Sun StorEdge™ A5X00 Array Family

Just the Facts

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 new 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™—an environment in which information and administration is centralized. Dedicated to storage, an Intelligent Storage Network 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 is standards-based, scalable, modular, multipathed, centrally managed, multi-vendor, and highly available. 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 enables the Intelligent Storage Network to become a reality. The flexibility, high performance, and reliability of Fibre Channel technology enables 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.

New Features in the Sun StorEdge™ 5X00 Array Family

Hubless Versions of the Sun StorEdge™ A5X00 Arrays

New hubless versions for the Sun StorEdge™ A5100 and A5200 arrays are now available and are included as part of the mission-critical customer support program for the Sun StorEdge A5100 and A5200 arrays. The hubless versions are new configurations of existing Sun StorEdge A5100 and A5200 products. No new features have been introduced.

The Sun StorEdge A5100 array delivers a significant density increase with the introduction of 18.2-GB, 7200-rpm drives in the existing 14-drive Sun StorEdge A5000 array enclosure. These high-capacity drives will yield twice the capacity in the same physical space at a resulting lower cost per megabyte. New upgrades from the SPARCstorage™ Array and non-Sun storage systems will be offered to the new Sun StorEdge A5100 array.

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The Sun StorEdge A5200 array delivers a significant density and performance increase with the introduction of 9.1-GB, 10000-rpm drives in a new 22-drive enclosure. The additional drives per enclosure, combined with the drive speed increase, will yield higher throughput and lower latency. New upgrades from the SPARCstorage Array and non-Sun storage systems will be offered to the new Sun StorEdge A5200 array.

Sun StorEdge Long-distance GBIC Module

The Sun StorEdge A5X00 product family now includes support for long-distance remote mirroring. Long-wave mirroring 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 be mirror data from storage devices over long distances. The long-wave gigabit interface converter (GBIC) module is an optical component based on longwave 1300nm 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. Capable of transmission distances up to ten kilometers, the long-wave GBIC also requires single mode duplex 9-micron fibre optic cable complying with Sun specified standards.

Capable of transmission distances up to ten kilometers, the long-wave GBIC also requires single mode fibre optic cable complying with Sun specified standards. Sun Network Storage will specify specific supported configurations for deploying remote sites and mirrored storage. The long-wave GBIC module is available as a Sun-installed option.

Key features include the following:

- Support for up to 10-kilometer distances between Sun StorEdge A5X00 array and host
- Installation included in price
- Hot-pluggable component
- Sun Professional Services assessment offering available

The new long-wave GBIC module can be installed into the Sun StorEdge A5X00 product line. Recently, Sun has enhanced and improved this product line to include the new the Sun StorEdge A5100 and A5200 arrays. The StorEdge A5100 array delivers a significant density increase with the introduction of 18.2-GB, 7200-rpm drives. These high-capacity drives yield twice the capacity in the same physical space as the original Sun StorEdge A5000 array, resulting in a lower cost per megabyte.

Sun StorEdge Fast Write Cache

Sun StorEdge Fast Write Cache is write cache option to the Sun StorEdge A5X00 family of storage systems. It is an application host-based write accelerator which improves performance for transaction processing and delivers fast response times to user requests for data by reducing the frequency of disk I/O accesses. Writes are cached in non-volatile memory and then the cached data is destaged to disk at a later time. Fast Write Cache release 1.0 is installed on Solaris™ servers and consists of the following:

- Two 32-MB SBus NVRAM (non-volatile memory) adapter cards used as cache memory
- Dual, redundant memory boards for reliability
- Storage cache-management software for the Solaris operating environment

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 A5X00 array family offers two configuration options: the 14-drive and the 22-drive subsystem enclosures. These offer users the flexibility of choosing a cost-effective with a low price per megabyte (Sun StorEdge A5100 array with 14 drives) or a high-performance unit (Sun StorEdge A5200 array with 22 drives running at 10,000 rpm).

Just the Facts

May 1999

- **Sun StorEdge A7000 array**

  The product of choice for mainframe-class environments. The Sun StorEdge A7000 Intelligent Storage Server provides the largest capacity, with a single enclosure accommodating over 2.9 TB of storage. Supporting up to 32 host connections from mainframe, UNIX®, and Microsoft Windows NT users alike, the Sun StorEdge A7000, The Intelligent Storage Server, provides true data sharing and mission-critical/mainframe-class reliability, availability, and serviceability (RAS) to the most demanding highly available computing environments.

Key Messages

The Sun StorEdge A5100 and A5200 subsystems offers high performance, high RAS, and leading-edge technology.

1. High Performance

Performance testing 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. (Performance testing is summarized in the “Test Results” table under “Performance Summary” in the System Architecture section.

2. High RAS (Reliability, Availability, Serviceability)

The RAS features of this array exceed the features of its predecessor, the SPARCstorage Array family. For example, the Sun StorEdge A5X00 system features dual paths to each disk; no SCSI array has this feature.

Feature	SPARCstorage Array	Sun StorEdge A5X00 Array
Redundant power	No	Yes
Redundant interfaces (array)	No	Yes
Redundant interfaces (drive)	No	Yes
Hot-swappable drives	No	Yes
Hot-swappable power	No	Yes
Hot-swappable cooling	No	Yes
Hot-swappable interfaces	No	Yes
Diagnostics (FRU revision levels)	No	Yes
Diagnostics (host adapter)	No	Yes
Diagnostics (array interface)	No	Yes
Diagnostics (tray)	No	Yes
Automatic loop failover	No	Yes
Load balancing across loops	No	Yes
Full CRC datapath support	No	Yes

3. Network Storage Strategic Direction

Sun continues to set the standard for Fibre Channel-based storage arrays with the Sun StorEdge A5X00 array family. A second-generation FC-AL subsystem, the Sun StorEdge A5X00 array models are the most popular Fibre Channel storage arrays available with over 3,300 TB of storage installed to date. The building block of Sun's Intelligent Storage Network, the Sun StorEdge A5X00 array family 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 Sun StorEdge A5000 subsystem began shipping in November 1997. In September 1998, rack density improved with the addition of the 72-inch Sun StorEdge cabinet. In January 1999, Sun introduced a new member to the product family, the Sun StorEdge A5200 array, using the latest high-density, high-performance disk drives. In February 1999, Sun also introduced the Sun StorEdge A5100 array with 18-GB Fibre Channel drives. The new Sun StorEdge A5100 doubles the capacity of the original A5000 subsystem.

- Hubless configurations of the Sun StorEdge A5X000 array GA: May 25, 1999
- Upgrades for the Sun StorEdge A5X00 array GA: June 1, 1999
- Upgrades for Hubless Configurations GA: June 8, 1999
- Sun StorEdge Long-wave GBIC module GA: June 23, 1999

Target Users

The Sun StorEdge A5X00 subsystem is the central building block of the Intelligent Storage Network, 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 family 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™ customers who desire factory-configured Sun StorEdge A5X00 arrays without hubs attached.

Industry/Customer	Key Features to Highlight
Disaster recovery	FC-AL future upgrade to a 10-km distance between arrays
Departmental storage	Tabletop design with proper capacity to support department sizes
Datacenter storage	Enterprise-class redundancy and mission-critical failover of components
Technical computing	High-performance data storage for engineering design projects
Scientific computing	High bandwidth for data capture, retrieval and storage
High-performance computing	FC-AL 100-MB per second interface for the most demanding performance needs
SPARCstorage array upgrades	Priced and packaged to migrate customers

The target markets for the long-wave GBIC feature include Sun StorEdge A5X00 array Fibre Channel customers such as large global accounts with multinational or a multisite presence, who are seeking the highest levels of data availability, security and recovery. Key requirements are reliability, availability, and serviceability (RAS). The market for remote mirroring is expected to increase to 25 percent over the next two years (IDC) as FC-AL solutions are more widely available.

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	Fastest 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 family 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

Due to its scalability, the Sun StorEdge™ A5X00 series is easily configured to meet the most demanding commercial database, financial, and manufacturing applications. The 100-MB-per-second, full-duplex Fibre Channels enable the array to excel at bandwidth-intensive applications such as data warehousing, web serving, seismic analysis, video production, MCAD and other technical applications.

Sun customers who purchase the Sun StorEdge A5100 array receive a high-availability, high-bandwidth storage subsystem with the RAS, performance, and scalability expected in modern information storage subsystems. The new, high-capacity drives offer superior storage packaging by doubling the current storage capability of the array.

The Sun StorEdge A5200 array delivers a significant density and performance increase with the introduction of 9.1-GB, 10000-rpm drives in a new 22-drive enclosure. The additional drives per enclosure, combined with the drive speed increase, will yield higher throughput and lower latency.

Hubless Configurations

New Sun StorEdge A5100 and A5200 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.

Long-wave GBIC

The long-wave GBIC module is an optical component technology new to the FC-AL market. Enabling a flexible, scalable remote-mirroring solution, it will open up what was a very expensive, monolithic market. Sun server customers have been anticipating this feature for some time.

Business continuance, reliability and disaster recovery are key elements of enterprise storage. Providing our customers with these solutions demonstrates a commitment and capability to support enterprise class, mission-critical environments. The new long-wave optical module will offer additional functionality and enhancements in this area.

Compatibility

The following tables list the systems that support the Sun StorEdge A5X00 arrays. All maximum capacities noted are configured with single 200-GB enclosures. Note: The maximum capacities on the Sun Enterprise™ 10000 server are stated per domain maximum tested.

Sun StorEdge A5100 Array Compatibility

Maximum capacities are stated in terms of 200-GB arrays. The exception to this is the Sun Enterprise 10000 server, which supports a maximum capacity of 10 TB per domain.

Servers Supported	Maximum Number of Internal Arrays	Maximum Number External Arrays	Maximum Supported External Storage Capacity
Sun Enterprise 10000	0	80	10 TB
Sun Enterprise 6500	3	72	18.3 TB
Sun Enterprise 6000	1	72	18.3 TB
Sun Enterprise 5500	4	48	12.2 TB
Sun Enterprise 5000	1	48	12.2 TB
Sun Enterprise 4500	0	48	12.2 TB
Sun Enterprise 4000	0	48	12.2 TB
Sun Enterprise 3500	0	24	6.1 TB
Sun Enterprise 3000	0	24	6.1 TB
SPARCcenter™ 2000E	0	72	18.3 TB
SPARCserver™ 1000E	0	8	2.0 TB
Sun Enterprise 450	0	8	2.0 TB
Sun Enterprise 250	0	4	1.0 TB
Sun Enterprise 2	0	16	3.2 TB
Sun Ultra™ 60	0	2	0.5 TB
Microsoft Windows NT server	0	4	1.0 TB

Sun StorEdge A5200 Array Compatibility

Maximum capacities are stated in terms of 200-GB arrays. The exception to this is the Sun Enterprise 10000 server, which supports a maximum capacity of 10 TB per domain.

Servers Supported	Maximum Number of Internal Arrays	Maximum Number External Arrays	Maximum Supported External Storage Capacity
Sun Enterprise 10000	0	80	10 TB
Sun Enterprise 6500	3	72	14.4 TB
Sun Enterprise 6000	1	72	14.4 TB
Sun Enterprise 5500	4	48	9.6 TB
Sun Enterprise 5000	1	48	9.6 TB
Sun Enterprise 4500	0	48	9.6 TB
Sun Enterprise 4000	0	48	9.6 TB
Sun Enterprise 3500	0	24	4.8 TB

Servers Supported	**Maximum Number of Internal Arrays**	**Maximum Number External Arrays**	**Maximum Supported External Storage Capacity**
Sun Enterprise 3000	0	24	4.8 TB
SPARCcenter 2000E	0	72	14.4 TB
SPARCserver 1000E	0	8	1.6 TB
Sun Enterprise 450	0	8	1.6 TB
Sun Enterprise 250	0	4	800 GB
Sun Enterprise 2	0	16	3.2 TB
Microsoft Windows NT server	0	4	800 GB

Some hosts will be supported after the announcement. 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 new operating functions.

Array Model	**Maximum Arrays per Loop**
Sun StorEdge A5000	Four arrays with up to 14 drives each for maximum of 56 total drives
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 Figure 3). 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.

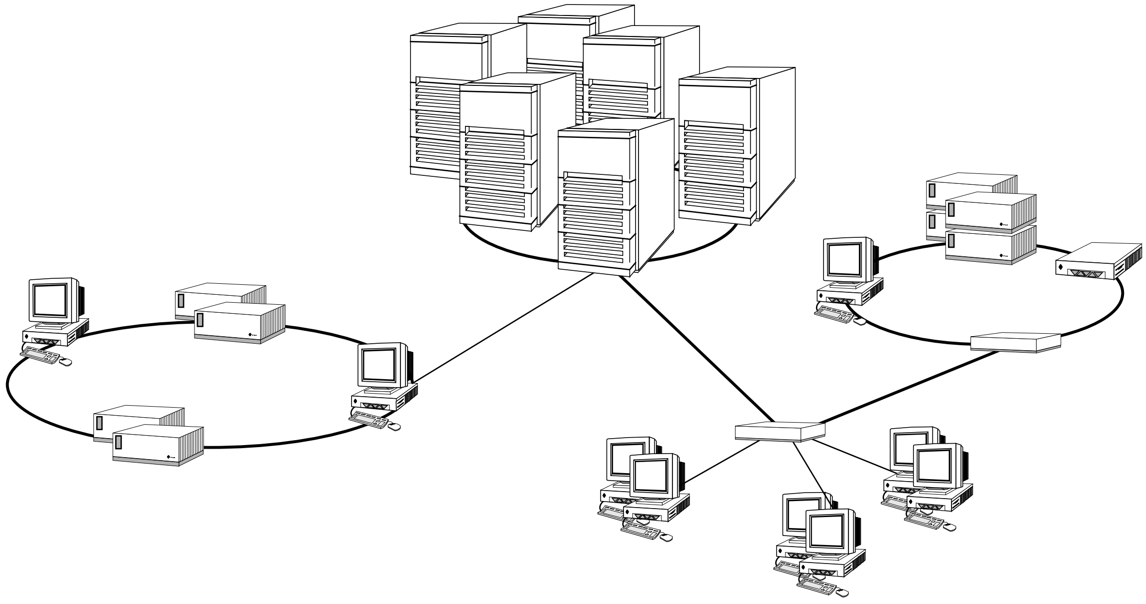


Figure 3. FC-AL's loop topology can support both simple and complex configurations

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 ensures 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-per-second data rates	40-MB-per-second data rates	Throughput to match modern computing, 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 30 meters using cable	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, disk arrays
Use of cyclic redundancy checks to ensure data integrity	Same	Better security and reliability
Simple serial protocol over a copper or fibre 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 200 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 A5X00 subsystem disk enclosure is capable of supporting up to fourteen 1.6-inch disk drives (Sun StorEdge A5100 array) or twenty-two 1.0-inch disk drives (Sun StorEdge A5200 array). 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.

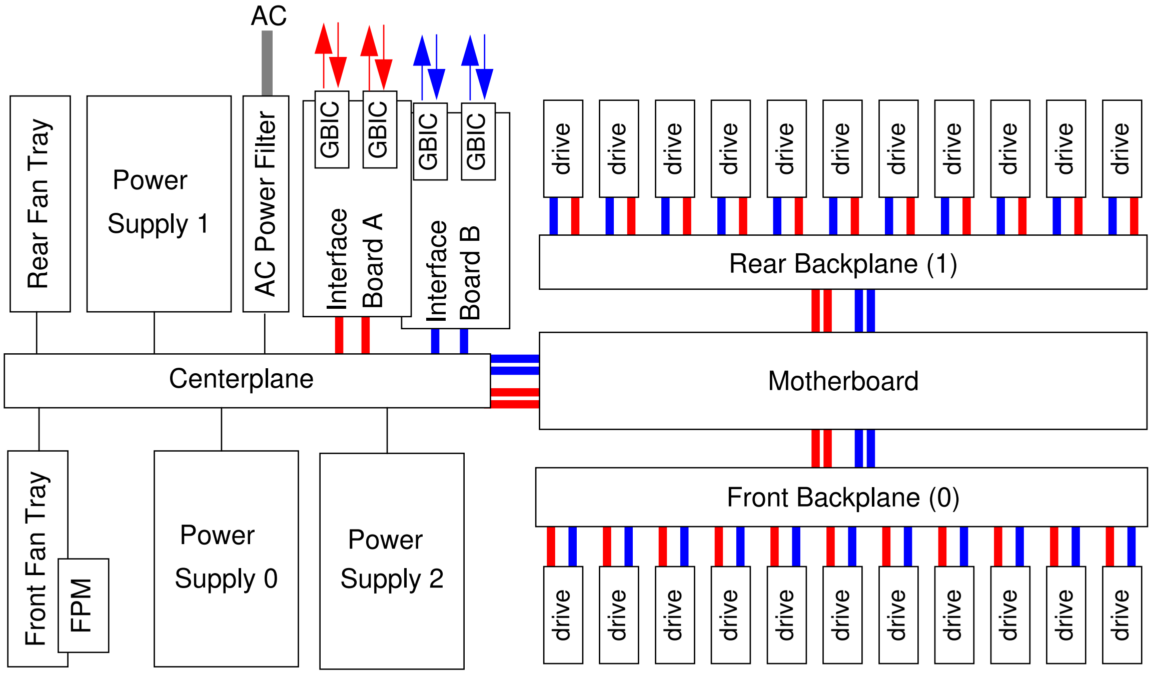


Figure 4. System architecture for the 22-drive configuration of the Sun StorEdge A5500 array. The 14-drive enclosure (Sun StorEdge A5100 array) places seven drives on each backplane.

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 Fibre Channel 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 as 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 family 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 family 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. Two form factors are available: half-height (1.6-inch) or low-profile (1.0-inch) disk drives.

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 next generation GBICs supported in the Sun StorEdge A5X00 array family support long-wave mode. 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 can run a maximum distance of ten kilometers.

The long-wave GBIC module 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 be mirror data from storage devices over long distances. The long-wave GBIC module easily enables long-distance mirroring across fibre channel between Sun StorEdge A5X00 storage systems and Sun Enterprise™ servers.

Long-wave GBIC module now allows customers to extend connections between Sun servers and storage up to a distance of ten kilometers. It also enables customers to mirror over long distances for disaster recovery, or to install campus clustering. This is major improvement of the current remote mirroring which is limited to a distance of 500 meters.

Supplying the interconnect technology for 10-km separation opens up a highly specialized enterprise computing arena: business continuance. The StorEdge A5X00 family can now step in to replace the SPARCstorage™ Array in remote mirror and campus cluster environments. The long-wave GBIC module will be offered as part of a remote mirroring and campus cluster solution.

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 A5X00 hubs, interface boards and host adapters. The long-wave GBIC also requires single-mode, fibre-optic cable complying with Sun specified standards. Sun Network Storage will specify specific supported configurations for deploying remote sites and mirrored storage.

The new long-wave GBIC module can be installed into the Sun StorEdge A5X00 product line. Sun has enhanced and improved this product line to include the Sun StorEdge A5100 and A5200 arrays. The StorEdge A5100 array delivers a significant density increase with the introduction of 18.2-GB, 7200-rpm drives. These high-capacity drives yield twice the capacity in the same physical space as the original Sun StorEdge A5000 array which result in a lower cost per megabyte.

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
• Sun StorEdge Volume Manager™ software	• Mirroring capability included at no charge with Sun StorEdge A5X00 array purchase

Sun StorEdge Fast Write Cache

Sun StorEdge Fast Write Cache is write cache option to the Sun StorEdge A5X00 family of storage systems. It is an application host-based write accelerator which improves performance for transaction processing and delivers faster response times to user requests for data by reducing the frequency of disk I/O accesses. Writes are cached in non-volatile memory and then the cached data is destaged to disk at a later time. Fast Write Cache release 1.0 is installed on Solaris™ servers and consists of the following:

- Two 32-MB SBus NVRAM (non-volatile memory) adapter cards used as cache memory
- Dual, redundant memory boards for reliability
- Storage cache-management software for the Solaris operating environment

Fast Write Cache is valuable to customers who run write-intensive applications. Adding the Fast Write Cache to configurations does not require that all writes on the application server be cached. With Fast Write Cache, 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.

Execution Platforms	Operating Environments	Storage Platforms	Software
Sun Enterprise 3X00 to 6X00 servers	• Solaris 2.6 • Solaris 7, 32 bit • Solaris 7, 64 bit	• Sun StorEdge A5000 • Sun StorEdge A5100 • Sun StorEdge A5200	• Sun StorEdge Instant Image 1.0 • VERITAS Volume Manager 2.6, 3.0.1 • VERITAS File System 3.2.1, 3.3.2

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 Service

Two 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.

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.

Touch Screen 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

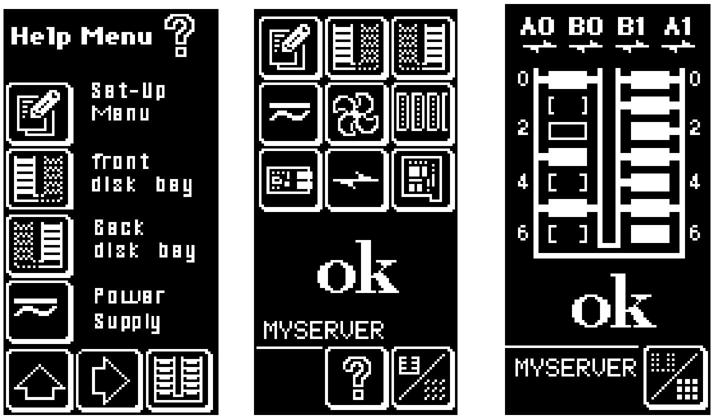


Figure 5. Front panel model touch screens

Fiber Cable

The Sun StorEdge A5X00 array family supports 50/125 multimode, duplexed, UL910- and UL1651-approved fibre 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 family 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 to be released).

RAID Support

Sun StorEdge Volume Manager software (VERITAS Volume Manager) 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. Sun StorEdge 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) enables 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) enables 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 family, 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.

Now with the Solaris 2.6 operating environment (or Solaris 2.5.1 operating environment), 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 Sun StorEdge Volume Manager software release 2.5 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. Sun StorEdge 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 access to their data can be obtained quickly. Sun StorEdge Volume Manager software enables 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 Sun StorEdge 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.

Sun StorEdge 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

Sun StorEdge 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.

Performance

Performance Summary

- Using a split-loop JBOD configuration with 9.1-GB, 10000-rpm drives, the Sun StorEdge™ A5200 array achieves its highest bandwidth of 316 MB per second and its highest I/O throughput of 9,468 IOPS.
- Using a RAID-5 configuration with 9.1-GB, 10000-rpm drives, the Sun StorEdge A5200 array achieves a bandwidth of 137 MB per second and I/O throughput of 3,185 IOPS.

Performance Test Results

The Sun StorEdge A5100 array is configured with fourteen 18.8-GB, 7200-rpm disk drives. The Sun StorEdge A5200 22-drive configuration provides significantly higher performance in both RAID 0+1 and RAID 5 configurations.

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).

Test Parameter	**RAID 0+1**				**RAID 5**			
	Sun StorEdge A5100 Array		**Sun StorEdge A5200 Array**		**Sun StorEdge A5100 Array**		**Sun StorEdge A5200 Array**	
Configuration	14 x 18.2-GB drives		22 x 9.1-GB drives		14 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	1,232		3,215		1,555		3,185	
• Random write	369		1,094		192		431	
• Sequential read		63		107		107		137
• Sequential write		60		83		19		25

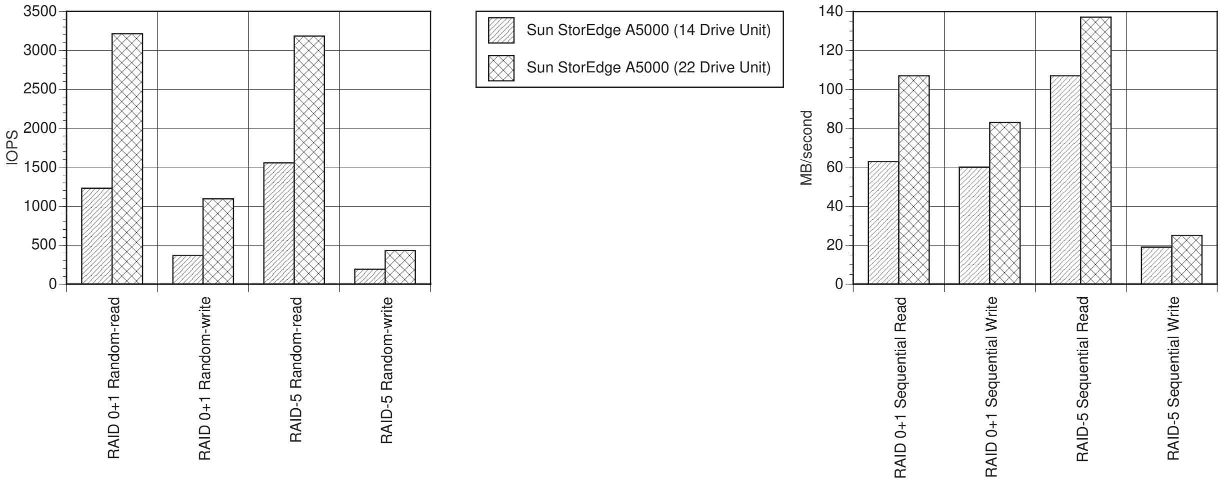


Figure 6. The Sun StorEdge A5X00 arrays provide high RAID performance

Raw Benchmark Configuration

The Sun StorEdge A5X00 array family was also tested in a JBOD configuration to determine maximum streaming performance. In the JBOD configuration, no striping or RAID levels are employed, and split loops with dynamic multipathing provide four FC-AL connections to each drive set, enabling full saturation of the subsystem to be achieved. To determine the maximum possible IOPS, the 2-KB I/O random seek ranges were small (120 MB), However, to determine the maximum bandwidth, large multi-threaded I/O (256 KB with 16 threads) was used.

The Sun StorEdge A5X00 array family I/O capacity is scalable in units of one Sun StorEdge A5X00 array enclosure within the limits of host bus, memory and processing resources.

	Sun StorEdge A5100 14 x 18.2-GB drives	**Sun StorEdge A5200 22 x 9.1-GB drives**	**SPARCstorage Array**
Maximum IOPS	3,782 IOPS	9,468 IOPS	3,340 IOPS
Maximum throughput	147 MB/sec.	316 MB/sec.	19 MB/sec.

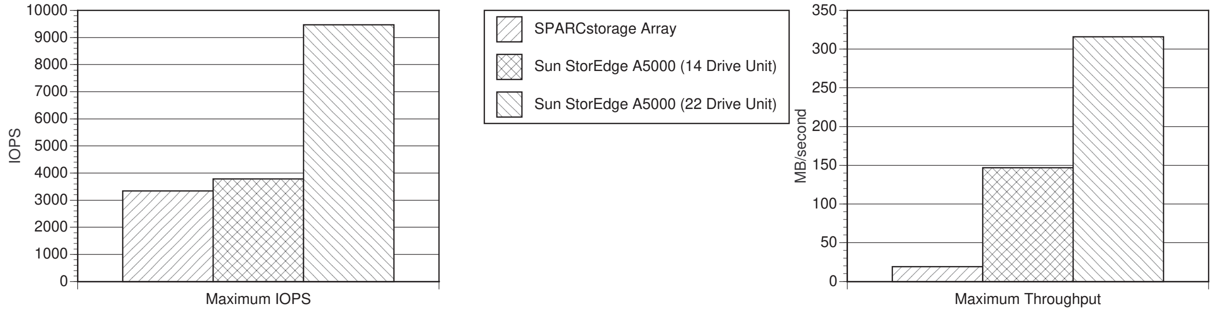


Figure 7. The Sun StorEdge A5X00 arrays provide high JBOD performance

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™ 2.6 operating environment Hardware: 2/97, with patches 105356-08, 105357-02, 105375-10, and 106129-06
- Solaris 2.5.1 operating environment Hardware: 11/97, with patches 104708-15, 105310-08, 105324-03, and 106129-06

Solaris operating environment patches are available on the SunSolve™ web site at `http://sunsolve.sun.com.`

System Configuration

The configuration choices for the Sun StorEdge A5X00 array family 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 electro-luminescent display which provides information on local test and status.

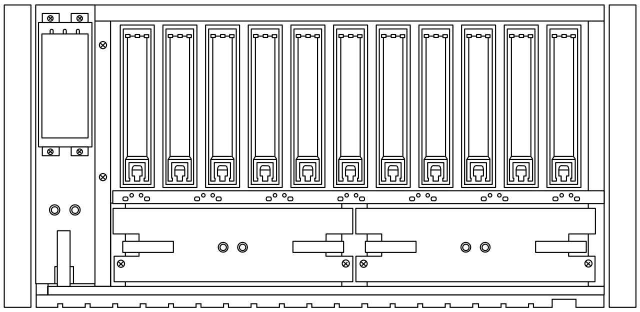


Figure 8. Front components

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 holds one GBIC module.

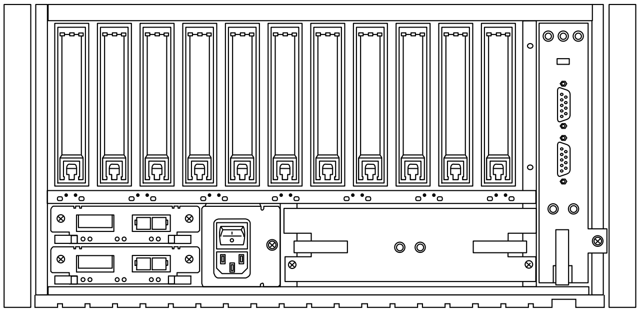


Figure 9. Rear components

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 tray.

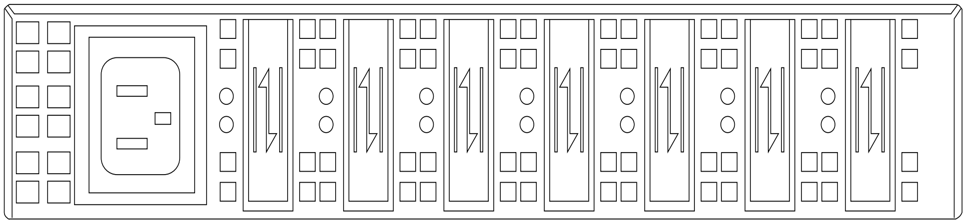


Figure 10. FC-AL seven-port hub

FC-AL SBus Host Adapter

The FC-AL host adapter for the Sun StorEdge A5X00 system is a dual-channel, 100-MB-per-second SBus card, which includes one GBIC optical module and support for one additional module. Up to eight arrays using 176 drives can be connected to a single host adapter. However, using a single host adapter is not recommended for environments needing high availability.

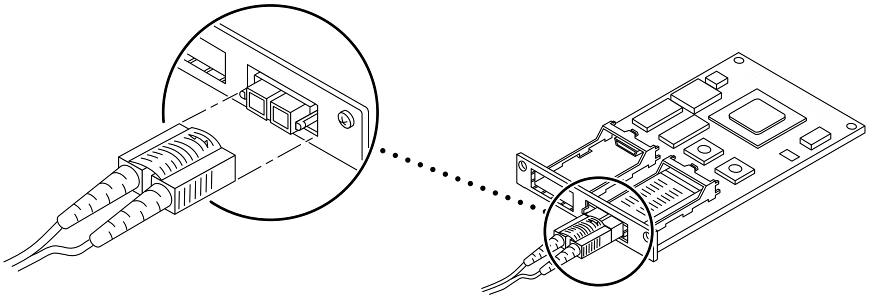


Figure 11. FC-AL SBus host adapter

GBIC

The gigabit interface converter (GBIC) for the Sun StorEdge A5X00 array family 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.

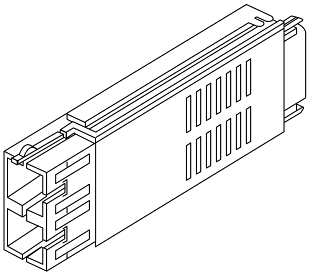


Figure 12. Gigabit interface converter (GBIC)

Long-wave GBIC

Prior to installation, long-wave GBIC modules require that customers have a fibre 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 SENA 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 1.2 TB in one cabinet. Using the Sun StorEdge A5100 array it is possible to store up to 1.5 TB in one cabinet. Preconfigured rackmount assemblies are offered, or the array may be rackmounted in the field with optional hardware.

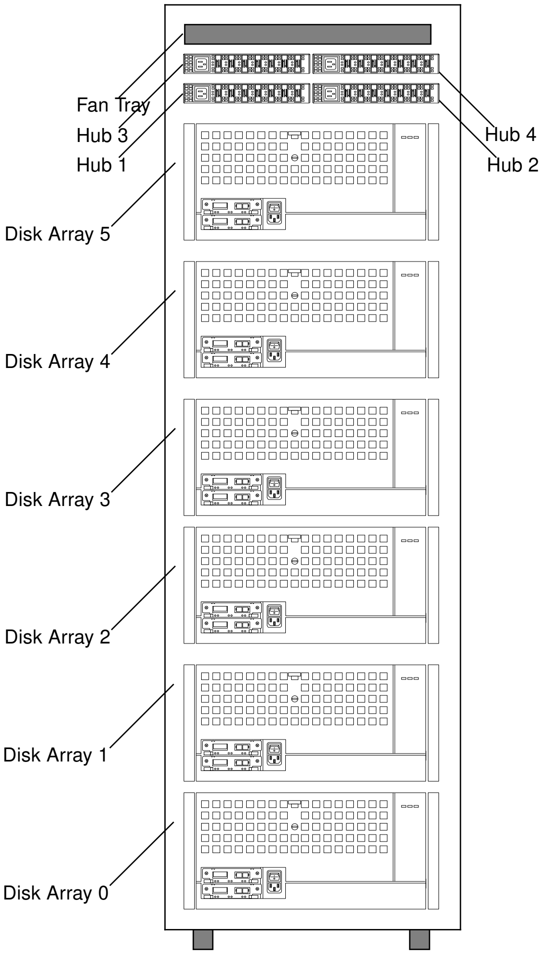


Figure 13. Rackmounting the Sun StorEdge A5X00 system

Interconnect

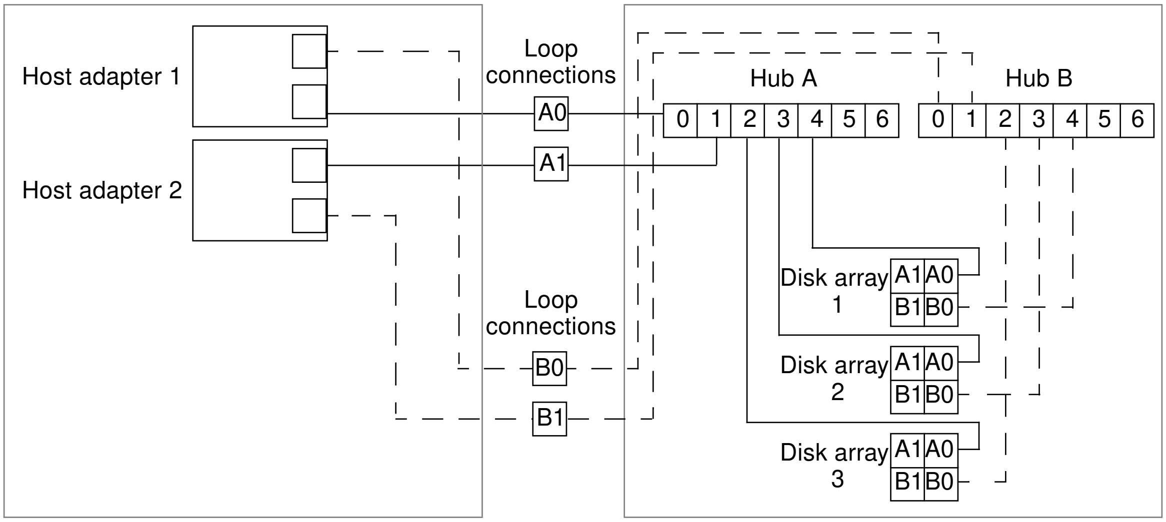


Figure 14. Interconnect

The Sun StorEdge A5X00 array uses 50-micrometer fibre 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 Management

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

Sun StorEdge 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	• Enables volumes to change as needs dictate
• File system expansion	• Enables file systems to grow dynamically
• On-line snapshots	• Facilitates on-line backups
• Graphical user interface	• Eases administration
• Performance analysis tool	• Enables problem (bottleneck) isolation and tuning

Support for Sun™ Cluster software is as follows:

- Sun Cluster 2.1 software is currently supported on the Sun StorEdge™ A5200 array
- Sun Cluster 2.1 software support on the Sun StorEdge A5100 array is scheduled for Q499
- Sun Cluster 2.2 software support on the Sun StorEdge A5100/A5200 arrays is scheduled for late Q499

Operating Environment

The Solaris™ Operating Environment

The Solaris™ 2.5.1 or Solaris 2.6 operating environment must be used to support the Sun StorEdge A5X00 system. Solaris patches are available on the SunSolve™ web site at `http://sunsolve.sun.com.`

The current release of the Sun StorEdge Volume Manager software is not available for the Solaris 7 operating environment product line. Consequently, the Sun StorEdge A5X00 array family will not be supported on the Solaris 7 operating environment product line until the next version of the Sun StorEdge Volume Manager (version 3.0.1) software is released in the third quarter of calendar year 1999.

Microsoft Windows NT Server

Sun is looking to drive further growth of the Fibre Channel business. To increase leadership in FC-AL storage and provide new customer flexibility with new and existing Sun StorEdge A5100 and A5200 arrays, Sun now offers support on the Microsoft Windows NT server operating system. Microsoft Windows NT Server 4.0 with Service Pack 3 is required for this functionality.

Localization and Internationalization

The Sun StorEdge A5100 and A5200 arrays are Year 2000 compliant and are listed on Sun's external web site. They meet the requirements of current rules governing internationalization and localization for Sun Enterprise™ products.

Sun StorEdge™ A5200 Arrays

Order Number	Title and Description
SG-XARY520A-63G	63-GB Sun StorEdge™ A5200 tabletop array, including seven 9.1-GB, 10000-rpm FC-AL drives, three power supplies, two interface boards, and two 2-meter fibre optic cables
SG-XARY520A-200G	200-GB Sun StorEdge A5200 tabletop array, including twenty-two 9.1-GB, 10000-rpm FC-AL drives, three power supplies, two interface boards, and two 2-meter fibre optic cables
SG-XARY521A-200G	200-GB Sun StorEdge A5200 array, including twenty-two 9.1-GB, 10000-rpm FC-AL drives, three power supplies, two interface boards, two 2-meter fibre optic cables for rackmounting in Sun StorEdge 72-inch expansion cabinet
SG-ARY522A-200G	200-GB Sun StorEdge A5200 array, including twenty-two 9.1-GB, 10000-rpm FC-AL drives, three power supplies, two interface boards, two 2-meter fibre optic cables for rackmounting in Sun Enterprise™ 5500 or 6500 server cabinet
SG-ARY523A-200G	200-GB Sun StorEdge A5200 array (hubless), including one array with twenty-two 9.1-GB, 10000-rpm FC-AL drives, three power supplies, two interface boards, twelve 15-meter fiber optic cables; rackmounted in 72-inch Sun StorEdge cabinet (no hubs attached)
SG-XARY523A-400G	400-GB Sun StorEdge A5200 cabinet, including two arrays with twenty-two 9.1-GB, 10000-rpm FC-AL drives each, two 7-port FC-AL hubs (three GBICs each), and two 15-meter fiber optic cables, mounted in a 72-inch Sun StorEdge cabinet
SG-XARY523A-800G	800-GB Sun StorEdge A5200 cabinet, including four arrays with twenty-two 9.1-GB, 10000-rpm FC-AL drives each, four FC-AL hubs (three GBICs each), and four15-meter fiber optic cables, mounted in a 72-inch Sun StorEdge cabinet
SG-XARY523A-1200G	1200-GB Sun StorEdge A5200 cabinet, including six arrays with twenty-two 9.1-GB, 10000-rpm FC-AL drives each, four 7-port FC-AL hubs (three GBICs each), and four 15-meter fiber optic cables mounted in a 72-inch Sun StorEdge cabinet

Sun StorEdge A5100 Arrays

SG-XARY530A-91G	91-GB Sun StorEdge A5100 tabletop array, including five 18.2-GB, 7200-rpm FC-AL drives, three power supplies, two interface boards (one GBIC each), and two 2-meter fibre optic cables
SG-XARY530A-254G	254-GB Sun StorEdge A5100 tabletop array, including fourteen 18.2-GB, 7200-rpm FC-AL drives, three power supplies, two interface boards (one GBIC each), and two 2-meter fibre optic cables
SG-ARY531A-254G	254-GB Sun StorEdge A5100 array, including fourteen 18.2-GB, 7200-rpm FC-AL drives, three power supplies, two interface boards (one GBIC each), and two 2-meter fibre optic cables for rackmounting in Sun StorEdge cabinet
SG-ARY532A-254G	254-GB Sun StorEdge A5100 array, including fourteen 18.2-GB, 7200-rpm FC-AL drives, three power supplies, two interface boards (one GBIC each), and two 2-meter fibre optic cables for rackmounting in Sun Enterprise 5500 or 6500 server cabinet
SG-ARY533A-254G	254-GB Sun StorEdge A5100 cabinet (hubless), including fourteen 18.2 GB, 7200 rpm drives, three power supplies, two interface boards, twelve 15-meter fiber optic cables, rackmounted in 72-inch StorEdge cabinet (no hubs attached)
SG-XARY533A-509G	509-GB Sun StorEdge A5100 cabinet, including two arrays with fourteen 18.2-GB, 7200-rpm FC-AL drives (28 drives total), two FC-AL hubs, (three GBICs each), and two 15-meter fibre optic cables mounted in a Sun StorEdge 72-inch cabinet
SG-XARY533A-1528G	1528-GB Sun StorEdge A5100 cabinet, including six arrays with fourteen 18.2-GB, 7200-rpm FC-AL drives (84 drives total), four FC-AL hubs, (three GBICs each), and four 15-meter fibre optic cables mounted in a Sun StorEdge 72-inch cabinet

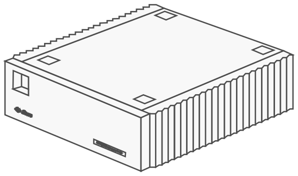
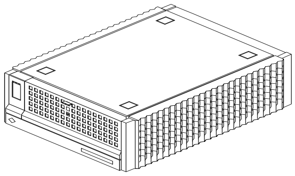
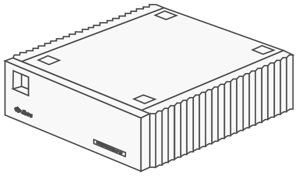
Options

Order number	Option Description	Maximum Number Supported	Comments
X6730A	100-MB/sec. FC-AL SBus dual-channel host adapter, including one GBIC module		2 GBICs maximum
X6729A	100-MB/sec. FC-AL PCI single channel host adapter		1 GBIC maximum
X6732A	100-MB/sec. FC-AL seven-port hub, no GBICs included	1 per loop	7 GBICs maximum
X6731A	100-MB/sec. FC-AL GBIC for host adapter or hub		
X6710A	9.1-GB, 10000-rpm FC-AL disk drive (A5200)	22 per array	
X6711A	18.2-GB, 7200-rpm FC-AL disk drive (A5100)	14 per array	
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-distance optical module. Includes one long-wave GBIC module; one 15-meter, single-mode, fibre optic jumper cable		Minimum of two long-wave GBIC modules required for each array. Requires Sales desk screening.
A6738A	Fast Write Cache for the Sun StorEdge A5X00 arrays. Includes two 32-MB NVRAM SBus adapter cards plus cache software for Solaris™ operating environment.		
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.
FWCACHE-INSTALL	Installation and initial configuration services for Sun StorEdge Fast Write Cache		

Upgrades

Upgrade Paths

Protect your investment in SPARCstorage™ Arrays by upgrading to the Sun StorEdge™ A5X00 array family. Sun-to-Sun and competitive upgrades to the Sun StorEdge A5X00 array family 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

SPARCstorage Array Upgrade Ordering

Sun StorEdge A5200 Array Upgrades

Order Number	Description
UG-A5000-63G	Sun array upgrade to 63-GB Sun StorEdge A5200 array
UG-A5000-200G	Sun array upgrade to 200-GB Sun StorEdge A5200 array
UG-A5000-200GR5	Sun array upgrade to 200-GB Sun StorEdge A5200 array (rackmounting attached for Sun StorEdge 72-inch expansion cabinet)
UGFA-A5200-200G	Sun array upgrade to hubless 200-GB Sun StorEdge A5200 array (rackmounting attached for Sun StorEdge 72-inch expansion cabinet)
UG-A5000-400G	Sun array upgrade to 400-GB Sun StorEdge A5200 array
UG-A5000-800G	Sun array upgrade to 800-GB Sun StorEdge A5200 array
UG-A5000-1200G	Sun array upgrade to 1200-GB Sun StorEdge A5200 array

Sun StorEdge A5100 Array Upgrades

Order Number	Description
UG-A5000-91G-18D	Sun array upgrade to 91-GB Sun StorEdge A5100 array
UG-A5100-254G-18D	Sun array upgrade to 254-GB Sun StorEdge A5100 array
UGFA-A5000-254G	Sun array upgrade to hubless 254-GB Sun StorEdge A5100 array (rackmounting attached for Sun StorEdge 72-inch expansion cabinet)
UG-A5000-509G-18D	Sun array upgrade to 509-GB Sun StorEdge A5100 array
UG-A5000-1528G-18D	Sun array upgrade to 1528-GB Sun StorEdge A5100 array

Competitive Upgrade Ordering

Sun StorEdge A5200 Array Competitive Upgrades

Order Number	Title and Description
CU-A5000-63G	Competitive array upgrade to 63-GB Sun StorEdge A5200 array
CU-A5000-200G	Competitive array upgrade to 200-GB Sun StorEdge A5200 array
CUFA-A5200-200G	Competitive array upgrade to hubless 200-GB Sun StorEdge A5200 array
CU-A5000-400G	Competitive array upgrade to 400-GB Sun StorEdge A5200 array
CU-A5000-800G	Competitive array upgrade to 800-GB Sun StorEdge A5200 array
CU-A5000-1200G	Competitive array upgrade to 1200-GB Sun StorEdge A5200 array

Sun StorEdge A5100 Array Competitive Upgrades

Order Number	Title and Description
CU-A5000-91G-18D	Competitive array upgrade to 91-GB Sun StorEdge A5100 array
CU-A5000-254G-18D	Competitive array upgrade to 254-GB Sun StorEdge A5100 array
CUFA-A5100-254G	Competitive array upgrade to hubless 254-GB Sun StorEdge A5100 array
CU-A5000-509G-18D	Competitive array upgrade to 509-GB Sun StorEdge A5100 array
CU-A5000-1528G-18D	Competitive array upgrade to 1528-GB Sun StorEdge A5100 array

Sun StorEdge A5100/A5200 Factory-configured Upgrades

Order Number	Title and Description
CU-CONSL-A5K-245G5	Factory-configured array upgrade to 254-GB Sun StorEdge A5100 array
CU-CONSL-A5K-509G	Factory-configured array upgrade to 509-GB Sun StorEdge A5100 array
CU-CONSL-A5-200GR5	Factory-configured array upgrade to 200-GB Sun StorEdge A5200 array
CU-CONSL-A5K-400G	Factory-configured array upgrade to 400-GB Sun StorEdge A5200 array

Service and Support

The SunSpectrum^{SM} 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, and telephone support for Sun software packages. The majority of Sun's customers today take advantage of the SunSpectrum program, underscoring the value it represents. Customers should check with their local Sun Enterprise™ Services representatives for program/feature variance and availability in their area.

FEATURE	SUNSPECTRUM PLATINUM^{SM} Mission-Critical Support	SUNSPECTRUM GOLD^{SM} Business-Critical Support	SUNSPECTRUM SILVER^{SM} Systems Support	SUNSPECTRUM BRONZE^{SM} 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
Personal technical account support	Yes	Yes	No	No
Account support plan	Yes	Yes	No	No
Software release planning	Yes	No	No	No
Onsite account reviews	Monthly	Semi-annual	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 onsite 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	No
7 day/24 hour onsite coverage	Yes	Option	Option	N/A
Customer-defined priority setting	Yes	Yes	Yes	No
– Urgent (phone/onsite)	Live transfer/ 2 hour	Live transfer/ 4 hour	Live transfer/ 4 hour	4 hour / N/A
– Serious (phone/onsite)	Live transfer/ 4 hour	2 hour/next day	2 hour/next day	4 hour / N/A
– Not critical (phone/onsite)	Live transfer/ customer convenience	4 hour/ customer convenience	4 hour/ customer convenience	4 hour / N/A
Additional contacts	Option	Option	Option	Option

FEATURE	SUNSPECTRUM PLATINUM^{SM} Mission-Critical Support	SUNSPECTRUM GOLD^{SM} Business-Critical Support	SUNSPECTRUM SILVER^{SM} Systems Support	SUNSPECTRUM BRONZE^{SM} Self Support
Enhanced Support Features				
Mission-critical support team	Yes	Yes	No	No
Sun Vendor Integration Program (SunVIP^{SM})	Yes	Yes	No	No
Software patch management assistance	Yes	No	No	No
Field change order (FCO) management assistance	Yes	No	No	No
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 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^{SM} license	Yes	Yes	Yes	Yes
SunSolve EarlyNotifier^{SM} Service	Yes	Yes	Yes	Yes

Warranty

The warranty on the array hardware is one year. 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
- Web-based course: FS16W.Z

Professional Services

Sun StorEdge ArrayStart™ Program

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 Sun StorEdge 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 family 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.
Channel	An interface directed toward high-speed transfer of large amounts of information.
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 Fibre Channel name.
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.
Full duplex	A communications protocol that permits simultaneous transmission in both directions, usually with flow control.
GBIC	Gigabit interface converter.
Hub	A device for connecting fiber cables.
IP	Internet protocol. A set of protocols developed by the United States Department of Defense to communicate between dissimilar computers across networks.
Laser	Light amplification by stimulated emission of radiation. A device for generating coherent radiation in the visible, ultraviolet, and infrared portions of the electromagnetic spectrum.
LED	Light emitting diode.
Link	One inbound fiber and one outbound fiber connected to a port.
Micron	One millionth of a meter. Also called “micrometer.”
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.
Optical fiber	Any filament of fiber, made of dielectric material, that guides light.
Point-to-point	A topology where exactly two ports communicate.
Port	An access point in a device where a link attaches.
Protocol	A convention for data transmission that defines timing, control, format, and data representation.
Receiver	The circuitry that receives signals on a fiber, and the ultimate destination of data transmission.
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.
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.
Switch	The name of an implementation of the fabric topology.
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.

Materials Abstract

All materials are available on SunWIN unless otherwise noted.

Collateral	Description	Purpose	Distribution	Token # or COMAC Order #
Powerpack				
– *Sun StorEdge™ A5000 Array Family—Just the Facts*	Reference Guide	Sales Tool, Training	SunWIN, Reseller Web	73714
– *Sun StorEdge A5000 Array Family 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,* 1/99	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
– *Sun StorEdge A5000 Family FAQ*	Frequently Asked Questions	Sales Tool, Training	SunWIN	73089
Product Literature				
– *Literature—Sun StorEdge A5000 Data Sheet,* 1/99	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 A5000 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 A5000 Array Configuration*	Technical Brief	Sales Tool, Training	SunWIN, Reseller Web	73709
– *Sun StorEdge A5000 Architecture White Paper, 1/99*	Technical Brief	Sales Tool, Training	SunWIN, Reseller Web	73711
– *Sun StorEdge A5000 Array Performance and Serviceability Report, 11/98*	Technical Brief	Sales Tool, Training	SunWIN	96117

Collateral	Description	Purpose	Distribution	Token # or COMAC Order #
– *Reliability, Availability, Serviceability in the Sun StorEdge A5000 White Paper*	Technical Brief	Sales Tool, Training	SunWIN, Reseller Web	76631
– *Sun StorEdge A5000 Technical Troubleshooting Guide*	Technical Brief	Sales Tool, Training	SunWIN, Reseller Web	76632
Videos				
– *A5000 Fibre Channel Array*	Video Tape	Sales Tool	Davkore	ME1617-0
Training				
– *Sales Training Kit: Sales IQ Guide—Sun StorEdge A5000 Array*	Sales IQ kit	Training	SunWIN	73692
– *Sales Training Kit: Sales Reference Guide—Sun StorEdge A5000 Array*	Reference Guide	Training	SunWIN	73694
– *Sales Training Kit: Sales Tech IQ Guide—Sun StorEdge A5000 Array*	Technical IQ kit	Training	SunWIN	73693
Competitive				
– *Competitive Edge Bulletin: CLARiiON*	White Paper	Training	SunWIN	74326
– *Competitive Edge Bulletin: DEC*	White Paper	Training	SunWIN	79870
– *Competitive Edge Bulletin: EMC*	White Paper	Training	SunWIN	74515
Success Stories				
– *Gan Canada*	Success Story	Sales Tool	SunWIN, Reseller Web	97344
– *Volvo Information Technology, North America*	Success Story	Sales Tool	SunWIN, Reseller Web	93183
– *University of California, Berkeley NOW Project*	Success Story	Sales Tool	SunWIN, Reseller Web	95349
Related Material				
– *Sun StorEdge Volume Manager™ 2.6—Just the Facts*, 7/98	Reference Guide	Sales Tool Training	SunWIN, Reseller Web	67745
– *VERITAS File System 2.3.1.1—Just the Facts*, 5/97	Reference Guide	Sales Tool Training	SunWIN, Reseller Web	67744
External Web Sites				
– *Fibre Channel Association*	`http://www.fibrechannel.com`			
– *Fibre Channel Loop Community*	`http://www.fcloop.org`			
– *SunSolve™ Web Site (for Solaris Patches)*	`http://sunsolve.sun.com`			