

# HP Entry-Level SAN Solutions

ESG9711SG0308

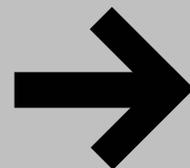


Student  
guide



HP Entry-Level SAN  
Solutions

ESG9711SG0308



training

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**Entry-Level SAN Solutions**

Student Guide

July 2003

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## Introduction

This course introduces you to applications and solutions that HP offers for companies interested in an entry-level SAN solution. The course also describes software and hardware requirements for installing and configuring the solutions offered by HP.

## Course Objectives

After completing this course, you should be able to:

- Explain the benefits of an entry-level SAN solution.
- Identify the features and benefits of a Modular SAN Array (MSA) 1000 and direct-attach storage (DAS) to SAN (DtS).
- Identify and discuss the function of the MSA1000 hardware components.
- Discuss the supported configurations, including restrictions, maximums, compatibility matrices, and zoning considerations.
- List the steps for installing an MSA1000 solution, including the installation of switches, hubs, drivers, and other support software.
- Recognize the manageable components and describe the use of management applications and tools for the MSA1000.
- Describe, install, and configure Secure Path for the MSA1000.
- Discuss the service and support functions for the MSA1000 SAN solution.

## Course Prerequisites

You should have successfully completed the following courses before attending this course:

- HP Storage Technologies
- HP StorageWorks Full-Line Technical Training (Web-Based)
- HP Storage Software and Solutions Full-Line Technical Training (Web-Based)

## Course Content

### Module Overview

- Module 1 — Benefits of a SAN
- Module 2 — MSA1000 Solutions
- Module 3 — MSA1000 Components
- Module 4 — MSA1000 Supported Configurations
- Module 5 — MSA1000 SAN Installation
- Module 6 — MSA1000 SAN Management
- Module 7 — Entry-Level SAN Multipathing Support
- Module 8 — MSA1000 Service and Support

### Lab Overview

- Module 3 Lab, MSA1000 Hardware Familiarization
- Module 5 Lab 1a, MSA1000 Installation for Windows 2000
- Module 5 Lab 2a, MSA1000 Controller Firmware Update for Windows 2000
- Module 5 Lab 1b, MSA1000 Installation for Linux Red Hat
- Module 5 Lab 2b MSA1000 Controller Firmware Update for Linux Red Hat
- Module 6 Lab 1a, MSA1000 Configuration with ACU for Windows 2000
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- Module 6 Lab 2, DAS to SAN Migration
- Module 6 Lab 3, External Boot from the MSA1000
- Module 7 Lab 1, Implementing Secure Path on Windows 2000
- Module 8 Lab, Basic Troubleshooting for the MSA1000
- Appendix — Lab, Managing the MSA1000 with Insight Manager 7

## Websites and Documentation

Storage products link at:

**<http://www.hp.com/go/storage>**

Documentation and related material for the MSA1000 at:

**<http://h18006.www1.hp.com/products/storageworks/msa1000/index.html>**

Documentation and related material for related support software at:

**<http://h18000.www1.hp.com/products/servers/management/cim7-description.html>**

**<http://h18000.www1.hp.com/products/servers/management/smartstart/index.html>**

Documentation and related material for Secure Path Windows Workgroup Edition at:

**<http://h18006.www1.hp.com/products/sanworks/secure-path/index.html>**

## Objectives

After completing this module, you should be able to:

- Discuss industry storage trends.
- Define storage area networks (SANs).
- Describe the features and benefits of a SAN.
- List the entry-level SAN supported switches.
- Describe the benefits of zoning.
- Explain why storage consolidation is needed in today's IT environments.
- Describe the direct-attach storage (DAS) to SAN (DtS) features and benefits of the HP StorageWorks Modular SAN Array (MSA) 1000 SAN.

## Industry Storage Trends

Growing IT Labor Shortage Requires Efficient IT Operations

Pressures for Continuous Operation (7 x 24)

E-Commerce, Email, and Data Mining — Driving Massive Demand for Storage



Cost of Managing Storage Rising as Cost per MB Falling

Centralized Management — Companies Becoming More Information Centric as Knowledge Is Recognized as a Corporate Asset

### Industry Storage Challenges Drive Storage Trends

Customers are facing an exponential demand for increasing storage capacity as their businesses grow and they continue to deploy more powerful, efficient solutions.

To maintain a competitive advantage, customers must have the ability to scale their solutions dynamically to meet increased resource demands. They also require highly available and easily managed solutions.

These demands have created the following challenges for storage solutions:

- Explosive storage growth with data capacities doubling every 18 months
- The need to have data online all the time with no interruption
- Shrinking backup windows
- Limited IT resources to manage their enterprise
- Rapidly shifting technologies

## Definition of a SAN



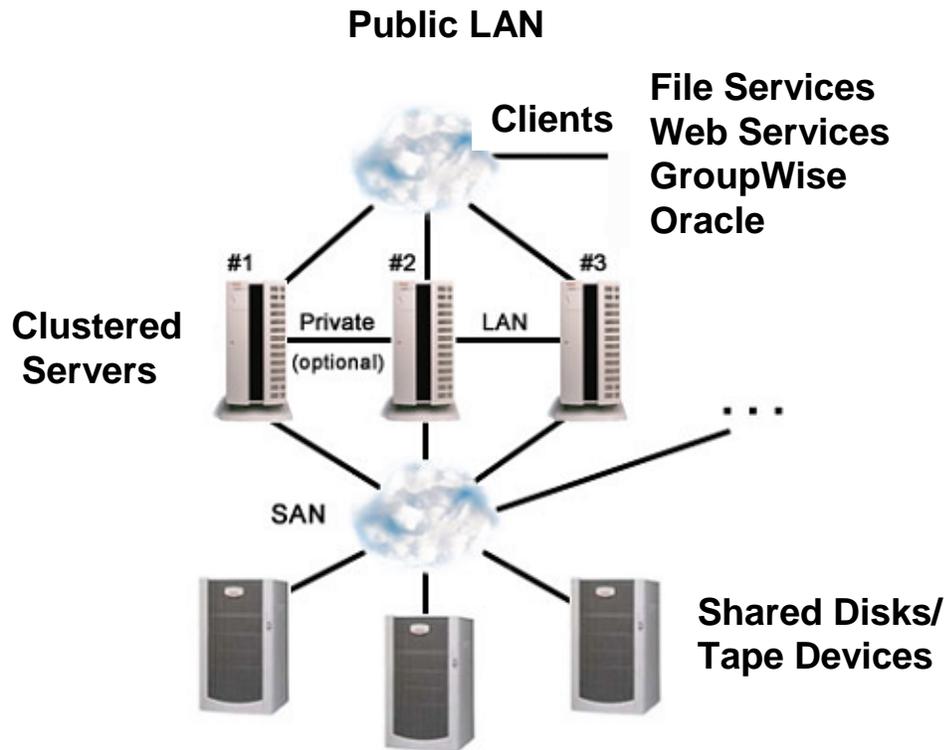
A SAN is a dedicated, centrally managed, secure information infrastructure that enables direct physical access to common storage devices or a storage pool.

The Storage Network Industry Association (SNIA) defines a SAN as,

*“A network whose primary purpose is the transfer of data between computer systems and storage elements and among storage elements. A SAN consists of a communication infrastructure, which provides physical connections, and a management layer, which organizes the connections, storage elements, and computer systems so that data transfer is secure and robust.”*

Within this definition there is no mention of Fibre Channel. SNIA recommends using the term Fibre Channel SAN when the network is based on Fibre Channel technology. Although a SAN typically references Fibre Channel, it can be based on other technologies such as ESCON (Enterprise System Connection).

## SAN Features and Benefits



SAN Example

### Features

SAN features include:

- A secure implementation of storage I/O methods over network transports
- A high-speed, scalable, robust network of servers and storage devices
- A storage service that:
  - Connects to enterprise-wide servers
  - Centralizes data
  - Moves data automatically for availability and replication
  - Provides accelerated data access
  - Supports advanced storage management
  - Provides for highly available configurations
- A natural platform for server clustering applications

SAN implementations from most storage vendors have been fairly simple—such as point-to-point configurations with a few switches between the servers and the storage.

Recent developments include:

- Fibre Channel extenders
- Fibre Channel-to-ATM gateways
- Fibre Channel-to-IP gateways

Future SAN technology will include the Internet small computer system interface (iSCSI) protocol. The iSCSI Protocol is an IP-based storage networking standard for linking data storage facilities. By carrying SCSI commands over IP networks, iSCSI is used to facilitate data transfers over intranets and to manage storage over long distances. The iSCSI protocol is among the key technologies expected to help bring about rapid development of the SAN market, by increasing the capabilities and performance of storage data transmission. Because of the size of IP networks, iSCSI can be used to transmit data over LANs, wide area networks (WANs), or the Internet and can enable location-independent data storage and retrieval.

iSCSI is one of two main approaches to storage data transmission over IP networks. The other method, Fibre Channel over IP (FC-IP), translates Fibre Channel control codes and data into IP packets for transmission between geographically distant Fibre Channel SANs. FC-IP (also known as *Fibre Channel tunneling* or *storage tunneling*) can only be used in conjunction with Fibre Channel technology; in comparison, iSCSI can run over existing Ethernet networks.

Using IP-based storage allows customers to realize SAN functionality and benefits by utilizing existing Ethernet capabilities to store and retrieve data. An iSCSI to Fibre Channel bridge (for example: the HP StorageWorks SR2122 Storage Router), enables access to block storage on a Fibre Channel SAN across an Ethernet network.

## Benefits

SANs reduce the cost of managing storage by consolidating storage and sharing the resources across multiple hosts.

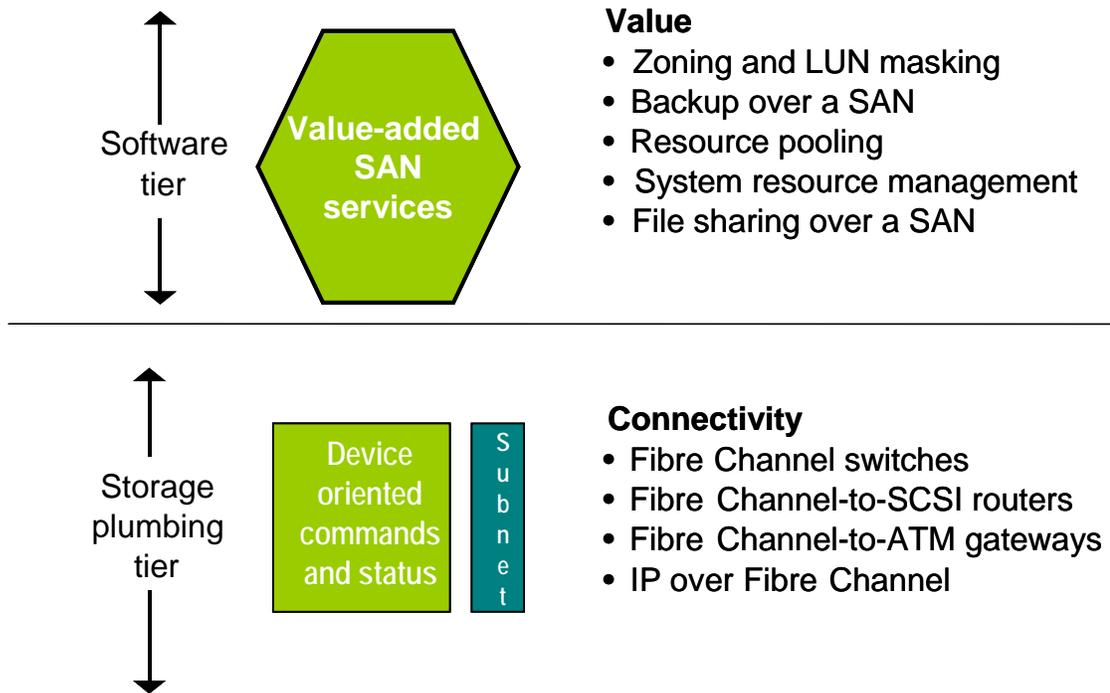
Most Fibre Channel-based storage supports changes made to storage configurations through a host operating system. This support allows storage resources to be added or deleted without interrupting production environments, thereby reducing downtime for storage changes.

Scaling storage can be as simple as plugging a storage array into a switch or adding drives into existing storage systems. This capability allows storage to be added on an as-needed basis.

The benefits of a SAN include:

- **Centralized storage** — Consolidating storage (primary and secondary) in a SAN and sharing the resource across multiple servers reduces the cost of storage management.
- **Elimination of server downtime while adding storage** — Using Fibre Channel-based storage, storage resources can be added or deleted without interrupting the production environment.
- **Improved availability** — Implementing advanced SAN designs enables fault-tolerant and disaster-tolerant configurations that are ideal platforms for clustered, mission-critical systems.
- **Modular scalability** — With modular scalability providing support for an unpredictable environment, the infrastructure can be changed as business needs evolve. Bandwidth, availability, redundancy, and capacity can be dynamically scaled on demand, providing maximum flexibility to accommodate business growth.
- **Serverless backup** — Having serverless backup enables direct backup from disk to tape without going through the host, which offloads data from the network. The host initiates the process but another intelligent device, such as the Network Storage Router (NSR), transfers the data.
- **Online storage migration** — Storage can be dynamically allocated and re-allocated among hosts without interruption, resulting in improved storage utilization.

## SAN Model



Gartner Group Two-Tier Model

This two-tier model represents how the Gartner Group views SANs:

- The first tier, storage plumbing, provides connectivity between nodes in a network fashion and transports device-oriented commands and status. At least one storage node must be connected to this network.
- The second tier uses software to provide value-added services that operate over the first tier.

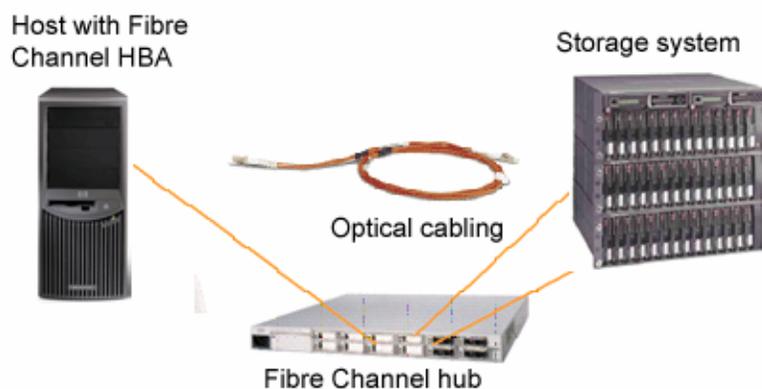
This model definition clearly differentiates network attached storage (NAS) from SANs. With NAS, a client makes a file system call over the network, as opposed to using device-oriented commands with SANs.

To qualify as a SAN, a configuration must provide separate value-added SAN services through software that operates across connected nodes, such as zoning and resource management.

## SAN Topologies

SANs can use either Fibre Channel Arbitrated Loop (FC-AL) or Fibre Channel Switched Fabric (FC-SW) topologies.

### FC-AL



The FC-AL network can be set up in two possible configurations—daisy-chained (loop) or through a hub. In the daisy-chain configuration, the transmit port of one device is connected to the receive port of the next device in the chain. Due to the shared nature of loop topologies, only one device may send data at any time. Access to the loop is determined by winning an arbitration to become the *loop master*.

Configuring FC-AL in a loop topology presents several limits to the performance of the network because performance is affected by the number of devices attached to the loop. The ability to make changes to the network is limited because the addition or removal of new devices or segments within a loop will bring down the entire loop.

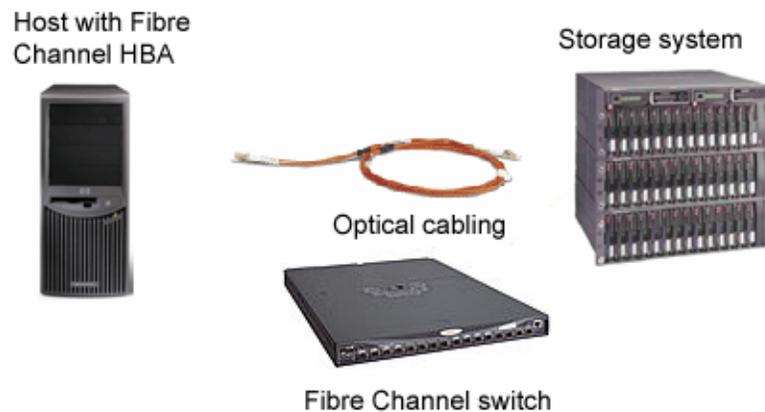
The most common topology used in the deployment of FC-AL uses a hub that forms a physical star interconnection. If a loop or non-responding device appears, the FC-AL hub will bypass the failure, thus maintaining the operational integrity of the network.

The preceding graphic shows the required components of a basic SAN based on an arbitrated loop topology.

These components include:

- Host
- Host bus adapter (HBA)
- Storage subsystem
- 7- or 12-port Fibre Channel hub or Fibre Channel arbitrated loop switch
- Cables and transceivers or GBICs

## FC-SW



FC-SW is the abbreviation for the standard governing the form of Fibre Channel network in which nodes are connected to a fabric topology implemented by one or more switches. Each N\_Port node of the FC-SW connects to an F\_Port on a switch. Pairs of nodes connected to a FC-SW network can communicate concurrently.

A fabric is a Fibre Channel switch or two or more Fibre Channel switches interconnected in such a way that data can be physically transmitted between any two N\_Ports on any of the switches. The switches comprising a Fibre Channel fabric are capable of routing frames using only the D\_ID (destination identifier) in a FC-2 (protocol level that encompasses signaling protocol rules and the organization of data) frame header.

In a switched fabric topology, many node-to-node connections can occur simultaneously, greatly increasing bandwidth. Cascading fabric switches provides scalability in the SAN solution.

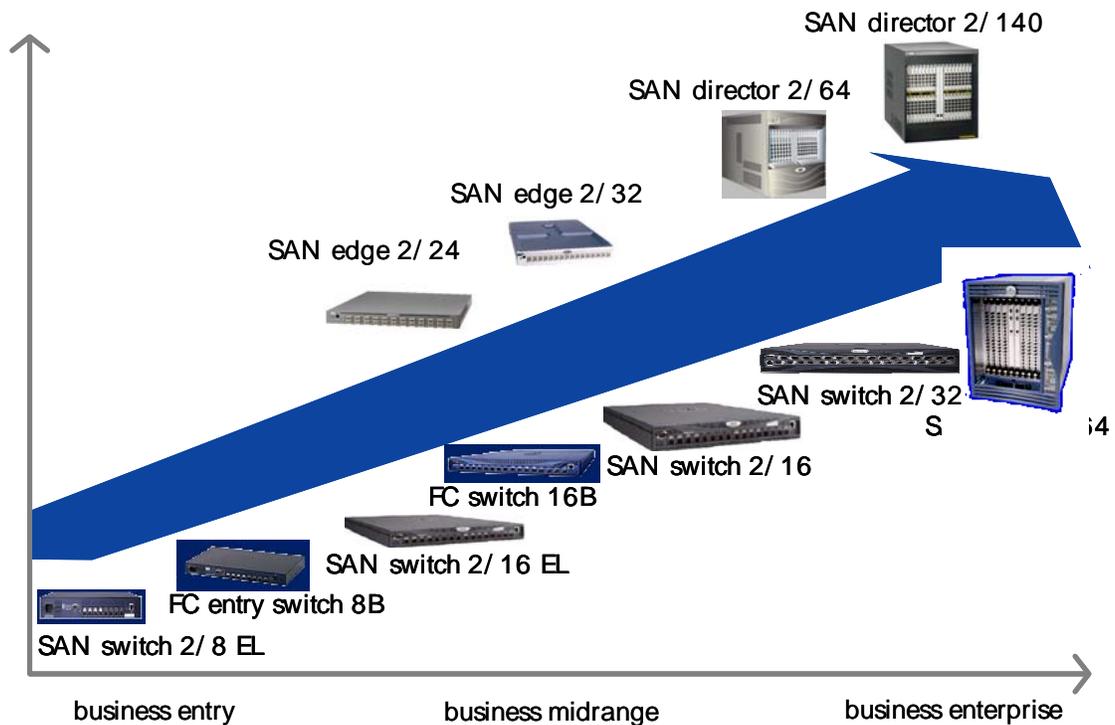
The preceding graphic displays some of the components of a basic SAN based on a switched fabric topology.

The SAN components include:

- HBA
- Host servers
- Storage subsystem
- Fibre Channel SAN switch
- Cables and transceivers or GBICs

## Supported Switches

Currently, HP supports numerous switches in one fabric and a maximum of seven hops (depending on the switch) from any initiator to any target.



## Configuration Rules for SAN Switches

The HP StorageWorks Modular SAN Array (MSA) 1000 storage systems is supported in the B (Brocade-based) and M (McData-based) class fabric product lines of Fibre Channel switches. The SAN connectivity rules for both storage systems apply uniformly to all switch products, unless specified otherwise.

In general, all MSA1000s have the same switch configuration specification. However, there could be some device-specific exceptions.

## Supported Switch Models — B Class (Brocade-Based)

HP supports a range of 1 and 2Gb/s SAN B class product line Fibre Channel switch models. Three broad classes of switches supported by HP include:

- **Directors** — High port count, high-bandwidth switch designed with fully redundant hot-pluggable field replaceable units (FRUs) that provide an availability of 99.999% (approximately 5 minutes of down time per year).
- **Fabric Switches** — Low to medium port count, high-bandwidth switch designed with redundant power supplies and cooling fans that provide an availability of 99.9% (approximately 8.8 hours of down time per year).
- **Fibre Channel Arbitrated Loop Switches (FC-AL)** — Low port count, low-bandwidth products. HP offers related products that act as loop-switching hubs and fabric-attach switches, which allow low-cost or low-bandwidth workgroup (edge) devices to communicate with fabric devices.

HP StorageWorks Switch Name	Number of Ports	
HP StorageWorks SAN Switch 2/32 Power Pak	32	
HP StorageWorks Core Switch 2/64	64 (2 switches per chassis, for a total of 128 ports per chassis)	

HP Switch Name	Compaq StorageWorks Switch Name	Number of Ports
Brocade 2400	SAN Switch 8	8
N/A	SAN Switch 8-EL	8
Brocade 2800	SAN Switch 16	16
N/A	SAN Switch 16-EL	16
Surestore FC Switch 6164 (64 ISL Ports)	SAN Switch Integrated/32 (64 ISL Ports)	32 (counts as 6 switches and 2 hops when applying configuration rules)
Surestore FC Switch 6164 (32 ISL Ports)	SAN Switch Integrated/64 (32 ISL Ports)	64 (counts as 6 switches and 2 hops when applying configuration rules)
Surestore FC 1Gb/2GB Entry Switch 8B	N/A	8
N/A	SAN Switch 2/8-EL	8
N/A	SAN Switch 2/16-EL	16
Surestore FC 1Gb/2Gb	N/A	8
Surestore FC 1Gb/2GB Switch 16B	SAN Switch 2/16	16

All switch models shown in the table are supported in the HP StorageWorks SAN provided that the same firmware versions and switch settings for each switch model family are used for the corresponding switch models listed.

### Note

Refer to the *SAN Product Support Tables* in the *HP StorageWorks SAN Design Guide* for the current required switch firmware versions for each switch model.

- For SAN fabrics consisting exclusively of Compaq switch models or a mix of pre-merger HP and pre-merger Compaq switch models (Compaq StorageWorks switch name in the above table), use the Compaq default switch settings. Configuration files with these settings are available from HP services.
- For SAN fabrics consisting exclusively of pre-merger HP switch models (HP switch name in the above table), use pre-merger HP switch settings. Configuration files with these settings are available from HP services.

## Fabric Maximums

Fabric maximums when using exclusively HP VA storage systems, or a mixture of HP XP or VA and StorageWorks Enterprise Virtual Array, EMA/ESA12000, EMA16000, MA/RA8000, MA6000, MSA1000, RA4000, or RA4100 storage systems:

- Up to 16 switches and up to 640 total ports in a single SAN fabric. Each fabric may contain any combination of supported 1Gb/s and 2Gb/s switch models listed, provided the individual switch model fabric limits listed below are not exceeded.
- The HP StorageWorks Core Switch 2/64 (maximum of two chassis total per fabric) — Each chassis contains two logical switches and consequently adds two to the fabric switch count. Maximum fabric configuration is two chassis with 12 other 8-, 16-, or 32-port switches (4x12). The Core PID addressing mode is required on all other switches in the same fabric with the hp StorageWorks core switch 2/64. Refer to “SAN Core and SAN Switch Addressing Mode” later in this module.
- StorageWorks SAN Switch Integrated 32 or 64, HP Surestore FC Switch 6164 (maximum of two chassis total per fabric) — Each chassis adds six switches to the fabric switch count. Maximum fabric configuration is two chassis with four other SAN switch model switches.
- Up to three switch hops (four switches) maximum between any two devices in a SAN fabric. Each SAN Switch Integrated 32 or 64, or HP Surestore FC Switch 6164 model switch used in a fabric adds up to two hops to the hop count between devices depending on the specific device-to-switch connections and device-to-device access.

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## Additional Fabric Rules

- StorageWorks SAN Switch 2/8-EL — By default, this switch is supported in SAN fabrics with up to four switches total only. A license upgrade is available to allow these switches to be upgraded for support in larger fabrics.
- HP Surestore FC 1Gb/2Gb Entry Switch 8B — Supported with a single E-port connection.
- Compaq Fibre Channel Switch 8 or Fibre Channel Switch 16 models — Up to four switches total per fabric using these model switches only, or when intermixed with 1Gb/s SAN switches.

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### Note

Intermixing Compaq Fibre Channel 8 and 16 switches and 1Gb/s StorageWorks SAN Switch models requires the compatibility mode (VC Encoded Address Mode) be set in the SAN switches (refer to the SAN switch documentation). Intermixing 1Gb/s Compaq Fibre Channel Switch 8 or Fibre Channel Switch 16 switch models and 2Gb/s switch models is not supported.

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- The Compaq FC-AL Switch 8 is supported for cascaded attachment to the SAN through a single FL-port on a Compaq SAN Switch 8, SAN Switch 16, SAN Switch 8-EL, or SAN Switch 16-EL.

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### Note

Cascaded attachment of the FC-AL Switch 8 connected to 2Gb/s switch models is not supported.

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- Within a single fabric where switches are interconnected, each switch must have a unique domain number (Domain ID) and a unique World Wide Name (WWN). All switch configuration parameters in each switch must be the same.

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### Note

Do not configure any switches with a domain ID of 8. HP systems reserve domain 8 for Private Loop devices.

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- Optional switch features may be used on any switch in the fabric if the feature is supported on that switch. For example, in a fabric consisting of four SAN switch 16 and four SAN Switch 2/16 switches, the Fabric Watch feature may be used on the SAN Switch 2/16 switches. If two 2Gb/s switches are connected together, trunking may be implemented if the feature is supported by both switch models.
- Any mix of servers and storage systems is allowed in a SAN provided the specific platform, operating system, and storage system fabric limits and rules are followed. Refer to the *HP StorageWorks SAN Design Guide* and the documentation listed in the section "Related Documents" in the preface of the *SAN Design Guide* for specific instruction on the implementation of switches in a SAN environment.

- HP requires that all switches in a single fabric or multi-fabric SAN use the same switch firmware revision for each switch model family. Two successive fabric firmware versions can be temporarily used in one fabric or in multiple fabrics in a SAN during switch firmware rolling upgrades.

## **SAN Core and SAN Switch Addressing Mode**

When using products from the HP StorageWorks Core Switch or SAN switch family of products, or pre-merger HP products from Brocade, for the switch firmware versions listed in this document, two different addressing modes are available. As SAN configurations grow to include more switches, we recommend that the “Core Switch” addressing mode should be used. This is obtained by setting the Core Switch PID configuration parameter bit.

All previous switches supplied by HP and Compaq were shipped with the Core Switch PID configuration bit cleared. When the switches are operated in this mode, certain restrictions apply regarding the maximum number of switches in a fabric and the maximum number of ports on a switch. If a StorageWorks Core Switch 2/64 or StorageWorks SAN Switch 2/32 is used anywhere in a fabric, then all the switches in the fabric must have the Core Switch PID configuration bit set. Because HP believes that the use of large port count switches will only become more common as time goes on, all switches are shipped with the bit set. SAN managers with existing fabrics must decide whether to change the Core Switch PID bit now or later. The trade-offs are:

- All switches in a fabric must have the same Core Switch PID bit setting, whether it is set or cleared, otherwise the fabric will segment. It must be set on all switches if a StorageWorks Core Switch 2/64 or StorageWorks SAN Switch 2/32 is part of the fabric.
- If you have two fabrics, you can change the Core Switch PID on one fabric at a time, so the SAN storage system can continue to operate during the changeover.
- HP-UX and IBM systems use the address bits to identify logical units, when the addressing bits are changed the logical unit definitions must also be changed. This requires a reboot of the servers and cannot be done without taking down the entire SAN storage system in a planned maintenance scenario.
- If you do not set the Core PID on your existing switches now, you will need to clear this bit on any new switches that you add because they ship with the Core PID bit set.

HP recommends that this change be done now, to avoid potential problems in the future. Additional information on the Core Switch PID is available on the HP SAN Storage website.

## Supported Switch Models — M Class (McData-based) Product Line

HP supports a range of 1Gb/s and 2Gb/s high availability fabric product line Fibre Channel switch models.

HP StorageWorks Switch Name		Number of Ports
HP StorageWorks SAN Edge Switch 2/16		16
HP StorageWorks SAN Edge Switch 2/24		24
HP StorageWorks SAN Edge Switch 2/32		32
HP StorageWorks Core Switch 2/140		140

HP Switch Name	Compaq StorageWorks Switch Name	Number of Ports
N/A	McData ES-3016	16
N/A	McData ES-3032	32
McData ED-5000		32
Surestore FC64	StorageWorks SAN Director 64	64
Surestore Director 2/64		64

### SAN Fabric Rules — M Class Product Line

All switch models shown in table above are supported in the HP StorageWorks SAN provided that the same firmware versions and switch settings are used. The default switch settings for this family of switches (from StorageWorks and Surestore) are the same.

### Fabric Maximums — M Class Fabric Product Line

Common HP StorageWorks SAN fabric rules for SANs consisting of exclusively HP VA storage systems, or a mix of HP XP or VA and StorageWorks Enterprise Virtual Array, EMA/ESA12000, EMA16000, MA/RA8000, MA6000, MSA1000, RA4000, or RA4100 storage systems. These rules can be considered a subset of the HP StorageWorks SAN fabric rules:

- Up to 16 switches with up to 1376 total ports (maximum 1024 user ports) are supported in a single SAN fabric. Each fabric may contain any combination of supported 1 and 2Gb/s switch models listed, provided the individual switch model fabric limits listed below are not exceeded.

---

#### Note

With eight HP StorageWorks Director 2/140 fully populated Directors, it is physically possible to exceed the 1024 user port maximum. The restriction is in the zoning configuration, as only 1024 unique zone members (user port) can be configured. However, the remaining ports can be used as Inter Switch Link (ISL) connections in the fabric.

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- HP StorageWorks Director 2/64 and HP StorageWorks Director 2/140—maximum of eight Directors total per fabric.
- McData ES-3016 and ES-3032 switches are not supported on HP VA storage.
- Up to three switch hops (four switches) maximum between any two devices in a SAN fabric.

## Additional Fabric Rules — M Class Switches

- Within a single fabric where switches are interconnected, each switch must have a unique domain number (Domain ID) and a unique World Wide Name (WWN). All switch configuration parameters in each switch must be the same.

---

### Note

Do not configure any switches with a domain ID of 8. HP systems reserve domain 8 for Private Loop devices.

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- Any mix of servers and storage systems is allowed in a SAN provided the specific platform, operating system, and storage system fabric limits and rules are followed. Refer to the appropriate sections in the *SAN Design Guide* and the documentation listed in the section "Related Documents" in the Preface of the *SAN Design Guide*.
- HP requires that all switches in a single fabric or multi-fabric SAN use the same switch firmware revision. Two successive fabric firmware versions can be temporarily used in one fabric or multiple fabrics in a SAN during switch firmware rolling upgrades.

## Third-Party Switch Support

Third-party switches and connectivity reliability have been verified through testing. However, support is subject to:

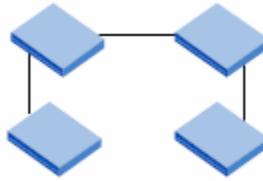
- No support for third-party switch functionality. If a defect must be fixed within the switch product, the customer needs to work directly with the third-party switch support organization.
- HP will make a best effort attempt to help the customer resolve issues as they pertain to the HP supported products within the environment.
- HP can support switches and additional functionality resold through other vendors providing the customer purchases third-party support through the appropriate HP support group.

Example of third-party switches:

- McData ED5000 = EMC Connectrix ED-1032
- InRange FC 9000

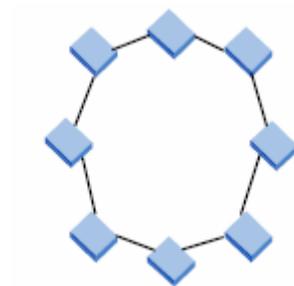
## Fabric Topologies

### Cascaded Fabric



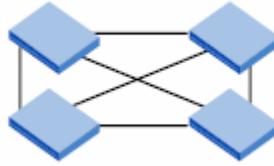
A cascaded fabric is a line of switches with one connection between each switch and the switch next to it. The switches on the ends are not connected.

### Ring Topology



A Ring topology is like a cascaded fabric, but with the ends connected. The ring has superior reliability to the cascade because traffic can route around an ISL failure or a switch failure.

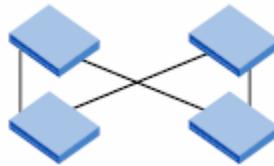
## Full Mesh Topology



In a full-mesh topology, every switch is connected directly to every other switch. Technically, almost any topology could be described as some sort of mesh. Since this is not a very useful definition, working definitions for two meshes are provided—the full mesh and the partial mesh. There are two special cases for a full mesh:

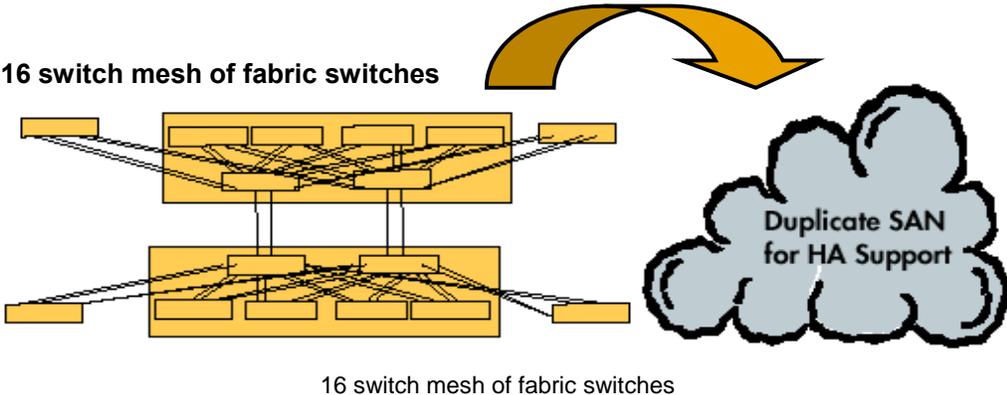
- A 2-switch full mesh is identical to a 2-switch cascade.
- A 3-switch full mesh is identical to a 3-switch ring.

## Partial Mesh Topology



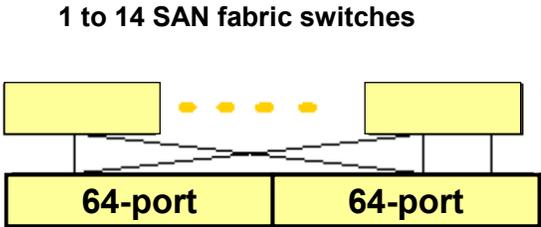
A partial mesh is similar to a full mesh, but with some of the ISLs removed. The common definition for a partial mesh is broad enough to encompass almost all fabrics that are not full meshes.

**Core/SAN Fabric Switch Configurations Examples (Brocade)**

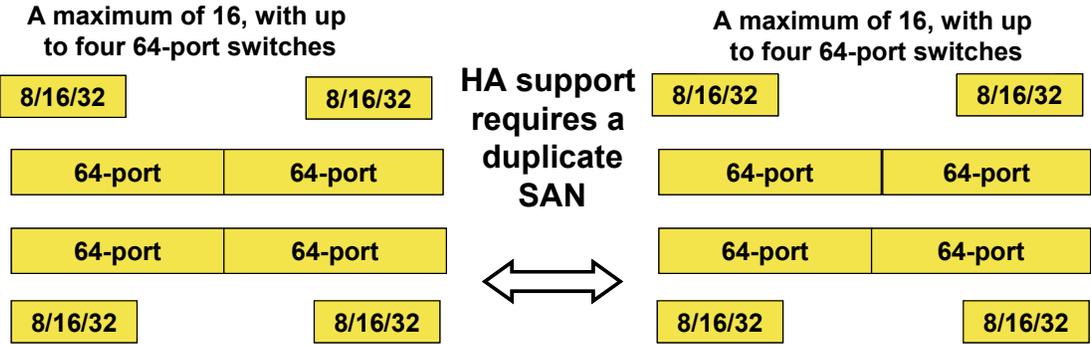


**TERMINOLOGY**  
 1 Core switch chassis  
 12000 'box' = 2  
 logical 64-port switches

64-port	64-port
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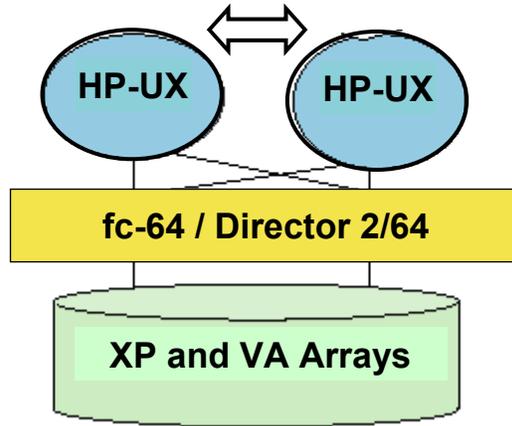
Core Switch definition and SAN fabric with up to 16 switches



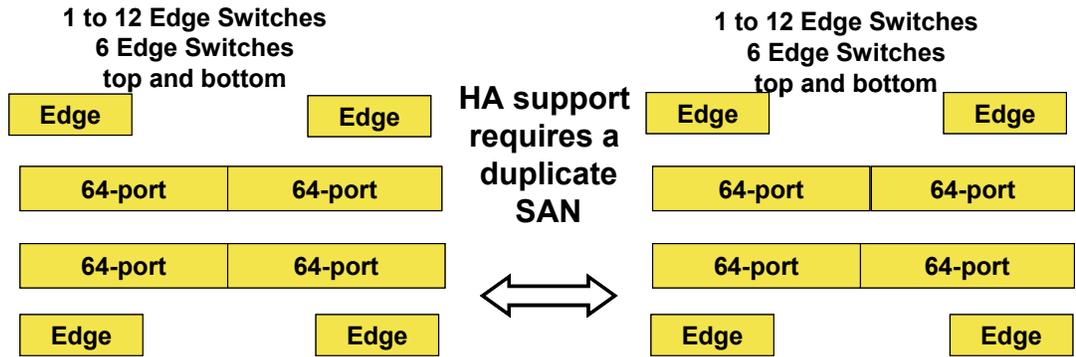
Two maximum SANs for high availability

## Director/Edge Switch Configurations Examples (McData)

Single-box  
HA Support



Single Director switch configuration



Director/Edge switch maximum SANs for high availability

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**Note**

A maximum of 16 switches are supported with up to eight directors in a single SAN.

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## 1 and 2Gb/s Fabric Topology Recommendations

There are no specific topology rules related to mixing of 1 and 2Gb/s components in a fabric. However, HP does strongly recommend these guidelines be followed:

- When using 1 and 2Gb/s switches in the same fabric, use 2Gb/s switches in the core for Core to SAN Switch or Director to Edge Switch topologies.
- Connect 2Gb/s switches together to take advantage of the ISL Trunking feature when using Fibre Channel switch models that support this feature.
- Use 2Gb/s switches for connections to 2Gb/s capable devices. In general, for SANs with 1 and 2Gb/s components, the transfer rate between devices and ports on switches are determined by the speeds supported by the individual ports that are connected. If two 2Gb/s devices or switch ports are connected together the speed will be 2Gb/s for that segment in the fabric. If two 1Gb/s devices or switch ports are connected together the speed will be 1Gb/s for that segment in the fabric. If a 2Gb/s and a 1Gb/s port are connected together the speed will be 1Gb/s for that segment.
- Zoning rules, SAN security, and SAN management for 2Gb/s switches are the same as for 1Gb/s switches.

## Zoning

A zone is a group of fabric-connected devices (storage, tapes, and hosts) arranged into a specified grouping. Any device connected to a fabric can be included in one or more zones. Devices within a zone possess an awareness of other devices within the same zone—they are not aware of devices outside of their zone.

Zone members (ports, WWNs, or aliases) are grouped into a zone. Zones, in turn, are grouped in a zone configuration (a collection of zones). Zones can overlap—a device can belong to more than one zone. A fabric can consist of multiple zones. A zone configuration can include both hardware-enforced and software-enforced zones and there can be any number of zone configurations resident on a switch.

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**Note**

Only one configuration can be active (enabled) at a time. The number of zones allowable is limited only by memory usage.

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Use zones to create logical subsets of the fabric to accommodate closed user groups or to create functional areas within the fabric. For example, include selected devices within a zone for the exclusive use of zone members, or create separate test or maintenance areas within the fabric.

Zoning is not used for the purpose of isolating I/O traffic in the SAN or Fibre Channel events from a third-party host such as LIPs. These events are automatically isolated through the switch and fabric topology.

## Zone Types

Zone types are:

- **Port Zone** — A zone containing members specified by switch ports (domain ID and port number), or aliases of switch ports, only. Port zoning is hardware enforced in the HP StorageWorks Fibre Channel SAN Switch 8 or 16 and beyond.
- **WWN Zone** — A zone containing members specified by device World Wide Names (WWN), or aliases of WWNs, only. WWN zones are hardware enforced in the HP StorageWorks Fibre Channel SAN Switch series. WWN zones are software enforced in the SAN switch 8 /16 switches.
- **Mixed Zone** — A zone containing some members specified by WWN and some members specified by switch port. Mixed zones are software enforced through the fabric name server only.

---

## Zone Enforcement

Zones can be hard (hardware enforced), soft (advisory), or broadcast. In a hardware-enforced zone, zone members can be specified by port number or by WWN, but not both. A software-enforced zone is created when a port member and WWN member are in the same zone.

- **Hardware Enforced Zones** — All zone members are specified as either switch ports or by WWN. Any number of ports or WWNs in the fabric can be configured to the zone.

If WWNs are used exclusively in a zone, new devices can be attached without regard to physical location. In hard zones, switch hardware ensures that there is no data transferred between unauthorized zone members. However, devices can transfer data between ports within the same zone. Consequently, hard zoning provides the highest level of security.

- **Software Enforced Zones** — At least one zone member is specified by WWN and one member is specified as a port. In this way, you have a mixed zone that is software enforced. When a device logs in, it queries the name server for devices within the fabric. If zoning is in effect, only the devices in the same zones are returned. Other devices are hidden from the name server query reply.

When using software-enforced zones, the switch does not control data transfer and there is no guarantee of data being transferred from unauthorized zone members. Use software zoning where flexibility and security are ensured by the cooperating hosts.

- **Broadcast Zone** — Only one broadcast zone can exist within a fabric. It is named “broadcast” and it is used to specify those nodes that are to receive broadcast traffic. This type of zone is hardware enforced—the switch controls data transfer to a port. When zoning is disabled, devices can communicate without regard to zone restrictions. When zoning is enabled, zoning is enforced throughout the fabric and devices can communicate only within their zones.

A switch can maintain any number of zone configurations. However, only one zone configuration can be enabled (enforced) at a time. Because multiple configurations reside in the switch, you can switch from one configuration to another as events dictate. For example, you can write a script to set up a pre-specified zone configuration to be enabled at certain times of the day, or, in the event of a disaster, you can quickly enable a defined configuration to implement your disaster policy.

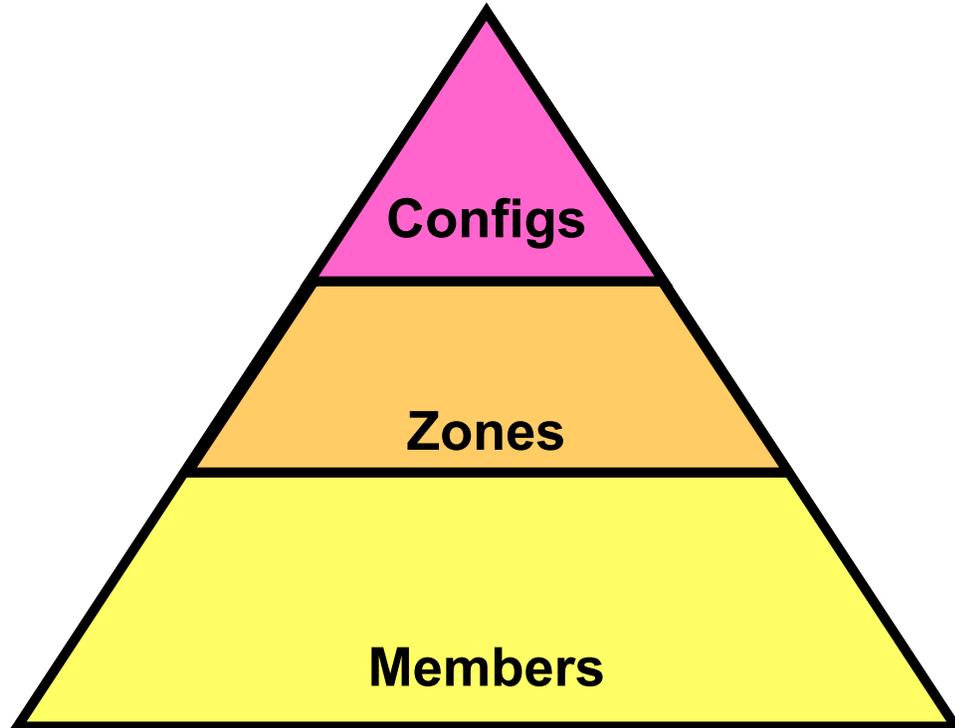
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### Note

The current version of the HP-UX driver has the issue that the switch port address is part of the device path. If the device is moved to another physical port, the HP-UX system will not be able to see the device until the device files are re-built (ioscan, reboot, and so on). This will be changed in a later HP-UX release when it changes to a worldwide name-based addressing scheme.

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## Zoning Implementation



Zoning can be implemented and administered from any switch in the fabric. When a change in the configuration is saved, it is automatically distributed to all switches in the fabric. For that reason, zoning requires that all switches in the fabric have an active zoning license. Zoning can be administered through:

- Telnet command interface
- Web Tools web interface



**Important**

Zoning is required when HP-UX 11.0 or 11i is used in a heterogeneous SAN with other operating systems. HP-UX is incompatible in zones with all other operating systems.

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## SAN Fabric Zoning Rules

The fabric zoning feature is supported with all HP Fibre Channel switch models. Zoning can be used to logically separate devices and different hardware platforms and operating systems in the same physical SAN. Use of zoning is required under these specific conditions:

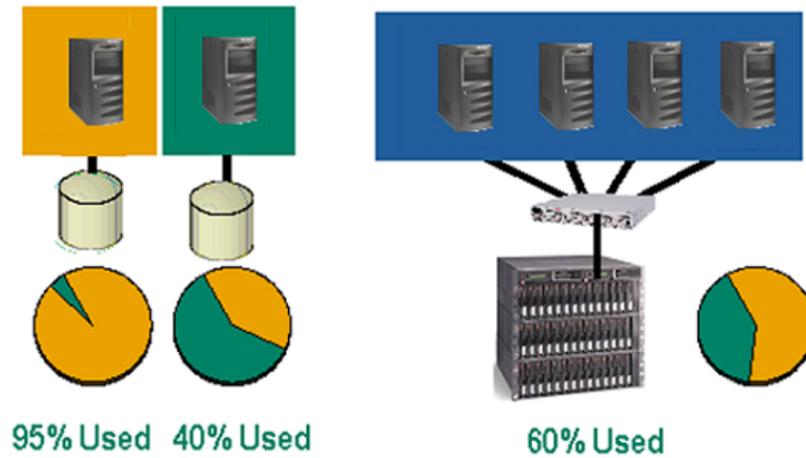
- When mixing pre-merger HP and pre-merger Compaq storage systems and servers in the same SAN fabric. Refer to Chapter four “Heterogeneous SAN Platform and Storage System Rules” in the *hp StorageWorks SAN design reference guide* for more information.
- When mixing different hardware platforms, operating systems, or storage systems that are currently only supported in homogenous SANs and it is unknown whether there are interaction problems. Refer to table 14 and 15 of the *hp StorageWorks SAN design reference guide* for specific information about zoning in heterogeneous SANs.
- When there are known interaction problems between different hardware platforms or operating systems and specific storage system types.
- When the number of nodes or ports in the SAN fabric exceeds a storage system connection support limit.

## Connectivity Rules

In general there is no limit on the maximum number of zones in a SAN and overlapped zones are supported.

## Storage Consolidation

- **Better disk capacity utilization than DAS**
- **More efficient storage growth with storage consolidation**



Industry experts believe a large number of IT companies are grossly underutilizing their existing storage resources, resulting in unnecessary storage expenditures and added management expenses. According to the experts, average direct-attached utilization rates are approximately 40%.

Storage consolidation saves money by creating a larger pool of storage for the hosts. In the preceding example, it is easy to see that distributed storage can be wasteful. If both servers had 100GB of storage you needed to add 40GB to the server with 95% of its storage used, you would be forced to purchase another 20GB of storage even though the server on the right has 60GB of unused space.

By consolidating storage, both servers can have access to the same shared pool. You can now the storage requirements without purchasing any additional storage.

With storage doubling every year and critical shortages of IT staff, the benefits of storage consolidation for a company are huge. According to a recent article by the Enterprise Storage Group, the average storage in a non-SAN environment that a single administrator can adequately handle is under 500GB.

In a SAN environment, that same administrator can manage up to four to six times that amount. With today's rapid growth, this could mean the difference between keeping up or shutting down a business.

## DtS with the MSA1000

Direct-attached storage (DAS) to SAN (DtS) architecture is an exclusive HP feature that provides a quick and easy way to migrate stored data protected by Smart Array controllers to the MSA1000 storage system.

DtS architecture provides:

- Instant consolidation of DAS into a SAN environment.
- An upgrade path from Smart Array controlled drives and data to a SAN environment.
- Simple redeployment of a DtS environment for growth management and capacity utilization that supports up to 42 drives and 32 volumes.

HP Array Controllers that support DtS are:

- Smart Array 3100ES
- Smart Array 3200
- Smart Array 4200
- Smart Array 4250ES
- Smart Array 431
- Smart Array 5i
- Smart Array 532
- Smart Array 5312
- Smart Array 5300
- RA4100 Controllers

## Learning Check

1. Briefly describe current industry storage trends.  
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2. Provide a simple definition for a storage area network (SAN).  
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3. List five features of a SAN.  
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4. List five benefits of a SAN.  
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5. What are the three classes of B class switches supported by HP? (p21)  
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6. What are HP recommended guidelines when mixing 1 and 2Gb/s switches?  
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7. Describe zoning.  
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8. When is zoning required on a HP-UX 11.0 or 11i?

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9. Describe two advantages of implementing storage consolidation.

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10. Describe the DAS to SAN (DtS) architecture.

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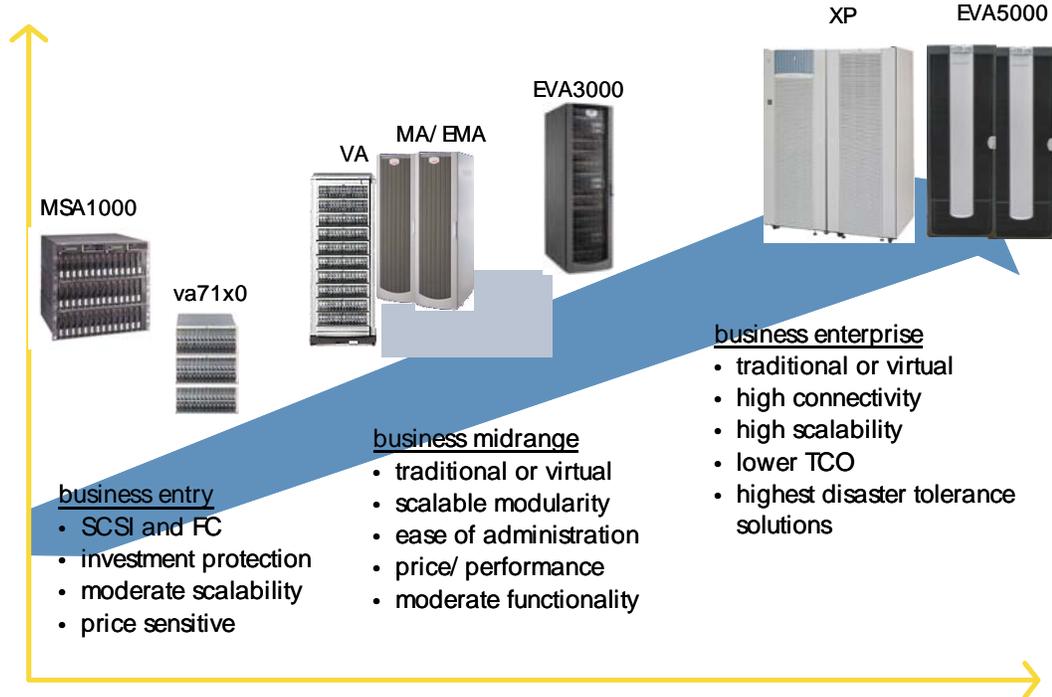


## Objectives

After completing this module, you should be able to:

- Position the Modular SAN Array (MSA) 1000 in relation to other HP StorageWorks products.
- List the features of an MSA1000 SAN solution.
- Describe the customer benefits of an MSA1000 solution.
- Describe direct-attached storage (DAS) to SAN (DtS) architecture.
- Explain the DtS process.

## HP StorageWorks Online Storage Systems



The HP online storage systems include a wide range of solutions offering industry-leading features and benefits. These include disk arrays, which offer superior storage solutions for mission-critical applications, with high availability, reliability and redundancy; outstanding performance and scalability; shared and secured heterogeneous environments.

The HP online storage portfolio includes Entry-Level, Midrange, and Enterprise-Level storage systems.

### Business Entry

Business Entry storage products from HP, which includes direct -and SAN-attached SCSI and Fibre Channel solutions, are price sensitive and provide moderate scalability. The Modular SAN Array (MSA) 1000, which includes direct attached storage (DAS)-to-storage area network (SAN) (DtS) support, scales from 2 – 42 drives. The va71x0 family provides Fibre Channel disk arrays featuring scalability, high performance, and advanced data protection. The va7100 includes a single controller enclosure with up to 15 disks and the va7110 supports over 6TB with up to 45 disks. Both the MSA1000 and va71x0 offer heterogeneous operating system support and are well suited for the Business Entry environment.

## Midrange

Midrange storage systems provide additional scalability and more robust storage capability than the Business Entry systems. Typical Midrange application environments can survive minutes of planned downtime. While budget limitations are still an issue, the midrange business values high-end functionality as equally important to affordable prices. Designed with high-end features at midrange prices, the HP va7400 family and MA8000/EMA12000/EMA16000 function in a heterogeneous environment that requires more scalability than Business Entry solutions.

## Enterprise-Level

The Enterprise-Level solution enables the highest levels of continuity, performance, consolidation, and manageability. For those enterprises with Mainframe and Open Systems storage, the HP XP storage system is the ideal choice to consolidate all platforms into a single, manageable storage system. For customers that require the flexibility to consolidate their open systems platforms and gradually increase levels of capacity, scalability, performance, virtualization and high availability, the HP Enterprise Virtual Array is the ideal modular choice.

## MSA1000 SAN Positioning

In a SAN environment, the MSA1000 SAN solution is appropriate for the midrange department or branch office. The MSA1000 position relative to other HP StorageWorks array products is at the business entry level along with the va71x0 products, providing moderate scalability and investment protection with the DtS architecture.

The MSA1000 provides Ultra3 SCSI connections to the hard drives and uses the HP universal 1-inch Ultra2, Ultra3, or Ultra320 drives. By using existing SCSI drives, the MSA1000 lowers the total cost of ownership and extends the customer's hardware investments into the future.

The MSA1000 can be remotely managed by using management tools such as Insight Manager 7, Array Configuration Utility (ACU) 6, and the StorageWorks Fabric Switch Management Utility.

The MSA1000 is positioned to be an easily affordable, scalable, high-performance storage system for entry-level to mid-range SAN environments.

The MSA1000 is positioned to provide:

- Lower price for an entry-level SAN.
- Outstanding performance.
- Scalability to build as you grow.
- A solution with a 2Gb/s embedded fabric switch.
- Seamless data migration from the Smart Array and RA4100 storage products.
- Investment protection for SCSI hard disk drives (HDDs).
- Support for heterogeneous SANs consisting of multiple operating systems on ProLiant servers and other x86 platforms.
- High availability for multioperating system ProLiant clusters.

## MSA1000 SAN Solution



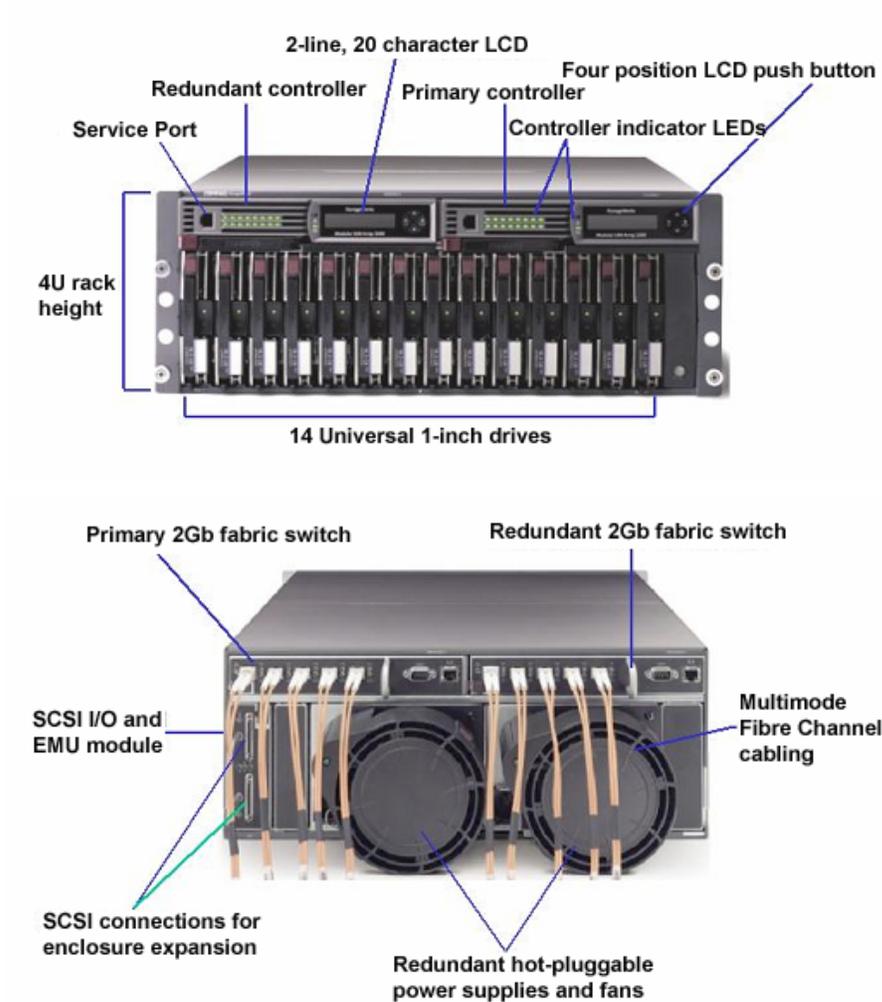
The MSA1000 is the next generation 2Gb Fibre Channel storage product designed for the mid-range x86 server market.

The MSA1000:

- Accommodates standard StorageWorks components such as the model 4300 storage shelves.
- Is a high-capacity storage solution that provides up to 6TB of capacity.
- Is based on the SA53xx controller architecture.

The MSA1000 has an optional embedded Fibre Channel switch called the MSA Fabric Switch 6 that provides integrated six-port, 2Gb/s fabric switch capability. Also available is an optional embedded three-port 2Gb Fibre Channel hub (MSA Hub 2/3) for low cost two-node clustering. It supports HP OpenView Storage Virtual Replicator to provide preventative actions before system failure.

## Features



The MSA1000 solution has the following key features:

- DtS architecture data migration.
- A 4U rack-mount design combining both the controller and disk shelf.
- 2Gb Fibre Channel connection to the hosts.
- Optional embedded six-port 2Gb Fibre Channel Fabric Switch (MSA Fabric Switch 6).
- Optional embedded three-port 2Gb Fibre Channel hub (MSA Hub 2/3) for low-cost two-node clustering.
- Ultra3 SCSI disk drive connections.
- Support for HP Ultra2, Ultra3, and Ultra320 universal 1-inch hard disk drives.

- Scalability from 3 to 42 physical drives with two optional storage expansion enclosures (StorageWorks 4200/4300 enclosures).
- Support for 1Gb and 2Gb Fibre Channel infrastructures.
- RAID Advanced Data Guarding (ADG) protection.
- Autonegotiated F, FL, and L Fibre Channel port login.
- Primary and secondary Inter-Controller Links (ICLs).
- Support for attaching multiple two-node clusters and single servers.
- Ability to hot-add clusters and drive enclosures.
- Support for Windows NT, Windows 2000, NetWare, and Linux.
- Optional support for Secure Path on Windows NT, Windows 2000, and NetWare.

## MSA1000 Customer Benefits Summary



The benefits to HP customers can be categorized into three areas: performance, availability, and investment protection.

### Performance

The MSA1000 offers affordable performance by providing the following features:

- 30,000 I/Os per second
- 2Gb host-side connections
- Ultra3 SCSI drive support
- 256MB battery-backed cache expandability to 512MB
- Modular expandability to 6TB capacity when using 146GB drives

### Availability

The MSA1000 offers extraordinary availability with these features:

- Redundancy and clustering support
- Redundant components
  - Controller
  - Primary and secondary ICLs
  - Cache (located on each controller)
  - Fabric switch and hub
  - Power supply
- SAN and switched fabric support
- RAID ADG

## Investment Protection

The MSA1000 controller offers integration and investment protection by providing the following features:

- Support for RAID 0, 1+0, 1, 5, and ADG fault tolerance options
- Fibre Channel support for server connection
- Support for 1-inch HP Ultra2, Ultra3, and Ultra320 hot-pluggable universal hard disk drives
- Online capacity expansion, online capacity extension (depending on the operating system), online stripe size migration, and online RAID migration
- Removable and upgradeable battery-backed cache with ECC memory (array accelerator)
- Scalable and expandable within the existing StorageWorks 4200/4300 family
- Performance monitoring through Insight Manager
- Prefailure notification on hard disk drives
- Array Configuration Utility (ACU)
- ROM Recovery and ROM Cloning
- Maximum of 32 logical drives per MSA1000
- Selective Storage Presentation (SSP)
- Smart array drive migration capability
- Multiple-path support using StorageWorks Secure Path 4.0 for Microsoft Windows Workgroup Edition and StorageWorks Secure Path 3.0c for Novell NetWare Workgroup Edition

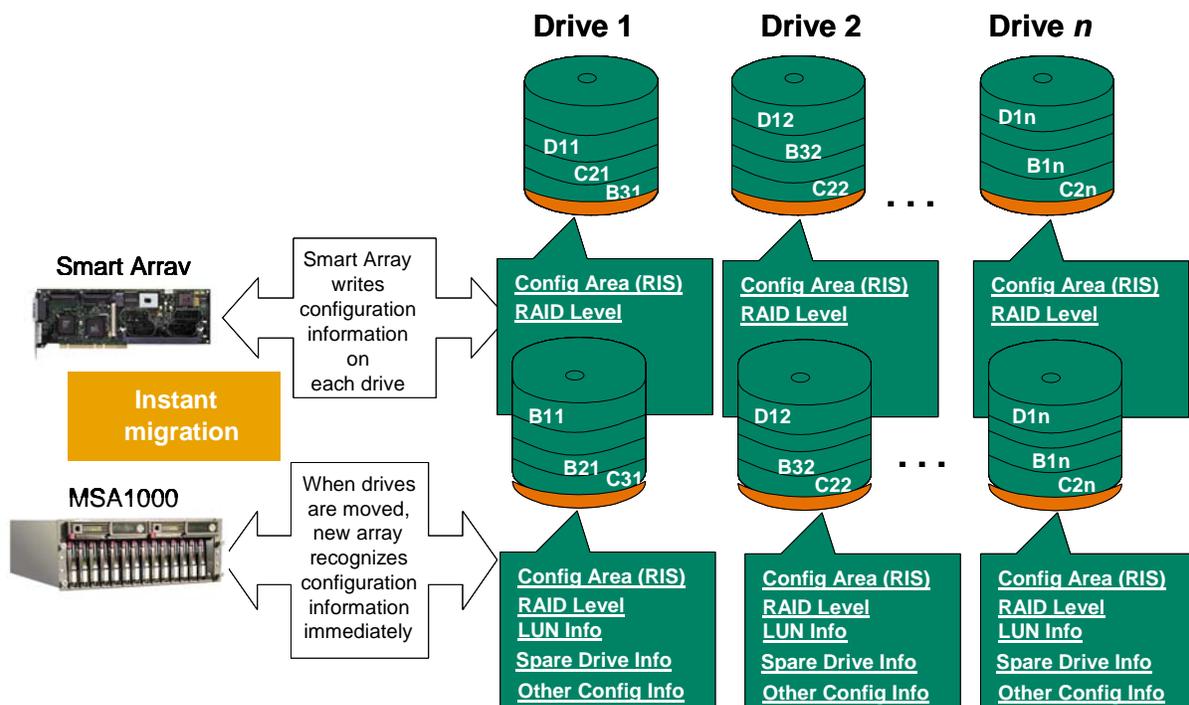
## DtS Architecture

DtS architecture is an exclusive HP feature that provides a quick and easy way to migrate stored data protected by a Smart Array controller to the MSA1000 storage system.

Data stored on 1-inch universal disk drives (Ultra2 and Ultra3) using newer Smart Array controllers and data stored on direct-attached RA4100 storage systems can be migrated to the MSA1000. Following a step-by-step procedure, you simply remove the drives from the older systems and insert them into the MSA1000.

The existing data and configuration information remains intact. In addition, the RAID set and data are preserved, allowing migration to be completed in minutes, not hours.

## DtS Process



The DtS process provides:

- Instant consolidation of DAS into a SAN environment.
- An upgrade path from Smart Array controlled drives and data to a SAN environment.
- Simple redeployment of the DtS environment for growth management and capacity utilization.
- Support for up to 42 drives and 32 volumes.

HP array controllers that support DtS are:

- Smart Array 3100ES
- Smart Array 3200
- Smart Array 4200
- Smart Array 4250ES
- Smart Array 431
- Smart Array 5i
- Smart Array 532
- Smart Array 5312
- Smart Array 5300
- RA4100 controllers

## Migrating Data

The following steps in Windows 2000 and Linux, illustrates the migration process from direct attached storage to the HP MSA1000—all controlled by the same host server.



### **Important**

It is recommended that you record the current configuration of all arrays and note which drives are part of each array prior to performing the migration. If you need to fall back to your former configuration, you will be required to re-enter all array and volume information.

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## Windows 2000 Data Migration

### Prerequisites

#### **Hardware**

Since the HP FCA2101 HBA is an industry standard PCI adapter, it should work in all PCI compliant slots, regardless of server vendor. However, refer to the compatibility matrix for more details on multi-vendor x86 platform support and ensure that the FCA2101 will work in your server.

#### **Software**

Minimum operating system levels for the host computers are: Microsoft Windows NT4.0 Server Enterprise Edition with Service Pack 6a and Microsoft Windows 2000 Advanced Server with Service Pack 2. For configuration of the HP MSA1000, Microsoft Internet Explorer v5.0 (or above) with the Microsoft Virtual Machine update is required.

## Data Drive Migration Steps

1. Back up and verify all data on the drives to be migrated to tape or disk.
2. Note and record the current configuration of all arrays and note which drives are part of which array. This can be done in Array Controller Utility (ACU) by highlighting one of the arrays and noting the drives that are flashing on the current SCSI array unit.
3. Power down the server. If you are running a cluster environment, power down all secondary nodes first and then power down the primary node (owner) last.
4. Remove the existing HP StorageWorks Fibre Channel host bus adapter (RA 4100) or the HP Smart Array Controller from the server and replace with the HP FCA2101 HBA. It is important to note that **all volumes** controlled by either the RA4100 or the HP Smart Array controller **must** be migrated to the MSA1000.
5. Install the HP FCA2101 HBA in the server slot and attach the fiber optic interconnect component for appropriate communication to the MSA1000. Interconnect drawings are shown on the *HP StorageWorks Modular SAN Array 1000 Installation Overview* poster that was shipped with the equipment. Ensure that all interconnect components are in place for proper communication from the FCA2101 to the MSA1000.
6. Migrate the drives from the existing arrays (for example, RA4100 or Smart Array controllers) to the MSA1000. Drive order is not important although it is recommended that drives be moved to the same bay position in the new unit. Note and record the locations of the drives and their corresponding arrays in case that information is needed for later use.
7. Make sure all drives are fully seated in the MSA1000 and power it on. When the startup process of the MSA1000 is complete, the following message displays: “01 COMPAQ MSA1000 STARTUP COMPLETE”
8. Scroll back through the messages on the MSA1000 display and verify that the number of volumes (arrays) you intended to migrate are detected. This can be verified by the message: “120 Configured Volumes: X” (where X is the number of volumes migrated/detected)

9. After the MSA1000 reports the correct number of migrated volumes, power on your server and run the server vendor's BIOS setup utility. Use the BIOS setup utility to perform the vendor-specific tasks required to install the adapter (if applicable). Save the configuration, and perform a reboot of the server.

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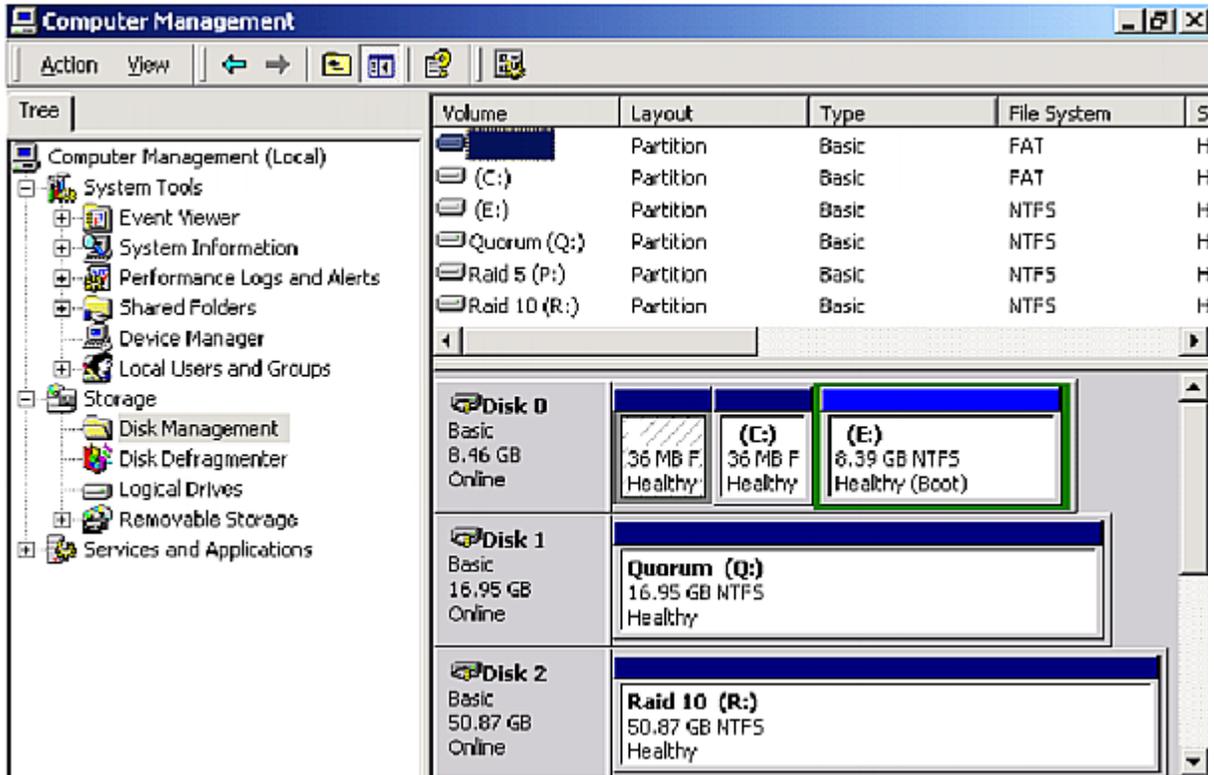
**Note**

If you are running a cluster environment, power on the primary node in the cluster (the last server that was powered down) and continue to follow the Migration Steps for the appropriate Operating System. After all Migrations Steps have been completed, repeat the steps for the other server members of your cluster.

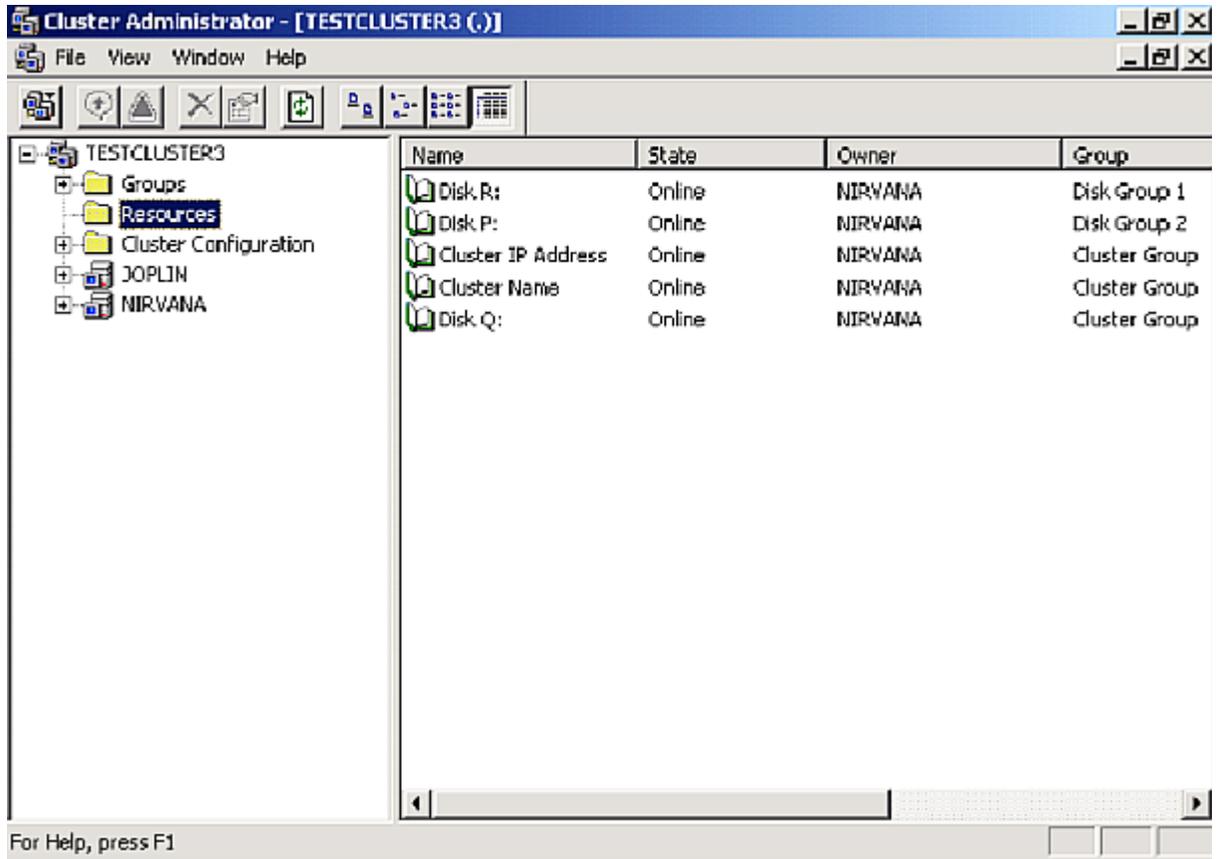
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10. When Windows 2000 has started, the Plug-and-Play message 'Found New Hardware' pop-up windows will appear stating it has found a 'Fibre Channel Controller and Installing...' for each HBA detected.
11. The New Hardware Wizard window appears next for each HBA found. Click *Cancel* to exit each Wizard screen.
12. Insert the MSA1000 Support Software v5.31 or higher CD into the CD-ROM drive and let it autostart the HP MSA1000 Setup Installation Program.
13. Click *Agree* for the License Agreement (after reading it) to continue the setup program.
14. Select the *Install Windows 2000 Drivers* option button from the HP Support Software Setup screen option list.
15. The HP Setup screen window appears with the following description: "HP KGPSA-xx, PCI-Fibre Channel Host Bus Adapter Driver Software Version: 5-4.54.7."
16. After the Setup program determines that the HBAs are physically installed in the system, the following statement displays: "Setup is ready to begin the install process. Please review the information about the current package below before continuing."
17. The following confirmation screen appears: "The software is not installed on the system, but is supported for installation."
18. When the following message appears... "Press the [Install] button to continue with the install or [Close] button to cancel." ...click *Install* to begin the process.
19. A rotating "Q" indicates the installation is in progress. Several Found New Hardware messages will appear and disappear as the drivers are installed for each device.
20. The following message displays: "The installation was completed successfully".
21. The system must reboot to finish the driver installation. If you do not wish to reboot, click *Close* to exit Setup.

22. After the system reboots, ensure that all the drives are recognized in the Microsoft Management Console (MMC) and that all clients and applications properly recognize all data on the drives. To access Disk Management, either:
  - From the Control Panel, select *Administrative Tools* → *Computer Management* → *Disk Management*.
  - Right-click *My Computer* and choose *Manage* and then *Disk Management*.



23. If you are migrating a cluster, ensure that all the drives are recognized in Cluster Administrator by going to Cluster Administrator under the Administrative Tools in the Programs menu of the Start button. Once this is verified, repeat steps 4–6 and 11–24 for all other servers in the cluster.



## Linux Data Migration

### Prerequisites

#### Hardware

As the HP FCA2214 HBA is an industry standard PCI adapter; it should work in all PCI compliant slots, regardless of server vendor. However, refer to the compatibility matrix for more details on multi-vendor x86 platform support and ensure that the FCA2101 will work in your server.

#### Software

Operating System levels for the host computers are: Linux Red Hat 2.1 Advanced Server, Linux Red Hat 7.2 Professional, and Linux SuSE SLES7. For configuration of the HP MSA1000, Microsoft Internet Explorer v5.0 (or above) with the Microsoft Virtual Machine update is required.



#### Important

The kernel source **must** be installed for the driver installation to complete. If kernel source is not installed, please see your vendor's documentation for steps on installing it.

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### Data Migration Steps

1. Back up and verify all data on the drives to be migrated to tape or disk.
2. Note and record the current configuration of all arrays and note which drives are part of which array. This can be done in Array Controller Utility (ACU) by highlighting one of the arrays and noting the drives that are flashing on the current SCSI array unit.
3. Power down the server.
4. Install the HP FCA2214 HBA in the server slot and attach the fiber optic interconnect component for appropriate communication to the MSA1000. Interconnect drawings are shown on the *HP StorageWorks Modular SAN Array 1000 Installation Overview* poster that was shipped with the MSA1000. Ensure that all interconnect components are in place for proper communication from the FCA2214 to the MSA1000.
5. Power on your server and run the server vendor's BIOS setup utility. Use the BIOS setup utility to perform the vendor-specific tasks required to install the adapter (if applicable). Save the configuration, and perform a reboot of the server.
6. Log on as root and mount the MSA1000 Support Software CD for NetWare / Linux.

7. Create a temporary directory for the HBA source code.
8. Navigate to the \LINUX directory on the CD.
9. Copy msainstall to the temporary directory.
10. Extract the contents of the FCA2214 HBA driver source to the temporary directory using the following command: `# tar -xvzf qla2x00src-v6.0.2.tgz -C <dir>` where <dir> is the path and name of the temporary directory created above.
11. Navigate to the temporary directory.
12. Run the provided script to rebuild a new kernel for use with the driver by entering: `# ./msainstall`

This script will compile a new kernel image, which allows Linux to detect the MSA1000 Controller and its configured LUNs. Without it, only the MSA1000 Controller will be recognized. The boot loader will be configured to boot to this new kernel. This process may take awhile.
13. Once this has completed, you will need to reboot. Eject the MSA1000 Support Software CD for Netware / Linux and reboot.
14. After the operating system is back up, log on as root again.
15. To load the driver, type: `# insmod qla2300`

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**Note**

The install process will attempt to put the HBA drivers in the startup scripts and in initrd. Please verify that the script added these—if not, it will have to be done manually.

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16. Shut down the server and its attached storage (if it is external).
17. Physically migrate the drives from the existing arrays (for example, RA4100 or Smart Array controllers) to the MSA1000. Drive order is not important although it is recommended that drives be moved to the same bay position in the new unit. Note and record the locations of the drives and their corresponding arrays in case that information is needed for later use.
18. Make sure all drives are fully seated in the MSA1000 and power it on. When the startup process of the MSA1000 is complete, the following message displays: “01 COMPAQ MSA1000 STARTUP COMPLETE”

19. Scroll back through the messages on the MSA1000 display and verify that the number of volumes (arrays) you intended to migrate are detected. This can be verified by the message: “120 Configured Volumes: X” (where X is the number of volumes migrated/detected)
20. After the MSA1000 reports the correct number of migrated volumes, power on your server.
21. As the operating system loads, most of the volumes should mount based on etc/fstab settings. If necessary, perform the command # `mount -a` Which will mount all volumes listed in etc/fstab . However, you may want to modify etc/fstab so these volumes will mount automatically. If etc/fstab is modified to mount the volumes (changing from Smart Array or RA4100 to MSA1000). Make a copy of etc/fstab (such as etc/fstab.old ) in case a fall back is needed to the old controller.
22. The volumes should now be mounted and controlled by the MSA1000.

## Learning Check

1. What is the position of the MSA1000 in relation to other HP StorageWorks products?

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2. List five key features of the MSA1000.

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3. Which customer benefit offers redundant components?

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4. What exclusive HP feature that provides a quick and easy way to migrate stored data protected by Smart Array?

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5. In the DtS process, explain the internal process that occurs when drives from the RA4100 to the MSA1000.

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



## Objectives

After completing this module, you should be able to:

- List the base components of the Modular SAN Array (MSA) 1000.
- List the additional components of the MSA1000.
- State the configuration options for the MSA1000.
- Describe the Network Storage Router (NSR).
- Discuss support for tape libraries.

## MSA1000 SAN Solution Base Components



The HP StorageWorks MSA1000 includes a 4U array that holds up to fourteen 1-inch HP universal hot-pluggable Ultra2, Ultra3, and Ultra320 drives.

Each MSA1000 includes the following standard components:

- One MSA1000 controller with 256MB cache
- One MSA Fibre Channel I/O Module with 2Gb/s SFP shortwave (SW) transceiver
- Redundant hot-pluggable power supply and blower assemblies
- Universal rack-mounting kit
- MSA1000 Software Support CD and documentation
- One Virtual Replicator (VR) license
- Two power cables
- Two 3-ft very high density interconnect (VHDCI) to VHDCI SCSI cables

The MSA1000 base unit 4U design combines the array controller and drive shelf, which holds up to fourteen 1-inch universal disk drives in a single 4U rack-mount cabinet. More storage can be easily deployed with the addition of up to two StorageWorks 4314 or 4214 enclosures for a maximum storage capacity of 6TB when using 146GB drives.

The MSA1000 design uses the latest 2Gb/s Fibre Channel technology to communicate with the hosts and storage devices. In addition to the single-port 2Gb/s Fibre Channel I/O module that comes standard, an optional six-port, 2Gb/s MSA Fabric Switch 6 fits inside the MSA1000. The MSA Hub 2/3 is an optional interconnect device designed to replace the single-port Fibre Channel I/O module that comes standard with the MSA1000.

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**Note**

Fibre Channel cables are ordered separately.

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The modular design of the MSA1000 makes it possible to add redundant controllers, single-port Fibre Channel I/O Modules, or fabric switches. With additional StorageWorks enclosures (two enclosures maximum), the MSA1000 can scale to a maximum of 42 drives in 10U of rack space.

## Hot-Pluggable Components

Hot-pluggable components enable qualified service personnel to remove and replace components without powering down the system. Four standard components and two optional components in the MSA1000 are hot-pluggable:

- **MSA1000 controller** — If your system has two controllers in a multibus Secure Path configuration and one controller fails, you can remove and replace the failed controller without shutting down the system. Refer to the MSA1000 user's guide for specific limitations when replacing hot-pluggable components.
- **Hard drives** — Failed hot-pluggable drives in RAID 1, 5, and Advanced Data Guarding (ADG) configurations can be replaced without interrupting system operation. Data on the failed drive is restored automatically to the replacement drive online. The MSA1000 supports 1-inch Ultra2, Ultra3, and Ultra320 hot-pluggable universal hard disk drives.
- **Fibre Channel I/O Module** — The Fibre Channel I/O Module is a single-port, 1 or 2Gb Fibre Channel device that includes a 2Gb SW Small Form Factor Pluggable (SFP) Transceiver port. This module can be replaced with other interconnect options, such as the MSA Fabric Switch 6 or the MSA Hub 2/3.
- **Power supply and blower assembly** — A redundant power supply enables you to remove either power supply and replace it without interrupting system operation. When one of the cooling blowers in the assembly fails, the other blower automatically operates at a higher speed. A failed blower can be removed and replaced without removing the power supply.



### Caution

Removing a power supply significantly changes the airflow within the MSA1000. After a power supply removal, the remaining power supply starts a timer that shuts down the system after approximately five minutes.

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- **MSA Fabric Switch 6** — The MSA Fabric Switch 6 is an optional, hot-pluggable integrated six-port module featuring a 12Gb/s switch engine that enables full-duplex, nonblocking performance on all ports. One port is internal to the switch, leaving five available external ports.
- **MSA Hub 2/3** — The MSA Hub 2/3 is an optional, hot-pluggable I/O device designed to replace the standard single-port I/O module. This optional component provides an inexpensive, easy way for a clustered pair of servers to access the storage controller, without having to buy an external hub or switch. Two SFP ports are external, and the third is an internal port that accesses the controller. The MSA Hub 2/3 ships with two SFP ports.

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### Note

With the latest firmware on the EMU/SCSI I/O module installed, you can also hot-plug (add) storage enclosures.

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## MSA1000 Controller

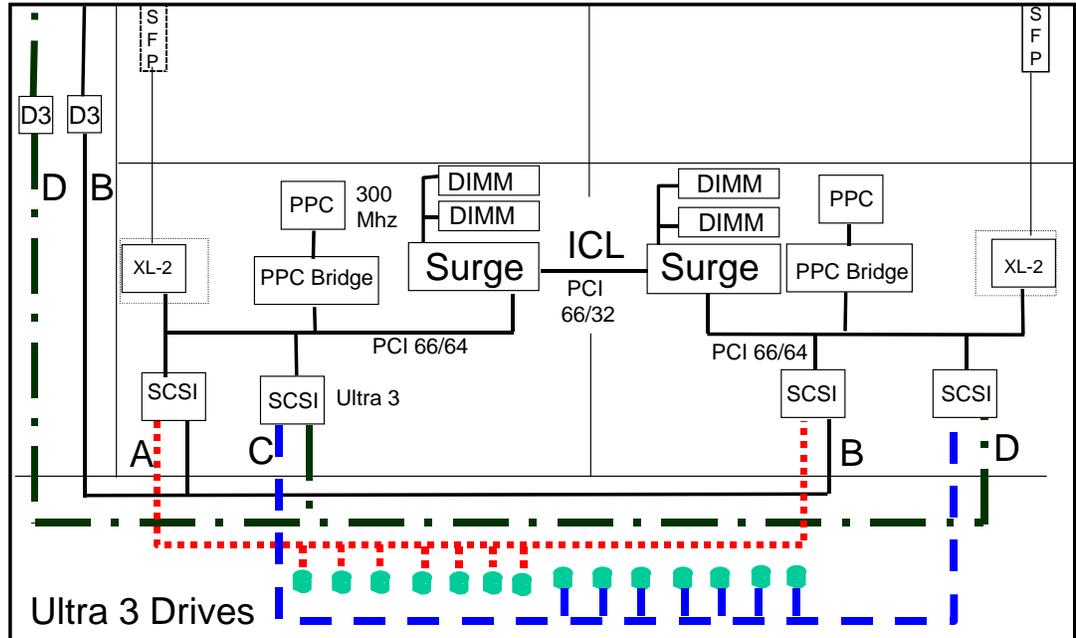


The MSA1000 controller is an integrated RAID controller with an integrated LCD/LED status display and 128MB read/write battery-backed cache (expandable to 256MB per controller). One MSA1000 controller is included with the MSA1000. A redundant MSA1000 controller is an option.

The MSA1000 controller provides:

- Support for RAID 0, 1+0, 1, 5, and ADG fault-tolerant options.
- 2Gb Fibre Channel connections, with support for 1 and 2Gb Fibre Channel infrastructures.
- Support for 1-inch Ultra2, Ultra3, and Ultra320 hot-pluggable universal hard disk drives.
- Online capacity expansion, capacity extension (depending on the operating system), stripe size migration, and RAID migration.
- Removable and upgradeable battery-backed cache with ECC memory (array accelerator).
- Performance monitoring through Insight Manager.
- Prefailure notification on hard disk drives.
- Array Configuration Utility (ACU).
- Recovery ROM and ROM Cloning.
- Maximum 32 logical drives (42 physical drives) per MSA1000.
- Selective Storage Presentation (SSP).

## Controller Specifications



The MSA1000 controller provides:

- **User interface** — Controller display with two status indicators, four push buttons, and 16 status indicators on front of the controller
- **Electrical interface** — Low-voltage differential (LVD)
- **Protocol support** — Wide Ultra3 SCSI (160MB/s per channel)
- **SCSI ports** — Four channels (two external and two internal)
- **Drives supported** — Up to 42 physical drives
- **Maximum capacity** — 6TB (42 drives with 146GB capacity)
- **Logical drives** — Up to 32 logical drives
- **RAID support:**
  - RAID ADG
  - RAID 5 (Distributed Data Guarding)
  - RAID 1+0 (striping and mirroring)
  - RAID 1 (mirroring)
  - RAID 0 (striping)

- **Cache memory:**
  - Up to 512MB read/write (256MB modules)
  - ECC protection, battery-backed, and removable
  - Standard 256MB cache memory
  - Two sockets enabling dual-module configurations (same size modules required in dual-module configuration)
  - Expandable to 512MB (2 modules with 256MB each)

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**Note**

Cache memory size cannot be mixed.

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- **Cache batteries** — Protect ECC memory data (Array Accelerator) against equipment failure or power outage for up to four continuous days
- **Upgradeable firmware** — 2MB flashable ROM
- **Disk drive and enclosure protocol support** — HP Ultra3, Ultra2, and Ultra320 SCSI 1-inch universal drives

## Controller LCD Panel

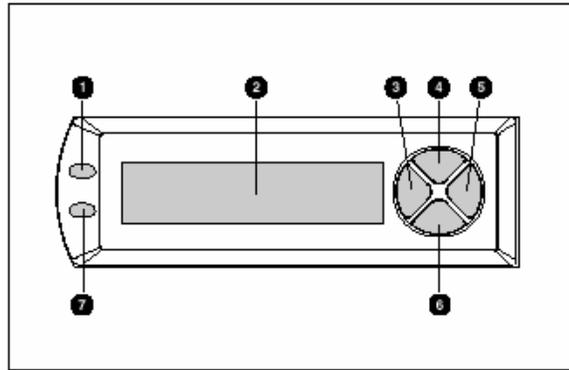


Figure 3-1: Controller display

- Fault indicator (amber)
- Display
- Left push button
- Up push button
- Right push button
- Down push button
- Redundancy Link indicator (green)

Each array controller in an MSA1000 contains an integrated display. This module is used for displaying informational and error messages showing the current status of the module, and for providing user input when required. Traditional Power-On Self-Test (POST) messages issued by PCI-based array controllers have been combined with runtime event notification messages to create a new set of controller display messages.

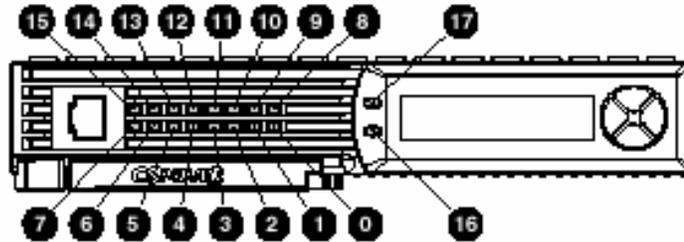
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### Note

For more information on the controller LCD messages and panel, refer to the *StorageWorks Modular SAN Array 1000 User Guide* or the *Modular SAN Array 1000 Maintenance and User Guide*.

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## MSA1000 Controller Indicators



During normal runtime, 18 LEDs on the MSA1000 indicate activity or malfunction of the controller. The following table describes the purpose and function of each indicator.

Indicator	Function	Description
0-2	Busy status	ON = This indicates this array controller is idle. OFF = This indicates this array controller is operating at full capacity.
3-7	Fibre Channel ID	This indicates the 5-bit Arbitrated Loop Physical Address (ALPA) is assigned to this array controller (not applicable when in fabric mode).
8	Idle	Heartbeat indicates the array controller is idle and functioning.
9	Active/Standby	ON = Controller is active. OFF = Controller is in standby.
10	Direct Memory Access (DMA) active	ON = DMA transfers are active.
11	Logical I/O active	ON = Currently processing logical requests from the host adapter.
12	SCSI Bus 0 active	ON = Indicates that requests are outstanding on the first SCSI bus.
13	SCSI Bus 1 active	ON = Indicates requests are outstanding on the second SCSI bus.
14	Cache activity	ON = Cache activity Cache active OFF = There is no cache activity. Blinking = Cache transfer is pending.
15	Drive failure	ON = A configured hard drive has failed in the array.
16	Redundancy active	Green indicates two controllers are in a redundant mode of operation.
17	Fault	Amber indicates an error message has been sent to the controller display.

## Recovery ROM

Each MSA1000 controller contains ROM (Read-Only Memory), which holds the firmware that operates the controller. The Recovery ROM feature stores two complete firmware images in the ROM: one active and one backup image. When the controller powers up, it checks both firmware images for validity. If either image is invalid, the valid image is copied over the invalid image to correct it. This is referred to as “autoflashing.”

The Recovery ROM validity check and autoflash functions are performed automatically by the controller and do not require user intervention.

## ROM Cloning

For an MSA1000 to operate in a redundant controller configuration, it must contain two controllers that are executing the same firmware version. During power-up (or if an optional controller is hot-plugged while the MSA1000 is already operating), the firmware versions on both controllers are compared. If they are not the same, then the ROM Cloning feature attempts to copy one version of firmware to the other controller. After the copy has been completed, the controller that was modified is automatically reset. After the reset controller has powered up, the two controllers start redundant operation.

ROM Cloning functions are also automatic and do not require user intervention. The determination of which firmware version to use is based on the following criteria:

- If the MSA1000 is powered up with both controllers inserted, then the most recent version of firmware is used, regardless of the controller on which it resides.
- If the MSA1000 is already operating and an optional controller is hot-plugged, then the version of firmware that is on the currently installed active controller is used, regardless of its version. This ensures that any host-initiated I/O to the controller is not interrupted.
- If a firmware version is not compatible with a controller hardware revision, the most recent firmware version that is compatible with both controllers is copied to the controller with the incompatible firmware version. However, if an updated controller is already operating and processing I/O, then it is not reset, and the MSA1000 does not enter into a redundant operation. (An appropriate message displays.) After the MSA1000 has been shut down and powered back on, the controllers enter into a redundant operation. On a subsequent power cycle, both controllers enter a redundant mode.

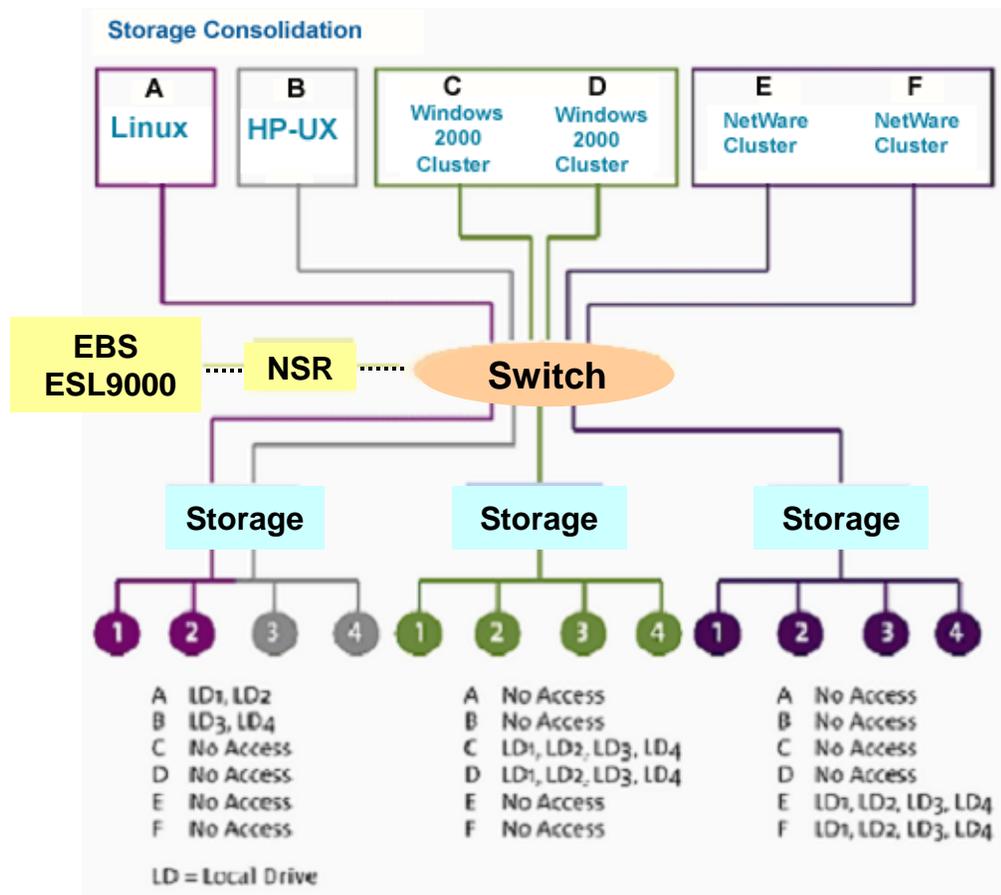
## Controller Management Features

- **SSP** — Enables logical units in array sets to be partitioned to multiple servers for SAN access.
- **Online RAID-level migration** — Enables an online post-configuration change to a RAID level without destroying data or volume information.
- **Online capacity expansion** — Allows you to add storage to an operational MSA1000, reducing expensive server downtime.
- **Online volume extension** — Enables the capacity growth of existing logical volumes.
- **Global online spare** — Reduces the risk of data loss by facilitating automatic rebuilds after a drive failure.
- **Logical drive capacity extension** — Enables the user to increase the size of existing logical drives online under Windows NT and offline for other operating systems.
- **Fault tolerance** — Uses several fault-tolerant configurations, which keep data available and servers running while drives are being replaced; supported RAID levels include:
  - **RAID ADG** — Allocates the equivalent of two parity drives across multiple drives and allows simultaneous write operations.
  - **RAID 5 (Distributed Data Guarding)** — Allocates parity data across multiple drives and allows simultaneous write operations.
  - **RAID 1 (drive mirroring), 1+0 (striped mirroring)** — Allocates half of the drive array to data and the other half to mirrored data, providing two copies of every file.
- **Fault recovery** — Minimizes downtime, reconstructs data, and facilitates a quick recovery from drive failure.
- **Online spares** — If a failure occurs, begins recovery with an online spare and reconstructs data automatically. One online spare can be assigned per array and used across multiple arrays. It is also possible to assign different online spares across different arrays.
- **Array Accelerator** — Provides onboard, battery-backed cache memory that protects data in the event of a power failure. In the unlikely event of a controller failure, the battery-backed cache will save critical data for up to three days.

## Selective Storage Presentation

SSP permits sharing of the MSA1000 between servers, including servers running different operating systems. SSP is implemented within the Fibre Channel array controller firmware. Each logical drive on the controller has an access control list that contains the World Wide Names (WWN) of server host adapters having access to that drive. If a server tries to send commands to a logical drive to which it does not have access, the firmware rejects the command.

The configuration utility maps the WWNs of server host adapters to connection name. It then sets up access control lists for logical drives based on these WWNs.



Basic Noncooperating Server Configuration Using the Switch

## SSP Settings

By using SSP, the user selects which host or hosts can access a logical drive. By restricting logical drive access, the user is assured that data will remain unharmed and secure because other hosts will not be able to access the drive.

### Note

SSP is disabled by default.

SSP settings can be accessed from the Selective Storage Presentation screen within the ACU application after you enable SSP. This procedure is covered in more detail in ACU lab exercises.



Set SSP access settings for each logical drive and rename connections.



ACU Selective Storage Presentation Settings Screens

## Expanding and Extending Capacity

Array capacity expansion is the addition of physical drives to an array that has already been configured. The capacity of the additional physical drives can be added to an existing logical drive on the array (capacity extension), or it may be configured into a new logical drive.

Logical drive capacity extension is the enlargement of an existing logical drive after the corresponding array has undergone capacity expansion.

Capacity expansion and extension are performed using ACU. A data backup and restoration cycle is not required, even in nonfault-tolerant configurations.

If you are using hot-pluggable drives, expansion can be performed online (that is, without shutting down the operating system). Online extension can only be performed if supported by the operating system.

## Important Considerations

- When extending a logical drive under Windows 2000, upgrade the disk to Dynamic before creating a partition on that disk. If the disk already has a partition when it is upgraded to Dynamic, Windows 2000 might not allow logical drive extension. (Refer to the Windows 2000 documentation for more information about Dynamic and Basic disks.)
- Windows NT 4.0 only allows four partitions on each logical drive. Additional drive space might not be accessible if the four partitions per logical drive limit is exceeded.
- If the system is running Windows 2000 with Microsoft Cluster Service (MSCS), logical drive extensions are not recommended. MSCS requires that disks be configured as Basic in Logical Disk Manager. To take advantage of logical drive extension, the drives must be configured as Dynamic when the volume is created. Because of the differences in requirements for MSCS and the HP logical drive extension feature, it is not recommended to perform a logical drive extension on a storage enclosure that is part of a Microsoft cluster.
- When expanding an array that has several logical drives, data is redistributed one logical drive at a time. Newly created logical drives do not become available until capacity expansion has finished.

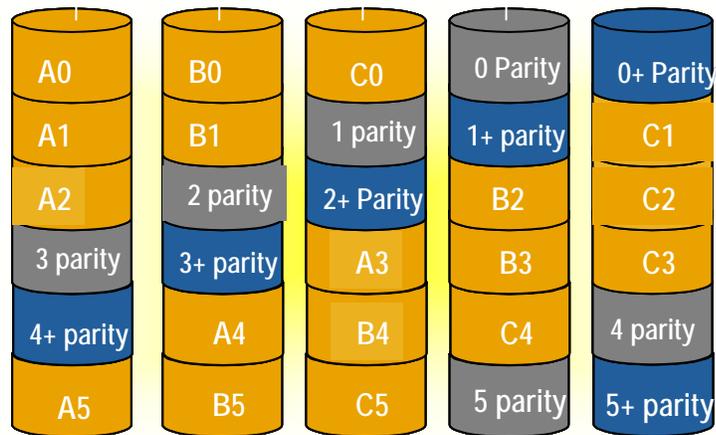
## **Fault Tolerance**

Using the capability of the MSA1000, the capacity of several physical drives can be combined into one or more arrays (logical drives). In this configuration, the read/write heads of all the constituent physical drives are simultaneously active, reducing the overall time required for data transfer.

To protect against data loss from hard drive failure, logical drives can be configured with fault tolerance. Several fault-tolerant methods have been devised;. Those supported by the MSA1000 controller are:

- RAID ADG
- RAID 5 (Distributed Data Guarding)
- RAID 1 (Drive mirroring)
- RAID 1+0 (Drive mirroring and striping)
- RAID 0 (No fault tolerance—striping only)

## Advanced Data Guarding



Advanced Data Guarding

RAID ADG is similar to RAID 5 in that parity information is generated (and stored) to protect against data loss caused by drive failure. With RAID ADG, however, two different sets of parity data are used. This allows data to still be preserved if two drives fail. As can be seen from the figure below, each set of parity data uses up a capacity equivalent to that of one of the constituent drives.

This method is most useful when data loss is unacceptable, but cost must also be minimized. The probability that data loss will occur when configured with RAID ADG is less than when configured with RAID 5.

### Advantages

- High read performance
- High data availability — Any two drives can fail without loss of critical data

## Disadvantage

The only significant disadvantage of RAID ADG is a relatively low write performance (lower than RAID 5), due to the need for two sets of parity data.

The table below summarizes the important features of the different kinds of RAID supported by the MSA 1000 Controller. The decision chart in the following table may help you determine which option is best for your situation.

	RAID 0	RAID 1 RAID 1+0	RAID 5	RAID ADG
Alternative name	Striping (no fault tolerance)	Mirroring	Distributed Data Guarding	Advanced Data Guarding
Usable drive space*	100%	50%	67% – 93%	50 – 95%
Usable drive space formula	N	N/2	(n-1)/n	(n-2)/n
Minimum number of hard drives	1	2	3	4
Tolerant of single hard drive failure?	No	Yes	Yes	Yes
Tolerance of multiple simultaneous hard drive failures?	No	In RAID 1+0, only when the failed drives are not mirrored to each other	No	Yes
Read performance	High	High	High	High
Write performance	High	Medium	Low	Lowest
Relative cost	Low	High	Medium	Medium

**\*Note:** The value for usable drive spaces is calculated assuming a maximum of 14 hard drives of the same capacity (or a maximum of 42 for RAID ADG) with no online spares. HP recommends that these maximum figures (excluding any allowable online spare) are not exceeded when configuring a drive array, due to the increased likelihood of logical drive failure with more hard drives.

	MOST IMPORTANT	ALSO IMPORTANT	SUGGESTED RAID LEVEL
Fault tolerance		Cost effectiveness	RAID ADG
		I/O performance	RAID 1+0
Cost effectiveness		Fault tolerance	RAID ADG
		I/O performance	RAID 5 (RAID 0 if fault tolerance is not required)
I/O performance		Cost effectiveness	RAID 5 (RAID 0 if fault tolerance is not required)
		Fault tolerance	RAID 1+0

## Online Spares

Further protection against data loss can be achieved by assigning an online spare (hot spare) to any configuration except RAID 0. An online spare is a hard drive with no data that is connected to the same controller as the array. When a hard drive in the array fails, the controller automatically rebuilds the information that was originally on the failed drive on to the online spare.

This process quickly restores the system to full RAID-level fault tolerance protection. However, in the event that another drive in the array fails while data is rewritten to the spare, the logical drives can still fail. Advanced Data Guarding—offered with the MSA1000—can withstand a two-drive failure with no data loss.

Each MSA1000 controller can support up to four online spares. When an online spare is configured for an array, it is automatically assigned to all logical drives in the same array. A spare can also be assigned to several arrays connected to the same controller. The guidelines for configuring spares are:

- A spare must be assigned to each array separately.
- The capacity of the spare must be greater than or equal to any drive that it is intended to replace.
- The same spare can be assigned to multiple controllers as long as its capacity is greater than or equal to any drives within the array of each controller.

---

### Note

After a failed hard drive is replaced, the controller rebuilds the replacement and resets the spare to its original state.

---

## Array Accelerator

The array accelerator is a high-performance, upgradeable, 256MB DIMM read/write cache—upgradeable to 2 x 256MB or 512MB per controller. It is particularly useful for increasing performance in database and fault-tolerant configurations. It performs protected “post-write” and “read-ahead” caching, allowing data to be accessed faster than from disk storage.

In protected post-write caching, data is written to the cache memory on the array accelerator rather than directly to the drives. When the system is idle, the controller writes the cached data to the drive array.

The read-ahead cache detects sequential accesses to the array. It reads-ahead the data, storing that data in cache until the next read access is requested. If the requested data is sequential, and in the read-ahead buffer, it can be transferred immediately from cache into system memory, avoiding disk access latency.

If the MSA1000 controller fails before cached data is stored on the disk, the array accelerator and its integrated batteries can be removed from one MSA1000 controller and installed on a replacement controller. Any data in the array accelerator that has not been written to the hard drive is transferred to the replacement MSA1000 controller.

Other array accelerator features include:

- It is mounted in sockets located on the array controller — This location allows stored data to be moved to another controller if the original controller fails.
- It has a replaceable battery backup.
- The read/write ratio is adjustable — This ratio is usually set during array configuration, but can be changed at any time.
- It has 16-bit error checking and correcting (ECC) SDRAM memory — This detects and corrects all single-bit memory errors. It also detects all two-bit memory errors in any position, as well as most three- and four-bit memory errors in a single SDRAM. With ECC, an entire memory chip can also fail without data loss. ECC provides a high level of data integrity by ensuring the correction of common memory errors without affecting system performance.

## Array Accelerator Batteries

The array accelerator has two rechargeable and replaceable NiMH battery packs. Under normal operating conditions, the batteries should last for three years before replacement is necessary. They are continuously recharged by a “trickle” (slow) charging process whenever the system is powered on.

The battery packs protect data on the array accelerator against equipment failure or power outage for up to four days. When power is restored to the system, an initialization process writes the preserved data to the disk drives.



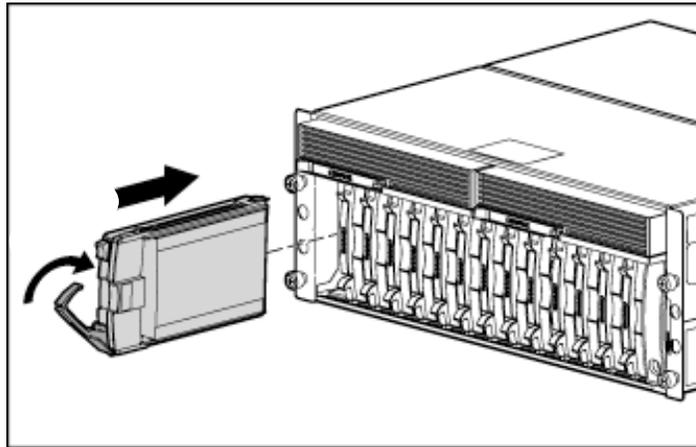
### Important

The batteries on a new MSA1000 controller might be discharged when the board is first installed. In this case, a POST message displays on the controller display panel when the controller is powered on, indicating that the array accelerator is temporarily disabled. No user action is required—the internal circuitry automatically recharges the batteries.

Recharging the batteries can take up to four hours. The MSA1000 controller functions properly during this time, although without the performance advantage of the array accelerator. When the batteries are charged to 90% of their capacities, the array accelerator is automatically enabled.

---

## Ultra320 Universal Hard Drives



The Ultra320 universal hard drives are hot-pluggable drives in RAID 1, 5, and ADG configurations that can be replaced without interrupting system operation. Data on the failed drive is restored automatically to the replacement drive online.

The MSA1000 supports 1-inch HP Ultra2, Ultra3, and Ultra320 hot-pluggable universal hard disk drives. The hard drives are installed in the front of the MSA1000.

The MSA1000 cabinet holds fourteen 1-inch universal drives.

- 18.2GB hot-pluggable Ultra320 universal hard drive, 15,000 rpm
- 36.4GB hot-pluggable Ultra320 universal hard drive, 15,000 rpm
- 72GB hot-pluggable Ultra320 universal hard drive, 15,000 rpm
- 36.4GB hot-pluggable Ultra320 universal hard drive, 10,000 rpm
- 72GB hot-pluggable Ultra320 universal hard drive, 10,000 rpm
- 146GB hot-pluggable Ultra320 universal hard drive, 10,000 rpm

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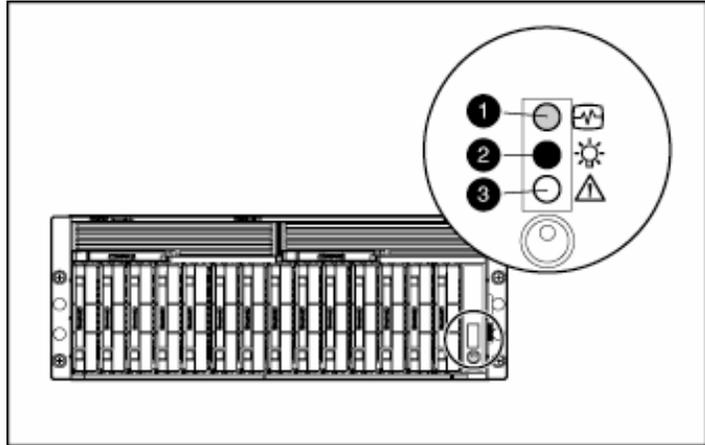
**Note**

The MSA1000 is compatible with the Ultra2 and Ultra3 hard drives but cannot be ordered with the product.

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## Hard Drive Indicators

1. On
2. Off
3. Flashing



The three disk drive status indicators define the operational status of each drive. The status indicators are displayed in the following table.

Activity <sup>1</sup>	Online <sup>2</sup>	Fault <sup>3</sup>	Meaning
On	Off	Off	The drive is being accessed, but it is: <ul style="list-style-type: none"> <li>■ Not configured as part of an array,</li> <li>■ A replacement drive and rebuild has not yet started,</li> <li>■ Spinning up during POST.</li> </ul>
Flashing	Flashing	Flashing	Do not remove the drive. Removing a drive during this process can cause data loss in nonfault-tolerant configurations. The drive is part of an array being selected by the Array Configuration Utility.

## Interpreting Component Indicators

If the fault indicators on any of the MSA1000 components are amber, or if Insight Manager 7 indicates a fault, determine the reason for this alert immediately. Examine the component indicators to see if any indicate a fault.

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### Note

For detailed information, refer to the *StorageWorks Modular SAN Array 1000 User Guide*.

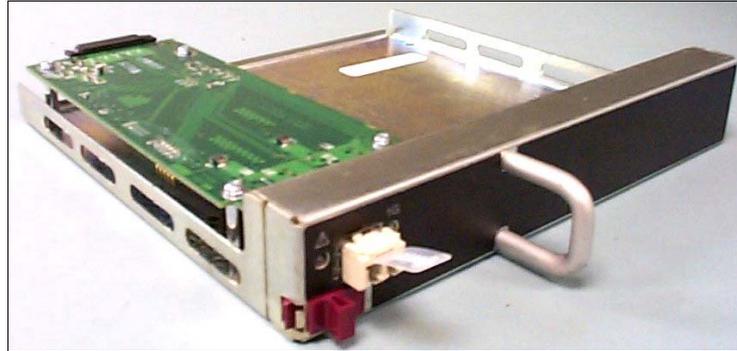
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## SCSI ID Assignments

SCSI IDs are assigned automatically in the storage system according to the drive bay used for each drive. It is not necessary to assign SCSI IDs manually.

Drive bay numbers are indicated on the front panel of the enclosure.

## MSA Fibre Channel I/O Module



The MSA Fibre Channel I/O Module provides a 2Gb/s SFP, Fibre Channel port. A second MSA Fibre Channel I/O Module can be installed for redundancy.

## 2Gb/s SFP SW Transceiver Kit



The StorageWorks 2Gb/s SFP SW Transceivers are industry-standard connection devices that hot plug into 2Gb/s infrastructure components, such as 2Gb/s fabric switches. The transceivers support distances up to 300m at 2Gb/s and 500m at 1Gb/s, using multimode fiber-optic cable.

### Data Rate

The removable serial transceiver module is designed to provide 2.125Gb/s or 1.0625Gb/s data rates for Fibre Channel and other protocols that use the same physical layer.

## System Power

System power to the MSA1000 does not shut off completely with the power switch. The two positions of the front panel power switch should be considered as On and Standby, rather than On and Off.

The Standby position removes power from most of the electronics and the drives, but portions of the power supply and some internal circuitry remain active. Consequently, to remove all power from the system, you must disconnect the power cord from the storage system. In systems with multiple power supplies, you must disconnect all the power cords to remove power completely from the system.



### **WARNING**

To reduce the risk of electric shock or damage to the equipment, disconnect power from the storage system by unplugging all power cords from either the electrical outlet or the storage system.

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## Power Supply and Blower Assembly

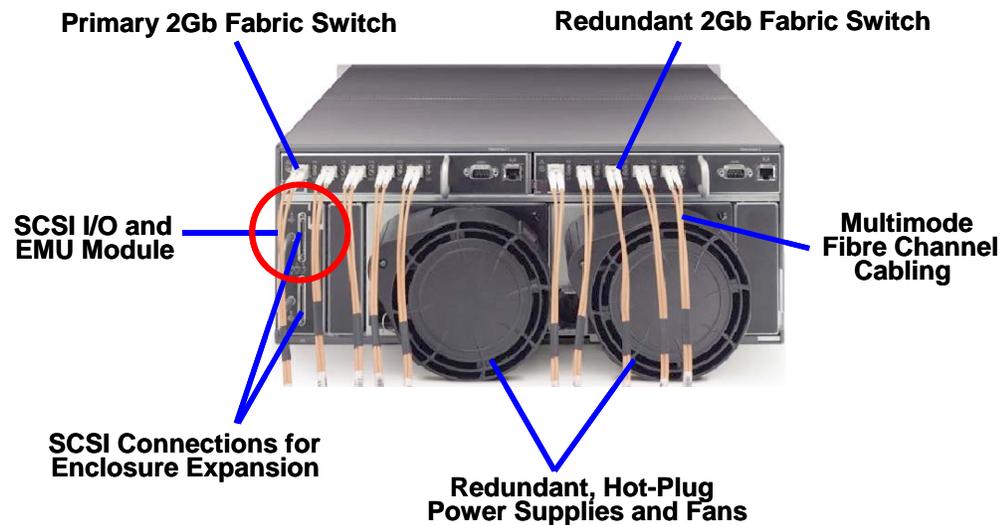
The green status indicators on the power supply assembly are lit when both the power supply and the blower are operational. When either a power supply or blower fault occurs, the power supply indicators go off. If the power supply indicators are off, either AC power is not present or a complete power supply failure has occurred.

## Other Base Components

Other base components, which are not hot-pluggable, include:

- The Environmental Monitoring Unit (EMU)
- Multimode Fibre Channel cables

## EMU



The EMU performs several functions, including:

- Monitoring:
  - Temperature
  - Power supplies
  - Blowers
- Detecting and reporting element changes in the enclosure and showing the addition or removal of a hot-pluggable component
- Controlling drive status indicators
- Providing expansion ports for external StorageWorks enclosures

## Multimode Fibre Channel Cables



MSA1000 Rear View with Cables

Multimode Fibre Channel cables provide a thin, flexible cabling solution that is immune to electromagnetic interference. HP offers cables to connect the MSA1000 to both 2Gb and 1Gb Fibre Channel infrastructures.

LC-to-LC cables are used when connecting the MSA1000 to other 2Gb Fibre Channel components because both connections will use SFP transceivers.

LC-to-SC cables are used when connecting the MSA1000 to 1Gb Fibre Channel components. Components that are 1Gb use the larger gigabit interface converter (GBIC) style transceivers.

- **Cable type** — LC-LC and LC-SC 50 $\mu$  multimode fiber
- **Available cable lengths** — 2m (6.5ft), 5m (16.4ft), and 15m (49.2ft)

## MSA1000 SAN Solution Additional Components

Additional MSA1000 components include:

- Fibre Channel Adapter 2101 (FCA2101) HBA for Windows
- Fibre Channel Adapter 2210/2214 (FCA2210/2214) HBA for NetWare/Linux
- Interconnect options:
  - MSA Fabric Switch 6 integrated six-port, 2Gb/s Fibre Channel fabric switch, 2Gb/1Gb frequency agile (one hop)

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**Note**

Interoperable only with another HP StorageWorks MSA Fabric Switch 6.

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- 2Gb Fibre Channel fabric switches — Infrastructure family of switches (up to seven hops).

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**Note**

Interoperable only with HP StorageWorks SAN Switch 2/8EL, 2/16EL, 2/16, 2/32 and core 2/64 products.

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- 2Gb Fibre Channel fabric switches — High availability family of switches (up to three hops).

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**Note**

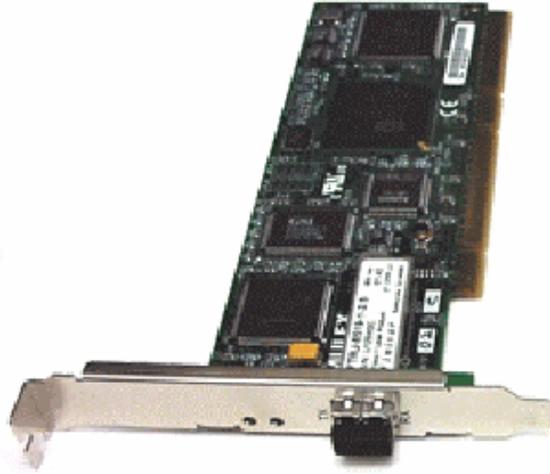
Interoperable only with HP StorageWorks director 2/140, director 2/64, edge switch 2/32, edge switch 2/24, and edge switch 2/16 products.

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- MSA Hub 2/3
- HP StorageWorks enclosure models 4214 or 4314 (to expand drive capabilities)
- Redundant controllers, power supplies, and fans
- Ultra320 universal hard drives
- I/O module kit

## Fibre Channel Host Bus Adapters

### Fibre Channel Host Bus Adapter FCA2101



The Fibre Channel FCA2101 HBA is located in a server with a local bus. It is connected to the MSA1000 by one of the following methods:

- Direct from the HBA to the Fibre Channel I/O Module
- MSA Fabric Switch 6
- MSA Hub 2/3
- Infrastructure SAN switches supported by HP
- High availability SAN switches support by HP

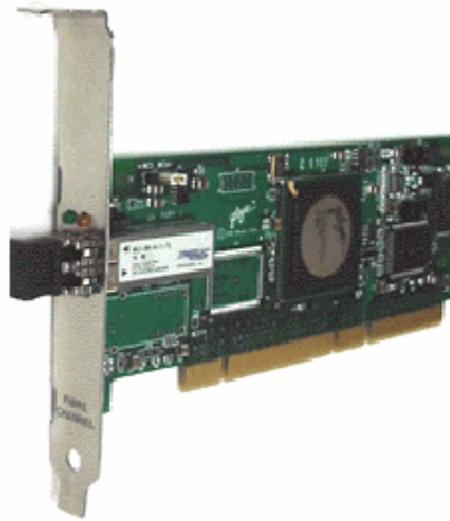
#### Features

- 64-bit, 66MHz PCI
- Full support for Fibre Channel service Class 2 and 3
- Shortwave embedded optic interface (SFF)
- Full fabric support using F\_Port and FL\_Port connections
- Simultaneous full-duplex 2Gb/s Fibre Channel that delivers up to 400MB/s
- Support for Microsoft Windows NT and Windows 2000

#### Fibre Cable Specifications

Maximum cable attenuation is 3.0dB/km at 850nm or 1.0dB/km at 1310 nm at 23° C (73° F).

## Fibre Channel Host Bus Adapter (FCA2210/FCA2214)



The Fibre Channel FCA2210/FCA2214 HBA is located in a server with a local bus. It is connected to the MSA1000 by one of the following methods:

- Direct from the HBA to the Fibre Channel I/O Module
- MSA Fabric Switch 6
- MSA Hub 2/3
- Infrastructure SAN switches supported by HP
- High availability SAN switches support by HP

### Features

- 64-bit, 133MHz PCI-X
- Embedded physical interface that requires no GBICs
- 64-bit PCI-X data and addressing
- Simultaneous full-duplex 2Gb/s Fibre Channel that delivers up to 400MB/s
- Full fabric support using F\_Port and FL\_Port connections
- Backwards compatible with 33MHz and 66MHz PCI
- Full support for Fibre Channel service Class 2 and 3
- Support for Fibre Channel tape devices
- Support for NetWare (FCA2210) and Linux (FCA2214)

### Fibre Cable Specifications

Maximum cable attenuation is 3.0dB/km at 850nm or 1.0dB/km at 1310 nm at 23° C (73° F).

## Remote Boot

The remote boot option provides a backup or disaster-recovery method of accessing the operating system through a server to external storage.

This process is intended for an advanced user who has a solid foundation of knowledge in server hardware, storage hardware, and operating system installation.

---

### Note

The specific steps for configuring the MSA1000 for external boot can be found in the Technical Note for the operating system on which the remote boot is being used. For example, *Configuring the StorageWorks MSA1000 for external boot with Microsoft Windows — New Installations*. Considerations and limitation only are included here.

---

## Windows 2000 and Window NT Considerations and Limitations

These procedures apply to Microsoft Windows 2000 Advanced Server and Microsoft Windows NT:

- All prerequisites and current scaling limitations for the MSA1000 apply
- Do not use SmartStart to install OS on server
- Firmware upgrades should be performed from a DOS boot to avoid loss of connectivity to the MSA1000
- Secure Path is not supported when the operating system is installed to the MSA1000
- Copy the FCA2101 driver files from the HP StorageWorks Modular SAN Array 1000 Support Software CD to a floppy for a part of the OS installation. During OS installation, you will be asked for controller drivers, and you can only install them using a floppy disk.

Microsoft Windows 2000: **X:\Win2k\\*.\*** (all files EXCEPT Lputilnt.EXE)

Microsoft Windows NT 4.0: **X:\Winnt4\\*.\*** (all files AND subdirectories EXCEPT Lputilnt.exe)

Where X: is the drive letter of your CD ROM drive.

- Do not perform any configuration on internal drives until the installation of the operating system has been completed on the MSA1000. After the system reboots, execute the Online RAID Configuration Utility and enable the internal drives.

- These procedures assume a clean install on both the server and the MSA1000—in other words, both are new, out of the box and have not previously been configured.
- Upgrades to HBA firmware should not be performed by utilities from within the operating system. Corruption of the firmware or the operating system may result. All firmware upgrades should be performed from a DOS boot using the LP6DUTIL utility found on the MSA1000 Support Software CD.
- Per the Microsoft recommendation, the *pagefile* for the operating system should be installed to an internal drive.
- Selective Storage Presentation must be used if multiple servers are to contain volumes on the same MSA1000.
- ProLiant servers are available in two configurations. Newer models use ROM Based Setup Utility (RBSU), while older models do not. For servers with RBSU, refer to the section “Setup for RBSU Servers”. For servers without RBSU, refer to the section “Setup for Servers without RBSU”. Select one of the following procedures based on your ProLiant server configuration.

### Setup for RBSU Servers

1. Boot the server from the ProLiant Smart Start CD-ROM version 5.3 or higher. As an alternative, you can download the latest ROM BIOS from <http://www.hp.com>.
2. Install the latest ROM from the Smart Start CD-ROM or the downloaded version.
3. Set the boot order:
  - a. While the system is booting, Press *F9* to start the ROM Setup Utility.
  - b. Choose *Boot Controller Order*.
  - c. Select the primary HBA and move it to *Controller Order 1*.
  - d. Exit the utility.

### **Setup for Servers without RBSU**

If your server does not have RBSU, or the current system partition installed, perform the following steps:

1. Download and install the latest system ROM from the website:  
**<http://www.hp.com/go/storage>**.
2. Download SOFTPAQ SP18002.
3. Run the SOFTPAQ program to create an upgrade diskette.
4. Boot from the ProLiant Smart Start CD-ROM and run the program to clear the configuration.
5. Reboot from the new upgrade diskette. The ORD . EXE program should start automatically.
6. Set the Primary HBA to *Position 1*.
7. Reboot the server.

### **FCA2101 HBA Installation Summary**

Installing the drivers for FCA2101 HBA and the MSA1000 is a three-step process:

1. Install the Fibre Channel Controller (KGPSA-xx PCI-Fibre Channel HBA).
2. Install the HP MSA1000 SCSI array device.
3. Install the Emulex Utility Ifc Dev. SCSI ASCIT8 Device (Emulex Simulate Device).

### **Remote Boot Setup**

After you have completed all these steps, you will be able to:

1. Configure the MSA1000 volumes using the Array Configuration Utility (ACU).
2. Configure the HBA Boot BIOS with Emulex BIOS Utility.
3. Install the operating system.

## Novell NetWare Considerations

Please read and understand the following:

- These procedures currently apply only to Novell NetWare versions 5.x and 6.x.
- All prerequisites and current scaling limitations for StorageWorks MSA1000 apply.
- Do not use SmartStart to install the operation system on server.
- Do not perform any configuration (using Array Configuration Utility) on internal drives until the installation of the operating system has been completed on the StorageWorks MSA1000.
- These procedures assume a clean install on both the server and the StorageWorks MSA1000—in other words, both are new, out of the box and have not previously been configured.

## Install the HBA in the Server

Install the HBA in an open slot in the server. Connect the appropriate fiber cables to the HBA and interconnect devices. Review the install documentation that came with the HBA or the Quick Install Guide (MSA 1000) for detailed instructions.

## Setup for RBSU Servers

1. Boot the server from the ProLiant Smart Start CD-ROM version 5.3 or higher. As an alternative, you can download the latest ROM BIOS from <http://www.hp.com/go/storage>.
2. Install the latest ROM from the Smart Start CD-ROM or the downloaded version.
3. Set the boot order:
  - a. While the system is booting, Press *F9* to start the ROM Setup Utility.
  - b. Choose *Boot Controller Order*.
  - c. Select the primary HBA and move it to *Controller Order 1*.
  - d. Exit the utility.

### **Setup for Servers without RBSU**

If your server does not have RBSU, or the current system partition installed, perform the following steps:

1. Download and install the latest system ROM from the website:  
**<http://www.hp.com/go/storage>.**
4. Download SOFTPAQ SP18002.
5. Run the SOFTPAQ program to create an upgrade diskette.
6. Boot from the ProLiant Smart Start CD-ROM and run the program to clear the configuration.
7. Reboot from the new upgrade diskette. The `ORD . EXE` program should start automatically.
8. Set the Primary HBA to *Position 1*.
9. Reboot the server.

### **Remote Boot Setup**

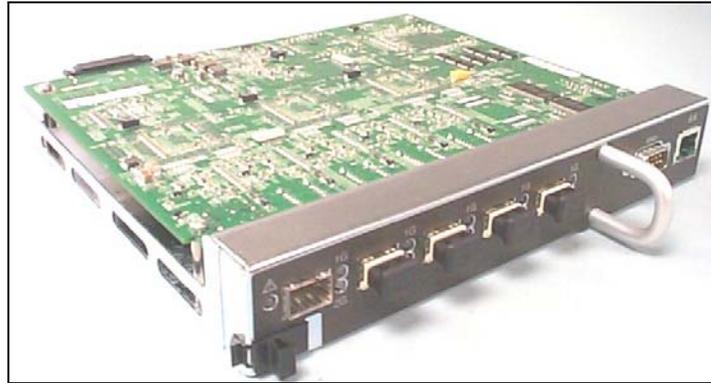
After you have completed all these steps, you will be able to:

1. Configure the MSA1000 volumes using the Array Configuration Utility (ACU).
2. Configure the HBA Boot BIOS with Qlogic BIOS Utility.
3. Install the operating system.

## Interconnect Options

### MSA Fabric Switch 6

The MSA Fabric Switch 6 is an optional 2Gb/s, integrated six-port module. It features a 12Gb/s switch engine that enables full-duplex nonblocking performance on all ports.



Fabric Switch 6

### Components

The MSA Fabric Switch 6 components include:

- A main board enclosing the 12Gb/s switching engine.
- Microprocessor and other hardware logic support for the firmware agents.
- MSA Fabric Switch 6 Management Utility, which includes:
  - Full-Duplex Communications—Increases communication speed using a pair of nodes to simultaneously send and receive data for an aggregate of 2Gb/s
  - Automatic Port Bypass—Improves SAN reliability by automatically bypassing misbehaving ports
  - Power indicators
- An RS-232 serial interface port for configuring the MSA Fabric Switch 6
- A 10-baseT Ethernet port for communications to host resident management software applications
- A null-modem cable for configuration with the serial port

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#### Note

Refer to Appendix E of the *MSA Fabric Switch 6 User Guide* for details on the Fabric Switch 6 Management Utility.

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## Features

Main features of this embedded switch include:

- Five external ports, one internal port
- Autoswitching between 1Gb and 2Gb speeds
- Out-of-band management
- Full redundancy
- Hot-pluggable
- An efficient, space-saving design

Small Form Factor  
Pluggable (SFP)  
Transceiver Port

4 Fixed Ports

Serial  
Port

Ethernet  
Port



MSA Fabric Switch 6 Ports



### Important

One-hop cascading is supported, but the MSA Fabric Switch 6 can only be connected to another MSA Fabric Switch 6.

---

## Setting the MSA Fabric Switch 6 Name

1. Use the ACU to specify a name for the MSA1000.
2. Click on the controller to set a name for the MSA1000.

The names display as follows and can be used to identify the switches on the network:

- The MSA1000 displays in ACU with the controller name instead of a serial number. The name is shown as “System Name <system name>”.
- The name is placed in front of - Switch 1 and - Switch 2 in the MSA Fabric Switch 6. The name now displays in both the graphical user interface (GUI) and the command line interface (CLI) (using the `SwCtl` command) as:

```
<system name> - Switch 1
```

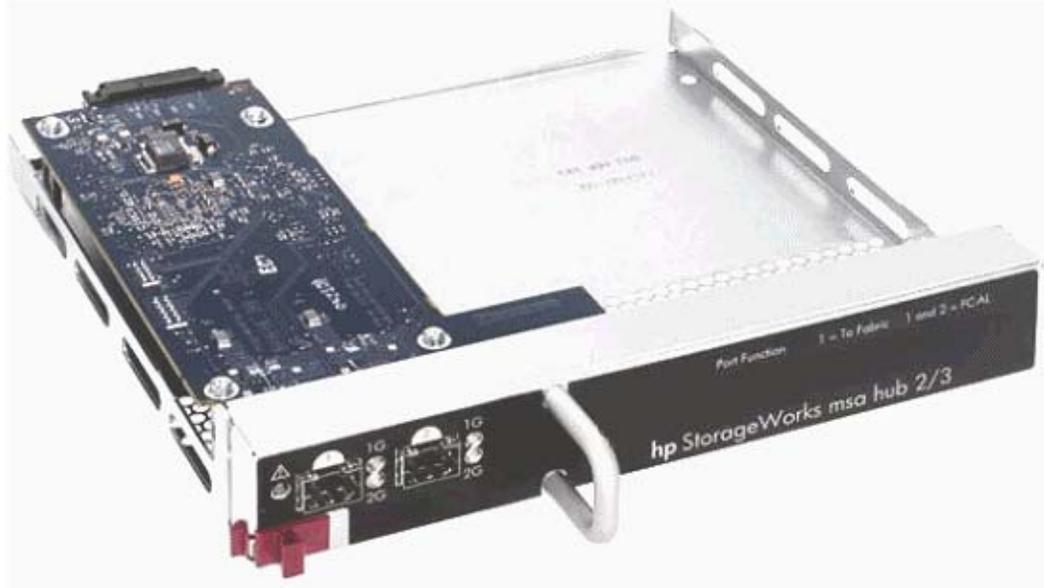
```
<system name> - Switch 2
```

---

### Note

- Switch 1 is the switch associated with Controller 1 (slot 1).
  - Switch 2 is the switch associated with Controller 2 (slot 2).
-

## MSA Hub 2/3



The MSA Hub 2/3 is an optional input/output device designed to replace the single-port Fibre Channel I/O Module that comes standard with the MSA1000. This optional component provides an easy way for a clustered pair of servers to access the storage controller without having to purchase an external hub or switch. Two external SFP ports on the hub are available for use, and an internal third port accesses the controller. A second MSA Hub 2/3 is required if a second controller is installed for redundancy.

## HP SAN Switches



HP StorageWorks SAN switches supported on the MSA1000 are:

- 2Gb Fibre Channel infrastructure family of switches.

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### Note

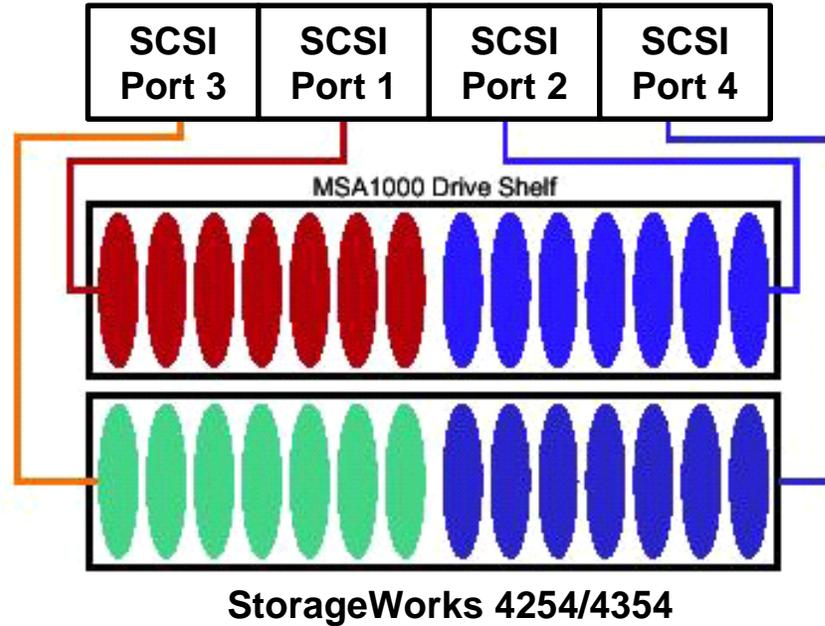
Interoperable only with HP StorageWorks SAN Switch 2/8EL, 2/16EL, 2/16, 2/32 and core 2/64 products.

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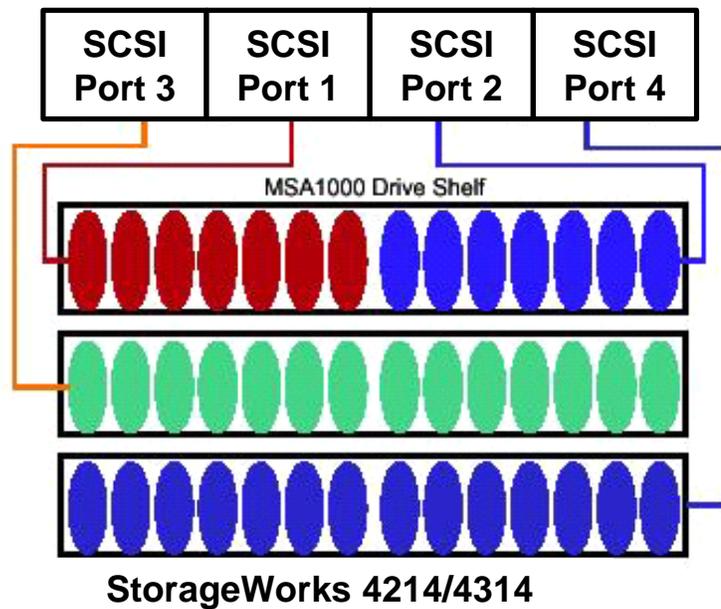
- 2Gb Fibre Channel high availability family of switches.

The MSA1000 automatically detects and adjusts to the correct Fibre Channel frequency.

## HP StorageWorks Enclosures



Dual Bus Enclosure



Single Bus Enclosure

The MSA1000 cabinet holds fourteen 1-inch universal drives. Add one StorageWorks Enclosure (4214 or 4314) for 28-drive capacity. Add two (maximum) StorageWorks Enclosures for 42-drive capacity.

## Features

- **LVD support (Ultra320)** — Supports data transfer rates up to 320MB/s.
- **Hot-pluggable drives** — Supports up to fourteen 1-inch Ultra2, Ultra3, Ultra320, or Wide Ultra SCSI LVD hot-pluggable hard disk drives (HDDs), 254GB per enclosure using 18.2GB 1-inch HDDs.
- **Integrated liquid crystal display (LCD)** — (Model 4314T) Comes with an LCD that displays enclosure and element status and fault information through simple text messages
- **Environmental Monitoring Unit (EMU)** — Monitors all aspects of the enclosure, from the power supply to the EMU disk drives
- **Longer SCSI cable lengths**
  - Wide Ultra2/3 LVD supports SCSI cable lengths up to 39.4-ft (12m)
  - Fast-Wide Ultra supports SCSI cables length up to 12-ft (3.7m)
- **LED indicator** — Shows EMU status, enclosure power, and enclosure and element faults
- **High availability** — Provides hot-pluggable hard disk drives, power supplies, and fans
- **Ultra robust SCA direct connect drive carrier** — Provides better cooling and reliability for high-performance drives
- **3U rack height** — Allows up to 14 enclosures to be housed in one 42U rack for a single rack storage capacity of up to 3.57TB disk storage, using 18.2GB one-inch HDDs.

## Hard Drive Arrays



MSA1000 Hard Drives

### Configuration

There are several ways to configure the physical drives, depending on the operating system and your preference of user interfaces (ACU or CLI). The MSA1000 configuration utilities are used to view, set up, and configure HP Smart Array controllers.

The ACU runs locally through a Windows Internet Explorer browser screen or remotely through Insight Manager (when configured to allow remote access). ACU supports Windows, NetWare, and Linux environments.

All the correct agent, network services, and management software must be installed, configured, and running before the ACU features and functions are operational. For web browser or network access, a combination of the following may need to be installed and properly configured:

- Windows Internet Explorer 5.0 or higher
- TCP/IP and SNMP services
- Insight Manager (or other management agents and software)
- Fibre Channel HBA drivers

The CLI can be used to configure and manage all aspects of the MSA1000, including hard drive array configuration. The CLI is accessed through a host computer connected to the RJ-45Z serial port of the MSA1000 in a Windows, NetWare, or Linux environment.

## MSA1000 Configuration Options

MSA1000 options are available to add redundancy capabilities, speed, and additional enclosures, or to increase space requirements. The MSA1000 component configurations and options are categorized in steps.

### Step 1 — Standard Items

- One MSA1000 controller with 256MB cache
- One MSA Fibre Channel I/O Module with 2Gb/s SFP SW transceiver
- Redundant hot-pluggable power supply and blower assemblies
- Universal rack-mounting kit
- MSA1000 support CD and documentation
- Two power cables
- Two 3-ft VHDCI-to-VHDCI SCSI cables

### Step 2 — Nonredundant System Options

- MSA Fabric Switch 6 — Includes four fixed 2Gb transceivers and a 2Gb hot-pluggable transceiver for a fifth port (not included)
- Optional MSA Hub 2/3
- FCA2101, FCA2210, or FCA2214 HBA
- 256MB cache module for controller battery-backed cache

### Step 3 — Redundant System Options

- MSA1000 redundant controller option kit — Includes 256MB battery-backed cache
- MSA1000 redundant Fibre Channel I/O Module option kit — Includes 2Gb hot-pluggable transceiver
- MSA Fabric Switch 6
- 2Gb/s SFP SW transceiver kit
- FCA2101, FCA2210, or FCA2214 HBA
- ProLiant Cluster HA/F200 for MSA1000
- Secure Path for Windows Workgroup Edition 4 or Secure Path for Windows Workgroup Edition 3.0C
- Redundant hot-pluggable power supply and blower assemblies

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**Note**

Redundant configurations require two HBAs per server, an additional controller, I/O module or fabric switch, and Secure Path for each server.

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## Step 4 — Choosing Supported Options for 2Gb/s or 1Gb/s Infrastructure

Fibre Channel cables for a 2Gb/s infrastructure, includes:

- 2m LC-LC Multimode Fibre Channel cable
- 5m LC-LC Multimode Fibre Channel cable
- 15m LC-LC Multimode Fibre Channel cable
- 30m LC-LC Multimode Fibre Channel cable
- 50m LC-LC Multimode Fibre Channel cable

Use 2Gb/s Fibre Channel cables when connecting the MSA Fibre Channel I/O Module or the MSA Fabric Switch 6 to FCA2101 HBAs.

Fibre Channel cables for 1Gb/s Fabric switches and hub includes:

- 2m LC-SC Multimode Fibre Channel cable
- 5m LC-SC Multimode Fibre Channel cable
- 15m LC-SC Multimode Fibre Channel cable
- 30m LC-SC Multimode Fibre Channel cable
- 50m LC-SC Multimode Fibre Channel cable

Use 1Gb/s Fibre Channel cables when connecting the MSA Fibre Channel I/O Module and FCA2101 HBAs to 1Gb/s fabric switches or hubs.

## Step 5 — Choose Hard Drives and StorageWorks Enclosures

- 72GB hot-pluggable Ultra320 universal hard drive, 15,000 rpm (1-inch)
- 36.4GB hot-pluggable Ultra320 universal hard drive, 15,000 rpm (1-inch)
- 18.2GB hot-pluggable Ultra320 universal hard drive, 15,000 rpm (1-inch)
- 146GB hot-pluggable Ultra320 universal hard drive, 10,000 rpm (1-inch)
- 72GB hot-pluggable Ultra320 universal hard drive, 10,000 rpm (1-inch)
- 36.4GB hot-pluggable Ultra320 universal hard drive, 10,000 rpm (1-inch)
- 18.2GB hot-pluggable Ultra320 universal hard drive, 10,000 rpm (1-inch)

The MSA1000 cabinet holds fourteen 1-inch universal drives. Add one StorageWorks Enclosure to increase capacity up to 28 drives. Add two StorageWorks Enclosures to increase capacity up to the maximum of 42 drives.

- StorageWorks Enclosure Model 4314R — Maximum of two can be connected to the MSA1000.
- StorageWorks Enclosure Model 4314R — Maximum of two can be connected to the MSA1000 (International).
- StorageWorks Enclosure Model 4314R — Maximum of two can be connected to the MSA1000 (Japan).
- StorageWorks Enclosure Model 4354R — Maximum of one can be connected to the MSA1000.
- StorageWorks Enclosure Model 4354R — Maximum of one can be connected to the MSA1000 (International).
- StorageWorks Enclosure Model 4354R — Maximum of one can be connected to the MSA1000 (Japan).

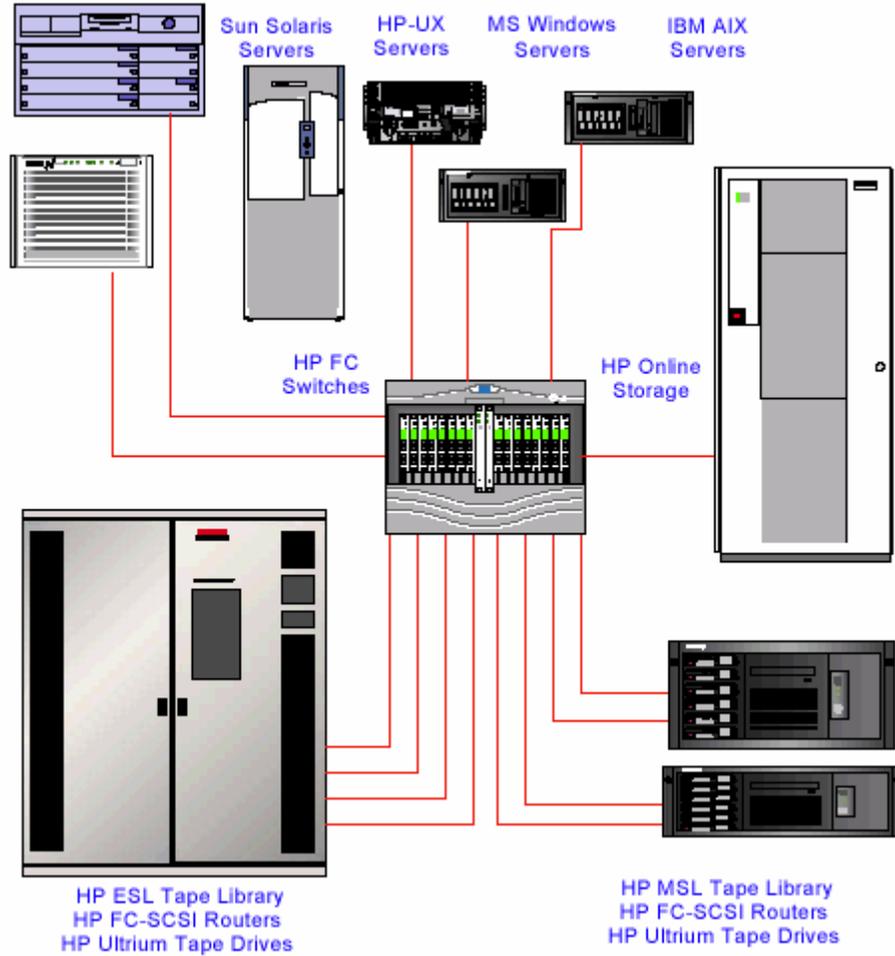
## Step 6 — Choose Rack Options

- HP 9142 rack
- HP 9136 rack
- HP 9122 rack
- HP 9842 rack
- HP 10622 rack
- HP 10636 rack
- HP 10642 rack
- HP 10647 rack

## Related Options

- 2Gb SW, hot-pluggable Fibre Channel transceiver
- 2Gb Multimode Fibre Channel cables (LC to LC – 2m, 5m, 15m)
- 1 to 2Gb Multimode Fibre Channel Cables (LC to SC – 2m, 5m, 15m)
- HP OpenView Storage Virtual Replicator 3 licenses, which come in packages of 1, 3, 5, 10, 25, or 50
- HP StorageWorks Secure Path 4.0 for Windows Workgroup Edition or Secure Path 3.0C for NetWare Workgroup Edition licenses, which come in packages of 1, 5, 10, 25, or 50

## Tape Libraries Support



A SAN backup configuration—sharing storage resources from behind a Fibre Channel switch out to multiple servers—enables IT staff to achieve the same benefits as a more traditional network backup—up to a 2x increase in tape resource utilization and one consolidated point of management—while also taking full advantage of high speed tape drive technology in order to more easily meet backup windows. In addition, because a SAN provides a dedicated backup network, the backup traffic is removed from the LAN with a subsequent increase in consistent LAN performance.

There are several significant benefits to deploying a SAN-based backup solution:

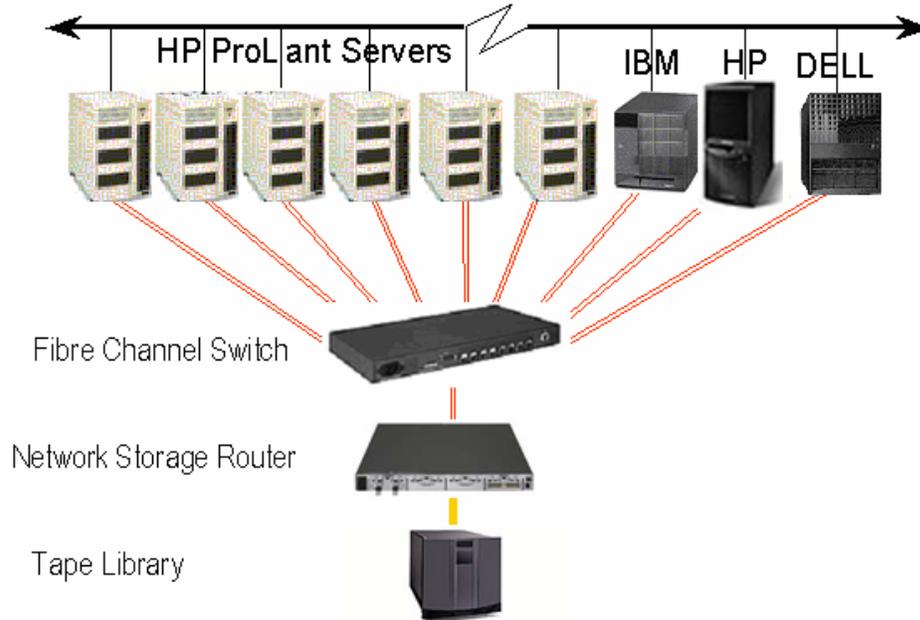
- **High Performance** — The solution provides performance comparable to direct-attach solutions. It does not suffer from network bandwidth limitations inherent in traditional network backup solutions.
- **Scalability** — Tape resources are pooled and shared across all hosts in the environment. Once the solution is deployed, capacity is easily expanded by adding additional tape drives to the pool.
- **Flexibility** — Backup capacity is readily allocated and reallocated as the environment changes. Tape drives are not dedicated or locked in to specific servers as with direct attach backups.
- **Leveraged Investment** — Tape drives and libraries are pooled. These investments shared across the enterprise data center.
- **Reduced Administrative Costs** — Consolidated backup operations, centrally located and managed hardware result in less administrative effort.

## SAN Backup Components

The key components SAN backup solutions add to the SAN are:

- **Tape Library** — Tape library and the tape drives it contains provide the offline storage for backup on the SAN. The tape library provides automated tape handling, which becomes a key requirement when consolidating backups across multiple servers.
- **Router** — Router (sometimes referred to as a bridge) device provides connection between Fibre Channel topologies and SCSI devices. It does this by presenting the SCSI devices as Fibre Channel devices to the SAN and then relaying Fibre Channel commands to these SCSI devices. Routers are typically used for tape drives and libraries.
- **Backup Software** — Backup software is deployed on each of the hosts on a SAN that will perform backups. This typically requires installing server-type licenses and software on each of these hosts.
- **SAN Management Software** — SAN Management software is used to manage resources, security, and functionality on a SAN. This can be integrated with host-based device management utilities or embedded management functionality, such as hub or switch Ethernet ports.

## NSR and the MSA1000



Network Storage Router in a SAN

HP offers Network Storage Routers (NSRs) to span the Entry-Level to Enterprise customer environment. The HP StorageWorks Network Storage Router is a Fibre Channel-to-SCSI bridge that allows multiple host servers to communicate with a tape device over a Fibre Channel link.

Available NSRs include:

- **e1200 and e2400** —The HP StorageWorks Network Storage Router e1200 and HP StorageWorks Network Storage Router e2400 provide embedded fiber options for the MSL and ESL tape libraries. They provide many of the same benefits as an external Network Storage Router without consuming extra rack space.
  - The e1200 is a 1 Fibre Channel x 2 LVD SCSI router/card that will slide into a slot in the back of the MSL5000 libraries. It will support up to four drives and can support multiple libraries.
  - The e2400 is a 2 Fibre Channel x 4 LVD SCSI router/card that is embedded into a card cage in the back of the ESL9000 libraries. The E2400 supports up to eight LVD drives and can be upgraded to a 4 Fibre Channel x 8 LVD SCSI router to support 16 LVD drives by purchasing an additional part number with two more cards.

- **N1200** — A 1U rackmount router with one Fibre Channel port and two SCSI ports. It allows customers to connect SCSI based tape libraries to the SAN increasing backup speeds up to 90%. The N1200 offers enterprise class features at a price point appealing to the low to mid range customers. It is targeted towards customers that want to reduce or remove their backup window. It offers support for serverless backup, 2Gb Fibre Channel and has web-based management allowing for remote management. This is the first router to bring 2Gb Fibre Channel to the midrange environment.
- **M2402** — A 1U rackmount Fibre Channel-to-SCSI router with two Fibre Channel ports and four SCSI ports on the base model, upgradeable to six fiber ports or twelve SCSI ports. It allows multiple host servers to communicate with a SCSI tape device over a Fibre Channel link making backup speeds five times faster. It is targeted towards customers whose backup window is impacting mission-critical business operations and who need to reduce or remove the backup window. It offers support for serverless backup, LVD/SE and HVD SCSI libraries, 1Gb and 2Gb Fibre Channel and has web-based management enabling remote management.

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**Note**

Detailed SAN-based backup implementations are covered in the *StorageWorks Heterogeneous Open SAN Design Reference Guide*.

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## Tape Libraries for the MSA1000



EBS Example with an MSA1000

The MSA1000 and HP StorageWorks EBS is a Fibre Channel-based tape backup and restore solution, integrated into primary storage SAN configurations and designed to assist backup needs in a SAN environment.

For data protection, the MSA1000 and EBS SAN backup provides:

- Shared tape storage
- Scalability
- Automation
- High performance
  - Backup rate up to 158.4GB/h
  - No network bottlenecks
- Snapshot with Virtual Replicator

Virtual Replicator snapshots enable:

- Minimal interruption to business (seconds)
- Strategy for online and offline data storage
- Fast recovery of data from online snapshots
- Backup to tape whenever necessary or desired

## Supported Tape Libraries



The MSA1000 business-class tape libraries supported include:

- MSL5026DLX, MSL5026S2, MSL5026SL, MSL5030L1, MSL5052S2, MSL5052SL, MSL5060L1
- SSL2020
- Ultrium 215, Ultrium 230, Ultrium 460

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**INTERNET** For a complete listing of supported tape libraries, visit the HP website at:  
<http://h18006.www1.hp.com/storage/tapestorage.html>

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## Learning Check

1. List three base MSA1000 components that are hot-pluggable.

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2. List two additional MSA1000 components.

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3. What are the nonredundant configuration options for the MSA1000?

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.....

4. What is a Network Storage Router?

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5. What are three benefits of an EBS SAN backup?

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## Objectives

After completing this module, you should be able to:

- List the supported operating systems, software, and configuration restrictions for the Modular SAN Array (MSA) 1000.
- Define single and redundant path configurations.
- Explain cascaded configurations:
  - SAN switch-to-SAN switch.
  - MSA Fabric Switch 6-to-MSA Fabric Switch 6.
- Explain MSA Fabric Switch 6 zoning considerations.
- Identify example ordering requirements for the cluster and redundant path configurations.

## Supported Software and Configuration Restrictions

### Supported Operating Systems

Operating System	Clustering	Connectivity	HBAs	MSA1000 Controller Firmware
NetWare 5.1 Support Pack 4	NCS	Multiple Paths Secure Path 3.1B	FCA2210—2Gb/s	V2.24
NetWare 6.0 Support Pack 1	NCS	Multiple Paths Secure Path 3.1B	FCA2210—2Gb/s	V2.24
Red Hat Linux Professional 7.2	Life Keeper (from Steel Eye)	Single Path Only	FCA2214—2Gb/s	v.2.24
Red Hat Linux Advanced Server 2.1	Future (from Steel Eye)	Single Path Only	FCA2214—2Gb/s	v.2.24
SuSE Linux Enterprise Server 7	Future (from Steel Eye)	Single Path Only	FCA2214—2Gb/s	v.2.24
Windows NT 4.0 SP6a	MSCS	Multiple Paths Secure Path Windows Workgroup Edition 3.0b	FCA2101—2Gb/s	V1.16
Windows 2000 Server/Advanced Server SP2	MSCS	Multiple Paths Secure Path Windows Workgroup Edition 3.0b	FCA2101—2Gb/s	V1.16

#### Note

Visit the HP storage website for a current list of supported operating systems and configuration restrictions: [www.hp.com/go/storage](http://www.hp.com/go/storage)

## Software

The following software and utilities are supported on the MSA1000.

Software	Operating System
Array Configuration Utility (ACU) 6.0	Windows: online Linux: offline NetWare: offline
Command Line Interface (CLI) (accessed through RJ-45Z serial port)	Windows, Linux, NetWare
Microsoft Clustering Services (MSCS)	Windows NT, Windows 2000
Novell Clustering	NetWare
SteelEye LifeKeeper	Linux
OpenView Storage Virtual Replicator 3.0A or later	Windows NT, Windows 2000
SmartStart 5.5 or later	Windows, Linux, NetWare
Insight Manager 7	Windows, Linux, NetWare
StorageWorks Secure Path 4.0 for Windows Workgroup Edition	Windows NT, Windows 2000
StorageWorks Secure Path 3.0c for NetWare Workgroup Edition	NetWare

## SAN Configuration Guidelines

When designing your MSA1000 SAN solution, refer to the *MSA1000 SAN Configuration Guide* white paper for a description of common configurations that are possible with the MSA1000.

## Configuration Rules

- One-hop (E\_port to E\_port) interconnect cascading per path is allowed with the MSA Fabric Switch 6.
- Three-hop (E\_port to E\_port) interconnect cascading per path is allowed with HP SAN high-availability switches.
- Seven hop (E\_port to E\_port) interconnect cascading per path is allowed with HP SAN infrastructure switches.
- Fabric interconnects can be cascaded (no hubs).
- A server supports only a single or redundant path to a SAN (a server cannot be attached to multiple SANs except with redundant paths).
- A redundancy configuration will only support similar interconnect configurations (both data I/O or both switches).

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**INTERNET** All restrictions listed are based on current operating system support and are subject to change. For the most current supported guidelines and configurations, refer to the HP website at:  
**<http://h18006.www1.hp.com/products/storageworks/msa1000/index.htm>**

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## MSA1000 Maximum Configurations

The MSA1000 can be configured to include a maximum of:

- Fourteen 1-inch drives per MSA1000 unit.
- Two controllers per enclosure.
- Two Fibre Channel I/O modules per enclosure.
- Two power supply/blower assemblies per enclosure.
- Expanded capacity of up to 42 physical drives with two optional storage expansion enclosures.
- Two 512MB SDRAM controller cache memory.

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### Note

For more information, see *Chapter 3* in the *hp StorageWorks modular SAN array 1000 user guide*, which contains graphic illustrations of various server and cluster configurations.

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## Other Configuration Rules

### Cluster Configurations

- Clusters can share an MSA1000 with other clusters.
- Clusters can share an MSA1000 with stand-alone servers.

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### Note

Microsoft and NetWare clusters and single servers running Secure Path can concurrently access an MSA1000. At this time, Linux clusters or single servers cannot access the same MSA1000 being accessed by clusters or servers with Windows or NetWare running Secure Path software.

---

### Redundant Configurations (Using Secure Path)

- The server can only support a single or redundant path—not both.
- The server cannot attach to multiple SANs.
- MSA1000 redundancy only supports similar I/O configurations—both data I/O, both switches, or both hubs.

### Other Configurations

- You can only cascade fabric interconnects.
- You cannot connect the MSA Fabric Switch 6 to an external SAN switch.

## Sample Configurations

The MSA1000 supports a variety of switches and hubs in both standalone and clustered environments. The following illustrations provide samples of possible configurations using the Fibre Channel I/O Module and MSA Fabric Switch 6. These sample configurations are in no way comprehensive.

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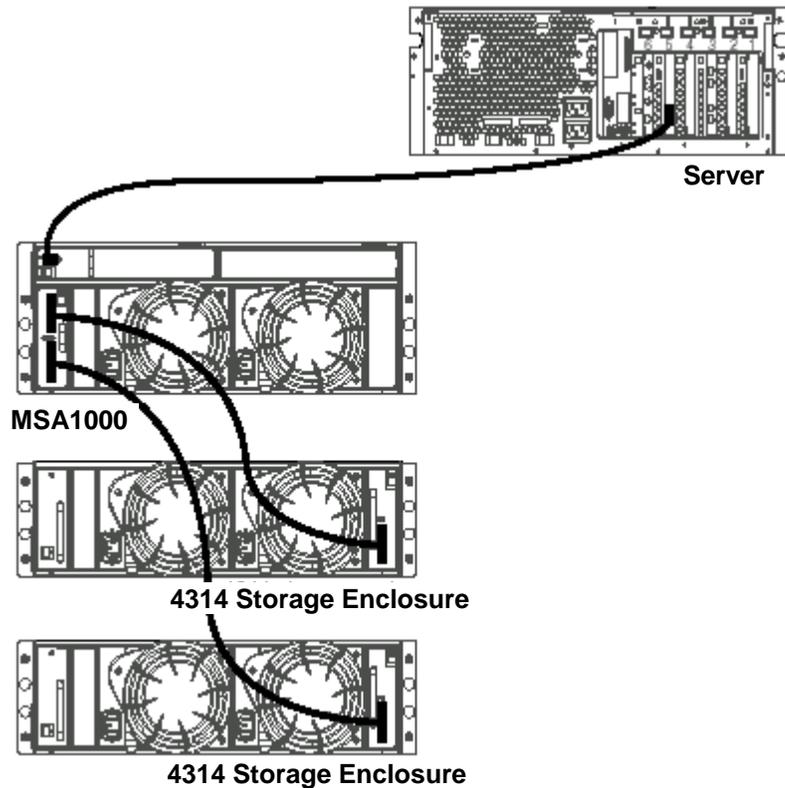
**Note**

Redundancy and cluster support are possible in all configurations.

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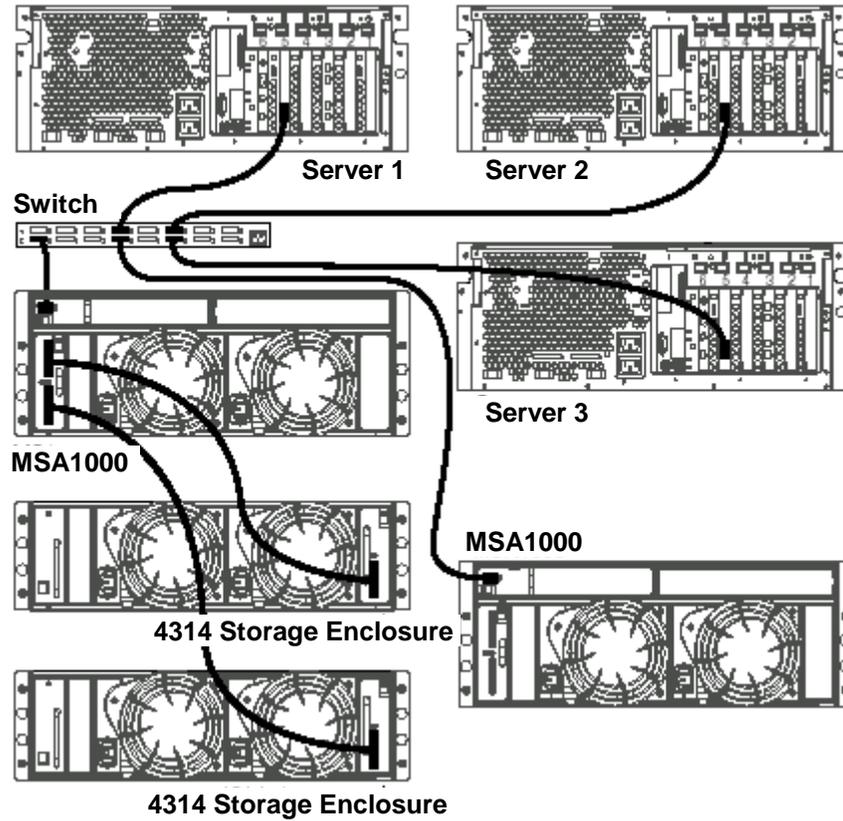
### Fibre Channel I/O Module Configurations

The MSA1000 can be connected directly to a server or can be connected to an external switch or hub. The following figure illustrates the most basic configuration of connecting one server directly to the Fibre Channel I/O module.



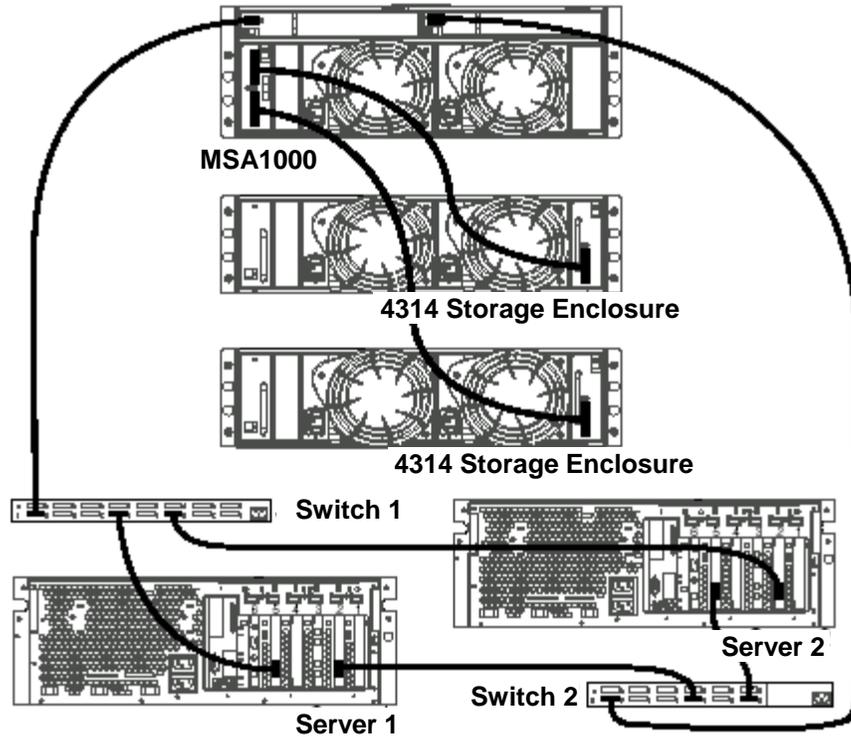
Fibre Channel I/O Module Directly Connected to a Server

You can also connect external SAN switches to the Fibre Channel I/O module. The following figure illustrates multiple servers and multiple MSA1000s connected to a SAN switch in a nonredundant configuration.



Fibre Channel I/O Module Connected to an External Switch, Nonredundant Configuration

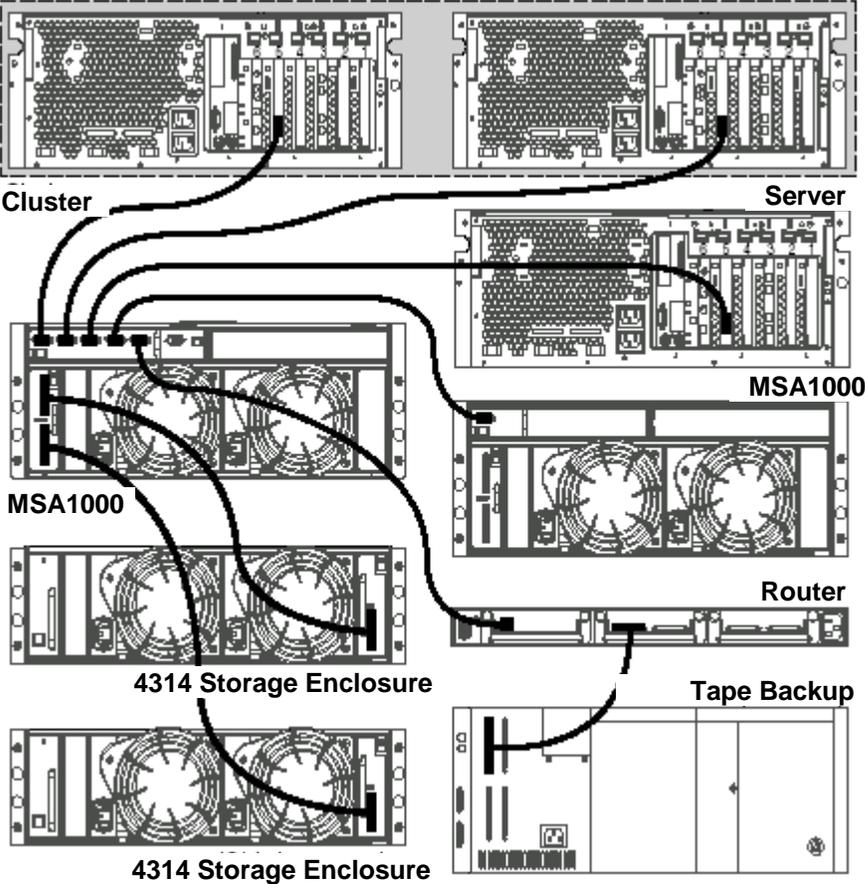
In redundant configurations connected to an external SAN switch, two MSA1000 controllers, two Fibre Channel I/O modules, two SAN switches, and two host bus adapters (HBAs) in each server are required. The figure below illustrates the redundant configuration of two external SAN switches connected to the Fibre Channel I/O modules.



Fibre Channel I/O Module Connected to an External SAN Switch, Redundant Configuration

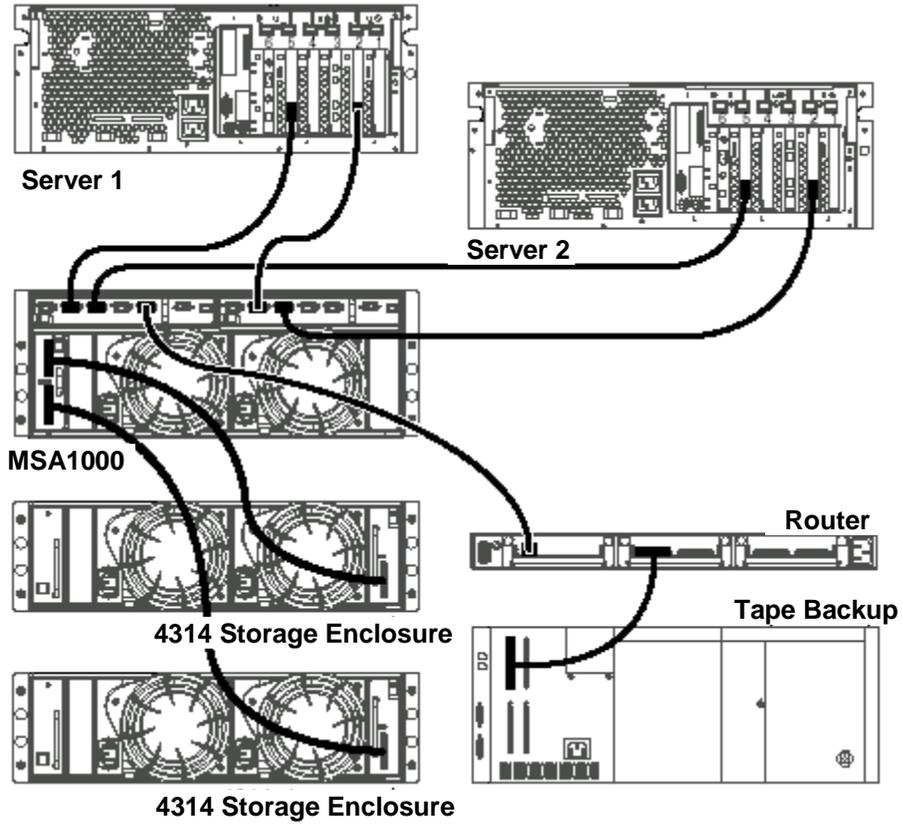
### Embedded MSA Fabric Switch 6 Configurations

The following figure illustrates the MSA Fabric Switch 6 installed with the Network Storage Router (NSR) in a nonredundant configuration.



MSA Fabric Switch 6/NSR—Nonredundant Configuration

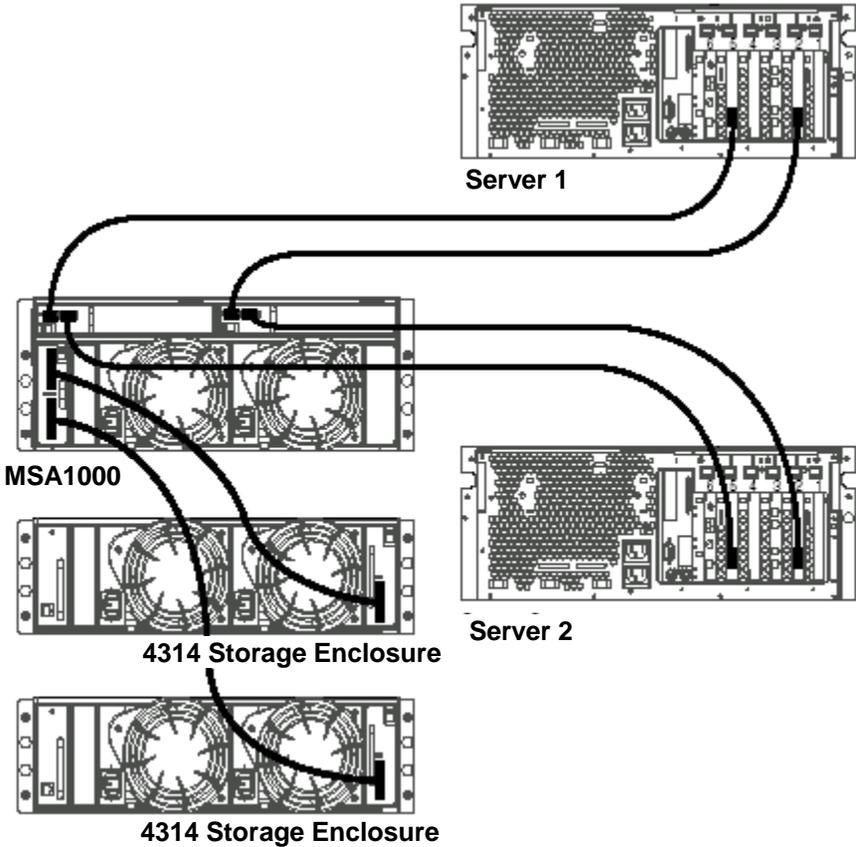
The following figure illustrates the MSA Fabric Switch 6 installed with the NSA in a redundant configuration.



MSA Fabric Switch 6/NSR—Redundant Configuration

### Embedded MSA Hub 2/3 Configurations

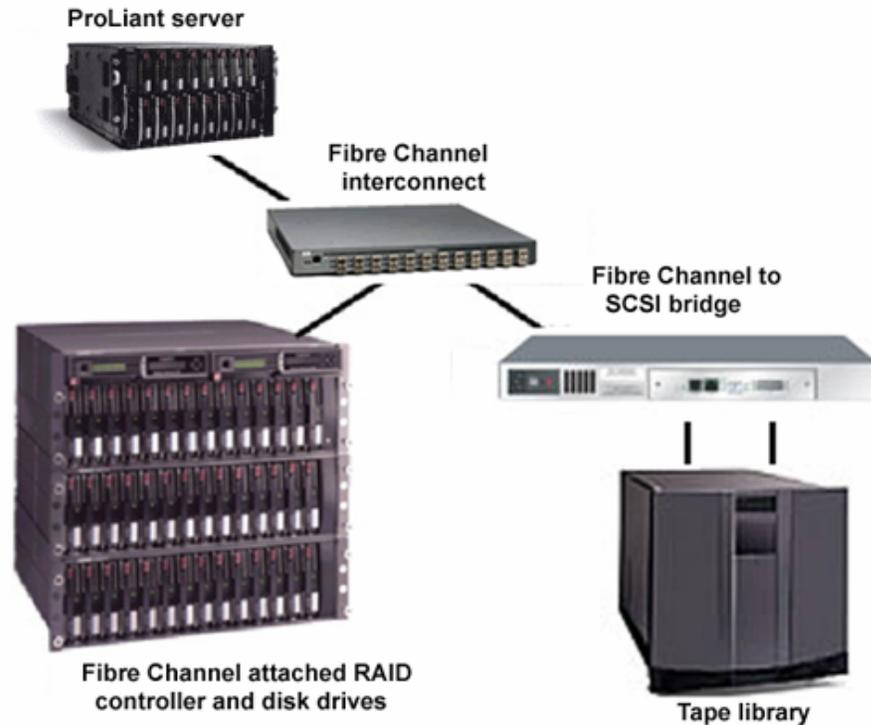
Another possible configuration includes using the MSA Hub 2/3 to connect two servers to the storage in a clustered environment. The following figure illustrates the MSA Hub 2/3 installed in a redundant configuration.



MSA Hub 2/3 Connected to Two Servers, Redundant Configuration

## Single and Redundant Path Configurations

### Single Path Configuration



Single Path (Nonredundant) Configuration

The single path configuration requires one HBA per server, one interconnect device, and one MSA1000 controller per storage.

The MSA Fabric Switch 6 has a total of five external Fibre Channel ports. Four of the external Fibre Channel ports are Small Form Factor Fixed (SFF) shortwave (SW) transceivers, which are embedded in the fabric switch. The fifth available port requires the installation of a Small Form Factor Pluggable (SFP) transceiver.

For a nonredundant configuration, remove the 2Gb/s SFP SW transceiver from the MSA Fibre Channel I/O Module and install it in the MSA Fabric Switch 6. A redundant MSA Fabric Switch 6 will require the purchase of a 2Gb/s SFP SW kit (P/N 221470-B21) to use the fifth external port.

The single path components include:

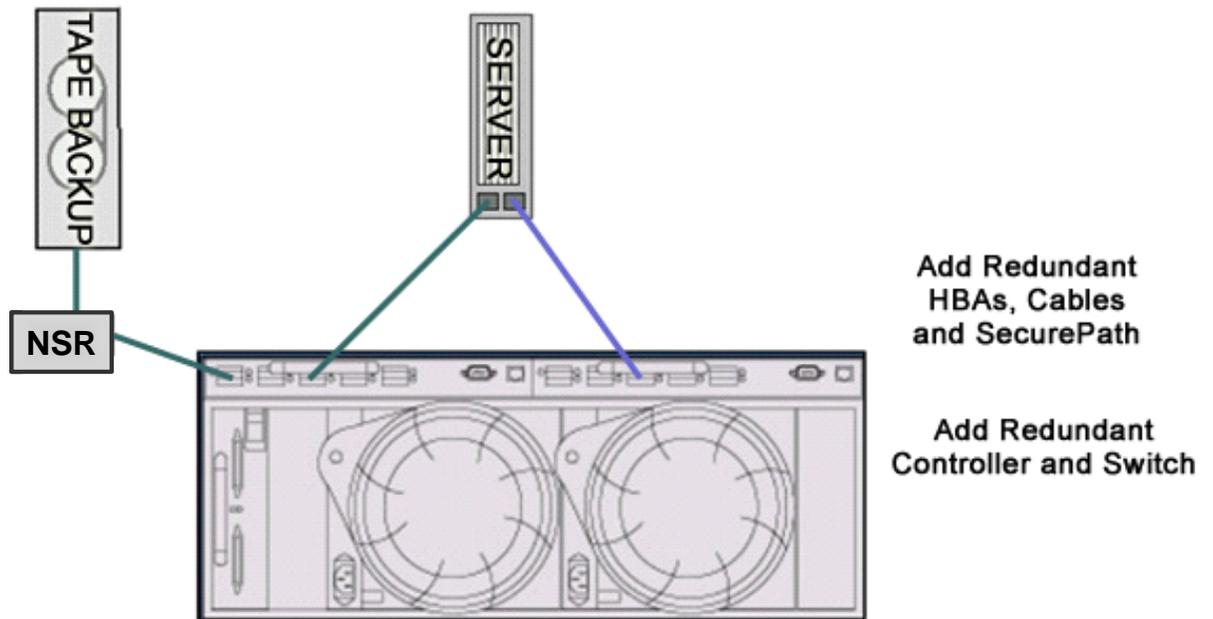
- A broad range of certified servers
- StorageWorks MSA1000
- One FCA2101, FCA2210, or FCA2214 HBA per server
- One hub or fabric switch
- One controller per storage array

## Redundant Configuration

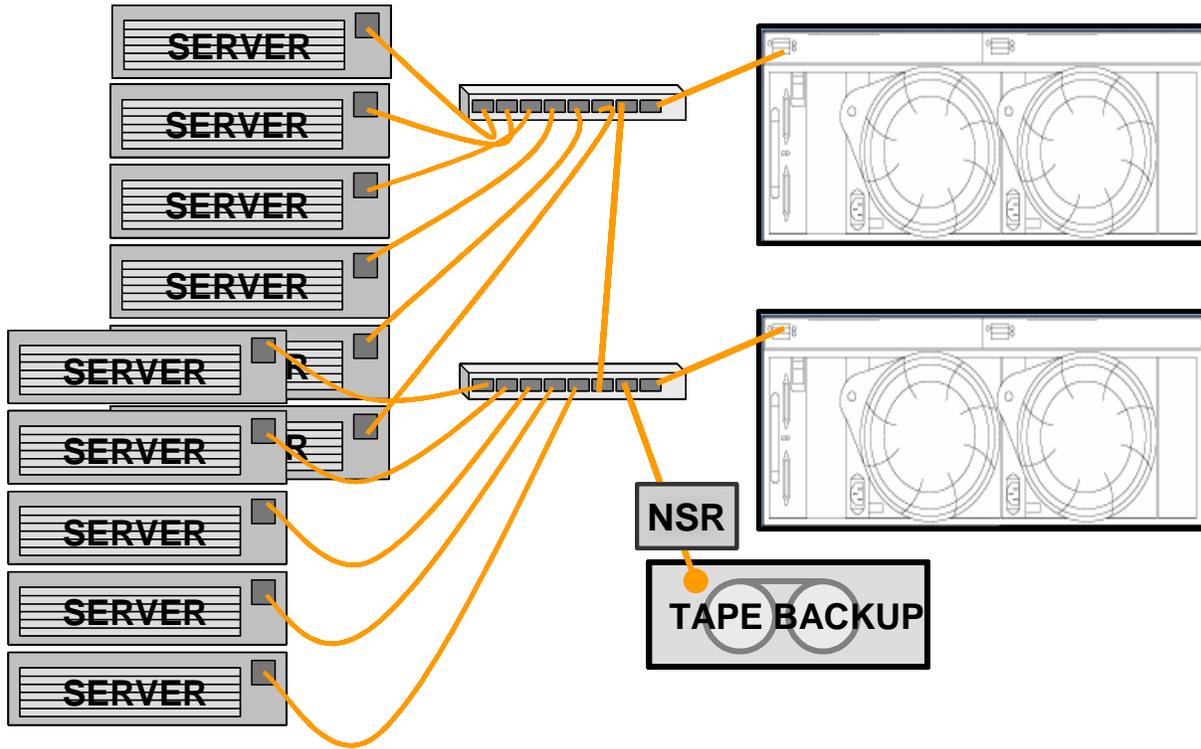
Redundant configurations require two HBAs per server, an additional controller and I/O module, MSA Fabric Switch 6, or MSA Hub 2/3, and Secure Path software for each server. For HP ProLiant clusters, Secure Path software can be substituted with the ProLiant Clusters HA/F200 Kit. This configuration provides no single point of failure.

Redundant configurations must use the same interconnect type. When configuring the MSA1000 for redundant controllers, use two MSA Fibre Channel I/O Modules, two MSA Fabric Switch 6 components, two MSA Hub 2/3 components, or two SAN switches.

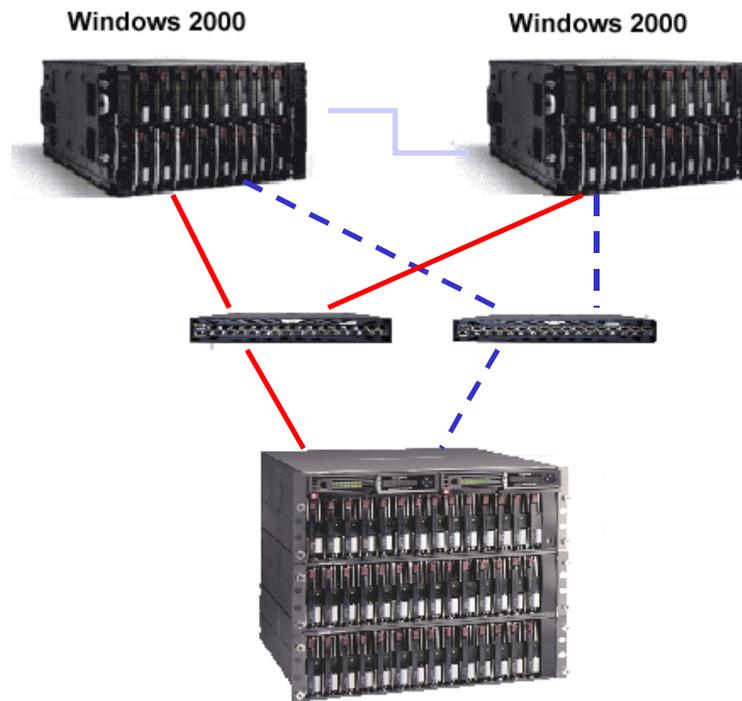
### SAN Configuration Using MSA1000 Embedded Fabric Switch



### SAN Configuration Using External Fabric Switches



## High-Availability Environment



In a high-availability environment:

- Redundant components provide no single point of failure.
- Clustering provides reduced risk of downtime and increase application availability.
- Multipath configurations cannot be mixed with single path configurations.

High-availability components include:

- A choice of certified servers
- StorageWorks MSA1000
- Two FCA2101, FCA2210, or FCA2214 HBAs per server
- Two MSA Hub 2/3s
- Two controllers per storage array
- Two Secure Path software licenses

**INTERNET**

For current information on supported operating systems and options, refer to the storage website at: [www.hp.com/go/storage](http://www.hp.com/go/storage).

## Cascading

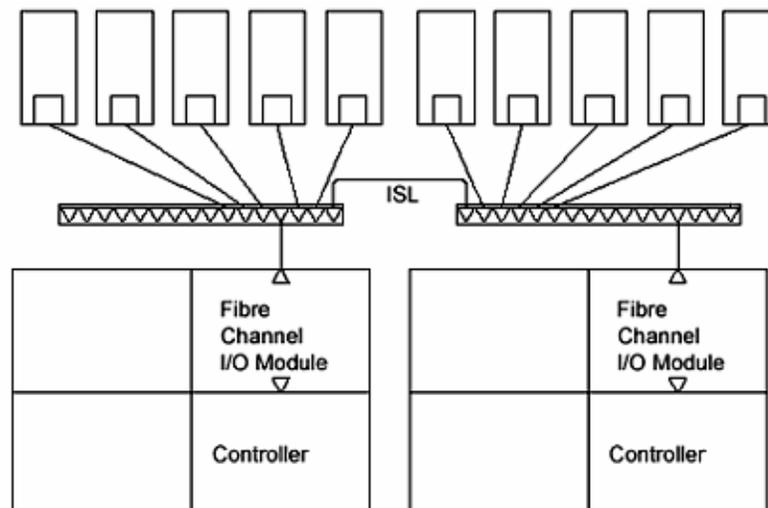
In the Fibre Channel fabric, the term cascading describes the way switches connect with each other to form the data network. For example, expanding or growing a fabric is performed by adding switches to an existing fabric. Switches cascade automatically when you add new switches.

Unlike Ethernet networks where only one port can be used to interconnect stackable hubs, Fibre Channel switching enables the use of any port for cascading.

The MSA1000 can be cascaded with the following rules:

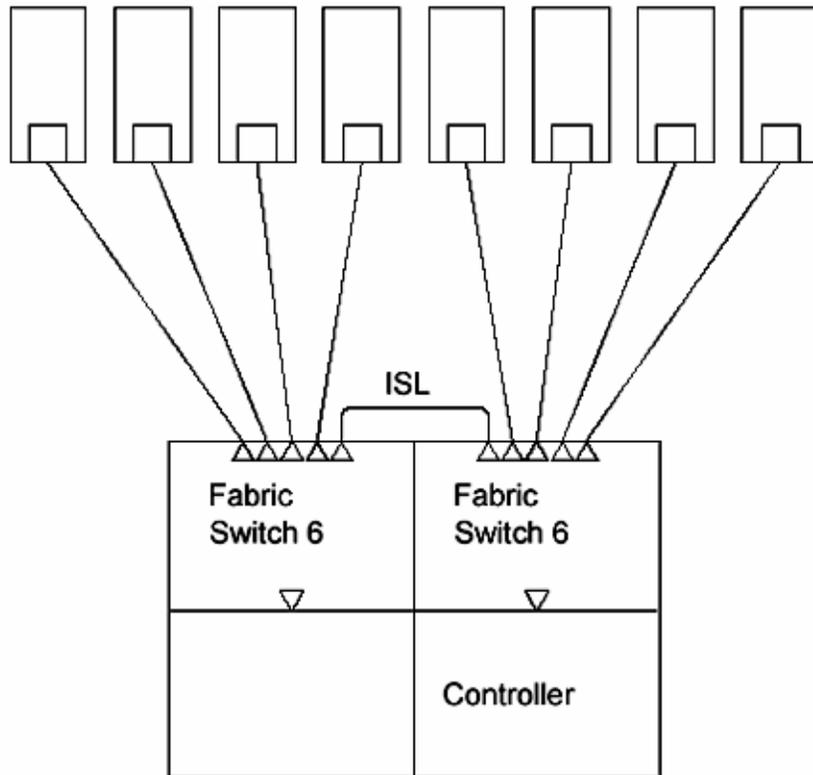
- One-hop (E\_port to E\_port) interconnect cascading per path (internal or external switches) is allowed for the MSA Fabric Switch 6.
- Three-hop (E\_port to E\_port) interconnect cascading per path (internal or external switches) is allowed for the HP Edge Switches.
- Seven-hop (E\_port to E\_port) interconnect cascading per path is allowed for the HP SAN Switches.
- Fabric interconnects can be cascaded (no hubs).

### SAN Switch-to-SAN Switch Example



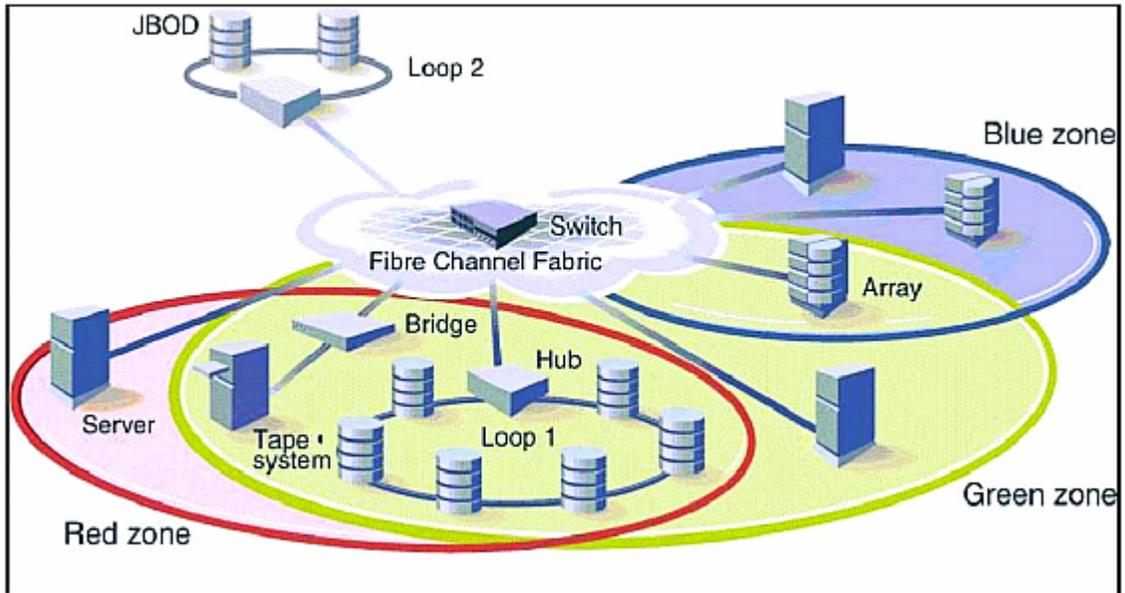
MSA1000 with Two External Fabric Switches (Cascaded)

## MSA Fabric Switch 6-to-MSA Fabric Switch 6 Example



Cascading Two MSA Fabric Switch 6 Switches in a Single MSA1000

## MSA Fabric Switch 6 Zoning Considerations



Zoning is an efficient method of managing, partitioning, and controlling access to SAN devices. Fabric zoning allows you to automatically or dynamically arrange fabric-connected devices into logical groups (zones) across the physical configuration of the fabric. These zones can include selected storage, servers, and workstations within a fabric. Information access is restricted to only the “member” devices in the defined zone.

Although zone members can access only other members in their zones, individual devices can be members of more than one zone. This approach enables the secure sharing of your storage resources, a primary benefit of storage networks. In addition to improving security, zoning can also help you simplify management of heterogeneous fabrics, maximize storage resources, and segregate storage traffic.

In the MSA Fabric Switch 6, zoning enables you to create isolated Fibre Channel networks with a limited number of connected devices. By limiting the number of devices in a zone, you can obtain more robust performance and enhance your access protection.

---

## Zoning Methods

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**Note**

Refer to the switch users guide for a detailed explanation of zoning methods.

---

You can perform zoning for the MSA Fabric Switch 6 using either the Command Line Interface (CLI) or using this MSA Fabric Switch Management Utility.

**WARNING**

Never add a zoned switch to an established fabric that has no zoning. If a switch configured with zoning is added to a fabric that has no configured zoning, the fabric's HBAs and targets will not be able to communicate and the traffic in the fabric will be disrupted. For best results, only add a switch configured with zoning to a fabric configured with the same zoning configuration.

---

Regardless of which tool you use, you must understand the following zoning elements before you begin to create zoning on a MSA Fabric Switch 6:

- **Zones** — Logical entities that represent groupings of zone members. Each zone must be assigned a unique zone name when it is defined.
- **Zone Sets** — Logical entities that enable grouping of a set of zones. They define a zoning configuration. Each zone set is assigned a unique zone set name when it is defined.

Zone sets are The MSA Fabric Switch 6 allows storing of multiple zone sets. However, only one of these zone sets can be activated at a time. The other zone sets can be used as backup, trials, or other user-defined configurations.

- **Zone Members** — Fibre Channel devices that are identified by their World Wide Port Names (WWPNs). Any device that you want to include in a zone must be identified as a zone member. Internally the zone members are tracked by their WWPNs, however, you can create a zone member name that acts as an alias for the device, making it easier to identify the devices during configuration and operation.

Examples of Fibre Channel devices that can be named as zone members are:

- Servers
- RAID systems
- Disk drives
- Tape libraries

---

**Note**

Although Fibre Channel devices do not need to be connected during configuration, HP recommends that all your Fibre Channel devices be connected to an MSA Fabric Switch 6 when you configure zone members.

---

## Display Zoning

MSA Fabric Switch 6 Management Utility allows you to display zoning in two ways:

- **Merged** — Used when you are interested in viewing information for zones merged with other switches on the fabric.
- **Local.** — Used when you are interested in viewing, creating, or editing zone sets, zones, and zone members for the switch presently being monitored.

## Configure Zoning with CLI

Use the CLI to configure zones, zone sets, and zone members and to apply the new or edited zone configurations to the switch.

To ensure uninterrupted operation of the MSA Fabric Switch 6, a three-stage process was developed for configuring zoning using CLI:

1. Create the zones, zone sets, and zone members in a temporary area called the pending table.
2. Verify the configuration in the pending table to ensure that the zoning configuration is what you need.
3. Save the pending table permanently in the active table, and then apply the new zoning configuration to the switch.

## Example Ordering Requirements

The MSA1000 SAN solution ordering requirements and part numbers are available on the product Quick Specs and documentation.

### Required Items

HP StorageWorks Modular SAN Array 1000 which includes:

- One MSA1000 Controller with 256 MB cache
- One MSA Fibre Channel I/O Module with 2Gb SFP SW Transceiver
- Redundant Hot Pluggable Power Supply/blower assemblies
- Universal Rackmounting Kit
- MSA1000 Support CD & Documentation
- Two Power cables
- Two 3-ft VHDCI to VHDCI SCSI cables

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#### Note

Fibre Channel cables are ordered separately.

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## Configuration Examples

### Two-Node Redundant Cluster Solution

Quantity	Description
1	HP StorageWorks Modular SAN Array 1000
1	MSA1000 controller
2	MSA Hub 2/3
4	Host Bus Adapter (appropriate for the operating system)
6	2m LC-SC Multimode Fibre Channel cable
1	ProLiant Cluster HA/F200 for MSA1000
14	36.4GB Hot-Pluggable Ultra3 Universal Hard Drive, 15K
1	Secure Path V4.0 for Windows Workgroup Edition

## Four Host, 1.5TB, Redundant SAN Solution

Quantity	Description
1	HP StorageWorks Modular SAN Array 1000
1	MSA1000 controller
2	256MB Cache Module (one additional for each controller)
2	SAN Switch 2/8-EL
1	2Gb/s SFP SW Transceiver Kit
8	Host Bus Adapter (appropriate for the operating system)
8	2m LC-LC Multimode Fibre Channel cable
4	Secure Path V4.0 for Windows Workgroup Edition
2	StorageWorks Enclosure Model 4314R
42	36.4GB Hot-Pluggable Ultra3 Universal Hard Drive, 15K

## Learning Check

1. What operating systems does the MSA1000 solution support?  
.....  
.....
2. Where would you find a current list of supported operating systems in the MSA1000 SAN solution?  
.....
3. Multiple Windows NT clusters can share one MSA1000 storage system.  
 True  
 False
4. How many hops are supported in the MSA Fabric Switch 6 for the MSA1000 SAN solution?
  - a. 0
  - b. 1
  - c. 2
  - d. 7
5. When implementing a no single point of failure configuration with the MSA1000 SAN, what components are required?
  - a. Dual host bus adapters per server
  - b. Dual array controllers in the MSA1000 storage system
  - c. Multipathing software, such as Secure Path
  - d. All the above
6. List the components that are required for a single path MSA1000 configuration.  
.....  
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.....  
.....

7. List the components that are required for a redundant MSA1000 configuration.

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.....

.....

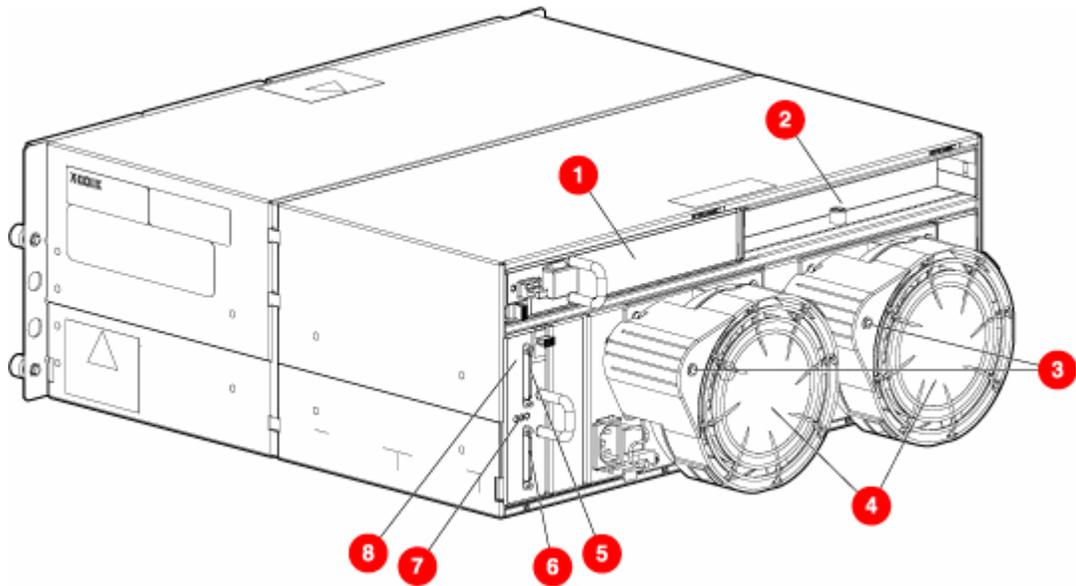
.....

## Objectives

After completing this module, you should be able to:

- List the steps to install the Modular SAN Array (MSA) 1000.
- Describe the MSA Fabric Switch 6 and MSA Hub 2/3 installations.
- State the function of the various drivers and support software.

## Installing an MSA1000 SAN Solution



Rear View MSA1000

The basic steps to building a SAN with the MSA1000 begin with installing a host bus adapter (HBA) in the host server. The HBA provides a high-speed interconnect to the SAN. Then the HBA is connected through a fiber optic cable to an interconnect device.

Finally, the Modular SAN Array 1000 Support Software CD is used to install the HBA drivers, configuration tools, and management tools on the host computer. These will not only assist with the installation of the operating system-specific drivers, but also with the configuration of the MSA1000 and its storage.

---

### Note

The Modular SAN Array 1000 Support Software CD is a bootable media that enables a server to boot into a Linux shell and launch the ACU or the ADU, allowing the user to configure the MSA1000 storage or generate a diagnostic report without requiring a pre-installed operating system or drivers.

---

The components in the preceding diagram are described in the following table.

Item	Description
1	Blank panel or optional Fibre Channel I/O Module (Do not remove—the blank panels are necessary for airflow)
2	Power supply/blower assemblies
3	Power supply/blower assembly indicators
4	AC power cord connectors
5	SCSI Port A connector
6	SCSI Port B connector
7 and 8	I/O with Integrated Environmental Monitoring Unit (EMU)

---

## MSA1000 Installation Steps

To install the MSA1000 SAN solution:

1. Install any optional components.
2. Install the MSA1000 storage system in a rack.
3. Install the interconnect device into a rack.
4. Install the HBA (appropriate to the operating system) in the server.

---

**Note**

Refer to the documentation supplied with each device for details.

---

5. Connect the HBA and the Fibre Channel switches or hub by using the appropriate length of Fibre Channel cable.
6. Connect the power cables.
7. Power on the system (see instructions for “Applying Power” below).
8. Follow the operating system specific instructions for installing the required drivers and utilities on the server. After installing the appropriate drivers and utilities, insert the Modular SAN Array 1000 Support Software CD in the CD-ROM drive. Launch the autorun.exe program to start the software installation.

## Applying Power

Before applying power to the MSA1000, all components of the storage system must be installed and connected to the supported interconnect options. Hard drives should be installed in the MSA1000 so that they can be identified and configured at power on.

The MSA1000 components must be powered on in the following order:

1. Power on all external interconnect devices (for example the HP SAN Switch 2/16).

---

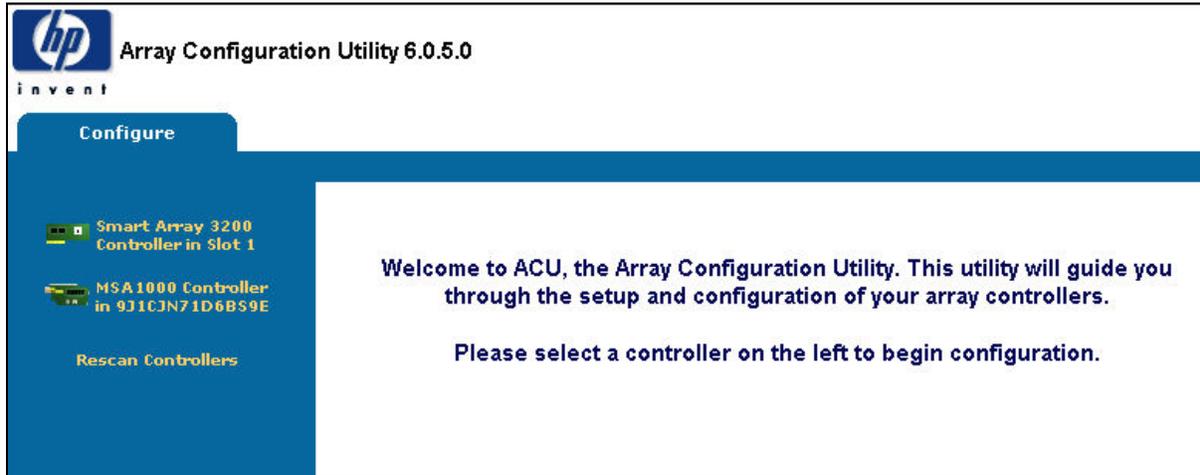
**Note**

Some switches may take several minutes to complete the power-on process.

---

2. Power on all external storage enclosures.
3. Power on the MSA1000 with the power switch located in the far-right lower area of the front panel. After powering on, wait until the message “MSA1000 Startup Complete” displays on your screen. This process might take up to two minutes.
4. Power on the servers.

## Configuration Volumes on the MSA1000 Controller



After the hardware is installed, configure the MSA1000 using Array Configuration Utility (ACU) to:

- Create arrays and logical drives with the required redundancy.
- Implement Selective Storage Presentation (SSP) to consolidate storage on one MSA1000 between two or more servers.
- Configure the drives under the operating system and test SSP

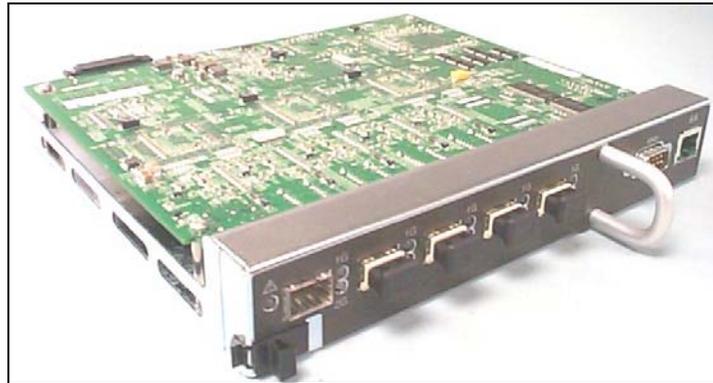
The ACU has a wizard for express configuration or advanced configuration modes. The wizard automatically starts when you have unconfigured storage.

1. Power on the server with Modular SAN Array 1000 Support Software CD in the CD-ROM.
2. After initialization, you will see the ACU.
3. A list of detected controllers displays on the left side of the screen.
4. Select the MSA1000 controller and select *Standard Configuration*.
5. The array controller and available drives display. Select *Create Array*.
6. Select the drives to be included in the array and click *OK*.
7. Select *Create Logical Drive*.
8. Configure the volume with the fault tolerance and parameters desired and select *OK*.

Configuration of the MSA1000 is complete.

9. Click *Save* → *Exit-ACU*. Close the browser window and the server will perform a restart. Remove the Modular SAN Array 1000 Support Software CD from the CD-ROM.

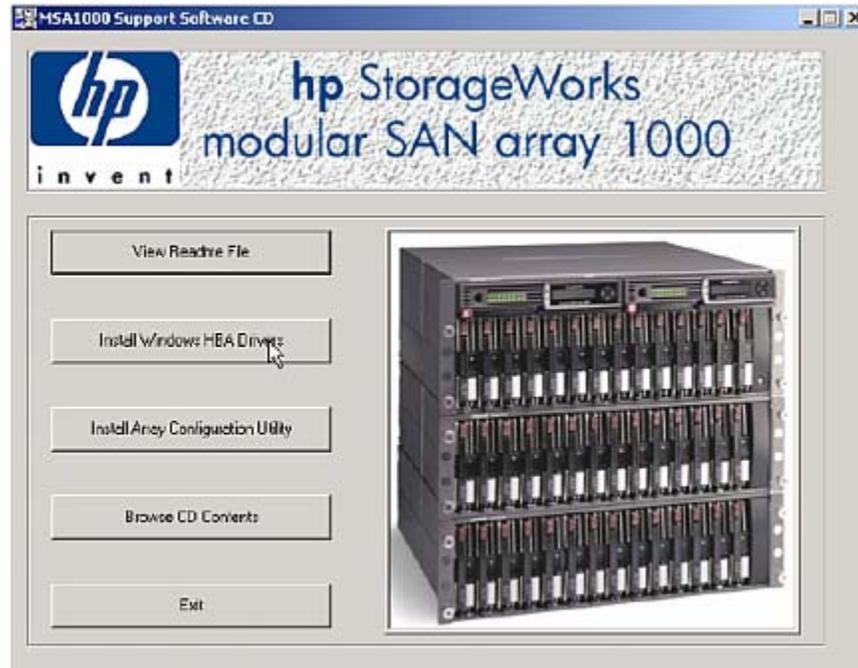
## MSA Fabric Switch 6 or MSA 2/3 Hub Installation



To install the interconnect device (Fabric Switch 6 or 2/3 Hub) into the MSA1000:

1. If there is a blanking panel in place, loosen the thumb-screw that holds the panel in place and remove the panel from the back of unit 2.
2. If an existing Modular SAN Array Fibre Channel I/O Module is being replaced with a switch or hub, remove the I/O Module from the slot.
3. Insert the interconnect device in to the MSA1000.

## Drivers and Software



### Important

There are special considerations in a MSA Fabric Switch 6 environment. In a configuration with these switches, if required, the switch firmware must be upgraded first to allow the controllers to be flashed without issues.

---

The Modular SAN Array 1000 Support Software CD includes documentation, drivers, software, and array configuration management for the operating environment in which the MSA1000 will be installed.

In addition to drivers that are included on the support CD, to keep devices operating at peak capabilities, HP introduced firmware upgrades as a means of disseminating the latest firmware for HP devices. HP utility software is used to upgrade the devices.

---

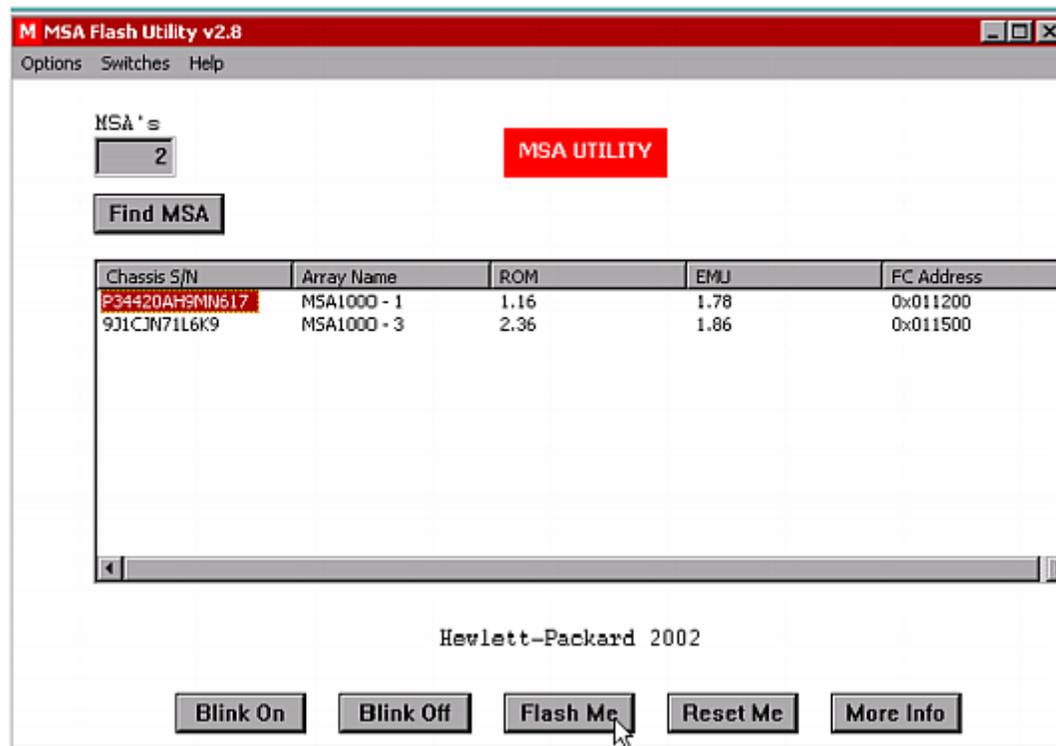
### INTERNET

To find the latest firmware and driver updates and documentation for the MSA1000, refer to the HP website at:

**<http://h18006.www1.hp.com/products/storageworks/softwaredrivers/msa1000/index.html>**

---

## MSA1000 Firmware — Microsoft Environments



To install or upgrade the MSA1000 controller firmware on a Microsoft server, use the MSA Flash Utility to meet the minimum required revisions from the Modular SAN Array 1000 Support Software CD.

If two controllers are installed the MSA1000, the ROM Cloning feature of the MSA1000 controller will upgrade the other controller. The MSA1000 redundant controller configuration must contain two controllers that are executing the same version of firmware.

During power on (or if an optional controller is hot-plugged while the MSA1000 is already operating), the firmware versions on both controllers are compared. If they are not the same, the ROM Cloning feature will attempt to copy the latest version of firmware on the controller with the older version of the firmware.

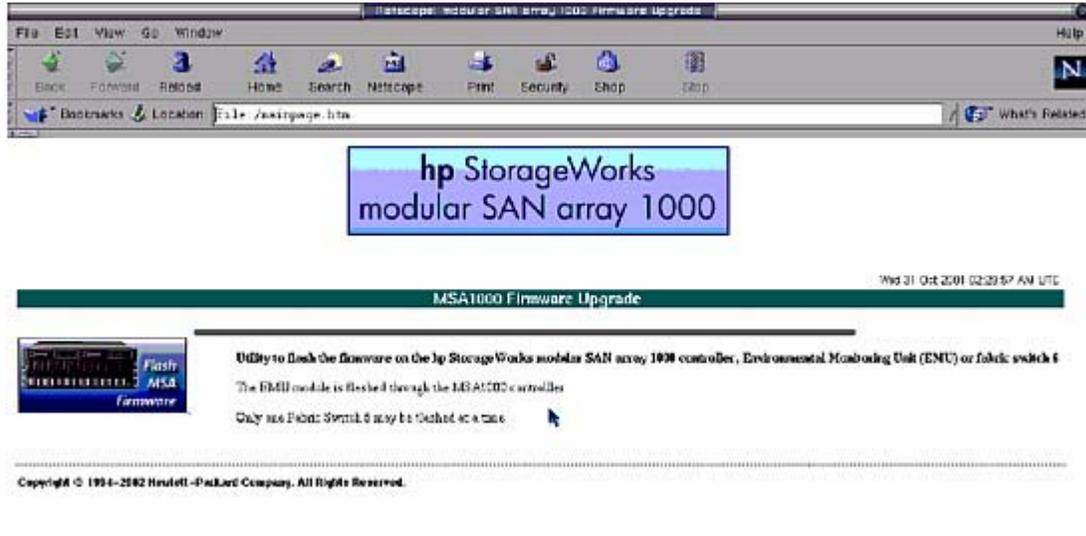
After the copy has been completed, the controller that was modified will be automatically reset. After the reset controller has powered on, the two controllers should then start redundant operation.

All of this functionality is performed automatically by the controllers and does not require any user intervention.

In addition to upgrading the controller, the MSA Flash Utility is used to upgrade the:

- EMU
- MSA Fabric Switch 6

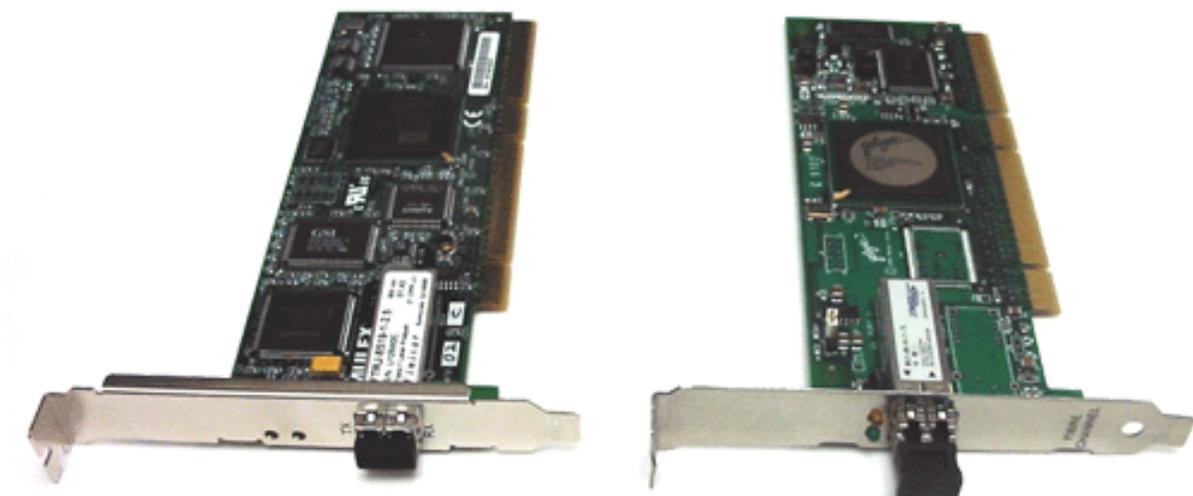
## MSA1000 Firmware — Linux and NetWare Environments



To install or upgrade the MSA1000 controller firmware on a Linux or NetWare server, boot to the MSA1000 Firmware Upgrade CD. When the utility is fully booted, the MSA1000 utility screen displays with the options to flash the MSA1000 controller firmware, the EMU, or the Fabric Switch 6 (if installed).

The MSA1000 ROM Cloning feature performs the same in the Linux and NetWare environments as it does in Microsoft operating systems.

## HBA Driver Installation and Update



### Windows 2000 FCA2101 HBA Driver Installation

1. With the HBAs installed in the server, power on the server and start up Windows 2000.
2. If the New Hardware Wizard window displays for the newly installed HBAs, click the *Cancel* button to exit the Wizard screens.
5. Insert the Modular SAN Array 1000 Support Software CD into the CD-ROM drive and let it automatically start the installation program.
6. To continue, click *Agree* when the license agreement displays.
7. Click *Install Windows HBA Drivers*.  
The files are extracted to a temporary directory. Wait for this operation to complete.
8. Click *Install* to continue.  
The following message displays:  
The installation was completed successfully.  
A restart is required to finish driver installation.
9. If required, install the Array Configuration Utility.
10. If you do not want to restart at this time, click *Close* to exit or to proceed with other installations.  
Remove the CD from the CD-ROM drive before restarting the server.

## Windows NT 4.0 FCA2101 HBA Driver Installation

1. With the HBAs installed in the server, power on the system and start up Windows NT 4.0.
2. After Windows has started, insert the Modular SAN Array 1000 Support Software CD into the CD-ROM drive and let it auto-start the installation program.
3. To continue, click *Agree* when the license agreement displays.
4. Click *Install Windows HBA Drivers*.

The HP Setup for Microsoft Windows NT 4.0 window displays. Under software details, it shows:

```
Emulex LP6000/LP7000/LP8000/LP9000/LP850/LP950, PCI-Fibre  
Channel HBA (with adjunct driver)
```

5. Click *Install* to continue.
6. Click *OK* to close the pop-up window and then click *Exit*.
7. If required, install the Array Configuration Utility.
8. A restart is required to finish the driver installation.
9. If you do not want to restart at this time, click *Close* to exit or to proceed with other installations.
10. Remove the CD from the CD-ROM drive before restarting the server.

## Linux FCA2214 HBA Driver Installation

To install the FCA2214 HBA drivers you must:

- Patch the Linux kernel.
- Install the driver from the provided RPM file.

Because this process involves building a new kernel for the MSA1000, HP recommends performing this task during inactive periods. Depending on the kernel configuration, this process might take longer than one hour. Some third-party drivers might require reinstallation on the new kernel.

### Patch the Linux Kernel

1. Install the HBAs in the server, power on the server, and start your Linux operating system.
2. Log on as the root user.
3. Insert the Modular SAN Array 1000 Support Software CD in the CD-ROM drive of the server and, from the console, mount the CD-ROM drive.
4. Navigate to the /LINUX directory on the CD.
5. Copy the source RPM file and the msinstall script to a temporary directory:  

```
cp qla2x00-6.0.2-2.src.rpm msinstall < directory>
```

where < directory> is the path of a temporary directory, such as /root/msa.
6. Eject the Modular SAN Array 1000 Support Software CD from the CD-ROM drive of the server.
7. Change to the temporary directory used step 5.
8. Run the provided script to prepare the server for the MSA1000 by entering:  

```
./msinstall
```

---

#### Note

The command `msinstall` uses the `.config` file in the `/usr/src/linux<kernel version>/` directory. If that directory has no `.config` file, the command `make oldconfig` creates one.

---

This script patches the kernel source and creates a new kernel image that enables Linux to detect the MSA1000 Controller and its configured LUNs. The boot loader will be configured to boot to this new kernel. This process may take longer than one hour.

9. Reboot your server to the new default kernel.

### Installing the Driver from the Provided RPM File

1. Change to the temporary directory where `qla2x00-6.0.2-2.src.rpm` is located.
2. Install the FCA2214 HBA driver on the new kernel by entering:  

```
rpm --rebuild qla2x00-6.0.2-2.src.rpm
```
3. Load the FCA2214 HBA driver on the new kernel by entering:  

```
insmod qla2300
```
4. If desired, add the `insmod qla2300` command to one of the startup configuration files, such as `/etc/rc.local`, to load the driver at each system startup.

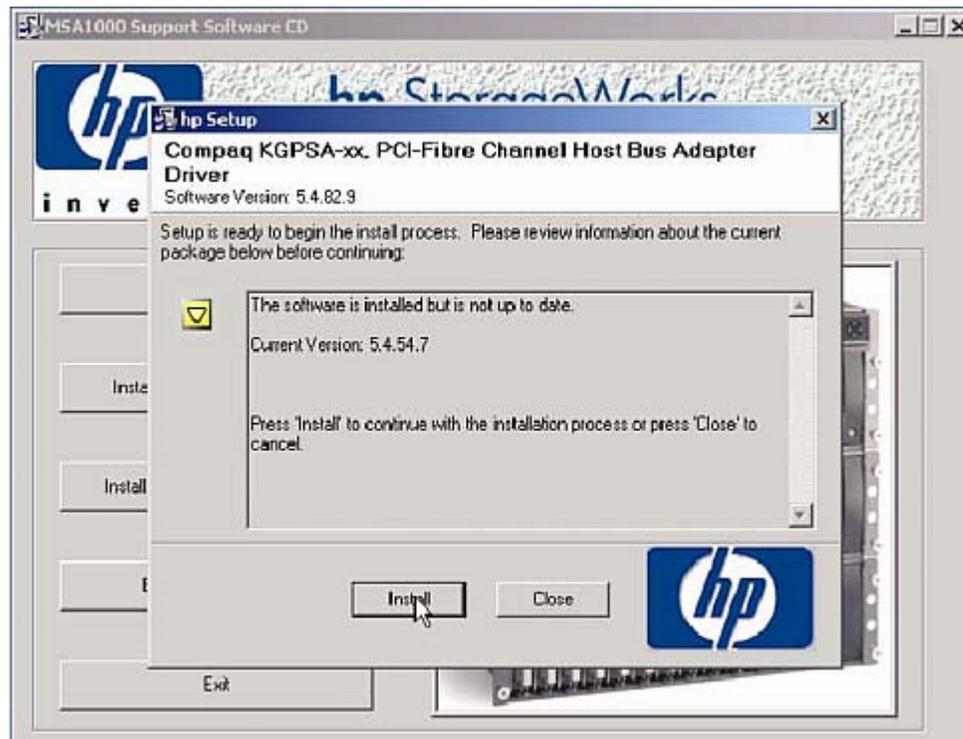
---

#### Note

If you need to build your own FCA2214 HBA driver module from source code or manually patch the Linux kernel, refer to *InstallNotes.txt* in the `/LINUX` directory on the Modular SAN Array 1000 Support Software CD.

---

## Windows 2000/Windows NT Driver Update



For the current version of the MSA1000, an updated driver for Windows systems must be installed. The updated driver is on the Modular SAN Array 1000 Support Software CD. Insert the CD into the CD-ROM drive of the server. When the menu displays, click *Install Windows HBA Drivers* (second option on the menu) to install or upgrade the HBA drivers. After clicking that option, the message “Extracting Drivers” displays. Click *Install* to complete the driver upgrade or installation.

---

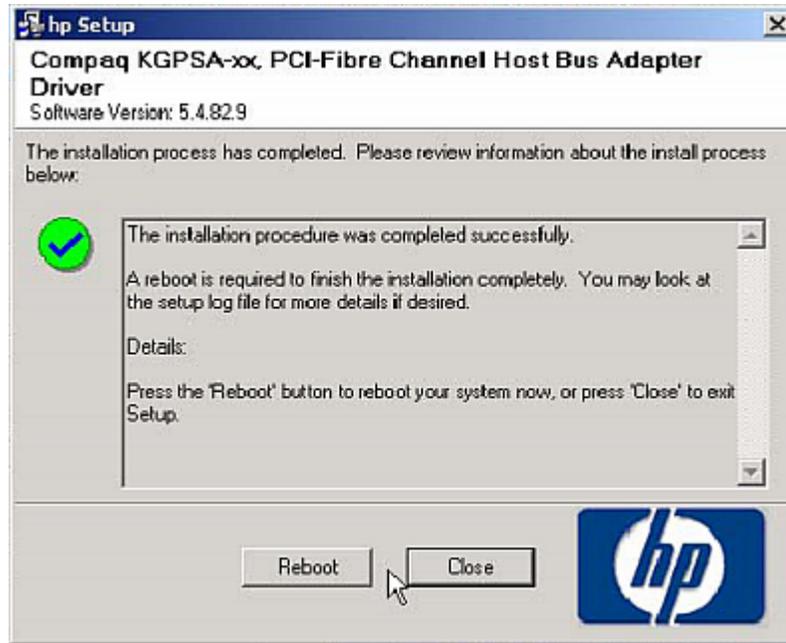
### Note

If the server has previously installed drivers, the message “The software is installed but is not up to date” displays. The installation process remains the same.

Driver versions may have dependencies to firmware versions of the controllers and EMU. Refer to the documentation on the HP storage website

<http://www.hp.com/go/storage> for the latest information.

---



When the installation completes, remove the CD from the CD-ROM drive and allow the system to reboot.



**Important**

In a Microsoft cluster environment, perform the HBA driver upgrade or install on the standby node first. After a successful upgrade of the standby node HBA driver, shut down that server. Then perform the same HBA driver update or install steps on the active node.

---

## Linux HBA Driver Update

For the current version of the MSA1000, an updated driver for Linux systems must be installed. The updated driver is on the Modular SAN Array 1000 Support Software CD. The following steps use script provided by HP to facilitate the Linux driver update.

Using the supplied script:

1. Log on as root and mount the Modular SAN Array 1000 Support Software CD 6.11.
2. Create a temporary directory for the HBA source code.
3. Navigate to the /LINUX directory on the CD.
4. Copy msainstall to the temporary directory.
5. Extract the contents of the FCA2214 HBA driver source to the temporary directory using the following command:

```
# tar -xvzf qla2x00src-v6.0.1.tgz -C <dir>
```

where <dir> is the path and name of the temporary directory created in step 2.

6. Navigate to the temporary directory.
7. Run the provided script to rebuild a new kernel for use with the driver by entering:

```
# ./msainstall -b
```

This script will compile a new kernel image, which enables Linux to detect the MSA1000 controller and its configured LUNs. Without it, only the MSA1000 controller will be recognized. The boot loader will be configured to boot to this new kernel. This process might take some time.

8. After the kernel build is complete, eject the Modular SAN Array 1000 Support Software CD for NetWare/Linux and reboot.
9. When the system is back up, log on as root again.
10. To load the driver, enter:

```
# insmod qla2300
```

---

### Note

This process does **not** put the HBA drivers in the startup scripts or in initrd. If this is desired, it must be done manually.

---

## Learning Check

1. List the basic steps to install the MSA1000 solution.

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

2. List the steps to install the MSA Hub 2/3.

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

3. What is the function of the `msainstall` script used to update the Linux HBA drivers?

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

## Objectives

After completing this module, you should be able to:

- Recognize the components of the Modular SAN Array (MSA) 1000 SAN solution that can be managed.
- Describe the use of the management applications for the MSA1000:
  - Array Configuration Utility (ACU) 6.0
  - Insight Manager 7
  - Command line interface (CLI)
- Describe the use of the management tools for the MSA1000 SAN:
  - Switch Management Utility
  - Brocade Web Tools

## MSA1000 SAN Management



Within the SAN and storage environment, customers are looking for tools to help them manage their storage. Most would like one tool but because of the diverse components that make up the SAN this is not always possible.

In an MSA1000 SAN components that can be managed include the:

- Array controller
- Physical and logical arrays configuration
- Logical unit numbers (LUNs)
- Storage presentation
- Access control list
- Switches

The management tools you can use were developed for the components that make up the SAN. Some of these tools include:

- ACU 6.0
- Insight Manager 7
- CLI
- Switch Management Utility
- Brocade Web Tools

---

**Note**

HP OpenView Storage Area Manager also supports the management of the MSA1000, Fabric Switch 6, and Brocade-based SAN Switches.

---

## MSA1000 Management Tools

### Array Configuration Utility

The ACU installs from the MSA1000 Support Software CD. When the CD is inserted into the CD-ROM drive, the installation program begins immediately.

---

**Note**

Refer to the “Hard Drive Arrays” Appendix of *StorageWorks Modular SAN Array 1000 User Guide*, for complete drive array concepts and information.

---

The ACU uses a graphical interface to help you configure the MSA1000 controller. The interface initially can be used to configure the controller, add additional disk drives to an existing configuration, or reconfigure an array controller.

The ACU is supported for the following operating systems:

- Microsoft Windows NT
- Microsoft Windows 2000
- Linux Red Hat
- Novell NetWare

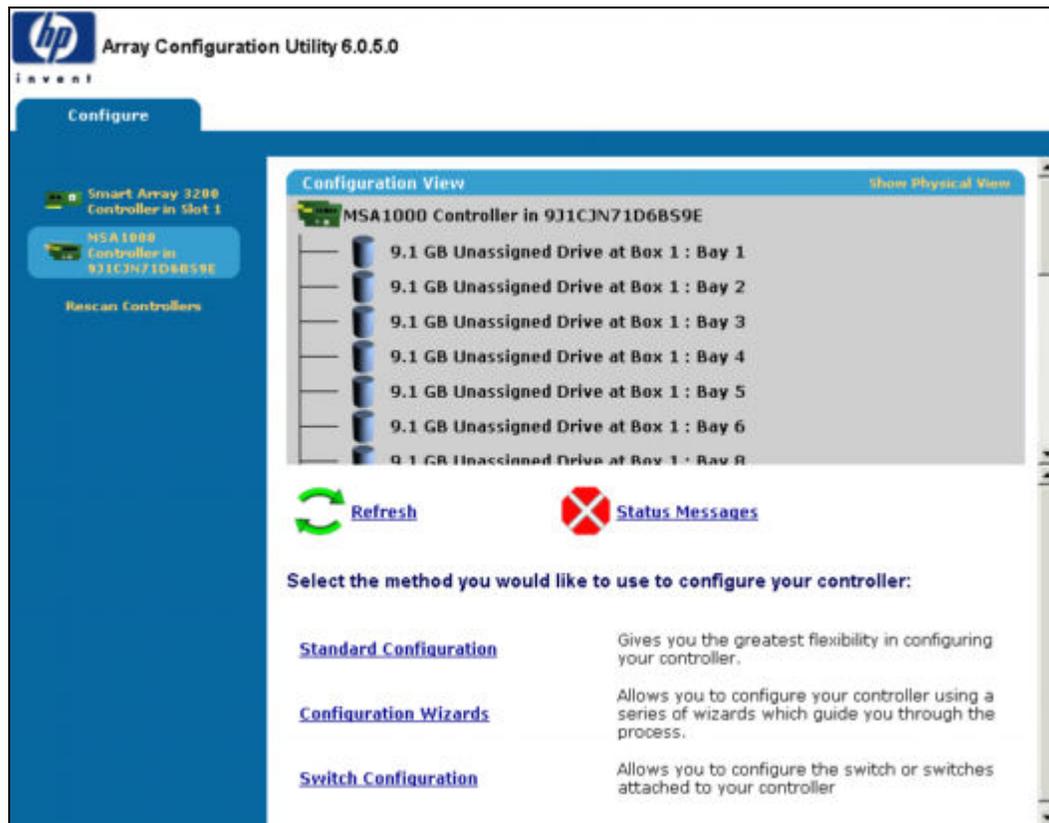
The ACU:

- Uses easy-to-understand graphics to illustrate controller configuration.
- Describes various configuration errors.
- Uses wizards that guide you through the configuration process.
- Can be used any time that the server is on.
- Has different operating modes, allowing faster configuration or greater control over the configuration options.
- Suggests the optimum configuration for an unconfigured system.
- Provides on-screen tips for individual steps of a configuration procedure.
- Allows online array capacity expansion, logical drive capacity extension, assignment of online spares, and RAID or stripe size migration.

The minimum display settings for optimum performance are 800 x 600 resolution and 256 colors. The server must have Microsoft Internet Explorer 5.0 installed and be running Microsoft Windows 2000, Windows NT 4, Novell NetWare, or Linux. Refer to the *README.TXT* file for further information about browser and Linux support.

You can run the ACU directly from *Start* → *Program*, or you can launch it from Insight Manager 7.

## Using ACU



1. Download the ACU component from the HP website or from the MSA1000 Support Software CD supplied with the controller.
2. Install the component on your system. When installation is complete, the ACU icon displays in the system tray.
3. Click *Start* and navigate to *Programs* → *Compaq System Tools* → *Compaq Array Configuration Utility*.
4. Choose whether you would like to enable remote access. If remote access is disabled, the ACU can only be run on the server that has the component installed.

5. Open your browser.
  - If remote access is enabled, enter the following text into the URL field (where *SERVERNAME* is the name or IP address of the host):  
`http://SERVERNAME:2301`
  - If remote access is disabled, enter the following text into the URL field:  
`127.0.0.1`

The Device Home Page for HP Web-Based Management opens.
6. Click the anonymous link near the top of the screen. A login screen opens. Enter your user name and password. When the ACU is first installed, use `administrator` for both the user name and password.

---

**Note**

To change the user name or password, click the appropriate link on this screen. The choice of user name is limited to user, guest, or administrator.

---

7. The Device Home Page displays again.
8. Click the *Array Configuration Utility* button near the bottom of the screen.

The ACU searches for controllers that are connected to your system and identifies them. This process might take a minute or two. When controller detection is complete, the introductory screen displays.

## Insight Manager 7

HP Insight Manager 7 SP2

device status: 0 errors, 1 warning, 0 info  
uncleared events: 0 errors, 4 warning, 0 info

support | logout

Home Devices Tools Settings

last update: Thursday January 16, 2003 - 2:52:46 PM

Device Search: Enter the name of the device: [input] Search

Home Page Options:
 

- Show this page when Insight Manager 7 starts
- Hide link sections
- Hide "Did You Know?" section

 Apply

Results From Query: All Servers

HW	MP	SW	PF	Device Name	Device Type	Device Address	Product Name
				snr16	Server	128.100.100.22	ProLiant 6400R

Devices and Events: Insight Manager 7 manages devices and receives events about those devices. You can display an [overview](#) of devices and events or quickly generate [reports](#) from the management database.

Queries: Queries let you group [devices](#), [events](#), [clusters](#) and [favorite queries](#) in different ways. Doing so allows you to concentrate on the things you want to see. Creating proper queries is the key to forming useful tasks.

Tasks: Tasks act on devices, events and clusters. Example tasks include:
 

- Software/Firmware Update
- Group Configuration
- Email Notification
- Pager Notification

Administration: Fine Tune Insight Manager 7 for your environment. Configure [Discovery](#), [Discovery Filters \(Enabled\)](#), [add users](#), change [Protocol settings](#) and [more](#).  
NOTE: Discovery has not yet been run. Go to the [Discovery page](#) and run it.

Did You Know?
 

- click here for hardware status info.
- click here for management processor status info.
- click here for performance status info.
- click here for software status info.

Insight Manager 7 provides web-based management for:

- Servers
- Clients
- Networking
- Storage switches and storage systems

The screenshot displays the HP Insight Manager 7 SP2 web interface. At the top, there are status indicators for 'device status' and 'uncleared events', both showing 0 errors, 1 warning, and 0 critical issues. The main content area is titled 'Device: srv16' and provides the following information:

The following information is known about this device:  
( Last Update: Thursday January 16, 2003 - 3:18:51 PM )

Device Information		Device Links	
Status:	<input checked="" type="checkbox"/> Major	<input checked="" type="checkbox"/> Major	<a href="#">Array Configuration Utility</a>
Address:	128.100.100.22	<input type="checkbox"/> Unknown	<a href="#">Configuration History Reports (Compaq Survey Utility)</a>
Management Protocols:	HTTP, SNMP, DMI		<a href="#">Insight Management Agents</a>
Device Name:	srv16		<a href="#">Insight Manager 7</a>
SNMP Alias:	SRV16		<a href="#">Legacy Version Control</a>
DNS Name:	srv16		<a href="#">ProLiant Performance Analyzer</a>
Device Type:	Server		<a href="#">Version Control Agent</a>
Product Name:	ProLiant 6400R		<a href="#">Version Control Repository Manager</a>
Description:	Hardware: x86 Family 6 Model 7 Stepping 3 AT/AT COMPATIBLE		<a href="#">System Management Homepage</a>
			<a href="#">SNMP Explorer</a>

A designated server runs the Insight Manager 7 application. You can launch a browser and point at the Insight Manager 7 server that displays information about the network and discovered devices.

Information on managed devices is maintained in a database that allows for a flexible format to display and report on managed devices.

To establish management with Insight Manager 7:

1. From the SmartStart Management CD, install the Insight Manager 7 server.
2. Launch the browser and select the Insight Manager 7 server, `//hostname:280`
3. Perform initial configuration:
  - a. Set up an IP address range.
  - b. Initiate IP range discovery.
4. Start using the application.

## Command Line Interface

The CLI is a general-purpose ASCII line interface separated by carriage returns.

---

**Note**

The CLI uses a zero-based numbering system. For example, LUN assignments begin with 0.

---

### Purpose

The CLI is used to configure and manage the MSA1000. In addition, the CLI is used to display system setup information and status. It can also provide information on devices that are attached to the controller.

### Functions

The CLI is accessed through a host computer connected to the serial port of the MSA1000.

Some CLI configuration and management tasks include configuring storage units (LUNs), setting the addressing mode, limiting access to storage, and viewing information on MSA1000 components (controller, unit, and cache).

After accessing the interface, the user enters a command string at the CLI prompt (CLI>). Commands are presented using specific, preset syntax. After a declarative command is entered and executed, the results display at the CLI prompt.

#### Dual-Controller Functions

When the MSA1000 has two controllers, the same firmware image is run on both controllers. The two controllers communicate with each other through a PCI bus called the inter-controller link (ICL). Each controller has a serial port. Therefore, each controller has a CLI available to the users who connect the serial port to a serial terminal.

Some CLI commands are entered from the CLI prompt one controller, but are for the other controller to execute. Command syntax instructs the controller to accept user input, pass the command to the other controller, and then display the execution result.

Some CLI commands need both of the controllers to act. For example, the command that sets the addressing mode of the controller is entered at the CLI prompt of one controller, but the other controller must set the addressing mode as well. Any CLI command that involves the other controller is called an inter-controller command.

## CLI Command Syntax

CLI commands are entered at the CLI prompt. Commands are **not** case sensitive. CLI command strings include the basic command plus specific command options, some of which are mandatory and some of which are optional

### Example

```
ADD UNIT 0 DATA="DISK101-DISK103" RAID_LEVEL=0
```

This example command has three portions—the basic command and two command options.

### Basic Command

```
add unit 0
```

The basic command includes a word or phrase used to instruct the controller. Commands usually contain a verb with a noun. Every CLI command begins with a basic command.

### Command Options

```
data="disk101-disk103"  
raid_level=0
```

An option is defined as words or phrases listed after the basic command that supply necessary information to support the command. Some CLI commands require these parameters. If parameters are required but are not entered, the CLI command string is considered invalid. The syntax of the parameter value is uniquely defined for each CLI command and must be less than 20 alphanumeric characters.

Some CLI commands support options that modify the command but are not required. If a modifying option is available but not used, a default value is used.

## Adding a Drive

The three basic steps for adding a drive **must** be performed in sequence:

1. Set up the serial port.

Information on setting up the serial port is covered in detail in the next section of this module.

2. Add the unit.

The `add unit` command is covered in the “Creating LUNs” section of this module.

Setting the RAID level is performed as part of the `add unit` command. The various command options for setting the RAID level are covered in the “Creating LUNs” and “Modifying Arrays and LUNs” sections of this module.

3. Set up the Selective Storage Presentation—Access Control List (ACL).

To set up the ACL, the following commands are used **in sequence**:

- a. View existing connection names and the World Wide Port Name (WWPN).
- b. Name a connection to a server.
- c. Enter ACL information.

More information on each of these commands is provided in the “Selective Storage Presentation — Access Control List Commands” section of module.

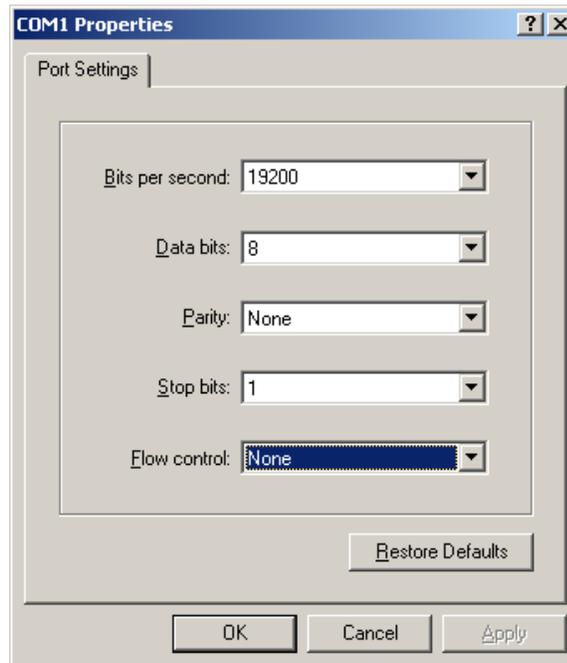
## MSA1000 CLI Setup

Before using the serial interface to connect to the MSA1000, a serial connection to the controller is established.

### Setting Up the Serial Connection

To access the CLI on the MSA1000, ensure that an MSA1000 Controller is installed in Slot 1 of the MSA1000. (Slot 1 is located on the front-right of the MSA1000.)

1. Obtain a serial cable with the appropriate adapters to connect the MSA1000 to a host computer:
  - a. MSA1000 adapter: RJ-45Z
  - b. Host computer adapter: serial port to connect PC to MSA1000
2. Open HyperTerminal or an equivalent program.



3. Enter the settings as listed in the preceding graphic in the COM1 Properties dialog box, and click *OK*. The CLI input screen displays.
4. Press the *Enter* key several times in the CLI session screen, until the command prompt (CLI>) displays.

Commands are now entered at the CLI prompt. The CLI setup process is complete.

## CLI Commands

### Using Help Commands

Help commands are used to display:

- A list of all basic commands.
- A list of all available commands.
- Help for a specific command.

The information displayed can include:

- Required command syntax
- A brief definition
- The number of characters for a command option value (or a list of allowed and disallowed characters)

The basic command is `HELP`, which can be modified with command options to more narrowly define the request.

### Displaying a List of All Basic Commands

If the `HELP` command is entered without a limiting command verb, the CLI displays the available basic command verbs.

#### Example

```
CLI> HELP
CLI> ?
```

---

#### Note

“HELP” and “?” are interchangeable.

---

#### Example Output

```
CLI> HELP

Possible command verbs:
?          help      add      copy
change     delete   get      rename
set locate  show     start
stop clear

Specify command verb:
```

## Displaying a List of All Available Commands

To see a list of all commands, use the following command:

```
CLI> HELP DISPLAY_ALL
```

The `DISPLAY_ALL` command produces a list of all currently supported commands, as shown in the following example output.

### Example Output

```
CLI> HELP DISPLAY_ALL
```

```
Displaying List of all currently supported CLI commands:
```

```
? help
add unit add connection
add acl add profile
add spare copy profile
change node delete acl
delete unit delete connection
delete profile delete spare
migrate unit expand unit
extend unit rename connection
set unit set unit_id
set prompt set this_controller
set other_controller set globals
set acl set connection
locate disk locate unit
locate bus locate box
locate all locate cancel
show connections show unit
show unit_id show this_controller
show other_controller show version
show disks show globals
show acl show profile
start perf stop perf
clear perf show perf
```

```
CLI>
```

## Displaying Help for a Specific Command

When the basic `HELP` command is followed by a specific command verb or a command verb and noun, the CLI displays helpful information about that command.

### Example

```
CLI> HELP ADD ACL
```

```
'add acl connection=name/wwpn=xxxxxxxx-xxxxxxxx unit=#'  
adds access rights for one connection to one or all  
units.
```

```
CLI>
```

### Example

```
CLI> HELP ADD
```

```
Possible command nouns:  
    unit      connection      acl  
    profile   spare
```

```
Specify command noun:
```

## Using LUN Management Commands

### Locating Hard Drives

A variety of commands are available for physically locating specific hard drives. You can locate all drives:

- Attached to the MSA1000.
- In a specific storage enclosure.
- On a specific SCSI bus.
- In a specific LUN or an individual hard drive.

When these commands are executed, the LEDs of the requested drives blink. These LEDs are visible from the front of the MSA1000 and its attached storage enclosures.

---

**Note**

If a time limit is not included with the `LOCATE` command, the LEDs blink for 30 seconds.

---

The basic command verb is `LOCATE`, but a variety of command nouns and options are available to customize the request.

The basic command is: `LOCATE`

The command options are:

`TIME=xxx` (optional) — The length of time to flash the LEDs, where `xxx` represents the number of seconds.

`ALL` — All drives connected to the MSA1000 storage subsystem are flashed.

`BOX` — The number of the storage enclosure that has the disks you want to flash.

1 = MSA1000 drive shelf

2 = Storage enclosure attached to SCSI port A

3 = Storage enclosure attached to SCSI port B

`BUS` — The number of the bus that has the disks you want to flash.

`UNIT` — The number of the LUN that has the disks you want to flash.

`DISKxxx-DISKyyy` — A range of drives to flash. Disks are identified by box number and bay number.

`DISKzzz` — A specific drive to flash. Disks are identified by box number and bay number.

There are multiple options available to locate drives:

- **Locating all drives attached to the MSA1000** — The command to flash the LEDs of all drives attached to the MSA1000 is:

```
CLI> LOCATE ALL
```

- **Locating all drives in a specific storage enclosure** — The command to flash the LEDs of all drives in the MSA1000 drive shelf or additional storage enclosures is:

```
CLI> LOCATE BOX 3
```

Where `BOX 3` indicates the drives in the storage enclosure attached to SCSI port B are flashed.

- **Locating all drives for a specific SCSI bus** — The command to flash the LEDs of all drives connected to a specific SCSI bus is:

```
CLI> LOCATE BUS 1
```

(Where `BUS 1` indicates all drives connected to bus number 1 are flashed.)

- **Locating all drives in a specific LUN** — The command to flash the LEDs and locate all drives associated with a specific LUN is:

```
CLI> LOCATE UNIT 1
```

Where:

`1` — Is the ID of the LUN to locate.

`ALL` — Flashes all drives incorporated in LUNs.

- **Locating specific drives** — The command to flash the LEDs to locate an individual drive or group of drives is:

```
CLI> LOCATE DISK DISK102-DISK106
```

Where `DISK DISK102-DISK106` directs the LEDs on drives 2 through 6 in box 1 to flash.

## Creating LUNs

A LUN is a logical storage unit, or logical volume, consisting of one or more hard drives. Several CLI commands are available to create LUNs.

When a LUN is initially created, the number assigned to the LUN is automatically set as the LUN Unit ID. This LUN ID name can be changed. See “Assigning a Name to a LUN” later in this module for more details.

The command to create a LUN is `ADD UNIT`.

The command options are:

- **DATA="DISKzzz"** — Indicates one drive to incorporate into the LUN. Disks are identified by box number and bay number. For example, `DISK110` identifies disk 10 in box number 1.
- **DATA="DISKxxx-DISKyyy"** — Indicates a range of drives to incorporate into the LUN. Box and bay number identifies the disks.

### Example

`DISK101-DISK105` identifies disks 1 through 5 in box number 1.

---

### Note

Quotation marks are required before and after the data disk drives to be included in the LUN.

---

- **RAID\_LEVEL=xxx** — Specifies the RAID fault-tolerance level to use, where `xxx` represents:
  - 0 = RAID 0 (no fault tolerance)
  - 1 = RAID 1 (mirroring)
  - 5 = RAID 5 (distributed parity)
  - ADG = Advanced Data Guarding
- **STRIPE\_SIZE=xxx (optional)** — Indicates the stripe size to assign, where `xxx` represents:
  - RAID 0 uses stripe sizes 8, 16, 32, 64, 128, and 256
  - RAID 1 uses stripe sizes 8, 16, 32, 64, 128, and 256
  - RAID 5 uses stripe sizes 8, 16, 32, and 64
  - RAID ADG uses stripe sizes 8, 16, 32, and 64
- **SIZE=xxxxyy (optional)** — Specifies how much of the available space on the indicated drives to be used for the LUN. Where `xxxx` represents the size and `yy` indicates the unit (GB, MB, or KB) that follows the number to specify whether the size is in gigabytes, megabytes, or kilobytes.

If no size is specified, the maximum available space of the included disks is assigned to the unit. See “Creating Multiple LUNs on a Group of Drives” for an example of using the `SIZE` command option.

- **SPARE=DISKxxx (optional)** — Assigns a spare disk to the unit, where *xxx* represents the disk number.
- **MAXBOOT=ENABLE/DISABLE (optional)** — Sets the size of the boot partition.  
     Enable = 8GB boot partition (default)  
     Disable = 4GB boot partition
- **CACHE=ENABLE/DISABLE (optional)** — Determines whether to use the array controller cache for the LUN.  
     Enable = Use the array controller cache (default).  
     Disable = Do not use the array controller cache.

### Creating a Single LUN from a Group of Drives

To create one LUN from an individual drive or group of drives use the command  
 ADD UNIT x DATA=xxxx RAID\_LEVEL=xxxx STRIPE\_SIZE=nn.

#### Example

```
CLI> ADD UNIT 0 DATA="DISK101-DISK107 DISK110"  
RAID_LEVEL=ADG STRIPE_SIZE=64
```

---

#### Note

These unit ID numbers are used in other CLI commands. Keep a record of the units created. Record the unit numbers, drives included, RAID type and size, and the order in which they are created.

---

The command options are:

- **0** — LUN 0 is to be created.
- **DATA="DISK101-DISK107 DISK110"** — Use drives 1 through 7 and disk 10 in box number 1 to create the LUN.
- **RAID\_LEVEL=ADG** — Use RAID level ADG when creating LUN 0.
- **STRIPE\_SIZE=64** — Use a stripe size of 64 when creating LUN 0.

#### Example CLI Response

```
First volume to be configured on these drives.  
Logical Unit size = 69460 MB  
RAID overhead = 0 MB  
Total space occupied by new unit = 69460 MB  
Unit 0 is created successfully.
```

## Creating Multiple LUNs on a Group of Drives

Use the `ADD UNIT` command with the `SIZE=` command option to create multiple LUNs from a drive or group of drives. Repeat the command using a unique LUN ID and the desired size parameter for each LUN.

### Example

```
CLI> ADD UNIT 1 DATA="DISK111-DISK114" RAID_LEVEL=5
STRIPE_SIZE=32 SIZE=1000MB
```

---

### Note

Keep a record of the units created. Record the unit numbers, drives included, RAID type and size, and the order in which they are created.

---

The command options are:

- `1` — Create LUN 1.
- `DATA="DISK111-DISK114"` — Use drives 11 – 14 in box number 1 to create LUN 1.
- `RAID_LEVEL=5` — Use RAID 5 when creating LUN 1.
- `STRIPE_SIZE=32` — Use a stripe size of 32 when creating LUN 1.
- `SIZE=1000MB` — Use 1000MB of the available space for LUN 1.

### Example CLI Response

This example is a continuation of the previous example—creating three LUNs on the same group of physical drives:

```
CLI> ADD UNIT 1 DATA="DISK111-DISK114" RAID_LEVEL=5
STRIPE_SIZE=32 SIZE=1000MB
```

First volume to be configured on these drives.

The logical unit size has been adjusted by 4MB for optimal performance.

Logical Unit size = 996 MB

RAID overhead = 498 MB

Total space occupied by new unit = 1494 MB

Unit 1 is created successfully.

```
CLI> ADD UNIT 2 DATA="DISK111-DISK114" RAID_LEVEL=5
STRIPE_SIZE=32 SIZE=2000MB
```

Logical Unit size = 2000 MB

RAID overhead = 1000 MB

Total space occupied by new unit = 3000 MB

Unit 2 is created successfully.

```
CLI> ADD UNIT 3 DATA="DISK111-DISK114" RAID_LEVEL=5
STRIPE_SIZE=16 SIZE=4000MB
```

Logical Unit size = 4000 MB

RAID overhead = 2000 MB

Total space occupied by new unit = 6000 MB

Unit 3 is created successfully.

## Creating a LUN with a Spare

Use the `ADD UNIT` command with the `SPARE=` command option to configure a LUN with an online spare.

### Example

```
CLI> ADD UNIT 3 DATA="DISK211-DISK212" RAID_LEVEL=1
      STRIPE_SIZE=128 SPARE=DISK213
```

---

### Note

Keep a record of the units created. Record the unit numbers, drives included, RAID type and size, and the order in which they are created.

---

The command options are:

- `3` — Create LUN 3.
- `DATA="DISK211-DISK212"` — Use drives 11 – 12 in box number 2 to create LUN 3.

---

### Note

Quotation marks must be entered both before and after the disk drive that is to be designated as a spare for the LUN.

---

- `RAID_LEVEL=1` — Use RAID 1 when creating LUN 3.
- `STRIPE_SIZE=128` — Use a stripe size of 128 when creating LUN 3.
- `SPARE=DISK213` — Use the drive in bay 13 of box 2 as a spare drive to LUN 3.

### Example CLI Response

```
First volume to be configured on these drives.
Logical Unit size           =      69460 MB
RAID overhead               =      69460 MB
Total space occupied by new unit =    138920 MB
Unit 3 is created successfully.
```

## Assigning a Name to a LUN

Each LUN can be assigned a unique name in addition to its number, using the command `SET UNIT_ID`.

### Example

```
CLI> SET UNIT_ID 0 ABC
```

The command options are

- `0` — Assign a name to LUN 0.
- `ABC` — The name assigned to LUN 0. The name of this LUN is now "ABC".

### Example CLI Response

```
Identifier "ABC" created for unit 0
```

## Adding a Spare to a LUN

To add a spare to an existing LUN, use the command `ADD SPARE`.

### Example

```
CLI> ADD SPARE UNIT=2 DISK109
```

The command options are

- `UNIT=2` — The unit to which to assign the spare. This is the same number that was given to the unit when it was created with the `ADD UNIT` command. In this example, LUN 2 is using the spare.
- `DISK109` — Indicates the drives to assign as the spare to the LUN. Box and bay number identify the disks. In this example, drive 9 in box number 1 is used.

### Example CLI Response

```
First volume to be configured on these drives.  
Logical Unit size = 69460 MB  
RAID overhead = 69460 MB  
Total space occupied by new unit = 138920 MB  
Unit 2 is created successfully.
```

## Deleting LUNs

To delete the last created LUN, use the command `DELETE UNIT`.



---

### Important

If more than one LUN is created, only the last LUN created can be deleted. It is important to maintain a record of the unit numbers and the **order** in which they are created.

After a LUN is deleted, its unit number remains unused until it is manually assigned to a new LUN. Unit numbers are not automatically reassigned when a LUN is deleted.

---

### Example

```
CLI> DELETE UNIT 4
```

Where 4 is the unit to delete. This is the same number that was given to the unit when it was created with the `ADD UNIT` command. In this example, LUN 4 is deleted.

### Example CLI Response

```
Data will be lost after the unit is deleted.
Do you still want to DELETE unit 4 (Y/N)? Y
Please wait while unit 4 is being deleted..
Unit 4 is deleted successfully.
```

## Deleting Spares

To remove a spare from use, use the command `DELETE SPARE`.

### Example

```
CLI> DELETE SPARE UNIT=2 DISK109
```

The command options are:

- **UNIT 2** — The unit that you no longer want to access the spare. This is the same number given to the unit when it was created using the `ADD UNIT` command. In this example, LUN 2 no longer has access to the spare.
- **DISK109** — The spare drive to remove from use. Box and bay number identifies the disks. In this example, drive 9 in box number 1 is no longer used as a spare for LUN 2.

## Modifying Arrays and LUNs

Occasionally, after an array or a LUN is created, its characteristics need to be changed. The features that can be changed include:

- Adding drives to an array
- Adding space to a LUN
- Changing the RAID characteristics of a LUN

## Adding Drives to an Array

To add additional physical drives to the array that contains a specific LUN, use the command `EXPAND UNIT`.

### Example

```
CLI> EXPAND UNIT 0 DISK101-DISK102 ADD_SIZE=1000MB
```

The command options are:

- `0` — Identifies one of the LUNs within the target array. Any LUN in the array can be entered to identify the array. The space is added to the array and not the LUN.
- `DISK101-DISK102` — Identifies the physical disks to add to the array. Box and bay number identifies the disks. In this example, `DISK101-DISK102` identifies disks 1 through 2 in box number 1.
- `ADD_SIZE=1000MB` — Specifies how much of the available space on the indicated drives is added to the array. In this example, 1000MB of space is added. The size limit must be specified as GB, MB, or KB. If no size is specified, the maximum available space of the included disks is assigned to the array.
- `NEW_SIZE=xxxxyy` — Used instead of `ADD_SIZE` to enter the total new size of the array. Where `xxxx` represents the size and `yy` indicates the units (GB, MB, or KB) that follow the number to specify whether the size limit is in gigabytes, megabytes, or kilobytes.

### Example CLI Response

```
The actual new array capacity will be 3000MB.  
The array with Unit 0 is being expanded.  
Use "show unit 0" to monitor progress.
```

## Adding Space to a LUN

To add available space in an array to a specific LUN, use the command `EXTEND UNIT`.

### Example

```
CLI> EXTEND UNIT 2 ADD_SIZE=1000MB
```

The command options are:

- **UNIT 2** — Identifies the LUN to which to add the space.
- **ADD\_SIZE=1000MB** — Specifies how much of the available space in the array to add to the LUN. In this example, 1000 MB of space is added. The size limit must be specified as GB, MB, or KB. If no size is specified, the maximum available space of the included disks is assigned to the array.
- **NEW\_SIZE=xxxxyy** — Used instead of `ADD_SIZE` to enter the total new size of the LUN. Where `xxxx` represents the size and `yy` indicates units (GB, MB, or KB) that follow the number to specify whether the size limit is in gigabytes, megabytes, or kilobytes.

### Example CLI Response

```
The actual new volume size will be 1992MB.  
Unit 2 is being extended.  
Use "show unit 2" to monitor progress.
```

## Changing the RAID Characteristics of a LUN

To change the RAID level or the stripe size of a LUN, use the command `MIGRATE UNIT`.

### Example

```
CLI> MIGRATE UNIT 0 RAID_LEVEL=5 STRIPE_SIE=32
```

The command options are:

- **UNIT 0** — Represents the number of the LUN to modify.
- **RAID\_LEVEL=~~xxx~~** — Specifies the RAID fault-tolerance level to use, where *xxx* represents:
  - 0 = RAID 0 (no fault tolerance)
  - 1 = RAID 1 (mirroring)
  - 5 = RAID 5 (distributed parity)
  - ADG = Advanced Data Guarding
- **STRIPE\_SIZE=~~xxx~~ (optional)** — Indicates the stripe size to assign, where *xxx* represents:
  - RAID 0 uses stripe sizes 8, 16, 32, 64, 128, and 256
  - RAID 1 uses stripe sizes 8, 16, 32, 64, 128, and 256
  - RAID 5 uses stripe sizes 8, 16, 32, and 64
  - RAID ADG uses stripe sizes 8, 16, 32, and 64

### Example CLI Response

```
The RAID level of Unit 0 will now be 5.  
Unit 0 is being migrated.  
Use "show unit 0" to monitor progress.
```

## Using Array Controller Configuration Commands

The CLI enables configuration the MSA1000 array controller, including:

- Indicating which controller is active
- Setting global variables
- Changing the CLI prompt

Each of these procedures uses the SET command, which changes the settings of the MSA1000 controller.

### Indicating which Controller is Active

In dual-controller deployments, the MSA1000 supports an active/standby configuration where one of the two controllers processes all commands and the other controller is available during failover. The failover process enables the standby controller to assume control of the storage subsystem when the active controller fails.

The commands to change the status of a controller include:

```
SET THIS_CONTROLLER/OTHER_CONTROLLER ACTIVE
```

```
SET THIS_CONTROLLER/OTHER_CONTROLLER STANDBY
```



#### Important

These commands are mutually exclusive. When a command is entered for one controller, the other controller is automatically set to the opposite setting. These commands are used to initiate failover.

---

#### Example

```
CLI> SET THIS_CONTROLLER ACTIVE
```

The command options are:

- **THIS\_CONTROLLER** — Modify the controller to which the CLI is connected.
- **OTHER\_CONTROLLER** — Modify the controller to which the CLI is **not** connected.
- **ACTIVE** — The specified controller is activated and the companion controller is placed in standby.
- **STANDBY** — The specified controller is placed in standby and the companion controller is activated.

#### Example CLI Response

On the front of the MSA1000, the controller display for each controller shows Redundancy Active and Standby Controller.

---

#### Note

In addition to the CLI display, LED 9 on the front of the MSA1000 controller indicates which controller is active. For more information, refer to the “Interpreting Component Indicators” chapter in the MSA1000 User Guide.

---

## Setting Global Variables

A single command with a variety of parameters is used to set the expand priority, the read/write ratio, and the system name. The command is `SET GLOBALS`.

### Example

```
SET GLOBALS EXPAND_PRIORITY=HIGH REBUILD_PRIORITY=HIGH  
SYSTEM_NAME="XXX" READ_CACHE=50 WRITE_CACHE=50
```

The command options are:

- **EXPAND\_PRIORITY=HIGH** — The expand priority. Options include low, medium, and high.
- **REBUILD\_PRIORITY=HIGH** — The rebuild priority. Options include low, medium, and high.
- **SYSTEM\_NAME="XXX"** — The system name, where *XXX* represents any user defined phrase, up to 16 alphanumeric characters. The symbols “\_” and “-” are allowed.
- **READ\_CACHE=50** — The read cache. This value must be between 0 and 100.
- **WRITE\_CACHE=50** — The write cache. This value must be between 0 and 100.

---

### Note

`Read_cache` plus `write_cache` must equal 100.

---

### Example CLI Response

Global Parameters:

```
System Name:           XX  
Rebuild Priority:      HIGH  
Expand Priority:       HIGH  
  
Total Cache:          28MB  
50% Read Cache:       4MB  
50% Write Cache:      64MB
```

## Display Commands

Several commands are available to view system information and setup, including:

- Physical disk information
- LUN information
- LUN names
- Controller settings

Each of these procedures uses the `SHOW` command to display the MSA1000 configuration.

## Viewing Physical Disk Information

The disk information that is displayed includes:

- Disk number
- Enclosure box and bay number
- Enclosure bus number and ID
- Disk size
- LUN in which the disk is used.

To display a list of physical disks contained in the MSA1000 and attached external storage enclosures, use the command `SHOW DISKS`.

### Example

```
CLI> SHOW DISKS
```

### Example CLI Response

Disk List:	(Box,Bay)	(Bus,ID)	Size	Unit[s]
Disk101	(1,01)	(0,00)	9.1GB	0
Disk102	(1,02)	(0,01)	9.1GB	0
Disk103	(1,03)	(0,02)	9.1GB	0
Disk104	(1,04)	(0,03)	9.1GB	0
Disk105	(1,05)	(0,04)	9.1GB	0
Disk106	(1,06)	(0,05)	9.1GB	0
Disk107	(1,07)	(0,08)	18.2GB	1
Disk108	(1,08)	(1,00)	18.2GB	1
Disk109	(1,09)	(1,01)	18.2GB	1
Disk110	(1,10)	(1,02)	18.2GB	1
Disk111	(1,11)	(1,03)	18.2GB	1
Disk112	(1,12)	(1,04)	36.4GB	2
Disk113	(1,13)	(1,05)	36.4GB	2
Disk114	(1,14)	(1,08)	18.2GB	None
Disk201	(2,01)	(2,00)	9.1GB	None
Disk202	(2,02)	(2,01)	9.1GB	None
Disk203	(2,03)	(2,02)	9.1GB	None
Disk204	(2,04)	(2,03)	9.1GB	None
Disk205	(2,05)	(2,04)	9.1GB	None

## Viewing LUN Information

The information displayed for the LUN includes:

- Unit identifier (user-defined name)
- LUN status (OK, Failed, and Rebuilding)
- Disk list of the disks included in the LUN
- Redundancy level
- Unit size, in MB

### Examples

To display all defined LUNs:

```
CLI> SHOW UNITS
```

To display a specific LUN:

```
CLI> SHOW UNIT 1
```

### Example CLI Response

```
Unit 1:  
In PDLA mode, Unit 1 IS LUN 2; In VSA mode, Unit 1 is  
LUN 1  
Unit Identifier:  
Device Identifier:600805F3-00006B20-AE277D4B-B0D100F7  
Cache Status      :Enabled  
Max Boot Partition: Disabled  
Volume Status: VOLUME OK  
Parity Init Status: 3% complete  
5 Data Disk(s) used by lun 1:  
  Disk107: Box 1, Bay 07, (SCSI bus 0, SCSI id 8)  
  Disk108: Box 1, Bay 08, (SCSI bus 1, SCSI id 9)  
  Disk207: Box 2, Bay 07, (SCSI bus 2, SCSI id 8)  
  Disk208: Box 2, Bay 08, (SCSI bus 2, SCSI id 9)  
  Disk307: BOX 3, Bay 07, (SCSI bus 3, SCSI id 8)  
  Disk308: Box 3, Bay 08, (SCSI bus 3, SCSI id 9)  
Spare Disk(s) used by lun 1:  
  No spare drive is designated.  
Logical Volume Raid Level: DISTRIBUTED PARITY FAULT  
TOLERANCE (RAID 5)  
                        stripe_size=16KB  
Logical Volume Capacity: 173,658MB
```

## Viewing LUN Names

To view the user-defined names that are assigned to the LUNs, use the command `SHOW UNIT_ID`.

### Example

```
CLI> SHOW UNIT_ID 0
```

The command option `0` is the number of the LUN to display.

### Example CLI Response

```
Unit 0: ABC
```

---

### Note

ABC is the assigned user-defined name.

---

## Viewing Controller Settings

The information displayed for the controllers includes:

- Controller identifier
- Controller hardware and software versions
- SCSI compliance information
- Controller SCSI ID
- Redundancy information
- Host port information
- Controller cache configuration and battery information

To commands to view controller configuration include:

```
SHOW THIS_CONTROLLER
```

```
SHOW OTHER_CONTROLLER
```

### Example

```
CLI> SHOW THIS_CONTROLLER
```

### Example CLI Response

```
Controller:
```

```
MSA1000© Compaq xxxxxx Software 2.12 Build 10
```

```
Hardware 7
```

```
Controller Identifier:
```

```
NODE_ID=YYYYYYYYY-YYYYYYYYY
```

```
SCSI_VERSION=SCSI-3
```

```
Supported Redundancy Mode: Active/Standby
```

```
Current Redundancy Mode: Active/Standby
```

```
Current Role: Active
```

```
Device Port SCSI address 6
```

```
Host Port_1:
```

```
REPORTED PORT_ID YYYYYYYYYY-YYYYYYYYY
```

```
PORT_1_TOPOLOGY=F_Port
```

```
Cache:
```

```
128 megabytes read cache 128 megabytes write cache
```

```
Version 2
```

```
Cache is GOOD, and Cache is enabled
```

```
No unflushed data in cache
```

```
Battery:
```

```
Battery is fully charged.
```

```
Battery is turned off.
```

## Selective Storage Presentation — Access Control List Commands

When multiple servers access the storage of the MSA1000, it is necessary to restrict access of LUNS to specific servers. Some programs, including the ACU, use the term “selective storage presentation” (SSP) when discussing limiting storage access. The CLI uses an Access Control List (ACL) to maintain the list of LUNs a server can access.

Commands used to set up or manage the ACL include:

- Viewing existing connections and the WWPN
- Naming a connection to a server
- Managing connection profiles
- Viewing the ACL
- Adding to the ACL
- Deleting information from the ACL
- Renaming a connection
- Changing the HBA of a connection
- Deleting a connection name
- Disabling the ACL

---

**Note**

Three ACL setup commands are covered in this module. For information on ACL commands not described in this module, consult the *MSA1000 User Guide*.

---

### ACL Setup Procedure

To set up the ACL, the following command activities are used **in sequence**:

1. View the existing connection names and the WWPN.
2. Name a connection to a server.
3. Enter the ACL information.

## Viewing Existing Connections and the HBA World Wide Name

If no connections are assigned user-defined names, the basic command `SHOW CONNECTIONS` displays the World Wide Names (WWNs) of each HBA attached to the MSA1000. If connections between the HBAs and the MSA1000 are given user-defined names, these names also display.

### Example

```
CLI> SHOW CONNECTIONS
```

The command options are:

- **Connection Name** — the name of a specific connection to display.
- **WWPN** — The WWPN of a specific connection to display.

### Example CLI Response

```
Connection Name: abc
  Host WWNN = 11111111-11111111
  Host WWPNN = 12345678-12345678
  Profile Name = Default
  Unit Offset = 0
  Controller 1 Port 1 Status = Online
  Controller 2 Port 1 Status = Online

Connection Name: <unknown>
  Host WWNN = 22222222-22222222
  Host WWPNN = 33333333-33333333
  Profile Name = Default
  Unit Offset = 0
  Controller 1 Port 1 Status = Online
  Controller 2 Port 1 Status = Online
```

---

## Naming a Connection to a Server

Assigning a name to a connection is optional however, is often used to make identification and setup of the ACL for this connection easier. To enter an alias for the connection between the MSA1000 and a server, use the command `ADD CONNECTION`.

### Example

```
CLI> ADD CONNECTION ABC WWPN=12345678-12345678
```

The command options are:

- **ABC** — The name to give the connection.
- **WWPN=12345678-12345678** — The WWPN of the active HBA inside the server attached to the MSA1000. The `show connections` command is used to obtain the WWPN.
- **WWNN** — The WWNN of the active HBA inside the server attached to the MSA1000. The `show connections` command is used to obtain the WWNN.
- **PROFILE=x** — Defines the platform of the host, where *x* represents:
  - Windows
  - OVMS
  - Tru64
  - Linux
  - Solaris
  - NetWare
  - HP

---

### Note

If a profile is not specified, a default profile is used.

---

### Example CLI Response

```
Connection has been added successfully.  
Profile Default_Profile is set for the new connection.
```

## Adding to the ACL

To indicate the allowable LUNs for each server, use the command `ADD ACL`.

The command options are:

- **CONNECTION=xxx** — The name of the connection to grant access, where xxx represents the connection name.
- **UNIT=xxx** — LUN to assign to the indicated server.

Options include:

- An individual LUN is assigned by entering one LUN ID (UNIT=0).
- A group of LUNs are assigned by entering a LUN range (UNIT=1-3).
- Access to all units is granted by entering UNIT=ALL.

Two methods of entering LUN assignments are available:

- Adding to the ACL using the connection name
- Adding to the ACL using the WWPN

---

### Note

There is no command to activate the ACL. Immediately after the first entry is added to the ACL, access to the storage is limited to the servers and LUNs listed in the ACL.

---

## Adding to the ACL Using the Connection Name

### Example

```
CLI> ADD ACL CONNECTION=ABC UNIT=ALL
```

The command options are:

- **CONNECTION=ABC** — Entries are added to the ACL of the connection named ABC.
- **UNIT=ALL** — All LUN are accessible to the connection named ABC.

### Example CLI Response

```
Allowing 12345678-12345678 access to unit 2.
```

## Adding to the ACL Using the WWPN

### Example

```
CLI> ADD ACL WWPN=12345678-12345678 UNIT=2
```

The command options are:

- **WWPN=12345678-12345678** — Entries are added to the ACL of the connection with a WWPN of 12345678-12345678.
- **UNIT=2** — LUN 2 is accessible to the named connection.

### Example CLI Response

```
Allowing 12345678-12345678 access to unit 2.
```

## Switch Management Utility

To manage a switch using a browser:

1. Ensure that your browser is configured according to the switch user's guide.
2. Point the browser at the switch and log in.
3. Enter "public" for the read community and "private" for the write community.

---

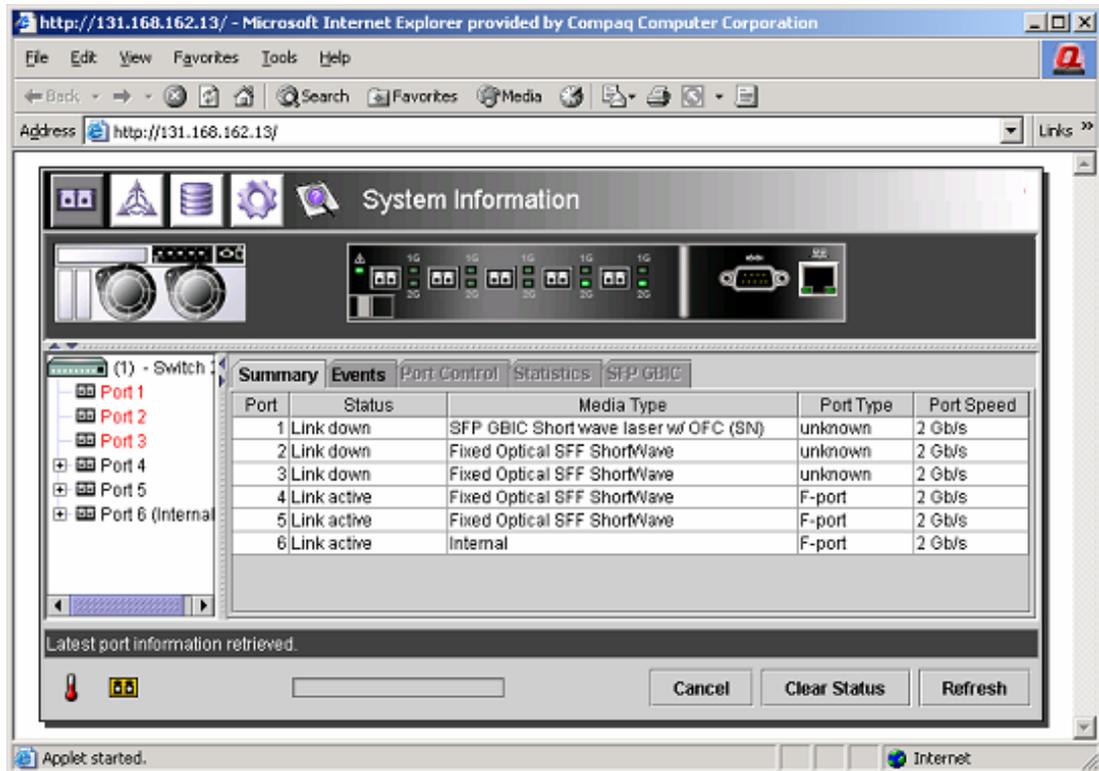
### Note

The user name and password are case sensitive:

- User Name: user
  - Password: ADMIN
- 



After a successful login the GUI displays and enables you to perform various management functions. The GUI also enables you to update the firmware and monitor the switch for error conditions.





## Web Tools Views



Web Tools provides access to and information about the fabric through a number of separate windows, making it possible to view several aspects of the fabric simultaneously.

The initial display after launching Web Tools is the Fabric View that displays a control panel. This panel provides access to fabric-wide options, a panel for each switch in the fabric, plus a legend that explains the meaning of the background colors on the Switch icons.

Each panel contains an icon that represents the switch itself, in addition to icons for Switch Events and the Administrative and Telnet interfaces. The background color of the switch icon represents the status of that particular switch or Integrated Fabric (as defined by the legend provided in the window).

---

### Note

Switch status is calculated approximately once per second; however, the initial calculation does not occur until 30 to 60 seconds after the switch is booted. It is calculated from the state of data structures in the switch, and stored as the variable "Switch Status."

---

## Web Tools Capabilities

Web Tools provides the following information and capabilities:

- Monitoring and managing the entire fabric:
  - The status of all switches in the fabric
  - Event log for entire fabric access
  - Zoning functions (optionally licensed)
  - Name Server Table access
  - Telnet functions
  - Switch beaconing for rapid identification in large fabric environments
  - Loop diagnostics, query and control of the loop, interface to aid in locating faulty devices
  - Ability to name and zone QuickLoops
- Monitoring and managing individual switches:
  - Summary information about each switch
  - Event logs for individual switch access
  - Switch configuration and administration
  - Ability to upgrade the fabric operating system and license key administration
  - Report capability for switch configuration information
- Monitoring and managing individual ports:
  - Port status
  - Information about gigabit interface converter (GBIC) serial IDs
  - Information about connected devices
  - Loop information
  - Port performance including frame counts (frames in, frames out) and error counts

## Learning Check

1. Which management application performs the initial configuration of the MSA1000?  
.....  
.....  
.....
2. What are the two components of a CLI command?  
.....  
.....  
.....
3. Which management application provides the most information on all components of the MSA1000 SAN?
  - a. Tape Management console
  - b. Web Tools
  - c. FC-AL Switch Management Utility
  - d. Insight Manager 7
4. List, and describe the use of five Web Tools used to manage a fabric switch.  
.....  
.....  
.....  
.....  
.....

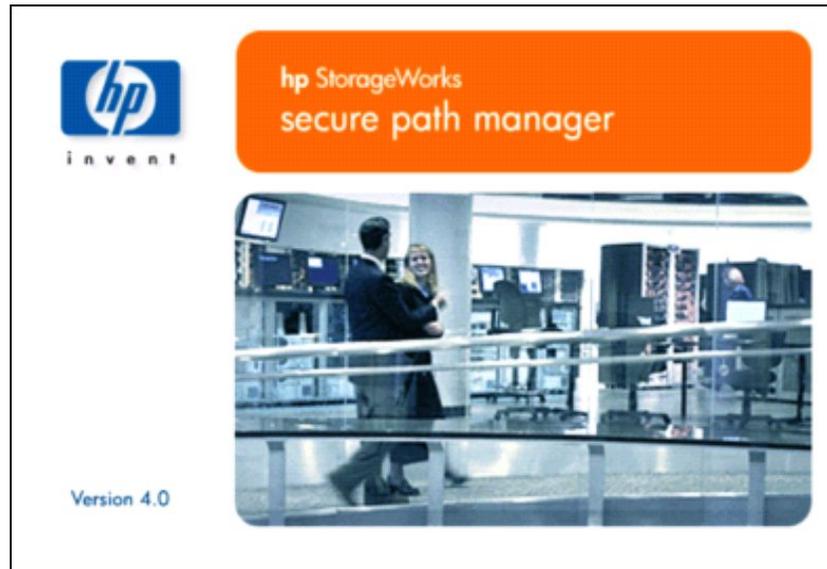


## Objectives

After completing this module, you should be able to:

- List the supported platforms and identify supported configurations when using Secure Path with a Modular SAN Array (MSA) 1000.
- Describe the Secure Path features.
- Install and operationally check Secure Path.

## Secure Path Overview



HP StorageWorks Secure Path is a server-based software product that enhances HP StorageWorks RAID Array storage systems. Secure Path provides automatic path management in the event of server-to-storage system connection component failures. Secure Path supports multiple I/O paths between host and storage, which improves overall data availability.

Supported operating systems for the MSA1000 v2 are: Microsoft Windows 2000, Microsoft Windows NT, and Novell Netware.

The Secure Path versions that support the MSA1000 are:

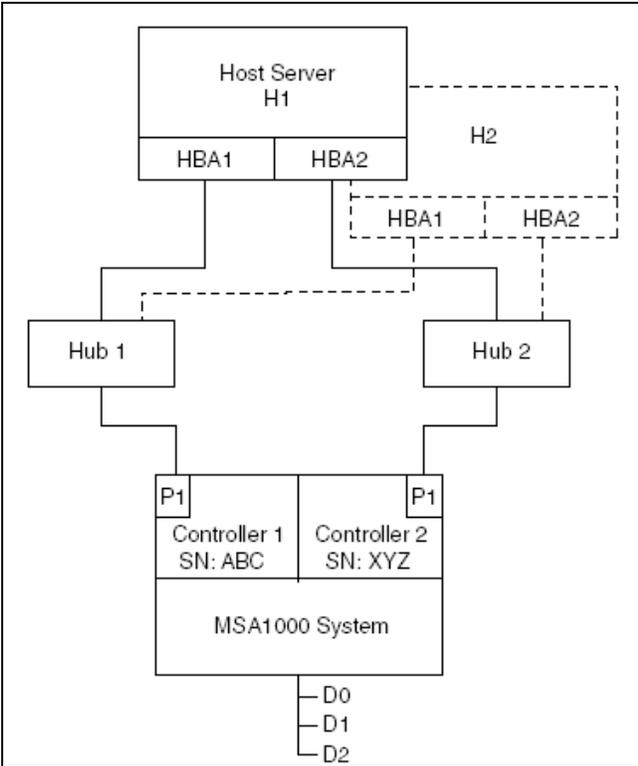
- Secure Path V4.0 for Windows Workgroup Edition
- Secure Path V3.0C for NetWare Workgroup Edition

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

Redundant physical connections define separate physical paths in a Secure Path hardware configuration. Each path originates at a unique HBA port on a server, and ends at a unique RAID controller port in the storage system. If any component in a path between host and storage fails, Secure Path redirects pending and subsequent I/O requests to an alternate path.

Secure Path eliminates the following single points of failure in a storage system:

- RAID controller
- Host bus adapter (HBA)
- Interconnect hardware (cables, switches, and connectivity devices)



## Features

### Secure Path:

- Provides redundant physical connectivity management along independent Fibre Channel paths, between switched dual-controller RAID systems and host servers equipped with multiple HBAs.
- Monitors each path and automatically reroutes I/O to a functioning alternate path if an HBA, cable, switch, or controller failure occurs.
- Determines the status of physical paths through the implementation of path verification diagnostics.
- Monitors and identifies failed paths and failed-over storage units.
- Facilitates online (static) load balancing between multiple storage systems.
- Automatically restores failed-over storage units to repaired paths with auto-failback capability enabled.
- Prevents failover and failback thrashing caused by marginal or intermittent conditions.
- Detects failures reliably without inducing false or unnecessary failovers.
- Implements failover and failback actions transparently without disrupting applications.
- Provides client-server web-based management capability and multiple storage system support.

## No-Single-Point-Of-Failure

Multiple path failover capability and redundant components architecture eliminate single-points-of-failure from server to storage in a clustered or single-server configuration. Depending on the host, Secure Path supports up to 32 paths per logical unit number (LUN).

## Manageability

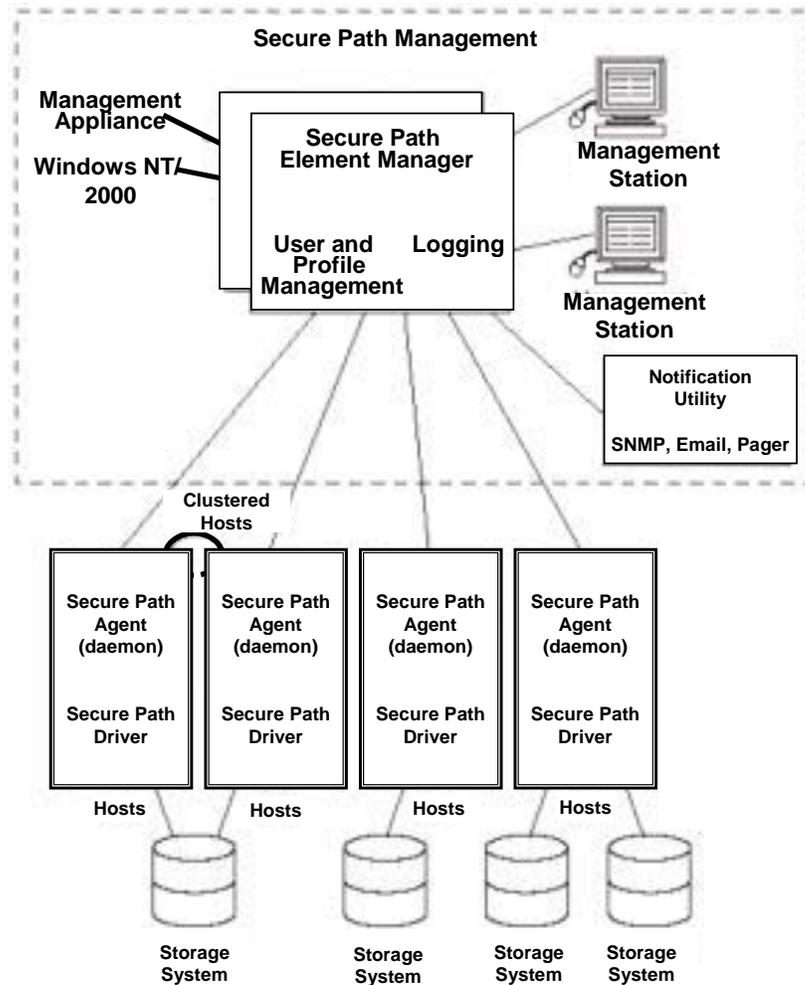
Windows and NetWare hosts are managed with Secure Path Manager Version 4 (SPM), a web-based management application that allows continuous monitoring of the multipath environment and displays path status and alerts on significant events. Secure Path Manager presents a SAN-wide view of path connectivity between managed hosts and LUNs.

Secure Path Manager runs on either the HP OpenView Storage Management Appliance or on a Windows 2000 Server. Users can browse to Secure Path Manager using standard web browsers to perform management tasks. Secure Path Manager allows the user to enable automatic load balancing to ensure maximum I/O efficiency, when managing the Enterprise Virtual Array, RA8000/ESA12000, MA8000/EMA12000/EMA16000, MA6000, and MSA1000 storage solutions.

## Multi-Host Management

Secure Path Manager Version 4 also supports the concept of management groups (or profiles) to manage groups of hosts with similar characteristics. One profile can have up to 128 hosts and up to 128 storage systems. Multiple profiles can be created to manage additional hosts or storage systems. A profile can contain a mixture of clustered and non-clustered hosts.

## Software Components



The Secure Path software kit for Windows Workgroup Edition includes:

- **Secure Path Manager (SPM)** — A web-based management utility capable of cross-platform Secure Path configurations. SPM lets you set up multiple path configurations, indicating the status of a user-defined set of hosts, storage systems, and paths.

SPM coexists with other utilities, such as Insight Manager. SPM enables you to efficiently manage your storage systems by:

- Providing continuous availability of RAID storage systems.
- Displaying all current path states.
- Providing remote notification of critical events.

- **Secure Path Element Manager (SPEM)** — A component of SPM that communicates directly with Secure Path agents. You can set up additional SPEMs that reside on other servers for redundancy.
- **Secure Path Agent** — A Windows service that communicates with SPM using the TCP/IP protocol and WinSock API. The agent installs on the host server, along with the RaiDisk driver.
- **Notification Utility (NU)** — A web-based application that alerts designated recipients to Secure Path Manager events by sending messages to pagers, email addresses, or SMTP traps.

## Defining Paths

Within Secure Path, a path is defined as the collection of physical interconnect components including HBAs, switches or hubs, and cables. The Secure Path filter driver component, RaiDisk, distinguishes physical paths by elements of the SCSI equivalent address (Bus-Target-LUN), as derived by the HBA.

### Path Mode

You can set the path to the following Path Modes using the Secure Path Manager interface:

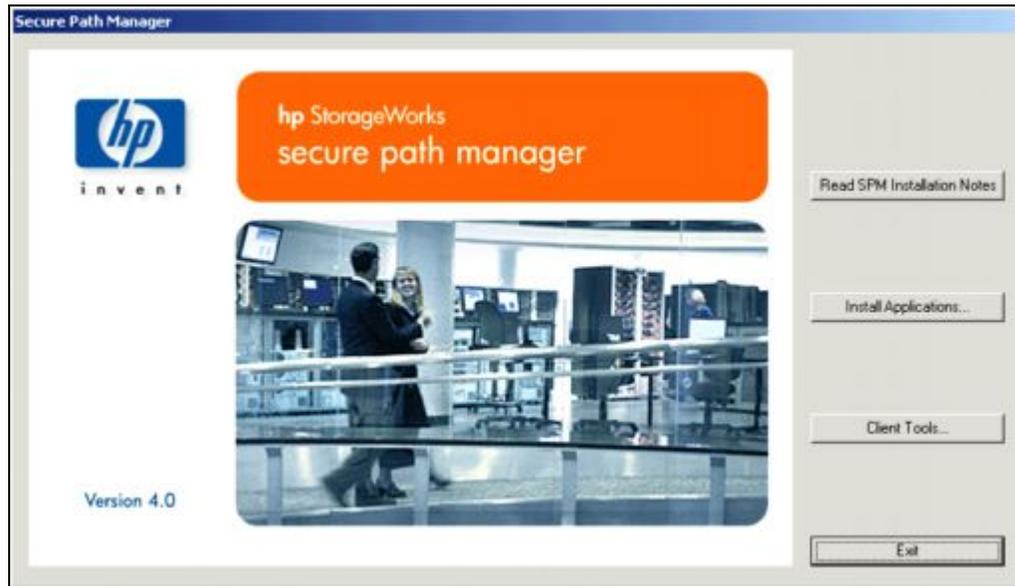
- **Preferred Path Mode** — Designates the user-specified path that will be used to communicate from a specific host to the specified storage set. RaiDisk declares the path to the owning controller as the Preferred path. Using Secure Path Manager, you can modify the default path settings of the driver.
- **Alternate Path Mode** — Designates paths that are not user-preferred. These paths provide redundancy in case the preferred paths fail.
- **Offline Path Mode (Alternate-Offline)** — Includes the original mode (via the prefix) and indicates that you have specified a path that should never be used for I/O. Paths are marked offline only as a result of user specification.

### Path State

The Path State is set automatically by RaiDisk and reflects the status of the current actual path, which can deviate from expectations because of path failures.

- **Active State** — Indicates that the associated path is currently servicing, or is capable of servicing, I/O to the storage set.
- **Available State** — Indicates that the associated path belongs to the set of redundant paths to the storage set that could be used during failover.
- **Failed State** — Indicates that the path has encountered errors, either during normal operation or as a result of path verification testing.

## Installation



### Secure Path Manager Installation

Secure Path Manager can be installed to run in two different environments:

- Standalone
- HP OpenView Storage Management Appliance

### Prerequisites

- **Solution software supported operating systems** — Windows NT4.0, Windows 2000, or NetWare.
- **Browser requirements (minimum)** — Internet Explorer 5.0 or later, Netscape Communicator 4.7 or later, Sun Java 2 Runtime Environment, (JRE) standard edition version 1.3.1 or later.
- **Secure Path Element Manager platforms** — Windows NT4.0, Windows 2000, or SMA.

## Network Connectivity

The user interface communicates with the Secure Path Element Manager on port 2301 for unsecured connections and on port 2381 for systems configured for secure socket layer (SSL) connections. The Secure Path Element Manager communicates with the agent using a password protected socket connection.

You must use a TCP/IP connection with SPM. Network connectivity includes:

- A connection from your browser to the Secure Path Element Manager (SPEM)
- A connection from the SPEM to each managed Secure Path Agent

## JRE Requirements

Check to see if you have Sun Java 2 Runtime Environment (JRE) standard edition version 1.3.1 or later already installed on your system. If you do not have version 1.3.1 or higher, the JRE attempts to download the correct version from a web distribution site. If it cannot download the software, the lower half of your display appears blank for a long period of time. In this case, you must upgrade the JRE on your system.

The SPM CD has the correct JRE version for Windows NT and Windows 2000. If you are running other operating systems, you must download JRE version 1.3.1 or higher from the JRE distribution site.

## Installing SPM

### Standalone Installation

To install Secure Path Manager in a standalone environment:

1. Insert the Secure Path Manager 4.0 CD into the host's CD-ROM drive. The setup program begins.

If the installation program does not start automatically, go to *Start* → *Run*, then browse the CD-ROM drive and select `\SPM\setup.exe`.

2. Click *OK*.
3. Follow the prompts on the screen to complete the installation.

### Management Appliance Installation

To install Secure Path Manager on a Management Appliance, browse to the Management Appliance splash screen and log in. From the Management Appliance main menu, follow these steps:

1. Expand the *Applications* folder in the Navigation pane.
2. Expand *Installation Services* from the Applications Navigation pane.
3. Insert the Secure Path Manager Version 4.0 CD into your CD-ROM drive.
4. Select *Install Products* from the Installation Services Navigation pane.
5. Select *CDROM* for the location of the application setup file.
6. Select *Next Step* from the top of the Content pane and follow the prompts to install Secure Path Manager.

## Installing Secure Path Server Software

Perform the following steps before you install the Secure Path server software:

- Verify receipt of the Secure Path software kit and the Fibre Channel hardware required for the installation.
  - The Secure Path Manager V4.0 CD that contains the browser-based Secure Path Manager, the Secure Path Element Manager, and related software. (Secure Path Manager replaces the Secure Path V3.x client component.)
  - The Secure Path V 4.0 Workgroup Edition CD that contains the Secure Path server, driver, and agent software.
- Install all the hardware components of the solution.
- Install the *Modular SAN Array 1000 Support Software Version 5.5x Solution Software* kit.
- Close any antivirus programs.
- Install the required operating system service packs:
  - Windows NT with SP6a
  - Windows 2000 with a minimum of SP2 (or optionally, SP3)
- Back up your computer.

### Software Installation Types

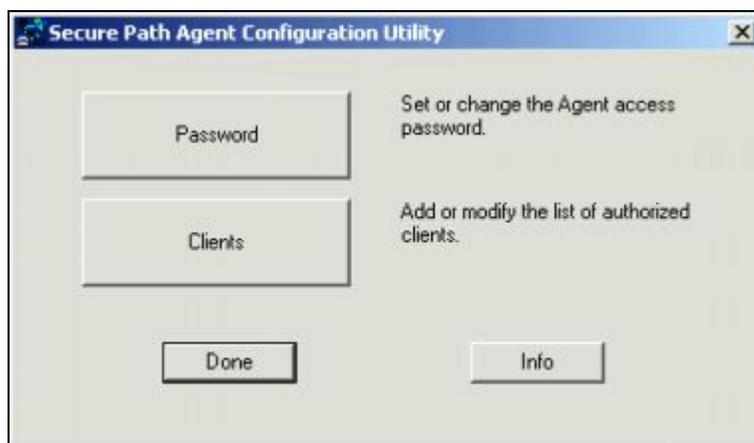
Your preparation may vary based on whether Secure Path has been previously installed. The actual installation is the same for all systems. You can install Secure Path Server on systems with:

- No previous Secure Path versions (new installations) on:
  - Standalone systems
  - Cluster configurations
- Previous versions of Secure Path on:
  - Standalone systems
  - Cluster configurations

## Secure Path Server Installation Steps

To install the Secure Path Server software:

1. Access the CD:
  - If you have AutoRun enabled on your server, the Secure Path setup program starts automatically. Otherwise, select *Start* → *Run*, and then browse to the *Launch.exe* program on the CD-ROM drive.
  - If you are accessing the CD on a Network drive, select *Start* → *Run*, and then browse to the *Launch.exe* program on the network drive.
2. Click *Yes* to agree to license terms.
3. Read the additional information and click *Next*.
4. Choose the location to install the Secure Path Server software and click *Next*.
5. Click *Next* to start the installation.
6. Select *Yes* or *No* to indicate whether or not you want to use an existing configuration file. If you selected *Yes*, indicate which clients you want to use and click *OK*.
7. Click *Password*. Enter and confirm your new password.
8. Click *Add Client*.



9. Enter the name of the client in the Client field.
10. Click *OK*.
11. Click *Exit*.
12. Click *Next* and do not review the log file.
13. Click *Finish* to complete your Secure Path Software installation.

## Supported Secure Path Configurations

Windows	
<b>Basic Configuration</b>	<ul style="list-style-type: none"> <li>■ <b>RA8000/ESA12000, MA8000/ EMA12000/ EMA16000, MA6000, and Enterprise Virtual Array solutions:</b> Host with one or more HBAs and storage system with dual controllers. Supports 32 paths (LUNs).</li> <li>■ <b>MSA1000 and RA4000/4100 solutions:</b> Host with multiple HBAs and storage system with dual controllers. Supports two paths (LUNs).</li> </ul>
<b>Storage Controller Software</b>	<ul style="list-style-type: none"> <li>■ <b>RA8000/ESA12000, MA8000/ EMA12000/ EMA16000, and MA6000 solutions:</b> Supports ACS v8.6 and ACS v8.7.</li> <li>■ <b>Enterprise Virtual Array solutions:</b> Supports VCS 2.0.</li> <li>■ <b>MSA solutions:</b> MSA1000 version 2.0.</li> <li>■ <b>RA4000/4100 solutions:</b> HP RA4x00 controller firmware version 2.60.</li> </ul>
<b>Operating System Support</b>	<ul style="list-style-type: none"> <li>■ <b>Enterprise Virtual Array, RA8000/ESA12000, MA8000/ EMA12000/ EMA16000, and MA6000 solutions:</b> Microsoft Windows NT. 4.0, Windows NT 4.0 Enterprise Edition SP5 or SP6A, Microsoft Windows 2000 and Windows 2000 Advanced Server SP2 and SP3, and Datacenter 1.1</li> <li>■ <b>MSA1000 solutions:</b> Microsoft Windows NT 4.0, Windows NT 4.0 Enterprise Edition SP6A, Microsoft Windows 2000 and Windows 2000 Advanced Server SP2 and SP3</li> <li>■ <b>RA4000/4100 solutions:</b> Microsoft Windows 2000 and Windows 2000 Advanced Server SP1 and SP2, SP3 (with the appropriate HBA driver update)</li> </ul>
<b>Application Support</b>	Microsoft Cluster Server, Oracle Parallel Server
<b>Host Adapters</b>	<ul style="list-style-type: none"> <li>■ HP StorageWorks 32bit/33Mhz PCI-to-Fibre Channel host bus adapter</li> <li>■ 64bit/33Mhz PCI-to-Fibre Channel host bus adapter</li> <li>■ FCA2101 2Gb Fibre Channel HBA</li> </ul>
<b>Host Platform</b>	ProLiant servers from HP or other x86 servers
Netware	
<b>Basic Configuration</b>	<ul style="list-style-type: none"> <li>■ <b>RA8000/ESA12000, MA8000/EMA12000/EMA16000, MA6000 solutions, and MSA1000 solutions:</b> Hosts with multiple HBAs and storage system with dual controllers. Supports eight paths (LUNs).</li> <li>■ <b>RA4100 and RA4000 solutions:</b> With two paths (LUNs).</li> </ul>
<b>Storage Controller Software</b>	<ul style="list-style-type: none"> <li>■ <b>MA6000, RA8000 and ESA12000 solutions:</b> Supports ACS v8.5f and ACS v8.6f</li> <li>■ <b>MSA1000 solutions:</b> MSA1000 v2 firmware</li> <li>■ <b>RA4000/4100 solutions:</b> HP RA4x00 controller firmware: 2.58</li> </ul>
<b>Operating System Support</b>	Novell NetWare v5.1, v6.0
<b>Application Support</b>	NetWare Cluster Server
<b>Host Adapters</b>	FCA2210 2Gb Fibre Channel HBA
<b>Host Platform</b>	ProLiant servers from HP or other x86 servers

## Learning Check

1. List the platforms for which there is Secure Path Windows Workgroup Edition support for the MSA1000.

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

2. Which feature of Secure Path is supported by Secure Path Manager?

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

3. What are the software components of Secure Path??

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

4. What are the two environments in which you can install Secure Path?

.....  
.....

5. What is the Secure Path supported HBA in a NetWare environment?

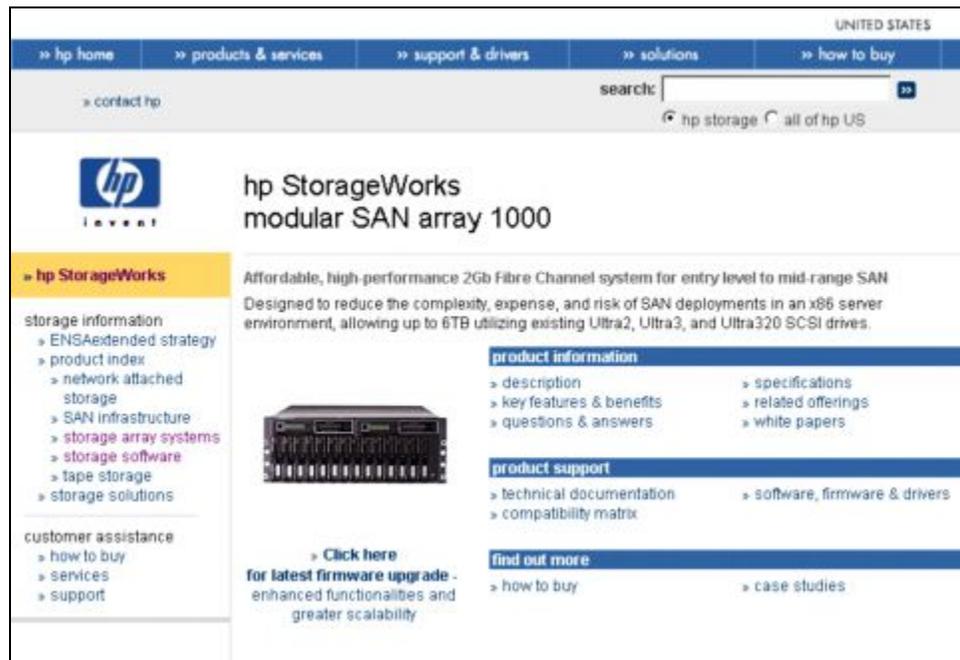
.....  
.....

## Objectives

After completing this module, you should be able to:

- Discuss sources of information for the Modular SAN Array (MSA) 1000 SAN solution.
- Discuss basic troubleshooting techniques:
  - Power on sequence
  - Visual indicators
  - LCD panels — error codes
- Explain the replacement procedures of the major components of the MSA1000.
- Identify some of the known service issues involving the MSA1000.

## Information Sources for the MSA1000 SAN Solution



All information relating to the MSA1000 SAN solution can be accessed on the HP website by selecting *storage* → *storage array systems*, then selecting *modular san array 1000* under the *modular array systems* category.

**INTERNET** The URL for the MSA1000 SAN web page is:  
<http://h18006.www1.hp.com/products/storageworks/msa1000/index.html>

## Troubleshooting Techniques — MSA1000

### Power on Sequence

Before applying power to the MSA1000, all components of the storage system must be installed and connected to the supported interconnect options. Hard drives should be installed in the MSA1000 so that they can be identified and configured at power on.

The MSA1000 components must be powered on in the following order:

1. Power on all storage expansion enclosures and interconnect devices.
2. Power on the MSA1000 using the power switch located in the far-right lower area of the front panel. After powering on, wait until the message “MSA1000 Startup Complete” displays on your screen. This process might take up to two minutes.
3. Power on the servers.

The system power in the MSA1000 does not shut off completely with the power switch, but instead goes into STANDBY, which removes power from most of the electronics and the drives, but portions of the power supply and some internal circuitry remain active. To remove the power completely, disconnect all power cords from the equipment.

## Visual Indicators

When you have connected all the components of the MSA1000 SAN solution and powered on the respective components, the first indication of problems can be easily detected by observing the LEDs on the various components.

If the fault indicator on any of the MSA1000 components is amber, or if Insight Manager 7 indicates a fault, determine the reason for this alert by examining the component indicators.

The MSA1000 has visual indicators on LCD panels for the:

- Controller.
- Fibre Channel I/O module.
- Fibre Channel I/O module link status.
- Hard drives.
- Power and blower assemblies.

Indicators and their functions that are not described here have been discussed in earlier modules.

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**Note**

For detailed information regarding the component indicator functions and meanings, refer to the *hp StorageWorks modular SAN array 1000 user guide* or the *hp StorageWorks modular SAN array 1000 maintenance and service guide*.

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## Fibre Channel I/O Module

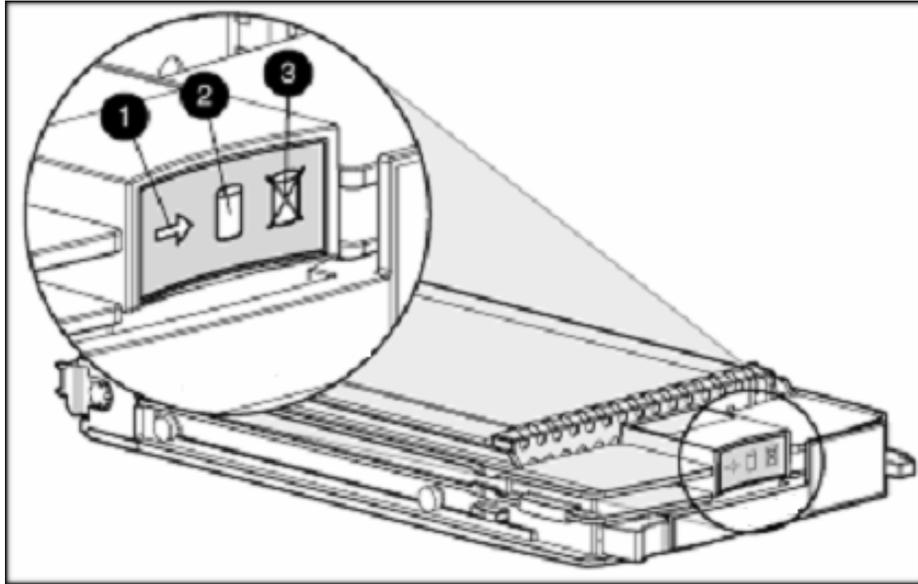
Description of indicators on the Fibre Channel I/O Module:

Condition	Description
Off	Power is not applied to Fibre channel I/O module, controller is not plugged in or unsuccessful controller Power-On Self-Test (POST) occurred.
Solid Green	Power was applied and connection was established between the Fibre Channel I/O module and the Fibre Channel controller.
Flashing Amber	Power is applied; however, the Fibre Channel controller is not present.

## Fibre Channel I/O Module Link Status Indicators

1Gb Indicator	2Gb Indicator	Description
Off	Off	A link has not been established since the application of power, initiation of reset, hot-plug of Fibre Channel I/O module, removal of transceiver, or hot-plug of the transceiver.
Green	Off	A 1Gb link is active and the status is good.
Flashing Amber	Off	A 1Gb link was established, but is now inactive.
Off	Green	A 2Gb link is active and the status is good.
Off	Flashing Amber	A 2Gb link was established, but is now inactive
Flashing Amber	Flashing Amber	The Fibre Channel controller was removed or there is no Fibre Channel card installed.

## Hard Drive Indicators



Look for amber drive failure indicators on any hot-pluggable drive tray. If any drive failure indicator displays amber, replace that drive as soon as possible.

To ensure that the component is replaced safely, refer to the component user guide for replacement components.

Several other ways to recognize that a hard drive has failed include:

- The amber status indicator lights up on the front of a HP storage system if failed drives are inside. (Other problems such as blower failure, redundant power supply, or over-temperature conditions will also cause this indicator to light.)
- A front panel display message lists failed drives whenever the system is restarted, as long as the controller detects one or more good drives.
- Insight Manager 7 detects failed drives locally or remotely across a network.

## Hard Drive Status from Indicator Combinations

Activity	Online	Fault	Meaning
On	Off	Off	The drive is being accessed but it is: <ul style="list-style-type: none"> <li>■ Not configured as part of an array.</li> <li>■ A replacement drive and the rebuild has not started.</li> <li>■ Spinning up during POST.</li> </ul>
Flashing	Flashing	Flashing	Do not remove the drive. Removing a drive during this process can cause data loss in nonfault-tolerant configurations. The drive is: <ul style="list-style-type: none"> <li>■ Part of an array being selected by the ACU.</li> </ul> <p style="text-align: center;">or</p> <ul style="list-style-type: none"> <li>■ Being upgraded by an Options ROMPaq.</li> </ul>
Off	Off	Off	OK to replace the drive online. The drive is: <ul style="list-style-type: none"> <li>■ Not configured as part of an array.</li> </ul> <p style="text-align: center;">or</p> <ul style="list-style-type: none"> <li>■ Configured as an online spare.</li> </ul>
On	Flashing	Off	Do <b>not</b> remove the drive. Removing a drive during this process can cause data loss in nonfault-tolerant configurations. The drive is: <ul style="list-style-type: none"> <li>■ A replacement drive and is being rebuilt.</li> </ul> <p style="text-align: center;">or</p> <ul style="list-style-type: none"> <li>■ Is being expanded (If <b>all</b> the online lights are flashing).</li> </ul>
Off	Off	On	OK to replace the drive online. The drive was taken offline because it failed.
Off, On, or Flashing	On	Off	Do not remove the drive. Removing a drive during this process can cause data loss in nonfault-tolerant configurations. The drive is online and configured as part of an array.
Off, On, or Flashing	On or Off	Flashing	A predictive failure alert has been received for this drive—replace it as soon as possible.

## **Power Supply and Blower Assembly**

The green indicator on the power supply assembly is lit when both the power supply and the blower are operational. When a power supply or blower fault occurs, the power supply indicator turns off. If the power supply indicator is off, AC power is not present, a complete power supply failure has occurred, or the blower has failed.

The power supply mounted blowers cool the enclosure by circulating air through the enclosure and elements. The rate at which air moves (airflow) determines the amount of cooling. This airflow is a function of blower speed (rpm).

These blowers, under the control of the Environmental Monitoring Unit (EMU) or the associated power supply, can operate at multiple speeds. Using multiple speeds ensures that when the enclosure temperature changes the blowers can automatically adjust the airflow.

If one blower operates too slowly or completely shuts off, the other blower will begin to operate at a higher speed. At the same time, the error condition is reported to the user.

## LCD Panels — Error Codes

Each array controller in an MSA1000 contains an integrated display. This module is used for displaying informational and error messages showing the current status of the module, and for providing user input when required. Traditional POST messages, issued by PCI-based array controllers, are combined with runtime event notification messages to create a new set of controller display messages.

The display module consists of:

- A 2-line, 20-column text display window.
- Four buttons arranged in a circular shape.
- Two status indicator lights.

### Operation Messages

The display module can hold up to 100 messages. After the maximum size has been reached, older messages are removed to make room for newer ones.

The three messages types are:

- Error
- Informational
- User input

### Error Messages

Error messages indicate that a problem has occurred and might require user action to correct it. An amber indicator to the left of the text display window will be on when an error message is viewed. This indicator will also be on if an error message sent to the display module has not been viewed because informational messages were sent to the display module after the error message. By scrolling backward and viewing all error messages, the indicator will light only when displaying an error message. A complete list of possible error messages and their meanings is contained in “Appendix F” of the *hp StorageWorks modular SAN array 1000 user guide*.

### Informational Messages

Informational messages indicate noncritical changes in the system that provides feedback to the administrator. The amber indicator to the left of the display text window will normally be off when an informational message is viewed unless an unviewed error message was previously sent to the display module. By scrolling backward and viewing all error messages, the indicator will light only when displaying an error message.

## User Input Messages

User input messages indicate that the system has encountered an issue that can be handled in two different ways. It enables you to choose which way to handle the issue. However, it will default to a standard choice after a set period of time.

User input messages only occur during system power on, not during run time. The amber indicator to the left of the text display window will blink when a user input message being viewed is available for input. If you do not provide input within the time-out period, the message will remain, but the indicator will stop blinking.

## Scrolling

Older messages are viewed by scrolling backward by pressing the *Up Arrow* (↑) button. Newer messages are viewed by scrolling forward by using the *Down Arrow* (↓) button. When a new message is sent to the LCD, the display shows that message, ignoring any previous scrolling position it had.

## User Input

User input messages present the user with two options, which are selected by:

- Pressing the *Left Arrow* (←) button.
- Pressing the *Right Arrow* (→) button.

The meaning of each button is defined in the text display window.

## Deleting Messages

The currently displayed message can be deleted from the display module by pressing the Left Arrow and Right Arrow buttons at the same time.

## Redundancy Link Light

A green indicator to the left of the text display window lights when two array controllers have been inserted into the MSA1000 and controller redundancy is enabled. The indicator does not light if only one array controller has been installed or if a failure causes a loss of array controller redundancy.

## Box Numbering

The display message can include a box number, which indicates to which MSA1000 component the message relates. The box numbers are:

- Box 1 — The MSA1000 chassis
- Box 2 — The storage enclosure attached to SCSI port A of the MSA1000
- Box 3 — The storage enclosure attached to SCSI port B of the MSA1000

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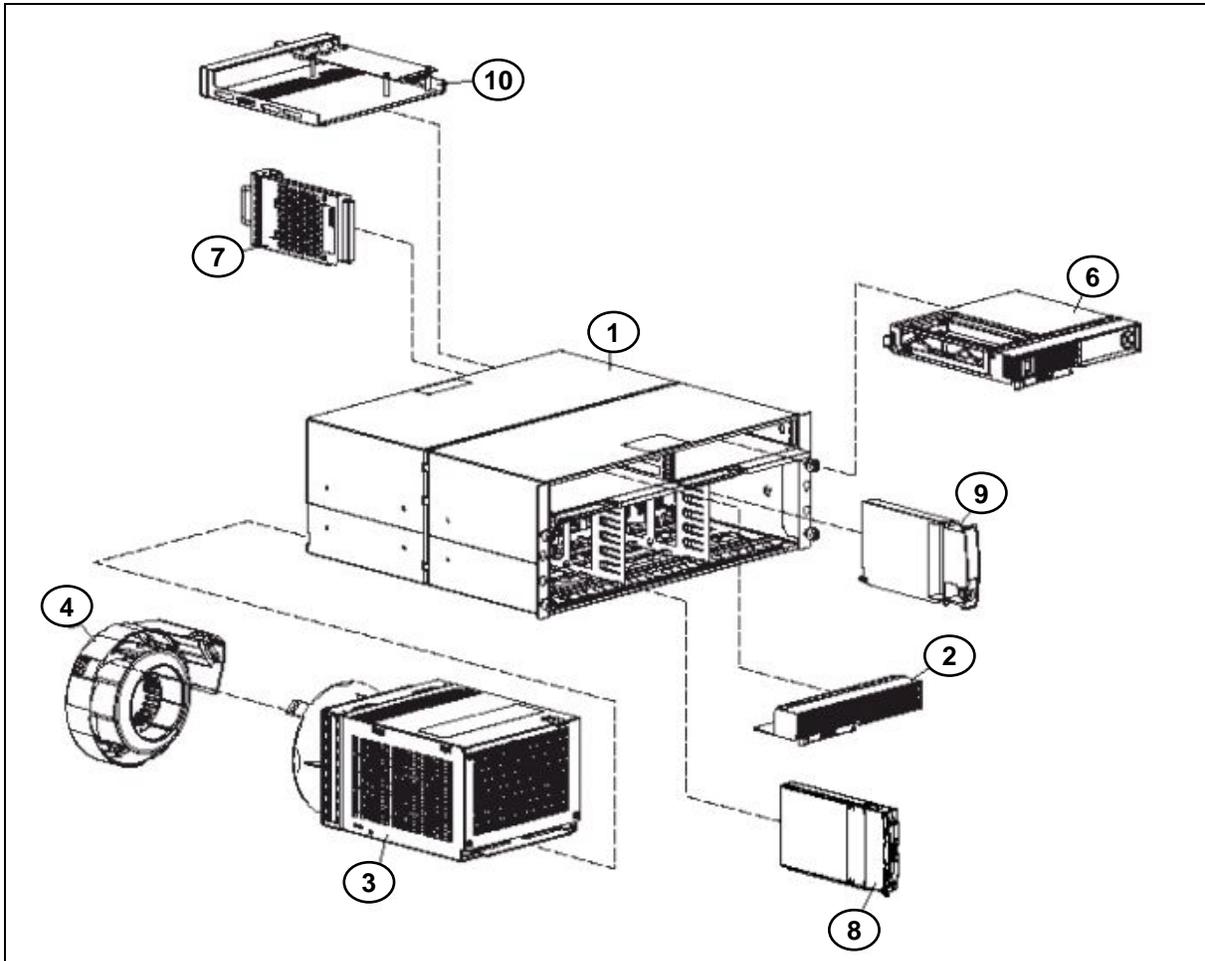
### **Note**

A table with the LCD messages and error codes is located in the *hp StorageWorks modular SAN array 1000 user guide*.

---

## Removing and Replacing Component Procedures

The following diagram shows the location of the main components of the MSA1000 system.

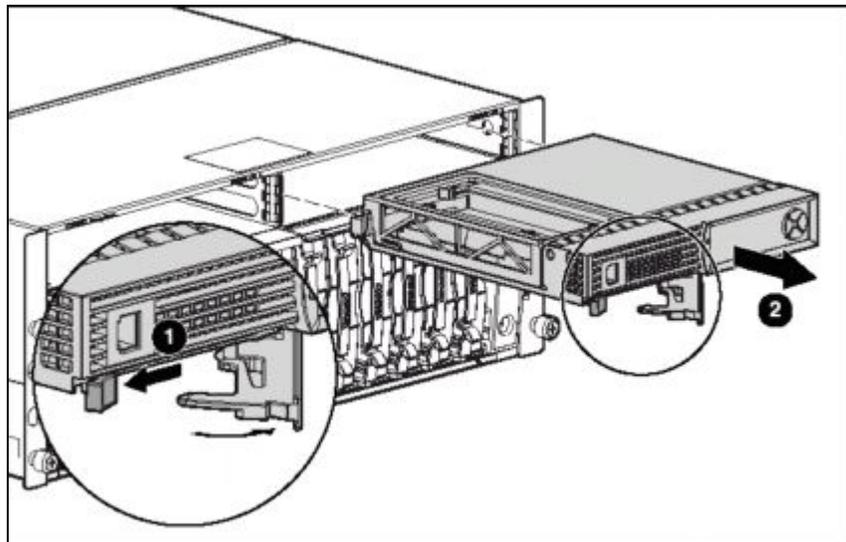


Number	Description
1	Chassis, 4U, with backplane
2	Controller blank
3	Power/cooling assembly
4	Shelf blower
5	AC power cord (not shown)
6	Controller
7	SCSI I/O module with Integrated EMU
8	Wide Ultra320 SCSI hard drive, 1 inch (Ultra2 and Ultra3 drives also supported)
9	Power switch assembly
10	Fibre Channel I/O module

## Replacing a MSA1000 Controller

The following steps explain how to replace a failed MSA1000 controller. Before replacing your controller, follow these guidelines:

- If your system is equipped with a single controller and that controller fails, it is recommended that the cache module from the failed controller be migrated to a new controller. Migrating the cache module to the new controller enables the completion of disk writes that might have been pending in the failed controller.
- If an expand process is occurring, a dual controller system transitions into a nonredundant state. If a controller failure occurs during an expand process, the cache module from the failed controller must be migrated to the replacement controller to complete the expand process. If the expand process does not complete the array contents will be invalid.



To replace the MSA controller:

1. Press the thumb latch on the controller and rotate the latch handle towards you.
2. Remove the MSA1000 controller by pulling it straight out of the chassis.
3. Insert the replacement controller into the chassis.
4. Push the controller in as far as it will go and press the latch inwards until it is flush against the front panel.

## Replacing the MSA1000 Controller Cache



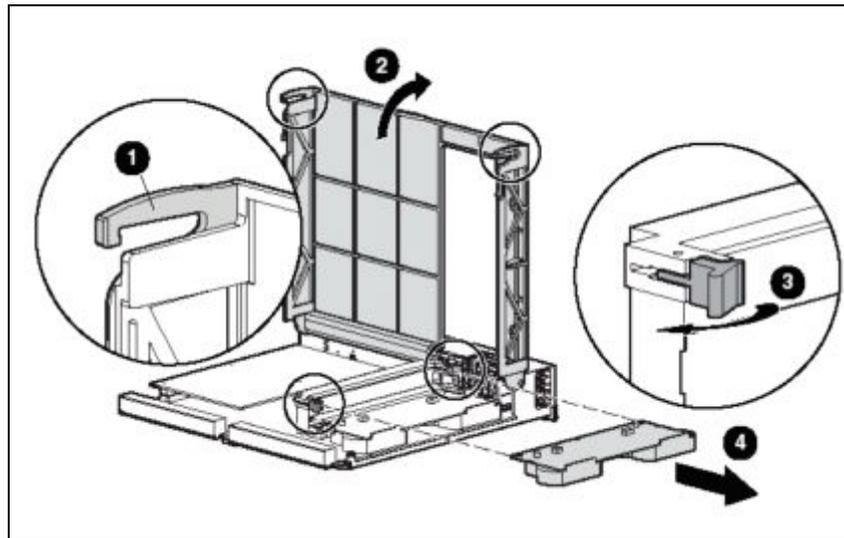
### Important

If your MSA1000 is equipped with a single controller and you replace the controller cache, you must power off the system before replacing it.

If your MSA1000 has two controllers and you want to replace a failed cache module with another of the same size, you can replace the module while the system is running.

If your MSA1000 has two controllers and you are replacing the cache module with a module of a different size, you must power off the system before changing the cache module on both controllers at the same time.

1. Press the thumb latch on the controller and pull the latch handle towards you.
2. Remove the MSA1000 controller by pulling it straight out of the chassis.
3. Unlatch the clips holding the MSA1000 controller cover and raise the cover.
4. Simultaneously unlatch both clips holding the MSA1000 controller cache module in place.



5. Carefully pull the cache module away from the controller board.
6. Slide the new MSA1000 controller cache module into the controller. Be sure the side latches are fully engaged.
7. Close the MSA1000 controller cover and be sure the clips are latched.
8. Push the controller in until it engages with the gear and then rotate the latch to engage the controller connector with the backplane.

## Controller Cache Battery Pack Replacement



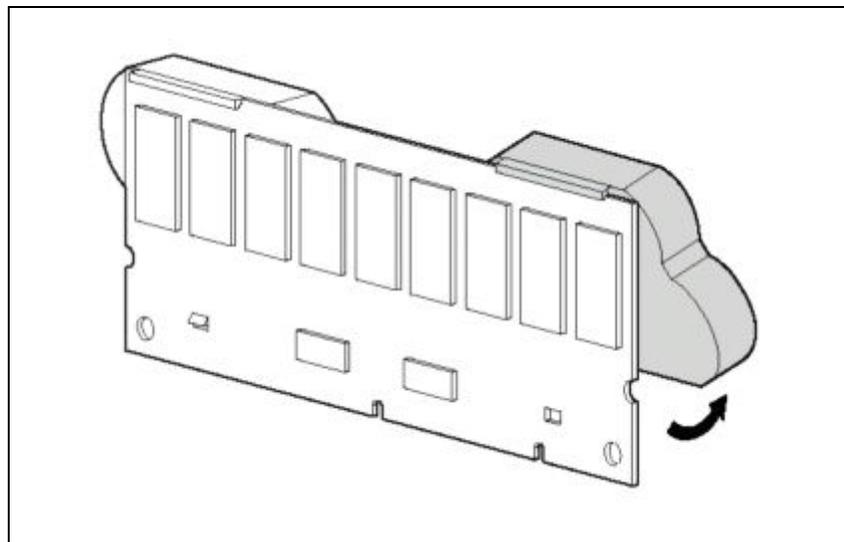
### WARNING

There is a risk of explosion, fire, or personal injury if the battery pack is replaced incorrectly or is mistreated. To reduce the risk:

- Do not attempt to recharge the battery outside of the controller.
- Do not expose to water or temperatures higher than 60°C (140°F).
- Do not abuse, disassemble, crush, puncture, short external contacts, or dispose of in fire or water.
- Replace only with the HP spare designated for this product.
- Array Accelerator battery disposal should comply with local regulations. Alternatively, return them by established parts return methods to HP for disposal.

To remove the old NiMH battery pack:

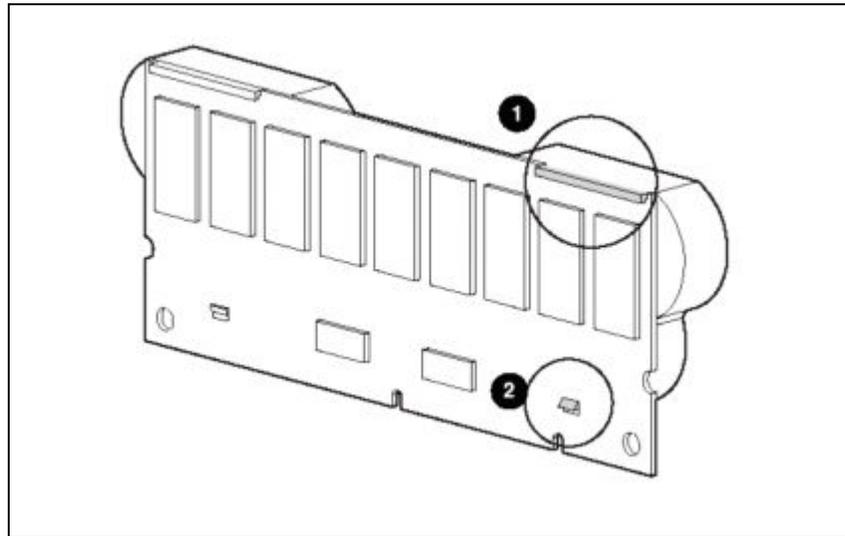
1. Push down on the bottom clip of the battery pack attached near the lower corner of the Array Accelerator.
2. Swing the battery pack away from the Array Accelerator to a 30-degree angle.



3. Lift the pack upward to unhook the top of the battery pack.
4. Repeat steps 1 to 3 for every battery pack you are replacing.

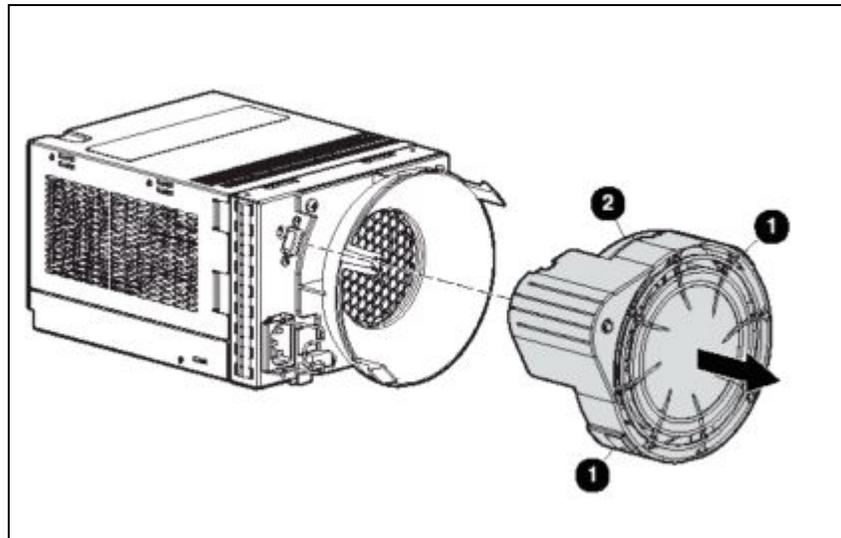
To install a new NiMH battery pack:

1. Wait about 15 seconds after removing the old battery pack to allow the battery charge monitor to reset.
2. Hook the top of the battery pack to the top of the Array Accelerator with the pack held at a 30-degree angle to the plane of the Array Accelerator board.
3. After the pack is hooked in position, swing the pack downward ensuring the bottom clip and two pegs line up with the holes in the Array Accelerator.
4. Be sure that the top hook and bottom clip on the battery pack are securely attached to the Array Accelerator. Installation of the new battery pack is complete. Repeat for the other battery pack.



## MSA1000 Hot-Plug Power Supply/Blower

### Replacing a Variable Speed Blower



#### Caution

Removing a power supply significantly changes the airflow within the MSA1000. After power supply removal, the remaining power supply starts a timer that will shut down the MSA1000 in five minutes.

1. To remove the blower from the power supply, push in the two port-colored blower tabs while pulling the blower element.



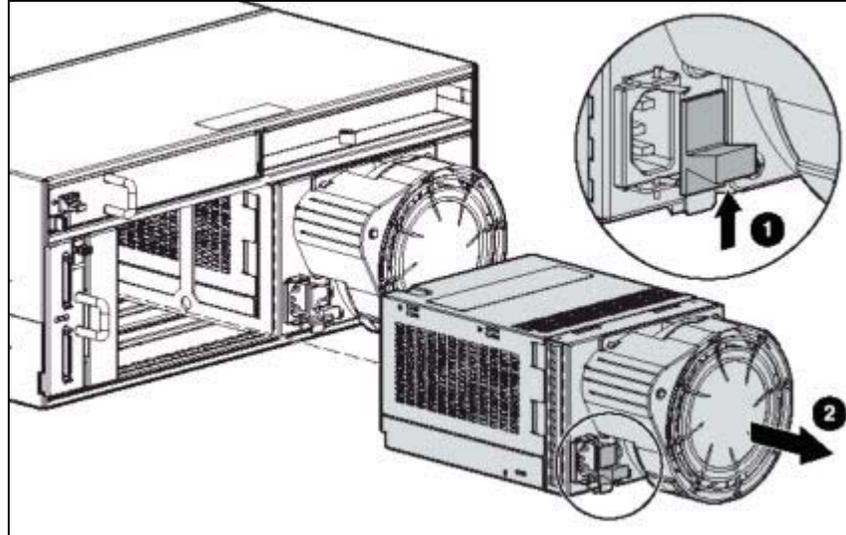
#### Caution

Pressing the center section of the blower can damage the blades. To prevent damage to the blades, press only the outer edge of the blower.

2. Align guidepost of the new blower with the power supply connector. Slide the replacement blower into the blower base until the tabs snap into place.
3. Be sure the following operational blower indications occur:
  - a. The blower starts operating immediately.
  - b. The blower indicator is On.

## Replacing a Power Supply

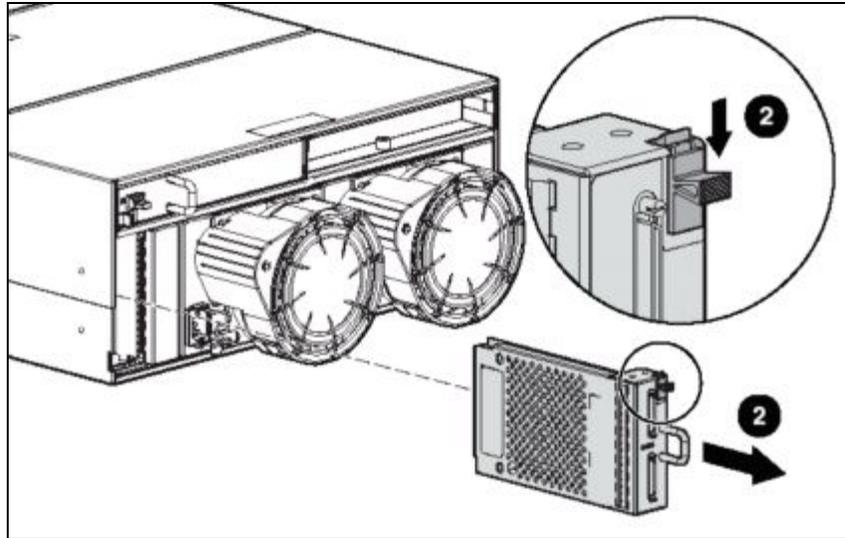
1. Disconnect the AC power cord from the failed power supply. While lifting up the power supply port-colored module latch, grasp the blower element and pull the failed power supply out of the enclosure.



2. Install the replacement power supply by lifting up the power supply module latch and pushing in the blower base until the assembly is fully seated in the enclosure.

## MSA1000 SCSI I/O Module with an Integrated EMU

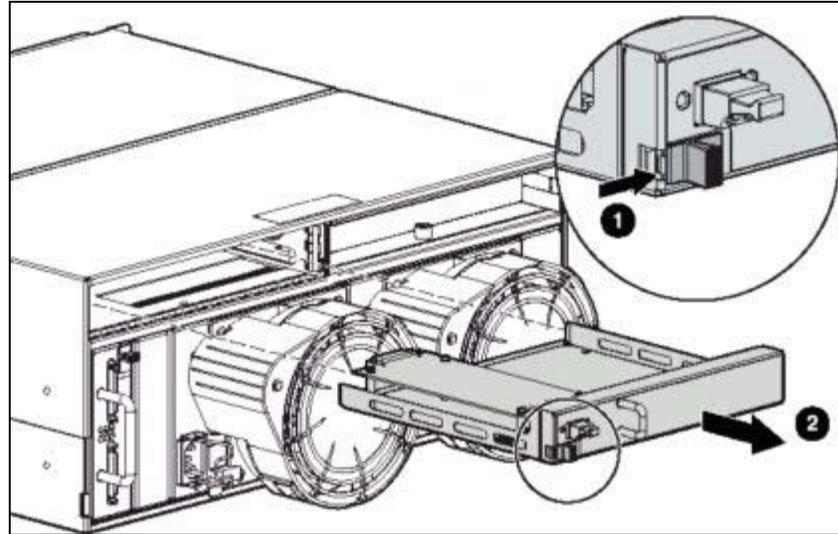
To remove the I/O EMU, press the I/O EMU latch and pull the I/O EMU out of the MSA1000.



To replace an MSA1000 I/O EMU, slide it into the bay until it clicks into place.

## MSA1000 Fibre Channel I/O Module

To remove an MSA1000 Fibre Channel I/O module, while grasping the module handle, slide the module latch to the right and pull the I/O module out of the enclosure.



To replace the I/O module, slide it into the bay until the module clicks into place.

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## Service Advisories for the MSA1000

### DOCUMENT NUMBER: OI021115\_CW01

**Service Pack 3 (SP3) for Microsoft Windows 2000 is not currently supported on systems running Secure Path 3.1B for Windows Workgroup Edition with an MSA1000**

Due to architectural incompatibilities with Secure Path, Service Pack 3 for Microsoft Windows 2000 is not currently supported on systems running Secure Path V3.1B for Windows Workgroup Edition with an MSA1000 using firmware version 1.16. As a result, if Service Pack 3 is installed, these systems will fill the System Event Log with Event ID 772 errors that falsely indicate a redundant fiber path failover. There may be subsequent performance degradation due to the frequency of these messages being posted to the event log. These Event ID 772s will occur primarily during system start-up and intermittently during system operation.

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**Note**

MSA1000 and RA4X00 systems not running Secure Path are not affected.

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Any systems running Secure Path V3.1A for Windows for RA4x00 or Secure Path V3.1B for Windows Workgroup Edition with Microsoft Windows 2000 Service Pack 3 installed are affected.

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**Note**

This issue does not affect HP EVA, HSG, MA or other HP storage solutions. This only occurs if Secure Path is installed on an RA4000, RA4100 or MSA1000 Storage System.

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**MSA1000:** There are 2 methods to permanently resolve this issue:

1. The first method only requires an upgrade to the MSA1000 controller ROM to version 1.18. This is available for download from the 1.18 firmware link on: <http://h18000.www1.hp.com/products/storageworks/MSA1000/index.html>
2. The second method is to upgrade the controller to firmware 2.38 or later. As this firmware upgrade also enables multi-node cluster support and other enhancements it does require that the following components are also upgraded:
  - a. FCA2101 HBA driver 5.4.82A9 or later, EMU firmware 1.86 or later, ACU 6.0 or later, Secure Path 4.0 Workgroup Edition

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**Note**

Microsoft is developing a Hotfix that resolves this issue. Upon successful completion of qualification and regression testing it will be made available.

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## DOCUMENT NUMBER: OI020517\_CW02

**A mandatory update is required on systems with Virtual Replicator V3.0. This includes the StorageWorks NAS E7000, B3000, and the MSA1000 Controller.**

This proactive advisory is to inform you that SANworks Virtual Replicator V3.0 utilizes the plug-and-play architecture and is therefore exposed to registry growth issues. A mandatory update is required to be installed on all systems operating SANworks Virtual Replicator V3.0.

The products affected by this are the SANworks Virtual Replicator 3.0 software package, the SANworks Virtual Replicator V3.0 CDROM that is included with the StorageWorks MSA1000, the StorageWorks NAS Executor E7000 and the StorageWorks NAS Executor B3000, which include SANworks Virtual Replicator as part of the factory image. This situation does not apply to SANworks Virtual Replicator V2.0A or prior versions. You can verify the version by launching Virtual Replicator SnapMgr and select the help icon on the MMC tool bar.

SANworks Virtual Replicator and StorageWorks MSA1000. HP is providing an update to Virtual Replicator to be re-released as V3.0A. Customers that have installed Version 3.0 need to update to V3.0A immediately. The **Virtual Replicator V3.0A Mandatory Update** is currently available for download at: <http://h18000.www1.hp.com/products/sanworks/softwaredrivers/vr/index.html>

You must ensure that the update is applied if version 3.0 is reinstalled.

### **StorageWorks NAS Executor E7000 and StorageWorks NAS B3000**

If you have an E7000 with version 2.0 or a B3000 with version 2.11 HP has developed an update for the software that will remedy the condition. If Quick Restored with version 2.0 or 2.11 of the NAS image, you must ensure that the update is applied. The StorageWorks NAS Executor E7000 version 2.0 and the StorageWorks NAS B3000 version 2.11 come installed with SANworks Virtual Replicator. This tool is available as a web downloadable update at: <http://h18006.www1.hp.com/storage/networkattached.html>

This update is **not** needed for the E7000 with the software image version 2.01 or higher or for the B3000 with the software image version 2.12 or higher as it is already included. A new quick restore CD is available for older products via services and support.

## DOCUMENT NUMBER: EU021120\_CW01

### **MSA1000 Will Not Be Displayed By Storage Agents For Linux After Array Configuration Utility-XE (ACU-XE) Is Started.**

HP StorageWorks Modular SAN Array 1000 (MSA1000) and its components (physical disk drives, logical disk drives, switches, etc.) will no longer be displayed by the Storage Agents for Linux 6.10.0-6 when the Array Configuration Utility-XE (ACU-XE) is started on any ProLiant server.

Any ProLiant server configured with the MSA1000 and running the Storage Agents for Linux 6.10.0-6 and the Array Configuration Utility-XE (ACU-XE) with any of the following operating systems:

- Red Hat Linux 7.2 Professional
- Red Hat Linux Advanced Server 2.1
- SuSE Linux Enterprise Server 7

To avoid this issue, restart the Storage Agents for Linux after running the Array Configuration Utility-XE (ACU-XE). To restart the Storage Agents, run the following command:

```
/etc/init.d/cmastor restart
```

**HARDWARE PLATFORMS AFFECTED:** ProLiant Cluster HA/F100 for MSA1000, ProLiant Cluster HA/F200 for MSA1000, ProLiant DL380, ProLiant DL380 G2, ProLiant DL380 G3, ProLiant DL580, ProLiant DL760, ProLiant ML370, ProLiant ML370 G2, ProLiant ML370 G3, ProLiant ML530, ProLiant ML530 G2, ProLiant ML570, ProLiant ML570 G2, ProLiant ML750

## **DOCUMENT NUMBER: EC020515\_CW01**

### **MSA1000 Controller Failure May Cause Some Node(s) To Drop Out Of Multi-Node Oracle 9i Real Application Cluster (RAC).**

The failure of one array controller in a Parallel Database Cluster (PDC/O2000) for a StorageWorks Modular SAN Array 1000 (MSA1000) storage enclosure in a multi-node Oracle 9i Real Application Clusters (RAC) cluster may cause one or more server nodes to drop out of the cluster. The Windows Event Log messages on the node(s) that dropped out will have an entry listing the following error message:

*Disk event error 15 indicating that "The device [hard drive location] is not ready for access yet".*

The Oracle Alert Log on the node(s) that dropped out reports:

*"O/S-Error: (OS 1167) The device is not connected".*

Any ProLiant server configured as a node in a PDC/O2000 for Oracle 9i RAC cluster with Microsoft Windows 2000 Advanced Server and the MSA1000 storage solution using StorageWorks Secure Path Software Version 3.1B.

After the problem occurs, recover the node(s) that dropped out by rebooting each node and allow the node(s) to rejoin the Oracle 9i RAC cluster and restart the database instance.

To prevent this problem from occurring, apply SoftPaq SP19812, "PDC/O2000 for MSA1000 Patch," to each server in the Oracle 9i RAC cluster. SP19812 can be downloaded from the following URL:

**<ftp://ftp.compaq.com/pub/softpaq/sp19501-20000/SP19812.EXE>**

## DOCUMENT NUMBER: OI021203\_CW01

### Novell Secure Path 3.0c Workgroup Edition/ Large Cluster Issue

In a SAN configuration with multiple MSA1000 storage arrays, HP Secure Path 3.0c for Netware Workgroup Edition may cause Abends in some or all of the clustered servers when complete power loss has occurred to an MSA1000 in the SAN or when the MSA1000 is accidentally removed from the SAN due to a cable pull:

1. Limit Clusters to 2 or less nodes.
2. Increase polling interval from the default of 90 seconds to greater than 300 seconds.
3. Ensure steps are taken to keep the MSA1000 from being abruptly removed from the SAN i.e. ensure cables are run off the floor, use separate power sources and battery backups are in use.
4. Ensure steps are taken to keep any attached storage shelves attached to the MSAs from being powered off or disconnected. Ensure cables are run off the floor, use separate power sources and battery backups are in use.

This condition is primarily visible with HP Secure Path 3.0c with NetWare 5.1 clustered server configurations with nodes exceeding more than 2 (i.e. 4, 6, 12) and more than one MSA1000 is accessed from the same host. This condition can also occur when one of the MSAs is totally removed from the SAN, by a total loss of power, or by both fiber I/O cables being pulled or disconnected.

The issue is being investigated and as soon as a fix is found, tested, and qualified then a patch will be posted to the following website:

**<http://h18000.www1.hp.com/products/storageworks/MSA1000/index.html>**

## DOCUMENT NUMBER: EX011221\_CW01

### **Mandatory Firmware Upgrade Needed To Support Stripe Size Greater Than The Default 16 KB For A Logical Drive Using Advanced Data Guarding (ADG).**

When configuring logical drives on the controllers listed in the "Scope" section of this document, a controller firmware upgrade is MANDATORY if both of the following conditions are true:

- A logical drive is configured for Advanced Data Guarding (ADG)
- A stripe size of 32 KB or 64 KB is selected (the default is 16 KB)

A logical drive is not affected by this issue if any of the following are true:

- The controller firmware has been upgraded as described in the Resolution.
- The logical drive is NOT using ADG (even if it resides on the same physical drive(s) configured with ADG).
- The logical drive is configured for RAID 1+0, RAID 5, RAID 1 or RAID 0.
- The logical drive is configured for ADG with a stripe size of 8 KB or 16 KB. This configuration is fully supported without the firmware upgrade listed in the Resolution.

HP strongly recommends that **all** affected controllers be upgraded in order to avoid potential problems that may occur if logical drives are later configured with ADG and a stripe size of 32 KB or 64 KB. Even if this configuration is used, potential problems would only occur if a physical drive also fails.

**Note:** This issue was discovered by HP and has NOT been reported by customers.

This issue affects the following HP storage products with the specified firmware version:

- HP ProLiant Cluster HA/F100 for MSA1000 with firmware version 1.14
- HP ProLiant Cluster HA/F200 for MSA1000 with firmware version 1.14
- HP ProLiant DL380 G2 Packaged Cluster with controller firmware version 1.08
- HP Smart Array 5302 Controller with firmware version 2.18 or lower
- HP Smart Array 5304 Controller with firmware version 2.18 or lower
- HP Smart Array Cluster Storage with firmware version 1.08
- HP StorageWorks Modular SAN Array 1000 (MSA1000) with firmware version 1.14
- For a HP StorageWorks Modular SAN Array 1000 with firmware version 1.14, upgrade to MSA1000 Firmware Release Version 1.16A.

For information on the HP StorageWorks Modular SAN Array 1000 firmware, the SoftPaq text file can be viewed at the following URL:

**<ftp://ftp.compaq.com/pub/softpaq/sp19501-20000/sp19663.txt>**

SoftPaq SP19663, "Compaq StorageWorks Modular SAN Array 1000 firmware," can be downloaded at the following URL:

**<ftp://ftp.compaq.com/pub/softpaq/sp19501-20000/sp19663.exe>**

**Note:** This upgrade allows the use of the Array Configuration Utility (ACU) with stripe sizes larger than the default stripe size of 16 KB.

## Learning Check

1. Where can you find information about the Modular SAN Array 1000 (MSA1000) SAN solution?  
.....

2. What is the correct power on sequence for the MSA1000?
  - a. Power on everything simultaneously
  - b. Interconnect, MSA1000, and secondary storage, servers
  - c. Expansion storage enclosures, MSA1000, and then server
  - d. Servers, external primary and secondary storage, interconnect

3. Which lights indicate the controller is not present?
  - b. Two blinking lights on the Fibre Channel I/O Module
  - c. Two blinking lights on the controller
  - d. Two blinking lights on link module.
  - e. One blinking light on the controller.

4. List the three types of operation messages.  
.....  
.....  
.....

5. The amber indicator on the power supply assembly is on when both the power supply and the blower are operational.  
 True  
 False

6. How many operational messages can the display module hold?
  - a. 40
  - b. 60
  - c. 80
  - d. 100

7. List three ways you can tell if a hard drive has failed.  
.....  
.....  
.....

8. What guidelines should you follow when replacing your controller?

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

9. What documents provide information on known issues and their resolution with the MSA1000?

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



## Module 1

1. Briefly describe current industry storage trends. (p2)  
Customers are facing an exponential demand for increasing storage capacity as their businesses grow and they continue to deploy more powerful, efficient solutions. Provide a simple definition for a storage area network (SAN).
2. List five features of a SAN. (p4)  
A secure implementation of storage I/O methods over network transports  
A high-speed, scalable, robust network of servers and storage devices  
A storage service that:
  - Connects to enterprise-wide servers
  - Centralizes data
  - Moves data automatically for availability and replication
  - Provides accelerated data access
  - Supports advanced storage management
  - Provides for highly available configurations
  - A natural platform for server clustering applications
3. List five benefits of a SAN. (p6)  
Centralized storage  
Elimination of server downtime while adding storage  
Improved availability  
Modular scalability  
Serverless backup  
Online storage migration
4. HP? (p11)  
Directors  
Fabric Switches  
Arbitrated Loop Switches
5. Describe zoning. (p20)  
Group of fabric-connected devices (storage, tapes, hosts) arranged into a specified grouping
6. When is zoning required on a HP-UX 11.0 or 11i? (p22)  
In a heterogeneous SAN

7. Describe two advantages of implementing storage consolidation. (p8)

Saves money by creating a larger pool of storage for the hosts

Servers can have access to the same-shared pool

Administrator can now meet his storage requirements without having to purchase any additional storage.

The average storage in a non-SAN environment that a single administrator can adequately handle is under 500GB. In a SAN environment, that same administrator can manage up to four to six times that amount.

8. Describe DAS to SAN (DtS) architecture. (p9)

Exclusive HP feature that provides a quick and easy way to migrate stored data protected by Smart Array controllers to a MSA1000 storage system.

DtS architecture is a direct-attached storage-to-storage area network that provides:

Instant consolidation of DAS into a SAN environment.

An upgrade path from Smart Array controlled drives and data to a SAN environment.

Simple redeployment of DtS environment for growth management and capacity utilization that supports up to 42 drives and 32 volumes.

## Module 2

1. What is the MSA1000 position in a SAN environment?(p3)  
The MSA1000 is positioned to be an easily affordable, scalable, high-performance storage system for entry-level to mid-range SAN environments.
2. List five key features of the MSA1000. (p6-7)  
Direct-Attach to SAN (DtS) architecture data migration.  
A 4U rack-mount design combining both the controller and disk shelf.  
2Gb Fibre Channel connection to the hosts.  
Optional embedded 6-port 2Gb Fibre Channel Fabric Switch (MSA Fabric Switch 6).  
Optional embedded 3-port 2Gb Fibre Channel hub (MSA Hub 2/3) for low cost 2-node clustering.  
Ultra3 SCSI disk drive connections.  
Support for HP Ultra2, Ultra3, and Ultra320 universal 1-inch hard disk drives.  
Scalability from 3 to 42 physical drives with 2 optional storage expansion enclosures (StorageWorks 4200/4300 enclosures).  
Support for 1Gb and 2Gb Fibre Channel infrastructures.  
Advanced Data Guarding (ADG) RAID protection.  
Autonegotiated F, FL and L Fibre Channel port login.  
Primary and secondary Inter-Controller Link (ICL).  
Support for attaching multiple two-node clusters and single servers.  
Ability to hot-add clusters and drive enclosures.  
Support for Windows NT, Windows 2000, NetWare, and Linux.  
Optional support for Secure Path on Windows NT, Windows 2000, and NetWare.
3. Which customer benefit offers redundant components? (p8)  
Availability

4. What exclusive HP feature provides a quick and easy way to migrate stored data protected by Smart Array? (p10)

DtS

5. In the DtS process, what occurs when drives are moved from the RA4100 to the MSA1000? (graphic p10).

New array recognizes configuration immediately

## Module 3

1. List three base MSA1000 components that are hot pluggable. (p4)  
MSA1000 Controller  
Hard Drives  
Fibre Channel I/O Module  
Power Supply/Blower Assembly  
MSA Fabric Switch 6  
MSA Hub 2/3
2. List two additional MSA1000 components. (p29-30)  
Fibre Channel Adapter 2101 (FCA2101) HBA  
Fibre Channel Adapter 2210/2214 (FCA2210/2214) HBA  
MSA Fabric Switch 6 Integrated six-port, 2Gb/s Fibre Channel fabric switch, 2Gb/1Gb frequency agile (one hop)  
2Gb Fibre Channel fabric switches—Infrastructure family of switches (up to seven hops).  
2Gb Fibre Channel fabric switches—High availability family of switches (up to three hops).  
MSA Hub 2/3  
HP StorageWorks Enclosures models 4214 or 4314 (to expand drive capabilities)  
Redundant controllers, power supplies, and fans  
I/O Module Kit  
Ultra320 Universal hard drives
3. What are the nonredundant configuration options for the MSA1000? (p44)  
MSA Fabric Switch 6 — Includes four fixed 2Gb transceivers and a 2Gb hot-pluggable transceiver for a fifth port (not included)  
Optional MSA Hub 2/3  
FCA2101, FCA2210, or FCA2214 Host Bus Adapter  
256MB Cache Module for Controller Battery-Backed
4. What is a Network Storage Router? (p50)  
Fibre Channel-to-SCSI bridge that allows multiple host servers to communicate with a tape device over a Fibre Channel link.

5. What are three benefits of an EBS SAN backup? (p52)
- Shared tape storage
  - Scalability
  - Automation
  - High performance
    - Backup up to 158.4GB/h
    - No network bottlenecks
  - Snapshot with Virtual Replicator

## Module 4

1. What operating systems does the Modular Storage Array 1000 (MSA1000) solution support? (p2)  
NetWare 5.1 Support Pack 4  
NetWare 6.0 Support Pack 1  
Red Hat Linux Professional 7.2  
Red Hat Linux Advanced Server 2.1  
SuSE Linux Enterprise Server  
Windows NT 4.0 SP6a  
Windows 2000 Server/Advanced Server SP2
2. Where would you find a current list of supported operating systems in the MSA1000 SAN solution?  
HP storage website
3. Multiple Windows NT clusters can share one MSA1000 storage system. (p5)  
 **True**  
 False
4. How many hops are supported in the MSA Fabric Switch 6 for the MSA1000 SAN solution? (p4, 16)
  - a. 0
  - b. 1
  - c. 2
  - d. 7
5. When implementing a no single point of failure configuration with the MSA1000 SAN what components are required? (p13)
  - a. Two HBAs per server
  - b. Dual array controllers in the MSA1000 storage system
  - c. Multipathing software, for example, Secure Path
  - d. All the above
6. List the components that are required for a single path MSA1000 configuration. (p12)  
one HBA per server  
one interconnect device  
one MSA1000 controller per storage

## Module 5

1. List the basic steps to install the Modular Storage Array 1000 (MSA1000) solution. (p2)

First, a host bus adapter (HBA) is installed in the host server.

Then the HBA is connected through a fiber optic cable to an interconnect device.

Finally, the MSA1000 Support and Software CD is used to install the HBA drivers, configuration tools, and management tools on the host computer

2. List the steps to install the MSA Hub 2/3. (p5)

If there is a blanking panel in place, loosen the thumb-screw that holds the panel in place and remove the panel from the back of unit 2.

If an existing Modular SAN Array Fibre Channel I/O Module is being replaced with a switch or hub, remove the I/O Module from the slot.

Insert the interconnect device into the MSA1000.

3. What is the function of the msainstall script used to update the Linux HBA drivers? (p11)

Patches the kernel source and creates a new kernel image that allows Linux to detect the MSA1000 Controller and its configured LUNs

## Module 6

1. Which management application performs the initial configuration of the MSA1000? (p4)

The ACU uses a graphical interface to help you configure the MSA1000 controller. The interface initially can be used to configure the controller

2. What are the two components of a CLI command? (p10)

Basic command plus specific command options

3. Which management application provides the most information on all components of the MSA1000 SAN? (p7)

- a. Tape Management console
- b. Web Tools
- c. FC-AL Switch Management Utility
- d. Insight Manager 7

4. List, and describe the use of, five Web Tools capabilities used to manage a fabric switch. (p42)

Monitoring and managing the entire fabric:

- The status of all switches in the fabric
- Event log for entire fabric access
- Zoning functions (optionally licensed)
- Name Server Table access
- Telnet functions
- Switch beaconing for rapid identification in large fabric environments
- Loop diagnostics and query and control of loop, interfacing to aid in locating faulty devices
- Ability to name and zone QuickLoops

Monitoring and managing individual switches

- Summary information about each switch
- Event logs for individual switch access
- Switch configuration and administration
- Ability to upgrade the fabric operating system and license key administration
- Report capability for switch configuration information

■ Monitoring and managing individual ports:

- Port status
- Information about Gigabit Interface Converter (GBIC) Serial IDs
- Information about connected devices
- Loop information
- Port performance including frame counts (frames in, frames out) and error counts

## Module 7

1. List the platforms for which there is Secure Path support for the MSA1000. (p2)  
Windows Workgroup Edition  
NetWare Workgroup Edition
2. Which feature of Secure Path is supported by Secure Path Manager? (p5)  
Manageability
3. What are the software components of Secure Path? (p6-7)  
Secure Path Manager (SPM)  
Secure Path Element Manager (SPEM)  
Secure Path Agent  
Notification Utility (NU)
4. What are the two environments in which you can install Secure Path Manager? (p8)  
Standalone  
HP OpenView Storage Management Appliance
5. What is the Secure Path supported HBA in a NetWare environment? (p13)  
FCA2210

## Module 8

1. Where can you find information about the Modular SAN Array 1000 (MSA1000) SAN solution? (p2)  
All information relating to the MSA1000 SAN solution can be accessed on the HP website by selecting *products* → *storage* → *storage array systems*, then select *modular san array 1000* under the *modular array systems* category.
2. The correct power on sequence for the MSA1000 is? (p3)
  - a. Power on everything simultaneously
  - b. Interconnect, MSA1000, and servers
  - c. Expansion storage enclosures, MSA1000, and then server
  - d. Servers, external primary and secondary storage, interconnect
3. Which lights indicate the controller is not present? (p4)
  - a. Two blinking lights on the Fibre Channel I/O Module
  - b. Two blinking lights on the controller
  - c. Two blinking lights on link module.
  - d. One blinking light on the controller.
4. List the three types of operation messages. (p9)  
Error  
Informational  
User input
5. The amber indicator on the power supply assembly is on when both the power supply and the blower are operational. (p8)
  - True
  - False
6. How many operational messages can display module hold? (p9)
  - a. 40
  - b. 60
  - c. 80
  - d. 100

7. List three ways you can tell if a hard drive has failed. (p6)

The amber status indicator will light up on the front of a HP storage system if failed drives are inside. (Other problems such as fan failure, redundant power supply, or over-temperature conditions will also cause this indicator to light up.)

A front panel display message will list failed drives whenever the system is restarted, as long as the controller detects one or more good drives.

Insight Manager 7 can detect failed drives locally or remotely across a network.

8. What guidelines should you follow when replacing your controller? (p13)

If your system is equipped with a single controller, and that controller fails, it is recommended that the cache module from the failed controller be migrated to a new controller. Migrating the cache module to the new controller allows the completion of disk writes that may have been pending in the failed controller's.

If an expand process is occurring, a dual controller system will transition into a non-redundant state. If a controller failure occurs during an expand process, it is required that the cache module from the failed controller be migrated to the replacement controller to complete the expand process. If the expand process does not complete the array contents will be invalid

9. What documents provide information on known issues and their resolution with the MSA1000? (p21)

Service Advisory

