Sun StorEdge™ A5X00 Array Family

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Positioning

Introduction

Today’s businesses are information driven. The need to access and analyze corporate information in real-time, update databases, perform trend analysis, provide high customer satisfaction, and operate in 24x7 environments is changing the demands placed on storage systems. It is no longer sufficient for mass storage subsystems to simply provide increasing levels of capacity—they must also be fast, available, reliable, and highly serviceable in order to meet the requirements of both users and applications.

Traditionally, storage systems were designed as an adjunct to the computing environment, with protocols like the small computer systems interface (SCSI) being created and modified as performance needs dictated. Perhaps the most popular add-on peripheral protocol to date, SCSI is reaching its performance and architectural limits. Combined with their other liabilities, distributed SCSI storage systems are becoming a severe bottleneck as computer systems and networking technology continue to advance and the demand for fast data access grows.

These trends underscore the need not only for recentralizing shared data, but also for ensuring that data can be accessed by a wide variety of users quickly and continually. By combining the latest storage technology breakthroughs with high speed networking, organizations can create a scalable Intelligent Storage Network™ environment, in which information and administration is centralized. Dedicated to storage, an Intelligent Storage Network environment offers many of the features associated with today's networks within a framework designed to meet changing data storage requirements. Like the best networks, an Intelligent Storage Network environment is standards-based, scalable, modular, multipathed, centrally managed, and multi-vendor. Like the best peripheral it has a high performance level and low latency. It is also highly available, configurable for a variety of work loads, and able to perform well in clustered environments.

Sun Microsystems believes that Fibre Channel is the core technology that allows the Intelligent Storage Network environment to become a reality. The flexibility, high performance, and reliability of Fibre Channel technology allows organizations to create big, fast storage networks into which not only disks and RAID subsystems can be plugged, but eventually tape backup, archive, hierarchical storage management (HSM), and library systems as well.

Sun StorEdge™ A5X00 Disk Array Family

Sun continues to set the standard for Fibre Channel-based storage arrays with the Sun StorEdge™ A5X00 family of arrays. A second-generation FC-AL subsystem, the Sun StorEdge A5X00 arrays are one of the most popular Fibre Channel storage arrays available. The building block of Sun's Intelligent Storage Network environment, the Sun StorEdge A5X00 arrays provide the FC-AL backbone that is central to providing data services in the storage network.

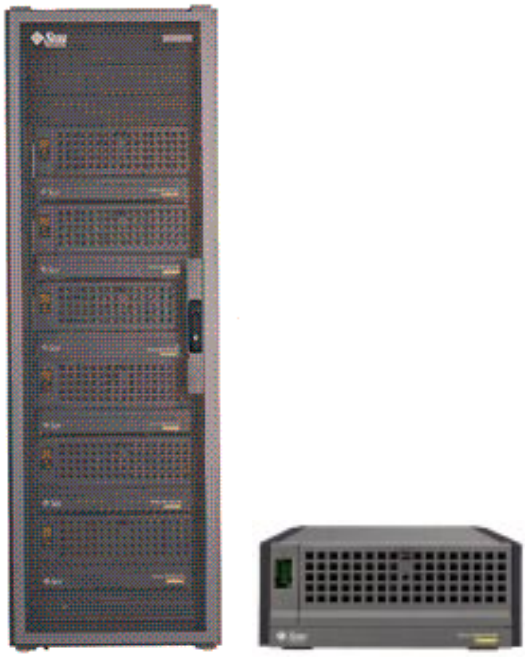


Figure 1. The Sun StorEdge A5X00 disk array

Using second-generation Fibre Channel technology and offering high reliability, availability, and serviceability (RAS) features, the Sun StorEdge A5X00 array family is scalable from the desktop to the data center—offering exceptionally high performance and scalability. Indeed, the Sun StorEdge A5X00 array family excels in high-bandwidth applications such as decision support, data warehousing, and other mission-critical environments.

The Sun StorEdge A5200 array offers a 22-drive subsystem enclosure. This enclosure offers users the flexibility of choosing a cost-effective unit with either low price per megabyte or high-performance drives.

New Features

The drive capacity of the Sun StorEdge A5200 storage arrays is now doubled with new 36-GB, 10000-rpm drives. These drives are now available along with associated upgrades.

The introduction of the 36-GB low-profile (LP) drives into the Sun StorEdge A5200 array doubles the storage available for each array to over 800 GB, and for each 72-inch rack to over 4.8 TB (using six arrays). This provides customers scalable, high-performance storage with very high density. The new drives also lower the cost per MB of storage.

Sun StorEdge Component Manager software is now bundled with the Sun StorEdge A5200 arrays, allowing large numbers of arrays to be centrally administered. Administrators can configure, monitor, control, and diagnose the Sun StorEdge A5200 storage system from a single graphical interface. This capability allows an organization to grow its storage capacity without increasing administration cost and complexity.

The Sun StorEdge A5100 array configurations are being transitioned. The introduction of the 36-GB LP drive for the Sun StorEdge A5200 array offers a denser equivalent at a lower price.

The 9-GB drive configurations of the Sun StorEdge A5200 array are being discontinued. The 18-GB drive array configurations offer twice the capacity for close to the same price as the 9-GB drive arrays.

Product Family Placement

The Sun StorEdge A5X00 array is part of a series of mass storage systems designed to support the Intelligent Storage Network environment. Sun solutions scale from small desk-side systems to mainframe-class storage solutions.

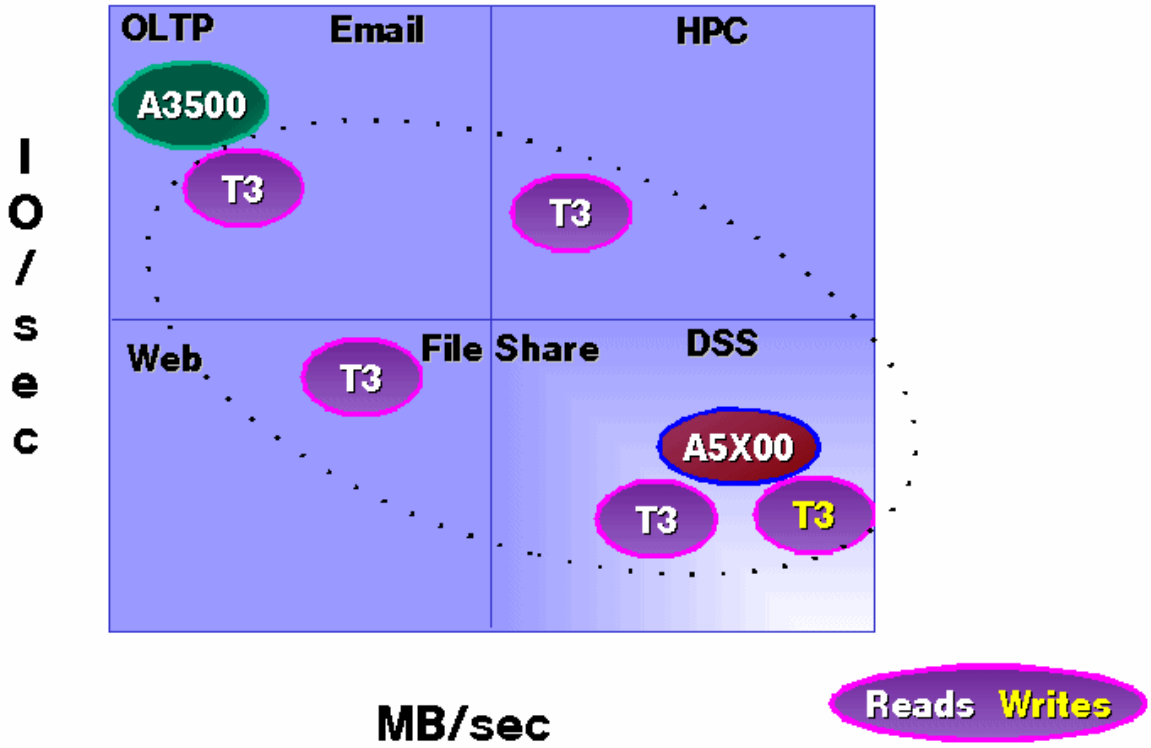


Figure 2. The Sun StorEdge product family positioning

The following products are included in the Sun StorEdge product family:

- **Sun StorEdge A1000/D1000 array**

  The product of choice for workgroups with storage requirements less than 150 GB. The Sun StorEdge A1000/D1000 array offers users Solaris™ Operating Environment, HP-UX, and Microsoft Windows NT connectivity, performance, and scalability at sensitive price points, and the choice of controller-based or host-based RAID.

- **Sun StorEdge A3000/3500 array**

  The ideal choice for environments that have stable capacity requirements (scalability is not a key factor), have centrally managed remote sites with limited on-site system administration support, and need a controller-based RAID solution with Microsoft Windows NT support.

- **Sun StorEdge A5X00 array**

  An excellent choice for mission-critical environments. The Sun StorEdge A5X00 array provides the outstanding scalability, availability, and performance using gigabit Fibre Channel technology in a host-based RAID solution. Sun StorEdge A5200 arrays are available in hubless configurations.

- **Sun StorEdge T3 array**

  The Sun StorEdge T3 arrays are general-purpose arrays using Fibre Channel technology. They come in two models: Sun StorEdge T3 array for the workgroup and the Sun StorEdge T3 array for the enterprise.

  – The Sun StorEdge T3 array for the workgroup includes these features: simple, cost-effective, flexible storage; direct-connect to application hosts; ideal for LAN environments; performance for business-critical web, graphics, video, NAS, NFS, collaboration, and file sharing applications.

  – The Sun StorEdge T3 array for the enterprise includes these features: highly available, massively scalable storage; indirect connect to multiple hosts; ideal for SAN environments; and continuous performance for mission-critical data warehousing, data marts, ERP, email, and e-commerce applications.

Key Messages

The Sun StorEdge A5X00 subsystems offer high performance, high RAS, and leading-edge technology.

1. High Performance

Performance test results show that the Sun StorEdge A5X00 subsystem provides exceptional raw system performance. How exceptional? The system provides over 9,400 input/output per second (IOPS) per loop (these are dual-loop systems) and 316 MB per second of actual user-data bandwidth per loop. The only announced competitor, Data General, is claiming performance of 5,000 IOPS and 75 MB per second per loop.

2. High RAS (Reliability, Availability, Serviceability)

The RAS features of this array exceed the features of its predecessor, the SPARCstorage™ Array family. Sun StorEdge A5X00 arrays include the following advanced features:

- Redundant power supplies
- Redundant interfaces (array)
- Redundant interfaces (drive)
- Hot-swappable drives
- Hot-swappable power
- Hot-swappable cooling
- Hot-swappable interfaces
- Diagnostics (FRU revision levels)
- Diagnostics (host adapter)
- Diagnostics (array interface)
- Diagnostics (tray)
- Automatic loop failover
- Load balancing across loops
- Full CRC datapath support

3. Network Storage Strategic Direction

Sun continues to set the standard for Fibre Channel-based storage arrays with the Sun StorEdge A5X00 array. A second-generation FC-AL subsystem, the Sun StorEdge A5X00 array models are one of the most popular Fibre Channel storage arrays available. The building block of Sun's Intelligent Storage Network environment, the Sun StorEdge A5X00 array provides the FC-AL backbone that is central to providing data services in the storage network.

Sun Microsystems is an acknowledged industry leader in Fibre Channel-based storage, with more than 4 petabytes shipped since 1993. The Sun StorEdge A5X00 subsystem builds upon that leadership by extending next generation Fibre Channel arbitrated loop (FC-AL) technology to disk drives.

Availability

The new Sun StorEdge A5200 array configurations are scheduled for General Availability on August 29, 2000. This release includes the 36-GB LP drives configurations and bundled Sun StorEdge Component Manager software.

Target Users

The Sun StorEdge A5X00 subsystem is the central building block of the Intelligent Storage Network environment, giving users a vision that begins with the second-generation Fibre Channel technology today.

Target User	**Buying Influence Needs**
MIS manager	FC-AL technology investment in the future
Procurement	Investment protection in FC-AL product line
Developer	Standards compliance for implementation of FC-AL products
Systems administrator	Flexible management in both software and hot-plug components
Operations	High availability, providing efficient system operation
End user	High performance, resulting in quick transaction response

Target Markets

The Sun StorEdge A5X00 array is well-suited for the capacity and performance requirements required by modern databases, operations application servers, network data services, and performance-oriented systems. Hubless configurations are ideal for Sun's high-performance, Sun Enterprise system customers who desire factory-configured Sun StorEdge A5X00 arrays without hubs attached. The Sun StorEdge A5X00 array is ideal for customers who require maximum storage per square foot of floor space, high performance with very high availability, and scalability to grow their storage easily.

Target markets include the following:

- Service providers (email, web servers, database, and e-commerce)
- Workgroup (NFS, e-mail, and file and print services)
- Enterprise and datacenter (OLTP, data warehouse, and e-commerce)
- Technical and scientific applications (high performance computing)
- Image capture and retrieval applications (medical imaging and high-performance data acquisition)

Applications

The Sun StorEdge A5X00 subsystem suits storage applications where superior throughput and high availability are required.

Application	Requirements
Data warehousing	High, scalable capacity for building large databases
Decision support systems	High, scalable throughput for delivery of large records and reports
On-line transaction processing	Fast I/O in support of multiple transactions
Network file service	Rapid random-read performance for file delivery service
Enterprise clusters	Business-critical application availability

Able to deliver high performance and high availability at low cost, the Sun StorEdge A5X00 array offers a scalable architecture that is ideal for cost-sensitive or volume applications where fast data access is required. With both tabletop and cabinet configurations, the Sun StorEdge A5X00 arrays are flexible, mass-storage subsystems supporting departmental, data center, and clustering environments with ease.

Selling Highlights

Market Value Proposition

The Sun StorEdge™ A5X00 product family is an open, scalable storage solution for customers who demand high availability and high performance. The Sun StorEdge A5X00 array also offers a very high density of storage for customers with limited floor space.

As organizations deal with the high costs of managing dispersed storage throughout their enterprise, the trend is to centrally locate and manage as much of the data as possible. A second trend is heightened awareness of the value of this data to the organization. As a result, storage is being called upon to deliver lower operational costs, high performance, and high availability. High availability includes not just ensuring that the storage is up and running, but also includes backing up the data without impacting service along with remote mirroring to protect against catastrophes.

The Sun StorEdge A5X00 family is designed to meet the challenges that organizations face in handling the increasingly critical data management. The hardware is designed so that no single point of failure exists. Arrays will typically be deployed using software mirroring (usually with striping for a combination of RAID levels 0 and 1) to provide excellent availability and performance. All or a portion of the Sun StorEdge A5X00 arrays can use software RAID 5 for high availability and good performance. Software management enhanced through the use of Jiro™ technology is available from Sun or third parties to simplify storage management and integrate it with other storage equipment. Multiple backup solutions combined with Sun StorEdge Instant Image software help ensure low-impact, fast, and reliable backup and restoration. Remote mirroring is available to allow mirroring data up to 10 km from the primary data location.

The introduction of the 36-GB disk in the Sun StorEdge A5200 array improves the value proposition for this array. More storage capacity is available in each array and rack. This helps increase the density of storage for a given footprint for space-limited customers. The cost per MB of storage is now much less expensive.

Hubless Configurations

Sun StorEdge A5200 array hubless versions provide greater customer flexibility in ordering and configuring at the factory. These configurations allow the customer to purchase a single array in a cabinet and then build to order with flexibility up to six arrays in a cabinet.

Compatibility

The following tables list the systems that support the Sun StorEdge A5X00 arrays.

Sun StorEdge A5200 Array Compatibility

Maximum capacities are stated in terms of 400-GB and 800-GB arrays. The exception is the Sun Enterprise™ 10000 server, which supports a maximum capacity of 30 TB per domain.

The table below shows a Sun StorEdge A5200 array with 18-GB drives.

Systems Supported	Maximum Number of Internal Arrays	Maximum Number External Arrays	Maximum Supported External Storage Capacity
Sun Enterprise 10000	0	60	30 TB
Sun Enterprise 6500	3	117	46 TB
Sun Enterprise 6000	1	117	46 TB
Sun Enterprise 5500	4	48	19 TB
Sun Enterprise 5000	1	48	19 TB
Sun Enterprise 4500-R	4	48	19 TB
Sun Enterprise 4500	0	48	19 TB
Sun Enterprise 4000	0	48	19 TB
Sun Enterprise 3500	0	24	9.6 TB
Sun Enterprise 3000	0	24	9.6 TB
Sun Enterprise 450	0	8	2.4 TB
Sun Enterprise 250	0	4	2.4 TB
Sun Enterprise 420R	0	2	800 GB
Sun Enterprise 220R	0	2	800 GB
Sun Ultra™ 80	0	2	800 GB
Sun Ultra 60	0	2	800 GB
Sun Ultra 2	0	2	800 GB

This table shows a Sun StorEdge A5200 array with 36-GB drives.

Systems Supported	Maximum Number of Internal Arrays	Maximum Number External Arrays	Maximum Supported External Storage Capacity
Sun Enterprise 10000	0	60	60 TB
Sun Enterprise 6500	3	117	92 TB
Sun Enterprise 6000	1	117	92 TB
Sun Enterprise 5500	4	48	38 TB
Sun Enterprise 5000	1	48	38 TB
Sun Enterprise 4500-R	4	48	38 TB
Sun Enterprise 4500	0	48	38 TB
Sun Enterprise 4000	0	48	38 TB
Sun Enterprise 3500	0	24	19.2 TB
Sun Enterprise 3000	0	24	19.2 TB
Sun Enterprise 450	0	8	6.4 TB
Sun Enterprise 250	0	4	3.2 TB

Systems Supported	Maximum Number of Internal Arrays	Maximum Number External Arrays	Maximum Supported External Storage Capacity
Sun Enterprise 420R	0	2	1.6 TB
Sun Enterprise 220R	0	2	1.6 TB
Sun Ultra 80	0	2	1.6 TB
Sun Ultra 60	0	2	1.6 TB
Sun Ultra 2	0	2	1.6 TB

Reference server configuration sites and storage support matrices for up-to-date compatibility information. Taking advantage of some features require loading additional patches to take advantage of operating functions.

Array Model	Maximum Arrays per Loop
Sun StorEdge A5100	Four arrays with up to 14 drives each for maximum of 56 total drives
Sun StorEdge A5200	Three arrays with up to 22 drives each for maximum of 66 total drives

Technology Overview

Fibre Channel technology is the answer to the growing problems of SCSI-based peripherals. Fibre Channel is a high-performance, serial-interconnect standard, designed for bidirectional, point-to-point communications between servers, storage systems, workstations, switches, and hubs. It offers a variety of benefits over other link-level protocols, including efficiency, high performance, scalability, simplicity, easy use, easy installation, and support for popular high-level protocols.

An important enhancement to Fibre Channel has been the development of Fibre Channel arbitrated loop (FC-AL) technology, developed specifically to meet the needs of storage interconnects. Employing a simple loop topology, FC-AL can support both simple configurations and sophisticated arrangements of hubs, switches, servers, and storage systems (see the figure below). Furthermore, by using SCSI protocols over the much faster, more robust Fibre Channel link, FC-AL provides higher levels of performance without requiring expensive and complex changes to existing device drivers and firmware.

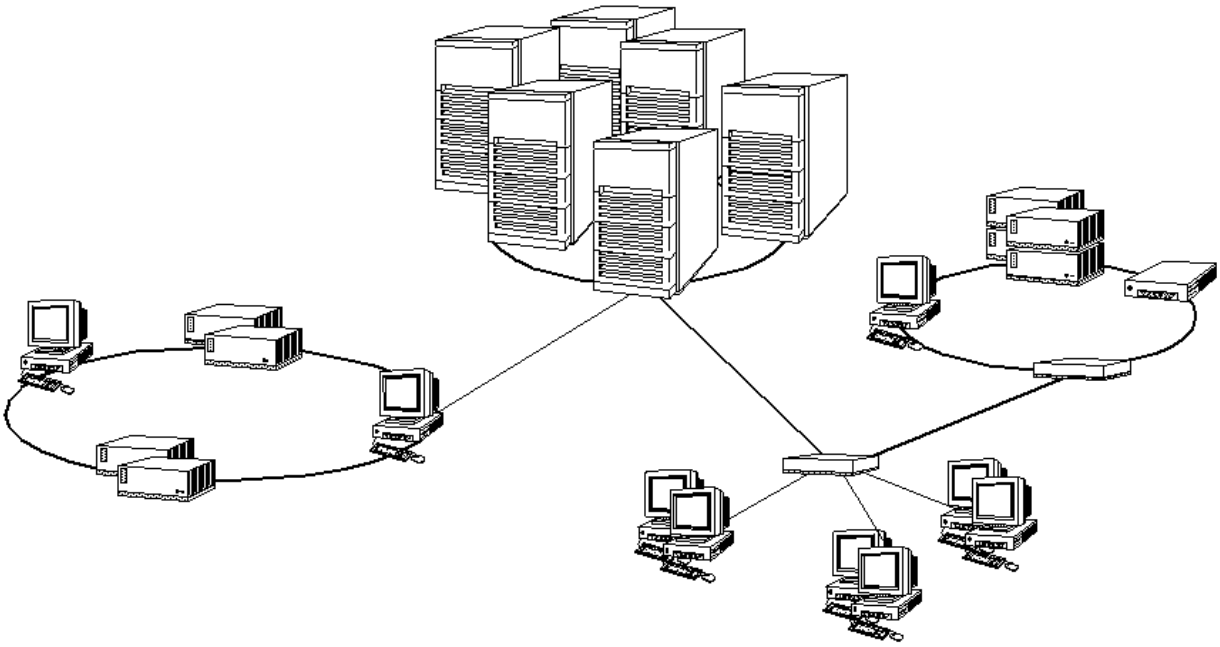


Figure 3. FC-AL's loop topology can support both simple and complex configurations

Impressive Specifications

FC-AL-based storage systems enable the creation of new applications that take full advantage of some impressive specifications:

- **Gigabit bandwidth—**FC-AL is capable of data transfer rates of up to 200 MB per second (full duplex), with 400 MB per second envisioned for the future. This is far faster than SCSI, serial storage architecture, or P1394 (FireWire®).

- **Suitability for networks—**In addition to performance, Fibre Channel is ideal for building storage networks. Employing hubs and switches just like those used in networks, Fibre Channel will allow complex arrangements of storage and systems to be connected together in highly scalable, highly available networks, or fabrics.
- **Use of existing SCSI protocols—**FC-AL allows SCSI command packets to be sent over a high-speed physical medium, reducing software and firmware costs and minimizing impact on existing software.
- **Node-addressability far better than SCSI—**With the ability to support up to 127 FC-AL devices on a single host adaptor, cost and implementation complexity is greatly reduced. Using optical fiber media, a single FC-AL loop can support nodes with a separation of up to ten kilometers.
- **Greatly simplified wiring and cabling requirements—**Because Fibre Channel is a simple, largely optical serial protocol, electrical interference and expensive cabling are much less of an issue than with the complex parallel data paths used by SCSI.

  In addition to these features, FC-AL supports redundant data paths, hot-pluggable components, multiple host connections, and dual ported drives—features that 15-year-old SCSI technology was never intended to support. The technical advantages of FC-AL alone would be enough to convince most that it clearly represents the future of high-speed peripheral interconnects, but FC-AL can also provide peace of mind to those who worry about the bottom line.
- **Industry-standard—**The FC-AL development effort is part of the ANSI/ISO accredited SCSI-3 standard, helping to avoid the creation of nonconforming, incompatible implementations.
- **Broadly supported—**Major system vendors are implementing FC-AL, as are all major disk drive and storage subsystem vendors. The Fibre Channel Association, an industry group dedicated to the promotion of Fibre Channel, is a Who's *Who* of systems, subsystems, drive, and component vendors. Such wide support provides competition, lower costs, and user choice.
- **Vastly more flexible**—Fibre Channel can also be used to do more than disk I/O. The Fibre Channel specification supports high-speed system and network interconnects using a wide variety of popular protocols, including HIPPI, TCP/IP, IPPI, FDDI, and ATM, in addition to SCSI. Many of the interconnect requirements of large enterprises may one day be met by Fibre Channel, promising lower costs, easier administration, and the easy deployment and redeployment of computing resources.

The following table shows a number of important technical advantages to Fibre Channel arbitrated loop (FC-AL) technology.

FC-AL Feature	Comparable SCSI Feature	FC-AL Benefits
100 MB/second data rates	40 MB/second data rates	Throughput to match modern computing, and peripheral and networking performance
127 devices per loop	16 devices per bus	Simpler, less expensive equipment requirements
Networking capability	None	Easier, simpler configuration of high-performance computing, file, and storage servers and clusters
Up to 10 km between nodes using optical fiber	Up to 25-meter differential	More flexible and secure hardware configurations
Hot-plug, dual porting	Hot plug, single porting	Support for high availability and disaster-tolerant configurations, and disk arrays
Use of cyclic redundancy checks to provide data integrity	Same	Better security and reliability

FC-AL Feature	Comparable SCSI Feature	FC-AL Benefits
Simple serial protocol over a copper or fiber medium	Parallel over copper	Less expensive, less complex cable requirements
Use of standard protocols like IP and SCSI	Same SCSI protocols	Reduced impact on system software and firmware; leverages existing code

Overview of System Architecture

The Sun StorEdge™ A5X00 subsystem is a high-availability, mass-storage subsystem that uses a disk enclosure capable of supporting up to 800 GB of storage with greater capacities to come as disk capacities grow. Active components in the disk enclosure are redundant and may be replaced while the subsystem is operating. The system includes a SCSI Fibre Channel protocol host adapter with dual Fibre Channel 100-MB FC-AL ports and supporting software. The Sun StorEdge A5200 subsystem disk enclosure is capable of supporting up to twenty-two 1.0-inch disk drives. The enclosure is designed to be mounted in a standard Sun rack or on a table top. Several disk enclosures may be attached in a loop. One or two interface boards may be installed in the enclosure. These boards provide FC-AL connections to the enclosure and additionally provide special services to report and control the state of the enclosure and its components. The enclosure has a front panel display and control panel that allow the configuration of the enclosure to be displayed and modified. No cables are used inside the Sun StorEdge A5X00 subsystem disk enclosure.

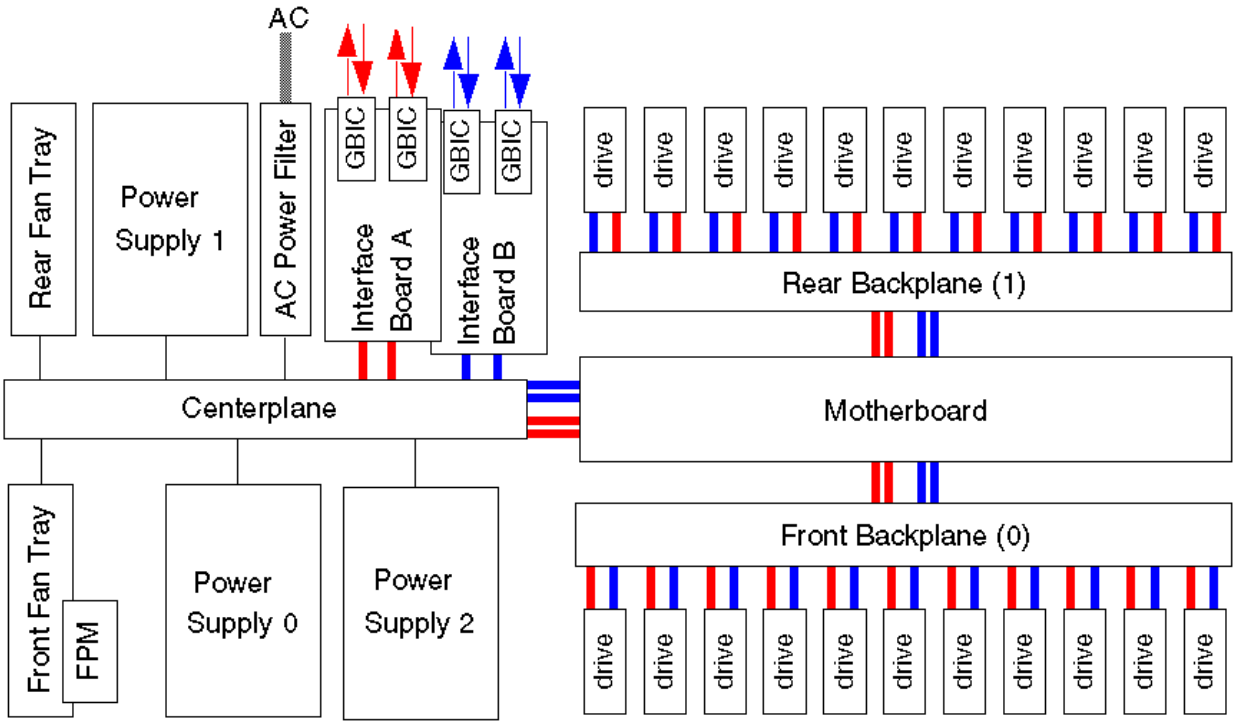


Figure 4. System architecture for the 22-drive configuration of the Sun StorEdge A5200 array.

Interface Board

There are slots for two identical interface boards in the lower rear of the Sun StorEdge A5X00 array enclosure. The interface board provides all intelligent controls in the enclosure, sensing and setting the environmental service signals as required by conditions inside the enclosure. The interface board interprets enclosure service commands from the host software or front panel module and performs the

indicated enclosure management and sensing functions. The interface board provides bypass services for two independent FC-AL ports and manages the configuration of the internal loops. Interface board unit A serves port A on each FC-AL disk drive. Interface board unit B serves port B on each FC-AL disk drive.

The Sun StorEdge A5X00 array enclosure can be configured as a single loop, a dual loop, or a split loop. When operating as a single loop, port 0 or port 1 of the interface board is connected to the Fibre Channel link. The other port is available for attachment of another Sun StorEdge A5X00 array enclosure or a host. When operating as a split loop, the front disk drives are connected to port 0 of the interface board and the rear disk drives are connected to port 1 of the interface board. This creates two separate FC-AL loops.

Loop Configurations

The Sun StorEdge A5X00 array uses a number of bypass circuits and multiplexors to allow reconfiguration of the nodes within the enclosure. The nodes can be configured as a full loop, or the loop may be split into two loops. Failing devices and circuits may also be bypassed. The loop configuration is controlled through the enclosure service commands set either from the host, by operator instructions through the front panel module, or automatically (to bypass failing or missing elements under control of the interface board).

Fibre Channel Disk Drives

All drives in the Sun StorEdge A5X00 array contain an FC-AL interface that supports the SCSI command set. Each drive uses a small form-factor, 40-pin single-connector attachment for FC-AL interconnect.

The FC-AL drives are dual-ported for multipath access. The A and B disk ports can be accessed through separate and independent interface boards. Each FC-AL disk drive is connected directly to the Fibre Channel loop and appears as a node on the loop. Each drive is identified by a World Wide Name that is unique. The FC-AL drives accept all standard SCSI-3 commands. Since SCSI commands are delivered directly to the drives via the Fibre Channel loop, a legacy copper SCSI interface is not required, enabling higher throughput and lower latency.

FC-AL drives are hot-pluggable. Software preparations, however, must be made for removal, replacement, and additions to be properly recognized and configured.

Gigabit Interface Converter (GBIC) Module

The gigabit interface converter (GBIC) module is a small, hot-pluggable, optical/electrical conversion unit that converts any of the standard Fibre Channel connector and signaling technologies to a standard internal serial connection. The full speed of the module is 1,062.5 Mbit per second.

The standard GBIC provided with the Sun StorEdge A5X00 array operates generically with either copper or optical connections. On one end is an electrical connection which interfaces with internal buses, while on the other end is an optical connection with the standard SC fiber cable connector. The GBIC uses a 780-nanometer shortwave laser that operates at an inherently safe power level so that no open fiber control safety circuits are required.

Using 50-micron fiber, the maximum length of a fiber should not exceed 500 meters. Controls to the GBIC allow for turning the transmitter on and off. Sense information from the GBIC indicates transmitter faults and loss of signal.

Long-wave GBIC

The long-wave GBIC module is an optical component technology which provides flexible and scalable remote mirroring solutions to mission-critical enterprise and storage customers. Long-distance mirroring is ideally suited for customers with campus networks or clusters that want to mirror data from storage devices over long distances. The long-wave GBIC module easily allows long-distance mirroring across Fibre Channel between Sun StorEdge A5X00 storage systems and Sun Enterprise™ servers.

Long-wave mode uses single-mode optical cables and long-wave lasers. Running in this mode and using 9-micron fiber, single-mode, optical cables, the cable length between Sun servers and storage can run a maximum distance of ten kilometers. This is major improvement of the current remote mirroring, which is limited to a distance of 500 meters.

The long-wave GBIC module is an optical component based on longwave, 1300-nanometer, laser-optical transceiver technology. The optical module is a hot-plug device which fits in existing Sun StorEdge A5X00 hubs, interface boards, and host adapters. The long-wave GBIC also requires single-mode, fiber optic cable complying with Sun specified standards. Sun Network Storage will specify supported configurations for deploying remote sites and mirrored storage.

Features	Benefits
• Up to 10-km remote mirror distance	• Protects your business through disaster recovery and provides business continuance
• Remote mirroring	• Provides high-level data protection and availability
• Campus clustering	• Extends flexibility is setting up your storage and server locations
• VERITAS Volume Manager software	• Mirroring capability included at no charge with Sun StorEdge A5X00 array purchase

Sun StorEdge Fast Write Cache 2.0 Accelerator

Sun StorEdge Fast Write Cache (FWC) is a host-based write accelerator available as a performance enhancement feature for the Sun StorEdge A5X00 product family. FWC improves the performance of write-intensive applications by minimizing the physical disk I/O accesses and delivers faster response times to user read requests for data. Writes are cached in non-volatile memory (NVRAM) and then the cached data is destaged to disk at a later time.

FWC is a host-based cache for the Sun StorEdge A5X00 array. Two NVRAM SBus or PCI adapters and storage cache management software are all installed onto the server platform accessing the Sun StorEdge A5X00 array; installation is not on the array itself. Release 2.0 is installed on Solaris™ Operating Environment servers and consists of the following:

- Two redundant 32-MB SBus NVRAM cache cards for the Sun Enterprise 3X00–10000 family of servers or two redundant 64-MB PCI NVRAM cache cards for the Sun Enterprise 250 and 450 servers
- Storage cache-management software for the Solaris Operating Environment

Features of FWC include the following:

- Support for dynamic reconfiguration/alternate pathing (DR/AP)
- GUI management
- Installation and initial configuration services bundled into the product

FWC is valuable to customers who run write-intensive applications. Adding the FWC product to configurations does not require that all writes on the application server be cached. With FWC, the system administrator can choose which volumes get cached and which volumes do not. Applications that do small sequential writes, such as OLTP, benefit from write caching. Therefore, the data for these applications should be cached.

The target applications for the Sun StorEdge Fast Write Cache product are:

- OLTP
- RAID 5
- Other write-intensive applications

Execution Platforms	Operating Environments	Storage Platforms	Software
• Sun Enterprise 250 • Sun Enterprise 450 • Sun Enterprise 420R • Sun Enterprise 220R • Sun Enterprise 3X00 to 6X00 • Sun Enterprise 10000 • Sun Ultra 60 • Sun Ultra 80	• Solaris 2.6 • Solaris 7 • Solaris 8	• Sun StorEdge A5000 • Sun StorEdge A5100 • Sun StorEdge A5200	• Sun StorEdge Instant Image 1.0 • VERITAS Volume Manager 2.6, 3.0.2 • VERITAS File System 3.2.1, 3.3.2

Notes: *Release 2.0 is not compatible with clusters because cache contents do not fail-over across cluster nodes attached to the same Sun StorEdge A5X00 array.*

There is a limit of one FWC product (two NVRAM boards) per server.

There is currently no plan to support the Solaris 2.5.1 Operating Environment with FWC.

The Sun StorEdge Fast Write Cache product is targeted for:

- Existing Sun StorEdge A5X00 array customers who run write-intensive applications and require additional disk I/O performance for these applications
- New Sun StorEdge A5X00 array customers who have high write performance requirements

Host Adapters

The SOC+ host adapter (SOC+HA) is a single-width, Fibre Channel SBus card. It operates in either 32-bit or 64-bit mode, and it has a second-generation Sun serial optical channel ASIC (SOC+) processor. The host adapter implements two independent FC-AL interfaces operating at 100 MB per second. One or two loops can be connected to each card using GBICs. The GBICs are hot-pluggable; the SOC+HA cards are not.

The SOC+HA supports both FC-AL loop and point-to-point FC-PH (SPARCstorage Array type) connections. However, the SPARCstorage Array is *not* supported on the SOC+HA due to speed incompatibility. SOC+HA also provides an open interface for connection of other devices meeting the same Fibre Channel protocol standards.

The host command buffer (HCB) and the SOC+ programming interface process requests with only a single interrupt (or less). As "tag queuing" is supported and multiple response entries may be in the queue when the host services the interrupt, it is possible to achieve less than one interrupt per I/O request.

A PCI connection via the FC-100 adapter is now available. Initially released for the Sun Enterprise 450 server, this adapter is a single-loop, 64-bit, 33-MHz PCI card. Two adapters are required for dual-loop operation. The optical GBIC is not removable on this adapter. All standard cables are supported.

Enclosure Services

Two standard mechanisms are provided for an operator to interact with the Sun StorEdge A5X00 array enclosure:

- The front panel module allows an operator to directly access most of the enclosure services.
- An operator can also access all the enclosure services through software (`luxadm`) running on the host computer. The SCSI Enclosure Services (SES) device model is used. This runs on the selected interface board's SOC+ chip using the Fibre Channel protocol for SCSI (FCP) across the FC-AL interface.

Note: *Customers can also order Sun StorEdge Component Manager software, a powerful Java™ technology-based application that helps manage attached Sun StorEdge arrays and their physical enclosures. The Sun StorEdge Component Manager application is described later in this section.*

All enclosure services are performed by the processor on the SOC+ chip on the appropriate interface board. If only one interface board is installed and operational, that interface board performs the enclosure services. If two interface boards are installed and operational, the enclosure services are performed cooperatively by the interface boards.

Enclosure services provide and/or accept configuration and maintenance information through the front panel module display and the host software. An interface board unit may override instructions from the host or from the front panel module operator if the instructions conflict with the requirement for maintaining proper and safe operating conditions in the enclosure.

The following units generate or receive enclosure status or control information:

- Power supplies
- Fan trays
- Interface boards
- GBICs
- Disk drives
- Disk drive backplanes

Front Panel Module

The Sun StorEdge A5X00 array enclosure has a front panel module which accepts touch switch inputs and provides graphic and alphanumeric information on an electroluminescent display screen. In addition, it has three LED indicators to provide summary status information. The front panel module has three main functions:

- Displays enclosure, drive, and loop status, and highlights errors
- Displays vital enclosure data—World Wide Name, box name, box ID, and so on
- Configures the enclosure—box name, loop configuration

The front panel module supplements the enclosure services provided through the SCSI-3 Environmental Services command set. The front panel module provides access to the same enclosure services and to some additional services even if the FC-AL is not connected or if the host processor's monitor and keyboard are distant from the array enclosure.

Touch Screen

The touch screen has a 3 x 6 array of touch areas which are under-labeled by images from the graphic display indicating when they are active and what action will be performed by each. The touch screen provides numeric inputs to the enclosure and provides buttons for stepping through the diagnostic and display menus.

These are the touch screen's main features:

- Bright, clear display
- 18-button touch screen for configuration and status
- Three-level menu system
  - Level 1—Menu and system view
  - Level 2—FRU groups and setup
  - Level 3—Individual FRU information and control
- Three system status summary LEDs

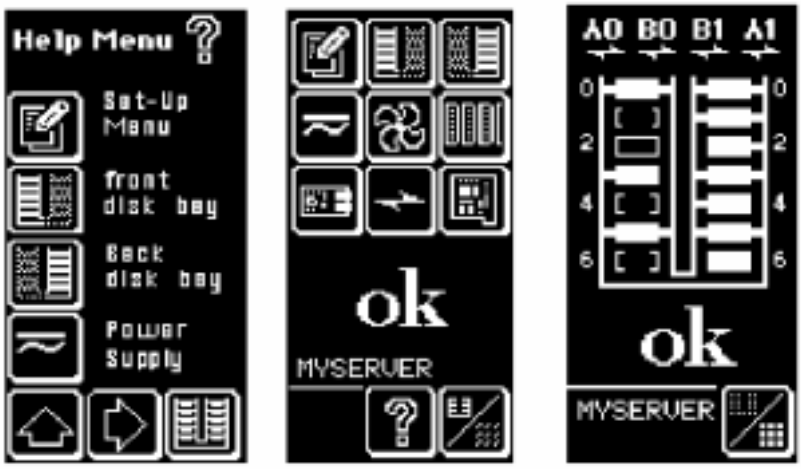


Figure 5. Front panel model touch screens

Fiber Cable

The Sun StorEdge A5X00 array supports 50/125 multimode, duplexed, UL910- and UL1651-approved fiber cable with OFNP marking. The connector is an SC connector with UL94V-2 rating (minimum). If the connectors do not have an overall jacket that keeps them together, it is advisable to color-code the connectors. Color-coding is particularly important in long cables (where the host and array are in locations remote from each other).

The Sun StorEdge A5X00 array also supports 9-micron, single-mode, EIA/TIA 492BAAA-approved, long-wave cabling, such as the Corning SMF-28 or Lucent equivalent. The connector is an SC connector with IEC-874-19 rating (for use with long-wave laser GBICs).

RAID Support

Sun StorEdge A5X00 arrays support RAID 0+1 and RAID 5. VERITAS Volume Manager software supports RAID technology to optimize performance, availability, and user cost. This technology

improves performance, reduces recovery time in the event of file system errors, and increases data availability even in the event of a disk failure. VERITAS Volume Manager software supports four RAID levels that provide varying degrees of availability with corresponding trade-offs in performance and cost:

- RAID 0 (striping and concatenation) allows data to span more than a single disk. While performance is improved, the lack of redundancy in this level leaves data unprotected.
- RAID 1 (mirroring) allows users to keep multiple copies of their data. In the event of a disk failure, data can be obtained from the remaining good copy, increasing data availability.
- RAID 0+1 (striping plus mirroring) provides the data protection of RAID 1 with the performance benefit of RAID 0.
- RAID 5 (striping with distributed parity) offers the ability to reconstruct data in the event of a single disk failure. Significantly less expensive than mirroring, RAID 5 is a common choice when low-cost availability is desired.

Dynamic Multipathing

Multipathing has traditionally meant that there are two hosts connected to a dual-ported drive set, each host with only one data path to the drives, with one host on each port. In order to take advantage of multiple access and failover capabilities, additional software is required to manage the two paths. This single data path has been a traditional operating system restriction. The traditional operating system has only one physical path for each device, and if that path fails, data access for that host is lost.

The dual interface boards in the Sun StorEdge A5X00 array, along with dual-ported disk drives, allow a configuration to have four possible data paths to a single enclosure. The drives, being dual-ported, also allow for a dual data path within the enclosure. This adds greatly to the overall reliability of the data path.

With the Solaris Operating Environment versions 2.5.1, 2.6, and 7, multiple paths per host to the same drives are recognized by the operation system. Host connections can now be redundant to dual ported drives. With the addition of VERITAS Volume Manager software with dynamic multipathing, these multiple pathways provide for better performance and automatic failover should a data path problem occur.

Hot Relocation

Data availability is needed even when a disk fails. VERITAS Volume Manager software permits users to specify disks as spares—disks that can be used for data reconstruction in the event of a disk failure. Data is automatically reconstructed and generated on the spare device, enabling the entire data set to maintain its availability.

Disk Groups

In the event of a system failure, users need assurance that they will have immediate access to their data. VERITAS Volume Manager software allows users to group disks and the volumes and file system that reside on them into disk groups. A disk group can be exported from a failed system and imported onto another system, providing users with access to the data.

On-line Resizing

File systems, and consequently the volumes on which they reside, change and grow over time. In the past, as file systems became full, administrators were required to take the file system off-line, back up the data, create a larger file system, and restore the data. With VERITAS Volume Manager software,

volumes and their UNIX® File Systems (UFS) can grow on-line, without disruption of user access. This capability increases data availability and eases administration.

On-line Backups

Backups are an essential part of any data management strategy, yet pose problems in enterprises that run 24 hours a day, 7 days a week, for 365 days a year. The traditional technique of performing backups during scheduled downtimes may be unacceptable for many organizations and application environments.

VERITAS Volume Manager software supports on-line backups through the use of snapshots, read-only copies of the volume and/or file system. When a snapshot is created, write operations continue to modify the active volume or file system, enabling application access to continue without interruption.

Performance Analysis Tools

VERITAS Volume Manager software includes performance analysis tools. The system can monitor the I/O load and obtain statistics on reads and writes at the disk and volume level. With this capability, users can monitor I/O performance and isolate bottlenecks. Once identified, bottlenecks can be removed by moving or reorganizing data, resulting in improved performance.

Sun StorEdge™ Component Manager Software

Sun StorEdge™ Component Manager software can be ordered with the Sun StorEdge A5200 array as a no charge item. Sun StorEdge Component Manager software is a Jiro™ open storage management platform-compliant, server-installed, Java™ technology-based application for managing attached Sun StorEdge arrays and their hardware components. Administrators and service personnel who install, monitor, and maintain supported Sun StorEdge arrays can use Sun StorEdge Component Manager software to perform a variety of subsystem tasks:

- Monitor enclosures by using hardware polling, alarm notification, event logging, and remote reporting for abnormal conditions and activities.
- Display the status of enclosures, enclosure components, and their associated properties.
- Exercise control directives on some enclosure components, for example, powering off a disk.

Note: *Sun StorEdge Component Manager software does not manage the logical organization of stored data.*

Sun StorEdge Component Manager 2.1 software runs on Sun Enterprise™ 250, 220R, 450, 420R, 3X00, 4X00, 5X00, and 6X00, and 10000 servers, and also on Ultra™ 60 and 80 workstations. Sun StorEdge Component Manager 2.1 software runs under the Solaris™ 2.6, Solaris 7, or Solaris 8 Operating Environment, and also supports the Microsoft Windows NT platform.

Use the Sun StorEdge Component Manager software when a graphical representation of array and enclosure attributes is preferred over selected command-line actions. Sun StorEdge Component Manager software may not be suitable, on server platforms with small memory configurations. On such platforms, Sun StorEdge Component Manager software's memory consumption of 70 MB and up for multiple arrays may outweigh the advantages of its graphical services.

Market Value Proposition

Sun StorEdge Component Manager software is new GUI-based software for managing the physical attributes of one or more attached Sun StorEdge enclosures. Sun StorEdge Component Manager software enhances the reliability, availability, and serviceability of storage assets under its custody through:

- Enclosure discovery
- Intuitive health displays
- Alarm generation
- Log monitoring
- Hardware control

Product Positioning

Sun StorEdge Component Manager software is positioned as a Java technology-based storage management software plug-in that is accessible from the Sun StorEdge Management Console software. Sun StorEdge Component Manager 2.1 software is fundamentally a tool for controlling and monitoring the physical attributes of the Sun StorEdge A5200 arrays. Sun StorEdge Component Manager software is ***not*** intended to address the logical organization of the data stored in those arrays.

In the larger picture, Sun StorEdge Component Manager software will take on the role of configuration, control, monitoring, and the diagnostic entry point for physical components. This will be an evolving

effort over the next few years, and will encompass new Sun StorEdge arrays, switches, and tape subsystems.

Sun StorEdge Management Console Software

Sun StorEdge Management Console software implements elements of the Jiro open storage management platform through a collection of fundamental Java technology-based storage management functions. Sun StorEdge Component Manager software and other Java technology-based Sun StorEdge management services rely on the Sun StorEdge Management Console software for these functions:

- GUI navigation
- Common event notification
- Common logging
- Alarm generation
- Remote notification (phone home)
- Distributed managed object discovery and communications
- Persistent state

The Sun StorEdge Management Console software launcher window presents a GUI for navigating through Sun StorEdge Component Manager software features. The main window includes a toolbar that the administrator can use to launch a new Sun StorEdge Management Console window, the Alarm Viewer, the Log Viewer, or online help. This window also includes management application tabs for Health, Configuration, and Control, plus alarm status buttons.

Sun StorEdge Component Manager Software GUI

Sun StorEdge Component Manager software's graphical user interface (GUI) and underlying management services run as plug-ins under the Sun StorEdge Management Console. Sun StorEdge Component Manager software's look-and-feel is consistent with other Sun StorEdge management services that are under development.

Sun StorEdge Component Manager software allows administrators and service personnel to monitor, display, and control devices and activities within supported Sun StorEdge A5X00 arrays. Descriptions for Sun StorEdge Component Manager software's basic functions follow.

Function	Description
Enclosure discovery	Identify the set of storage arrays and associated enclosures managed by a host.
Enclosure monitoring—health	Monitor and log the operational status of one or more storage arrays and associated enclosures managed by a host.
Enclosure monitoring—alarm generation and viewer	Create, display, and manage alarms generated by abnormal events detected by Sun StorEdge Component Manager software. Notification can include a combination of visual alarms to the GUI, e-mail messages, or SNMP traps for remote reporting.
Enclosure management and control	Control storage array and associated enclosure components; enable and disable RAID controllers
Log viewing	View log entries by administrator. Logging provides auditing results of tasks executed by Sun StorEdge Component Manager software, or provides information about a sequence of events.
Log file monitoring	Monitor a log file continuously for particular string patterns. Once a pattern is identified, rules that are preset in the application can trigger alarms or events.

Architecture

Sun StorEdge Component Manager software is a client-agent model application. The client part is a lightweight Java technology-based application GUI. The agent part is also written in the Java programming language, and runs on a Solaris Operating Environment server (host) to which the storage enclosure is attached.

Sun StorEdge Component Manager software is comprised of three layers:

- The top layer is the GUI-client layer that accepts user commands and reports results.
- The middle layer is the application layer that contains the logic to initiate data acquisition, process information, and schedule and generate sets of actions.
- The bottom layer is the managed-objects layer that performs hardware commands to satisfy requests through the underlying Java Native Interface (JNI).

The three layers communicate through distributed object management facilities in the Sun StorEdge Management Console software.

Performance Summary

- **Sun StorEdge™ A5200 array—9.1-GB model**

  Using a RAID 0+1 configuration with 9.1-GB, 10000-rpm drives, the Sun StorEdge A5200 array achieved a bandwidth (sequential reads) of 107 MB per second and I/O throughput of 3,215 IOPS.

- **Sun StorEdge A5200 array—18.2-GB model**

  Using a RAID 0+1 configuration with 18.2-GB, 10000-rpm drives, the Sun StorEdge A5200 array achieved a bandwidth (sequential reads) of 117 MB per second and I/O throughput of 3,417 IOPS.

- **Sun StorEdge A5100 array—36.4-GB model**

  Using a RAID 0+1 configuration with 36.4-GB, 10000-rpm drives, the Sun StorEdge A5100 array achieved a bandwidth (sequential reads) of 122 MB per second and I/O throughput of 3,286 IOPS.

Performance Test Results

The Sun StorEdge A5200 arrays are configured in both 22 x 9.1-GB and 22 x 18.2-GB models. The 18.2-GB and 9-GB Sun StorEdge A5200 array models achieved high I/O throughput of 3,417 and 3,215 respectively.

The Sun StorEdge A5100 array is now configured with fourteen 36.4-GB, 10000-rpm disk drives. The Sun StorEdge A5100 array using 36.4-GB, 10000-rpm drives provides a substantial performance improvement over the original Sun StorEdge A5100 array with 18-GB, 7200-rpm disks.

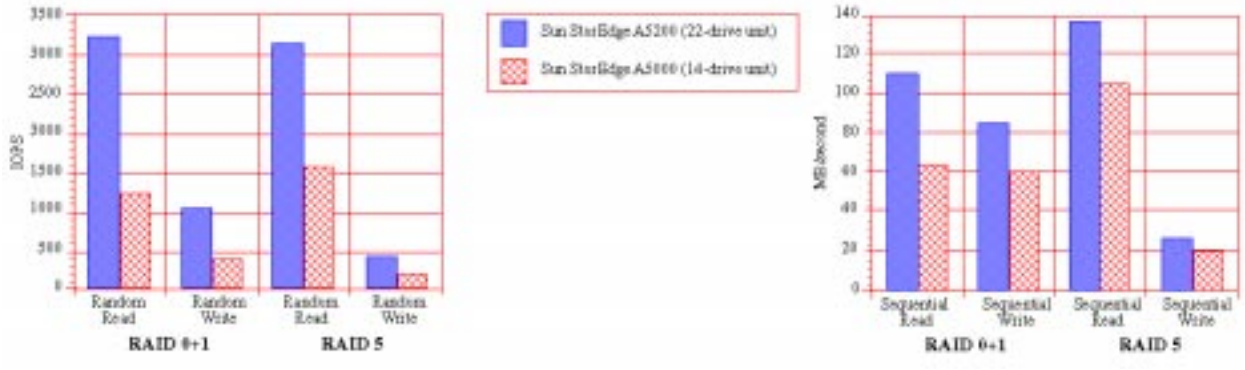
The Sun StorEdge A5X00 array utilizes dual-ported drives that can be split into separate front and rear subsystems. Two loops and dynamic multipathing with half of the disks on each loop were utilized, enabling a total of four discrete FC-AL loops to be configured for maximum performance.

Both RAID 0+1 and RAID-5 configurations were tested. The data in the following table was compared using full loops with dynamic multipathing—two host connections to each drive set. The random test seek range is 4 GB with a 2-KB I/O size. The RAID 0+1 configuration is configured with six drives in each submirror (6+6), while the RAID-5 configuration is comprised of ten data disks and one parity disk (10+1).

Sun StorEdge A5200 Array Performance Chart

Test Parameter	**RAID 0+1**				**RAID 5**			
Configuration	**22 x 18.2-GB drives**		**22 x 9.1-GB drives**		**22 x 18.2-GB drives**		**22 x 9.1-GB drives**	
Workload	IOPS	MB/sec.	IOPS	MB/sec.	IOPS	MB/sec.	IOPS	MB/sec.
• Random read	3,417		3,215		3,155		3,185	
• Random write	988		1,094		719		431	
• Sequential read		117		107		78		137
• Sequential write		88		83		32		25

The graphs below illustrate the performance of the Sun StorEdge A5200 array with twenty-two 9.1-GB drives compared to the previous-generation Sun StorEdge A5000 array with fourteen 9.1-GB drives.



Sun StorEdge A5100 Array Performance Chart

Test Parameter	RAID 0+1		RAID 0+1		RAID 5		RAID 5	
	Sun StorEdge A5100 Array		Sun StorEdge A5100 Array		Sun StorEdge A5100 Array		Sun StorEdge A5100 Array	
Configuration	**14 x 36.4-GB drives**		**14 x 18.2-GB drives**		**14 x 36.4-GB drives**		**14 x 18.2-GB drives**	
Workload	IOPS	MB/sec.	IOPS	MB/sec.	IOPS	MB/sec.	IOPS	MB/sec.
• Random read	3,286		1,232		3,134		1,555	
• Random write	1478		369		759		192	
• Sequential read		122		63		109		107
• Sequential write		88		60		30		19

The graphs below compare the performance of the 36.4-GB drive option for the Sun StorEdge A5100 array with the 18.2-GB drive option.

Requirements and Configuration

System Requirements

The Sun StorEdge™ A5X00 arrays are mass-storage subsystems using network technology and gigabit FC-AL to create high-performance, high-availability storage networks. The enclosure is designed to be mounted in a standard Sun system or expansion cabinet, or stand alone on a tabletop.

Operating Environment

- Solaris™ 8 Operating Environment
- Solaris 7 Operating Environment
- Solaris 2.6 Operating Environment
- Solaris 2.5.1 Operating Environment Hardware: 11/97, with patch 105310-13; Sun StorEdge Fast Write Cache 2.0 is not supported with this environment

Solaris Operating Environment patches are available on the SunSolve℠ web site at `http://sunsolve.sun.com`.

Notes: *The Solaris 7 and 8 Operating Environments are supported on the Sun StorEdge A5X00 arrays but require VERITAS Volume Manager 3.0.2 or later.*
Customers using the Solaris 2.5.1 Operating Environment must install a patch update to support 18-GB and 36-GB drives for installation in existing Sun StorEdge A5X00 systems.

Supported Host Platforms

The Sun StorEdge A5X00 array is supported on the following platforms:

- Sun Ultra™ 2, 60 and 80 workstations
- Sun Enterprise™ 250, 450, 220R, 420R workgroup servers
- Sun Enterprise 3500–6500 servers
- Sun Enterprise 10000 server

Note on limitations: *Long wave GBIC is only supported on Sun Enterprise 3X00–6500 and 10000 servers. Sun StorEdge Fast Write Cache is supported on Sun Enterprise 3X00–6500 servers*

System Configuration

The configuration choices for the Sun StorEdge A5X00 array should be application-driven. Balance availability, performance and price in determining the configuration:

- When configuring for availability, data and hardware redundancy are key. The choice of RAID method determines the level of data redundancy.
  - Mirroring (RAID 1) is best for availability in mission-critical applications and the only certain solution for disaster tolerance.
  - Parity (RAID 5) also offers good availability.

- When configuring for performance, the best benchmark is the application. Striping (RAID 0) is the largest performance booster.
- When price is the priority, minimum hardware and RAID 0 might be the best choice.

Front Components

The Sun StorEdge A5X00 array enclosure is accessible from both the front and the rear. At the front of the array is the first row of seven FC-AL hot-plug disk drives. Also accessible from the front of the system are two hot-plug power supplies and the first of two hot-plug fan trays. The front panel module is the electroluminescent display which provides information on local test and status.

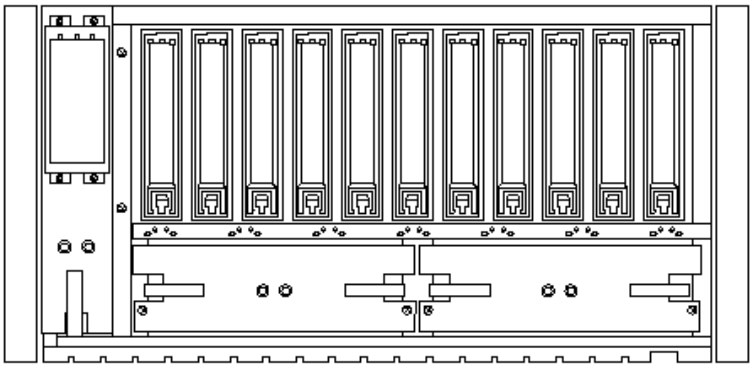


Figure 6. Front components

Rear Components

At the rear of the Sun StorEdge A5X00 array is the second row of FC-AL disk drives. Also, the third power supply and the other fan tray are accessed from this side, as well as two interface boards, each of which can hold up to two GBIC modules.

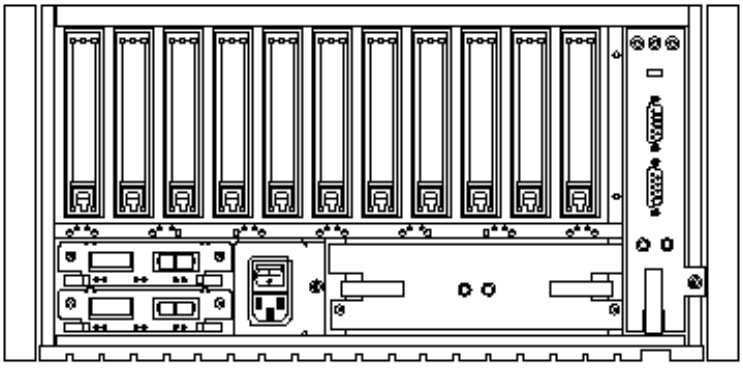


Figure 7. Rear components

FC-AL Seven-port Hub

The FC-AL hub supplied as an option is a seven-port device which simplifies the cabling of arrays. Each slot can hold one GBIC optical module, up to a total of seven. Four hubs can be mounted at the top of a Sun StorEdge expansion cabinet. Up to four Sun StorEdge A5100 arrays are supported per hub pair. Up to three Sun StorEdge A5200 arrays are supported per hub pair.

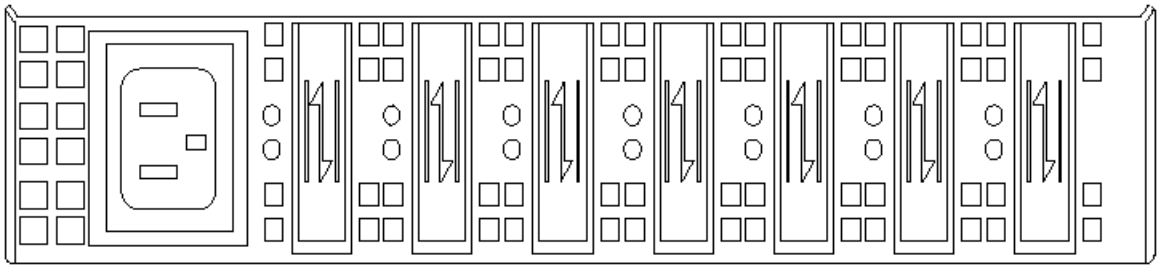


Figure 8. FC-AL seven-port hub

FC-AL SBus Host Adapter

The FC-AL host adapter for the Sun StorEdge A5X00 system is a dual-channel, 100 MB/second SBus card, which includes one GBIC optical module and support for one additional module. Up to six arrays using 132 drives can be connected to a single host adapter. However, using a single host adapter is not recommended for environments needing high availability.

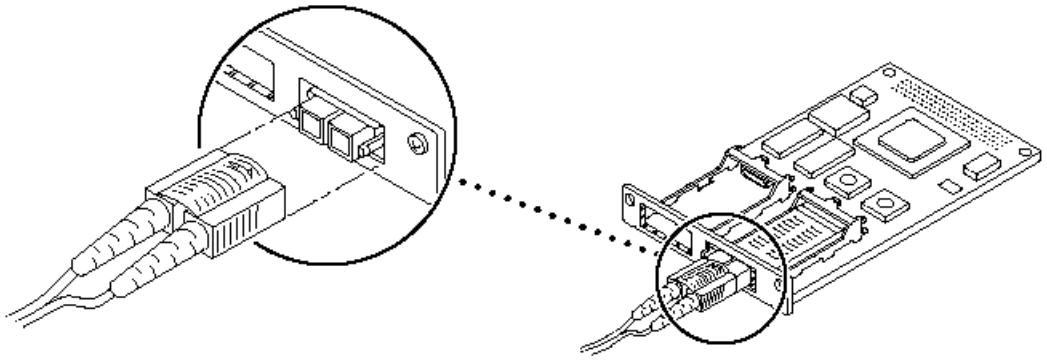


Figure 9. FC-AL SBus host adapter

GBIC

The gigabit interface converter (GBIC) for the Sun StorEdge A5X00 array converts FC-AL electrical signals to optical signals for connecting fiber optic cables. It is a hot-plug device supported on the array interface boards, host adapter, and hub.

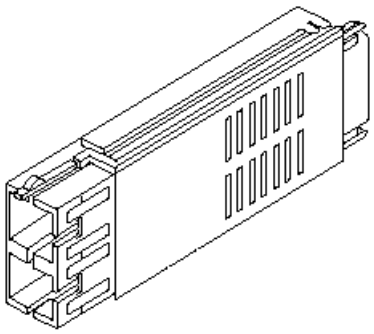


Figure 10. Gigabit interface converter (GBIC)

Long-wave GBIC

Prior to installation, long-wave GBIC modules require that customers have a fiber optic cable plant installed. Relevant standards supported by the long-wave module include the following:

- EIA/TIA 492CAAA (Cable Plant)
- ANSI NCITS 326:199x

Software/firmware requirements include Matrix rev. 1.16 (Release 6) and release 1.09 of Sun StorEdge A5X00 IB firmware.

Rackmounting the Sun StorEdge A5X00 Array

Up to six Sun StorEdge A5X00 arrays can be mounted in a Sun StorEdge expansion cabinet. Arrays are cabled into four FC-AL hubs at the top of the cabinet. Using the Sun StorEdge A5200 array it is possible to store up to 4.8 TB in one cabinet. Preconfigured rackmount assemblies are offered, or the array may be rackmounted in the field with optional hardware.

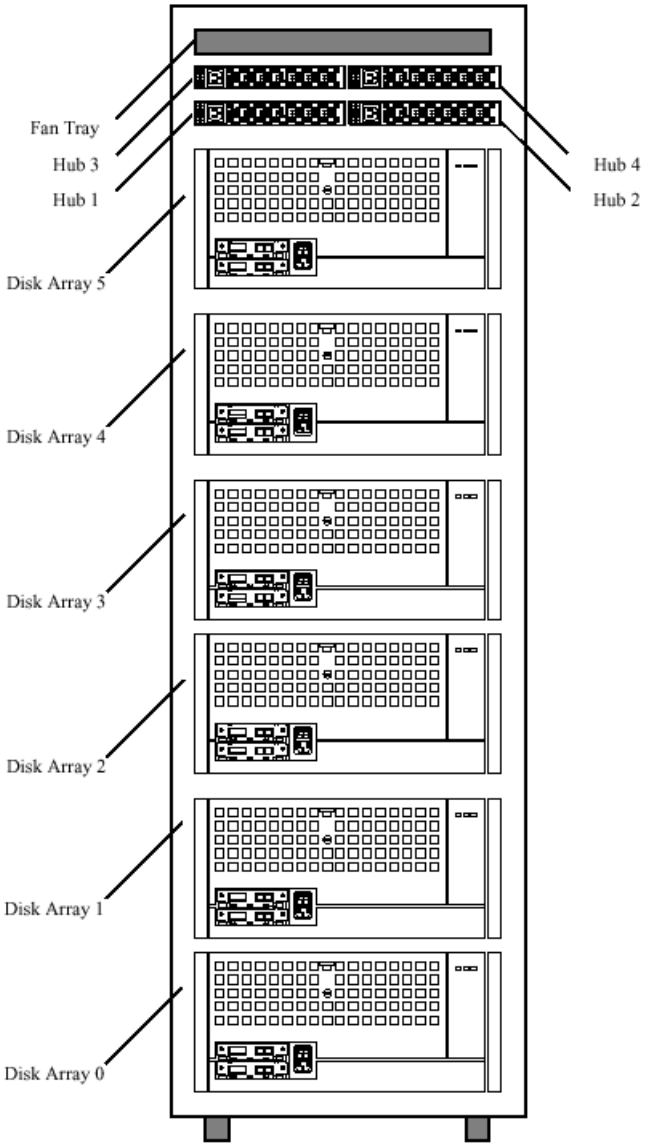


Figure 11. Rackmounting the Sun StorEdge A5X00 system

Interconnect

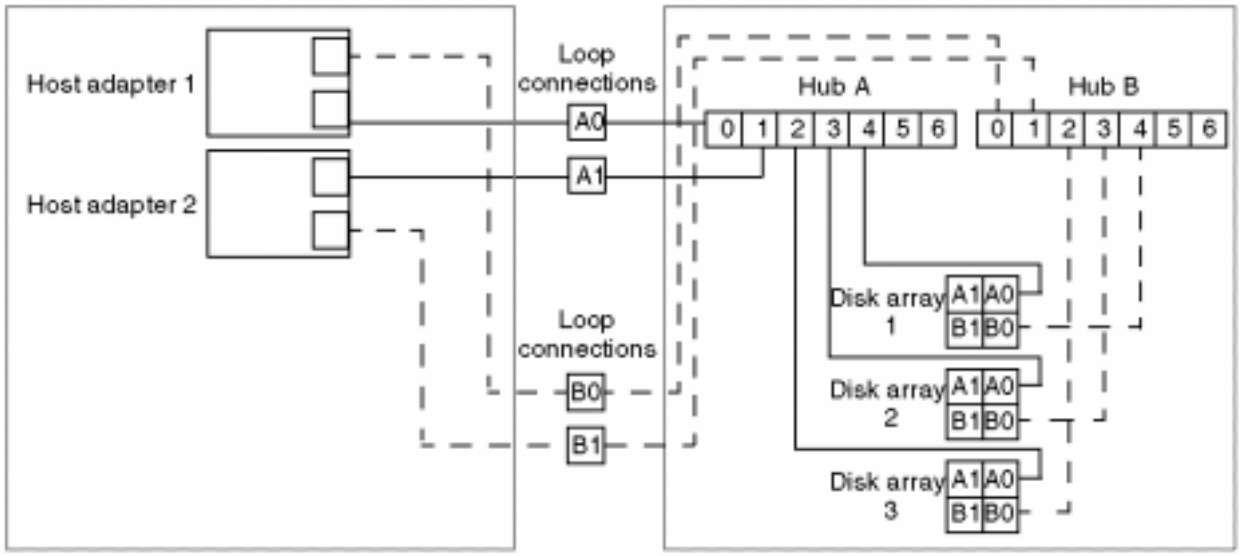


Figure 12. Interconnect

The Sun StorEdge A5X00 array uses 50-micrometer, fiber optic cables to connect arrays, hubs, and host adapters. Fiber optic cables are keyed and connect to the GBICs on each end. Each interface board and host adapter is supplied with one GBIC, standard. Each interface board is capable of supporting two GBICs each. Additional GBICs can be added to increase connectivity as illustrated above. In addition, FC-AL hubs simplify cabling of multiple arrays. The dual-loop, dual-hub configuration outlined above is an example of the redundant channels possible with two hubs and two host adapters.

System Administration

All active FRUs can be installed or replaced without powering down the subsystem. Disk drives can be exchanged by simply opening either the front or back door of the enclosure and then making the exchange. For all other components it is necessary to first remove the door and then remove the trim panel/hinge that supports the door and covers the other components. The hot-pluggable FRUs are:

- 3.5-inch disk drives (must match backplane type)—either seven 1.6-inch drives or eleven 1.0-inch drives per side
- Power supplies (at least two should remain installed to maintain power)
- Fan trays (must be exchanged promptly as overheating will shut down enclosure)
- Front panel module (removal does not affect unit operations)
- Interface boards (at least one must remain installed or unit powers down)
- Gigabit interface converters (one per loop maintains continuity)

Software

The Sun StorEdge™ A5X00 array is compatible with the following software products:

- Sun StorEdge Fast Write Cache host accelerator card
- Sun StorEdge Long Wave GBIC
- Sun StorEdge Instant Image 2.0
- Sun StorEdge Network Data Replicator (SNDR) 2.0
- Solstice Backup™ 5.5.1
- Solstice DiskSuite™ 4.2, 4.2.1
- Sun Enterprise Server Alternate Pathing (AP) 2.3.1
- Sun Management Center (SMC) 2.0.1
- Sun StorEdge Component Manager (CM) 2.1
- Sun StorEdge Remote Services (SRS) 2.0.1
- Sun Cluster 2.2
- StorTools™ 3.3
- VERITAS NetBackup (NBU) 3.4
- VERITAS Volume Manager (VxVM) 3.0.4
- VERITAS File System (VxFS) 3.3.3, 3.4

VERITAS Volume Manager Software Support

The VERITAS Volume Manager software is a management solution to help users manage disks and disk arrays connected to Sun systems. This host-based disk management software helps enable users to address a variety of needs including storage management, administration, availability, and performance.

VERITAS Volume Manager 3.0.2 software and later releases allow the Sun StorEdge A5X00 array to support the Solaris™ 7 and 8 Operating Environment.

VERITAS Volume Manager software is a GUI-based storage management application. With it, users can organize their disks into volumes, and create, manage, and backup file systems or raw partitions. By employing various levels of RAID technology, VERITAS Volume Manager software helps enable users to structure their data for increased reliability, availability, and performance.

VERITAS Volume Manager software provides logical volume management features, such as concatenation, striping, mirroring, hot spares, and dynamic expansion of devices and UNIX® file systems. Through these features, VERITAS Volume Manager software provides excellent data availability and data integrity, as well as a variety of storage management alternatives with minimal impact on, and in some cases improvement of, performance. VERITAS Volume Manager software supports RAID 1, RAID 0+1, RAID 1+0, RAID 5, hot relocation, and disk groups to enable data availability in the event of a disk or system failure.

VERITAS Volume Manager software provides the storage management needed by organizations with the high performance they desire.

VERITAS Volume Manager software is intended for enterprise computing environments. Its availability, reliability, performance, and administration features help meet the needs of large corporations running mission-critical applications.

A variety of application environments can benefit from the use of VERITAS Volume Manager software, including the following:

- OLTP systems
- Database servers
- High performance file servers

VERITAS Volume Manager software consists of a series of software layers that work together to create and manage volumes and the data that resides on them. It consists of utilities, a database to configure, monitor, and manage the system, and a volume driver. The principal component, the volume driver resides on top of the physical device drivers and below the file systems and other applications. It performs requested I/O and configuration changes. File systems and applications now access volumes instead of traditional UNIX physical disk partitions.

VERITAS Volume Manager software provides customers with the following benefits:

Features	Benefits
• RAID levels 0, 1, 0+1, 5	• Improves performance and data availability
• Dynamic multipathing	• Balances performance and adds reliability
• Hot relocation	• Increases data availability
• Disk groups	• Facilitates movement of data between hosts
• Volume resizing	• Allows volumes to change as needs dictate
• File system expansion	• Allows file systems to grow dynamically
• On-line snapshots	• Facilitates on-line backups
• Graphical user interface	• Eases administration
• Performance analysis tool	• Allows problem (bottleneck) isolation and tuning

Operating Environment

The Solaris Operating Environment

The Solaris Operating Environment versions 2.5.1, 2.6, 7 and 8 must be used to support the Sun StorEdge A5X00 system. Solaris Operating Environment patches are available on the SunSolve℠ web site at `http://sunsolve.sun.com`.

Note: *The Solaris 7 and 8 Operating Environments are supported on the Sun StorEdge A5X00 arrays but require VERITAS Volume Manager 3.0.2 or later.*

Localization and Internationalization

The Sun StorEdge A5200 arrays meet the requirements of current rules governing internationalization and localization for Sun Enterprise systems.

Basic Specifications

Each Sun StorEdge™ A5200 array includes one, two, or six array configurations with each tray containing:

- Two interface controllers (with one GBIC each)
- Seven or twenty-two 18-GB or 36-GB, 10000-rpm FC-AL disk drives
- Three power supplies
- Two 2-meter fiber optic cables (some configurations have 15-meter cables)
- Rackmounted (Sun StorEdge A5200 array, one, two, or six array systems)
- Tabletop or rackmount ready (Sun StorEdge A5200 array, one array system)
- Sun StorEdge Component Manager 2.1 software, media, documentation (separately ordered at no charge)
- VERITAS Volume Manager (VxVM) 3.0.4 (separately ordered at no charge)

Sun StorEdge A5200 Arrays—18-GB Model

Order Number	Title and Description
SG-XARY540A-127G	127-GB Sun StorEdge A5200 tabletop array (7 x 18.2-GB, 10000-rpm drives), three power supplies, two interface boards, (one GBIC each), power cord, and two 2-meter fiber optic cables
SG-XARY540A-400G	400-GB Sun StorEdge A5200 tabletop array (7 x 18.2-GB, 10000-rpm drives), three power supplies, two interface boards (one GBIC each), power cord, and two 2-meter fiber optic cables
SG-ARY540A-400G	400-GB Sun StorEdge A5200 array (22 x 18.2-GB, 10000-rpm drives) hubless cabinet version, includes one array rackmounted in a 72-inch Sun StorEdge cabinet for direct connect to host (no hubs attached), three power supplies, two interface boards, power cord, and twelve 15-meter fiber optic cables
SG-ARY542A-400G	400-GB Sun StorEdge A5200 rackmountable array (22 x 18.2-GB, 10000-rpm drives) three power supplies, two interface boards (one GBIC each), power cord, 2-meter fiber optic cables; rackmounting attached for Sun Enterprise™ system cabinet

Order Number	Title and Description
SG-ARY543A-400G	400-GB Sun StorEdge A5200 array, hubless cabinet version; includes one Sun StorEdge A5200 400-GB (22 x 18.2-GB, 10000-rpm drives) array rackmounted in 72-inch Sun StorEdge cabinet for direct connect to host (no hubs attached), three power supplies, two interface boards, twelve 15-meter fiber optic cables
SG-XARY543A-800G	800-GB Sun StorEdge A5200 cabinet, includes two 400-GB arrays (44 drives total) and two FC-AL hubs (three GBICs each) mounted in a 72-inch Sun StorEdge expansion cabinet with two power cords and four 15-meter fiber optic cables
SG-XARY543A-2400G	2400-GB Sun StorEdge A5200 cabinet, includes six 400-GB arrays (132 drives total) and four FC-AL hubs (four GBICs each) mounted in a 72-inch Sun StorEdge expansion cabinet with two power cords and four 15-meter fiber optic cables
SG-ARY541A-400G	400-GB Sun StorEdge A5200 rackmountable array (22 x 18.2-GB, 10000-rpm drives), three power supplies, two interface boards (one GBIC each), power cord, and two 2-meter fiber optic cables; rackmounting attached for 72-inch Sun StorEdge expansion cabinet
SG-XARY542A-400G	400-GB Sun StorEdge A5200 rackmountable array (22 x 18.2-GB, 10000-rpm drives) three power supplies, two interface boards (one GBIC each), power cord, 2-meter fiber optic cables; rackmounting attached for Sun Enterprise system cabinet

Sun StorEdge A5200 Arrays—36-GB Model

Order Number	Title and Description
SG-XARY563A-4804G	4804.8-GB Sun StorEdge A5200 cabinet, including six 800.8-GB arrays (22 x 36.4-GB, 10000-rpm, low-profile FC-AL drives) including four hubs with four GBICs each, two 15-meter fiber optic cables mounted in 72-inch Sun StorEdge expansion cabinet. Fans and door included. (standard configuration)
SG-XARY560A-254G	254.8-GB Sun StorEdge A5200 tabletop array (7 x 36.4-GB, 10000-rpm, low-profile FC-AL drives), includes three power supplies, two interface boards (1 GBIC each), and 2-meter fiber optic cables
SG-XARY560A-800G	800.8-GB Sun StorEdge A5200 tabletop array (22 x 36.4-GB, 10000-rpm low-profile FC-AL drives), includes three power supplies, two interface boards (one GBIC each), and 2-meter fiber optic cables

Order Number	Title and Description
SG-XARY561A-800G	800.8-GB Sun StorEdge A5200 rackmountable array for the 72-inch cabinet (22 x 36.4-GB, 10000-rpm, low-profile FC-AL drives), includes three power supplies, two interface boards (one GBIC each), and 2-meter fiber optic cables
SG-ARY561A-800GR5	800-GB Sun StorEdge A5200 rackmountable array (22 x 36.4-GB, 10000-rpm, low-profile, FC-AL drives) includes three power supplies, two interface boards (one GBIC each), two 2-meter fiber optic cables. Rackmounting kit installed for factory configuring into 72-inch Sun StorEdge expansion cabinet.
SG-XARY562A-800G	800.8-GB Sun StorEdge A5200 Rackmountable for the 68-inch cabinet (22 x 36.4-GB, 10000-rpm low-profile FC-AL drives), includes three power supplies, two interface boards (one GBIC each), and 2-meter fiber optic cables
SG-ARY563A-800G	800-GB Sun StorEdge A5200 hubless version, includes one 800-GB array (twenty-two 36.4-GB 10000-rpm, low profile FC-AL drives), twelve 15-meter fiber optic cables, mounted in 72-inch Sun StorEdge expansion cabinet (no hubs included).
SG-XARY563A-1601G	1601.6-GB Sun StorEdge A5200 cabinet, including two 800.8-GB arrays (22 x 36.4-GB, 10000-rpm low-profile FC-AL drives) including two hubs with 3 GBICs each, two 15-meter fiber optic cables mounted in 72-inch Sun StorEdge expansion cabinet. Fans and door included.
SG-ARY563A-1601G	1601.6-GB Sun StorEdge A5200 cabinet, including two 800.8-GB arrays (22 x 36.4-GB, 10000-rpm low-profile FC-AL drives) including two hubs with three GBICs each, two 15-meter fiber optic cables mounted in 72-inch Sun StorEdge expansion cabinet. (Factory configured for Sun Enterprise 10000 server)
SG-ARY563A-4804G	4804.8-GB Sun StorEdge A5200 cabinet, including six 800.8-GB arrays (22 x 36.4-GB, 10000-rpm low-profile FC-AL drives) including four hubs with four GBICs each, four 15-meter fiber optic cables mounted in 72-inch Sun StorEdge expansion cabinet for Sun Enterprise 10000 system. (Factory configured).

Ordering Instructions for VERITAS Volume Manager

Order Number	Description
Media Kit and Documentation	
VVMGS-304-9999	VERITAS Volume Manager 3.0.4 for Sun StorEdge A5X00 arrays; media and documentation
VVMGS-304-999C	VERITAS Volume Manager 3.0.4 Japanese for Sun StorEdge A5X00 arrays; media, documentation, and license
Upgrade for Full VERITAS Volume Manager License	
VSSAS-999-W9U9	VERITAS Volume Manager license upgrade on Solaris for Sun StorEdge A5X00 or T3 arrays to desktop and workgroup server class
VSSAS-999-D9U9	VERITAS Volume Manager license upgrade on Solaris for Sun StorEdge A5X00 or T3 arrays to departmental server class
VSSAS-999-E9U9	VERITAS Volume Manager license upgrade on Solaris for Sun StorEdge A5X00 or T3 arrays to enterprise server class
VSSAS-999-S9U9	VERITAS Volume Manager license upgrade on Solaris for Sun StorEdge A5X00 or T3 arrays to Sun Enterprise 10000 server class

Notes: The VERITAS Volume Manager documentation and license kit for Sun StorEdge A5X00 arrays must be ordered with each Sun StorEdge A5X00 array. Please note that VERITAS Volume Manager is free of charge (customer must pay shipping and handling) with the purchase of any Sun StorEdge A5X00 array. For Sun StorEdge A5X00 array customers, the following is included with the VERITAS Volume Manager server license:

- The ability to manage the Sun StorEdge A5X00 array and implement software RAID.
- The limited license bundled with the Sun StorEdge A5X00 array can be installed on any server accessing the Sun StorEdge A5X00 array, but an upgrade to a full VERITAS Volume Manager license is required for all servers using VERITAS Volume Manager to support non-Sun StorEdge A5X00 disk subsystems. The upgrade includes support for non-Sun StorEdge A5X00 disks, RAID 5, DMP, VxSmartSync, and striping.
- The customer is allowed to mirror only their boot disks regardless of where they are (Sun StorEdge A1000/D1000 arrays, Sun StorEdge A3500 arrays, and so on). If they have other disks in the Sun StorEdge D1000 array that they wish to RAID which do not hold the kernel, they would be required to purchase a full VERITAS Volume Manager software copy for their machine.

Ordering Instructions for Sun StorEdge Component Manager Software

The Sun StorEdge Management Console and Sun StorEdge Component Manager products ship on a common CD with software and documentation.

The following part number should be ordered at no-charge when entering new orders for Sun StorEdge A5X00 arrays.

Order Number	Title and Description
SCMMS-210-9P99	Sun StorEdge Component Manager 2.1 software for Sun StorEdge A5X00 or T3 arrays on Solaris™ Operating Environment, media, and documentation. Sun StorEdge Management Console software is included with this part number.

Note: *Sun StorEdge Management Console software is a prerequisite to the Sun StorEdge Component Manager product.*

Ordering Instructions for Sun StorEdge Fast Write Cache (FWC)

To order the Sun StorEdge Fast Write Cache 2.0 option, order:

- One software media kit, FWC9S-200-R999
- One set of cache boards, X6739A (PCI) or X6745A (SBus), depending upon the server platform on which FWC will be installed

Installation Services are now included in the Sun StorEdge Fast Write Cache product marketing part number.

It is expected that the Sun StorEdge Fast Write Cache accelerator will be installed by either Sun Enterprise Services or a qualified reseller. Resellers have the option of having Sun Enterprise Services do the installation, or providing the installation services themselves.

In the short term, a reseller is qualified to install and configure Sun StorEdge Fast Write Cache if they have received and reviewed the following:

- Sun StorEdge Fast Write Cache Support Readiness Training Video
- Sun StorEdge Fast Write Cache Installation and User's Guide
- Sun StorEdge Fast Write Cache Release Notes

In the long term, reseller training for these products as well as other data services products will be offered through Sun Education.

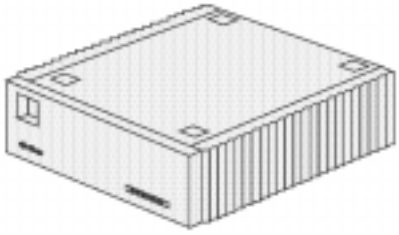
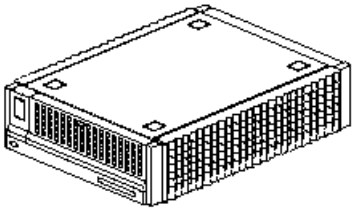
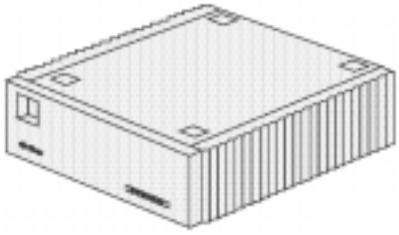
Options

Order Number	Option Description	Maximum Number Supported	Comments
X6729A	100-MB/sec. FC-AL PCI single-channel host adapter		1 GBIC maximum
X6730A	100-MB/sec. FC-AL SBus dual-channel host adapter, including one GBIC module		2 GBICs maximum
X6732A	100-MB/sec. FC-AL seven-port hub, no GBICs included	2 per loop	7 GBICs maximum
X6731A	100-MB/sec. FC-AL GBIC for host adapter or hub		
X6720A	18.2-GB, 10000-rpm, low-profile FC-AL disk drive		
X6724A	36.4-GB, 10000-rpm, low-profile (1-inch) FC-AL disk drive		
X6734A	Interface board with one GBIC	2 per array	2 GBICs maximum
X9687A	Power supply	3 per array	
X9654A	Array rackmounting kit for Sun StorEdge cabinet	1 array	
X9655A	Array rackmounting kit for Sun Enterprise system cabinet	1 array	
X6735A	Hub rackmounting kit	2 hubs	
X6737A	Long-Wave optical module; includes one Long-Wave GBIC module; one 15-meter, single-mode, fiber optic jumper cable		Requires service desk screening
X6745A	Sun StorEdge Fast Write Cache 2.0 SBus version, includes two 32-MB NVRAM SBus adapter cards plus installation services	1 installation per server (2 cards)	
X6739A	Sun StorEdge Fast Write Cache 2.0 PCI version, includes two 64-MB NVRAM PCI adapter cards plus installation services	1 installation per server (2 cards)	
FWC9S-200-R999	Sun StorEdge Fast Write Cache media kit and documentation		
X973A	2-meter fiber optic cable	4 per array	2 included with array
X978A	15-meter fiber optic cable		Included with cabinet
A5200-INSTALL	Sun StorEdge ArrayStart℠ Installation Service; includes on-site installation of factory configured Sun StorEdge A5X00 arrays		This part is only valid for use with parts that qualify for the Mission Critical Support Program.

Upgrades

Upgrade Paths

Protect your investment in SPARCstorage™ Arrays by upgrading to the Sun StorEdge™ A5X00 array. Sun-to-Sun and competitive upgrades to the Sun StorEdge A5X00 array provide excellent trade-in values for older SPARCstorage Arrays, making it more cost-effective to migrate to the latest technology. See the ordering information below for available upgrade configurations.

From	Receive	Return
 SPARCstorage Array	 Sun StorEdge A5X00 array	 SPARCstorage Array

Sun Array Upgrades

Since August 29, 2000, Sun has offered customers a simple, flexible, and easy-to-understand way of ordering desktop workstation upgrades. The Sun UAP program has a new percentage-based upgrades model. This new model simplifies the upgrades process by providing a trade-in value as a percentage allowance. This percentage allowance can then be applied to the list price of a regular Sun system configuration.

Under the Sun UAP program, allowance codes or part numbers have been created and the percentage allowance is built into this part number. These allowance codes replace the previous UG/CU marketing codes used for all desktop upgrades.

Allowance codes can be found in the Sun Pricebook starting with the September 2000 version. Please note that allowance codes apply to configured systems and cannot be applied to X-options.

Contact a Sun Enterprise Services representative for specific information about upgrades for this product.

Sun StorEdge Fast Write Cache Upgrades

Customers with either a SunSpectrum℠ program Metal contract who purchase the LIC option will receive version upgrades from Sun Enterprise Services for free. Similarly, customers with a Software Only contract will also receive version upgrades form Sun Enterprise Services for free.

Service and Support

The SunSpectrum℠ program is an innovative and flexible service offering that allows customers to choose the level of service best suited to their needs, ranging from mission-critical support for maximum solution availability to backup assistance for self-support customers. The SunSpectrum program provides a simple pricing structure in which a single fee covers support for an entire system, including related hardware and peripherals, the Solaris™ Operating Environment software, and telephone support for Sun™ software packages. The majority of Sun's customers today take advantage of the SunSpectrum program, underscoring the value that it represents. Customers should check with their local Sun Enterprise Services representatives for program and feature availability in their areas.

FEATURE	SUNSPECTRUM PLATINUM℠ Mission-critical Support	SUNSPECTRUM GOLD℠ Business-critical Support	SUNSPECTRUM SILVER℠ Systems Support	SUNSPECTRUM BRONZE℠ Self Support
Systems Features				
Systems approach coverage	Yes	Yes	Yes	Yes
System availability guarantee	Customized	No	No	No
Account Support Features				
Service account management team	Yes	No	No	No
Local customer support management	No	Yes	No	No
Personal technical account support	Yes	Yes	Option	No
SunStart℠ installation service	Yes	No	No	No
Account support plan	Yes	Yes	No	No
Software release planning	Yes	No	No	No
On-site account reviews	Monthly	Semiannual	No	No
Skills assessment	Yes	No	No	No
Site activity log	Yes	Yes	No	No
Coverage / Response Time				
Standard telephone coverage hours	7 day/24 hour	7 day/24 hour	8 a.m.–8 p.m., Monday–Friday	8 a.m.–5 p.m., Monday–Friday
Standard on-site coverage hours	7 day/24 hour	8 a.m.–8 p.m., Monday–Friday	8 a.m.–5 p.m., Monday–Friday	N/A
7-day/24-hour telephone coverage	Yes	Yes	Option	Option
7-day/24-hour on-site coverage	Yes	Option	Option	N/A
7-day/12-hour on-site coverage	No	Option	No	No
5-day/24-hour on-site coverage	No	Option	No	No

FEATURE	SUNSPECTRUM PLATINUM Mission-critical Support	SUNSPECTRUM GOLD Business-critical Support	SUNSPECTRUM SILVER Systems Support	SUNSPECTRUM BRONZE Self Support
Coverage / Response Time (cont.)				
Customer-defined priority setting	Yes	Yes	Yes	Option
• Urgent (phone/on site)	Live transfer/ 2 hour	Live transfer/ 4 hour	Live transfer/ 4 hour	4 hour / N/A
• Serious (phone/on site	Live transfer/ 4 hour	2 hour/next day	2 hour/next day	4 hour / N/A
• Not critical (phone/on site)	Live transfer/ customer convenience	4 hour/ customer convenience	4 hour/ customer convenience	4 hour / N/A
2-hour on-site response	Yes	Option	Option	N/A
Additional contacts	Option	Option	Option	Option
Premier Support Features				
Mission-critical support team	Yes	For urgent problems	No	No
Sun Vendor Integration Program (SunVIP℠)	Yes	Yes	No	No
Software patch management assistance	Yes	No	No	No
Field change order (FCO) management assistance	Yes	No	No	No
Hardware Support Delivery				
Replacement hardware parts	On-site technician	On-site technician	On-site technician	Courier
Two day parts delivery	N/A	N/A	N/A	Yes
Overnight parts delivery	N/A	N/A	N/A	Option
Same-day parts delivery	Yes	Yes	Yes	Option
Remote Systems Diagnostics				
Remote dial-in analysis	Yes	Yes	Yes	Yes
Remote systems monitoring	Yes	Yes	No	No
Remote predictive failure reporting	Yes	Yes	No	No
Software Enhancements and Maintenance Releases				
Solaris Operating Environment enhancement releases	Yes	Yes	Yes	Yes
Patches and maintenance releases	Yes	Yes	Yes	Yes
Sun unbundled software enhancements	Option	Option	Option	Option
Internet and CD-ROM Support Tools				
SunSolve℠ license	Yes	Yes	Yes	Yes

FEATURE	SUNSPECTRUM PLATINUM Mission-critical Support	SUNSPECTRUM GOLD Business-critical Support	SUNSPECTRUM SILVER Systems Support	SUNSPECTRUM BRONZE Self Support
SunSolve EarlyNotifier℠ Service	Yes	Yes	Yes	Yes

Warranty

The warranty on the Sun StorEdge™ A5X00 array includes the following:

- 90 days telephone, software installation support
- First year on-site service (second business day turnaround); telephone support 8 a.m. to 5 p.m. local time, Monday through Friday
- Second year parts return to Sun; telephone support 8 a.m. to 5 p.m. local time, Monday through Friday

All FC-AL disk drives carry a five-year warranty. Software is warranted for 90 days.

Education

- IQ Kit Sales Guide
- IQ Kit Tech Guide
- SunU: Sun StorEdge Disk Array, 2 day, FT957W

Professional Services

Sun StorEdge ArrayStart™ Program

The Sun StorEdge ArrayStart™ program provides an installation and custom-configuration service that quickly gets mission-critical data-center applications up and running. For one fixed fee, this service includes consultation for determining the configuration that best meets the customer's needs, installation of the hardware and RAID management software, and configuration to the appropriate RAID profile determined during the consultation.

Solstice DiskSuite™ Software to VERITAS Volume Manager Software

Data Migration

A Sun Professional Service consultant will deliver four days of onsite consulting services to assist customers who wish to migrate their mission-critical data from existing storage system to a new array. This service will help customers complete the transition with minimal downtime and without risking loss of their valuable data. Specially trained Sun consultants will use their extensive data-migration expertise to complete the service in the most cost- and time-effective manner available. Sun consultants will also fully integrate and optimize the Sun StorEdge A5X00 array into the customer's computing environment.

If desired, customers can choose tasks from the following list to customize the service to meet their specific business needs:

- Design and configuration planning
- Capacity planning

- Performance tuning and optimization

Travel and expenses incur an additional charge for delivery requiring more than 50 miles of travel. When this service is desired by the customer, the account manager will contact the SunPS℠ Data and Storage Management Competency Practice to schedule delivery of the service.

Glossary

Arbitrated loop	A loop topology where two or more ports can be interconnected, but only two ports at a time may communicate.
Bus	A point-to-point network component. Used by Sun™ Management Center software to represent a network link to which many other hosts may be connected.
Channel	An interface directed toward high-speed transfer of large amounts of information.
Chunk	A quantity of information that is handled as a unit by the host and disk device.
Circuit-switched bus	A bus in which a transaction is normally implemented in an automatic fashion. Simple and easy to construct, a circuit-switched bus is often less efficient than a comparable packet-switched bus. An SBus is a circuit-switched bus.
Concatenation	A volume created by sequentially mapping blocks on disks to a logical device. Two or more partitions can be concatenated and accessed as a single device.
Disk array	A subsystem that contains multiple disk drives, designed to provide performance, high availability, serviceability, or other benefits.
Disk group	A grouping of disk drives and the data on them that facilitates organization and the movement of disks between systems.
ECC	Error checking and correcting. ECC code is used to verify the integrity of data and can be used to correct some data errors. The ECC code used in the Sun Enterprise™ 3500–6500 servers is able to detect and correct single-bit errors, and detect double-bit errors.
Event	A change in the state of a managed object.
Fabric	A group of interconnections between ports that includes a fabric element.
FC-AL	Fibre Channel arbitrated loop. A loop topology used with Fibre Channel.
Fiber	A wire or optical strand. Spelled *fibre* in the context of Fibre Channel.
Fiber-optic cable	Jacketed cable made from thin strands of glass, through which pulses of light transmit data. Used for high-speed transmission over medium to long distances.
Frame	An indivisible unit for transfer of information in Fibre Channel.
FRU	Field replaceable unit.
Full duplex	A communications protocol that permits simultaneous transmission in both directions, usually with flow control.
GBIC	Gigabit interface converter.

GUI	Graphical user interface. The GUI provides the user with a method of interacting with the computer and its special applications, usually via a mouse or other selection device. The GUI usually includes such things as windows, an intuitive method of manipulating directories and files, and icons.
Heterogeneous hosts	Various application servers that run the Solaris™ Operating Environment or Microsoft Windows NT server operating environment and are attached to the same storage.
Hot-plug	A hot-plug component means that it is electrically safe to remove or add that component while the machine is still running. Typically, the system must be rebooted before the hot-plug component is configured into the system.
Hot spare	A drive in an array that is held in reserve to replace any other drive that fails. Hot spares are continuously powered up and spinning. This allows the array processor to have immediate access to a functioning drive for possible reconstruction of lost data.
Hot-swap	A hot-swap component can be installed or removed by simply pulling the component out and putting the new one in. The system will either automatically recognize the component change and configure itself as necessary or will require user interaction to configure the system; however, in neither case is a reboot required. All hot-swappable components are hot pluggable, but not all hot-pluggable components are hot-swappable.
Hub	A device for connecting fiber cables.
Interleaved memory	Helps reduce memory access time by permitting multiple memory components to operate in parallel. Memory is divided into *n* banks arranged so that every *n*th byte is supplied by a different memory bank. In a two-way interleaved system, the first double word is supplied by bank 0 while the second is supplied by bank 1. Normally, the size and extent of interleave is arranged so that a single typical request is satisfied by as many banks as possible. This arrangement permits a single memory request to be fulfilled without waiting for memory recycle time.
I/O rate	A measure of a device's capacity to transfer data to and from another device within a given time period, typically as I/O operations per second.
IOPS	Input/output operations per second. A measure of I/O performance, this is commonly used to quote random I/O performance.
IP	Internet protocol. A set of protocols developed by the United States Department of Defense to communicate between dissimilar computers across networks.
Jiro	An open platform initiative that simplifies storage management by providing interoperability between storage vendor products.
LED	Light emitting diode.
Link	One inbound fiber and one outbound fiber connected to a port.

LRC	Loop redundancy circuit.
MIA	Media interface adapter. A small electronic device that converts electrical signal to optical signals. It performs that same function as a gigabit interface converter (GBIC) but is installed on the outside of the storage array. Sun selected the MIA so the installed base of PCI and SBus host bus adapters could be used with this new generation of storage arrays.
Micron	One millionth of a meter. Also called *micrometer*.
Mirror synchronization	The process by which VERITAS Volume Manager software keeps two or more copies of data identical.
Mirroring	In RAID terminology, refers to the redundant storage of data, either by duplicating the exact data or generating parity data bit-for-bit.
Module	A software component that may be loaded dynamically to monitor data resources of systems, applications, and network devices.
Multimode fiber	An optical wave guide which allows more than one mode (rays of light) to be guided.
Network	An arrangement of nodes and connecting branches, or a configuration of data processing devices and software connected for information exchange.
N_Port	A port attached to a node for use with point-to-point or fabric topology.
NL_Port	A port attached to a node for use in all three topologies (point-to-point, arbitrated loop or fabric.
Node	A device that has at least one N_Port or NL_Port.
NVRAM cache	A non-volatile (battery-backed) random access memory area used as an intermediate store for data between a host computer system and disk drives.
Optical fiber	Any filament of fiber, made of dielectric material, that guides light.
Packet-switched bus	A bus in which information is transmitted in fixed-sized units. This type of bus is often associated with the use of split transactions. Gigaplane™ and UPA are packet-switched buses.
Parity	In an array environment, data that is generated from user data and is used to regenerate user data lost due to a drive failure. Used in RAID 5.
Point-to-point	A topology where exactly two ports communicate.
Port	An access point on a device for attaching a link.
Protocol	A convention for data transmission that defines timing, control, format, and data representation.
RAID	Redundant array of independent disks. A set of disk drives that appear to be a single logical disk drive to an application such as a database or file system. Different RAID levels provide different capacity, performance, high availability, and cost characteristics.

RAID 0	RAID level 0, or striping. Data is distributed among disks for performance. No redundancy is provided, and the loss of a single disk causes the loss of data on all disks.
RAID 0+1	The combination of striping and mirroring. Data is distributed among disks for performance, and mirroring is used to provide redundancy.
RAID 1	RAID level 1, or mirroring. Multiple copies of the data are kept. This is inherently expensive.
RAID 1+0	The combination of mirroring and striping. Data is mirrored to provide redundancy and distributed among disks for performance.
RAID 5	RAID level 5, or striping with distributed parity. Both data and parity are distributed across disks. No single disk can compromise the integrity of the data. RAID 5 optimizes performance, reliability and cost.
RAS	Reliability, availability, and serviceability. Reliability is a measure of the likelihood that problems will occur. A highly reliable system will have few problems. Once a problem occurs, availability is the measure of how the system will protect the user from being adversely affected by the problem. Serviceability is a measure of how easy it is to repair the problem.
Receiver	The circuitry that receives signals on a fiber, and the ultimate destination of data transmission.
Reconstruction	The process of rebuilding lost data on a replacement drive after a drive failure.
Redundancy	Duplication for the purpose of achieving fault tolerance. Refers to duplication or addition of components, data and functions within the array.
Responder	The logical function in an N_Port responsible for supporting the exchange initiated by the originator in another N_Port.
SCSI	Small computer systems interface. An ANSI standard for controlling peripheral devices by one or more host computers.
SAN	Storage area network. SAN architecture uses high-performance, high-capacity Fibre Channel switches to connect storage islands. This approach provides physical connectivity, but does facilitate information sharing or simplify management across servers.
Serial transmission	Data communication mode where bits are sent in sequence in a single fiber.
Single-mode fiber	A step index fiber wave guide in which only one mode (ray of light) will propagate above the cutoff wavelength.
SNMP	Simple network management protocol. A simple protocol designed to allow networked entities (such as hosts, routers) to exchange monitoring information.
Striping	Spreading or interleaving logical contiguous blocks of data across multiple independent disk spindles. Striping allows multiple disk controllers to simultaneously access data, improving performance.

Switch	The name of an implementation of the fabric topology.
Switched-loop architecture	Splits the drive interface into multiple, independent loops so that the RAID controller has its own drive loop, plus access to other drive loops. Improves performance and expansion flexibility for enterprise networks.
Throughput	A measure of sequential I/O performance, quoted as megabytes per second (MB/second). *See also* IOPS and I/O rate.
Topology	The components used to connect two or more ports together. Also, a specific way of connecting those components, as in point-to-point, fabric, or arbitrated loop.
Transceiver	A transmitter/receiver module.
Transfer rate	The rate at which bytes or bits are transferred, usually measured in megabytes per second.
URL	Uniform resource locator. An URL is a textual specification describing a resource which is network-accessible.
Volume	A volume is a virtual disk into which a file system, DBMS, or other application can place data. A volume can physically be a single disk partition or multiple disk partitions on one or more physical disk drives. Applications that use volumes do not need to be aware of their underlying physical structure. Software handles the mapping of virtual partition addresses to physical addresses.

Materials Abstract

All materials are available on SunWIN unless otherwise noted.

Collateral	Description	Purpose	Distribution	Token # or COMAC Order #
Powerpack				
– *Sun StorEdge™ A5X00 Array: Just the Facts*	Reference Guide (this document)	Sales Tool, Training	SunWIN, Reseller Web	73714
– *Sun StorEdge A5X00 Array Customer Presentation*	Presentation Overview with Slide Notes	Sales Tool	SunWIN, Reseller Web	74320
References				
– *Sun Intro: Sun StorEdge A5200: Highest Performing Fibre Channel Storage Array*	Introduction E-mail	Sales Tool	SunWIN, Reseller Web, E-mail	98410
– *Quick Reference Card: Sun StorEdge Product Line Overview*	Quick Reference Card	Sales Tool	SunWIN, Reseller Web	73691
Product Literature				
– *Literature: Sun StorEdge A5X00 Data Sheet*	Data Sheet	Sales Tool	SunWIN, Reseller Web COMAC	73372 DE789-1
– *Literature: Sun StorEdge ArrayStart℠*	Data Sheet	Sales Tool	SunWIN, Reseller Web	98994
White Papers				
– *Sun StorEdge A5X00 Array Configuration Guide*	Technical Brief	Sales Tool, Training	SunWIN, Reseller Web	73710
– *Fibre Channel Technology from Sun Microsystems*	Technical Brief	Sales Tool, Training	SunWIN, Reseller Web	65659
– *Fibre Channel versus Alternative Storage Interfaces: An Overview*	Technical Brief	Sales Tool, Training	SunWIN, Reseller Web	65663
– *A Simple Guide to Sun StorEdge A5X00 Array Configuration*	Technical Brief	Sales Tool, Training	SunWIN, Reseller Web	73709
– *Sun StorEdge A5X00 Remote Mirroring White Paper*	Technical Brief	Sales Tool, Training	SunWIN, Reseller Web	107700
– *Sun StorEdge A5X00 Architecture White Paper*	Technical Brief	Sales Tool, Training	SunWIN, Reseller Web	73711

Collateral	Description	Purpose	Distribution	Token # or COMAC Order #
White Papers (cont.)				
– *Sun StorEdge A5X00 Technical Troubleshooting Guide*	Technical Brief	Sales Tool, Training	SunWIN, Reseller Web	76632
– *Sun StorEdge A5X00 Array Performance and Serviceability Report*	Technical Brief	Sales Tool, Training	SunWIN	96117
– *Reliability, Availability, Serviceability in the Sun StorEdge A5X00 White Paper*	Technical Brief	Sales Tool, Training	SunWIN, Reseller Web	76631
– *Sun StorEdge Fast Write Cache White Paper*	Technical Brief	Sales Tool, Training	SunWIN, Reseller Web	104507
– *Sun StorEdge Fast Write Cache Configuration*	Technical Brief	Sales Tool, Training	SunWIN, Reseller Web	106075
– *Sun StorEdge Fast Write Cache Best Practices*	Technical Brief	Sales Tool, Training	SunWIN, Reseller Web	104914
Videos				
– *Sun StorEdge A5X00 Fibre Channel Array*	Video Tape	Sales Tool	Davkore	ME1617-0
Training				
– *Sales Training Kit: Sales IQ Guide: Sun StorEdge A5X00 Array*	Sales IQ kit	Training	SunWIN	73692
– *Sales Training Kit: Sales Reference Guide: Sun StorEdge A5X00 Array*	Reference Guide	Training	SunWIN	73694
– *Sales Training Kit: Sales Tech IQ Guide: Sun StorEdge A5X00 Array*	Technical IQ Kit	Training	SunWIN	73693
Related Material				
– *VERITAS Volume Manager Software: Just the Facts*	Reference Guide	Sales Tool Training	SunWIN, Reseller Web	67745
– *VERITAS File System: Just the Facts*	Reference Guide	Sales Tool Training	SunWIN, Reseller Web	67744

Collateral	Description	Purpose	Distribution	Token # or COMAC Order #
External Web Sites				
– *Sun StorEdge A5000 Array Information*	`http://www.sun.com/storage/A5000`			
– *Sun StorEdge A5100 Array Information*	`http://www.sun.com/storage/A5100`			
– *Sun StorEdge A5200 Array Information*	`http://www.sun.com/storage/A5200`			
– *Fibre Channel Association*	`http://www.fibrechannel.com`			
– *Fibre Channel Loop Community*	`http://www.fcloop.org`			
– *SunSolve℠ Web Site (for Solaris™ Operating Environment Patches)*	`http://sunsolve.sun.com`			
Internal Web Sites				
– *Storage Products Internal*	`http://webhome.ebay/networkstorage/products/A5000`			
– *Installed Base Business Web Site*	`http://webhome.ebay/WWIBB`			
– *Complete Performance Report Web Site*	`http://webhome.ebay/networkstorage/techmark_site/photon/main/index.html`			
– *Product Serviceability Web Site*	`http://webhome.ebay/networkstorage/techmark_site/stortools/index.hmtl`			
– *Resources Web Site*	`http://webhome.ebay/networkstorage/contacts/`			
– *Help Desk*	`http://webhome.ebay/networkstorage/salesupportctr/`			

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Competitive Information

The Sun StorEdge™ A5200 array is a highly competitive product in the performance oriented market which also needs high availability. This product also provides excellent density and flexibility. Sun's top competitors and Sun StorEdge A5200 array selling strategies follow.

- **EMC (Symmetrix)**

  EMC offers the enterprise storage benchmark Symmetrix product line (e.g., the EMC Symmetrix 3630). EMC's strengths include software features, particularly those related to availability features. EMC uses lots of cache memory in their arrays to compensate for a moderate performance architecture. Only at the very high end of the data center space can EMC command their high price with premium support and software capabilities.

  Selling strategies include combining the Sun StorEdge A5200 array with data service features to challenge EMC. The Sun StorEdge A5200 arrays will be the favored choice when the customer's criteria are high performance combined with availability.

- **EMC (CLARiiON)**

  EMC's acquisition of Data General in 1999 has been difficult. Employee moral is down and current OEM customers are wary of EMC. The CLARiiON product line is exposed while EMC try to decides how to position it with Symmetrix. Symmetrix can be expected to be sold in larger configurations.

  CLARiiON FC5500 and FC5700 products were resold by HP, SGI, Dell, STK, and others. These products are either gone or about to be replaced. EMC is having serious problems maintaining OEMs so expect radical changes in this space.

  The CLARiiON FC5300 was announced in October 1999. This value-oriented FC-AL RAID solution is targeted at smaller configurations requiring less performance. Capacities vary from 18 GB to 3.5 TB. Each tray has up to ten disks and one or two RAID controllers. Bandwidth performance is mediocre, but adequate for smaller configurations. Initial pricing has been high.

  Push the Sun StorEdge A5200 array when performance, future growth, and density are important. Pricing should not be an issue.

  Strategic benefits of the Sun StorEdge A5200 array include its modular design, density, reliability and peformance. Emphasize the ease of administration and control when selling against the CLARiiON FC5300/5500/5700. Sun covers the workgroup to enterprise range with one scalable Sun StorEdge A5200 array building block.

- **HP**

  HP generally competes only in their own market like Sun, so HP-branded arrays do not normally appear in the Sun market.

- **Compaq/DEC**

  Compaq StorageWorks says that their multi-vendor Fibre Channel-based products are ideal for a broad range of mission-critical applications. Compaq's acquisition of DEC added the StorageWorks product line to their portfolio, giving Compaq the lead in overall open systems share. The RA8000 and ESA 12000 products use separate controllers and SCSI disks. Compaq has been aggressive in defending storage opportunities on their servers, with tactics like dramatic price drops, low bids, and