

HP OpenView Storage Area Manager Fundamentals

ESG4382SG20311



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HP Training

Student guide

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Student Guide 2

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Glossary

Objectives

After completing this module, you should be able to:

- Identify the Storage Builder architectural components.
- Identify Storage Builder scalability limits.
- Define key terms Storage Builder uses when reporting storage device capacity and host storage utilization.
- Access Storage Builder information using Capacity view panels.
- View and modify Storage Builder charts.
- Schedule host data collection.
- Force collection of host data.
- Schedule summarization of capacity data.
- Add capacity-related thresholds and triggers.

Product overview and features

Storage Builder monitors and reports storage capacity in a storage network. It routinely discovers the physical capacity of storage devices and the logical capacity of hosts and NAS devices, and analyzes the information for current usage, past and future usage trends, and threshold notification. You must install and license Storage Builder to use these features.

Storage Builder adds the following features to Storage Area Manager:

- **Capacity views of hosts, NAS devices, storage devices, and the domain** — For hosts and NAS devices, view panels show the used and free file space. For storage devices, view panels show the disk space that is visible to hosts, still unformatted, and spent in overhead.
- **Lists of the directories, disks, users, volumes, and volume groups on each host** — Click any of these labels in the Resources tree to view corresponding capacity data, including file system and logical volume metrics. Select a specific resource from the list to view more information about the individual directory, disk, user, volume, and so on.
- **Physical and logical cross references** — At the storage device view, you can see how LUN space is distributed to hosts and volumes. At the host view, you can see the LUNs where volumes reside. When logical volume managers are present, a graphical map shows you the LUN-volume correspondence within volume groups.
- **Past and future usage trends** — Display a line graph of past and future capacity. Storage Builder predicts future capacity using sophisticated statistical models that are sensitive to directional tendencies, seasonal variation, and the recency of the data. You can select the model and adjust these factors to fit the nature of the data and the purpose of the prediction. You can also set the confidence level of the prediction and view the corresponding range of possible values.

- **Capacity thresholds and threshold events** — Storage Builder monitors the current and predicted capacity of individual resources for threshold violations. If measured or predicted capacity exceeds or falls below a specified target, Storage Builder sends a threshold violation to Storage Area Manager's event panel as soon as data becomes available on the management server. Administrators can set thresholds and configure event triggers.
- **File analysis** — View reports on stale files, junk files, the largest files, largest directories, and all files and directories on each and all hosts in the domain. You can modify the default reports to perform specialized functions.
- **Backup assessment** — Line graphs show you the space needed for full and incremental backups and the number of files modified each day.
- **Volume manager data** — Storage Builder collects and displays information about volume groups on hosts that use Veritas (VxVM) or Logical Volume Manager (LVM).

New features in Storage Builder 3.1

Storage Builder 3.1 offers the following new features.

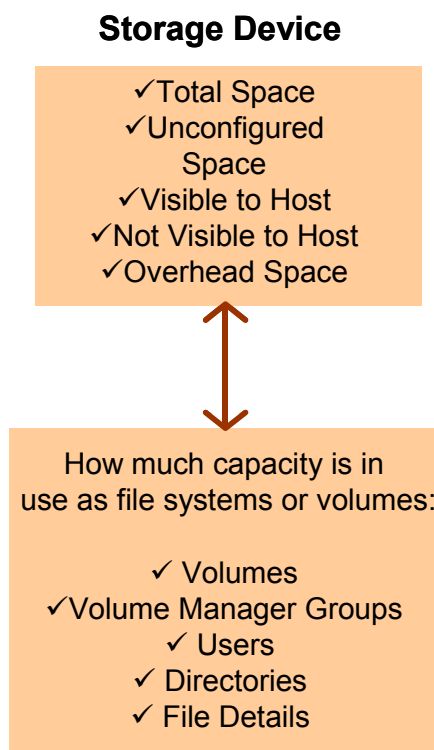
- **Managed application support** — Existing features of Storage Builder that applied to host, volume, user, directory, arrays, and LUNs are now extended to Microsoft Exchange and Oracle Applications.
- **Capacity views of managed applications** — For Oracle, capacity views are available for tablespaces, data files, log files, and dump spaces. For Microsoft Exchange Server, Storage Builder provides capacity views of public folder stores, and mailbox stores. These capacity views provide a view of storage usage by application, including the used, free and total storage capacity
- **Past and future usage trends** — Display a line graph of past and future application claimed capacity. Storage Builder predicts future capacity by identifying trends in past data. You can turn this feature on or off, and you can select from a wide range of predictive models.
- **Application-host-file-storage device-LUN mapping** — Storage Builder's managed application map visually displays the relationships between a supported application and hosts, volumes, files, storage devices, and LUNs on a storage network.
- **Windows Logical Disk Manager (LDM) support** — Storage Builder now collects and displays information about volume groups on hosts that use Windows Logical Disk Manager (LDM).
- **Cluster support** — Storage Builder now supports most common cluster configurations on HP-UX, Windows and Solaris platforms. This support allows Builder to account for shared volumes when calculating the volume sums for all the hosts in the domain, folder, organization, etc. For cluster platforms that do not support concurrent storage access, when a volume fails over to another cluster node, historical data is preserved in the database for the configurable period of time.

Storage Builder scalability matrix

Storage Builder supports the following:

SAN Characteristic	Target
Hosts	500
Volumes (per host)	50,000
Users (per host)	50,000
Files (per host)	5,000,000
Managed Directories (per host)	25,000

Types of Storage Information



Storage Builder reports on two distinct types of storage:

- Storage device capacity
- Host storage utilization

Storage device capacity

For each supported storage device on the SAN, the device's *total*, *unconfigured*, *visible to host*, and *not visible to host* capacity is stored in the database. Derived from these metrics is the total *overhead* of the storage device.

A storage device has associated with it a certain amount of storage; this is referred to as the storage device's *total capacity*. This capacity is not functional for use by hosts until it has been apportioned into LUNs. The capacity that has not been apportioned into LUNs is referred to as *unconfigured capacity*.

Capacity that has been apportioned into LUNs is functional for hosts to use. This functional capacity can be viewed by either SAN hosts (hosts which have a host agent installed on the SAM defined domain) or non-SAN hosts. Functional capacity viewed by SAN hosts is referred to as *visible by host* capacity. Functional capacity not viewed by SAN hosts is referred to as *not visible by host*.



Important

Not visible by host does not necessarily mean that the space is available. It may be in use by a host that does not have the Host Agent installed.

The *overhead* associated with a storage device refers to capacity that is not functional for use by a host. Typically, this is storage used by the device in mirroring, RAID, and so on. The overhead is the capacity derived from the total minus free, visible to host, and not visible to host. All storage space is measured and stored in bytes.

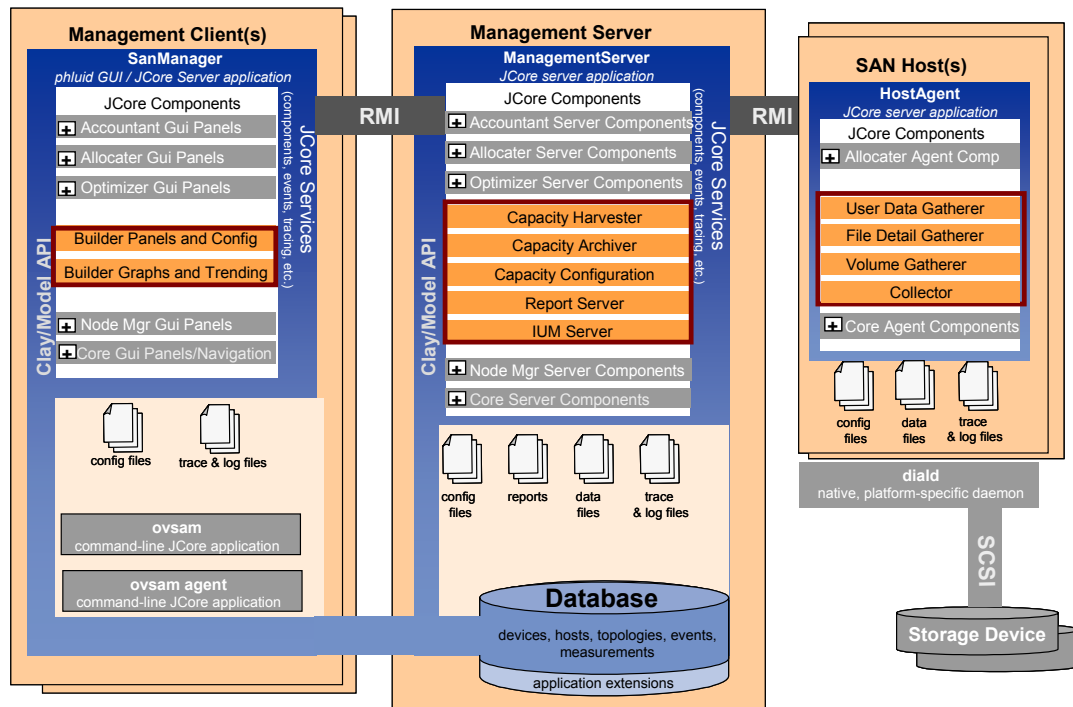
Host storage utilization

Host storage utilization refers to the total amount of storage available and in use on a host as files systems or volumes. This can be broken into four areas: Volume, User, Directory, and File Detail capacity information. At the volume level this consists of the total, used, and free size. Derived from these values is any overhead associated with the volume.

At the user level, this consists of the total capacity in use by each user account on a particular volume. Derived from this is the total consumption by each user account across the host. On the directory level, it is the total size of files within a specified directory.

On the file detail level is the total size of files matching a particular characteristic. These characteristics are user-definable, and include the total size of junk files, stale files, and so on.

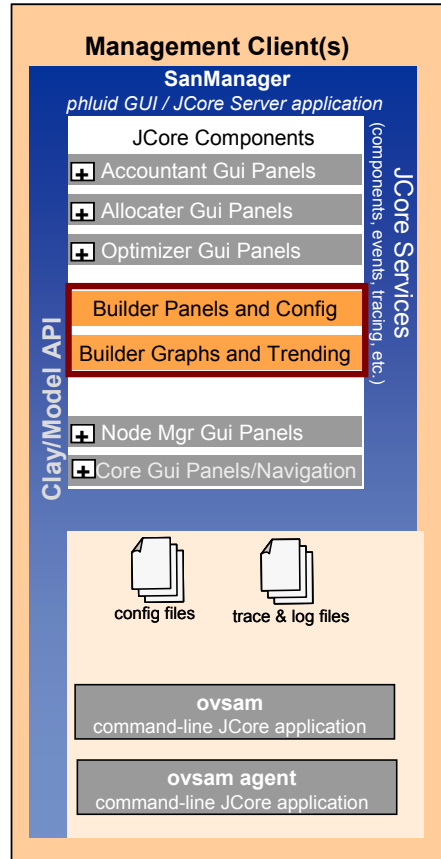
Storage Builder architecture



The above diagram shows the Storage Builder components that reside on the management client, management server, and SAN host.

As with the other Storage Area Manager applications, Storage Builder delivers its functionality in a set of JCore components.

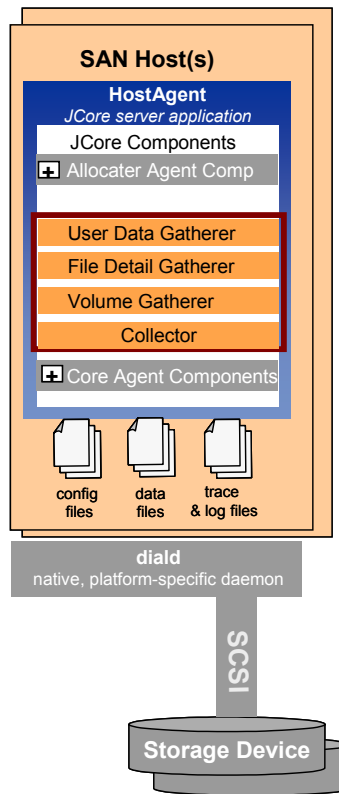
Storage Builder client components



Two Storage Builder components reside on the management client:

- **Storage Builder panels and configuration dialog** — Extends the tree to include Storage Builder-specific navigation, adds capacity view panels, and extends the Configuration window to include Storage Builder options.
- **Storage Builder graphs and trending** — Extracts information from the database and flat files through RMI, sends it to a graphing package, and ensures all data is valid.

Storage Builder SAN host components



The following Storage Builder components reside on the SAN host:

- User Data Gatherer
- File Detail Gatherer
- Volume Gatherer
- Collector

User Data Gatherer

The User Data Gatherer collects information on which user accounts are currently defined on the host system. The User Data Gatherer only collects the list of local users on Windows, and local and NIS users on UNIX. Windows domain-level users and all user capacity information is collected by the file gathering process.

- **Data collected**

- timestamp, username, userID, assignedgroup, fullname

- **Files used**

- config/UserGatherer.scp (loads the gatherer)
- config/UserGatherer.prp (saves configuration information)

- **Generated files**

- data/users.csv — data sent to repository (flat file resides on the Host Agent)

File Detail Gatherer

The File Detail Gatherer collects host file detail information, using the data collected by the Volume Gatherer to first obtain a list of volumes on the system. Then it looks at each volume to determine the file-level details.

This collection is most likely done once per night at most (user configurable) because it is fairly resource intensive on the host and, depending on the size of the volume, could take several seconds/minutes to perform.

- **Data collected**

- time stamp, mount point, pathname, type, size, mode, owner, creation time, last modified time, last access time, size (of file, or non-recursive size of directory), and recursive size (for directories only)

- **Files used**

- config/FileGatherer.scp (loads the Gatherer)
- config/FileGatherer.prp (saves configuration information)

- **Files generated**

- data/files-X.csv, where x is a number that corresponds to the mounted file system (one file per mounted file system)

Volume Data Gatherer

The Volume Data Gatherer collects high-level information of all the file systems that are visible to the host—both local and remote. The Volume Gatherer also collects Volume Manager information. It retrieves information from supported host volume managers and maps the relationship between file system volumes and the LUNs on the attached storage devices.

- **Data collected**

- timestamp, localMountPoint, remoteMountPoint, localDrive, type, blocksize, totalBlocks, usedBlocks, and freeBlocks

- **Files used**

- config/VolumeGatherer.scp (loads the gatherer)
- config/VolumeGatherer.prp (saves configuration information)

- **Generated files**

- Data stored in data/volumes.csv

Volume Manager data collection is performed using the following CLUI commands:

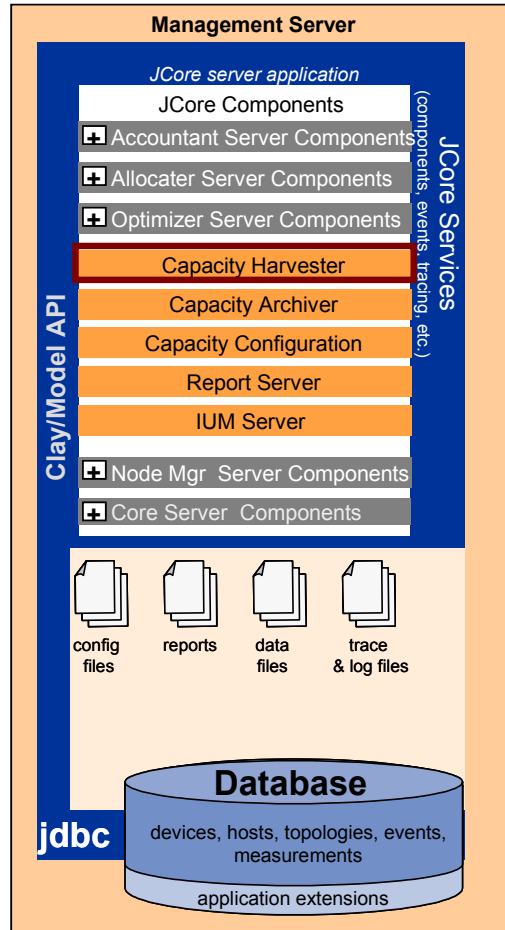
- **VxVM:** vxvol (-v), volinfo, vxdisk
- **LVM:** lsvg, lspv, lslv

All Volume Manager data is stored in a file named: *vm.xml*

Collector

The Collector is a framework component that loads and handles application management plug-ins which enable the managed application feature of Storage Builder. The Collector provides a standard interface for sending application-related events and gathering and scheduling application data from the management server.

Storage Builder management server components



The following Storage Builder components reside on the management server:

- Capacity Harvester
- Capacity Archiver
- Capacity Configuration
- Report Server
- IUM Server

Capacity Harvester

The Capacity Harvester is used in the collection and processing of data from each of the host agents. There are two Harvester instances:

- **CS Harvester** — Processes volume/volume manager information (part of Core Services)
- **CP Harvester** — Processes remainder of Storage Builder-specific information (file details, users, directories, and so on)

Capacity Archiver

The Capacity Archiver is a data summarization and trimming mechanism for managing the size of the data contained within the database. The Capacity Archiver runs and searches the database for old and obsolete data (user-configurable). Data that is defined to be of a certain age is summarized with a set of other old data points. Data that is considered to be obsolete is trimmed.

Summarization

The Capacity Archiver takes a set of the oldest archive snapshots over a time interval and summarizes each data point within the snapshot, such that summarized snapshot of data is created with the same set of data points. Each data point now consists of not simply a raw number, but rather an object that contains the weighted average, min/max, and standard deviation. These summarized snapshots are also created on a periodic interval (such as every week) and are stored back into the model/repository.

Trimming

The Capacity Archiver takes the archive snapshots that were used to create the summarized snapshots during archiving, and trims them from the model/repository after the summarized snapshot is created. The summarized snapshots are only kept for a user-configurable amount of time (such as one year) and are trimmed when they age beyond this time.

Capacity Configuration

The Capacity Configuration component handles all Storage Builder configuration on the management server and SAN host, including:

- Collection Schedules
- Threshold Configuration
- Archive Schedules

Report Server

The Report Server provides a report retrieval mechanism for the management client. When requests (GUI or CLUI) for reports are made on the management client, the Report Server obtains access to the report and delivers it to the management client for viewing.

The Report Server is responsible for streaming data files from the management server over to the client through RMI. Depending on the Storage Object Descriptor and the report type given, the Report Server identifies the correct file.

The Report Server uses a Resource Directory to pick up the correct .xml data file for the report. It then applies the correct .xsl template to generate the desired report (in .csv, .html, or .xml format) in the locale of the client.

Internet Usage Manager Server

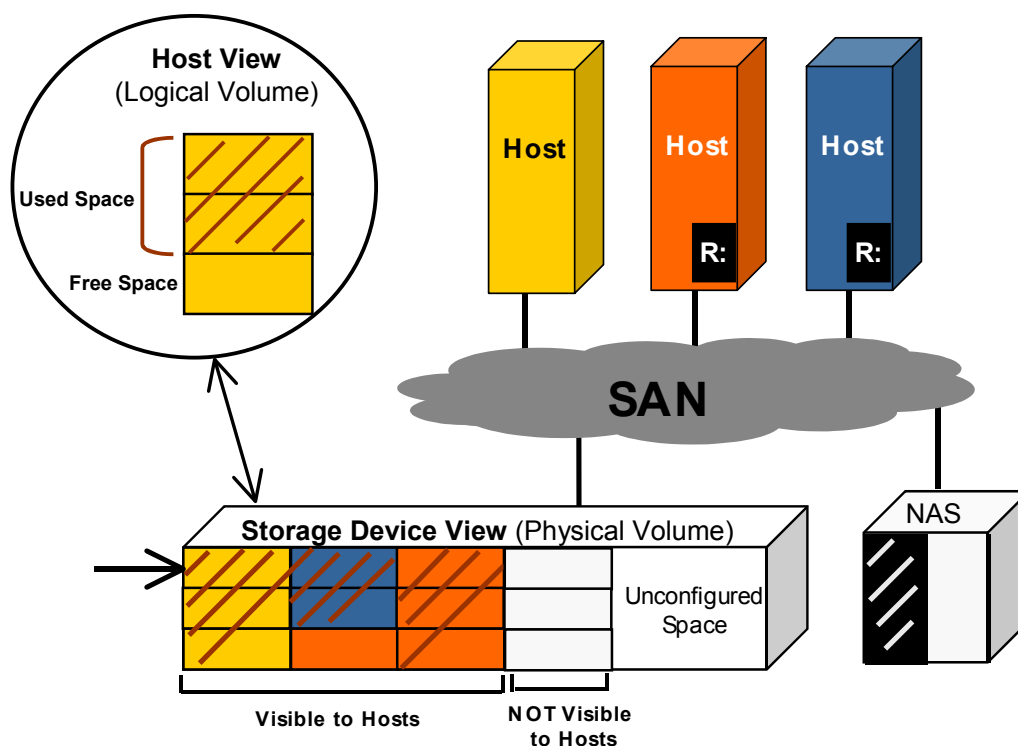
The Internet Usage Manager Server exports data that is periodically collected by IUM, using the Storage Area Manager http server.

The files exported correspond to three types of capacity data collected from the SAN: volume capacity, directory capacity, and user account consumption. These files contain a listing of each change in value throughout the day of monitoring, and then at the end of the day list all items and their currently known values.

Viewing capacity information

Storage Builder information is accessed through Capacity view panels. This section covers key terminology used by Storage Builder and procedures for accessing Capacity view panels for the storage domain, storage network, hosts, directories, users, volumes, volume groups, storage devices, and organizations.

Storage device versus host capacity views



Host view

Used space on Hosts is the amount of the total space in the file system that is consumed by files. You see used space when you select a host and view its capacity.

Free space on a host is the space that remains in a host's file systems for storing files. File systems are created on physical space, but their capacity does not equal the size of the assigned physical space. Some physical space is consumed by system overhead. Also, the free capacity that you see when you select a host may include file systems that reside on devices not discovered by Storage Area Manager.

Storage device view

Visible to Hosts denotes space that is formatted and has a physical path to one or more Storage Area Manager hosts. The ability to "see" the space does not mean that the host has access to it. A host may not be able to use the space because Storage Allocator or other logical management tool has assigned the space to another host.

Not Visible to Hosts is space that is formatted, but not reported by a Storage Area Manager host. We will only see this in the XP device because XP is the only device that Storage Area Manager discovers, both in-band and out-of band.

Unconfigured space on a storage device is raw, unformatted disk space. The term applies specifically to disk arrays, before the space is allocated to LUNs. When you select a disk array in the device map or resource tree and view its capacity, you will see the amount of unconfigured space left on the device.

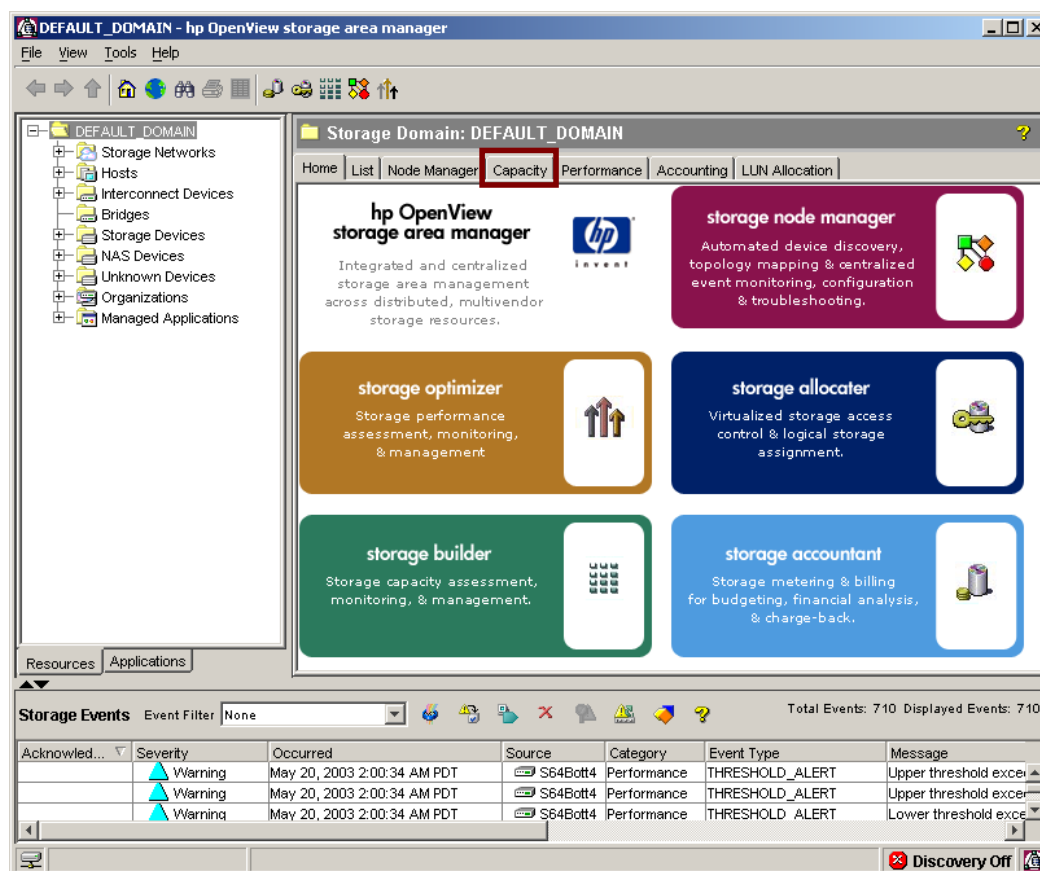
About NAS devices

Storage Builder discovers space on a NAS device through host data collection, but the space is reported with the NAS device. The illustration above shows NAS device space mounted as drive R: on two hosts.

Note

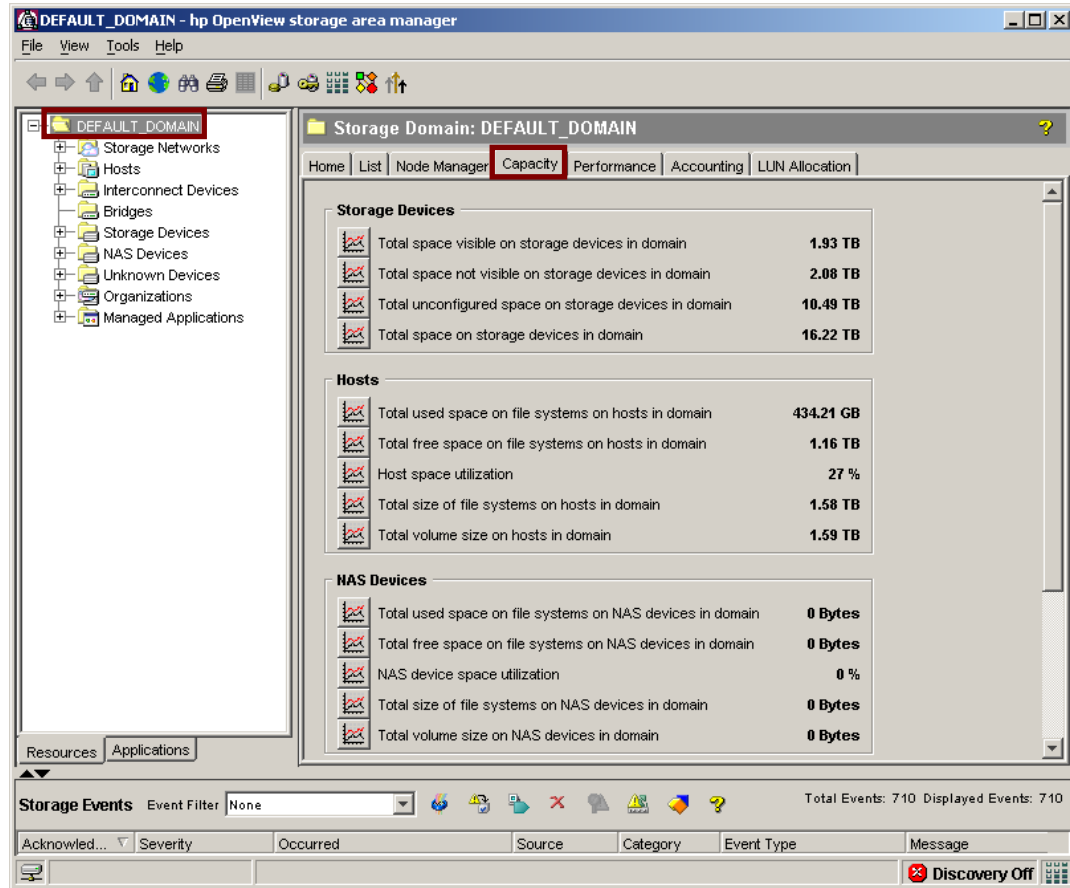
NAS device space must be mounted on a UNIX host to be discovered by Storage Builder.

Accessing Storage Builder information



Storage Builder information is accessed through Capacity view panels. The availability of these view panels is dependent on the node selected in the tree and Storage Builder support for the device. If Storage Builder is not installed, Capacity view panels are not present.

Viewing capacity over the domain



For the most comprehensive view of storage capacity, select the *storage domain* and then click the *Capacity* tab. The results show the total used and free space on all hosts and NAS devices in the domain, and the total visible, not visible, and unconfigured space on all storage devices in the domain.

View domain-level reports and capacity graphs by clicking the corresponding *Report* or *Graph* buttons.

Viewing storage network capacity

The screenshot shows the 'RemPOC 1GB SAN-2 - hp OpenView storage area manager' window. The left pane displays a tree view under 'DEFAULT_DOMAIN' with 'Storage Networks' expanded, and 'RemPOC 1GB SAN-2' selected. The right pane shows the 'Capacity' tab for the selected storage network.

Storage Network: RemPOC 1GB SAN-2

Map | List | Node Manager | **Capacity**

Storage Devices

Total space visible on storage devices in topology	537.15 GB
Total space not visible on storage devices in topology	18.34 GB
Total unconfigured space on storage devices in topology	481.79 GB
Total space on storage devices in topology	1.38 TB

Hosts

Total used space on file systems on hosts in topology	42.21 GB
Total free space on file systems on hosts in topology	37.46 GB
Host space utilization	53 %
Total size of file systems on hosts in topology	79.67 GB

Storage Events Event Filter: None Total Events: 710 Displayed Events: 710

Acknowled...	Severity	Occurred	Source	Category	Event Type	Message
	Warning	May 20, 2003 2:00:34 AM PDT	S64Bott4	Performance	THRESHOLD_ALERT	Upper threshold exce
	Warning	May 20, 2003 2:00:34 AM PDT	S64Bott4	Performance	THRESHOLD_ALERT	Upper threshold exce
	Warning	May 20, 2003 2:00:34 AM PDT	S64Bott4	Performance	THRESHOLD_ALERT	Lower threshold exce
	Warning	May 20, 2003 2:00:34 AM PDT	S64Bott4	Performance	THRESHOLD_ALERT	Lower threshold exce

Discovery Off

To view the storage capacity of a storage network, expand the *Storage Networks* node and then select a specific storage network, such as SAN-2. Next, click the *Capacity* tab. The results show the total used and free space on all hosts in the selected network, and the total visible, not visible, and unconfigured space on all storage devices in the network.

Viewing capacity for all hosts

The screenshot shows the HP OpenView storage area manager interface. The left pane displays a tree view with 'Hosts' selected. The main pane shows the 'Capacity' tab for 'Hosts'. The table below shows capacity data for two hosts. A red bracket groups the 'Total', 'Total F...', 'F/S Us...', and 'F/S Free' columns, labeled 'Volume Gatherer'. Another red bracket groups the 'Space...', 'Files A...', and '% Util...' columns, labeled 'File Gatherer'.

System	Orga...	Total ...	Total F...	F/S Us...	F/S Free	Space...	Files A...	% Util...
ul1.r...		7.21 GB	6.21 GB	1.42 GB	4.49 GB	0 Bytes	0	24 %
USA...		16.95 GB	16.95 GB	6.03 GB	10.92 GB	5.79 GB	26450	36 %
Totals		24.16 GB	23.16 GB	7.45 GB	15.4 GB	5.79 GB	26450	33 %

The bottom pane shows 'Storage Events' with a table of events. The 'Discovery On' button is visible at the bottom right.

Storage Builder allows you to view the capacity of every host in the domain, or only the capacity of a selected host.

To view the used, free, and total space on every host in the domain, select *Hosts* in the tree and then click the *Capacity* tab.

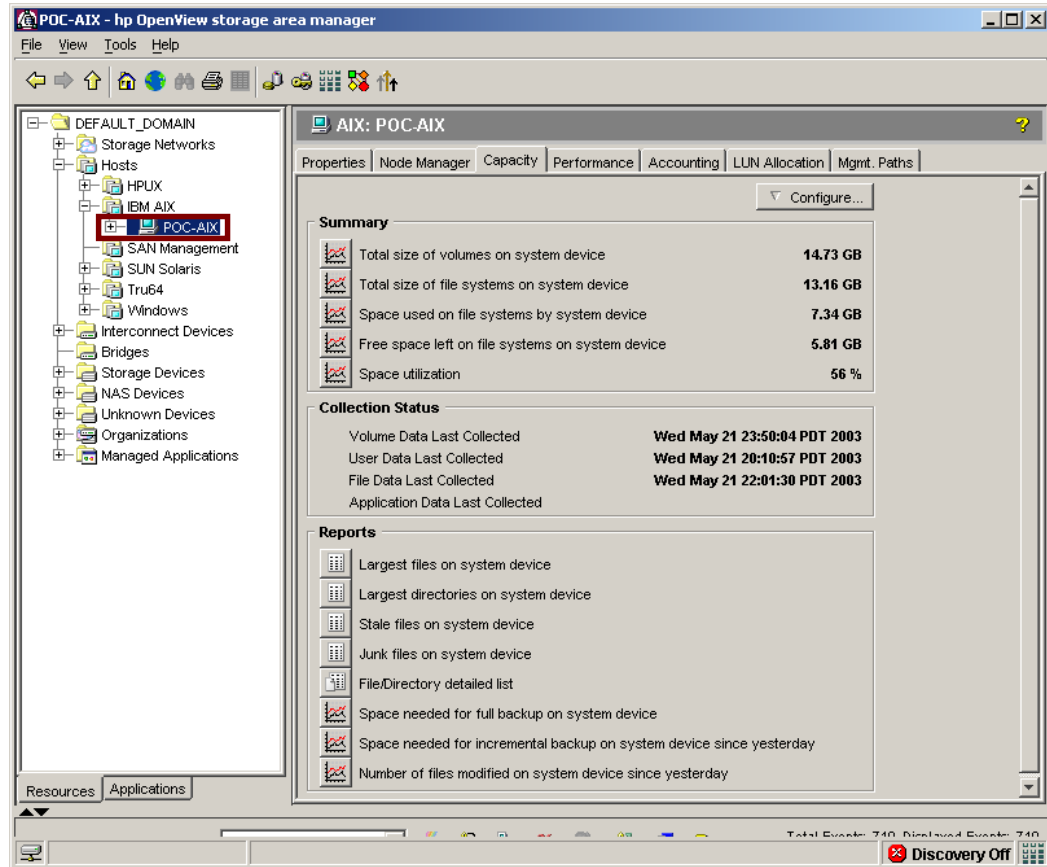
Use this procedure to assess file space on a host to determine, for example, if space is available for new or growing directories and files. The results show the total size of all volumes and file systems on the host, as well as the total used and free space in those file systems.

As shown in the example, the Hosts Capacity view panel displays the following information:

- **System Name** — Name of host
- **Total Size of Volumes** — Total size of volumes, including file systems and logical volume space
- **Total File System size** — Total size of file system space configured on the host
- **File System space used** — Total size of file system space currently occupied by files and directories
- **File System space free** — Total size of file system space that is free, or not currently occupied by files and directories
- **Space accessed** — Total file system size that has been accessed by the host in the last 24 hours (relative to the last file collection time)
- **Files accessed** — Number of files that have been accessed by the host in the last 24 hours (relative to the last file collection time)

The information in this view panel is collected by both the Volume and File data gatherers. The Volume data gatherer collects the *Total Volume Space*, *Total File System Space*, *File System Used Space* and *File System Free Space*. The File data gatherer collects the total *Space Accessed* and number of *Files Accessed*.

Viewing capacity for a specific host



To view the used, free, and total space on a selected host, select a specific host, and then click the *Capacity* tab.

The results show summary information including total, used and free space, as well as current space utilization.

The view panel also includes access to several host-level capacity reports:

- Largest Files
- Largest Directories
- Stale Files
- Junk Files
- File Directory Listing
- Backup

Viewing directory capacity

Managed Directories are added by clicking **Add Directories** button

Note: File collection must run at least once before managed directories can be added

Directory Name	Volume	SystemDevice	Used (Recursive)
/var/sam/core on POC-...	/dev/vg00/ivol7 on PO...	POC-HPUX	96 Bytes
/opt/graphics/starbase...	/dev/vg00/ivol4 on PO...	POC-HPUX	288 Bytes
/opt/ignite/share/man/...	/dev/vg00/ivol4 on PO...	POC-HPUX	1.92 KB
/opt/webadmin on POC...	/dev/vg00/ivol4 on PO...	POC-HPUX	6.13 KB
/opt/ignite/share on PO...	/dev/vg00/ivol4 on PO...	POC-HPUX	6.53 KB
/opt/audio/sounds on P...	/dev/vg00/ivol4 on PO...	POC-HPUX	72.6 KB
/var/mail on POC-HPUX	/dev/vg00/ivol7 on PO...	POC-HPUX	467.04 KB
/eva/ivol13 on POC-HPUX	/dev/vg01/ivol3 on PO...	POC-HPUX	1.98 MB
/eva/ivol1 on POC-HPUX	/dev/vg01/ivol1 on PO...	POC-HPUX	2.11 MB
/eva/ivol2 on POC-HPUX	/dev/vg01/ivol2 on PO...	POC-HPUX	2.12 MB
/eva/ivol4 on POC-HPUX	/dev/vg01/ivol4 on PO...	POC-HPUX	2.27 MB
/var/tmp on POC-HPUX	/dev/vg00/ivol7 on PO...	POC-HPUX	2.3 MB
/var on POC-HPUX	/dev/vg00/ivol7 on PO...	POC-HPUX	762.62 MB

773.95 MB

Add Directories... Remove Selected

Total Events: 740 Discovered Events: 740

Discovery Off

To view the space used by managed directories, expand a host node in the tree then select *Directories*. Next, click the *Capacity* view panel. Directory space is the sum of the sizes of all files in the directory, excluding subdirectories.

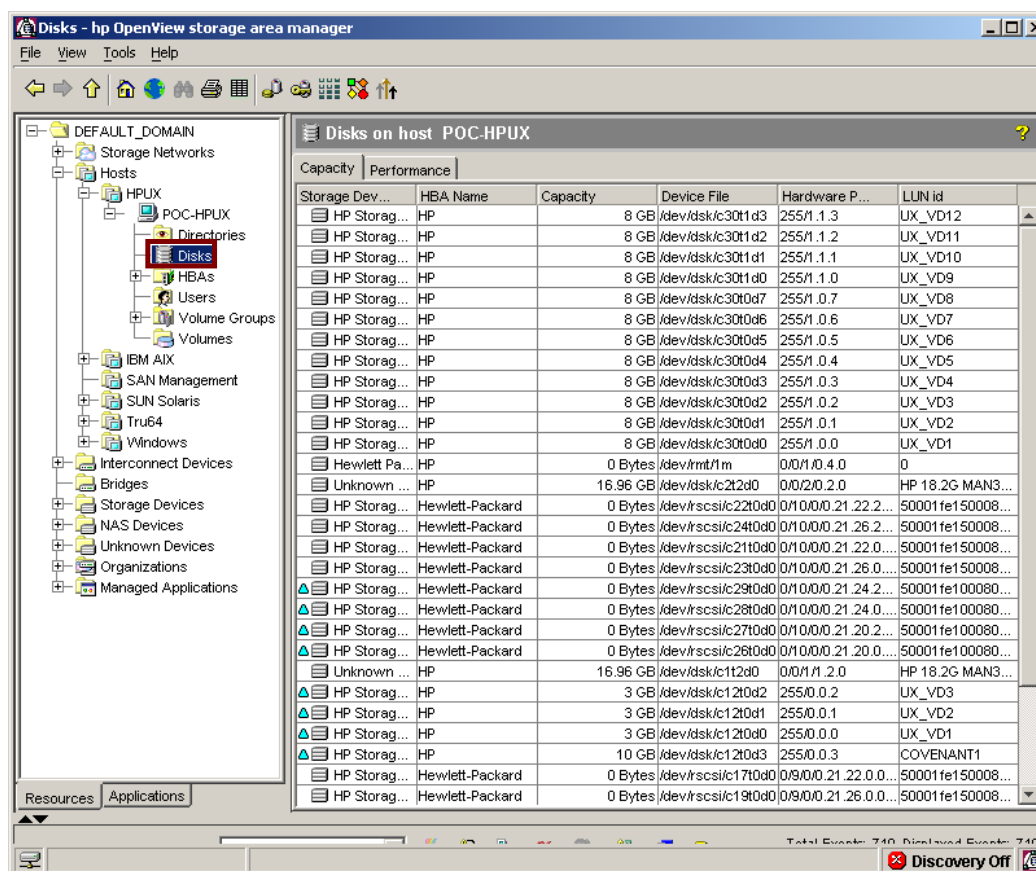
The result displays a list of the managed directories on the selected host or NAS device, and the size of each directory. Selecting a directory from the list displays additional information, including the percentage of volume space used by the selected directory.

Notes

Before you can view managed directory capacity, file data must be collected and the directories must be managed. To view the capacity of unmanaged directories, view a detailed file report.

Directories do not display in this view panel until they are added as a managed directory by the administrator.

Viewing host disk capacity



Use this procedure to view the disk space that is visible to a selected host. The result is a list of all the disks/LUNs that a selected host has a physical path to and, for each, the size, storage device, device file name, hardware path, HBA, and LUN ID.

Note

Disks that are visible to a host are not necessarily usable by the host. They may be exclusively assigned to another host, using Storage Allocator or other LUN management tool.

The information available from this view panel is updated whenever a host sees a new LUN appear on the device, an old LUN disappears off of the device, or when an existing LUN on the device changes. By default, hosts check for these changes every 15 minutes.

Viewing user consumption

Users on POC-HPUX

Capacity

User Name	Used
POCHPUX:hpdb	0 Bytes
POCHPUX:nobody	0 Bytes
POCHPUX:nuucp	0 Bytes
POCHPUX:www	0 Bytes
POCHPUX:adm	53.09 KB
POCHPUX:sys	168.36 KB
POCHPUX:lp	628.18 KB
POCHPUX:uucp	980.06 KB
POCHPUX:daemon	1.09 MB
Unknown	33.42 MB
POCHPUX:oracle	1.22 GB
POCHPUX:bin	1.37 GB
POCHPUX:root	16.85 GB
Totals	19.48 GB

Total Events: 740 Discovered Events: 740
Discovery Off

To access the file space that specific users are consuming on selected hosts and NAS devices, select the *Users* node under a specific host, then click the *Capacity* tab.

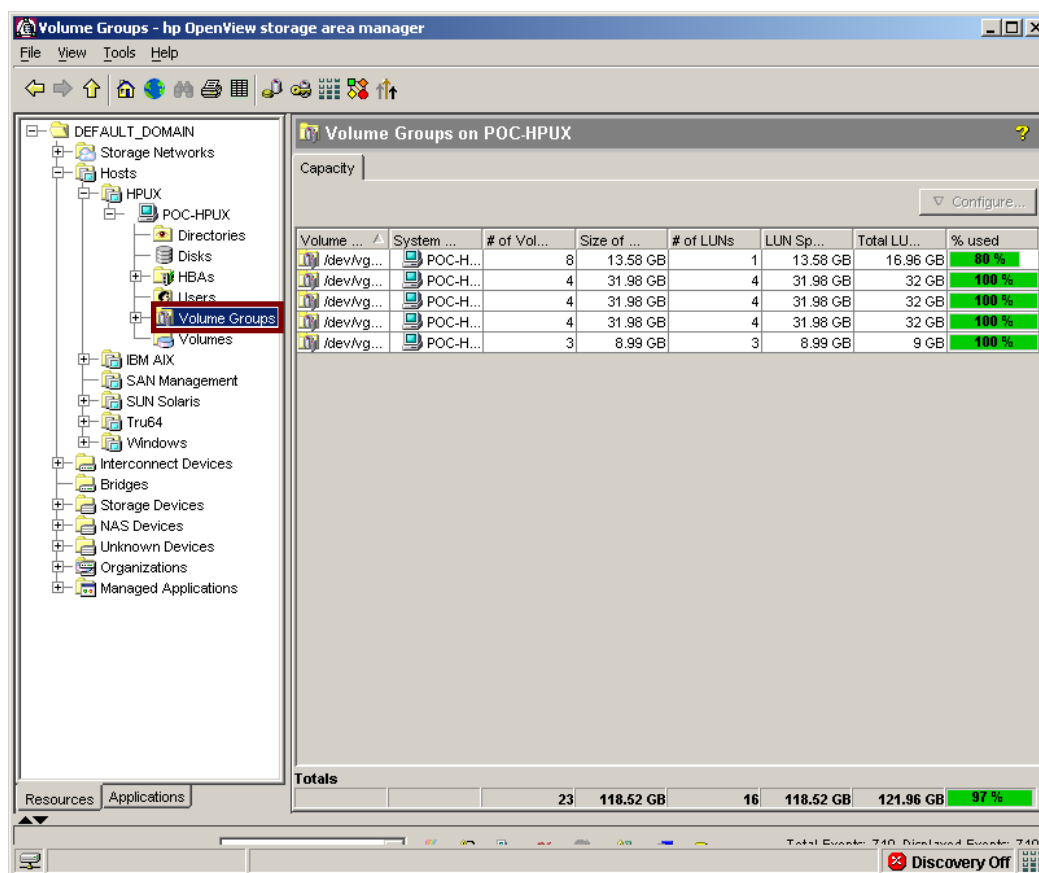
The result is a list of users and their total file space on the selected host or NAS device. Domain and NIS users are listed by the domain name and user account. Local users are listed by the machine name and user account.

Users are log-in accounts and can include Windows user groups, such as *Administrators*, as well as the individual users, such as *Administrator*.

The data displayed is collected by the User and File data gatherers.

Double-click a user name to view specific volume usage.

Viewing volume group capacity



To access the volume space on a selected host or NAS device, select the *Volume Groups* sub-folder.

Note

A Volume group is simply a pool of LUNs that have been created using Logical Volume Manager, Veritas Volume Manager, Logical Storage Manager.

Use this procedure to determine if space is available for new files and directories in existing volumes. The result is a list of all volumes on the selected host or NAS device and, for each volume with a file system, the total used and free space.

Volumes without file systems are identified by their paths. Select a volume from the list to display additional capacity information about the volume, including volume reports, the space used by managed directories and users, and the space used on storage devices.

The information displayed on this view panel is collected by the Volume Manager data gatherer.

Storage Builder supports the following volume manager software:

- HPUX and AIX: Logical Volume Manager (LVM)
- Solaris, HPUX, Windows 2000: Veritas Volume Manager
- Tru64: Logical Storage Manager

**Important**

Please refer to the *HP OpenView Storage Area Manager 3.1 Supported Components and Configurations Guide* for specific volume manager versions supported by Storage Area Manager.

Viewing volume group maps

The screenshot shows the HP OpenView Storage Area Manager interface. The title bar indicates the selected volume group is `/dev/vg04 on POC-HPUX`. The **Map** tab is selected, showing a graphical representation of the volume group's configuration. The map shows a host (POC-HPUX) connected to three storage devices (HP StorageWorks Enter) via three logical volumes (lv). The map is labeled with **Host**, **Logical Volume(s)**, and **Storage Device(s)**.

Below the map, a table titled "Map Data For Volume Group" lists the mapped devices and their properties:

Volume	% of Volume on ...	Storage Device	LUN id	LUN Space Used
/dev/vg04/lvol3 ...	100 %	HP StorageWo...	UX_VD3	2.74 GB
/dev/vg04/lvol2 ...	8 %	HP StorageWo...	UX_VD3	264 MB
/dev/vg04/lvol1 ...	4 %	HP StorageWo...	UX_VD2	132 MB
/dev/vg04/lvol2 ...	92 %	HP StorageWo...	UX_VD2	2.87 GB
/dev/vg04/lvol1 ...	96 %	HP StorageWo...	UX_VD1	3 GB

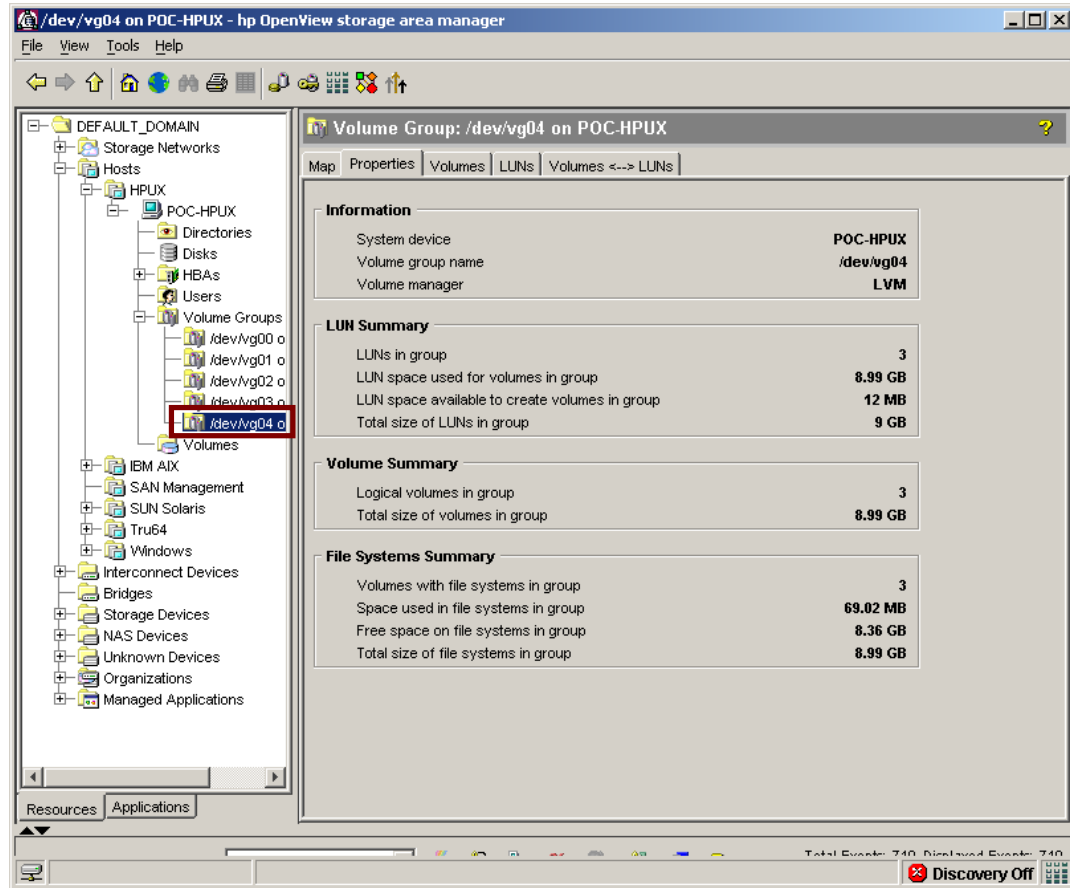
The interface also shows a left-hand tree view with categories like Storage Networks, Hosts, POC-HPUX, Directories, Disks, HBAs, Users, Volumes, IBM AIX, SAN Management, SUN Solaris, Tru64, Windows, Interconnect Devices, Bridges, Storage Devices, NAS Devices, Unknown Devices, Organizations, and Managed Applications. The bottom status bar shows "Total Events: 740, Disabled Events: 740" and "Discovery Off".

To view a graphical representation of how a volume group is configured, select a specific volume group and then click the *Map* tab.

Below the map, a corresponding table lists each volume (logical volume/file system) configured in the selected volume group. For each logical volume/file system, it lists the name, the percent of the logical volume/file system residing on the listed LUN, storage device name the LUN is configured on, LUN ID, and amount of LUN space used for the selected logical volume/file system.

As a logical volume/file system may span more than one LUN, this view panel shows which LUN(s) each of the logical volume/file systems physically reside on.

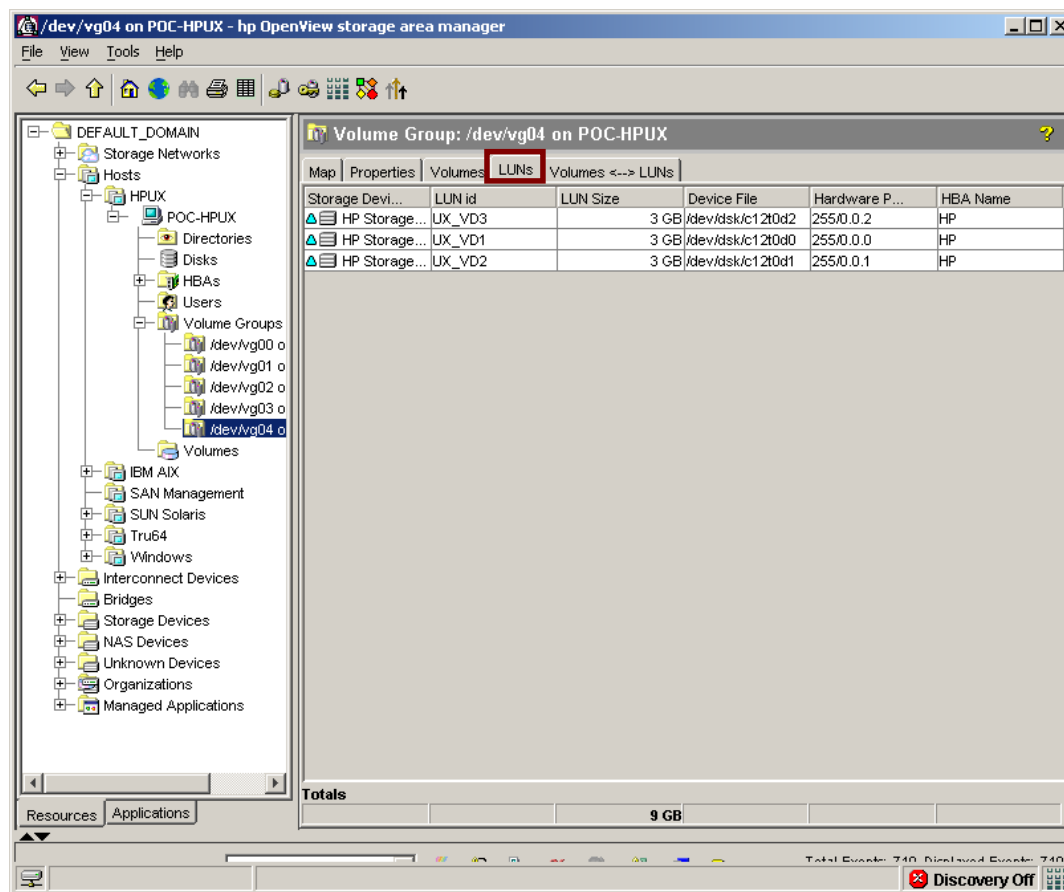
Viewing volume group properties



Click the *Properties* tab to display general capacity data for the Volume Group, including LUN, volume, and file system summary information.

This view panel lists the Volume Manager software used to create the selected volume group.

Viewing LUNs in a volume group



To view detailed information about the LUNs in a volume group, select a specific volume group and then click the *Luns* tab.

The result is a list of all the LUNs that have been added to the selected volume group, including each LUN's storage device, size, device file name, HBA, and hardware path on the selected host.

Note

Storage Builder displays volume group information only for hosts that use supported volume managers.

Viewing LUN-volume correspondence in a volume group

The screenshot shows the HP OpenView storage area manager interface. The left pane displays a tree view of the storage hierarchy, with the 'Volumes' folder under 'Volume Groups' selected. The right pane shows the 'Volume Group: /dev/vg04 on POC-HPUX' details. The 'Volumes <--> LUNs' tab is selected, displaying a table of volume-to-LUN mappings.

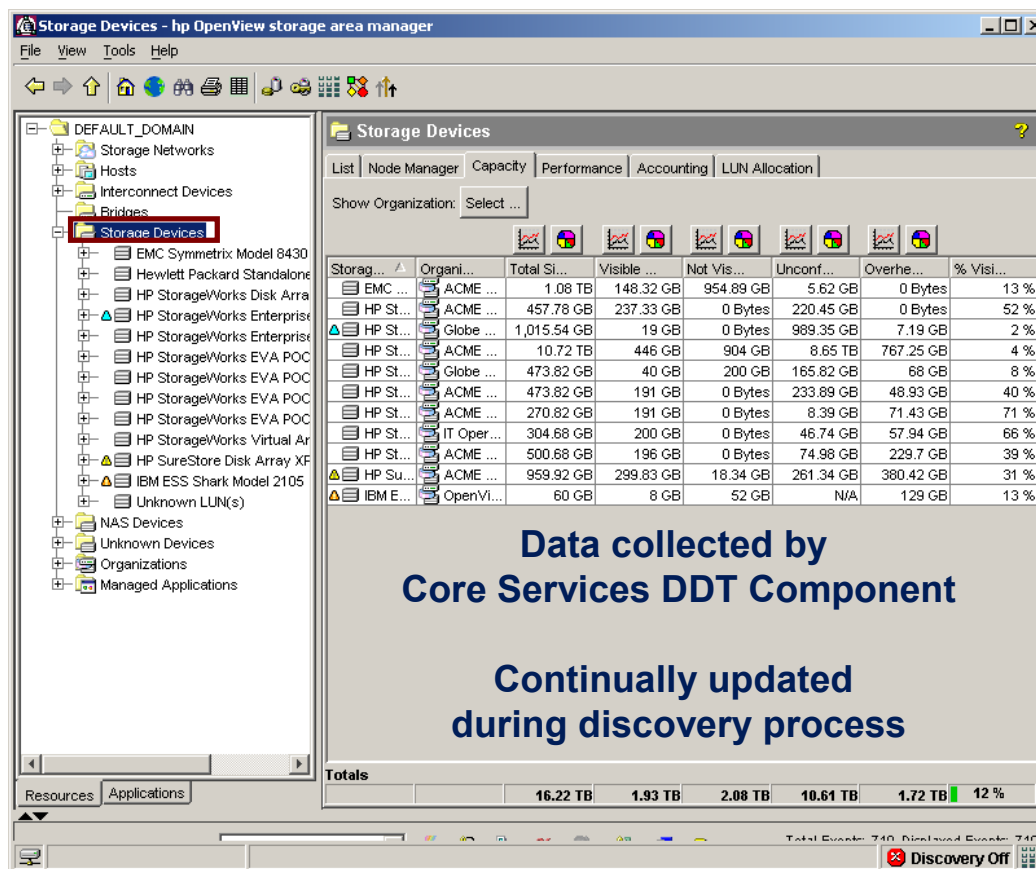
Volume	% of Volume on ...	Storage Device	LUN id	LUN Space Used
/dev/vg04/lvol3 o...	100 %	HP StorageWor...	UX_VD3	2.74 GB
/dev/vg04/lvol2 o...	8 %	HP StorageWor...	UX_VD3	264 MB
/dev/vg04/lvol1 o...	4 %	HP StorageWor...	UX_VD2	132 MB
/dev/vg04/lvol2 o...	92 %	HP StorageWor...	UX_VD2	2.87 GB
/dev/vg04/lvol1 o...	96 %	HP StorageWor...	UX_VD1	3 GB

The 'Totals' row at the bottom indicates a total of 8.99 GB. The status bar at the bottom right shows 'Discovery Off'.

To trace logical volumes to LUNs, and vice versa, in a volume group, select a specific volume group and then click the *Volumes<-->Luns* tab.

The result is a list of the LUN-volume pairings that make up a volume group. Volumes that are on more than one LUN display more than once in the list, each instance showing how much of the volume is on the corresponding LUN.

Viewing storage device capacity information



You can view storage device capacity alongside other storage devices in the domain, as shown in the example, or only for a specific device.

To assess the space on storage devices, select the storage devices node, or select a specific storage device and then click the *Capacity* tab.

Use this procedure to determine, for example, if space is available to create LUNs or physical volumes. The results show how much space is visible to hosts, not visible to hosts, unconfigured, and attributed to overhead (for example, space used by RAID parity or hot spares).

Note

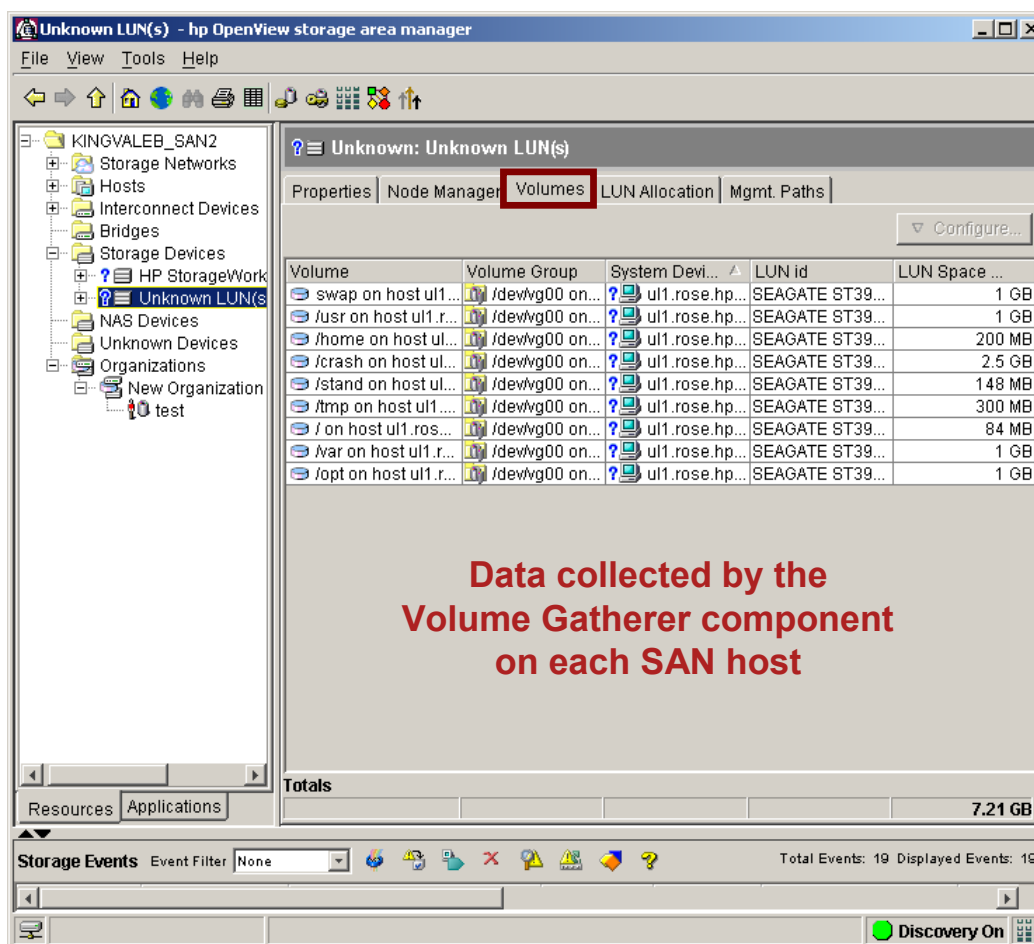
To view past or future trends of the displayed capacity data, click the corresponding *Graph* button.



Important

Storage Devices need a Core DPI class to be supported by Storage Builder. Refer to the *Architecture and Integrating New Devices* module for more information on DPIs.

Viewing volumes on a storage device



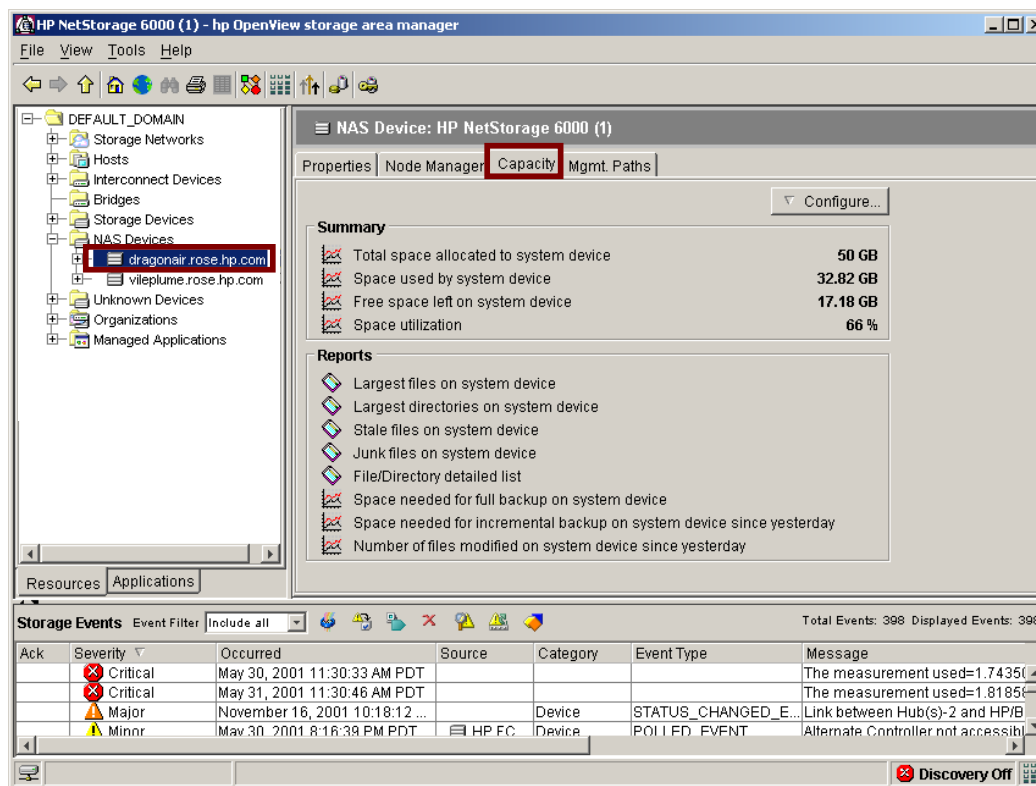
To identify the volumes that are using space on a selected storage device, select a specific storage device and then click the *Volumes* tab. The result is a list of volumes with the LUNs and LUN space that the volumes use on the storage device.



Important

Storage Builder displays volume information for storage devices only if the volumes reside on hosts that use supported volume managers, or if the volumes reside on an HP-UX host and map to a single LUN.

Viewing NAS capacity



You can view NAS device capacity with other NAS devices in the domain, or on individually selected NAS devices.

To identify access space on NAS devices, select the *NAS Devices* node, or select a specific NAS device and click the *Capacity* tab.

Use this procedure to determine, for example, if space is available for new or growing directories and files. The results show the total size of all volumes and file systems on the device and the total used and free space in those file systems. It also provides easy access to capacity-related reports and graphs for each NAS device.

Viewing organization capacity

Different device type views are available:
Host, Storage Device, or NAS Device Capacity Utilization

Organization

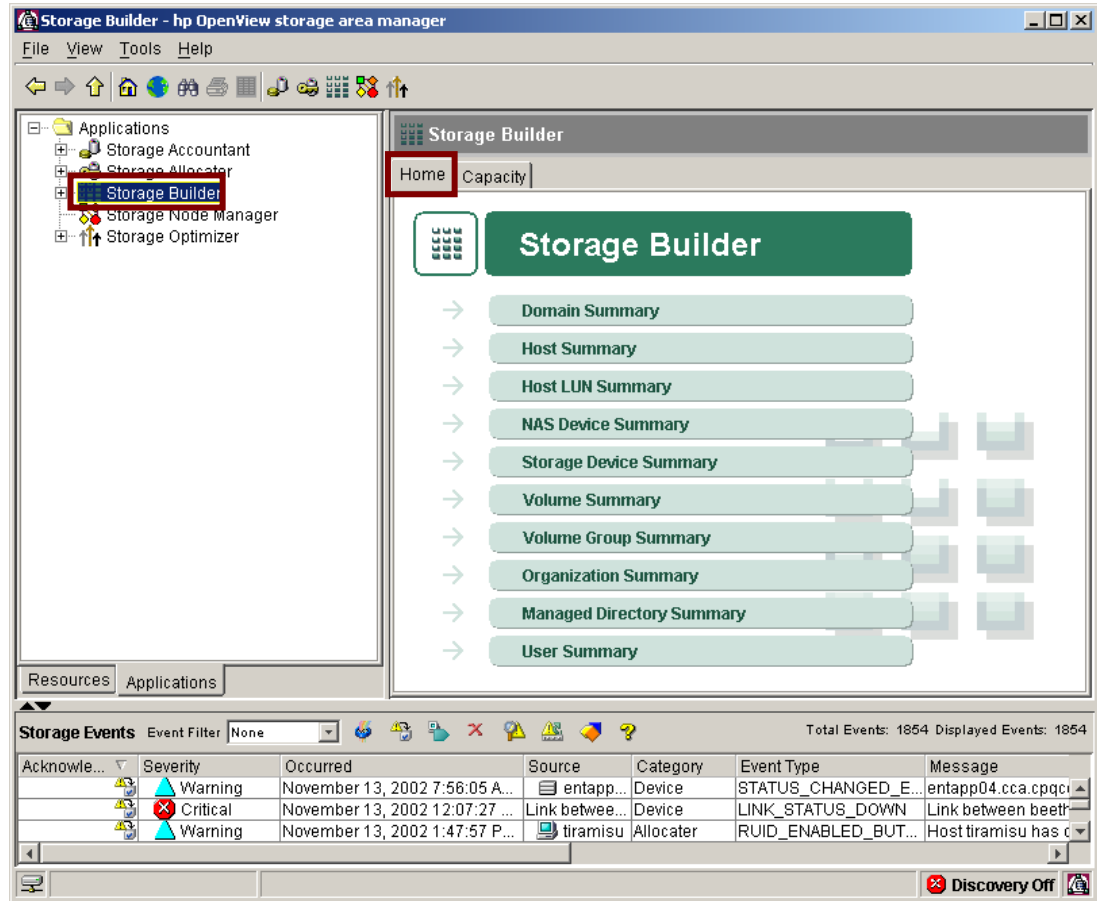
Organization	Total Size o...	Total F/S Size	F/S Used	F/S Free	Host Count
OpenView ...	0 Bytes	0 Bytes	0 Bytes	0 Bytes	0
World Outso...	0 Bytes	0 Bytes	0 Bytes	0 Bytes	0
ACME Corp...	84.83 GB	84.83 GB	13.2 GB	71.63 GB	2
Ecomdotnet	129.35 GB	127.34 GB	20.12 GB	104.27 GB	2
IT Operations	436.68 GB	443.97 GB	263.98 GB	179.84 GB	4
Globe Media	576.34 GB	575.34 GB	28.54 GB	543.98 GB	3

If no hosts are in the Organization, all fields will show "0"

To view space on the resources that belong to organizations, select the *Organization* node and click the *Capacity* tab. The Organizations Capacity view panel provides three resource views to choose from:

- **Host Capacity Utilization** — Total, used, and free space on all the host members of the organization
- **Storage Device Capacity Utilization** — Total, visible to hosts, not visible to hosts, and overhead space on all the storage device members of the organization
- **NAS Device Capacity Utilization** — Total, used, and free space on all the NAS device members of the organization

Storage Builder home page



To access the Storage Builder home page, select the *Storage Builder* node from the *Applications* tree and then click the *Home* tab. The Storage Builder home page can also be accessed from the Tools menu.

The Storage Builder home page contains links to capacity overviews for the domain and all storage resources.

Viewing directory capacity

Directories - hp OpenView storage area manager

File View Tools Help

Managed Directories on Builder

Capacity Configure...

Top-N Query

Available Metrics: Used | Return: 100 | View: Largest values Run Query

Directory Name	Volume	SystemDevice	Used
C: on host Win...	C: on host Win...	Win2000(2)	2.19 GB
C: on host Win...	C: on host Win...	WinNT(2)	1.75 GB
C: on host Win...	C: on host Win...	WinNT(3)	1.43 GB
C: on host Win...	C: on host Win...	Win2000(1)	1.42 GB
/ on host Linux	/ on host Linux	Linux	1.25 GB
C: on host Win...	C: on host Win...	WinNT(1)	1.08 GB
Totals			11.24 GB

Add Directories... Remove Selected

Total Events: 374 Displayed Events: 374

Category: Capacity | Event Type: UNKNOWN_THRESH...

Discovery Off

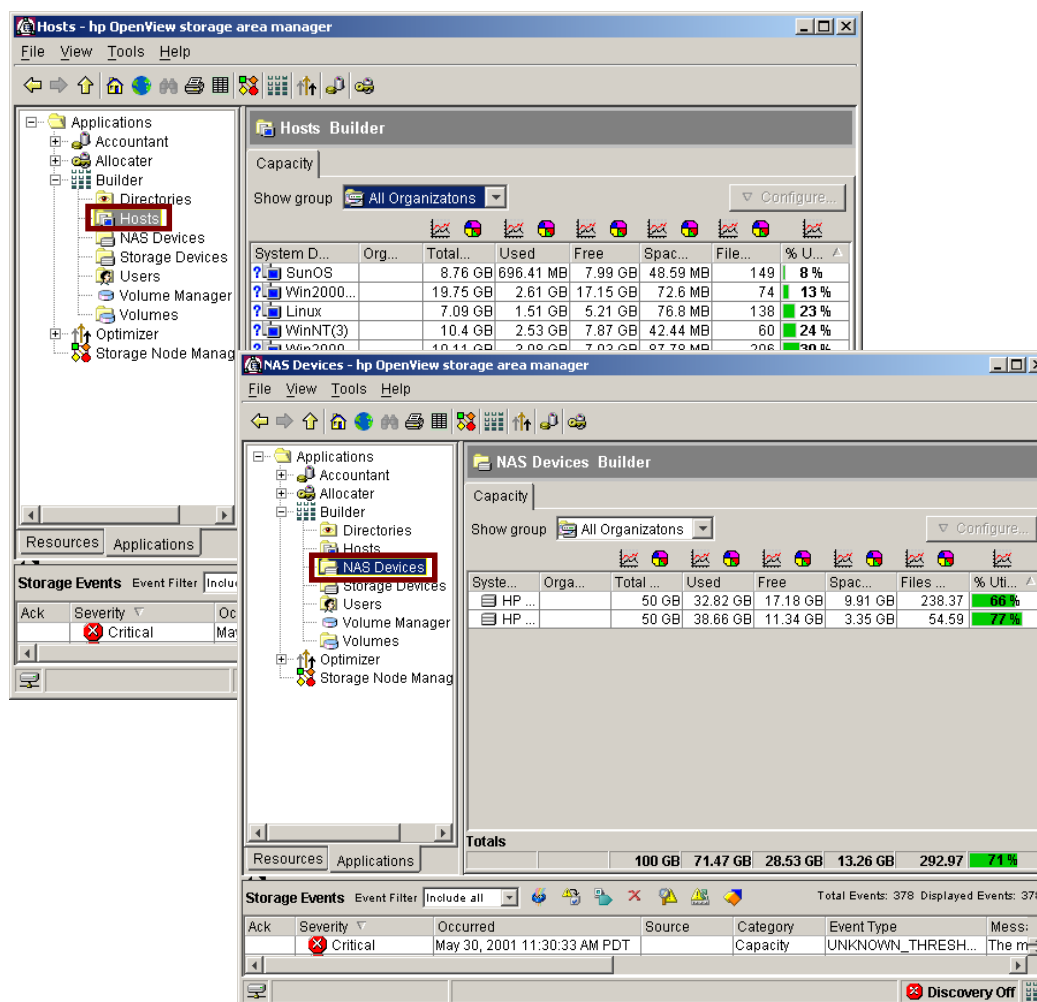
Select which directories are to be managed by clicking *Add Directories* button

File collection must run at least once before managed directories can be added

To view all managed directories for the entire domain, expand the *Storage Builder* node and select *Directories* from the Applications tree.

From this view panel, add and remove directories and run queries based on the largest or smallest values for used space.

Viewing host and NAS capacity from the Applications tree



To view all the SAN hosts configured in the domain, along with the organization (if any), expand the *Storage Builder* node in the Applications tree and select *Hosts*.

To view all the NAS configured in the domain, along with the Organization (if any), expand the *Storage Builder* node in the Applications tree and select *NAS Devices*.

Both view panels display total, used, and free space, the amount of space and number of files accessed in the last 24 hours, and a utilization percentage.

Viewing storage device capacity from the Applications tree

Storage Devices - hp OpenView storage area manager

File View Tools Help

Storage Devices Storage Builder

Capacity

Show Organization All Organizations

Storage...	Organi...	Total S...	Visible...	Not Vis...	Unconf...	Overhe...	% Visi...
HP X...		579.72 GB	17.91 GB	111.92 GB	449.9 GB	0	3 %
HP X...		1,002.41 GB	60.14 GB	641.54 GB	300.72 GB	0	6 %
HP V...		66.76 GB	12 GB	0	1.26 GB	53.5 GB	18 %
HP F...		84.8 GB	38.88 GB	0	11.76 GB	34.15 GB	46 %
HP F...		84.8 GB	59.08 GB	0	28 KB	25.71 GB	70 %

Totals

		1.78 TB	188.02 GB	753.46 GB	763.65 GB	113.36 GB	10 %
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Storage Events Event Filter None Total Events: 381 Displayed Events: 381

Acknowledge...	Severity	Occurred	Source	Category	Event Type	Message
	Informational	May 30, 2001 10:35:34 AM PDT		Capacity	UNKNOWN_THRESH...	The measurement
	Informational	May 30, 2001 10:35:35 AM PDT		Capacity	UNKNOWN_THRESH...	The measurement
	Informational	May 30, 2001 10:35:35 AM PDT		Capacity	UNKNOWN_THRESH...	The measurement

Discovery Off

To view all supported storage devices within the domain, expand the *Storage Builder* node in the Applications tree and select *Storage Devices*. The view panel displays total, visible, not visible, unconfigured, and overhead space, as well as percent utilization.

Viewing user capacity from the Applications tree

The screenshot shows the HP OpenView Storage Area Manager interface. The 'Users' node is selected in the Applications tree. The 'User: Administrators' panel displays a table of volumes and their space usage. A red arrow points from the 'Users' node to the 'User: Administrators' panel.

Volume	System Device	Space Used
G: on host Win2000(2)	Win2000(2)	85
H: on host Win2000(2)	Win2000(2)	85
T: on host WinNT(1)	WinNT(1)	85
D: on host Win2000(2)	Win2000(2)	20.08 KB
F: on host Win2000(1)	Win2000(1)	20.17 KB
H: on host Win2000(1)	Win2000(1)	200.58 MB
E: on host WinNT(1)	WinNT(1)	385.37 MB
F: on host Win2000(2)	Win2000(2)	401.13 MB
E: on host WinNT(2)	WinNT(2)	565.1 MB
C: on host WinNT(1)	WinNT(1)	587.42 MB
F: on host WinNT(3)	WinNT(3)	1.12 GB
C: on host WinNT(3)	WinNT(3)	1.17 GB
C: on host Win2000(1)	Win2000(1)	1.23 GB
E: on host Win2000(1)	Win2000(1)	1.4 GB
C: on host WinNT(2)	WinNT(2)	1.62 GB
C: on host Win2000(2)	Win2000(2)	1.81 GB

Totals: 10.43 GB

Storage Events: Total Events: 476 Displayed Events: 476

Acknowledgement	Severity	Occurred	Source	Category	Event Type
Information	September 7, 2002 8:38:30 AM...	HP X...	Device	INTERRUPT_EVENT	

Discovery Off

daemon 3.82 GB

games 3.8 GB

news 3.21 GB

ftp 2.74 GB

operator 2.45 GB

bin 1.92 GB

smtp 824.55 MB

Totals: 59.52 GB

Storage Events: Total Events: 476 Displayed Events: 476

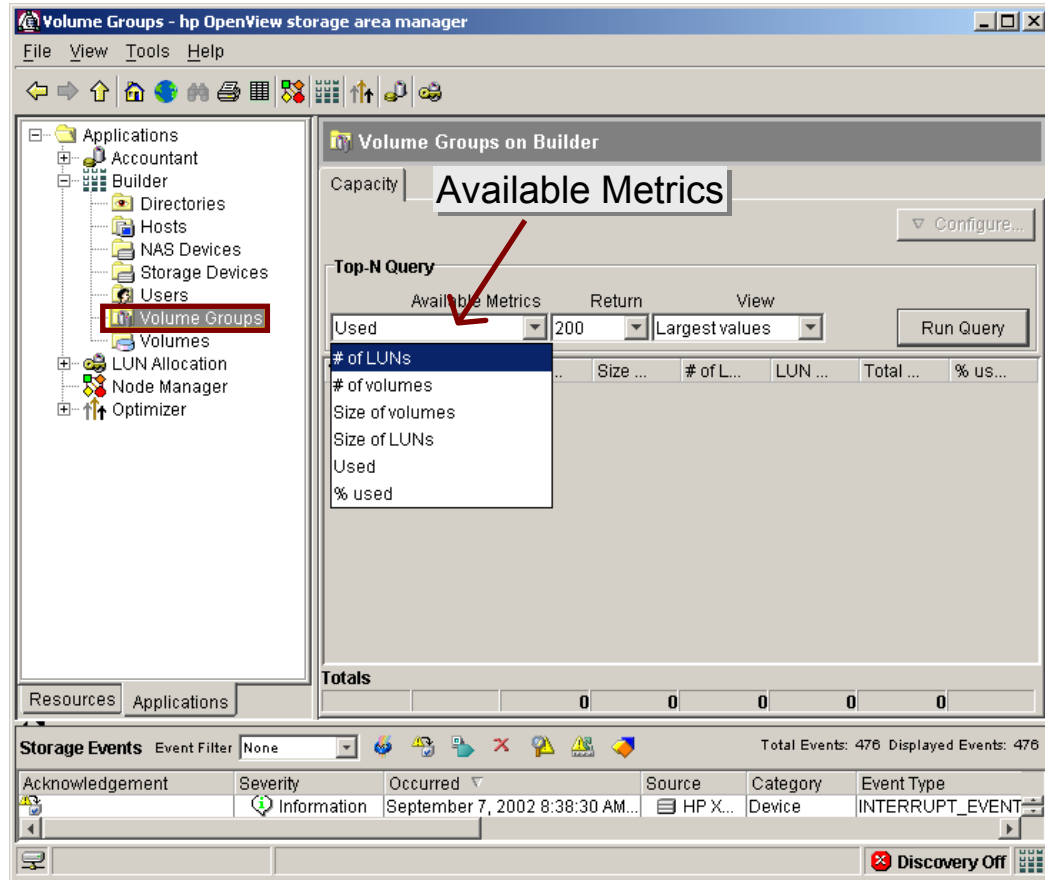
Acknowledgement	Severity	Occurred	Source	Category	Event Type
Information	September 7, 2002 8:38:30 AM...	HP X...	Device	INTERRUPT_EVENT	

Discovery Off

To view all user accounts in the domain and their corresponding used space, expand the *Storage Builder* node in the Applications tree and select *Users*.

From this view panel, view Top N largest versus smallest values. Double-click any user account in the view panel to view property and volume usage information.

Viewing volume group capacity from the Applications tree



To view a list of all volume groups configured within the domain, expand the *Storage Builder* node in the Applications tree and select *Volume Groups*.

Note

Only supported OS volume groups are listed (LVM and Veritas).

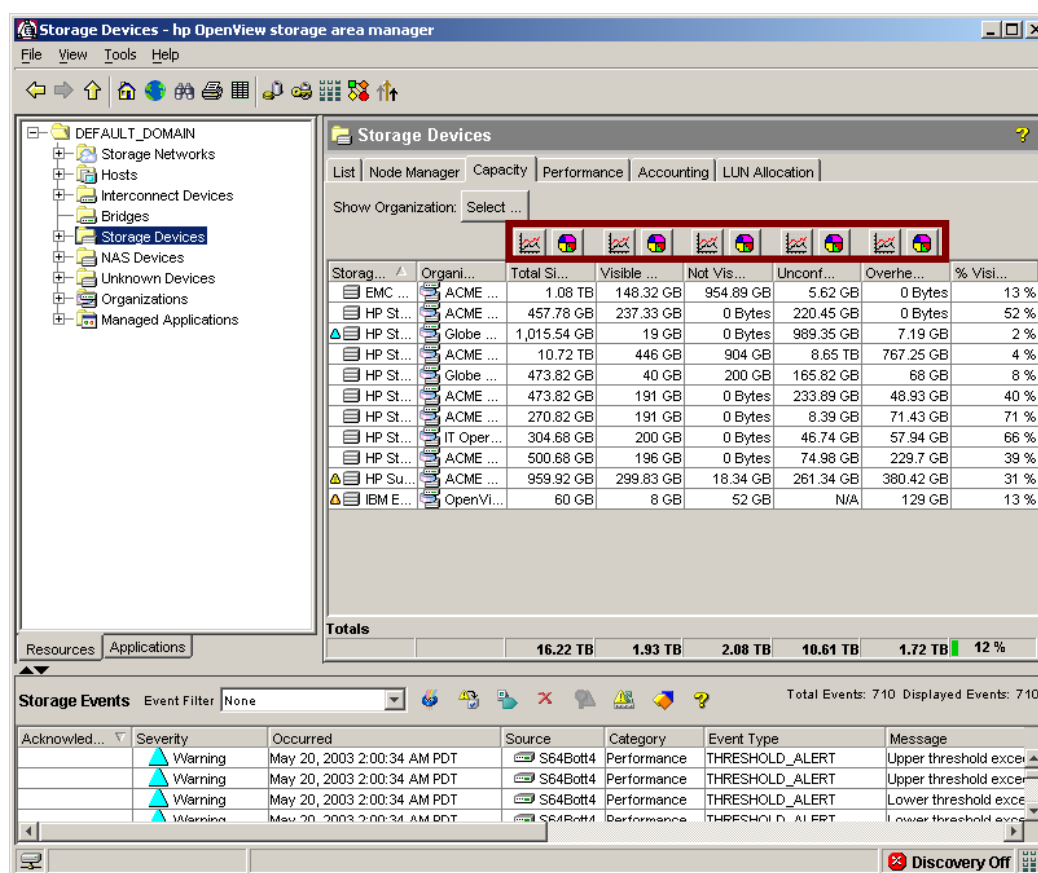
To run queries, select desired parameters in Available Metrics, Return, and View drop-down boxes and click the Run Query button.

Capacity graphs and reports

Storage builder provides access to a variety of capacity-related graphs and reports, including:

- **Historical graphs** — Line graphs that show historical data and trending predictions
- **Snapshot comparisons** — Pie charts that show part(s) of a whole, given the current data
- **Canned reports** — Domain and Host level Reports

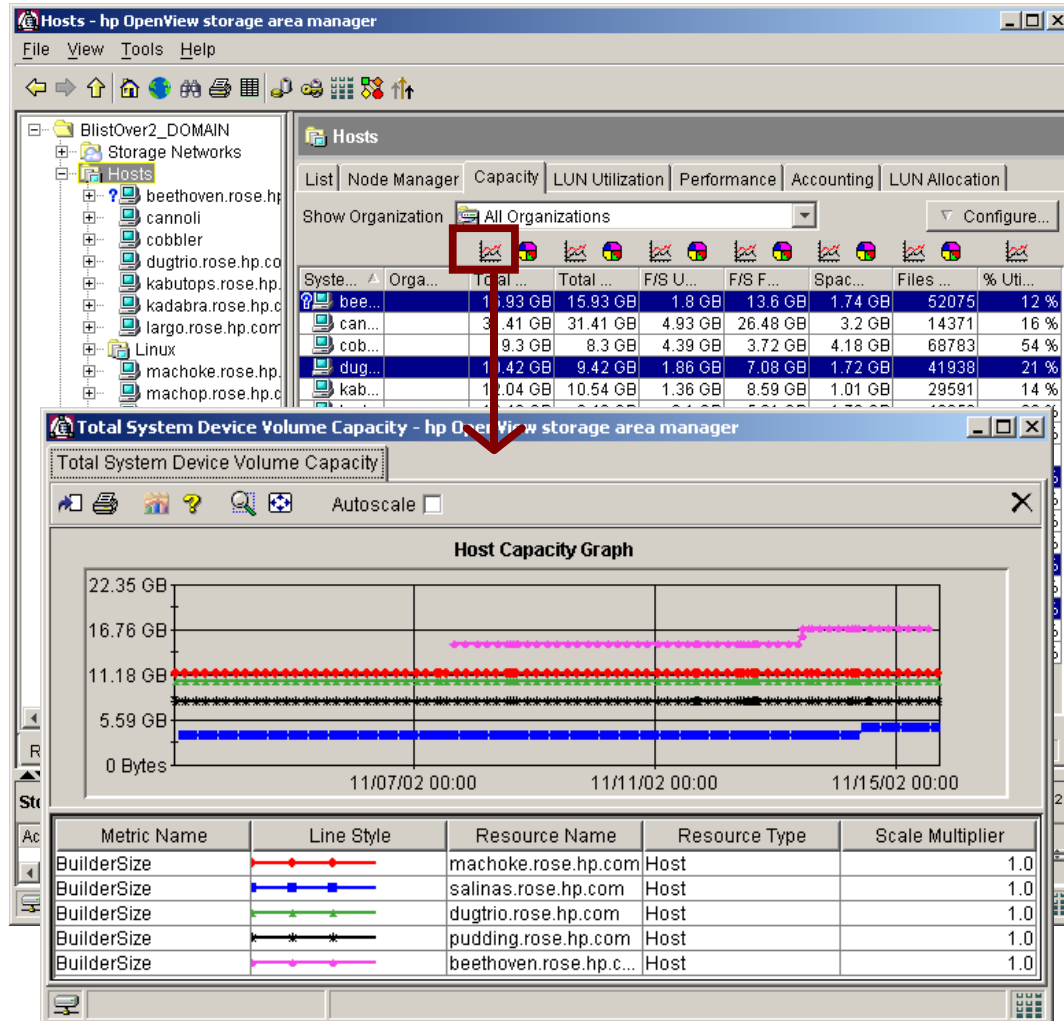
Launching graphs and charts



To view a historical graph or comparison pie chart, press the *CTRL* key to select which objects to display on the graph. Then, click the icon above the desired metric.

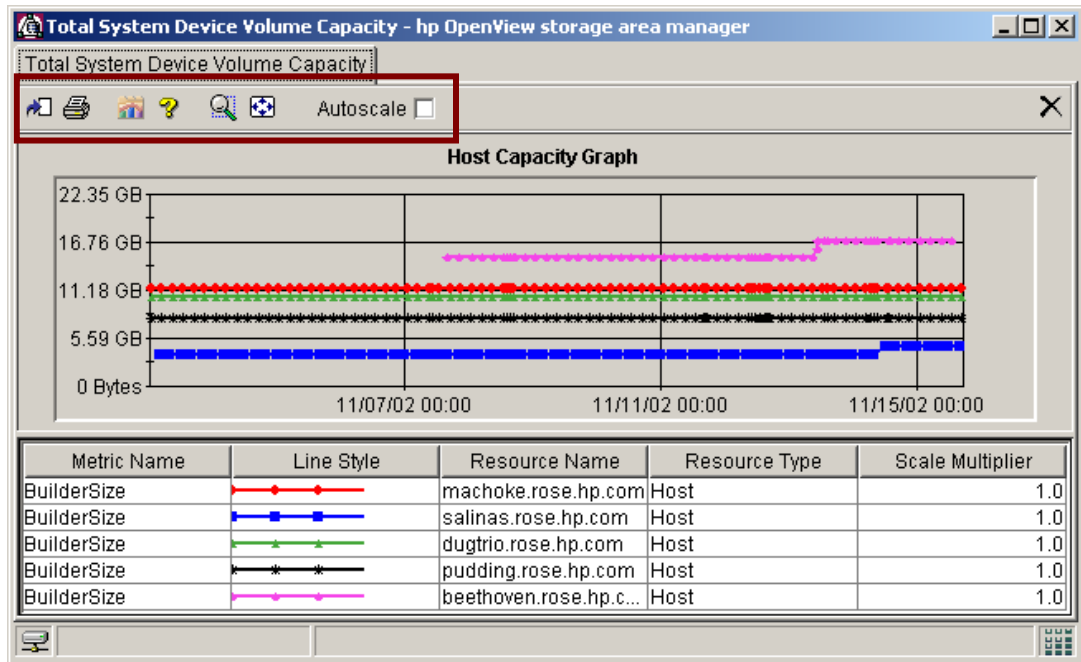
If no objects are selected, the first five objects will be graphed.

Viewing historical graphs



Capacity graphs show past and future trends for a capacity characteristic. Which characteristic is shown depends on which graph button you click in the Capacity view panel. The characteristic is identified on the tab of the Graph view panel.

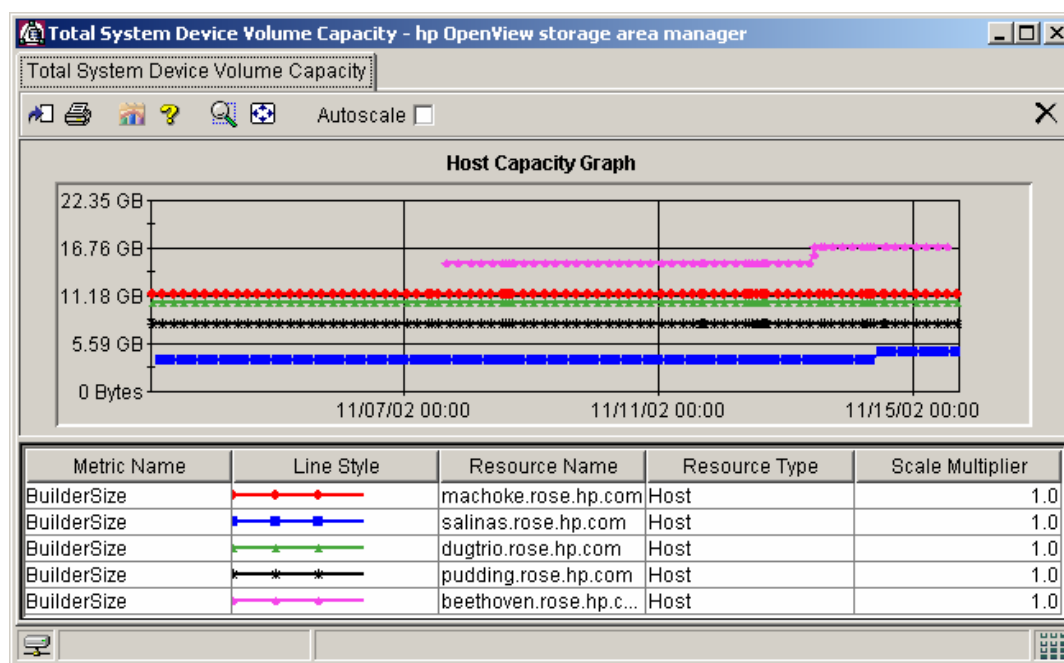
Historical graph toolbar



Click the icons on the Historical Graph toolbar to:

- Export data content of the graph.
- Print the graph.
- Modify time period, trending options, and appearance of the graph.
- Zoom in on a portion of the graph.
- Scale data to y units of 0 to 100.
- View this Help topic.

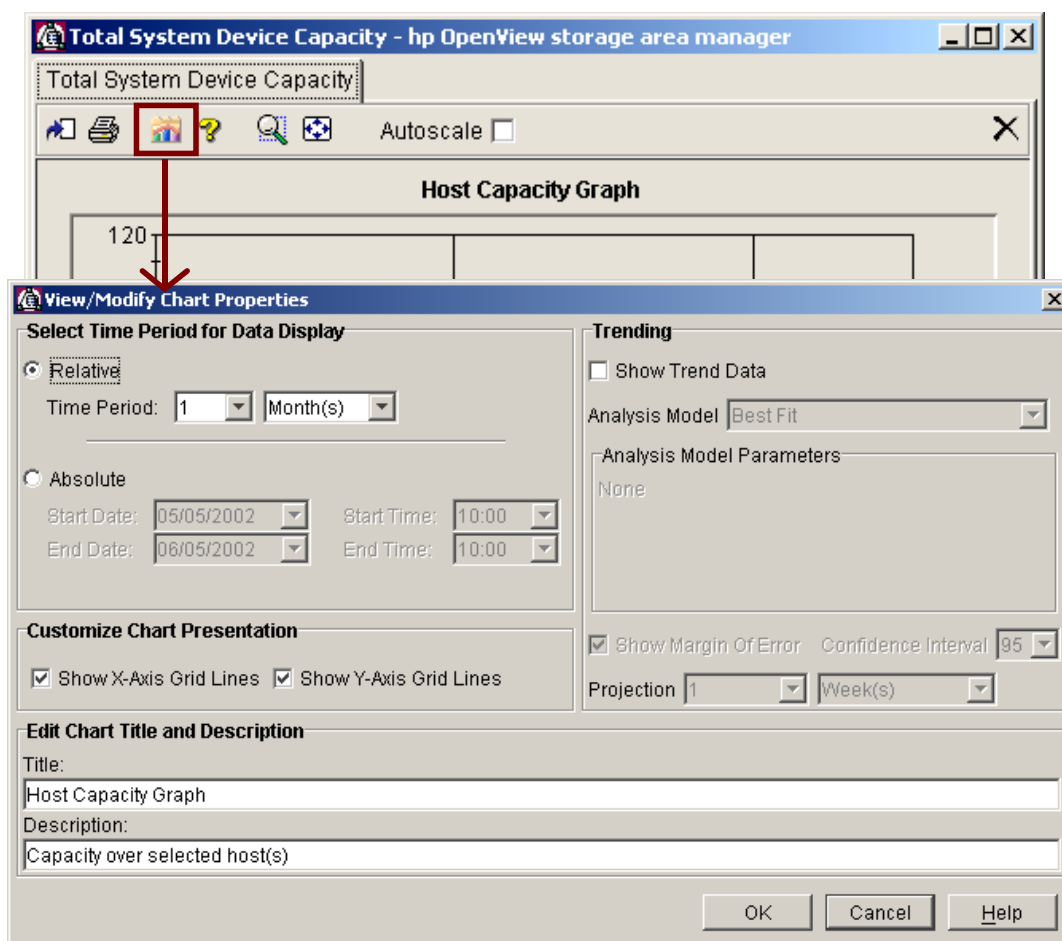
Historical graph window



The graph shows summarized and unsummarized capacity measurements as a series of connected data points. Click any data point to see the date and time that the data was collected or summarized.

The graph's y axis (capacity) automatically scales to the maximum size (GB) of the data. To compare graphs with dissimilar y units, check the Autoscale option. The y axis changes to a scale of 0 to 100 and the data is converted accordingly. The x axis (time) scales to the selected time period. The default period is from the current date to one month in the past. Use the Zoom tool to expand selected time units and to separate densely packed data points.

Modifying historical graph properties



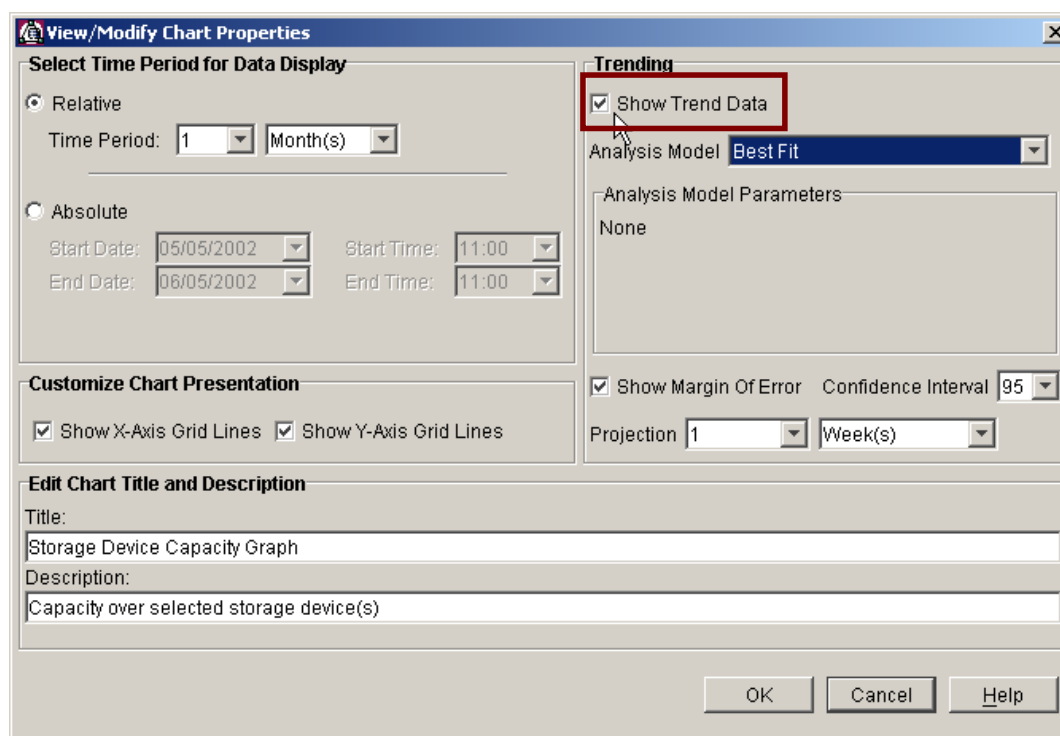
To change the way capacity graphs display data, click the *Edit Chart Properties* button on the graph toolbar. Change the time period, enable or disable trending, and turn the grid lines on or off. Selections take effect immediately in the open graph and in other graphs for like devices until you exit Storage Area Manager.

In the Modify Chart Properties window, change the time period by selecting *Relative* or *Absolute* and selecting the associated options.

Note

The archive schedule determines whether or not data is available for the time period you select. For example, if you choose to display 1 year of data, but you keep summary data for only 6 months, then the first half of the graph will be empty.

Enabling historical graph trending



Click the *Show Trend Data* check box to toggle trend data on or off. A check in this box activates other options in the trending section. The display of trend data is disabled by default.

Select an analysis model. Depending on which model you select, additional options appear in the Analysis Model Parameters section. The default model—Best Fit—lets Storage Builder choose the unsmoothed model (polynomial, exponential, or logarithmic) that most closely matches the data displayed.

Select analysis model parameters, as required.

Select the projection period—hour, day, week, and so forth—and then select the number of periods into the future that you want to predict the capacity data. In general, the projection period should be half as long as the period that is specified for data display. The default projection period is one week.

Note

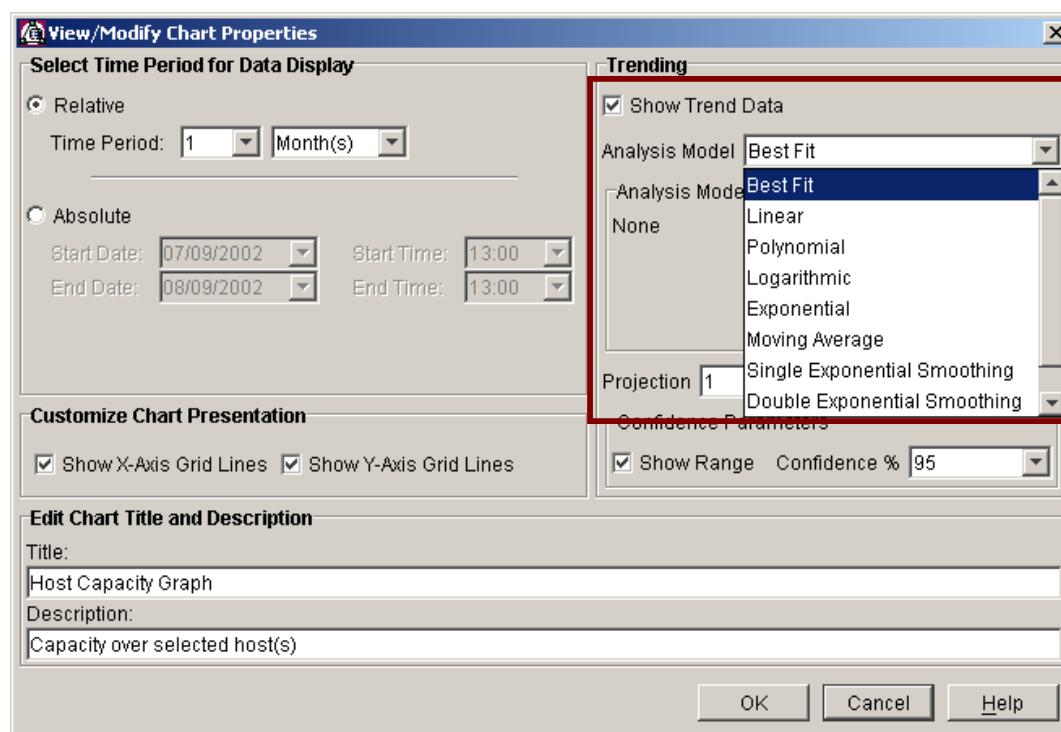
To increase the period of collected data and consequently the reliability of the projection, select a longer time period in the Select Time Period for Data Display section.

To specify a level of confidence for the predicted values, select the *Show Range* check box and then the *Confidence %*. Greater degrees of confidence allow greater ranges of possible values. The confidence range is indicated by vertical bars crossing the trend line. The default is 95%.

To toggle grid lines on or off, select the *Show X-Axis Grid Lines* and *Show Y-Axis Grid Lines* check boxes.

Click *OK* to save the displayed options and close the window.

Analysis models



Analysis models improve the projection of future capacity by taking into account the general characteristics of collected data and the relative weight of specific characteristics. You can choose any of the following 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.

- **Linear** — The linear model draws the best line through the collected data, that is, the line with the smallest differences between actual and depicted data points. Choose this model if the selected metric tends to rise or fall in a straight line.
- **Polynomial** — The polynomial model draws the best curve through the collected data, that is, the line with the smallest differences between actual and depicted points. Choose this model if the selected metric tends to rise and fall, as shown here (or the opposite, fall and rise). You select the polynomial order. The higher the order, the more turns (rises and falls) the line accepts and, therefore, the better potential fit. However, very high orders combined with some metrics may generate numbers that are too large for the computer to represent.

- **Logarithmic** — The logarithmic model 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** — The exponential model 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.
- **Best fit** — This selection allows Storage Builder to determine which of the above models (third-order polynomial, logarithmic, or exponential) best matches the collected data.
- **Moving average** — The moving average model is the most common smoothing technique. It calculates the next value by calculating the average of the last user-defined N observations. Because this is an average, all previous N observations are equally weighted at $1/N$. Generally, the larger N is, the smoother the results are.
- **Single exponential smoothing** — This model applies greater weight to more recent data, also called baseline sensitivity. The older the observation, the less weight it has on the future value. Choose this model if you believe that more recent data is a better predictor of future capacity.
- **Double exponential smoothing** — The double exponential smoothing model 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. You specify the baseline sensitivity (how fast the weight increases from older to newer data) and the trend sensitivity (how much weight to give up and down tendencies). Specify a weight between 0 and 1, where 0 eliminates the weight given to the variable, and 1 gives maximum emphasis to the variable.
- **Triple exponential smoothing** — The triple exponential smoothing (Holt-Winters) model provides baseline sensitivity, trend sensitivity, and seasonality sensitivity. Seasonality sensitivity gives greater weight to periodic variations in data. Choose this model if these variables are important to an accurate prediction. You choose the length of the season (a day or a week). In the example here, the season spans four data points.

Specifying the margin of error and confidence interval

View/Modify Chart Properties

Select Time Period for Data Display

☒ Relative
Time Period: 1 Month(s)

☐ Absolute
Start Date: 05/05/2002 Start Time: 11:00
End Date: 06/05/2002 End Time: 11:00

Customize Chart Presentation

☒ Show X-Axis Grid Lines ☒ Show Y-Axis Grid Lines

Edit Chart Title and Description

Title: Storage Device Capacity Graph
Description: Capacity over selected storage device(s)

Trending

☒ Show Trend Data
Analysis Model: Best Fit
Analysis Model Parameters: None

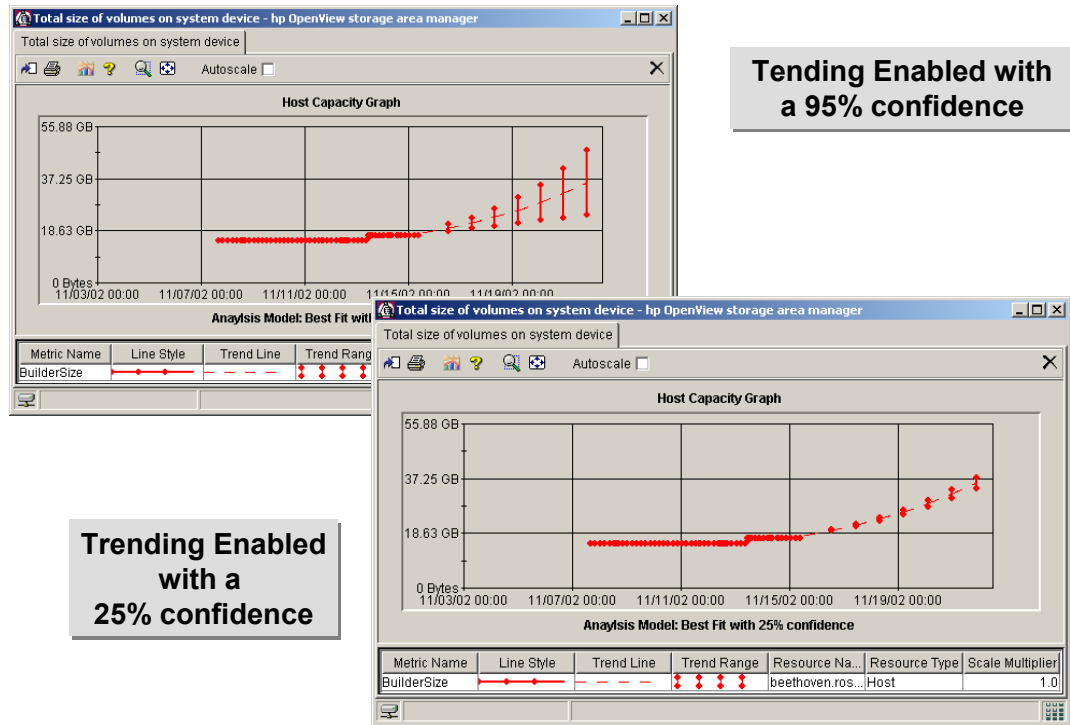
☒ Show Margin Of Error Confidence Interval: 95
Projection: 1 Week(s)

OK Cancel Help

When enabling trending for a capacity graph, also select the project period and the level of confidence.

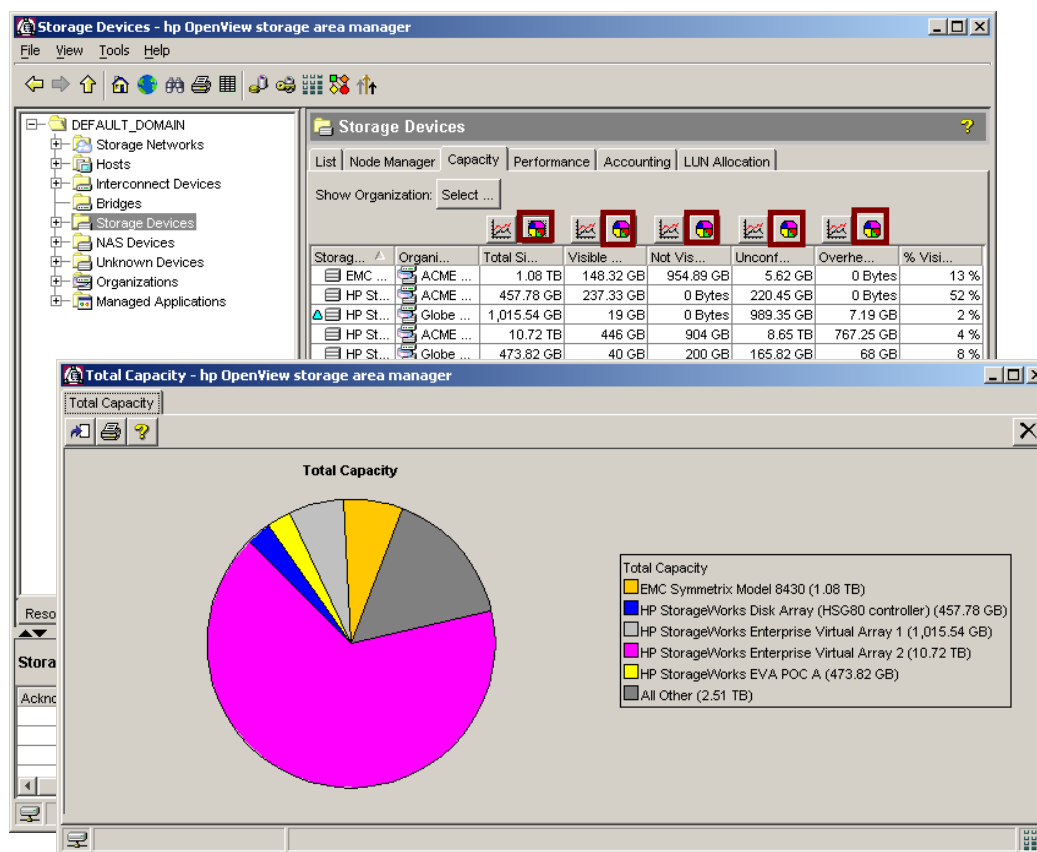
To show the margin of error as vertical bars alongside the trend line, select the *Show Margin of Error* checkbox and adjust the *Confidence Interval*. Higher levels of confidence increase the range of accepted values.

Trending examples



The capacity graph examples above demonstrate the effects of enabling trending and adjusting the levels of confidence. Note that in the top graph the confidence level has been set at 95%. As a result, the margin of error (displayed as vertical bars) is greater than when the confidence level is set to 25%.

Viewing snapshot comparison charts



A capacity pie chart shows the relative contributions of one or more resources to the combined capacity of all such resources. Resources can be devices, managed directories, volumes, organizations, or users—whatever is listed in the Capacity view panel. If you do not select a resource, the chart shows the first five resources in the list. Use pie charts to compare the capacity of like devices.

Hovering over a pie segment displays a ToolTip containing the size of the segment.

Canned reports

Capacity reports track the size of certain files and directories in the storage domain. If file data is being collected, you can produce the following reports:

Note

To enhance Storage Builder usability, as well as to reduce the amount of stress on the management server, this canned set of capacity reports are processed whenever file collection runs. Reports are stored on the management server in a compressed format.

- **Stale files** have not been opened in a specified number of days. You can get a list of the stale files on a selected host, NAS device, or volume or you can get the total number and size of all stale files on all the hosts and NAS devices in the domain.
- **Junk files** can be identified by specific characters, such as .tmp, in their names. You can get a list of the junk files on a selected host, NAS device, or volume, or you can get the total number and size of all junk files on all the hosts and NAS devices in the domain.
- **Largest files** is a list of the largest files on a selected host, NAS device, or volume. The list includes each file's location, owner, size, file mode, time created, and last time opened or modified.
- **Largest directories** lists the file contents of the largest directories on a selected host, NAS device, or volume. Contents include each file's location, owner, size, mode, time created, and last time opened or modified.
- **Files/directories detailed list** is a list of all files and directories on a selected host, NAS device, or volume. The report includes each file's size, owner, file mode, time created, and last time opened or modified. This report is written to a user-specified file and not displayed.

Administrator privileges are required to set the criteria that define stale files, junk files, and the largest files and directories, as well as to choose the report format.

Example report: Junk Files

Storage Area Manager Report: Capacity - Microsoft Internet Explorer

Address: C:\Documents and Settings\Shellie\Local Settings\Temp\capacity_report55373.html

Junk Files: Windows 2000: USAM2

Report generated on Oct 23, 2002 12:11:06 PM, sorted descending on 'Size (Bytes)'.

Total Size (Bytes): 34244839

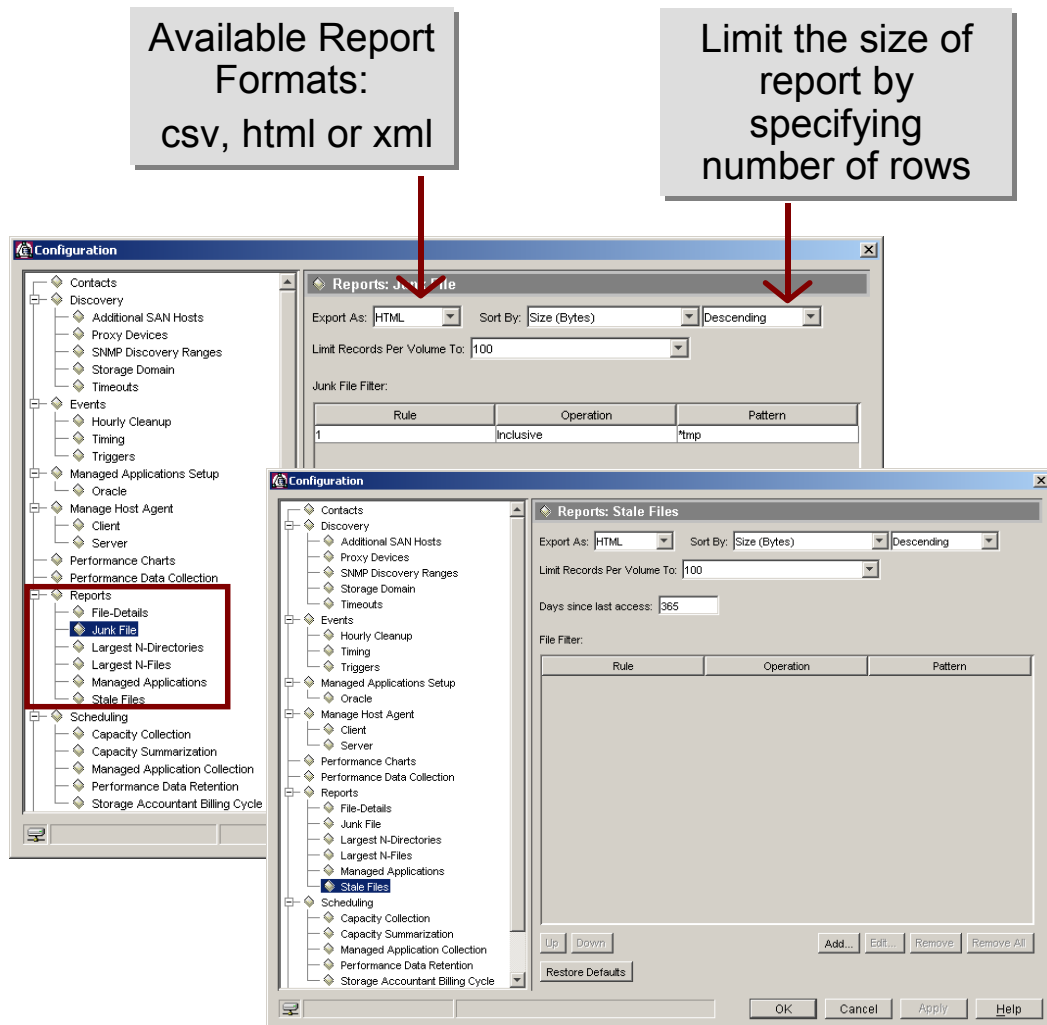
Path Name	Type	Size (Bytes)	Mode	Owner	Status Change Time	Last Modification Time	Last Access Time
C:\Documents and Settings\Administrator\Local Settings\Temp\pft2~tmp\Reader\AcroRd32.exe	f	3870784	33133	USAM2:Administrators	Mar 27, 2001 9:44:58 PM PST	Mar 27, 2001 9:44:58 PM PST	Feb 19, 2002 1:46:40 PM PST
C:\Documents and Settings\Administrator\Local Settings\Temp\pft2~tmp\SVG Files\SVGView.dll	f	1597491	33060	USAM2:Administrators	Mar 14, 2001 2:07:52 PM PST	Mar 14, 2001 2:07:52 PM PST	Feb 19, 2002 1:46:41 PM PST
C:\Documents and Settings\Administrator\Local Settings\Temp\pft2~tmp\Reader\CoolType.dll	f	1441792	33060	USAM2:Administrators	Mar 14, 2001 10:06:02 AM PST	Mar 14, 2001 10:06:02 AM PST	Feb 19, 2002 1:46:40 PM PST
C:\Documents and Settings\Administrator\Local Settings\Temp\jar_cache15194.tmp	f	1439860	33206	USAM2:Administrators	Oct 16, 2002 11:19:43 AM PDT	Oct 16, 2002 11:19:43 AM PDT	Oct 16, 2002 11:19:43 AM PDT
C:\Program Files\Hewlett-Packard\samgr\hostagent\data\filetmp-0.csv	f	1336634	33206	USAM2:Administrators	Oct 23, 2002 11:51:35 AM PDT	Oct 23, 2002 11:51:39 AM PDT	Oct 23, 2002 11:51:39 AM PDT

Done My Computer

A sample Junk File report is shown in the example above.

The *Status Changed Time* field refers to the time the file was last changed (not necessarily modified) on a UNIX host, and the creation time on a Windows system. The *Mode* field is the octal representation of all of the file type, its attributes, and access control summary.

Report settings



To define any of the canned reports, from the Configuration window, expand the *Reports* node and choose the specific report. Junk files are defined using *rules*. Storage Builder first compares the file path with the pattern. Then, if they match, Storage Builder will either include or exclude the file in the report, depending on the Rule definition. If no rules are listed, the report will be empty. Default rules include *tmp* and *temp*. Only one rule is allowed per line. Other report attributes include the report export format (.xml, .html or .csv), sorting options, and report size.

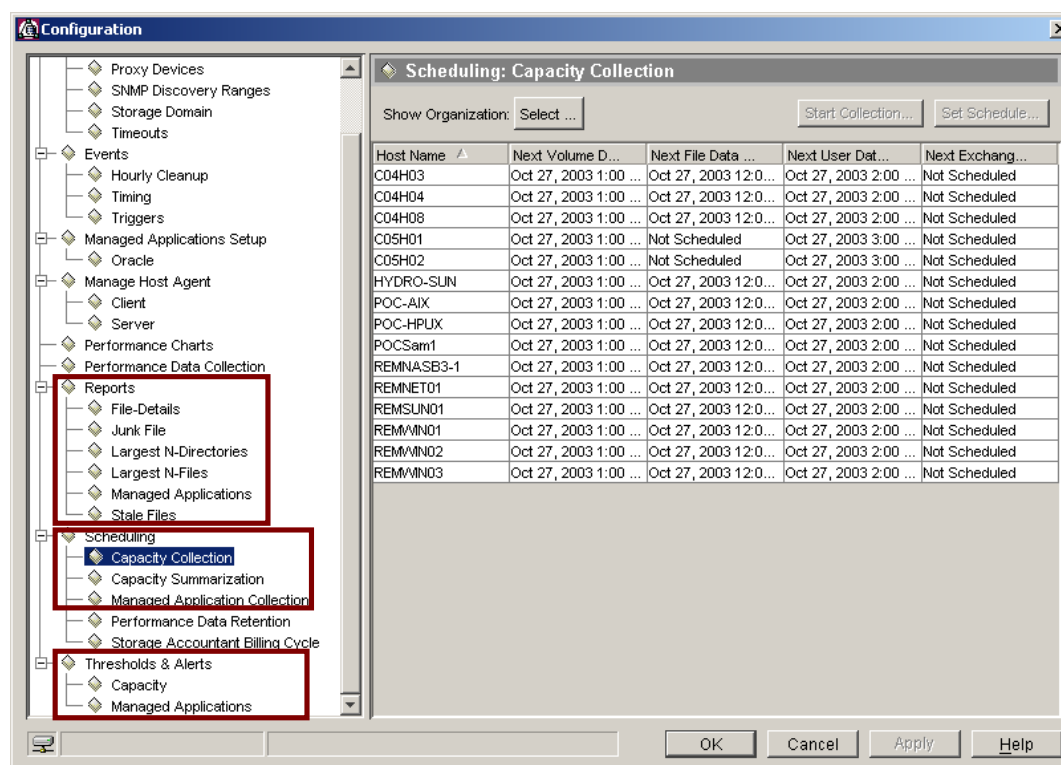
A *stale file* is defined as “number of days since file was last accessed = n”, where n is 365 days by default. Rules can be added to filter the report. By default, there are no rules.

Storage Builder configuration

Storage Builder configuration falls into several categories:

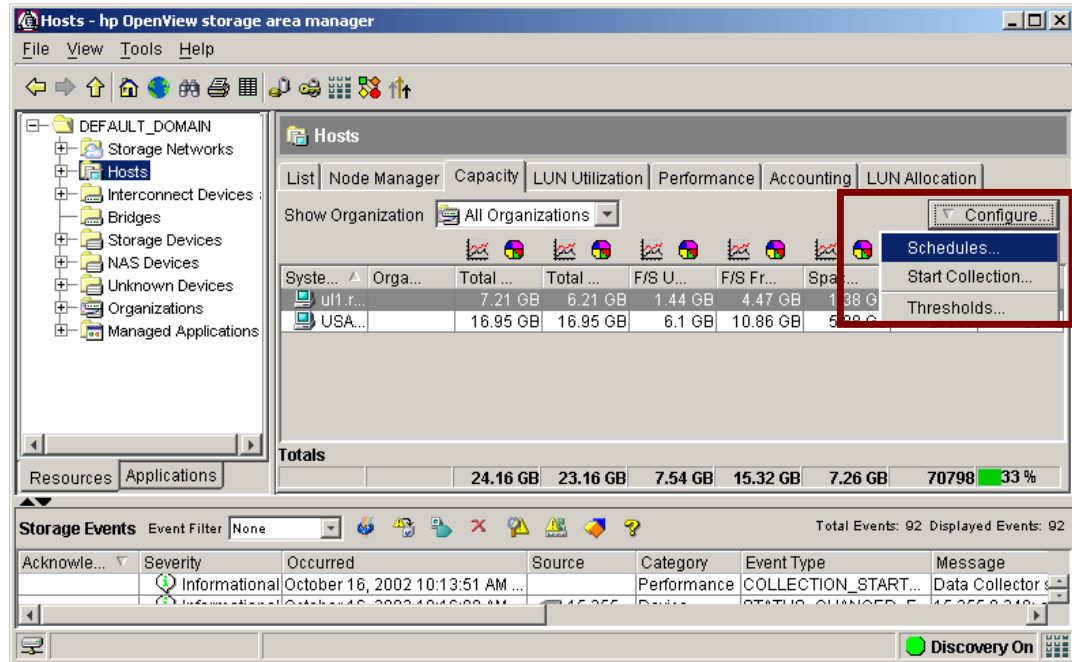
- Scheduling capacity data collection
- Scheduling capacity data summaries
- Setting capacity thresholds
- Configuring triggers
- Defining reports

Using the Configuration window



Access Storage Builder configuration view panels from the Configuration window.

Context access to Storage Builder configuration



Additionally, access Storage Builder configuration view panels for Hosts and NAS devices directly from the Capacity view panels.

Scheduling capacity data collection

Storage Builder relies on Storage Area Manager Core Services to collect storage device capacity information. This information (total device capacity, unconfigured capacity, visible to hosts, not visible to hosts) is updated automatically as discovery runs on a continuous basis.

Host capacity data collection is performed by the Storage Builder Host Agent components. Set collection schedules for individual hosts and three types of data:

- **Volume Data** — Includes the used and free space in a volume's file systems, size of the volume, and association of logical volumes with LUNs and volume groups on the selected host.
- **File Data** — Includes the size and activity of files and directories on the selected host. File data must be collected to manage directories, report files, monitor user consumption, and determine the space needed for backups.

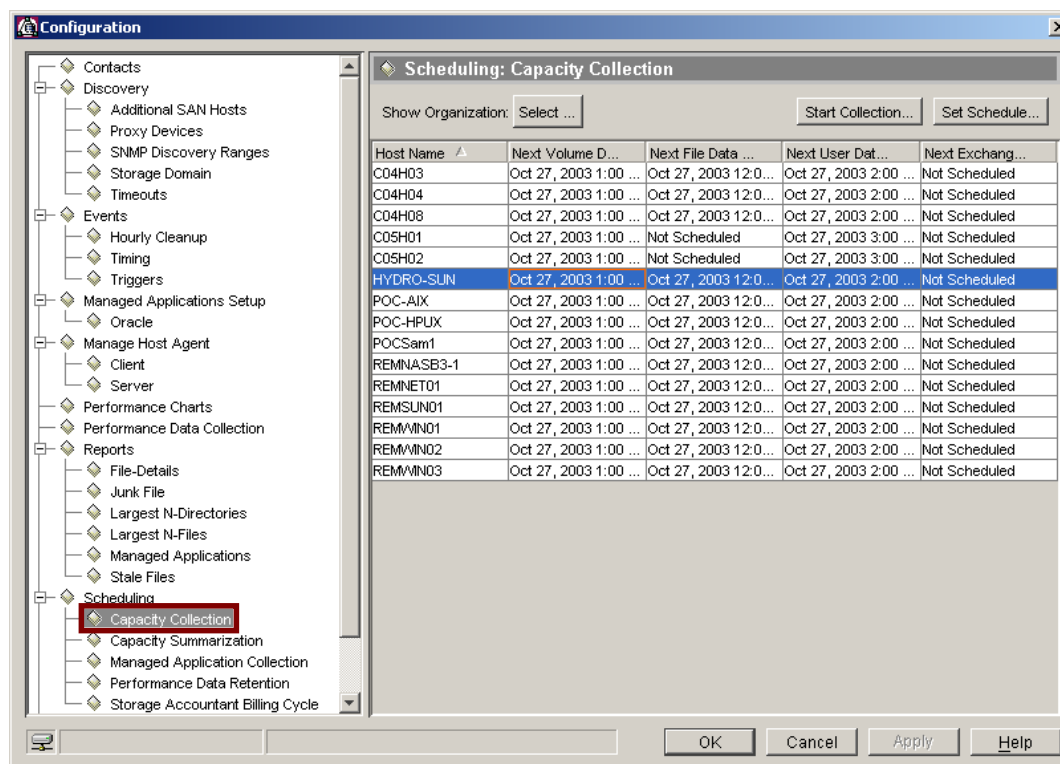
Notes

HP recommends scheduling file collection once a day, when the management server is not in heavy use.

File data cannot be collected for NAS devices on Windows NT and Windows 2000 systems. NAS device capacity is reported only for volumes that are mounted on UNIX hosts.

- **User Data** — Identifies users on the selected host. If the host is a domain controller or NIS server, all users are identified. Otherwise, only the local users are identified. The capacity associated with user accounts is discovered during file data collection.

Host-centric data collection

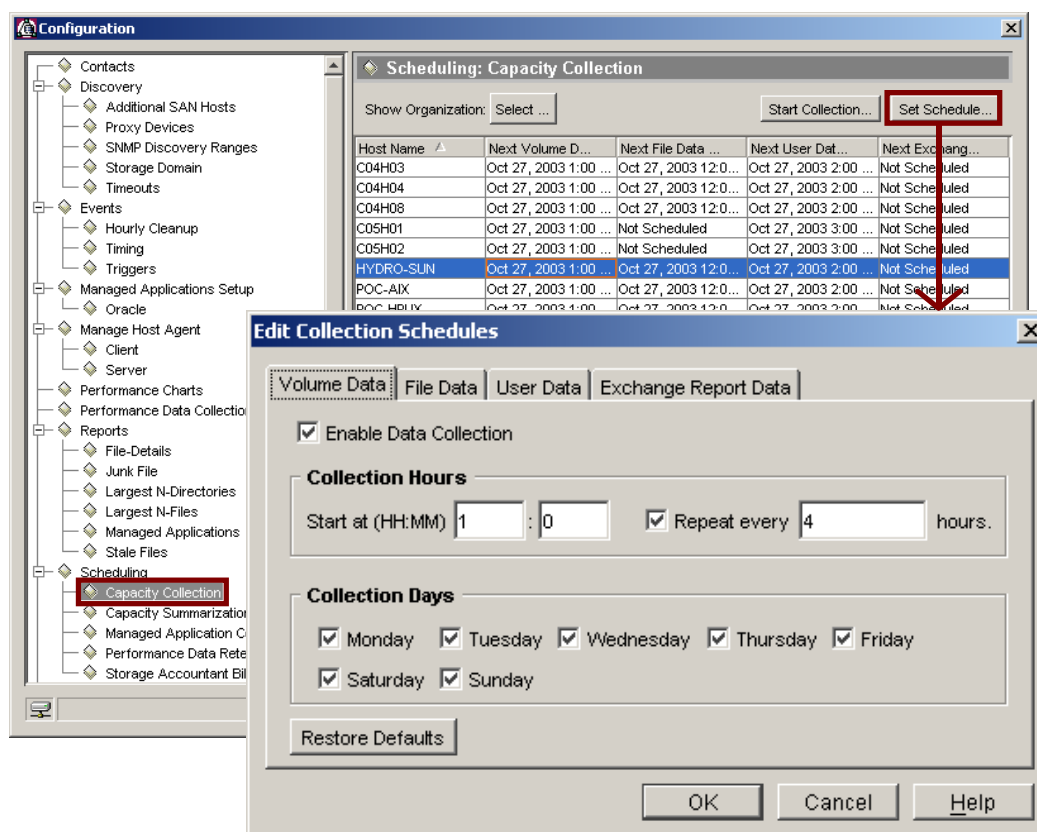


Set collection schedules per host for volume, file, and user data.

The default settings include:

- Volume data collection runs every 4 hours, beginning at 1:00 a.m.
- File data collection is disabled.
- User data collection runs every 4 hours beginning, at 2:00 a.m.

Customizing host collection times



To specify the collection times for host capacity data

1. Select *Capacity Collection* under Scheduling in the Configuration tree. The Capacity Collection scheduling panel displays a list of hosts and the dates and times of the next scheduled collections on each. Filter the list by selecting an organization in the Show Organization box.
2. Select the host(s) whose schedule(s) you want to change. (To select multiple hosts, use the *Shift* or *Control* key.)
3. Click the *Set Schedule* button at the top of the view panel.
4. Click the tab of the collection schedule—for volume, file, or user data—that you want to change.
5. To enable or disable collection of the selected data, click the *Enable Data Collection* check box. A check mark indicates data will be collected as specified by the other entries in the window.

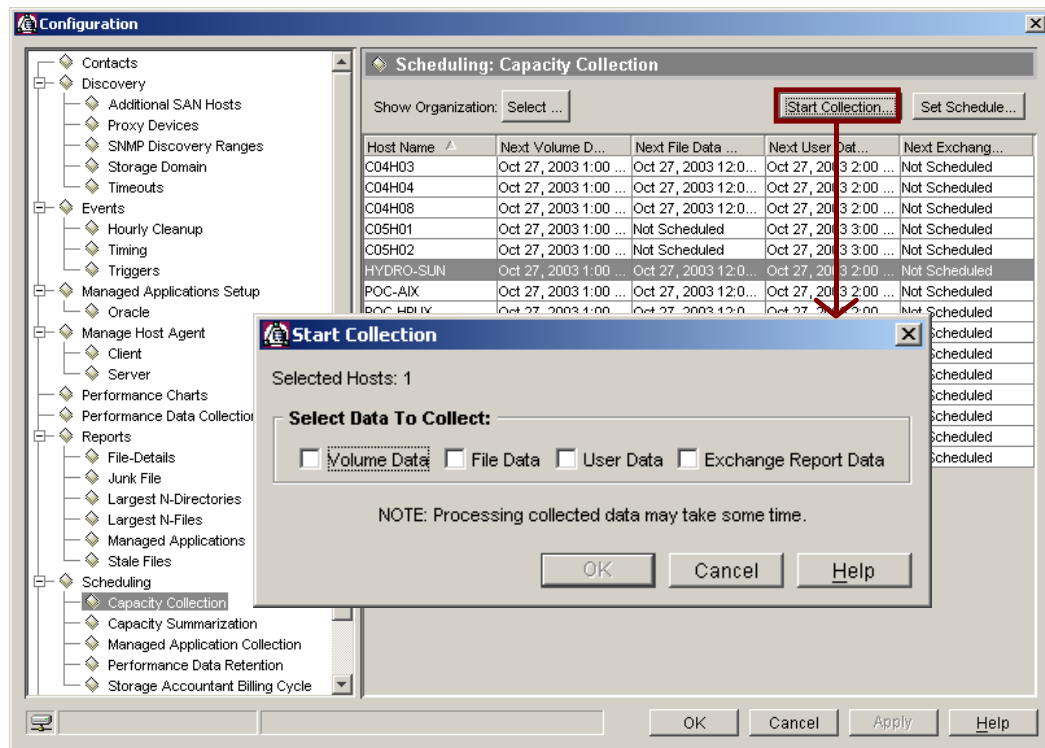
6. Once collection is enabled, specify the hours of collection as follows.
 - Enter the hour (0 through 24) and the minute (0 through 59) of the first collection of the day in the Start at boxes.
 - For periodic collections until the end of the day, check the Repeat check box and, in the box at the right, enter the number of hours that will elapse between each collection.
7. In the Collection Days section, select each day of the week that data will be collected. The hours specified in Collection Hours will apply to each day you select.

Note

Whenever you want to return the settings to the factory defaults, click the *Restore Defaults* button.

8. To change another capacity collection schedule for the same host, click its tab and repeat steps 5 through 7.
9. When you are satisfied with the volume, file, and user data schedules, click *OK* in the Edit Collection Schedules window.
10. Click the *Apply* button in the Capacity Collection scheduling panel to implement the schedule changes and continue scheduling collection for other hosts. Click *OK* to apply your changes and close the Configuration window.

Forcing SAN data host collection



To initiate immediate collection of selected capacity data on the selected host(s), click the *Start Collection...* button.

Data displays in Capacity view panels after it is collected and stored in the database. Depending on the amount of data requested and other factors, this may take awhile.

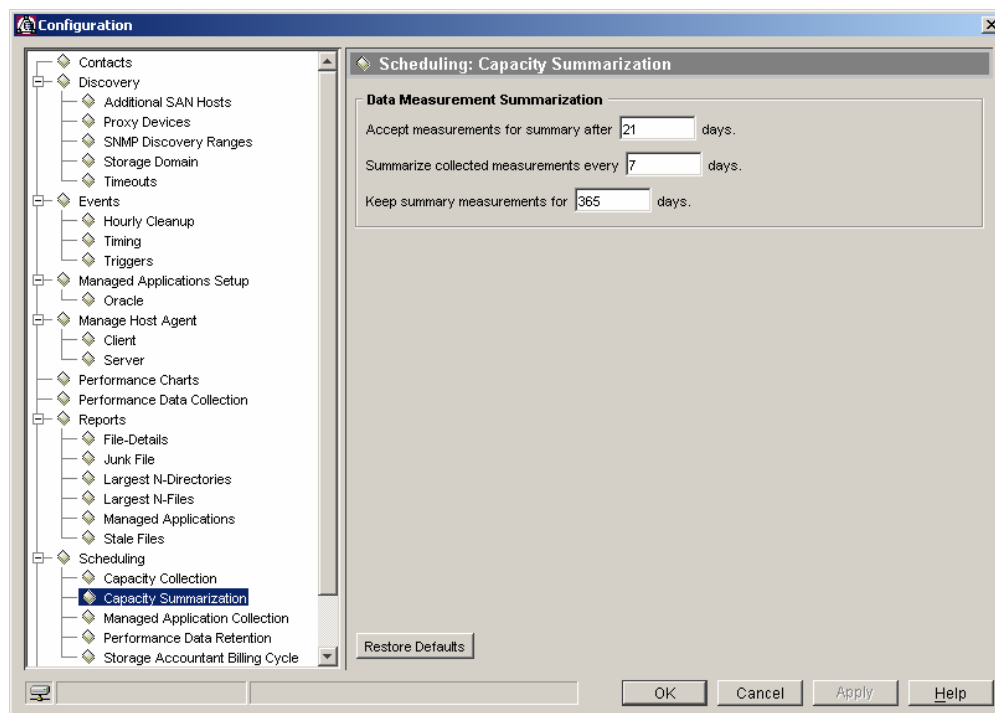
Note

If the host or Host Agent is unavailable, or if the capacity data collector is busy when you attempt to start collection, a Storage Builder event alerts you that data collection failed to start. Check the status of the Host Agent and the Storage Builder data collectors on the specified host.

Capacity summarization

For the sake of economy, Storage Builder routinely summarizes the data that has been collected over several days and then discards the original data. Summaries contain the weighted average, minimum and maximum values, and standard deviation for each measurement that Storage Builder collects. These values enable Storage Builder to display capacity history, predict future capacity, and conserve space in the database.

Setting capacity summarization



To set the schedule for summarizing collected capacity data and for deleting aged summaries, select *Capacity Summarization* under *Scheduling* in the Configuration tree.

To change the minimum number of days that data is kept before it can be summarized, enter a value for *Accept measurements for summary after* ____ days. Higher values increase the time that unsummarized data is displayed in capacity graphs. The default is 7 days. Collected data is deleted after it is summarized.

To change the number of days of collected data that summaries include, enter a value for *Summarize collected measurements every* ____ days. Higher values increase the interval between summaries in capacity graphs. The default is 7 days.

Note

Higher summary intervals also affect the period for which unsummarized data is displayed in capacity graphs. For example, if data must be kept 7 days before it can be summarized and summaries occur every 5 days, some data will be 12 days old before it is summarized.

To increase or decrease the number of days that capacity summaries will be kept, enter a value for *Keep summary measurements for ____ days*. Historical data is displayed in capacity graphs for as long as summaries exist. The default is 365 days.

Note

Whenever you want to return settings to the factory settings, click the *Restore Defaults* button.

Click the *Apply* button to implement changes and continue making changes, or click *OK* to apply changes and close the Configuration window.

Capacity thresholds

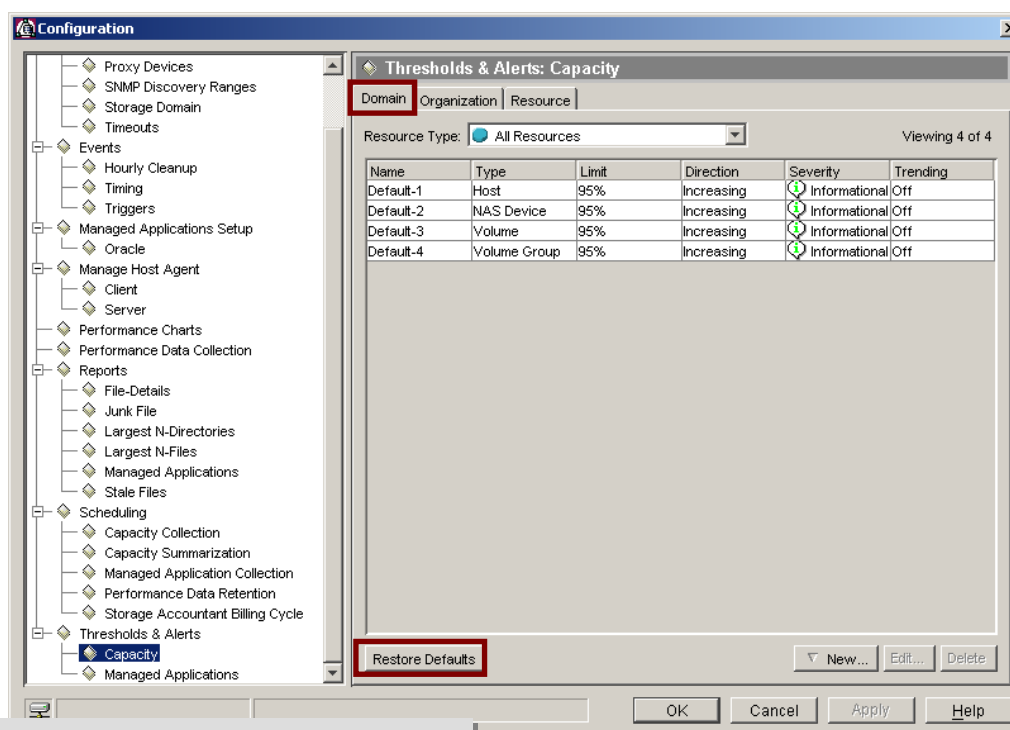
A Capacity Threshold is a user-defined limit on used space that, when exceeded, may need administrative attention.

Limits can be minimums or maximums, and are expressed as percentages (%) or absolute quantities (KB or MB).

Capacity thresholds can be set on:

- Individual resources: a host, volume, volume group, managed directory, and/or user.
- Resources that are global for the entire domain.
- Resources that are part of a specific organization.

Domain thresholds



Default thresholds can be edited or deleted
Click *Restore Defaults* button to reset original default settings

To set global consumption alerts on all hosts, NAS devices, volumes, volume groups, managed directories, or users, select *Capacity* under *Thresholds & Alerts*. The procedure displays a list of the current domain-level thresholds and a window for editing a selected threshold or adding a new one. The new settings take effect at the next collection of capacity data.

Note

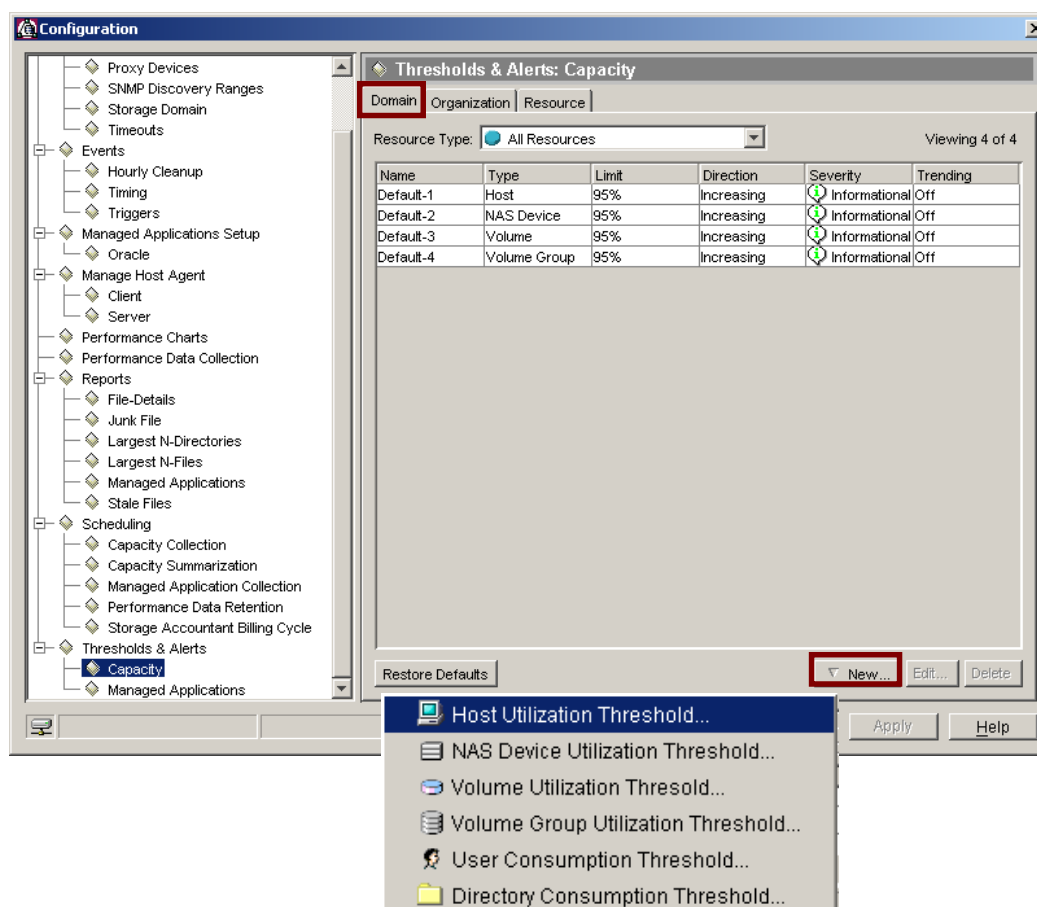
At least one cycle of volume or file data collection must occur before you can set thresholds on volumes, volume groups, managed directories, or users.

When editing or creating a new threshold, note the following:

- Names cannot use more than 64 characters or be duplicates.
- In the Limit box, enter or change the minimum or maximum amount of used space that will cause a threshold event. (Direction, the next labeled box in the window, determines whether the limit is a minimum or maximum.) For user and directory limits, select the unit of measure in the adjacent box. All other limits are percentages (space used over total space). The default limit is 95%.

- Select *Increasing* in the Direction box to cause a threshold event when used space exceeds the limit value, or select *Decreasing* to cause a threshold event when used space falls below the limit value. The default direction is *Increasing*.
- Select the severity level of the threshold event in the Severity drop-down box. The default level is *Informational*.
- To set or edit a threshold on future consumption, click the *Trending* tab. Next, click *Enable Threshold Trending* to toggle the threshold for future capacity on and off. A check in this box activates the other text boxes in this tab.
 - If threshold trending is enabled, select the *Projection* period, the number of months (1 to 12) into the future that Storage Builder will check for threshold violations. An event will occur if predicted consumption passes the threshold limit any time in the projection period.
 - If threshold trending is enabled, select the needed confidence that a threshold violation will be detected. Drag the slider toward *More Alerts* to increase the confidence up to 95% and toward *Fewer Alerts* to decrease the confidence down to 5%. Greater confidence allows greater ranges of possible values and therefore increases the likelihood of threshold events. For example, if 95% confidence tests all predicted values within 100 bytes of the threshold limit, then 5% confidence would test predicted values within only 10 bytes of the threshold limit.

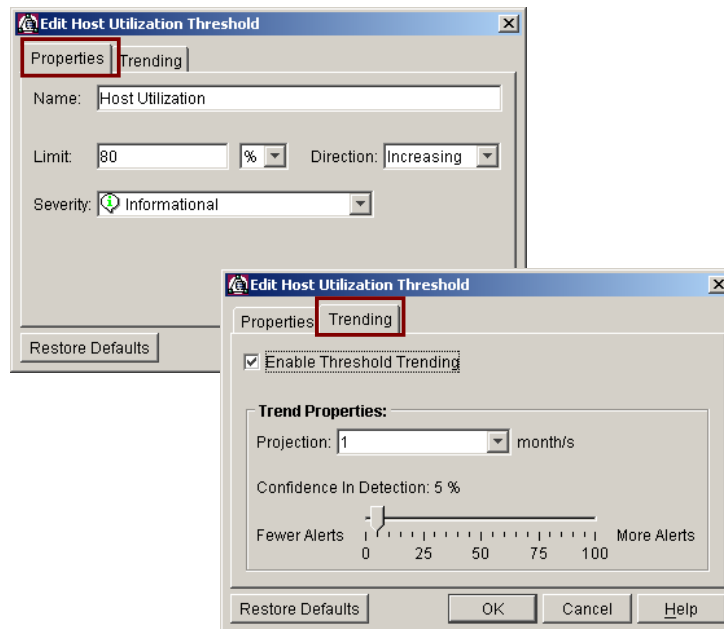
Adding domain thresholds



To create a new domain threshold, from the Thresholds & Alerts: Capacity view panel, click the *New* button and then select the desired resource type from the short-cut menu.

Domain thresholds can be set hosts, NAS devices, volumes, volume groups, users, and directories.

Threshold properties & trending

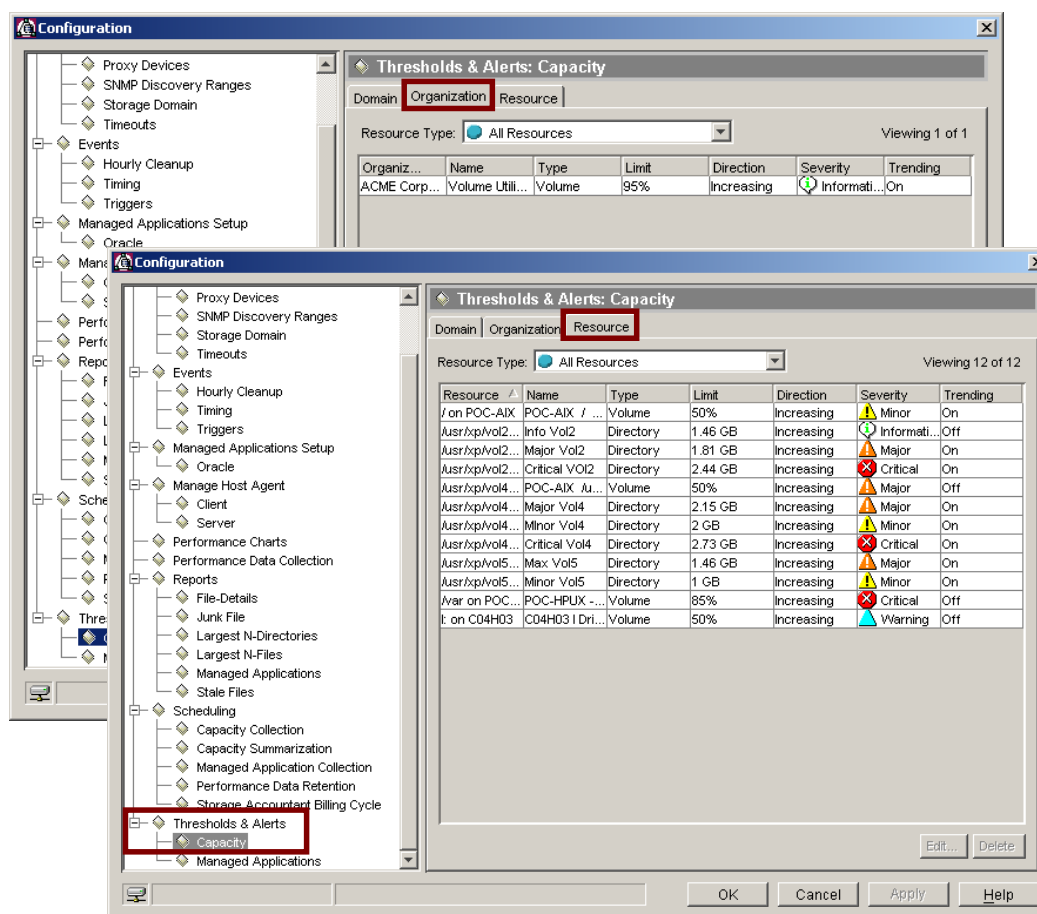


If threshold trending is enabled, you can select the Projection period, the number of months (1 to 12) into the future that Storage Builder will check for threshold violations. An event will occur if predicted consumption passes the threshold limit any time in the projection period.

Additionally, you can select the needed confidence that a threshold violation will be detected. Drag the slider toward *More Alerts* to increase the confidence, up to 95%, and toward *Fewer Alerts* to decrease the confidence, down to 5%. Greater confidence allows greater ranges of possible values, and therefore, increases the likelihood of threshold events.

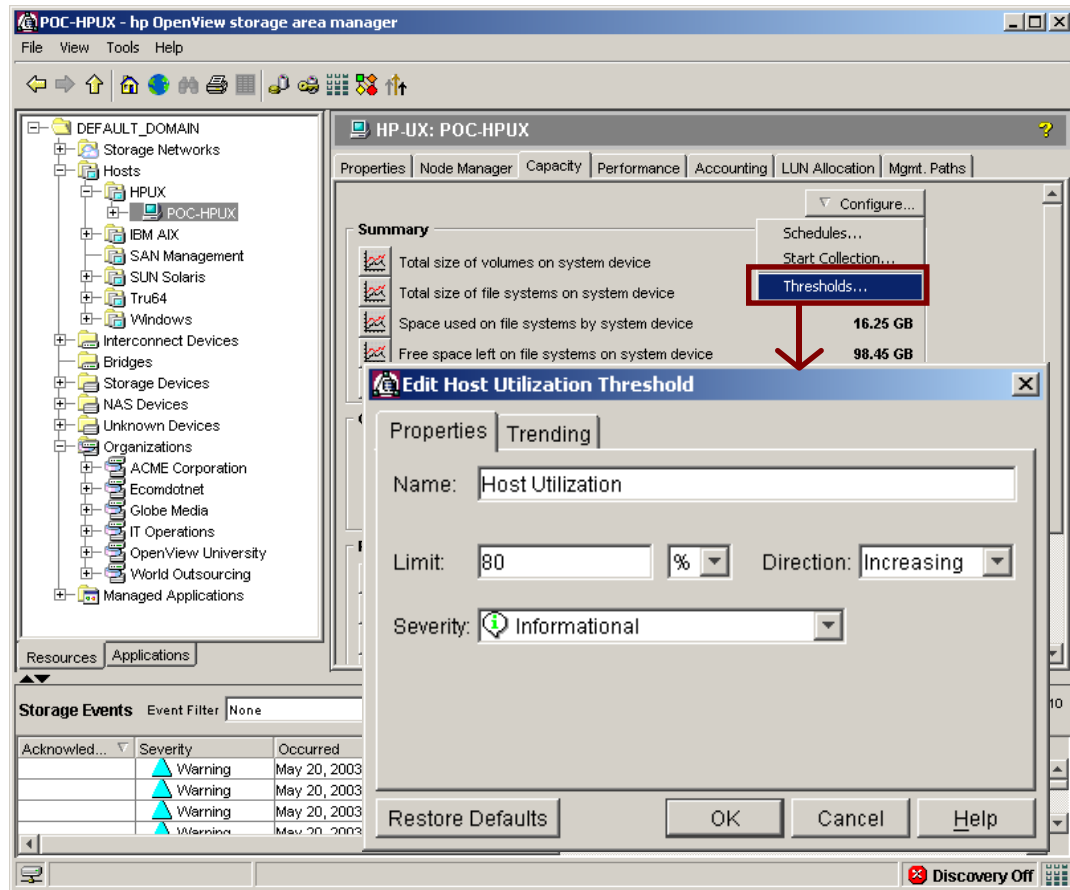
For example, if 95% confidence tests all predicted values within 100 bytes of the threshold limit, then 5% confidence would test predicted values within only 10 bytes of the threshold limit.

Resource and organization thresholds



Capacity thresholds can also be set for a specific resource or a resource within an organization. The user must add resource and organization thresholds. There are no default resource and organization thresholds provided.

Adding resource and organization thresholds



Resource and organization thresholds can only be added from the Resources tree.

To add a resource or organization threshold, select a node, click the *Configure* button from the Capacity view panel, and then select *Thresholds* from the shortcut menu.

Note

Once resource and organization thresholds are added, they may be edited or deleted within the Configuration Window

Capacity and event triggers

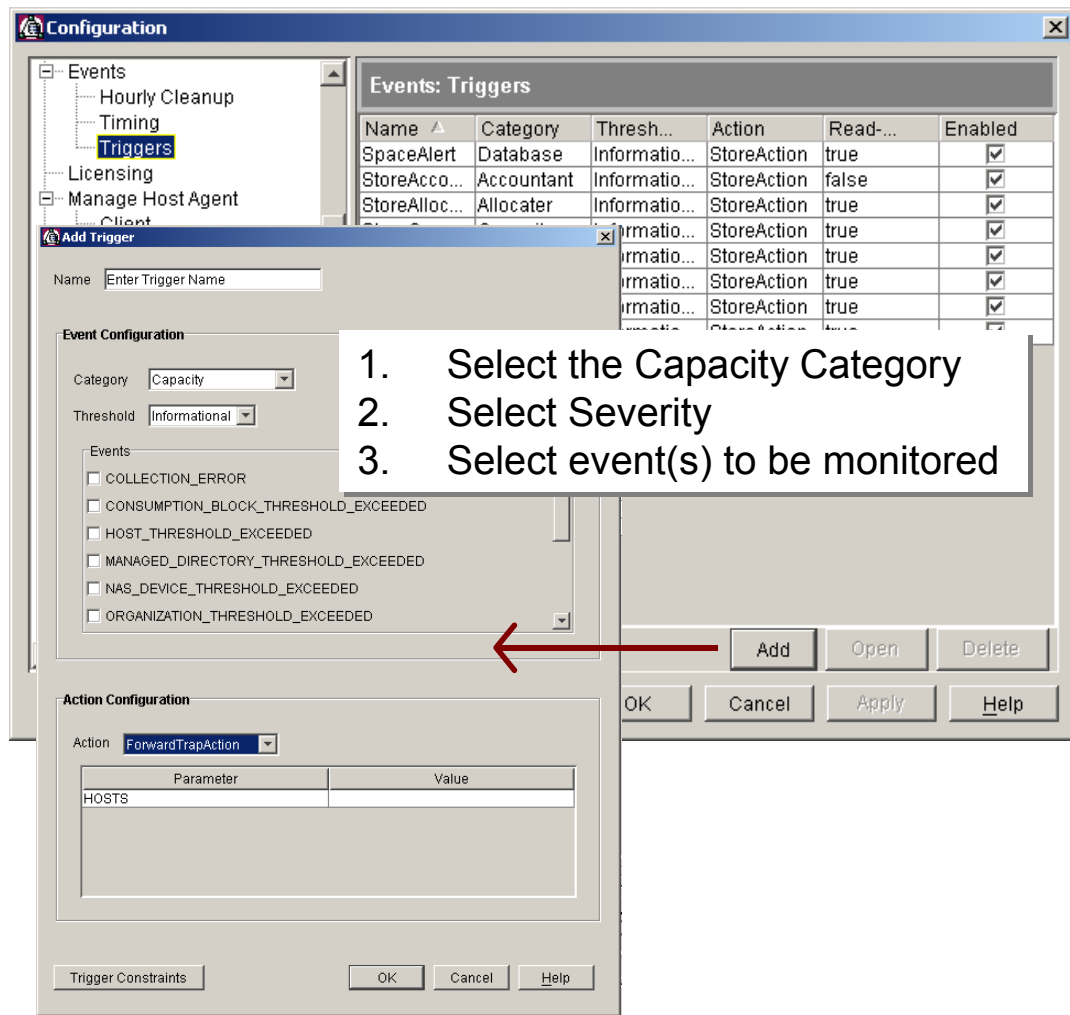
Two things will cause capacity-related events to be stored in the Event view panel:

- Capacity thresholds
- Triggers

By default, capacity-related events are sent to the Event view panel when a capacity threshold is met. Create triggers to perform other actions when a capacity threshold is met, such as:

- Email the SAN administrator on-call
- Run a command
- Forward a trap

Setting capacity event triggers



As with all Storage Area Manager applications, create capacity-related triggers from the Configuration window.

Default triggers are set to send all capacity-related informational events to the Event view panel. Default triggers cannot be modified or deleted, but they may be disabled.

Learning check

1. Storage Builder supports up to 1000 hosts.
☐ True
☐ False
2. Match the Storage Builder component with its description.

a. Capacity Harvester	.....	Collects information on which user accounts are currently defined on the host system
b. User Data Gatherer	.....	Collects file and directory information on all volumes
c. File Detail Gatherer	.....	Collects high-level information of all the file systems that are visible to the host—both local and remote
d. Volume Gatherer	.....	Collects and processes data from Host Agents
3. Before you can view managed directory capacity, file data must be collected and the directories must be managed.
☐ True
☐ False
4. List two volume managers supported by Storage Builder.
.....
.....
5. Which of the following terms is used to denote disk or LUN space that has a physical path to one or more SAN hosts.
 - a. Visible to hosts
 - b. Used space
 - c. Free space
 - d. Unconfigured space

6. A junk file report displays:
 - a. A list of files that have not been opened in a specified amount of time.
 - b. A list of the largest files on a selected host, NAS device, or volume.
 - c. A list of files that can be identified by specific characters, such as .tmp, in their names.
 - d. A list of the file contents of the largest directories on a selected host, NAS device, or volume.

7. Storage Builder relies on OpenView Performance Agents to collect storage device capacity information.
 - ☐ True
 - ☐ False

8. HP recommends scheduling file collection once a day, when the management server is not in heavy use.
 - ☐ True
 - ☐ False

Objectives

After completing module, you should be able to:

- Describe the purpose of the Storage Area Manager managed application functionality
- List the two applications that are supported at initial release
- Describe the architecture employed to collect application data
- View and interpret application capacity and status information
- Configure Storage Area Manager to manage applications

Introduction to managed applications

Managed application features of Storage Area Manager provide early warnings of application problems that are caused by the storage subsystem.

Storage Area Manager Host Agents communicate directly with applications and provide a visual end-to-end mapping of the application through the host file, storage device, down to the individual LUNs the application resides on. You also can

- View storage capacity usage by application through detailed screens and reports.
- View historical trends of application capacity usage.
- Set thresholds to monitor for times when capacity usage exceeds desired values. Although managed application features are currently provided by Core Services and Storage Builder, future releases will extend these abilities to the other applications in the Storage Area Manager suite, providing capabilities such as end-to-end performance monitoring.

Supported database applications

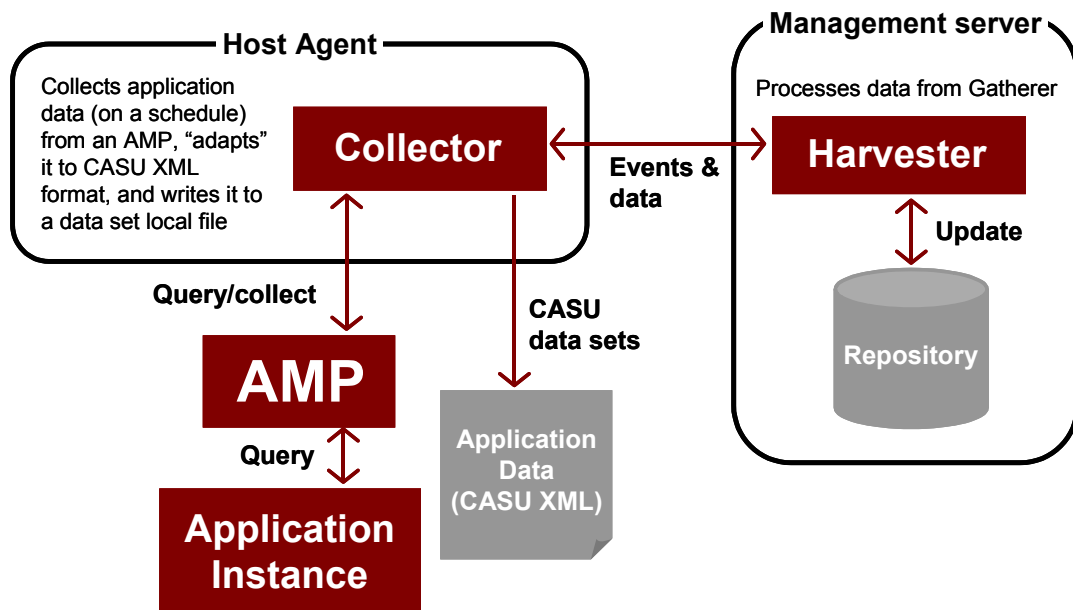
Storage Area Manager currently provides managed application support for Oracle and Microsoft Exchange Server and HP plans to extend this support in the near future.

At initial release, Microsoft Exchange 2000 — Single Instance, Windows 2000 is supported. Several versions of Oracle are supported.

Supported Oracle Versions

Oracle Single Instance Version	HP-UX except 11.20	Solaris	Windows NT 4.0	Windows 2000	Windows Server 2003	Tru64 5.1a and 5.1b
8.0.6.3	X	X	X	X		X
8.1.7.4	X	X	X	X		X
9.0.1.4	X	X	X	X		X
9.2.0.3	X	X	X	X	X	X
9.2.0.4	X					

Application data collection architecture

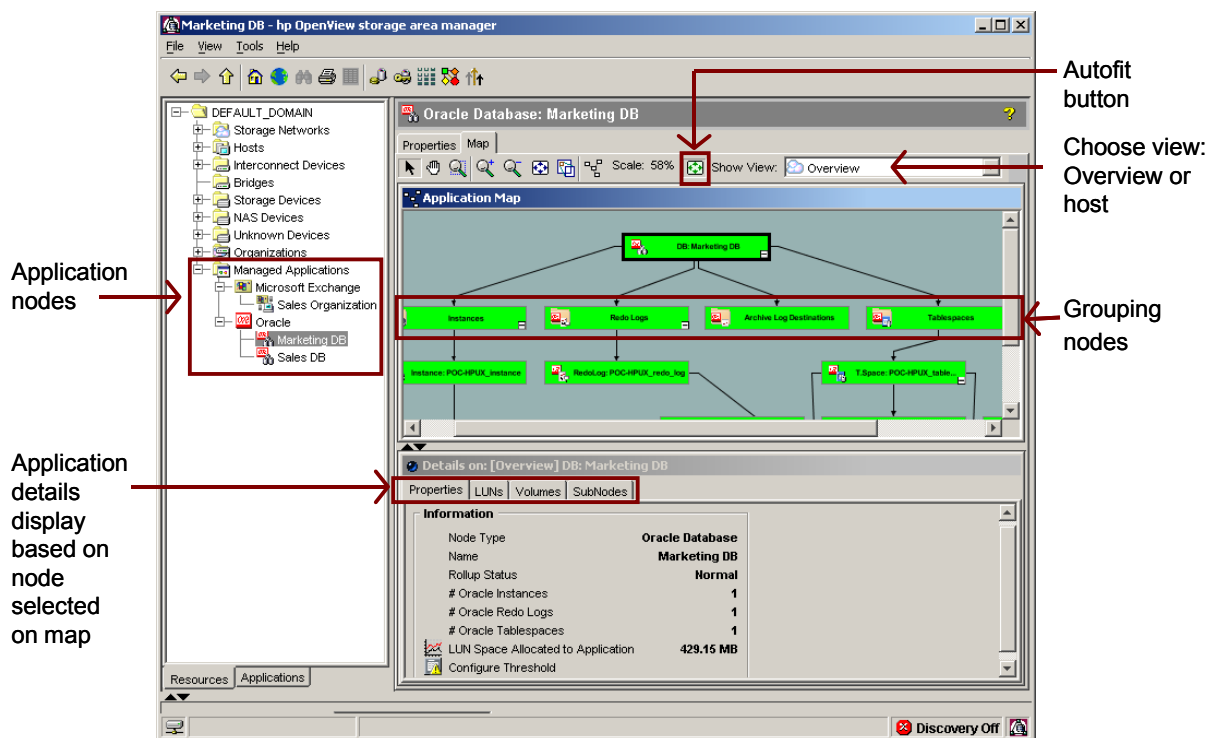


Application Management Plug-ins (AMPs) interface with the Collector Host Agent component. The AMP queries an application instance for data. The Collector correlates it and formats the data in Common Application Storage Usage (CASU) XML, and then notifies the management server that a collection has occurred. The management server harvests the data and stores it in the central repository.

Application Management Plug-ins

AMPs, which are developed and customized by the HP OpenView Smart Plug-in team, are the primary interfaces to applications and are responsible for the collection of data. AMPs must be installed on each host where an application you want to collect data from is installed. AMPs are not part of the default Host Agent installation.

Viewing managed applications

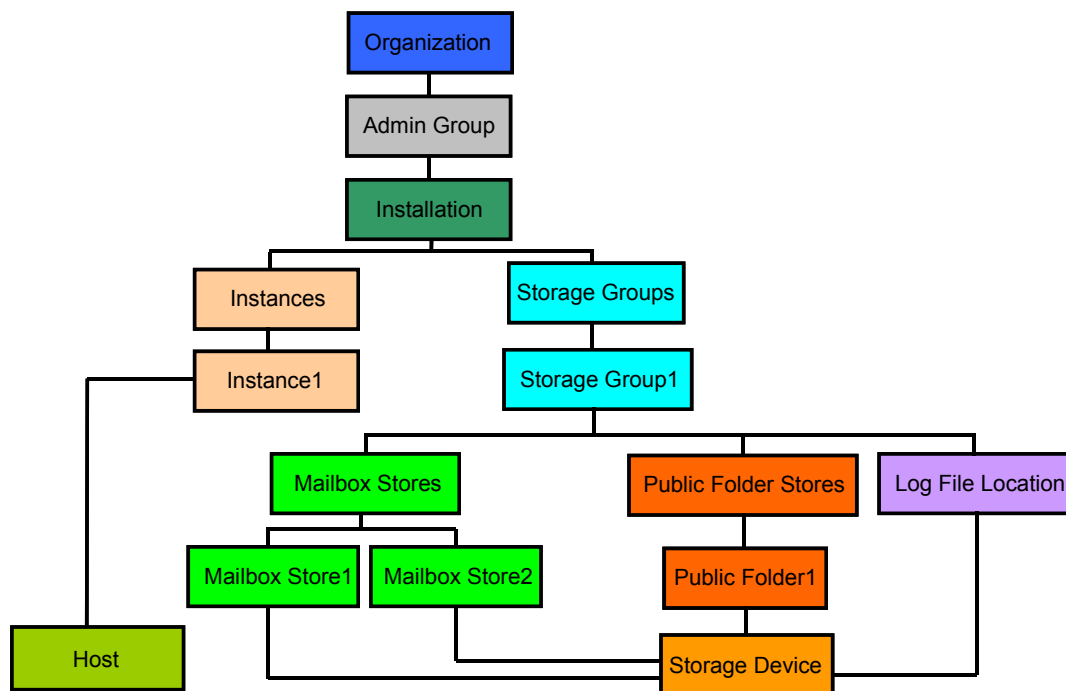


The Managed Applications node and its subnodes display in the Resources tree. Consistent with other Storage Area Manager features, clicking on a node in the tree displays the corresponding information on the right side of the screen, including a map and detailed view panels at the bottom.

The top-level nodes are referred to as *root* nodes for the application. For Microsoft Exchange this would be an *organization*. For Oracle this would be a *database*.

Additionally, the application nodes in the tree and on the map are grouped logically based on the application they represent. The high-level nodes, such as instances and tablespaces for Oracle applications, are referred to as *grouping* nodes.

Microsoft Exchange structure and terminology



Storage Area Manager application views mirror the structure of the application itself.

In Microsoft Exchange, the top-level node is the *Organization*. Each Windows domain corresponds to one organization.

An *Admin Group* is a collection of Exchange objects that are grouped together for the purpose of managing permissions.

An *Installation* refers to the physical installation of Exchange on a server. An installation could be broken out into multiple instances; for example, in a clustered environment where multiple system processes each allow database access.

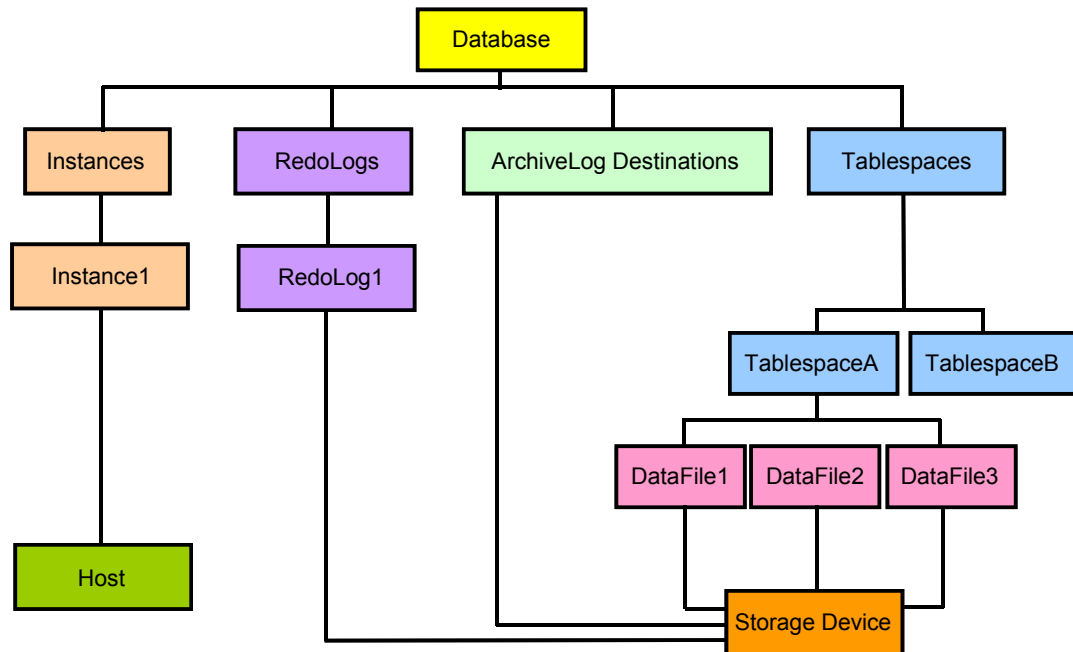
A *Storage Group* is a set of stores that share the same set of transaction log files.

Mailbox Stores contain user data.

Public Folder Stores contain shared data.

Log Files are history files that are useful in backing up and restoring Exchange data.

Oracle structure and terminology



A *database* is at the highest level of an Oracle Application and is a collection of operating system files that comprise one physical data store or node.

An *Instance* is a set of operating system processes and shared memory structures that allow an application to access data in a database.

The *System Identifier (SID)* is the instance name.

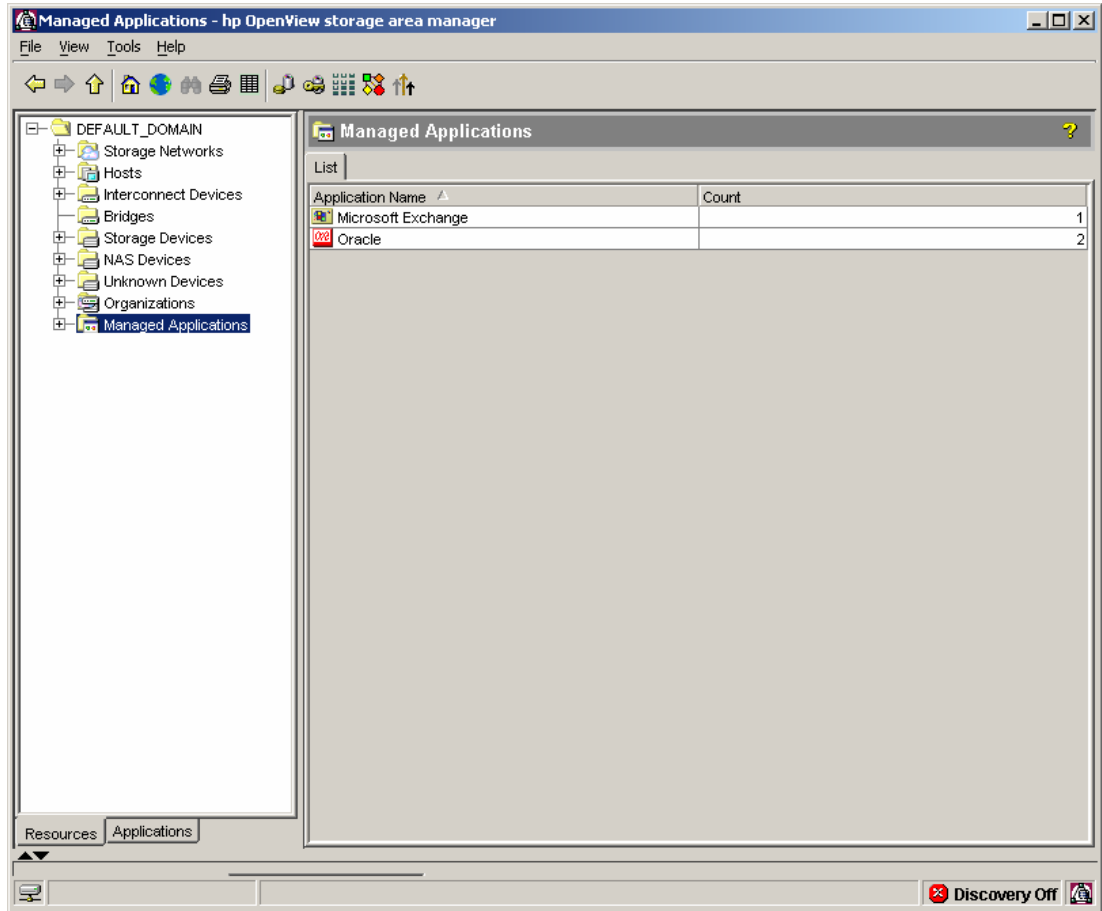
A *Tablespace* is named collection of one or more physical files used for storing database objects.

Data Files are physical structures or files that hold the database data.

Redo Logs are Oracle logs that are necessary for redo transactions in the event of a database failure.

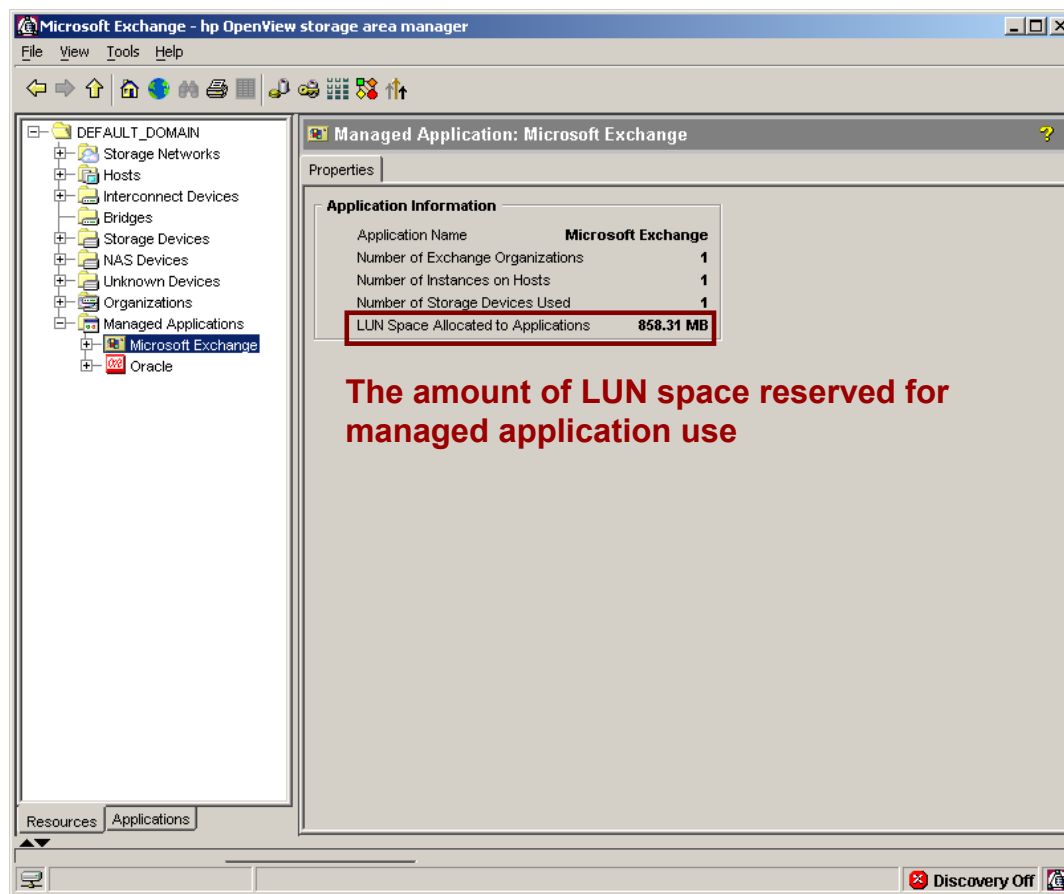
Archive Log Destinations refer to the destination directory to which the Redo Logs will be copied when they become full.

Viewing the managed applications list



Selecting the Managed Applications node in the Resource tree displays a list of applications and a count of the installations viewed from the management server.

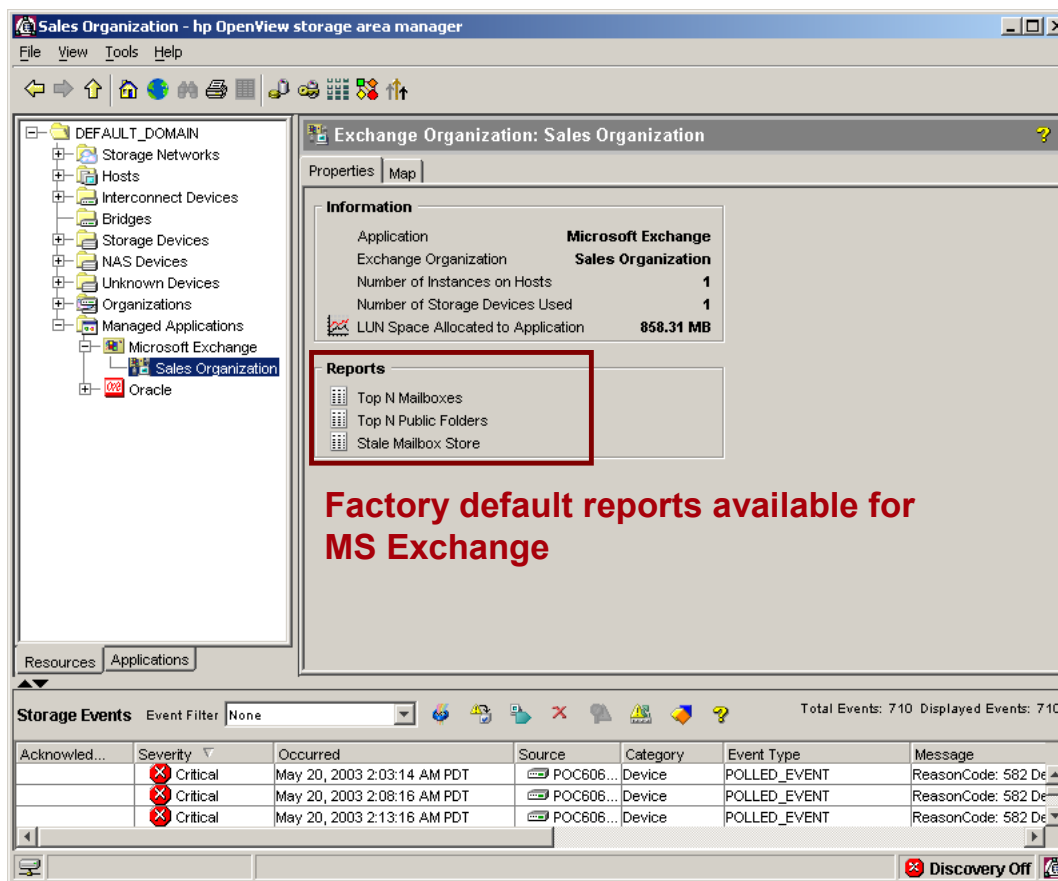
Viewing an application summary



Expand the Managed Applications node and select an application such as Microsoft Exchange to see a high-level aggregate view of all Exchange Server installations.

For example, the screen displays the number of Exchange organizations, number of instances on hosts, number of storage devices used, and the amount of LUN space allocated to applications. This is the amount of LUN space *reserved* for all Exchange installations.

Viewing a root node



Under each Application node, is a list of root nodes. A root node represents the top level for that application. An example root-node for Oracle is the Oracle database; for Exchange, it is the Exchange Organization. Click a root node in the tree to see the corresponding view panel. The properties tab provides summary information and, if the application selected is Microsoft Exchange, several factory-defined reports.

Viewing the application map and properties

The screenshot shows the 'Sales Organization - hp OpenView storage area manager' window. On the left is a tree view of the storage hierarchy. The main area displays the 'Application Map' for the 'Exchange Organization: Sales Organization'. Below the map is a 'Details' panel with tabs for 'Properties', 'LUNs', 'Volumes', and 'SubNodes'. The 'Properties' tab is active, showing information about the 'Exchange Organization'.

View graphs and configure thresholds →

Status propagated from children

Exchange Organization	
Name	Sales Organization
Rollup Status	Normal
# Exchange Admin Groups	1
# Exchange Installations	1
LUN Space Allocated to Application	858.31 MB
Configure Threshold	

The map panel initially shows a collapsed map of the application.

Expand the map to view links to all the storage devices that this application root node and its descendents consume space on. All resources that belong to the application itself display within the gray rectangle on the map background.

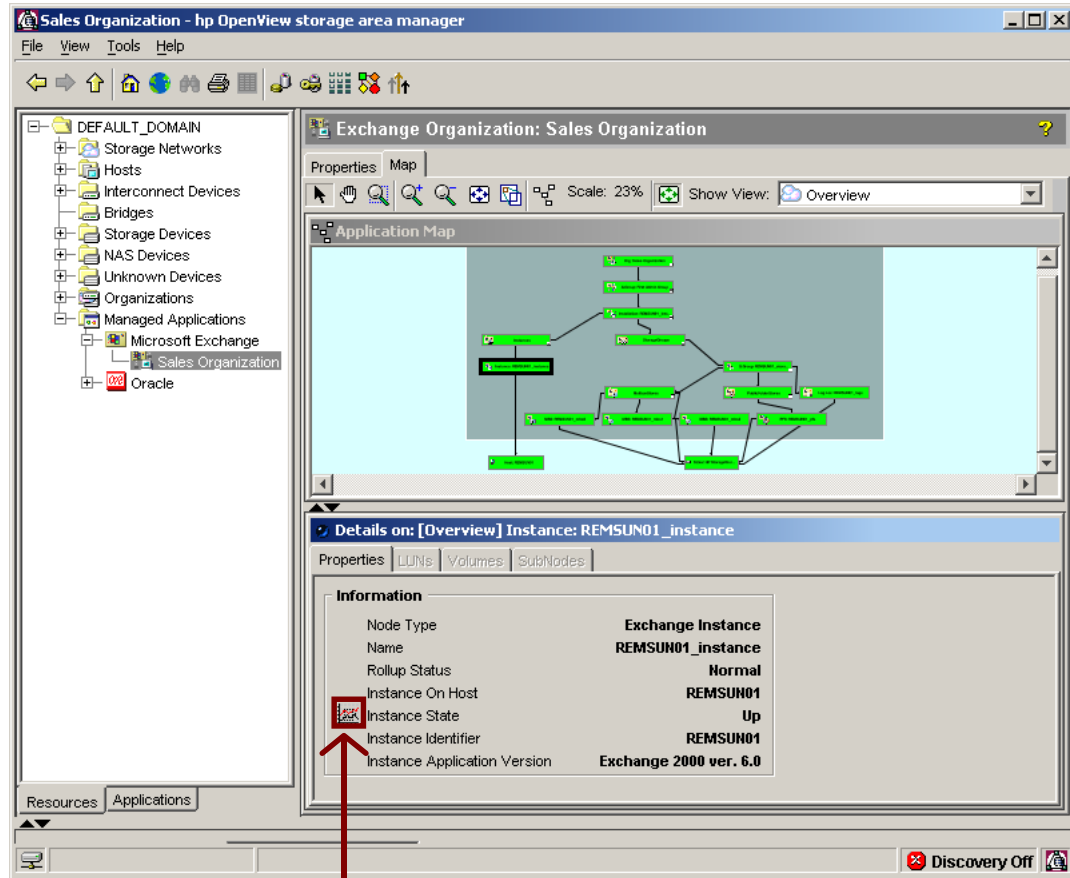


Important

Supported Volume Manager software must be installed in order to view the linkages all the way down to the storage device.

Click a node in the map to display corresponding information at the bottom of the view panel. The Properties tab displays basic information about the node selected and enables you to view a graph of the LUN space allocated to the application and enables you to configure thresholds.

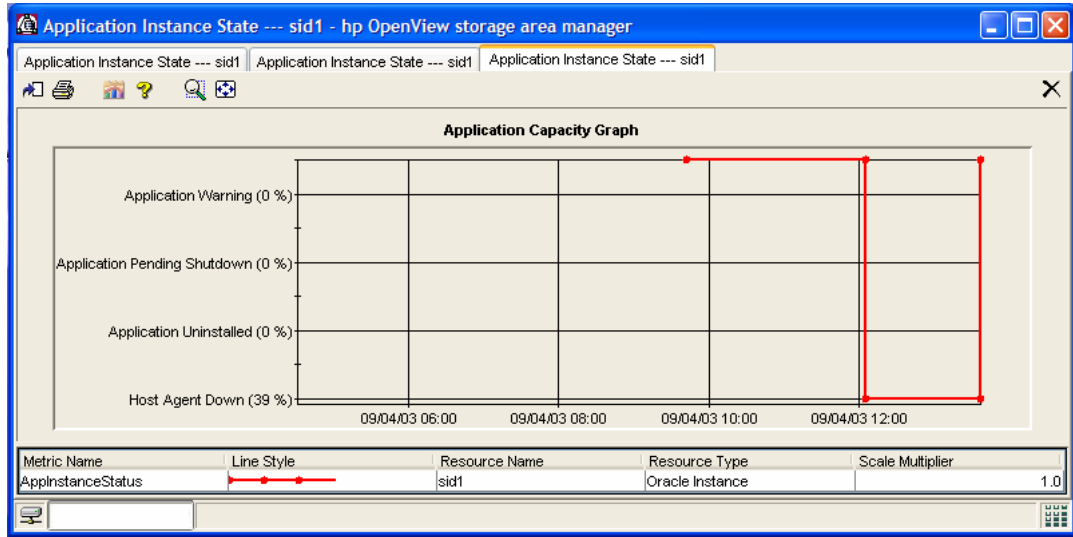
Viewing application status



Click to view
historical
perspective

Application status is indicated by the color of the nodes on the map. The status rolls up to the root node, and each node displays the “worst case” of all of its children. Click the chart button next to Instance State to view a history of application instance status.

Viewing a graph of application status



The preceding sample graph shows a loss of communication with the Storage Area Manager Host Agent near 12:00. Note that Storage Area Manager can differentiate between losing communication with the Host Agent and losing communication with the application itself.

Interpreting application status

Several different states can be obtained directly from an application, and these are reflected in several different places in the Storage Area Manager GUI. For example, if the Administrator has locked the Oracle database, this will be reflected in the instance state of the property panel as “Locked,” on the graph as “Unavailable,” in the Rollup Status of the property panel as “Locked,” and by the color cyan on the map.

The “HA Down” state indicates that someone intentionally shut down the Storage Area Manager Host Agent. “HA Unknown” indicates that the system itself went down. This distinction is made because if the Host Agent is down, Storage Area Manager has no way of knowing what has happened to the application.

The “HA Down” state will also be reflected if you uninstall the AMP. Because the Host Agent is stopped and restarted as part of the AMP removal process, the last thing the AMP can report on before it is removed is that the Host Agent was shutdown. When the Host Agent is restarted, the AMP is no longer there to reflect that the Host Agent is up.



Important

The scenario discussed in the paragraph above has a potential to cause confusion for a customer. For example, if they uninstall their AMP, the managed application features will indicate that the Host Agent is down but the rest of the Storage Area Manager features will indicate that the Host Agent is up and running.

Application status

Host Agent state	Instance state (Properties panel)	Graph status	Rollup status (Properties panel)	Map color
Locked	Locked	Unavailable	Warning	Cyan
Up	Up	Healthy	Normal	Green
Down	Down	Down	Critical	Red
Warning	Warning	Warning	Warning	Cyan
Unavailable	Warning	Warning	Warning	Cyan
Uninstalled	Uninstalled	Uninstalled	Warning	Cyan
Unknown	Unknown	Unknown	Unknown	Blue
Pending shutdown	Pending shutdown	Pending shutdown	Warning	Cyan
HA Down	HA Down	HA Down	Major	Orange
HA Unknown	HA Unknown	HA Unknown	Major	Orange

Viewing application LUNs

Exchange Organization: Sales Organization

Properties | Map

Scale: 19% Show View: Overview

Application Map

Details on: [Overview] Org: Sales Organization

LUN	Device	Visible to...	Total	Total Used	Allocated...	Free
VD003	HP Stor...	REMSUN01	100 GB	47.69 GB	762.94 MB	52.31 GB
VD004	HP Stor...	REMSUN01	10 GB	9.96 GB	49.79 MB	40 MB
VD005	HP Stor...	REMSUN01	10 GB	9.12 GB	45.57 MB	904 MB
Totals			120 GB	66.77 GB	858.31 MB	53.23 GB

Resources Applications

Discovery Off

If Builder is not installed or its license is out of compliance, "Unlicensed" will display in the column

The LUNs tab shows the LUNs that are used by the selected application node.

This tab displays:

- The LUN name reported by the storage device. If the device does not report a name, Storage Area Manager creates a unique LUN name.
- The name of the storage device that contains this LUN.
- The hosts that have a physical path to this LUN.
- Total usable LUN capacity, including used and unused space.
- The capacity of the assigned LUN space that is allocated to volumes.
- The amount of LUN space reserved for managed application use.
- The capacity of the assigned LUN space that is available to create volumes.

Viewing application volumes

Resource Status indicates clustering:

- Shared = clustered
- Private = clustered not shared
- Blank = not clustered

If Builder is not installed, Volumes and Subnodes tabs will not display. If its license is out of compliance, they will be inactive

Volume	Host/N...	Resour...	Total	Total U...	Allocat...	Free	% Allo...
F:\on R...	REMS.		19.08 GB	6.36 GB	95.37 MB	12.72 GB	0 %
G:\on ...	REMS.		47.69 GB	15.9 GB	762.94 MB	31.79 GB	2 %
Totals			66.77 GB	22.26 GB	858.31 MB	44.51 GB	1 %

True total; does not double-count clusters

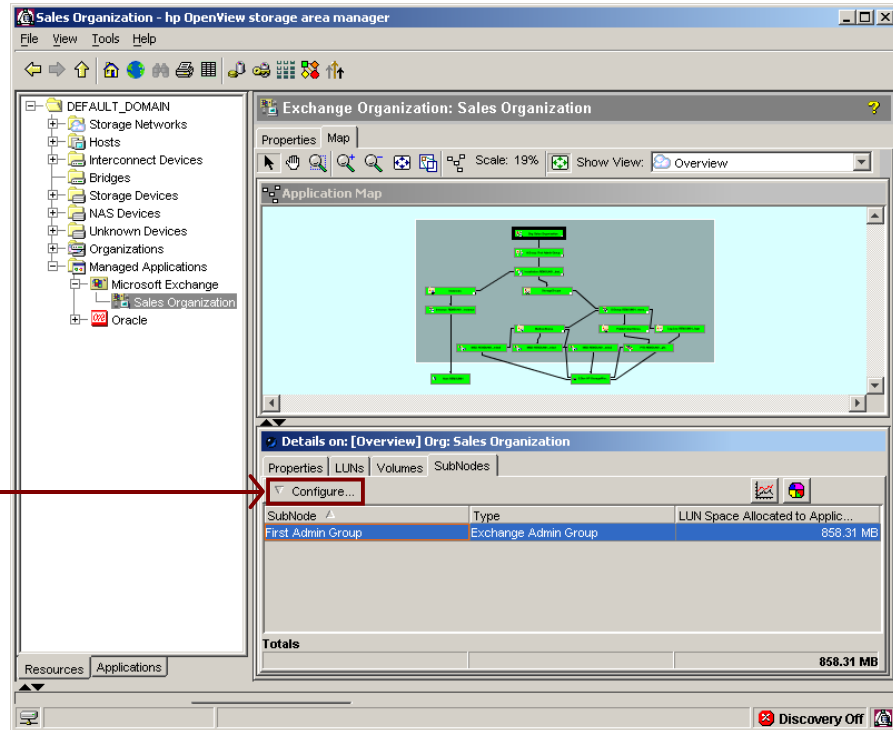
The Volumes tab shows the volumes that are used by the selected application node. It displays:

- Path of the listed host to the volume.
- The host or NAS device on which the volume exists.
- The share status for the volume. The status is shared for volumes that are visible to multiple cluster nodes, private for volumes that are visible only to the current host (whether a cluster node or not), and unavailable for volumes that are not visible to this host.
- The total capacity of the volume.
- The amount of space on the volume that is currently occupied by files and directories.
- The amount of volume space reserved for managed application use.
- The amount space on the volume that is free, or not currently occupied by files and directories.
- The percentage of the total volume size that is reserved for managed application use.

You can also use the Volume tab to view capacity graphs and pie charts.

Viewing application subnodes

To configure thresholds, Select subnode and click Configure...



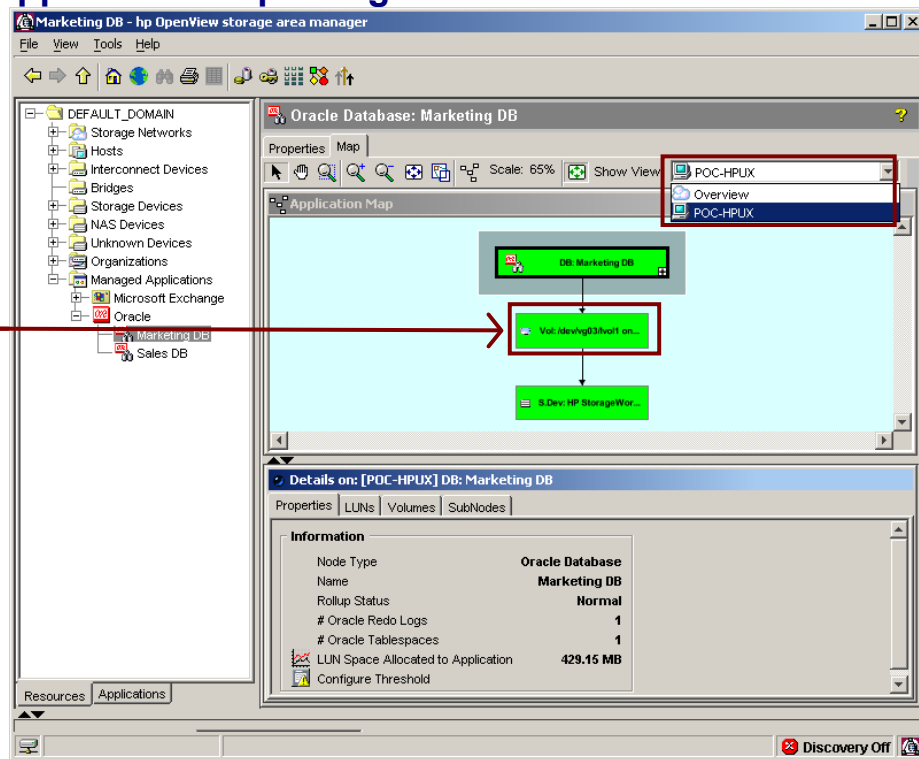
The SubNode tab displays information about the application the level below the node you have selected in the tree or map.

This tab is useful for displaying a more granular view of information. For example, if the tablespace node is selected in the map, you can click the Subnodes tab to view a listing of the capacity of all the data files in that tablespace.

This tab also enables you to directly configure thresholds for a chosen subnode.

Viewing the application map using the host

Only host
view
shows
Volumes
on the
map



view

Two ways to view managed applications are:

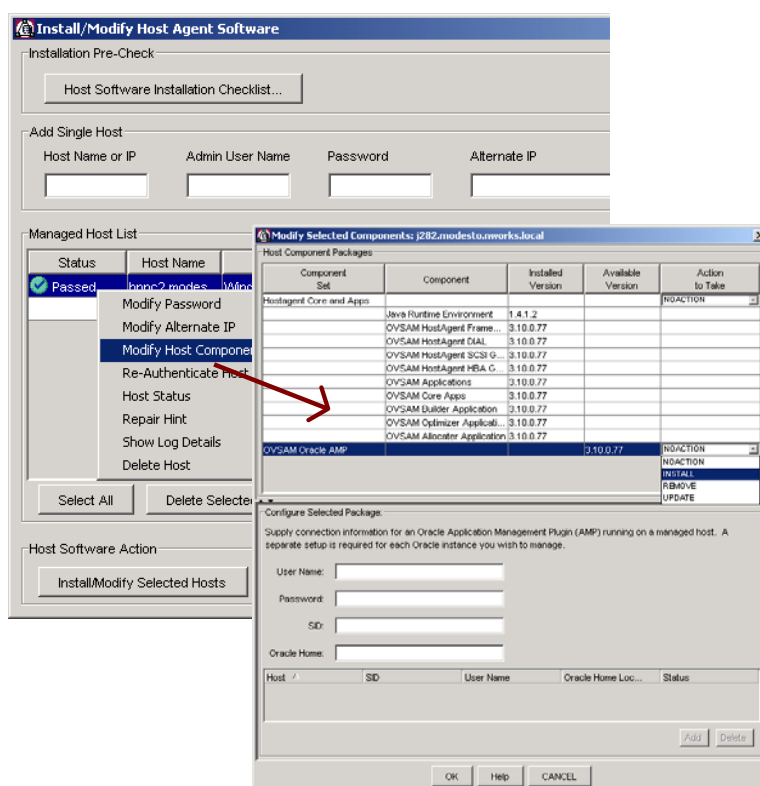
- Overview, which is the default view, gives a host-independent perspective of the application and also displays all the instances that support the root node. Use this view to show how an application is using storage across hosts and storage devices.
- Host view, which shows information about the application from the perspective of the selected host. It does not list all the application instances, but instead lists the volumes on that host the application root-node is using. Use this view to show how an application is impacting the storage capacity of a particular host.

Configuring Storage Area Manager to manage applications

Five key tasks must be performed to configure Storage Area Manager to manage applications:

- Installing AMPs
- Setting up AMPs
- Scheduling data collection
- Working with reports
- Setting thresholds & alerts

Installing AMPs



To enable Storage Area Manager to collect information about applications, install AMPs on each host where the application to be managed resides.

The AMPs may be installed remotely as Host Agent component packages or installed locally. They are not installed as part of the default Host Agent installation.

On local installations, the user is prompted to answer whether they would like to install the optional AMP package. On local removals, the AMP is automatically removed.

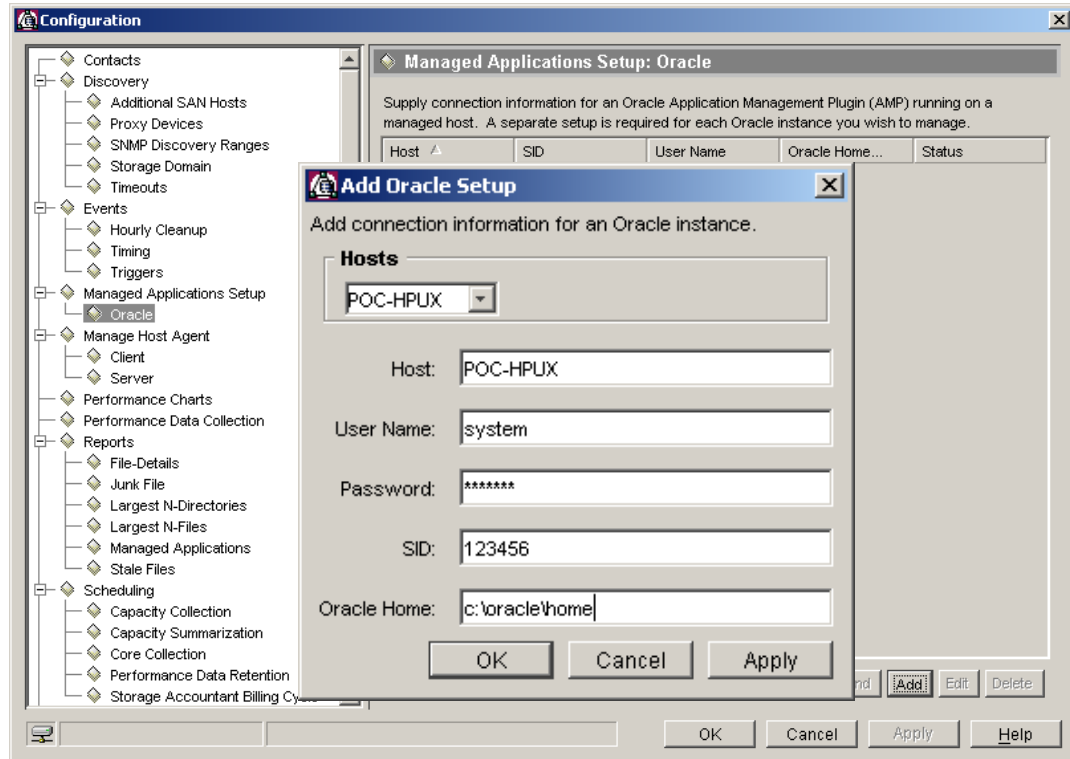
AMP setup requirements

AMPs for some applications may require additional information before they can begin collecting data.

The Oracle AMP must be supplied with the following information:

- **Host:** IP or DNS name of the host where the application resides
 - **Username/Password:** Must be the Oracle user *system*
 - Use script called *dbsamocr* in <sanmgr>/hostagent/sbin/amp/Oracle
 - **SID:** The System Identifier of an Oracle database running on the host
 - There may be more than one database on each host; however all SIDs for those databases must be unique
 - **Oracle Home:** Fully qualified location of the Oracle home directory
- There are no specific setup requirements for Microsoft Exchange. Storage Area Manager supplies the local administrator or domain administrator user name and password during the installation and uses this authentication to access the application.

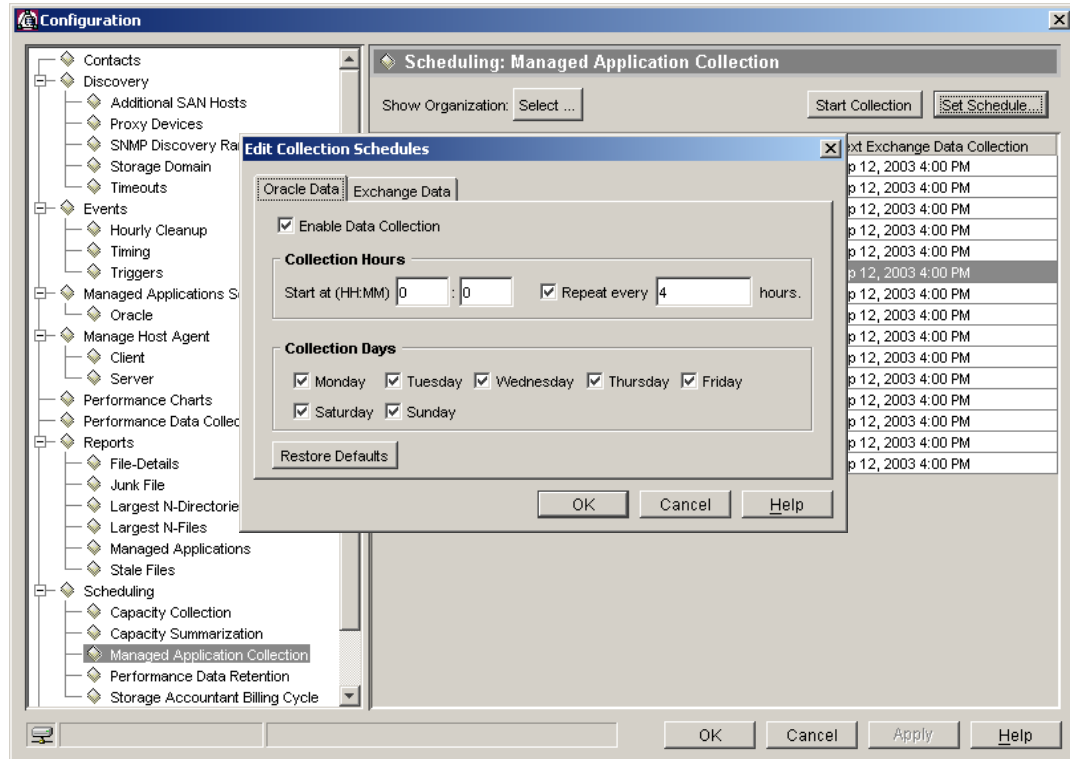
Setting up AMPs



AMPs can be set up from the *Tools* → *Configure* window. You can also set up AMPs when installing or modifying the Host Agent by using the Modify Host Component Selection.

1. From the Configuration Window, select *Oracle* under Managed Applications Setup.
2. Click the *Add* button.
3. Select a host name from the drop-down menu or enter a name in the Host box.
4. Enter the user name. In the case of Oracle, it must be *system*.
5. Enter the password for the user name.
6. Enter the system identifier for the Oracle instance.
7. Enter the fully qualified location of Oracle home.

Scheduling application data collection

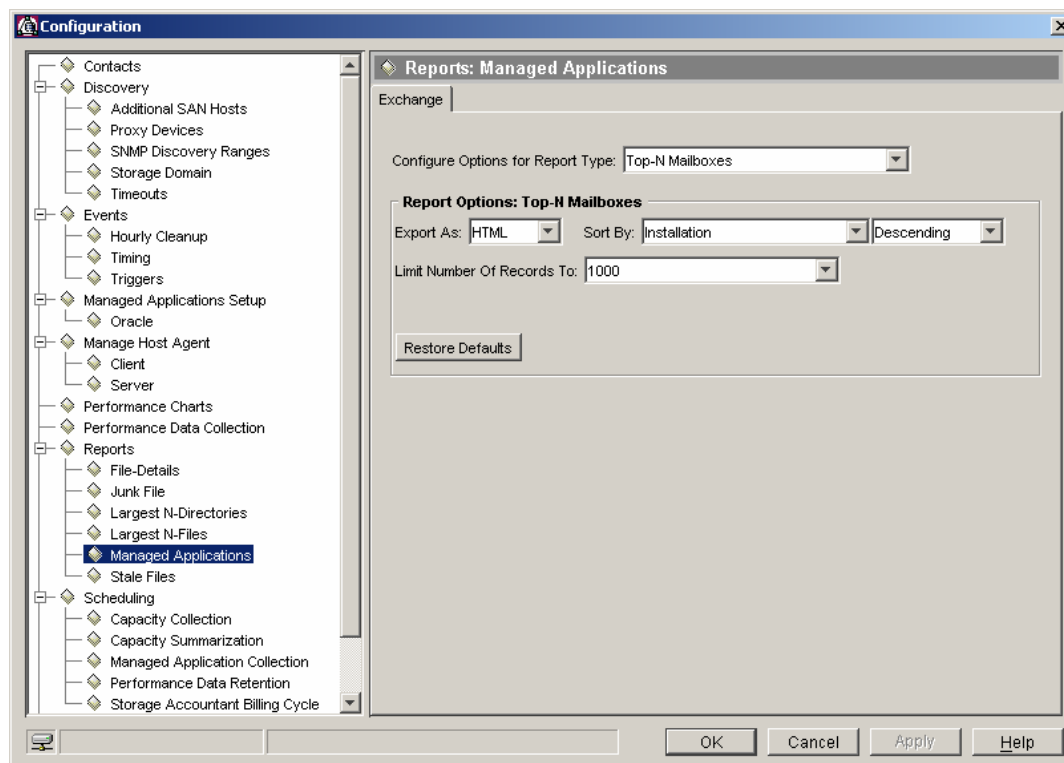


Just as a collection schedule can be set for other capacity data, schedules can also be set for the collection of managed application data.

1. Select *Tools* → *Configure* from the main menu.
2. Under Scheduling, select *Managed Application Collection*.
A list of all managed hosts with their next scheduled collection times displays.
3. Select one or more hosts and click the *Set Schedule* button.
4. Using the tabs provided, select the application you would like to schedule. In this case, either Oracle or Exchange.
5. Set the collection start time and whether you would like it to run repetitively, for example every 2 hours or every 4 hours.
6. Select the days of the week on which the collection should run.

To run an unscheduled collection, click the *Start Collection* button. The systems begins gathering data for the application selected.

Working with managed application reports



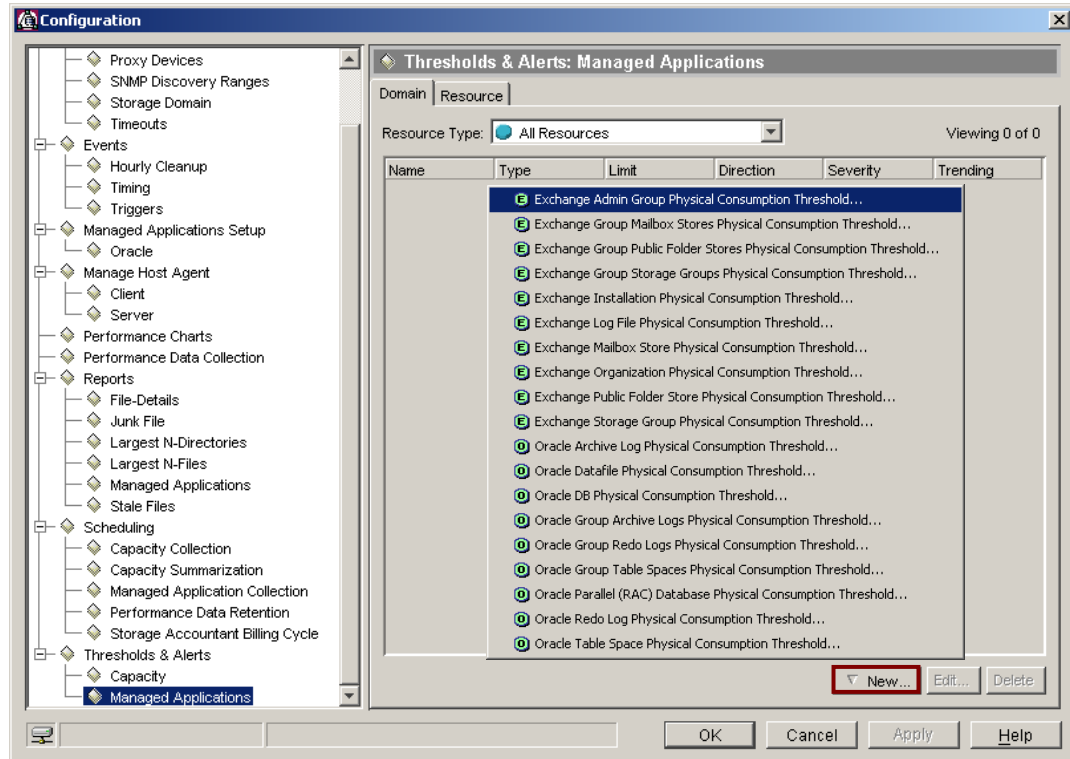
Storage Area Manager provides three reports for Microsoft Exchange:

- **Top-N Mailboxes** — lists the largest mailboxes from all installations in the selected Exchange organization.
- **Top-N Public Folders** — lists the largest public folders from all installations in the selected Exchange organization.
- **Stale Mailbox Stores** — lists stale mailboxes from all installations in the selected Exchange organization.

To customize the reports, go to *Tools* → *Configure* and select *Managed Applications* under *Reports*. Specify the export format, sorting criteria, and maximum number of records.

There are not factory-defined reports provided for Oracle.

Setting thresholds and alerts on managed applications



Storage Builder produces Storage Area Manager events when application usage exceeds or falls below user-specified limits. These user-defined limits are called *managed application thresholds*.

You can set capacity thresholds for the domain or specific to a single resource. You can also set thresholds on predicted application usage.

1. Select *Tools* → *Configure* from the main menu.
2. Select *Managed Applications* under *Thresholds & Alerts*.
3. To create a new global threshold, click the *New* button. Select the desired threshold from the list, such as *Exchange Mailbox Store Physical Consumption Threshold*.
4. Give the threshold a name.
5. Specify the limit. In other words, the minimum or maximum used space that, when passed, causes a threshold event.
6. Specify the direction, which determines whether the limit is a minimum or maximum.
7. Specify the severity level of the threshold event.

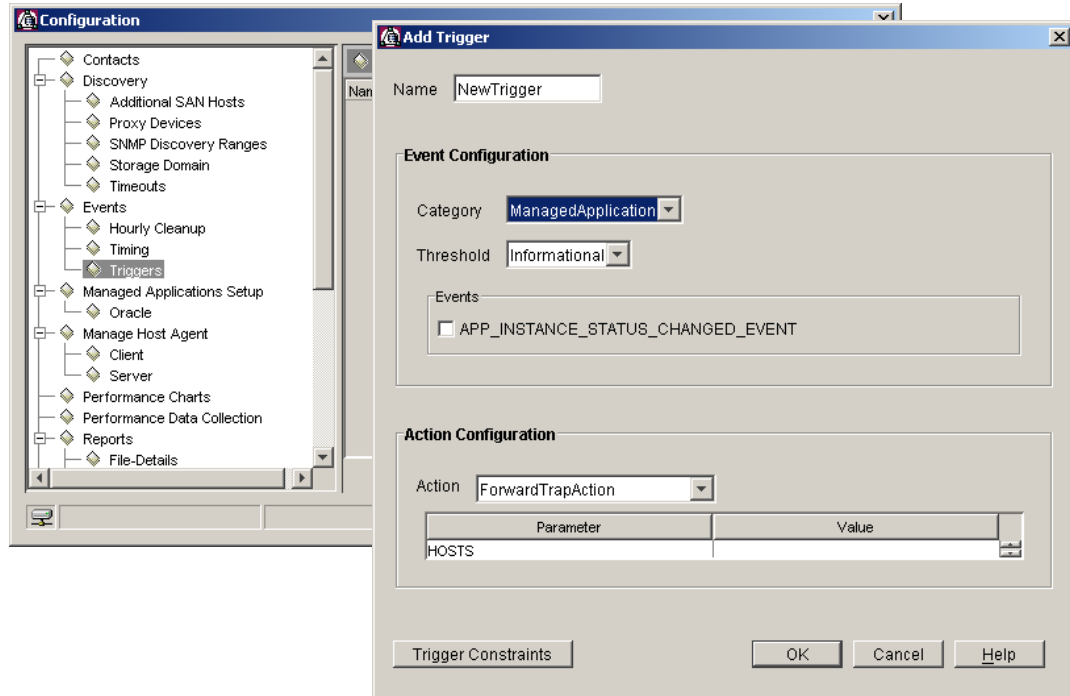
If you would like to be notified of potential shortages, select *Trend Thresholding* from the Trending tab.

Specify the projection period, which can be 1 to 12 months.

You can then control the number of events that are generated by adjusting the trending *ConfidenceInterval*. Greater confidence allows greater ranges of possible values and therefore increases the likelihood of threshold events.

All threshold violations will be sent to the Storage Area Manager Event panel.

Creating triggers for managed applications



By default, when an application instance changes, an event is sent to the Storage Area Manager Event panel. To perform other actions when this occurs, configure a Trigger.

1. Select *Tools* → *Configure* from the main menu.
2. Select *Triggers* from the tree.
3. On the Triggers configuration window, click the *Add* button.
4. Enter a name for the Trigger.
5. Select the *ManagedApplication* category.
6. Select the application event.
7. Select the desired action and any necessary parameters. For example, send an email to the on-call administrator when the status of the application instance changes.

Learning check

1. Storage Area Manager managed application features enable you to view which type of application data?
 - a. Accounting
 - b. Capacity
 - c. Performance
 - d. Allocation

2. Oracle AMPs are installed as part of the default Host Agent deployment process and do not require any additional setup procedures to be performed.
☐ True
☐ False

3. Which is **not** a managed application feature?
 - a. Maps
 - b. Thresholds and alerts
 - c. Reports
 - d. Preconfigured application launching
 - e. Data collection scheduling

7. Volume Manager software is required to view which of the following?
 - a. Application status
 - b. Any application capacity information
 - c. Storage device linkages on the map
 - d. Historical charts of application status

8. At initial release, Storage Area Manager 3.1 provides capacity and status information for which two applications? (choose two)
 - a. Oracle
 - b. SAP
 - c. Microsoft Exchange
 - d. Lotus Notes
 - e. DB2

Objectives

After completing this module, you should be able to:

- List the major features of Storage Accountant.
- Describe the major concepts of Storage Accountant.
- Describe the steps involved in setting up Accountant.
- List the Storage Accountant architectural components.
- Create and manage Organizations, Accounts and Service Levels.
- Describe Service Levels.
- Assign LUNs to Service Levels.
- Generate organization, device and service level billing reports.
- List the supported devices of Storage Accountant.

Product overview and features

Storage Accountant meters storage space in organization accounts and reports the associated cost at the end of each month. Accounts belong to internal or external organizations. You must install and license Storage Accountant to use its features.

Storage Accountant adds the following features to Storage Area Manager:

- **Monthly and interim bill reports** — Storage Accountant rolls up daily charges into a monthly bill that is arranged by organization and account. Detailed bills describe the charges for each LUN. Summary bills show only the total charges for each organization and account. The Bill Viewer is used to view, export, and print bills for the current (interim) or past billing periods, and for all or individual organizations.
- **Storage device and service level billing reports** — Storage Accountant creates monthly billing reports that are organized by storage device or service level. Summary reports show the total charges for the storage device or service level LUNs that are in accounts and not in accounts. Detailed reports show summary information and a LUN-by-LUN description of charges.
- **High-level statistics in the Reports tab of the Accountant Home view panel** — This view panel is used to view reports and bill generation information, as well as configure the billing period.
- **Centralized setup functions in the Accounting tab of the Accountant view panel** — This view panel provides the tools to set up storage billing. In the Accounting tab, click icons to view, create, and add LUNs to service levels; view and create organizations; add organization accounts; and attach LUNs to accounts. Viewing the total number of service levels, organizations, LUNs in service levels, and total storage value that is billed and not billed can be accomplished from the Storage Accountant view panel.
- **Service Level, Organization, and Account nodes in the Resources tree** — Storage Accountant associates LUNs with service levels and then associates the service-rated LUNs with organization accounts. The Resources tree contains nodes used to view, create, add LUNs to, and maintain service levels and organization accounts.
- **Audit log of billing transactions and LUN events** — A quick look at the audit log indicates when changes were made to organizations, accounts, service levels, or the billing schedule; if daily usage is being regularly collected; when bills were generated and exported; and if a LUN's status changed. The Audit Log Viewer is used to display, export, and print the audit log.
- **Accountant scheduler for billing** — The Storage Accountant billing cycle scheduler in the Configuration window is used to specify when the monthly bill is generated, when old bills and audit entries are deleted, and the format and location of exported files.

- **CLUI commands** — The CLUI is available to expedite most of the tasks that can be performed in the graphical user interface; for example, adding LUNs to service levels or accounts, creating organizations, removing LUNs from service levels, and generating bills.
- **Integration with HP OpenView Internet Usage Manager (IUM)** — Storage Accountant outputs LUN state data on a monthly basis. This data can then be incorporated into IUM. To enable this functionality, a HP support representative must complete the integration procedure.
- **Exported bills in CSV, HTML, and XML format** — Storage Accountant automatically exports monthly bill reports in a configurable format and location. Set event triggers that launch a third-party billing application once the report is exported. The details needed to integrate Storage Accountant bills with other applications are provided in the *hp OpenView storage area manager administrator's guide* and in Storage Area Manager's document directory (.\\client\\doc\\export_files).

Storage Accountant concepts

This section covers two concepts fundamental to Storage Accountant: accounts and service levels.

Accounts

- Storage Accountant maintains a list of one or more accounts associated with each organization.
- Accounts are used to represent different user groups, project teams, or financial divisions within an organization. In a corporate setting, where organizations might be used to represent separate business units or divisions, accounts could be used to represent the departments, locations, or data centers within the organization.
- Storage Accountant billing is performed on an account basis, which is then rolled up into an organization.
- The maximum number of accounts supported is 25 per organization.
- Account names must be unique within an organization, but can be duplicated across organizations.
 - Within an organization account names must be unique (“Marketing”, “Sales”, “Mfg”, “Distribution”, “Finance”, and so on.). However, these same Account names can be used again in separate organizations.

Service levels

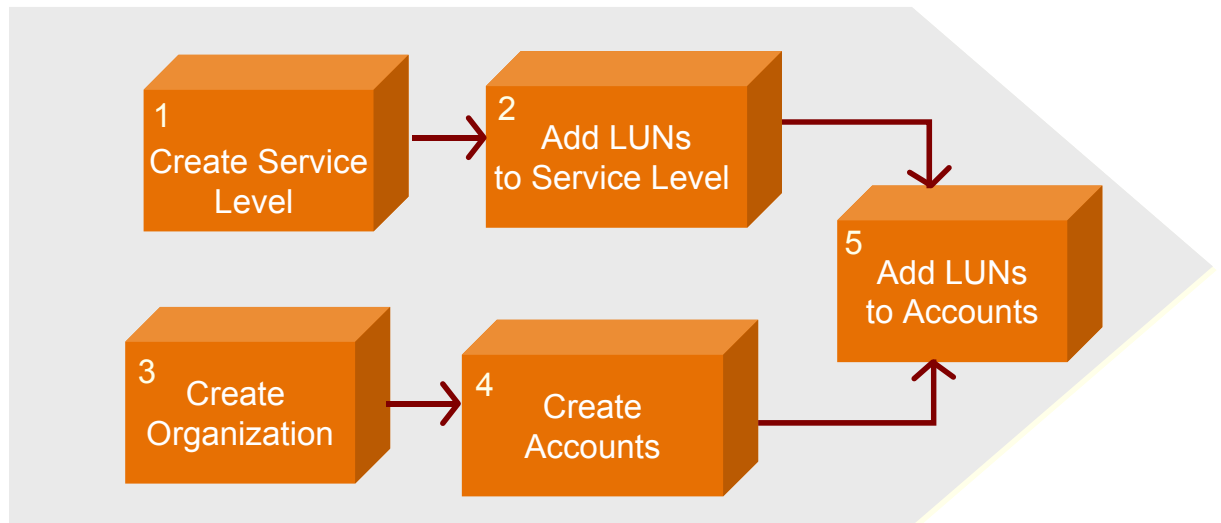
- Service levels allow storage providers to set up groups of LUNs with the same price.
 - A service level is specified as “cost per gigabyte hour (GB/hr)” of storage.
 - Service levels can also be thought of as pricing levels.
- The purpose of service levels is to determine the price that will be charged for LUN use and typically reflect the relative value of the LUN or LUN service.
- The service level represents storage hardware (vendor, model, and RAID level) and any services associated with the device (backup, mirroring)
- The storage administrator can use any factors in determining the rates to be charged to users of storage. These could include:
 - The speed and type of hardware used in providing storage to the user.
 - The level of backup services, including frequency of backup, ability to perform on-line backups, and response time for restoring from backup.
 - The human resources required to support and respond to customer requests, as well as ongoing planning for storage requirements.
- The maximum number of service levels supported is 99 per management server.
- LUNs are associated with a pricing level by assigning them to a service level. By default, LUNs do not have a service level/price associated with them. As a result, billing for storage resources does not begin until this association is configured.

Note

Before LUNs can be added to an account for usage charging, the LUN must first be added to a user-created service level.

Storage Accountant setup process

Before Storage Accountant can produce bills, service levels and customer accounts must be configured and LUNs assigned. This figure illustrates the Storage Accountant setup process.



The Storage Accountant setup process consists of five steps:

1. Create Service Level
2. Add LUNs to Service Level
3. Create Organization
4. Create Accounts
5. Add LUNs to Accounts

The arrows in the figure above indicate the necessary sequences. For example, to place LUNs in a service level (step 2) the service level must first be created (step 1). Most importantly, to add LUNs to an account (step 5), all of the previous actions (1, 2, 3, and 4) must first be completed.

Storage Accountant billing

Bills are summaries of storage charges to organizations. Bills are produced either as text that is displayed in the Bill Viewer window, or as an exportable file that is automatically saved at the end of each billing period.

- Storage Accountant provides the ability to create bills for Customers at scheduled intervals (also known as “the billing cycle”) or on-demand (current billing period).
- All summary and detailed customer bills can be exported to .csv, .html, and .xml formats for budgeting, financial analysis, and web-based reporting.
- At the end of each day, Storage Accountant records all of the day’s transactions that affect storage charges (for example, a LUN is added or removed from an account, the service level price is changed, or the LUN is resized).
- Once a month, these daily records are compiled into a single binary file of usage information, such as LUN 01 used by Account AA from October 1, 2001, 09:27:54, to October 30, 2001, 23:59:59, at a price of \$.07/GB/hr. The information in this file is sorted by organization and account to display requested bills in the Bill Viewer, and to produce specially formatted files that can be imported by a third-party billing application.
- Charges are based on the size and price of the storage units that a customer has access to, as opposed to the amount of space that the customer actually consumes at any point in time. The price of the storage unit is determined by its assigned service level.

The amount charged is the product of the size and price per GB of the storage unit and the number of days that the unit is available during the billing period, as shown in the following formula:

Storage Unit Charge = LUN Size (GB) X Price per GB per hour X Hours
Accessible

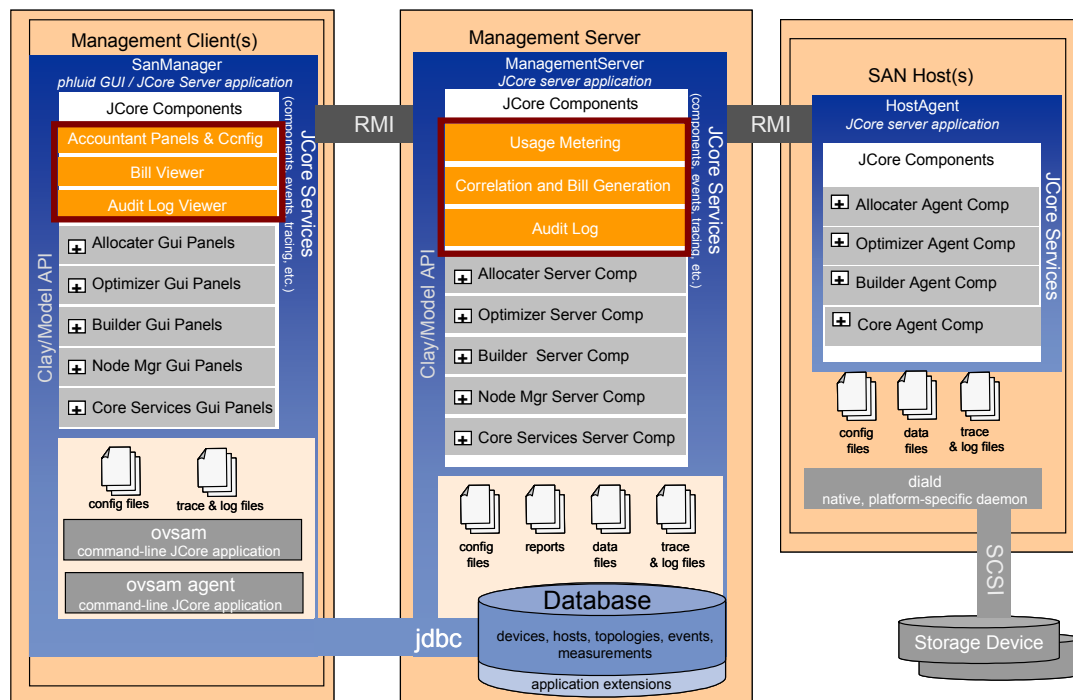
Example

Given that a customer has a 9 GB storage unit whose price is \$25 per day, the charge after 30 days of service would be:

9GB X \$25 X 30 days or \$6750.

Storage Accountant records day-to-day changes in the charge factors and sums them up at the end of the billing period.

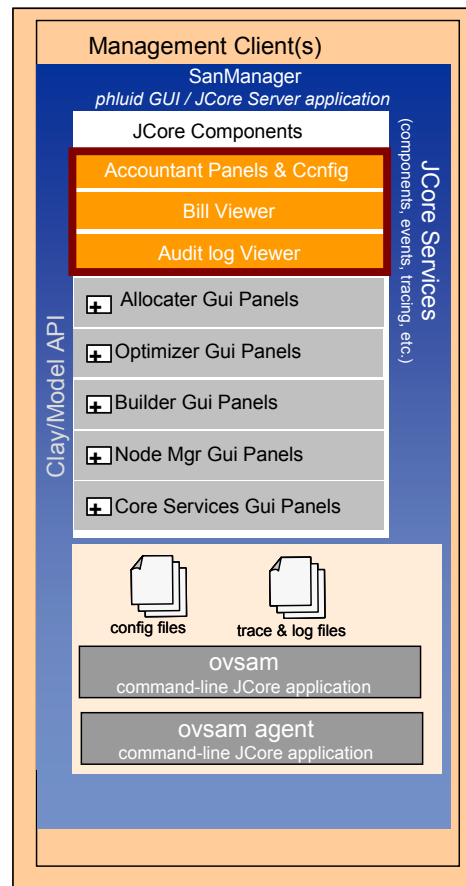
Storage Accountant architecture



The above diagram shows the Storage Accountant components that reside on the management server and the management client.

As with the other Storage Area Manager applications, Storage Accountant delivers its functionality in a set of JCore components. These components reside on the management server and management client. Notice, there are no Storage Accountant-specific components that reside on the SAN host.

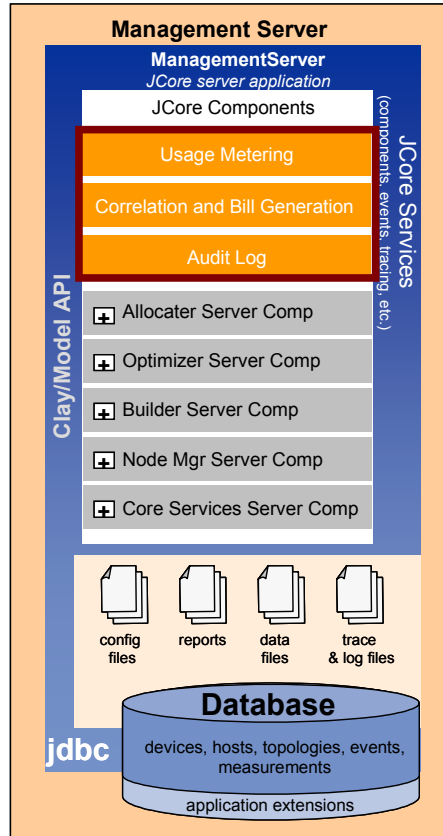
Storage Accountant client components



Three Storage Accountant components reside on the management client:

- **Accountant panels and configuration dialog** — Extends the tree to include Storage Accountant-specific navigation, adds Storage Accountant view panels, and extends the configuration window to include Storage Accountant options.
- **Audit log viewer** — Allows launching of a separate window for display of the audit log. Allows audit log entries to be viewed by:
 - Billing Period
 - Log (event) Type
 - Organization
 - Account
- **Bill viewers** — Allows launching of a separate window for display of bills. Allows bills to be viewed by:
 - Summary or Detail Report
 - Billing Period
 - Organization

Storage Accountant management server components



The following Storage Accountant components reside on the management server:

- Usage Metering
- Correlation and Bill Generation
- Audit Log

Usage metering, data correlation, and bill generation processes are divided into three distinct steps:

1. Usage metering, which consists of monitoring (or listening) for events related to LUNs. This step is handled by the StorageCollector component.
2. Summarizing (or correlating) of the collected events and determining usage. This step is handled by the StorageCorrelator component.
3. Exporting the correlated usage information to an internal XML file and output files configured by the user.

Usage Metering

The StorageCollector listens for database-generated events that indicate changes to LUNs. These events are translated into a data structure called a *Normalized Metered Event (NME)* and stored in a binary file. There is one binary file for each collection period (once per day)

Correlation and bill generation

The StorageCorrelator reads and then aggregates the events stored in its daily binary files into usage information. For example, a usage can be thought of in terms of LUN0 used by Org1 for the period of June 1, 2002 to June 30, 2002 at a price of \$20/GB/hr. This usage information is also in NME form in a binary file.

Correlation can be started in two ways:

- At the end of the scheduled billing period
- On demand by the client GUI bill viewer when the user wants to see the billing information for the current billing cycle (billing generation has not occurred since the billing period has not ended)

Correlation usage information can also be exported. The export process is:

- Read the usage information stored in the correlated binary files.
- Summarize the information by organization and account.
- Write the summarized bill to human (.html) and machine (.csv or .xml) readable form.

Audit log

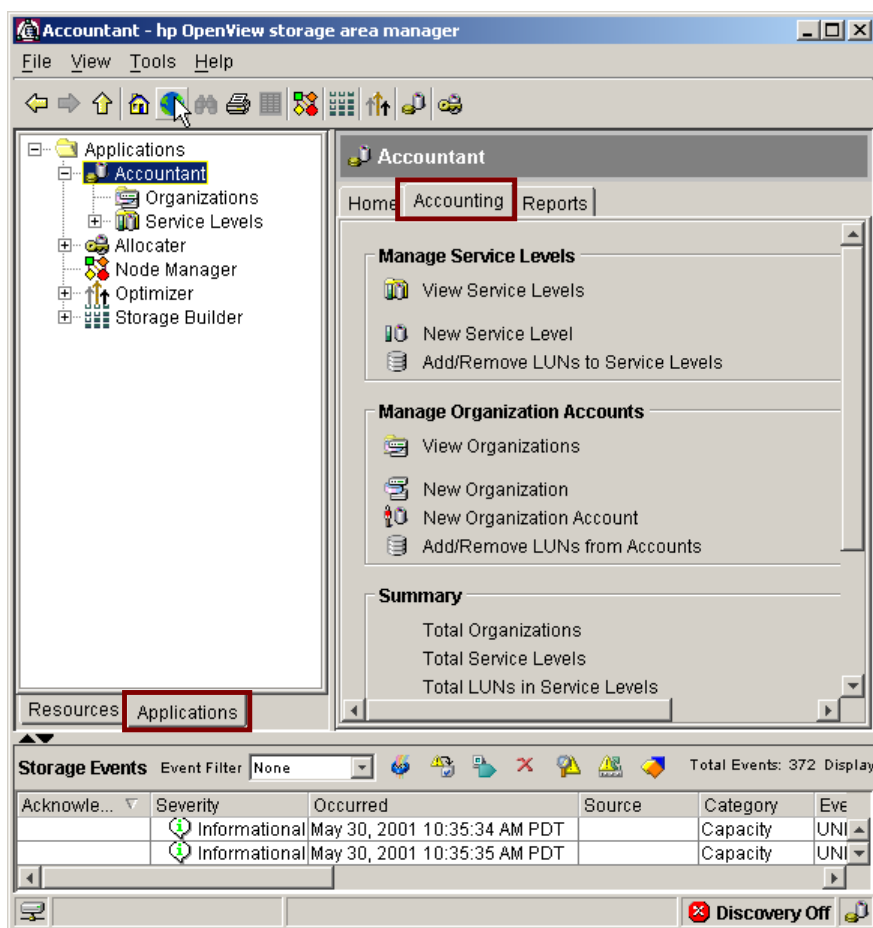
All events related to usage metering and billing are stored in a persistent audit log. Example entries include: When a billing cycle ends, or when a service level's price changes. The audit log is part of the Storage Area Manager database. Audit information needs to be kept for a relatively long period of time (one year), but the amount of information being logged each day is minimal. The audit log is viewable in the GUI and readable from a CLUI command.

By default, Storage Accountant events are not sent to the Storage Area Manager event browser. Triggers must be configured to forward Accountant events to the Storage Area Manager event browser.

Using Storage Accountant to bill for storage use

This section covers the process for setting up Storage Accountant to begin billing for storage use.

Applications tree: Accounting View panel



To manage service levels, organizations, and accounts from within a single view panel, select *Storage Accountant* in the Applications tree and then click the *Accounting* tab.

Service levels

Service Levels on Storage Accountant

Service L...	Cost/GB/...	LUNs in ...	Space in ...	LUNs not...	Space no...	% of Serv...
Subsidiar...	\$0.020000	4	3 GB	0	0 Bytes	100 %
Departm...	\$0.030000	0	0 Bytes	4	9 GB	0 %
Project-A...	\$0.040000	5	59.08 GB	1	N/A	100 %
Economy...	\$0.060000	14	20.44 GB	10	18.44 GB	53 %
Standard...	\$0.080000	49	334.14 GB	27	180.43 GB	65 %
Premium...	\$0.100000	24	53.72 GB	33	73.86 GB	42 %
Totals						
# Service Lev...	--	96	470.38 GB	75	281.74 GB	63 %

Storage Events Event Filter: None Total Events: 331 Displayed Events: 331

Acknowledge...	Severity	Occurred	Source	Category	Event Type	Message
	Informational	May 30, 2001 10:35:34 AM PDT		Capacity	UNKNOWN_THRESH...	The measurement
	Informational	May 30, 2001 10:35:35 AM PDT		Capacity	UNKNOWN_THRESH...	The measurement

Services levels determine the price that will be charged for LUN use. To view a summary of all service levels that have been created, expand the *Storage Accountant* node in the Applications tree and select *Service Levels*.

Note

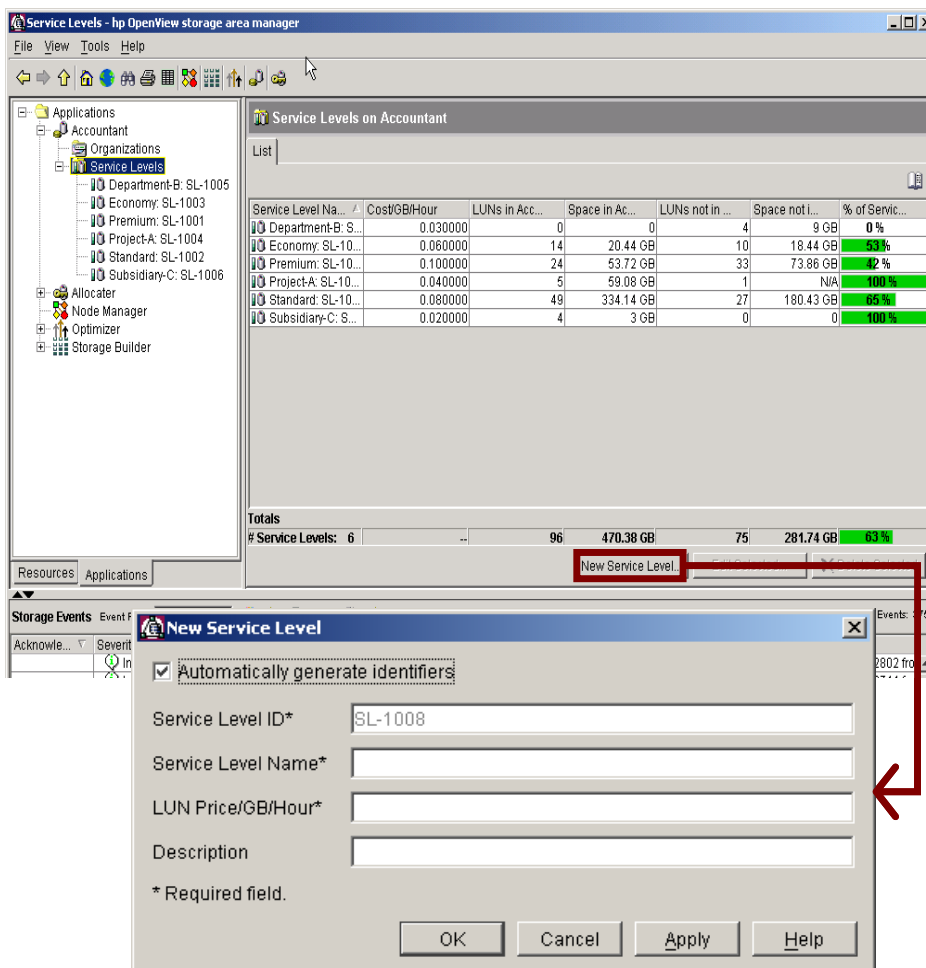
Because service levels are specific to Storage Accountant, service level information can only be accessed from within the Applications tree under the Storage Accountant node.

The view panel displays the following information:

- **Service Level** — Service level name
- **Cost/GB/Hour** — Price charged to the account for use of any LUN assigned to this service level.
- **LUNs in Account** — Number of LUNs that are configured in the service level that are currently assigned to an account.
- **Space in Account** — Amount of service level space currently being used by an account.

- **LUNs NOT in Accounts** — Number of LUNs configured in the service level, though not added to an Account
- **Space NOT in Accounts** — Amount of service level space available. In other words, service level space that has NOT been added to an account
- **% of Service Level** — (Service level space used by accounts) / (Total amount of space configured in service level)

Creating new service levels



Before LUNs can be attached to an account, they must have a service level.

To create a new service level, click the *New Service Level* button on the Service Level view panel. In the New Service Level window, enter the information required to define the service level.

The Automatically Generate ID option lets Storage Accountant generate the unique identifier that is required for this service level. To specify the identifier manually, clear the checkbox.

Service Level properties include:

- **Service Level ID** — An alphanumeric value that uniquely identifies this service level. To enter an ID, the Automatically Generate ID check box must be de-selected. Special characters are allowed.

Note

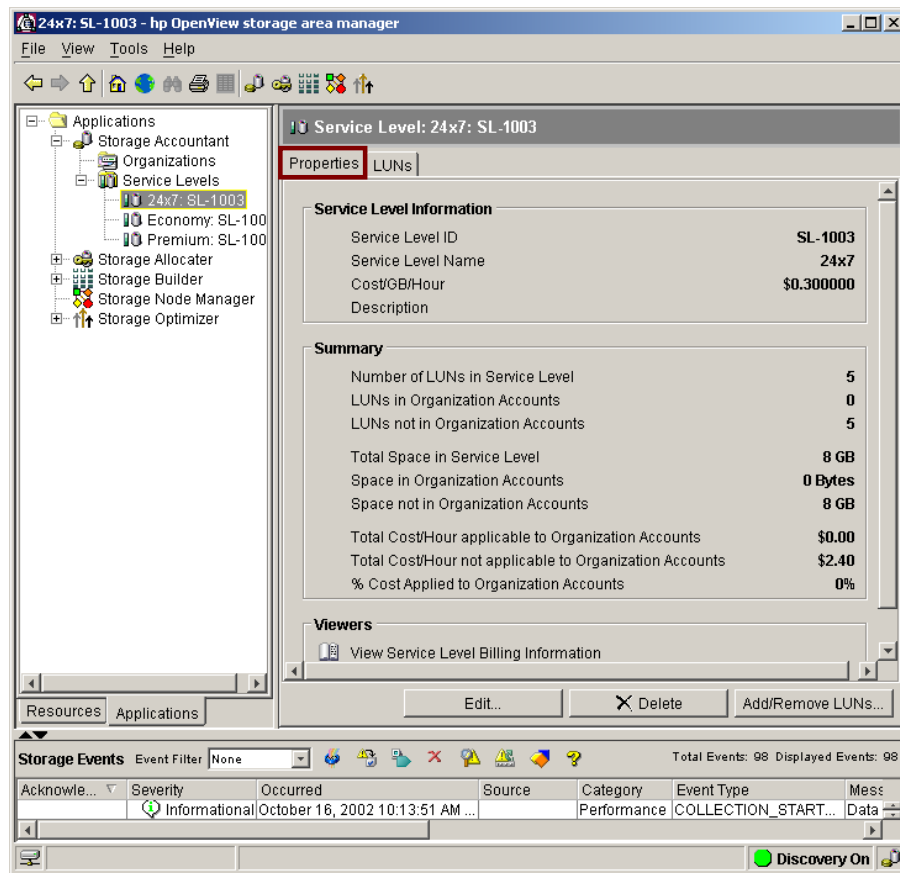
When managing service levels using the Storage Accountant CLUI, the Service Level ID is used. Therefore, using a unique descriptive name is helpful.

- **Service Level Name** — The name that this service level is known by in business communications
- **LUN Price/GB/Hour** — The price, in any currency, that will be charged per GB per hour of access to this LUN
- **Description** — The descriptive information about the service level

There are two ways to add service levels within Storage Accountant, both use the Applications tree:

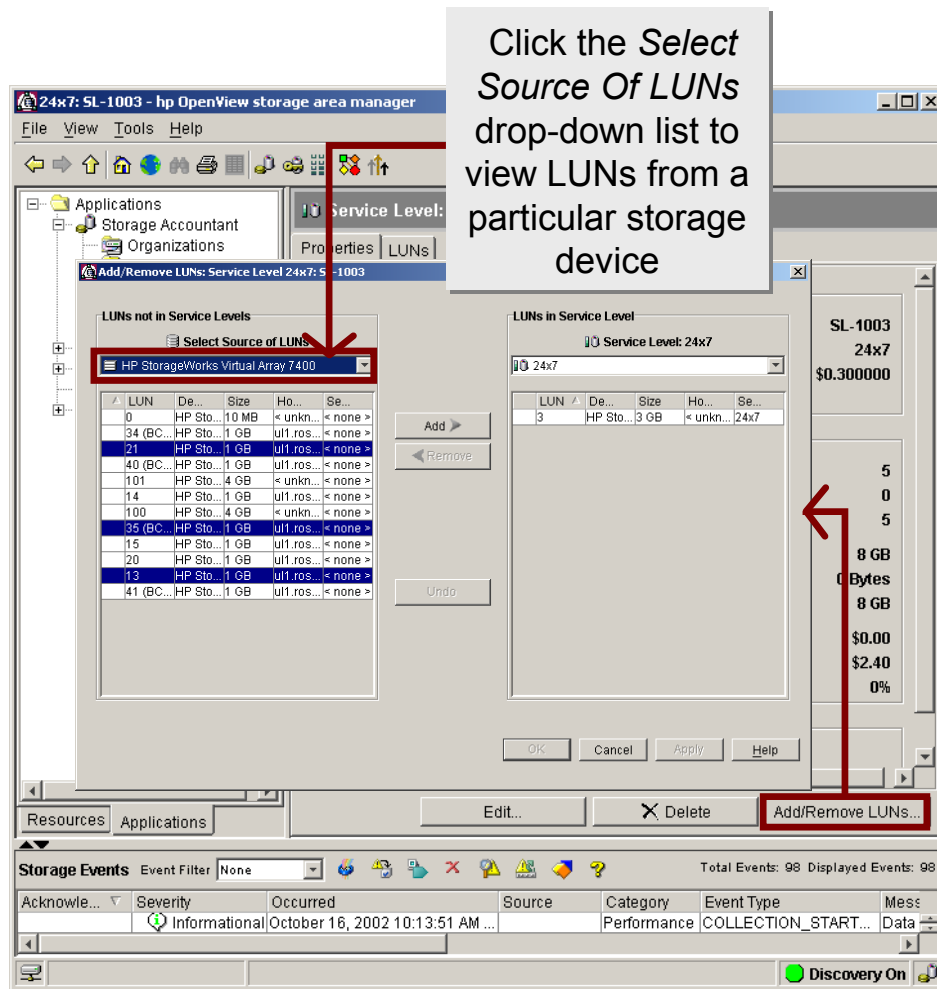
- Right-click the *Service Level* node and select *New Service Level*.
- Select the *Storage Accountant* node and use the Accounting view panel

Viewing service level properties



To view service level properties, expand the Service Levels node and select the specific service level. Click the *edit* button at the bottom of the service level properties view panel to modify any of the properties.

Adding LUNs to a service level



LUNs must have a service level before they can be added to accounts. Conversely, LUNs must be removed from accounts before their service level can be removed.

To add or remove LUNs to a service level, click the *Add/Remove LUNs* button on the service level properties view panel. The selected service level is indicated in the window title bar.

The information listed in the LUNs view panel is obtained directly from the repository. All storage device-specific information is obtained from Storage Area Manager Core Services through DDT.

Use the drop-down menus at the top of the panels to filter the lists that display. To add and remove LUNs, select the LUNs in either panel and click the *Add* or *Remove* button as appropriate.

When a LUN is added to, or removed from an account, the operation is pending until the *Apply* or *OK* button is clicked. When a LUN is added to an account, it is displayed with a right arrow icon, and is listed in gray text on the left and in blue text in the Add List. Removed LUNs are displayed with a left arrow icon, and are listed in gray text on the right and blue text in the Remove List.

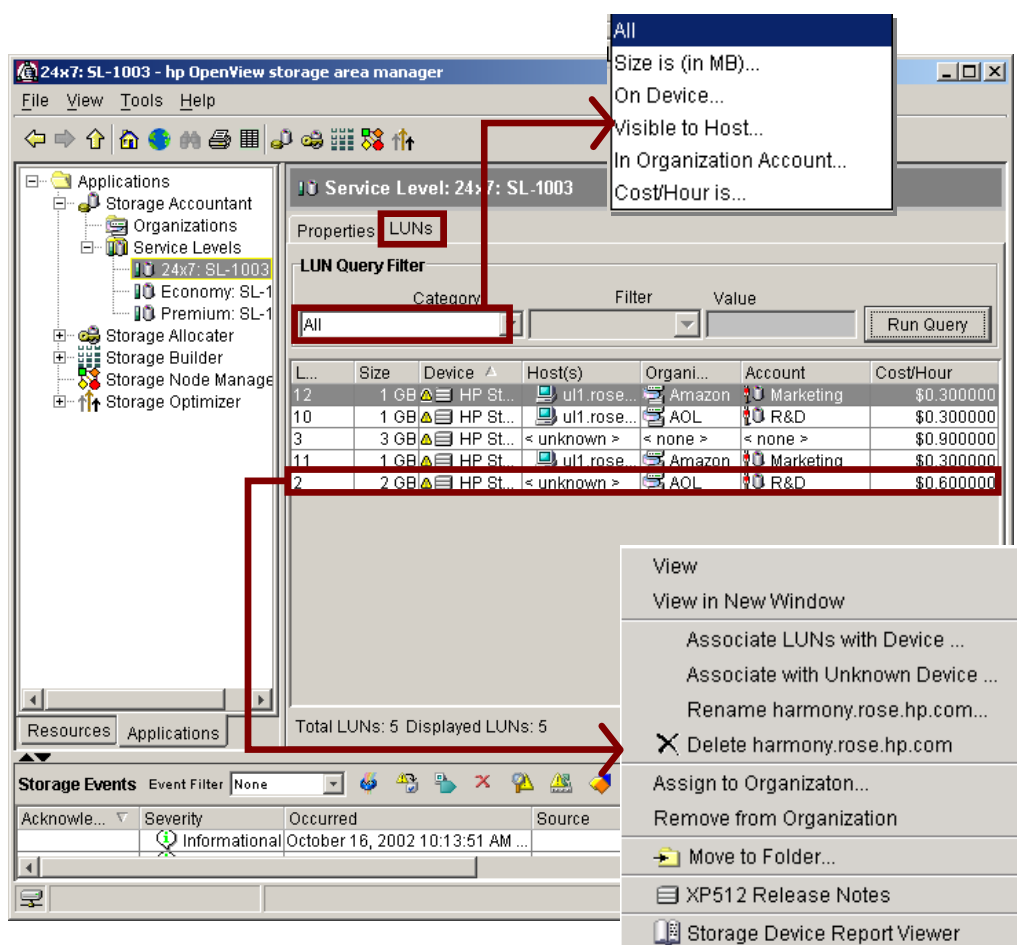
To undo one or more pending operations, select the operations in the Add or Remove list and click the *Undo* button.

Note

Moving large numbers of LUNs increases the time it takes to apply the changes, about a minute for every 2000 LUNs. During this time, a message window shows the progress of the changes. There is a short delay before the view panel is updated with the changes.

Note

For best performance, HP recommends limiting the total number of LUNs in a service level to 2000. If more than 2000 LUNs need to use the same price, alternate service levels with the same price should be created.

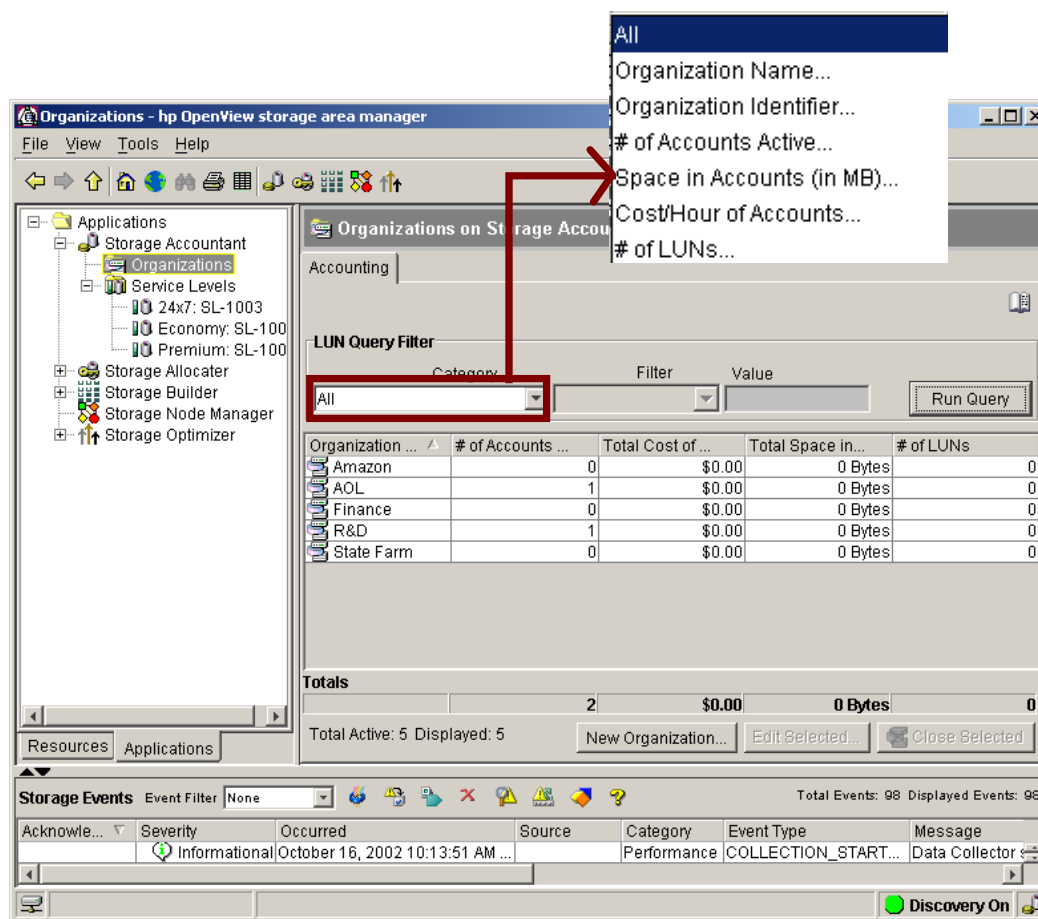


To display a list of the Service Level LUN assignments and their cost per hour, expand the Service Levels node, select a specific service level, and then click the LUNs tab. Select from the drop-down menus to specify the parameters of the query you want to run and then click the *Run Query* button.

- **All** — Displays all LUNs associated with the selected service level
- **Size in MB** — Displays all LUNs that are either greater than or equal to a given size in megabytes, or less than or equal to the specified size.
- **On Device** — Displays all LUNs that are on a specific storage device. This filter automatically lists all known storage devices and allow the user to select a device. This could be useful to ensure that the LUNs for a device have been assigned to the correct service level.
- **Visible to Host** — Displays LUNs that are visible to a specific host. As with the On Device filter, this filter automatically lists the known hosts and allows selection of a specific host.

- **In Organization Account** — Displays LUNs associated with a specific organization (these cannot be filter by account).
- **Cost/Hour** — Displays all LUNs with a cost per hour that is either greater than or equal to a given cost per hour in the selected currency, or less than or equal to the specified cost.

Organizations



To view a list of all existing organizations, expand the *Storage Accountant* node and select *Organizations*.

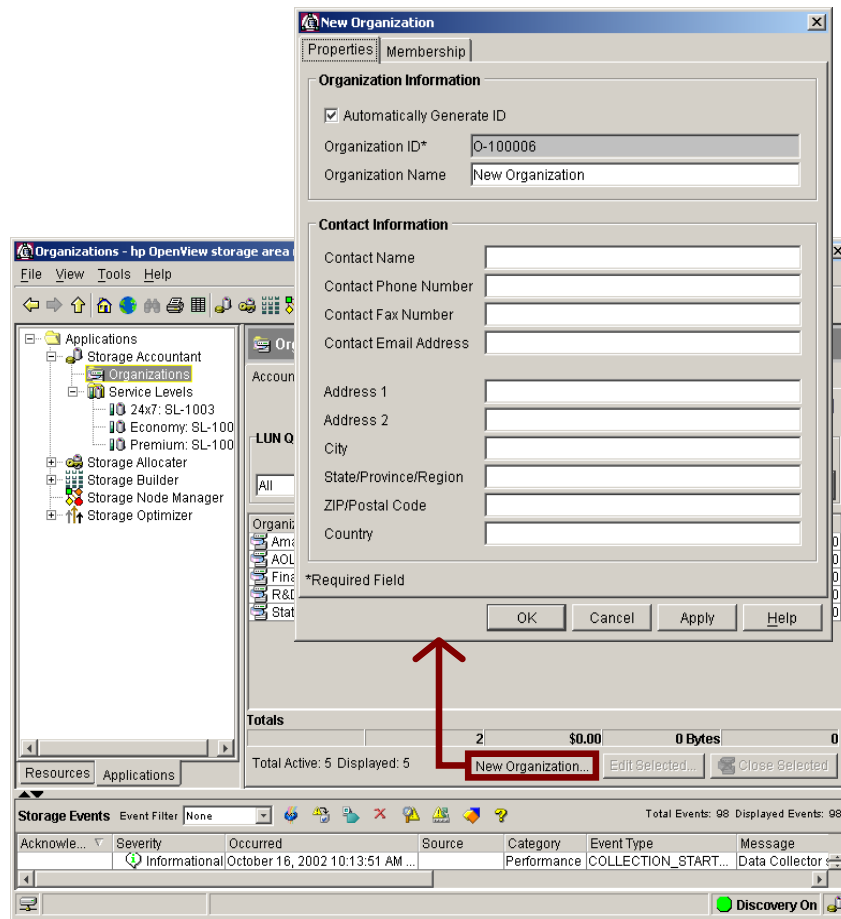
Select from the drop-down menus to specify the parameters of the query you want to run and then click the *Run Query* button.

Available query filters include: Organization name, Organization ID, Number of Active Accounts, Space in Accounts, Cost per Hour of Accounts, and Number of LUNs.

The Organizations node lists all organizations created within Storage Area Manager, including those that do not have associated accounts created for Storage Accountant.

The LUN Query Filter limits the results shown in the table. Available filters are: Organization Name, Organization ID, Number of Active Accounts, Space in Accounts, Cost per Hour of Accounts and Number of LUNs. The *Run Query* button must be clicked in order for any values to display.

Creating new organizations



To create a new organization, click the *New Organization* button on the Organizations view panel. In the New Organization window, enter the information required to define the organization.

The Automatically Generate ID option lets Storage Accountant generate the unique identifier that is required for this organization. To specify the identifier manually, clear the checkbox.

Organization information can be edited at any time. However, when an organization is “closed,” it cannot be edited or re-opened. Storage Accountant does, however, retain all closed organization account information.

Because organizations are used throughout Storage Area Manager, they can be created from either the Applications or the Resources tree.

Accounts

Double-click on any organization to view Account information

Organization Name	# of Accounts A...	Total Cost of Ac...	Total Space in A...	# of LUNs
B&D Corporation	3	\$16.56	201.4 GB	42
Engineering	0	\$0.00	0 Bytes	0
marketing	0	\$0.00	0 Bytes	0
Marketing	0	\$0.00	0 Bytes	0
Sample Group	0	\$0.00	0 Bytes	0

Organization: ACME Corporation

Properties | Membership | Node Manager | Accounting

Select View: Show Active Accounts Only

Account Name	Total Cost/Hour	Total Space in Account	# LUNs
Manufacturing	\$2.35	40 GB	5
Marketing	\$1.55	19.28 GB	6
Order Processing	\$3.35	41.26 GB	6
Sales	\$2.59	31.96 GB	6
Service	\$0.94	16 GB	2
Training	\$1.99	33.9 GB	1
Totals			
# Accounts: 6	\$12.77	182.4 GB	26

Filter list on only active accounts or include both open and closed accounts

To view an account summary for all organizations:

1. In the Resources tree, select *Organizations*.
2. In the view panel, click the *Accounting* tab.

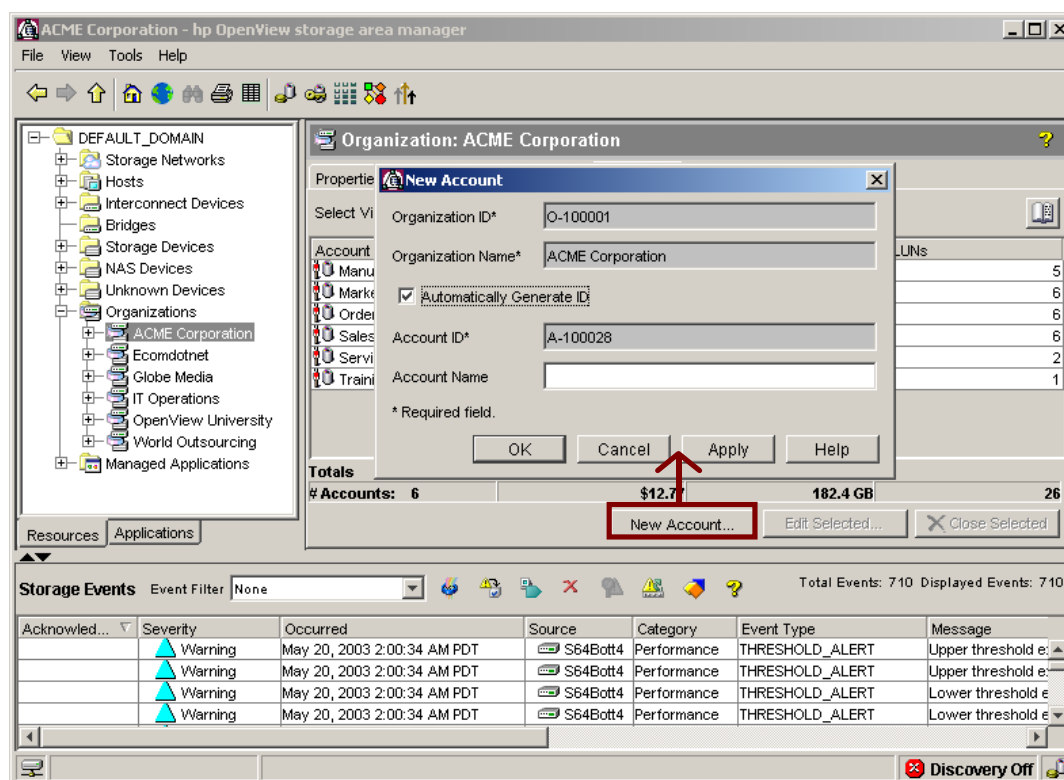
To view an account summary for an individual organization:

1. In the Resources tree, expand *Organizations*.
2. Select the organization for which you want to view accounts.
3. Click the *Accounting* tab.

To view an account summary for an account:

1. In the Resources tree, expand *Organizations*.
2. Expand the organization for which you want to view accounts.
3. Select the account for which you want to view information and click the *LUNs* tab.
4. Use the LUN Query Filter to specify a set of LUNs, as follows:
 - a. Select a category.
 - b. If necessary, enter additional information (for example, when listing LUNs by device, select a device).
 - c. Click the *Run Query* button.

Creating new accounts



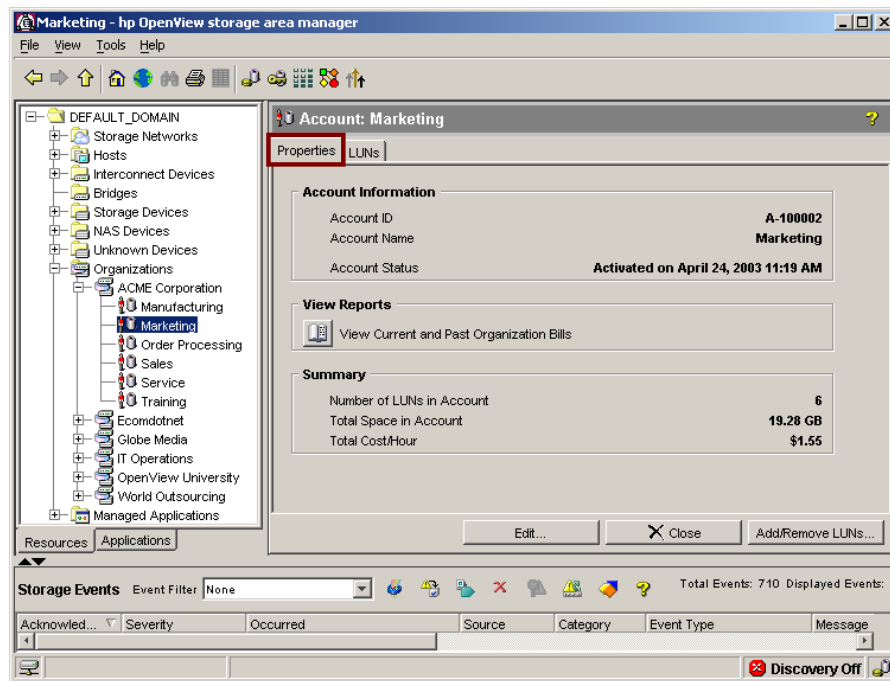
To create a new account, select the Organization that the account will be associated with in the *Resources* tree and then click the *New Account* button.

Alternatively, accounts can be created from the Accounting view panel available from the Applications tree.

The New Account window prompts for the information that is needed to create an account. Storage is attached to and charged by account. The Finance department, for example, could be one of the organization's accounts.

Automatically generate ID option lets Storage Accountant generate the value that uniquely identifies this account. To specify the identifier manually, clear the check box.

Viewing account properties



To view the properties for an account, expand the *Organizations* node and select the specific account. The Account view panel displays the following information:

- Account identification information
 - **Account ID** — Alphanumeric code that uniquely identifies this account.
 - **Account Name** — Name that this account is known in business communications. It must be unique among other accounts that belong to this organization. If no name is entered, the account is identified in the Resources tree by its ID.
 - **Account Status** — Last state change associated with an account and the date of that state change. Only the account activated state is viewable. When an account is closed, it cannot be viewed in Storage Accountant.
- View reports
 - **View Current and Past Organization Bills** — Displays the Bill Viewer with the account detailed billing report for the current billing period to date
- Display account usage summary
 - **Number of LUNs in Account** — The number of LUNs that have been assigned to the selected account
 - **Total Space in Account** — The total space allocated to the account
 - **Total Cost/Hr** — The total cost of all LUNs in the account on a per hour basis

Adding LUNs to an account

Use the Select Source of LUNs drop-down window to show LUNs from a particular service level or storage device

LUNs not in Accounts

Select Source of LUNs

Service Levels

Department-B

LUN	Devl...	Size	Host...	Servi...
1	HP VA71...	1 GB	HP-UX(1)	Departm...
2	HP VA71...	2 GB	HP-UX(1)	Departm...
3	HP VA71...	3 GB	HP-UX(1)	Departm...
4	HP VA71...	3 GB	HP-UX(1)	Departm...

LUNs in Account

Account: Marketing [B&B Corporation]

Marketing

LUN	Devl...	Size	Host...	Servi...
0:00	HP XP512	2.24 GB	< unkno...	Premium
0:01	HP XP512	2.24 GB	< unkno...	Premium
0:02	HP XP512	2.24 GB	< unkno...	Premium
0:03	HP XP512	2.24 GB	< unkno...	Premium
0:04	HP XP512	2.24 GB	< unkno...	Premium
0:05	HP XP512	2.24 GB	< unkno...	Premium
0:06	HP XP512	2.24 GB	< unkno...	Premium
0:07	HP XP512	2.24 GB	< unkno...	Premium
0:08	HP XP512	2.24 GB	< unkno...	Premium
0:09	HP XP512	2.24 GB	< unkno...	Premium
0:0a	HP XP512	2.24 GB	< unkno...	Premium
0:0b	HP XP512	2.24 GB	< unkno...	Premium
0:0c	HP XP512	2.24 GB	< unkno...	Premium
0:0d	HP XP512	2.24 GB	< unkno...	Premium

Storage Events

Acknowledge...	Severity	Occurred	Source	Category	Event Type	Message
	Informational	October 16, 2002 10:13:51 AM ...		Performance	COLLECTION_START...	

Organizations are billed for the LUNs that are added to their accounts.



Caution

Make sure that LUNs are physically and logically accessible to the organization adding them to an account. Otherwise, organizations can be charged for LUNs that they cannot use.

Note

Only LUNs that have been placed in service levels can be added to accounts.

To attach service level LUNs to a specified account:

1. In the Resources tree, expand *Organizations* and the individual organization that includes the desired account.
2. Right-click the specified account and select *Add/Remove LUNs* from the short-cut menu. A new window lists all available LUNs on the left panel and all LUNs that are already attached to the account on the right panel.

Note

To select LUNs from a particular storage device or service level, select Storage Devices or Service Levels in the top box in the left panel. The contents of the second box change accordingly. When a specific storage device or service level is selected from the second box, the list of available LUNs shows only the LUNs in that device or service level.

3. In the left box, select the LUN or LUNs that are to be attached to the selected account and click the *Add* button. The selected LUNs are dimmed in the list on the left and added in blue to the Add List on the right. A green arrow appears in the Status column beside the moved LUNs in each list, indicating that the addition is pending.

Continue selecting LUNs and clicking *Add*. Select and remove LUNs from the list on the right. All actions remain pending until *Apply* or *OK* is pressed.

Note

Moving large numbers of LUNs will increase the time it takes to apply the changes, about a minute for every 2000 LUNs. During this time, a message window shows the progress of the changes. There will be a short delay before the view panel is updated with the changes.

Note

For best performance, HP recommends limiting the total number of LUNs in an account to 2000. To assign more than 2000 LUNs to the same organization, assign the LUNs to multiple accounts, and then assign the accounts to the organization.

4. Click *OK* to save the LUN placements and close the window.

Viewing host and storage device accounting information

This section covers the host and storage device view panels that are available for displaying Storage Accountant information.

Viewing the accounting summary for hosts

The screenshot shows the HP OpenView storage area manager interface. On the left, the 'Resources' tree is expanded, and 'Hosts' is selected. The main window displays the 'Hosts' Accounting tab, which shows a table of host accounting information. The table columns are: Host, Organization, Space in ..., Costs App..., Space not..., Costs not ..., and Space not... The table lists various hosts and their associated organizations, along with their storage space and costs. A 'Totals' row at the bottom summarizes the data for all 15 hosts.

Host	Organization	Space in ...	Costs App...	Space not...	Costs not ...	Space not...
C04H03	ACME Cor...	279.99 GB	\$20.04	42.88 GB	\$2.67	61.95 GB
C04H04	ACME Cor...	279.99 GB	\$20.04	42.88 GB	\$2.67	59.95 GB
C04H08		0 Bytes	\$0.00	100 GB	\$6.34	250 GB
C05H01		0 Bytes	\$0.00	0 Bytes	\$0.00	203.51 GB
C05H02		0 Bytes	\$0.00	0 Bytes	\$0.00	135.67 GB
HYDRO-...	Ecomdotnet	0 Bytes	\$0.00	0 Bytes	\$0.00	16.87 GB
POC-AIX	Ecomdotn...	6.88 GB	\$0.56	6.88 GB	\$0.56	31.53 GB
POC-HPUX	Ecomdotn...	16 GB	\$1.01	16 GB	\$1.01	116.92 GB
POCSam1		0 Bytes	\$0.00	0 Bytes	\$0.00	0 Bytes
REMNAS...	Globe Media	0 Bytes	\$0.00	0 Bytes	\$0.00	830.98 GB
REMNET01	Globe Media	0 Bytes	\$0.00	0 Bytes	\$0.00	73.9 GB
REMSUN...	IT Operatio...	50 GB	\$3.17	100 GB	\$6.34	58.43 GB
REMMVND1	IT Operatio...	243.36 GB	\$16.71	0 Bytes	\$0.00	135.61 GB
REMMVND2	IT Operatio...	101 GB	\$6.40	10 GB	\$0.63	304.9 GB
REMMVND3	IT Operatio...	101 GB	\$6.40	10 GB	\$0.63	304.9 GB
Totals						
#Hosts: 15		1.05 TB	\$74.33	328.63 GB	\$20.86	2.52 TB

To view a list of all known host systems by platform type with the corresponding Storage Accountant information, select *Hosts* in the Resources tree and click the *Accounting* tab.

Viewing the accounting summary for host LUNs

The screenshot shows the HP OpenView Storage Area Manager interface. The left pane displays a tree view of the storage environment, with the host **REMWIN02** selected under the **Windows** category. The right pane shows the **Accounting** tab for **Windows 2000: REMWIN02**. The **Accounting** tab is highlighted with a red box. Below the tab, the **Total Number of LUNs: 16** is displayed. A table lists the LUNs with their sizes, devices, organizations, accounts, services, and costs per hour.

LUN	Size	Device	Organiz...	Account	Service ...	Cost/Hour
VD002	40 GB	HP Sto...	< none >	< none >	< none >	< N/A >
VD001	10 GB	HP Sto...	OpenVie...	Account...	Platinum:...	\$0.634000
VD004	1 GB	HP Sto...	ACME C...	Marketing	Platinum:...	\$0.063400
VD003	100 GB	HP Sto...	< none >	< none >	< none >	< N/A >
VD006	10 GB	HP Sto...	World O...	E-Mail	Platinum:...	\$0.634000
VD005	10 GB	HP Sto...	< none >	< none >	< none >	< N/A >
VD008	10 GB	HP Sto...	IT Opera...	CR2 Op...	Platinum:...	\$0.634000
VD007	10 GB	HP Sto...	< none >	< none >	Platinum:...	\$0.634000
VD004	1 GB	HP Sto...	< none >	< none >	< none >	< N/A >
VD003	100 GB	HP Sto...	< none >	< none >	< none >	< N/A >
VD002	40 GB	HP Sto...	IT Opera...	CR2 Op...	Platinum:...	\$2.536000
VD001	10 GB	HP Sto...	< none >	< none >	< none >	< N/A >
VD006	10 GB	HP Sto...	IT Opera...	CR2 Op...	Platinum:...	\$0.634000
VD005	10 GB	HP Sto...	< none >	< none >	< none >	< N/A >
VD008	10 GB	HP Sto...	IT Opera...	CR1 Op...	Platinum:...	\$0.634000
VD007	10 GB	HP Sto...	World O...	E-Mail	Platinum:...	\$0.634000

The bottom pane shows the **Storage Events** section with an event filter set to **None**. The total number of events is 710, and 7 events are displayed. The **Discovery Off** status is indicated in the bottom right corner.

To view the Accounting summary for all LUNs for a specific host, select a host and click the *Accounting* tab.

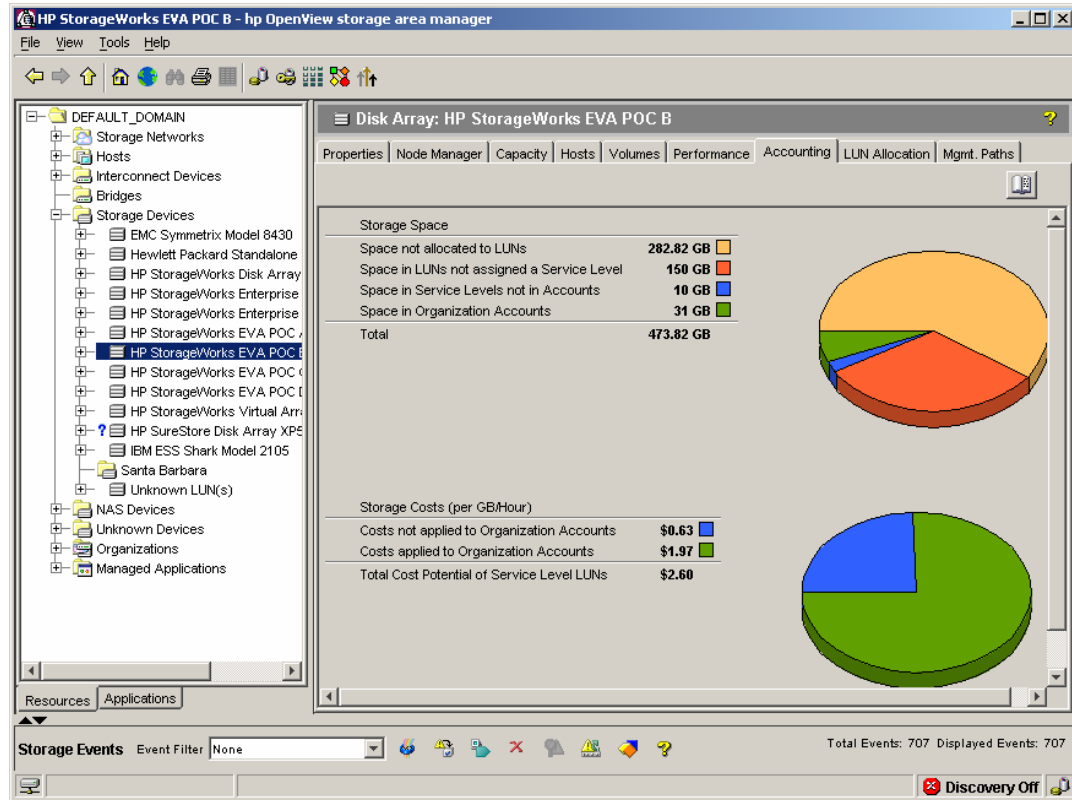
Viewing the accounting summary for storage devices

The screenshot shows the 'Storage Devices - hp OpenView storage area manager' window. The left pane displays a tree view with 'Storage Devices' selected. The main pane shows the 'Accounting' tab, which contains a table of storage devices and their accounting details. The table has columns for Device, Organiz..., Space i..., Costs A..., Space ..., Costs n..., and Space The 'Accounting' tab is highlighted with a red box. Below the table, there is a 'Totals' section showing the sum of all devices. At the bottom, there is a 'Storage Events' section with an event filter set to 'None' and a 'Discovery Off' button.

Device ...	Organiz...	Space i...	Costs A...	Space ...	Costs n...	Space ...
EMC S...	ACME C...	55.62 GB	\$3.53	27.81 GB	\$1.76	1 TB
HP St...	ACME C...	135.61 GB	\$7.96	0 Bytes	\$0.00	322.17 GB
HP St...	Globe M...	0 Bytes	\$0.00	0 Bytes	\$0.00	1,015.54 GB
HP St...	ACME C...	16 GB	\$1.01	116 GB	\$7.35	10.59 TB
HP St...	Globe M...	0 Bytes	\$0.00	0 Bytes	\$0.00	473.82 GB
HP St...	ACME C...	31 GB	\$1.97	10 GB	\$0.63	432.82 GB
HP St...	ACME C...	70 GB	\$4.44	0 Bytes	\$0.00	200.82 GB
HP St...	IT Oper...	50 GB	\$3.17	100 GB	\$6.34	154.68 GB
HP St...	ACME C...	120 GB	\$7.04	36 GB	\$2.11	344.68 GB
HP Su...	ACME C...	272.32 GB	\$22.11	13.75 GB	\$1.12	673.85 GB
IBM E...	OpenVi...	0 Bytes	\$0.00	0 Bytes	\$0.00	60 GB
Santa B...						
Totals						
# Storage D...		750.56 GB	\$51.23	303.56 GB	\$19.32	15.19 TB

To view the Accounting summary for storage devices, select the *Storage Devices* node or a specific storage device, and then click the *Accounting* tab.

Viewing accounting summary charts for storage devices



To display a chart of accounting summary information, select the *Accounting* tab for a Storage Device sub-node.

Two comparison pie charts are available:

- Storage Space
- Storage Cost

The sections of the charts correspond to the data columns displayed in the Storage Devices Summary table, but also include the amount of space on the device that has not been sectioned into LUNs (identified as *overhead* space in Storage Builder).

Viewing accounting information for logical units

The screenshot displays the HP OpenView storage area manager interface. The left pane shows the 'Logical Units' sub-node selected under the 'HP SureStore Disk Array XP512' device. The main pane shows the 'Accounting' tab for Logical Units on this device. The table below represents the data shown in the main pane.

LUN	Size	Host(s)	LUN Type	Organiz...	Account	Service ...	Cost/Hour
Total Number of LUNs: 63							
0:00	2.29 GB	< unknown >	Direct Access	< none >	< none >	< none >	< N/A >
0:01	2.29 GB	< unknown >	Direct Access	< none >	< none >	< none >	< N/A >
0:02	2.29 GB	< unknown >	Direct Access	< none >	< none >	< none >	< N/A >
0:03	2.29 GB	< unknown >	Direct Access	< none >	< none >	< none >	< N/A >
0:04	2.29 GB	< unknown >	Direct Access	< none >	< none >	< none >	< N/A >
0:05	2.29 GB	< unknown >	Direct Access	< none >	< none >	< none >	< N/A >
0:06	2.29 GB	< unknown >	Direct Access	< none >	< none >	< none >	< N/A >
0:07	2.29 GB	< unknown >	Unknown	< none >	< none >	< none >	< N/A >
0:08	2.29 GB	POC-AIX	Direct Access	< none >	< none >	< none >	< N/A >
0:09	2.29 GB	POC-AIX	Direct Access	< none >	< none >	< none >	< N/A >
0:0a	2.29 GB	POC-AIX	Direct Access	< none >	< none >	< none >	< N/A >
0:0b	2.29 GB	POC-AIX	Direct Access	< none >	< none >	< none >	< N/A >
0:0c	2.29 GB	POC-AIX	Direct Access	< none >	< none >	< none >	< N/A >
0:0d	2.29 GB	POC-AIX	Direct Access	< none >	< none >	< none >	< N/A >
0:0e	6.88 GB	POC-AIX	Direct Access	ACME C...	Order Pr...	Platinum ...	\$0.558448
0:0f	6.88 GB	POC-AIX	Direct Access	< none >	< none >	Platinum ...	\$0.558448
0:10	2.29 GB	REMM...	Direct Access	ACME C...	Marketing	Platinum ...	\$0.186112
0:11	2.29 GB	REMM...	Direct Access	IT Opera...	Manage...	Platinum ...	\$0.186112
0:12	2.29 GB	REMM...	Direct Access	ACME C...	Sales	Platinum ...	\$0.186112
0:13	2.29 GB	REMM...	Direct Access	IT Opera...	Manage...	Platinum ...	\$0.186112
0:14	2.29 GB	REMM...	Direct Access	ACME C...	Sales	Platinum ...	\$0.186112
0:15	2.29 GB	REMM...	Direct Access	IT Opera...	Manage...	Platinum ...	\$0.186112
0:16	2.29 GB	REMM...	Direct Access	IT Opera...	Manage...	Platinum ...	\$0.186112
0:17	2.29 GB	REMM...	Direct Access	IT Opera...	Manage...	Platinum ...	\$0.186112
0:18	2.29 GB	REMM...	Direct Access	ACME C...	Marketing	Platinum ...	\$0.186112

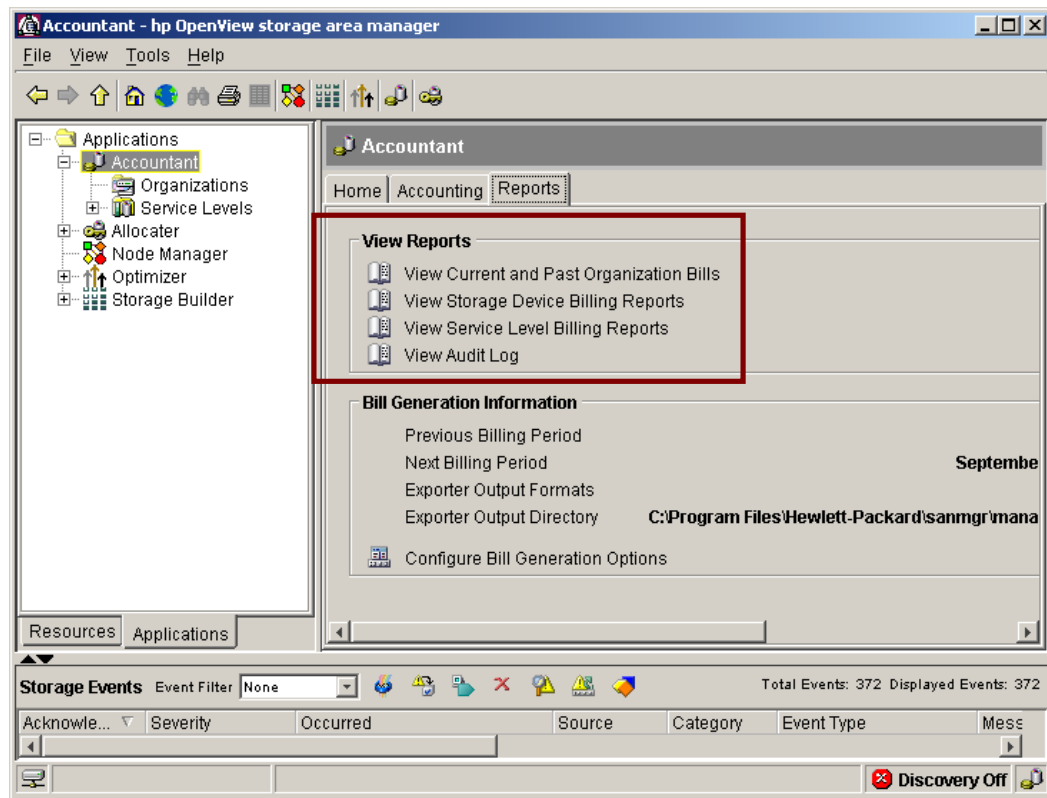
To view accounting information for logical units, select the Logical Unit sub-node under a specific device in the Resources tree and click the *Accounting* tab.

The Logical Units accounting view panel is used to view a summary of LUN costs. LUN cost summary for LUNs that are visible to a host or LUNs that belong to a particular storage device can be viewed.

The Logical Units accounting view panel is accessed from the Accounting view panel under the *Logical Units* sub-node. It also provides detailed information on each LUN on the given device.

The Storage Devices Logical Units table provides detailed information on each LUN on the given device.

Reports



Storage Accountant provides cost-related information that can be accessed by the reporting function. Summary reports are available from the Reports view panel. They include:

- Current and Past Organization Bills
- Storage Device Billing Report
- Service Level Billing Report
- Audit Log

Reports can be viewed several ways:

- From the Applications tree, using the Reports tab of the Storage Accountant view panel (shown above)
- By selecting *Tools* → *Storage Accountant*
- By clicking context-sensitive launch points

How charges become bills

Bills are summaries of organizations' storage charges. They are available in two formats:

- Text that is displayed in the Bill Viewer window
- An exportable file that is automatically saved at the end of each billing period

In each case, Storage Accountant produces the bill from information that it collects during the billing period.

At the end of the day, Storage Accountant records all the day's transactions that affect storage charges (for example, a LUN is added or removed from an account, a service level price that changed, or a LUN is resized)

Once a month, Storage Accountant compiles these daily records into a single binary file of usage information.

Example

LUN 01 used by Account AA from October 1, 2001, 09:27:54, to October 30, 2001, 23:59:59, at a price of \$.07/GB/hr.

The information in this file is then sorted by organization and account to display requested bills in the Bill Viewer and to produce specially formatted files that can be imported by a third-party billing application. The formats (.csv, .html, or .xml) are specified along with the directory on the management server where the exported files are stored. The day and time of the monthly compilation is also specified.

Viewing current and past organization bills

The screenshot shows the 'Bill Viewer' application window. At the top, there is a 'Billing Period' dropdown menu set to 'Current Billing Period'. Below this, a table displays the billing period details:

Billing Period		
From	To	Hours
6/12/02 3:17 PM	6/12/02 3:30 PM	0.2164

Below the billing period table, there are two organization summaries. The first is for 'B&D Corporation (C-100001)' and the second is for 'The Garage Inc. (C-100002)'. Each summary table lists account names, account IDs, and account totals.

B&D Corporation (C-100001) Organization Summary

Account Name	Account ID	Account Total
Manufacturing	O-100001	\$1.45
Marketing	O-100003	\$0.70
Research	O-100002	\$1.55
Organization Total		\$3.70

The Garage Inc. (C-100002) Organization Summary

Account Name	Account ID	Account Total
Finance	O-100004	\$0.50
Marketing	O-100005	\$1.58
Research	O-100007	\$0.52
Services	O-100006	\$1.68
Organization Total		\$4.29

To launch the Bill Viewer and view past or current charges for organizations, click the icon next to View Current and Past Organization Bills on the Accountant Reports tab.

Select from the Billing Period drop-down menu to specify the viewing period.

Bills can be viewed in two forms: summary and detail. A summary bill contains information about one or more organizations, including the charges for each account, and the total charge to each organization. Click an organization name to launch the Detail Organization Bill.

To print the bill, select *File* → *Print* to output the displayed bill to the default printer. Select *File* → *Page Setup* to specify the paper size and source, orientation, and margins of the printed copy.

To export the bill, select *File* → *Export*. Click *Detail* or *Summary*, and then select a file type from the submenu.

Viewing detailed organization bills

The screenshot shows the 'Bill Viewer' application window. At the top, there's a menu bar with 'File' and 'Help'. Below it is a 'Billing Period' dropdown menu set to 'Current Billing Period'. The main content area is divided into several sections:

Billing Period		
From	To	Hours
6/12/02 3:17 PM	6/12/02 3:30 PM	0.2164

B&D Corporation (C-100001) Organization Summary		
Account Name	Account ID	Account Total
Manufacturing	O-100001	\$1.45
Marketing	O-100003	\$0.70
Research	O-100002	\$1.55
Organization Total		\$3.70

Organization Detail								
Manufacturing (O-100001)								
Storage Device	LUN	Description	Occurred	Service Level	Size (GB)	Price (GB/Hr)	Hours	Charge (Size*Price*Hours)
HP VA7100 Array	5	Same as Previous Billing Period	6/12/02 3:17 PM	Subsidiary-C	2.000	\$0.020000	0.2164	\$0.008656
HP VA7100 Array	6	Same as Previous Billing Period	6/12/02 3:17 PM	Subsidiary-C	1.000	\$0.020000	0.2164	\$0.004328
HP VA7100 Array	7	Same as Previous Billing Period	6/12/02 3:17 PM	Subsidiary-C	0.000	\$0.020000	0.2164	\$0.000000
HP VA7100 Array	7	Same as Previous Billing Period	6/12/02 3:17 PM	Subsidiary-C	0.000	\$0.020000	0.2164	\$0.000000

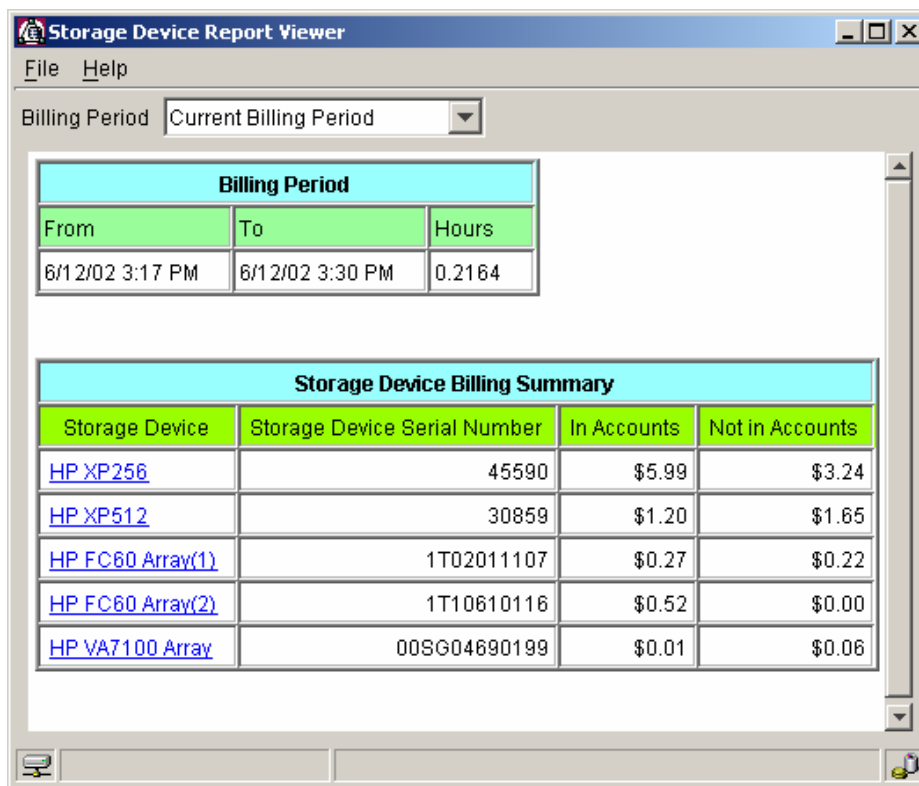
View Detailed Organization bills by clicking an organization name in the Summary Organization report, or by right clicking a specific organization in the Resources tree and selecting *Bill Viewer* from the shortcut menu.

A detail bill contains the summary information, plus details for each LUN.

Each line in the detailed bill describes a persistent state of factors in the charge for the specified LUN. If the LUN price, size, or presence in the account changes, a new line shows the new charge. Consequently, LUNs can display multiple times in a bill. The change that initiated a new charge is described in the bill's Description column, with the date and time of the change in the adjoining column.

The total hours that are shown on each line of the detailed bill are the hours going forward from the change that is shown in the Description column. The hours are calculated by subtracting the start time, which is shown in the Occurred column, from the end time of the changed state. The end time is either the start of another change or, if there is no change, the end of the billing period. A special case of the formula "end time minus start time" is the deletion of a LUN, which is considered an instantaneous state. The start and end time of a LUN deletion are the same, so that the total hours are zero and there is no charge for a deleted LUN.

Viewing storage device summary bills



The screenshot shows the 'Storage Device Report Viewer' application window. It has a menu bar with 'File' and 'Help'. Below the menu bar is a 'Billing Period' dropdown menu set to 'Current Billing Period'. The main content area contains two tables. The first table, titled 'Billing Period', has three columns: 'From', 'To', and 'Hours'. The second table, titled 'Storage Device Billing Summary', has four columns: 'Storage Device', 'Storage Device Serial Number', 'In Accounts', and 'Not in Accounts'. The data in the second table is as follows:

Storage Device	Storage Device Serial Number	In Accounts	Not in Accounts
HP XP256	45590	\$5.99	\$3.24
HP XP512	30859	\$1.20	\$1.65
HP FC60 Array(1)	1T02011107	\$0.27	\$0.22
HP FC60 Array(2)	1T10610116	\$0.52	\$0.00
HP VA7100 Array	00SG04690199	\$0.01	\$0.06

To launch the Bill Viewer and display a summary storage device bill, select *Tools* → *Storage Accountant* → *Storage Device Report Viewer*. Alternatively, click the icon next to View Storage Device Billing Reports on the Accountant Reports tab.

The storage device summary bill includes the following information:

- Billing period
- Storage device name
- Storage device Serial number
- For the specified billing period, the total charge for LUNs in accounts
- For the specified billing period, the total charge for LUNs not in accounts

Viewing detailed storage device bills

Billing Period								
From	To	Hours						
11/1/02 1:30 AM	11/14/02 11:01 PM	333.5292						

Storage Device Billing Summary			
Storage Device	Storage Device Serial Number	In Accounts	Not in Account
HP StorageWorks Virtual Array 7400	00SG127C0052	\$5,679.35	

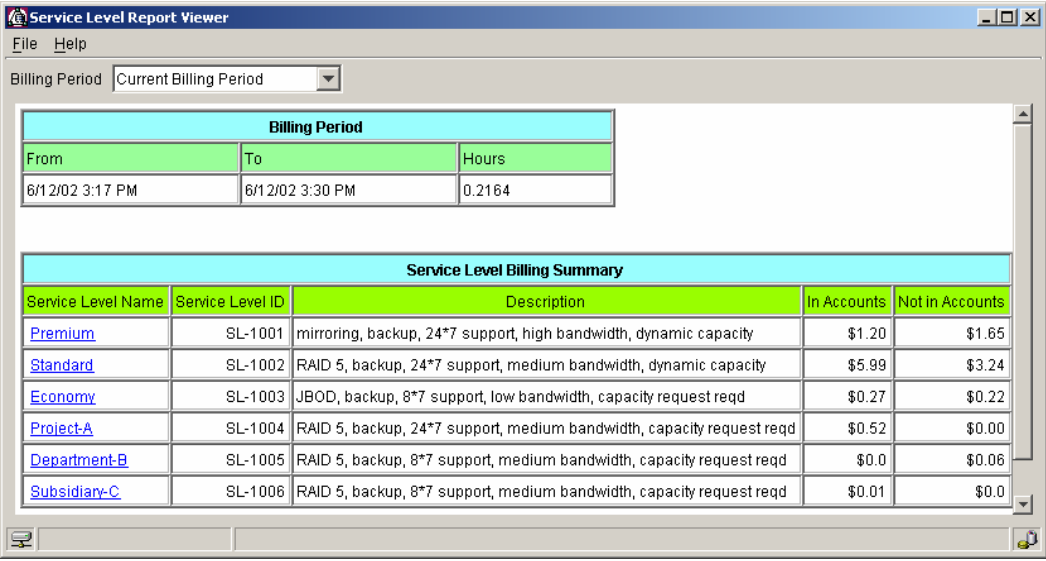
Activity of LUNs in an Account								
LUN	Organization	Account	Description	Occurred	Service Level	Size(GB)	Price(GB/Hr)	Hours
20	Energy Solutions	Alternative Energy Solutions	LUN Added to Account	11/1/02 11:58 AM	Premium Plus	1,000	\$1.259840	1.2597
20	Energy Solutions	Alternative Energy Solutions	Management server started (restarted)	11/1/02 1:13 PM	Premium Plus	1,000	\$1.259840	3.1769
20	Energy Solutions	Alternative Energy Solutions	LUN Status Changed	11/1/02 4:24 PM	Premium Plus	1,000	\$1.259840	0.9922
20	Energy Solutions	Alternative Energy Solutions	Management server started (restarted)	11/1/02 5:24 PM	Premium Plus	1,000	\$1.259840	91.8811
20	Energy Solutions	Alternative Energy Solutions	Service Level Price Changed	11/5/02 1:16 PM	Premium Plus	1,000	\$0.125984	45.3831
20	Energy Solutions	Alternative Energy Solutions	Management server started (restarted)	11/7/02 10:39 AM	Premium Plus	1,000	\$0.125984	124.1981
20	Energy Solutions	Alternative Energy Solutions	LUN Status Changed	11/12/02 2:51 PM	Premium Plus	1,000	\$0.125984	0.0519
20	Energy Solutions	Alternative Energy Solutions	Management server started (restarted)	11/12/02 2:54 PM	Premium Plus	1,000	\$0.125984	56.1142
							\$1.259840	1.3353
							\$1.259840	2.1775

- Launched from within the Summary Storage Device report or by selecting a specific device under the **Storage Devices** node in the Resources Tree and selecting the **Report Icon**
- Provides detailed LUN activity for the selected Storage Device

To launch the Bill Viewer and display a detailed bill for storage devices, select a specific device on the storage devices summary bill. Alternatively, select a specific device in the Resources tree and click the *Report* icon in the Accounting view panel.

When Storage Area Manager detects that a storage device is unreachable, Storage Accountant records the change for each LUN in the device. Lines in the detailed bill show the description "LUN Status Changed" and the time that the unreachable status was detected, and the total hours of the new state. A superscript "U" in the Occurred column indicates the status. Charges are calculated as usual, and the affected LUNs can be added or removed from accounts and service levels as usual. All such changes are reported with the superscript "U" in the Occurred column as long as the device is unreachable. When the device status becomes anything other than unreachable, new lines in the detailed bill state "LUN Status Changed" with no "U" in the Occurred column.

Viewing service level summary bills



The screenshot shows the 'Service Level Report Viewer' window. At the top, there is a menu bar with 'File' and 'Help'. Below it is a 'Billing Period' dropdown menu set to 'Current Billing Period'. The main content area contains two tables. The first table, titled 'Billing Period', shows the time range from 6/12/02 3:17 PM to 6/12/02 3:30 PM, totaling 0.2164 hours. The second table, titled 'Service Level Billing Summary', lists six service levels with their respective descriptions and billing amounts.

Billing Period				
From	To	Hours		
6/12/02 3:17 PM	6/12/02 3:30 PM	0.2164		

Service Level Billing Summary				
Service Level Name	Service Level ID	Description	In Accounts	Not in Accounts
Premium	SL-1001	mirroring, backup, 24*7 support, high bandwidth, dynamic capacity	\$1.20	\$1.65
Standard	SL-1002	RAID 5, backup, 24*7 support, medium bandwidth, dynamic capacity	\$5.99	\$3.24
Economy	SL-1003	JBOD, backup, 8*7 support, low bandwidth, capacity request reqd	\$0.27	\$0.22
Project-A	SL-1004	RAID 5, backup, 24*7 support, medium bandwidth, capacity request reqd	\$0.52	\$0.00
Department-B	SL-1005	RAID 5, backup, 8*7 support, medium bandwidth, capacity request reqd	\$0.0	\$0.06
Subsidiary-C	SL-1006	RAID 5, backup, 8*7 support, medium bandwidth, capacity request reqd	\$0.01	\$0.0

To launch the Bill Viewer and display a summary service level bill, select *Tools* → *Storage Accountant* → *Service Level Report Viewer*. Alternatively, click the icon next to View Service Level Billing Reports on the Accountant Reports tab.

Click a specific service level to launch a detailed service level report.

Viewing detailed service level bills

Service Level Report Viewer

File Help

Billing Period:

Billing Period		
From	To	Hours
9/10/02 11:09 AM	9/12/02 11:00 PM	59.8425

Service Level Billing Summary				
Service Level Name	Service Level ID	Description	In Accounts	Not in Accounts
Premium	SL-1001	mirroring, backup, 24*7 support, high bandwidth, dynamic capacity	\$288.96	\$397.32

Service Level: Premium (SL-1001)

Activity of LUNs in a Service Level and an Account									
Storage Device	LUN	Organization	Account	Description	Occurred	Size(GB)	Price(GB/Hr)	Hours	Charge
HP XP512	0:00	B&D Corporation	Marketing	Initial Configuration	9/10/02 5:12 PM	2.238	\$0.100000	53.7922	\$12.038694
HP XP512	0:01	B&D Corporation	Marketing	Initial Configuration	9/10/02 5:12 PM	2.238	\$0.100000	53.7922	\$12.038694

- Launched from within the Service level summary report or by selecting a specific Service Level under the **Service Levels** node in the Applications Tree and selecting the **Report Icon**

To launch the Bill Viewer and display a detailed bill for service levels, select a specific service level on the service level summary bill. Alternatively, select a specific service level in the Applications tree and click the *Report* icon in the Accounting view panel.

Viewing the audit log

Date	Event Type	Organization	Account
November 1, 2002 1:30:01 AM PST	Bill exported		
November 1, 2002 1:30:01 AM PST	Bill exported		
November 1, 2002 1:30:01 AM PST	Bill generation		
November 1, 2002 1:30:01 AM PST	Aging data files		
November 1, 2002 1:30:01 AM PST	Checking data files		
November 1, 2002 11:00:10 PM P...	Usage collection		
November 2, 2002 9:49:10 PM PST	Organization created	AOL: O-100003	
November 2, 2002 9:49:39 PM PST	Organization created	State Farm: O-100004	
November 2, 2002 9:50:07 PM PST	Organization created	Amazon: O-100005	
November 2, 2002 9:58:19 PM PST	Service level created		
November 2, 2002 9:58:43 PM PST	Service level created		
November 2, 2002 9:59:10 PM PST	Service level created		
November 2, 2002 9:59:58 PM PST	Service level modified		
November 2, 2002 10:01:04 PM P...	LUNs assigned to Service Level		
November 2, 2002 10:01:07 PM P...	LUNs assigned to Service Level		
November 2, 2002 10:01:09 PM P...	LUNs assigned to Service Level		
November 2, 2002 10:01:11 PM P...	LUNs assigned to Service Level		
November 2, 2002 10:01:12 PM P...	LUNs assigned to Service Level		
November 2, 2002 10:04:10 PM P...	Account created	AOL: O-100003	R&D: A-100002
November 2, 2002 11:00:10 PM P...	Usage collection		
November 3, 2002 7:58:02 AM PST	Organization closed		
November 3, 2002 8:16:08 AM PST	Account created	Amazon: O-100005	Marketing: A-100003
November 3, 2002 8:16:54 AM PST	LUNs assigned to Account	Amazon: O-100005	Marketing: A-100003
November 3, 2002 8:16:57 AM PST	LUNs assigned to Account	Amazon: O-100005	Marketing: A-100003
November 3, 2002 8:17:54 AM PST	LUNs assigned to Account	AOL: O-100003	R&D: A-100002
November 3, 2002 8:17:57 AM PST	LUNs assigned to Account	AOL: O-100003	R&D: A-100002
November 3, 2002 11:00:10 PM P...	Usage collection		

The Audit Log stores all accountant-related events. To view the Audit Log, select *Tools* → *Storage Accountant* → *Audit Log Viewer*. Alternatively, click the icon next to View Audit Log on the Accountant Reports tab.

Use the Audit Log to research billing transactions and system events that can explain changes in an organization's bill. The Audit Log can be viewed for all or for specific dates, events, organizations, accounts, and service levels. All information remains in the Audit Log for a default of 365 days. This value is user-customizable through the Accountant Scheduling Configuration window.

Note

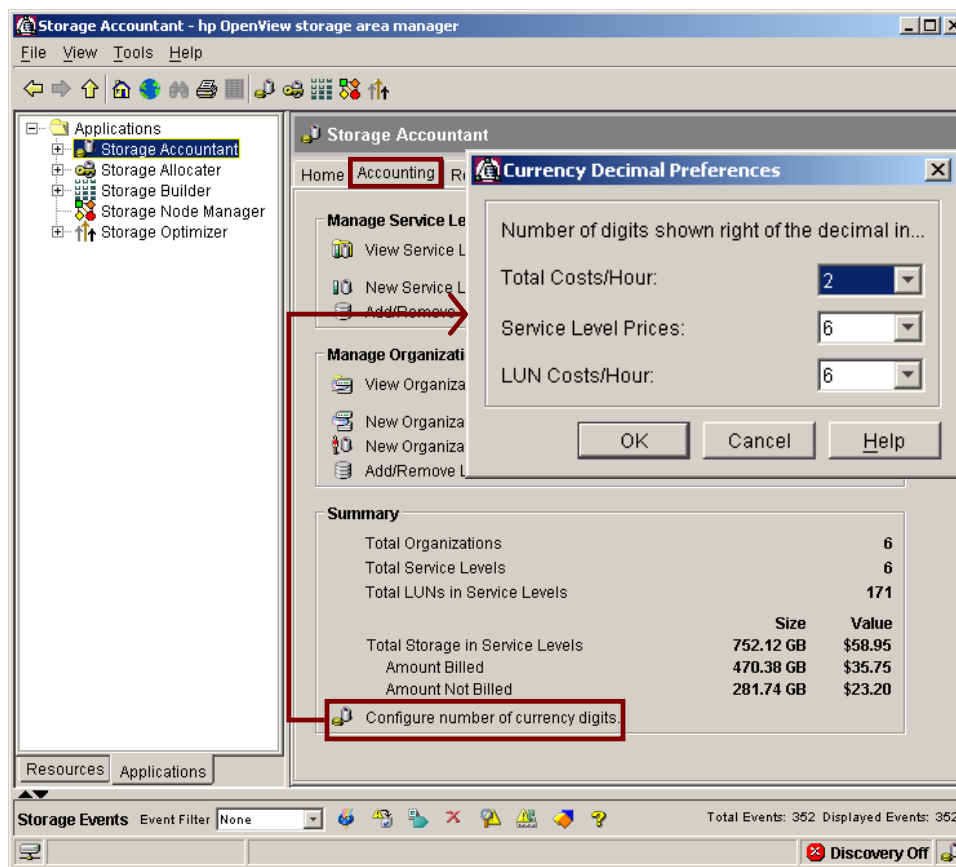
Audit Log entries can be set to post in the Event panel, and can be configured for automatic notification or other actions.

Configuring Storage Accountant

Storage Accountant configuration falls into several categories:

- Setting currency decimal preferences
- Scheduling bill generation
- Configuring Storage Accountant-related event triggers

Setting currency decimal preferences

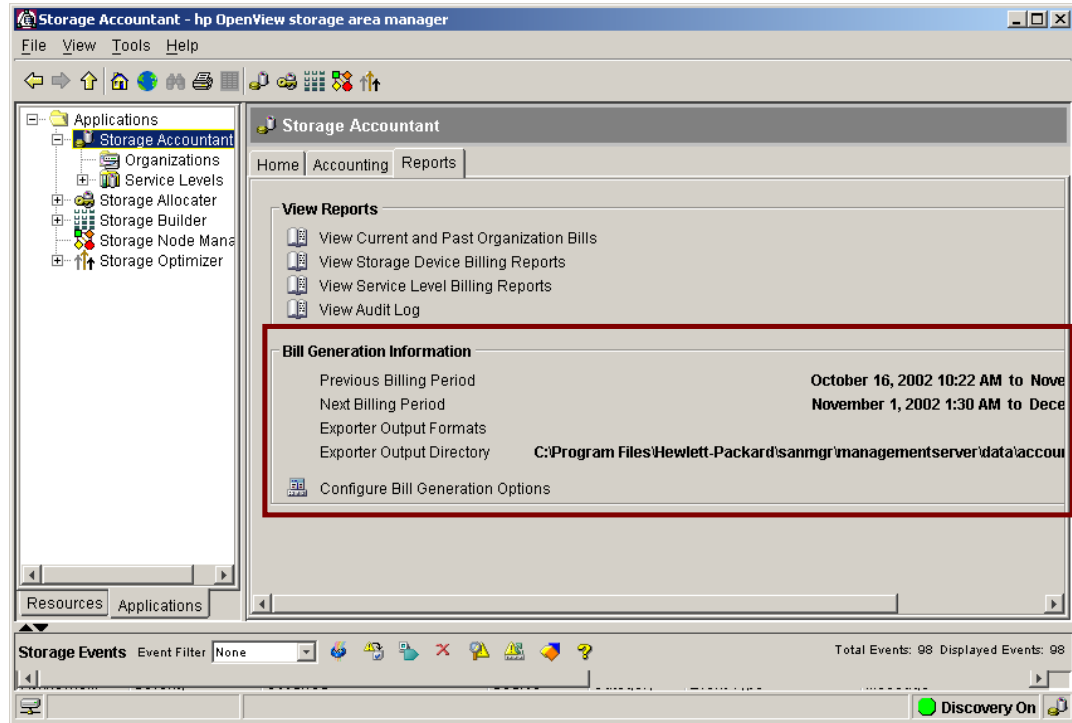


To specify the number of digits shown to the right of the decimal place in Storage Accountant, click the *Configure number of currency digits* icon from the Accounting view panel. In the Currency Decimal Preferences window, specify the number of digits to display for Total Cost/Hour, Service Level Prices, and LUN Cost/Hour.

The currency settings in this window apply only to the user interface, and do not affect billing calculations or the Bill Viewer

Use this procedure to change default settings for the number of digits shown to the right of the decimal place in the Accountant user interface. The display settings can be changed for cost per hour totals of billed and unbilled storage, service level price, and cost per hour of individual LUNs.

Viewing bill generation information

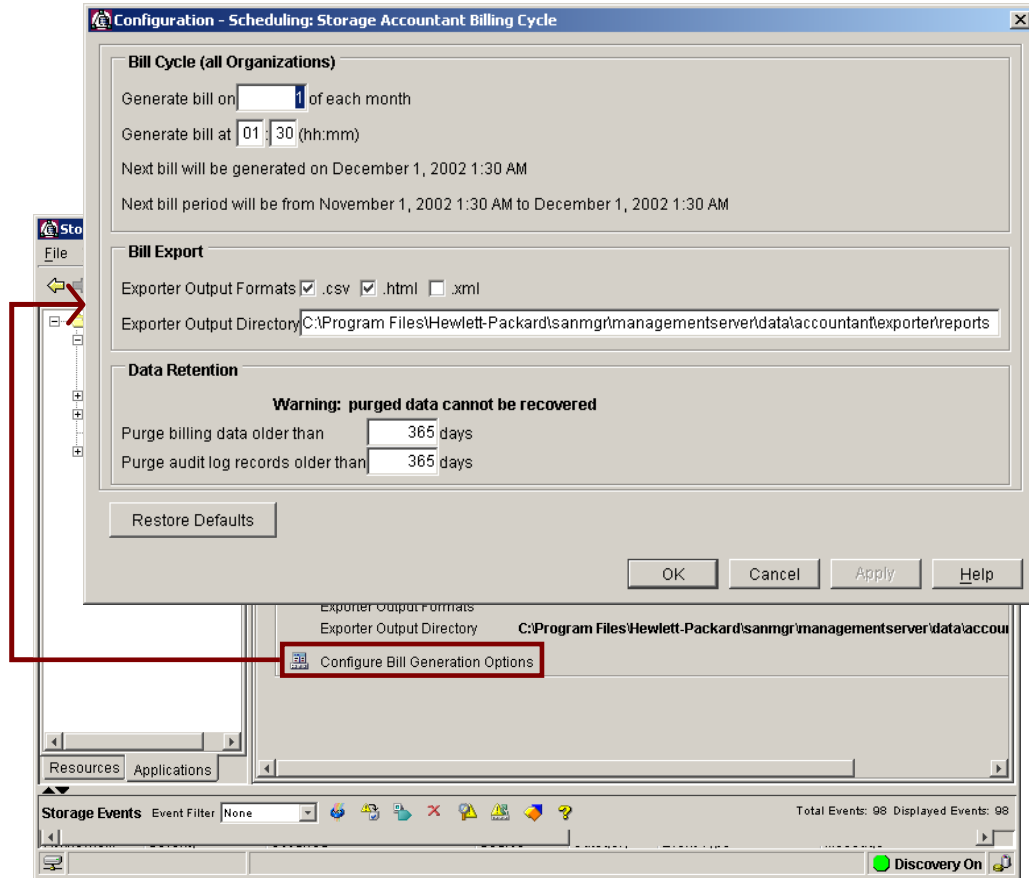


To view bill generation information, select *Storage Accountant* from the Applications tree and click the *Reports* tab.

The bill generation information provided includes:

- Previous billing period
- Current billing period
- Current settings for output

Scheduling bill generation



To configure bill generation for Storage Accountant, click the icon next to Configure Bill Generation Options on the Reports view panel.

Accountant scheduling consists of three steps:

1. Specifying the billing cycle
2. Specifying the export format and path
3. Specifying data retention period

Specifying the billing cycle

The Billing cycle is the same for all organizations. It starts at the day and hour entered here and ends a month later. For example, the bill cycle that starts on June 28 at 23:00 ends on July 28 at 22:59. Use these boxes to set the start of the billing period.

- **Generate bill on** — Specifies the day of the month that the bill will be generated. For example, 5. The number must be between 1 and 31. The default day is 1, the first day of the month.
- **Generate bill at** — Specifies the time (hh:mm) on the above day that the bill will be generated. For example, 22:30 (10:30 p.m.). The default time is 01:30 (1:30 a.m.).
- A display-only line displays the date and time that the next bill will be generated and the duration of the next billing period.

Specifying the export format and path

Bills are automatically exported in one or more of the formats that you select by marking the Exporter Output Formats check boxes. CSV and HTML are selected by default.

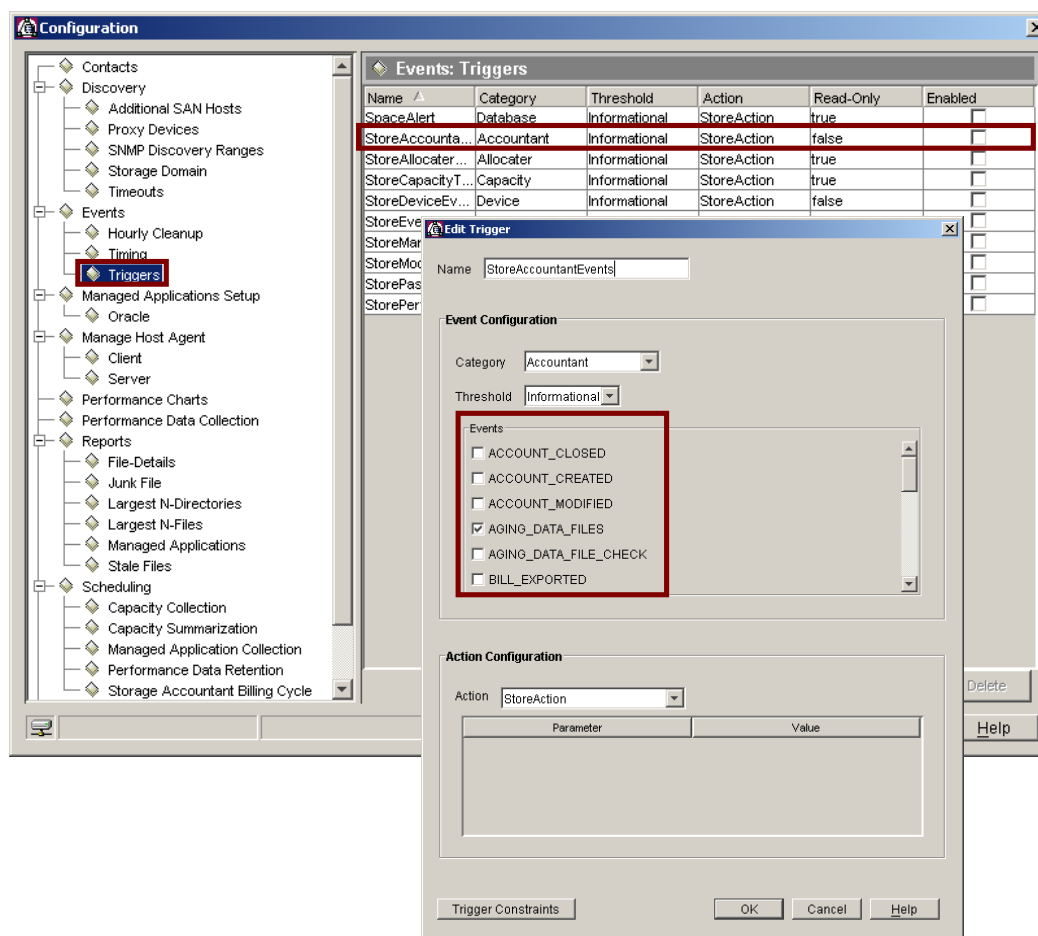
Exporter Output Root Directory specifies the name of the directory where export files will be stored. The default directory is <install directory>\managementserver\data\accountant\exporter\reports.

Specifying the data retention period

The data retention period determines how long bills and Audit Log entries will be retained.

- **Purge billing data older than** — Specifies the number of days that monthly bills will be kept. Monthly bills older than the specified number will be deleted and not viewable. The default age is 365 days.
- **Purge audit log records older than** — Specifies the maximum age of entries in the Audit Log. Entries older than the number of days specified are automatically deleted from the log. The default is 365 days.

Configuring Storage Accountant triggers



Event triggers enable actions to be assigned to specified events. The type of event and its associated action is based on criteria defined for each trigger.

By default, all Storage Accountant-related events are sent to the Audit Log, not the Event view panel. If appropriate, configure triggers to send certain event types to the Event view panel. Additionally, triggers might be useful within the context of Storage Accountant to send email notification if a specific event occurs, or can be used to run a command.

Learning check

1. What is the purpose of a service level?
.....
2. What are the five steps necessary for setting up Storage Accountant?
 - a. Create Service Levels
 - b. Create Organizations
 - c. Configure the Billing Period
 - d. Add LUNs to Service Levels
 - e. Create Accounts
 - f. Add LUNs to Accounts
 - g. Add LUNs to Accounts or Organizations
 - h. Assign Device Membership to Organizations
3. Storage Accountant can be used to assign LUNs to hosts.
☐ True
☐ False
4. Organizations can only be created through the Storage Accountant application.
☐ True
☐ False
5. List the Storage Accountant management server JCore components:
.....
6. Service Levels must be created before accounts are created.
☐ True
☐ False
7. A LUN can be a member of only one service level.
☐ True
☐ False
8. Storage Accountant's LUN assignment GUI ensures that organizations are only billed for LUNs that they are actually using?

- ☐ True
 - ☐ False
9. LUNs must be added to a Service Level before they can be associated with an Account?
- ☐ True
 - ☐ False
10. A manager has requested a report of under-utilized devices and the cost per day of unallocated space. How could you best provide this information?
-
11. LUNs that are not assigned to accounts are shown in the Detailed Service Level report.
- ☐ True
 - ☐ False
12. Billing data and audit log records are kept for how long?
- a. 1 month
 - b. 6 months
 - c. 1 year
13. Reports can be exported in which formats?
- a. TEXT
 - b. HTML
 - c. CSV
 - d. XML
14. Storage Accountant events are written to the Storage Area Manager event browser.
- ☐ True
 - ☐ False

Objectives

After completing this module, you should be able to

- List the Storage Allocator architectural components.
- Create security and organizational groups.
- Assign hosts and LUNs to groups.
- Describe the three methods for activating Storage Allocator and the appropriate customer environment for each.
- Describe the purpose of the Special Unassign command.
- Identify rogue host messages in the Event panel.

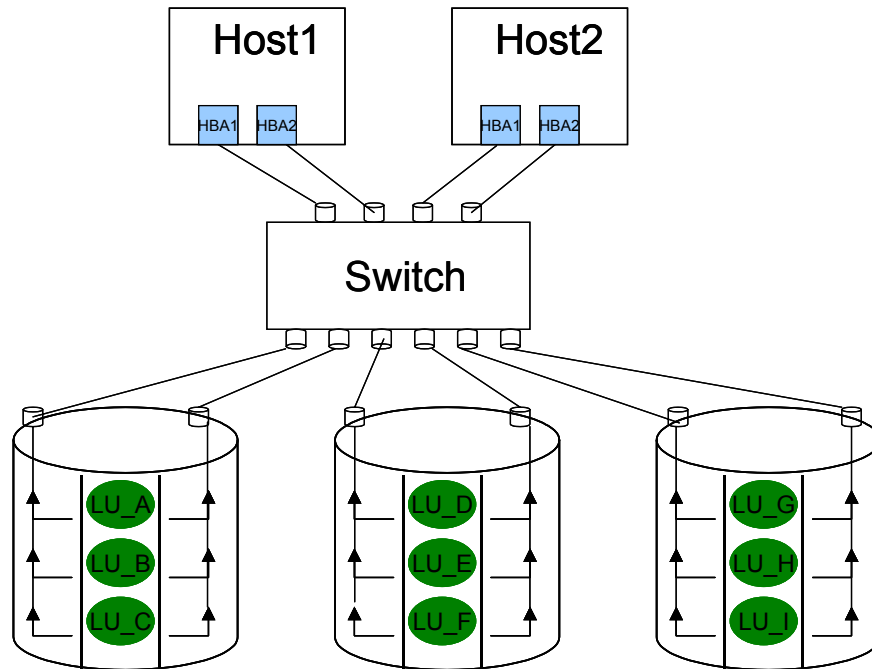
Product overview and features

Storage Allocator controls storage access and provides security by assigning logical units (LUNs) to specific hosts or share 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. You must activate and license Storage Allocator to use these features.

Storage Allocator brings the following features to Storage Area Manager:

- **Security groups** — Share groups and associated LUN groups help to streamline storage assignments. Share groups allow hosts to share the same storage devices. Associated LUN groups keep sets of LUNs (for example, stripe sets or mirror sets) together, requiring them to be assigned and unassigned as a unit.
- **Organizational groups** — Host groups and LUN groups allow you to arrange hosts and LUNs into hierarchical groups in the Storage Area Manager user interface.
- **Reports** — Storage Allocator can generate reports that show all LUNs, assigned LUNs, or unassigned LUNs. These reports allow you to quickly view the assignment status of all the LUNs in the current storage domain.
- **System availability** — Storage Allocator provides increased system availability by enabling storage to be assigned, unassigned, and reassigned without reboots.

LUN security methods



There are generally three types of LUN security methods currently available:

- Host-based
- Interconnect-enhanced
- Storage-based

Each of these methods provides LUN security in different ways with somewhat different capabilities. All these methods are secure from breaches of LUN security if they are employed in a compatible environment and managed in accordance with the operational and functional features of each method. These methods differ mainly in the type, scope, convenience, and flexibility of LUN security provided.

Host-based security

Host-based security is usually enabled through software, such as OpenView Storage Allocator, and relies on host-based (server) agents, such as volume managers and LUN control software, to implement LUN security management. For Storage Allocator, server-based host agents act as filters to effectively isolate the storage (LUNs) from the server's operating system. This permits Storage Allocator to provide centralized, secure, and "Always On" LUN management and assignment from a centralized pool of storage.

Host-based security is generally considered the most flexible, scalable, heterogeneous, and universal form of LUN security, because it is not dependent on, or scoped by, hardware. Also, these applications are generally transport-independent as well.

Host-based security is a fairly fault-tolerant form of LUN security because failure of the central management station server only temporarily suspends LUN assignment changes, and does not suspend LUN security or access. Existing LUN access assignment and security still continue to function in an "Always On" manner based on the decentralized host agents.

Interconnect-enhanced security

Interconnect-enhanced security is based on limiting access to portions of the interconnect infrastructure; thus defining LUN access through path control. Interconnect devices do not currently have software functionality that permits active LUN security management, and, in fact, interconnect devices cannot currently distinguish LUNs. If interconnect device LUN security software becomes available, the initial functionality will probably be similar to storage-based security although more dynamic and flexible host-based security might be implemented if the interconnect device is developed to function as a management server, as well as an interconnect device.

Today, interconnect devices enhance LUN Security by providing three basic methods of path control:

- **Individual Port Control** — Enable, Disable, and HBA or Storage Binding by port
- **Hard Zoning** — Zones a collection of ports
- **Soft Zoning** — Zones by World Wide Name (WWN) independent of ports

Any of these three path control methods can be used to enhance, but not replace, the LUN security provided by host-based or storage-based LUN security.

Soft zoning is usually the preferred security enhancement for host-based security, because the zoning can be confined to specific World Wide Names identifying servers with host agents. In other words, soft zoning configures the fabric interconnect to recognize, and communicate with, only devices whose World Wide Names are included, or listed, in the soft zone. As a result, this form of zoning is not vulnerable to unplanned physical connections, since unlisted devices plugged into the fabric interconnect will not be recognized. soft zoning, once set up, requires less attention from administrators and is virtually invulnerable to accidental interconnect problems, such as the addition of unmanaged servers or storage. Soft zoning is highly recommended as an enhancement to Storage Allocator-managed, host-based LUN security. The reason for this recommendation is that Soft zoning positively prevents the accidental attachment to a Storage Allocator managed SAN of an NT/Windows-based server with no Storage Allocator host agents deployed. Although Storage Allocator provides positive LUN security in a configuration-managed SAN, soft zoning protects against an accidental breakdown in SAN configuration management.

Storage-based security

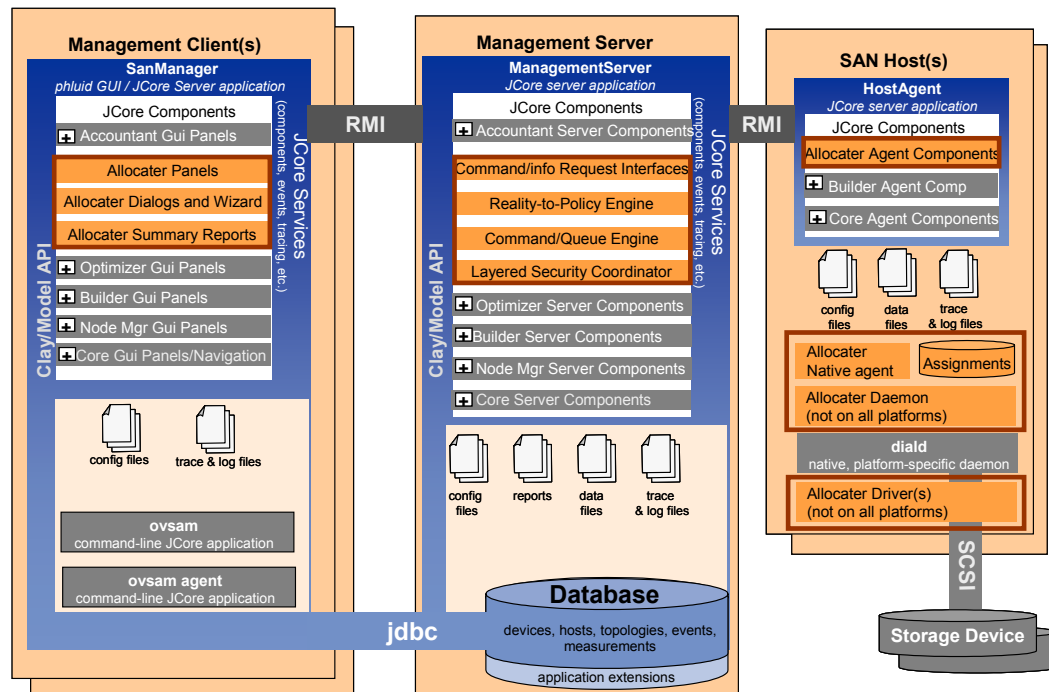
Storage-based security provides LUN Security from a storage device perspective. This method provides LUN security for common storage devices, usually by storage port or WWN. Storage device access control is usually based on Access Control Lists (ACLs) configured by an administrator against storage ports, storage controllers, or LUNs published by the storage device. The scope of the LUN security management is limited to the storage device, itself, and the servers the storage device can communicate with through port connections and the interconnect infrastructure. This method requires administration at the storage level, is limited in scope to common storage devices, and is hardware-dependent. However, it provides a highly secure method for LUN Security.

When to use Storage Allocator

Storage Allocator is a good fit for environments where:

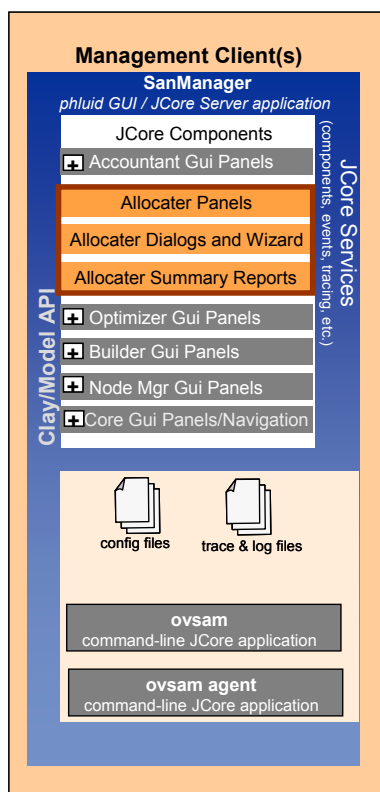
- There are an extremely large number of devices and/or hosts as this implies a large number of assignments.
 - Storage Allocator adds the value of a single network view (as opposed to manually configuring thousands of LUNs across hundreds of servers).
- Access control is required for storage devices that do not provide masking (for example, JBOD, and/or tape).
- The customer wants protection from un-assignment of storage in use, to remove storage without reboots, and to automatically mount file systems on Windows.

Storage Allocator architecture



The above diagram shows the Storage Allocator components that reside on the management client, management server, and SAN host. As with other Storage Area Manager applications, Storage Allocator delivers its functionality in a set of Jcore components.

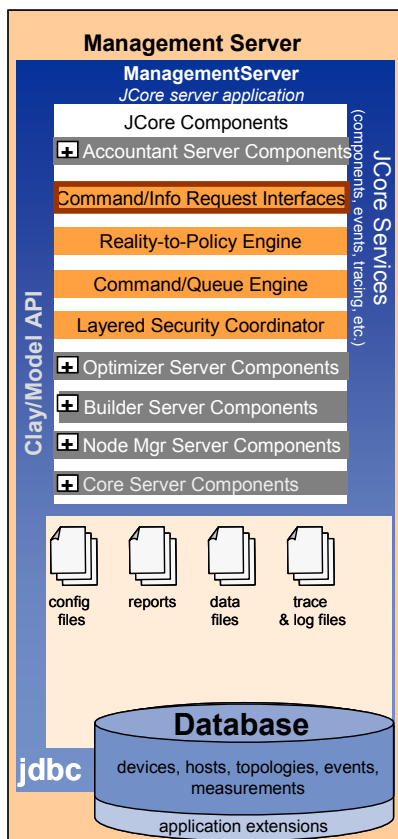
Storage Allocator client components



Three Storage Allocator components reside on the management client:

- **Storage Allocator panels and configuration dialog** — Extends the tree to include Storage Allocator-specific navigation, and adds LUN Allocation view panels
- **Storage Allocator dialogs and wizard** — Allows Storage Allocator activation using the look-and-feel of other deployment dialogs, and adds Storage Allocator Edit dialog; Activation wizard allows retention of storage access while activating
- **Allocator summary reports** — Enables creation of Storage Allocator reports.

Storage Allocator management server components



The following Storage Allocator components reside on the management server:

- Command/Information Request Interfaces
- Reality-to-Policy Engine
- Command Engine
- Layered Security Coordinator

Command/Information Request Interfaces

The Command Request (CR) and Information Request (IR) interfaces are the main programmatic interfaces into the Storage Allocator management server component. The Storage Allocator client GUI uses these interfaces to present information to, and handle requests from, the user.

All of Allocator's assignment, grouping, and object creation or deletion operations are available through the CR interface.

The IR interface provides lists of Allocator objects, which may be filtered and sorted by user-defined filters. One purpose of the IR interface is to place the performance strain of sorting and filtering on the management server.

Reality-to-Policy Engine

The Reality-to-Policy (R2P) engine monitors the difference between reality (access control currently active in the storage network) and policy (access control the administrator has defined for the storage network). If it finds differences, the R2P engine attempts to make reality match policy. If reality cannot be made to match policy, R2P updates the policy to ensure that future assignment changes account for the active access control configuration. A secondary goal of R2P is to monitor the activation state and health of Storage Allocator's storage consumer filters. If R2P finds a problem, it notifies the administrator through the event panel. (Users can assign triggers to the event, if needed).

R2P was implemented to help ensure that the access control policy that the administrator desires is actually in place. If the storage network is operating properly, the R2P engine is not actively needed because there will not be conflicts between reality and policy. When an unforeseen event causes reality to differ from policy, the R2P engine corrects it.

Command Engine

This block of logic processes all commands from the Command Request Interface and the Reality-to-Policy Engine in a synchronized fashion. This allows multiple Storage Allocator GUI/CLUI client requests and internal requests to be processed with all interdependencies between the requests understood and managed appropriately.

For example, if one administrator assigns an unassigned logical unit to host A, but a different administrator tries to assign the same logical unit to host B shortly afterwards (it takes a short time for client GUIs to update), the second request to assign the logical unit is rejected. If the current state of the logical unit does not match its state when the assignment request was made, the Command Engine rejects the request in order to ensure consistent and correct assignments.

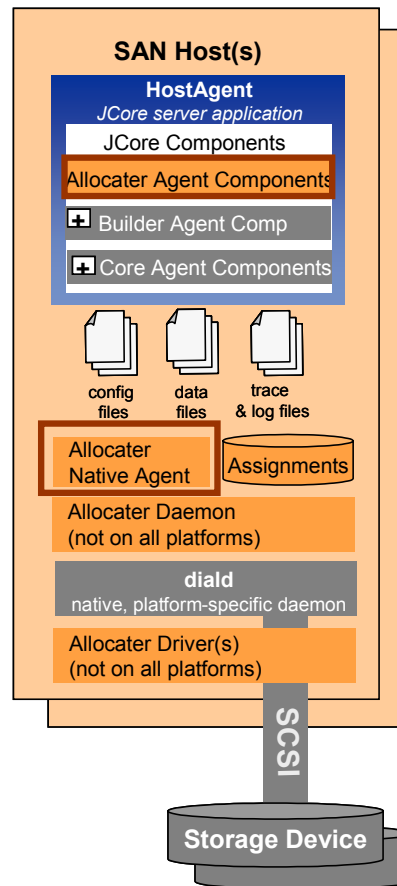
The Command Engine also separates requests into basic assign and unassign operations, and packages the requests into batches that are handed to the Layered Security Coordinator (LSC) for processing.

Layered Security Coordinator

The LSC processes batches of assignment and unassignment requests that it receives from the Command Engine (a batch usually contains all interdependent requests). The LSC tries to carry out the requests it receives, and if errors occur, will undo the changes in a sensible way (depending on the batch request semantics).

The term *layered* refers to the plug-in design of the LSC that allows it to manage not only host-based access control, but also other access control methods. Currently, the LSC only supports Storage Allocator's host-based access control.

Storage Allocator SAN host components



The following Storage Allocator components reside on the SAN host:

- Storage Allocator Host Agent
- Local Assignment Database
- Access Control Components

Storage Allocator Host Agent

The Storage Allocator Host Agent is comprised of two parts: A JCore component that runs as part of the normal Storage Area Manager Host Agent, and a native compiled library (one for each supported operating system) that provides a bridge between the JCore component and operating system specific software. The main purpose of the common Host Agent is to listen for requests from the management server and convey those requests to the native Storage Allocator components.

Local Assignment Database

SAN hosts running Storage Allocator can run autonomously (without communication from the management server) once their LUN assignments are configured. This method of operation is achieved by storing each host's assignments in a local assignment database. The location and form of the local assignment database varies depending on the operating system, but it is always stored in a secure location with root access-only permissions. For example, on Windows systems the assignment database is stored in the registry with SYSTEM account permissions.

The local assignment database is used when a host configures logical unit access early in the boot process, without the need to contact the management server. Storage Allocator manages the contents of the local boot database, and administrators cannot manage these contents directly. The Reality-to-Policy Engine monitors the contents of the local assignment database to ensure that it is consistent with the configured access control policy.

Access control components

Access control is provided by specialized software components that run as drivers in the kernel of the operating system, or as a daemon. These components provide logical unit access control by using assignment information that is obtained from the local assignment database, or received from the management server. This information is used to filter operating system I/O paths and to manipulate storage-related operating system data structures. The process used to accomplish this varies depending on the operating system.

Windows NT hosts

SCSI Filter Driver (trfilter.sys)

- Sits in the I/O path and blocks unauthorized SCSI requests

Disk Class Filter Driver (trdisk.sys)

- Replaces the standard Windows disk class driver for SAN attached storage
- Allows for dynamic assignment and unassignment
- Windows NT does not provide this capability as part of the standard disk driver
- Support for common multiple-path drivers used with multi-ported storage arrays

Windows 2000 hosts

Assignment filter driver (Trlm.sys)

- Blocks any I/O targeted at LUNs that are not assigned to the host
- Specialized functions:
 - Dynamically hiding and exposing LUN devices when they are enabled or disabled
 - Support for common multiple-path drivers used with multi-ported storage arrays
- Other Windows 2000-specific components loaded with the Host Agent:
 - Portion of the native library helps driver unmount file systems and remove device nodes associated with LUNs that are to be unassigned.
 - Dynamically loaded library (TrlmCheck.dll) monitors registry entries critical to the proper operation of the filter driver

Linux hosts

Linux Loadable Kernel Driver Module (trfilter.o)

- Sits between different class drivers (disk, generic, and tape) and the SCSI mid-level driver, and filters all logical units seen by the class drivers
- Also provides additional features that are not part of the standard Linux operating system:
 - Dynamic rescan capability
 - Dynamic detection of devices on plug-in
 - Device file persistence across reboots
 - Multiple path detection

Solaris hosts

Configuration File and Boot Database (sd_fcst.conf)

- Ability to control which class driver Allocator uses to control different classes of devices (tapes, controllers, media changers, and so forth)

Single Filter Driver (sd_fcst)

- SAN-attached HBAs are configured to use this driver, instead of the standard Solaris disk class driver
- Special features (relative to Solaris scsi disk class driver):
 - Dynamic assignments and unassignments of LUNs
 - Dynamic discovery of newly attached storage, without modifying driver configuration files
 - Fibre channel friendly error recovery

HP-UX hosts

Access Control Daemon (TRAllocator_d)

- Non-kernel invasive approach to filtering
- Kernel components allowed to discover all devices, but daemon hides unassigned LUNs from the user after discovery has been run
- Allows the assignment of LUNs without running 'ioscan'

Ioscan Replacement

- Original ioscan is preserved on the system
- Allocator-aware ioscan calls into original ioscan, and then notifies daemon that scan has taken place, so that the daemon may perform filtering
- Ioscan does not return until filtering has taken place

AIX hosts

Access Control Daemon (TRAllocator_d)

- Non-kernel invasive approach to filtering
- Kernel components allowed to discover all devices, but daemon hides unassigned LUNs from the user after discovery has been run
- Allows the assignment of LUNs without running 'cfgmgr'

cfgmgr Replacement

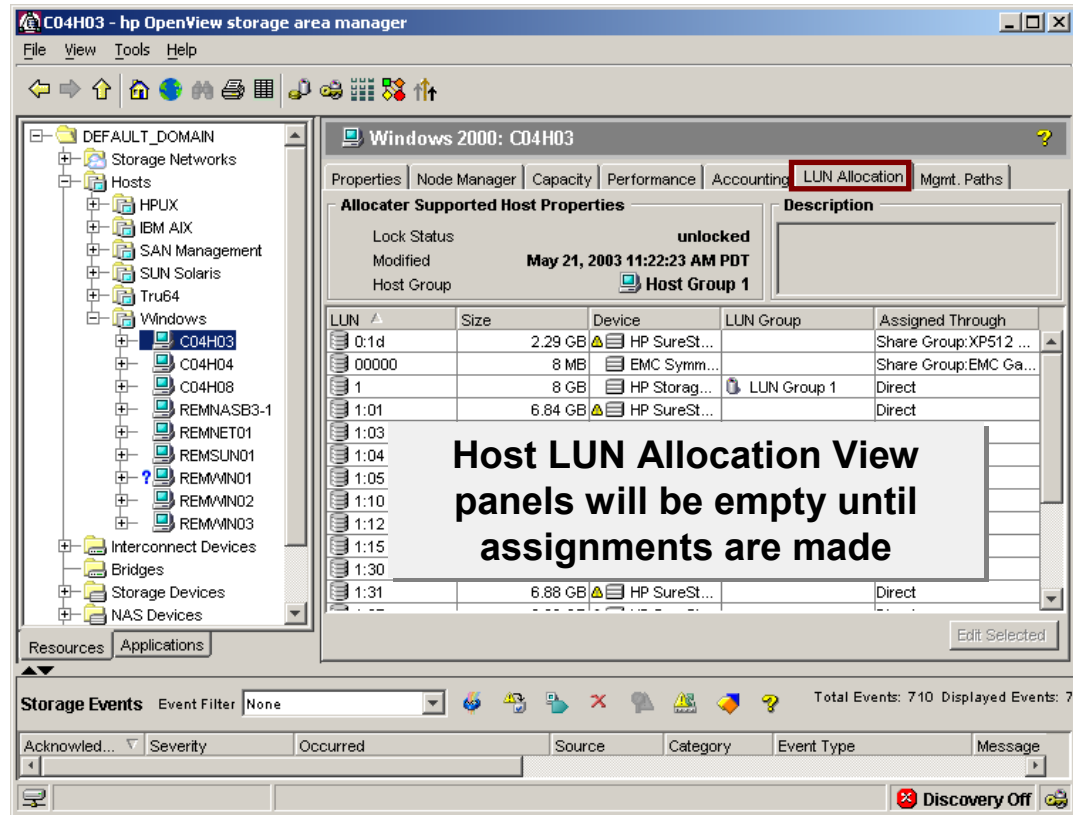
- Original cfgmgr preserved on the system
- Allocator-aware cfgmgr calls into original cfgmgr, and then notifies daemon that scan has taken place, so that the daemon may perform filtering
- Cfgmgr does not return until filtering has taken place

Managing storage assignments and groups

Storage Allocator controls storage access and provides security by assigning LUNs to specific hosts or groups.

This section covers the types of groups that can be created, the rules that are associated with them, and how to make assignments and unassignments.

Getting started—Host LUN Allocation View panel



The Host LUN Allocation view panel provides a list of all LUNs to which a selected host has access. For a host to access LUNs, they must first be assigned to that host.

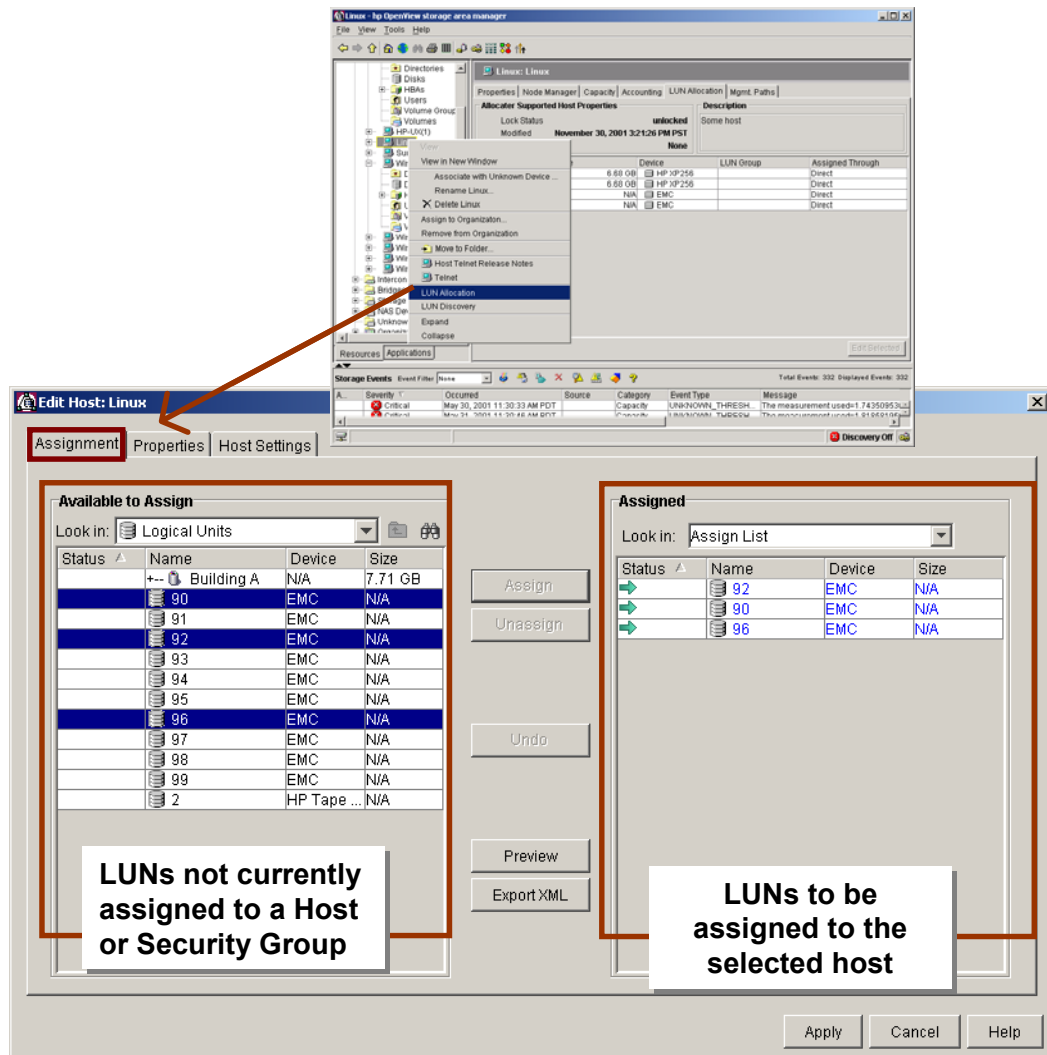
To view all the LUNs that are assigned to a specific host, select that host and click the *LUN Allocation* tab.

The procedure displays a list of the host's assigned LUNs, their properties, LUN group, and whether they are exclusively assigned, or assigned through a shared assignment.

Note

When Allocator is first activated, no LUNs are available to any hosts and the view panel is empty.

Assigning LUNs to a host



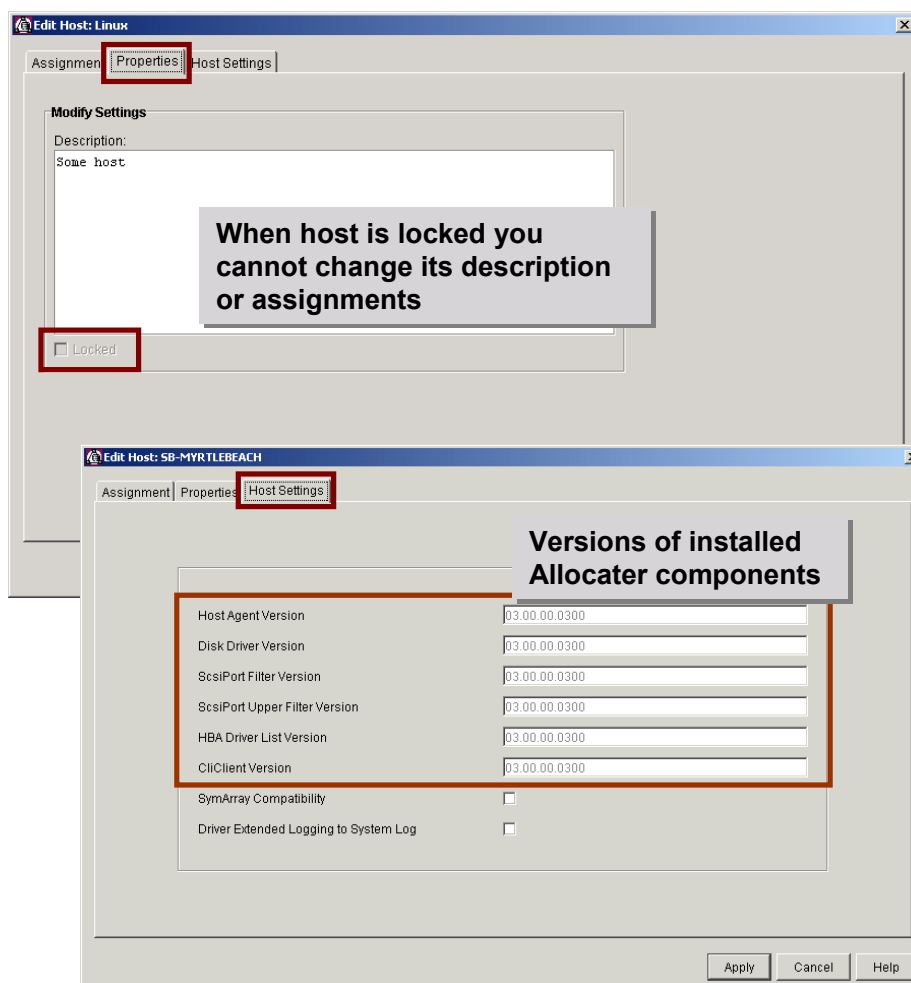
To assign LUNs to a host, right-click the host in the Resources tree and select *LUN Allocation*. The procedure displays the Edit window, which has tree tabs: Assignment, Properties, Host Settings.

Storage and group assignments are made by moving logical units and groups between the Available to Assign and Assigned sections in the Edit window's Assignment tab. All assignment changes are pending until you click the *Apply* button.

The following features are available from the Edit window Assignment tab:

- **Look in box** — Lists the items that are assigned or available to assign.
- **Up Folder button** — Causes the table to show the contents of the parent of a Group. The parent will now be displayed in the table. Organizational groups can be nested within other Groups.
- **Find button** — Searches for available LUNs, LUN groups, associated LUN groups, or hosts. Depending on what is selected in the Look in box when you click *Find*, Storage Area Manager prompts you for the search criteria. When editing hosts and share groups, the Find tool searches for items that are visible to the selected host or share group. To view all items, check the *Show All* check box.
- **Undo button** — Undoes pending assignment changes prior to clicking *Apply*.
- **Preview Button** — Launches a dialog that displays a list of items that are pending configuration from the current session.
- **Export XML button** — Exports all pending assignment changes to an XML file. The exported file can be used to configure assignment changes remotely with the command line user interface (CLUI).
- **Apply button** — Applies assignment changes.

Viewing host properties and host settings



To set the properties for a group or host, select the Edit window *Properties* tab. Editable properties for groups include: name, description, and lock state. Editable properties for hosts include name and lock state. Rename hosts using the Rename object features.

Note

When a group is locked, you cannot change its name, description, or assignments; when a host is locked, you cannot change its description or assignments.

To specify settings for a host, select the Edit window *Host Settings* tab. The content of this tab varies depending on the operating system of the host selected.

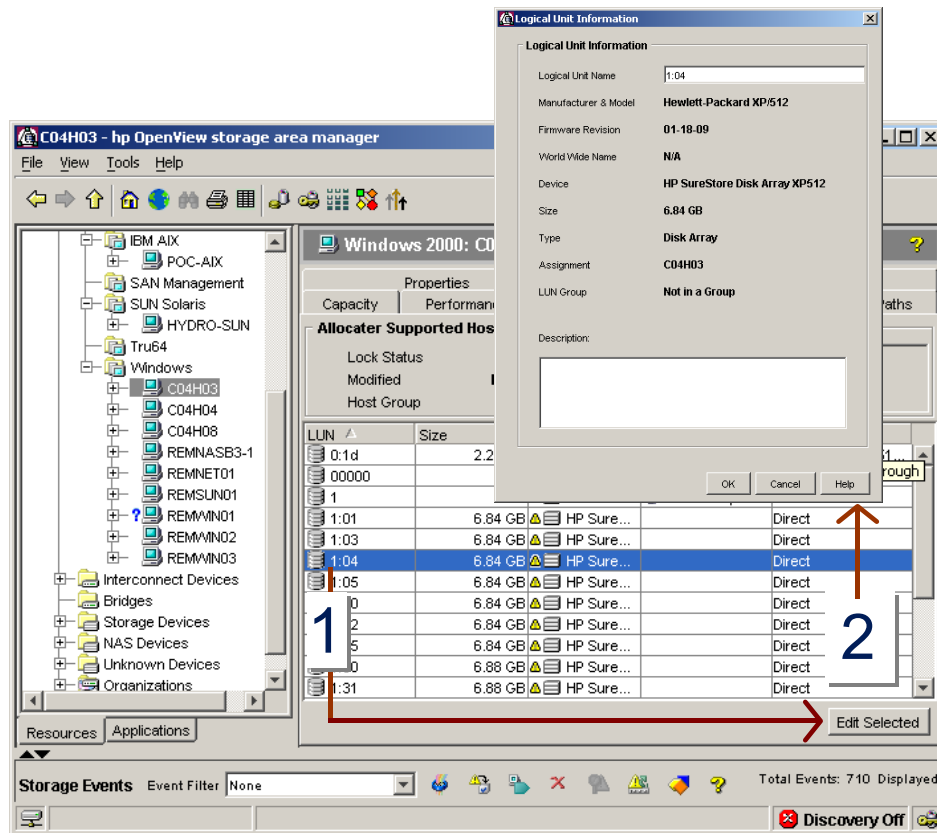
For all platforms, the versions of the installed Storage Allocator components are displayed.

On Windows NT hosts only, users can edit the Windows NT Registry through the Host Settings tab. The registry settings available through this tab affect Storage Allocator's logging features and Allocator's performance when used with certain third-party hardware and software.

**Important**

See the *hp OpenView storage area manager administrator's guide* for recommended registry settings.

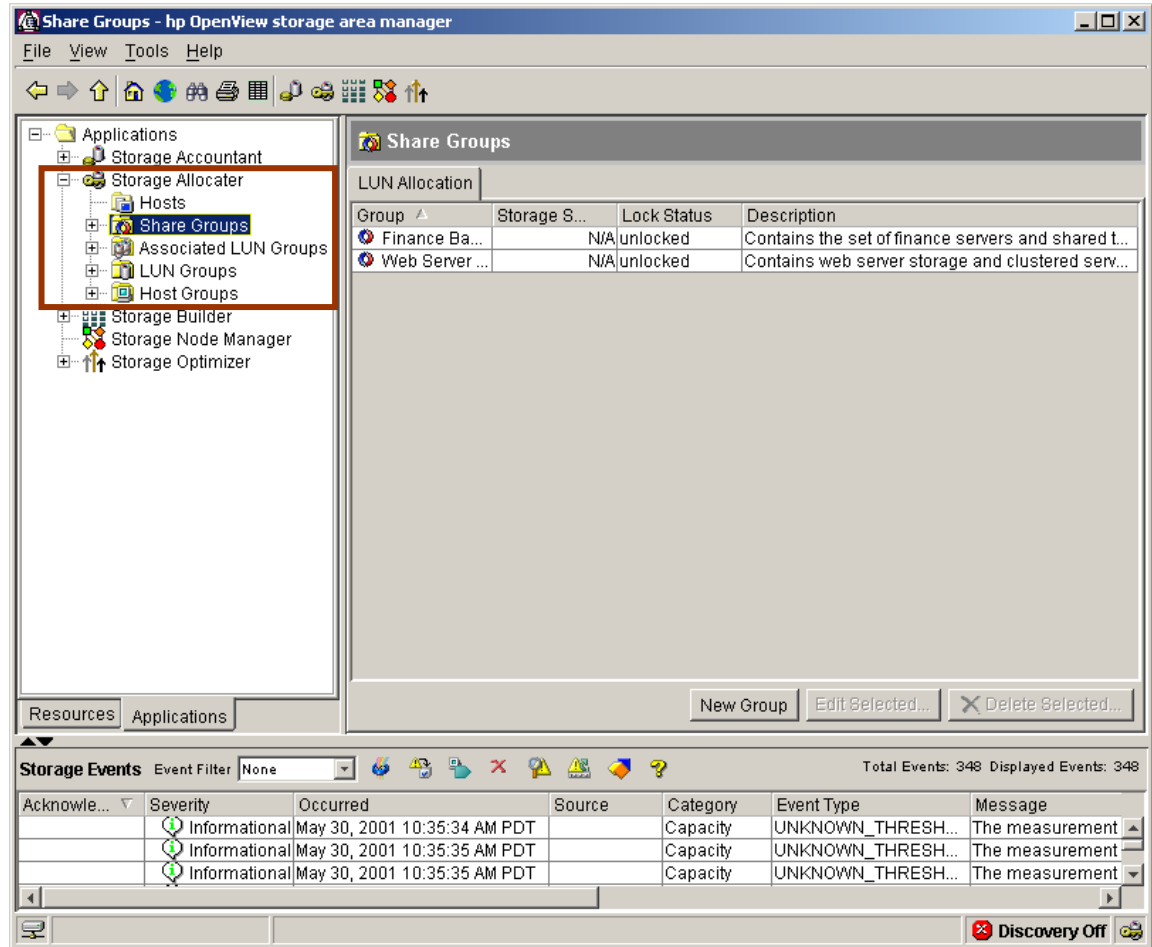
Viewing LUN information



Once LUNs are assigned to a host, you can view detailed information about them. To view LUN information, select the LUN in the LUN Allocation view panel and click the *Edit Selected* button. The Logical Unit Information window displays the following items:

- **Logical Unit Name:** The LUN's name. This name is initially generated by Storage Area Manager, and can be changed in this window.
- The **Manufacturer** and **Model** of the storage device that contains this LUN.
- **Firmware Revision:** The version of the firmware on the listed LUN.
- The node **World Wide Name** of the storage device.
- **Device:** The name of the storage device that contains this LUN.
- **Size:** The capacity of the listed LUN.
- **Type:** The type of storage device that contains the LUN.
- **Assignment:** The host, associated LUN group, or share group to which the LUN is assigned.
- **LUN Group:** The LUN group that contains the LUN.
- **Description:** A description of the LUN.

Storage Allocator groups



After activating Storage Allocator, you can create security and organizational groups. These groups are optional, but they help you to streamline storage assignments and organize information within the Storage Area Manager's user interface.

Share groups and associated LUN groups are called *security groups* because their manipulation affects storage access.

Host groups and LUN groups are called *organizational groups* because they are used to organize information in the Storage Area Manager user interface.

Host group rules

- Can contain hosts or other host groups
- A host can be a member of only one host group

LUN group rules

- Can contain logical units and other LUN groups
- A logical unit can be a member of only one LUN group
- To assign logical units that are part of a LUN group, you must select and assign the individual logical units from within the Group. If you want to assign and unassign several LUNs as a unit, use the associated LUN groups feature

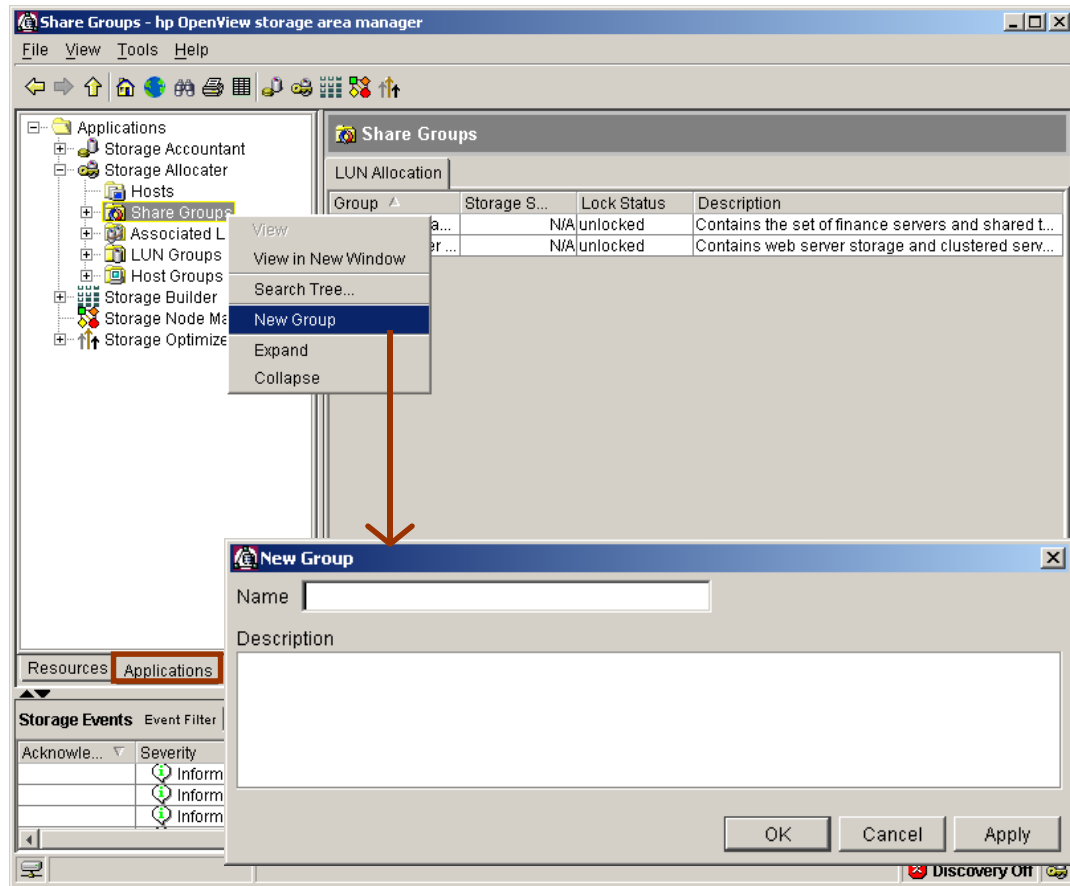
Share group rules

- A host can be in one or more share groups
- Logical units and associated LUN groups can only be assigned to one share group
- Logical units and associated LUN groups can be assigned directly to hosts that are members of one or more share groups.
- Share group hosts have exclusive access to any storage that is assigned to them directly
- When editing share groups, you cannot apply a configuration request that includes host and logical units or associated LUN groups. You must assign and unassign hosts and storage separately.

Associated LUN group rules

- Can contain logical units
- Assignment and unassignment changes can be applied with a single request
- If a requested assignment or unassignment is not successful for all of the group members, the operation fails for the entire group.
- When you assign or unassign storage from an associated LUN group that is assigned to a host or share group, the storage is automatically assigned or unassigned from the host or share group hosts

Creating groups



To create either a security or an organization group, access the Applications tree. Next, right-click the desired group type and select *New Group* from the short-cut menu. Enter the group properties, including the group name and a description.

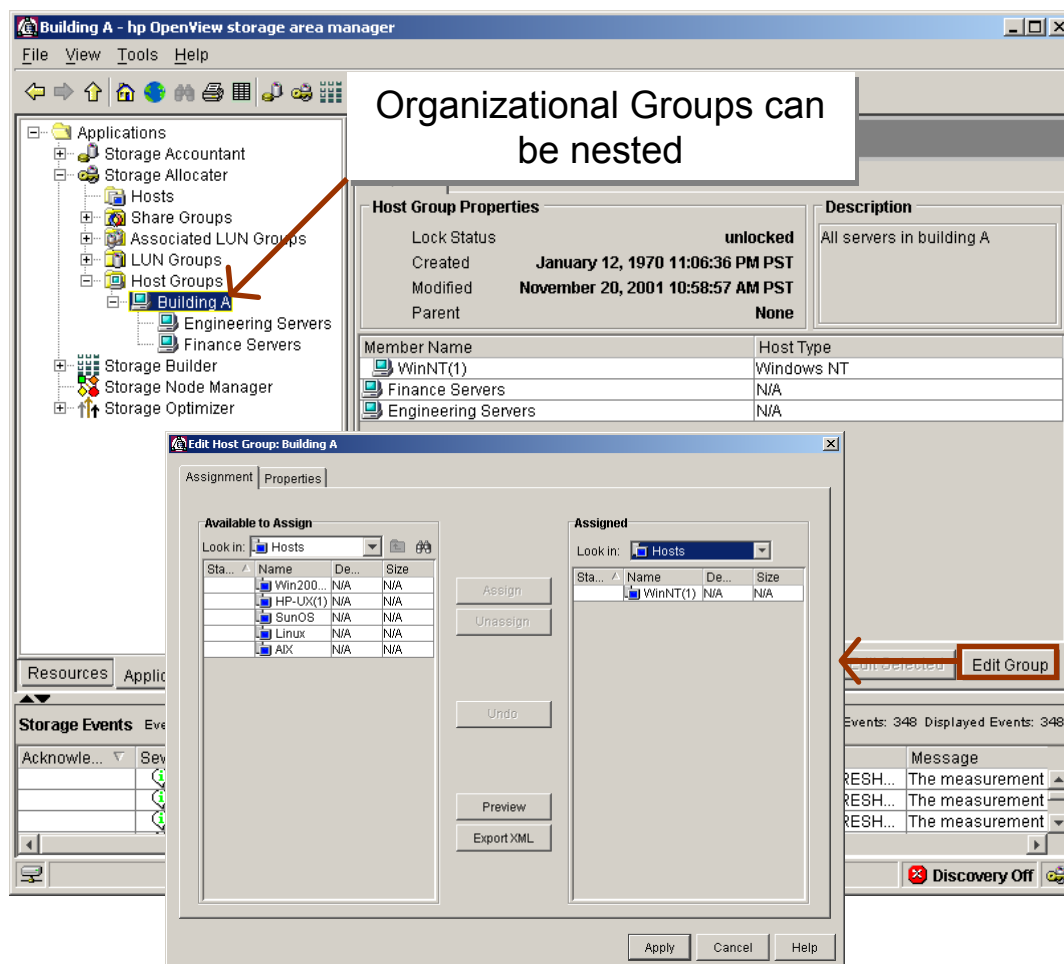
Types of assignment/unassignment

There are three types of assignments in Storage Allocator:

- When you assign items to host groups and LUN groups, the items become part of an organizational structure that is displayed in the Storage Area Manager user interface.
- When you assign storage to a host or share group, the individual or grouped hosts are granted read-write access to the assigned storage.
- When LUNs are grouped into an associated LUN group, they are bound together and must be assigned and unassigned as a unit.

In general, unassignments work the same way as assignments. When you unassign items from an organizational structure, they are removed from that structure. When you unassign storage from a host or share group, the storage is no longer available to the affected host(s).

Working with organizational groups

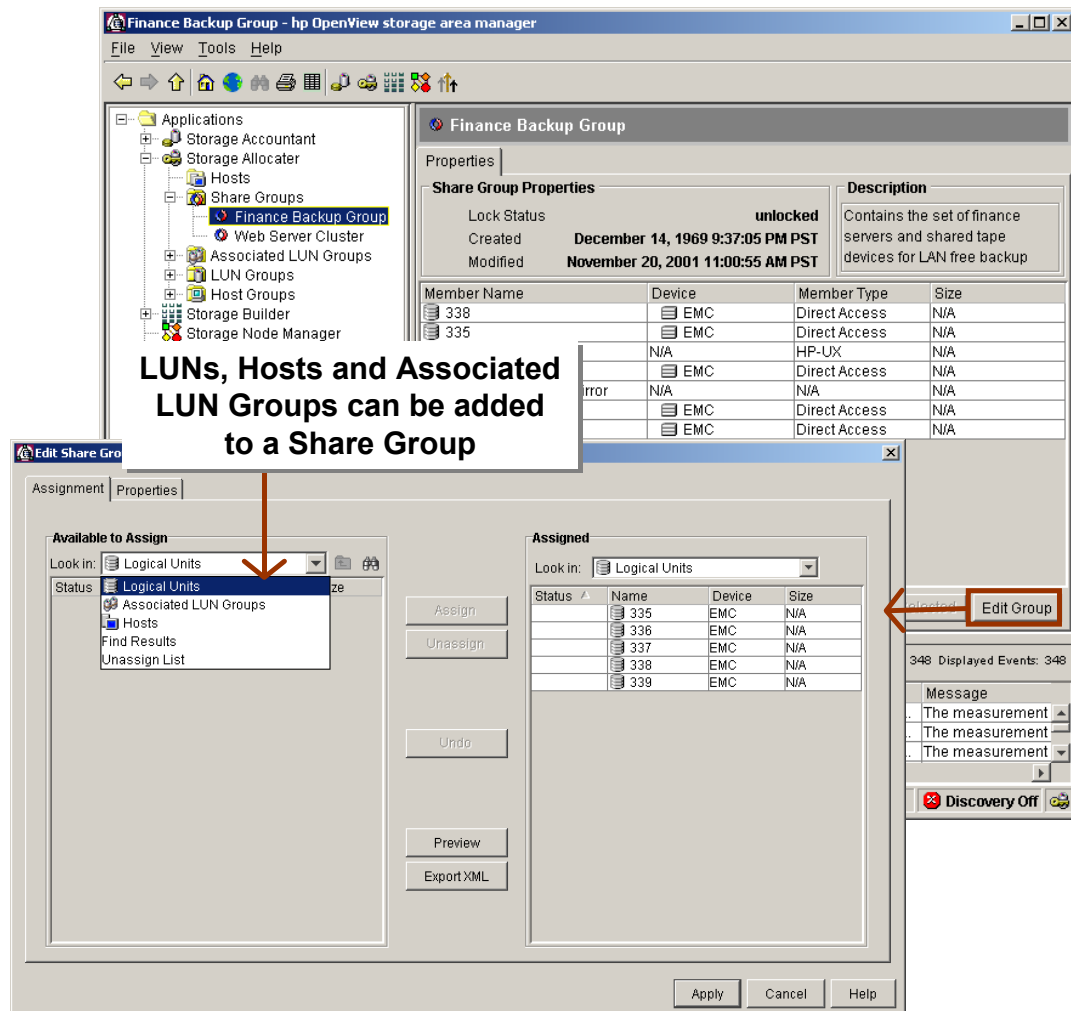


Organizational groups provide a way to logically organize hosts and LUNs. When you assign items to host groups and LUN groups, the items become part of an organizational structure. They do not affect storage access.

Organizational groups allow you to create a hierarchy of groups. When you are configuring and viewing organizational groups, you may have to expand several group levels in order to select a group.

To access the Edit window in order to manage group assignments, select the group and click the *Edit Group* button.

Share groups



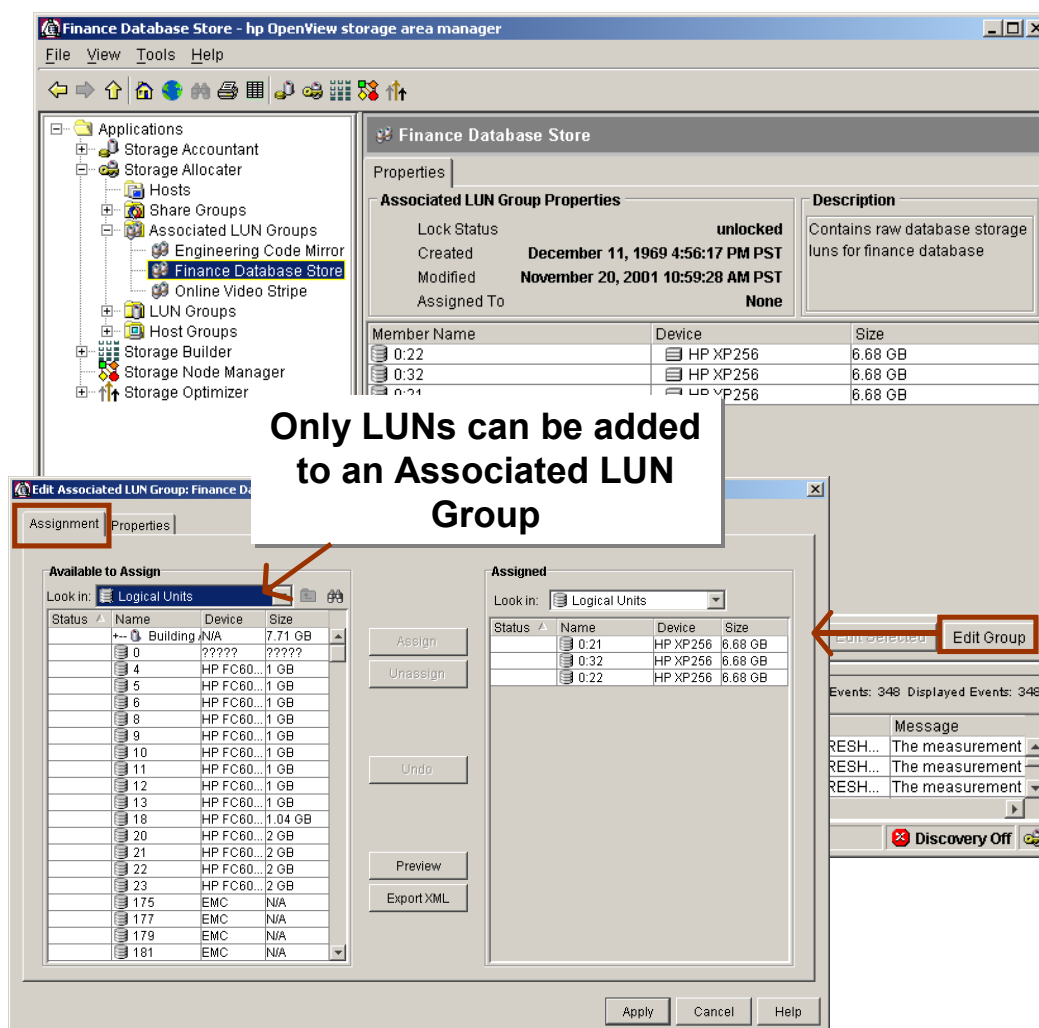
A *share group* is a security group that can contain hosts, LUNs, and associated LUN groups. Each host in a share group has read-write access to all the assigned LUNs and associated LUN groups. Share groups can be used to share data LUNs, or LUNs that are needed by utilities on all systems that access data LUNs on a specific device (for example, array management LUNs).



Caution

When using share groups with data LUNs, you must use an application that preserves data integrity on shared storage (for example, Microsoft Cluster Server on Windows NT or Veritas Cluster Server on Solaris). Without this type of application, data corruption may occur.

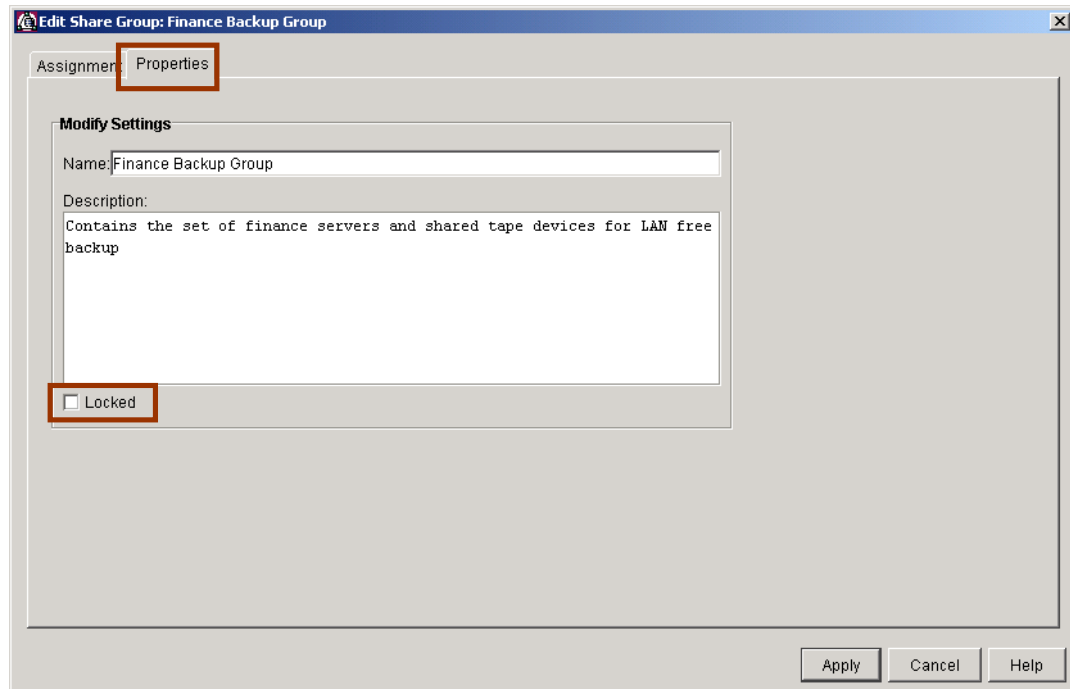
Associated LUN groups



An *associated LUN group* is a security group that allows you to group a set of LUNs into a single assignable item. Once grouped, the LUNs can be assigned only as a set. Associated LUN groups can be used for any set of LUNs that needs to be assigned or unassigned as a unit (for example, stripe sets, mirror sets, and sets of LUNs that contain parts of the same database).

When assigning and unassigning associated LUN groups, if the requested assignment or unassignment is not successful for all the group members, the operation fails for the entire group.

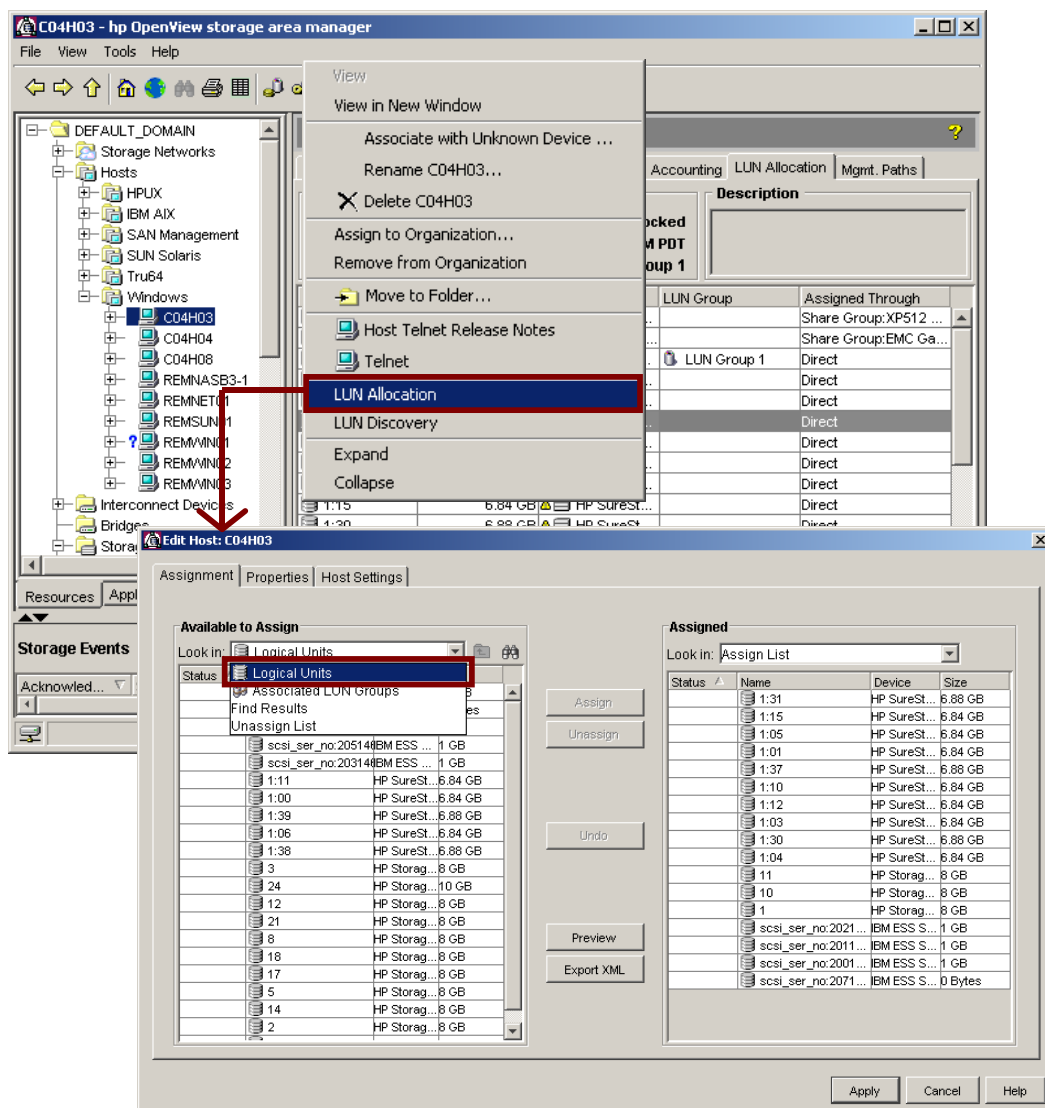
Viewing group properties



To view group properties from the Edit window, click the *Properties* tab.

If the Group is “locked,” you cannot change its description or assignments. Only Administrators are able to lock or unlock groups.

Working with associated LUN groups



Using assigned LUNs

After assigning LUNs, consider the following OS-specific guidelines:

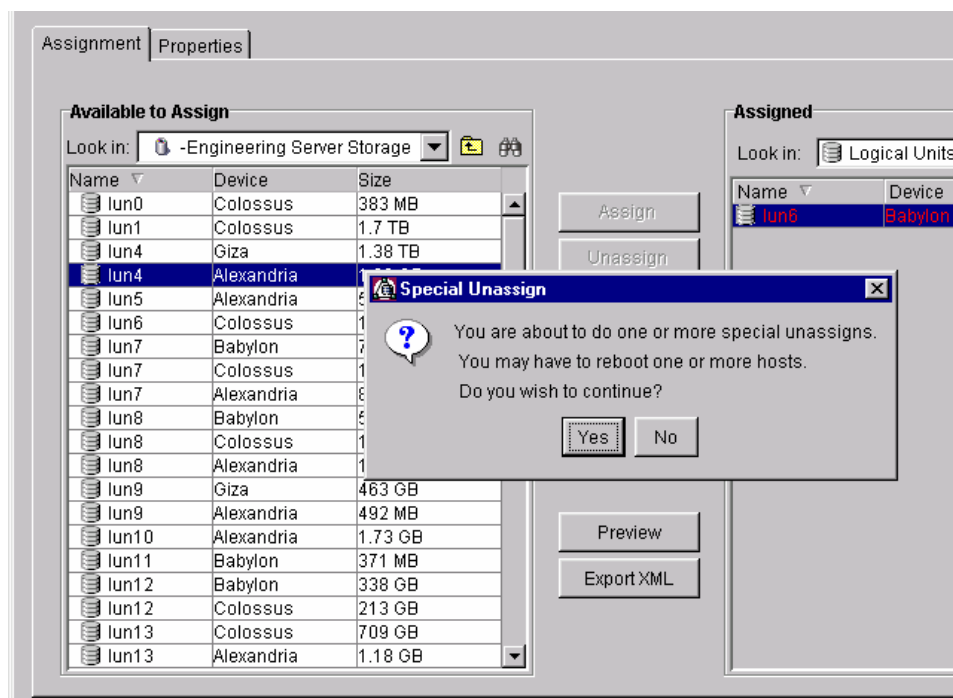
Windows hosts

- If a file system exists on the LUN, the LUN is automatically mounted if a (free drive letter exists).
- The use of Disk Administrator is required if the LUN doesn't already contain a file system or no driver letter is available.
- If a file system was once assigned a drive letter, Allocator attempts to make that file system available at the same drive letter when assigned.

Unix hosts

- If a UNIX file system already resides on the disk, then it is accessible as soon as it is mounted.

Special unassignments



In some cases, usually when a host or share group cannot release LUNs that are in use, a host, LUN, or associated LUN group cannot be unassigned with the *Unassign* command. In these cases, check the involved Windows, Solaris, Linux or AIX hosts and try to solve the issue that prevents the unassignment.

Note

For tips on troubleshooting unassignments, see the *HP OpenView Storage Area Manager Administrator's Guide*, chapter 8.

If the item still cannot be unassigned, use the Special Unassign command, which requires a reboot of all affected hosts.

When using the Special Unassign command, note the following:

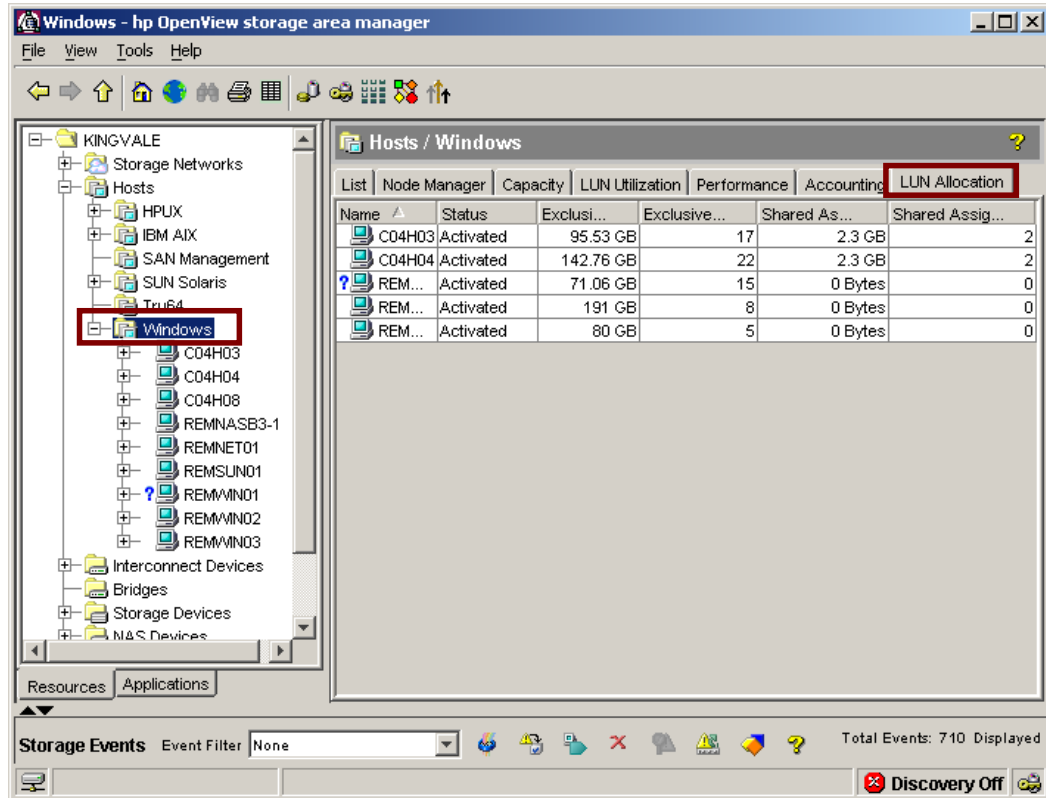
- When you right-click one or more assigned items and select *Special Unassign*, the selected items are dimmed in the list on the right and added in magenta to the Unassign List on the left. A green-and-magenta arrow appears in the Status column beside the moved items in each list, indicating that a special unassignment is pending.
- Until you click the *Apply* button, you can undo a pending special unassignment by selecting an item in the Unassign list and clicking the *Undo* button, or by dragging the item from the Unassign List into the Assigned section of the Edit window. Once you apply a special unassign request, you cannot undo the request, and you must reboot the affected hosts.

- When you try to perform a special unassignment, Storage Area Manager first tries a regular unassignment. If the regular unassignment is successful, the item that was unassigned is removed from the Assigned section of the Edit window and is available for immediate assignment elsewhere. If a regular unassignment is not possible, the item remains in the Assigned section of the Edit window, and is listed in magenta text.
- If a host that is involved in a special unassignment is in one or more share groups, the host is listed in magenta text in the Edit Share Group window until it is rebooted.
- When you click *Apply*, the Configuration Status window displays and reports the status of the requested special unassignment. If hosts need to be rebooted, they are listed in the Configuration Status window and in the event panel.
- You cannot special unassign hosts from a share group at the same time that LUNs or associated LUN groups are being special unassigned. You must special unassign hosts and storage separately.

Viewing LUN allocations

LUN allocation information is available in the view panel and in the form of reports. This section covers the view panels and reports that Storage Allocator provides, the contents of each, and how to access the information.

Viewing the host LUN allocation summary

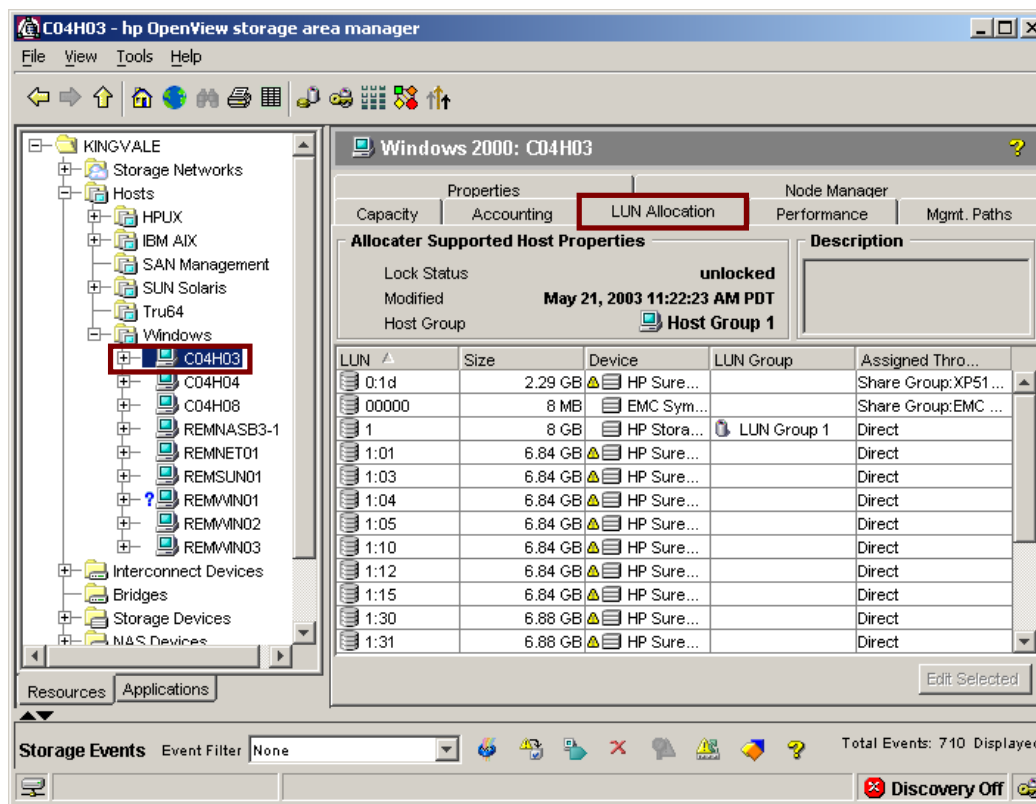


To view a list of all hosts that have Storage Allocator activated, select the desired host-related folder in the Resources tree and click the *LUN Allocation* tab.

The host LUN allocation summary includes:

- Host name
- Storage Allocator activation status
- Exclusively assigned capacity
- Number of exclusively assigned LUNs
- Shared capacity
- Number of shared assigned LUNs

Viewing host LUN allocation details

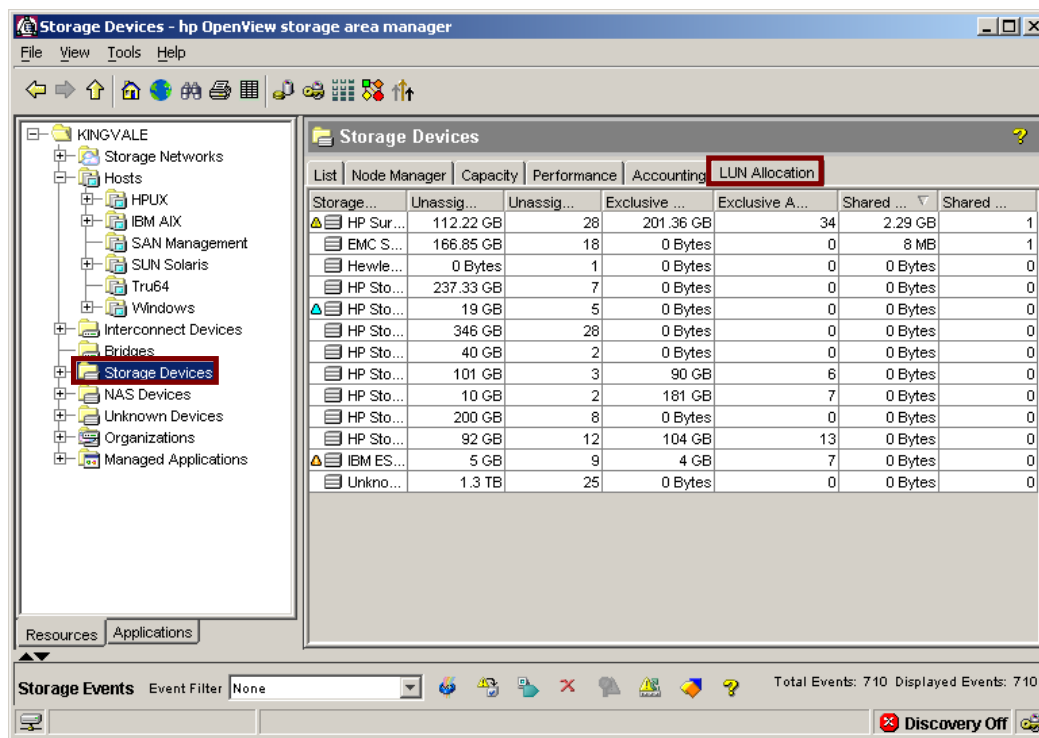


To view LUN allocation details of a specific host, select the host in the Resources tree and click the *LUN Allocation* tab.

Host LUN allocation details include:

- Host properties, including: lock status, date last modified, and the host group, (if any). A listing of all LUNs that are currently assigned to the selected host with:
 - LUN number
 - LUN size
 - Device name
 - LUN group (if any)
 - Assignment

Viewing the storage device LUN allocation summary

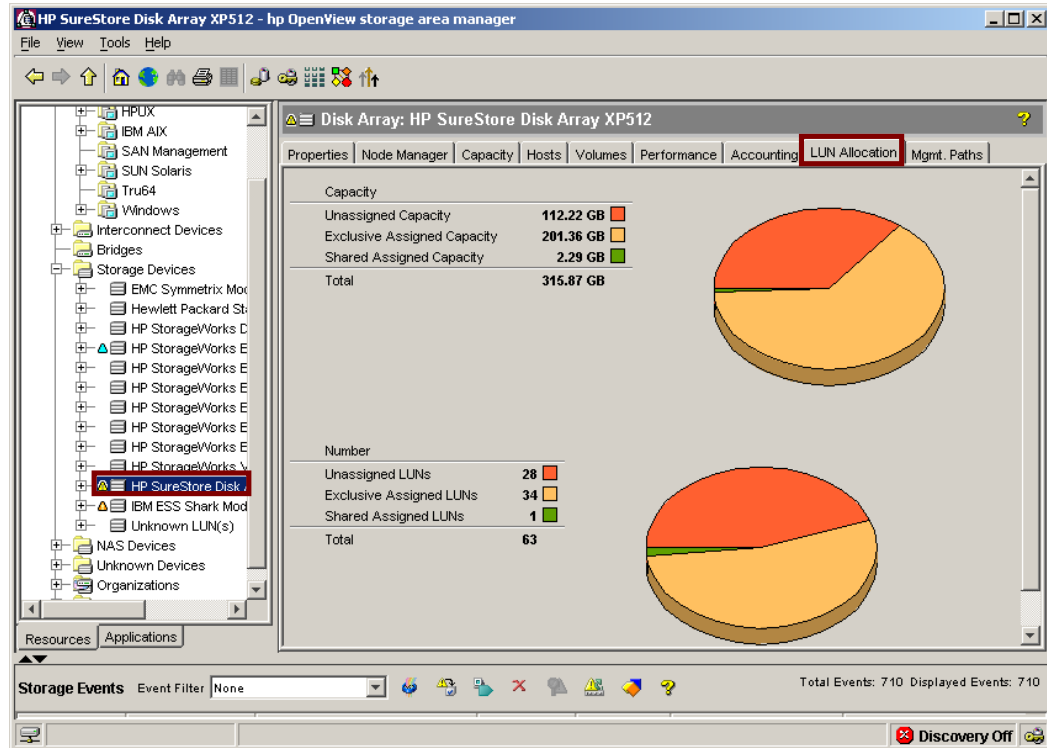


To view a summary of LUN allocation statistics for all storage devices, select *Storage Devices* in the Resources tree and then click the *LUN Allocation* tab.

The storage device allocation summary includes:

- Storage device
- Unassigned capacity
- Unassigned LUNs
- Exclusively assigned capacity
- Exclusively assigned LUNs
- Shared assigned capacity
- Shared assigned LUNs

Viewing storage device LUN allocation details



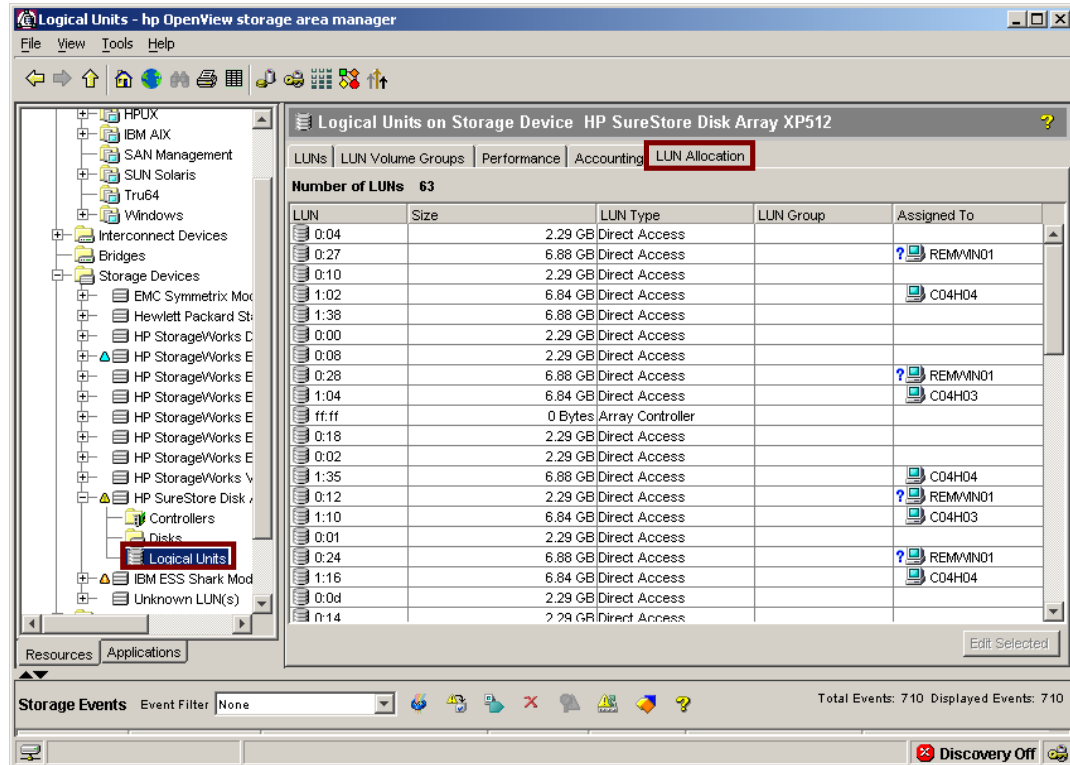
To view LUN allocation details of a specific storage device, select the storage device in the Resources tree and click the *LUN Allocation* tab.

Storage device LUN allocation details are provided in the form of two pie charts.

The top chart illustrates the amount of LUN capacity that is unassigned, exclusively assigned, and shared.

The bottom chart illustrates the number of LUNs that are unassigned, exclusively assigned, and shared.

Viewing the logical units panel

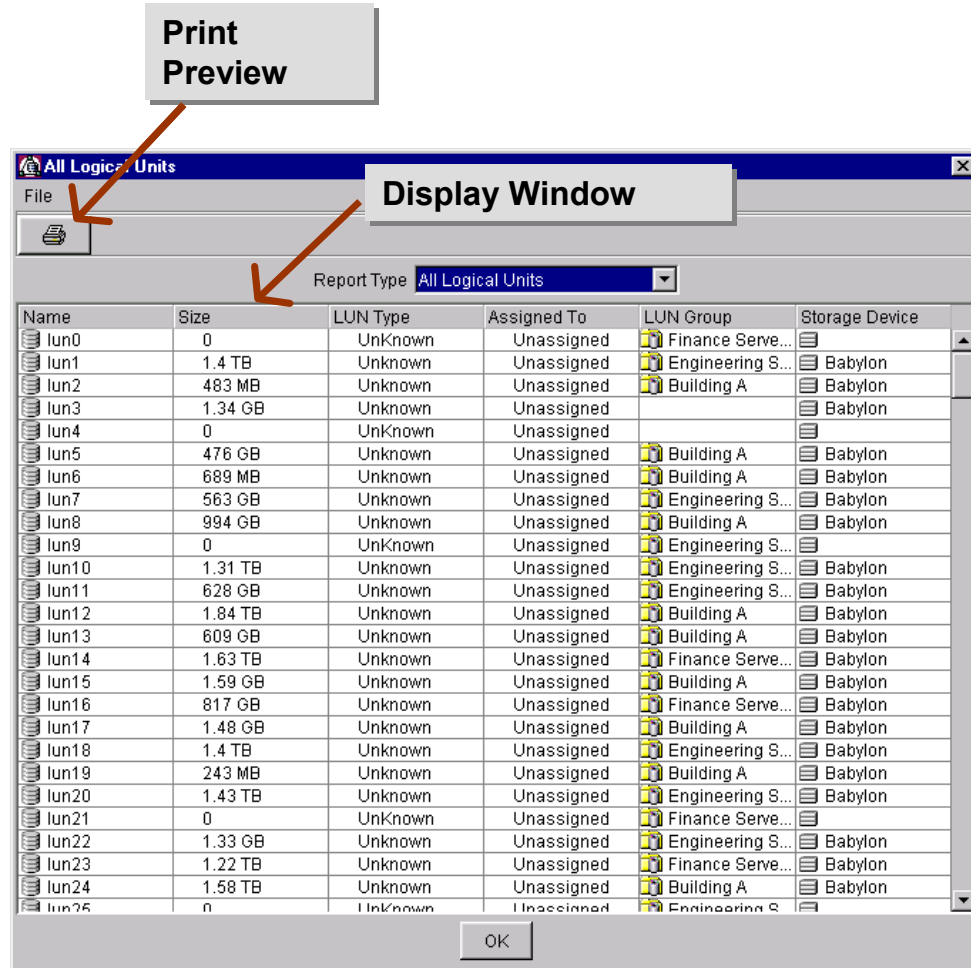


To view a listing of all LUNs configured for all storage devices or a specific storage device, select *Storage Devices* or a specific device in the Resources tree and then click the *LUN Allocation* tab.

The procedure display the Logical Units panel which includes LUN size

- LUN type
- LUN group the LUN belongs to (if any)
- Host the LUN is currently assigned to (if any)

Viewing LUN allocation reports



Storage Allocator reports are a filtered display of logical units that output in a “print-friendly” format. There are three reports that can be created:

- All logical units in the storage network
- All the logical units that are assigned in the storage network
- All the logical units that are not assigned

Create reports from the following launch points:

- Storage Allocator home page
- *Tools* → *Storage Allocator* → *LUN Allocation Report*
- *Domain Node*, *LUN Allocation tab*

Activating Storage Allocator

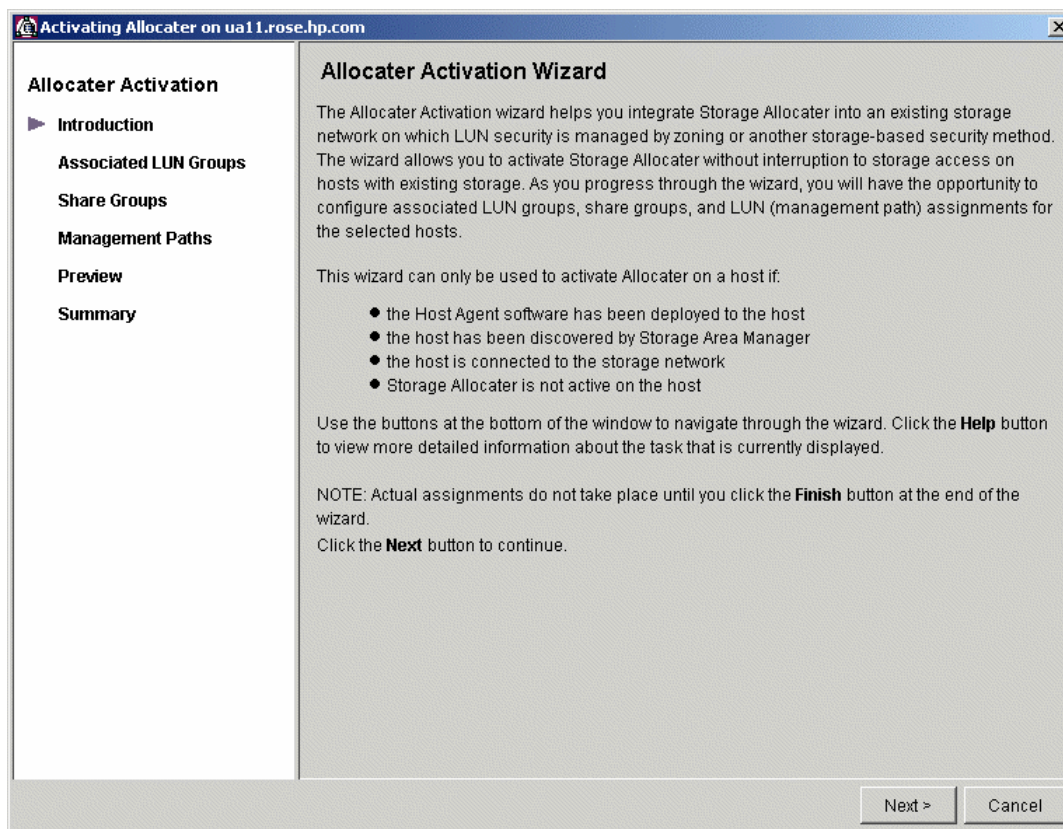
To take advantage of the storage access control provided by Storage Allocator, you must activate the application on every SAN host within a storage network fabric.

Storage Area Manager provides three methods to activate Storage Allocator. The table below lists methods, the customer environment appropriate for each method, and the timing the activation should take place within the initial setup of Storage Area Manager.

Storage Allocator Activation Methods

Method	Customer Scenario	Timing
Within Storage Area Manager Setup Assistant	New SAN	When prompted by the Setup Assistant
Using the Storage Allocator Activation wizard	Existing SAN with LUN security managed by zoning or another storage-based security method	After using the Setup Assistant, starting the discovery process, and adding undiscovered hosts
Locally using CD-ROM	Host behind a firewall	After using the Setup Assistant, starting the discovery process, and adding undiscovered hosts

The Allocator Activation Wizard

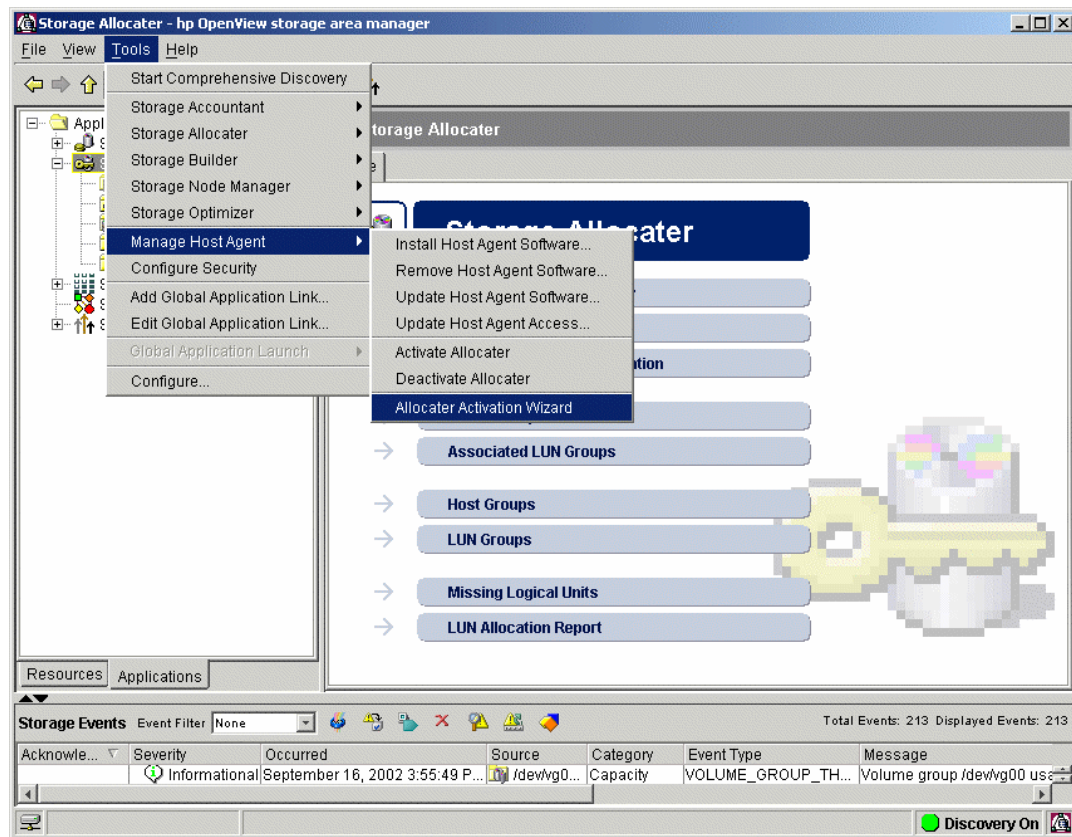


The Storage Allocator Activation wizard integrates Storage Allocator into an existing storage network on which LUN security is managed by zoning or another storage-based security method. The wizard allows activation of Storage Allocator on hosts that are using existing storage with minimal or no interruption to storage access.

The wizard enables activation and assignment to occur in a single step. Additionally, it allows assignment by management path versus LUN.

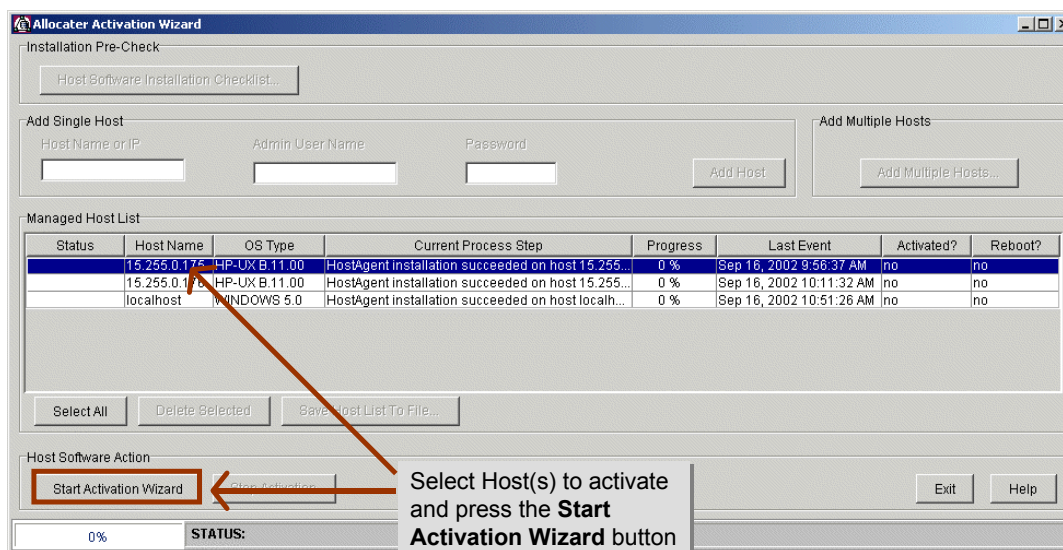
Use the LUN assignment feature when the storage devices in the environment use device management applications requiring connectivity to command LUNs. Also, use the Activation wizard when a storage device that requires at least one of its LUNs to be assigned to a particular host before any of the LUNs are visible to that host.

Launching the Allocator Activation Wizard



To launch the Allocator Activation wizard, select *Tools* → *Manage Host Agent* → *Allocator Activation Wizard*.

Starting the Allocator Activation Wizard



The Managed Host List contains all the hosts that are running the Host Agent software.

Note

If the Host Agent software was installed locally on a host, the host will not appear in this list. To add a locally installed host to the list, open the Install Host Agent window, enter the host in the Add Single Host area, and click the *Add Host* button.

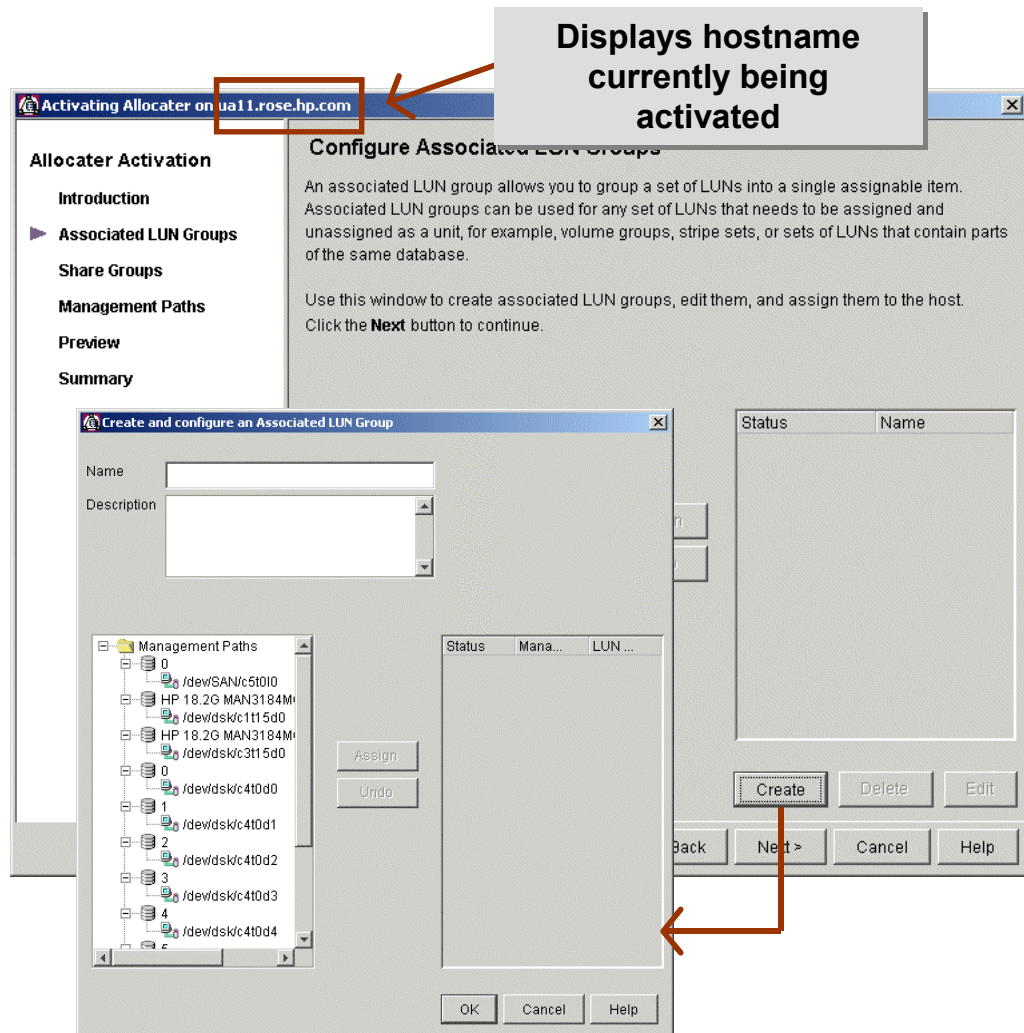
It includes the following information for each host:

- The status of the current operation
- The host name
- The host's operating system
- The current process step in the activation procedure
- The percentage of the activation procedure that is complete
- The date and time of the last host action that was performed through the Setup Assistant or Manage Host Agent menu
- If Storage Allocator is active on the host
- If the host needs to be rebooted

Note

The information about rebooting applies only to the current Storage Allocator activation session. This information will not be saved when you close the window.

Configuring associated LUN groups



Use this step in the wizard to create an associated LUN group. Associated LUN groups are used to group a set of LUNs into a single, assignable item. Use them for volume groups, stripe sets, or sets of LUNs that contain the same database.

To create an associated LUN group, drag and drop LUNs from the visible list (left) to the Pending Assignments list (right). Alternatively, use the *Assign* button to move LUNs.

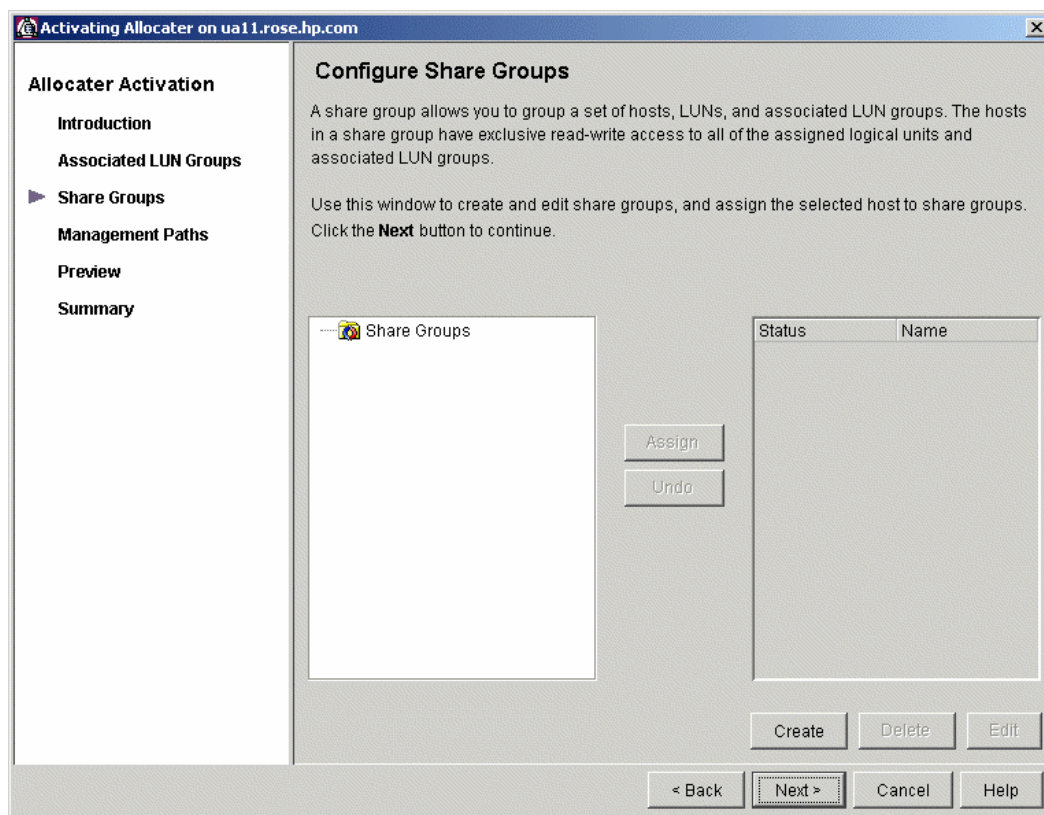
Note

Actual associated LUN group assignments do not take place until you click the *Finish* button at the end of the wizard.

Note

To undo a pending assignment, select one or more LUNs in the pending assignments list and click the *Undo* button, or drag selected LUNs from the pending assignments list into the visible LUNs list.

Configuring share groups



Use this step in the wizard to create a share group. Share groups are used to group a set of hosts, LUNs, and associated LUN groups. Hosts in a share group have exclusive read/write access to all of the assigned LUNs and associated LUN groups.

To create a share group, drag and drop LUNs from the visible list (left) to the Pending Assignments list (right). Alternatively, use the *Assign* button to move LUNs.

When using the Activation wizard, you can add the selected host to share groups, but you cannot add additional hosts. To add additional hosts to share groups, use the standard procedure for modifying share groups.

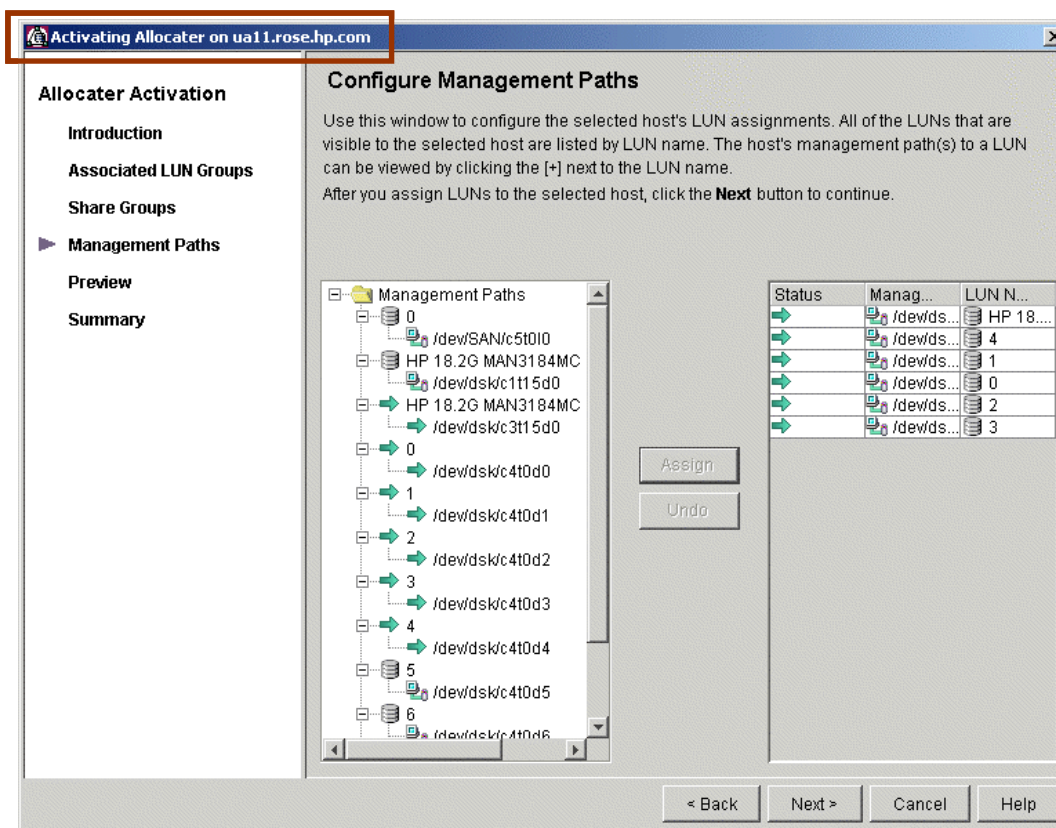
Note

Actual associated share group assignments do not take place until you click the *Finish* button at the end of the wizard.

Note

To undo a pending assignment, select one or more LUNs in the pending assignments list and click the *Undo* button, or drag selected LUNs from the pending assignments list into the visible LUNs list.

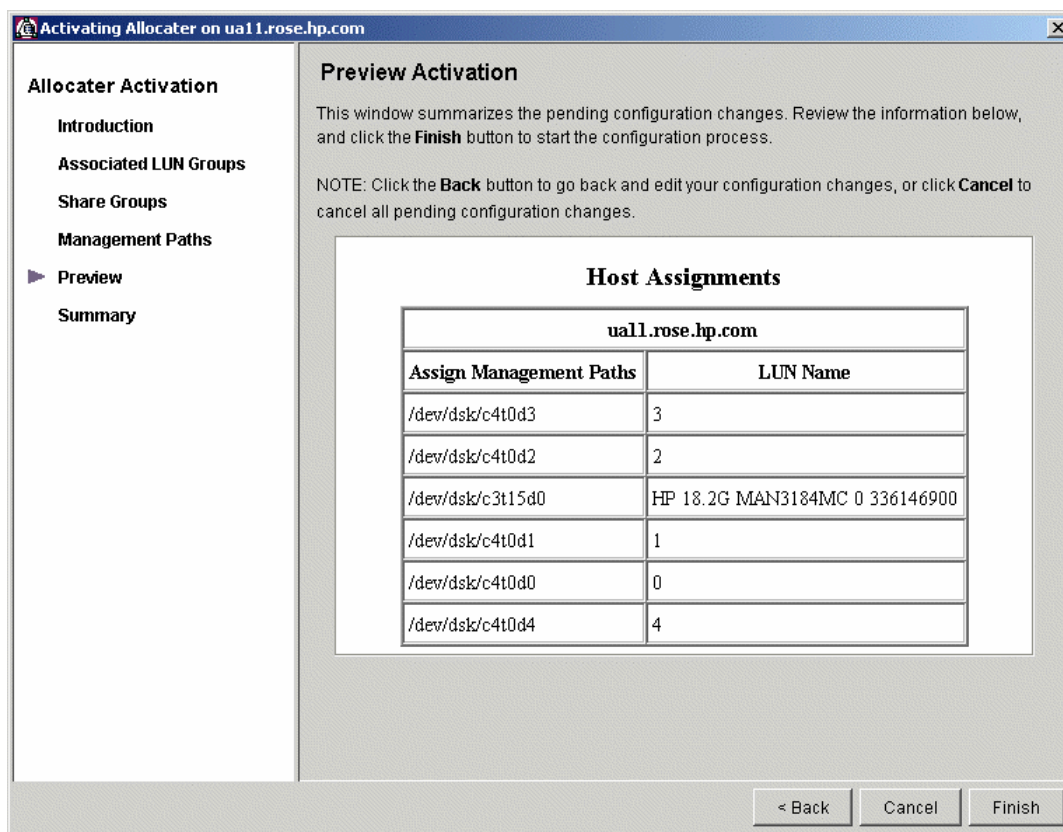
Selecting management paths



Use this step in the wizard to give a host exclusive access to LUNs. View a host's management path(s) to a LUN by clicking the * next to the LUN name.

To make assignments, drag and drop LUNs from the visible list (left) to the Pending Assignments list (right). Alternatively, use the *Assign* button to move LUNs.

Previewing activation



Use the final step in the wizard to preview a summary of configuration changes. Click the *Finish* button to start the configuration process. Click the *Back* button to go back and edit the configuration changes, or click *Cancel* to cancel all pending configuration changes.

Managing hosts and LUNs

This section covers procedures that need to be performed due to changes in the environment, such as:

- Moving a Storage Allocator host from one management server to another.
- Hardware failures that cause hosts to go offline.
- Adding/removing storage devices from the SAN.

Additionally, this section covers Storage Area Manager rogue server event notification and how to configure Storage Area Manager to perform a specified action in the event a rogue host is detected.

Moving a host from one management server to another

To move a Storage Allocator host from one management server to another, you must uninstall the Host Agent software from the host, and then reinstall the Host Agent software and activate Storage Allocator from the new management server. This step is required because the Host Agent software is tied to an individual management server that is configured during the installation of the Host Agent software.

1. Unassign all storage from the host and remove the host from any share groups.
2. Detach the host from the storage network.
3. Uninstall the Host Agent software from the host.
4. In the Storage Area Manager Resources tree, right-click the host and select *Delete <host name>* on the shortcut menu.
5. If necessary, connect the host to the same LAN as the new management server, but do not attach it to the storage network.
6. Install the Host Agent software from the new management server and activate Storage Allocator, as described in the *HP OpenView Storage Area Manager Installation Guide*.
7. Attach the host to the storage network.

Managing a “dead” host

If a host goes offline because of a hardware failure and it cannot be brought back online to unassign its storage, use the following procedure to remove the host from the storage network:

1. Detach the host from the storage network.
2. In the Storage Area Manager user interface, right-click the host and choose *Delete <host name>*.
3. When prompted to confirm the deletion, click *Yes*. When the host is deleted, it is removed from the Storage Area Manager database, all of the storage assigned to it is unassigned (which makes it available for assignment to other hosts), and the host is removed from any groups it is assigned to.

If the host becomes usable, but it is not going to be reattached to the storage network, use the local uninstall procedure to uninstall the Host Agent software from the host. For uninstall instructions, see the *hp OpenView storage area manager installation guide*.

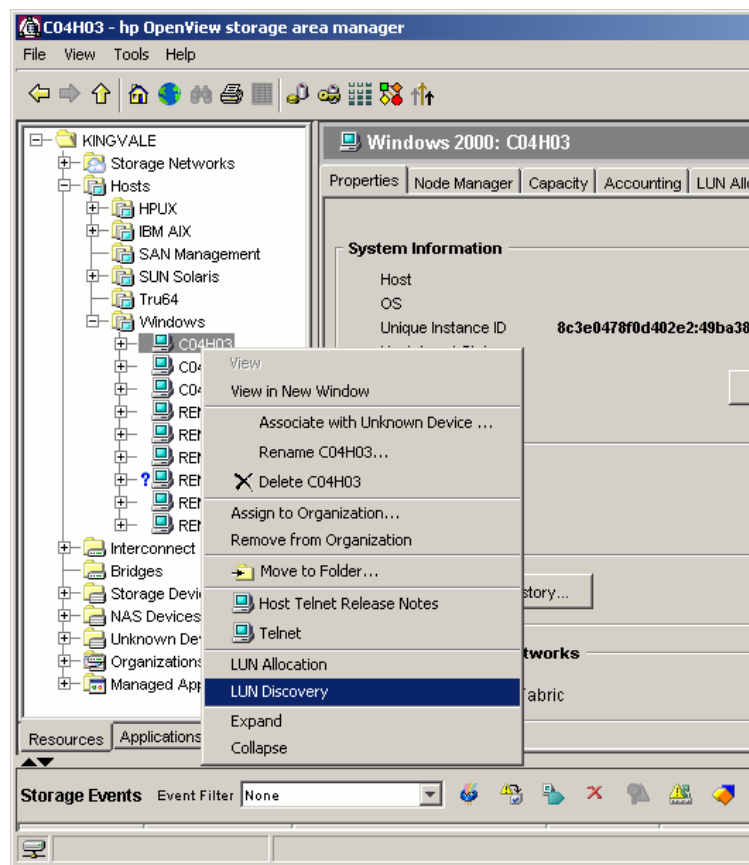
If the host becomes usable and it is going to be reattached to the storage network and added back into the Storage Area Manager database, then it is not necessary to uninstall the Host Agent software. Ensure that the host is not attached to the storage network until it has been added back into the Storage Area Manager database through the Ethernet network, and any potential multiple-writer situations have been corrected.



Caution

Reattaching a host to the storage network is not recommended. If the host is reattached to the storage network before it is added to the database, it will have access to any storage that was unassigned in step 3. If another host already has access to this storage, a multiple-writer situation may occur and cause data corruption.

About missing LUNs



When new storage is added to the SAN, hosts typically do not become aware of the new storage until they are rebooted or they are directed to scan for new storage. Such a scan may be triggered by various methods. Using the LUN Discovery feature is one method (using Disk Administrator or running `ioscan` are others).

To initiate a scan on a host, right-click the host in the Resources tree and select *LUN Discovery* from the short-cut menu.

Note

The LUN Discovery command triggers an `ioscan` on HP-UX hosts.

Once a host on the network has found a new storage device, the Storage Area Manager discovery process can discover the device. Depending on the host platform and when the discovery process finishes, the devices may not show up immediately in the Storage Area Manager user interface.

Use the LUN Discovery command when new storage has been added to the storage network, but is not available for assignment through Storage Allocator. Also use the LUN Discovery command if a host cannot find an assigned LUN.

Deleting LUNs

When you delete a storage device from the Storage Area Manager database, you must also delete the storage device's LUNs, or they may be listed in the Edit window even though the device is no longer attached to the storage network

Storage Area Manager rogue server notification

The screenshot shows the HP OpenView Storage Area Manager interface. A 'Storage Event Details' window is open, displaying the following information:

Acknowledgement Status	Not Acknowledged
Severity	Critical
Date & Time	October 1, 2002 2:44:46 PM PDT
Source	sb-pinehurst.rose.hp.com
Category	Allocator
Event Type	ROGUE_SERVER
Message	Host sb-pinehurst.rose.hp.com is a rogue server. Detailed messages: 0x10006B: Unable to contact the LUN filter

Below the 'Storage Event Details' window, the 'Storage Events' panel is visible. It shows a table of events with the following columns: Severity, Occurrence, Source, Category, Event Type, and Message. A red box highlights a warning icon in the 'Storage Events' panel, with an arrow pointing to the 'Storage Event Details' window.

• Automatic notification sent to the Event View panel when rogue hosts are found

• Storage Allocator checks each hour for rogue hosts, and after SAN Host Agent restarts

A *Storage Area Manager rogue server* is a host that has access to LUNs that are not assigned to it, resulting in a possible multi-writer situation. A *possible rogue server* is essentially the same. However, Storage Allocator cannot confirm it is a rogue server because it is unable to make contact with the host for some reason (for example, due to network issues).

Storage Area Manager automatically sends events to the Event view panel when rogue hosts are detected. Storage Allocator checks each hour for rogue servers and whenever Host Agents are restarted.

Adding triggers for rogue server events

Add Trigger

Name:

Event Configuration

Category:

Threshold:

Events:

- ☐ MULTIPLE_WRITER_SCENARIO
- ☒ POSSIBLE_ROGUE_SERVER
- ☐ REALITY_TO_POLICY
- ☒ ROGUE_SERVER
- ☐ RUID_ENABLED_BUT_NOT_VISIBLE
- ☐ SCSI_SCAN

Action Configuration

Action:

Parameter	Value
HOSTS	

Trigger Constraints

OK Cancel Help

If appropriate for the environment, use triggers to configure Storage Area Manager to take the following additional actions upon detecting a rogue or possible rogue server:

- Forward trap
- Email
- Run command

Learning check

1. Storage Allocator provides which of the following types of LUN security?
 - a. Host-based security
 - b. Storage-based security
 - c. Interconnect-enhanced security
 - d. User-based security

2. Match the Storage Allocator component with its description.

a. Command/Information Request Interfaces	.....	Specialized software components that run as drivers in the kernel of the operating system or as a daemon. Provides LUN access control by using assignment information in the local assignment database or received from the management server.
b. Reality-to-Policy Engine	.....	Processes commands from the Command/Information Request Interface and the Reality-to-Policy Engine. Allows multiple Allocator GUI/CLUI and internal requests to be understood and managed.
c. Command Engine	.....	Handles all assignment, grouping, object creation, or deletion operations.
d. Layered Security Coordinator	.....	Monitors the difference between access control currently active in the storage network (reality) and access control the administrator has defined for the storage network (policy).
e. Local Assignment Database	.....	Allows Storage Allocator to run without communication from the management server once LUN assignments are configured..
f. Access Control Components	.....	Provides a bridge between JCORE and OS native Storage Allocator components.
g. Common Host Agent	.....	Listens for requests from the OV SAM management server and sends request to the native Storage Allocator components.
h. Native Compiled Library	.....	Processes batches of assignment and unassignment requests that it receives from the Command Engine.

3. Describe the types of groups that can be created with Storage Allocator.
.....
.....
4. List the three methods available for activating Storage Allocator and describe the appropriate environment for each.
.....
.....
.....
5. To receive automatic event notification if a rogue server is discovered, a trigger must be configured.
☐ True
☐ False
6. What Storage Allocator command makes hosts aware of new storage?
.....
7. The Special Unassign command is required for HP-UX hosts.
☐ True
☐ False

Objectives

After completing this module, you should be able to:

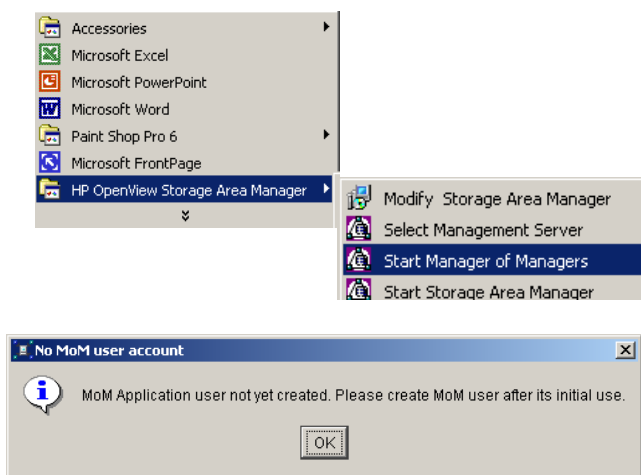
- List MoM features.
- Set up MoM.
- Monitor storage domains.
- Manage events.
- Launch management clients.
- Install and authorize MoM clients.

MoM overview and features

The Manager of Managers (MoM) enables you to monitor up to 50 storage domains from one console. You can configure MoM to retrieve and display status and event information from each Storage Area Manager management server in your environment. This feature allows Storage Area Manager to easily scale in large, complex storage environments.

MoM is installed automatically with the management server. No additional license is required. Additionally, MoM can be downloaded from the management server to a remote management client.

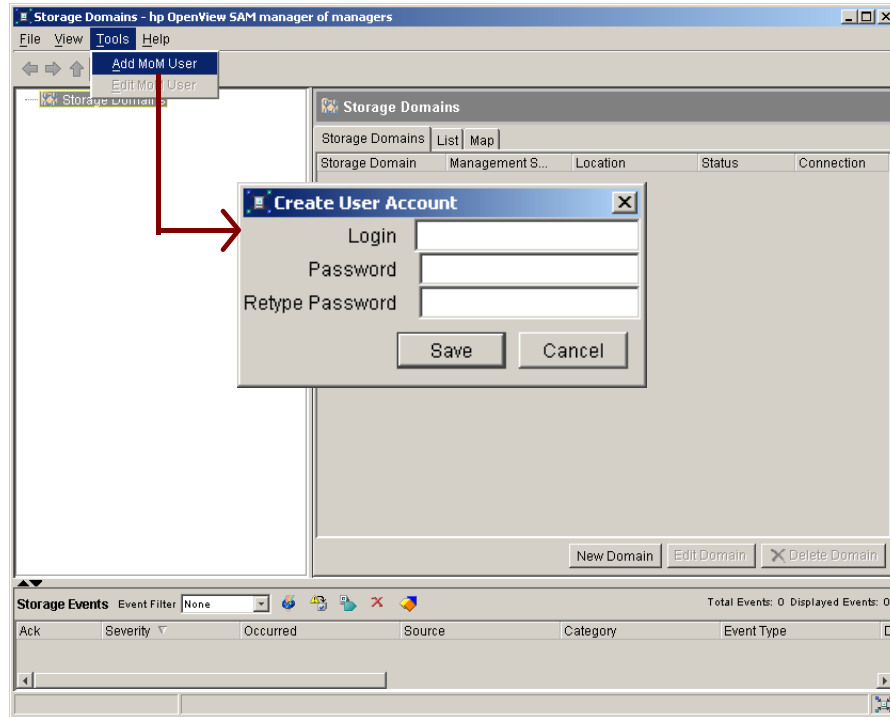
Setting Up MoM



Setting up MoM is a two step process:

1. Create a user account.
2. Add storage domains.

Creating user logins and passwords



When the MoM user interface starts for the first time, the application notifies you that no MoM user account has been created. For security reasons, HP recommends that you configure a user account. This user account controls the users that have access to MoM and the database information. The login and password information needs to be entered only once.

To create a user account:

1. Start the MoM user interface.

Windows hosts: Select *Start* → *Programs* → *HP OpenView Storage Area Manager* → *Start Manager of Managers*.

Unix hosts: Navigate to `/opt/sanmgr/mom/bin` and enter the following command: `/mom`

If no user account exists, the No MoM user account window displays.

2. Click *OK*. The Storage Domains – hp OpenView SAM Manager of Managers window displays.

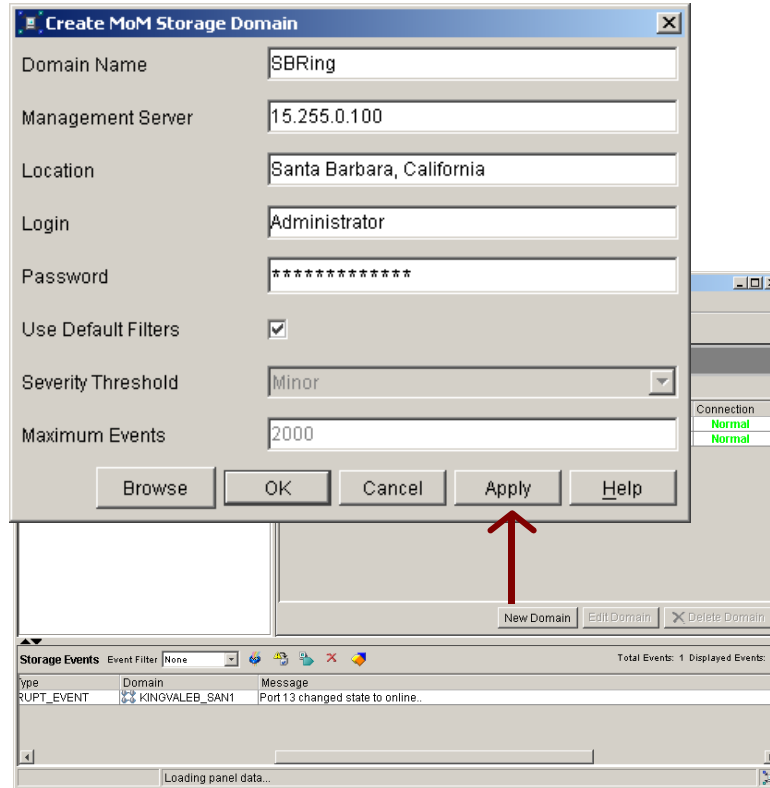
3. Select *Tools* → *Add MoM User*.

Note

If you do not create a user account, you will have only guest privileges for any domain that you add to MoM.

4. Enter the user login and password.
5. Click *Save* when you are finished.

Adding storage domains



To add storage domains:

1. In the tree on the left side of the window, right-click *Storage Domains* and select *Add* in the short-cut menu.
2. Enter the storage domain information. The following fields are required: Domain Name, Management Server, Severity Threshold, and Maximum Events.
 - **Domain Name.** The name of the storage domain. Click the *Browse* button to choose from the available storage domains. The storage domain name can be different from the name that is used on the management server, and must be unique within the MoM application.
 - **Management Server.** The IP address of the management server.
 - **Location.** Any user-defined criteria for identifying the physical location of the management server.
 - **Login.** A Storage Area Manager user name for the management server.
 - **Password.** A Storage Area Manager password for the management server.
 - **Use Default Filters.** To use the default settings for the Severity Threshold and Maximum events, mark the *Use Default Filters* check box.

- **Severity Threshold.** The severity threshold value controls the severity of the events that are displayed in the MoM event panel. When you select a severity, that severity and all higher severity events are displayed. For example, if you select the default value (minor), all minor, major, and critical events are displayed, but information and warning events are not displayed.
- **Maximum Events.** The maximum events value controls the maximum number of events displayed in the MoM event panel for the selected management server. The default setting is 2000.

When the number of events on a management server reaches the MoM application's maximum events setting, the MoM application makes room to display new events by removing events from the MoM event panel. Acknowledged events are removed first, followed by low-severity events, and then old events.

**Important**

For optimal performance, the recommended maximum number of events, for all management servers combined, is 50,000.

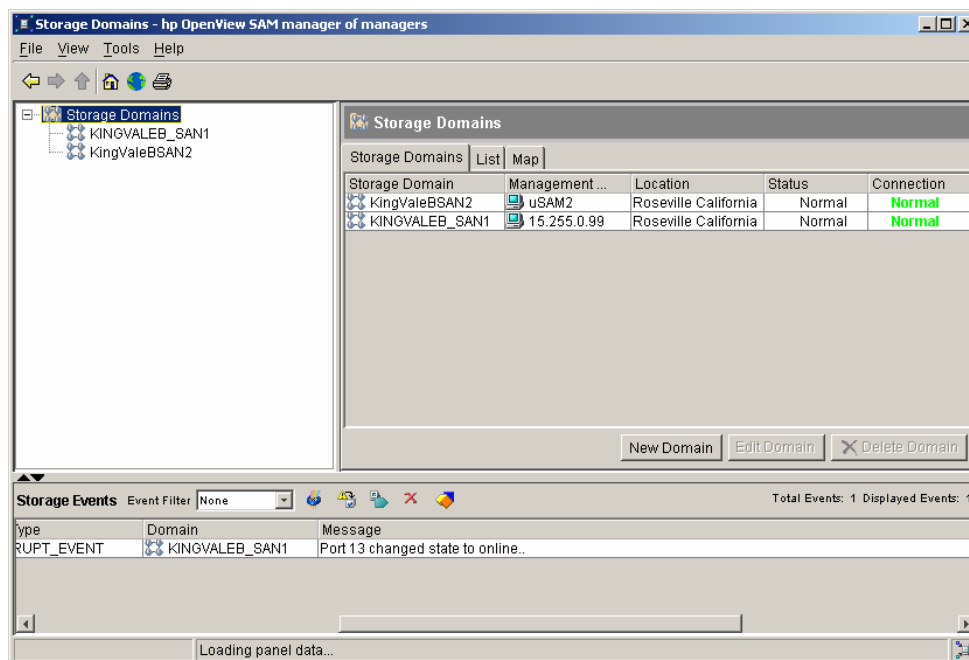
3. Click *OK*. The storage domain displays in the Storage Domains view panel.

If after a storage domain has been added, you need to edit its properties, right-click the storage domain in the tree and select *Edit* from the short-cut menu.

Monitoring storage domains

MoM provides several methods for monitoring storage domains. This section covers the features available for viewing storage domain information in both map and inventory list forms, as well as the features provided for monitoring events.

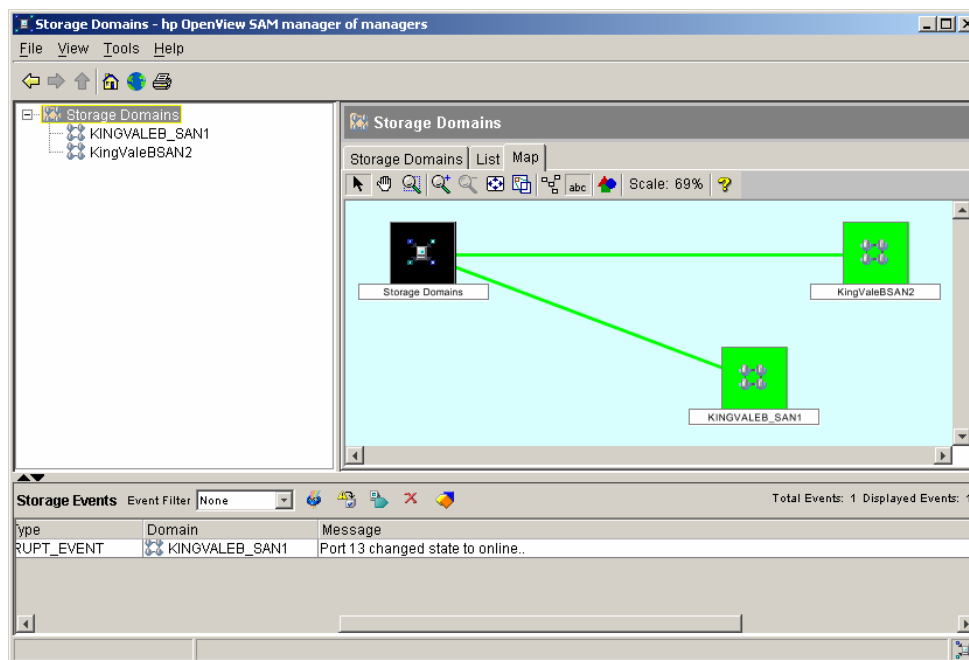
Viewing storage domains



The storage domains view panel is the MoM home page. It shows the following information:

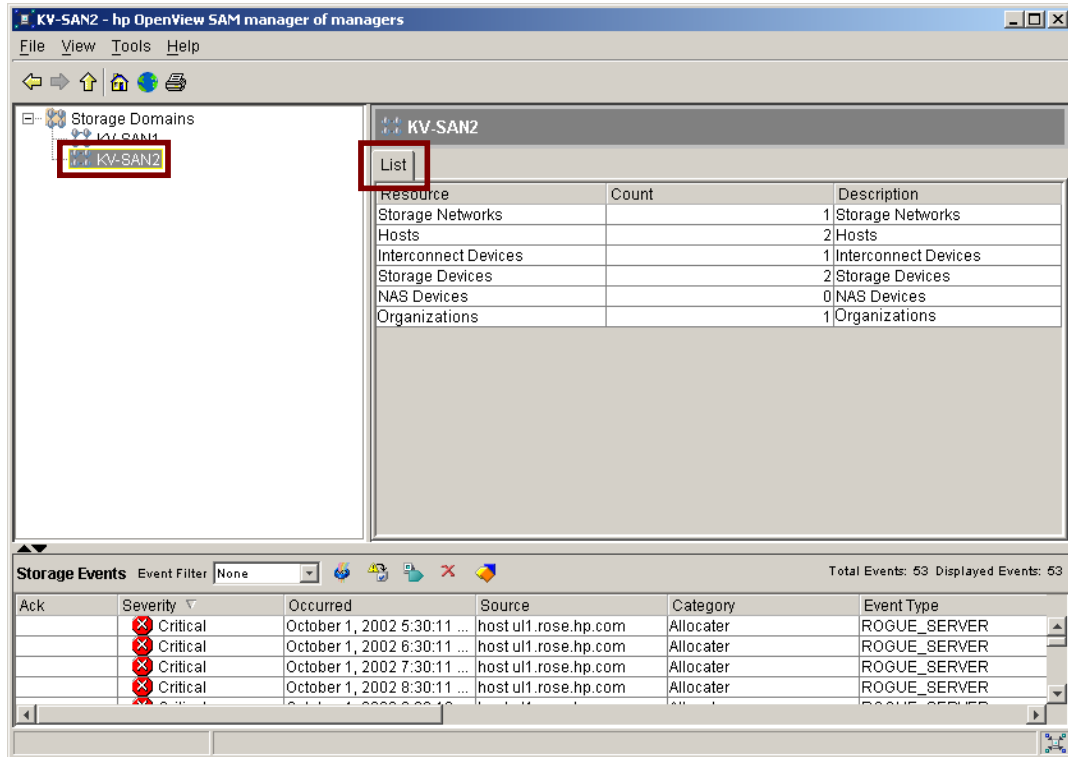
- Storage domain name
- Management server: The IP address of the management server
- Location: The user-defined location of the management server
- Severity: The severity of the most severe unacknowledged event for the storage domain.
- MoM connection: The status of the MoM remote connection to the domain's management server. The possible values are normal and broken (no connection to the management server).

Viewing storage domain maps



To view the map for a storage domain, click the *Map* tab on the view panel. The storage domain map displays each storage domain and its connection to the MoM. Link status is displayed as either up (green) or down (red). The color of the domain icon represents the worst event status in the domain.

Viewing storage domain inventory

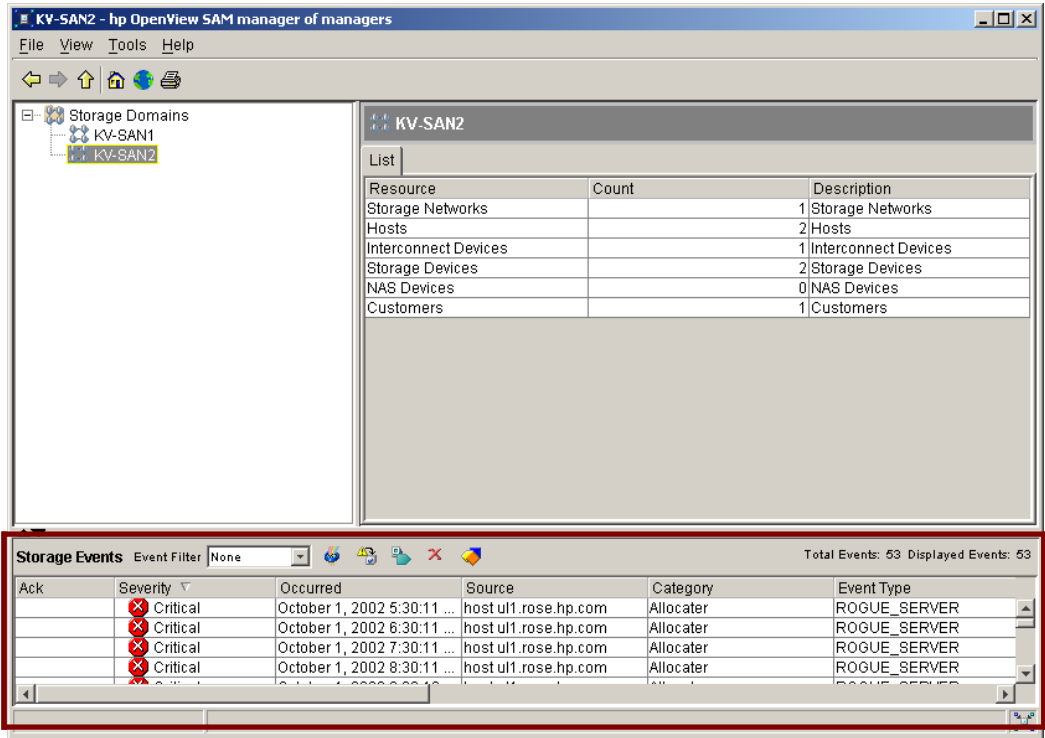


To view an inventory list for all storage domains, select *Storage Domains* in the tree and click the *List* tab. To view an inventory list for a specific domain, select the storage domain in the tree and click the *List* tab.

The List tab displays a count of the following resources:

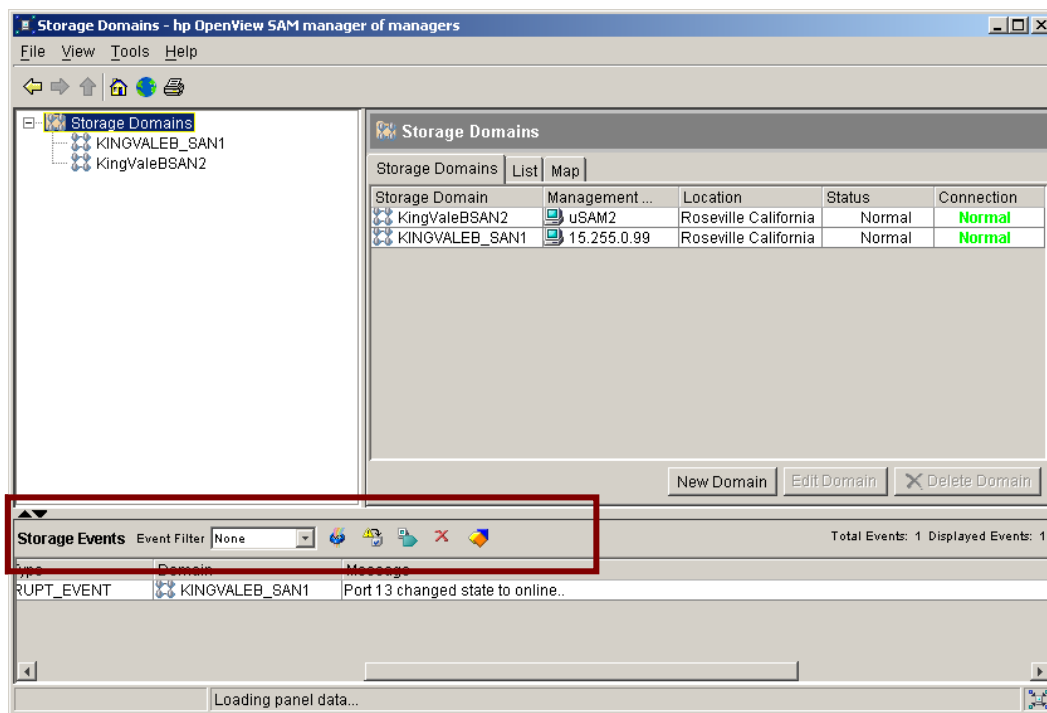
- Storage Networks
- Hosts
- Interconnect Devices
- Storage Devices
- NAS Devices
- Organizations

Viewing events



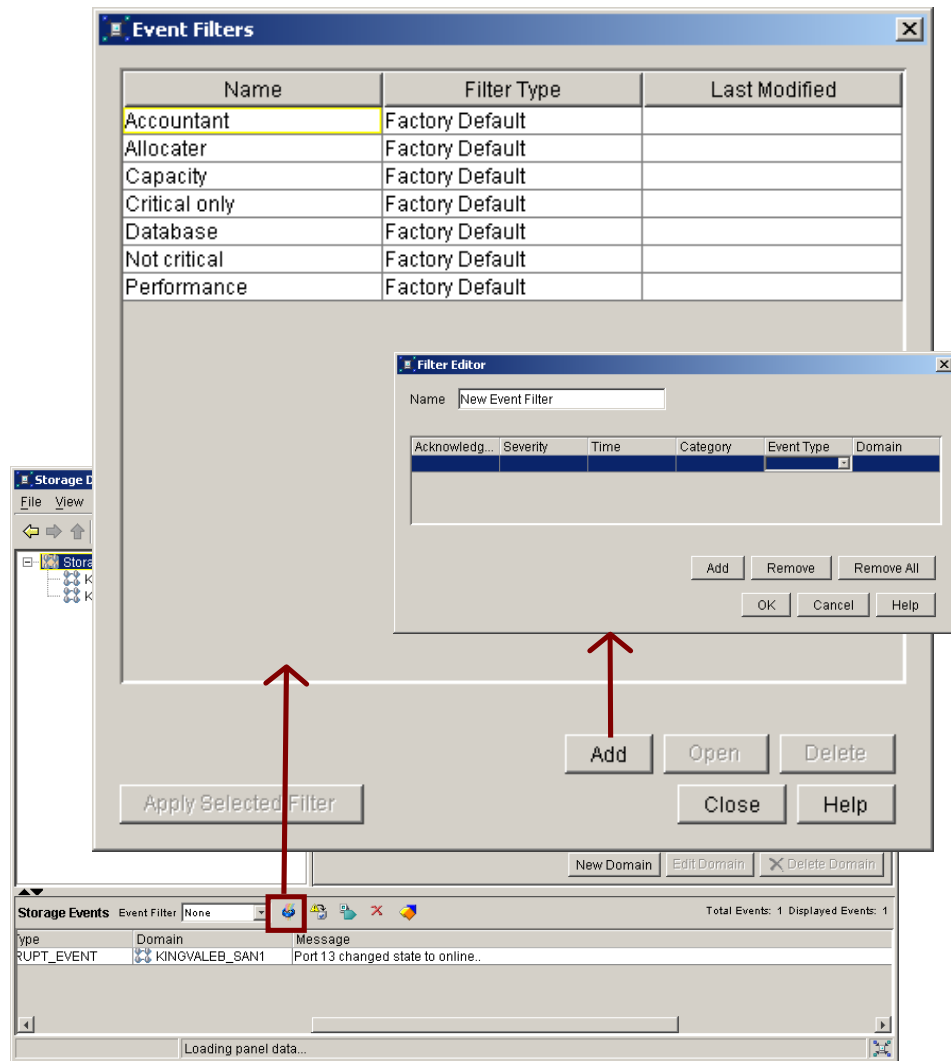
Events for all monitored events display in the Event view panel. Each event entry includes the name of the storage domain generating the event, as well as other detailed event information (severity, source, category, type, and so on).

Managing events



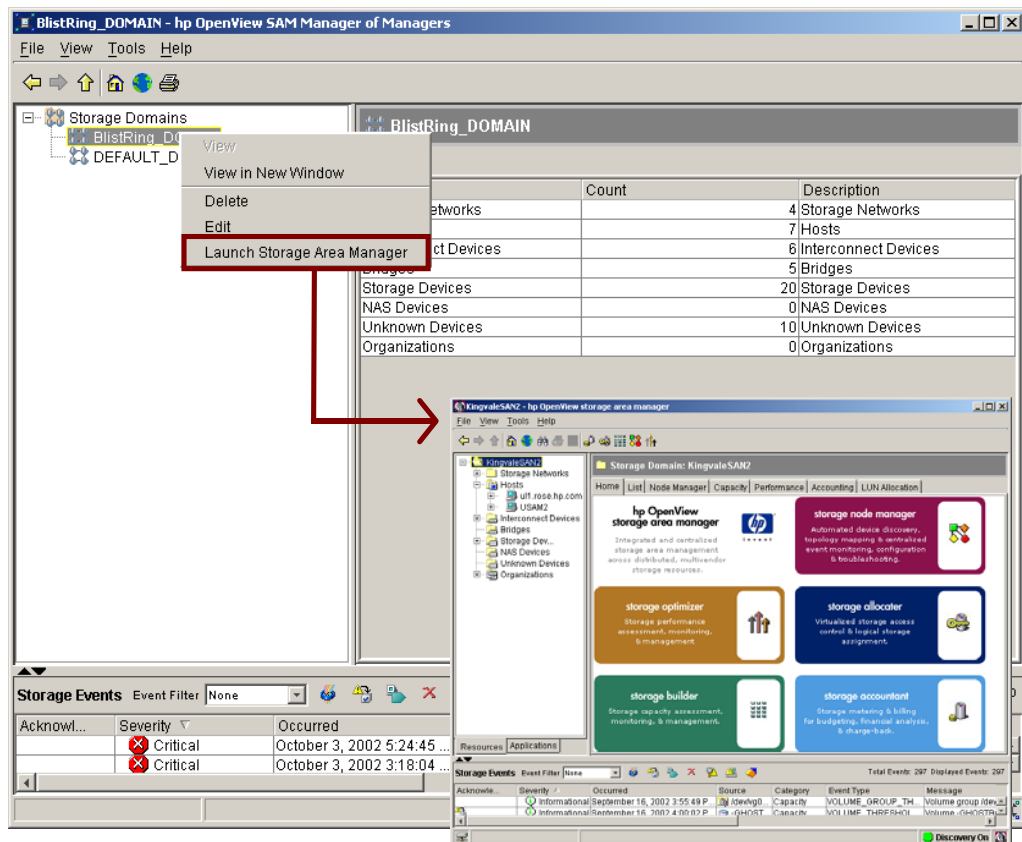
MoM includes the same event management features available within the main Storage Area Manager GUI. Only MoM clients with administrative privileges can acknowledge or delete events. If an event is acknowledged or deleted from MoM, it is also automatically acknowledged or deleted on the corresponding management server.

Filtering events



MoM provides several default event filters, including storage domain. To create a new filter, click the *New Filters* icon on the Event toolbar.

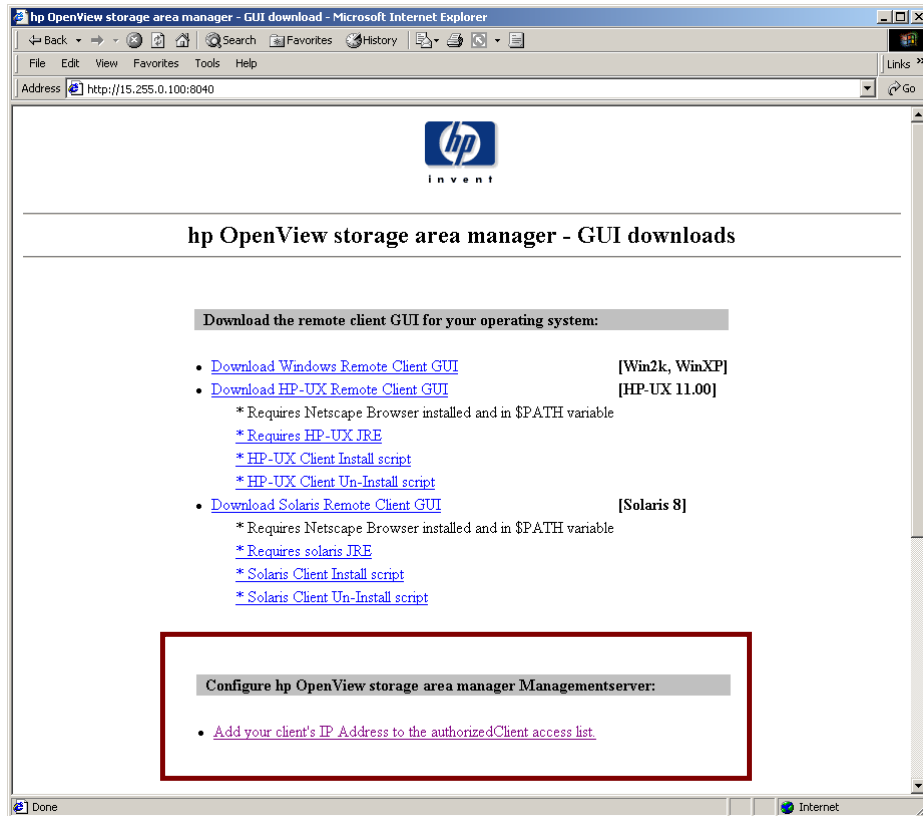
Launching management clients



To launch management clients from MoM, right-click the storage domain and select *Launch Storage Area Manager* from the short-cut menu.

Launching a management client requires that the management client or the storage domain username/password have either guest or administrator privileges.

Installing a MoM client



MoM clients are supported on Windows, HP-UX, and Solaris hosts.

To download a MoM client to a windows host:

1. Access the management server GUI Download page by typing **http://<hostname>8040**.
2. Click the *Download Windows MoM GUI* link and save the momsetup.exe to disk.
3. Double-click *momsetup.exe* and follow the prompts provided by the MoM Installation wizard.
4. From the management server GUI Download page, add the MoM client's IP address to each management server it will be monitoring by clicking the *Add your client's IP address to the authorizedClient access list* link.

Learning check

1. A special license is required to access Storage Area Manager MoM features.
☐ True
☐ False
2. Which of the following is NOT a feature of MoM?
 - a. Provides Host Agent deployment to multiple SAN hosts at a time
 - b. Consolidates filtered events from multiple management servers
 - c. Provides in-context launching of multiple management clients
 - d. Displays status from multiple management servers
3. Storage Area Manager supports up to 25 MoM user accounts.
☐ True
☐ False
4. Each MoM client must be added to the authorizedclients.dat file of each management server being monitored.
☐ True
☐ False

Database management and basic troubleshooting

Module 16

Objectives

After completing this module, you should be able to:

- Identify tools available for troubleshooting Storage Area Manager.
- Start and stop services on the management server and SAN host.
- Investigate deployment issues by viewing Repair Hints and <hostname>.log.
- Identify key log files used to troubleshoot Storage Area Manager.
- Identify situations when it is appropriate to check the contents of ddt.cfg.
- Gather troubleshooting information by running CLUI commands.
- Use the SAMTools utility to troubleshoot problems.

The Storage Area Manager database

Storage Area Manager uses a third-part database called Solid FlowEngine (version 3.7). The default maximum for the database is 5 GB.

- Runtime files are stored in `\sanmgr\managementserver\solid`
- The database configuration file is: `\sanmgr\managementserver\db\solid.ini`
- Transaction log file is: `\sanmgr\managementserver\db\solmsg.out`

Database backup

The database automatically backs up daily at 11:00 a.m. and 11:00 p.m. Backups are stored in `\sanmgr\managementserver\db\backup`. They are overwritten each time. If desired, write a script to copy backup files to a protected location.

Database commands

The following commands are useful in managing the Storage Area Manager database:

- **backupdb.cmd**
 - Provides on-demand, online backup of the database
 - Backup stored in backup subdirectory, as specified in `solid.ini`
 - Check `\sanmgr\managementserver\db\solmsg.out` to determine if the backup action has completed.
- **createnewdb.cmd**
 - Restores the database to the factory defaults
 - Any existing data in the database will be lost.
 - Stops all services, deletes the current database, restores the factory default database, and then restarts the services
 - When Storage Allocator is installed, you must stop and restart the Host Agent software after using this command.

- **restoredb.cmd**
 - Restores the database that was backed upAssumes the factory defaults used in solid.iniIf database has been relocated, this script will not work.
 - Restored database can be found in the backup subdirectory under \sanmgr\management server\db
- **revivedb.cmd**
 - Used to restore the database to the current state (last database saved by the scheduled backup or by the on-demand backup)
 - Database is restored to the current state by inserting all of the transactions found in the transaction log file \sanmgr\managementserver\db\sol_____.log

Specifying database locations manually

HP recommends that database locations be specified during initial installation using the Setup Assistant. However, database locations can be specified manually using the following procedure:

1. Stop management server services
2. Move all sanmgr.db files (sangmr.db to sanmgr20.db) to another disk drive on the management server.
3. If a third disk drive is available, move the \backup subdirectory to that drive.
4. Edit solid.ini to reflect the new location of the database files. The first of the 20 lines to be edited is shown below:

FileSpec_1=<new location path>sanmgr.db 256m
5. Continue scrolling down solid.ini to edit the line shown below to reflect the new location of the data repository backup files.

BackupDirectory=<new location path>backup
6. Save the changes and close solid.ini.
7. Restart management server services.

Sample solid.ini file

```
;/*****\
;** File      * solid.ini
;** Description * This is a predefined 'solid.ini' file for SOLID
;**          * Embedded Engine database
;** NOTE      * Please note that most settings are initially
;**          * commented out with ';' and SOLID executes using
;**          * the platform specific default settings.
;** Copyright  (c) 1992-2000 Solid Information Technology Ltd
; \*****/
;Server connection definitions as logical names
[Data Sources]
;original
;SOLID Embedded Engine eval server=tcp 1313,Local eval db connection
HP SAN Manager Repository Server=tcp 2600,HP SAN Manager Repository Connection

[Com]

;*** NETWORK NAME ***
;Listen=<protocol> <name or port>
;
;SOLID listens to the network using certain protocols and listening
;names or port numbers. Client processes must use a matching network
;name, when connecting to a server.
;The default listening names vary depending on platform.
;Select, edit and uncomment a suitable listening setting from below:
Listen=tcpip 2600          ; Generic
;Listen=tcpip 1313, upipe SOLID      ; Unix
;Listen=tcpip 1313, shmem SOLID      ; Windows
;Listen=tcpip 1313, decnet SOLID; OpenVMS
;Listen=spx SOLID          ; NetWare

[IndexFile]

;*** DATABASE FILES ***
;FileSpec_1=solid.db 2000m ;filepath & maximum size in bytes
```

```
;SOLID uses by default 'solid.db' as the first database file,  
;with maximum size of 2 gigabytes.  
;You may use m for megabytes or k for kilobytes.
```

```
;*** CACHE SIZE ***  
;CacheSize=8m    ; bytes  
;  
;SOLID uses platform specific default settings for cache size, until the  
;following setting is uncommented.  
;Please use multiplies of 8KB (database file block size)  
;You may use m for megabytes or k for kilobytes.  
;  
CacheSize=64m
```

```
** Insert new path here  
FileSpec_1=**sanmgr.db 256m  
FileSpec_2=**sanmgr2.db 256m  
FileSpec_3=**sanmgr3.db 256m  
FileSpec_4=**sanmgr4.db 256m  
FileSpec_5=**sanmgr5.db 256m  
FileSpec_6=**sanmgr6.db 256m  
FileSpec_7=**sanmgr7.db 256m  
FileSpec_8=**sanmgr8.db 256m  
FileSpec_9=**sanmgr9.db 256m  
FileSpec_10=**sanmgr10.db 256m  
FileSpec_11=**sanmgr11.db 256m  
FileSpec_12=**sanmgr12.db 256m  
FileSpec_13=**sanmgr13.db 256m  
FileSpec_14=**sanmgr14.db 256m  
FileSpec_15=**sanmgr15.db 256m  
FileSpec_16=**sanmgr16.db 256m  
FileSpec_17=**sanmgr17.db 256m  
FileSpec_18=**sanmgr18.db 256m  
FileSpec_19=**sanmgr19.db 256m  
FileSpec_20=**sanmgr20.db 256m
```

[Logging]

```
;*** LOG FILES LOCATION ***
```

```
FileNameTemplate=db\sol####.log
```

```
;
```

```
;SOLID writes by default the log files into the directory where it is
```

```
;started. However, it is recommended to store the logfiles on a separate
```

```
;physical drive than where the database files reside.
```

```
;Replace '<log_file_path>' above with the actual directory, where logfiles
```

```
;should be stored. The string '#####' will be substituted with the current
```

```
;log file sequence number by SOLID when creating new log files.
```

[General]

```
;*** BACKUP LOCATION ***
```

```
;BackupDirectory=<default_backup_path>
```

```
;
```

```
;There is no default location for backups. The backup directory can be
```

```
;given also as parameter to administration command 'backup'.
```

```
;It is recommended to store the backups on a separate physical drive than
```

```
;where the database files reside.
```

```
;Replace '<default_backup_path>' above with the actual directory, where
```

```
;backup files should be stored when 'backup' is started without parameters.
```

```
BackupDirectory=db\backup
```

Tools for troubleshooting Storage Area Manager

There are a variety of tools and techniques that can be used to troubleshoot and resolve problems with Storage Area Manager. They include:

- Product documentation
- Starting/stopping services
- Device release notes
- Repair Hints
- Log files
- Configuration files (ddtcfg.prp)
- CLUI commands
- SAMTools
- Troubleshooting hints

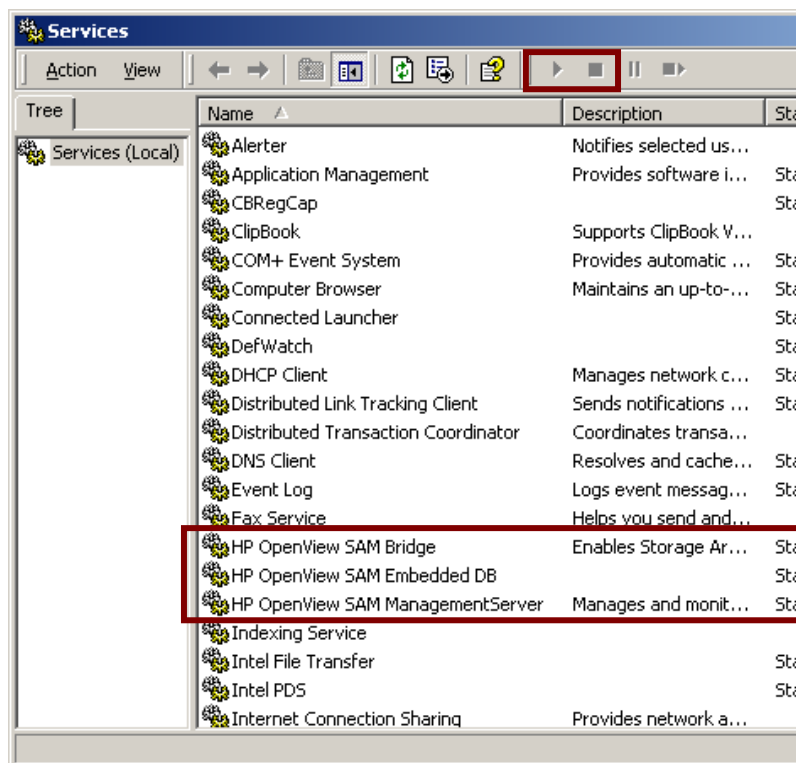
Product documentation

Refer to the following documentation for symptoms and resolutions of all potential problems known at the time of product release:

- Chapter 6: Troubleshooting, *hp OpenView Storage Area Manager Installation Guide*
- Chapter 9: Troubleshooting, *hp OpenView Storage Area Manager Administrator's Guide*
- Online Help

Additionally, refer to the *Storage Area Manager 3.1 Release Notes* for known issues and workarounds.

Starting and stopping management server services



Three services run on the management server:

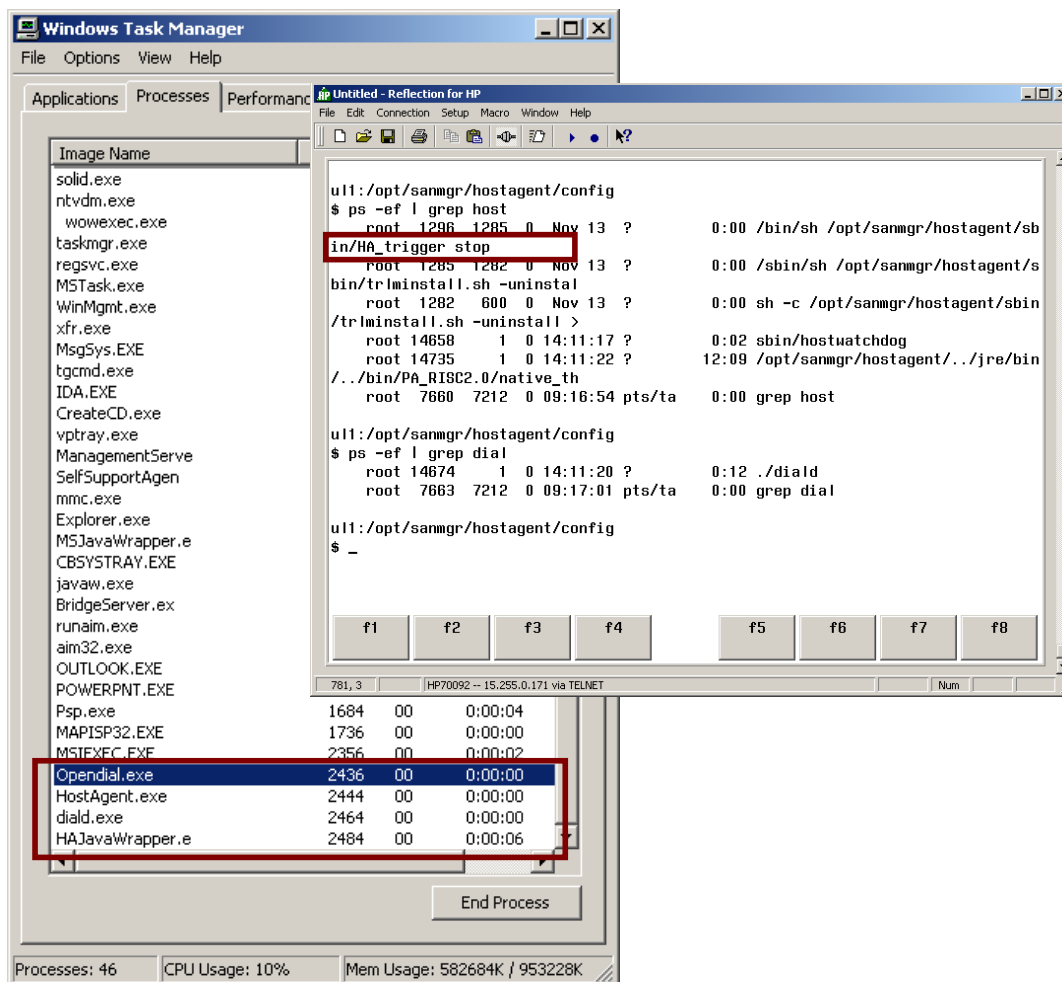
- HP OpenView SAM Bridge
- HP OpenView Embedded DB
- HP OpenView SAM Management Server

If experiencing difficulties with the management server, check to ensure these services are running. Restart them if they are not running.

It may also be necessary to stop and restart these services when:

- Performing system maintenance.
- Adding a new DPL.
- Editing solid.ini in order to specify the database location or increase size.

Starting and stopping Host Agent services



Several Host Agent services/processes run on each SAN host. The services/processes differ based on the operating system of the host.

The following processes run on Unix SAN hosts:

- HA_trigger
- Diald
- Hostwatchdog

The following processes run on Windows SAN Hosts

- HostAgent.exe
- diald.exe
- OpenDial.exe

If experiencing Host Agent problems (for example, cannot discover devices connected to a specific SAN Host) ensure the appropriate processes are running. Restart them if they are not running.

It may also be necessary to stop and restart these processes when performing system maintenance or editing dial.cfg in order to set the polling, logging, or status levels.

The commands to start processes on Unix SAN Hosts are located in /opt/sanmgr/sbin/

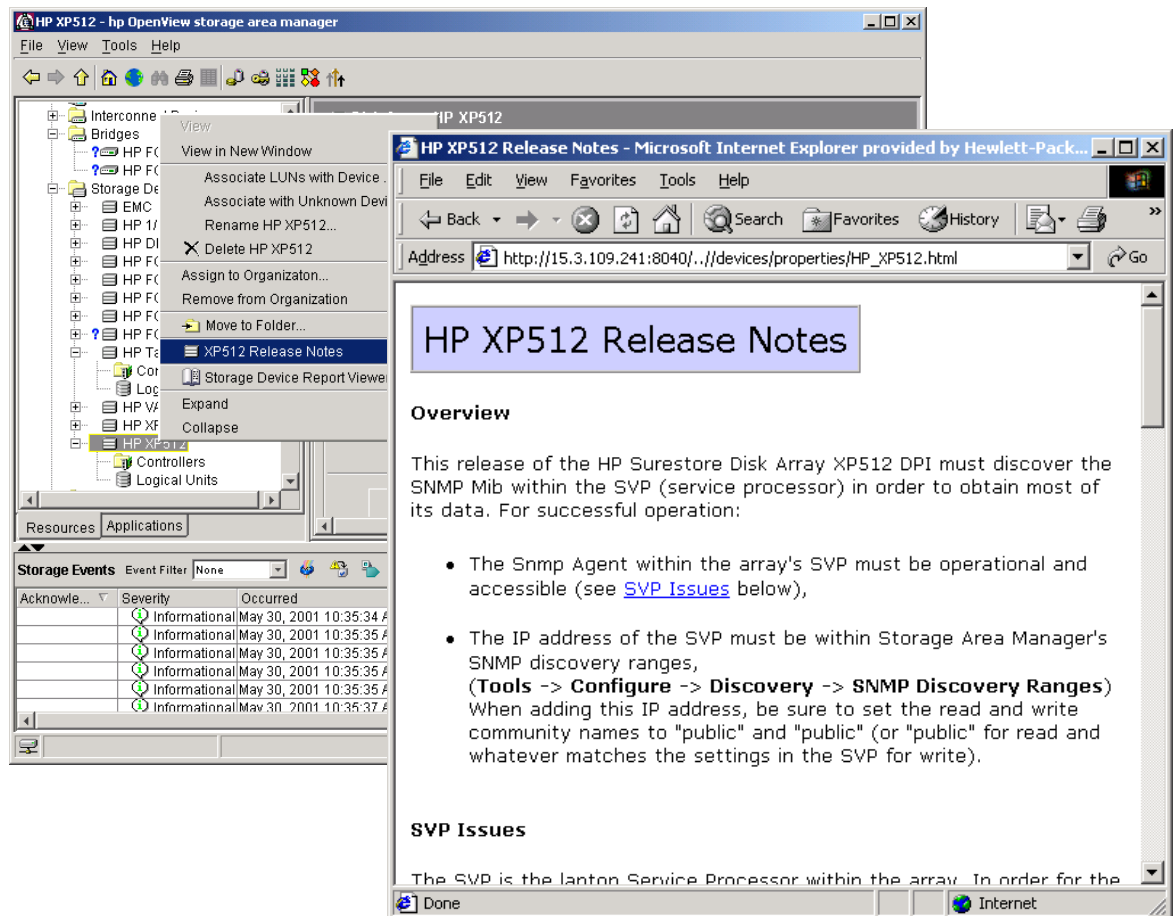
The commands required to start/stop these processes include:

- HA_Trigger start/stop
- dial_trigger start/stop
- wd_trigger start/stop/restart

Note

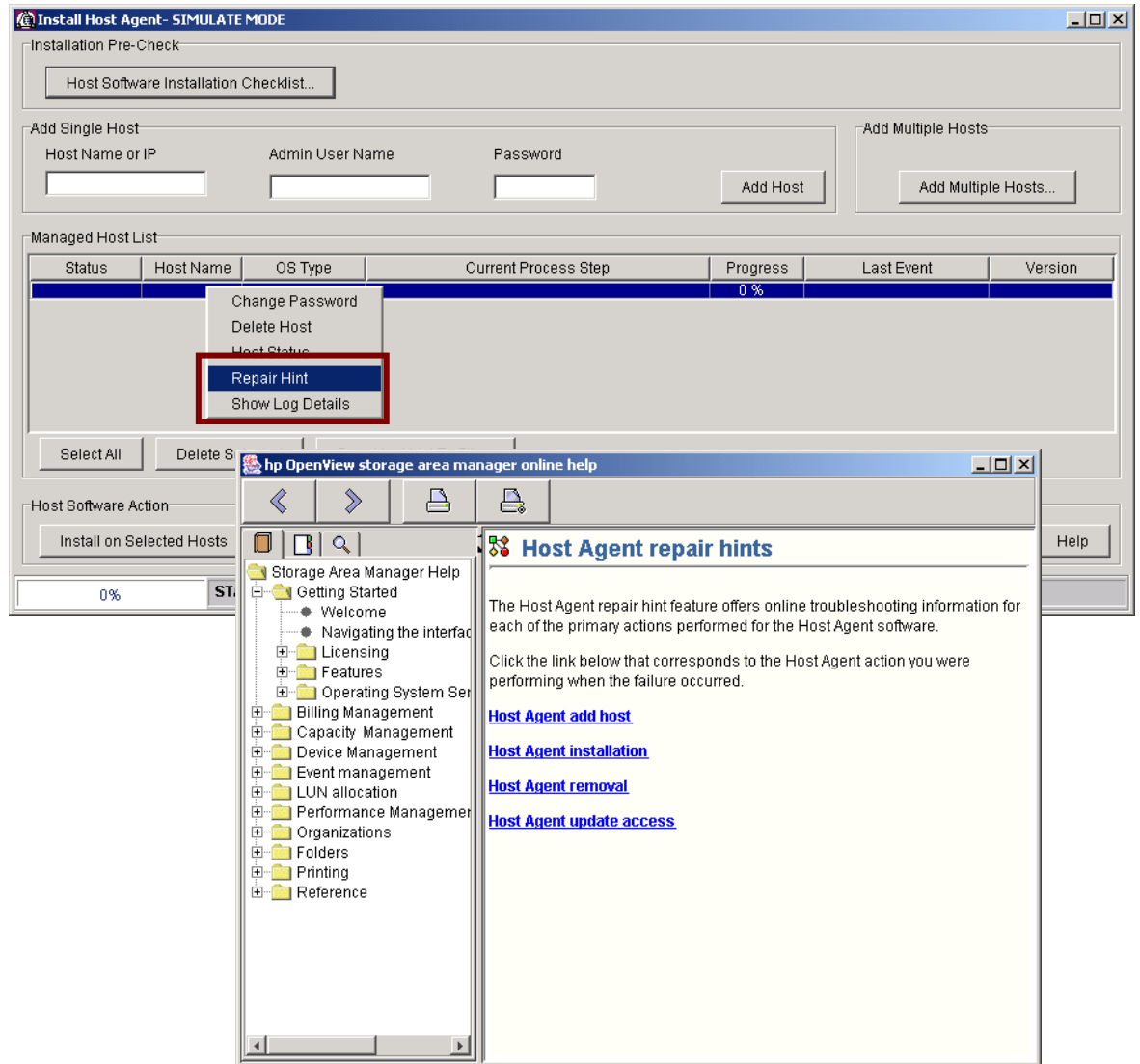
wd_trigger needs to be started first in order for the other two to be registered

Device release notes



If experiencing any problems with a specific device (for example, obtaining device status or difficulty launching a management application), first check the release notes for the device by right clicking the device in the tree or map and clicking *<device name> Release Notes*.

Repair hints and <hostname>.log



If a failure occurs on a specific host when using any of the Host Agent tools, right-click on the host in the *Managed Host List*, to display

- *Repair hints*—an online help facility that specifically provides assistance with deployment issues
- *<hostname>.log*—the Storage Area Manager log file that captures deployment information for a specific host

Note

The *<hostname>.log* can also be found in the directory
 sanmgr\managementserver\logs\deploy\

Log files

Storage Area Manager stores log files on the management server, management client, and SAN host. This section identifies the log files most useful for troubleshooting Host Agent deployment issues.

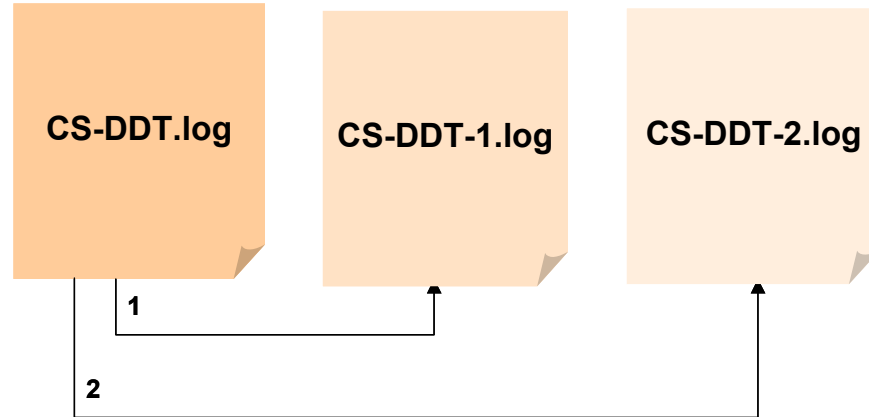
Key Core Services log files residing on the management server and client

Log files are located on the management server in the `\sanmgr\ManagementServer\logs` directory. The management server log files most useful for troubleshooting include:

- `<hostname>.log`—captures information related to any of the Manage Host Agent functions
 - See *Interpreting <hostname>.log* section for more information on how to interpret contents
 - Logging level set through GUI or configuration file
 - This log resides in the `deploy` subdirectory
- `deployserver.log`—shows deploy service startup and shutdown, start time for each hosts deploy action. Check this log file in order to determine the last thing that happened on a host if the system becomes unresponsive.
- `deploy.log`—captures software errors or exceptions (for example, you click a button on the Deploy screen and nothing happens)
- `<component>.log` (for example, `ddt.log`)—captures exceptions or errors related to each of the management server components. This log file is usually most useful for the Lab engineers.
 - Logging level set through `loggers.prp` configuration file

Additional, client log files are located on each client in the `\sanmgr\client\logs` directory.

When log files reach maximum file size



In the example above, CS-DDT.log reaches maximum log size as specified by the MaxFileSize parameter in loggers.prp. When this occurs, CS-DDT.log is renamed to CS-DDT-1.log and logging resumes. When CS-DDT-1.log reaches its maximum log size again, CS-DDT-1.log is renamed to CS-DDT-2.log and logging resumes. This continues until the maximum number of files is met as specified in the MaxNumFiles parameter. Management server log file parameters are specified in loggers.prp. This file contains explicit parameters for the Core Services log files as well as includes parameters for other log configuration files (files with .lgp extension) through the use of a SCANFILESPEC=.lgp command.

Key Core Services log files residing on the SAN host

Log files reside on each SAN host in the following directories:

- Unix: /var/opt/sanmgr/hostagent/log
- Windows: \sanmgr\hostagent\log

The most useful for troubleshooting include:

- *SAM-HostAgent.log*—captures information related to any of the components (SCSI Gateway, DIAL, and so on.)
 - Entries indicating potential problems are preceded by ERROR or EXCEPTION tags
- *dialog.log*—captures errors related to the DIAL process.
 - Unless there is an error, this file is empty
 - Logging level set in dial.cfg (default is error, level 1)
 - ♦ On Unix SAN hosts, dial.cfg resides in /etc/opt/sanmgr/hostagent/config
 - ♦ On Windows SAN hosts, dial.cfg resides in \sanmgr\hostagent\config

Several other Host Agent log files also exist, though they are typically only useful to product development engineers. They include

wd.log—captures errors related to the Watchdog process. Unless there is an error, this file is empty

HostAgentErr.log—captures Jcore or JVM errors

HostDebug.log—useful for debugging the JVM if it core dumps or crashes

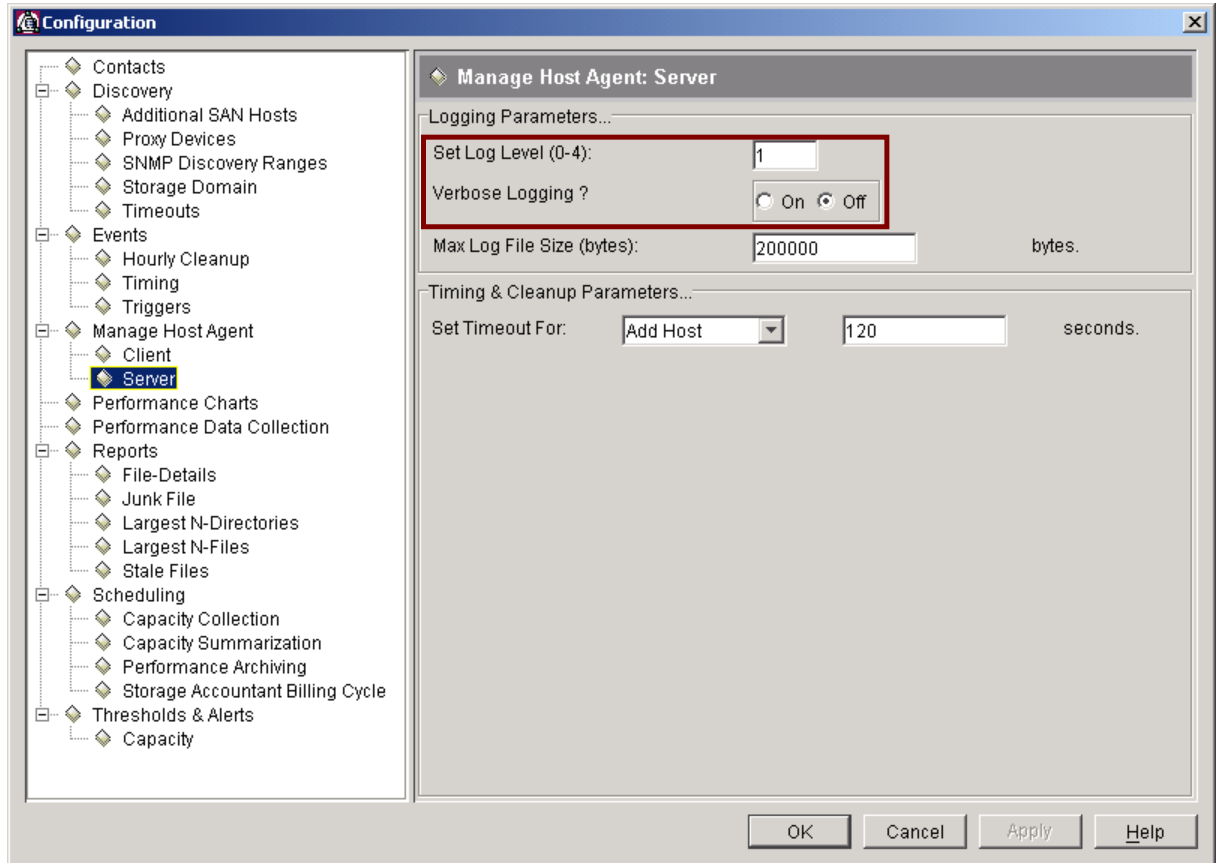
While not actually log files, the following additional Host Agent files may be useful in troubleshooting:

- *hostagent.alive*—produced every few minutes. If it is old or missing, indicates the Host Agent needs to be restarted
- *dial.alive*—produced every few minutes. If it is old or missing, indicates DIAL needs to be restarted
- *path.xml*—captures all hosts and devices that Storage Area Manager was able to identify during its discovery process.

These files can be found in the following directories:

- Unix: /var/opt/sanmgr/hostagent/data
- Windows: \sanmgr\hostagent\data

Setting the logging level for <hostname>.log



To set the logging level for <hostname>.log through the Configuration window, first select *Server* under *Manage Host Agent*. Enter the desired log level and turn verbose logging on or off. Click the *OK* button.

Additionally, logging for <hostname>.log can also be set by editing the Deployment configuration file on the management server. The configuration file is called `DeployServerConfig.prp` and resides in `sanmgr\managementserver\config\`.

Storage Accountant log files

The following Storage Accountant log files reside on the management server in `sanmgr\managementserver\logs\`

- CM-CMServer.log
- CM-Exporter.log
- CS-err.log

CM-CMServer.log entries

Message	Meaning/Solution
setUpBillingEvent Next billing date is:yyyy mm dd hh mm 2003 0 1 1 30	Occurs when CMServer successfully schedules the next billing date. Note: The months range from 0-11, and not 1-12. When you change a billing schedule from the Configuration window, this is where you can cross-check if the schedule was set properly.
License listener exit, no processing done	License check done successfully.
Storage Accountant audit log creation successful	Audit log entry created successfully.
Bill generation triggered, but not completed because license is out of compliance	Billing event is triggered, but Account license got out of compliance previously. Ensure Accountant is licensed properly.
Bill usage collection triggered, but not completed because license is out of compliance	Daily usage collection did not get completed and the Collector is shut down. Collector will only be restarted when license becomes compliant again. Ensure Accountant is licensed properly.
License is out of compliance, Storage Accountant is not starting the usage collector	At startup, itself, the CMServer detects that license is not compliant, so does not start the collector at all. Ensure Accountant is licensed properly.
Storage Accountant bill generation failed	When the internal XML file generation fails. Check if there is a correlator file for that billing period in the StorageCorrelator directory. Also, check the CM-Exporter.log for any error messages.
runBillingEvent(): Exporter FAILED to generate internal xml billing file	When the internal XML file generation fails. Check if there is a correlator file for that billing period in the StorageCorrelator directory. Also, check the CM-Exporter.log for any error messages.
Storage Accountant:runBillingEvent, found no collector files	If there are no usage collection files in the StorageCollector directory when the billing event happens, an empty billing file will be generated for that billing period. The next billing period should have information if there is any Storage Accountant activity.
Storage Accountant:setup of collection events failed	Internal error, which resulted in the CMServer not being able to schedule collection event times in the task scheduler. Contact your next level of support.
Storage Accountant:setup billing event failed	Internal SAM error, which resulted in the CMServer not being able to schedule collection event times in the task scheduler. Restart the management server.
The collector thread is dead, usage collection not done	CMServer attempted to initiate a collection and found that the collector thread is dead. Check the CM-SIUCollectors.log for further error messages.

CM-Exporter.log entries

Message	Meaning/Solution
Sent an XML file Exported event to AUDIT LOG	.xml file exported. Should also find corresponding entry in the Audit log.
Sent an CSV file Exported event to AUDIT LOG	Bill is exported to CSV format.
Sent an event HTML file Exported event to AUDIT LOG	Bill is exported to HTML format.
User Directory to store the detailed report types is not set in property file. So did not generate any special report types	Internal .xml bill report was generated, but was not exported to other report types. Check the Exporter Output Directory from the Configuration window. To generate the reports that were skipped, open the bill in Bill viewer and use the File-> export option to export to csv, xml, or html.
FAILED to create the user output directory structure	Exporter tried creating the exporter output directory structure. Make sure that the directory path provided can be created. Create it manually and give write permissions, so that the Exporter can use it when it is invoked during the next billing event.
There is no [NMESchema] entry inside the NMESchema.config	Internal configuration file is not correct. May have been accidentally modified. Get the correct NMESchema.config file from the CD and initiate the billing event manually again from the Configuration window.
Failed in Configuring the NMESchema Instance inside Exporter Constructor	Internal configuration file is not correct. May have been accidentally modified. Get the correct NMESchema.config file from the CD and initiate the billing event manually again from the Configuration window.
FAILED to create the internal XML reports dir	Exporter could not create the sanmgr/managementserver/data/accountant/exporter directory. Make sure proper write permissions are provided. Create the directory manually so the Exporter doesn't fail again.
FAILED to update the Current bill report\n"+ "Leaving it as it is. See the messages in the log elsewhere"	The update current billing file creation failed. Correlator failed to create the file in exporter/tmp directory. Check CM-SIUCollectors.log file for any error messages.
getXMLReport(): Did not find the file requested in exporter dir. So returning a null file handle.	There was a request for a file that has been either deleted accidentally or has been aged out. If it has been aged out, then retrieve it from archive and put it back into the Exporter/ dir. (Follow instructions in Online Help). Increase the ageing period in the Configuration window.
Problem reading file ./config\StorageCollector.config: java.io.FileNotFoundException: ./config\StorageCollector.config (The system cannot find the file specified)	sanmgr/managementserver/config/StorageCollector.config file is missing. Check to see if the file has been accidentally deleted from the config/ directory. If so, copy it from the CD into the config/ directory, and then restart the management server.
Fatal error: Could not find configuration for StorageCollector	sanmgr/managementserver/config/StorageCollector.config file is missing. Check to see if the file has been accidentally deleted from the config/ directory. If so, copy it from the CD into the config/ directory, and then restart the management server.
Problem reading file ./config\NMESchema.config: java.io.FileNotFoundException: ./config\NMESchema.config (The system cannot find the file specified)	The Collector cannot find the config/NMESchema.config file. The file may have been accidentally deleted. If so, copy it from the CD.

CS-err.log entries

Message	Meaning/Solution
Bill Viewer cannot connect to server	The Bill Viewer cannot contact the server. See if the CMServer process is running by looking at the CM-CMServer.log.
Bill Viewer can not get ExporterQueryIF	This failure may occur if the Accountant server component is not running.
Usage information is not available for the selected period	The.xml data file cannot be found. Either the .xml file aged out or Exporter had some problem generating the file. Look in CM-Exporter.log for further error messages.
Could not delete temporary XML file	The temporary .xml data file cannot be deleted in the directory sanmgr/managementserver/data/accountant/exporter/tmp/xxxxxx.xml. If for some reason the file is not deleted, it should not affect the operation of Storage Accountant any way. However, such tmp files can accumulate over time. Manually delete the files and give write permission on the directory.

Storage Allocator log files

The following Storage Allocator log files reside on the management server in `sanmgr\managementserver\logs\`

- `LM-CONFIGUI.log`—Typically not useful for field personnel.
- `LM-ERRORCONFIGUI.log`—Typically not useful for field personnel.
- `LM-LmGUI.log`—Contains entries used in debugging mode only. Typically not useful for field personnel.
- `LM-LMMS.log`—Contains entries tracking management server interaction with the Storage Allocator component on SAN hosts. The majority of log entries will be found in this log. It reports Allocator host and LUN creation, assignment/unassignment of LUNs, and tracking of the periodical check of the hosts to see if they are filtering the LUNs correctly.
- `LM-MSERROR.log`—Contains error entries related to Storage Allocator management server and host interaction. These include rogue server and reality-to-policy (LUN assignment) events, and when the host cannot be contacted.

Allocator Is activated on the host

When the Storage Allocator portion of the Host Agent service is started, the entries “ONETIMEINIT was successful!!!” and “LMHost up and ready!” are made to the `SAM-HostAgent.log`. All Storage Allocator entries are denoted with `LMHost`. When these entries are made, it indicates that the Storage Allocator component of the Host Agent service is active and functioning correctly.

Host boot event tells the management server the host is activated

Every time the Host Agent service starts on a host, it notifies the management server with what is known as the “boot event”. When the boot event makes it to the management server, the Storage Allocator component determines if the host is a Storage Allocator activated host, and if so, what its state is. If the boot event cannot initially succeed after activation, the host will not be listed as a Storage Allocator host, and no Storage Allocator functions are visible (LUN Allocation/LUN Discovery) on the GUI for that host. When a host boot event is received, it is tracked in the `LM-LMMS.log`. On the SAN host, tracking of the boot event success is in the `SAM-HostAgent.log`. Failure of the host boot event will show in the `HostAgentErr.log`.

LUN assignments/unassignments

All Logical Unit assignments/unassignments that are sent to a host are tracked in `managementserver\logs LM-LMMS.log`. On the SAN host, they are tracked in the `SAM-HostAgent.log`

Storage Builder log files

The following Storage Builder log files reside on the management server in `sanmgr/managementserver/logs/`:

- `Builder-DataHarvester.log`
- `IUM-CPMonitor.log`
- `CoreService-Harvester.log`

Builder-DataHarvester.log entries

Message	Meaning/Solution
Harvester enable state is...	Tells if the Builder harvester is enabled or not. If it is not enabled, you will get no Builder data. If it is not enabled, check for license compliance.
CPHarvester has successfully completed initialization.	Builder data harvester has been initialized on the Management Server
FileCapacity on has begun. Priority of '0' and timeout of '14400000' msec	<p>You will see these entries when a File data collection on a Host Agent has occurred.</p> <p>If you are expecting a data collection (either from a scheduled collection or from a forced collection) and don't see this entry shortly after, check the <code>SAM-HostAgent.log</code> on the host to verify that the data set collection was requested and successfully sent.</p> <p>This is the entry you should see in the <code>SAM-HostAgent.log</code>:</p> <pre>##\$==> 4 2003.11.21 at 14:38:50.528 2003.11.21 at 14:38:50.528 -1 cap49ers.rose.hp.com FileGatherer FileGathereTask ...collection ended</pre> <p>Posted a <code>COLLECTION_END</code> event</p> <p>Try restarting the Host Agent and forcing another collection. Otherwise, call next level of support. Lab is needed to debug</p>

UserAccountUpdate on 'capeagles.rose.hp.com' - DBID '41229'. has begun. Priority of '5' and timeout of '600000' msec.	<p>You will see these entries when a User data collection on a Host Agent has occurred.</p> <p>If you are expecting a data collection (either from a scheduled collection or from a forced collection) and don't see this entry shortly after, check the SAM-HostAgent.log on the host to verify that the data set collection was requested and successfully sent.</p> <p>This is the entry you should see in the SAM-HostAgent.log:</p> <pre> \$\$\$==> 4 2003.11.21 at 14:38:50.591 2003.11.21 at 14:38:50.591 -1 cap49ers.rose.hp.com UserGatherer UserGathererTask Collection successfully ended </pre> <p>Posted a COLLECTION_END event</p> <p>Try restarting the Host Agent and forcing another collection. Otherwise, call next level of support. Lab is needed to debug</p>
Handler 'FileCapacity on..... has completed successfully. Total service time 25875 msec.	Expected message after the 'FileCapacity' Handler on.... has begun' message. This means the File data collection completed successfully
Handler 'UserAccountUpdate on .....has completed successfully. Total service time 25719 msec.	Expected message after the 'UserAccountUpdate' Handler on.... has begun' message. This means the User data collection completed successfully
Handler 'FileCapacity on ... has failed to complete. Total service time ... msec.	If there has been a problem processing File data, you will see this message and probably a stack trace or a warning between the ' FileCapacity on.... has begun' message and this one.
Handler 'UserAccountUpdate on ... has failed to complete. Total service time ... msec.	<p>Call next level of support. Lab is needed to debug.</p> <p>If there has been a problem processing User data, you will see this message and probably a stack trace or a warning between the ' UserAccountUpdate on.... has begun' message and this one.</p> <p>Call next level of support. Lab is needed to debug.</p>

IUM-CPMonitor.log entries

Message	Meaning/Solution
Starting/Stopping CplUMServer	Expected message
Exception: Cannot start ium server	Call next level of support. Lab is needed to debug
Exception: Exception occurred for <volume>	Call next level of support. Lab is needed to debug

CoreService-Harvester.log entries

Message	Meaning/Solution
VolumeDataActionHandler on.... has begun. Priority of '5' and timeout of '600000' msec.	<p>You will see these entries when a volume data collection on a Host Agent has occurred.</p> <p>If you are expecting a data collection (either from a scheduled collection or from a forced collection) and don't see this entry shortly after, check the SAM-HostAgent.log on the host to verify that the data set collection was requested and successfully sent.</p> <p>This is the entry you should see in the SAM-HostAgent.log:</p> <pre> \$\$\$==> 4 2003.11.18 at 01:00:01.904 2003.11.18 at 01:00:01.904 -1 holly1.nfl.rose.hp.com VolumeGatherer getData: returning data for category 7cee94defd3ba59f:186d4c1:f8ece78427:-8000 set vm </pre> <p>Try restarting the Host Agent and forcing another collection.</p> <p>Otherwise, call next level of support. Lab is needed to debug</p>
Handler 'VolumeDataActionHandler ... has completed successfully. Total service time ... msec.	Expected message after the 'VolumeDataActionHandler on.... has begun' message.
Handler 'VolumeDataActionHandler on ... has failed to complete. Total service time ... msec.	<p>If there has been a problem processing volume data, you will see this message and probably a stack trace or a warning between the 'VolumeDataActionHandler on.... has begun' message and this one.</p> <p>Call next level of support. Lab is needed to debug.</p>
ApplicationDataHandler on ... has begun. Priority of '5' and timeout of '12600000' msec.	<p>You will see these entries when an application data collection on a Host Agent has occurred.</p> <p>If you are expecting a data collection (either from a scheduled collection or from a forced collection) and don't see this entry shortly after, check the Collector.log on the host to verify that the data set collection was requested and successfully sent.</p> <p>This is the entry you should see in the Collector.log:</p> <pre> \$\$\$==> 4 2003.11.20 at 09:53:34.446 2003.11.20 at 09:53:34.446 -1 holly1.rose.hp.com Collector getData: returning data for msuid 7cee94defd3ba59f:c2ea3f:f8f69c7f8c:-8000 set Oracle </pre> <p>Try restarting the Host Agent and forcing another collection.</p> <p>Otherwise, call next level of support. Lab is needed to debug</p>
Handler ApplicationDataHandler ... has completed successfully. Total service time ... msec.	Expected message after the 'ApplicationDataHandler on.... has begun' message.

Handler ApplicationDataHandler on ... has failed to complete. Total service time ... msec.

If there has been a problem processing volume data, you will see this message and probably a stack trace or a warning between the 'ApplicationDataHandler on.... has begun' message and this one.

Call next level of support. Lab is needed to debug.

Storage Optimizer log files

The following Storage Optimizer log files reside on the management server in `sanmgr\managementserver\logs\`

- **Optimizer-DataCollector.log** — Contains entries related to Optimizer's data collector. The majority of log entries will be found in this log.
- **Optimizer-PMBeans.log** — Contains entries related to Optimizer's usage of Device Plug-Ins
- **Optimizer-CLUI.log** — Contains entries related to Optimizer's command-line user interface.
- **Optimizer-Baseline.log** — Contains entries related to Optimizer's baselining and auto-thresholding.
- **Optimizer-Db.log** — Contains entries related to Optimizer database communication.

Optimizer-DataCollector.log entries

Message	Meaning/Solution
License Compliance: If there are no Performance tabs showing up in the GUI or data collection does not appear to be working, look for the following messages to determine if Storage Optimizer is appropriately licensed.	
PMCollectorComponent::PMLicenseEventListener::processEvent() – Determined Optimizer license compliance	Optimizer is licensed.
PMCollectorComponent::PMLicenseEventListener::processEvent() – Determined Optimizer is not licensed	Optimizer is not licensed. Install a license for Optimizer.
DPI Issues: PerformanceBeanExceptions occur when there is a problem collecting performance data from a host or device. The PerformanceBeanExceptions that appear in this log are the exceptions that appear from the Data Collector's standpoint. For additional errors, exceptions, or information look, at the Optimizer-PMBeans.log and try to match the entry times with those in this log file.	
PERFORMANCE_BEAN_PLUGIN_DISABLE D	PHA is disabled or plug-in is disabled.
PERFORMANCE_BEAN_PLUGIN_NOT_STARTED	Request to collect data was made before PHA was fully started.
PERFORMANCE_BEAN_EXTRACT_ERROR	Request to extract data caused an error with the tool.
PERFORMANCE_BEAN_PLUGIN_NOT_INSTALLED	Attempt to collect from tool, even though it is not installed.
PERFORMANCE_BEAN_PLUGIN_NOT_RUNNING	Attempt to collect from tool's daemon, even though it is not running.
PERFORMANCE_BEAN_JCORE_EMPTY_INTERFACE	PHA interface is null. Re-install performance agent.
PERFORMANCE_BEAN_PLUGIN_EMPTY_INTERFACE	Data returned back is null. Most likely a remote object/network issue.
PERFORMANCE_BEAN_JCORE_CONNECTION	Could not make Jcore connection. Most likely the Host Agent is down or there are network issues.
PERFORMANCE_BEAN_EXTRACT_ERROR	OVPA format changed (not likely to happen unless running OVPA 4.XX alpha), or out of disk space.

Optimizer-PMBeans.log entries

Message	Meaning/Solution
PERFORMANCE_BEAN_EXTRACT_ERROR for HBA	HBA Gateway component is missing, or there is a problem reading .xml.
PERFORMANCE_BEAN_EXTRACT_ERROR for EMC Symmetrix	Gateway locked errors.
PERFORMANCE_BEAN_EXTRACT_ERROR for Brocade/QLogic switches	Device timed out, OID changed on after it was discovered.
XP Performance Bean has device with no serial number	Likely the XP array in question has only been discovered through SCSI/FC and not through DHCP. Ensure that the array's SVP is in the SNMP discovery range.
XP Performance Bean Got List of Device Pathways for XP # <serial number> from XPPerformance Bean <ip addresses>	Refers to the list of hosts that the DPI will check for the XPPA CLUI software.
NULL SPI!! @ : <ipaddress>	Error with the Host Agent listed. It is missing the Storage Optimizer components.
Found an interface with no component installed@ <ip address>	XPPA CLUI not installed on the host listed.
XP Performance Bean attempt to collect from PA for XP with serial number # <serialnumber> failed... trying next host	DPI attempted to collect through a particular host and failed. It will try the next host in the list.
XP Performance Bean failed to collect, check status of Performance Advisor for XP <serial number>	DPI went through all hosts and did not succeed at collecting, or a null pointer occurred.
XP Performance Bean unable to find Performance Advisor running anywhere for XP #<serial number>	None of the hosts that Storage Optimizer knows are SAN-attached to the array were found to have the XPPA CLUI installed.
XP Performance Bean unable to find Performance Advisor running anywhere for XP #<serial number>	None of the hosts that Storage Optimizer knows are SAN-attached to the array were found to have the XPPA CLUI running.

Optimizer-CLUI.log entries

Message	Meaning/Solution
Could not find a metric to match <metricname>	The user input a metric name that is not in the database.
Exception in formatDataTXT() method in CLIPmActionHandler string missing from resource bundle:	The CLUI resource bundle is corrupt or missing.
Exception in <methodname> method in <classname>	A remote exception occurred.
RemoteException in <methodname> method in <classname>	A remote exception occurred.
Optimizer exception in getOrganizationDevices	The file config/PmDefaultMetrics.xml is missing.
IOException in <methodname> method in <classname>	An IOException occurred.
initDeviceConfig failed for device: <deviceName> in <method abbreviation>	Optimizer did not successfully initialize a deviceconfig for the device.
File Not Found Exception in <method> method in <methodname>	An expected file is missing.
Could not find a storableobject to match the device name typed in by the user:	The user input a name of a device that does not match any in the database.
Could not find any HBA Objects for device	The host name submitted by the user has no HBA objects associated with it.

Additionally, Storage Optimizer logs other error messages to CS-err.log which resides on the management client in the sanmgr\client\logs directory.

CS-err.log file entries

Message	Meaning/Solution
Could not get Remote Retriever!!!	Could not get a reference to the Metric Retriever on the management server. Make sure the management server is alive and responsive. Restart the management server if it is down.
AAIClientInterface.checkPermission	The user is not an administrator and cannot execute the piece of functionality. Ensure that the user has Administrator privileges.
majorChangeInCompliance	License compliance has changed; Optimizer may start nagging the user about licenses. Ensure that there is a valid license.
Any call to the Remote Metric Retriever that throws an exception	Could not get a reference to the Metric Retriever on the management server. Make sure the management server is alive and responsive. Restart the management server if it is down.
Not getting DeviceConfig or any Configuration	Could not get Optimizer-specific configuration information from the management server. Ensure that the management server is alive and responsive. Restart the management server if it is down.
IOException trying to export data	Problem saving exported files to the file system. Ensure that there is enough space on the file system.

Configuration files (ddtcfg.prp)

ddtcfg.prp is the configuration file for the DDT management server component. Several of the parameters that are specified in the Storage Area Manager GUI (such as domain, SNMP discovery range, additional hosts, and so on) are stored in this file.

This file resides on the management server in \sanmgr\managementserver\config.

Cross-check the contents of this file with the GUI settings if experiencing difficulties such as

- Discovering devices outside of the SNMP range specified
- Discovering hosts that are not part of the management server's domain
- Not discovering hosts that are listed in the Configuration window under Additional Hosts

The following table lists the parameters included in ddtcfg.prp, a description of the parameter, and where, if any, the parameter is set within the Storage Area Manager GUI. **Do not change these setting unless instructed to do so by Lab personnel.**

Parameter	Description	Where Parameter is Set in the GUI
WATCHDOG_TP_ABORT_TIME_MS=60000	Abort timeout if SNMP library fails to return.	
HOST_WATCHDOG_CYCLE_WAIT=60000	Controls how often the HostWatcher part of DDT will go ask each HostAgent if it has changed. Each of these polls is small in both CPU & Network usage. If events are not being received from the Host Agents, this value could be made smaller so that polling occurs more often. Or if concerned that this polling was creating too much network traffic, this value can be increased dramatically.	
DOMAIN=DEFAULT_DOMAIN	The Storage Domain – The name given by the user to the area of the SAN that this management server is responsible for	Configuration window, Storage Domain
NET_MASK_FILE_NAME=config/hostmask.prp	When DDT initially turns on after install, it has a default SNMP range. It reads that from this file. hostmask.prp is created by the installation process.	
SHOW_CONSOLE_DIALOG=false	Is used during development to turn on a "debug console". Is not used in the shipping product.	
SNMP_RETRIES=2	Controls how often an SNMP request is sent to the SNMP library	
HostHandlerThreadPoolName=Host_HandlerPool	Not used	
ZOMBIE_MONITOR=false	Detects Zombied database objects. Will cause EXCESSIVE memory usage over time if turned on. Used for debugging cache consistency issues with database. Output is difficult to understand unless someone really knows that portion of the code.	
SNMP_RETRIES_MIN=0	The minimum value for SNMP retries settable by the user.	

Parameter	Description	Where Parameter is Set in the GUI
DPI_PATH=devices	The root directory of DPIs & custom discovery code	
DOD_TP_ABORT_TIME_MS=1200000	How long DDT will spend to any one particular device before it gives up.	
SNMP_RETRIES_MAX=5	The Max value the customer can enter for SNMP retries in the GUI	
RMI_HOST_CONNECTION_TIMEOUT=30	Not used	
INTERVAL=900	Controls how often a host will go rescan for new devices	Configuration window, Discovery
RMI_HOST_CONNECTION_TIMEOUT_MIN=1	Not used	
SNMP_TIMEOUT=2	The timeout value for SNMP calls, in seconds	
START_DISCOVERY=true	Determines if Discovery is ON	Configuration window, Discovery
RMI_HOST_CONNECTION_TIMEOUT_MAX=60	Not used	
SNMP_WATCHDOG_CYCLE_WAIT=60000	Time to wait between walking the SNMP Range	
WATCHDOG_WARMUP_FREQUENCY=ON NEW_REPO	Not Used	
HostHandlerThreadPoolMinThreads=1	Not Used	
CLASSIFIER_TP_ABORT_TIME_MS=360000	Not used	
MIN_IDLE_BETWEEN_CYCLES_SEC=300	Not used	
SNMP_TIMEOUT_MIN=1	The minimum value the user can type in for an SNMP timeout	
WAIT_FOR_COMPONENTS_IDLE_MS=10000	Not used	
WATCHDOG_WARMUP_TIME_SEC=60	Not used	
SNMP_TIMEOUT_MAX=60	The maximum value the user can type in for an SNMP Timeout	
HostHandlerThreadPoolMaxThreads=1	Not used	
DEFAULT_SUBNET_MASK=255.255.255.0	If the SNMP range supplied by the installer is larger then 255 entries, use this netmask as a default instead.	
HostHandlerThreadPoolLifetime=10000	Not used	
ADDITIONAL_HOSTS {	List of hosts that Storage Area Manager can't discover using multicast	Configuration window, Additional Hosts
SNMP_IP_RANGES {	The SNMP discovery range	Configuration window, SNMP Discovery Ranges
ip1=15.43.208.1-15.43.208.254;public;public		
DOD_INITIAL_POLL_WAIT_MS=14400000	Initial time at DDT startup before DPI polling will occur on a timer (versus the initial events coming in at startup)	
DOD_CYCLE_WAIT_MS=14400000	Continuing timer that DDT uses to poll the DPIs	

CLUI commands for troubleshooting

Two Storage Area Manager CLUI commands exist specifically for use by support personnel. They include

- `support.cmd`
- `host_support.cmd`

These commands are typically used for gathering Storage Area Manager troubleshooting information so that it may be sent to product development engineers for further diagnosis.

support.cmd

To gather management server troubleshooting information, execute `\sanmgr\managementserver\sbin\support.cmd` on the management server.

This command creates an image of management server data and log files in `\sanmgr\managementserver\` called *support.zip*. It contains the following

- Version strings of key .jar files
- Status of Host Agent services
- Configuration files
- Device Property files
- Log files that reside on the management server (Host Agent, client, Bridge)

Running this command without any options to gathers data from

`...\ManagementServer\logs` directory

`...\ManagementServer\solid` - only the solid log files from this directory

Running this command with the `-data` option also gathers the

`...\ManagementServer\data` directory (which can be very large)

Additionally, this command creates the file *!hostAgentStatus.txt* in `\sanmgr\managementserver\log`. Use this file to identifies whether connection to data hosts is working or not. Errors are denoted by ******.

host_support.cmd

To gather SAN host troubleshooting information, execute `\sanmgr\managementserver\sbin\host_support.cmd hostname` on the management server. While executed on the management server, this command remotely gathers Host Agent data for the *hostname* it is passed. This command creates an image of Host Agent data and log files in `\sanmgr\managementserver\sbin\` called *hostname_support.zip*. It contains the following

- System information (services, processes, disk space, etc.)
- Version information (Java .jar files, Java JRE, etc.)
- Configuration information (all Host Agent and component config files, access.dat)
- Log information (all Host Agent, JCORE, *component.log* files)

The individual files that are packaged in *hostname_support.zip* are also placed in the `\sanmgr\managementserver\logs` directory. They can be identified by the *!hostname* prefix.

The same Host Agent data can be gathered by running the script version of the command on the SAN host itself. This is useful in instances where there are communication problems between the management server and the Host Agent.

To run the script from a Unix SAN host, execute the following command and re-direct the output to a file:

```
/opt/sanmgr/sbin/get_host_support_data_cmd parameter >  
filename
```

To run the script from a Windows SAN host, execute the following command and re-direct the output to a file:

```
\sanmgr\hostagent\sbin\get_host_support_data_cmd parameter >  
filename
```

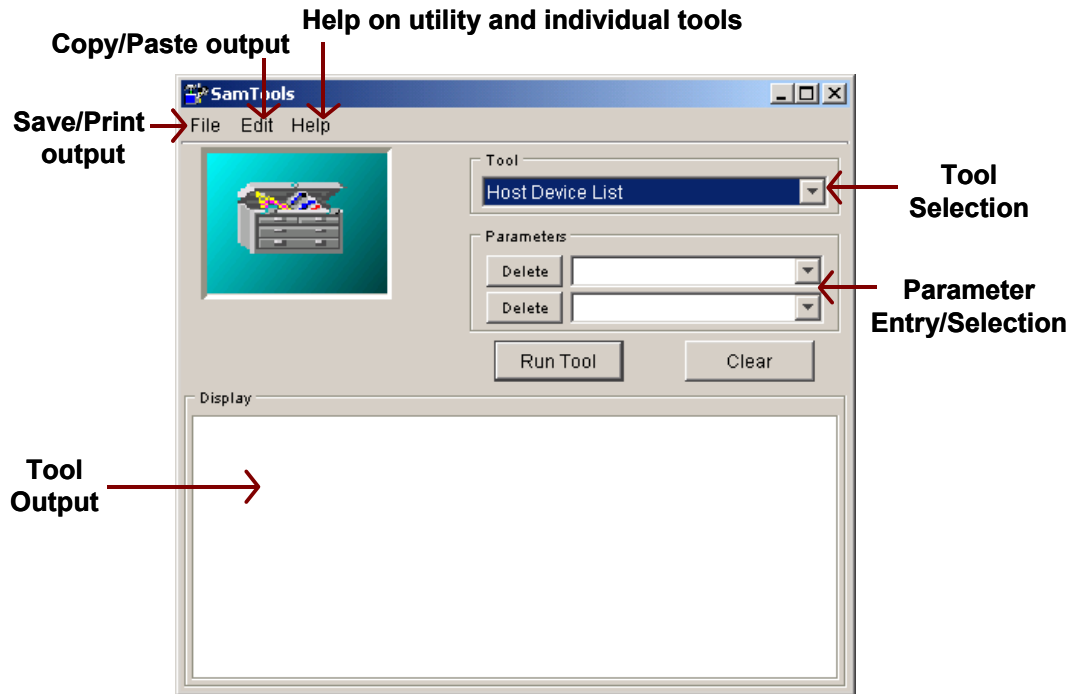
The script versions of the command may be passed optional parameters in order to only gather a subset of the available Host Agent data. The parameters are

- Version (default)
- Config
- Log
- System
- All

To gather Host Agent data from the management client, execute:

```
\sanmgr\client\bin\hostagentcmd -h hostname  
get_host_support_data parameter
```


SAMTools support utility



Storage Area Manager provides an **unsupported** utility called SAMTools that can be used for troubleshooting.

This utility is a basic, Java-based GUI wrapped around a set of tools developed by the product engineers. It was put together primarily for use by support personnel to assist in diagnosing problems associated with Storage Area Manager.

The SAMTools utility includes an extensive online help.

SAMTools requirements

SAMTools requires Java 1.3.1 or later.

Note

The required version of Java is installed when the Storage Area Manager management server or management client is installed.

Obtaining Access to SAMTools

SAMTools is available as a .zip file on the Storage Area Manager product CD-ROM in the \sanmgr\support directory. Additionally, in the future you can download SAMTools from

<http://support.openview.hp.com/support.jsp?fromOV=true>.

SAMTools features

The following table lists the features provided by the SAMTools utility, a description of each tool and tips on when to use each. Refer to the SAMTools online help for more detailed information on each tool.

SAMTools quick reference

Tool	Description	When to Use/What Results May Indicate
Host Device List	Produces a row/column report of all reported host LUNs and HBAs. This is a formatted version of output returned by the Host Raw Data tool.	<ul style="list-style-type: none"> ■ If HBAs or LUNs on a host are not discovered ■ To verify host connectivity ■ To get Host Lun address for SCSI Info
Host Raw Data	Retrieves the data from the Host Agent, in the form of an .xml file, for all discovered HBAs and host LUNs and presents it in its raw, detailed form.	HBAs or LUNs on a host that are not as expected. Host services are down, Host Agent is not installed or was installed by other management server (security issues)
Host Status (HostStatus)	Queries the Host Agent and returns the version number. Most useful when run from the management server.	<ul style="list-style-type: none"> ■ To check if Host Agent services are running ■ To validate discovery DOMAIN if a host is not discovered ■ To validate version strings Dial or Host Agent is down. Host Domain does not match management server. Host is running old software from another application (CommandView XP)
Host Performance Info (HostPerformance Data)	Retrieves performance data from the Host Agent. Pages through a list of OV Performance Agents to see if they're installed, verifies they're running, and returns performance information captured by those agents.	When Storage Optimizer performance data is not present or ceases to be captured OpenView Performance Agent is not running or the Host Agent service has stopped.
Host HBA Info	Queries the Host Agent and returns detailed information about the fibre channel HBAs on the host that are known to the SNIA libraries.	<ul style="list-style-type: none"> ■ If physical links to storage are not being reported ■ To validate HBAs (Vendor, versions, and so on) SNIA libraries are not installed. HBAs may not be as expected.
Ipconfig	Returns the IP address and other network adapter configuration information on the local machine.	Validate local network configuration and status (subnet mask, IP address, and so on) Server may be multi-homed (requiring IPADDR file update. See <i>Installation Guide</i>) or network may be down or misconfigured.
MibWalker	Used to verify that the device is communication via SNMP. Walks the Mib of the specified server and displays the first 20 entries. Most useful when run from the management server. Can be used without OV SAM installed	If an SNMP device is unreachable or not discovered The device is or is not communicating via SNMP. May indicate that the device is not configured correctly.

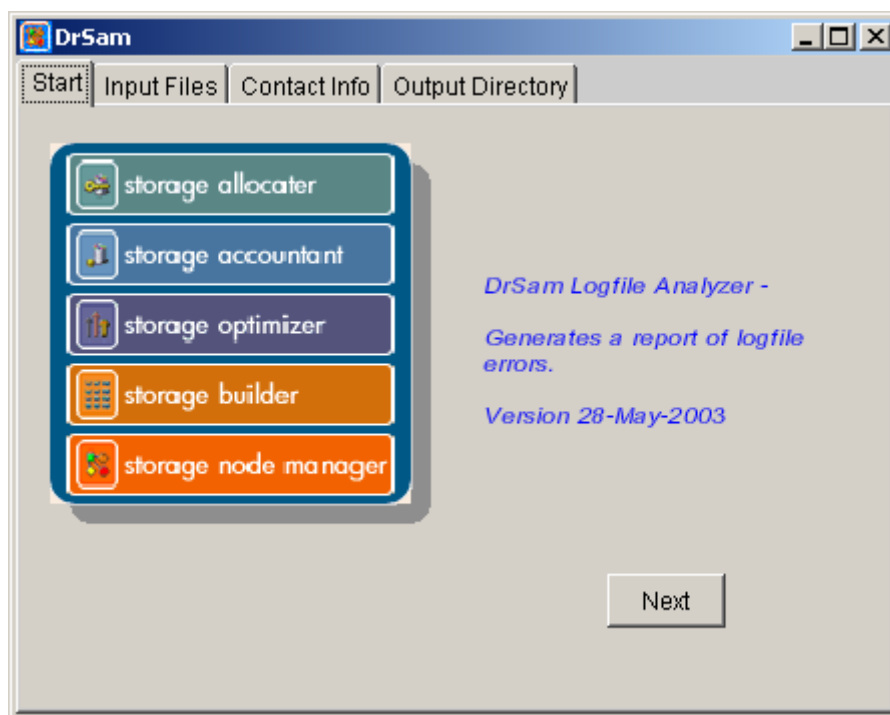
Ping	Pings the system specified to verify communication.	<p>To test communication between two OV SAM systems (for example, management server and Host Agents, management server and clients)</p> <p>The network is experiencing difficulties.</p>
SCSI Info	Performs a SCSI Inquiry to retrieve the Product Id, Vendor Id, firmware revision, and serial number of a LUN device.	<ul style="list-style-type: none"> ■ To verify that a host LUN is accessible ■ To verify that the host's SCSI gateway is operational ■ When a device is not being recognized <p>The LUN is inaccessible or SCSI Gateway is down.</p>
SCSI Info – PC	<p>Performs a SCSI Inquiry to retrieve Product Id, Vendor Id, firmware revision of disks on the local machine. Serial number is not retrieved.</p> <p>Can be used without OV SAM installed.</p>	<p>To determine what LUNs are on the local machine</p> <p>LUNs on local machine.</p>
Supported Devices Report	Produces a report showing which devices are recognized by Storage Area Manager. Included in the report are the property file name, its version, level of integration, the type of device, and the name.	<ul style="list-style-type: none"> ■ To verify that a DPI is installed ■ To verify what version of the DPI is installed <p>Missing or old DPI.</p>
XP Array Trap Simulation	Generates an SNMP trap encoded in the same format that an HP XP512 Disk Array generates.	<ul style="list-style-type: none"> ■ To verify that management server can receive traps ■ To demonstrate the event system ■ To demonstrate event formatting with and without DPI <p>Whether the management server is operational for receiving traps.</p>
XP MIB Refresh	XP Mib does not automatically know about the current hardware configuration, and must be externally requested to “refresh” its internal device knowledge. This tool uses the product code to force this refresh.	<ul style="list-style-type: none"> ■ Verify that Mib is refreshed and can be accessed ■ Verify that community names are correct <p>Mib is not working properly or community names are incorrect. May explain lack of port or storage data.</p>

Top SAMTools uses

Some of the most common uses for SAMTools include:

- A device is not being discovered and you want to verify that the device is being seen by DIAL (Host Device List)
- The map is not showing physical connections and you want to verify that there are SNIA libraries on the host (Host HBA Info)
- A device is not being discovered and you want to verify that the Host Agent is operating correctly (Host Status)
- You want to know if you have the latest version of a DPI (Supported Devices Report)
- You need to demonstrate that SNMP trap receiver is working correctly (XP Trap Simulator)
- A host is not being discovered and you suspect issues with the Jcore Domain (Host Status)
- You want to verify the IP address of an SNMP device such as an XP SVP, Brocade switch, Galactica tape library, and so on (MibWalker)
- You want to verify the SCSI inquiry information returned by some host (Host Device List and ScsiInfo)
- You cannot successfully communicate with the sVP in your XP array (MibWalker, XP Mib Refresh)

DrSAM

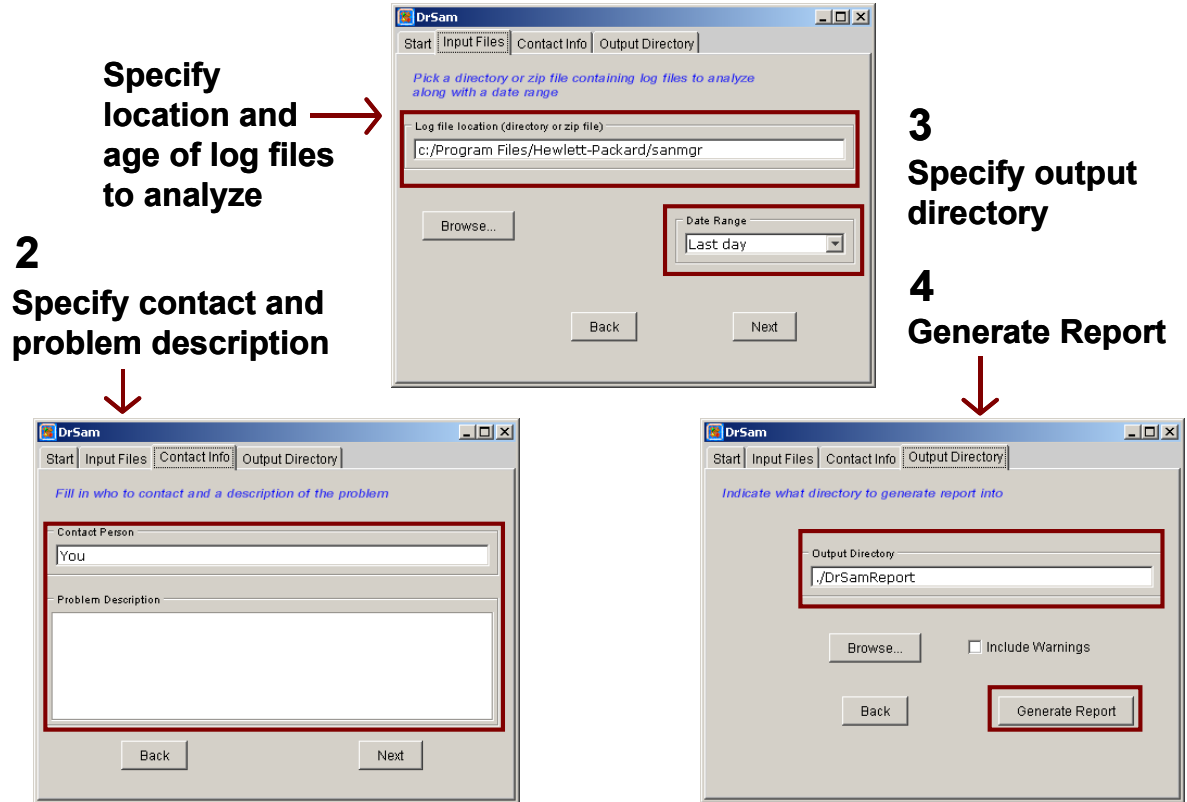


DrSAM is an unsupported, GUI software tool that can be used to locate and diagnose Storage Area Manager log file entries.

HP employees can download DrSAM from <http://tmilner.rose.hp.com/DrSam/>. DrSAM requires Java version 1.3.1 or later.

In the future, channel partners will be able to download DrSAM from <http://support.openview.hp.com/support.jsp?fromOV=true>.

The DrSAM GUI



Using DrSAM to generate a report is a four step process:

1. On the Input Files tab, specify the location and age of log file to analyze.
2. On the Contact Info tab, specify contact and problem description.
3. Specify the output directory.
4. Click Generate Report.

Troubleshooting hints

Problem	Solution
Unable to collect zoning from Brocade Switches	Install Adobe Acrobat. Storage Area Manager is dependant on the shared library /winnt/system32/msvc60.dll as an API
Unable to register for SNMP Traps with Brocade Switches	Telnet to the switch and use agtcfgShow to verify if another IP has been registered as trap receiver. Use the agtcfgDefault to reset to factory defaults. Storage Area Manager should now be able to automatically register itself with the switch
Unable to telnet to Brocade Switches. Session window immediately closes	Telnet is disabled on the switch for security reasons
Unable to launch Brocade Web Tools, or Element Manager via device manager links. Browser window is blank	Install JRE 1.3.1 or later on the Storage Area Manager management server
Unable to gather EVA capacity, performance, and LUN information from SMA/Proxy Device	Use default Element Manager login/password of administrator/administrator in the proxy device setup, restart Storage Area Manager services
HP-UX management tool SAM produces errors when using Storage Area Manager Host Agent for CVSDM communication	Install CVSDM agent first, then the Storage Area Manager Host Agent (opposite to what the CVSDM guide specifies)
Unable to discover HSV/HSG arrays FC attached to SWMA after loading a SAM Host Agent and/or setting up the Proxy Device and restarting Storage Area Manager services	Install Storage Area Manager Host Agent to a supported host with a LUN mounted from each array. The primary means of array discovery is in-band from the Storage Area Manager Host Agent. Installing an agent to the SWMA is not supported. The managed, FC-attached arrays will not be discovered in-band due to a modified HBA driver.
Storage Optimizer data missing	<p>It's possible that the management server's system clock/date is wrong, causing all incoming data to be time stamped in the past. Try setting the chart properties to display the previous year and see if the data is there.</p> <p>Note: It is important to get the system time/date checked before installing the Storage Area Manager Evaluation Kit, as the license will expire if the date is rolled forward after installation, requiring a call to the password delivery center for an extension</p>

Learning check

1. What is the name of the database configuration file?
.....
2. List the commands to start the Host Agent and DIAL processes on the SAN host.
.....
.....
3. What is the name of the log file that captures information about any of the Manage Host functions?
.....
4. Logging for <hostname>.log can be set from the Configuration window or by editing DeployServerConfig.prp on the management server.
☐ True
☐ False
5. Many of the GUI configuration settings are stored in a configuration file on the management server called gui.prp.
☐ True
☐ False
6. List two commands for gathering support related information on the management server and SAN host.
.....
.....
7. SAMTools is a web-based application used for troubleshooting problems with Storage Allocator.
☐ True
☐ False

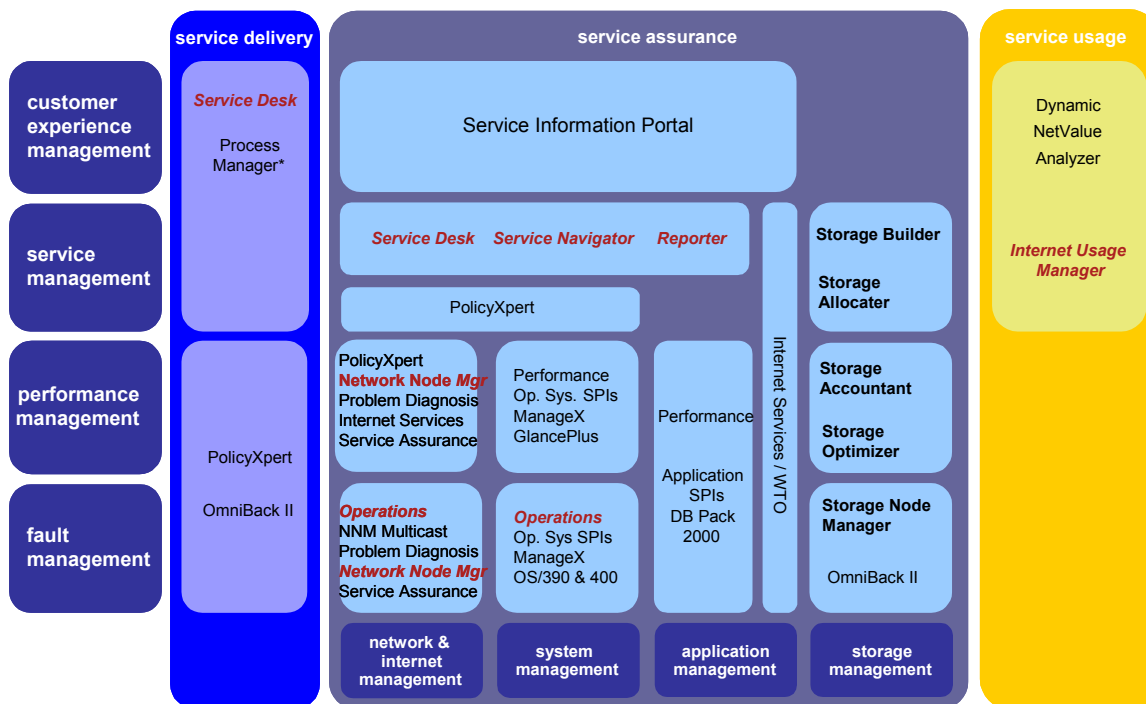
Objectives

After completing this module, you should be able to:

- Describe the function of the Storage Area Manager Bridge.
- Describe how the OpenView products are used by customers.
- Identify the major features of integration between Storage Area Manager and OpenView Operations.
- Identify the major features and dependencies of the integration with OpenView Service Desk.
- Describe the major features of the integration with OpenView Reporter and the method used to feed Storage Area Manager metrics into OpenView Reporter.
- Describe the features provided by the integration with Internet Usage Manager.

The OpenView solution

The OpenView Solution graphic shown here lists the products that make up the OpenView Suite.



The products are displayed in blocks as OpenView products work together like building blocks. Customers can select those products that meet their needs to develop a customized solution. As needs grow and change, products can be added.

The *vertical boxes* (fault management, performance management, service management and customer experience management) show the management category that each OpenView product manages, the *horizontal boxes* (network & internet, system, application and storage management) indicate the functional area that the product addresses

hp OpenView Storage Area Manager brings storage management into the OpenView Solution.

The goal of the OpenView Solution is to respond to customer requirements for enterprise-wide management.

Network management platform

hp OpenView Network Node Manager has, since the late 1980's, been the industry standard network management platform. Because of NNM's success and the fact that it was the original OpenView foundation product, in many peoples' minds *OpenView* is Network Node Manager. The reality is that OpenView is a family of enterprise-wide management solutions.

Integrated management platform

hp OpenView Operations is the central operations management console which integrates Network, System and Application Management into a central management platform. The successful Smart Plug-In program for application management includes dozens of hp and third party application management modules that integrate with OVO.

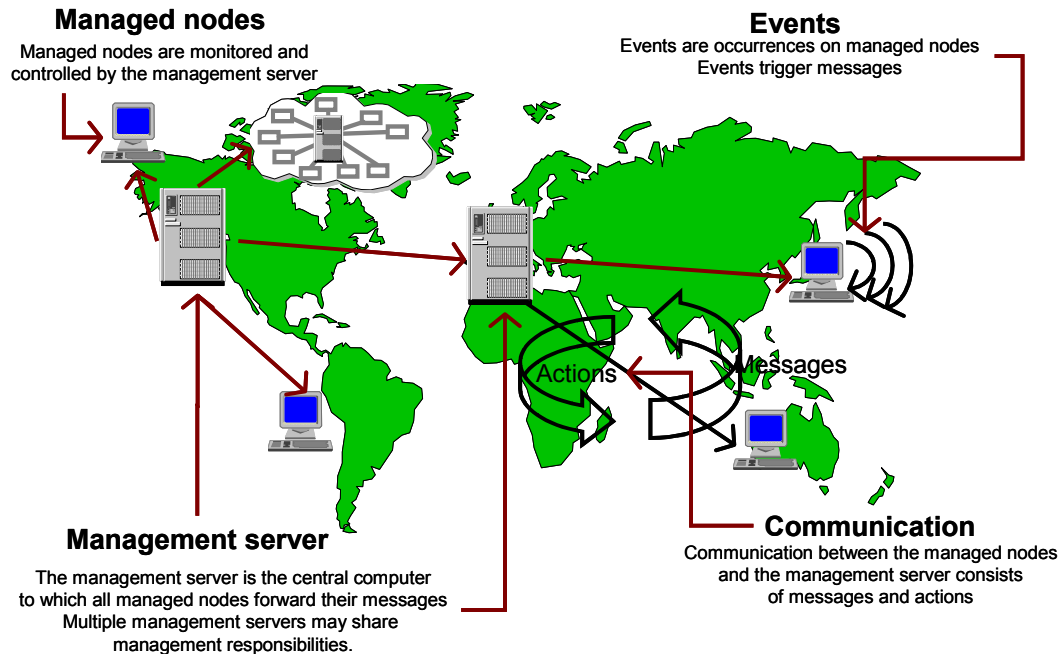
Note

OpenView Operations (OVO) has had three previous names since its introduction and these names are still used by some customers. In order of usage the names were OperationsCenter (OpC), IT/Operations (ITO) and VantagePoint Operations (VPO).

Service delivery platform

hp OpenView Service Desk is the service delivery platform for the OpenView suite of products. It includes tight integration with OVO so that an IT organizations operations, help desk and management are integrated into a single service management solution.

OpenView in action



Many customers already have hp OpenView products installed and they may not always recognize what they can do. Organizations need to understand the service that IT provides to its customers. Instead of identifying problems it identifies key business differentiators and uses the tools that are available to present how they are doing at providing the service to them.

hp OpenView is already used by 99 of the Fortune 100 companies. The hp OpenView suite of modular service management tools help prioritize IT activities. It enables IT staff to determine how each service contributes to the overall success of the enterprise. hp OpenView covers management of everything from networks, storage and systems to services like e-mail, enterprise resource planning and e-commerce.

The hp OpenView tools can be used to build the service model and configuration management database that connects IT infrastructure and people to the services that IT delivers. Additionally, it can implement proven IT Infrastructure Library (ITIL) based processes into products like hp OpenView Service Desk to automate business critical processes.

hp OpenView offers reporting capabilities that enable customers to generate reports that describe the quality of a service that is delivered. Moreover, IT can communicate with their lines of business in real time with products like hp OpenView Service Information Portal, which provides a customizable reporting and monitoring interface for individuals groups and lines of business.

With the service management solutions from hp OpenView, operators have been able to detect 95 percent of the problems in their infrastructures before end users noticed that services were unavailable.

OpenView products

Storage Area Manager integrates with the OpenView products described below.

OpenView Operations (OVO)

- Monitors, controls, and reports on IT environment health
- Provides a unified management point of view and integrated performance and availability management

OpenView Operations (OVO) provides a centralized console and intelligent agents to manage systems, applications and networks. It is the primary integration point for enterprise-wide management based upon the OpenView Solution family. Two versions of OVO are available, one with a Unix (HP-UX or Solaris) based management console, OVO for Unix, and the other with a Windows based console, OVO for Windows.

Service Navigator and Service Maps

- Creates and maintains service maps

The OVO for Unix *service navigator* and OVO for Windows *service maps* provide a graphical customer service view of the environment. Service maps are created based upon customer services (order entry, purchasing, and so on.). A hierarchy of dependent components is created under each service with rules about how problems in the underlying infrastructure affect the customer service.

OpenView Reporter

- Gathers the data captured by hp OpenView performance agents into valuable reports available through standard web browsers
- Provides reports related to IT service quality levels such as application response times and service availability

Reporter provides web-based reports to users and staff members based upon data collected from OpenView performance agents and Smart Plug-Ins. Reports are automatically generated nightly and posted on an IIS web server.

OpenView Service Desk (SD)

- Manages the service delivery and service support processes from the customer perspective
- Manages support process by service level

Service desk manages service delivery and the support process based on the ITIL methodology. Both the hp ITSM Reference Model as well as service desk are based on this methodology. ITIL stands for IT infrastructure library. It consists of a set of books that describe the best practices of IT organizations world wide in performing certain common processes.

Service Desk is designed to manage and measure these processes

Internet Usage Manager (IUM)

- Collects, aggregates, and correlates usage data from across the network (traffic flows), systems (CPU utilization), and storage
- Repository of information required to implement usage-based billing systems, manage capacity and analyze subscriber behavior

Internet Usage Manager is a framework product designed for service providers. It is used to gather usage information from network devices and/or services. One of the primary goals of IUM is to implement usage-based billing systems. This integration forwards usage information from *Storage Builder* and *Storage Accountant* to IUM.

OpenView integration features

OpenView product	OpenView Storage Area Manager application	Integration type
OVO/Unix & OVO/Windows	Accountant, Allocator, Builder, Optimizer, SNM	Event forwarding, process monitors, node groups, user, applications, actions, message group
Service Navigator / Service Maps	Allocator, Core, SNM, (Bridge)	Service map creation/updates
Reporter	Builder, Accountant, SNM, (Bridge)	Reports, custom storage area manager gather
Service Desk	Core, (Bridge)	Import configuration items, create categories, forward events
Internet Usage Manager	Accountant, Builder	Capacity usage data and LUN allocation data

OpenView Operations

The OVO for Unix and Windows SPI is built upon the ability to forward events from and monitor the Storage Area Manager management system to OVO using the OVO agent. The OVO agent is installed on the Storage Area Manager management server and monitored via templates that are part of the Storage Area Manager SPI for OVO.

This integration forwards events from the Storage Accountant, Storage Allocator, Storage Builder, Storage Optimizer and Storage Node Manager modules to OVO. Process monitors watch for the management server and Host Agent processes and notify the OVO operator when they stop. Via the OVOs application desktop, the SPI allows the user to stop and start the Storage Area Manager management server and Host Agent services.

Service Navigator/Service Maps

The service navigator (OVO for Unix) and service map (OVO for Windows) features provide the OVO user with a service view of the managed environment. With this capability, instead of providing only an event oriented view of the network, provides the IT organization with a customer service view of the state of the IT infrastructure.

The Storage Area Manager SPI supports the service view by performing a discovery of the Storage Area Manager Host Agent components and drawing the service map representation of Storage Area Manager. It will also create a second service map that shows the storage links based upon the Storage Node Manager map. As events or status changes occur on host nodes and the management server, the events displayed in the OVO message browser will also affect the status of the service view. The service maps are drawn from information gathered by the Storage Node Manager, Core services and Storage Allocator.

Reporter

With the OVO for Reporter integration information from the Storage Node Manager, Storage Builder and Storage Accountant applications is gathered and stored in the OV Reporter database. Crystal reports are generated nightly and made available to users via the IIS web server installed on the reporter system.

Service Desk

Using the Service Desk (SD) integration, customers can automatically import the object definitions from the Storage Area Manager database into Service Desk and SD configuration items. Via Service Desk's integration with OVO, events from Storage Area Manager can be forwarded to SD to create incidents.

Internationalization

The integrations are tested with

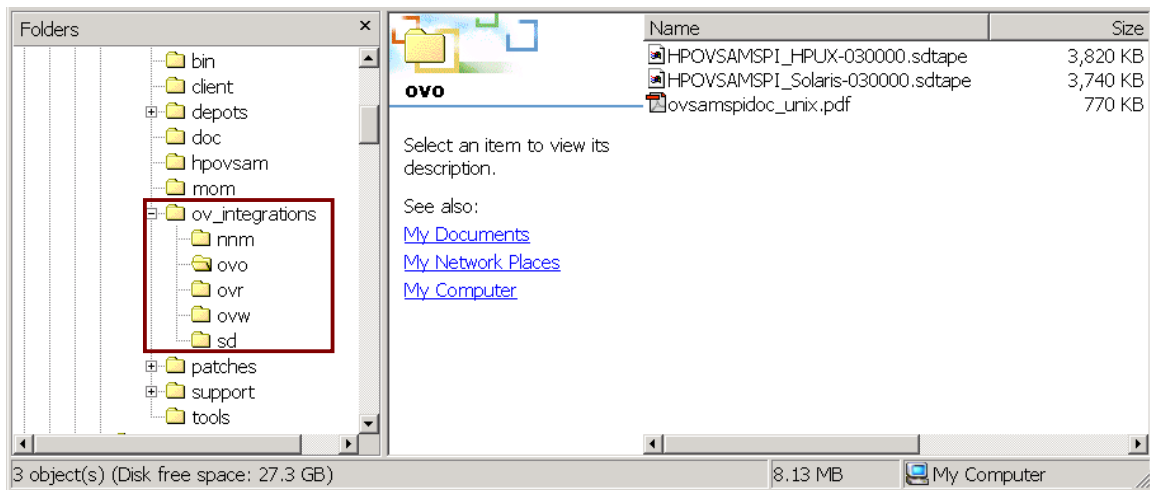
- Storage Area Manager Management Server installed on localized Windows
- Localized versions of OpenView products

OpenView integration components

The required installation components and their delivery mechanisms follow.

OpenView product	Required installation component(s)	Component delivery mechanism
OVO/Unix 7.0, 7.1 and Service Navigator	OVO/Unix SPI Installation Package	OV SAM CD
OVO/Windows 7.0, 7.1 and OVOW Service Maps	OVO/Windows SPI Installation Package	OV SAM CD
Reporter 3.0, 3.5	Integration Install Package	OV SAM CD
Service Desk 4.0, 4.5	Integration Install Package	OV SAM CD
Internet Usage Manager 4.1	Files automatically Installed with OV SAM & IUM	OV SAM CD & IUM

Storage Area Manager integration directories



The OpenView integration modules can be found on the Storage Area Manager CD under the `ov_integrations` directory. Each integration and documentation is provided in its' own directory:

nnm – Network Node Manager mib file and readme document

ovo – OVO for Unix SD depots (HP-UX & Solaris management servers) and manual

ovr – Reporter installation package and manual

ovw – OVO for Windows installation package and manual

sd – Service Desk installation package and manual

Storage Area Manager Bridge

The Storage Area Manager Bridge service is component that is installed with the management server. It provides a point of integration for external applications. The initial use of the Storage Area Manager Bridge is to support the OpenView integrations.

It consists of a HTTP server enhanced to allow programmatic access to Storage Area Manager information. The server is running but inactive (from the standpoint of the OpenView integration modules). By default, the Bridge accepts HTTP requests on port 8041.

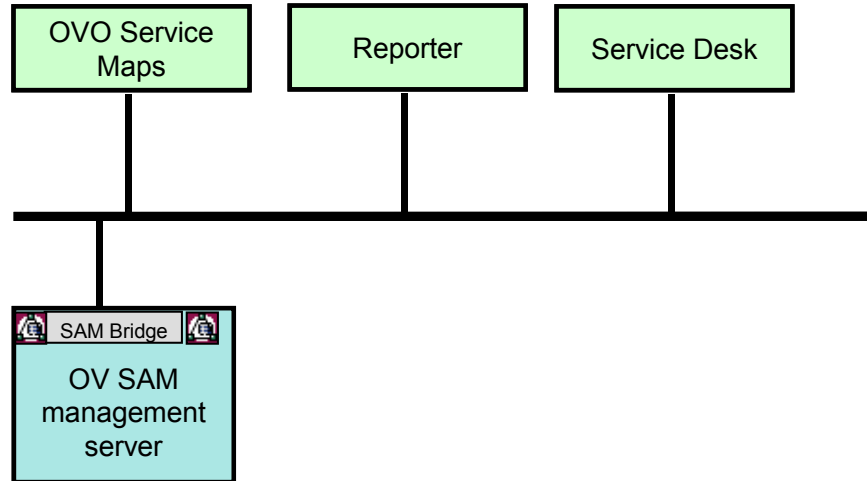
The Bridge provides the following services:

- Report generation and retrieval bridge/interface
- Command line execution bridge
- Database access bridge
- Service hierarchy/map bridge

The Bridge is used in the following integrations:

- Service Navigator (OVOU) and Service Map (OVOW) hierarchy creation and updates
- Reporter data importing for reports
- Service Desk configuration item retrieval

Storage Area Manager Bridge configuration



To use the Bridge, applications must provide a Storage Area Manager management server login with a user name and password. Each of the OpenView integrations provides a mechanism to configure the user name and password it uses to communicate with the management server via the bridge. These applications will typically recommend use of either the default user “User” or Administrator based on whether they need read-only or read-write access to Storage Area Manager data.

OpenView integration Bridge parameter configuration

The OpenView integration modules that interface with the Bridge each provide a mechanism to configure the parameters associated with their communication:

- OpenView Reporter: Using the Gatherer Configuration Editor GUI tool
- OVOU Service Navigator integration: During the integration install script - `ovsamconf.sh`
- OVOW Service Maps: Using the `ovsamsd.bat` configuration script
- Service Desk: Using the `SamCIExtractor` utility

Storage Area Manager Bridge configuration

The Bridge service itself uses a file to configure the server portion of Storage Area Manager Bridge. The configuration file is <install-dir>\sanmgr\bridge\config\SAMBridge.cfg. The administrator can hand configure the following keys. *If any of the values are changed, the Storage Area Manager Bridge service must be restarted.*

Configuration file keywords

Typically, only the CONFIGURED_MANAGEMENT_SERVER_LIST parameter needs to be modified to add more than one management server to the bridge configuration. For more details, see the Bridge Configuration chapter in the *Storage Area Manager Administrator's Guide*.

PORT is the port number that Storage Area Manager Bridge will be listening on. Default port number is 8041.

DEFAULT_MANAGEMENT_SERVER is the management server that will receive requests from the Storage Area Manager Bridge.

CONFIGURED_MANAGEMENT_SERVER_LIST contains a comma-separated list of management servers that can accept requests from a Storage Area Manager Bridge handler.

Default is a list with only "localhost" in the list.

Example of how to configure multiple management servers

CONFIGURED_MANAGEMENT_SERVER_LIST = localhost,ms1,ms2,ms3

MAX_CLIF_CONNECTION is the maximum number of connections that the clif connection pool will create for a management server. Default is 4.

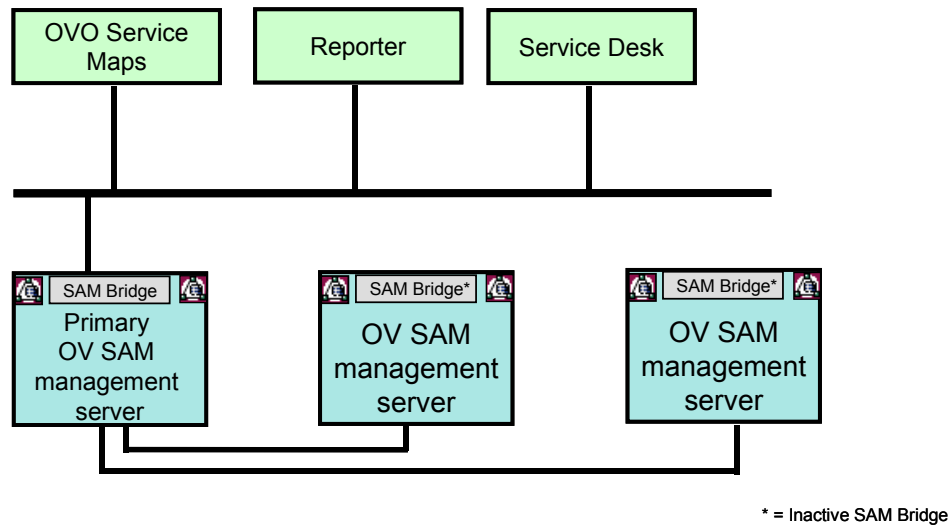
CONNECTION_TIME_OUT is the time in milliseconds that a SharedJCore connection will wait in order to login to a management server. Default is 8000 (8 seconds)

SSL-related configuration file keywords

For secure communication, the Storage Area Manager Bridge can be configured to use SSL (Secure Sockets Layer). SSL is a protocol for transmitting private information via TCP/IP. It works by using a public key to encrypt data that's transferred over the SSL connection.

To configure the Storage Area Manager Bridge for SSL, refer to the chapter on *Configuring the Bridge* in the *hp OpenView storage area manager 3.0 administrator's guide*.

Bridge configuration: Multiple management servers

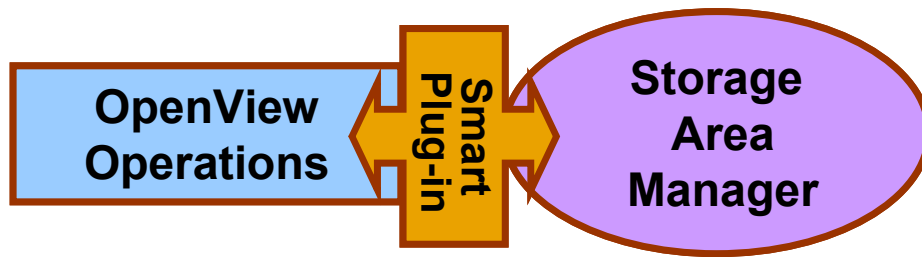


If multiple Storage Area Manager management servers are in use, one server should be configured as the primary Storage Area Manager management server to which the OpenView modules interface. The Storage Area Manager Bridge on this server is configured to gather data from all Storage Area Manager management servers.

Using this configuration, the bridge services on the remaining management servers are inactive.

The details for implementing this type of configuration can be found in the *hp OpenView storage area manager administrator's guide*.

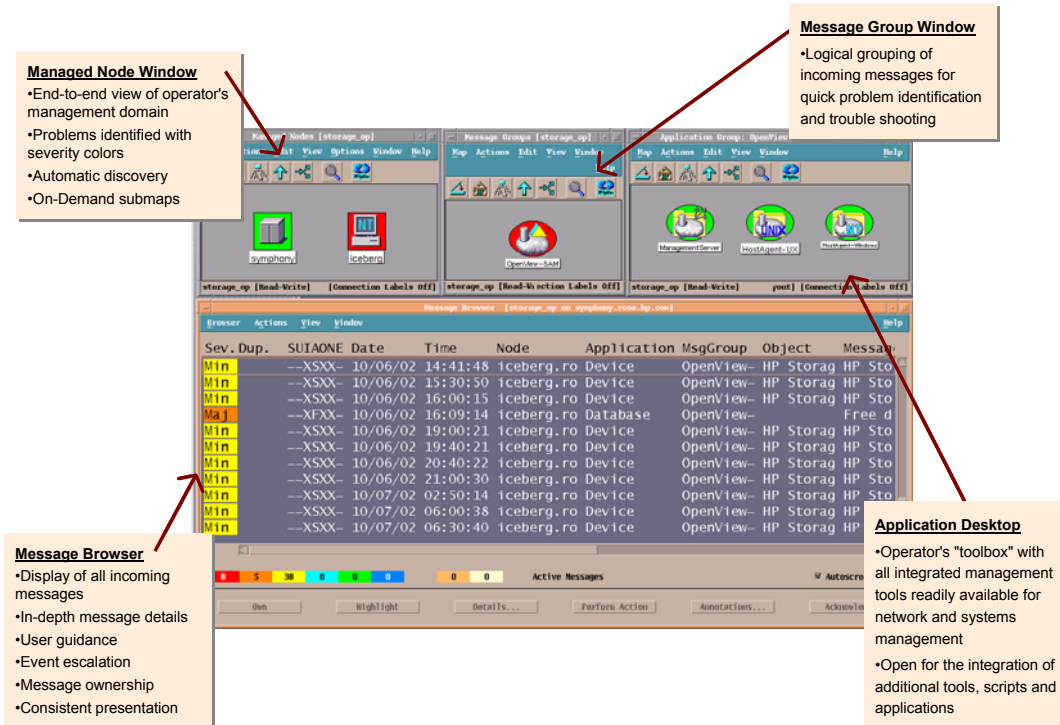
What is a Smart Plug-In?



Smart Plug-Ins (SPI) are certified integrations for hp OpenView Operations. A SPI offers pre-packaged, application specific management knowledge that delivers tailored monitoring, alerting, analysis and corrective actions for a specific application. Some of the more popular SPI's available from hp are the Database SPI (Oracle, SQL Server, Sybase, Informix), the Microsoft Exchange SPI, and the SAP SPI among others.

SPIs were originally integrations with OpenView Operations. Today, a fully integrated OpenView Smart Plug-In provides interfaces to OpenView Operations, OpenView Performance Agents, OpenView Reporter, and Service Navigator.

OVO for Unix overview



This is a snapshot of the OVO for Unix Motif GUI showing the Storage Area Manager application groups and messages.

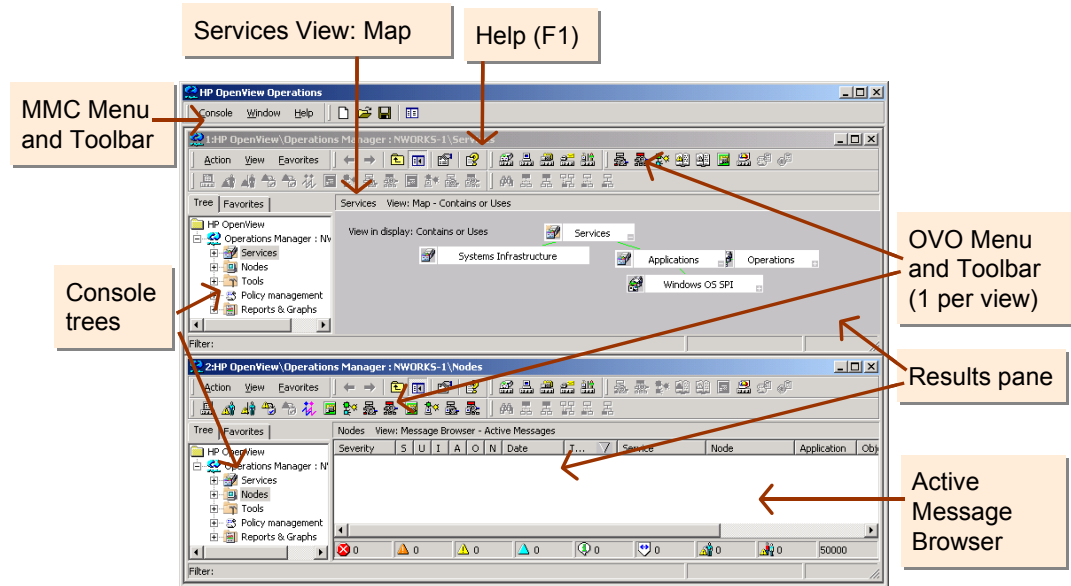
The primary OVO user interface is Motif-based and provides access to all of OVO's user and administrative capabilities except for the Service Navigator function. A separate Java GUI is available which provides user access including the Service Navigator. Administrative functions, including installation and configuration of Smart Plug-Ins, can only be performed via the Motif GUI.

Note

OVO was previously named VantagePoint Operations (VPO) and before that IT/Operations (ITO) and before that OperationsCenter (OpC). Many customers still use name ITO to refer to OVO for Unix. Many OVO commands use the original 'opc' name.

In addition to the centralized management console, the other key component of OVO is its intelligent agent. Via the console, the administrator configures monitoring of log files, processes and execution of scripts and programs that perform monitoring functions and take actions. These templates are downloaded from the console to the OVO intelligent agents that actually perform the monitoring, filter messages, and forward the results back to the management server.

OVO for Windows overview



This is a snapshot of the OVO for Windows GUI showing the Storage Area Manager application groups and messages.

The primary OVO user interface is a snap-in to the Microsoft Management Console (MMC) and it provides access to all of the OVO user and administrative capabilities including Service Maps. A separate web GUI is available which provides access to some user functions including message browsing.

Note

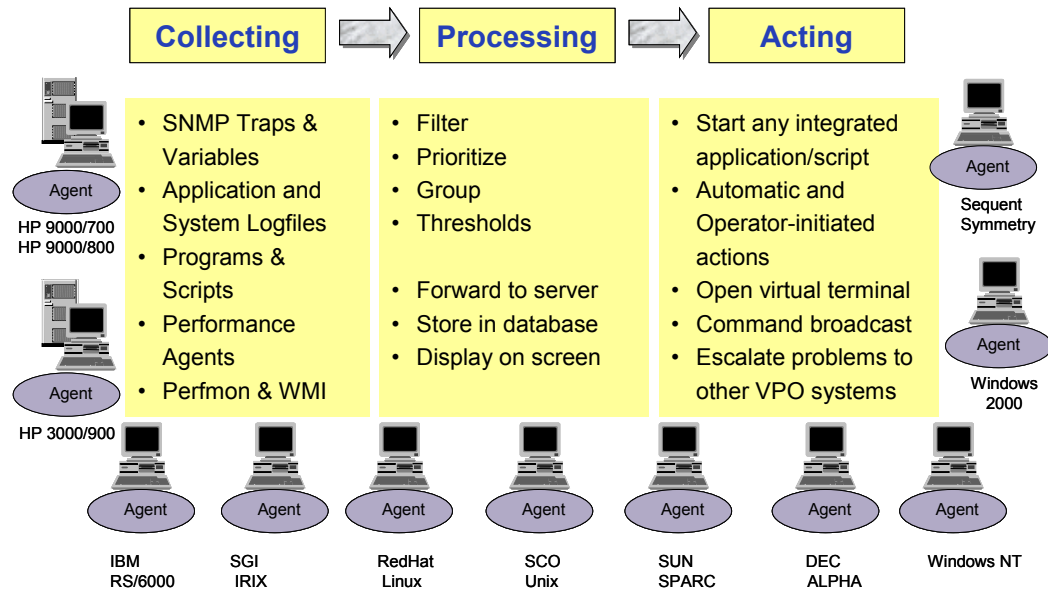
OVO for Windows was previously named VantagePoint Windows (VPW).

OVO for Windows uses a three-tier architecture made up of a management server, management consoles, and agents running on the managed nodes. The simplest implementation of OVO for Windows uses a single management server. More complex solutions can involve tying multiple management servers together in a hierarchy, which is called a manager-of-managers configuration. OVO for Windows can be combined with other OVO for Windows management servers or OVO for UNIX management servers as dictated by the requirements of the implementation.

At the heart of OVO for Windows is the management server. The management server uses a database to store the service model, information about the managed nodes, methods used to manage the nodes, and events that have occurred on the managed nodes. Reports, graphs, and forwarding to OVO for Unix policies are all handled on the management server.

OVO for Windows uses policies to manage the environment. Policies are stored centrally on the management server and deployed to the managed nodes automatically or by the OVO for Windows administrator.

OVO event processing



OVO for Unix and Windows share a common core feature which is the processing of events from across the IT infrastructure.

Note

While OVO for Unix includes Network Node Manager, it is not included with OVO for Windows although NNM for Windows can be loaded on the same management station and does integrate with OVO for Windows.

Collecting

Collecting is the phase when events are created and are detected by OVO components. Many different sources may be taken as the originator of events - SNMP Traps & Variables; Application and System Logfiles; Programs and scripts; Performance Agents; PerfMon counters; WMI events and counters.

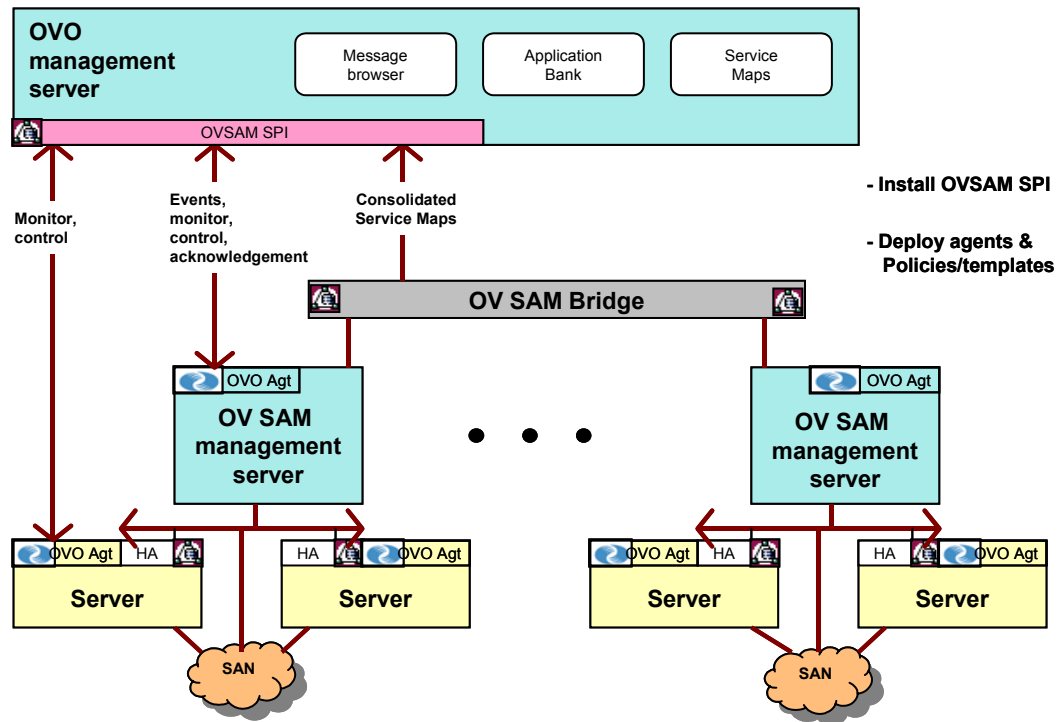
Processing

Processing is the phase when events are evaluated and classified. We can define policies regarding filtering to suppress or forward selected messages, prioritizing using severity, grouping into message groups, and threshold checking of metrics.

Acting

Acting is the phase when messages are taken as the starting point for the (human or automatic) activities. Some of the actions include starting programs or scripts to correct a problem or gather more information at the time that the problem occurs either automatically or at the option of an operator; escalate events to other management servers; forward events to trouble ticketing systems, notification software or event correlation engines.

SPI integration

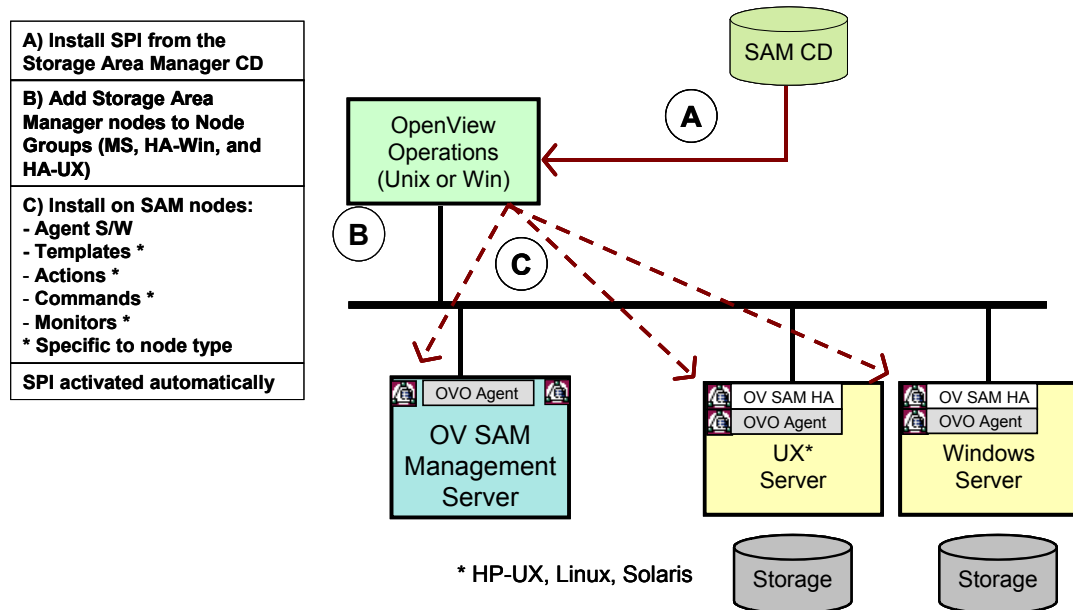


The Storage Area Manager integration with OVO includes:

- **Storage Area Manager installation** – Storage Area Manager is installed to manage the customers SAN.
- **OVO Management Server installation** – OVO is installed and used by customer to manage their IT infrastructure.
- **SPI Installation** – The Storage Area Manager SPI is installed on the OVO management station.
- **OVO Agent Distribution** – The customer distributes the OVO Agent and the Storage Area Manager SPI policies/templates to the Storage Area Manager nodes (management servers and Host Agents)
- **SPI Activated** – Once deployed, the SPI policies/templates are automatically executed by the OVO agent to monitor Storage Area Manager and the customers SAN.
- **Host Agent Monitoring** – The SPI monitors the Host Agent processes and allows the OVO user to start, stop, and check on the status of the Host Agents via the OVO application desktop or tools.
- **Management Server** – The SPI monitors the Storage Area Manager management server, forwards Storage Area Manager events and sends OVO event acknowledgements back to Storage Area Manager.

Service Maps – Service maps are automatically created and updated into OVO on a periodic basis. The SPI uses the Storage Area Manager Bridge to access the Storage Area Manager database to draw the service maps.

SPI installation



The high level steps to install the Storage Area Manager SPI are shown here. The Storage Area Manager SPI installs in much the same manner as other OVO SPIs.

1. Install the SPI from Storage Area Manager CD using Software Distributor on OVO/Unix systems and a standard Microsoft installer on OVO/Windows management stations.
2. Add the Storage Area Manager nodes to OVO and deploy the OVO agent.
3. Deploy the Storage Area Manager SPI to the Storage Area Manager management server and on all nodes and hosts that contain the Storage Area Manager Host Agent (HA).

The Storage Area Manager SPI automatically starts monitoring.

SPI for OVO integration features

The main features provided by the Storage Area Manager SPI for OVO are:

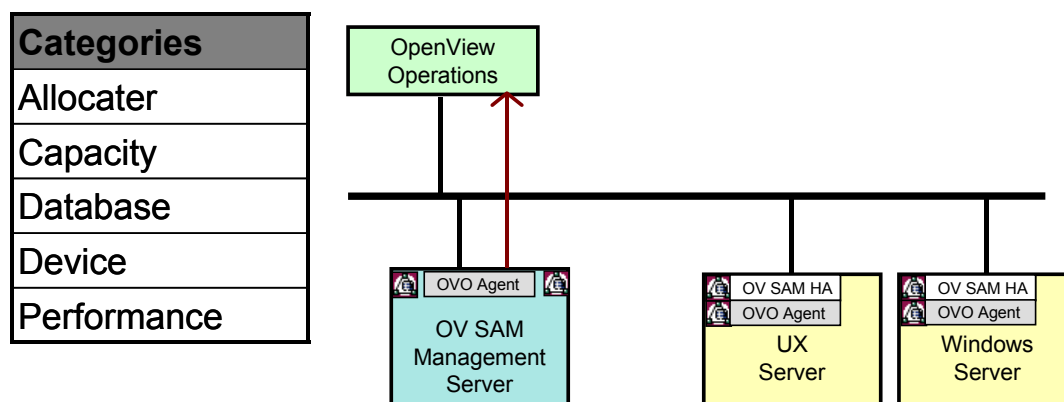
- Event Forwarding
- Process Monitoring
- Administrative Application Access
 - Using OVO Application Bank / Tools
- Operator-assisted actions
 - Context-sensitive Storage Area Manager GUI launching
- Event acknowledgement from OVO to Storage Area Manager

The latest release of the SPI also includes custom icons to depict the Storage Area Manager message group and application group. Custom icons for Storage Area Manager management servers and Host Agents are also provided for the OVO node bank, and a new application icon for the Storage Area Manager application desktop items.

The SPI does **not** provide the following features:

- Textual Storage Area Manager Event Reports within OVO GUI
- Automated actions of Storage Area Manager events

SPI event forwarding



The Storage Area Manager SPI uses OVO log file encapsulation to forward Storage Area Manager events to the OVO agent. The OVO agent must be installed on the Storage Area Manager management server since the log file template must be distributed to the Storage Area Manager management server. Events are forwarded from the Storage Area Manager management server to OVO through the Storage Area Manager event template.

Event categories

The picture above shows the categories of storage events that are forwarded from the OVO Agent that is deployed on the Storage Area Manager management server. The OVO log file template provided with the SPI specifies which storage events are forwarded to OVO and which are suppressed (not sent to the OVO management server). Events are also filtered to eliminate duplicates.

Storage Area Manager GUI operator action

Note that the latest (3.1) version of the SPI has added support for performing context-sensitive launching of the Storage Area Manager GUI as an OVO operator-initiated action. This capability is provided based on information that has been added to the Storage Area Manager SPI event forwarding. In addition, improved event suppression reduces the possibility that duplicate events concerning the same Storage Area Manager problem will be received.

Note

The Storage Area Manager Remote GUI client must be installed on the OVO management server for the context sensitive actions to work. The GUI can be installed from the Storage Area Manager CD or by connecting to the Storage Area Manager server with a web browser – **`http://<ov-sam-server>:8040`**

ASCII logfile

Storage Area Manager events are written to the following files:

- <ManagementRoot>\managementserver\logs\CS-EventExport.log
- <ManagementRoot>\managementserver\logs\CS-AckDelExport

These files roll over when the Storage Area Manager service is restarted, or when its size threshold is reached. The threshold size is specified in the file:

<ManagementRoot>\managementserver\config\Loggers.prp

The files are renamed to CS-EventExport_0.log, CS-EventExport_1.log and so forth.

Template customization

As with any OVO SPI, it is recommended that the customer review the template conditions to determine which events should be forwarded and which should be suppressed in their environment.

Events

Following is a list of the events written to the CS-EventExport.log file. If customers want to customize the OVO events, this is the list of all possible events they can capture and forward to OVO.

Accountant events

Event Name	Event Identifier	Event Description
AGING_DATA_FILES	0x0000000000000010	Data files aging out
ACCOUNT_CREATED	0x0000000000000100	Account created
ACCOUNT_CLOSED	0x0000000000000200	Account deactivated
ACCOUNT_MODIFIED	0x0000000000000400	Account modified
LUN_ASSIGNED_TO_ACCOUNT	0x0000000000000800	Assign LUN to Account
LUN-DEASSIGNED_FROM_ACCOUNT	0x0000000000001000	Deassign LUN from Account
SERVIDE_LEVEL_CREATED	0x0000000000010000	Service Level created
SERVIDE_LEVEL_DELETED	0x0000000000020000	Service Level deleted
SERVIDE_LEVEL_MODIFIED	0x0000000000040000	Service Level modified
LUN_ASSIGNED_TO_SERVIDE_LEVEL	0x0000000000080000	Service Level LUN assignment
LUN-DEASSIGNED_FROM_SERVIDE_LEVEL	0x0000000000100000	Service Level LUN deassignment
BILL_EXPORTED	0x0000000000200000	Bill Report exported

BILL_SCHEDULE_CHANGED	0x0000000000400000	Bill Schedule changed
BILL_GENERATED	0x0000000004000000	Bill Generated
USAGE_COLLECTED	0x0000000008000000	Usage collected
GENERATED_MISSED_BILL	0x0000000010000000	Missed bill generated
LUN_STATUS_CHANGED	0x0000000020000000	Device reported LUN status changed
LUN_SIZE_CHANGED	0x0000000040000000	Device reported LUN size changed
LUN_DELETED	0x0000000008000000	Device reported LUN deleted

Allocator events

Event Name	Event Identifier	Event Description
REALITY_TO_POLICY	0x0000000000000010	Reality to policy event
MULTIPLE_WRITER_SCENARIO	0x0000000000000020	Very dangerous! Client needs to take care of this
ILLEGAL_OBJECT_DELETION	0x0000000000000040	An illegal object was deleted
HOST_DELETION	0x0000000000000080	A host was deleted
CONFIGURE_REQUEST_SUB_STATUS	0x0000000000000200	Part of a whole configuration request.
SCSI_SCAN	0x0000000000000400	A host initiated a SCSI scan
CONVERT_SEVENT_TO_STORAGE_EVENT	0x0000000000080000	Convert to StorageEvents
ACTIVATION_WIZARD_CONFIGURE_REQUEST	0x0000000000100000	Activation Wizard
ROGUE_SERVER	0x0000000000000100	Rogue Server
HOST_COMMAND_SET_COMPLETED	0x0000000000000800	Host Command Set Completed
POSSIBLE_ROGUE_SERVER	0x0000000000002000	Possible Rogue Server
RUID_ENABLED_BUT_NOT_VISIBLE	0x0000000000040000	LUN assigned but not visible to the host
CONFIGURE_REQUEST_STATUS	0x0000000000000001	Allocator configuration dialog status

Builder events

Event Name	Event Identifier	Event Description
UNKNOWN_THRESHOLD_EXCEEDED	0x0000000000000001	Value of some capacity measurement falls outside a preconfigured threshold range
STORAGE_DOMAIN_THRESHOLD_EXCEEDED	0x0000000000000002	Value of a storage domain capacity measurement falls outside a preconfigured threshold range
STORAGE_DEVICE_THRESHOLD_EXCEEDED	0x0000000000000004	Value of a storage device capacity measurement falls outside a preconfigured threshold range
HOST_THRESHOLD_EXCEEDED	0x0000000000000008	Value of a host capacity measurement falls outside a preconfigured threshold range
NAS_DEVICE_THRESHOLD_EXCEEDED	0x0000000000000010	Value of a NAS device capacity measurement falls outside a preconfigured threshold range
VOLUME_THRESHOLD_EXCEEDED	0x0000000000000020	Value of a volume capacity measurement falls outside a preconfigured threshold range
MANAGED_DIRECTORY_THRESHOLD_EXCEEDED	0x0000000000000040	Value of a managed directory capacity measurement falls outside a preconfigured threshold range
USER_ACCOUNT_THRESHOLD_EXCEEDED	0x0000000000000080	Value of a user account capacity measurement falls outside a preconfigured threshold range
USER_THRESHOLD_EXCEEDED	0x0000000000000100	Value of a user-related capacity measurement falls outside a preconfigured threshold range
CONSUMPTION_BLOCK_THRESHOLD_EXCEEDED	0x0000000000000200	Value of a consumption block capacity measurement falls outside a preconfigured threshold range
ORGANIZATION_THRESHOLD_EXCEEDED	0x0000000000000400	Value of an organization related capacity measurement falls outside a preconfigured threshold range
VOLUME_GROUP_THRESHOLD_EXCEEDED	0x0000000000000800	Value of a group-wide capacity measurement falls outside a preconfigured threshold range
COLLECTION_ERROR	0x0000000000001000	Lists corrupt volumes encountered when gathering file data on a host
APP_ORACLE_THRESHOLD_EXCEEDED	0x0000000000002000	Value of an Oracle capacity measurement falls outside a preconfigured threshold range
APP_EXCHANGE_THRESHOLD_EXCEEDED	0x0000000000004000	Value of an Exchange capacity measurement falls outside a preconfigured threshold range

Database events

Event Name	Event Identifier	Event Description
SPACE_ALERT	0x0000000000000001	Not enough free space for database to get to maximum size
PERCENT_ALERT	0x0000000000000002	Database has reached the configured percentage
EVENT_ALERT	0x0000000000000004	Total number of events are greater than the configured setting
SPACE_PANIC	0x0000000000000008	Free space in database is less than configured amount
FLAT_DIRECTORY_DISK_SPACE_ALERT	0x0000000000000010	Free disk space on a volume being used for binary data storage is very low

Discovery events

Event Name	Event Identifier	Event Description
CYCLE_START	0x0000000000000001	Discovery cycle started
CYCLE_DONE	0x0000000000000002	Discovery cycle finished
CYCLE_LONG	0x0000000000000004	Discovery cycle long
NEW_DEFS_JAR	0x0000000000000008	New discovery class/device object/device properties/icons on server
TURNED_ON	0x0000000000000010	Discovery turned on by user
TURNED_OFF	0x0000000000000020	Discovery turned off by user

Storage Node Manager (device events)

Event Name	Event Identifier	Event Description
STATUS_CHANGED_EVENT	0x0000000000000001	Signifies a status change was detected for a device
POLLED_EVENT	0x0000000000000002	Signifies an event was retrieved from a device via polling
INTERRUPT_EVENT	0x0000000000000004	Signifies an SNMP trap was received by the management
LINK_STATUS_UP	0x0000000000000008	Signifies a status change was detected for a link
LINK_STATUS_DOWN	0x0000000000000010	Signifies a status change was detected for a link

Passphrase cache events

Event Name	Event Identifier	Event Description
BAD_PASSPHRASE	0x0000000000000001	A passphrase requested is not known or is wrong. The user needs to correct this.

Model events

Event Name	Event Identifier	Event Description
OBJECT_ADDED	0x0000000000000001	Model object added
OBJECT_DELETED	0x0000000000000002	Model object deleted
OBJECT_UPDATED	0x0000000000000004	Model object updated
ATTRIBUTE_ADDED	0x0000000000000008	Model object attribute added
ATTRIBUTE_DELETED	0x0000000000000010	Model object attribute deleted
ATTRIBUTE_UPDATED	0x0000000000000020	Model object attribute updated

Optimizer events

Event Name	Event Identifier	Event Description
COLLECTION_STARTED	0x0000000000000001	Performance data collection has started
COLLECTION_STOPPED	0x0000000000000002	Performance data collection has stopped
COLLECTION_BACKLOG	0x0000000000000004	Performance data collection has backlogged
THRESHOLD_ALERT	0x0000000000000008	Threshold for a particular metric has been exceeded
PB_TOOL_NOT_INSTALLED	0x0000000000000010	Tool for collecting performance data is not installed
PB_TOOL_NOT_RUNNING	0x0000000000000020	Tool for collecting performance data is not running
SNAPSHOTS_PURGED	0x0000000000000040	Performance data has been purged from database
BASELINES_EXCEEDED	0x0000000000000080	Number of available baselines has been exceeded
PROCESS_WAITING	0x0000000000000100	Scheduled process is waiting

Managed application events

Event Name	Event Identifier	Event Description
APP_INSTANCE_STATUS_CHANGED_EVENT	0x0000000000000001	Signifies a status change was detected for a managed application instance

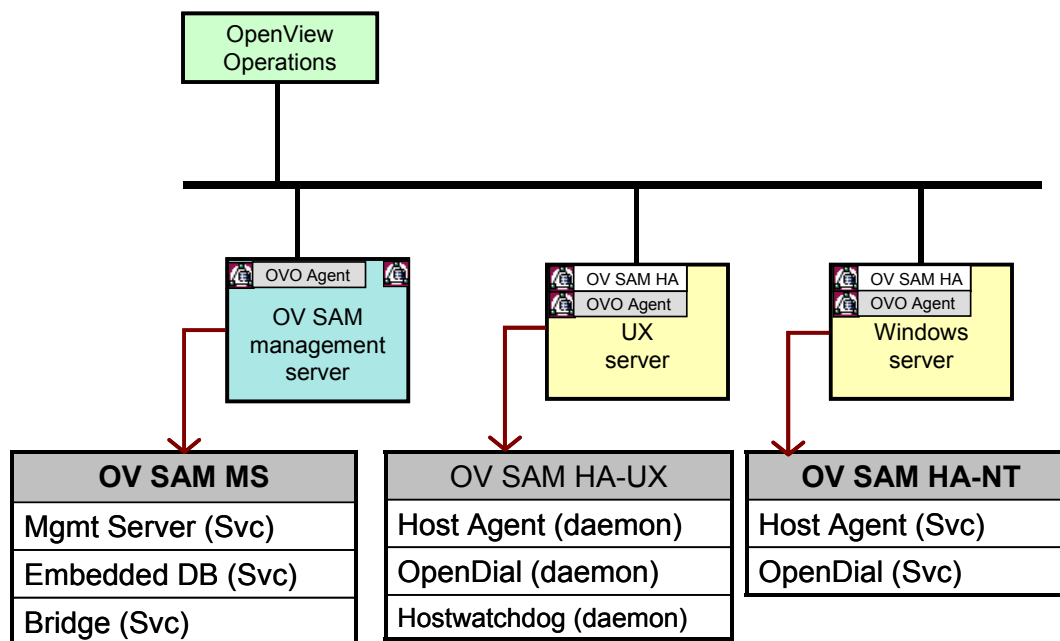
Event management events

Event Name	Event Identifier	Event Description
PERIODIC_EVENT_DELETION	0x0000000000000001	Periodic Storage Event deletion
AUTO_CONSTRAINT_ADDED	0x0000000000000002	Automatically added a constraint to block events (SNMP traps) from an unmanaged device

Framework events

Event Name	Event Identifier	Event Description
COMPONENT_STARTED	0x0000000000000001	All components of the server have been initialized/started
COMPONENT_SHUTDOWN	0x0000000000000002	All components of the server have been shutdown
CLIENT LOGIN	0x0000000000000004	A client has connected and logged in successfully
CLIENT LOGOFF	0x0000000000000008	A client has logged out and disconnected
CLIENT DEAD	0x0000000000000010	A client has disconnected without logging in
SERVER BROKEN	0x0000000000000020	Server connection heartbeat fails

SPI process/services monitoring

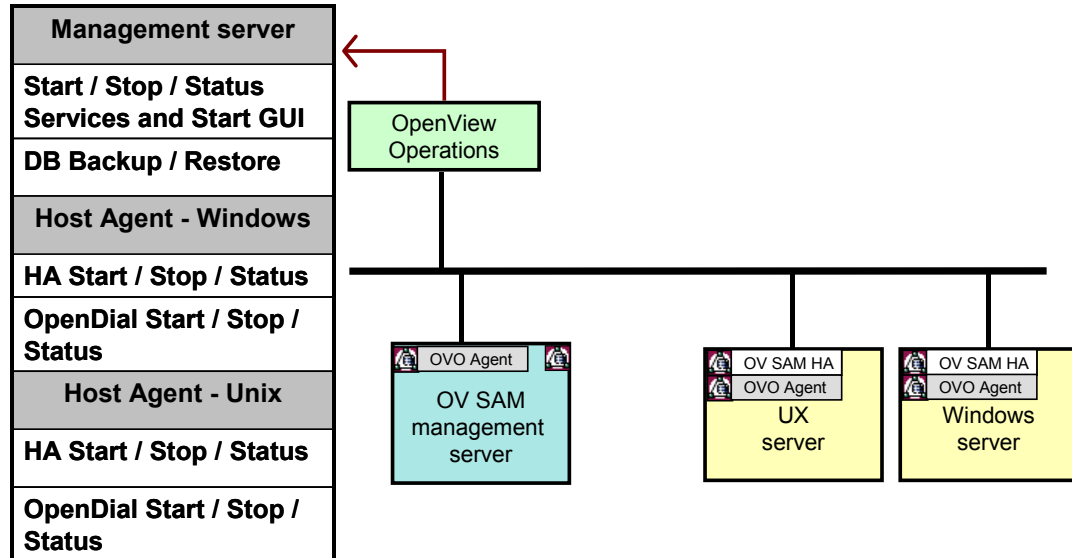


The OVO Agent monitors Storage Area Manager processes on the management server and on Host Agents every five minutes. If any process stops, an event is generated and an OVO operator-initiated action is provided to restart the process.

Normally, you would not need to restart any service that the monitor reported as being stopped. All the services of Storage Area Manager are under control of a watchdog process that automatically restarts processes that have “died”. However, you can start up a service that was stopped manually (via the OVO application desktop item or on the system directly). Once the process is restarted, the event is automatically acknowledged in the OVO events browser.

These services are also depicted in the service maps that are maintained by the Service Navigator and OVOW service map integration.

SPI application desktop



The Storage Area Manager SPI creates an application group in OVO for Unix (*Tools* within OVO for Windows) called *OpenView SAM* in the OVO Application Desktop. The SPI application group is further broken down into three application groups called *Management Server*, *HostAgent-Windows*, and *HostAgent-UX*.

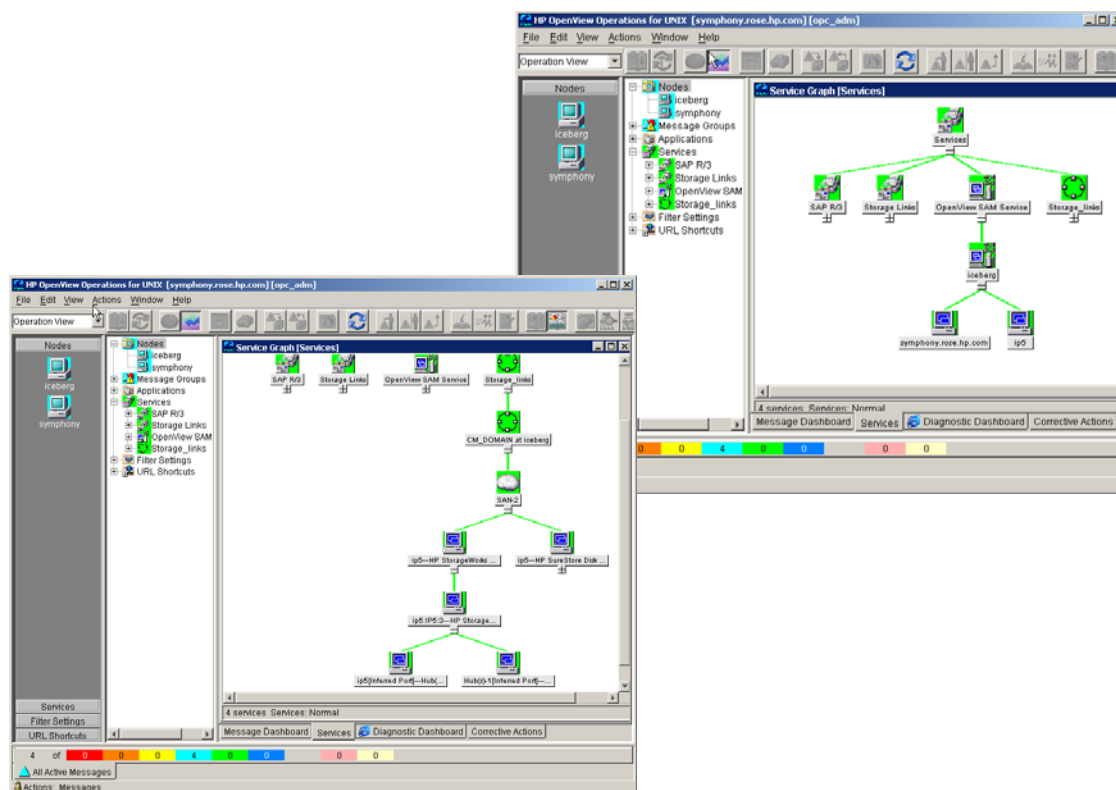
This slide shows the type of control that can be applied to Storage Area Manager from OVO. With the 3.0 release of Storage Area Manager, the SPI enhanced application desktop integration includes:

- Management server status application
- Host Agent status application
- Access to the Storage Area Manager GUI

Note

Note that the Storage Area Manager client package must be installed on the OVO management server to access the Storage Area Manager GUI.

Service Navigator/Map integration



The concept of providing a service view is to map the problems discovered by OVO to the IT services being monitored. Instead of focusing on single elements within a complex IT environment, management can be done by focusing on IT services.

Both OVO for Unix and OVO for Windows have the capability of providing service views of the IT infrastructure. In OVO for Unix, this capability is provided by Service Navigator and for OVO for Windows it is provided by Service Maps.

hp OpenView Service Navigator is an add-on component of the hp OpenView Operations for Unix Java-based operator GUI. It is integrated within the OVO for Windows Microsoft Management Console interface.

These products enable management of the IT environment by focusing on the IT services provided. While OpenView Operations can detect, solve, and prevent problems from occurring in networks, systems, and applications in the IT environment, service views goes a step further by showing and diagnosing problems from the user's view of a service

These products are based on OVO and depend on the monitoring, message, and action capabilities that OVO provides. If a problem occurs on one of the objects managed by OVO, a message about the problem is generated and sent to the user responsible for the area concerned. With service views configured, the message is mapped to the service that is impacted by the problem and sent to the user responsible for that service.

Application service views

The application service views provided by both products can capture the elements of a complex end-to-end service environment, such as network elements, computer systems, databases, and the actual applications. It then displays their interdependencies in an easy-to-understand manner. IT staff can look at the complex dependencies between these managed elements and interpret lower-level data in terms of importance to the higher-level service.

Status propagation

Interpreting lower-level data in terms of its importance to the higher-level services is essential for preventing problems before they impact the business. An advanced real-time status propagation mechanism in hp OpenView Service Navigator allows IT management staff to immediately determine the impact of a component failure on the overall service. This helps IT professionals to better prioritize their problem-solving efforts.

Within a complex environment, it can be quite difficult to identify the root cause of an existing or emerging problem. hp OpenView Service Navigator allows IT professionals to efficiently pinpoint problems by quick navigation to faulty components of a service for further diagnosis or problem resolution, speeding up mean time to recovery (MTTR).

Root cause analysis

Root cause analysis performs a top-down investigation of the hierarchy of selected services or nodes, and stops at the hierarchical level of the service or node that caused the status to change. There may be more levels below that, but they are not displayed because the services or nodes on those levels do not contribute to the problem.

In a complex environment with many hierarchical levels, it can be difficult to determine whether the service, or one or more sub-services, have caused a severity change.

To help determine the source of a problem, Service Maps provide root cause analysis to quickly identify the service or node that is not performing. Root cause analysis starts at the level of a selected node or service, stops at the level where the cause of the problem lies, and draws a map of the problem source and the nodes or services affected.

Impacted services

Impact analysis works in the other direction from root cause, (from the bottom up), by searching through the service hierarchy to display other services or nodes that are impacted by the change in status. The nature of the impact is determined by the status propagation and calculation rules configured by the administrator. The impact path of a service or node is displayed in the console tree.

Because the impact analysis only considers negative impacts (status changes from good to bad), the impact graph does not necessarily display the top-level service or node. Instead, it stops where the impact occurred or at the highest level of services registering a status change.

Service Navigator/Map integration features

The Storage Area Manager integration with Service Navigator and Service Maps includes the following:

- Definition of the service hierarchy
- Definition of the status propagation rules
- Periodic updates of the service hierarchy based on changes discovered by Storage Area Manager

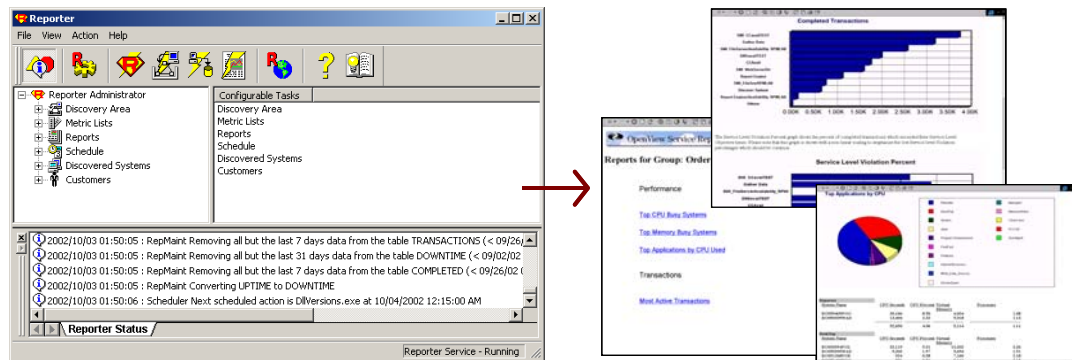
The service map update process is scheduled to update the maps based on the Storage Area Manager database once every hour.

The integration with Service Navigator provides two service maps:

- A Storage Area Manager service map
- An operational storage links service map

Services in the map are not removed until five discoveries have occurred without the service. Using the Storage Area Manager Bridge, this integration can consolidate maps from multiple management servers.

OpenView Reporter



OpenView Reporter provides the following key features:

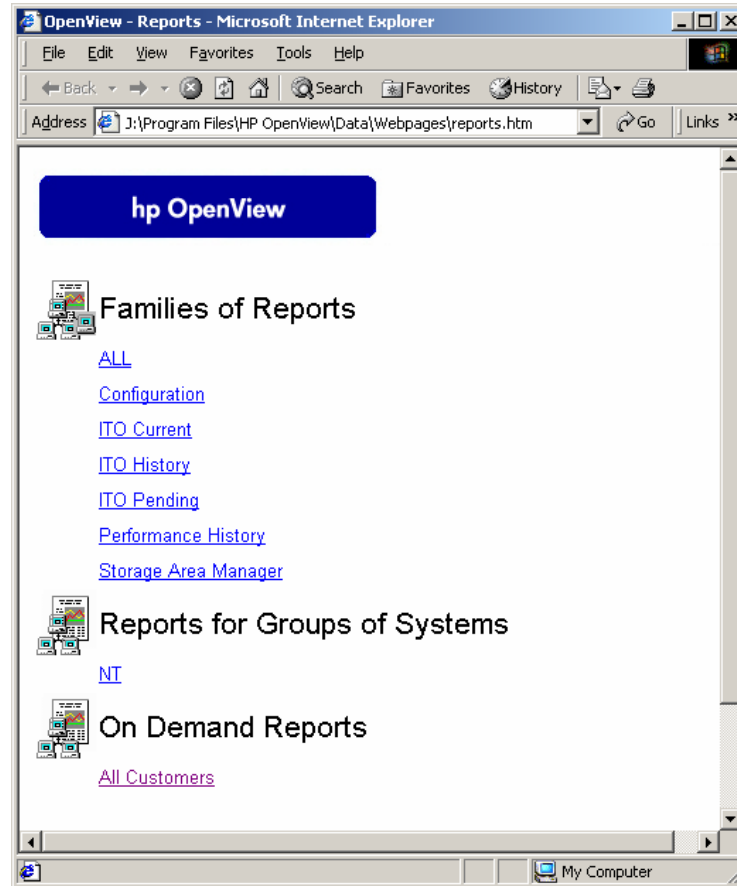
- Collects and reports on status of business services, applications, systems, and networks gathered from hp OpenView Storage Area Manager
- Creates scheduled web-based reports based on OpenView data
- Generates reports in HTML and posts to IIS server for browser viewing
- Provides a one-stop shop for reports (many OpenView products provide Reporter integration)

OpenView Reporter integration

The main features of Storage Area Manager integration with Reporter include:

- Required integration components are bundled into an easy-to-install package.
- Storage Area Manager data is gathered using the gather_sam process through the Storage Area Manager Bridge.
- Information across multiple management servers is consolidated into a single set of reports.
- Storage Area Manager “organizations” are related to Reporter “customers” for customer-based reporting.
- Ability to create “on-demand” reports and graphs on any of the data collected from Storage Area Manager. This provides the ability to look at trends over a user selectable time period. By default, 14 “on-demand” reports are provided.
- Information is stored in the Reporter database.
- Thirty-seven report templates are provided.

Reporter Web page



The Reporter web page can be displayed from the Reporter administrator GUI by selecting the *Globe* icon on the toolbar.

The reports are divided into families. The web page shown above displays the Storage Area Manager link. This link is automatically added to the Reporter web page after the first time the Storage Area Manager reports have been run by Reporter.

Storage Area Manager reports

Reports in Family: Storage Area Manager



Reports for All Systems

Inventory

[Inventory of Bridges](#)

[Inventory of Hosts](#)

[Inventory of Interconnect Devices](#)

[Inventory of NAS Devices](#)

[Inventory of Storage Devices](#)

Capacity

[Capacity of Applications](#)

[Capacity of Exchange Admin Groups](#)

[Capacity of Hosts](#)

[Capacity of NAS Devices](#)

[Capacity of Oracle Database Components](#)

[Capacity of Storage Devices](#)

[Capacity of Volume Managers](#)

[Capacity of Volumes](#)

[Maximum Directory Consumption](#)

[Maximum Consumption by User](#)

Capacity Overview by Domain

[Allocation on Storage Devices](#)

[Consumption on Hosts](#)

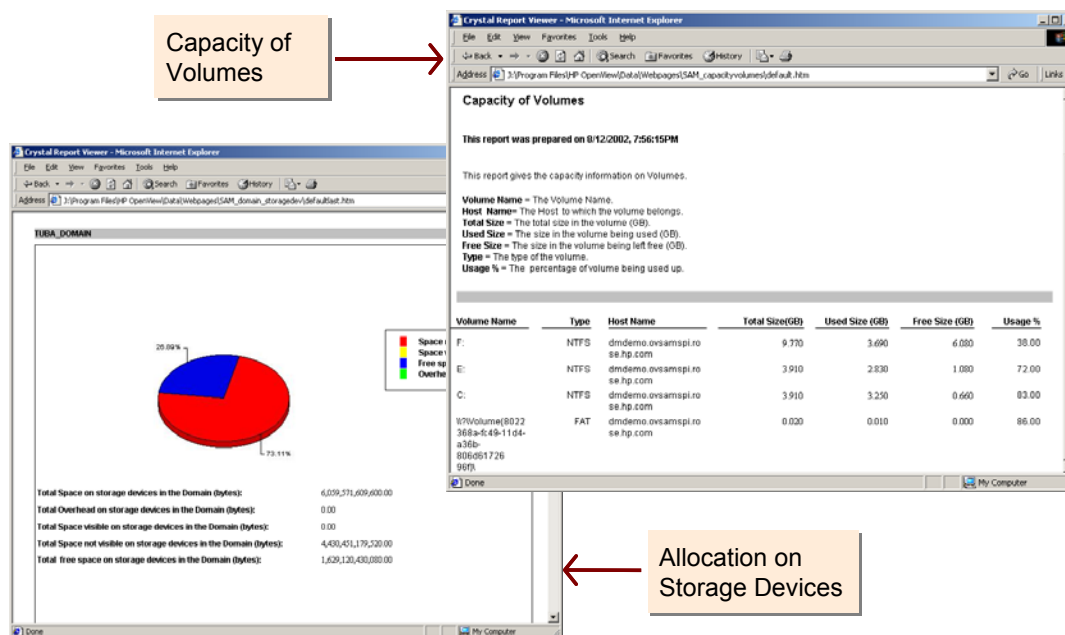
[Consumption on NAS Devices](#)

Service Level Information

As with all of its reports, Reporter presents the Storage Area Manager reports using its IIS-based web pages. The Storage Area Manager reports are organized into logical categories:

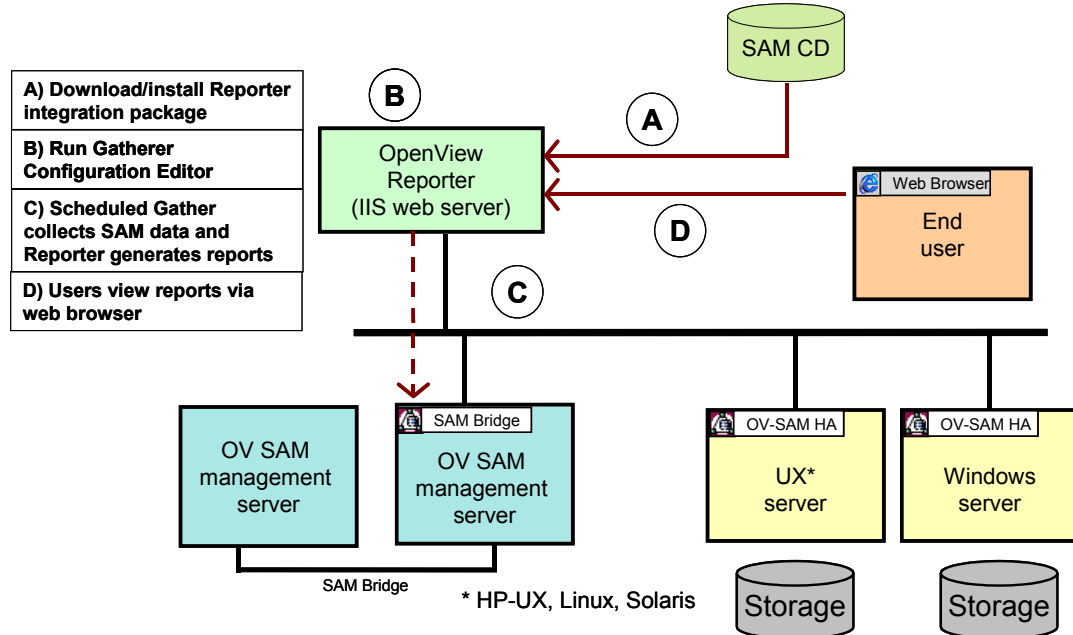
- Inventory
- Capacity
- Capacity Overview by Domain
- Service Level Information
- Customer-Based Reports

Example Storage Area Manager reports



Shown here are examples of two of the reports that are part of the Storage Area Manager integration with Reporter. The *Capacity of Volumes* report shows capacity information for the file systems contained on managed hosts and NAS devices discovered in the storage network. The *Allocation on Storage Devices* report displays a summarized graph by storage domain showing the allocation of storage devices discovered in the storage network.

Reporter integration installation



The example above provides an overview of how to install the Storage Area Manager integration for Reporter. The integration is installed on the Reporter Windows management server. The steps to install the integration include:

- Inserting the Storage Area Manager CD into the OV Reporter system and running the <cd-rom>\ov_integrations\ovr\setup.exe program.
- Either waiting for the gather_sam.exe and RepChrys.exe programs to run over night, or forcing them to run now (one after the other).
- Connecting to the IIS web server on the Reporter system to view the Storage Area Manager reports.

Service Desk

hp OpenView Service Desk automates IT infrastructure management processes to control the quality and delivery of business-critical IT services. The supported IT management processes can be managed against agreed-upon service levels. The service level is negotiated and agreed upon by the customers of the service.

Service Desk provides a solution for integrated call management, incident management, problem management, configuration management, change management, and service level management. It is integrated with OVO for Unix and other OpenView products.

The goals of Service Desk are to:

- Increase the quality and quantity of delivered services.
- Decrease the time required to resolve incidents.
- Prevent incidents from occurring or reoccurring.
- Reduce the risk associated with an evolving IT infrastructure.
- Manage processes involved in delivering high-quality service levels.

The Service Desk product has three modules:

- **Helpdesk** — Includes call, incident, problem, work, asset, and config
- **Change** — Includes work, changes, project, asset, and config
- **Service Level Manager** — Includes services and SLAs, asset, and config

Service Desk integration

The main features of the Storage Area Manager integration with Service Desk include:

- Storage Area Manager *Configuration Item Categories* are created in Service Desk.
- Storage Area Manager managed devices are imported directly into Service Desk as Configuration Items.
- Storage Area Manager events are forwarded to Service Desk as incidents.
- Storage Area Manager events acknowledged in Service Desk are acknowledged in OVO and Storage Area Manager (using the OVO-Service Desk integration package).
- Configuration items and events are forwarded from multiple Storage Area Manager management servers through the Storage Area Manager Bridge.

Note

Forwarding of events from Storage Area Manager, as well as acknowledgement of Storage Area Manager events by Service Desk, are both dependent on implementation of the OVO Service Desk integration.

Internet Usage Manager

The main features of Internet Usage Manager include:

- Provides a flexible, scalable platform for deploying mediation and usage management solutions for service providers
- Collects, aggregates, and correlates usage data from across the network (traffic flows), systems (CPU utilization), and storage
- Implements usage-based billing systems, manages capacity, and analyzes subscriber behavior

The IUM framework gathers usage information from network devices and/or services (routers, ATM switches, Web servers, mail servers, VOIP and wireless gateways, and so on.). It filters and combines that information based on customer site needs, and then makes the information easily available to any application through file-based or programmatic (API) means.

IUM implements usage-based billing systems, manages capacity, and analyzes subscriber behavior to develop strategic marketing programs and profitable value-added services. IUM can support both prepaid and post-paid billing models with a single implementation. IUM has also been used to enable auditing and allow for immediate processing of usage data.

The goals of IUM are to:

- Increase visibility into complex infrastructures.
- Enable easy plug-in of new mediation and management capabilities with minimum risk to existing infrastructure and processes.
- Provide the data needed to implement usage-based billing models and maximize revenues from existing services.
- Scale to millions of subscribers.

Integration goals

The goals of the Storage Area Manager integration with IUM include:

- Allows IUM customers to include Storage Area Manager capacity and billing information to provide a broader view of resource usage in their environment
- Supports HP's charge-back scenario
- Supports HP's pay-per-use (PPU) initiative

The HP's Pay-Per-Use (PPU) program has very specific requirements and test procedures that the IUM integration is designed to support. The PPU program supports the leasing of HP equipment in such a way that the customer pays for only what they are using. Both the IUM integration and the HP PPU program use the Storage Area Manager interface described here.

When used with IUM, the retrieved Storage Area Manager files are sent to the IUM Usage Database application for aggregation and compilation of the individual usage records. The aggregated output of the Usage Database provides chargeable metrics that are sent to HP's billing division, FCG, for manual or automated billing procedures.

IUM integration features

The main features of the Storage Area Manager integration with IUM include:

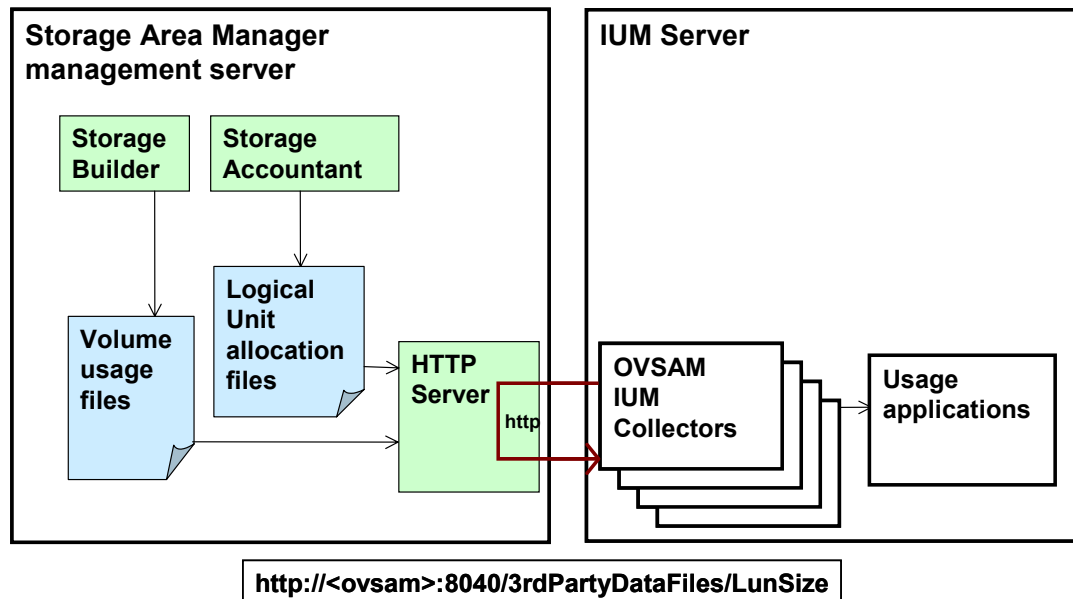
- File System (volume) utilization of the discovered hosts
- LUN allocation of the discovered storage devices

New usage information provided with Storage Area Manager 3.0 includes:

- Directory consumption
- User consumption
- Enhanced file system mapping to LUNs to include utilization of storage
- LUN utilization (on LUNs used by host volume managers, such as LVM and VxVM)

Storage Builder and Storage Accountant data is passed independently of one another. Storage Builder and Storage Accountant interfaces to IUM can be configured separately. In addition, a license for Storage Builder and Storage Accountant must be available to pass data from these modules to IUM.

IUM integration architecture



Storage Area Manager provides key usage metrics periodically to IUM: Storage Builder outputs file system (volume, capacity, and user) utilization information

- Storage Accountant outputs Logical Unit (LUN) allocation information

The Storage Area Manager IUM Storage Collector retrieves the usage information by accessing the built-in Storage Area Manager http server at port 8040.

Depending on the IUM configuration, this information can eventually be forwarded to applications that analyze, rate, and collect bill usage information from a variety of IUM sources.

The output files for the volume information updated to include the Logical Volume Manager data resides in:

`<OVSAM install>/managementserver/webroot/3rdPartyDataFiles/CapacityUsage/`

Storage Area Manager keeps ten days worth of files and appends sequence numbers on the files that range from 0 – 9. The file names begin with the directory name and append the next appropriate sequence number:

`CapacityUsage0.txt, CapacityUsage1.txt, ..., CapacityUsage9.txt`

The temporary file used for capacity information until finalization is:

`CapacityUsage.tmp`

The data files are available through the Storage Area Manager built-in HTTP server. The URLs associated with the data files are:

`http://<OV SAM host>:8040/3rdPartyDataFiles/LunSize`

`http://<OV SAM host>:8040/3rdPartyDataFiles/CapacityUsage`

IUM integration requirements

Host Agents must be installed to gather host volume info. The gathered data is used to do billing on a PPU basis.

Device and LUN information is available with Veritas and LVM systems (HP-UX and AIX).

One important configuration step that must take place in order to collect user and directory information is to enable file data collection on each Host Agent. By default, this type of collection is not enabled.

When determining the directories to be metered by Storage Accountant, they must be configured as a managed directory using the Storage Area Manager GUI.

Where to get more information

Storage Area Manager integration manuals are available from
http://ovweb.external.hp.com/lpe/doc_serv

- *hp OpenView Smart Plug-In for hp OpenView storage area manager administrator's reference for HP OpenView Operations on HP-UX and Solaris*
- *hp OpenView Smart Plug-In for hp OpenView storage area manager administrator's reference for HP OpenView Operations on Windows*
- *hp OpenView storage area manager Reporter Integration administrator's reference*
- *hp OpenView storage area manager Service Desk Integration administrator's reference*

The HP OpenView Web Site is accessible from
<http://www.openview.hp.com/OpenView> product patches are accessible from
<http://support.openview.hp.com/patches/>

Learning check

1. IUM can be integrated with which of the following Storage Area Manager applications?
 - a. Storage Accountant
 - b. Storage Allocator
 - c. Storage Builder
 - d. Storage Node Manager
2. Internet Usage Manager is a turn-key storage billing system.
☐ True
☐ False
3. The IUM integration is enabled with the Storage Area Manager applications on an individual module basis.
☐ True
☐ False
4. A web server must be installed on the management server to enable the IUM integration to gather data from Storage Area Manager.
☐ True
☐ False
5. To collect user and directory information, what collection type must be enabled on the Host Agents?
.....
.....
6. If directories are to be metered, is there a configuration step that is required in the Storage Area Manager GUI and, if so, what must be configured?
.....
.....

Learning check answers

Module 1: Introduction to Storage Area Manager

1. Match the Storage Area Manager application with its key features:

a. Core Services	<u>d.</u> Host-based storage access control
b. Storage Node Manager	<u>c.</u> Storage metering and billing
c. Storage Accountant	<u>f.</u> Host Disk and Volume metric performance monitoring
d. Storage Allocator	<u>a.</u> Underlying framework containing several components that are shared amongst all products
e. Storage Builder	<u>b.</u> Device and link status; application launching
f. Storage Optimizer	<u>e.</u> 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	<u>c.</u>	Any host in the SAN that has the Storage Area Manager Host Agent software installed
b. Management Client	<u>a.</u>	A Windows 2000 host with the Storage Area Manager server application software installed
c. SAN Host	<u>e.</u>	Storage Area Manager client application that consolidates storage information from multiple storage domains.
d. Storage Domain	<u>f.</u>	Web server application that allows other applications access to Storage Area Manager functionality.
e. MoM	<u>g.</u>	Storage Area Manager software component that must be installed on each host in the SAN that is to be managed
f. Bridge	<u>d.</u>	A management server, its deployed hosts, and any interconnect and storage they are connected to
g. Host Agent	<u>b.</u>	Any host that 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 or raw (TB) storage in the SAN.
 - ☐ True
 - ☐ False

- 5. Storage Area Manager is available in English, Japanese, or German.
 - ☐ True
 - ☐ False

Module 2: The Storage Area Manager environment

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.
Supported OS, Host Agent software, HBA supporting the SNIA API
3. Describe the purpose of Storage Area Manager organizations.
Organizations are supported by Storage Builder and Storage Accountant and allow segmentation of resources for the purpose of reporting.
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

Module 3: Core Services/Storage Node Manager architecture

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

a. AA Server	e. Receives and processes events
b. Bridge	g. Basic web server that allows access to the GUI download page
c. DDT	d. Key host agent component that does in-band, Fibre channel and SCSI discovery
d. DIAL	h. The database management component
e. EAR	f. 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	c. Management server component that handles discovery and figuring out the topology
g. HTTP Server	a. Controls security; keeps track of all users and permissions
h. Repository Server	b. 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?

The management server sends a multicast request for managed hosts to reply, informing the management server that they are available.

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.

Storage Area Manager discovers devices on the storage network through both out-of-band and in-band methods. Discovered devices are matched with their corresponding property files. If the device properties file specifies a DPI, Discovery instantiates the DPI core class and implements device-specific interfaces in order to collect detailed device information. The information is saved in the repository.

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

In-band status is obtained using SCSI Gateway. Out-of-band status is obtained asynchronously from SNMP traps or MIB contents.

7. List the three services that run on the management server
HP OpenView SAM Bridge, HP OpenView Embedded DB, HP OpenView ManagementServer

Module 4: Event management

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.

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. For example, you could configure a trigger to send email notification if the status for a specific device becomes critical.

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 that events can be exported to
.txt, .csv, .xml

Module 5: Device maps

1. List the two Storage Area Manager map modes and describe the recommended use of each.

Storage Area Manager provides two device map modes: physical and inferred. Physical map mode is recommended for most environments. Inferred map mode is recommended in environments with many fibre channel hubs.

2. Describe the purpose of the un-mapped devices node bank.

When in physical map mode, devices that do not provide sufficient information for Storage Area Map to map them with certainty appear in a node bank at the bottom of the map. To accurately complete the map, users are expected to make associations with actual devices.

3. List the three types of device links.

Physical, logical, user-defined

4. Describe two methods for associating an unknown placeholder with the actual device.

(1) If in the same map, drag the unknown device from the node bank and drop it onto the placeholder icon in the device map.

(2) If in different maps, right-click the unmapped device in the Resources tree, and select *Associate with Unknown Device* from the shortcut menu.

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

Module 6: Application links

1. List two types of application links.
Global and device-specific
2. Device-specific links are a feature of which Storage Area Manager application?
 - e. Storage Accountant
 - f. Storage Allocator
 - g. Storage Builder
 - h. Storage Node Manager
 - i. 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?
Right-click on a device on the device map or in the tree and select Release Notes (if available) from the shortcut menu.
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?
Browser. Note that this must be the first keyword in the command.

Module 7: Implementation process

1. List the name of the document that is the primary source of information regarding devices supported by Storage Area Manager.

hp OpenView storage area manager 3.0 Supported Components and Configuration Guide

2. What is the purpose of the SAN Verification Worksheet and who is the intended audience?

The SAN Verification Worksheet is used by the implementer (typically an ASE) to gather information about the customer environment prior to installing Storage Area Manager. The information gathered is used to verify that the environment is properly prepared.

3. List three tasks that need to be performed prior to installing Storage Area Manager.

See Pre-installation tasks on page 7-15.

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.

See Setting up and Configuring Storage Area Manager on page 7-19

Module 8: Installation

1. List the authorization files that reside on the management server and SAN host.
authorizedclients.dat resides on the management server.
access.dat resides on each 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.
The interface through which the SAN host communicates with the storage network is not its primary interface AND the host agent software was installed locally.
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
 - e. The inability to launch the TCM Element Manager from the Storage Area Manager GUI
 - a. Dual-redundant configurations appearing on Storage Area Manager map as two separate SANs
 - b. Duplicate events appearing on the SMA
 - c. Unpredictable performance as Storage Area Manager is not supported in dual-redundant fabric configurations

Module 9: Device Plug-ins

1. VA disk arrays are discovered via SNMP?
☐ True
☐ False

2. The XP DPI receives events from which of the following:
 - e. Command View XP
 - f. SNMP Traps
 - g. Performance Advisor XP
 - h. Business Copy XP

3. Which of these DPI's require 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:
 - i. Command View XP
 - j. Command View EVA
 - k. Command View SDM
 - l. OpenView Network Node Manager

6. To support all of the features available from the XP DPI, which of the following is true?
 - e. The SNMP agent must be enabled
 - f. A Storage Area Manager host agent must be installed on at least one host with access to the XP
 - g. Performance Advisor XP must be installed on the Storage Area Manager management station.
 - h. 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, you must have the following information about the EVA:
 - 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 HSG DPI supports which disk arrays:
 - a. MA6000, MA8000, EMA12000, EMA16000
 - b. MA8000, RA8000, EMA12000, EMA16000
 - c. MA8000, RA8000, EMA12000, ESA12000
 - d. MA8000, EMA12000, EMA16000

9. The EMC Symmetrix DPI has 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.

Module 10: Storage Optimizer

1. Match the Storage Optimizer component with its description.

<ol style="list-style-type: none"> a. Data Collector b. Model Manager c. Autopurger d. Metric Retriever e. Performance Host Agent 	<ol style="list-style-type: none"> <u>c.</u> Responsible for trimming data in order to manage database resources. <u>b.</u> Filters Storage Optimizer supported devices from the database of devices by Core Services. <u>a.</u> Responsible for the collection of performance data from various sources of performance data, such as a hosts, switches, and storage devices. <u>e.</u> Provides the framework to extract data from performance tools residing on the SAN host. <u>d.</u> Serves as a connection between collected data stored in the database and the reports and graphs that use that information.
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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. In order to properly gather metrics from HBAs, what does Storage Optimizer require be installed?
OpenView Performance Agents (OVPA). OVPA is not supported on Linux, therefore Storage Optimizer has a built in performance collector for Linux operating systems.

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	d. Allows for closer inspection of a specific area of a chart.
b. Baselineing	a. Enables prediction of future performance
c. Autoscale	b. Identifies resources that are performing abnormally
d. Zoom	c. 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

Module 11: Storage Builder

1. Storage Builder supports up to 1000 hosts.
 - ☐ True
 - ☐ False

10. Match the Storage Builder component with its description.

a. Capacity Harvester	b. Collects information on which user accounts are currently defined on the host system
b. User Data Gatherer	c. Collects file and directory information on all volumes
c. File Detail Gatherer	d. Collects high level information of all the file systems that are visible to the host—both local and remote
d. Volume Gatherer	a. Collects and processes data from Host Agents

11. Before you can view managed directory capacity, file data must be collected and the directories must be managed.
 - ☐ True
 - ☐ False

12. List the two volume managers supported by Storage Builder.
HPUX and AIX: Logical Volume Manager (LVM)
Solaris, HPUX, Windows 2000: Veritas Volume Manager
Tru64: Logical Storage Manager

13. Which of the following terms is used to denote disk or LUN space that has a physical path to one or more SAN Hosts.
 - a. Visible to hosts
 - b. Used space
 - c. Free space
 - d. Unconfigured space

14. A junk file report displays
- a. A list of files that have not been opened in a specified amount of time
 - b. A list of the largest files on a selected host, NAS device, or volume
 - c. A list of files that can be identified by specific characters, such as .tmp, in their names
 - d. A list of the file contents of the largest directories on a selected host, NAS device, or volume
15. Storage Builder relies on OpenView Performance Agents to collect storage device capacity information.
- ☐ True
 - ☐ False
16. HP recommends scheduling file collection once a day, when the management server is not in heavy use.
- ☐ True
 - ☐ False

Module 12: Managed applications

1. Storage Area Manager managed application features enable you to view which type of application data?
 - i. Accounting
 - j. Capacity
 - k. Performance
 - l. Allocation

2. Oracle AMPs are installed as part of the default Host Agent deployment process and do not require any additional setup procedures to be performed.
☐ True
☐ False

3. Which is **not** a managed application feature?
 - a. Maps
 - b. Thresholds and alerts
 - c. Reports
 - d. Preconfigured application launching
 - e. Data collection scheduling

17. Volume Manager software is required to view which of the following?
 - a. Application status
 - b. Any application capacity information
 - c. Storage device linkages on the map
 - d. Historical charts of application status

18. At initial release, Storage Area Manager 3.1 provides capacity and status information for which two applications? (choose two)
 - a. Oracle
 - b. SAP
 - c. Microsoft Exchange
 - d. Lotus Notes
 - e. DB2

Module 13: Storage Accountant

1. What is the purpose of a Service Level?
The purpose of Service Levels is to determine the price that will be charged for LUN use.
2. What are the five steps necessary for setting up Storage Accountant
 - a. Create Service Levels
 - b. Create Organizations
 - c. Configure the Billing Period
 - d. Add LUNs to Service Levels
 - e. Create Accounts
 - f. Add LUNs to Accounts
 - g. Add LUNs to Accounts or Organizations
 - h. Assign Device Membership to Organizations
3. Storage Accountant can be used to assign LUNs to hosts.
☐ True
☐ False
4. Organizations can only be created via the Storage Accountant application.
☐ True
☐ False
5. List the Storage Accountant management server JCore components:
Usage Metering, Correlation and Bill Generation, Audit Log
6. Service Levels must be created before Accounts are created.
☐ True
☐ False
7. A LUN can be a member of only one Service Level.
☐ True
☐ False
8. Storage Accountant's LUN assignment GUI insures that organizations are only billed for LUNs that they are actually using?
☐ True
☐ False

9. LUNs must be added to a Service Level before it can be associated with an Account?
- ☐ True
- ☐ False
10. A manager has requested a report of under utilized devices and the cost per day of un-allocated space. How could you best provide this information?
- The Storage Devices Accounting Summary report
11. LUNs that are not assigned to Accounts are shown in the Detailed Service Level report.
- ☐ True
- ☐ False
12. Billing data and audit log records are kept for how long?
- a. 1 month
- b. 6 months
- c. 1 year
13. Reports can be exported in which formats?
- a. TEXT
- b. HTML
- c. CSV
- d. XML
14. Storage Accountant events are written to the Storage Area Manager event browser?
- ☐ True
- ☐ False

Module 14: Storage Allocator

1. Storage Allocator provides which of the following types of LUN security?
 - a. Host-based security
 - b. Storage-based security
 - c. Interconnect-enhanced security
 - d. User-based security

2. Match the Storage Allocator component with its description.

a. Command/Information Request Interfaces	<u>f.</u>	Specialized software components that run as drivers in the kernel of the operating system or as a daemon. Provides LUN access control by using assignment information in the local assignment database or received from the management server.
b. Reality-to-Policy Engine	<u>c.</u>	Processes commands from the Command/Information Request Interface and the Reality-to-Policy Engine. Allows multiple Allocator GUI/CLUI and internal requests to be understood and managed.
c. Command Engine	<u>a.</u>	Handles all assignment, Grouping, object creation, or deletion operations.
d. Layered Security Coordinator	<u>b.</u>	Monitors the difference between access control currently active in the storage network (reality) and access control the administrator has defined for the storage network (policy).
e. Local Assignment Database	<u>e.</u>	Allows Storage Allocator to run without communication from the management server once LUN assignments are configured
f. Access Control Components	<u>h.</u>	Provides a bridge between JCORE and OS native Storage Allocator components
g. Common Host Agent	<u>g.</u>	Listens for requests from the OV SAM management server and sends request to the native Storage Allocator components
h. Native Compiled Library	<u>d.</u>	Processes batches of assignment and unassignment requests that it receives from the Command Engine

3. Describe the types of groups that can be created with Storage Allocator.
Security groups (share and associated LUN groups)
Organizational groups (host and LUN groups)
4. List the three methods available for activating Storage Allocator and describe the appropriate environment for each.
For new SANs, activate Storage Allocator within the Setup Assistant.
For existing SANs, use the Storage Allocator Activation wizard.
For environments with hosts behind a firewall, activate Storage Allocator locally using the CD-ROM.
5. To receive automatic event notification if a rogue server is discovered, a trigger must be configured. True
☐ False
6. What Storage Allocator command makes hosts aware of new storage?
LUN Discovery
7. The Special Unassign command is required for HP-UX hosts.
☐ True
☐ False

Module 15: MoM

1. A special license is required to access Storage Area Manager MoM features.
☐ True
☐ False

2. Which of the following is NOT a feature of MoM?
 - a. Provides Host Agent deployment to multiple SAN hosts at a time
 - b. Consolidates filtered events from multiple management servers
 - c. Provides in-context launching of multiple management clients
 - d. Displays status from multiple management servers

3. Storage Area Manager supports up to 25 MoM user accounts.
☐ True
☐ False

4. Each MoM client must be added to the authorizedclients.dat file of each management server being monitored.
☐ True
☐ False

Module 16: Database management and basic troubleshooting

1. What is the name of the database configuration file?
solid.ini
2. List the commands to start the Host Agent and DIAL processes on the SAN host.
HA_trigger start
dial_trigger start
3. What is the name of the log file that captures information about any of the Manage Host functions?
<hostname>.log
4. Logging for <hostname>.log can be set from the Configuration window or by editing DeployServerConfig.prp on the management server.
☐ True
☐ False
5. Many of the GUI configuration settings are stored in a configuration file on the management server called gui.prp.
☐ True
☐ False
6. List two commands for gathering support related information on the management server and SAN host.
support.cmd is used for gathering management server information and
host support.cmd is used for gathering SAN host information
7. SAMTools is a web-based application used for troubleshooting problems with Storage Allocator.
☐ True
☐ False

Module 17: OpenView integration

1. IUM can be integrated with which of the following Storage Area Manager applications?
 - a. Storage Accountant
 - b. Storage Allocator
 - c. Storage Builder
 - d. Storage Node Manager

2. Internet Usage Manager is a turn-key storage billing system?
 - ☐ True
 - ☐ False

3. The IUM integration is enabled with the Storage Area Manager applications on an individual module basis.
 - ☐ True
 - ☐ False

4. A web server must be installed on the management server to enable the IUM integration to gather data from Storage Area Manager.
 - ☐ True
 - ☐ False

5. To collect user and directory information what collection type must be enabled on the Host Agents?

File data collection

6. If directories are to be metered, is there a configuration step that is required in the Storage Area Manager GUI and if so, what must be configured?

Yes, the managed directories must be set in the Storage Area Manager GUI.

Agent

A program or process running on a remote device or host system that responds to management requests, performs management operations, and/or sends event notifications. For example, the Host Agent component that resides on each SAN host.

Assignment

There are three types of assignments in Storage Allocator. When you assign items to host groups and LUN groups, the items become part of an organizational structure that is displayed in the Storage Area Manager user interface. When you assign storage to a host or share group, the individual or grouped hosts are granted read-write access to the assigned storage. When you assign LUNs to an associated LUN group, these LUNs are bound together and must be assigned and unassigned as a unit. When you assign an associated LUN group, if all the included LUNs cannot be assigned to a host or group, Storage Area Manager will not assign any of the LUNs to the host or group.

Associated LUN group

An associated LUN group allows you to group a set of LUNs into a single assignable item. Once grouped, the LUNs can be assigned only as a set. Associated LUN groups can be used for any set of LUNs that needs to be assigned and unassigned as a unit, for example, stripe sets, mirror sets, and sets of LUNs that contain parts of the same database.

Baseline

The baseline is a trend that represents normal performance. Deviations from the baseline trigger threshold events. Performance baselines use triple exponential smoothing with an adjustable threshold sensitivity.

Baseline sensitivity

Baseline sensitivity is a measure of the emphasis given to newer data in double and triple exponential smoothing models for predicting future performance or capacity.

Billing period

The billing period is the period between bills. One period ends and another begins on the day of the month that is specified in Accountant's bill schedule. For example, the period that begins on June 27 at 1:00 am ends on July 27 at 1:00 am.

Bill

A bill is a monthly summary of daily billing transactions arranged by organization and account.

Bridge

An interconnect device which allows hosts using one communication protocol to communicate with peripherals using another communication protocol. In the case of Fibre Channel, a bridge allows a Fibre Channel-based host to communicate with a non-Fibre Channel device. Bridges also increase the number of peripherals that can be connected to the host.

Capacity summaries

Capacity summaries condense capacity data that has been collected for a specified number of days, 7 days by default. Summaries contain the weighted average, minimum and maximum values, and standard deviation for each measurement that is collected. The weighted average is displayed in capacity graphs. The minimum, maximum, and standard deviation are used to construct capacity trends.

Capacity threshold

A capacity threshold is a user-defined limit on used space that, when exceeded, may need administrative attention. Limits can be minimums or maximums and are expressed as percentages (%) or absolute quantities (KB, MB, GB, TB, and so on).

CLUI (Command Line User Interface)

An alternative interface to the user interface, which allows you to perform most Storage Area Manager tasks in a Command window. Each Storage Area Manager application includes its own set of CLUI commands.

Summary and detail bills and reports

A Summary bill/report shows information about an organization, service level, or storage device and the charges for its LUNs.

A Detailed bill/report shows the same summary information plus a LUN-by-LUN description of charges.

Device management application

Any application that is linked to a specific device or device type. You can only launch device management applications when you select the associated device or device type.

Device

Any host, interconnect device, bridge, storage device, or NAS device in your storage network.

Directories

Directories are divisions and subdivisions of volumes; for example, "data" in "C:\data", where "C:" is a volume.

Disk array

A Fibre Channel or SCSI subsystem consisting of multiple disk drives under command of an array controller, incorporating several unique features that differentiate it from more traditional devices.

Environment

The conceptual layout of the storage domain and its components. In essence, your environment is everything that you can see from within Storage Area Manager. The environment is comprised of storage networks.

Event

A generic term for an unsolicited message emitted by a managed device or internally by Storage Area Manager. An event is an occurrence of some defined activity.

Exclusive assignment

A Storage Allocator exclusive assignment occurs when storage is assigned directly to a host rather than indirectly through a share group.

Fibre Channel

A data transfer protocol that merges high-speed I/O and networking functionality to achieve a maximum data transfer rate of up to 200 MB/second over copper and fiber optic cabling at distances of up to 10 km. Fibre Channel supports multiple topologies including direct connect, arbitrated loop, and fabric. Fibre Channel is an open standard as defined by ANSI and OSI.

File mode

File mode is an octal summary of the `st_mode` field in the `_stat` data structure. The digits in this octal indicate the file type, attributes, and access mode of the associated file or directory. To interpret specific digits, refer to the documentation on your operating system (`/usr/include/sys/stat.h` on UNIX systems).

Free space

Free space is file system space that is not consumed by files.

Host

A generic term used to describe a computer system on which a software application or application component is installed.

Host Agent

Host Agent is a distributed component that gathers information on the configuration and status of host Fibre Channel resources. Host Agent reports this information to Storage Area Manager, providing real-time updates that are displayed throughout the user interface.

The Host Agent component must be installed on each SAN host. You can remotely install the Host Agent from the Storage Area Manager user interface, or you can install it locally from the product CD. See the *hp OpenView storage area manager installation guide* for instructions on local installation of the Host Agent software.

Host Bus Adapter (HBA)

A peripheral controller card that provides a host system access to the network, which can be Fibre Channel or SCSI based.

Host group

A host group is an organizational tool that allows you to group hosts into logical sets. You can group hosts by platform, location, department, or other criteria.

Hub

An interconnect device that provides a common connection point for devices in a network.

In-band management

Communication management with a device via the primary protocol, Fibre Channel.

Interconnect

A term used to describe any device that provides connections between multiple storage devices and/or hosts. Switches, hubs, and bridges are interconnect devices.

JBOD (Just a Bunch Of Disks)

A multiple disk drive configuration, internal or external to a host computer, in which there is no storage controller. The disk drives are managed by the host system.

Junk files

Junk files are files that you can identify by the characters in their names, such as tmp. Typically, these are files that can be deleted to reclaim file space, but junk files can be defined for any need.

Lock/unlock

The lock status of a host or group can be changed in the Properties tab of the Edit window. When a group is locked, you cannot change its name, description, or assignments; when a host is locked, you cannot change its description or assignments.

Logical unit (LUN)

A logical unit (LUN) is a physical or virtual device addressable through another device. Logical units can be thought of as separate storage devices for operational purposes, although physically that may not be the case.

In Storage Area Manager, "LUN" refers to a logical unit, not a logical unit number.

LUN group

A LUN group is an organizational tool that allows you to group LUNs into logical sets. You can group LUNs by platform, location, department, or other criteria.

Managed host

The hosts in the SAN that are managed by Storage Area Manager. The Host Agent component must be installed on each SAN host. You can remotely install the Host Agent from the Storage Area Manager user interface, or you can install it locally from the product CD. See the *hp OpenView storage area manager installation guide* for instructions on local installation of the Host Agent software. Also referred to as a SAN host.

Management client

The management client is the user interface that uses a common navigation and presentation framework to display the storage information stored within the database located on the management server.

The management client is automatically installed on the management server when you install Storage Area Manager. You can also download the management client to remote Windows, HP-UX, and Solaris hosts. You can perform the same tasks from local and remote management clients. Changes made while working from a remote management client are stored in the database on the management server.

Refer to the *hp OpenView storage area manager installation guide* for detailed instructions on downloading and setting up a management client.

Menu bar

The area of the main window located directly below the title bar that contains the labels for pull-down menu commands.

NAS (network attached storage)

A technology in which an integrated storage system is attached to a messaging network that uses common communications protocols, such as TCP/IP. The HP Surestore NetStorage 6000 is an example of a NAS device supported by Storage Area Manager.

NIS

Network Information Name Service (NIS) is the UNIX equivalent of Windows domain user accounts. NIS users can log on from any machine on the network. Their opposites are local users who can log on a specific machine.

Node

Common name for a Fibre Channel device or storage resource.

Organization

A user-defined collection of storage resources. Organizations do not necessarily reflect a physical relationship within the storage network. A storage resource can be a member of more than one organization.

Out-of-band management

Communication management with a device that occurs via a protocol other than Fibre Channel. For example, the SNMP protocol.

Performance thresholds

Performance thresholds are the boundaries of normal performance. When measured performance falls outside these boundaries, threshold warnings are sent to the event panel. Performance thresholds are automatically determined by the baseline.

Polynomial order

Polynomial order is the number of turns in the polynomial model for predicting future capacity or performance. For example, the polynomial order of a curve that increases and then decreases is 2.

Port

The hardware I/O by which Fibre Channel devices, or nodes, provide access to the outside world.

Property

A characteristic or attribute associated with a resource. A property is a placeholder in which a specific value is assigned to provide information about the state of the resource.

RAID (Redundant Array of Independent Disks)

The use of many low cost disk drives as a group to improve performance while providing redundancy for data security.

Resource

Any object managed by Storage Area Manager that appears in the Resources tree. Resources include devices discovered by Storage Area Manager and organizations that you create within Storage Area Manager.

Rogue host

A rogue host is a host that has access to LUNs that are not assigned to it, resulting in a possible multi-writer situation.

SAN host

The hosts in the SAN that are managed by Storage Area Manager. The Host Agent component must be installed on each SAN host. You can remotely install the Host Agent from the Storage Area Manager user interface, or you can install it locally from the product CD. See the *hp OpenView storage area manager installation guide* for instructions on local installation of the Host Agent software. Also referred to as a managed host.

Seasonality sensitivity

Seasonality sensitivity is a measure of the emphasis given to periodic variation in the triple exponential smoothing model for predicting future capacity or performance. It says that data tends to manifest a pattern periodically, for example, daily or weekly.

Service level

A service level is a category that sets the price that will be charged for LUN use. The category typically reflects the relative speed, size, reliability, or other LUN quality.

Share group

A share group is a security group that can contain hosts, LUNs, and associated LUN groups. Each host in a share group has read-write access to all the assigned LUNs and associated LUN groups. Share groups can be used to share data LUNs or LUNs that are needed by utilities on all systems that access data LUNs on a specific device (for example, array management LUNs).

Shared assignment

A Storage Allocator shared assignment is made when storage is assigned to a host indirectly, through a share group.

Smoothing

Smoothing is a technique for reducing random fluctuations in the analysis of data that is collected over time. Smoothing models—moving average and single, double, and triple exponential smoothing—allow a clearer view of the true underlying behavior of the data.

Space not visible to hosts

Space that is not visible to hosts has been configured into LUNs but has not been discovered on any Storage Area Manager hosts.

Space visible to hosts

Space that is visible to hosts has been configured into LUNs and is being used by at least one host.

Special unassign

If a host, LUN, or associated LUN group cannot be unassigned from a share group, host, or associated LUN group, you can unassign it by using the Special Unassign command and rebooting the affected host(s). The Special Unassign command removes assigned LUNs from an involved host's local list of assigned LUNs, so after the host is rebooted, it can no longer access the LUNs.

Stale files

Stale files are files that have not been accessed in a specified number of days.

Storage Allocator host status

There are three status options for Allocator hosts:

Activated. Storage Allocator is installed and active on this host.

Deactivated. Storage Allocator was deactivated on this host, and LUNs are still assigned to the host.

Nonfunctional. LUN allocation is not functional or working on this host.

Storage Allocator supported host

A Storage Allocator supported host is a host on which Storage Allocator is installed and active.

Storage network

Defined in Storage Area Manager as a group of storage resources, such as hosts, interconnect devices, bridges, and storage devices, which have a common interconnection. Each storage network is an island of Fibre Channel connectivity, and each device in a storage network map is able to send Fibre Channel commands to all other devices in the map. Your installation of Storage Area Manager may include several storage networks. They are labeled as SAN-1, SAN-2, etc.

Generically defined as a network for which the primary purpose is the transfer of data between hosts and storage resource and among storage resources.

Switch

A generic interface between each node and the physical layer. Each node is connected to a switch and receives a non-blocking data path to any other connection on the switch.

Tape library

A Fibre Channel or SCSI subsystem consisting of multiple tape drives under command of a library controller.

Title bar

The area at the top of the main window which, by default, contains the title of the software application that is running in that window (Storage Area Manager) as well as information about what is currently displayed and selected in the user interface:

For example:

DEFAULT_DOMAIN - hp OpenView storage area manager

Toolbar

The area of the main window located directly below the menu bar which contains shortcut buttons for frequently used commands. Simply click a toolbar button to activate its corresponding command. Device maps and performance and capacity graphs also include toolbars.

Trap

A trap is a message sent from a remote system (an agent) to a manager, without being explicitly requested by the manager. Agents send traps to managers to indicate that an error has occurred or an event has taken place. For example, a device (agent) sends a trap to Storage Area Manager (manager) when an error occurs at the device.

Traps are also known as notifications or events. You can configure Storage Area Manager to generate traps that can be received by other management applications.

Trend

A trend is a mathematical pattern that is derived from historical data to predict future values.

Trend sensitivity

Trend sensitivity is a measure of the emphasis given to the up and down tendencies in double and triple exponential smoothing models for predicting future capacity or performance.

Unassignment

There are three types of unassignments in Storage Allocator. When you unassign items from host groups and LUN groups, they are removed from their organizational structure in the Storage Area Manager user interface. When you unassign storage from a host or share group, the individual or grouped hosts are no longer able to access the storage for read-write access. When you unassign a LUN from an associated LUN group, the LUN is no longer part of a group that must be assigned as a unit. When you unassign an associated LUN group from a host or group, if all the included LUNs cannot be unassigned, then Storage Area Manager will not unassign any of the LUNs in the group.

Unconfigured space

Unconfigured space is disk space that has not yet been configured into LUNs or physical volumes.

Unique instance ID

A unique number that Storage Area Manager assigns to each discovered device and host to distinguish it from other devices and hosts.

Used space

Used space is file system space that is consumed by data.

User interface

The software component which is the Java-based browser for the user's environment in Storage Area Manager. The user interface has administrative capabilities which allow you to change editable properties of Storage Area Manager and its applications, as well as manage the devices in the storage network.

Users

Users are login accounts on hosts in the storage domain. Domain and NIS (machine independent) users are identified by the domain name and user account. Local (machine dependent) users are identified by the machine name and user account. Users include NT user groups, such as Administrators, and the members of user groups.

Visible LUN

A LUN is visible to a host when the host has a physical path to the LUN.

Volumes

Volumes are logical chunks of physical disk space. Volumes include logical volumes, which are created using volume managers (Veritas and Logical Volume Manager), and physical volumes, also called partitions, which are created using Windows format utilities (such as Disk Administrator).

Volume group

A volume group is a pool of LUNs that has been created using Logical Volume Manager (LVM) or Veritas Volume Manager. Volume manager groups allow you to extend logical volumes on the fly, that is, without destroying and re-creating the existing volume and moving all the data it contains.

Zone

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

Zone set

Zone sets are a named group of zones. A zone may 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.