

Sun StorEdge™ 6120 Array

Just the Facts



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Important Note

Common Information Model (CIM)

To ease interoperability with leading IT management utilities and simplify storage management, the Sun StorEdge™ 6120 array uses the following CIM, open standards-based terms for common storage and data management functions.

Old Term		CIM Term
Volume	—>	Storage Pool
Slice	—>	Volume
LUN	—>	Volume
Administrative Domain	—>	Storage Array
Partner Pair	—>	Storage Array
Enclosure	—>	Tray (Storage Module)
Expansion Unit	—>	Expansion Unit
Controller Tray	—>	Controller Tray

Tray (Storage Module)

Refers to a single Storage Module, or tray. Multiple 'trays' connected together, are a Storage Array. Trays with a controller are Controller Trays. Trays without a controller are Expansion Units.

Controller Tray

A tray with an installed RAID controller. The controller tray is the smallest possible storage array configuration. The architecture integrates disks, data cache, hardware RAID, power, cooling, uninterrupted power supply (UPS), diagnostic capabilities, and administration into a versatile, standalone component. The controller tray includes external connections to a data host (or switch), and to a management network.

Expansion Unit

A Tray without an installed RAID controller.

Storage Array

A storage system containing multiple disk drives, designed to provide performance, high availability, serviceability, or other benefits. Disk arrays may provide mechanisms to create virtual extents of volumes, such as RAID groups. The physical and logical elements of the storage array are managed as a group. A storage array must contain at least one tray with a RAID controller.

Extent

A set of disk blocks with logical consecutive addresses. Extents can be smaller or larger than physical disks. Storage arrays with RAID allow you to combine several disks together into a larger "virtual disk". Although the underlying disks are separate extents, the resulting virtual disk is addressed from zero up to its new size; so this virtual disk is also an extent. A volume manager provides a similar capability of merging extents from disks into larger virtual extents.



Storage Pool

A collection of storage extents with the same “quality of service”.

Storage Policy

A Sun midrange storage array or system configuration that is uniquely tuned to meet the needs of specific application workloads.

Volume

A volume is a virtual disk into which a file system, a DBMS, or an application can place data. A volume may be a single physical disk or a virtual disk mapped from one or more underlying extents. Applications that use volumes do not need to be aware of their underlying physical structure. Software or firmware handles the mapping of virtual addresses to physical addresses.

Quality of Service

“Quality of service” refers to the objective of obtaining a desired level of system behavior achieved by using tunable system factors within a storage array. RAID level, number of hot spare disks, multi-path access, and disk speed are some of the factors that influence quality of service. Quality of service can be very specific—for example, no single point of failure, must use RAID 1, must have at least one hot spare—or very general—for example, any storage will do.



Positioning

Introduction



Figure 1. Sun StorEdge™ 6120 array, HA configuration

The Sun StorEdge™ 6120 array is a distributed, very dense hardware-based RAID, Fibre Channel array that combines robust data availability and intuitive manageability with an immensely flexible architecture. The highly reliable Sun StorEdge 6120 array is simple to use, massively scalable, and provides the solid, predictable results demanded by today's business-critical applications. It can help enterprises increase operational efficiency and reduce costs by provisioning storage performance, capacity and availability they need, when they need it.

A successor to the Sun StorEdge T3 array for the Enterprise and Workgroup products, the Sun StorEdge 6120 array is a new midrange storage array that provides increased manageability, better performance, greater flexibility, and higher density and capacity than the previous generation of midrange arrays.

Through the use of open standards and the Solaris™ Operating Environment, the Sun StorEdge 6120 array can be easily integrated with IT management utilities, including Sun's N1 IT architecture, Sun StorEdge Enterprise Storage Manager (ESM) software for centralized storage management, Sun StorEdge Traffic Manager software for optimal load balancing and path fail-over, and Sun Cluster software for high-availability clustering. For heterogeneity these arrays support multiple platforms with a common storage infrastructure. Supported systems are Microsoft Windows NT/2000, HP-UX, IBM-AIX, Red Hat Linux, and the Solaris Operating Environment.

The Sun StorEdge 6120 array is offered in two configurations, each providing different levels of availability, scalability, and performance. With new, standards-based, open management software and application-specific storage policies, these midrange arrays simplify storage provisioning and can be easily tuned to match virtually any application workload.

- The Sun StorEdge 6120 array High Availability (HA) configuration provides redundant hardware RAID controllers with mirrored cache and hot-swappable hardware components for high-availability enterprise environments. The HA configuration can be scaled from two controller trays (2x2) with just seven drives per tray (504 GB) to a total of six trays (2x6), comprised of two controller trays and four expansion trays with a total of 84 drives (12 TB).
- The Sun StorEdge 6120 array is a single RAID controller array offering reliable, cost-effective storage with hot-swappable hardware components. The Sun StorEdge 6120 array can be scaled from one controller tray (1x1) with just seven drives (252 GB) to three trays (1x3) comprised of one controller tray and two expansion trays with a total of 42 drives (6 TB).



Key Features

Key features of the Sun StorEdge 6120 array include the following:

- Sun StorEdge Configuration Service for the Sun StorEdge 6000 Family. Easy-to-use, CIM compliant management software for array configuration and central administration
- Storage Policies for simplified storage provisioning to specific application workloads
- Storage Automated Diagnostic Expert software for precise monitoring and quick diagnostics
- Storage services software package that includes Sun StorEdge Availability Suite 3.1 software (HA configurations only) for advanced data protection with point-in-time copy and remote replication functionality, and Sun StorEdge Enterprise Storage Manager 1.2 software, providing centralized SAN management for the Sun StorEdge 6120 array and other Sun Open SAN devices
- Three administrative access levels for array management
- Online controller firmware upgrades for HA configurations
- High-density chassis (3RU, 18-inch deep) accommodates up to fourteen (14), 1-inch drives
- Drive depopulation, supporting a minimum of seven drives/tray
- A maximum of two expansion trays can be attached to a Sun StorEdge 6120 controller tray
- Scale from 504 GB to 12.2 TB of storage capacity in an HA configuration (84 HDDs)
- Fibre Channel architecture front to back with 2Gb to host Fibre Channel operation
- Multi-volume functionality supports up to 64 volumes
- Volume masking offers volume security and controls access to volumes
- Minimum volume size is 10 MB; maximum size is 2 TB
- Available with workload-matching, bi-directional, dual-ported 2-Gb capable FC-AL disk drives include the following capacities:
 - 36 GB at 15,000 rpm
 - 73 GB at 10,000 rpm
 - 73 GB at 15,000 rpm
 - 146 GB at 10,000 rpm
- Five block sizes: 4 KB, 8 KB, 16 KB, 32 KB, or 64 KB
- Fibre Channel loop or fabric point-to-point (p2p) topology connectivity
- Hardware-based RAID 5, RAID 1(1+0), or RAID 0
- Split-loop mode allows multiple back-end drive loops for increased performance (HA configurations)
- High-availability, hot-swap/redundant fail-over dual-mirrored cache controllers (HA configurations)
- Each drive tray includes dual hot-swap/redundant power cooling units with integrated, redundant UPS batteries, four hot-swap/redundant electrically independent cooling fans, hot-swap/redundant interconnect cards, and support for up to 14 drives for predictable linear performance scalability, and consistent availability
- Each controller tray includes a highly reliable hardware RAID controller featuring 1-GB data cache with ECC protection, one 2-Gb Fibre Channel host interface, two 1-Gb drive channels per RAID controller and UPS protected controller cache



- Sun Indicator Standard (SIS) compliant LEDs on the front of every Sun StorEdge 6120 array assist users in quickly locating specific arrays and FRUs in a heavily populated data center
- Customer friendly "Ready to Replace" blue LEDs on every externally visible customer-replaceable unit
- Robust NEBS compliant design
- Power cooling unit featuring 410 Watts of power, temperature sensors, and integrated battery
- High-performance, modular loop card serial communication protocol offers better failure fencing, fault containment in case of hardware failure
- Quick snap locking mechanisms for easy insertion/extraction of disks and other FRUs
- Rackmounting options for Sun StorEdge 72-inch cabinets, Sun Fire™ server cabinets, Sun Rack 900 series cabinets
- Optional installation, configuration, and support services available
- Data-in-place investment protection, provides easy interoperability and seamless upgradability with all systems in the Sun StorEdge 6000 family
- Heterogeneous Interoperability, including the Solaris™ Operating Environment, Microsoft Windows 2000/NT/2003, MSCS, Rat Hat Linux, IBM-AIX, HACMP, HP/UX and mc/Serviceguard



Features and Benefits

The Sun StorEdge 6120 storage array provides intuitive manageability, robust availability, immense flexibility, and data-in-place interoperability with Sun's midrange storage systems, making it the ideal choice for today's agile business.

Features	Benefits
<ul style="list-style-type: none">• Sun StorEdge Configuration Service for the Sun StorEdge 6000 Family—easy-to-use, CIM compliant management software for array configuration and central administration	<ul style="list-style-type: none">• Reduces complexity and costs by simplifying storage provisioning and management
<ul style="list-style-type: none">• Storage Policies	<ul style="list-style-type: none">• Reduces time-to-deploy and improves predictability by enabling quick provisioning to specific application workloads
<ul style="list-style-type: none">• Configuration replication or cloning	<ul style="list-style-type: none">• Reduces time-to-service by rapidly duplicating a configuration to all user-selected arrays
<ul style="list-style-type: none">• Three administrative access levels for array management	<ul style="list-style-type: none">• Improves manageability by enabling simultaneous and distributed management of the array
<ul style="list-style-type: none">• Storage Automated Diagnostic Expert software for precise monitoring and quick diagnostics	<ul style="list-style-type: none">• Reduces potential down time by enabling administrators to quickly identify and isolate problem areas
<ul style="list-style-type: none">• 3RU form, 18-inch deep chassis holds up to fourteen 1-inch drives	<ul style="list-style-type: none">• High-density packaging allows for more storage capacity per square foot
<ul style="list-style-type: none">• Choice of bi-directional, dual-ported 36-GB 15000-rpm, 73-GB 10000-rpm, 73-GB 15000-rpm or 146-GB 10000-rpm 2-Gb FC-AL disk drives	<ul style="list-style-type: none">• Matches storage to the value of data — high-speed drives for high-performance or high-capacity drives for massive expansion — pay for exactly what is needed when it is needed
<ul style="list-style-type: none">• Up to 64 multi-volumes per array group with full volume masking support	<ul style="list-style-type: none">• Fully utilize the array at its optimal performance levels while maintaining complete access control over all host side volumes
<ul style="list-style-type: none">• Minimum 10 MB and maximum 2 TB per volume	<ul style="list-style-type: none">• Flexible for all computing environments
<ul style="list-style-type: none">• Depopulated drive support	<ul style="list-style-type: none">• Lower entry and expansion price
<ul style="list-style-type: none">• Expansion trays	<ul style="list-style-type: none">• Lower overall TCO
<ul style="list-style-type: none">• Fibre Channel loop or fabric point-to-point (p2p) topology host connectivity	<ul style="list-style-type: none">• Provides choice of DAS or SAN deployments



Features	Benefits
<ul style="list-style-type: none"> • Supports Array Hot Spare Pool 	<ul style="list-style-type: none"> • May increase availability of system when used in conjunction with dedicated hot spares • Reduces amount of storage used for hot spare capability, because numerous storage pools can share disks in an array hot spare pool within the array
<ul style="list-style-type: none"> • Data services with Sun StorEdge Availability Suite 3.X software (No Charge 1TB RTU License per 2x2 controller pair storage module) 	<ul style="list-style-type: none"> • Helps minimize disruption to on-line data processing • Keeps uptime to a maximum by allowing on-line processing to continue while backup processes occur • Accelerates new application development by testing with actual production data • Facilitates data sharing between numerous applications • Helps increase data accessibility under extreme and new situations
<ul style="list-style-type: none"> • SAN management with Sun StorEdge Enterprise Storage Manager 2.X LE software with unlimited RTU. 	<ul style="list-style-type: none"> • Simplifies management of Sun Open SAN environments through a centralized management console • Helps improve reliability and availability of Sun Open SAN environments through SAN-wide expert-based health monitoring and management • Understands data path and SAN element relationships with Global Discovery; identifies and maps all Fibre Channel elements on Sun Open SAN
<ul style="list-style-type: none"> • Split-loop mode (HA configurations only) 	<ul style="list-style-type: none"> • Helps increase performance on the backend (the drives) by dedicating specific drives to specific loops, providing load balancing and allowing full use of all available bandwidth
<ul style="list-style-type: none"> • Five block sizes are supported: 4, 8, 16, 32, and 64 KB 	<ul style="list-style-type: none"> • Flexible for a wide range of applications (email, OLTP, DSS, HPTC, and more)
<ul style="list-style-type: none"> • Four-way scalability — linear performance, massive capacity, consistent availability, and functional manageability 	<ul style="list-style-type: none"> • Performance increases steadily as capacity is added; availability remains constant as capacity is added; security and utilization remain constant as capacity is added
<ul style="list-style-type: none"> • Supports Solaris Operating Environment, Microsoft Windows NT, Microsoft Windows 2000, Linux, HP-UX, and IBM AIX host platforms 	<ul style="list-style-type: none"> • Save money and time by standardizing on one common centrally managed high-performance, high-availability storage platform
<ul style="list-style-type: none"> • Highly scalable rack-ready, or factory rack mounted configurations 	<ul style="list-style-type: none"> • Flexible installation choices allow customers to pay for what is needed when it is needed and cost-effectively grow storage along with a business



Features	Benefits
• Data-in-place migration to the Sun StorEdge 6320 system	• Investment protection with a seamless upgrade path to Sun's midrange storage systems
• Fully redundant, hot-swappable hardware components (all major FRUs)	• Virtually continuous data availability and reliability; easy, quick, and non-disruptive serviceability
• Online reconfiguration	• Virtually continuous storage availability
• Dual redundant load-sharing/load-balancing power supplies	• Virtually continuous data integrity protection from power outages and power spikes
• Four electrically independent cooling fans	• Excellent array protection against over temperature conditions in data centers
• Proactively adjusts fan speed based on temperature monitoring	• Excellent array protection against over temperature conditions in data centers
• Mirrored cache (HA configurations)	• Helps ensure data protection with no single point of failure
• Battery-backed cache with integrated hot-swap/redundant UPS batteries to allow immediate de-stage to disk upon sense of power loss	• Full power problem protection to help ensure maximum data integrity and availability
• No internal cabling	• Helps minimize the chance of internal array failures due to a cable FRU failure
• Dual power cords on each array	• Power supplies can be connected to isolated power sources helping to minimize the chances of a complete catastrophic power outage
• Data cache and processor buffers are ECC protected	• Provides transparent and automatic error detection and correction
• Field-replaceable units (FRUs) are easy to identify, access, and hot-swap	• Easy serviceability, decreased downtime, and reduction in potential service errors
• Hardware RAID controller with dedicated XOR parity engine	• Provides data protection, high-speed low-latency RAID 5 performance and increased availability
• Sun Remote Service (SRS) Event Monitoring and Management Service 2.0 ready	• In Sun Enterprise Services, service orders are generated when systems problems are first detected, decreasing the time it takes to resolve problems
• Two-year warranty (24x7 phone support, same business day on-site repair response)	• 24x7 remote system monitoring with 4-hour, on-site response time
• Installation and configuration through the optional Sun StorEdge System Array Installation Service offering	• Experienced systems engineers help ensure proper installation and configuration
• Solaris Volume Manager software multipathing (HA configurations)	• Helps increase availability through automatic host loop failover



Product Family Placement

The Sun StorEdge 6120 array provides simple, reliable, predictable midrange storage for economical application deployments. The Sun StorEdge 6120 array is an intelligent modular Fibre Channel RAID array that provides the industry's most complete storage array in its class and marks the entry point into the Sun StorEdge 6000 family of modular storage systems.

These high-bandwidth arrays combine ease of manageability with an immensely flexible architecture, striking a solid balance between performance, availability, manageability, and overall cost. The Sun StorEdge 6120 array helps enterprises increase operational efficiencies while reducing costs by matching the cost of storage to the value and criticality of data. Inherently efficient, these systems allow the procurement and configuring of storage to a customer's unique business requirements.

The Sun StorEdge 6120 array offers cost-effective performance and availability that can be matched to a wide variety of application workloads and the value of the data, making the Sun StorEdge 6120 array ideal for companies facing rapidly growing storage capacity on disparate open host platforms.

Key differentiating features and benefits of the Sun StorEdge 6120 array:

- Storage policies, for simple and easy provisioning to precise application workloads
- Storage services software package for advanced data protection and SAN-wide manageability
- Rapid replication (cloning) for reduced time-to-service
- Immense scalability from 504 GB to over 12 TB
- Single unified, open standards-based management interface
- Published application workload profiles, combined with storage policies, enable predictable storage provisioning and reduce misprovisioning costs
- Data-in-place investment protection provides easily migration to Sun's other midrange storage systems

Combined, these key differentiators demonstrate how the Sun StorEdge 6120 array is the most complete product in its class.

Key Messages

The Sun StorEdge 6120 array delivers the following advantages:

- Reliability – robust RAS features and field-proven reliability enables this new midrange array to comfortably secure today's business-critical environments
- Flexibility – immense scalability and configuration options helps businesses right-size the storage to their business requirement
- Simplicity – easy to deploy, manage, monitor, and control from a central administration console
- Predictability – predefined storage policies for specific application workloads reduce the risk of overprovisioning and help conserve costs
- Fully supported by world-class Sun service



4-Way Scalability

The Sun StorEdge 6120 array provides four-way scalability for flexible capacity, performance, availability, and functional manageability.

- **Massive capacity** — Each drive tray has a minimum of seven and a maximum of 14 disk drives; simply add more expansion trays to increase storage capacity using 36-GB, 73-GB, or 146-GB disk drives.
- **Linearly increase performance** — Each hardware RAID controller with pipelined XOR and split backend loops is responsible for a maximum of up to 42 hard drives (three trays with 14 hard drives per tray). So, bandwidth and I/O are additive; that is, adding controller units help increase overall system throughput, I/O, and/or response time performance in a predictable, linear fashion. The Sun StorEdge 6120 array provides performance strengths in transaction- and throughput-intensive application workloads.
- **Consistently increase availability** — Each expansion tray consists of exactly two hot-swap/redundant load-sharing, load-balancing power supplies and four hot-swap/redundant electrically independent fans (if one of the power supplies fails, all four fans continue to spin) to power and cool a maximum of 14 hard drives. Every time another expansion tray with seven to fourteen hard disks is added, another two power supplies and four cooling fans are added so the system does not exceed its power or temperature boundaries.

Moreover, each time a controller tray is added, another data path is added for the hard disks, so each additional controller tray means additional data paths for increased overall system resiliency. Cache for the RAID controller is battery-backed by two integrated hot-swap redundant UPS batteries that are also dedicated to exactly 14 hard drives. So, if a power loss is detected, the data staged in the write cache is immediately written (de-staged) to the hard disks and then the unit gracefully shuts down (with no data loss). Availability can be scaled in one of three ways:

- Each Sun StorEdge 6120 array HA configuration provides dual controllers in an HA mode with redundant automatic failover hot-swap RAID controllers and a fully duplexed cache for host failover environments.
 - Sun StorEdge 6120 array units can be added in host-mirrored pairs.
 - Sun StorEdge 6120 array units can be added individually.
- **Consistently maintain functional management** — Each RAID controller (Sun StorEdge 6120 arrays) or dual RAID controller (Sun StorEdge 6120 arrays, HA configurations) supports up to a maximum of 64 volumes and volume masking. As capacity is added by way of an individual controller tray (1x1, 1x2, or 1x3) or by way of an HA controller configuration (2x2, 2x4, or 2x6), the volume count can be increased linearly, the volume sizes can remain consistent (or they can be changed as needed), and secure access to the data can be maintained in a consistent manner. And, because all Sun StorEdge 6120 arrays and the HA configurations are managed from one convenient, central, management GUI, no additional administrative resources are required to monitor or control the storage as capacity grows.

Simplicity, Ease of Use

The open, modular architecture of the Sun StorEdge 6120 array makes it easy to install, configure, service, and administer:

- Storage policies and rapid replication enable quick right-sizing of the storage architecture to almost any application workload.



- Volumes are sliced, configured, and secured through an easy-to-use Web-based GUI.
- All major components are easily accessed either at the front or rear of the array.
- All components except the system chassis (including the cableless passive midplane board) are hot-swapped. Hot-swappable, redundant-capable, field-replaceable units (FRUs) include 14 preconfigured RAID disk drives, two power/cooling units, two integrated batteries, two unit interconnect cards (UICs), and the RAID controller card.
- Interconnectivity between units is easily accomplished using the interconnect cables on each UIC; no recabling within the storage module is required.
- The administrative console is host platform independent, so Sun StorEdge 6120 arrays connected on the same Ethernet LAN can be centrally administered from one console.
- Sun's Storage Automated Diagnostic Environment software provides an intuitive, web-based graphical user interface for managing the Sun StorEdge 6120 array controller unit physical enclosure.
- Solaris Volume Manager software allows enhanced management of disk volumes.

World-Class Sun-Backed Service and Support

Each Sun StorEdge 6120 array is backed by Sun's Global Warranty Program. Sun StorEdge 6120 array models include a 2-year warranty with 2 years of 24x7 phone support and same business day hardware repair support. Optional installation services are also available via the Sun StorEdge Array Installation offering.

Each Sun StorEdge 6120 array is backed by Sun's world-class service and support. Sun StorEdge 6120 arrays are serviced worldwide by trained and certified Sun personnel so customers received high-quality service and highly reliable support.

Serviceability features include SNMP monitoring; failure detection, reporting, and recovery for all FRUs; hot-swap capability for all FRUs; and support for online reconfiguration through an independent Ethernet interface.

Storage Management Software

The Sun StorEdge 6120 arrays includes two key storage management software packages:

- Sun StorEdge Configuration Service for the Sun StorEdge 6000 Family offers wizard-based configuration for the Sun StorEdge 6120 arrays from a single management console.
- Sun's Storage Automated Diagnostic Environment provides health checking, intelligent diagnosis, and fault isolation for the Sun StorEdge 6120 arrays from a single management console.

Both the Sun StorEdge Configuration Service and the Storage Automated Diagnostic Environment are Common Information Model (CIM) compliant. The CIM methodology has been endorsed by the Storage Network Industry Association (SNIA) as the standard interface for exchanging management information in heterogeneous storage environments, helping customers to lower TCO and improve application service levels.

Sun StorEdge Configuration Service for the Sun StorEdge 6000 Family

The Sun StorEdge Configuration Service software is a comprehensive, centralized, web-based management platform for the Sun StorEdge 6120 array, which simplifies storage management and IT operations. This software discovers, monitors, and configures the Sun StorEdge 6120 arrays from a single management console. With storage policies and a rapid replication (or cloning utility), this wizard-based array management software limits administrative errors and eases provisioning of the array.



Sun's Storage Automated Diagnostic Environment Software

Sun's Storage Automated Diagnostic Environment software offers proactive health monitoring, intelligent diagnostics, event notification, and fault management reporting, which help improve infrastructure uptime, thus contributing to overall improved application service levels.

Storage Services Software Package

To provide enterprises with a wide breadth of data service functionality and a unified SAN management tool, the Sun StorEdge 6120 array includes a storage services package. This full-featured software package delivers; a SAN-wide management utility with the Sun StorEdge Enterprise Storage Manager 1.2 software, and a host-based load-balancing and path fail-over software with the Sun StorEdge Traffic Manager for Solaris. For the Sun StorEdge 6120 array, HA configurations, the Sun StorEdge Availability Suite 3.1 is also included in the storage services package for data services.

Sun StorEdge Enterprise Storage Manager 2.X (ESM) is designed to reduce the cost of storage management through the economics of consolidation by providing several core management functions from a single console. ESM is an open, standard-based architecture, which provides heterogeneous storage management support today, yet is adaptive to support new storage technologies in the future through the central management of SAN infrastructures. End-to-end proactive and expert-based health management within ESM fortifies SAN infrastructure availability, helping to improve application service levels and reduce costs associated with downtime.

Sun StorEdge Availability Suite 3.X is a robust data protection software package that provides point-in-time copies and remote replication functionality. It enables businesses to maximize data availability, while improving utilization of their key storage resources.

With load-balancing and path fail-over, Sun StorEdge Traffic Manager for Solaris software dramatically increases the effectiveness of the Solaris Operating Environment-based servers to interoperate with the Sun StorEdge 6120 array.

Target Users

The primary customers for the Sun StorEdge 6120 arrays are Sun network storage direct accounts, storage-only resellers, solution resellers, OEMs, distributors, and system integrators. The Sun StorEdge 6120 array meets the needs of a variety of users, as shown in the table below.

Individual User	Buying Influence Needs
Systems administrator	Easy-to-use management GUI with highly flexible options for controlling and monitoring the storage
IT manager, IT director	Identifies need, can influence or make purchasing decision
CIO	Involved in platform, infrastructure strategy decisions; definitely influences or makes purchasing decision
CFO	Budget allocation, can influence or make purchasing decision
CEO	Involved in business-level problem and/or competitiveness enhancements
Developer	Standards compliance for implementation of FC-AL products
MIS manager	Flexible, configurable, scalable architecture
Operations	High availability coupled with high performance, allowing efficient system operation
End user	The ability to access/retrieve needed data in a timely manner



Target Markets

The Sun StorEdge 6120 array is well-suited for the capacity, availability, and performance requirements of application servers, network data services, and performance-oriented systems. Strategic uses for this array within the manufacturing, education, government, finance, and entertainment industries include those shown in the table below.

Industry/Customer	Key Features to Highlight
Disaster recovery	Support for remote mirroring to 10 kilometers (using FC switches)
Enterprise storage	Configurable for no single point of failure with hot-swappable redundant components
Technical and scientific computing	High-performance, high-availability data storage

The highly flexible and configurable Sun StorEdge 6120 array is ideal for environments in these price ranges (in US dollars):

- \$100,000 and up for enterprises
- \$25,000 to \$100,000 for workgroups and departments

Targeted groups/industries within these market segments are:

- Global 1000 customers moving to storage area networks (SANs)
- NFS system customers
- Data modeling and data-intensive customers
- Technical and scientific customers
- Internet service providers (ISPs)
- E-commerce customers (interactive online, e-commerce organizations, digital media, financial services organizations, and Internet-centric organizations)
- Education
- Healthcare
- Government
- Media and entertainment industries.

Target Applications

The highly flexible and configurable Sun StorEdge 6120 array is one of the best storage arrays for customers with diverse storage requirements on the market today. The Sun StorEdge 6120 array provides the optimal performance and availability for the following applications:

- Technical and scientific applications (high-performance computing)
- Enterprise and data center (OLTP, data warehouse, e-commerce)
- Computer generated animation (CGA)
- Service providers (e-mail, v-mail, static/dynamic web servers, e-commerce)
- Image capture/retrieval applications (medical imaging, high-performance data acquisition)
- Video streaming applications



Selling Highlights

Market Value Proposition

The Sun StorEdge™ 6000 family delivers outstanding value to medium and large enterprises by combining open modular flexibility and comprehensive management with robust availability to optimize asset utilization. This is designed to allow enterprises to help increase operational efficiencies and reduce costs by provisioning precisely the storage performance, capacity, and availability they need, when they need it.

Organizations of all sizes, in every industry, want a simple, reliable, and manageable approach to storage. Customers seek solutions based on open standards that are capable of solving their needs for access to information across their networks. The Sun StorEdge 6120 array is an economical, yet powerful and scalable, modular storage array. This array helps maximize performance in NFS, web serving, messaging, database, and a variety of other applications. The array's design is based on an immensely flexible architecture, combining advanced Fibre Channel RAID technology with high-availability in a modular package. Combining controller and expansion trays with advanced management features, creates a high-performance, highly available network storage array that can be centrally administered. The flexibility, configurability, and scalability of the Sun StorEdge 6120 array combine to allow customers to quickly and cost-effectively grow their storage infrastructure as their business needs dictate.

Capable of matching a wide range of application requirements, Sun StorEdge 6120 arrays can cost-effectively be configured for a high degree of flexibility in balancing cost and performance while helping to maximize availability. For heterogeneity these arrays support multiple platforms with a common storage infrastructure. Supported are the Solaris™ Operating Environment, HP-UX, IBM-AIX, Red Hat Linux, and Microsoft Windows NT and 2000. Sun's expertise in the UNIX® environment with the Solaris Operating Environment puts Sun in an excellent position to optimize these systems for Sun™ Cluster software for high-availability clustering and Sun StorEdge Traffic Manager software for optimal load balancing. Additionally, Sun's consulting and installation services leverage Sun's expertise in the UNIX platform space. These systems and arrays provide industry-leading management interoperability. Sun delivers a management interface that is designed according to SNIA-based open standards (CIM) to provide customers with seamless interoperability with open-standards-based management tools, including Sun StorEdge ESM software.



Supported Features and Product Attributes

The following table lists the supported features and product attributes for both the Sun StorEdge 6120 array configurations:

Feature	Description
Sun StorEdge 6120 array High Availability (HA) configuration	<ul style="list-style-type: none"> • Dual RAID controllers and dual 2-Gb Fibre Channel host interfaces • Depopulation is supported with choice of seven to fourteen 36-GB 15000-rpm, 73-GB 10000-rpm, 73-GB 15000-rpm, or 146-GB 10000-rpm FC-AL drives/tray • Expansion to 2x4 or 2x6 configurations from a 2x2 HA controller configuration • Dual hot-swap redundant RAID controllers with 1-GB mirrored cache • RAID 5, RAID 1(1+0), or RAID 0 • Up to 64 volume/array group (2x2, 2x4, or 2x6) with associated volume masking support • Global Hot Spare (Array or Dedicated hot spare) • Rack-mounted or rack-ready packaging options • Installation through optional Sun StorEdge Array System Installation Service
Sun StorEdge 6120 array	<ul style="list-style-type: none"> • One-array, single hardware RAID controller configuration • Depopulation is supported with choice of seven to fourteen 36-GB 15000-rpm, 73-GB 10000-rpm, 73-GB 15000-rpm, or 146-GB 10000-rpm FC-AL drives/tray • Expansion to 1x2 or 1x3 configurations from a 1x1 controller tray • Single RAID controller with 1-GB cache • RAID 5, RAID 1(1+0), or RAID 0 • Up to 64 volume/array group (1x1, 1x2, or 1x3) with associated volume masking support • Global Hot Spare (Array or Dedicated hot spare) • Rack-mounted or rack-ready packaging options • Installation through optional Sun StorEdge Array System Installation Service
Software features	<ul style="list-style-type: none"> • Web-based GUI and CLI management interface • Storage policies • Configuration replication (cloning) • Wizard-based configuration services • Proactive health checking, intelligent diagnosis, on-line monitoring, event notification and fault isolation
Software	<ul style="list-style-type: none"> • Sun StorEdge 6000 Family Host Installation software, includes: <ul style="list-style-type: none"> – Sun StorEdge Configuration Service software, license, media, and on-line documentation – Sun's Storage Automated Diagnostic Environment software, license, media, and on-line documentation – Sun StorEdge SAN Foundation software, release 4.2 – Sun StorEdge Traffic Manager for Solaris • Sun StorEdge Enterprise Storage Manager software 2.X LE media with unlimited TB RTU license; provides host-based SAN management services • Sun StorEdge Availability Suite 3.x media, 1-TB RTU license provides host-based data protection services (Sun StorEdge 6120 array, HA configurations only)



Enabling Technology

Features Overview

The Sun StorEdge™ 6120 array employs the following impressive features:

- Intuitive, comprehensive management software. Sun StorEdge Configuration Service and Storage Automated Diagnostic Environment (StorADE) software, which provides server-based, single-point administration and proactive array diagnostics
- Scales to over 12 TB (six storage trays with 84 disk drives)
- Storage services package with a wide breadth of data service functionality, a unified SAN management tool.
- 3U, 18-inch deep, high density chassis accommodates up to fourteen 1-inch drives
6U, HA configurations with dual tray enclosures
- Drive depopulation supports a minimum of seven drives per tray (50 percent of total capacity)
- A maximum of two expansion trays can be attached to a Sun StorEdge 6120 controller tray
- Fibre Channel architecture front to back with 2 Gb to host Fibre Channel operation
- 1.0-inch drive bays support four drive choices of 36-GB 15000-rpm, 73-GB 10000-rpm, 73-GB 15000-rpm, or 146-GB 10000-rpm disks for high-capacity or high-performance applications
- Controller-based, multi-volume (volume slicing) functionality with volume masking security
- A highly flexible and configurable modular storage unit design which provides linear performance, consistent availability, and scalability to match to the application workload type and to the value of the data
- Full-Fibre Channel, non-blocking architecture that utilizes Fibre Channel loop or fabric point-to-point (p2p) topology, a split loop-switching design, and failover security
- Global Hot Spare (Array or Dedicated hot spare)

Flexible, Non-Blocking Fibre Channel Architecture with 1-inch Drive Bays

No two business, customers, IT environments, or applications are exactly alike. The only thing they all have in common is that they all have different performance, availability, and budget requirements.

Traditional Fibre Channel arrays typically consist of one or two controllers connected to multiple disk expansion trays, which are built for one specific purpose: to perform under transaction-heavy read workloads. For throughput-intensive or transaction-heavy write applications, for example, these arrays are quickly saturated and performance bottlenecks quickly occur, severely impacting overall storage performance. And, in general, adding more capacity does not increase performance in these situations. As such, these single-use arrays tend to treat all businesses, customers, IT environments, and application (workloads) alike, which means they are very expensive for any application which is not small record read-oriented.

The Sun StorEdge 6120 array employs a radically different approach, which allows it to be used in virtually any business, with virtually any IT environment, and with virtually any application type.



The Sun StorEdge 6120 array segments the disk interconnect loops on a tray-by-tray basis into smaller dedicated sub-loops which can all operate independently and concurrently without interference. This function is under the dynamic, independent control of the distributed 1-GB caching controllers, which optimizes performance under virtually any condition. By providing this split loop full Fibre Channel design which employs four drive choices (36-GB 15000-rpm, 73-GB 10000-rpm, 73-GB 15000-rpm, or 146-GB 10000-rpm disks), with a constant cache-to-drive ratio, the Sun StorEdge 6120 array can be configured and connected to match the workload characteristics of virtually any type of application workload: read- or write-intensive, transaction- or throughput-oriented. So, whether response time, throughput, or I/O is the key to bottleneck-free data access, the Sun StorEdge 6120 array is the ideal choice.

The Sun StorEdge 6120 array High Availability configuration delivers 2 GB of distributed cache (1 GB of cache for every 7 to 42 disk drives) for applications with demanding I/O requirements. Compare this to the design of competitive arrays, and it is easy to see why the Sun StorEdge 6120 array performs extremely well in write-intensive small-record environments. (Writes are staged in cache, then de-staged to the backend disks, so competitive arrays with smaller caches experience bottlenecks as soon as the cache is overrun.)

Each Sun StorEdge 6120 array and the HA configuration deliver as many as 64 volumes with full volume masking security for the Solaris™ Operating Environment, or for any of the supported operating environments (Windows NT, Windows 2000, HP-UX, IBM AIX, Linux).

The Sun StorEdge 6120 array RAID controller supports five block sizes (4, 8, 16, 32, and 64 KB), and can be configured with four different types of high-performance drives (36-GB 15000-rpm, 73-GB 15000-rpm for transaction-oriented applications, 73-GB 10000-rpm for throughput-oriented applications, or 146-GB 10000-rpm for streaming applications). In addition, Sun StorEdge 6120 array controller units can be connected via direct HBA or via switch. This powerful combination of drive and connectivity choices allows the Sun StorEdge 6120 array to be specifically configured and matched to virtually any type of application workload in the most cost effective manner possible.

Four-Dimensional Scalability: Capacity, Performance, Availability, and Functional Manageability

The ability to adapt to rapid and unexpected change in performance and capacity requirements while delivering continuous availability and manageability is another design requirement for today's businesses. The Sun StorEdge 6120 array addresses this requirement by delivering exceptional overall scalability. The array scales capacity, performance, availability, and storage functionality in a linear and predictable fashion. Capacity can be scaled with 36-GB, 73-GB, or 146-GB drives. As capacity increases, performance increases by a predictable amount. Availability scales consistently as additional data paths and redundancy are added with each array. And, as capacity is added by way of an individual controller tray (1x1, 1x2, or 1x3) or by way of an HA controller tray configuration (2x2, 2x4, 2x6), the volume count can be consistently increased along with the ability to provide data access security to each and every additional volume.

Most IT environments facing rapid storage growth also have mixed workload requirements. For example, an increase in streaming audio or visual content drives the demand for more bandwidth as capacity is expanded, while a growing SAP application drives the demand for I/O as capacity is expanded. Sun StorEdge 6120 arrays are highly flexible, offering RAID level, drive, and volumes choices, allowing customers to scale on any combination of capacity, performance (I/O, bandwidth, or response time), and volume count without being forced into "over buy" situations which are common with many of the large traditional arrays available on the market today.



Sun StorEdge 6120 arrays are highly flexible:

- If the demand for capacity increases, a Sun StorEdge 6120 array can be added to an existing Sun StorEdge 6120 array configuration in a SAN without disruption of service.
- If the demand for capacity increases, a Sun StorEdge 6120 array expansion tray or dual expansion trays can be added to an existing Sun StorEdge 6120 controller tray as an offline upgrade. Multiple trays of the Sun StorEdge 6120 arrays can be connected together via the loop card interconnect cables. Each of the Sun StorEdge 6120 hardware RAID controller can support up to a total of three trays; one controller tray and two expansion trays. With the Sun StorEdge 6120 array HA configuration, dual controller trays can expand to a total of six trays; two controller trays and four expansion trays, (12 TB with eighty-four 146-GB 10000-rpm drives).
- If the demand for more I/O or faster response time increases, a Sun StorEdge 6120 array or HA arrays configured for RAID 1 (1+0) can be added to an existing Sun StorEdge 6120 array configuration without disruption of service which introduces additional horsepower via more cache and high-speed spindles (when 15000-rpm drives are added).
- If the demand for more throughput increases, a Sun StorEdge 6120 array controller or HA controller configuration configured for RAID 5 can be added to an existing Sun StorEdge 6120 array configuration without disruption of service which introduces additional bandwidth via additional Fibre Channel backend loops and drives.
- If the demand for later utilization or data access security arises, additional Sun StorEdge 6120 arrays can increase the number of volumes in 64-volume increments, and can allow the volumes to be accessed by any host(s) via volume masking.

Enhanced RAID 5 Performance

The Sun StorEdge 6120 array is designed for outstanding Fibre Channel RAID 5 performance. The system employs a revolutionary hardware-based pipelined XOR (pXOR) engine that calculates the parity data at the full internal data bus speed of the array. This capability helps reduce the requirement for cache memory accesses, which create bottlenecks in most RAID 5 arrays.

The Sun StorEdge 6120 arrays pXOR unit can help improve performance by reducing mechanical disk seek and latency periods. The pXOR engine does this by accumulating partial XOR sums (up to 128), allowing the array to accumulate stored write-behind data in its cache memory and deliver it to the disk back-store in large chunks that can take advantage of the command sorting feature of the disks. Reducing mechanical wait states is among the most effective ways to improve application performance.

In addition, the ability of the Sun StorEdge 6120 array to dynamically optimize physical disk I/O access patterns helps deliver improved application response time and improved overall system performance.

ECC Cache Protection

On each 1-Gb cache controller, ECC circuitry exists on all critical data paths. All of the data paths within the pXOR array are ECC protected, including the data cache and the accumulator memories. ECC protection provides the transparent and automatic detection and correction of internal errors to the Sun StorEdge 6120 array.



System Architecture

Basic Architecture

The Sun StorEdge 6120 Array

The Sun StorEdge 6120 arrays architecture begins with a basic *controller unit*. The standalone controller unit (1x1) is the smallest possible array configuration. The architecture integrates disks, loop management, data cache, hardware RAID controller, power, cooling, uninterruptible power supply (UPS), diagnostic capabilities, and administration into a versatile, standalone component. The controller unit includes external connections to a data host (or switch), and to a management network.

Each controller tray can support a maximum of two expansion trays. Additional expansion trays can be added to the controller tray to create the 1x2 and 1x3 configurations.

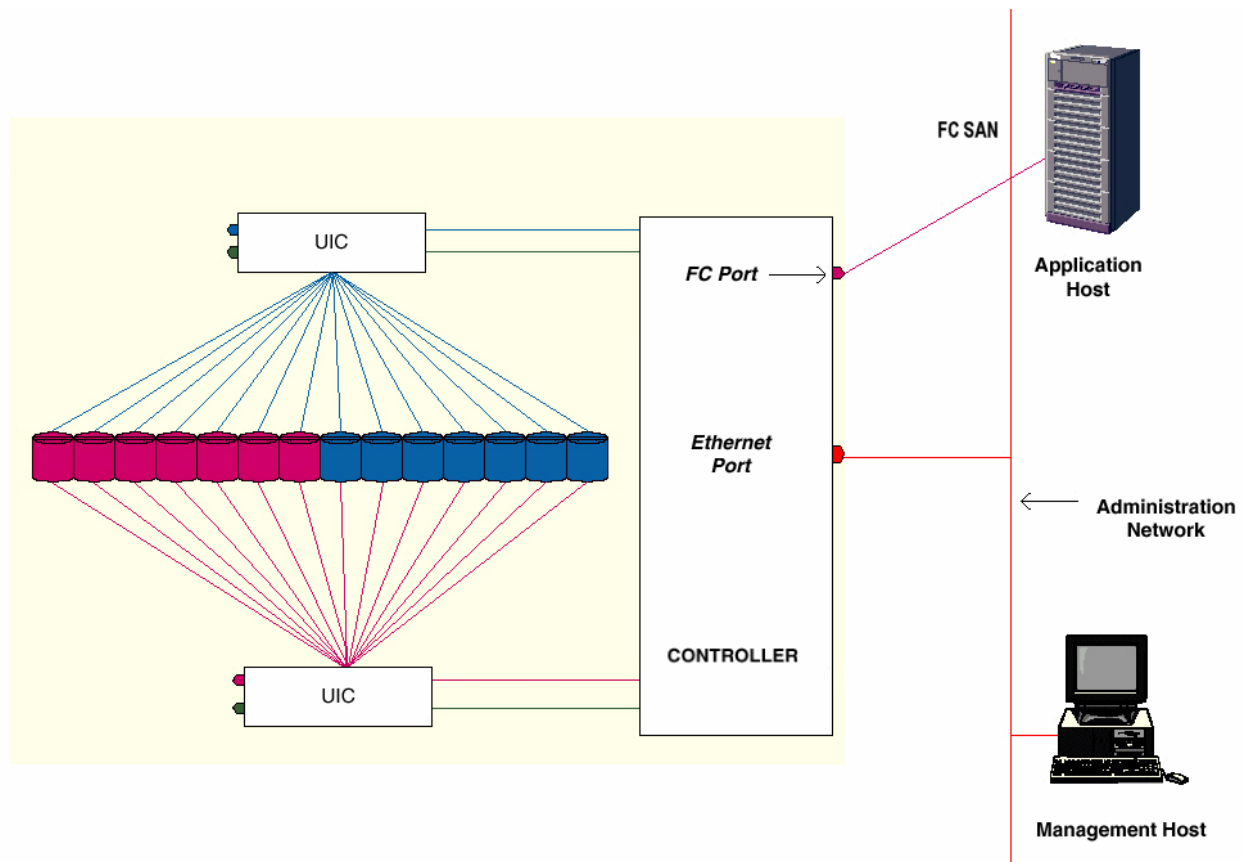


Figure 2. Logical view of the Sun StorEdge 6120 array, 1x1 controller unit, with separate data path connected to an application host and administration path connected to a management host



The Sun StorEdge 6120 Array HA Configuration

Two controller trays units can be looped into a *High Availability (HA) configuration* to create a configuration with hot-swap redundant controllers and redundant data and management paths, allowing for cache mirroring, controller failover, and path failover capability. The HA configuration with two Controller trays, 2x2, is the minimum storage configuration for mission-critical environments that call for high availability.

In an HA configuration, the dual controller trays can support a maximum of four expansion trays. Additional expansion trays can be added to the 2x2 HA controller trays to create the 2x4 and 2x6 configurations.

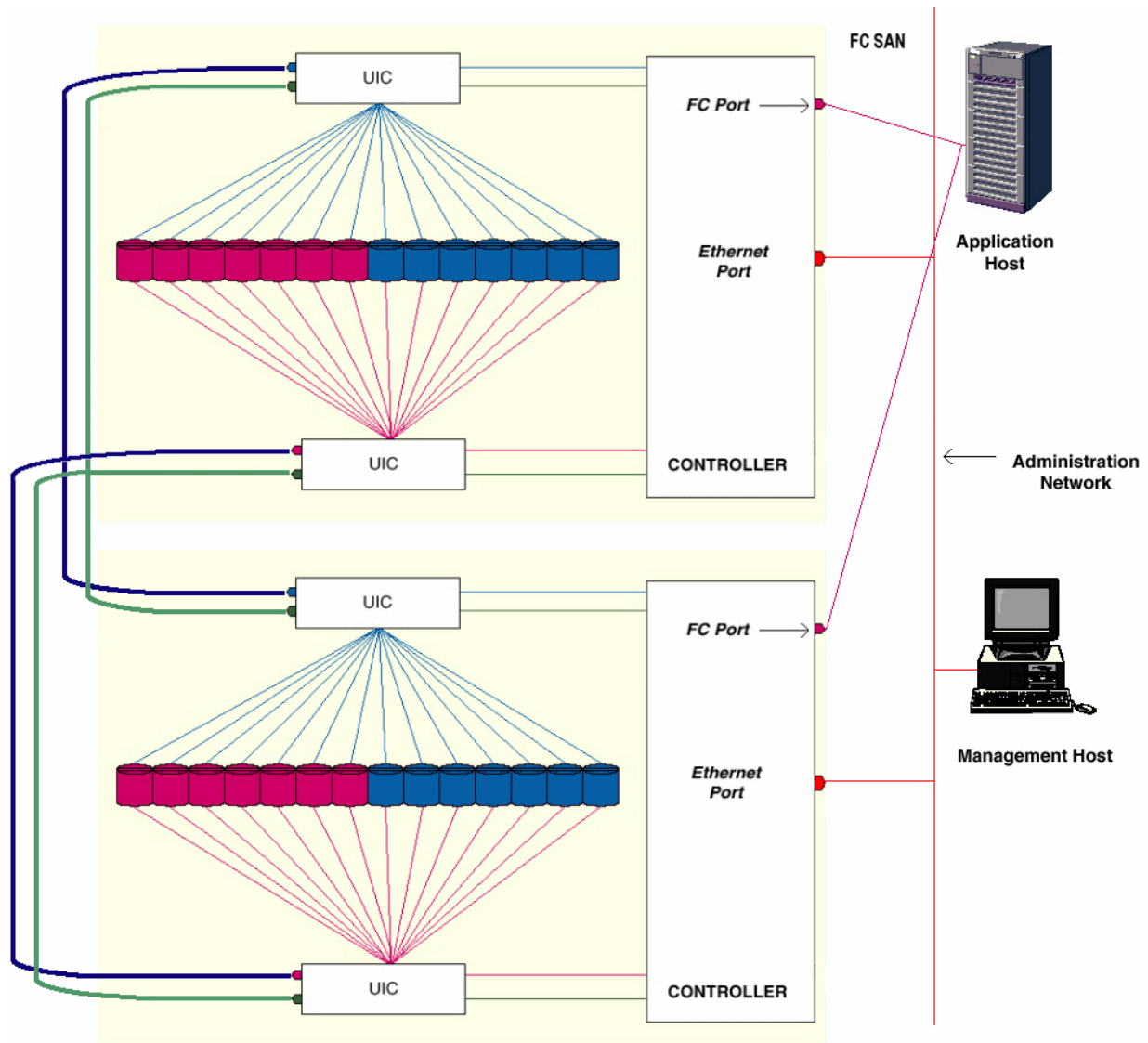


Figure 3. Logical view of the Sun StorEdge 6120 array HA configuration – 2x2 controller units



External Interfaces

The Sun StorEdge 6120 array controller module includes three external interfaces. A 2-Gb Fibre Channel (LC) port transports data to the application host. An Ethernet port handles administrative (configuration, monitoring) communication with the management host. And, finally, an RJ-45 serial port (RS-232) is used for advanced service procedures, such as boot diagnostics.

Only application data travels across the FC port, and only administrative information moves across the network channel. This separation of responsibilities has several advantages:

- It helps enable greater reliability, because diagnostic reporting is preserved even when the host channel is down.
- It provides greater performance, because administrative traffic does not interfere with application I/O.
- It provides greater security, because a junior system administrator can be granted access to monitor and service the unit without access to the application server or even application data on the array.

In addition, the separate administrative path enables greater efficiency and productivity in the data center by allowing for centralization of administration. A site can have multiple, heterogeneous, geographically distributed application servers with local Sun StorEdge 6120 arrays. All Sun StorEdge 6120 arrays can be connected via Ethernet and TCP/IP to a single management server, which provides centralized administration with a single user interface.

Administration Path

On the Sun StorEdge 6120 array, the administration path provides connectivity from the controller card in the master controller unit (and alternate master controller unit) to all FRUs throughout the entire HA configuration. It also connects the master controller unit (and alternate master controller unit) to the external Ethernet and serial ports. It is over this path that configuration, diagnostics, and monitoring takes place.

The Sun StorEdge 6120 array has two internal serial lines connecting the CPU with all non-disk FRUs. These lines are used as redundant internal administration paths, communicating configuration, control, monitoring, and diagnostic information. The serial lines extend through the daisy-chain unit interconnect cables to all units in an HA configuration, creating a single administrative domain.

The external Ethernet administration path is used to exchange configuration and monitoring information between the Sun StorEdge 6120 array unit's CPU and the management host(s). The CPU has no access to the application data, and no application data is available via the administration path. This separation of data and administration paths provides security by shielding application data from those individuals performing everyday service and administration. The path disunion also means a path for communicating with the Sun StorEdge 6120 array remains available even if the data path or application host has failed.

In an HA configuration, one controller unit is always designated as the master controller unit, and the other controller unit is the alternate master controller unit. Both controllers are actually FC active, but only the master controller is active for management.

All administration and all external communication, on behalf of both units in an HA configuration, are conducted via the master controller. Only in case of master controller failure does the alternate master controller take over administration.



Four-Dimensional Scalability

The Sun StorEdge 6120 arrays architectural design provides for four-dimensional scalability. The Sun StorEdge 6120 array scales capacity, performance, availability, and storage functionality in a linear and predictable fashion. Capacity can be scaled with 36-GB 15000-rpm, 73-GB 15000-rpm, 73-GB 10000-rpm, or 146-GB 10000-rpm disk drives. As capacity increases, performance increases by a predictable amount. Availability scales consistently as additional data paths and redundancy are added with each array. And, as capacity is added by way of an individual controller tray (1x1, 1x2, or 1x3) or by way of an HA controller configuration (2x2, 2x4, or 2x6), the volume count can be consistently increased along with the ability to provide data access security to each and every additional volume.

Availability, Reliability, and Serviceability via FRUs

In the Sun StorEdge 6120 array, all active components are hot-swap redundant capable, including the disk drives, power supplies, cooling fans, integrated UPS batteries, interconnect cards, and mirrored caching controllers (High Availability configurations only). On the back end, loops, loop switching, diagnostics, and administration channels are also redundant. In a HA configuration, controllers, host channels, and external administration channels are redundant.

Active components are consolidated into four types of field replaceable units (FRUs): disk drive, power/cooling unit (PCU) with integrated UPS battery, unit interconnect card (UIC), and hardware RAID controller. All FRUs are hot-pluggable to help prevent servicing downtime and to help minimize the time to repair a failure.

Disk Drives

Every Sun StorEdge 6120 array drive tray (controller tray or expansion tray) is configured with a minimum of 7 and a maximum of 14 bidirectional dual-ported 2-Gb-capable FC-AL disk drives of either 36-GB 15000-rpm, 73-GB 10000-rpm, 73-GB 15000-rpm, or 146-GB 10000-rpm capacity and speed. Each disk drive FRU is concealed by a removable front bezel installed in a SPUD-3 1-inch drive bracket which holds a disk drive (the drive plus the SPUD-3 drive bracket constitutes the disk FRU) and provides electromagnetic interference (EMI) shielding. Individual disk drives are not visible to the application host; rather, they are configured into one or two RAID 5, RAID 1(1+0), or RAID 0 storage pool per tray. Each storage pool should contain disk drives with the same capacity and spindle speed. The 14th disk can optionally be configured as a non-floating hot-spare for each tray.

A hot-spare is a drive, which, when a drive within the controller unit has failed, is used by the RAID controller to replace the failed drive. A non-floating hot-spare is a drive, which, after the failed drive has been replaced and the mirror resilvered or the stripe rebuilt, reverts back to hot-spare status; a floating hot-spare is a drive which, remains an active data drive — the new replacement drive now becomes the new hot-spare drive. The advantage of non-floating hot sparing is that the storage administrator always knows exactly where each and every hot-spare drive is located with the storage infrastructure.

Each drive has a private region of 200 MB reserved for system use. All remaining capacity is available for use by the application host. On the master and alternate master controller units, the system area is used on all drives as mirror, containing a copy of the operating system, file system, and firmware. Multiple versions of firmware can be saved, allowing the flexibility to back out or revert to an earlier version if necessary. On the master controller unit, the system area also includes configuration information, system log, and other assorted files for internal use.



Disk Drives: Mixed Drive Sizes Within Trays

Each tray of the array group supports up to two storage pools. Each storage pool should contain disk drives with the same capacity and spindle speed/RPM. If a storage pool has different capacity drives, the smallest capacity is used for creating the storage pool. Extra capacity in the larger drive(s) is truncated and left unused.

Each individual disk tray (controller tray or expansion tray) shipping from the factory has disk drives of the same capacity and spindle speed within a tray. For the Sun StorEdge 6120 array High Availability configurations, the factory only ships the dual HA controller trays or dual expansion trays containing the same number of drives per tray with the same capacity/spindle RPM speed. Disk drives in the controller trays can be different than the disk drives in the expansion trays.

In addition, the drive size of the hot-spare (if a hot-spare is used), whether an array or dedicated hot spare, must be greater than or equal to the smallest drive sizes in the storage pools in the tray.

Best Practice: Although the two storage pools within a tray can have mixed capacity hard disk drives, it is recommended that the same capacity and spindle speed disk drives should be used within each tray and each array group (2x2, 2x4, 2x6, 1x1, 1x2, or 1x3). For the High Availability configurations, it is recommended that disk drives in the two HA controller trays should have the same number of drives with the same capacity and spindle speed (rpm).

Disk Drives: Depopulated Trays

For maximum scalability, drive depopulation is supported with the Sun StorEdge 6120 arrays and the HA configurations. Drive depopulation allows additional spindles to be added to non-fully populated Sun StorEdge 6120 drive trays. Each of the Sun StorEdge 6120 drive trays can start with just seven drives, or 50 percent of the tray capacity, and can accommodate a maximum of fourteen 1-inch drives per tray with a single drive increments.

The Sun StorEdge 6120 array's 14-drive chassis is designed with drive slot by-pass capability and analog signal detection to distinguish between a real disk drive and a diskless SPUD-3 drive bracket. For proper air circulation and cooling of the array, a diskless SPUD-3 drive bracket is mandatory with all the unused/empty drive slots.

Best Practice: To avoid backup, reconfigure and restore of existing data, it is recommended to plan for two storage pools per tray from the beginning in two-step increment. Although a single drive increment to a depopulated tray is supported, additional drives should be added to the tray as the second and last storage pool for the tray.

Power Cooling Unit (PCU)

Each Sun StorEdge 6120 arrays tray includes two redundant power and cooling units (PCUs) with SIS compliant LEDs and temperature sensors. Each PCU has an external power connection, allowing for connection to two independent power grids or circuits. There is one internal 410-Watt auto-switching power supply per PCU. In case of external power failure or PCU failure, one power supply is sufficient to indefinitely power a maximum of fourteen drives contained within a Sun StorEdge 6120 array controller or expansion tray.

The power supplies share the voltage load (load sharing) and the current load is evenly distributed across both power supplies (load balancing), both of which combined greatly increase the life of the power supplies compared to those systems which either do not load share or load balance. Virtually all power supplies must operate within specific boundary conditions, which are above 15 percent and below 85 percent of the average load rating — any constant load outside those boundaries significantly shortens the life of the power supplies, which can result in frequent failures. To prevent failures caused by overload,



the power supply circuitry inside the Sun StorEdge 6120 array is designed to evenly split both the voltage and the current loads across both power supplies, thereby insuring approximately a 50/50 load on each supply, which is well within the 15/85 boundary condition.

The four cooling fans in the Sun StorEdge 6120 array are fully redundant — if any one fails, the controller unit remains operational indefinitely, as the 7 to 14 hard drives continue to be cooled within the predetermined operating temperature range. Moreover, these cooling fans are electrically independent from the power supplies, so that if one power supply should fail, all four cooling fans continue to spin indefinitely.

The power cooling unit has integrated thermal protection to ensure optimal operating temperature and to prevent damage or degradation due to overheating. Multiple temperature sensors are located in the inlet air stream of the fan within each PCU unit to provide real time temperature readings of supply conditions. The internal temperature sensors are accessed and monitored by the individual interconnect loop card. A temperature fault is defined as temperature exceeding 60° Celsius under full load. When temperature is above 55° Celsius, the system sends a warning message to the user and converts to write thru mode for data. When temperature is above 60° Celsius, the system begins shutdown. The remaining functional cooling fans continue spinning. When ambient temperatures return to normal and the Sun StorEdge 6120 array detects normal temperatures have returned, the system reverts to normal write behind cache mode.

Unit Interconnect Card (UIC)

Each Sun StorEdge 6120 arrays disk tray (controller tray and expansion tray) includes two unit interconnect cards (UICs) with SIS compliant LEDs. The UIC has three major interrelated functions: joins drives and trays in a daisy chain; performs management functions to monitor the back-end loop and drives; provides environmental monitoring for the enclosure housing the disk drives and PCUs. There are two UICs per array, one for each back-end loop.

The SSC100 enclosure controller provides control for internal Fibre Channel switching and bypass circuit and connects all the back-end Fibre Channel components. This includes all the 14 drives, one of the back-end QLogic 2200A Fibre Channel controller interfaces, and one pair of ports on the UIC used to join units together in a daisy chain. The SSC100 is connected to FLASH PROM, FRU ID, and a Quad UART. The administration serial line from the controller connects through the mid-plane to UIC and then to the Quad UART, which extends one serial line to each of the two back-end external ports.

Each UIC connects to one of the two Fibre Channel ports on each disk drive, and to one of the back-end ports on the RAID controller board. In addition, each UIC provides one management interface port and an "up" and "down" port. This provides totally independent paths from the controller to the drives in case of component failure. Each UIC unit provides the management functions needed to drive the enclosure. The dual UICs function together in a master/alternative master relationship. That is, if the master UIC becomes disabled, the slave UIC automatically becomes the master. The master UIC unit is responsible for the enclosure and individual component management. The UIC Fibre Channel loop switching capability is used to achieve a better back end RAS capabilities. In normal operation, each UIC selectively enables a subset of its components for purposes of load balancing, cache mirroring, and redundancy.

The UIC switching function also provides powerful diagnostic capabilities. In case of failure on a loop, a diagnostic routine can be run in which the UIC systematically switches components in and out of the loop until the offending component has been identified. Then, the UIC can switch off, or bypass, that component until it is replaced. By fencing off the failed component from the loop, the loop can be restored to active use.

In addition to the Fibre Channel port used to link the data path between units, the UIC includes a serial port to link the administrative path between units. The Fibre Channel and serial ports are combined into a



single HSSDC2-X2 connector. A single Sun proprietary cable, called the loop back cable, combines the Fibre Channel and serial lines that link the Sun StorEdge 6120 arrays.

The application data path is used to process I/O between the application host and disks exclusively. No configuration or monitoring is performed over the data path to the host, other than normal SCSI inquiry requests. No configuration or monitoring is handled over the internal data paths, other than to store/retrieve configuration and monitoring data to/from the reserved system area on the disk drives.

Data movement is done by DMA to and from the QLogic 2200 ASICs. All data goes through the cache and the inline XOR engine on the RAID controller. The system uses static load balancing to spread I/O across the two back-end loops. Because all XOR operations are completed as data moves in and out of cache, there is virtually no performance penalty for calculating RAID 5 parity on the Sun StorEdge 6120 array. When write-behind mode is enabled, host writes are acknowledged when they reach cache, and are later de-staged to disk. When cache mirroring is enabled in an HA group configuration, host writes are acknowledged only after they both reach cache and are copied to the alternate master controller's cache. Write data are later de-staged to disk according to cache de-stage rules, based on idle time, utilization, and error conditions.

Expansion Trays

The Sun StorEdge 6120 array architectural design provides for scalability in capacity, spindle count with expansion tray. Multiple units can be connected together via loop card interconnect cables. A unit without a controller is called an expansion tray. An expansion tray can be upgraded to a controller tray by inserting a hardware RAID controller card. Controller/expansion configurations are addressed using the following format:

(# of Controller tray) X (total # of disk trays : Controller tray + Expansion tray)

For example:	Single controller configurations	1x1, 1x2, or 1x3
	Dual controller configurations (HA)	2x2, 2x4, or 2x6

Each of the Sun StorEdge 6120 hardware RAID controller can support up to a total of three trays; one controller tray and two expansion trays. In the Sun StorEdge 6120 array, a maximum of two additional expansion trays can be added to each of the controller tray. With the Sun StorEdge 6120 array HA configuration, the dual controller trays can expand to a total of six trays; two controller trays and four expansion trays, or 12 TB with eighty-four 146-GB 10000-rpm disk drives. The controller location is fixed to allow the array to provide a better performance and upgrade/downgrade strategy. Though the system can work correctly (no loss of integrity) irrespective of the alternate controller location, the performance of the system is far less.

RAID Controller Card

The RAID controller card provides cache, RAID management, administration, diagnostics, and external interfaces. Controller trays include one controller FRU. Two controller trays are looped in an HA configuration for cache mirroring and controller redundancy.

The controller is both the data processing and administrative "brain" of the Sun StorEdge 6120 array. The controller provides all the Sun StorEdge 6120 arrays external interfaces and controls all back-end activities, whether they be related to data management or administration. The controllers data host interface is a QLogic 2300 FC-AL interface ASIC. This interface connects to a 64-bit, 50-MHz PCI bus, which functions as the backbone of the Sun StorEdge 6120 array. Also residing on the PCI bus is 1GB of SDRAM cache, with a custom inline FPGA XOR engine that has 2 MB of VRAM. Two more QLogic 2200s provide the interfaces to two back-end FC-AL loops. Finally, there is a bridge chip on the backbone, providing a transition to a 32-bit, 25-MHz PCI administration bus to the controller CPU.



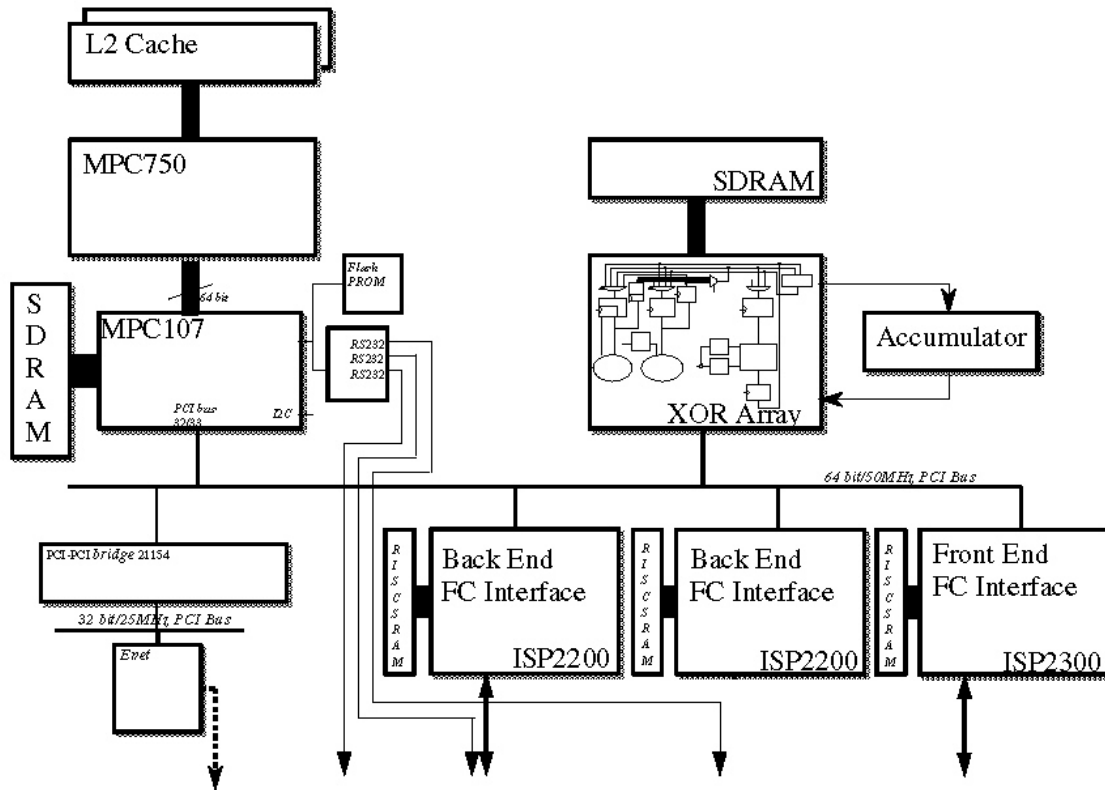


Figure 4. Sun StorEdge 6120 hardware RAID controller architecture

The controller has an administration bus, which connects FLASH PROM/FRU ID, external 10/100BASE-T Ethernet port, and serial line interface to an external RS-232 (RJ-45). The external ports use standard connectors: Native LC, SFF – FC-AL connectors, RJ45 for Ethernet, and RJ45 for the serial port (RS-232). Connector pinout specifications are provided in the product documentation. The administration bus also connects to two internal serial lines to the UICs.

The controller CPU is a PPC750 running at 400 MHz. Note that the CPU is not on the system bus; its involvement with application data is limited to managing the data, not manipulating it. Although the CPU controls DMA transfer of data between host interface FC-AL ASIC and cache, and between cache and back-end FC-AL ASICs, data never travels through the CPU itself. Even XOR parity calculations are performed not by the CPU but rather by the inline XOR engine, as data moves in and out of cache. This efficient data flow is a key factor in achieving excellent RAID 5 performance in the Sun StorEdge 6120 array.

Because the Ethernet and serial lines are also isolated from the controller backbone, it is not possible to transfer data through the external Ethernet or serial ports. They are available exclusively for administration, just as the external 2-Gb Fibre Channel port is available exclusively for application I/O.

To achieve high availability using the Sun StorEdge 6120 array, two controller units are configured in a single HA configuration. Although united in an HA configuration, each controller unit processes data to its disks independently. However, write data that is placed in cache to be de-staged at a later time is mirrored to the alternate master controller unit cache prior to returning an ACK through the host interface. The mirroring is accomplished over one of the two back-end FC-AL loops. Under normal operation, Loop 1 in each controller unit remains independent of the alternate controller's Loop 1.



Loop 2, which provides the cache mirroring path, is a continuous loop between the two HA controllers. To help ensure an open path for cache mirroring performance, fewer drives are put on Loop 2.

Each controller has its own data path to the application host, or switch. In normal operation, each path to a given controller carries only data for the volumes contained within the same Sun StorEdge 6120 array as its controller — the path serves as the active or primary path for those volumes. However, each controller/path is also capable of carrying data intended for the alternate master controller/path — the path also serves as the secondary or passive path for the alternate master controller unit if necessary.

The failover scheme for the Sun StorEdge 6120 array distinguishes between two types of failures: path failures and controller failures. The failover approaches for both failure types have much in common, but they also exhibit some distinct differences.

Path Failure

Path failure occurs when I/O to a unit is interrupted for any reason other than for a controller failure — the failure could be in a cable, in a host adapter, or could even occur because of a non-I/O root cause, such as removal of an application host system I/O board. Regardless of the cause of the interruption, I/O requests targeted at a volume eventually times out due to a bad HBA, Fibre Channel cable, and so on. The I/Os are then redirected to the alternate path for that volume — the path to the other Sun StorEdge 6120 array in the High Availability (HA) configuration. The redirection is managed on the application host by the alternate pathing software appropriate to that host. On Solaris™ Operating Environment platforms, the user can choose between Solaris Operating Environment, Sun StorEdge Traffic Manager software (multipath I/O), and VERITAS Dynamic Multipathing (DMP). On other platforms, users can choose between VERITAS DMP and the Sun-supplied failover driver available with the Sun StorEdge 6120 array.

When a controller receives an I/O request targeted at a volume belonging to the other controller, it verifies the other controller is healthy, and then takes over control of the volume. This procedure is called a volume failover. The back-end connection between Loop 1 of Unit 1 and Loop 1 of Unit 2 is healed, so that there is now a single Loop 1 for the entire HA configuration, as well a single Loop 2 (recall that there is already a single Loop 2 in normal operation, which provides a path for cache mirroring). I/O targeted at the other controller's volume is directed across the back end (Loop 1 or Loop 2, as appropriate) and into the proper drives.

In a path failure scenario, both controllers remain healthy. So, if write-behind cache was enabled, it remains enabled. Writes go into the controller with the live path, are written into the local cache, copied via Loop 2 into the other controller's cache, acknowledged to the application host, and, in due course, de-staged to disk across the back-end channels.

Even when a failure occurs on the data path to the master controller, administrative procedures continue unchanged. The controller and administrative path remain healthy, so the master controller continues administration even though it can have temporarily ceased performing data I/O operations.

Also note that no special communication, or "heartbeat" is needed between the application host and HA configuration to initiate failover or fail-back.

With the exceptions of SCSI inquiry or read/write of block 0 of any volume, the occurrence of I/O down the alternate path automatically triggers failover. Likewise, resumption of I/O down the primary path (except for SCSI inquiry or read/write of block 0 of any volume) automatically triggers fail-back. It is the responsibility of the alternate pathing software to "ping" the primary path periodically (by sending a SCSI inquiry or read/write of block 0 of any volume), to see if it has been restored.



Implicit LUN Failover vs. Explicit LUN Failover

The LUN failover mechanism just described is more specifically called "implicit LUN failover" (ILF) because there is no explicit communication between host and Sun StorEdge 6120 array that anything has gone wrong; rather the need to perform a LUN failover is implicit in the fact that I/O has started coming down the alternate path. This mechanism works well when the Sun StorEdge 6120 array HA configuration is connected to a single host, and helps eliminate the complexity and overhead of explicit communications between host and Sun StorEdge 6120 array when a path fails.

However, when a Sun StorEdge 6120 array HA configuration is connected to two hosts which share LUNs, it is possible for a path failure to occur that affects only one of the two hosts. For example, an HBA could fail in one of the hosts, or the path between switch and one of the hosts could fail. The host which sees the failure sends I/O down the alternate path, while the second host, unaware of any failure, continues to send I/O down the primary path. This causes a "ping-pong" effect: a series of failovers and failbacks that thrash the HA configuration and bring I/O to a halt.

In this case, explicit communication regarding the failure is required between Sun StorEdge 6120 array HA configuration and the two hosts, in order to prevent the failure. This mechanism, combining LUN failover with Sun StorEdge 6120 array communication to the hosts, is explicit LUN failover (ELF). The Sun StorEdge 6120 array High Availability configuration coordinates with ELF-aware alternate patting software on the host to ensure that if one host has suffered a path failure causing LUN failover, the primary path to the other host is locked out, forcing it to switch to its alternate path as well. Examples of ELF-aware alternate patting software on the Solaris Operating Environment platforms include Sun StorEdge Traffic Manager software and VERITAS Volume Manager (VxVM) 3.5 (or later) DMP. On other platforms, the user can choose between VERITAS DMP and the native failover driver supplied with the Sun StorEdge 6120 array.

Best Practice: If using VERITAS Volume Manager with DMP (VxDMP), Sun highly recommends that customers use either Maxi or Sun StorEdge Traffic Manager software (STMS) for volume failover. In this situation, STMS uses explicit LUN failover (ELF) and VxDMP does not need to perform multipathing and failover. If MPxIO or STMS is not used with VxDMP, VxDMP uses implicit LUN failover (ILF), which can result in a "ping-pong" effect (continuous failover).

Note: In the ILF mode, an I/O to the secondary path causes path failover. There is no mechanism for a host to determine whether the current online path is a primary or secondary path. In a multi-host configuration, if one of the host loses the primary path to a Volume, then it causes a continuous failover situation, wherein the host losing the primary path causes a failover to the secondary path and other hosts cause a failover back to the primary path.

In summary, if using VxDMP in a multihost environment, Sun highly recommends that Sun StorEdge Traffic Manager is used for multipathing. (Factory default setting is: mp_support = mpzio)

Controller Failure

To the application host, a controller failure appears identical to a path failure, and the response and recovery procedures are also identical. I/O requests down the channel of the failed controller time out. The host-based alternate pathing software reroutes I/O down the failover channel. The software periodically pings the primary channel, and when it gets a response, it then re-routes I/O back to the primary channel. The time it takes to effect a controller failover is slightly longer than the time needed to effect a volume failover.

On the Sun StorEdge 6120 array, the path failover resulting from controller failure causes volume failover, as with any other path failover. But there the similarity ends — loss of communication heartbeat



informs the surviving controller the other controller unit has failed. The surviving controller then takes significant additional recovery actions on both the data and administration fronts.

Write-behind cache and cache mirroring are both disabled. Both back-end Loop 1 loops on both HA configurations are joined into a single loop, just like Loop 2. Any uncommitted write data in the surviving cache is then flushed to disk, including mirrored uncommitted write data destined for volumes of the failed controller.

If the alternate master controller has failed, then no administrative changes are needed. If the master controller has failed, then the alternate master controller must take over the role of the master controller. The alternate master controller takes on the MAC and IP addresses of the master controller, as well as the host name, activates its dormant Ethernet connection, and resumes IP activity on its administration path. As far as the network and any management consoles are concerned, nothing about the network topology has changed — the alternate master controller, for all intents and appearances, is now the master controller.

Because the MAC and IP addresses for the HA configuration have not changed, there is no need to change routing tables and maps. When a failed Sun StorEdge 6120 array controller is replaced, insertion of the replacement controller is automatically detected, the controller is booted, and the unit's heartbeat is restored. Volume fail-back is achieved the same manner as non-controller path failover: when the host pings the primary path and receives a response, it reroutes I/O back to the primary path. However, if the controller failure resulted in administrative controller failover, controller replacement does not cause administrative fail-back. The former alternate master controller continues to act as the new master controller, rather than suffer the overhead of the administrative fail-back. The former alternate master administrative network controller continues to act as master controller until a system reset or power cycle, or failure of that controller. In any of these cases, the controller in Unit 1 is restored as master controller.

Note that even when the alternate master controller takes over as master controller, the populated system area continues to be a nine-way mirror on Unit 1. This means the system boots from a firmware image on the drives of Unit 1, and the syslog continues to be written on Unit 1 drives.

Data Flow

The application data path is used to process I/O between the application host and disks exclusively. No configuration or monitoring is performed over the data path to the host, other than normal SCSI inquiry requests. No configuration or monitoring is handled over the internal data paths, other than to store/retrieve configuration and monitoring data to/from the reserved system area on the disk drives.

Data movement is by DMA to and from the QLogic 2200/2300 ASICs. All data goes through the cache and inline XOR engine. Because all XOR operations are completed as data moves in and out of cache, there is virtually no performance penalty for calculating RAID 5 parity on the Sun StorEdge 6120 array. When write-behind mode is enabled, host writes are acknowledged when they reach cache, and are later de-staged to disk.

When cache mirroring is enabled in a high availability configuration, host writes are acknowledged only after they both reach cache and are copied to the other controller's cache. Write data is later de-staged to disk according to cache de-stage rules, based on idle time, utilization, and error conditions. Within the Sun StorEdge 6120 array, all data travels through cache. The system uses static load balancing to spread I/O across the two back-end loops. Data destined for specific drives is sent through Loop 1, while cache mirroring data, plus data destined for the other set of drives, is sent through Loop 2. Should one loop become disabled, the surviving loop handles the full back-end load.



Data Cache

The primary purpose of the data cache in the Sun StorEdge 6120 array is to provide a low latency buffer for write data, allowing writes to be quickly acknowledged to the application host. The cache is especially crucial to RAID 5 write performance, because it can coalesce several partial-stripe writes into a single read/modify/write operation. A secondary benefit of the cache is to buffer read data, allowing for low latency on repeated reads of the same data.

Adaptive cache is a key feature of the Sun StorEdge 6120 array. The algorithms used for allocating, coalescing, and flushing data are automatically and dynamically adjusted based on I/O patterns. This limits the amount of cache configuration needed to be performed by the user, thus greatly simplifying administration, improving ease of use, and enabling optimal cache behavior for current I/O patterns.

Each Sun StorEdge 6120 array controller includes 1GB SDRAM data cache. Cache organization and behavior are tightly coupled with Volume stripe width and Sun StorEdge 6120 array block size (the amount of data in the stripe that goes on each disk). The Sun StorEdge 6120 array block size is a system configuration parameter set by the user to be 4, 8, 16, 32, or 64 KB. The cache buffer size equals the block size, so the block size configuration parameter defines both the size of the cache buffers and the unit of data written to each disk in a RAID stripe.

Each cache block is composed of eight segments. This means that segment size is 512 KB, 1 KB, 2 KB, 4 KB, or 8 KB, for a block size of 4 KB, 8 KB, 16 GB, 32 KB, or 64 KB, respectively. Segmentation of the cache block is crucial to performance of the adaptive cache, because the segment size defines the Sun StorEdge 6120 array controller units atomic I/O to disk. This means not only is it possible to optimize for partial stripe reads and writes, but it is also possible to optimize for partial block reads and writes.

Note the host I/O size is not necessarily the same as the Sun StorEdge 6120 array block size. There are cases where optimal performance can be achieved when the segment size matches the host I/O size or where the stripe size matches the host I/O size.

All data travels through cache, and all data in the cache is read cache. Therefore, all data — whether read or written into cache; whether dirty or clean — is available for subsequent host read requests as a cache hit. Dirty write data is limited to 800 MB to help ensure that, in case of power failure, there is sufficient battery power to ensure all dirty data is safely written to disk. Writes are cached only when write-behind mode is enabled.

Dirty write data is flushed to disk under the following conditions:

- **Demand flushing** — When the dirty write data 80 percent threshold has been reached, the CPU causes as many as 20 stripes of dirty data to be flushed to disk. The least recently used stripes are chosen to be flushed.
- **Idle time flushing** — If no host requests are received for a full second, one stripe is flushed. After 10 msec. with no host requests, two stripes are flushed. After another 10 msec., four stripes are flushed, and so on, continuing up to a maximum of 128 stripes per flush, until either the cache is emptied of dirty write data or a host command is received. The stripes chosen for each flush are those least recently used.
- **Volume flushing** — If a storage pool is unmounted by the user, any dirty cache associated with that storage pool is flushed. All host commands are queued while the Volume data is flushed.
- **Controller flushing** — All dirty data in the cache is flushed when the system is shut down, when the user manually forces a "sync" operation, when there is a controller failure, or when a power failure has occurred.



Configuration Details

Multiple Volume

The Sun StorEdge 6120 hardware RAID controller allows for volume "slicing" or multiple volumes which is similar to partitioning a hard drive of a desktop computer. This new feature allows smaller storage addressing increments, which is especially useful when the array is configured with large-capacity drives.

A maximum of 64 volumes or "slices" can be made for a Sun StorEdge 6120 array or the High Availability configuration. Each slice is mapped to a volume. The maximum number of storage pools per tray is two.

Each modular Sun StorEdge 6120 array controller tray consists of up to 14 disk drives which can be configured into one or two storage pools. These storage pools are presented to the host by the Sun StorEdge 6120 array controller as a volume of the logical unit number (LUN). Thus, the application host does not see individual disk drives.

The following rules govern volume creation and reconfiguration:

- There can be either one or two storage pools per modular Sun StorEdge 6120 disk tray
- Storage pools must consist of whole drives.
- A drive cannot be partitioned into different storage pools.
- A maximum of two storage pools are allowed per 6120 array disk tray.
- A storage pool (volume) must equate to one drive group. A drive group is the exact equivalent of one RAID level. A RAID level is either striped (RAID 0 or RAID 5) or striped and mirrored (RAID 1+0). Thus, a drive group using RAID 5 can consist of either 3 to 14 disk drives, and a RAID 1+0 drive group must consist of at least two drives.

If drive 14 is used as a hot-spare, it must be specified when a given volume is created. If the user creates two volumes, they can both use drive fourteen as a hot-spare if the hot-spare is designated when they are created. If the user wants to designate a hot-spare with an existing volume, that volume must be deleted and then recreated with a hot-spare (drive 14) designated.

Volume Slicing

The rules for volume slicing are as follows:

- Volume slicing must be enabled with the `sys enable_volslice` command
- A maximum of 64 slices are allowed per Sun StorEdge 6120 array or HA configuration.
- The minimum slice size is 10 MB and must be rounded on a RAID stripe boundary. So, for example, if a RAID stripe is 9 blocks, and 1GB were to equal 100 blocks, then the minimum slice size would be 108 blocks (12x9 because 11x9 is only 99, not enough for 100, so go one more set of nine blocks over).
- All slice sizes must be in multiples of the minimum slice size (e.g., 10 MB, 20 MB, 30 MB, 40 MB, etc. Not 15 MB, 12.5 MB, 22 MB, etc.).
- The maximum slice size is 2 TB and is dependent on the volume size (that is, the maximum slice size cannot exceed the volume size; that is, no concatenation of volumes is allowed).



- All space in a volume need not be used.

Sun StorEdge 6120 array controller tray is configured with either one or two storage pools (volumes). When enabling slicing, a default slice for each existing pool is created having the size of that storage pool. The resulting default slices are mapped to volumes as 1:1 (one slice mapped to one volume). The resulting default permissions are read/write.

Slicing a slice is not allowed; therefore, for more than two slices, the (one or two) default slice(s) must first be removed.

Volume Masking (Volume Security)

Volume masking is the term used for assigning volume permissions (read-only, read/write, or none) to a host. Volume masking eases storage administration while allowing for a more secure environment. When a volume is masked from a host it is not available to be configured and thus prevents the volume from being assigned to multiple hosts accidentally.

Each host HBA port is assigned a unique world-wide number (WWN). Volume masking requires the verification each host I/O with an ID by checking the host port WWN against the permissions. The Sun StorEdge 6120 array controller firmware does not recognize (register) a WWN until the WWN is recorded by the volume `perm` or `hwwn add` commands.

WWNs can either be assigned to a specific volume or a specific set of volumes, or they can be grouped and assigned to a specific volume or a specific set of volumes. This is referred to as volume masking.

RAID Levels

There are three RAID levels to choose from, as follows:

- **RAID 0** — Striping without parity or mirroring protection; if a drive fails, all the data is lost and non-recoverable unless it is available somewhere else within the organization. *Note that this RAID level, due to its lack of redundancy, is not usually recommended.* The minimum size for a RAID 0 disk group is two disks and the maximum size is fourteen disks, and there can be up to two RAID 0 disk groups per drive tray if no other RAID level is used. Use this level for high-speed streaming of large file reads (for example, video) of non-critical data which is easily available elsewhere within the organization.
- **RAID 1(1+0)** — Each data block in a RAID 1(1+0) volume is mirrored on two drives, and the blocks are striped across all the drives in the volume. If one of the mirrored HA configuration fails, the data from the other drive is used. Because the data is mirrored, half the capacity of the assigned drives is used for online storage. For example, if the user creates a four-drive RAID 1+0 volume with 36-GB drives, the resulting usable data capacity is 72 GB. The advantage of RAID 1+0 (over simple RAID 1) is that the system can tolerate more than one non-adjacent drive failure. With simple RAID 1, two drive failures anywhere in the storage pool would kill the volume.
- **RAID 5** — Striping with rotated parity (both file data and parity data are evenly distributed across all drives in the array). The minimum size for a RAID 5 disk group is three disks and the maximum size is fourteen disks, and there can be up to two RAID 5 disk group per controller tray if no other RAID level is used. Use this level for most applications which do not require the special characteristics of the above RAID levels.

If a hot-spare drive is required, it must be used with all volumes in a given tray, and it must be declared when the first volume on a tray is created.



These rules can appear restrictive, but they provide for a much greater degree of simplicity of configuration compared to competitive systems on the market today. The user just makes five basic decisions:

1. Will there be a hot-spare drive or not?
2. How many storage pools per tray – one or two?
3. What RAID level is required?
4. How many volumes?
5. How should the volumes be assigned/masked?

Storage Pool Configurations per Tray

Choosing the number of storage pools per tray requires balancing considerations of capacity, performance, and availability.

A configuration of a single storage pool per tray provides better performance over dual storage pools per tray because of the additional administrative overhead required for two managing storage pools. However, one storage pool per tray requires a RAID 5 stripe of at least thirteen disks, and a failure of one of those disks can result in double the reconstruct time — which is the time the RAID is in a vulnerable state because the subsequent failure of another drive within the same stripe causes data loss — compared to a RAID 5 stripe of only six or seven disks when two storage pools are configured. And, using smaller drives in a RAID 5 stripe further decreases the reconstruct time.

Example of Storage pool configurations:

- **RAID 1(1+0)** — Minimum 2 disks, maximum 14 disks (no hot-spare) or 13 + 1 hot-spare.
- **RAID 5** — Single storage pool: either 14 disks (13+1) and no hot-spare or 12 disks (12+1) with hot-spare. Dual storage pools: Either one 7-disk (6+1) storage pool and one 6-disk (5+1) storage pool with hot-spare or two 7-disk storage pools (6+1 each) and no hot-spare. Sun StorEdge 6120 array hardware and firmware have been optimized for RAID 5; in most cases, RAID 5 performs as well RAID 1(1+0).
- **RAID 0** — Single storage pool: 14 disks (no hot sparing possible). Dual storage pool: 7 plus 7 disks (no hot sparing possible). Use of RAID 0 is advised only in conjunction with an external form of data protection, such as using host-based mirroring across two Sun StorEdge 6120 arrays, or in the rare case of using host-based RAID 5 stripes, across multiple trays.

Stripe Unit Size

Stripe unit size, which is also known as block size, is the size of the data unit being "striped" across the disks. There are five possible stripe unit size (or block size) settings for the Sun StorEdge 6120 array: 4 KB, 8 KB, 16 KB, 32 KB, or 64 KB, and should be matched to the I/O size of the application. In general, transaction-processing environments (such as most database, ISP, and EPR applications) use a small I/O size and tend to benefit from using a 4-KB stripe unit size. Applications using large I/O sizes (such as decision support systems (DSS), high performance computing (HPC), data warehousing, and imaging) tends to benefit from using a 64-KB stripe unit size. For latency-sensitive applications such as OLTP applications, using a 16-KB block size is best. Applications using a medium I/O size (such as NFS file servers, especially in a data-intensive environment) should fare best with a stripe unit size in the middle, so a 8-KB, 16-KB, or 32-KB setting is recommended. The choice of stripe unit size intuitively follows the I/O size of the application, and should be easy to select once the application environment is understood. The stripe unit size setting for the Sun StorEdge 6120 array also determines internal settings in the controller (such as number of parallel XOR operations the controller can perform) which affect the self-tuning behavior of the array. This is the single most important "tuning knob" for the array.



Adaptive Cache Optimizations

For small-block random writes (OLTP), the minimum write size from host into the cache is a segment (1/8 of a Sun StorEdge 6120 array units block). If a host write is smaller than one segment, then the entire segment must be read from disk and modified by the write. The block is held in cache as long as possible to allow subsequent random writes of additional segments in the same block to occur. When the entire block is filled, it can be written as a single atomic write to disk, thus consolidating eight host writes into a single disk write.

Even when less than an entire block must be written, if the segments are contiguous, they can be written as a single atomic write to disk, without having to read the remainder of the block from disk into cache. If, for some reason, one or more non-contiguous segments in a block must be written (for example, because the 80 percent write threshold was reached), then a read/modify/write sequence of the entire block must be performed.

The algorithm of segment write with block writes from host to disk is especially crucial to RAID 5 partial stripe write performance. In addition, it benefits RAID 1(1+0) write performance.

- **Large-block sequential writes**

For large-block sequential writes, the ideal host I/O size for large-block sequential writes is equal to either the Sun StorEdge 6120 array unit's block size or to an integer multiple of Sun StorEdge 6120 array unit's block size. This allows full block atomic writes to be performed. If RAID 5 is being used, this further allows for parity to be calculated in atomic units of segments.

Another feature of Sun StorEdge 6120 array unit's adaptive cache is that even with write-behind mode in effect, large-block sequential writes are treated as write-through data. There is little advantage to holding large-block sequential writes in cache because they are unlikely to be read again soon as cache hits.

Furthermore, large sequential I/O tends to saturate cache, eventually resulting in the same effect as write-through mode, but meanwhile monopolizing the cache at the expense of other random I/O which might also be occurring. So when the Sun StorEdge 6120 array detects large-block sequential I/O, it writes to disk before sending an acknowledgment to the host, thus freeing up the same block for the next sequential write, and keeping the remainder of the cache available for random writes.

- **Small-block sequential reads**

For small-block sequential reads, the cache read-ahead parameter is configurable. If more than two host I/O blocks (*Note: Not Sun StorEdge 6120 array blocks*) are read consecutively, then the entire array block which holds those I/O blocks is read into cache. The default setting is "on," indicating read-ahead mode is enabled. The read-ahead parameter can be viewed and set from any administrative CLI or GUI tool which has write access to the Sun StorEdge 6120 array.

Examples of small-block sequential reads are:

- **Example 1:** Sun StorEdge 6120 array with a 64-KB block size, 8-KB host I/O block size, read-ahead enabled. Two consecutive 8-KB blocks are read by the host, causing two 8-KB array segments of a 64-KB block to be read into cache. Because read-ahead is enabled, the Sun StorEdge 6120 array reads the remainder of its 64-KB block (that is, six more 8-KB segments) into cache.
- **Example 2:** Sun StorEdge 6120 array with a 64-KB block size, 2-KB host I/O block size, read-ahead enabled. Two consecutive 2-KB blocks are read by the host, causing one 8KB 6120 segment, four host I/O blocks, to be read into cache. Because read-ahead is enabled, the array reads the remainder of its 64-KB block (that is, seven more 8-KB segments, 28 more host I/O blocks) into cache. Thus, a total of 32 host I/O blocks is read into cache: the two requested blocks plus 30 more.



- **Example 3:** Sun StorEdge 6120 array with a 64-KB block size, 64-KB host I/O block size, read-ahead enabled. Two consecutive 64-KB blocks are read by the host, causing two entire 64KB blocks to be read into cache. Even though read-ahead is enabled, the array does not read any additional data into cache, because there is no remaining portion of a Sun StorEdge 6120 array block to read.

Note: If the host I/O block size multiplied by two is as large or larger than the Sun StorEdge 6120 array block size, then the read-ahead parameter has no effect, and read ahead never occurs, even if the read-ahead parameter is enabled.

Disk Scrubbing

Disk scrubbing helps to improve system availability by running a background consistency check on the virtual disks. Disk scrubbing verifies the integrity of data blocks that are stored on disk by reading the stored data to find any uncorrected errors that may be lying dormant in the storage. Thus, disk scrubbing ensures that any errors on the drives are detected and reduces the scenarios of double drive failures. Disk scrubbing is turned on in every array that ships with the Sun StorEdge 6120 system.

Readahead = “on” and “off”

Readahead is applied at the storage array level and refers to the array controller firmware. By default, all arrays shipped with the Sun StorEdge 6120 arrays come preconfigured from the factory with readahead = “on”. This instructs the array to identify a sequential data access pattern and optimize read performance by presetting the next set of data for this workload.

- Readahead = “on”: For a block of I/O coming in, irrespective of whether subsequent blocks of I/O are sequential or not, readahead will be always be performed (i.e., entire cache buffer is always read).
- Readahead = “off”: For a block of I/O coming in, 2 subsequent blocks of I/O will be checked to see if they are sequential. If so, then readahead will be performed (i.e., entire cache buffer will be read only if subsequent I/O blocks are sequential).

Hot Spares

The rightmost drive bay, slot #14, of each tray can optionally be used for a non-floating hot-spare. There are two types of hot spares – *array hot spares* and *dedicated hot spares*.

Array hot spares

- A maximum of 8 array hot spares can be combined to form an *array hot spare pool*.
- An array hot spare pool can be shared amongst all trays associated with a controller pair.

Dedicated hot spares

- Dedicated hot spares cannot be shared amongst trays or even storage pools. In other words, a dedicated hot spare can be dedicated to one and only one storage pool.
- Dedicated hot-spare drives do not need to reside in the same tray as the storage pool and should be greater than or equal to largest drive capacity of the storage pool.

Hot spares from an Array Hot Spare Pool and dedicated hot spares can be used simultaneously. Hot-spare drives are continuously powered up and spinning. Drives preconfigured in the factory as array hot spares can be reconfigured for use as either a dedicated hot spare or as a data drive.



Array Hot Spare Pool

Adding/deleting drives to/from an array hot-spare pool can happen at any time (i.e., these actions do not need to be performed at initial system configuration).

Drives do not need to be allocated to an array hot-spare pool. If this is desired and, since an array hot spare pool comes preconfigured from the factory, customers must reconfigure these array hot-spare drives.

More hot-spare drives (than those preconfigured from the factory) can be added to an array hot-spare pool, up to a maximum of 8 per array. If adding drives to an array hot-spare pool, assignment is made from the rightmost available drives. In addition, array hot spares will be allocated from expansion trays before controller trays. (In other words, the hot spares should be balanced across slot 14 of each tray in array before using any slot 13 of an array. Stated a different way, the array hot spare pool should attempt to span all controller and expansion trays before two array hot spares reside in one tray.)

All capacities of drives in an array hot spare pool should be greater than or equal to the largest capacity of any storage pool that the pool is serving.

Simultaneous Use of Dedicated and Array Hot-Spares

Both array hot-spare and dedicated hot-spare drives can be used simultaneously, which enhances high availability of the Sun StorEdge 6120 array at the expense of less available storage for data.

If a drive in a storage pool fails and the storage pool is associated with both an array hot spare pool and a dedicated hot spare, the dedicated hot spare drive is used first. If the dedicated hot spare is unavailable, a drive from the array hot spare pool is then used.

Fast Volume Initialization

Fast Volume Initialization reduces RAID sets initialization time of the array(s) within the Sun StorEdge 6120 arrays. Depending on the array configuration, the RAID sets initialization time can be reduced by as much as 90% in a 2x6 configuration.

Backend Fault Isolation Task (BEFIT) Utility

To ensure the availability of the back-end drives at all times and increases the overall reliability of the Sun StorEdge 6120 array, the RAID controllers have been enhanced with the Backend Fault Isolation Task utility (BEFIT). The Backend Fault Isolation Task utility is designed to provide monitoring of the back-end loop for fault detection. In particular this task targets a single faulty disk which has the potential to bring down both the backend loops. BEFIT can identify and attempt to isolate a faulty FRU without any I/O performance impact to the Sun StorEdge 6120 array. The Backend Fault Isolation Task utility is turned "on" by default in every array that ships with the Sun StorEdge 6120 system.



Split-Loop Mode

The split-loop mode in the Sun StorEdge 6120 array HA configuration is enabled by default to improve the back end performance of the Fibre Channel loops. The split loop could be disabled by modifying some system parameters. The splitting of one of the HDD loops allows the Sun StorEdge 6120 array to extract 300 MB/sec. instead of the usual 200 MB/sec. performance from the back-end disk drives. The split-loop mode does not apply to the single controller configuration of the Sun StorEdge 6120 array.

In the non-split-loop configurations the 28 disk drives of the Sun StorEdge 6120 array, 2x2 HA configuration could be accessed through each unit interconnect card (28 through Fibre Channel loop A and 28 through Fibre Channel Loop B). The Sun StorEdge 6120, HA configuration split-loop mode split the Loop A in to two loops so that 10 drives are communicated through Loop A1, 10 drives through Loop A2 and 8 through Loop B.

The system during boot time comes up in a fully healed configuration (no splitting of loops) and split loop is enabled once the health of the High Availability (HA) configuration is verified. The split loop mapping of drives to one of the three loops has been changed in the Sun StorEdge 6120 array HA configuration to utilize more loop bandwidth. The following diagram shows how the loop is split and the drive assignment. The following table summarizes the split loop drive mapping for the Sun StorEdge 6120 array, 2x2 HA configuration.

Platform	Loop A1	Loop A2	Loop B
Sun StorEdge 6120 array High Availability configuration, 2x2	u1d1, u1d2, u1d4, u1d5, u1d7, u1d8, u1d10, u1d11, u1d13, u1d14	u2d1, u2d2, u2d4, u2d5, u2d7, u2d8, u2d10, u2d11, u2d13, u2d14	u1d3, u1d6, u1d9, u1d12, u2d3, u2d6, u2d9, u2d12, and cache mirror data

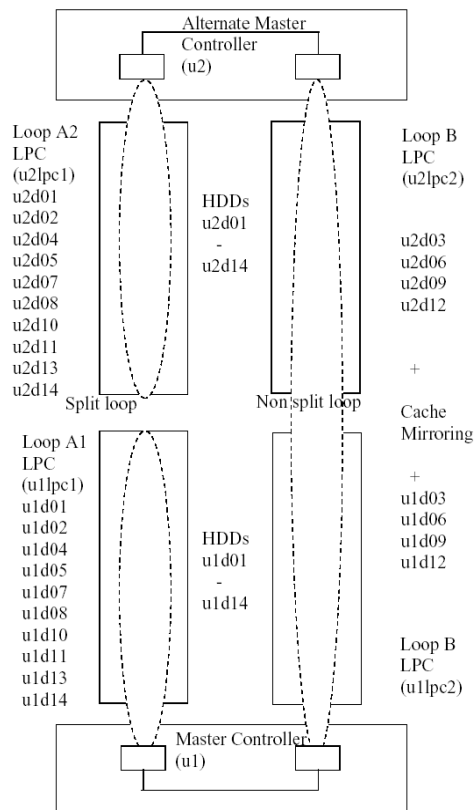


Figure 5. Sun StorEdge 6120 array, split-loop mode: drive distribution



Reconstruction Rate (RAID 5)

The reconstruction rate can be set at high, medium, or low and by default is set to medium. The setting controls how much reconstruction I/O the controller can perform between servicing host I/Os. At no time is all I/O activity completely halted. Setting the reconstruction rate parameter to medium or low allows for more I/O activity during rebuild, which increases the time period it takes to perform a complete rebuild. The default setting of medium is a good compromise between acceptable performance to the host and time to completely reconstruct the data (which is also the window of vulnerability to a catastrophic double-failure). If the reconstruction time needs to be as short as possible and severely degraded performance during that time is acceptable, the reconstruction rate should be set to high; if host performance needs to be as high as possible and reconstruction time is not important, the reconstruction rate should be decreased to low. At the extremes of low and high, the controller is almost entirely dedicated to servicing host I/O in degraded mode or reconstructing lost data onto a properly working disk. In general, use the default setting of medium unless the application has a strong compelling reason to use another setting. Remember that during the time a RAID 5 set is running with one drive short, it is vulnerable to data loss due to the failure of one more drive, and performance is negatively impacted during this time as well. It is important to restore the stripe to full capacity and functionality as quickly as possible, although it is important to realize that in order for this to occur, I/O activity can be significantly affected.

Degraded Mode

Degraded mode occurs when a disk drive fails with no hot-spare available in the configuration. The reconstruction mode occurs during one of the following scenarios:

- When the Sun StorEdge 6120 unit is reconstructing all of the failed drive information to the hot-spare drive from parity or mirror drive information
- When a failed disk drive is replaced with new disk drive

In degraded mode, a Sun StorEdge 6120 array with a logical volume containing a failed disk drive showed a significant decrease in performance. However, the second logical volume in the HA configuration operated normally without any performance changes. The reconstruction time varied, depending on how the "reconstruction rate" parameter is set and the number of I/O requests from the host. The higher the reconstruction rate parameter is set, the faster the reconstruction rate and the slower the I/O to the host.

Capacity Planning

Capacity planning involves understanding the overall system demand today and in the future, and configuring sufficient resources to have a high level of confidence in meeting those demands. Using the Sun StorEdge 6120 array, capacity planning is easy. Characteristics such as linear scalability, predictable performance, and simplified tuning help minimize many of the traditional capacity planning challenges.

Version (v2.0) of the *Configuration Rules for Mission-Critical Storage* incorporates the Sun StorEdge 6120 array and provides more information on capacity planning. Using that document even a novice engineer can arrive at a well-designed and sized configuration. Contact a Sun sales representative for more information about this process.



Best Practice: Random vs. Sequential Environments

Random Write Environments – Record Sizes Greater Than 16 KB

For heavy random I/O write environments which use record sizes greater than 16KB (an OLTP database with text and graphics, for example), it is desirable to maintain a 1:14 ratio between controllers and high-rpm drives (that is, install only disk trays with controllers or 2x2 configurations of the Sun StorEdge 6120 array using 15000-rpm disks) so that cache is evenly distributed to handle writes. Also, due to the higher write penalty inherent when using RAID 5, a RAID 1(1+0) configuration is recommended.

Random Write Environments – Record Sizes Less Than 8 KB

For heavy random I/O write environments which use record sizes less than 8 KB (an OLTP database with just text records, for example), expansion units can be added to help reduce overall system costs, but it is advisable to not exceed a 1:28 ratio between controllers and high-rpm drives (that is, install disk trays with controllers plus one expansion tray per controller or 2x4 configurations of the Sun StorEdge 6120 array using 15000-rpm disks), so that cache is evenly distributed to handle writes. Again, due to the higher write penalty inherent when using RAID 5, a RAID 1+0 configuration is recommended.

Random Read Environments

For random I/O read environments, expansion units should be added to help reduce overall system costs. Thus, it is desirable to maintain a 1:42 ratio between controllers and high-rpm drives (that is, install disk trays with controllers plus two expansion trays per controller or 2x6 configurations of the Sun StorEdge 6120 array using 15000-rpm disks). For random, non-sequential reads, either a RAID 5 or a RAID 1(1+0) configuration can be used.

Sequential Environments

For sequential environments (such as a DSS database or a high-performance technical computing application), maintain a 1:14 ratio between controllers and large-capacity drives (that is, install only disk trays with controllers or 2x2 configurations of the Sun StorEdge 6120 array using 73-GB or 146-GB disks) to ensure adequate bandwidth and help reduce the potential for channel saturation.



Reliability, Availability, and Serviceability (RAS)

Reliability

Reliability features of the Sun StorEdge™ 6120 arrays include the following:

- Error checking and correction on disk drives
- Skip sectors and spare cylinders on disk drives
- Automatic sector reallocation on RAID controller
- Link redundancy chip and 8- to 10-bit encoding on FC-AL loops
- ECC on data cache
- Passive midplane (except ID signature)
- Hardware support for parity for RISC RAM
- PCU proactively adjusts fan speed based on temperature monitoring
- Temperature sensors located closer to heat spots to provide accurate temperature measurements
- High performance modular loop card serial communication protocol offers better failure fencing, fault containment in case of hardware failure
- Back End Fault Isolation Task (BEFIT) enhancements in the firmware
- Fast RAID Set Initialization
- RAID Set / Disk Scrubbing
- Global Hot Spare (Array or Dedicated hot spare)
- Loop card Loop back diagnostic
- Loop card FC loop down detection (Backend Loop Down Detection)
- IO Statistics

Availability

Availability features of the Sun StorEdge 6120 array include the following:

- Dual hot-swappable redundant load-sharing/load-balancing auto-sensing 110VAC/220VAC power supplies with individual power cord
- Integrated hot-swappable redundant UPS batteries for cache backup which power the controller unit and its fourteen disks so the contents in cache can be de-staged to the disks upon sense of power loss. This procedure ensures no matter how long the power is out, data is not lost
- Four hot-swappable redundant electrically independent cooling fans with temperature sensors
- Hot-swappable redundant unit interconnect cards (UIC)
- Hot-swappable redundant dual-ported FC-AL drives, non-floating hot-sparing capability, and dual backend drive loops per controller
- Hot-swappable redundant RAID controllers for automatic failover and cache mirroring (Sun StorEdge 6120 array High Availability configurations)



- Redundant host interfaces (Sun StorEdge 6120 array High Availability configurations)
- Enhanced temperature sensors for continuous threshold-based temperature monitoring.
- Persistent group reservation (for use with any software supporting industry-standard SCSI-3 persistent reserve commands)
- Automatic hardware-based bypass of the faulty drive in case of a faulty drive causing loop disruptions.
- Unit interconnect card with industry standard SSC100 management processor and VSC055 serial backplane controller for better enclosure management
- Array-based CLI, host-based GUI/CLI management software

Serviceability

The system administrator can selectively replace unit components as needed. Serviceability features of the Sun StorEdge 6120 array include the following:

- Low FRU count (five excluding cables)
- The four basic FRUs — the drives, the PCUs with integrated UPS battery, the interconnect cards and the RAID controller — can be hot-swapped with no tools required
- SIS compliant status/failure LED on each FRU to quickly locate the defective component
- Addition of blue LEDs to ensure only failed FRUs get pulled for replacement
- Summary fault LEDs to the front the the Sun StorEdge 6120 array for a visual indicator that a FRU within a particular Sun StorEdge 6120 array needs service
- Each FRU is electronically identifiable
- Fibre Channel world-wide name support
- Online installation, scaling, and service
- Upgradeable drive firmware (with only the associated volume off-line during upgrade)
- Detection and reporting for incorrect drive position
- Automatic drive-ID selection
- Quick snap locking mechanisms for easy insertion/extraction of disks and other FRUs
- Blind-mate connectors to avoid bent pins on FRU insertion
- Auto-versioning helps ensure the HA configuration are always running the same controller firmware levels regardless of the firmware level on the controller FRU
- Host-based phone home capability
- Network time protocol (NTP) allows a network system of Sun StorEdge 6120 arrays to automatically synchronize their internal system time with a designated NTP master Sun StorEdge 6120 array
- Fibre channel ECHO ELS support allows for both external echo test (invoked from T4) and passive echo test (invoked from switch)
- External and internal loopback test of RAID controller front-end and backend FC ports and QLogic ASICs.
- Hardware support to create a diagnostics loops of disks for performing background tests
- Loop card standalone self tests (SAT)
- Ready for remote monitoring and management service



Specifications

Specifications for the Sun StorEdge™ 6120 array controller unit include those shown in the following table.

StorEdge 6120 Array	Specifications
Raw disk capacity	Per controller/expansion tray: 14 x 36 GB (504 GB total) Per controller/expansion tray: 14 x 73 GB (1022 GB total) Per controller/expansion tray: 14 x 146 GB (2044 GB total) Per HA configurations: 28 x 36 GB (1008 GB total) Per HA configurations: 28 x 73 GB (2044 GB total) Per HA configurations: 28 x 146 GB (4088 GB total)
Controller read/write cache	1 GB per controller, 2 GB cache per HA controller configuration
Physical Planning	
Rack ready unit dimensions	5.25 inches high 3U (13.3 cm) /10.50 inches high 6U (26.6 cm) (HA configuration) 17.5 inches wide (44.5 cm) 18.9 inches deep (48.0 cm)
Weight	90 lb. (41 kg)/180 lb. (82 kg) (HA configuration)
Input power	500W maximum, 5.0A
Auto-ranging	100/240 VAC at 47 to 63 Hz single-phase
FRU access at front	Disk drives
FRU access at rear	Controller card, unit interconnect cards, integrated UPS battery and power/cooling units
Environmental (operating)	
Temperature	5 to 40°C, maximum gradient 20°C per hour
Relative humidity	10 to 90%, noncondensing
Effective altitude	-1, 000 to +10, 000 feet (-305 to +3, 048 meters)
Shock (from any axis X, Y, Z)	4.0 g for maximum duration of 11 ms (half sinewave)
Vibration (from any axis X, Y, Z)	5 to 500 Hz at 0.25 g
Environmental (nonoperating)	
Temperature	-40 to 65°C, maximum gradient 20°C per hour
Relative humidity	93%, noncondensing
Effective altitude	-1, 000 to +40, 000 feet (-305 to +12, 192 meters)
Shock (from any axis X, Y, Z)	10.0 g for maximum duration of 11 ms (half sinewave)
Vibration (from any axis X, Y, Z)	5 to 500 Hz at 1.0 g
Connectors	



StorEdge 6120 Array	Specifications
Disk drives	3.5-inch, 36GB 15,000-rpm, 73GB 10,000-rpm, 73GB 15,000-rpm, 146GB 10,000-rpm, bi-directional dual-ported FC-AL drives
Controller card	Native FC connectors RJ45 10/100BASE-T (100 meters max. cable) RJ45 RS-232 (25 meters max. cable)
Native FC	LC/SFP small form factor pluggable connections
Unit interconnect cards	HSSDC2-X2
Power/cooling unit	CEE 22-V (latching)
Power plug	NEMA 5-15P
Standards Compliance - Meets or exceeds the following	
Safety and emissions	EN55022, FCC 47CFR Part 15 Class A, EN61000-3-2, EN61000-3-3 EN55024, EN300 386 V.1.3.1 (09-2001), UL 60950:2000, CSA-C22.2 No. 60950-00, EN 60950:2000, IEC 60950 , TUV CB Scheme with all national differences, FCC Class A, UL/CSA, CE
Interfaces and protocols	FC-AL, SCSI, HTTP, HTML, Telnet, and FTP
Policies	L10N, I18N (except RAID controller firmware)
Regulatory Markings:	CE, FCC-A, ICES-003-A, C-tick, VCCI-A, GOST-R, BSMI-A, MIC, UL/cUL, TUV-GS
Ergonomics:	EK1-ITB-2000
Other	RS232C Ethernet 802.3



System Requirements

Operating Environments

Supported Operating Environments

The Solaris™ 8 Operating Environment (04/01) or later

Non-Solaris Operating Environment Support

- Microsoft Windows NT Enterprise Server 4.0 SP6 (both single- and multi-path support) + MSCS
- Microsoft Windows 2000 Server, Advanced Server SP3 (both single- and multi-path support) + MSCS
- Microsoft Windows 2003 Server Standard, Enterprise, and Web Web Editions + MSCS
- IBM AIX 4.3.3 (32-bit), 5.1 (32- and 64-bit)(both single- and multi-path support) + HACMP
- Hewlett-Packard HP-UX 11.0 and 11.i (both single- and multi-path support) + mc/Serviceguard
- Red Hat Linux 7.2 (single-path support only)
- Red Hat Linux, Enterprise Edition, 2.1 WS/AS/ES (32-bit)

Sun™ Software

- Sun StorEdge™ Performance suite (QFS 4.0 or later)
- Sun StorEdge™ Utilization suite (SAM-FS 4.0 or later)
- Sun StorEdge™ Availability Suite 3.1 or later
- Sun StorEdge™ Resource Management suite
- Sun StorEdge™ Enterprise Storage Manager software 1.2 or later
- Sun StorEdge™ Management Software Kit
- Sun StorEdge™ Network Data Replicator software 2.0, or later
- Sun StorEdge Traffic Manager (SSTM) software 3.0, or later for multipathing management
- Sun™ Cluster 3.0 software, update 3¹ (with Solstice DiskSuite™ software)
- Sun Cluster 3.1 software (with Solstice DiskSuite software and VxVM 3.5)
- Sun StorEdge™ Enterprise Backup software 7.0
- Solstice™ Backup (SBU) 6.1.X
- Solstice™ DiskSuite 4.2 and 4.2.01.00 software, or later
- Sun StorEdge™ Data Management Center 3.0, or later
- Solstice DiskSuite™ 4.2.1 software (in conjunction with Solaris™ 8 Operating Environment)
- Solaris Volume Manager software (embedded in Solaris 9 Operating Environment)
- Sun StorEdge SAN software release 4.2 or later

¹Only Solaris™ Volume Manager software can be used with Sun Cluster 3.0 software. When Sun Cluster 3.1 software is supported on the Sun StorEdge 6320 system, either VERITAS Volume Manager 3.5 or Solaris Volume Manager software can be used.



Third-Party Software

- VERITAS NetBackup (VxNBU) 4.5, or later
- VERITAS Volume Manager with DMP (VxVM/DMP) 3.2², 3.5 or later
- VERITAS File System (VxFS) 3.5, or later
- VERITAS Cluster Server (VCS) 3.5, or later

VERITAS Volume Manager ASL Software Packages

VERITAS Volume Manager 3.2² or 3.5 provide support for the Sun StorEdge 6120 array in the form of Array Support Library (ASL) software packages. The ASL packages and related documentation can be obtained from the Sun Download Center site at:

<http://www.sun.com/software/download/>

3rd Party Operating System and Application Certification

Microsoft Windows Hardware Quality Lab (WHQL)

The Sun StorEdge 6120 array is now listed in the Windows Server catalog as supported for Windows 2000. URL: <http://www.microsoft.com/whdc/hcl/search.msp> Search for "StorEdge"

What Works With What

For the latest *What Works With What* support matrix for the StorEdge 6120 array, please refer to the following URLs for the latest SAN 4.X WWW matrix:

External URL:

http://www.sun.com/storage/san/multiplatform_support.html

Internal URL:

<http://webhome.ebay/networkstorage/sales/matrix.html>.

Multi-Platform Support

Sun StorEdge Traffic Manager (SSTM) V3.0 or later software is available (from Sun for a fee) for hosts running IBM AIX, HP-UX, Windows NT, and Windows 2000. This is available from Sun for a fee (that is, it does not ship with the Sun StorEdge 6120 array and must be purchased separately from Sun Microsystems Inc.)

² It is recommended that EOL versions of VxVM (ex: VxVM3.2) to be updated to the current VxVM version to ensure maximum reliability and availability.



System Configuration

The Sun StorEdge 6120 array is offered in two configurations, each providing different levels of availability, software, and services.

- The Sun StorEdge 6120 arrays, High Availability configurations offers hot-swap redundant hardware RAID controllers with mirrored cache for high-availability enterprise and data center environments.
 - Dual high-availability hardware RAID controller for RAID 0, RAID 1(1+0), or RAID 5
 - Mirrored battery-backed 1Gb read/write cache
 - Choice of 36-GB, 73-GB 15000-rpm or 73-GB, 146-GB 10000-rpm FC-AL disk drives
 - Support for up to 64 volumes per HA configuration with volume masking security function
 - Choice of Fibre Channel loop or fabric point-to-point (p2p) host connection topology
 - Dual dedicated hardware RAID 5 pipelined XOR parity engines
 - Dual hot-swappable redundant power/cooling modules
 - Global Hot Spare (Array or Dedicated hot spare) capability
 - Dual host data paths
 - Two-year warranty, 24x7 phone support and same business day hardware repair response
 - Storage Services package (included with 2x2 controller trays purchase only):
 - Sun StorEdge Enterprise Storage Manager software 2.X LE, unlimited RTU license
 - Sun StorEdge Availability Suite 3.1 media, 1-TB RTU license
 - Sun StorEdge 6000 Family Host Installation software, includes:
 - ✓ Sun StorEdge Configuration Service software
 - ✓ Sun's Storage Automated Diagnostic Environment (StorADE) software
 - ✓ Sun StorEdge SAN Foundation software, release 4.2
 - ✓ Sun StorEdge Traffic Manager for Solaris.
- The Sun StorEdge 6120 arrays (single controller tray) with a single hardware RAID controller with 2Gb host interface offers a reliable and cost-effective storage system.
 - Hardware RAID controller for RAID 0, RAID 1(1+0), or RAID 5
 - Choice of 36-GB, 73-GB 15000-rpm or 73-GB, 146-GB 10000-rpm FC-AL disk drives
 - Choice of Fibre Channel loop or fabric point-to-point (p2p) host connection topology
 - Battery-backed 1GB read/write cache
 - Dedicated hardware RAID 5 pipelined XOR parity engine
 - Dual hot-swappable redundant power/cooling modules
 - Global Hot Spare (Array or Dedicated hot spare) capability
 - Two-year warranty, 24x7 phone support and same business day hardware repair response
 - Storage Services package(included with 1x1 controller tray purchase only):
 - Sun StorEdge Enterprise Storage Manager software 2.X LE, unlimited RTU license
 - Sun StorEdge 6000 Family Host Installation software, includes:
 - ✓ Sun StorEdge Configuration Service software
 - ✓ Sun's Storage Automated Diagnostic Environment (StorADE) software
 - ✓ Sun StorEdge SAN Foundation software, release 4.2
 - ✓ Sun StorEdge Traffic Manager for Solaris.



Front Components

The front of the Sun StorEdge 6120 array unit provides user access to the 14 Fibre Channel RAID disk drives. Each disk drive has its own dual Fibre Channel interface and circuitry, and front-panel LEDs for drive activity: ready (green), fault (amber) and OK to remove (blue). Disk drives are positioned sideways with their SIS LEDs at the bottom.

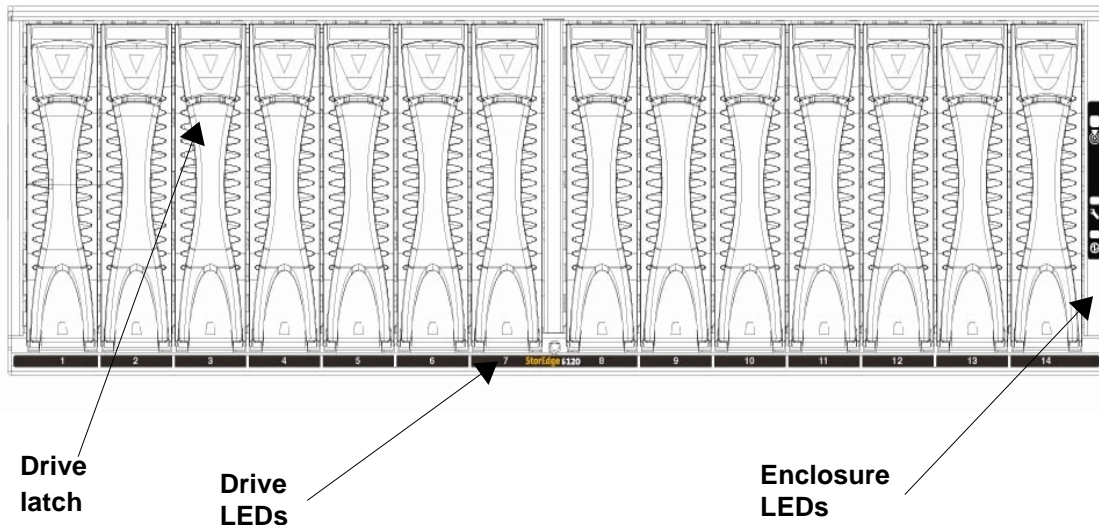


Figure 6. Front view of the Sun StorEdge 6120 array controller unit

Rear Components

The rear of the Sun StorEdge 6120 array controller unit provides user access to redundant Fibre Channel unit interconnect cards (lower left and right), one RAID controller card (lower center), and redundant power/cooling units (upper left and right):

- Each of the two unit interconnect cards (UICs) includes interface circuitry and two Fibre Channel connectors for interconnecting units.
- The RAID controller card includes RAID controller hardware and firmware, one 2Gb host Fibre Channel interface, a 10BASE-T/100BASE-T Ethernet host interface, and an RJ-45 COM service port.
- Each of the two power/cooling unit contains a power supply, two cooling fans, an integrated UPS battery, and status indicators: Ready (green), Fault (amber), and OK to Remove (blue).



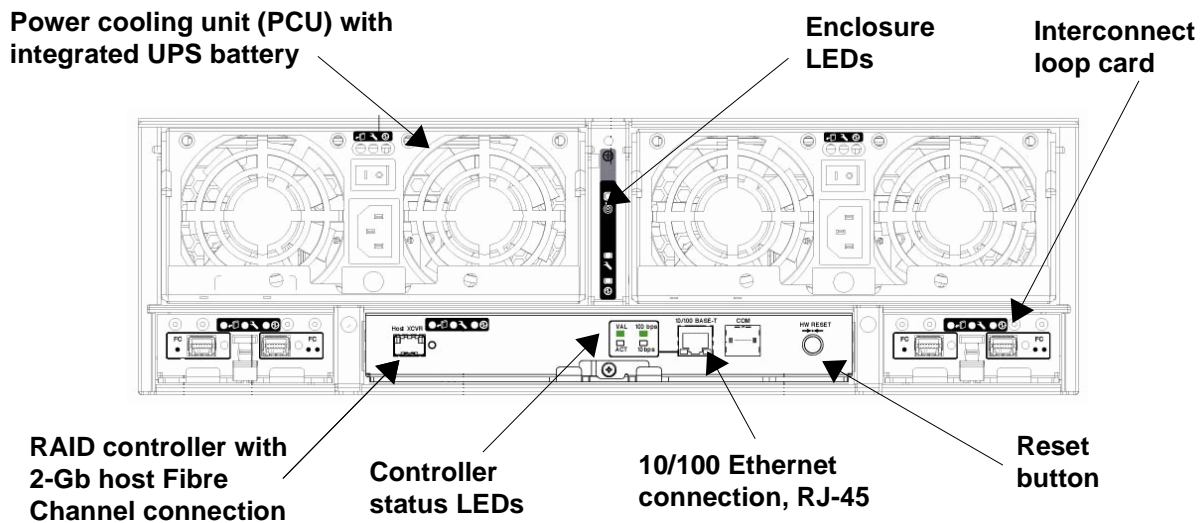


Figure 7. Rear view of the Sun StorEdge 6120 controller unit

Interconnect

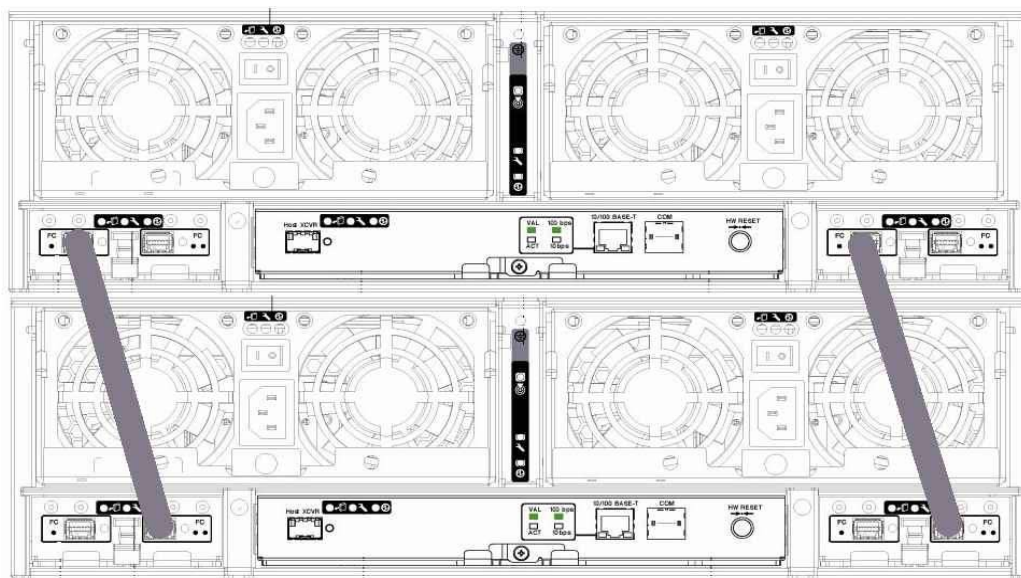


Figure 8. Sun StorEdge 6120 arrays, interconnect

The Sun StorEdge 6120 array uses two unit interconnect cables for connecting units together. The unit interconnect cables use a proprietary connector. In addition to FC-AL signals, these cables also carry a serial bus which functions as the nerve system of the Sun StorEdge 6120 array. The serial bus carries FRU state information to the RAID controller card that then processes the information. This data are used to create syslog entries.

The unit interconnect cables can be replaced without taking the array off-line. One cable **MUST** be in place at all times for the array group to remain functional. A Native LC Fiber Channel Connector supplied with each controller unit, is used to attach a multimode fiber cable. This cable is then attached to a supported FC-AL HBA.



Configuration Options

Refer to the diagrams in this section and the Ordering section for more details.

- There are two packaging options: rack-ready, or rack mounted.
- There are two tray options: controller tray, or expansion tray
- There are four drive types (36 GB 15000-rpm, 73 GB 10000-rpm, 73-GB 15000-rpm, or 146 GB 10000-rpm).
- There are eight drive depopulation options: minimum seven drives per tray with one drive increments to a maximum of 14 drives per disk tray
- There are three single-controller array configurations:

1x1 = One controller tray	Total: 1 tray
1x2 = One controller tray and one expansion tray	Total: 2 trays
1x3 = One controller tray and two expansion trays	Total: 3 trays
- There are three HA or dual-controller array configurations:

2x2 = Two controller trays – minimum HA configuration	Total: 2 trays
2x4 = Two controller trays and two expansion tray	Total: 4 trays
2x6 = Two controller trays and four expansion trays	Total: 6 trays



Configuration Diagrams

Symbols of the Basic Building Blocks

There are four basic modular building blocks for the Sun StorEdge 6100 family, a controller tray (1x1) or an expansion tray (0x1). For HA configurations, redundant building blocks are utilized, dual controller trays (2x2) and dual expansion trays (0x2). The HA controller trays (2x2) provide additional loop back cables to provide failover with no single point of failure.

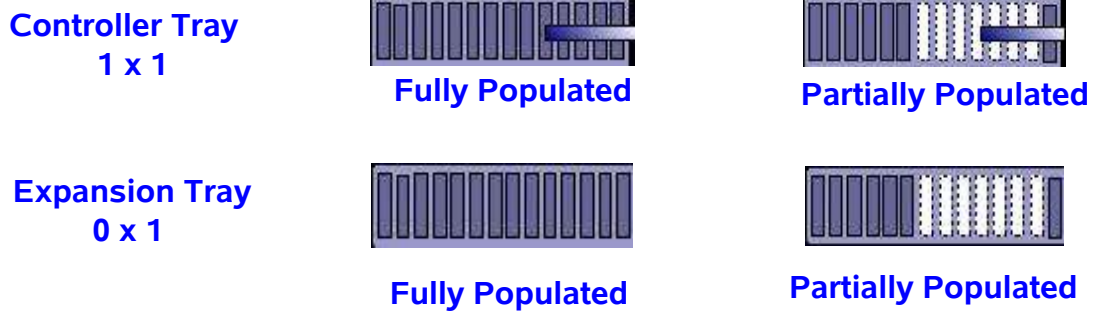


Figure 9. Building blocks for the Sun StorEdge 6120 arrays

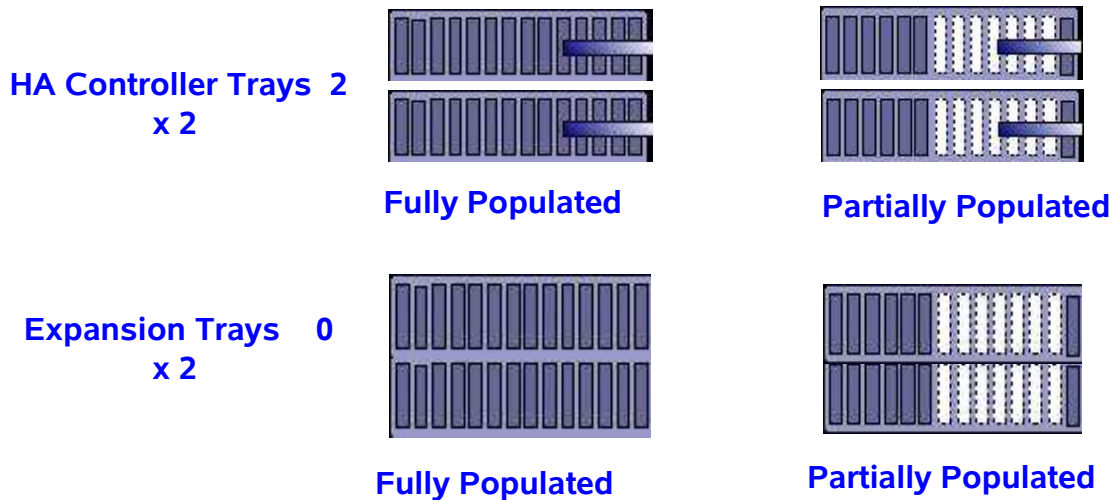


Figure 10. Building blocks for the Sun StorEdge 6120 arrays, HA configurations

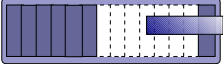
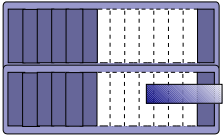
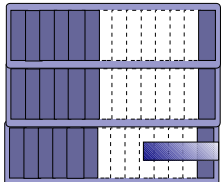
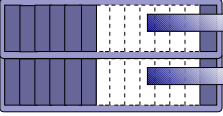
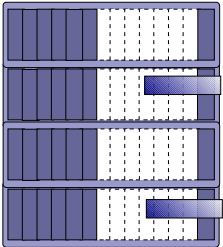
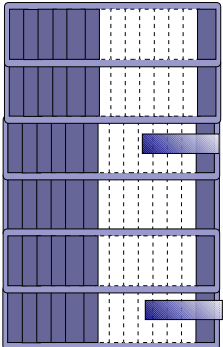
Using the basic modular building blocks, the Sun StorEdge 6120 array has a total of six possible array group configurations:

- Sun StorEdge 6120 arrays: 1x1, 1x2, 1x3
- Sun StorEdge 6120 arrays, HA configurations: 2x2, 2x4, 2x6



Naming Conventions

C x T = C (# Controller trays, CU) x T (Total # of trays, CU+EU)

C X T	# of Controller Tray (CU)	# of Expansion Tray (EU)	Total # of Trays (CU+EU)	Spindle Counts/ Capacity	Controller Placement
Sun StorEdge 6120 Arrays					
1x1	One	--	One	7 – 14 drives 252 GB – 2 TB	
1x2	One	One	Two	14 – 28 drives 504 GB – 4 TB	
1x3	One	Two	Three	21 – 42 drives 756 GB – 6 TB	
Sun StorEdge 6120 Arrays, HA Configurations					
2x2	Two	--	Two	14 – 28 drives 504 GB – 4 TB	
2x4	Two	Two	Four	28 – 56 drives 1 TB – 8 TB	
2x6	Two	Four	Six	42 – 84 drives 1.5 TB – 12 TB	



SNIA Terminology

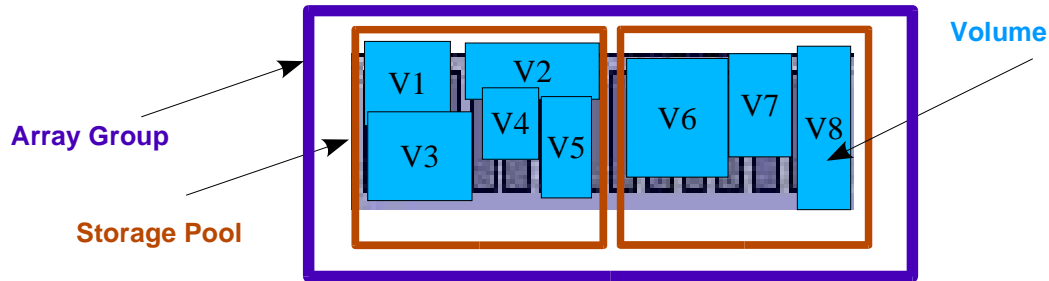


Figure 11. Illustration of SNIA terminology

All Array Group configurations, from a single Sun StorEdge 6120 array to a fully configured 2x6 HA configuration, can provide a maximum of 64 volumes. These volumes are built from a maximum of two storage pools per Sun StorEdge 6120 tray in the configuration.

- An array group is a controller tray, dual controllers, and/or expansion tray Sun StorEdge 6120 array, configurations: 1x1, 1x2, 1x3, 2x2, 2x4, 2x6.
- Storage pools are RAID groups made up of set of disk drives.
- A volume is a virtual disk of a LUN or a slice.

Configuration	Array Groups	Pool or RAID Group		Volume	
		Minimum	Maximum	Minimum	Maximum
Sun StorEdge 6120	1x1	1	2	1	64
	1x2	2	4	2	64
	1x3	3	6	3	64
Sun StorEdge 6120 HA configuration	2x2	2	4	2	64
	2x4	4	8	4	64
	2x6	6	12	6	64



System Administration

System Maintenance

The modular design of the Sun StorEdge™ 6120 array makes it easy to replace failed components. Field replaceable units (FRUs) within a single controller tray include the following:

- Hardware RAID controller card (one per controller tray)
- up to fourteen disk drives
- Two FC-AL unit interconnect cards (UICs)
- Two power/cooling units
- Two UPS batteries (integrated with the PCU)
- Empty chassis (with center-plane installed)

All major FRUs can be hot-swapped to ease system maintenance and help prevent system downtime. (with the exception of the chassis/midplane)

The fourteen disk drives can be accessed simply from the front of the enclosure. The rear of the Sun StorEdge 6120 unit provides access to the other FRUs. See the "Requirements and Configuration" section for front and rear diagrams and additional information.

Localization and Internationalization

The Sun StorEdge 6120 array is compliant with localization and internationalization policies, with exception of the controller firmware and `syslog` entries. The following components are localized:

- The management software GUI is localized into French, Japanese, and Simplified Chinese.
- Messages are localized into Japanese only.
- Installation instructions are localized into French and Japanese.

Documentation is localized into French, Japanese, Simplified Japanese, Traditional Chinese, and Korean.



Software Administration

This section describes the following aspects of software administration for the Sun StorEdge™ 6120 array:

- Multipathing Software:
 - Sun StorEdge Traffic Manager software (SSTM/MPxIO) = For Solaris™ Operating Environment
 - Sun StorEdge Traffic Manager software (SSTM) = For Non-Solaris Operating Environment
- Compatible Sun and third-party software products
- Supported host operating environments
- Storage Management and Value-added Software
 - Sun StorEdge Configuration Service software
 - Sun's Storage Automated Diagnostic Environment (StorADE) software
 - StorEdge Enterprise Storage Manager software
 - Sun StorEdge Availability Suite software

Multipathing Software

Host software is required for multipathing. Such software includes MPxIO (for hosts running Solaris Operating Environment), Sun StorEdge Traffic Manager (SSTM) software V3.0 (for hosts running IBM AIX, HP-UX, Windows NT, and Windows 2000), and VERITAS Volume Manager with DMP. All hosts connected to the same virtual device must use only one form of multipathing management.

Multipathing Software — Solaris Operating Environment Hosts

- Multipathing software for use on Solaris Operating Environment hosts ships with the Sun StorEdge 6120 arrays as part of Sun StorEdge SAN software release 4.2. This software provides the following features:
 - Multipath configuration management (allows mapping of available paths to client devices)
 - Failover support (ELF-based failover mechanism)
 - Automatic path fail-back (that is, automatic fail-back to the restored path occurs when a failed path is restored subsequent to a failover)
 - Load balancing support (selects and routes I/O requests from attached hosts/initiators using round-robin services to the Sun StorEdge 6120 array)

Note: This software does not currently allow the user to set preferences and specify path usage (that is, a primary path to a device through a switch vs. a secondary path through an interswitch link).

Multipathing Software — Non-Solaris Operating Environment Hosts

Sun StorEdge Traffic Manager (SSTM) software V3.0 is available (from Sun for a fee) for hosts running IBM AIX, HP-UX, Windows NT, and Windows 2000. This is available from Sun for a fee (that is, it does not ship with the Sun StorEdge 6120 array and must be purchased separately from Sun)



Sun StorEdge Traffic Manager (SSTM) software V3.0 (for HP-UX, Windows NT, Windows 2000) provide the following features:

- Multipath configuration management (allows mapping of available paths to client devices)
- Failover support (ELF-based failover mechanism)
- Automatic path fail-back (that is, when a failed path is restored subsequent to a failover, SSTM causes automatic fail-back to the restored path)
- Load balancing support (selects and routes I/O requests from attached hosts/initiators using round-robin services to the Sun StorEdge 6120 array)

Sun StorEdge Traffic Manager, SSTM V3.0 (for AIX) provides the following features:

- Multipath configuration management (allows mapping of available paths to client devices)
- Failover support (ELF-based failover mechanism)
- Automatic path fail-back (that is, when a failed path is restored subsequent to a failover, SSTM causes automatic fail-back to the restored path)

Note: Sun StorEdge Traffic Manager software V3.0 does not yet allow the user to set preferences and specify path usage (that is, a primary path to a device through a switch vs. a secondary path through an interswitch link).

Storage Management Software

Storage Management Software: Sun StorEdge Configuration Service Software

The Sun StorEdge Configuration Service software delivers business value to customers by providing them with a centralized, comprehensive, web-based array management platform which simplifies storage and IT operations. It discovers, monitors, and configures the Sun StorEdge 6120 arrays from a single management console. This wizard-based array management utility limits administrative error and eases the configuration of the array.

The Sun StorEdge Configuration Service software has three role-based access levels with access as follows: complete access to all features, access to device-specific management features, and read access only. The management software of the Sun StorEdge 6120 arrays allows the following key functions to be performed:

- Volume and storage pool creation and configuration
- Storage Policies
- Create volumes from storage pools
- Volume masking — supports masking based on HBA groups
- Volume slicing — two storage pools per tray can be created and then up to 64 volumes can be sliced per Sun StorEdge 6120 array HA controller configuration
- Inform StorADE when configuration changes are in progress
- Discovery of Sun StorEdge 6120 arrays
- View detailed configuration utility messages in the logfile



Storage Automated Diagnostic Environment

Sun's Storage Automated Diagnostic Environment (StorADE) offers proactive health checking, intelligent diagnosis, and fault isolation, which are designed to improve recoverability and increase storage infrastructure uptime, leading to greater application service levels.

StorADE provides monitoring and diagnostics capability for the Sun StorEdge 6120 arrays on a 24-hour basis. It provides Simple Network Management Protocol (SNMP) information about Sun StorEdge 6120 arrays. In particular, it throws traps when the configuration changes or alert conditions occur.

More specifically, StorADE provides the following functionality:

- Collects data
- Evaluates statistical error reports
- Notifies designated parties about events, when action is required (messages indicate array location, component location, component identifiers, probable cause, and recommended action)
- Checks the configuration of the system as well as individual configuration of the Sun StorEdge 6120 arrays within the system
- Monitors host message files for errors in order to obtain status information about the Sun StorEdge 6120 arrays
- Makes decisions on actionable service issues
- Troubleshooting/fault isolation of the Sun StorEdge 6120 arrays
- Provides mechanisms for service personnel to remotely access the system to gather additional data, perform maintenance, perform upgrades, and invoke diagnostics
- Guides service personnel through FRU isolation, replacement, and validation
- Device revision checking for firmware of the Sun StorEdge 6120 arrays
- Provides some predictive failure analysis (PFA) such as collecting FC statistics like ITW and CRC error counts

Both the Sun StorEdge Configuration Service and StorADE can be easily integrated with the Sun StorEdge Enterprise Storage Manager through ESM's Link and Launch capability. ESM reduces the cost of storage management through the economics of consolidation by providing several core management functions from a single console. By supporting the Common Information Model (CIM) standard for storage management, ESM is an open, standard-based architecture, which provides heterogeneous storage management support today, yet is adaptive to support new storage technologies in the future through central management of SAN infrastructures. End-to-end proactive and expert-based health management within ESM fortifies SAN infrastructure availability, thereby improving application service levels and reducing costs associated with downtime. Furthermore, ESM provides optimization of the Sun stack from servers through the storage infrastructure, while delivering a storage management solution which supports heterogeneous storage elements.

Value-added Software: StorEdge Enterprise Storage Manager software

StorEdge Enterprise Storage Manager software provides centralized management of Sun Open SAN environments. This is a host-based software and most effectively deployed from a Solaris-based Sun management station, and provides customers with the opportunity to view and manage all elements of their Sun Open SAN environment from a single console. It provides storage managers a central location from which to view frequently accessed information needed for day-to-day SAN management. It provides valuable information such as health status (path and device level), storage asset inventory, as well as current device configuration status. StorEdge Enterprise Storage Manager software also provides



the flexibility to “drill-down” into other Sun Open SAN device configuration and health management tools, such as StorEdge Configuration Service for the StorEdge 6120 arrays and the Storage Automated Diagnostic Environment (StorADE), health management software.

Value-added Software: Sun StorEdge Availability Suite (included with the HA configurations only)

The Sun StorEdge Availability Suite software provides customers with the key elements of data continuance and disaster recovery so that data is continually available and is protected from corruption or loss as well as planned and unplanned downtime. The Suite's collaboration of replication solutions provides IT with high quality of availability, rich functionality, reliability, and ease of administration in support of data continuance plans that help to facilitate a 24x7 global business environment.

Features of the Sun StorEdge Availability Suite 3.1 software:

- Remote mirror protocol performance improvements significantly improves performance of remote mirror transfers over TCP/IP.
- Remote mirror parallel IOs provides lower latency IO for local LANs and for one-to-many topologies.
- Point-in-time copy open API provides an open API for ISVs to integrate applications with the point-in-time copy service.
- Point-in-time copy locking allows users to lock the data of a point-in-time copy set preventing the accidental change of PIT data by one process while it is being used by another.
- Statistics monitoring gathers detailed statistics about point-in-time copy, remote mirror, and cache.
- Installation procedures enhancements make getting started more intuitive and easier for administrators to become operational faster.



Ordering Information

Ordering information and part numbers for the Sun StorEdge™ 6120 array are provided in this section. Note that documentation is available on-line and does not ship with the Sun StorEdge 6120 products.

Shipping Configurations

The basic Sun StorEdge 6120 array shipping configuration includes single or HA array configurations with each tray containing up to fourteen 36-GB 15,000-rpm, 73-GB 10,000-rpm, 73-GB 15,000-rpm, or 146-GB 10,000-rpm, 2 Gb capable FC-AL disk drives and “START HERE” Guide :

- Controller tray: One hardware controller card per tray
- Expansion tray: NO controller card
- Minimum of 7 drives per tray, maximum of 14 drives per tray
- Rack ready, and rack-mounted configurations
- Two-year on-site warranty
- A country kit with the appropriate power cords is added by the WEBDESK depending on the destination of the shipment
- All the rack ready configurations include:
 - (1) 5-meter LC-LC Fibre Channel cable per tray
 - (1) 6-meter RJ45-RJ45 Ethernet cable per tray
- All the *rack ready and ATO rack-mounted* configurations include the appropriate number of unit interconnect cables (loop card cables), as listed below:

– Sun StorEdge 6120, 1x1 controller tray	NO interconnect cables
– Sun StorEdge 6120, 0x1 expansion tray	2 interconnect cables
– Sun StorEdge 6120-HA, 2x2 controller trays	2 interconnect cables
– Sun StorEdge 6120-HA, 0x2 expansion trays	4 interconnect cables



Configuration Matrix / Marketing Part Numbers

Ordering Details and Marketing Part Numbers

Orders for the Sun StorEdge 6120 arrays **must be placed through WebDesk**. Depending on the configurations, WebDesk will automatically select the appropriate marketing part numbers to build your orders. There are basically 3 options for WebDesk to create your orders:

- 1) X-option “Sweet Spot” Model: Rack Ready Only
- 2) Customer ATO option: Rack Ready
- 3) Fixed- ATO option with Max. and Min. drives configurations: Rack-mounted

1) X-option - Rack Ready (Notes 1)

X-option part numbers are the high volume configurations and are stocked to provide optimal shipping time. The following X-option part numbers are standard configurations.

Rack Ready	Drive Type	Sun StorEdge 6120 0x1	Sun StorEdge 612 1x1	Sun StorEdge 6120 0x2	Sun StorEdge 6120 2x2
7 drives per tray	36 GB 15000 rpm	XTA6120R01A0S252	XTA6120R11A1S252	XTA6120R02A0S504	XTA6120R22A1S504
	73 GB 10000 rpm	XTA6120R01A0T511	XTA6120R11A1T511	XTA6120R02A0T1022	XTA6120R22A1T1022
	73 GB 15000 rpm	XTA6120R01A0V511	XTA6120R11A1V511	XTA6120R02A0V1022	XTA6120R22A1V1022
	146 GB 10000 rpm	XTA6120R01A0U1022	XTA6120R11A1U1022	XTA6120R02A0U2044	XTA6120R22A1U2044
14 drives per tray	36 GB 15000 rpm	XTA6120R01A0S504	XTA6120R11A1S504	XTA6120R02A0S1008	XTA6120R22A1S1008
	73 GB 10000 rpm	XTA6120R01A0T1022	XTA6120R11A1T1022	XTA6120R02A0T2044	XTA6120R22A1T2044
	73 GB 15000 rpm	XTA6120R01A0V1022	XTA6120R11A1V1022	XTA6120R02A0V2044	XTA6120R22A1V2044
	146 GB 10000 rpm	XTA6120R01A0U2044	XTA6120R11A1U2044	XTA6120R02A0U4088	XTA6120R22A1U4088

2) Custom ATO Option - Rack Ready (Notes 1, 2)

The Custom ATO option will result in multiple marketing part numbers (disk-less trays, type and number of drives per tray). This option allows trays to be built with 7 to 14 drives per tray in single drive increments.

A. Disk-less trays:

Packaging	Sun StorEdge 6120 0x1	Sun StorEdge 6120 1x1	Sun StorEdge 6120 0x2	Sun StorEdge 6120 2x2
Rack Ready	TA6120R01A0	TA6120R11A1	TA6120R02A0	TA6120R22A1



B. Drive type (WebDesk requires a minimum of 7 HDDs or a maximum of 14 HDDs per tray):

Part Number	Description
6867A	36-GB, 15000-rpm drive
6815A	73-GB, 10000-rpm drive
6893A	73-GB, 15000-rpm drive
6817A	146-GB, 10000-rpm drive

3) Fixed-ATO Configurations – Rack Mounted with 7 or 14 HDDs (Notes 1)

Fixed-ATO configurations are pre-build configurations for factory integration with server systems and other Sun supported racks. (Please also see Customer Ready Ready (CRS) program for additional details).

Rack mounted	Drive Type	Sun StorEdge 6120 0x1	Sun StorEdge 612 1x1	Sun StorEdge 6120 0x2	Sun StorEdge 6120 2x2
7 drives per tray	36 GB 15000 rpm	TA6120M01A0S252	TA6120M11A1S252	TA6120M02A0S504	TA6120M22A1S504
	73 GB 10000 rpm	TA6120M01A0T511	TA6120M11A1T511	TA6120M02A0T1022	TA6120M22A1T1022
	73 GB 15000 rpm	TA6120M01A0V511	TA6120M11A1V511	TA6120M02A0V1022	TA6120M22A1V1022
	146 GB 10000 rpm	TA6120M01A0U1022	TA6120M11A1U1022	TA6120M02A0U2044	TA6120M22A1U2044
14 drives per tray	36 GB 15000 rpm	TA6120M01A0S504	TA6120M11A1S504	TA6120M02A0S1008	TA6120M22A1S1008
	73 GB 10000 rpm	TA6120M01A0T1022	TA6120M11A1T1022	TA6120M02A0T2044	TA6120M22A1T2044
	73 GB 15000 rpm	TA6120M01A0V1022	TA6120M11A1V1022	TA6120M02A0V2044	TA6120M22A1V2044
	146 GB 10000 rpm	TA6120M01A0U2044	TA6120M11A1U2044	TA6120M02A0U4088	TA6120M22A1U4088

NOTES:

- When ordering the rack-mounted "M" or the rack ready "R" part numbers (for example: XTA6120R02A0S1008 or TA6120M02A0S1008) include the appropriate Fibre Channel cables and 3U rackmount rail kits for the following cabinets (availability dates are approximate):
 - Sun Fire system cabinets
 - Sun StorEdge 72-inch system cabinet
 - Sun Rack 900
- Must order a minimum of 7 drives per tray



Sun StorEdge 6120 Array Part Numbers

Part Number	ATO/X-Option Rack-mounted/ Rack Ready	Must Order Drives?	No. of Controllers	No. of Trays	No. of Drives	Drive Size and RPM	Raw Capacity
Rack Ready – Diskless Tray, Custom ATO							
TA6120R01A0	• ATO • Rack ready	Yes, min. 7 HDDs	0	1	0	N/A	0
TA6120R11A1	• ATO • Rack ready	Yes, min. 7 HDDs	1	1	0	N/A	0
TA6120R02A0	• ATO • Rack ready	Yes, min. 14 HDDs	0	2	0	N/A	0
TA6120R22A1	• ATO • Rack ready	Yes, min. 14 HDDs	2	2	0	N/A	0
Rack Ready – Expansion Trays, X-option, Fix Configuration with 7 or 14 Drives/Tray							
XTA6120R02A0S504	• X-Option • Rack ready	No	0	2	14	36 GB 15000 rpm	504 GB
XTA6120R02A0T1022	• X-Option • Rack ready	No	0	2	14	73 GB 10000 rpm	1022 GB
XTA6120R02A0V1022	• X-Option • Rack ready	No	0	2	14	73 GB 15000 rpm	1022 GB
XTA6120R02A0U2044	• X-Option • Rack ready	No	0	2	14	146 GB 10000 rpm	2044 GB
XTA6120R02A0S1008	• X-Option • Rack ready	No	0	2	28	36 GB 15000 rpm	1008 GB
XTA6120R02A0T2044	• X-Option • Rack ready	No	0	2	28	73 GB 10000 rpm	2044 GB
XTA6120R02A0V2044	• X-Option • Rack ready	No	0	2	28	73 GB 15000 rpm	2044 GB
XTA6120R02A0U4088	• X-Option • Rack ready	No	0	2	28	146 GB 10000 rpm	4088 GB
Rack Ready – Controller Trays (HA) , X-option, Fix Configuration with 7 or 14 Drives/Tray							
XTA6120R22A1S504	• X-Option • Rack ready	No	2	2	14	36 GB 15000 rpm	504 GB
XTA6120R22A1T1022	• X-Option • Rack ready	No	2	2	14	73 GB 10000 rpm	1022 GB
XTA6120R22A1V1022	• X-Option • Rack ready	No	2	2	14	73 GB 15000 rpm	1022 GB
XTA6120R22A1U2044	• X-Option • Rack ready	No	2	2	14	146 GB 10000 rpm	2044 GB
XTA6120R22A1S1008	• X-Option • Rack ready	No	2	2	28	36 GB 15000 rpm	1008 GB



Part Number	ATO/X-Option Rack-mounted/ Rack Ready	Must Order Drives?	No. of Controllers	No. of Trays	No. of Drives	Drive Size and RPM	Raw Capacity
XTA6120R22A1T2044	• X-Option • Rack ready	No	2	2	28	73 GB 10000 rpm	2044 GB
XTA6120R22A1V2044	• X-Option • Rack ready	No	2	2	28	73 GB 15000 rpm	2044 GB
XTA6120R22A1U4088	• X-Option • Rack ready	No	2	2	28	146 GB 10000 rpm	4088 GB
Rack Ready – 2x4 HA Configuration, X-option, Fix Configuration							
XTA6120R24A1S2016	• X-Option • Rack ready	No	2	4	56	36 GB 15000 rpm	2016 GB
Rack Mounted – Expansion Tray, Fixed-ATO Configuration with 7 or 14 Drives/Tray							
TA6120M01A0S252	• ATO • Rackmounted	No	0	1	7	36 GB 15000 rpm	252 GB
TA6120M01A0T511	• ATO • Rackmounted	No	0	1	7	73 GB 10000 rpm	511 GB
TA6120M01A0V511	• ATO • Rackmounted	No	0	1	7	73 GB 15000 rpm	511 GB
TA6120M01A0U1022	• ATO • Rackmounted	No	0	1	7	146 GB 10000 rpm	1022 GB
TA6120M01A0S504	• ATO • Rackmounted	No	0	1	14	36 GB 15000 rpm	504 GB
TA6120M01A0T1022	• ATO • Rackmounted	No	0	1	14	73 GB 10000 rpm	1022 GB
TA6120M01A0V1022	• ATO • Rackmounted	No	0	1	14	73 GB 15000 rpm	1022 GB
TA6120M01A0U2044	• ATO • Rackmounted	No	0	1	14	146 GB 10000 rpm	2044 GB
TA6120M02A0S504	• ATO • Rackmounted	No	0	2	14	36 GB 15000 rpm	504 GB
TA6120M02A0T1022	• ATO • Rackmounted	No	0	2	14	73 GB 10000 rpm	1022 GB
TA6120M02A0V1022	• ATO • Rackmounted	No	0	2	14	73 GB 15000 rpm	1022 GB
TA6120M02A0U2044	• ATO • Rackmounted	No	0	2	14	146 GB 10000 rpm	2044 GB
TA6120M02A0S1008	• ATO • Rackmounted	No	0	2	28	36 GB 15000 rpm	1008 GB
TA6120M02A0T2044	• ATO • Rackmounted	No	0	2	28	73 GB 10000 rpm	2044 GB



Part Number	ATO/X-Option Rack-mounted/ Rack Ready	Must Order Drives?	No. of Controllers	No. of Trays	No. of Drives	Drive Size and RPM	Raw Capacity
TA6120M02A0VT2044	• ATO • Rackmounted	No	0	2	28	73 GB 15000 rpm	2044 GB
TA6120M02A0U4088	• ATO • Rackmounted	No	0	2	28	146 GB 10000 rpm	4088 GB
Rack Mounted – Controller Tray, Fixed-ATO Configuration with 7 or 14 Drives/Tray							
TA6120M11A1S252	• ATO • Rackmounted	No	1	1	7	36 GB 15000 rpm	252 GB
TA6120M11A1T511	• ATO • Rackmounted	No	1	1	7	73 GB 10000 rpm	511 GB
TA6120M11A1V511	• ATO • Rackmounted	No	1	1	7	73 GB 15000 rpm	511 GB
TA6120M11A1U1022	• ATO • Rackmounted	No	1	1	7	146 GB 10000 rpm	1022 GB
TA6120M11A1S504	• ATO • Rackmounted	No	1	1	14	36 GB 15000 rpm	504 GB
TA6120M11A1T1022	• ATO • Rackmounted	No	1	1	14	73 GB 10000 rpm	1022 GB
TA6120M11A1V1022	• ATO • Rackmounted	No	1	1	14	73 GB 15000 rpm	1022 GB
TA6120M11A1U2044	• ATO • Rackmounted	No	1	1	14	146 GB 10000 rpm	2044 GB
TA6120M22A1S504	• ATO • Rackmounted	No	2	2	14	36 GB 15000 rpm	504 GB
TA6120M22A1T1022	• ATO • Rackmounted	No	2	2	14	73 GB 10000 rpm	1022 GB
TA6120M22A1V1022	• ATO • Rackmounted	No	2	2	14	73 GB 15000 rpm	1022 GB
TA6120M22A1U2044	• ATO • Rackmounted	No	2	2	14	146 GB 10000 rpm	2044 GB
TA6120M22A1S1008	• ATO • Rackmounted	No	2	2	28	36 GB 15000 rpm	1008 GB
TA6120M22A1T2044	• ATO • Rackmounted	No	2	2	28	73 GB 10000 rpm	2044 GB
TA6120M22A1V2044	• ATO • Rackmounted	No	2	2	28	73 GB 15000 rpm	2044 GB
TA6120M22A1U4088	• ATO • Rackmounted	No	2	2	28	146 GB 10000 rpm	4088 GB



Storage Services package for the StorEdge 6120 Arrays

The following value-added software will be included automatically by Webdesk.

Part Number ³	Title and Shipping Configuration	StorEdge 6120 1x1	StorEdge 6120 0x1	StorEdge 6120 2x2	StorEdge 6120 0x2
NCSSS-230-9FN9	Sun StorEdge 6000 Family Host Installation software Media, on-line Documentation (no charge when purchased with Sun StorEdge 6120 arrays)	Yes	No	Yes	No
NMK9S-00C-9FY9	Sun StorEdge Management Software Kit which includes Sun StorEdge Enterprise Storage Manager 2.1 Media & Documentation L10N; Sun StorEdge Enterprise Storage Manager 2.0 LE RTU license; Sun Storage Automated Diagnostic Environment 2.3 Media, Documentation and RTU license Eng; Sun SAN Foundation Software 4.4. No charge when purchased with the 6000 family of products.	Yes	No	Yes	No
NAVIS-320-1FNS	Sun StorEdge™ Availability Suite 3.2 Media, on-line Documentation and 1TB RTU license (no charge when purchased with Sun StorEdge 6120 Systems one per 2x2)	No	No	Yes	No

Optional — Sun StorEdge Traffic Manager Software for Non-Solaris Operating Environments

Part Number	Title and Shipping Configuration
MPDIN-300-99YS	Sun StorEdge Traffic Manager 3.0 Media Kit for Windows 2000/NT
MPDIB-300-99YS	Sun StorEdge Traffic Manager 3.0 Media Kit for AIX
MPDIH-300-99YS	Sun StorEdge Traffic Manager 3.0 Media Kit for HP-UX 11.0
MPDIN-LCO-992S	Sun StorEdge Traffic Manager 1 RTU for Windows 2000/NT (1 RTU license)
MPDVN-LCO-992S	Sun StorEdge Traffic Manager 5 RTU for Windows 2000/NT (5 RTU licenses)
MPDYN-LCO-992S	Sun StorEdge Traffic Manager 25 RTU for Windows 2000/NT (15 RTU licenses)
MPDIH-LCO-992S	Sun StorEdge Traffic Manager 1 RTU for HP-UX (1 RTU license)
MPDVH-LCO-992S	Sun StorEdge Traffic Manager 5 RTU for HP-UX (5 RTU license)
MPDIB-LCO-992S	Sun StorEdge Traffic Manager 1 RTU for AIX (1 RTU license)
MPDVB-LCO-992S	Sun StorEdge Traffic Manager 5 RTU for AIX (5 RTU license)

³Please refer to the Webdesk Configurator for the current marketing part numbers of the latest software releases.



Options

Part Number	Description	Category
X6867A	FC-AL 36.4-GB, 15000-rpm disk drive in Spud-3 mounting bracket for the Sun StorEdge 6120 arrays, X-option	Hard disk drives
6867A	FC-AL 36.4-GB, 15000-rpm disk drive in Spud-3 mounting bracket for the Sun StorEdge 6120 arrays, ATO-option	
X6815A	FC-AL 73.4-GB, 10000-rpm disk drive in Spud-3 mounting bracket for the Sun StorEdge 6120 arrays, X-option	
6815A	FC-AL 73.4-GB, 10000-rpm disk drive in Spud-3 mounting bracket for the Sun StorEdge 6120 arrays, ATO-option	
X6893A	FC-AL 73.4-GB, 15000-rpm disk drive in Spud-3 mounting bracket for the Sun StorEdge 6120 arrays, X-option	
6893A	FC-AL 73.4-GB, 15000-rpm disk drive in Spud-3 mounting bracket for the Sun StorEdge 6120 arrays, ATO-option	
X6817A	FC-AL 146-GB, 10000-rpm disk drive in Spud-3 mounting bracket for the Sun StorEdge 6120 arrays, X-option	
6817A	FC-AL 146-GB, 10000-rpm disk drive in Spud-3 mounting bracket for the Sun StorEdge 6120 arrays, ATO-option	
X9730A	0.8-meter LC-to-LC FC optical cable (used with 2-Gb switches/HBAs)	LC – LC Fibre channel cables
X9732A	2-meter LC to LC Fibre Channel optical cable	
X9733A	5-meter LC to LC Fibre Channel optical cable	
X9734A	15-meter LC to LC Fibre Channel optical cable	
X9720A	SC to SC Fibre Channel cable coupler with female to female SC connections	LC – SC connectors Fibre channel cables and accessories
X9721A	0.4-meter LC to SC Fibre Channel optic cable.	
X9722A	2-meter LC to SC Fibre Channel optic cable	LC= SFF (small form factor)
X9723A	5-meter LC to SC Fibre Channel optic cable	
X9724A	15-meter LC to SC Fibre Channel optic cable	
X973A	2-meter SC to SC Fibre Channel optic cable	SC – SC Fibre channel cables
X9715A	5-meter SC to SC Fibre Channel optic cable	
X978A	15-meter SC to SC Fibre Channel optic cable	
X6888A	Sun StorEdge 6120 hardware RAID controller card, X-option	Sun StorEdge 6120 controller card
X6886A	3U single rackmount rail kit for the Sun StorEdge 72-inch cabinet, the Sun Fire system 3800-6800 system cabinet, Sun Rack 900 and RETMA cabinets, X-option	Rack rail kits
6886A	3U single rackmount rail kit for the Sun StorEdge 72-inch cabinet, the Sun Fire system 3800-6800 system cabinet, Sun Rack 900 and RETMA cabinets, ATO-option	
TA-EXPCAB-060	Sun StorEdge expansion cabinet for the Sun StorEdge 6320	Rack and accessories
SG-XARY030A	Sun StorEdge 72-inch cabinet, X-option	
SG-ARY070A	Sun StorEdge 72-inch cabinet, ATO	



Part Number	Description	Category
SG-XPCI1FC-QF2 / X6767A	Sun StorEdge 2-Gb PCI single Fibre Channel network adapter	Host Bus Adaptors
SG-XPCI1FC-JF2	JNI 2-Gb PCI single Fibre Channel network adapter	
SG-XPCI2FC-QF2 / X6768A	Sun StorEdge 2-Gb PCI dual Fibre Channel network adapter	
SG-XPCI2FC-JF2	JNI StorEdge 2-Gb PCI dual Fibre Channel network adapter	
X6799A	Sun StorEdge PCI single Fibre Channel network adapter (1Gb)	
X6727A	Sun StorEdge PCI dual Fibre Channel network adapter (1Gb)	
X6748A	Sun StorEdge cPCI dual Fibre Channel network adapter (1Gb)	
X6757A	Sun StorEdge SBus dual Fibre Channel network adapter (1Gb)	
XSFP-LW2Gb	Long wave, small form pluggable 2-Gb Fibre Channel transceiver	GBIC module
XSFP-SW2Gb	Short wave, small form pluggable 2-Gb Fibre Channel transceiver	
SG-XSW162Gb	Sun 16-port, 2-Gb Fibre Channel switch	Switches
SG-XSW82Gb	Sun 8-port, 2-Gb Fibre Channel switch	
SG-XSWBRO3800	Brocade 3800 16-port Fibre Channel switch	
SG-XSWBRO3200	Brocade 3200 16-port Fibre Channel switch	
X6746A	Redundant Fibre Channel 1-Gb 8-port switch pair including two 8-port Fibre Channel switches, documentation, and 19-inch rackmount hardware for both the switches and rack	
SG-XSW16-32P	Redundant Fibre Channel 1-Gb 16-port switch pair including two 16-port Fibre Channel switches, documentation, and 19-inch rackmount hardware for both the switches and rack	

Optional — Software Support “S4” part numbers

Part Number	Title
NMK9S-99Y9-1ST	Sun StorEdge Management Software Kit which includes Sun StorEdge Enterprise Storage Manager - 1 year standard support.
NMK9S-99Y9-1PR	Sun StorEdge Management Software Kit which includes Sun StorEdge Enterprise Storage Manager - 1 year premium support.
NMK9S-99Y9-3ST	Sun StorEdge Management Software Kit which includes Sun StorEdge Enterprise Storage Manager - 3 year standard support.
NMK9S-99Y9-3PR	Sun StorEdge Management Software Kit which includes Sun StorEdge Enterprise Storage Manager - 3 year premium support.
NAVIS-1FNS-1ST	Sun StorEdge Availability Suite - 1 year standard support.
NAVIS-1FNS-1PR	Sun StorEdge Availability Suite - 1 year premium support.
NAVIS-1FNS-3ST	Sun StorEdge Availability Suite - 3 year standard support.
NAVIS-1FNS-3PR	Sun StorEdge Availability Suite - 3 year premium support.



Optional – Sun Services

The Sun StorEdge 6120 array models have optional enhanced services package, which allows customers to rapidly implement complex data storage environments. This extended service package helps ensure the use of sound storage installation and configuration practices, thereby allowing Sun to put the support infrastructure in place that is required to maintain the most demanding enterprise and data center environments.

Recommended services available for the Sun StorEdge 6120 arrays are shown in the table below.

Installation Service	Americas Part Number	EMEA/APAC Part Number
Sun StorEdge Array Installation, base charge for the StorEdge 6120 system	ARRAY-INS-BAS2	EIS-ARRAY
Sun StorEdge Tray Installation, per tray charge for StorEdge 6120 system	ARRAY-INS-PER-TRAY	EIS-ARRAY-TRAY
Sun StorEdge Array Installation, after hours base charge for the StorEdge 6120 system	ARRAY-INS-BAS2-AH	EIS-ARRAY-AH
Sun StorEdge Tray Installation, after hours per tray charge for the StorEdge 6120 system	ARRAY-INS-PRTRY-AH	EIS-ARRAY-TRAY-AH
Various storage services are offered by Sun Professional Services (SunPS SM)	Various	Available now, please refer to the following URL for more details: http://sunps.central/services/storage/index.html

SunSpectrumSM Instant Upgrades (Warranty Upgrades)

The SunSpectrumSM program is a service offering that allows customers to choose the level of service best suited to their needs. 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 SolarisTM Operating Environment software, and telephone support for SunTM software packages. Customers should check with their local Sun Services representative for program and feature availability in their areas.

For information specific to the Sun StorEdge 6120 system, refer to:

<http://www.sun.com/service/support/products/storage/>

SunSpectrum program support contracts are available both during and after the warranty program. Customers can choose to uplift the service and support agreement to meet their business needs by purchasing a SunSpectrum contract.

The four levels of SunSpectrum support contracts range from SunSpectrum BronzeSM level to SunSpectrum Platinum level. Contact a Sun Services representative for further details. The following part numbers can be used to upgrade system warranty to the given level of SunSpectrumSM service for each specified product:

Part Numbers	Service
W9D-6120-1-2P	Sun StorEdge 6120 array (1 tray) upgrade to 2-year SunSpectrum Platinum SM service



Part Numbers	Service
W9D-6120-1-24-2G	Sun StorEdge 6120 array (1 tray) upgrade to 2-year SunSpectrum Gold SM (7/24) service
W9D-6120-2-2P	Sun StorEdge 6120 HA array (2 trays) upgrade to 2-year SunSpectrum Platinum service
W9D-6120-2-24-2G	Sun StorEdge 6120 HA array (2 trays) upgrade to 2-year SunSpectrum Gold (7/24) service

Warranty

The following table indicates warranty details for the Sun StorEdge 6120 system:

Repair Support Duration	Software Support Duration	Phone Coverage		Hardware Coverage		
		Hours of Coverage	Call-Back Response Time	Hours of Coverage	Response Time ⁴	Delivery Method
2 years	90 days	24x7	Customer-defined priority	Local, extended business hours	<ul style="list-style-type: none"> • Same business day • 4 business hours 	On-site

For the latest warranty information for the Sun StorEdge 6120 system, refer to:

<http://www.sun.com/service/support/warranty/features.html>

⁴Average response times may vary by country.



Service and Support

The SunSpectrumSM 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 SolarisTM Operating Environment software, and telephone support for SunTM software packages. The majority of Sun 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.

For information specific to the Sun StorEdgeTM 6120 array models, refer to:

<http://www.sun.com/service/support/products/storage/>

SunSpectrum program support contracts are available both during and after the warranty program. Customers may choose to uplift the service and support agreement to meet their business needs by purchasing a SunSpectrum contract.

Warranty Duration and Terms

The following table indicates warranty details for the Sun StorEdge 6120 system:

Repair Support Duration	Software Support Duration	Phone Coverage		Hardware Coverage		
		Hours of Coverage	Call-Back Response Time	Hours of Coverage	Response Time ⁵	Delivery Method
2 years	90 days	24x7	Customer-defined priority	Local, extended business hours	<ul style="list-style-type: none"> • Same business day • 4 business hours 	On-site

For the latest warranty information for the Sun StorEdge 6120 storage system, refer to:

<http://www.sun.com/service/support/warranty/features.html>

Education

SunED course number: **ES-343**

Course Title: **Sun StorEdge 6320 and 6120 Array Installation and Administration**

Sun Educational Services Course Description:

The Sun StorEdge 6320 and 6120 Array Support Readiness Training course provides students with the knowledge to successfully describe, install, configure, access, maintain, and diagnose the Sun StorEdge 6320 and 6120 arrays. Students receive classroom training and hands-on experience with the Sun StorEdge 6320 and 6120 arrays. Topics include installation, array configuration, volume configuration, array upgrades, array maintenance, and array failure diagnostics.

For further information on courses visit Sun Ed Web site at <http://www.sun.com/service/suned>, or to order, call: 1-800-422-8020.

⁵Average response times may vary by country.



Glossary

Array group	An arrangement of disk drives and the data on them which conform to a RAID level that facilitates organization and the movement of disks between systems. <i>See also</i> Disk group.
Block	The amount of data sent or received by the host per I/O operation, or the size of an atomic read/write operation to or from a disk. In the context of the Sun StorEdge 6120 array, represents the size of each cache buffer, and also the disk interleave factor (also known as stripe unit, chunk, interlace factor). Sun StorEdge 6120 array block size can be 4KB, 8KB, 16KB, 32KB, or 64KB.
Bus	A point-to-point network component. Used by Sun™ Management Center software to represent a network link to which many other hosts can be connected.
Cache hit	A read or write request for data that is already in cache. Therefore, a request can be serviced without needing to go to disk.
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.
Clean data	Any read data or write data that has been committed to disk. In other words, a copy of data that is safely on disk.
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.
Controller tray	A tray with an installed RAID controller. The standalone controller tray is the smallest possible array configuration. The architecture integrates disks, data cache, hardware RAID, power, cooling, uninterrupted power supply (UPS), diagnostic capabilities, and administration into a versatile, standalone component. The controller unit includes external connections to a data host (or switch), and to a management network.
Dirty data	Write data that is in cache and has been acknowledged to the application host, but which has not yet been committed to disk.
Disk array	A storage subsystem containing one or more arrangements of multiple disk drives, designed to provide performance, high availability, serviceability, or other benefits. Disk arrays can provide mechanisms to create virtual extents of volumes, such as RAID groups. The physical and logical elements of the array are managed as a group. A disk array can contain multiple trays of disks.



Disk group	An arrangement of disk drives and the data on them which conform to a RAID level that facilitates organization and the movement of disks between systems. <i>See also</i> Array group.
Duplexed cache	Cache mirroring with duplicate data paths to and from the cache. <i>See</i> Mirrored cache.
ECC	Error correction code: Extra bits added to Words, or Double Words, that correct all single-bit errors, and detect all double-bit errors. A superior technology to parity, which detects, but does not correct, single-bit errors, and cannot detect double-bit errors.
Event	A change in the state of a managed object.
Expansion Unit	A tray without an installed RAID controller (also called expansion tray)
Extent	A set of disk blocks with consecutive logical addresses. Extents can be smaller or larger than physical disks. On the Solaris Operating Environment, the format utility can subdivide a disk into several extents called slices (Windows and Linux have a similar concept called partitions). RAID arrays allow users to combine several disks together into a larger "virtual disk". Although the underlying disks are separate extents, the resulting virtual disk is addressed from zero up to its new size; so this virtual disk is also an extent. A volume manager provides a similar capability of merging extents from disks into larger virtual extents.
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 <i>fib</i> re 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. A component which can be removed and replaced during service in the field.
GBIC	Gigabit interface converter.
Heterogeneous hosts	Application servers running different (disparate) operating systems which are attached to the same storage system.
High Availability/HA configuration	Two controller units paired together to create a configuration with redundant controllers with redundant data and management paths, allowing for mirrored cache duplexing which provide controller failover, and path failover capability. The High Availability (HA) configuration is thus the minimum storage configuration for enterprise environments that call for high availability. Applies to Sun StorEdge 6120 array HA configurations only.
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	Drive(s) within a storage system held in reserve to replace any other drive when it fails. Hot-spares are continuously powered up and spinning, but are not actually part of the array because they contain no data. This allows the array processor to have immediate access to a functioning drive for possible reconstruction of lost data when a disk fails.
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 either automatically recognizes the component change and configure itself as necessary or requires 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.
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 devices 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.
LED	Light emitting diode.
Link	One inbound fiber and one outbound fiber connected to a port.
LRC	Loop redundancy circuit.
Micron	One millionth of a meter. Also called <i>micrometer</i> .
Mirror synchronization	The process by which VERITAS Volume Manager software keeps two or more copies of data identical.
Mirrored cache	Redundant copies of data residing in cache — the (write) data residing in cache which has not yet been written to the hard disks is duplicated for failover operation. <i>See</i> Duplexed cache.
Mirroring (RAID)	Redundant storage of data, achieved by duplicating files (so, there is always a primary file and a copy of the primary file) onto separate disks. Duplicate files are either copied in whole (RAID 1).
Module	A software component that can 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 to achieve faster writes and in some cases, faster reads.
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.
Pool	<i>See</i> Storage pool.
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.
Quality of service (QoS)	Quality of service refers to the objective of obtaining a desired level of system behavior achieved by using system tunables within a storage array. RAID level, number of hot-spare disks, multi-path access, and disk speed are some of the factors that influence quality of service. Quality of service can be very specific (no single point of failure, must use RAID 1, must have at least one hot-spare) or very general (any storage will do).
RAID	Redundant array of independent disks. A set of disk drives which 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, without parity or mirroring protection. Data is distributed evenly at the block level among disks for performance. No redundancy is provided, and the loss of a single disk causes the loss of data on all disks. Use this level for high-speed streaming of large file reads (for example, video) of non-critical data which is easily available elsewhere within the organization.
RAID 1(1+0)	RAID level 1+0, or mirroring with striping. Data is stored at the file level. Files reside on separate disks, and two copies of the data are kept. Use this level for mirroring the host operating system and/or application programs or for creating a high-traffic log volume. The advantage of RAID 1+0 (over simple RAID 1) is that we are able to tolerate more than one non-adjacent drive failure. With simple RAID 1, two drive failures anywhere in the storage pool would kill the volume.



RAID 5	RAID level 5, or striping with distributed parity. Both data and parity are distributed evenly across all the disks in the array at the block level. No single disk can compromise the integrity of the data. RAID 5 balances the optimization of performance, reliability and cost. Use this level for most applications which do not require the special characteristics of the above RAID levels.
RAID Group	A set of disks in which part of the physical storage capacity is used to store redundant information about user data stored on the remainder of the storage capacity. The redundant information enables regeneration of user data in the event that one of the array's member disks or the access path to it fails. Although it does not conform to this definition, disk striping is often referred to as RAID (RAID Level 0).
RAS	Reliability, availability, and serviceability. Reliability is a measure of the likelihood that problems will occur. A highly reliable system has few problems. Once a problem occurs, availability is the measure of how the system protects the user from being adversely affected by the problem. Serviceability is a measure of how easy it is to repair the problem.
Read-ahead	Sequential data read from disk into cache without having actually been requested by the application host, in anticipation that it will be requested by the host. When the request occurs, it can be serviced as a low latency cache hit, thus improving host application performance.
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 to servers. This approach provides physical connectivity, facilitating information sharing or simplify management across servers.
Segment	An overly used term; in the context of the Sun StorEdge 6120 array, 1/8 of a cache buffer. In the Sun StorEdge 6120 array, a segment is the smallest size of I/O possible between cache and disk. Segment size is 2, 4, or 8 KB, depending on block size.
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) propagates above the cutoff wavelength.



SNMP	Simple network management protocol. A simple protocol designed to allow networked entities (for example, hosts, routers) to exchange monitoring information.
Stripe size	Total amount of data in a disk stripe; that is, the block size multiplied by number of data disks in the stripe.
Stripe width	Total number of disks in a disk stripe.
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.
Storage array	A storage system containing multiple disk drives, designed to provide performance, high availability, serviceability, or other benefits. Disk arrays can provide mechanisms to create virtual extents of volumes, such as RAID groups. The physical and logical elements of the storage array are managed as a group. A storage array must contain at least one tray with a RAID controller.
Storage pool	A collection of storage extent with the same Quality of Service The service level could be very precise (must be RAID protected with at least one hot-spare) or vague (any disk storage, with or without redundancy). There can be multiple pools with the same service level. (also called RAID group)
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). <i>See</i> 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.
Transfer rate	The rate at which data is transferred, usually measured in Megabytes (MB) per second.
Tray	Refers to a single Sun StorEdge 6120 enclosure. If one is referring to multiple "trays" connected together, that new entity would be referred to a storage array (see definition below).
Volume	A volume is a virtual disk into which a file system, DBMS, or other application can place data. A volume can be a single physical disk or a virtual disk mapped from one or more underlying extents. 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.
Write-behind mode	A data write is acknowledged to the application host as soon as it is in cache, without having yet been committed to disk, in order to reduce write latency. Also known as write-back or fast-write mode.
Write-through mode	A data write is acknowledged only after data has been fully committed to disk.



Materials Abstract

All materials are available on SunWIN except where noted otherwise.

Collateral	Description	Target Audience	Distribution	Token # or COMAC Order #
Just The Facts				
– <i>Sun StorEdge™ 6120 Array , Just the Facts</i>	Reference Guide	Sales Tool	SunWIN, Reseller Web	367056
– <i>Sun StorEdge SAN 4.X release, Just the Facts</i>	Reference Guide	Sun SE	SunWIN, Reseller Web	345251
– <i>Sun StorEdge Enterprise Storage Manager (ESM) Software, Just The Facts</i>	Reference Guide	Sun SE	SunWIN, Reseller Web	352908
– <i>Sun StorEdge Availability Suite 3.1 Just The Facts</i>	Reference Guide	Sun SE	SunWIN, Reseller Web	327180
– <i>Sun StorEdge Utilization Suite and Performance Suite Just The Facts</i>	Reference Guide	Sun SE	SunWIN, Reseller Web	304737
– <i>VERITAS Volume Manager, Just The Facts</i>	Reference Guide	Sun SE	SunWIN, Reseller Web	67745
Customer Presentations				
– <i>Sun StorEdge 6120 Array and Sun StorEdge 6320 System Customer Presentation</i>	Presentation	Sales Tool	SunWIN, Reseller Web	367054
– <i>Sun StorEdge Availability Suite 3.1 Customer Presentation</i>	Presentation	Sales Tool	SunWIN, Reseller Web	317927
– <i>Sun StorEdge Utilization Suite and Performance Suite NDA</i>	Presentation	Sales Tool	SunWIN, Reseller Web	354784
– <i>Sun StorEdge Unified 2 GB SAN Infrastructure Customer Presentation</i>	Presentation	Sales Tool	SunWIN, Reseller Web	345252
– <i>VERITAS Volume Manager Customer Presentation</i>	Presentation	Sales Tool	SunWIN, Reseller Web	134067 115226
Technical Presentations				
– <i>Sun StorEdge 6120 Array and Sun StorEdge 6320 System Technical Presentation</i>	Technical Presentation	Sales Tool	SunWIN, Reseller Web	374939
Competitive Note				
– <i>Sun StorEdge 6120 Array Beat Sheet</i>	Beat Sheet	Sales Tool	SunWIN, Reseller Web	374936



Collateral	Description	Target Audience	Distribution	Token # or COMAC Order #
References				
– <i>Sun StorEdge 6120 Array and Sun StorEdge 6320 System Data Sheet</i>	Data Sheet	Sales Tool	SunWIN, Reseller Web, COMAC	367052, DE1812-0
– <i>Sun StorEdge 6120 Array Pocket Facts</i>	Fast Facts	Sales Tool	SunWIN, Reseller Web	367053
– <i>Sun StorEdge 6120 Array and Sun StorEdge 6320 System Elevator Pitch</i>	Elevator Pitch	Sales Tool	SunWIN, Reseller Web, COMAC	374938, DE1561-1
– <i>Sun StorEdge Availability Suite Data Sheet</i>	Data Sheet	Sales Tool	SunWIN, Reseller Web, COMAC	317926, DE1561-1
– <i>Sun StorEdge HBA Product Brief</i>	Sales Guide	Sales Tool	SunWIN, Reseller Web	345257
– <i>SAN 4.X WWW Matrix</i>	Configuration Matrix	Sales Tool	SunWIN, Reseller Web	347688
White Papers				
– <i>Sun StorEdge Availability Suite 3.0 and 3.1 Software — Using Remote Mirror Software in Asynchronous Replication Mode</i>	Technical Brief	Sales Tool	SunWIN, Reseller Web	368350
– <i>Sun StorEdge Availability Suite Software Improving Data Replication Over a Highly Latent Network</i>	Technical Brief	Sales Tool	SunWIN, Reseller Web	356832
– <i>Sun StorEdge Availability Suite Software Performance Improvement White Paper</i>	Technical Brief	Sales Tool	SunWIN, Reseller Web	356830
– <i>Sun StorEdge Availability Suite Software — Compared With ORACLE Replication</i>	Technical Brief	Sales Tool	SunWIN, Reseller Web	351157
– <i>Sun StorEdge Availability Suite Software — Maximizing Read-Only Volume Access</i>	Technical Brief	Training	SunWIN, Reseller Web	351155
– <i>Point-in-Time Copy Software — Maximizing Backup Performance</i>	Technical Brief	Training	SunWIN, Reseller Web	351159
– <i>Fibre Channel Technology from Sun Microsystems</i>	Technical Brief	Training	SunWIN, Reseller Web	65659
– <i>Fibre Channel versus Alternative Storage Interfaces: An Overview</i>	Technical Brief	Training	SunWIN, Reseller Web	65663
– <i>The Sun Storage Value Proposition for High Performance Computing White Paper, 01-01-02</i>	Technical Brief	Training	SunWIN, Reseller Web	334572



Collateral	Description	Target Audience	Distribution	Token # or COMAC Order #
– <i>Business Continuity Goes Better with SANs — The 3 Rs of Resilience White Paper, 02-06-02</i>	Technical Brief	Training	SunWIN, Reseller Web	332518
External Web Sites				
– <i>Sun StorEdge 6120 Array Main Page</i>	http://www.sun.com/storage/6100			
– <i>Fibre Channel Association</i>	http://www.fibrechannel.com			
– <i>Sun StorEdge Availability Suite</i>	http://www.sun.com/storage/software/availability/			
– <i>Fibre Channel Loop Community</i>	http://www.fcloop.org			
– <i>Sun StorEdge 6120 Array Multiplatform Support</i>	http://www.sun.com/storage/san/multiplatform_support.html			
– <i>VERITAS Volume Manager</i>	http://www.sun.com/storage/software/storage_mgmt/volumemgr/index.html			
Internal Web Sites				
– <i>Storage Products Internal Site for the Sun StorEdge 6000 Family</i>	http://webhome.sfbay/networkstorage/products/6000			
– <i>Storage Products Internal Site for the Sun StorEdge 6120 Series</i>	http://webhome.sfbay/networkstorage/products/6120			
– <i>Sun StorEdge Availability Suite Software Site</i>	http://webhome.ebay/networkstorage/products/software/availability/			
– <i>Switch Information</i>	http://webhome.ebay/products/switch/index.html			
– <i>VERITAS Volume Manager</i>	http://webhome.ebay/networkstorage/products/volumemgr/			
– <i>Configuration Rules Page</i>	http://webhome.ebay/networkstorage/performance/confrules			
– <i>WWW Matrix Web Page</i>	http://webhome.ebay/products/sales/matrix.html			
– <i>Storage Products Internal Site for Sun StorEdge Utilization Suite and Sun StorEdge Performance Suite</i>	http://webhome.sfbay/datapath/sam-qfs			
– <i>Resources Web Site</i>	http://webhome.ebay/networkstorage/contacts/			
– <i>Network Storage Sales Center (Help Desk)</i>	http://webhome.sfbay/networkstorage/sales			
– <i>SunSpectrumSM Program Information</i>	http://service.central/TS/ESP/SunSpectrum/Feature_Matrix/index.html			



FAQs

Sun StorEdge 6120 array Frequently Asked Questions can be found on the following URLs:

- Internal use only = Sun StorEdge 6120 array INTERNAL FAQs, found on <http://webhome.sfbay/networkstorage/products/6120>
- External use = Sun StorEdge 6120 array EXTERNAL FAQs, found on <http://www.sun.com/storage/midrange/6000/6100/6120/index.html>

The FAQ lists are now kept as separate documents because of the frequency of updating required. This way, customers can find them in the same place and can know that they are up to date. Both FAQ lists are formatted using Courier 10 font to maintain formatting for copy and pasting into text-driven applications such as UNIX® platform-based e-mail messages.

