Sun StorEdge™ 9900

Storage System

Just the Facts

Sun Internal / Partner Version

March 2006

Sun microsystems

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Positioning

Introduction

Figure 1: Sun StorEdge™ 9990 System

The Sun StorEdge 9990 represents the next-generation in the evolution of the Sun StorEdge 9900 industry leading storage solution series. The StorEdge 9990 provides significant improvements in:

- Performance
- Scalability
- Availability
- Configurability
- Management

The Sun StorEdge 9990 has capabilities far beyond any other storage system in the industry, today. The heart of the StorEdge 9990 is the next generation crossbar switch offering more than two times the performance over the prior generation switch. This switch provides levels of storage consolidation unattainable previously in the industry and brings to reality the virtualization of both internal and external heterogeneous storage under a single storage system.

The base StorEdge 9900 supports up to 336TBs of highly available internal storage. In the future, an additional 31.67PBs (petabytes) may be supported by aggregating or pooling heterogeneous storage connected and managed by a single StorEdge 9990 system. This is referred to as external storage.. Additionally, the StorEdge 9990 provides partitioning support of both internal and external physical resources to create up to 32 "Virtual Private Storage Machines (VPSM)" to satisfy stringent "Quality of Service (QoS)", and allocate resources to fulfill application requirements often demanded in "Service Provider" business models. VPSMs complement Dynamic System Domains (DSD) provided in Sun

New storage software solutions supporting these extended capabilities of the StorEdge 9990 include:

Features Which Achieved Generally Availability (GA) Status after September 2004

Effective February 2006, a 18 month major release cycle for both the SE 9990 was concluded.

This means all major features planned for this platform have been released.

The following features have reached general availability status. Please initiate sales activities with all of the features listed below.

- StorEdge 9990 Virtual Partition Manager – supports the logical partitioning of ports, cache, and disk capacity (parity groups) on the StorEdge 9990 to create independently managed Virtual Private Storage Machines.
- StorEdge 9990 Universal Replicator – is disaster recovery software which features disk journaling and "pull" technology as key differentiators. This software masks outages from customer and avoid re-synch operations.
- StorEdge 9990 Universal Volume Manager – provides the virtualization of a multi-tiered storage area network, comprising heterogeneous storage systems. The StorEdge 9990 Universal Volume Manager supports the operation of multiple storage systems connected to a StorEdge 9990 to be managed as if they were all in a single system through common management tools and software.
- StorEdge 9990 Tiered Storage Manager faciliates movement of data to the correct tiered storage based on value of the data, frequency of access, performance, availablity, and cost requirements. TSM represents data movement at the volume level, and requires that you already know where the data that is intended to be moved resides.
- StorEdge 9990 In-System Replication. This package combines the old and the new. This package include Shadow Image, which provides up to 9 full duplicate copies. This is mature software which has been available for a long time. New is "Copy On Write" (COW), which copies only changes. Shadow Image is a prerequesite for COW.
- 300 GB 10K HDDS
- RAID 6 + 2 recommended but no longer required for 300 GB HDD
- RAID 5 (7+1) with 300 GB HDDs now available
- 146 GB 15K HDDs
- 12 GB Shared memory
- 256 GB Data Cache
- 4 Gbit Front End Director (255 MB/sec) It is recommended that you *not* sell this. We are cutting over to the 350 MB/sec model which customers are expected for find to be a much more satisfactory solution.

Futures

The following features are expected to be released during 4QFY06 through 1QFY07.

- 4 Gbit Front End Director (350 MB/sec). This is expected during the late July 2006. Check with the hdsconfig.global@sun.com alias for last minute slippages in schedule.
- Hi Command Global Link Availability Manager. This provides common services such as configuration, reporting, and management to populations of heterogeneous servers running Hi Command Dynamic Link Manager (HDLM is multipathing software) This is expected in the July-August timeframe. Pricing discussions are on-going. Check with the hdsconfig.global@sun.com alias for last minute slippages in schedule.
- Low Cost Fibre Channel Disk. This is expected late 1QFY07. This will consist of a Fibre Channel interface to IDE HDD to faciliate tiered storage internal to the SE 9990. Check with the hdsconfig.global@sun.com alias for last minute slippages in schedule. Please note that this was previously referred to as FATA. Sun is no longer referring to this as FATA. Instead we are referring to this a "Low Cost Fibre Channel Disk".
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Items Undergoing Internal Discussion at Sun

- SE 9985 Diskless. SE 9900 Product Marketing is analyzing messaging and positioning. HDS is planning to GA on May 16. Please stay tuned to hdsconfig.global@sun.com where the results of the Sun marketing discussion will be published.
- iSCSI. This is expected to be a low demand item, which complicates deployment/installation/services issues. Please stay tuned to hdsconfig.global@sun.com where results will be published.
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All current Sun StorEdge 9900 software products are supported on the new StorEdge 9990 providing a complete suite of storage management, data/information lifecycle management, and business continuity solutions.

Key Messages

The Sun StorEdge 9990 system helps enable enterprises to reduce costs with improved service levels and is designed to deliver optimal performance through better utilization and simpler management of new and existing storage resources. It is especially beneficial for enterprise customers that run multiple, disparate applications and are experiencing rapid data growth with limited synchronization of business and storage policies.

Key Messaging Statements with Respect to Current Product Line

- Product line extension of the EOL'd StorEdge 9970 and StorEdge 9980 products.

- Tailored to the same environment as StorEdge 9970 and StorEdge 9980 products.

- Evolutionary product supported by advanced new hardware and software features.

- All current StorEdge 9900 series software offerings are available on the new StorEdge 9990 storage system.

Key Messaging Statements with Respect to Competition

- **Extreme Availability**: All components with a StorEdge 9990 are fully redundant. customers A 100% data availability guarantee available with the appropriate customer engagement.

Claim about HDS have more scalabilty removed.DMX 3 support 1920 HDDs

- **Extreme Performance:** Over three times the nearest competitor.

- **Extreme Configurability**: Comprehensive heterogeneous server support for both storage area networks (SANS), and network attached storage (NAS) environments. Added to this is the StorEdge 9990's ability to seamlessly aggregate heterogeneous storage systems for cohesive management from a single system.

- **Extreme Manageability:** Comprehensive software offerings available to install, manage, and optimize storage assets.

- **Excellent Customer Value:** The StorEdge 9990 can dramatically reduce the total cost of ownership in enterprise customer environments and offers customers best in class return on their investment.

- **End-to-End Solutions**: Procurement, implementation, services and support - Sun exceeds the competition in providing outstanding support for our enterprise data center customers

- **One hand to hold:** Seamless joint global support and service centers through Sun professional and support services. Extensive services offerings dedicated to data migration, consolidation and optimization -- with premier 24X7 same day/ (2) hour on-site response.

- Remove claim that The **StorEdge 9970 and StorEdge 9980 are up-to-date current**

Summary

- The StorEdge 9990 reduces costs through simplified, consolidated management of multiple enterprise-class storage classes and resources.

- The StorEdge 9990 offers industry leading performance to meet growing transactional requirements.

- The StorEdge 9990 is designed and developed with no single point of failure for increased reliability and availability.

- The StorEdge 9990 offers 100% complete data protection for all customer data.

- The StorEdge 9990 supports scalability in terms of both performance and capacity to 336TBs, internally, satisfying application data growth requirements.

- The StorEdge 9990 offers a wide range of storage protocol network connections to support open system servers and mainframe environments.

- The StorEdge 9990 will in the future consolidate existing storage resources under a single system image through attachment of up to 31.67PBs of other heterogeneous storage systems.

- The StorEdge 9990 permits partitioning of resources to support specific application performance requirements and to achieve quality of service (QoS) objectives.

- The StorEdge 9990 offers a wide range of business continuity solutions to protect customers critical data assets.

- The StorEdge 9990 offers complete storage resource management solutions to simplify and reduce the costs of managing the entire storage infrastructure.

- The StorEdge 9990 can be non-disruptively upgraded with additional storage capacity, front-end network connections, or back-end connections.

- The StorEdge 9990 improves the service levels through unique self testing procedures to ensure continuous operation.
- The StorEdge 9990 reduces total cost of ownership (TCO) by extending the life of storage resources, processes, and knowledge.
- The StorEdge 9990 protects existing capital assets (investment) by consolidating existing heterogeneous storage systems under a simpler and more robust management model, enabling more efficient usage of existing storage resources.

General Availability (See Page 134 for additional information)

The StorEdge 9990 was released in two phases.

- StorEdge 9990 GA Phase 1
  - Revenue Release (RR) - September 14, 2004
  - General Availability (GA) - October 19, 2004

Features Available at Revenue Release September 14, 2004

- Aggregate System Bandwidth 81 GB/sec (68 GB/sec data bandwidth and

  13 GB/sec control bandwidth)
- Internal raw capacity 165 TB (146 GB HDD)
- 1152 Disk drives
- Data Cache is 128 GB
- Control Cache is 6 GB
- 192 FC connections
- 2 Million IOPS
- 16,384 Logical Devices

The follow list of features all achieved "Generally Available" Status by February 2006.

Please intiate sales activities around these featues. The major product and feature release cycle from September 2004 to Febuary 2006 is now complete.

Features Available at GA Phase 2

- "External Storage". This is implemented by the Universal Volume Management software.
- "Virtual Private Storage Machines is implemented by "Virtual Partition Manager" software
- Universal Replicator

- Copy on Write software (Actually, this comes
- 256 GB Cache
- 12 GB Control Memory
- 300 GB disks (which increases internal capacity to 330TB)
- Chargeback Module
- SE 9900 Cross System Copy (formerly known as Hi Copy)
- SE 9990 NAS Blade Feature
- iSCSI
- RAID 6

Features and Benefits

Features	Benefits
• Proven third-generation enterprise-class storage system	• Provides investment protection • Maintains compatibility with Sun StorEdge 9900 Series systems
• Internally supports up to 165TBs of internal storage	• Permits maximum scalability within one storage system • Ideal for storage consolidation
• StorEdge 9990 will support an additional 31.67PBs of heterogeneous storage post GA	• Simplifies configuration and management • Solves pressing business continuity data problems. • Simplifies virtualization of storage resources • Protects investment of existing storage resources
• Next generation non-blocking switch architecture	• Over two times performance improvement over previous generation switch • Gives even performance as system is scaled • Provides performance to high transactional applications
• Separate data and control memory caches	• Increases reliability • Increases serviceability
• 2Gbps disk interfaces	• Improves back-end performance • Improves back-end scalability
• New back-end director design	• Improves reliability • Removes performance bottlenecks • Supports application consolidation • Supports quality of service (QoS) objectives
• Enhanced RAID support	• Increases reliability • Increases recovery • Increases security
• 64 switched data paths, yielding a cache bandwidth of 68GB/s (Aggregate Bandwidth is 81 GB/sec)	• Results in outstanding overall system performance (Over a 500% increase)

Features	Benefits
• 64 control paths to control memory, yielding a control memory bandwidth of 13GB/s.(Aggregate Bandwidth is 81 GB/sec)	• Results in outstanding overall system performance (Over a 100% increase)
• 128 concurrent cache memory operations	• Results in outstanding overall system performance • Supports simultaneous I/O requests from multiple critical applications
• Up to 256GBs of data cache memory and up to 12GBs of separate control memory	• Allows system to scale with no performance impacts • Delivers performance to applications
• New flexible front-end director design	• Improves configurability • Improves reliability – reduces outages, increases productivity
• Expanded front-end director connectivity	• Increases choice of connectivity – Fibre Channel, ESCON, FICON, NAS
• Up to 192 front-end Fibre Channel connections	• Improves configurability – three times that of the competition • Facilitates storage consolidation
• Up to 64 back-end 2Gbps Fibre Channel Arbitrated Loops	• Increases performance – all active-active and twice as many as the competition • Improves reliability
• Support for approximately 2 million IOPS	• Results in performance four times that of the competition • Scales without any performance degradation.
• Up to 32 separate Virtual Private Storage Machines (VPSM)	• Allows consolidation, behind one system, of heterogeneous environments requiring different storage characteristics • Provides better quality of service control • Eases consolidation and asset management • Maintains separation and security between partitions • Reassigns resources between partitions if not required or used • Complements Dynamic System Domains (DSD) provided by Sun Servers. DSD is a form of server partitioning. Together, VSPM and DSD support customers who intend to implement "Service Provider Business Models"
• Retains all StorEdge 9900 software functions	• Provides compatibility between StorEdge systems • Eases migration • Requires no additional user training
• StorEdge 9990 Universal Volume Manager software	• Provides support of externally connected storage systems • Transparent use of different technologies beyond a single point of control • Matches applications with specific storage characteristics • Supports both open and mainframe environments • Manages up to 32 PBs of internal and external storage

Features	Benefits
• StorEdge 9990 Universal Replicator software	• Provides new replication technology (journaling schema) • Supports replication for disparate storage systems, including other vendor's storage systems • Simplifies management • Lowers operational costs • Gives customers new choice for a business continuity solution
• StorEdge 9900 Copy-on-Write Snapshot	• StorEdge 9900 Copy-on-Write Snapshot and StorEdge 9900 ShadowImage come in one part number: "StorEdge 9900 In system Replication. StorEdge 9900 ShadowImage is a prerequisite for StorEdge 9900 Copy-on-Write Snapshot • Minimizes performance impact via snapshot of changed information versus full volume replication. • Use less disk space, saving the customer both time and money.

Product Family Placement

The Sun StorEdge 9990 is positioned above the previous-generation Sun StorEdge 9970 and StorEdge 9980 storage systems for enterprises requiring extreme levels of performance, availability, and heterogeneity, including mainframe attachment. An "Entry" StorEdge 9990 configuration is roughly equivalent in performance to a small StorEdge 9980 system. On the other hand, the SE9990 is expected to be priced lower than a similarly configured SE9980. An "enhanced" StorEdge 9990 system is twice the performance of a StorEdge 9980 with fewer components resulting in higher efficiency and reliability. Finally, a high-end StorEdge 9990 is about four times the performance of a StorEdge 9980 and is the ultimate answer in storage consolidation and transaction processing. Net, the StorEdge 9990 is targeted at enterprise data center customers where priority is placed on the highest possible availability, performance, scalability and manageability levels.

For entry-level storage applications the Sun StorEdge 3000 family is the answer providing simple storage configurations. With immense flexibility and a simple management interface, these discrete arrays are the ideal solution for small to medium-sized businesses with a singular application with lower availability/capacity/scalability requirements than what the StorEdge 9990 offers.

For mid-range storage the Sun StorEdge 6000 family delivers exceptional value by combining the flexibility of a discrete array (as in the Sun StorEdge 3000 family) and the manageability of a monolithic system, (as in the Sun StorEdge 9000 family). In effect, businesses get the best of both worlds — open, modular flexibility with comprehensive, robust manageability. This modular architecture allows customers to implement a system that is tailored for their application environment today, and then easily expand as capacity and performance needs grow.

Selling Highlights

Market Value Proposition

The SE 9000 Family, of which the SE 9990 is the flagship, provides the following: "Provide our customers with end to end, best of breed, data center class solutions that deliver unbeatable availability,scalability and manageability - while delivering compelling value and Total Cost of Ownership.

When a customer buys a SE9990 array, they get simplified storage management and a lower TCO because the virtualization features simplify the connectivity of their network allowing them to save on environmental costs, licensing fees, and maintenance costs.

For customers who need to optimize their corporate assets, increase their productivity, and require their IT departments to meet Service Level Agreements, the SE9990 provides a critical piece in a complete end-to-end solution that simplifies storage management, and enables hyper-consolidation through enhanced virtualization features on an architecture that has proven itself reliable, resilient and unrivaled in performance - unlike point-product solutions based on an old architecture.

Selling Highlights

For enterprises facing rapid data growth and multiple, disparate applications, the Sun StorEdge 9990 system helps reduce costs and improve service levels through better management of new and existing storage resources.

- **Simplified Management** — The Sun StorEdge 9990 system's application oriented storage-management utility abstracts storage complexity, enabling users to simplify management by pooling storage resources. Sun refers to this as Multi-Vendor Storage Pooling, and this is a future deliverable. With conventional provisioning, it is difficult to know how storage inventory is configured or how much is utilized at any given time, which can prove costly and time-consuming. With the Sun StorEdge 9990 System, however, the boundaries of physical storage devices are abstracted to a *virtual inventory* of enterprise-class storage classes and resources that are easily managed, enabling quick and precise provisioning based on application workloads. This can greatly reduce complexity and improve operational efficiencies that translate into cost savings.

- **Extreme Scalability —** The Sun StorEdge 9990 system can also improve performance and service levels with an architecture that enables predictable, seamless scalability of performance and capacity to meet changing application needs, increasing agility and improving service levels. In contrast to typical modular storage arrays — which scale for capacity only, causing applications to compete for storage resources — the Sun StorEdge 9990 system's extreme scalability scales capacity, performance, connectivity, and data services as required by application or business needs.

- **Extreme Availability** — All Sun StorEdge 9990 systems have been designed to ensure that the entire system has no single point of failure. Further, should a component in a StorEdge 9990 experience an outage, a redundant component takes over the tasks of a failing component until repaired. All of this is transparent from an application's perspective to the operation of the storage system. The result is Sun is one of the few companies in the industry to offer a 100% data availability guarantee to customers selecting a StorEdge 9990 storage solution for complete protection of their digital assets.

- **Extreme Performance** — The StorEdge 9990 is the industry leading storage platform in terms of performance. This system easily has twice the performance over any competitor's storage system. With the next generation non-blocking crossbar switch at the heart of all StorEdge 9990 systems, the resulting throughput of the entire system provides outstanding performance to even the highest I/O intensive transactional applications. Additionally, the StorEdge 9990 is the only storage system in the industry to offer the ability to partition resources to further ensure application quality of service objectives are maintained.

- **Extreme Configurability** — Each StorEdge 9990 system can be tailored to fit the most demanding customer environment. The front-end connectivity to servers is supported through Fibre Channel, Ethernet, ESCON, and FICON directors, permitting concurrent attachment to open system servers and mainframe systems. In fact, the StorEdge 9990 supports up to 192 Fibre Channel connections, three times as many as the nearest competitor. Back-end disk drive connectivity is provided through advanced back-end directors supporting up to 64 2Gpbs Fibre Channel Arbitrated Loops, all active-active, twice as many as the nearest competitor.

- **Ensured Business Continuity —** Complimenting the StorEdge 9990 system is a suite of business continuity software, ensuring that all essential data managed by a 9990 is fully protected. The StorEdge 9990 provides two point-in-time local copy protection packages – StorEdge 9900 ShadowImage In-System Replication and StorEdge 9900 Copy-on-Write Snapshot. To support remote replication of data, the StorEdge 9990 offers the StorEdge 9900 True Copy Remote Replication software that permits both synchronous and asynchronous data replication across StorEdge 9990 systems. Finally, new to the StorEdge 9990 is the StorEdge 9990 Cross System Copy that supports data replication across heterogeneous storage systems.

- **Centralized Data Services** — The Sun StorEdge 9990 system boosts application performance and creates operational efficiencies by delivering data services without diverting compute or storage resources from their intended purpose, which can help lower the total cost of ownership (TCO). Traditionally, data services delivery is either array-based or host-based. In the first case, data services are delivered via the data path, which can negatively affect application performance. In the second case, CPU cycles are consumed that could be dedicated to processing transactions. With the Sun StorEdge 9990 system, data services are system-wide and have dedicated compute resources existing outside of the data path and independent of the host, enabling virtually unparalleled application performance.

Offering simplified, application-oriented management, vast scalability in terms of performance and capacity, outstanding availability, tailored configurability, and robust business continuity, the Sun StorEdge 9990 system can help to:

- Reduce costs through consolidated management

- Reduce TCO by extending the life of storage resources

- Improve service levels through predictable application and data growth.

- **Supports Implementation of "Service Provider" Business Models**

By Complementing Dynamic System Domains (DSD) provided by Sun Servers and Solaris Containers, SE 9990 Virtual Private Storage Machines (VPSM) support customer's initiative's to implement "Service Provider" Business Models. DSDs are a form of server partitioning. Solaris Containers are a form of software partitioning provided by the Solaris Operating System.

Partner Business Proposition

The Sun StorEdge 9990 system enables channel sales partners to quickly and easily deploy enterprise storage resources with predictable business and application results.

- **Easy, Predictable Deployment** —The Sun StorEdge 9990 system comes with a wide range of management support tools to allow partners the ability to setup and configure the system.

- **No Hidden Costs** — The Sun StorEdge 9990 system includes a wide breadth of standard features of any system in its class. With Sun StorEdge Enterprise Storage Manager, Sun StorEdge 9900 Availability Suite, and Sun-server based load balancing, this system comes pre-tested with the complete set of functions required to host today's business-critical application environments.

- **Predictable Scaling and Performance** — The Sun StorEdge 9990 system is one of the first products in its class that enables enterprises to dedicate and scale storage resources to meet changing application needs.

- **Feature Support** —The Sun StorEdge 9990 provides for a complete set of connectivity and upgrade features to respond to changing customer environments. This provides partners the ability to manage customer expectations through deployment of non-disruptive upgrades to the system.

- **Software Support** —The wide range of Sun StorEdge 9900 software allows partners to respond to customer requirements through acquisition of complimentary software solutions for storage resource management, business continuity, quality of service specification, and the like.

- **Increase Business Annuity** — The Sun StorEdge 9990 system provides partners with a best-of-breed system for enterprise IT environments.

Target Applications

The highly flexible architecture of the Sun StorEdge 9990 system provides a mix of optimal performance and availability for business-critical applications such as database, technical computing, and messaging.

Databases — Online Transaction Processing (OLTP) and Decision Support Services (DSS)

Databases for online transaction processing (OLTP) are performance-hungry business applications characterized by very high amounts of small, random, non-sequential read and write transactions within concentrated periods.

The Sun StorEdge 9990 system provides high application performance through 2-gigabit per second, full-fabric Fibre Channel ports and 256 GB of data cache. With more than 336 TBs of internal capacity, the Sun StorEdge 9990 system is an unsurpassed enterprise storage solution for multiple high-performance applications.

Messaging — Electronic Mail

Email applications combine the workload characteristic of OLTP and DSS databases. I/O is highly random and therefore unpredictable, and record sizes range from small text-only messages to large

messages with file attachments. These environments require a storage system capable of performing both transaction-heavy and throughput-heavy I/O.

The Sun StorEdge 9990 system can be scaled to optimize I/O request operations, data movement, or a combination of both. I/O optimization does not sacrifice data protection, making this system an ideal storage solution for messaging applications.

Mission-Critical Environments

As more and more data becomes mission critical and an increasing number of businesses need data access 24 hours per day, data availability is more important than ever.

In order to meet the high availability (HA) characteristics required in mission-critical environments, the Sun StorEdge 9990 system storage trays are designed to be fully redundant and available. Hot-swap, redundant RAID controllers, disk drives, cache, interconnect cards, data paths, mid-planes, power supplies, and cooling fans work in tandem to provide high levels of stability and data protection. In addition, the storage tray's RAID controller is equipped with enough embedded battery power to completely de-stage cache to disk in case of power failure for maximum data integrity. Eight minutes of battery power is available for destaging cache.

The Sun StorEdge 9990 system's *no single point of failure* architecture (through embedded dual fabrics and total redundancy), combined with Sun StorEdge Traffic Manager Software (SSTM) software on the host, also offers ease of deployment while maintaining a high level of data protection.

In addition, the Sun StorEdge 9990 system is even more suitable for mission-critical environments with its ease of management and multi-platform connectivity features.

Storage Consolidation

The problem faced by many business executives in today's IT environment is their ability to manage exponential storage growth at reduced IT budgets. By consolidating storage needs onto a Sun StorEdge 9990 solution, customers can achieve higher levels of storage utilization, improve availability and scalability of storage environments, enhance management of storage infrastructures, and simplification of business continuity needs to protect critical data assets, all at effectively lower costs.

With the StorEdge 9990's unique ability to manage other heterogeneous storage systems through aggregation of these resources under one "umbrella"(Sun refers to this as Multi-Vendor Storage Pooling), the StorEdge 9990 takes storage consolidation to the next level.

Data Warehousing / Business Intelligence

Over the past decade, data warehousing and business intelligence has emerged as a "must-have" solution for myriad of business challenges – from addressing the need for consistent information across the enterprise to enabling rapid response to business change. Today, companies considering data warehouse / business intelligence deployments face an evolving array of architectures, solutions and tools from which to choose.

The Sun StorEdge 9990 system is the ideal storage platform for implementing data warehousing and business intelligence solutions. A StorEdge 9990 provides heterogeneous connectivity and offers extreme levels of availability, performance and security for the largest data warehouse / business intelligence environments. The Sun StorEdge 9990 system incorporates the highest levels of scalability, along with virtualization and blade architecture to add easily capacity as data demands of a warehouse increase. The

Sun StorEdge 9990 series systems are ideal for data warehouse SAN solutions and as storage companions to Sun Fire 25K and Sun Fire 20K servers, underscoring the value of Sun's complete systems approach to meeting customer needs.

Data / Information Lifecycle Management

One of the next big things in the storage industry is data lifecycle management (DLM) and information lifecycle management (ILM). Simply stated, data lifecycle management allows for the correct storage of data based on the data's information value. Information lifecycle management extends this concept through the grouping of data and storage into classes and migrating data based on established policies from one storage device to another. Data and information lifecycle management has become critical to companies for compliance and regulatory reasons.

A Sun StorEdge 9990 is an ideal storage system from a data / information lifecycle management perspective. With the StorEdge 9990's future ability to support other heterogeneous systems through aggregation or pooling storage resources under a single 9990 system. Critical digital assets can be maintained on the StorEdge 9990 and less critical digital assets can be migrated to lower-cost storage systems managed by the StorEdge 9990. Adding to this software support for hierarchical storage management, such as Sun's StorEdge SAM-FS and StorEdge QFS products, the Sun StorEdge 9990 becomes the answer to an enterprise's information lifecycle management needs.

Business Continuity

• With outstanding reliability and availability characteristics, the StorEdge 9990 is an enterprise's answer to providing complete data protection for their critical data assets. The StorEdge 9990 system compliments its data availability through a suite of business continuity software, ensuring that all essential data managed by a StorEdge 9990 is fully protected. The StorEdge 9990 provides two point-in-time local copy protection packages – StorEdge 9900 ShadowImage In-System Replication and StorEdge 9900 Copy-on-Write Snapshot. To support remote replication of data, the StorEdge 9990 offers StorEdge 9900 True Copy Remote Replication that permits both synchronous and asynchronous data replication across StorEdge 9990 systems. Finally, new to the StorEdge 9990 is the StorEdge 9990 Cross-System Copy that supports data replication across heterogeneous storage systems.

Product Specifications

Product Overview

The StorEdge 9990 intelligent storage systems are the most powerful enterprise systems in the industry today and two generations ahead of the competition. The new architecture used in the StorEdge 9990 Series has over twice the internal processing power and five times bandwidth of our earlier enterprise systems. From an introductory overview perspective, key features of the StorEdge 9990 are:

- Next generation non-blocking switch architecture
- Improved internal architecture with faster and additional processors for improved performance and reliability
- Up to 256GBs of internal data cache and up to 12GBs of internal control memory
- Increase of aggregated bandwidth from 15.9GBs in the StorEdge 9980 to 81GB/s in the StorEdge 9990 – approximately 5 times improvement
- Over 2 million I/O operations per second (theoretical)
- Over 2GB/s sequential throughput
- Up to sixty-four (64) back-end Fibre Channel Arbitrated Loop (FC-AL) connections
- Support for up to 1,152 internal disk drives consisting of 73GB, 2Gbps FC-AL, 15Krpm disk drives; 146GB, 2Gbps FC-AL, 10K and 15K rpm disk drives; and 300GB, 2Gbps FC-AL, 10Krpm disk drives. In the future (estimated, non-committed data is 1QFY07) will be Low Cost Fibre Channel disk. We do not have specifications of the LCFCD at this time.
- Configurable for Fibre Channel Storage Area Network (SAN), network attached storage (NAS), and IBM zSeries mainframe environments
- Support for Fibre Channel, Gigabit Ethernet, FICON, and ESCON connectivity
- Up to 192 Fibre Channel ports, 96 ESCON ports, or 48 FICON ports are supported
- Support for boot devices (LUN 0).

Figure 2: Sun StorEdge 9990 System Internal View
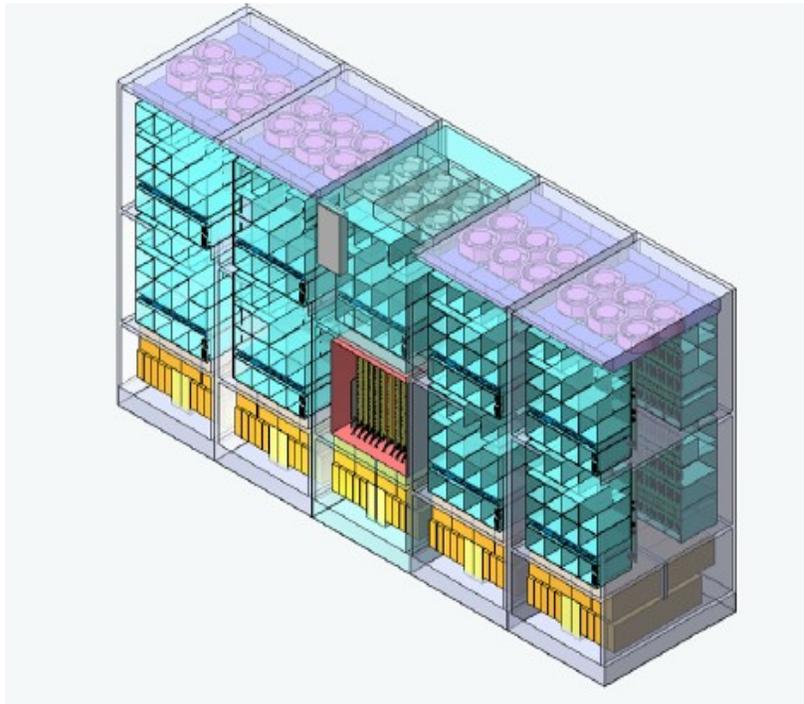
Sun StorEdge 9990 Packaging

The StorEdge 9990 system consists of a single control/array frame and up to an additional four array frames. The control/array frame serves as the intelligence center of each system and manages up to four additional array frames connected via 2Gbps Fibre Channel arbitrated loops.

A StorEdge 9990 system can be seamlessly and non-disruptively upgraded through the addition of:

- Array frames
- Front-end directors (previously referred to as channel host adapters or CHAs)
- Back-end directors (previously referred to as array control processors or ACPs)
- Cache switches
- Cache memory
- Control memory
- Disk Drives.

Control/Array Frame

The StorEdge 9990 control/array frame is the heart of each StorEdge 9990 system. Inside each control/array frame are:

- Up to 128 64-bit symmetrical microprocessors
- 3rd generation non-blocking switch
- Up to 256GBs of cache memory

- Up to 12GBs of control memory

- Sixteen adapter slots (four reserved for front-end directors)

- Eight disk drive trays each containing sixteen disk drives

- Service processor(s)

- Redundant power supply modules

- Redundant battery backup modules

- Cooling fans.

Each control/array frame contains 16 adapter slots supporting various front-end director and back-end director configurations. Note, each front-end director or back-end director requires two slots. Additionally, there are 8 hard disk drive trays in each control/array frame that can contain up to 16 drives per tray for a total of 128 drives.

The physical dimensions of the StorEdge 9990 control/array frame are 1860mm high, 782mm wide, and 925mm deep.

Array Frames

Each array frame of the StorEdge 9990 system can contain up to 256 disk drives. These are arranged in 16 drive trays each containing 16 disk drives. Additionally, each array frame contains cooling fans, redundant power supply modules, and redundant battery backup modules.

The physical dimensions of each StorEdge 9990 array frame are 1860mm high, 650mm wide, and 925mm deep.

Next Generation Switch

At the heart of the StorEdge 9900 Series are up to four cache switches. Together, these four switches use a parallel switch fabric bus. The cache switch is a specially designed crossbar switch that functions as a combination multiplexor, path arbitrator, and non-blocking network switch. The cache switch functions as a multiplexor by supporting 16 paths into the processor side of each switch and 16 paths to the cache modules. All total, there are 64 paths at the processor side of the fabric network and 64 paths to the cache modules from the cache side of the fabric network. The result is the StorEdge 9990 next generation switch can support up to 128 concurrent cache memory operations.

The internal StorEdge 9990 switch architecture consists of two separate networks: the cache hierarchical star network and the control memory hierarchical star network. The cache hierarchical star network is the network transfers data to and from the main global data cache at a rate of 68GB/s. The second network is the control memory hierarchical star network. This is a point-to-point network that handles the exchange of control information between the processors and shared memory and transfers data at a rate of 13GB/s. The total aggregate data rate supported by this next generation switch is 81GB/s. Control memory contains in formation about the status, location, and configuration of the cache, the data in the cache, and the configuration of the StorEdge 9990 Series system (as well as other information related to the operational state of the system). Two control memory areas are mirrored images of each other. Essentially, control information is handled "out of band" from the data paths, both through a separate memory area and network.

The StorEdge 9990 next generation switch can support up to 256GBs of data cache, all directly addressable. Separate shared memory modules, up to 12GBs, are used for shared memory storage and

are no longer installed on the cache memory board as in the StorEdge 9970 or 9980 system. Instead, control memory is installed in a dedicated location. Competitive systems use their cache for both data and control information, limiting the amount of usable data cache and creating performance limitations for certain workloads.

On top of this next generation switch, the StorEdge 9990 system has advanced cache algorithms and software solutions to provide exceptional performance.

Cache Memory

Within the control/array frame of each StorEdge 9990 system is the data cache memory. This memory is used to cache read and write requests from the attached storage arrays. In the initial release this memory is packaged on cache memory cards. Each cache memory card can contain from 4GBs to 32GBs of ECC data cache memory. A minimum of two cards is required per system for redundancy and a maximum of four cards can be installed in the system. Data cache memory is available in 8GB increments. Thus, a fully populated data cache in the StorEdge 9990 contains 256GBs of ECC memory (4 cards x 64GBs = 256GBs).
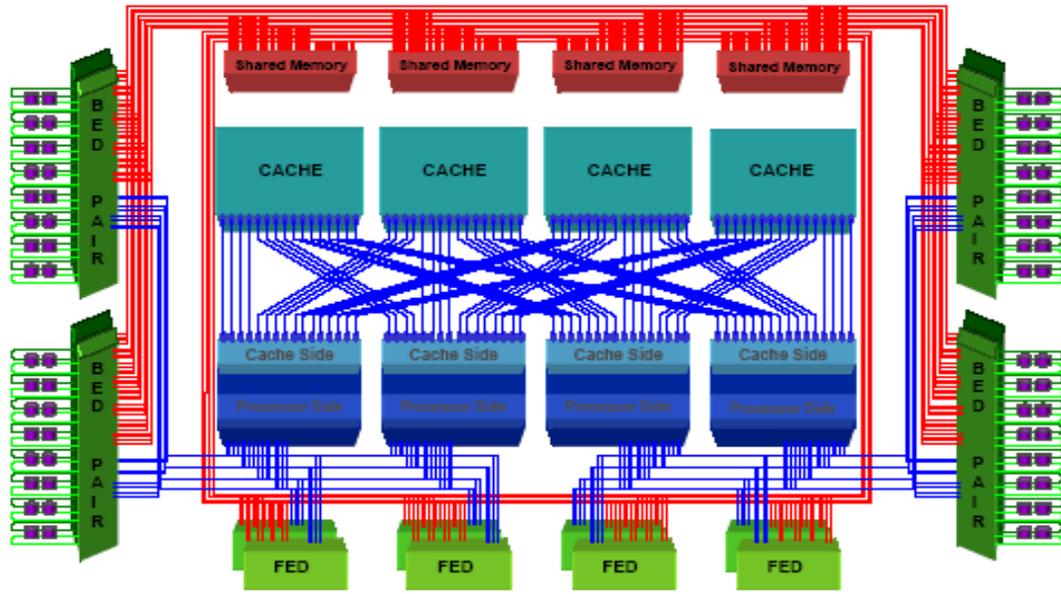
Figure 3: Next Generation Switch

Shared Memory

As stated above, the shared memory contains status information regarding the operation of a StorEdge 9990 system. This shared memory is now separately located from the data cache memory, unlike theSE9970 and SE9980. Again, there are two control memory cards (for redundancy) and each card can contain 3GBs of ECC memory. Thus, in a minimum system configuration there is 6GBs of ECC control memory and on a fully populated system there is 12GBs of ECC control memory.

Front-End Directors

The Sun StorEdge 9990 system support from one to six front-end director configurable features. These front-end directors consist of a pair of channel host adapters (CHAs), as they were previously known. Each front-end director adapter pair occupies two slots in the StorEdge 9990 control/array frame. There are four slots reserved on a StorEdge 9990 control/array frame for front-end directors only.

There are five types of front-end directors for the StorEdge 9990 for customizing the system to support customer environments:

- Fibre Channel Feature
- FICON Feature
- ESCON Feature
- NAS Blade Feature
- iSCSI Blade Feature Current plan is to release August 1.. Please stay tuned. If/when it does come out, it will be constructed just like any other Front End Directors. This means an iSCSI

feature will consist of two printed circuit boards in two separate slots in two different hardware clusters. Some have speculated that the iSCSI feature would be a single printed circuit board in order to save costs. This is not true.

StorEdge 9990 Fibre Channel Feature

The StorEdge 9990 Fibre Channel Feature consists of a channel host adapter pair and occupies two slots in a StorEdge 9990 control/array frame. This adapter is offered in two configurations – 16 Fibre Channel ports or 32 Fibre Channel ports. Both configurations utilize Gigabit Interface Converters (GBICs) to connect to Fibre Channel cabling. Both configurations are half populated with 2Gbps GBICs and GBICs must be ordered in multiples of 4 port increments. Both configurations support short-wave GBICs and long-wave GBICs can be intermixed.

StorEdge 9990 FICON Feature

The StorEdge 9990 FICON Feature consists of a channel host adapter pair and occupies two slots in a StorEdge 9990 control/array frame. This adapter provides 8 FICON ports operating at full duplex data rates of 200MBps or 400MBps (1Gbps or 2Gpbs) for connection to IBM zSeries mainframe environments. The FICON adapter supports both short-wave and long-wave, however they cannot be intermixed.

The FICON front-end director feature will be enhanced to support up to 16 FICON ports operating at 4Gbps. This is a post GA deliverable.

StorEdge 9990 ESCON Feature

The StorEdge 9990 ESCON Feature consists of a channel host adapter pair and occupies two slots in a StorEdge 9990 control/array frame. This adapter provides 16 ESCON ports operating at full duplex data rates of 400Mbps for connection to IBM zSeries mainframe environments.

StorEdge 9990 NAS Blade Feature

The StorEdge 9990 NAS Blade Feature consists of an adapter pair and occupies two slots in a StorEdge 9990 control/array frame. There are a total of eight 1Gbps Ethernet ports per NAS blade supporting CIFS and NFS NAS protocols. A maximum of 32 Ethernet ports are supported on a single StorEdge 9990 system.

Back-End Directors

The Sun StorEdge 9990 system supports from one to four back-end directors. Each back-end director consist of a pair of array control processors (ACPs), as they were previously known.   Each back-end director adapter pair occupies two slots in the StorEdge 9990 control/array frame. Each back-end director supports sixteen 2Gbps Fibre Channel Arbitrated Loop (FC-AL) connections to the disk drives contained with a StorEdge 9990 system. On the initial back-end director there are four microprocessors controlling the I/O operations on four FC-AL connections.

Disk Drives

All disk drives contained in a StorEdge 9990 system are dual-ported bi-directional 2Gbps FC-AL drives and are configured as active-active. Four disk drives are available:

- 73GB / 15Krpm disk drive
- 146GB / 10Krpm disk drives

- 146GB / 15Krpm disk drives
- 300GB / 10Krpm disk drives

Specific disk drive specifications are:

Disk Specifications	72GB Disk Drive	146GB Disk Drive	146GB Disk Drive
Manufacturer	Seagate	Seagate (1) / Hitachi (2)	Seagate
Formatted Capacity	71.50GB	143.76GB	143.76GB
Disk Diameter	2.5 inches	3.0 inches	3.0 inches
Number of Heads	8	8 (1), 10 (2)	8
Number of Disks	4	4 (1), 5 (2)	4
Revolution Speed (RPM)	14904	10025	15000
Seek Time (ms) / Read/Write (ms)	0.4 / 0.6	0.5 / 0.7	.4/.6
Average Read/Write Time (ms)	3.8 / 4.2	4.9 / 5.4	3.8/4.1
Maximum Read/Write Time (ms)	6.7 / 7.1	10.0 / 11.0	6.7/7.1
Average Latency (ms)	2.01	2.99	2.01
Interface Type	Dual Active FC	Dual Active FC	Dual Active FC

Disk Specifications	72GB Disk Drive	300 GB Disk Drive
Manufacturer	Hitachi	Seagate
Formatted Capacity	72.91	288.20GB
Disk Diameter	2.5 inches	3
Number of Heads	3	8 *6/10*7

Disk Specifications	72GB Disk Drive	300 GB Disk Drive
Number of Disks	2	4 *6/5*7
Revolution Speed (RPM)	10000	10000
Seek Time (ms) / Read/Write (ms)	0.4 / 0.45	0.65 / 0.85
Average Read/Write Time (ms)	4.7/5.1	4.9 / 5.5
Maximum Read/Write Time (ms)	10/11/00	10.0 / 11.0
Average Latency (ms)	2.99	2.99
Interface Type	Dual Active FC	Dual Active FC

All disk drives are over-engineered for extended life and the drive's firmware can be updated non-disruptively. A dual vendor supply policy is applied wherever possible.

With a maximum of 1,152 drives total, the total internal system raw capacity of a single StorEdge 9990 system is 336TBs.

RAID Support

The StorEdge 9990 system supports RAID 5, RAID 1+ and RAID 6 sets. In RAID 5 sets both 4-drive stripe depth (3 data drives+ 1 parity drive) and 8-drive stripe depth (7 data drives + 1 parity drive) is supported. Similarly, in RAID 1 sets both 4-drive stripe depth (2 data drives + 2 mirror drives) and 8-drive stripe depth (4 data drives + 4 mirror drives) is supported.

RAID 6 is similar to RAID 5 as blocks of data and parity information is striped across an array of drives, except that in RAID 6 implementation there are two sets of parity information striped across an array of drives. This duplication is solely to improve fault tolerance – RAID 6 can handle the failure of any two drives in the array while other single parity RAID levels can handle at most one fault. Performance-wise, RAID 6 is generally slightly worse than RAID 5 in terms of write operations due to the added overhead of more parity calculations, but may be slightly faster in random read operations due to the spreading of data over one more disk. The StorEdge 9900 will support RAID 6 sets as 8-drive stripe depth (6 data drives + 2 parity drives).

When 300 GB disk drives were released, RAID 6 was initally required with 300 GB disk drives due to the larger data set and rebuild times assocaited with 300 GB disk drives.This restriction has been released and RAID 5 (3D + 1P) and RAID 5 (7D +1P) is now allowed, mainly to accommodate those cusstomers who place a higher value on performance over availability. The key take away however, is that the customer should be made aware of the trade offs.

To provide total protection for customer critical data there are a maximum of 40 non-floating dynamic global spares. All disk drives can be replaced without disruption to the operation of the system.

Service Processor

New in the StorEdge 9990 system is a base service processor (SVP) integrated with the control/array frame cabinet, instead of a laptop PC as on the StorEdge 9970 and StorEdge 9980 systems. This ensures a consistent platform for all systems and simplifies the support process. A secondary service processor may be ordered as a feature to ensure continual monitoring in the event the base service processor fails.

Introduced with the Sun StorEdge 9990 system is the ability to monitor new StorEdge 9990 performance data through the SVP. The statistics about the performance of a StorEdge 9990 include:

- Cache Usage Information
  - Cache use Rate (%)
  - Cache Write Pending Rate (%)
  - Case Read Rate (%)
  - Cache Side File Rate (%)
  - Cache Side Asynchronous File Rate (%)
  - Cache Side Universal Replicator Rate (%)
- Processor Usage Information
  - Processor Work Rate (%)
- Logical Device Usage Information
  - Transaction Rate (IOPS)

- Transfer Rate (GB/s or MB/s)
- FICON Usage Information
  - Read Data Transfer Rate (MB/s)
  - Write Data Transfer Rate (MB/s)
  - HTP Processing Rate (%)
- Fibre Channel Usage Information
  - Loss of Signal Count
  - Bad Received Character Count
  - Loss of Synchronization Count
  - Link Failure Count
  - Received EOFs Count
  - Discarded Frame Count
  - Bad CRC Count
  - Protocol Error Count
  - Expired Frame count

Additionally, each service processor contains an industry standard 18-pin monitor connector, USB mouse port, and keyboard port. These interfaces provide connections to an external monitor, mouse, and keyboard, respectively. Use of external monitor, mouse, and keyboard is a secondary is not recommended except in a recovery situation. To install, the monitor, mouse, and keyboard a re-boot of the SVP is required, and this operations is not recommend. A separate PC type of device is recommended as the preferred access method. Sun Enterprise Services has the recommended specifications for the PC type of device.

Power Specifications

The StorEdge 9990 system supports both 30 amp three-phase and 50 amp single-phase power connections. 60 hertz operation is supported for US environments and 50 hertz operation is supported for international environments. All power supplies are dual power supplies and provide for hot-swap replacement for redundancy. A minimum StorEdge 9990 system requires 1.95KVA and the maximum StorEdge 9990 system requires 26.15KVA. Specific plug and receptacle configurations and part numbers are specified in the StorEdge 9990 installation guide.

Note that SUN does not offer Single Phase 30 amp power. Even thought it is listed as suported in the maintenance manuals, Sun does not sell this options. Hitachi Ltd of Japan provides this option. However, Hitachi Data Systems, the sales and marketing arm of Hitachi Ldt, has chosen not to resell this feature to SUN.

To provide complete protection to all data, the StorEdge 9990 provides for standard battery backup. With the standard battery backup an I/O operation can be continued on an instantaneous power failure for a one minute duration. In the case of a power failure whose duration is longer than one minute, it is possible to retain data in the cache by means of the memory backup. When the power stoppage of the

control/array frame occurs, the logical device (LDEV) is detached temporarily and after the power supply is recovered the LDEV status is returned to normal, automatically.

An optional battery can be installed in a StorEdge 9990 control/array frame. When a power failure lasting longer than 1 minute occurs with the optional battery installed, the data on the data cache can be destaged to disk for up to eight minutes. If destaging is not completed with eight minutes, the data in the cache is retained by means of memory backup.

When an external UPS is connected, the destaging can be done for the time specified according to the capacity of the external UPS and the data in the data cache can be retained by means of the memory backup.

Cooling

All frames on a StorEdge 9990 system come with dual cooling fans an provide for hot-swap replacement on failure for continuous operation. A minimum StorEdge 9990 system requires 6,341BTUs of heat dissipation. The maximum StorEdge 9990 system requires 114,611 BTUs of heat dissipation.

In the SE 9990, cooling fans blow air from the bottom to the top.

In contrast, in the SE 9985, cooling fans blow air from front to rear.

Software Solutions

Complimenting the Sun StorEdge 9990 system is a set of specific software offerings providing storage resource management, performance tuning, and business continuity solutions. At the heart of Sun StorEdge 9900 Software Solutions are the Sun StorEdge 9900 Resource Management Suite, Sun StorEdge 9900 Performance Enhancement Suite, and Sun StorEdge 9990 Business Continuity Suite.

StorEdge 9900 Resource Management Suite

The Sun StorEdge software and hardware solutions are managed through the powerful StorEdge 9900 HiCommand Resource Manager Utilityt Suite. This management tool substantially lowers total cost of ownership by enabling storage hyper-consolidation and the intelligent remote management of critical information. The business value of centralized, global storage management is to increase business agility through heightened operational excellence and greatly reduced total cost of ownership.

There has been some confusion regarding Resource Manager, Device Manager, and Mainframes.

1. Resource Manager
   A) Is it optional or required with the SE 9900 ?
   B) Answer: Required

2. Device Manager
   A) Confusion with the Hitachi Data Systems bundle consisting of Resource Manager and Device Manager
   B) Sun does not sell this

3. Resource Manager and Mainframes
   A) Is it optional or required with the SE 9900?
   B) Answer: Required

See detailed discussion at the end of this section.

StorEdge 9900 Resource Manager

The StorEdge 9900 Resource Manager software delivers simplified storage management capabilities-right to your fingertips. With Resource Manger, customers control the Sun StorEdge 9900 series system's configuration and adjust performance to best suit your applications.

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Resource Manager Utility Suite v1.0 provides a number of functions for
the management of the SE9990 and SE9985 to help improve and simplify
storage management processes. Resource Manager is a comprehensive
offering and includes the following components: Virtual LVI, LUN
Expansion, LUN Management, Cache Residency, Cache Residency z/OS,
Performance Monitor, Volume Security, Data Retention, Data Retention
z/OS, Volume Port Security, Volume Shredder, Serverless Backup,
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Storage Navigator, SNMP API, JAVA API, Database Validator, CA
Integration, NDMP modules, DB Discovery, VSS HW Provider.

As part of the SE9900 software simplification initiative, the
following features have been consolidated into the Resource Manager
Utility Suite. These additions were either stand-alone products, or
previously incorporated as part of other products.

* Performance Monitor replaces Graph-Track and offers an efficient,
  reliable and centralized way to manage performance, including
  storage system performance monitoring, robust in-system monitoring
 (adds array group utilization; cache monitoring).

* Data Retention Utility for Open and for z/OS provides virtual WORM
  (Write Once Read Many).

* Volume Shadow Copy Service (VSS) hardware provider supports direct
  storage system-based point-in-time copies for Microsoft VSS enabled
  applications using ShadowImage or TrueCopy software.

* NDMP agents - agents add support to HDS arrays for the open standard
  Network Data Management Protocol (NDMP) for enterprise-wide backup
  of heterogeneous network-attached storage.

* Serverless Backup Enabler (formerly eCopy) manages the actual backup
  data movement directly from disk to tape without impacting server or
  LAN resources. Works in conjunction with host-based backup
  software, such as VERITAS NetBackup

* Volume Shredder enables the volume shredding engine in the Universal
  Storage Platform and Network Storage Controller microcode for use by
  other products such as Hitachi HiCommand? Tiered Storage Manager.

* Database Validator integrates with Oracle H.A.R.D. technology to
  ensure that corrupt data is never written to disk.

* DB Discovery is a software library plugged into Oracle File Mapping,
  Oracle's file topology extraction functionality, to enable database
  administrators to visually identify and extract information about
  Oracle data file locations within Hitachi storage systems.

* Volume Security Port Option assigns logical volume(s) to specific
  storage system ports. It protects a logical volume(s) assigned to
  one mainframe or LPAR port from being accessed by another mainframe
  or LPAR. Also available for open systems.

Detailed discussion of Resource Manager in context of mandatory/optional, HDS bundle, and
mainframes.

II. Resource Manager
    A) Is it optional or required with the SE 9900

Resource Manager is still required when attached SE 9990 or SE 9985 are attached to a mainframe. Here is what is confusing. Under Resource manager there are about 10 other software elements which are not overtly stated. These comprise an element manager, which is essential to the operation of the SE 9990.

I understand the logic that you just went through, because if you look at the high level user guide, it lists a number of features which are not needed, since the Mainframe software will handle these operations.

However, you still need the underlying element manage in Resource Manager in order for the SE 9985 or SE 9990 to operate.

There is a technical reason why mainframe customers need Resource Manager. What these HDS colleague have not told you is as soon as the customer requests ShadowImage, HUR, TrueCopy, they will need Resource Manager. You cannot use PPRC to setup pairs in the mainframe environment.

Beside with the new Resource Manager, we include Performance Monitor and other features to make Resource Manager more acceptable to mainframe customers.

II. Device Manager and Resource Manager Bundle
    A) Confusion with the HDS bundle consisting of RM and DM
    B) Sun does not sell this

HDS sells a bundle consisting of Resource Manager and Device Manager. Sun does not sell this bundle.

The reason why Sun does not sell this bundle is that our part number system combined with Federal Procurement regulations does to facilitate bundling several part numbers/features under a single part number. The revision rates under of the underlying features lead to an incredible amount of part number churn.

III.

3. Resource Manager and Mainframes
    A) Is it optional or required with the SE 9900

There is a technical reason why mainframe customers need Resource Manager. What your HDS colleague may not have not told you is as soon as the customer requests ShadowImage, HUR, TrueCopy, they will need Resource Manager. You cannot use PPRC to setup pairs in the mainframe environment.

StorEdge 9900 HiCommand Device Manager

The StorEdge 9900 HiCommand Device Manager software provides a single platform for centrally managing, configuring, and monitoring Sun StorEdge 9900 series and any storage product that complies with the Storage Management Initiative Specification (SMI-S) standard set by the Storage Networking Industry Association. By significantly boosting the volume of storage that each administrator can manage, the single point-of-control design of Device Manager software can help raise storage management efficiency in these environments as well as reduce costs.

Easy-to-use Device Manager software views storage resources logically, while maintaining independent physical-management capabilities. By offering a continuously available view of actual storage usage and configuration, Device Manager software allows administrators to precisely control all managed storage systems. The result? Highly efficient use of administrative time and storage assets. When combined with StorEdge 9900 HiCommand Tuning Manager and StorEdge 9900 HiCommand Storage Services Manager modules, Device Manager software helps automate entire storage environments.

For a very limited period of time, HDS released a feature referred to as "Hi Command Device Manager Lite". It was quickly withdrawn. It is not price listed or sold by HDS or Sun.

StorEdge 9900 HiCommand Tuning Manager

The StorEdge 9900 HiCommand Tuning Manager software enables tuning of large storage infrastructures and helps manage storage growth. Beyond monitoring and reporting on capacity and performance, it employs predictive trending to forecast future storage requirements to help you satisfy service-level agreements. Besides deep integration with Sun storage systems, it accesses basic application-based utilization information from heterogeneous storage systems to:

- Predict and respond to capacity crises
- Consolidate existing storage resources and plan for new ones
- Identify performance bottlenecks.

Key difference between Tuning Manager and Performance Manager:

- Tuning Manager has a database which can store historical performance data
- Performance Manager does not use a database.

StorEdge 9900 HiCommand Data Link Manager

The capabilities of the StorEdge StorEdge 9900 Dynamic Link Manager™ software)—including path fail-over and fail-back and automatic load balancing—can provide higher availability and accessibility to data than other solutions. If one path fails, the Dynamic Link Manager path fail-over feature

automatically switches the I/O to an alternate path, helping to ensure that an active route to your data is always available. Data Link Manager software also helps maintain outstanding system performance by balancing workloads across available paths. By removing the threat of I/O bottlenecks and protecting key data paths, Data Link Manager software can boost not only performance and reliability, but information-retrieval rates as well.

StorEdge 9900 Hi Command Storage Services Manager (HSSM)

The field is advised to sell StorageTek Operations Manager rather than Hi Command Storage Services Manager. Be advised that HSSM is on B-hold and will released to field for us in very specific situations.

The StorEdge 9900 HiCommand Storage Services Manager is the main console for Sun's heterogeneous storage infrastructure management software. Storage Services Manager provides:

- auto-discovery of hosts, HBAs, SAN switches, and disk subsystems
- graphical topology mapping
- dependency and path management
- capacity and performance reports
- event management
- trending information
- policy-based automation
- role-based security.

Built-in Advisors and Automators simplify complex tasks such as

- replacing HBAs
- upgrading firmware
- understanding what users and data are impacted by planned or unplanned downtime
- identifying new capacity that can be utilized by individual application.

The StorEdge 9900 HiCommand Storage Services Manager will be available post GA.

StorEdge 9990 Universal Volume Manager

The StorEdge 9990 Universal Volume Manager provides the virtualization of a multi-tiered storage area network, comprising heterogeneous storage systems. This is the software which implements "external storage".

For supported External Storage, please see the FAR or Feature Availabilty report. Here is where you can find it:Support Matrixs can be found here; they all lead to the

   same token #: 344150

1. https://onestop.sfbay.sun.com/9990/index.shtml?a2z
2. http://sejsc.ebay/

3. both of these URLs point to SunWin Token 385413

Go to the UVM tab of the document. It will list the Sun, EMC, IBM, and HP storage that can be virtualized behind the SE 9985 and SE 9990. It is imporant that only qualified storage be selected from this list. If unsupported storage is selected, then your customer will not receive support from Sun Service and you will have difficulty installing external storage and there will be no backline support for you.

Universal Volume Manager enables the operation of multiple storage systems connected to the 9990 system as if they were all in one system and provides common management tools and software. The shared storage pool, composed of external storage volumes, can be used with storage system-based software for data migration and replication, as well as any host-based application. Combined with the StorEdge 9900 Volume Migrator (formerly CruiseControl), Universal Volume Manager provides an automated data lifecycle management solution across multiple tiers of storage.

StorEdge 9900 SANtinel

Sun StorEdge 9900 SANtinel software delivers simplified and centralised volume access control within a Sun StorEdge 9900 series SAN environment by establishing access control around allocated information for complete data protection. From a central management console, administrators can intuitively designate particular logical units (LUNs) to communicate with specified servers through industry-standard Fibre Channel naming conventions. This prevents unauthorised users from viewing the secured LUN and restricts access to its information.

StorEdge 9900 Graph-Track

Graphtrack is no longer available for the SE 9985 and SE 9990. Use Performance Monitor or Tuning Manager instead. Graph-Track is still available for SE 9910, SE 9960, SE 9970, SE 9980.

Sun StorEdge 9900 Graph-Track software tool monitors hardware activities and provides complete storage system information through a graphical user interface (GUI). Graph-Track displays real-time or historical information that identifies spikes in system utilization and processing trends. It then pinpoints specific high-load activities that pose a threat to system operations and allows you to fine-tune your configuration for premier performance.

StorEdge 9990 Virtual Partition Manager

The StorEdge 9990 Virtual Partition Manager enables the logical partitioning of ports, cache, and disk capacity (parity groups) on Sun StorEdge 9990 systems to create independently managed Virtual Private Storage Machines. These logical partitions allocate separate, independently managed, dedicated storage resources for specific users (servers, applications, etc.), and available only to those users.

Storage resources can be allocated based on business requirements and priorities and be re-assigned as needed. To the host, the partition appears as if it is its own storage system and can be managed as such. Administrators will have access to configure and manage resources within their assigned partitions. Overall system priorities, disk space and tiers of storage can be managed and used most efficiently based on business applications and requirements by allocating and adjusting resources to each partition.

Virtual Partition Manager is scheduled for release post GA.

StorEdge 9990 Remote Console – Storage Navigator

The Remote Console for StorEdge 9900 Series systems – Storage Navigator is provided as a Java applet program, which can execute on any machine that supports a Java Virtual Machine (JVM). The Remote Console – Storage Navigator PC hosts the Storage Navigator Java applet program and is attached to the StorEdge 9900 Series system(s) via a TCP/IP LAN. When a Storage Navigator accesses and logs into the desired service processors (SVPs), the Remote Console applet is downloaded from the SVP to the Remote Console and runs on the Web browser of the Remote Console PC. In this way, the Remote Console communicates with the attached StorEdge 9900 Series systems via a TCP/IP network.

StorEdge 9900 Performance Enhancement Suite

The StorEdge Performance Enhancement Suite increases performance service levels for business-critical on-line transaction processing and decision support system applications, thereby enabling more rapid deployment of new applications by managing data more intelligently.

StorEdge 9900 Cache Residency

The StorEdge 9900 Cache Residency software (previously known as StorEdge 9900 FlashAccess) helps achieve consistent performance levels of application-critical files by dynamically "locking and unlocking" information into cache in real time. Cache Residency ensures that all read and write functions occur at cache speeds with no disk access delays, customers control and configure the allocations as required. For example, a specific portion of cache can be allocated to designated volumes. Adding, deleting, or changing allocations can be managed at any time-quickly and easily.

StorEdge 9900 Performance Monitor

The StorEdge 9900 Performance Monitor software is a powerful utility that provides a variety of performance measurements for system administrators to optimize performance of their Sun StorEdge 9900 Series systems. Sun StorEdge 9900 Performance Monitor software is required with the purchase of either Sun StorEdge 9900 Volume Migrator software or Sun StorEdge 9900 Server Priority Manager software.

The StorEdge Performance Monitor software monitors systems and allows users to obtain statistics about workloads on the disks and ports. If the system encounters a problem (for example, server hosts suffer delayed response time), the software may help detect the cause of the problem.

StorEdge 9900 Server Priority Manager

The StorEdge 9900 Server Priority Manager (formerly known as Priority Access) software allows users of open systems to designate prioritized ports (for example, for production servers) and non-prioritized ports (for example, for development servers), and set thresholds and upper limits for the I/O activity of these ports. Users can tune the performance of the development server without affecting the production server's performance. With Sun StorEdge 9900 Server Priority Manager software, users can define and optimize data access performance, helping to ensure that production servers have prioritized access to data over development servers.

StorEdge 9900 Volume Migrator

The StorEdge 9900 Volume Migrator software helps simplify the way users manage performance levels in the Sun StorEdge 9900 series. Sun StorEdge 9900 Volume Migrator software automatically monitors, analyzes, tunes, and balances high volumes of information, then forecasts performance levels to system administrators. Performance level thresholds can be set and approved in either manual or automatic mode. Users can define and control the guidelines; StorEdge 9900 Volume Migrator software does the work. This eliminates the requirement of physically managing performance levels, and liberates staff to work on other more productive, revenue-generating projects within the organization.

StorEdge 9900 Traffic Manager Software (SSTM)

The StorEdge Traffic Manager software provides server-based dynamic path SAN-wide I/O fail-over, fail-back, and load balancing. The software, which can help improve the performance and availability of business and mission-critical SAN-enabled applications, supports multiple I/O paths concurrently to help eliminate single points of failure within the SAN, thereby maintaining continuous access to both data and Fibre Channel storage devices. Sun StorEdge Traffic Manager software helps ease administrative overhead, allowing bandwidth on demand and new LUN creation without rebooting to be easily managed across multiple disparate host servers.

StorEdge 9900 Business Continuity Suite

Sun Microsystems has an industry-unique commitment to the paradigm of continuous business. Continuous business refers to an enterprise's ability to minimize system downtime, whether it is planned or unplanned. This is distinct from business continuity, which refers to the ability to recover from unplanned downtime. Building on the Sun Microsystems reputation for bulletproof reliability, StorEdge 9900 Series storage systems offer complete redundancy and hot-replaceable components, delivering maximum uptime. To these already-robust platforms, Sun Microsystems adds business continuity solutions to ensure quick recovery from unplanned downtime resulting from acts of nature, human errors, application errors, and malicious attacks.

StorEdge 9900 Cross-System Copy

The StorEdge 9900 Cross-System Copy (formally StorEdge 9900 HiCopy) provides business continuity answers with its high-speed, bidirectional data movement capabilities between Sun StorEdge 9900 storage systems. Since Cross-System Copy software can use StorEdge 9900 ShadowImage In-System Replication in-system replication software copies as the source for the data movement process, it can ensure that these tasks are performed non-disruptively. Production applications can remain online during the entire process.

Cross-System Copy software quickly and easily replicates, distributes, and stores data between Sun StorEdge 9900 series enterprise storage systems, wherever they reside. With Cross-System Copy software, customers benefit from consolidated backup capabilities and the ability to move data between storage tiers, either within a data center or across remote locations.

StorEdge 9900 ShadowImage In-System Replication

The StorEdge 9900 ShadowImage In-System Replication along with the Sun StorEdge 9900 series, allows information to be protected and accessible 24x7. StorEdge 9900 ShadowImage In-System Replication software helps ensure continuous access to information. ShadowImage In-System Replication software replicates large volumes of information within the Sun StorEdge 9900 series without impacting service levels, timing out, or affecting performance levels. The information volumes can then be split away from the host application and used for system backups, testing, and data mining applications while your business continues to run at full capacity.

StorEdge 9900 Copy-on-Write Snapshot

The high-speed, non-disruptive, copy-on-write technology of Sun's StorEdge 9900 Copy-on-Write Snapshot software rapidly creates up to 14 point-in-time copies of any data volume within a StorEdge 9900 series systems, without impacting host service or performance levels. Since Copy-on-Write Snapshot copies only store the changed data blocks in the Copy-on-Write Snapshot storage pool, the volume of storage capacity required for each Copy-on-Write Snapshot copy is substantially smaller than the source volume. As a result, a significant savings is realized when compared with full cloning methods. The Copy-on-Write Snapshot copies are fully read/write compatible with other hosts and can be used for rapid data restores, application testing and development, data mining/data warehousing, or non-disruptive backup or maintenance procedures.

StorEdge 9900 True Copy Remote Replication Suite

The TrueCopy Remote Replication Suite can now offer heterogeneous Disaster Recovery using both TrueCopy synchronous and asynchronous remote replication software providing support for heterogeneous external (including mainframe and open systems environment) devices attached to the SE9990.

The SE9900 TrueCopy Remote Replication Suite provides a continuous, non-disruptive, host-independent remote data replication solution for disaster recovery or data migration over any distance. For distances within the same metropolitan area, TrueCopy synchronous mode provides a no data loss, rapid restart solution. TrueCopy Asynchronous mode can be deployed for wide-area disaster protection across virtually any distance. Asynchronous mode uses a unique method of sequence numbers and timestamps in each data record to insure proper sequencing and data integrity during transmission and recovery. The version for open systems uses sequence numbers ,and the version for mainframes uses timestamps. By eliminating complex and manual tape-based restore methods, TrueCopy dramatically reduces the duration of planned and unplanned outages.

The TrueCopy Remote Replication Suite is now made up of: TC Synchronous and TC Asynchronous, TC Open and TC z/OS, and CCI (Command Control Interface) .

The TrueCopy synchronous replication software offers short distance remote replication. TrueCopy asynchronous replication software enables replication with full data integrity beyond the distance limitations

of synchronous copy to ensure data at a secondary site is safely beyond a wide-area disaster's impact zone. Moving data to a secondary site for switchover of primary processing can eliminate scheduled downtime and is critical when an unexpected event compromises your primary site. Unlike traditional data recovery processes that are labor-intensive and can span several days, recovery based on TrueCopy replication software can help businesses resume operations rapidly, almost from the point where they broke off.

TrueCopy supports Geographically Dispersed Parallel Sysplex (GDPS), an IBM service offering for system failover, workload balancing, and data mirroring.

StorEdge 9990 Universal Replicator

The StorEdge 9990 Universal Replicator is intended for organizations that have enterprise-class heterogeneous data replication needs for business continuity or operational improvement requirements. All current copy products will work within a StorEdge 9900 series environment. When used in conjunction with the StorEdge 9990 system, the Universal Replicator becomes the first storage-based replication software component that provides server-free and application-transparent journal-based multi-target replication features for data from heterogeneous storage environments.   And it does this in a way that accommodates both open and mainframe systems users and maximises the performance of the replication process.

The disk journalling and pull technology are the two key factors which differentiate Universal Replicator.

Disk journaling masks outages from the customer, and allows the customer to avoid re-synchs. Here is an example. If there is an outage of a telecommunications link, transactions continue to be written to the disk journal as if there is no telecommunications outage. When the telecommunications link is restored, transactions transmission resumes as if an outage did not occur.

Pull technology means that the intermediate site or remote site polls the central site to initiate data transmission. The polling by the remote site therefore off loads housekeeping chores from the central site in terms keeping track of what data needs to be transferred. Data will be transmitted when according to the size of the available communications pipe. The communications pipe does not need to be sized for peak loads as is with TrueCopy.

Customers using Universal Replicator technology can optimise their ability to control recovery time objectives and recovery point objectives, while maximizing their investment in StorEdge 9900 True Copy Remote Replication software by leveraging their existing investment in the StorEdge 9900 Series storage systems. It provides an unmatched business continuity framework that enables local, remote, and multi-site data replication among 9990 systems including between and among hosted storage systems.

Discussion and Diagrams Illustrating Significant Features

Universal Volume Manager and External Storage
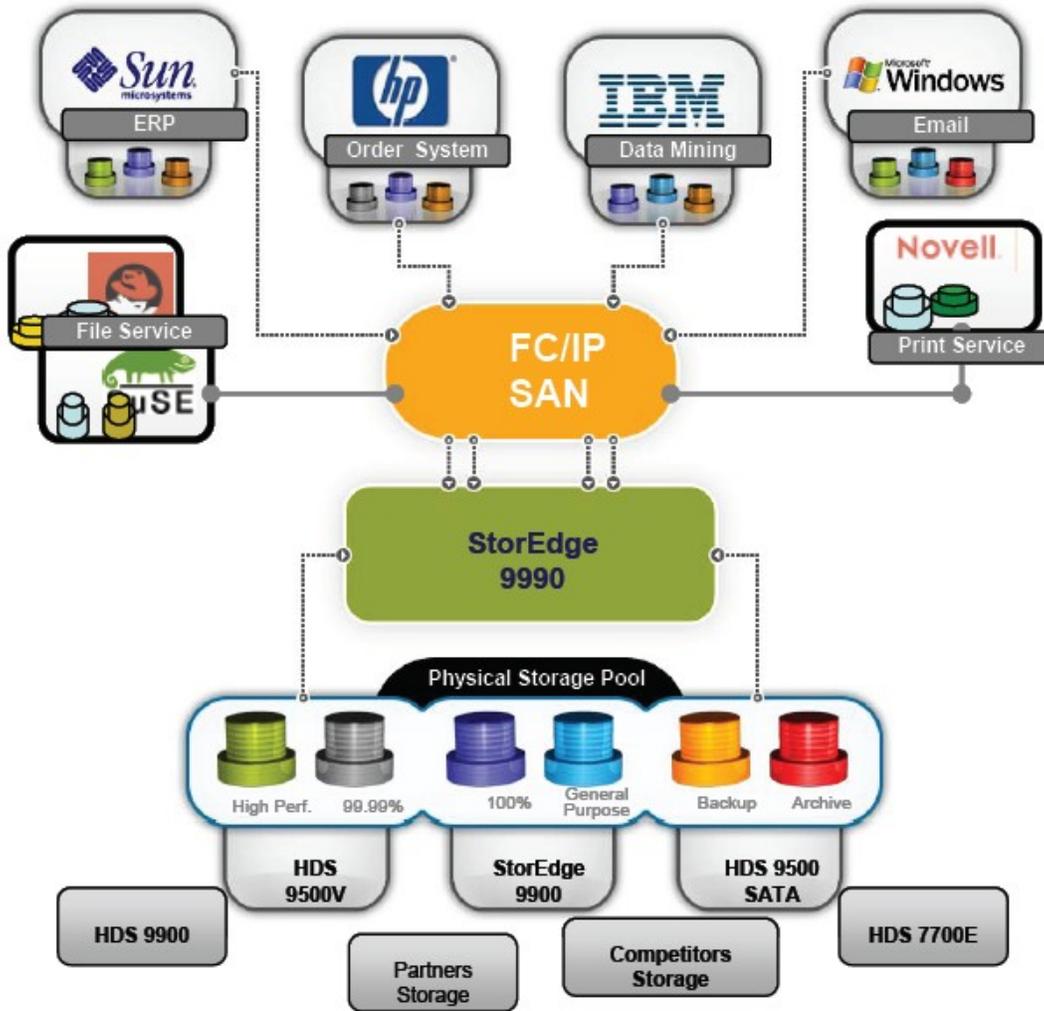
Figure 4: Sun StorEdge 9990 : Universal Volume Manager and External Storage

The method by which the StorEdge 9990 implements multi-vendor host platform storage pooling is through mapping an external LUN (ELUN) to a LUN within the StorEdge 9990 system. An external LUN (ELUN) requires no physical disk storage on the StorEdge 9990. This LUN mapping is illustrated in Figure 5.
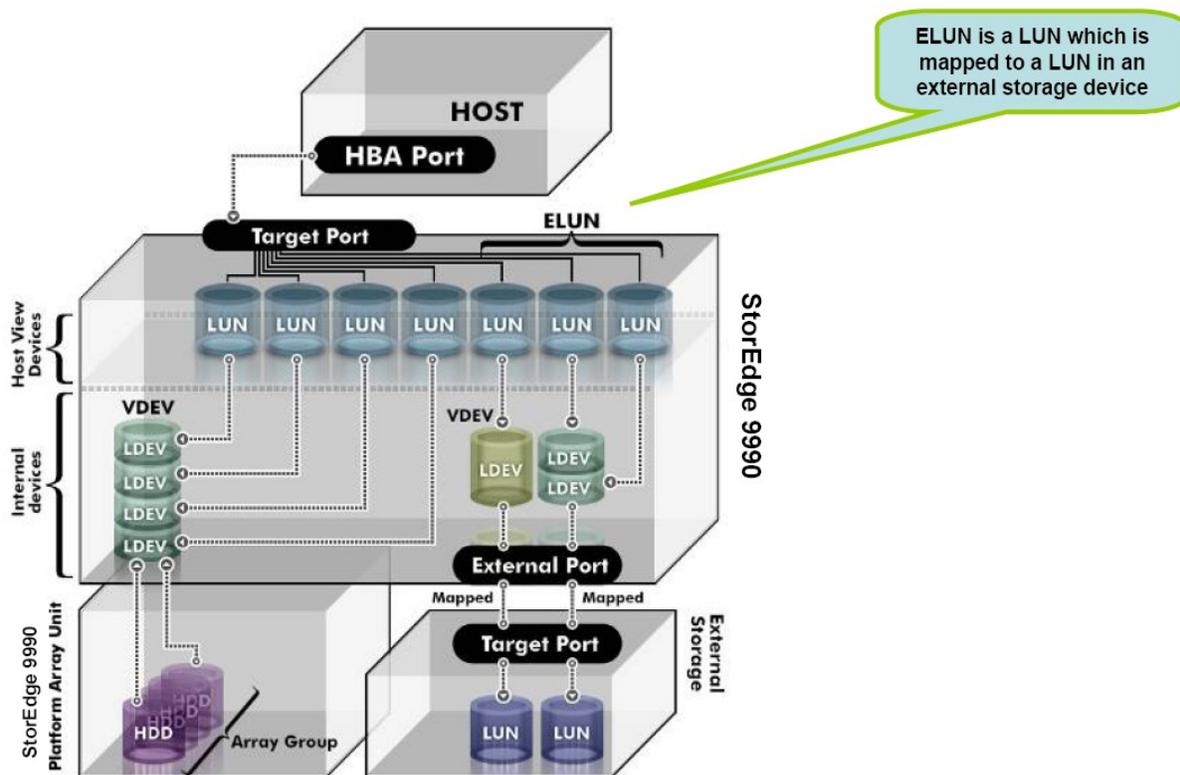
Figure 5: Virtualization and External LUN Mapping

As illustrated in Figure 6, an external heterogeneous storage system can be connected to a StorEdge 9990 system (1) through a direct connection, (2) through a switch, or, remotely, through extenders.

Currently, the following heterogeneous storage systems are supported by the StorEdge 9990 multi-vendor host platform storage pooling:

- Sun StorEdge 9900 series storage systems
- HDS Lightning 9990V series storage systems

- HDS Thunder 9500V series storage systems
- HP XP series storage system

Additional Sun and other vendor's storage systems will be added to this support matrix as they are qualified and support agreements reached.
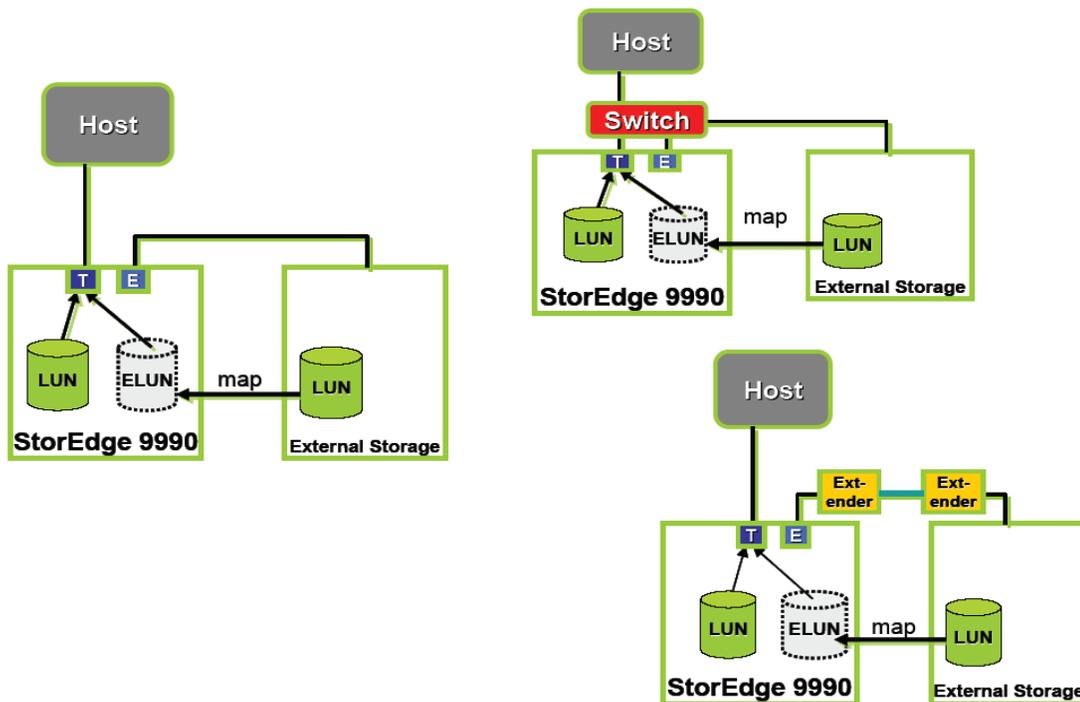
Figure 6: Multi-Vendor Storage Pooling Connection Examples

Virtual Private Storage Machines

Another unique feature of the StorEdge 9990 system is the ability to create Virtual Private Storage Machines within the system. Through the StorEdge 9990 Virtual Partition Manager, up to 32 separate Virtual Private Storage Machines can be defined, each with unique cache, channel, back-end resource aggregation specifications. This virtual partitioning feature of the StorEdge 9990 allows users to consolidate heterogeneous storage environments to provide known quality of service (QoS) metrics to applications and users.

VPSMs complement Dynamic System Domains (DSD) provided in Sun Servers. DSDs are a form of server partitioning. VPSMs also complement Solaris Containers, which are a form of software partitioning at the operating system level. Together, VPSMs, DSD, and Solaris contains provide end-to end partioning capability.

VPSMs, DSD, and Solaris container supports a customer's "Service Provider" business model initiatives.

Each Virtual Private Storage Machine within a StorEdge 9990 is dynamically allocated and statically used. This capability allows the assignment of resources between partitions if not required or used. Additionally, full separation and security is maintained between configured partitions.

The benefits of the StorEdge 9990 Virtual Private Storage Machines are:

- Better resource usage
- User and application aggregation with predictable QoS metrics
- Lower operational costs.

The virtual partitioning feature of a StorEdge 9990 is ideal for dedicating storage resources to critical applications, or in a storage provider model, allocating storage resources to specific clients with varying service level agreements. One example of the use of virtual partitioning would be the creation of separate storage partitions, each with different characteristics, supporting individual SunFire server domains. Figure 7 conceptually portrays the StorEdge 9990 virtual partitioning functionality.

Four levels of access control (from more to less) are provided for 4 different categories of system administrators.

Figure 7: StorEdge 9990 Virtual Partitioning

The concepts behind the StorEdge 9990 virtual partition is via definitions of a Storage Logical Partition (SLPR) and a Cache Logical Partition (CLPR). The Storage Logical Partition (SLPR) defines the assignment of one or more Cache Logical Partitions (CLPRs) and the assignment of one or more target physical ports for the Cache Logical Partitions (CLPRs) to use. Each Cache Logical Partition (CLPR) defines the assignment of a specific data cache allocation and the assignment of one or more parity groups assigned to that cache allocation. This mapping of resources through a Storage Logical Partition (SLPR) and a Cache Logical Partition (CLPR) is depicted in Figure 8.

The StorEdge 9900 Storage Navigator is used to maintain user access control for each Virtual Private Storage Machine. Storage Navigator provides administrator and user level authorities and maintains an access control directory to keep manage user authorities. This ensures that each defined Virtual Private Storage Machine within a StorEdge 9990 system is fully secure.
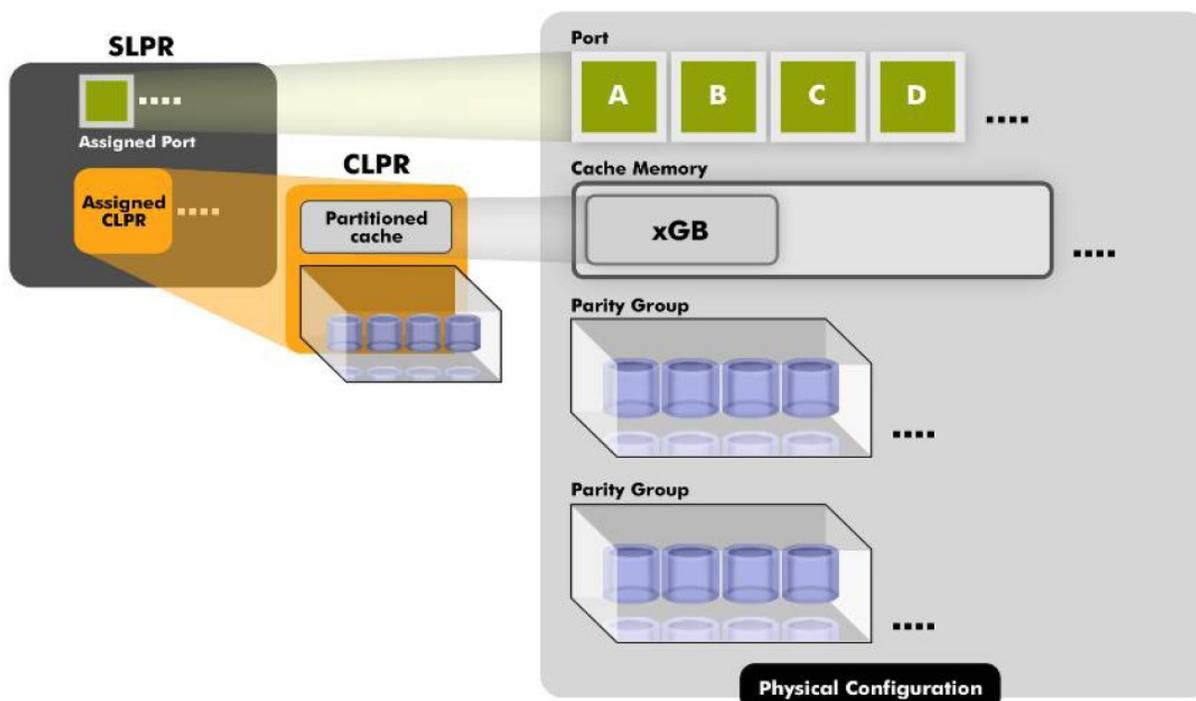
Figure 8: StorEdge 9990 Virtual Private Storage Machine Basic Concepts

Increased Fibre Channel Connectivity

With six front-end directors available for host connectivity, the StorEdge 9990 can support six Fibre Channel front-end directors, each containing up to 32 2Gbps Fibre Channel ports. The total Fibre Channel port count available is an outstanding 192 ports – three times as many as the nearest competitor's storage system. This large Fibre Channel count provides the StorEdge 9990 with ample room to scale, both in terms of host connections and heterogeneous external storage connections.

Back-End Directors

The design of the StorEdge 9990 back-end director (an Array Control Processor pair) is completely new from that of the StorEdge 9980 and 9970 systems. The result is much faster performance to disk arrays through Fibre Channel Arbitrated Loops. Further, the back-end directors now support 2Gbps Fibre Channel Loops, matching the speed of the disk drives supplied with the StorEdge 9990.

New Service Processor Implementation

The new service processor in the StorEdge 9990 is fully integrated within the system, unlike the StorEdge 9980 or 9970 systems which used standalone laptop PCs. This ensures a consistent service platform for all systems and simplifies the support process. A secondary service processor can be

optionally added to ensure continual monitoring in the event the primary service processor becomes inoperative.

Additionally, each service processor contains an industry standard 18-pin monitor connector, USB mouse port, and keyboard port. These interfaces provide connections to an external monitor, mouse, and keyboard, respectively. Use of external monitor, mouse, and keyboard is a secondary is not recommended except in a recovery situation. To install, the monitor, mouse, and keyboard a re-boot of the SVP is required, and this operations is not recommend. A separate PC type of device is recommended as the preferred access method. Sun Enterprise Services has the recommended specifications for the PC type of device.

Hardening the SVP

This section contains consolidated security information that can be used used to harden the SVP. The following information has evolved over the past 2 years.

SVP Security Discussion

Historically, it has been required that the SVP be administered on a private management network. By doing this, the SVP is protected from the public internet or open corporate networks, which have a high risk of transmitting viruses.

However, customers have raised several security issues. Many of these issues are driven by a customer's desire to do remote adminstration despite guidance the manufacturers' guidance to keep SE 9900 systems on private networks.

Therefore, Sun field teams often find them in the position of hardening the SVP in order to accommodate customer's requirements for remote administration.

Installation of Anti-virus software

The first security issue is associated with viruses infecting the SVP. This usually occurs when the SVP is placed on an open corporate network which has either a known or "unknown"connection to the internet. With respect to the term "unknown", this means that the customer may not know that a system on the a supposedly private network is actually on the public internet, and may actually be infected and spreading viruses across a supposedly secure private network. In this scenario, installation of anti-virus software is a recommended, pro-active measure which can mitigate the risk associated with this situation.

Please refer to the following Sun Service Bulletin to secure the SVP with anti-virus software.

http://sejsc.ebay/almain.html#SECURITY

Please note that the Symantec Anti-Virus Corporate Edition provided as part of the Sun IWork installation CD is licensed to Sun Microsystms employees only. This license does not allow Sun to give or resell Symantec Anti-Virus Corporate Edition software to customers.

Trade Offs Between Placement of the SVP on a Private Network in Context of Remote Administration.

It is generally recommended that the SVP be administered on a private management network. By doing this, the SVP is protected from the public internet which has a high risk of transmitting infection.

However, many customers have chosen to administer their systems remotely. If this occurs, then the security problem should be reframed as a general network security, administration, and integration issue. The issue may also be framed as a trade off between being secure on a private network versus opening up to an open corporate or even the public internet, which increases security risks.

Therefore utilizing remote administration across open corporate networks or the public internet surfaces a new set of challenges in context of general network security, administration, and integration issues instead of a narrowly focused SVP issue.

Tips for Hardening the SVP and Where To Go for More Information

Please ensure that encryption is turned on with respect to avoidance of having a password being transmitted in the clear. To address that issue, the Apache Server residing on the SVP should be installed with SSL enabled.

Please refer to the following manual for guidelines

- OpenSA Manual, see chapter 5
- http://subdude.central.sun.com/toi/hds/9990manual/21web.pdf
- Encrypted Communications User Guide MK94RD168-01
- The ISO image of "Open SA CD" and also zip file is posted at
     http://se9990/eng/ssl/
- These two files can also be found on sunsolve.sun.com under /coresdirectory.

There can be some challenges re-installing the Apache Web server with SSL enabled. Pls. contact ken.ow-wing@sun.com to direction to the appropriate resources which can assist you.

- For those customer who strongly prefer to engage in remote administration, please check with Ken.Ow-Wing@Sun.com for the latest in terms improvement to security on this system.

-

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New SVP Security Capabilites Introduced During 2005and 2006

1. Protecting unused ports on the SVP
2. AcAfee support on SE 9970/SE 9980/SE 9985/SE 9990
3. Anti-virus on the SE 9990/SE 9985, Symantec Anti Virus
4. Security Section in SE 9985 JTF

For protecting Un-Used Ports on SVP see ECN #5I0-5I5-m092r7 page 22.
This ECN has information to on how to upgrade the SVP OS
to close off vulnerable un-used ports.

McAfee is supported on the SE 9970 and SE 9980 as per ECN DKC 460I-M137
Appendix A, 8.0I , V14 Microcode 21-14-02

McAfee is supported on the SE 9985 and SE 9990 as per the following

.

Universal Replicator Software

The new StorEdge 9990 Universal Replicator represents an evolution of remote copy protection (StorEdge 9900 True Copy Remote Replication) for critical digital assets.   The process used by the Universal Replicator software in providing remote replication is achieved through data journaling. When data is written to a volume of the primary system, the Universal Replicator "captures" these write data requests in a journal file. The Universal Replicator then transmits this journal file to a remote storage system where they are applied to the corresponding remote volume.

Using these journaling techniques, the Universal Replicator improves levels of reliability and robustness in remote copying operations, thereby also achieving better data recovery capabilities.

Universal Replicator is based on polling technology. The intermediate or remote site polls the central site and keeps track of data to be transferred. There are two effects. First, housekeeping work such as tracking data to be transferred is off loaded from the central site. Also a small telecommunications pipe can be sized smaller because of the polling technolgy. This can save the customer money.

Disk journalling also masks outages from the customer, since transactions can be written to the journal while the telecomunication link is done. This also helps the customer avoid resynch operations.

  Further, the Universal Replicator provides customers with greater levels of flexibility, including support for "cascading" and "multi-target" configurations. The expanded functionality achieved by the Universal Replicator journaling technique can also be used in point-in-time data backup and data recovery scenarios.

Interoperability

Please refer to the following web page for the latest compatibility information. This information changes on a regular basis and it is strongly recommended that this web site be reviewed rather than depending on the information in this "Just the Facts" document which may rapidly become out of date.

I.Support Matrixs can be found here; they all lead to the same to the two most important support

matrixes
   1. The What Works With What (WWWW) , Token #: 344150
   2. The "Feature Availablity Report" (FAR), Token # 385413

II. These documents can also be accessed by URL also:
   1. https://onestop.sfbay.sun.com/9990/index.shtml?a2z
   2. http://sejsc.ebay/
   3. These all lead to SunWin Token 344150 (WWWW) and Token 385413 (FAR or Feature
      Availabilty Report)
   4. Look to your left column on this web page.
          3) Click on "SE9900 WWWW"
Please refer to the documents described below,.

•   What Works With What (WWWW) (Issued by Hitachi LTD and republished by Sun)

This document identifies the the supported combinations of Servers, Operating Systems, Switches, and Switch Firmware levels which are supported. Token # 344150

Mainframe WWWW can be found at token # 475425. This is new. We will provide a URL at a later date.

•   Feature Availability Report (FAR) (Issued by Hitachi LTD and republished by Sun) Token # 385413

External support is found at the UVM tab in this document. This is important.

This document focuses primarily on software support, with specific usefulness centered around TrueCopy Link Matrix, Cluster Support, and Multipathing Support.

SAN Support is usually integrated in the WWWW document (token 344150). In rare cases, when the document is being rushed to the field, it is published as a standalone. So look for it in the several files under Token 355150 (Issued by Hitachi LTD and republished by Sun) This document states exactly which StorEdge 9990 and Sun SAN products have joint Sun/Hitachi Support Statements. Joint Sun/Hitachi Support Statements are required before Sun support can be declared.

III. Here is what you do if what you need is not supported in the WWWW or FAR.

1. Send an e-mail to "hdsconfig.global@sun.com
     A) State what element you're missing
     B) State the full combination that you need qualified
     Storage + Server + OS + HBA + Switch + Switch Firmware level
     This usually take 3-10 days to process.
     C) If in plan, we will advise you. Don't worry, be happy
     D) If not in plan, and is merely one small element in the combination, then we will
     advise you to do a GTY (or Get To Yes)
     https://onestopwiki.sfbay/index.php?title=Storage_SPM:_Get_to_Yes_Program
     E) If you need something completely different (Such as an AS/400), you need to
     contact Ken Ow-Wing, Product Line Manger, SE 9900 program with a business
     case with unit and revenue forecast and strategic value of your customer. Ken will
     ask you to fill out a form called an ISR. This could take a long time

IV. Here's what not to do.

1. Please do not call Sun Service. They fix things that break. They don't do interoperability

2. Only those items specifically stated in the WWWW or FAR are supported. If it is not on the WWWW
or the FAR, it is not supported. You can also go to III above if not explicity supported.
3. If an component is claimed as supported, but it is not, please do not count on quick turn around
 to extract your team from an unhappy situation. Qualification and the proper reviews must
 flow between Hitachi Ltd Japan -->> HDS Santa Clara - Sun, and this can take a bit of time. During this
time, your customer will be unsupported, and Sun Service will not support you. Product Management
will not support you because the priorty is to manage a program and deliver items which support the
entire field, rather than helping a single account where an avoidable error was made.

Operating System Support

The following operating systems are supported on the SE 9990 and SE 9985. Please refer to the WWWW (Token #344140) and FAR (Token # 385413) for specifics. Mainframe WWWW can be found at token # 475425.

- Open Systems
    - Sun Solaris
    - HP HP-UX
    - HP Tru64
    - HP OpenVMS
    - IBM AIX
    - Microsoft Windows
    - Novell Netware
    - RedHat Linux
    - SUSE Linux
    - Red Flag Linux
    - SGI IRIX
    - VMware
- Mainframe Systems
    - z/OS
    - z/VM
    - VSE

"Price Reference Configurations"

Provided below are three sample "Price Reference Configurations" StorEdge 9990 configurations – an Entry configuration, Enhanced configuration, and a High-End Configuration. Remember that the StorEdge 9900 can be easily and non-disruptively upgraded through the addition of additional array frames, disk drives, front-end directors, back-end directors, cache switches, and cache memory. To be clear, these price reference configurations **do not** represent additional models within this product family. There are merely pricing reference points, and components can be added and removed from the "Pricing Reference Configuration" as needed.

Entry Configuration

A typical entry StorEdge 9990 configuration consists of:

- One control/array frame
- Optional additional array frame
- Up to 256 disks (up to 74TBs raw capacity with 300GB disk drives)
- Two next generation switches
- One data cache memory feature (64GBs max capacity) with 4 GB minimum
- Two control memory cards (6 GB capacity) with 2 GB minimum.
- Single back-end director
- One or two Fibre Channel, ESCON, FICON, or NAS Blade Feature

.
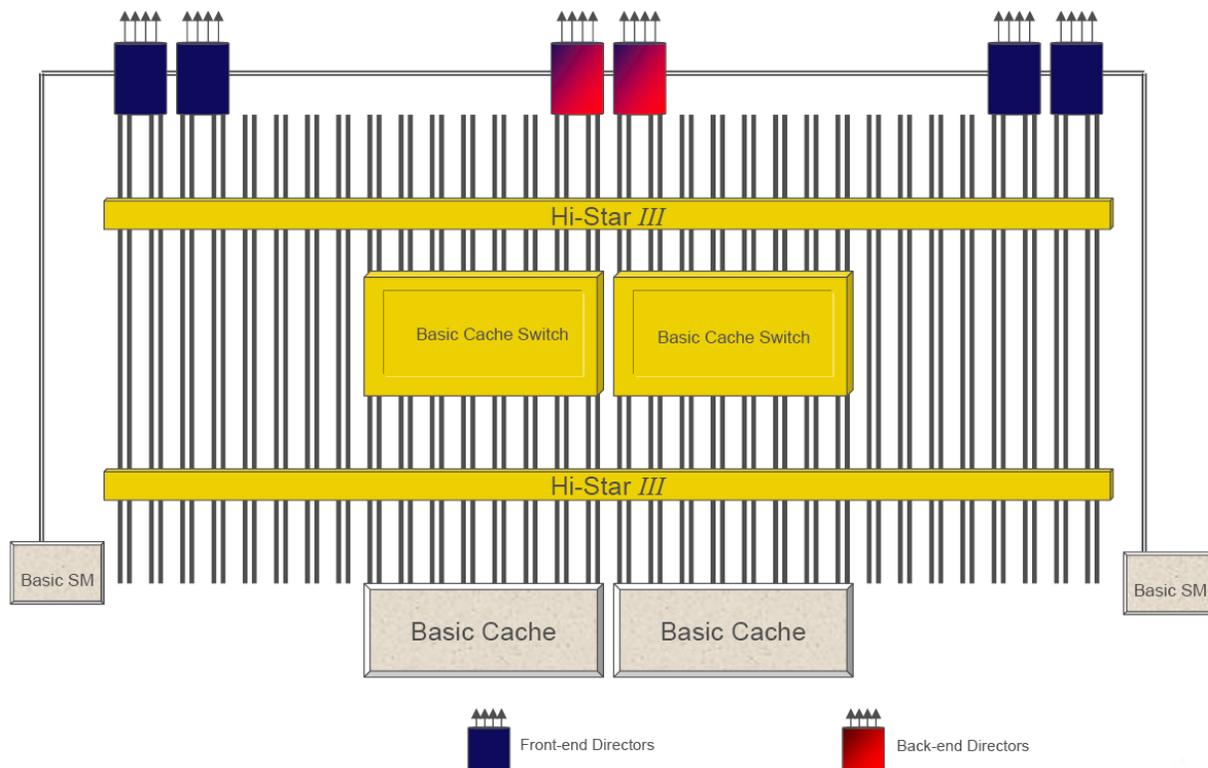
Figure 9: Sun StorEdge 9990 Entry Level Internal Schematic

This configuration is equivalent in performance to a small StorEdge 9980 system.

Model 600 Enhanced Configuration

A typical Enhanced StorEdge 9990 configuration consists of:

- One control/array frame
- One or two additional array frames
- Up to 512 disks (up to 148 TBs raw capacity with 300 GB disk drives)
- Four next generation switches
- Two data cache memory cards (maxium capcity of 128GBs) with minimum of 16 GB.
- Two control memory cards (maximum of 12 GB) minimum of 3 GB
- Two back-end directors
- One or six Fibre Channel, ESCON, FICON, or NAS Blade Features .

Figure 10: Sun StorEdge 9990 Midrange Internal Schematic
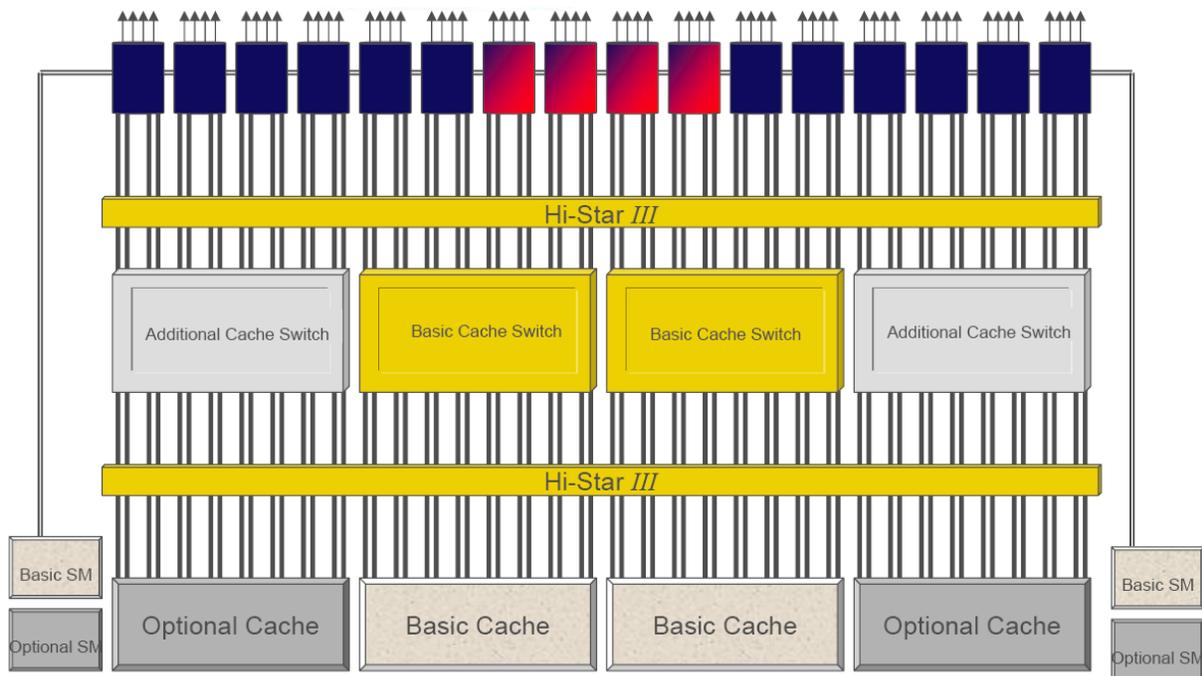
Additional cache memory and control memory are available as an optional upgrade. This configuration is approximately twice the performance to a StorEdge 9980 system.

High-End Configuration

A typical midrange StorEdge 9990 configuration consists of:

- One control/array frame
- Four additional array frames
- Up to 1152 disks (up to 336TBs raw capacity with 300GB disk drives)
- Four next generation switches
- Four data cache memory cards (maximum capacity256GBs) - minimum of 32 GB
- Four control memory cards (maximum 12GBs) with 4 GB minium capacity
- Four back-end directors
- One or six Fibre Channel, ESCON, FICON, or NAS Blade Feature

Figure 11: Sun StorEdge 9990 High-End Internal Schematic
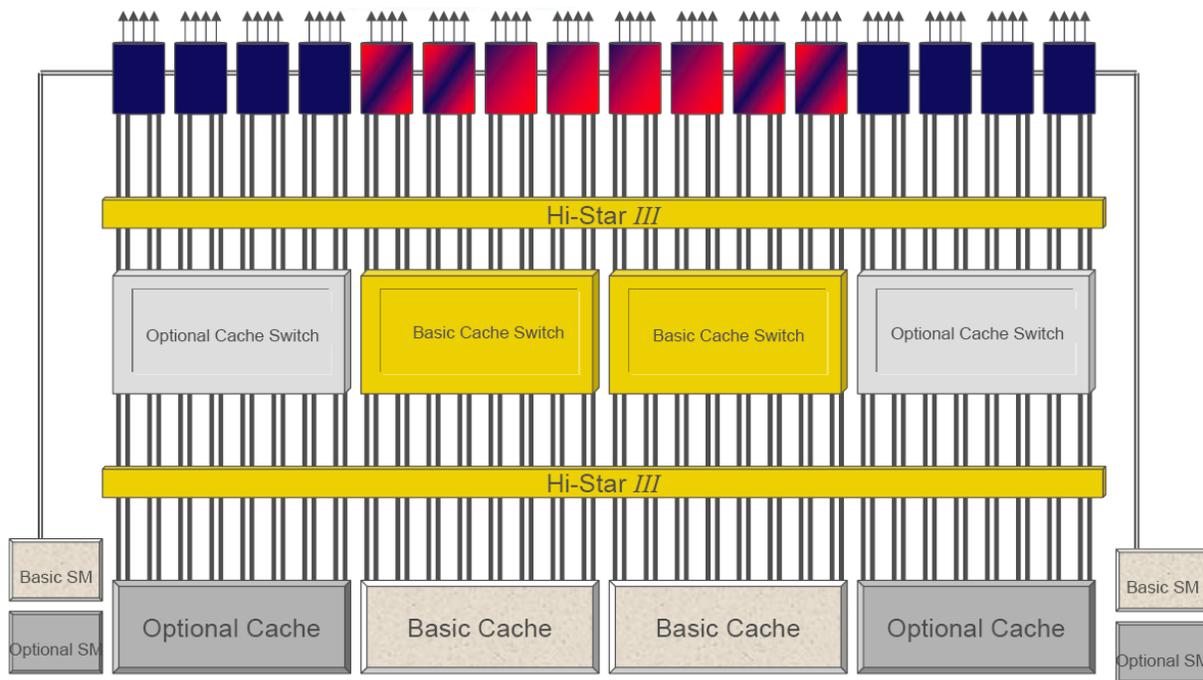
This configuration is approximately four times the performance to a StorEdge 9980 system and represents the ultimate for storage consolidation or application transactional support.

Configuration Summary

The following table summarizes these configurations.

	SE 9985	SE 9990 Model 100	SE 9990 Model 600	SE 9990 Model 1100
Array Frames/Configuration	1 or 2 Racks	0,1cabinet	1,2cabinet	1,2,3,4cabinet
Number of Disk Drives (with spares)	0–240	5-256	64-512	129-1152
Number of Spares (min/max)	1/4	1/8	1/16	1/40
		Disks		
Active-Active FC 15,000RPM	73GB and 146GB	73GB and 146GB	73GB and 146GB	73GB and 146GB
Active-Active FC 10,000RPM	146GB	146GB	146GB	146GB
Active-Active FC 10,000RPM	300GB	300GB	300GB	300GB
		Internal Raw Capacity (TB)		
Minimum (73GB disks)	0	0.286	4.741	9.152
Maximum (146GB disks)	34.5	37	74	165
Maximum (300GB disks)	69	74	148	332

Total Internal and External Capacity (PB)	16PB	32PB	32PB	32PB
Maximum Usable Capacity RAID-6 (TB) (300GB drives)				
Open Systems	48.4	61.5	123.65	247.27
z/OS-compatible	45.2	57.64	117.27	234.55
Maximum Usable Capacity RAID-5 (TB) (300GB drives)				
Open Systems	56.5	62.4	128.8	287.8
z/OS-compatible	53	58.6	117.2	270.4
Maximum Usable Capacity RAID-1+ (TB) (300GB drives)				
Open Systems	34	36.4	72.8	165.0
z/OS-compatible	29.6	31.6	63.0	143.6
Private Virtual Storage Machines	8	32	32	32
Logical Devices Supported	16,384	16,384	16,384	16,384

Component	*Description*	*SE 9985*	*SE 9990 Model 100*	*SE 9990 Model 600*	*SE 9990 Model 1100*
	Basic Platform Unit				
	Integrated Control/Array Frame	1	1	1	1
	Universal Star Network™ Crossbar Switch				
	Number of Switches	2	2	4	4
	Cached Bandwidth (GB/sec)	8.5	17	34	68
	Control Bandwidth (GB/sec)	3.6	6.5	6.5	13
	Aggregate Bandwidth (GB/sec)	12.1	23.5	40.5	81
	Cache				
	Cards	1	2	2	4
	Base Memory (GB)	4	4	16	32
	Maximum (GB)	64	64	128*	256
	Control Memory				
	Cards	2	2	2	4
	Base Memory (GB)	2	3	3	4
	Maximum (GB)	6	6	12	12
	Front-end Directors				
	Cards	1-2	1-4	1-6	1-6

Fibre Channel Ports (1, 2, or 4Gb/sec)	16-48	0-128	0-192	0-192
Virtual Ports	Up to 6,144	Up to 16,384	Up to 24,576	Up to 32,768
FICON Ports	0-16	0-64	0-96	0-96
ESCON Ports	0-16	0-64	0-96	0-96
NAS Blades/Ports**	0-1/0-8	0–4/0–32	0–4/0–32	0–4/0–32
iSCSI Blade / Ports	0-1/0-8	0–4/0–32	0–4/0–32	0–4/0–32
Back-end Directors				
Type	Std	Std	Std	Std
Numbers	1	1	2	2,4
Logical Devices Supported				
Open Systems	16,384	16,384	16,384	16,384
z/OS	65,536	65,536	65,536	65,536

*Upgradable to 256GB.
**Each NAS Blade consists of dual NAS servers.

Security

Security is addressed from two perspectives:

1. What are the security features I can combine in order to provide both perimeter defense and defense in depth.

2. How can I harden the Service Processor when a customer insists on remote adminstration?

New in this update of the SE 9990 are the following subjects:

- Protecting unused ports on the SVP
- MAcAfee support on SE 9970/SE 9980/SE 9985/SE 9990

What are the security features I can combine in order to provide both perimeter defense and defense in depth.

Monitoring and Diagnostics Software (StorEdge Hi-Track)

The main security features of this software are:

- 128-bit secure socket layer (SSL) encryption support for the user interface between the customer's management LAN and the Storage Service Processor
- Password protection in the user interface.

LUN Mapping

LUN mapping is the task of assigning a LUN number to a volume. This helps ensure that the storage administrator can tightly control access to particular volumes.

Storage Domains

This feature lets the user carve the Sun StorEdge 9990 system into several storage domains (see Figure 2 below). Storage domains can be used to create multiple logical *arrays* and to assign volumes to these arrays. The domains serve as logical *buckets*, into which new servers and storage can be easily added via the Configuration Service software of the Sun StorEdge 9990 system.

This allows:

- More efficient storage management — storage domains allow collapsing multiple departments or applications into a single storage management infrastructure.

- More efficient utilization of storage capacity — all attached servers and departments receive storage from a unified storage pool, reducing the amount of capacity overhead required and eliminating the unused storage that typically sits wasted in a distributed environment.

LUN Masking

LUN masking is the term used for assigning access permissions — read-only, read/write, or none — to a volume. LUN masking eases storage administration while allowing for a more secure environment. When a volume is masked from a host, that volume is not available to be configured from that host and thus cannot be assigned to multiple hosts accidentally.

WWNs (world-wide number) can either be assigned to a specific volume or a specific set of volumes, or multiple WWNs can be grouped and assigned to a specific volume or a specific set of volumes.

Virtual Private Storage Machines

Each Virtual Private Storage Machine defined within a StorEdge 9990 is protected through an access control directory to maintain and manage administrator and user level authorities. This ensures that each defined Virtual Private Storage Machine within a StorEdge 9990 system is fully secure from outside access.

Command Line Interface (CLI)

The CLI uses encryption and authentication.

Encryption

Only encrypted services are provided on the Sun StorEdge 9990 system — that is, the monitoring and diagnostic software as well as the management software support only through https encrypted communications.

The system does not provide data encryption. If data encryption is required, typically an out-of-band third party device is employed.

Volume Shredding

This product is designed to destroy customer data by using uniquely definable overwrite patterns for each pass. Hitachi's Volume Shredder will allow up to eight (8) overwrite pass each with its own unique overwrite data pattern. This product can be used in concert with Data Retention Utility.

Hitachi Volume shredder will overwrites all of the data on the volume with dummy with customer definable data or the default data is "00-FF-00". The default is to overwrite the volume three times which is the recommended minimum number of overwrites. The customer can define the settings, you can overwrite the data up to eight times.

The intended audience is any customer who requires that all data be erased/overwritten on each LDEV. Historically, the National Intelligence Agencies such as CIA, NSA, DIA, ect. have been the primary sources of demand for these capabilities. However, demand is extending into the commerical sector. Commercial companies are now demanding very strong errasure/overwrite capabilites to product data that has become more valuable and accessible in context of both the internet era and increase of identity theft.

Key examples data that customers must be able to erase/overrite with a high level of reliablity and effectiveness include credit card numbers and social security numbers.

The key market value propositon is prevention of important data from being acquired by unauthorized people or organizations. The array provides a reliable data erase feature, which complies with the US Department of Defense standard. The US Department of Defense standard DoD5220.22-M defines that data needs to be overwritten three or more times in all the storage locations in order to prevent HDD data from being restored.

Key benefits and features includes the following: Volume Shredder enables users to specify the LDEV to be deleted and also specify how to delete (the number of writes, contents to be deleted, necessity of verification)

Volume Shredder checks and reports whether data is written to the LDEV .

Volume Shredder software is embedded in USP Series microcode and is activated by obtaining a license key. Volume Shredder software is then enabled on the Remote Console-Storage Navigator. There is no host software required for the Volume Shredder operation. There is no additional software or requirement for the
external storage systems.

Documentation is included in both the current *Storage Navigator User's Guide and LUN Expansion (LUSE)/Virtual LVI/LUN (VLL) User's Guide.*

How can I harden the Service Processor when a customer insists on remote adminstration?

It is generally recommended that the SVP be administered on a private management network. By doing this, the SVP is protected from the public internet or open corporate networks, which have a high risk of transmitting viruses.

However, customers have raised several security issues. Most of these issue are general in nature.

Installation of Anti-virus software

The first security issue is associated with viruses infecting the SVP. This usually occurs when the SVP is placed on an open corporate network which has either a known or "unknown"connection to the internet. With respect to the term "unknown", this means that the customer may not know that a system on the a supposedly private network is actually on the public internet, and may actually be infected and spreading viruses across a supposedly secure private network. In this scenario, installation of anti-virus software is a recommended, pro-active measure which can mitigate the risk associated with this situation.

Please refer to the following Sun Service Bulletin to secure the SVP with anti-virus software.

http://sejsc.ebay/almain.html#SECURITY

Both Symantec and McAffee anti-virus are supported. For Symantec, see the URL above.
For McAffee, see URL below.

http://se9990.eng/HECN/V03/5m043r1.pdf
Go to page 13 of this ECN dated Feb 14, 2006.

McAfee is supported on the SE 9985 and SE 9990 as per the following ECN 5m043r1

McAfee is supported on the SE 9970 and SE 9980 as per the following
  A) ECN DKC 460I-M137
  B) Appendix A, 8.0I
  C) V14 Microcode 21-14-02

Trade Offs Between Placement of the SVP on a Private Network in Context of Remote Administration.

It is generally recommended that the SVP be administered on a private management network. By doing this, the SVP is protected from the public internet which has a high risk of transmitting infection.

However, many customers have chosen to administer their systems remotely. If this occurs, then the security problem should be reframed as a general network security, administration, and integration issue. The issue may also be framed as a trade off between being secure on a private network versus opening up to an open corporate or even the public internet, which increases security risks.

Therefore utilizing remote administration across open corporate networks or the public internet surfaces a new set of challenges in context of general network security, administration, and integration issues instead of a narrowly focused SVP issue.

Please ensure that encryption is turned on with respect to avoidance of having password being transmitted in the clear. To address that issue, the Apache Server residing on the SVP should be installed with SSL enabled.

Please refer to the following manual for guidelines

- OpenSA Manual, see chapter 5
- http://subdude.central.sun.com/toi/hds/9990manual/21web.pdf
- Encrypted Communications User Guide MK94RD168-01
- The ISO image of "Open SA CD" and also zip file is posted at
  http://se9990/eng/ssl/
- These two files can also be found on sunsolve.sun.com under /coresdirectory.

There can be some challenges re-installing the Apache Web server with SSL enabled. Pls. contact ken.ow-wing@sun.com to direction to the appropriate resources which can assist you.

In spring 2006, additional security features were provided to address vulnerablities associated with un-used ports on the SVP:

- Advise your team to see ECN #5I0-5I5-m092r7 page 22.
- This has information to on how to upgrade the SVP OS
  to close off vulnerable un-used ports.

-
-

Additional Monitoring Capability:

Introduced with the Sun StorEdge 9990 system is the ability to monitor new StorEdge 9990 performance data through the SVP. The same capability is provided for the SE 9985. The statistics about the performance of a StorEdge 9985 include:

- Cache Usage Information
    - Cache use Rate (%)
    - Cache Write Pending Rate (%)
    - Case Read Rate (%)
    - Cache Side File Rate (%)
    - Cache Side Asynchronous File Rate (%)
    - Cache Side Universal Replicator Rate (%)
- Processor Usage Information
    - Processor Work Rate (%)
- Logical Device Usage Information
    - Transaction Rate (IOPS)
    - Transfer Rate (GB/s or MB/s)
- FICON Usage Information (future)
    - Read Data Transfer Rate (MB/s)
    - Write Data Transfer Rate (MB/s)
    - HTP Processing Rate (%)
- Fibre Channel Usage Information
    - Loss of Signal Count
    - Bad Received Character Count
    - Loss of Synchronization Count
    - Link Failure Count
    - Received EOFs Count
    - Discarded Frame Count
    - Bad CRC Count
    - Protocol Error Count
    - Expired Frame count

Additionally, each service processor contains an industry standard 18-pin monitor connector, USB mouse port, and keyboard port. These interfaces provide connections to an external monitor, mouse, and keyboard, respectively. Use of external monitor, mouse, and keyboard is a secondary is not recommended except in a recovery situation. To install, the monitor, mouse, and keyboard a re-boot of the SVP is

required, and this operations is not recommend. A separate PC type of device is recommended as the preferred access method. Sun Enterprise Services has the recommended specifications for the PC type of device.

Reliability, Availability, and Serviceability (RAS)

Reliability

The Sun StorEdge 9990 system includes the following reliability features:

- Monitoring and diagnostic software aids early detection and notification of faults on a 24-hour basis
- Non-disruptive firmware upgrades through a combination of monitoring and diagnostic software that tracks version levels of Sun StorEdge 9990 system components
- Error checking and correction on all disk drives
- Skip sectors and spare cylinders on all disk drives
- Automatic sector reallocation on RAID controllers
- Redundant data and control caches
- ECC on all data and control caches
- ECC on all data paths
- Redundant next generation non-blocking switch
- Temperature sensors in the Sun StorEdge 9990 system located near heat spots to provide accurate temperature measurements
- Power on self test of all FRU's
- Protection on all data paths within the SVP
- DSP error logging to NVRAM
- Hardware support for parity for RISC RAM
- RAID set/disk scrubbing
- Global hot-spares
- Loop card loop back diagnostic
- Back-end director down detection
- Front-end director down detection

Availability

The Sun StorEdge 9990 system has the following availability features:

- Multi-pathing capability
- Symmetric access to volumes
- Simultaneous use of both dedicated and array hot-spare drives
- Redundant power distribution units (PDUs)
- Storage Service Processor(s)
- Optional second storage service processor
- Because of redundant architecture, replacing non hot-swap FRUs does not impact data availability
- Hot-swap components in the Sun StorEdge 9990 system include disk drives, power supplies, cooling fans, integrated UPS batteries, interconnect cards, loops, loop switching cards, administration channels, and controllers
- Dual hot-swappable redundant load-sharing/load-balancing auto-sensing power supplies (with individual power cord) in the Sun StorEdge 9990 system
- Integrated hot-swappable redundant UPS batteries in the Sun StorEdge 9990 array for cache backup
- Four redundant electrically independent cooling fans (with temperature sensors) in the Sun StorEdge 9990 system
- Hot-swappable redundant unit interconnect cards (UIC) in the Sun StorEdge 9990 array
- Hot-swappable redundant dual-ported FC-AL drives and dual backend drive loops per controller in the Sun StorEdge 9990 system
- Hot-swappable redundant back-end directors for automatic fail-over and cache mirroring in the Sun StorEdge 9990 system
- Redundant processors, data cache, and control memory accessible via next generation switch
- Redundant data interfaces on the Sun StorEdge 9990 system
- Temperature sensors in the Sun StorEdge 9990 system for continuous threshold-based temperature monitoring
- Automatic hardware-based bypass of a faulty drive in case a faulty drive causes loop disruptions
- Redundant, hot-swappable dual power supplies, fans, MIC's, and switch fabrics

Serviceability

The Sun StorEdge 9990 system has the following serviceability features:

- Phone home capability
- Enclosure chassis LED (locator/fault LED)
- Sun-standard FRU ID support
- Wiring harness allows cables to be individually replaced in the event of a failure
- Service access panel provides connection to the Storage Service Processor in order to perform routine maintenance or reconfigure the storage system
- Every Storage Service Processor is configured with the same hardware and software components to facilitate ease of replacement
- All FRUs of the Sun StorEdge 9990 system can be hot-swapped for non-disruptive service
- All firmware of the Sun StorEdge 9990 system can be replaced without disrupting operation
- Complete system interrogation through the service processor
- Upgradeable drive firmware (with only the associated volume off-line during the upgrade)
- Detection and reporting for incorrect drive position in the Sun StorEdge 9990 array
- Automatic drive-ID selection on the Sun StorEdge 9990 array
- Quick snap locking mechanisms on the Sun StorEdge 9990 array for easy insertion and extraction of disks and other FRUs
- Blind-mate connectors on the Sun StorEdge 9990 array to avoid bent pins on FRU insertion
- External and internal loopback test of Sun StorEdge 9990 back-end directors
- External and internal loopback test of Sun StorEdge 9990 front-end directors

System Administration

The following are the five key system adminstration User Guides:

*   StorEdge 9990 LUN Manager User's Guide (MK-94RD203)
*   StorEdge 9990 LUN Expansion (LUSE)/Virtual LVI/LUN (VLL) User's Guide (MK-94RD205)
*   StorEdge 9990 ShadowImage User Guide (MK-94RD204)
*   StorEdge 9990 Storage Navigator User's Guide (MK-94RD206)

Excerpts from these User Guides below at the end of this section:

Here is a broader list of End User Guides:

StorEdge 9990 TrueCopy – z/OS® User and Reference Guide	MK-94RD214-P
StorEdge 9990 TrueCopy™ User and Reference Guide (Synchronous and Asynchronous for UNIX®/PC Servers)	MK-94RD215-P
StoragEdge 9990 Command Control Interface (CCI) Users Guide (Factory Source: RAID300/400/450/500 RAID Manager Basic Specifications (CCI))	MK-90RD011-14
StorEdge 9990 Database Validator User's Guide	MK-94RD207-P
StorEdge 9990 Compatible PAV for z/OS® User's Guide (HPAV)	MK-94RD211-00
StoragEdge 9990 9900/ 7700E Cache Manager User's Guide (Factory Source: RAID300 / 400 / 450/ 500 Cache Manager Users Guide)	MK-91RD045-04P
StorEdge 9990 Cache Residency Manager User's Guide (was FlashAccess)	MK-94RD208
StorEdge 9990 LUN Expansion and Virtual LVI/LUN User's Guide (LUSE)	MK-94RD205-P
StorEdge 9990 LUN Manager User's Guide	MK-94RD203-P
StorEdge 9990 Storage Navigator™ User's Guide (Incls. CFL @ HUR)	MK-94RD206-P
StorEdge 9990 Serverless Backup Enabler User's Guide (was e-copy)	MK-94RD217
StorEdge 9990 Performance Manager User's Guide (Performance Monitor, Volume Migration, and Server Priority Manager)	MK-94RD218
StorEdge 9990 Storage Navigator Error Codes	MK-94RD202-P

StorEdge 9990 Multiplatform Backup User's Guide (HMBR)	MK-94RD209-0
StorEdge 9990 Volume Retention Manager User's Guide (was LDEV Guard)	MK-94RD219-01 (07.19.04)
StorEdge 9990 Data Retention Utility User's Guide (was Open LDEV)	MK-94RD210-0 (07.01.04)
StorEdge 9990 Volume Security User's Guide (was SANtinel - S/390)	MK-94RD216-01 (07.19.04)
StorEdge 9990 ShadowImage User Guide (Incls. FlashCopy Mirror)	MK-94RD204-P0 (06.17.04)
StorEdge 9990 ShadowImage for z/OS® User's Guide	MK-94RD212-P0 (06.17.04)
StoragEdge 9990 RapidXchange Code Converter User's Guide	MK-93RD152
StorEdge 9990 SNMP API Reference Guide	MK-94RD213
StorEdge 9990 Universal Volume Manager User's Guide (aka External Storage Manager. Includes Hi-Copy)	MK-94RD220-P0
StoragEdge 9990 Universal Replicator - z/OS® User and Reference Guide (HUM)	MK-94RD224
StorEdge 9990 Configuration File Loader	MK-94RD244-P (06.15.04)
StoragEdge 9990 ShadowImage FlashCopy	MK-94RD245
StoragEdge 9990 Hitachi Cross-OS File Exchange for TagmaStore™ (HRX)	MK-94RD246
StoragEdge 9990 /Hitachi Freedom Storage Lightning 9900V Series Encrypted Communications User's Guide	MK-94RD248
StoragEdge 9990 Cross-System Copy User's Guide	MK-94RD252
StoragEdge 9990 (TM) User and Reference Guide	MK-94RD231
StorEdge 9990 Univeral Storage Platform IBM AIX Configuration Guide	MK-94RD232
StorEdge 9990 Red Hat Linux Configuration Guide	MK-94RD233
StorEdge 9990 Univeral Storage Platform SuSE Linux Configuration Guide	MK-94RD234
StorEdge 9990 Univeral Storage Platform HP-UX Configuration Guide	MK-94RD235
StorEdge 9990 Univeral Storage Platform SUN Solaris Configuration Guide	MK-94RD236
StorEdge 9990 Univeral Storage Platform SGI IRIX Configuration Guide	MK-94RD237

StorEdge 9990 Univeral Storage Platform Novell NetWare Configuration Guide	MK-94RD238
StorEdge 9990 Univeral Storage Platform HP OpenVMS Configuration Guide	MK-94RD239
StorEdge 9990 Windows NT Configuration Guide	MK-94RD240
StorEdge 9990 Univeral Storage Platform Windows 2000 Configuration Guide	MK-94RD241
StorEdge 9990 Windows 2003 Configuration Guide	MK-94RD242
StorEdge 9990 HP Tru64 UNIX Configuration Guide	MK-94RD243
StorEdge 9990 Business Continuity Manager User's Guide (CopyCentral)	MK-94RD247

LUN Manager User's Guide (mp-94rd203-00)

Overview of LUN Manager

The LUN Manager feature of the StorEdge 9990 subsystem enables the user to define the SCSI-to-LUN paths for the StorEdge 9990 logical units (LUs) and configure the StorEdge 9990 orts and LUN security. Each StorEdge 9990 LU can be mapped for access from multiple ports, providing alternate paths for path failover and nonstop data availability. LUN Manager allows the user to reconfigure the LUs at any time to accommodate system configuration changes and/or optimize subsystem performance.

LUN Manager is used to configure the command device for Command Control Interface (CCI) operations and apply command device security. LUN Manager also enables the user to set the port modes and fibre topology. The StorEdge 9990 fibre-channel ports support a high-speed mode that increases throughput. This is configured using LUN Manager.

This document describes and provides instructions for performing LUN Manager operations using the licensed StorEdge 9990 Storage Navigator software. The StorEdge 9990 Storage Navigator software communicates directly with the StorEdge 9990 subsystems via a local-area network (LAN). The Storage Navigator software displays detailed LUN Manager information and allows the user to perform LUN Manager operations on the StorEdge 9990 subsystem.

ShadowImage User's Guide (mp-94rd204-00)

The ShadowImage feature enables you to maintain subsystem-internal copies of all user data on the StorEdge 9990 storage subsystem for purposes such as data backup or duplication. The RAID-protected duplicate volumes are created within the same Lightning 9900™ V subsystem as the primary volume at hardware speeds. ShadowImage is used for UNIX®-based and PC server data. ShadowImage can provide up to nine duplicates of one primary volume. ShadowImage is a key component of Hitachi Data Systems' solutions and service offerings.

This document describes and provides instructions for performing ShadowImage operations using the Lightning 9900™ V Storage Navigator. The licensed ShadowImage software on the Lightning 9900™ V Storage Navigator displays the ShadowImage information and allows you to perform ShadowImage operations. The Lightning 9900™ V Storage Navigator can be attached to several Lightning 9900™ V subsystems via the Lightning 9900™ V-TCP/IP local-area network (LAN). The Storage Navigator communicates and exchanges data directly with the service processor (SVP) of each attached StorEdge 9990 subsystem. For further information on the *StorEdge 9990* Remote Console - Storage Navigator and software, refer to the *StorEdge 9990 Remote Console - Storage Navigator User's Guide* (MK-94RD101).

ShadowImage operations are nondisruptive and allow the primary (main) volume of each volume pair to remain online to all hosts for both read and write I/O operations. Once established, ShadowImage operations continue unattended to provide asynchronous internal data backup. Usability is further enhanced through a resynchronization capability that reduces data duplication requirements and backup time, thereby increasing user productivity. ShadowImage also supports reverse resynchronization for maximum flexibility.

The licensed StorEdge 9990 Remote Console – Storage Navigator software allows you to configure the ShadowImage option on the StorEdge 9990 subsystem. The StorEdge 9990 Storage Navigator software communicates directly with the StorEdge 9990 subsystem via a LAN. For further information on the StorEdge 9990 Storage Navigator software, please refer to the *StorEdge 9990 Remote Console – Storage Navigator User's Guide* (MK-94RD206).

ShadowImage operations can be performed in conjunction with TrueCopy operations (see section) to provide additional remote copies of ShadowImage volumes. ShadowImage also supports the Open Volume Management Virtual LVI/LUN and Cache Residency Manager features of the StorEdge 9990 subsystem, ensuring that all user data can be duplicated by ShadowImage operations. See section for further information on combining ShadowImage with these and other data management features.

ShadowImage operations can also be performed in conjunction with Universal Volume Manager operations to create pairs with the external volumes. For information about the external volumes, please refer to the *StorEdge 9990 Volume User's Guide,* MK-94RD220.

ShadowImage operations can also be performed from the UNIX® and/or PC-server host using the StorEdge 9990Command Control Interface (CCI) software. For information and instructions on using CCI to perform ShadowImage (or TrueCopy) operations, please refer to the *StorEdge 9990 Command Control Interface (CCI) User and Reference Guide*.

Storage Navigator User's Guide (mp-94rd205-00)

StorEdge 9990 Web Server and Web Client

The StorEdge 9990 Storage Navigator consists of a group of Java™ applet programs that enable the user to manage the StorEdge 9990 subsystem. The Storage Navigator Java™ applet programs run on a web browser to provide a user-friendly interface for the StorEdge 9990 web client functions. The StorEdge 9990 service processor (SVP) is the computer inside the subsystem that uses Java Virtual Machine™ (JVM™) to function as a web server. The SVP is also used by Sun representatives to perform maintenance. The Storage Navigator computer functions as a web client. Each time you log onto the

Storage Navigator computer and connect to the SVP, a Java™ applet program is downloaded from the SVP to the Storage Navigator computer.

This document describes and provides instructions for using the licensed StorEdge 9990 Storage Navigator software. The Storage Navigator software communicates directly with the StorEdge 9990 subsystems via a local-area network (LAN) to obtain subsystem configuration and status information, and send user-requested commands to the subsystem. The Storage Navigator software displays the detailed subsystem information, and allows you to configure and perform operations on the StorEdge 9990 subsystem.

The StorEdge 9990 subsystem can be connected to two LANs. The internal LAN is a private LAN that is used to connect the SVPs of multiple subsystems. Your intranet is a public LAN that allows you to access one or more SVPs from individual Storage Navigator computers. This configuration allows you to easily access and control the registered StorEdge 9990 subsystems. In a SAN environment, where several subsystems may be connected together, you must designate a primary SVP, which can be either an SVP connected to a StorEdge 9990 subsystem, or a web server with the exact same configuration as an SVP.

Figure 1.1 illustrates the relationship between the Storage Navigator computer(s) and the SVP.
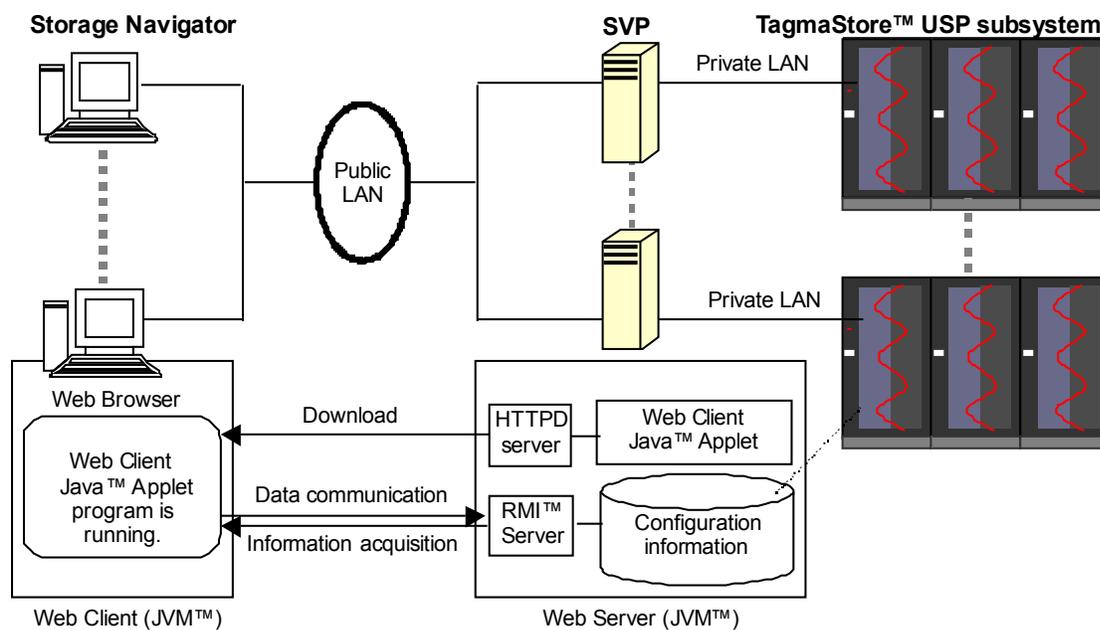
Figure 1.1   Sample Storage Navigator and SVP Configuration

The Storage Navigator Java™ applet program displays the configuration information for the attached StorEdge 9990 subsystems and enables you to perform the following types of operations:

Enabling and disabling options

Viewing the equipment and status information of the subsystem

Viewing the basic information, equipment and status information of the subsystem

Launching the desired option

Editing the storage device list

Editing the user account list

Setting the Storage Navigator environment parameters

Viewing the Storage Navigator log information

Downloading the log and configuration files

Restoring backup files

Viewing Storage Navigator information and changing your own password

Extending cache memory or LUNs using the Just In Time functions

Downloading Storage Navigator trace files using FD Dump Tool

Setting SNMP Agent properties

LUN Expansion and Virtual LVI/LUN User's Guide (mp-94rd206-00)

LUN Expansion (LUSE) operations allow hosts that can only use a limited amount of LUs per fibre interface to have access to larger amounts of data by using expanded LUs (see). See and for LUSE and VLL LUSE specifications.

LUSE operations include the following:

Viewing concatenated parity groups (see section)

Creating new LUSE volumes (see section)

Resetting an unregistered LUSE volume (see section)

Releasing a LUSE volume to individual LUs (see section)

Changing the size of a LUSE volume (see section)

The following guidelines apply to LUSE operations:

Access for the LU(s) to be expanded or released must be set to read/write. For more information on setting LDEV access, please see *StorEdge 9990 Open Volume Retention Manager User's Guide* (MK-93RD158).

LUSE volumes can consist of between 2 and 36 LDEVs. The maximum number of volumes includes LDEVs already included in a LUSE volume.

A maximum of 256 expanded LUs can be configured on the same port.

LDEVs that are to be combined into LUSE volumes should have no assigned SCSI paths and be unmounted from the host. These are known as free (or available) LDEVs. For instructions on deleting SCSI paths, please see *StorEdge 9990 LUN Manager User's Guide* (MK-94RD203).

Combining non-sequential LDEVs into a LUSE is supported.

Combining normal volumes and LUSE volumes into the same LUSE volume, and combining existing LUSE volumes into another LUSE volume are supported.

If you combine LDEVs number 00, 03 and 05 in to a LUSE volume ("LUSE 1"), then combine LDEVs number 02 and 04 into a second LUSE volume ("LUSE 2"), and LDEVs number 06 and 07 into a third LUSE volume ("LUSE 3"), you can then combine LUSE 1 and LUSE 3 into a LUSE volume, but you

cannot combine LUSE 1 and LUSE 2, because the LDEV range of LUSE 1 overlaps the LDEV range of LUSE 2.

Combining Virtual LVI/LUN volumes into a LUSE is supported, provided they are all of the same size and emulation type. The order of operations is important: you must first create one or more Virtual LVI/LUN volumes, and then combine those VLL volumes into a LUSE volume. For more information on creating VLL volumes, see sections and . For more information on creating LUSE devices see section .

You cannot perform Virtual LVI/LUN operations on an existing LUSE volume because a LUSE volume must have a SCSI path already specified.

TrueCopy-z/OS®, TrueCopy, ShadowImage-z/OS®, and ShadowImage pair volumes cannot be targets of LUSE operations because a LUSE volume must have a SCSI path already specified.

Combining Virtual LVI/LUN volumes and normal volumes into the same LUSE is not supported.

Combining command devices, Just In Time or Volume Migration volumes into a LUSE is not supported.

Combining RAID 1 and RAID 5 volumes into the same LUSE is not recommended.

Combining emulation types (OPEN-3, OPEN-8, OPEN-9, OPEN-E, OPEN-L or OPEN-V) into the same LUSE is not supported.

Combining LUSE volumes into larger LUSE volumes is not supported.

Some operating systems may experience slow disk access times with large logical units, particularly if they contain a large number of high-usage files.

The size of a LUSE can affect the amount of time required to perform backups. The maximum supported capacity is 60 TB.

Combining TagmaStore™ subsystem volumes and external volumes into the same LUSE volume is not supported.

When you are online, the host mode must not be 0x0C (Windows®).

LDEVs combined into a LUSE volume must have the same IO suppression mode and cache mode settings.

StorEdge 9990 User and Reference Guide (MK-94RD231)

Overview of the

Key Features of the

The StorEdge 9990 constitutes a new computing revolution that promises to deliver efficient and flexible IT infrastructure, breaking away from computing that is rigid and expensive and involves underutilitzed resources. The enables you to extend the life of current storage investments and take advantage of new functionality on yesterday's storage products. Multiple and tiered heterogeneous storage systems can be connected to and managed through a unique new feature introduced on the SE 9990. Interoperability issues are eliminated and performance and capacity management is simplified to reduce overall storage costs. The SE 9990 creates a data lifecycle management (DLM) foundation and enables massive consolidation and storage aggregation across disparate platforms.

The SE 9990 is a multiplatform, high-performance, large-capacity storage array that provides high-speed response, continuous data availability, scalable connectivity, and expandable capacity in heterogeneous system environments. The provides non-stop operation for 7x24 data centers and is compatible with industry-standard software. The advanced components, functions, and features of the represent an innovative and integrated approach to DLM.

The SE 9990 employs and improves upon the key characteristics of generations of successful Hitachi disk storage subsystems to achieve the highest level of performance and reliability currently available. The features third-generation improvements to the Hierarchical Star Network (HiStar) architecture, the ground-breaking technology introduced and proven on previous-generation Hitachi storage arrays, as well as faster microprocessors on the front-end and back-end directors.

The can operate with multihost applications and host clusters, and is designed to handle very large databases as well as data warehousing and data mining applications that store and retrieve terabytes of data. The SE 9990 supports an intermix of fibre-channel, FICON™, and ESCON® host attachment and can be configured for all-open, all-mainframe, and multiplatform operations.

The provides many benefits and advantages as well as advanced new features for the user, including double or more scalability from the 9900V in both capacity and performance. The HiCommand® licensed software products also support theSE 9990for maximum flexibility in configuration and management.

Best Practices

An IT organization's goals to consider to ensure best practices in defining their storage requirements include:

- Preventing data loss
- Offering adequate capacity that can easily scale as storage needs grow
- Providing fast access to data without interruptions
- Preparing for equipment failures
- Using cost-effective technologies.

Technology alone, however, cannot solve all the issues that impact an organization's data strategy. However, the Sun StorEdge 9990's comprehensive solutions can be tailored to satisfy the most demanding requirements.

Assessing Enterprise Storage Requirements

One of the misconceptions about storage resource planning is that a total storage solution can be created overnight and that, by deploying the right storage system, the task is complete. This is far from the truth. Shown in the figure below, implementing the correct enterprise storage solution involves a continuous process.
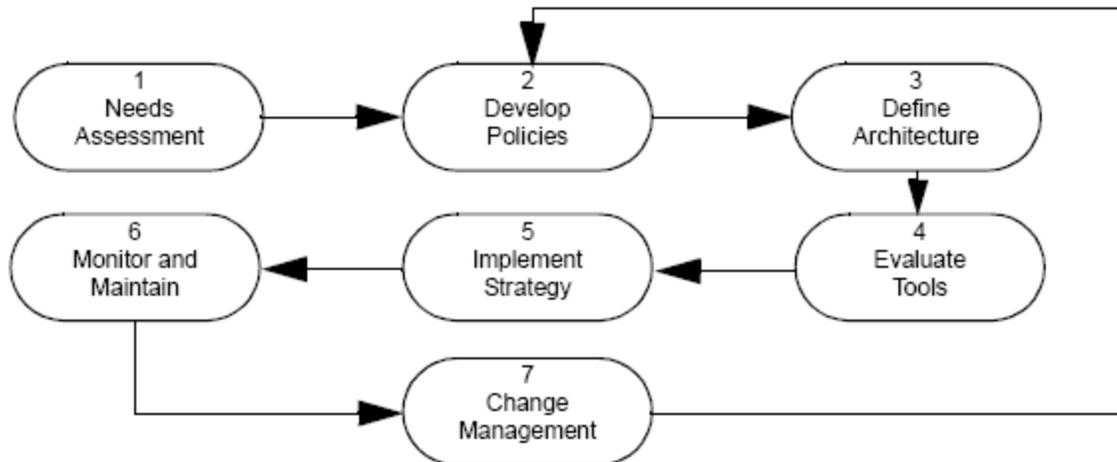
Figure 12: Storage Assessment Process

Needs Assessment

Creating storage management best practices begins with a needs assessment phase, which analyzes the current storage environment and documents the storage management requirements. Effective storage management best practices assess the following:

- What does an IT organization have in their current storage resource inventory?
- What types of data are being stored, who owns them, when were they created, when were they last modified, when were they last accessed, how large are they, and so on?
- What solutions are already in place for data continuance, such as types of RAID, mirroring, remote copies?
- How are data sets maintained, along with their data movements?
- Are any archival storage practices in place?
- Is a Hierarchical Storage Management (HSM) solution in place?
- What are the data movements? How are they maintained?
- What is the backup policy?
- Does the customer have a disaster recovery plan? Has it ever been tested?
- How are file servers utilized?
- Have customers analyzed all previous "trouble tickets" associated with data unavailability? What did this cost?
- Are any application performance issues associated with storage?

Once these questions have been answered and their implications understood, budgets should be compared with the expected storage acquisitions over a period of two or more years.

Defining Storage Policies

Following the assessment phase, IT organizations can begin to define their storage requirements. These are defined at a high level and consider both the application oriented storage, storage infrastructure, and supporting storage software. IT organizations intent on creating a storage environment that provides the highest possible return on their investments should develop a guideline to assist in their storage solution. Some of the storage policies that should be consider are:

- Applications – determine what application data is critical to an organization, current size of this data, and projected growth rates.
- Online Data – determine what data needs to be stored online, the performance requirements for this data, and storage requirements.
- Near-line Data - determine data to be stored on near-line storage devices and processes for moving data between online, near-line, and offline storage systems.
- Business Continuity Policies – determine what data needs to be backed up and where to ensure business survival in the event of a disaster. Further, ensure that the data can be recovered.
- Data / Information Lifecycle Management – determine how data is staged across online, near-line, and offline storage devices based on value and tools required to implement movement and access.
- Management – determine what software tools are necessary to effectively manage a storage infrastructure.
- Capacity Planning – determine how storage is to be reported and managed as it grows.

- Change Control – determine procedures to facilitate changes in the infrastructure impacting storage policies.
- Security – determine how data is protected and the tools that will provide this protection.

Define the Architecture

With the storage policies in place, the architecture of the storage infrastructure can be determined. This is conceptually at a high level and considers the definition of storage system requirements such as:

- Type of storage device to support online data
- Type of storage device to support near-line data
- Type of storage device to support offline data
- Business continuity processes and tools
- Storage availability schema (e.g., RAID type)
- Storage management tools
- Data and information lifecycle management tools
- Storage security procedures and tools.

Evaluation

The next phase of the process involves the evaluation of the various storage solutions and tools offered in the industry and how they best fit an IT organization's architecture and budget. Here, IT organizations determine specific products that solve their storage requirements – both in the short term and in the long term. Specifically, this evaluation should include:

- Storage platforms for online, near-line, and offline data.
- Storage software necessary to implement business continuity plans
- Storage software necessary to support the movement of data
- Storage monitoring, reporting, and management tools
- Storage security tools.

This evaluation should lead to specific vendor selection that implements their defined storage architecture.

Implementation

Once the evaluation phase is complete, the actual implementation phase can begin. This involves:

- Installation
- Configuration
- Testing
- Acceptance.

It is strongly recommended that an IT organization work as a team with their storage vendors to successfully install and configure their storage infrastructure. This process involves not only the

definition of storage volumes, but also must consider security procedures such as fabric zoning, LUN masking, access control and authentication, and the like. The completion of this phase involves the testing of any new storage environment, leading to acceptance of the storage solution.

Monitoring and Maintaining

Now that a storage infrastructure is in place, it needs to be monitored and maintained on a consistent basis to ensure satisfactory operation. Storage management tools, effectively used, can greatly assist in this operation and reduce human resource requirements in monitoring and managing a storage environment. Additionally, the disaster recovery procedures should be periodically tested to ensure business continuity.

Change Management

Unfortunately, an IT organization's storage environment is not static. Changes are going to occur. These changes can result from additional capacity requirements, reclassification of their data assets, new applications, and from other organizational factors. IT organizations need to be proactive and facilitate changes within their storage environments, rather than being reactive to changes. An established change management procedure goes a long way to being proactive regarding storage environmental changes.

Summary

Implementing an effective storage resource best practice strategy is a critical component to IT planning. It is necessary for IT organizations to deploy the correct storage solution to satisfy application oriented storage needs, provides security and protection to their data assets, reduces operating costs, and cope with continuous infrastructure change.

One of the most effective ways IT organizations can implement a best practices storage strategy is by engaging the Sun team – Sun storage consultants, Sun Professional Services, and Sun Services. IT organizations working together with the Sun team can ensure that a best practice storage strategy can be defined, implemented, maintained, and managed.

Compatible Software

The following software is compatible with the Sun StorEdge 9990 system. IMPORTANT NOTE:

Do not rely on this page for interoperability. Go to Interoperability section on page 52 and reference the Support Matrixs (WWWW and FAR) for up to date information.

Sun Software

- StorEdge Enterprise Backup Software (EBS) 7.,1
- StorEdge QFS software 4.0, or later
- StorEdge SAM-FS software 4.0, or later
- Sun StorEdge Enterprise Storage Manager 2.1 software, or higher
- Sun StorEdge Enterprise Backup software (EBS) 7.1
- Solstice DiskSuite™ 4.2.1 software (in conjunction with Solaris 8 Operating System)
- Solaris Volume Manager software (embedded in Solaris 9 and 10 Operating System)
- Sun Cluster 3.0 software, update 3, and 3.1 base
- Sun StorEdge SAN Foundation 4..4.7 release (SF v.6.4)

Third-Party Software

- VERITAS NetBackup (VxNBU) 5.0, or higher
- Veritas Storage Foundation. which include Veritas Volume Manager and Veritas Filessystem

-
  For all Veritas products sold by Veritas and/or others including SUN, the Veritas website and other Veritas instruments are the correct means where one would check for qualification and support of the Veritas product/s. This is independent of- and has nothing to do with- Hitachi/HDS. The statement at # 1 is correct.

- VERITAS Volume Replicator
- Legato NetWorker 7.1, or higher
- Working with Veritas to publish their website
  This is one exception case where we do refer the field to a third party website for support statemens.

Ordering Information

ECTION II - PRICING INFORMATION

========= (to be distributed to customers, partners, and SUN personnel)

11. SPECIFIC PART AND ORDERING INFORMATION - UNRESTRICTED SALES

   (AVAILABLE TO ALL CUSTOMERS IN ALL GEOS)

!!! IMPORTANT !!!   !!! IMPORTANT!!!

In compliance with Demand Supply Initiative 10.0, "ASAP" as a requested

delivery date will no longer be allowed. If a customer requests

delivery on a specific date, then Ops will assign a shipment schedule

based on that date. If the requested delivery date is inside standard

leadtimes, Ops will assign a shipment schedule date based on fixed

leadtime unless approved for expedited handling.

A. NEW PARTS NOW AVAILABLE FOR SALE:

Order Number	List Price	Discount Category	SunSpectrum(SM) Price*	Note

```
E9990 Components
------------------------------------------------------------

TJ9DKCF460I-3ECDR $1,095.00   P     N/A
            Description:
Sun StorEdge(TM) 9990 Power Cable Kit; for three Phase 30 Amp AC 200V/50Hz
installations; 1 * power cable unit; (required when a three phase SE9990
integrated disk controller and array frame unit (DKC510I) and/or disk array
frame unit (DKU505I) is shipped to Europe; one kit per unit).RoHS-5 compliant
      TJ9DKCF460I-3UCDR $1,095.00   P     N/A
            Description:
Sun StorEdge(TM) 9990 Power Cable Kit; for three Phase 30 Amp AC 200V/60Hz
installations; 1 * power cable unit; (required when a three phase SE9990
integrated disk controller and array frame unit (DKC510I) and/or disk array
frame unit (DKU505I) is shipped to USA; one kit per unit).RoHS-5 compliant
      TJ9DKCF510I-16SR  $22,995.00  P     N/A
            Description:
```

Sun Confidential – For Internal Use and Authorized Partner Use Only

Sun StorEdge(TM) 9990 ESCON (Serial) 16-Port Front End Director; 2 * 8 port channel adapter printed circuit boards each equipped with 8 serial ports; for the SE9990 integrated disk controller and array frame unit (DKC510I)).RoHS-5 compliant

    TJ9DKCF510I-1ECR $795.00   P   N/A
        Description:
Sun StorEdge(TM) 9990 Power Cable Kit; for single phase 50 Amp AC 200V/50Hz installations; 1 * power cable unit; (required when a three phase SE9990 integrated disk controller and array frame unit (DKC510I) and/or disk array frame unit (DKU505I) are shipped to Europe; one kit per unit.)RoHS-5 compliant

    TJ9DKCF510I-1PSR $1,345.00   P   N/A
        Description:
Sun StorEdge(TM) 9990 AC Power Supply Box Kit; for single phase/200V 50 Amp installations; 2 * AC power supply distribution boxes; (one required per Sun StorEdge(TM) 9990 integrated disk controller and array frame unit (DKC510I) and/or disk array frame unit (DKU505I) when units are connected to single phase input).RoHS-5 compliant

    TJ9DKCF510I-1UCR $795.00   P   N/A
        Description:
Sun StorEdge(TM) 9990 Power Cable Kit; for single Phase 50 Amp AC 200V/60Hz installations; 1 * power cable unit; (required when a three phase SE9990 integrated disk controller and array frame unit (DKC510I) and/or disk array frame unit (DKU505I) are shipped to the USA; one kit per unit). RoHS-5 compliant

    TJ9DKCF510I-32HSR $84,995.00 P   N/A
        Description:
Sun StorEdge(TM) 9990 Fibre Channel 32-Port Front End Director for Short Wavelength; 2 * 16 port channel adapter printed circuit boards with LC type optical connectors, 1-2Gbps Auto-sensing; All 32 fibre channel ports come standard populated with SE9990 Fibre Small Form Factor Pluggable(SFP) Transceivers for Short Wavelength (multi-mode); for the SE9990 integrated disk controller and array frame unit (DKC510I).RoHS-5 compliant

    TJ9DKCF510I-3PSR $1,345.00   P   N/A
        Description:
Sun StorEdge(TM) 9990 AC Power Supply Box Kit; for three phase/200V 30 Amp installations; 2 * AC power supply distribution boxes; (one required per Sun StorEdge(TM) 9990 integrated disk controller and array frame unit (DKC510I) and/or disk array frame unit (DKU505I) when units are connected to three phase input).RoHS-5 compliant

    TJ9DKCF510I-400R $85,995.00 P   N/A
        Description:
Sun StorEdge(TM) 9990 Back End Director; consists of 2 * disk adapter printed circuit boards (1 disk adapter pair - 2 PCBs), that control 8 * 2Gbps fibre channel ports per PCB, using 4 * 400 MHz Microprocessors per PCB.; for the SE9990 integrated disk controller and array frame unit (DKC510I); (Note: a maximum of four of this feature can be installed per DKC).RoHS-5 compliant

    TJ9DKCF510I-8MLR $45,995.00 P   N/A
        Description:
Sun StorEdge(TM) 9990 FICON 8-Port Front End Director for Long Wavelength; 2 * 4 port channel adapter printed circuit boards with LC type optical connectors, 1-2Gbps Auto-sensing; mainframe fibre channel ports conform to

the Long Wavelength (single mode); for the SE9990 integrated disk controller and array frame unit (DKC510I)).RoHS-5 compliant

TJ9DKCF510I-8MSR $39,995.00 P   N/A
          Description:
Sun StorEdge(TM) 9990 FICON 8-Port Front End Director for Short Wavelength; 2 * 4 port channel adapter printed circuit boards with LC type optical connectors, 1-2Gbps Auto-sensing; mainframe fibre channel ports conform to the short Wavelength (multi- mode); for the SE9990 integrated disk controller and array frame unit (DKC510I)).RoHS-5 compliant

TJ9DKCF510I-ABR $1,345.00   P   N/A
          Description:
Sun StorEdge(TM) 9990 Additional Battery; 2 * battery boxes, 2* battery control printed circuit boards; for the SE9990 integrated disk controller and array frame unit (DKC510I) and/or disk array frame unit (DKU505I).RoHS-5 compliant

TJ9DKCF510I-APR $3,795.00   P   N/A
          Description:
Sun StorEdge(TM) 9990 Additional Power Supply; 4 * redundant power supplies, 3.3V and 12V capable; for the SE9990 integrated disk controller and array frame unit (DKC510I)); (Required when the configuration includes one of the following: 1) total number of installed DKA and CHA options equal four or more and/or 2) cache memory to be installed is 68GB or more and/or 3) 65 or more hard disk drives are to be installed).RoHS-5 compliant

TJ9DKCF510I-CSWR $46,995.00 P   N/A
          Description:
Sun StorEdge(TM) 9990 Data Path Expansion Kit; 2 * printed circuit boards for data path expansion; for the SE9990 integrated disk controller and array frame unit (DKC510I).RoHS-5 compliant

TJ9DKCF510I-L11CR $595.00   P   N/A
          Description:
Sun StorEdge(TM) 9990 Device Interface Cable Kit; 1 * cable unit assembly; required when connecting the SE9990 Back End Director within the SE9990 integrated disk controller and array frame unit (DKC510I) to the SE9990 disk array frame unit (DKU505I) in the L1 position; (connects DKC to DKU-L1).RoHS-5 compliant

TJ9DKCF510I-L12CR $595.00   P   N/A
          Description:
Sun StorEdge(TM) 9990 Device Interface Cable Kit; 1 * cable unit assembly; required when connecting the fourth SE9990 Back End Director within the SE9990 integrated disk controller and array frame unit (DKC510I) to the SE9990 disk array frame unit (DKU505I) in the L2 position; (connects DKC to DKU-L2).RoHS-5 compliant

TJ9DKCF510I-PCIR $895.00   P   N/A
          Description:
Sun StorEdge(TM) 9990 Power Control Interface Kit for Mainframe; 1 *remote power control device; (this option performs the remote power control via the PCI interface with the IBM mainframe host).RoHS-5 compliant

TJ9DKCF510I-R11CR $595.00   P   N/A
          Description:
Sun StorEdge(TM) 9990 Device Interface Cable Kit; 1 * cable unit assembly; required when connecting the DKU-R0 (SE9990 Back End Director) within the SE9990 integrated disk controller and array frame unit (DKC510I) to the

SE9990 disk array frame unit (DKU505I) in the R1 position; (connects DKU-R0 to DKU-R1).RoHS-5 compliant

     TJ9DKCF510I-R12CR $595.00   P   N/A
           Description:
Sun StorEdge(TM) 9990 Device Interface Cable Kit; 1 * cable unit assembly; required when connecting the second SE9990 Back End Director within the SE9990 integrated disk controller and array frame unit (DKC510I) to the SE9990 disk array frame unit (DKU505I) in the R1 position; (connects DKC to DKU-R1).RoHS-5 compliant

     TJ9DKC510I-5R $86,995.00 P   N/A
           Description:
Sun StorEdge(TM) 9990 Integrated Disk Controller and Disk Array Frame Unit with doors, factory-configured, supports RAID 5/RAID 1 configurations, contains up to 128 hard disk drives; Frame dimensions: Height:1860mm, Width:782mm, Depth:925mm, 4 * 3.3V/12V redundant power supplies, 20 * redundant fans, 1 * service processor (SVP), 1 * 14ft LAN Cable, 1 * 12ft phone cable, microcode kit, HiTrack, modem card; installation included.RoHS-5 compliant

     TJ9DKUF505I-EXCR $495.00   P   N/A
           Description:
Sun StorEdge(TM) 9990 Device Interface Cable Kit; 1 * cable unit assembly; required when connecting the SE9990 disk array frame units (DKU505I) in the following positions: R1 to R2 and L1 to L2; (connects DKU to DKU).RoHS-5 compliant

     TJ9DKUF505I-FSWAR $27,995.00 P   N/A
           Description:
Sun StorEdge(TM) 9990 Disk Path Expansion Kit; 16 * FSW-A printed circuit boards, 8 * ALPA printed circuit boards; required for extending the disk path between the SE9990 integrated disk controller and array frame unit (DKC510I) and disk array frame unit (DKU505I). RoHS-5 compliant

     TJ9DKU505I-18R $46,495.00 P   N/A
           Description:
Sun StorEdge(TM) 9990 Disk Array Frame Unit with doors; factory-configured; contains four hard disk unit boxes (each box accommodates 64 hard disk drives), installed as the standard and capable of containing a maximum of 256 hard disk drives; conforms to both 3-phase AC power and single-phase AC power specifications; Dimensions of frame : Height: 1860, Width: 650mm and Depth: 925mm; (AC power supply and AC power cable not included).RoHS-5 compliant

     TJ9KCFB0913003M1CR $195.00   P   N/A
           Description:
Sun StorEdge(TM) 9990 ESCON MTRJ-F/ESCON-F Fibre Optic Cable, 3 meter(for US installations). RoHS-5 compliant

     TJ9JCFB1313031M1CR $250.00   P   N/A
           Description:
Sun StorEdge(TM) 9990 ESCON MTRJ-F/MTRJ-F Fibre Optic Cable, 31 meter(for US installations). RoHS-5 compliant

     TJ9JCFB1313022M1CR $210.00   P   N/A
           Description:
Sun StorEdge(TM) 9990 ESCON MTRJ-F/MTRJ-F Fibre Optic Cable, 22 meter(for US installations). RoHS-5 compliant

     TJ9JCFB1313013M1CR $170.00   P   N/A
           Description:

Sun StorEdge(TM) 9990 ESCON MTRJ-F/MTRJ-F Fibre Optic Cable, 13 meter (for US installations). RoHS-5 compliant
    TJ9JCFB1313122M1CR $655.00   P   N/A
        Description:
Sun StorEdge(TM) 9990 ESCON MTRJ-F/MTRJ-F Fibre Optic Cable, 122 meter (for US installations). RoHS-5 compliant
    TJ9JCFB1313061M1CR $395.00   P   N/A
        Description:
Sun StorEdge(TM) 9990 ESCON MTRJ-F/MTRJ-F Fibre Optic Cable, 61 meter(for US installations). RoHS-5 compliant
    TJ9JCFB1313046M1CR $335.00   P   N/A
        Description:
Sun StorEdge(TM) 9990 ESCON MTRJ-F/MTRJ-F Fibre Optic Cable, 46 meter(for US installations). RoHS-5 compliant
    TJ9MTFESCF003R $230.00   P   N/A
        Description:
Sun StorEdge(TM) 9990 ESCON MTRJ-F/ESCON-F Fibre Optic Cable, 3 meter(for Europe installations). RoHS-5 compliant
    TJ9MTFMTF013R $205.00   P   N/A
        Description:
Sun StorEdge(TM) 9990 ESCON MTRJ-F/MTRJ-F Fibre Optic Cable, 13 meter (for Europe installations). RoHS-5 compliant
    TJ9MTFMTF022R $250.00   P   N/A
        Description:
Sun StorEdge(TM) 9990 ESCON MTRJ-F/MTRJ-F Fibre Optic Cable, 22 meter(for Europe installations). RoHS-5 compliant
    TJ9MTFMTF031R $300.00   P   N/A
        Description:
Sun StorEdge(TM) 9990 ESCON MTRJ-F/MTRJ-F Fibre Optic Cable, 31 meter(for Europe installations). RoHS-5 compliant
    TJ9MTFMTF046R $400.00   P   N/A
        Description:
Sun StorEdge(TM) 9990 ESCON MTRJ-F/MTRJ-F Fibre Optic Cable, 46 meter(for Europe installations). RoHS-5 compliant
    TJ9MTFMTF061R $485.00   P   N/A
        Description:
Sun StorEdge(TM) 9990 ESCON MTRJ-F/MTRJ-F Fibre Optic Cable, 61 meter(for Europe installations). RoHS-5 compliant
    TJ9MTFMTF122R $795.00   P   N/A
        Description:
Sun StorEdge(TM) 9990 ESCON MTRJ-F/MTRJ-F Fibre Optic Cable, 122 meter(for Europe installations). RoHS-5 compliant
    TJ9FICSMLCLC025MR $260.00   P   N/A
        Description:
25M Fibre Channel LC-LC Longwave Single Mode 9UM cable. RoHS-5 compliant
    TJ9FICSMLCLC050MR $345.00   P   N/A
        Description:
50M Fibre Channel LC-LC Longwave Single Mode 9UM cable. RoHS-5 compliant
    TJ9FICSMLCLC100MR $520.00   P   N/A
        Description:
100M Fibre Channel LC-LC Longwave Single Mode 9UM cable. RoHS-5 compliant
    TJ9FICSMSCLC025MR $265.00   P   N/A

Description:
25M Fibre Channel SC-LC Longwave Single Mode 9UM cable. RoHS-5 compliant
    TJ9FICSMSCLC050MR $355.00   P   N/A
        Description:
50M Fibre Channel SC-LC Longwave Single Mode 9UM cable. RoHS-5 compliant
    TJ9FICSMSCLC100MR $530.00   P   N/A
        Description:
100M Fibre Channel SC-LC Longwave Single Mode 9UM cable. RoHS-5 compliant
    TJ9FICSMSCSC025MR $250.00   P   N/A
        Description:
25M Fibre Channel SC-SC Longwave Single Mode 9UM cable. RoHS-5 compliant
    TJ9FICSMSCSC050MR $340.00   P   N/A
        Description:
50M Fibre Channel SC-SC Longwave Single Mode 9UM cable. RoHS-5 compliant
    TJ9FICSMSCSC100MR $520.00   P   N/A
        Description:
100M Fibre Channel SC-SC Longwave Single Mode 9UM cable. RoHS-5 compliant
    TJ9DKCF510I-16MLR $75,995.00 P   N/A
        Description:
Sun StorEdge(TM) 9900 FICON 1Gb/sec frontend director (channel adapter);This
option is a channel adapter consisting of 16 1-2Gbps mainframe fibre channel
ports conforming to the long wavelength (single mode). The option is composed
of the two channel adapter PCBs in each of which eight fibre channel ports
are equipped. Incidentally, the LC type optical connectors are installed on
the PCBs;(For SE9990 & SE9985) RoHS-5 compliant
    TJ9DKCF510I-16MSR $69,495.00 P   N/A
        Description:
Sun StorEdge(TM) 9900 FICON 1Gb/sec frontend director (channel adapter);This
option is a channel adapter consisting of 16 1-2Gbps mainframe fibre channel
ports conforming to the short wavelength (multi-mode). The option is composed
of the two channel adapter PCBs in each of which eight fibre channel ports
are equipped. Incidentally, the LC type optical connectors are installed on
the PCBs.(For SE9990 & SE9985) RoHS-5 compliant
    TJ9DKCF510I-CXR $4,595.00   P   N/A
        Description:
Sun StorEdge(TM) 9990 Cache Data Path Expansion Kit; 2 * printed circuit
boards for installing cache memory; 32GB cache can be installed on each
printed circuit board; for the SE9990 integrated disk controller and array
frame unit (DKC510I). RoHS-5 compliant
    TJ9DKCF510I-SVPR $7,995.00   P   N/A
        Description:
Sun StorEdge(TM) 9990 SVP High Reliability Support Kit; 1 * service processor
(for use as a failover device); for installation in an SE9990 integrated disk
controller and array frame unit (DKC510I). RoHS-5 compliant
    TJ9DKCF510I-SXR $4,595.00   P   N/A
        Description:
Sun StorEdge(TM) 9990 Shared Memory Path Expansion Kit; 2 * printed circuit
boards for mounting shared memory; 6GB shared memory can be installed on each
printed circuit board; for the SE9990 integrated disk controller and array
frame unit (DKC510I). RoHS-5 compliant

Ordering Notes:

2   Sun (S4) Software Support offerings will be generally available on

   10/5/04. For inquires regarding the quoting and ordering of software

   support prior to 10/5/04, please contact

   michael.l.hall@sun.com, michelle.lemieux@sun.com and

   ken.ow-wing@sun.com.

1   SunSpectrum(SM) Instant Upgrade 3 Year Platinum level.

+ Previously announced part.

* Amounts shown in SunSpectrum(SM) Price column represent monthly
  service charges for the recommended level of hardware support.

  All parts representing Documentation Only should show N/A under
  the service column. Such products never have a service price.

E. INTEGRATED STACK CONTENTS
 N/A

F. SUN UPGRADE ADVANTAGE PROGRAM (UAP) - NEW PARTS
   N/A

Release Schedule

The following hardware components were available at the initial release of the StorEdge 9990 system September 2004. The reason for provision of this information is to provide context to those new to this program or have older systems in their accounts.

- Control/Array frame with 3rd generation non-blocking switch
- Array frame
- 1152 total disk drive capacity
- 128GB data cache
- 6GB control memory
- 72GB disk drives
- 146GB disk drives
- Fibre Channel front-end director feature
- ESCON front-end director feature supporting
- FICON front-end director feature

The following software components are available at the initial release of the StorEdge 9990 system:

- StorEdge 9900 HiCommand Device Manager
- StorEdge 9900 HiCommand Tuning Manager
- StorEdge 9900 HiCommand Data Link Manager
- StorEdge 9990 Universal Volume Manager
- StorEdge 9900 SANtinel
- StorEdge 9900 Graph-Track
- StorEdge 9900 Remote Console – Storage Navigator
- StorEdge 9900 Cache Residency
- StorEdge 9900 Performance Monitor
- StorEdge 9900 Server Priority Manager
- StorEdge 9900 Volume Migrator
- StorEdge 9900 Resource Manager
- StorEdge Traffic Manager
- StorEdge 9900 Cross-System Copy
- StorEdge 9900 ShadowImage
- StorEdge 9900 True Copy Remote Replication

Post GA hardware enhancements to the StorEdge 9990 system have been released These include:

- 256GB data cache
- 12GB control cache
- 300GB disk drives
- NAS Blade Feature
- 4 Gbit FC FED at 350 MB/sec

Post GA, software enhancements to the StorEdge 9990 system will be released. These include:

- Universal Volume Manager (software which implements external storage.)
- StorEdge 9990 Virtual Partition Manager
- StorEdge 9900 Copy-on-Write Snapshot (actually combined with Shadow Image in a package called "In-System Replication".
- StorEdge 9990 Universal Replicator
- RAID 6 support

Key Future Hardware releases (as of 7-10-06)

- iSCSI blade feature
- Low Cost Fibre Channel Disk, 500 GB, 7,200 rpm. It is a SATA drive with a FC interface
- 4 Gbit FICON

Competitive Comparison

When you look strictly at the facts, nothing on the market compares to the Sun StorEdge 9990 system. But that won't stop our competition at the highest end of the centralized storage platform market from trying to win hearts and minds though creative positioning.

In this section, you'll learn what the overall marketplace is like and who's likely to say what. You'll also find three competitive snapshots of our strongest competitors, and three matrixes that show how the Sun StorEdge 9990 compares with our closest competitors in three areas: hardware, business continuity, and storage area management.

Of course, under no circumstance should these materials be shared with customers.

They are intended merely to arm you for discussion on competitive features should such discussion ensue. Our Competitive Snapshots will give you a strategy to counter whatever the competition might throw at you. We hope the Snapshots' format makes them easy to scan for the information you need.

Overview of the Market

The usual suspects are going to focus lots of attention on answering the StorEdge 9990 challenge, and the primary competitors are IBM, HP, EMC, and STK. As they do when competing with the Sun StorEdge 9900 Series enterprise storage systems, these vendors are going to market their high-end systems to compete with StorEdge 9990. HDS and HP will be selling their own versions of StorEdge 9990, so displaying our continued mutual respect in selling situations will be important.

The two most certain candidates for direct competition are:

- EMC, with the EMC Symmetrix DMX Series

IBM, with the IBM Enterprise Storage Server (ESS Shark) and IBM SAN Volume Controller. With its unique features and functions, StorEdge 9990 solutions can be targeted for the highest-level business requirements that even the Sun StorEdge 9980 enterprise system can't achieve. The StorEdge 9980 system already represents the pinnacle of high-end enterprise storage systems, and the StorEdge 9990 will become the new standard.

Competitive Overview Chart

	Sun StorEdge Family			Competition		
	J1	SE9980	SE9970	EMC - Symmetrix DMX-2/1000	EMC - Symmetrix DMX-2/3000	IBM 2105-ESS
Architecture	Switched	Switched	Switched	Direct Matrix	Direct Matrix	Shared Bus
Announced	Target Sept 04	May-02	May-02	Feb-04	Feb-04	1999/2000
Packaging	Floor Standing	Floor Standing	Floor Standing	Floor Standing	Floor Standing	Floor Standing
	Max Drives: 1,152	Max Drives:1024	Max Drives: 128	Max Drives: 144	Max Drives: 576	Max Drives: 384
	Max Capacity 250TB	Max Capacity 147TB	Max Capacity 18TB	Max Capacity 21TB	Max Capacity 84TB	Max Capacity 56TB
HDDS Supported	146GB / 10Krpm; 73GB / 15K rpm; 300GB (Q1Cal 05)	73GB, 146GB; 36GB, 73GB – 15K rpm	73GB, 146GB; 36GB, 73GB – 15K rpm	73GB, 146GB – 10Krpm 73GB – 15K rpm	73GB, 146GB – 10Krpm 73GB – 15K rpm	18GB, 73GB, 146GB, – 10Krpm, 36GB, 73GB – 15K rpm
Bandwidth	60GB/s	16GB/s	8GB/s	16GB/s	16GB/s	3GB/s
Max Cache Size (MB)	256GB	128GB	64GB	128GB	256GB	128GB
Host Interface Qty	256	64	48	48	64	32
Host Interfaces	ESCON, FICON,iSCSI, NAS, FC-AL	ESCON, FICON,iSCSI, NAS, FC-AL	ESCON, FICON,NAS, FC-AL	ESCON, FICON, iSCSI, FC-AL	Gigabit Ethernet, ESCON, FICON, iSCSI, FC-AL	ESCON, FICON, 2Gb/s FC-Switch, 1Gb/s FC-Switch, Ultra2 SCSI
UC Model	YES	YES	NO	OpenScale (Mkt Vapor) - Limited availability, 50TB start, etc		CoD via GS
Incremental Advantage	Traffic Manager, Leadville, End to End Data Management			Embedded Base, HDDs w/CX, Perceived Price, Storage Focus		Global Services, Mainframe

Detailed Competitive Overview

* 64 switched data paths = 68GB/s Cached   Data Bandwidth
   - a 541% Increase in Cached Bandwidth

* Separate 64 control paths connect to cache memory = 13GB/s Control Bandwidth
   - a 145% Increase in Control Bandwidth

* 300% more active paths in/out of cache memory than EMC Symmetrix DMX 3000-2
   - a 50% Increase over the Hitachi Lightning 9980V™ and EMC DMX-2

* 128 concurrent cache memory operations

* 128GB of Cache Memory plus 6GB of   Control Memory

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* Up to 192 FC connections
   -Three times as many as our closest competitor

* 96 ESCON or 48 FICON ports
   - 50% more than anyone else
* Over 2GB/s sequential throughput
   - 400% improvement over DMX
* Almost 2Million IOPS cache hit operations
   - 4 times the competition
* Up to 64 Back-end FC loops
   - All active-active, twice as many as the competition

Sun StorEdge 9990 Stands Alone

The Sun StorEdge 9990 is a double-edged sword, allowing Sun Microsystems to compete both with high-end enterprise storage systems *and* virtualization appliances. However, the most important thing customers can learn is that StorEdge 9990 is the foundation for a comprehensive storage solution that far exceeds anything offered by the competition. Consider the following facts: *StorEdge 9990 is more than just storage; it's an architectural foundation for combining storage, software, and services.*

- StorEdge 9990 internal capacity will be twice or more that of any competing storage system.

- Its internal capacity will be twice or more than that of any competing storage system.

- Its maximum internal and external capacity combined will be 16 times that of IBM SVC.

- Storage partitioning and cache partitioning capabilities protect line-of-business (LOB) storage investment and enable storage utility-type charge-back.

- StorEdge 9990 will have twice the maximum number of internal hard disk drives of the nearest competitor.

- It will feature more than five times the maximum internal bandwidth of the nearest competitor.

- The Sun StorEdge 9990 Universal Replicator for the StorEdge 9990 software represents the first storage-based replication software facility that is server-free and application-transparent, while providing journal-based, multi-target replication features to data in heterogeneous, tiered-storage environments.

Key Advantages Over EMC and IBM

There are several ways in which Sun's StorEdge 9990 can be seen to beat EMC's and IBM's closest offerings.

- It's a far superior consolidation platform.

- It enables application oriented storage solutions with unique, application-centric management capabilities.

- It simplifies and unifies business continuity and storage area management.

- It enables customers to manage external storage systems without inserting a virtualization appliance.

- It's an architectural foundation for data lifecycle management or information lifecycle management strategy in a single platform.

With that, presented in the following tables are individual snapshots comparisons for EMC, IBM and STK.

Competitive Snapshot: EMC

Overview
Competing against any EMC platform implies competing against all four of its networked storage platforms, including the Symmetrix DMX Series, the CLARiiON CX Series, the EMC Network Attached Storage "family," and Centera Content Addressed Storage (CAS). EMC is particularly adept at cultivating unfair competitive comparisons with customers and changing their proposed platform during the evaluation process. For example, EMC has a history of positioning a high-end modular CLARiiON (CX600 or CX700) against the enterprise Sun StorEdge 9970 high-end modular storage with the intent of creating a cost advantage for the EMC solution. EMC has also made it a common practice to lead with the CLARiiON CX Series and "up sell" to the Symmetrix. Therefore, it's critical to know the entire collection of EMC platforms and be prepared to educate the customer on the appropriate positioning of those alternatives.

Products that might get bid against StorEdge 9990 platform	
Summary of the DMX Series	EMC enjoys all of the benefits of past market leadership including a substantial Symmetrix installed base and enviable brand recognition. EMC continues to spread the message that the Symmetrix DMX provides the highest performance and availability in the enterprise storage market. The Symmetrix DMX was introduced to the market on 3 Feb 2003 and has since been enhanced twice, with the addition of the DMX3000 on 30 July 2003 and the most recent DMX-2 hardware enhancement on 9 Feb 2004. While the fast pace of DMX enhancements is cast by EMC as response to customer demand, it's really a series of failed attempts to catch up to the Sun StorEdge 9900 Series systems. There are three major levels of Symmetrix DMX hardware in the market today: the "hybrid" DMX800, the standard integrated DMX models (DMX1000, DMX2000, and DMX3000), and the integrated DMX-2 models (DMX1000-M2, DMX1000-P2, DMX2000-M2, DMX2000-P2, and DMX3000-M2). EMC has stated that they believe that most customer requirements will be met by non-DMX2 levels of hardware.
The "hybrid" DMX800	The DMX800 combines the lower-cost "rack and stack" packaging associated with midrange or modular storage with the enterprise-level Enginuity operating environment. It is the latter that solely defines the DMX800 system as a Symmetrix. While the DMX800 is more costly compared to the high end of the CLARiiON CX Series, it lacks the availability and scalability of the remaining Symmetrix DMX models. Before the StorEdge StorEdge 9990 announcement, the Symmetrix DMX800 was positioned against the Sun StorEdge 9970 systems. Relative to StorEdge 9990, the DMX800 will compete with the StorEdge 9990 entry model.

The standard integrated Symmetrix DMX models	The DMX1000, DMX2000, and DMX3000, along with the DMX800 are positioned by EMC as sufficient to meet most customer requirements. These models utilize the 500MHz PowerPC microprocessors and can scale to a maximum of 576 HDDs. Before the StorEdge 9990 announcement, the standard, integrated Symmetrix models were positioned against the Sun StorEdge 9970 and StorEdge 9980 systems. Relative to StorEdge 9990, these models will compete with the StorEdge 9990 depending on the customer requirements and objectives.
The integrated DMX-2 models	The DMX1000-M2, DMX2000-P2, DMX2000-M2, DMX2000-P2, and DMX3000-M2 models announced on 9 Feb 2004, are positioned by EMC for the most demanding customer environments. These models utilize 1GHz PowerPC microprocessors (as well as hardware and Enginuity performance enhancements) and scale to a maximum of 576 HDDs. Before the StorEdge 9990 announcement, the integrated DMX-2 models were positioned against the StorEdge 9970 and StorEdge 9980 systems. Relative to StorEdge 9990, these EMC models will compete with the StorEdge 9990 entry and midrange configurations. Although EMC is certain to position these DMX models against all StorEdge 9990 configurations, they do not measure up to the StorEdge high-end model maximums by any measure and lack key StorEdge 9990 functionality, such as external tiered storage attachment and the StorEdge 9990 Universal Replicator feature.

Response Tactics
·EMC is adept at choosing a market message and consistently delivering that message with an authoritative, visionary tone. ·EMC's current market message is Information Lifecycle Management or ILM. · Customers are more skeptical than they have ever been about EMC's marketing message and in many cases do not believe that EMC alone can drive the industry to ILM nirvana. With that said, EMC deserves credit for initiating the ILM discussion and in many cases the company has defined the term ILM for a great number of analysts and customers. ·The Symmetrix DMX Series is one of four networked storage platforms that EMC prescribes in the first phase of an EMC ILM implementation. ·In the enterprise market, EMC has seen the most significant decline, beginning with the introduction of the the StorEdge 9900 Series. Since the introduction of the StorEdge 9900 Series, Sun has been the market and technology leader in enterprise storage and EMC has been playing catch-up with both the Symmetrix 8000 and DMX Series of storage systems. ·The greatest advantage that EMC holds is its substantial Symmetrix-based install base. Depending upon your perspective, this can be a matter of "customer loyalty" or "customer lock-in." In many cases it's a little of both. The loss of Symmetrix footprints impacts hardware revenue but has an even greater impact on software revenue. ·Hence, EMC often appears as a low-price leader, seeking to maintain customer and footprint control with the long-term objective of preserving software revenue.
Competitive Strengths
. Aggressive sales and marketing campaign, driven through its ILM vision. · EMC has partially addressed some of the competitive deficiencies of the EMC Symmetrix DMX Series, specifically storage capacity, availability, and connectivity. · Installed base, whether through customer lock-in or customer loyalty. . Broad suite of complementary software products.
Competitive Weaknesses
· Lack of mirrored write cache. · EMC continues to bet their future on a hybrid, switch-wannabe, Direct Matrix Architecture. Increased storage capacity without any enhancements to the architecture or additional internal paths is an invitation to performance problems. Performance doesn't scale with capacity. · EMC follows Sun. EMC is a technology laggard. Switched architecture, more HDDs, asynchronous remote copy, FICON - all Sun firsts, compared to EMC. · Lack of credibility in delivering consultative as well as integration and implementation services. · Unproven asynchronous remote replication via SRDF/A. · Unproven RAID-5.

Competitive Pricing
EMC was regarded as premium-priced storage up until recently. Market share loss, feature/function delay and a generally more competitive environment has forced EMC to lower prices. In an effort to regain lost share in key markets, such as IBM S/390®-z/OS® environments, EMC has directed its sales organizations to not lose the deal even if they have to be the low-price bidder in some cases. Much of EMC's competitive positioning has keyed around their software offerings, which have been shown to be expensive, point-product shelfware in many cases. The Sun StorEdge StorEdge 9990 is clearly years ahead of EMC DMX and our application-oriented software is far more integrated than anything EMC can offer. Pointing out the many unique advantages of StorEdge StorEdge 9990, coupled with the superiority of Sun HiCommand Storage Services Manager and Application Optimized Storage solution software will overwhelm EMC.

Hardware Offerings	
High-end **Symmetrix DMX Series**	Symmetrix is EMC's enterprise storage system brand. Although Symmetrix has been in the market since December 1990, the current Symmetrix DMX Series, based on the Direct Matrix Architecture was introduced to the market on 3 Feb 2003. Since the 3 Feb 2004 architecture and product introduction, the Symmetrix DMX Series has been enhanced twice: on 30 July 2003 with the introduction of the DMX3000 and again on 9 Feb 2004 with the DMX-2 level of hardware. EMC currently sells nine distinct models of the DMX Series from the "hybrid" DMX800 up to the high-end DMX3000-M2 with a maximum configuration of 576 HDDs.
Modular **The CLARiiON CX Series**	CLARiiON represents EMC's modular or midrange storage system. The CLARiiON product was obtained by EMC though the Data General acquisition in 1999. The most recent CLARiiON CX Series was introduced in late 2002 and was updated in early 2004 with three new models: the CLARiiON CX300 departmental storage system, the CLARiiON CX500 workgroup storage system, and the CLARiiON CX700 Data Center storage system. EMC has introduced a new, low-cost, entry-level CLARiiON storage system, the AX100 SATA system, to be sold primarily through their channel partners.
NAS **EMC's Network Attached** **Storage**	NAS offerings include the Celerra Clustered Network Server (CNS); the midrange NS700 Series, which includes the NS700G (gateway) and NS700; as well as the entry-level NetWin 200, based on Microsoft Windows Storage Server 2003 operating system. All of these offerings use either Symmetrix or CLARiiON for the storage device. EMC has also introduced the new entry-level NAS NetWin 110 system, intended to exploit the new CLARiiON AX100 in an attack on the lowest levels of the SMB market segment.
Archive storage **The Centera Content** **Addressed Storage**	Centera is the fourth and newest storage platform available from EMC. Born of the April 2001 acquisition of FilePool, EMC introduced Centera in April 2002 as a unique solution for the storage of fixed content.

Storage Management Software
EMC is trying to convince customers that a bunch of disparate products with different architectures acquired from different companies is a best-in-class, integrated solution. It's simply not true. They've just slapped a fancy Web user interface on top of six different products and provided "link-and-launch" pointers to each one. Basic screen scraping is being positioned as integration. EMC is JUST STARTING TO BE open. EMC spent so long spreading fear about how SMI-based solutions can't expose "hidden" device features that you have to wonder a bit about their newfound commitment to SMI. They certainly are nowhere near industry-leading HiCommand device support, having just recently proceeded beyond discovery of HDS hardware…but not far beyond it. EMC has made three recent acquisitions: Astrum—Astrum's file-level SRM functionality has been branded as VisualSRM. Legato—Legato enables EMC to stake a stronger claim in backup and HSM, where they have been weak. Analysts consider the acquisition complementary to EMC's existing product set and customer base. BMC PATROL SRM software—EMC acquired all 50 customers of BMC's SRM product, and the application-centric SRM thinking and strategy that BMC plagiarized from HighGround. Two executives from HP/Compaq now drive EMC's software strategy—Mark Lewis and Mark Sorenson. Neither showed independent software vision while at Compaq. Their SRM strategy was to OEM from HighGround.

Business Continuity
Although EMC has a comprehensive suite of business continuity solutions, EMC continues to deliver products specific to each of their storage platforms and have nothing to match Universal Replicator software

Service Offerings
EMC Global Services' offerings are organized into four primary categories—Consulting Services, Implementation and Integration Services, Support and Management Services, and Education—which extend into EMC's indirect sales channel via the Authorized Services Network (ASN) Partner Program. EMC's strongest services offerings tend to derive from its Consulting Services branch, due in large part to the relationship with consulting firm Accenture. Beyond that, the proprietary EMC-provided professional services, and partner-provided implementation, integration, and support services, are highly suspect.

Data/Information Lifecycle Management Strategies	
Summary of ILM strategy	On 8 September 2003, EMC launched a full offensive of marketing hype for Integrated Lifecycle Management (ILM). Today, almost every EMC hardware, software, and service offering is marketed as a component of ILM. Although many companies now highlight an ILM strategy, EMC was first-to-market with an ILM story. Most customers and analysts derive their understanding of ILM from EMC documents and presentations.
	According to EMC, there are three major customer challenges related to information management: strong growth of information, information is playing a more important role in determining business success, and information changes in value, and many times not necessarily in a linear fashion. These challenges are the foundation of the business requirement for ILM.
	The process of implementing and expanding upon an information lifecycle management strategy consists of four activities.
Classifying data and applications…	… on the basis of business rules and policies to enable differentiated treatment of information
Implementing policies with information management tools…	…from creation to disposal of data
Managing the environment…	…with heterogeneous and integrated tools that interface with multivendor platforms and reduce operational complexity of point solutions
Matching tiered storage resources to classes of data…	…storing information in the right type of infrastructure based on its current value
ILM road map **Phase 1**	· Enable networked storage · Automate the environment · Classify applications/data
Phase 2	· Define business policies for various information types · Deploy ILM components into principal applications
Phase 3	· Implement ILM across applications · Policy-based automation · Full visibility into all information

Every product is now placed in an ILM context	EMC's ILM road map phase 1 focuses on products and solutions available today with the goal to being "ILM-enabled" across a few enterprise-critical applications. In phase 1, the goal is to get the customer's environment to an automated networked storage environment. This is the basis for any policy-based information management. The value of tiered storage platforms can be exploited manually until ILM is fully implemented. Symmetrix DMX will be positioned as a networked storage system and therefore part of phase 1 on their ILM road map.
	EMC has firmly embraced ILM as the definition of their overall strategy in the storage market. ILM is EMC's vision for storage. By describing ILM as the extraction of maximum value from information at the lowest total cost over the information life-span, EMC gives storage executives and administrators an ILM vision they can easily relate to on a high level. ILM is by nature a solution and, as such, this makes services and software an integral part. Since EMC's goal is to increase software and services revenue as hardware revenue decreases, ILM as the guiding and governing light of EMC storage strategy makes perfect sense.
	By virtue of extensive investments for both internally developed and externally acquired products and an omnipresent marketing campaign spelling out their ILM road map and vision, EMC has established a leadership role as an ILM provider.
	EMC marketing now places every storage product in an ILM context. When all recent acquisitions are considered, EMC's ILM "coverage" spans across all types of data (structured, semi-structured, and unstructured), includes all of their hardware platforms plus almost all of their key software products, and has drawn in the necessary partners to fill out the remaining gaps (for example, ADIC for tape). This allows EMC to place all storage initiatives in an ILM context and to claim to be the #1 ILM company.

Recommended Strategy AGAINST EMC	
Focus prospects on the superiority of the Sun hardware platform.	· EMC follows Sun. EMC is a technology laggard. Switched architecture, more HDDs, asynchronous remote copy, FICON—all Sun firsts, relative to EMC. · EMC continues to bet their future on a hybrid, switch-wannabe, Direct Matrix Architecture. More storage capacity without any enhancements to the architecture or additional internal paths is an invitation to performance problems. · EMC platforms lack mirrored-write cache. · Unproven RAID-5.
Push the importance and benefits of the common management of StorEdge 9990 and all other Sun storage.	· EMC platforms continue be isolated from one another: lack of common management tools, specialized Centera platform not SAN-enabled for fixed content, etc. · Sun SAM Suite and its HiCommand modules, as well as StorEdge 9990 provide unmatched commonality and single point of command for all storage needs. · Our application-oriented software is far more integrated than anything EMC can offer.

Elevate the importance of StorEdge 9990 system exclusives in the minds of customers.	· StorEdge 9990 internal capacity is twice or more than that of any competing system; maximum internal and external capacity (combined) is 16 times that of closest competitor
	· More than five times the maximum internal bandwidth of the closest competitor
	· Unique multiprotocol connectivity and Host Storage Groups maximize the flexibility of any solution built around StorEdge 9990.
	· "Virtual Private Storage Machine (VPSM) capabilities can guarantee QoS, allow depreciation of storage investment at LOB level if required, and simplify "storage utility" type charge-back . "VPSM" are complementary to Dynamic System Domains in Sun Servers, and support a customer's "Server Provider" Business Model initiatives.
	· Connectivity for external storage systems enables storage aggregation and makes multitiered storage management and data movement practical, not just something to prepare for.
	· Universal Replicator provides the enterprise performance associated only with storage-based replication along with the cost benefits and higher data protection of journal-based technology. It can greatly simplify the task of highly resilient multitarget replication in heterogeneous, tiered storage environments.
	· StorEdge 9990 has unmatched security services.
	· StorEdge 9990 NAS Blade(s) offer the ideal massive consolidation platform for plug-and-play, mission-critical file sharing, offering the highest bandwidth, reliability, and capacity to reduce NAS "islands" through consolidation and simplify management.
Highlight Sun's advantages in business continuity.	· EMC has unproven asynchronous remote replication via SRDF/A, whereas Sun StorEdge 9900 True Copy Remote Replication Remote Replication software pioneered replication over any distance and has unmatched data integrity safeguards.
	· StorEdge 9990 Universal Replicator software takes the True Copy Remote Replication technology to a higher level, with the advantages of n-to-n replication for any platform that can connect to Universal Replicator software and the advantages of journaling.
	· We are particularly strong with mainframe offerings, from compatibility with IBM replication software to Sun StorEdge Business Continuity Manager software (formerly StorEdge CopyCentral software) for automating overall process.

Help prepare your prospect for EMC's misleading competitive positioning practices.	· They may position a lower-cost product against StorEdge 9990 to win a deal, knowing they can up-sell later. Therefore, you need to know most of the EMC line and the appropriate positioning and capabilities of each platform.
Stress that while EMC is trying to get customers to the preparatory "level 1" in ILM, StorEdge 9990 makes ILM practical today .	· EMC has its customers stuck in preparatory stage today because their different storage platforms are largely incompatible with different storage management and data movement software for each.
	· The software EMC needs to work together seamlessly to implement ILM is only glued together with an HTML launch menu.
	· StorEdge 9990 simplifies data movement across not only tiers of Sun storage but also for all other tiers of storage. That ability coupled with the superiority of StorEdge 9900 HiCommand Storage Services Manager software at controlling heterogeneous environments and our strength in data movement software makes us much more capable today. Application oriented storage solutions are already real.

Competitive Snapshot: IBM

Overview
IBM can be expected to utilize their full storage product suite as they compete against StorEdge 9990. IBM has two storage system lines and can address both mainframe and open systems requirements. IBM also offers an in-band virtualization appliance that can attach both IBM product lines as well as non-IBM systems. Like EMC, they offer NAS heads that front for both Shark and FAStT arrays. Finally, IBM will use "one-stop shopping" appeal against us with deals that include servers and its full-scope service and solutions offering.

Products that Might be Bid Against StorEdge 9990	
Enterprise Storage Server (ESS Shark) Model 800	With an optional Turbo II feature, ESS Shark is designed to offer the performance, accessibility, security, and reliability needed to support 24/7 operations of the "on-demand world." IBM touts Shark as a world-class product with low total cost of ownership (TCO) as well. Shark can simultaneously support mainframe and open systems host attachment.
SAN Volume Controller (SVC)	SAN Volume Controller (SVC) for high-end, enterprise-class, open-systems SAN storage environments that customers wish to manage as a single resource while at the same time reducing the complexity and costs of managing their storage networks. SVC supports only open systems hosts, but does allow Shark storage systems to be attached to both the SVC and a mainframe host at the same time. Existing Shark and FAStT products are identified as the ideal storage systems to serve as back-end storage for SVC, but non-IBM systems can also be attached to SVC.
IBM FAStT100, FAStT600, and FAStT900	IBM FAStT100, FAStT600, and FAStT900 are open systems storage systems that will also be presented by IBM to compete in open-systems-only environments, primarily as part of an ILM or tiered storage solution. IBM's FAStT product line is based on LSI's Fibre Channel Storage Systems.
IBM NAS500G	Expected in a bid against the StorEdge 9990 NAS Blade Feature, the NAS500G is a NAS gateway that provides file-serving services for back-end Shark and FAStT storage systems. The NAS500G is based on an IBM p-Series server running the AIX OS.

Response Tactics

IBM's competitive strategy centers on their "On Demand" marketing campaign. Central to delivering On Demand storage will be IBM hardware products (servers, disk, tape, SAN infrastructure), IBM Tivoli software, IBM Virtualization Family (software and appliances) and IBM Global Services. IBM has several alternative tactics to draw on depending on the nature of the competitive situation. Much emphasis is placed on the benefits of IBM as a single-source supplier for all components of the solution.

IBM has succeeded with Shark not by challenging the Sun 9900 family's obvious superiority but rather by positioning Shark as "good enough" to meet customer functional, capacity, and performance requirements. They underscore that posture by being the low-price bidder. IBM's value proposition of "good enough + cheap enough" for Shark proves to be a compelling argument for many customers.

With the advent of SAN Volume Controller and SAN File System, IBM has created an alternative competitive tack, positioning the SVC virtualization appliance as a centralized migration and consolidation platform to manage IBM Shark and FAStT systems plus other heterogeneous storage systems with one set of replication and management services for all attached storage. IBM's primary value message for SVC is that it eliminates SAN "storage islands," recoups stranded capacity, provides centralized management for all SVC storage, offers dynamic data migration, and provides a common platform for advanced functions like replication services with a single software license fee, regardless of the storage attached to SVC.

Both IBM strategies contain problems for customers:

·   Shark may be cheap, but its bus architecture is a major bottleneck that inhibits its ability to adequately service demanding, disparate, multi-tenant workloads.

·   Shark's architecture also inhibits large-scale storage consolidations, requiring multiple Shark footprints when a single StorEdge 9990 Series system would suffice. As a result, Shark is inherently less efficient and more complicated to manage in a large-scale consolidation.

·   Shark management tools are not as well integrated as HiCommand software modules and fail to provide application-level storage management.

·   SVC software is a Linux application running on Intel servers. It can be clustered, but customers are understandably reluctant to run all their storage resources through Linux and Intel servers.

·   SVC represents a huge conversion project that will consume administrative resources "On Demand" like a locust swarm. It's not as easy as IBM marketing implies.

  This is why IBM recommends a phased approach to SVC implementation, one application at a time.

  This means double systems and all the complications that implies. How long will two storage management platforms be running side-by-side before SVC consolidation benefits can be reaped?

·   SVC Copy Services appear to be familiar but have been completely rewritten for SVC—a risk for early implementers.

·   An SVC + SFS implementation is essentially a locked-in commitment to IBM storage. It constitutes a proprietary solution. As an IBMer has said: "Once you convert—we've got you."

Competitive Strengths
· One-stop shopping for server, storage, software, and services
· Shark has widespread acceptance and large install base, especially in z/OS
IBM "good enough" marketing campaign successful
Continuous enhancements to Shark performance and replication
Demonstrated commitment to SMI-S- and CIM-compliant software and hardware
· SAN Volume Controller receiving positive reviews from analyst community
Large Shark and FAStT install base provides lots of opportunity
Supports attachment of large variety of non-IBM storage
Creates more efficient storage pools across all attached storage systems
§ Manages volumes from multiple controllers as a single resource
SMI-S and CIM- compliant
Enables multivendor storage environment
Provides a relatively nondisruptive way to migrate off other vendors' storage into an IBM environment
Moves storage intelligence off the storage system and into the network
Only need to purchase one license of copy services software for use across all attached storage systems
· IBM and IBM Global Services offerings have great depth and breadth
Huge world-wide presence
"One-stop-shopping" for customers
· Development, integration, deployment, management, rules technology

Competitive Weaknesses
· Shark may be "good enough" for some uses, but not for the uses where a StorEdge 9990 is needed
Bus-architecture bottlenecks inhibit ability to serve as consolidation platform
Capacity, connectivity, performance and replication nowhere near that of StorEdge 9990 or StorEdge 9980 / 9970 systems
Level of integration within the complete IBM solution not as good as IBM marketing claims
§ No integration with FAStT management or replication software
§ SVC PPRC and Compatible Mirroring for IBM Compatible Mirroring for IBM FlashCopy different from Shark versions
· SAN Volume Controller (SVC) is a new, evolving IBM technology
Major customer effort to convert/adapt existing storage resources into SVC control
§ Once this effort is expended you become a captive of IBM's virtualization techniques
§ A new name for "vendor lock-in"
IBM In-band virtualization appliance unproven, especially in large consolidations of heterogeneous storage systems
Internal code is not microcode, but application running on Linux OS in the SVC xSeries processor nodes
SVC versions of PPRC and Compatible Mirroring for IBM Compatible Mirroring for IBM FlashCopy are complete re-writes—immature, have limited functionality
§ No asynchronous support in initial releases

Competitive Pricing
IBM is usually the low-price bidder on storage, particularly in the case of Shark. This is the essence of their "good enough—cheap enough" strategy. If their low prices can avert the focus away from Shark's relative deficiencies compared to StorEdge 9990 family systems, they have a fighting chance. IBM is also a major practitioner of bundling and will deploy everything they have to gain an advantage through package deals.
To battle this strategy effectively, you must 1) use StorEdge 9990 or 9900 Series advantages to generate a lower TCO via fewer footprints and reduced administrative costs, and 2) gain recognition for the value of better performance when more application data is housed in a single footprint. Shark is cheaper but StorEdge 9990 moves the bar so much higher that it may no longer be "good enough." Since Shark can't compete head-to-head even with 9900 family systems, you can expect Shark to get even cheaper. You must get value recognition for all unique advantages of StorEdge 9990 and 9900 family systems.

Hardware offerings	
IBM may try and shift focus to SVC to a certain extent when up against StorEdge 9990. But they will certainly not abandon "good enough" when they can't really match either the first or second tier of our offerings.	
High-end **Total Storage ESS "Shark" Series**	IBM will position the Enterprise Storage Server (ESS) "Shark" as the choice enterprise storage system, identifying HDS, and EMC as primary competitors. IBM positions the Shark as "good enough" storage at the right price, especially when competing against the Sun 9900 family systems. · Highly scalable enterprise storage · Standard-setter for performance, automation, and integration · Capabilities that support continuous availability · Advanced functionality for disaster recovery and backup · Optional Turbo II feature for higher performance · Share data across multiple platforms: z/OS, UNIX, Linux, and Windows · Multiple connectivity options: Fibre Channel/FICON, ESCON, and SCSI · Local, remote, and long-distance storage system-based data replication options · Web-based management tools · CIM and SMI-S compliant
Modular **IBM FASTT900 Modular Storage**	Will also be positioned against Sun StorEdge StorEdge 9990 when there are no S/390-z/OS connectivity requirements. IBM has been positioning the FAStT900 as a high-performance, enterprise disk storage system comparable to Shark in regards to performance, capacity, advanced functionality, and reliability. Since FAStT supports S-ATA disk drives it is likely that it will be offered to help lower the costs of IBM storage solution proposals, particularly when there are ILM requirements, i.e., tiered storage.

Virtualization appliance **SAN Volume Controller (SVC)**	Given the opportunity, IBM will attempt to insert the SAN Volume Controller (SVC), a storage virtualization appliance with no native storage of its own, into the role of high-end storage system. Since the SVC sits in the data stream, it serves as a front-end for storage systems such as Shark, FAStT, and non-IBM arrays. SVC is an integral part of IBM's overall storage strategy to move storage intelligence and functionality out of the storage system and into the storage network, and IBM is aggressively marketing it. If IBM is successful, the actual storage systems behind an SVC will have difficulty differentiating themselves or providing unique value, relegated by SVC to serve as raw storage and nothing more.

Storage Management Software
IBM's offerings include tools to manage heterogeneous storage infrastructure with policy-based automation of storage management tasks. This includes monitoring and management capabilities for SAN fabric, disk systems and server usage of storage.

Business Continuity
IBM provides advanced function copy services for each of its storage product lines. For the SVC, ESS Shark and FAStT families, these copy services are specific to each product line despite common copy product names and do not provide inter-family replication. SVC can provide copy services for Shark and FAStT storage systems, but only once the storage resource has been "virtualized" by the SVC appliance; the Shark or FAStT system-based Compatible Mirroring for IBM Compatible Mirroring for IBM FlashCopy/PPRC code is/can not used by the SVC or the individual storage systems at that point. This places IBM in the position of having three different versions/types of each PIT or remote copy product, one for each storage family and one for the SVC. Once this is understood, IBM's motivations to push customers to an SVC-based storage solution become obvious. Residing within the SVC are not only do IBM's key value propositions to the customer, but also lower storage product costs for IBM.

Service Offerings
IBM's storage services are now driven by the managed-hosting and outsourcing engagements of IBM Global Services (IGS). Storage services are integrated with its broader set of IT services, which enable on-demand business models through outsourcing, managed hosting, or customer-enabled solutions. Additional storage-related services are integrated with consulting services and "On Demand Business" infrastructure solutions. The company is investing heavily in "on demand" services, including storage services and developing or acquiring new tools and technologies to execute against this strategy. IGS claims to have more than 180,000 service professionals in 160 countries (having acquired roughly 31,000 from PwC Consulting). As a result of the PwC Consulting acquisition, IGS assumes the top revenue position in all worldwide IT professional service segments (except process management services)—and accounts for approximately 45 to 50 percent of IBM's overall revenue.

Data/Information Lifecycle Management Strategies	
IBM doesn't have a specific ILM strategy per se. Instead, they incorporate the variety of products, practices, services, and processes other vendors typically refer to as ILM/DLM into an "On Demand Storage Environment," which is a subset of their overall "On Demand" strategy. "On Demand" is about every aspect of a business, internal as well as external, functioning as one cohesive unit. By virtue of the sheer size of IBM—especially its Global Services unit, but also including a complete catalog of products and partners—IBM can and does portray itself as all things to all people.	
The storage environment aspect of On Demand centers the around several main areas:	
Disk systems house information as part of larger solutions; these can be offsite, pay-as-you-go external systems.	· IBM positions its virtualization hardware and software as the vehicle to streamline IT infrastructures while lowering cost and increasing productivity. · IBM frequently bundles a collection of existing hardware, software, and services as a new branded solution. For example: Data Retention 450 for management and enforcement of data retention policies (includes IBM servers, disk, and tape, as well as Tivoli software) Content Manager for Message Monitoring and Retention for e-mail/messaging regulatory compliance Tivoli Security Compliance Manager for data access, privacy, and auditing regulatory compliance Lotus Workplace for Business Controls for Sarbanes-Oxley Act compliance More typically, storage products or product families are portrayed relative to a given industry solution, i.e., IBM TotalStorage PACS Solutions, etc.
IBM Tivoli software solutions fall under two broad categories.	· Business continuity · Business efficiency (Dozens of specialized Tivoli titles)

IBM Global Services offerings are designed to assess, plan, and implement solutions using IBM disk, tape, and storage products Management software, Storage and Storage Networking.	· Existing On Demand solutions implemented in a variety of industries: Automotive, Banking, Electronics, Health Care, Insurance, Retail, Telecom, etc.
IBM On Demand Storage Environment definition	· Data is classified (processes and practices) · Active files are pooled (virtualization) · Inactive files are stored in variable-cost storage hierarchy (storage orchestration) · Infrastructure changes are nondisruptive (virtualization) · Management interfaces are common and open (SMI-S enabled) · Administrative efficiency is enhanced (workflow automation) · Human errors (human) are eliminated (workflow automation)
IBM TotalStorage Open Software Family provides "storage orchestration" and workflow automation in the On Demand storage environment.	· Supports platforms, applications, networks, and storage in heterogeneous LAN/SAN environments · Enterprise Storage Management for active data · Tivoli Storage Resource Manager . Tivoli SAN Manager . TotalStorage Multiple Device Manager · Hierarchical Storage Management for inactive data . Tivoli Storage Manager for Space Management · Archive Management with automation technology . Tivoli Storage Manager Archive · Recovery Management with automation technology . Tivoli Storage Manager
IBM TotalStorage Virtualization Family facilitates hardware changes without interrupting applications.	· IBM SAN Volume Controller (SVC) virtualizes the disks . Attaches IBM and non-IBM disk storage systems . Common replication platform for all attached disk
IBM SAN File System (SFS) supports "utility storage."	· SFS supports tiers of storage segmented according to business need

Differentiators
· IBM Global Services organization size, depth, and breadth lends credence to IBM's know-all, be-all claims
· Full range of product options that span solution requirements from servers to storage to software
· SVC ability to pool storage and replicate data across heterogeneous disk storage systems
· SFS promises to bring mainframe-class storage management (DFSMS) to open systems

Recommended Strategy Against IBM	
Focus prospects on the superiority of Sun hardware platform	Shark may be "good enough" for some uses, but not for the uses that bring out the best in a StorEdge 9990 · Bus-architecture bottlenecks inhibit ability to serve as a consolidation platform · Capacity, connectivity, performance, and replication nowhere near that of StorEdge StorEdge 9990 or even the 9980 / 9970 · Level of integration within the complete IBM solution not as good as IBM marketing claims -- For example, there is no integration with FAStT management or replication software · SVC PPRC and Compatible Mirroring for IBM Compatible Mirroring for IBM FlashCopy have different from Shark versions

Point out the issues with SAN Volume Controller if the customer is seriously considering it	SAN Volume Controller (SVC) is a new, evolving IBM technology
	
	· Major customer effort is required to convert/adapt existing storage resources into SVC control
	
	   - Once this effort is expended you become a captive of IBM's virtualization techniques
	
	   - A new name for "vendor lock-in"
	
	· IBM in-band virtualization appliance is unproven, especially in large consolidations of heterogeneous storage systems
	
	· SVC's software is not an integral part of the storage platform controllers with the associated performance advantages and built-in redundancy, but, rather, an application running on Linux OS. Do you really want to trust all your enterprise storage to it?
	
	· SVC versions of PPRC and Compatible Mirroring for IBM Compatible Mirroring for IBM FlashCopy are complete re-writes—immature, have limited functionality
	
	   - No asynchronous support in initial releases
	
	   - PPRC Synchronous limited to 10km Fibre Channel distance

Elevate the importance of StorEdge 9990 exclusives in the minds of customers	· StorEdge 9990 internal capacity is twice or more than that of any competing storage system; maximum internal and external capacity (combined) is 16 times that of closest competitor. · StorEdge 9990 offers more than five times the maximum internal bandwidth of the closest competitor. · Unique multiprotocol connectivity and Host Storage Groups maximize the flexibility of any solution built around StorEdge 9990. · Virtual Private Storage Machine (VPSM) capabilities can guarantee QoS, allow depreciation of storage investment at LOB level if required, and simplify "storage utility" type charge-back . "VPSM" are complementary to Dynamic System Domains in Sun Servers, and support a customer's "Server Provider" Business Model initiatives · Connectivity for external storage systems enables storage aggregation and makes multitiered storage management and data movement practical, not just something to prepare for. · Universal Replicator software provides the enterprise-performance associated only with storage-based replication along with the cost benefits and higher data protection of journal-based technology. It can greatly simplify the task of highly resilient multitarget replication in heterogeneous, tiered storage environments. · StorEdge 9990 has unmatched security services. · StorEdge 9990 NAS Blade Features offer the ideal massive consolidation platform for plug-and-play, mission-critical file sharing offering the highest bandwidth, reliability, and capacity to reduce NAS "islands" through consolidation and simplify management.

Frequently Asked Questions

1. How do I keep up to date on the latest information regarding the SE 9900 product line?

Recommendation: Have one account team memeber subscribe to hdsconfig.global@Sun.com. Please subscribe via the NetAdmin tool.

This is recommended for any field team seriously involved involved in selling the SE 9900 product line.

What is the benefit to you? New features and schedule changes occur very frequently on this program. Near real-time updates are sent to this alias, so your team will know the latest information. Changes occur so frequently it is hard to keep all the documents up to date.

2. Where do I find out what external storage is supported?

Feature Availability Report (FAR) (Issued by Hitachi LTD and republished by Sun) Token # 385413. External support is found at the UVM tab in this document. This is important.

It is recommended that you review the entire Interoperablity Section in this document. It is on page 55.

3. How many microprocessors does a Front End Director contain.

The Front End Directors (FED) contain 16 microprocessors. As with all of the channel adapter features, the FED consists of two boards. In this case, the two boards each contain 8 microprocessors. The architecure is active/active so both boards are processing incoming transacitons. They also reside in two differenct hardware clusters for failover.

4. What is the ratio of microprocessors to ports?

FEDs come in 16 port and 32 port versions. For the 16 port versions., there is one microprocessor for for every port. For 32 port versions, there is one microprocessor for every two ports.

5. What professional services are available?

Please contact David H. Lindsay of professional services. Please note that in many cases, Sun sub-contracts to HDS for professional services for HDS specific/sourced software. Under these circumstances, engage Sun Professional Services, and they will in turn subcontract to HDS professional services.

6. Should I propose JNI HBAs in new proposals?

We recommend not to propose JNI HBAs to customers. JNI is not longer doing buisness and their products are EOLed. There is no qualification of JNI HBAs with Solaris 10.

7. What will happen if I propose something which is not supported?

There is a good chance that you customer will become very unhappy. For major items which are not supported, such AS/400, new multipathing software, Linux Clustering such as GFS, a GTY (Get To Yes) is not the appropriate route to take. See the Interoperablity section of this document on page 55. Qualification will likely take longer than you would expect, and this will make your customer unhappy.

Therefore, please ensure that you have a qualified configuration before you sell to your customer.

8. Do the HDS subsystems that HP sells, from a microcode perspective, (the subsystem) run/execute the same code as the subsystems that we or HDS sell?

 Our intelligence indicates that HP and HDS (and therefore Sun with the SE 9985 and SE 9985) use identical microcode. This rumor re-surfaces every 3 months. We took a good hard look at it several months ago and this is what our investigation concluded. Circa 2000 , HP at one time did use a different verison of microcode on their XP 256. This microcode system provided a variable SCSI que depth, increased the number of LUNS supported (256), , and enhanced HP-UX SAN security . However, these changes were driven back into the original Hitachi-sourced microcode and the microcode has returned to being identifical. Please note, however, that the Product ID (PID) and VID (Vendor ID) are different. HP field personnel may seek to exploit this difference, but in reality the microcode is the same. Don't let them fool the customer by telling them the PID and VID are different and therefore the microcode is different. Later, HP also incorporated change some of the interfaces to HP OpenView so they could boast better compatibility with HP OpenView. But we understand that HP withdrew from this effort because the need to maintain the interfaces in context of multiple microcode releases made it financiallly and operationally non-feasible. The information we received indicated HP did not want to maintain resource on what is essentially maintenace function which added minimal value add.

Periodically we receive assertions that HP has differentiated their product but when we ask for specific and or evidence to back up the assertion, the e-mail trail goes silent. I am willing to examine any contrary data anybody has.

9. With the recent contract extension that was just signed does that now allow us to sell upgrades to a subsystem that was originally sold by HP and/or HDS?

Generally speaking are positive goal is to result in net new sales and revenue for HDS and Sun. We should avoid taking business in HDS accounts because our objective is to work with HDS and take business away from IBM and EMC and HP.

10. Can we provide hardware wservice on boxes sold by HP or HDS boxes?

Sun **can only maintain** HDS units that Sun sells (Sun Logo'd units). This includes HP logo'd or HDS logo'd units. Sun is contractually prohibited from supporting any other HDS units without HDS's direct approvals.

11. What difference does it make that HP's relationship is with Hitachi and ours is with HDS (primarily)?

Sun has a distributor relationship. We also call it a reseller relationship. We take the product as is and leverage HDS Santa Clara support (e.g. their product and relationship managers) . Our relationship is with HDS Santa Clara although we do communicate with Hitachi Ltd. Japan.

HP has an OEM relationship and has a direct relationship with Hitachi Ltd.Japan. HP can change the product if they wished but our intellience suggest they tried this strategy and withdrew from it. See question 8 above. If a vendor such as HP chooses to change and OEM product, more responsbility and expense comes with an OEM relationship such as maintaining more engineers, product managment ect.

12. Of Hitachi's 35 or so percent of the high end storage market, what is the percentage for each vendor (for HDS, HP, SUN, and others)?

HDS Sun HP have rough 30 % each of HDS revenue. Sometimes Sun is ahead, sometimes HP is ahead.

13. On the 9985, is all software based on the frame (i.e., not capacity based)?
Not all software on SE 9985 is framebased. There are quite a few software packages which are capacity based. All you need to do is look at Partner Express (also known at PX tool - which is the configurator)

14 What are the equivelent Sun and HDS product names?

SE 9985 = NSC 55

SE 9990 = USP (Tagmastore Ultimate Storage Platform.

15. Will SATA drives be supported internally?

Actually, we refer to them as "Low Cost Fibre Channel Drives. They are expected late 1QFY07 or

early 1QFY07. The drives will have a Fiber Channel inteface to a SATA drive, 500 GB capacity at 7,200 RPM.

16. Will a 300 GB 15K rpm HDD be released on the SE 9985 or SE 9990?

There are no plans at this time.

Announcement Overview

1. What is being announced and when?

On September 14, 2004 Sun Microsystems will announce the Sun StorEdge 9990 system. With capabilities far beyond any other storage system, the StorEdge 9990 system establishes a new industry category: Powered by the next generation crossbar switch, the StorEdge 9990 system reaches previously unattainable levels of consolidation and provides the architecture to position the customer to move forward toward the virtualization of internal and external heterogeneous storage in one pool. Put simply, Sun is once again changing the industry paradigm for deploying and managing storage resources.

The StorEdge 9990 system provides a comprehensive set of storage and data services including application-centric storage area management, and simplified, unified data replication across as much as 336TB internal storage. As an integral component of the portfolio of Sun Application Optimized Storage™ solutions, the StorEdge 9990 system provides an unequaled foundation for matching application requirements to the attributes of different classes of storage, while fully leveraging, and even adding value to, current investments.

When complemented by services and solutions designed to realize its potential with best storage practices, the StorEdge 9990 system assists customers in more closely aligning IT and business objectives. In summary, Sun Microsystems is announcing the world's first storage platform, which unifies data and storage services across heterogeneous storage, supporting industrial-strength virtualization, replication, migration, and single pane-of-glass management. *Now, customers can use just one platform to manage all of their storage systems.*

2. What is unique about the StorEdge 9990 system?

The StorEdge 9990 system offers unique capabilities far beyond those presented by traditional enterprise-class storage systems, including:

- Superior performance (81GB/sec internal bandwidth supporting 2 million IOPS), scalable capacity (336TBs), and industry-leading number of connections (up to 192 Fibre Channel, over 24,000 virtual storage ports) for unequalled configuration flexibility

To put it into perspective, the StorEdge 9990 system scales to five times the capacity and five times the performance of today's high-end storage systems. Equally important, it allows data to be moved between storage systems and provides common management and common replication regardless of system type. In fact, it's the first storage platform that protects and even adds value to existing investment in Sun and non-Sun storage.

Going forward, the advanced architecture of the **StorEdge 9990 System not only positions customes with** massive scalability, capacity, performance, and manageability now, but also equips customers with the infrastructure to take the customer into the future. Existing applications such as High Volume OLTP (online transaction processing), Large scale Business Intelligence, and management of high volumes of operational and reference data to support regulatory compliance data can be made more effective with the outstanding throughput and performance of the SE9990. In the future, the customer will be able to add additional features which support advanced forms of Data Lifecycle Management and manageability.

4. What benefits do these unique attributes of the StorEdge 9990 system provide for customers?

- Reduced costs through storage consolidation/aggregation and increased management efficiencies

- Enhanced application QoS through matching of application requirements to storage attributes whether internal or externally attached

- Significantly improved SLA and lower costs associated with business continuity deployment and practices

- Enables a storage utility environment by providing secure, Virtual Private Storage Machiness and along with the ability to charge-back storage users.

- Higher return on investment by extending the life of current assets and enabling more efficient implementation new technologies.

5. Why is Sun Microsystems bringing the StorEdge 9990 system to market in September 2004?

The StorEdge 9990 system is much more than just a bigger, faster successor to the StorEdge 9980 series enterprise storage systems. It represents another advance in Sun's continuing record of innovation in developing products which have consistently anticipated the needs of enterprise customers.

In February 2002, Sun announced the enterprise-class StorEdge 9900 Series systems. These systems, in addition to higher performance, port-level virtualization with secure multi-tenancy (Host Storage Domains), enabled customers to take advantage of the systems' throughput and multi-tasking capabilities to implement massive storage consolidation. Today, the 9900 family is recognized as the technology leader in the high-end of the market.

Now, the time is right for Sun to release a storage platform that not only extends the capacity and performance of traditional storage systems, but also adds a host of storage services for which customers are beginning to identify a growing need. The 9990 system extends the Virtual Storage Ports/Host Storage Domains capabilities to logical partitioning of all resources and to managing of externally attached storage. As such, the StorEdge 9990 system introduces a new industry paradigm, offering much more than hardware and software, providing an architectural foundation not only for massive consolidation, but also for *aggregation across heterogeneous storage systems.*

6. Is Sun Microsystems announcing support for third-party storage systems?

Yes. Sun Microsystems will support the attachment of qualified, non-Sun branded storage to our SE9990 subsystem. Sun Global Customer Services will continue to manage heterogeneous product interoperability and support through existing third party support

agreements. Sun is committed to ensuring that seamless support is provided to our customers with external third-party storage attachments.

8. What StorEdge 9990 system models are available?

In response to requests from the sales channels the StorEdge 9990 system is one seamlessly upgradeable line. This is in contrast to the 9980 and 9970 in which there were two distinct models with no upgrade possible from one to the other. A single product line makes it easier to manage, forecast, and propose and allows selling from the bottom up with an easier to understand storage progression. To make ordering easier, there are three StorEdge 9990 "Pricing Reference Points" Each model is described briefly in the table below:

HDS Names   Sun Names

Tagmastore USP 100   Entry   SE9990 Entry

Tagmastore USP 600   Enhanced   SE9990 Enhanced

Tagmastore USP 1100 High End   SE9990 High End

Tagmastore USP is a HDS branding term and stands for " Tagmastore

".

Component	Description	NSC55	USP100 Entry	USP600 Enhanced	USP1100 High-end
Basic Platform Unit					

Integrated Control/Array Frame	1	1	1	1
Universal Star Network™ Crossbar Switch				
Number of Switches	2	2	4	4
Cached Bandwidth (GB/sec)	8.5	17	34	68
Control Bandwidth (GB/sec)	3.6	6.5	6.5	13
Aggregate Bandwidth (GB/sec)	12.1	23.5	40.5	81
Cache				
Cards	1	2	2	4
Base Memory (GB)	4	4	16	32
Maximum (GB)	64	64	128*	256
Control Memory				
Cards	2	2	2	4
Base Memory (GB)	2	3	3	4
Maximum (GB)	6	6	12	12
Front-end Directors				
Cards	1-2	1-4	1-6	1-6
Fibre Channel Ports (1, 2, or 4Gb/sec)	16-48	0-128	0-192	0-192
Virtual Ports	Up to 6,144	Up to 16,384	Up to 24,576	Up to 32,768
FICON Ports	0-16	0-64	0-96	0-96
ESCON Ports	0-16	0-64	0-96	0-96
NAS Blades/Ports**	0-1/0-8	0–4/0–32	0–4/0–32	0–4/0–32
iSCSI Blade / Ports	0-1/0-8	0–4/0–32	0–4/0–32	0–4/0–32
Back-end Directors				
Type	Std	Std	Std	Std
Numbers	1	1	2	2,4
Logical Devices Supported				
Open Systems	16,384	16,384	16,384	16,384
z/OS	65,536	65,536	65,536	65,536

These items do not represent different models of the SE9990. These items are merely "Pricing Reference Points".

There is only one model of the SE9990. Here is what this means. There is a SE9990 Control Frame which is the same and used for all "Pricing Reference Points" as identified above. Each "Pricing Reference Point" represents a different level of configuration. This means that each "Pricing Reference Point" uses the same control frame with more components in it. Greater capacity is provided via additional array

frames to the existing control frame. There is no forklift upgrade to move between the "Pricing Reference Points" mentioned above. Only more components need to be added to or attached to the SE9990 control frame. This is not like the SE9970 and SE9980, where the SE9970 is a single control frame that is not expandable.

9. What is the maximum internal and external capacity of the StorEdge 9990 system?

At introduction the StorEdge 9990 system will support a raw internal capacity of 336TB with 300 GB HDDs. Up to 31.67 petabytes of external storage can be managed and connected directly or through a switch to a 9990 system. This is a theoretical number.

10. What hard disk drives are supported?

Internal storage supports 72GB 15and 146GB 10K and 15K disk drives with 300GB 10K drives being a post GA deliverable. However, don't forget the externally connected drives.

11. How much cache does the 9990 system have?

At introduction, the 9990 system will support 256 GB of Data Cache and 12GB of Shared Memory

12. What host connectivity will be supported?

ESCON, FICON, and Fibre Channel. NAS are supported now. iSCSI is targeted for support 1QFY07.

13. How does StorEdge 9990 system increase storage and server utilization?

StorEdge 9990 system systems allow users to group and pool storage and make it available to the appropriate application or server.

15. How is the Service Processor (SVP) configured in the SE9990?

The SE9990 does not come equipped with a laptop, which in the past has been referred to as a Service Processor or SVP. Instead, service personnel will be expected to provide their own PC type of device to interface to the SE9990 for maintenance purposes.

A SE9990 will come initially with a SVP blade embedded in a control frame. It has similar capabilities to the SVP used in the SE9970 and SE9980 with the difference being that it is embedded in a slot in the Control Frame. A second SVP blade may be embedded for redundancy purposes. It is recommended that customers take advantage of SVP redundancy by purchasing a second SVP.

16. What are Back End Directors and Front End Directors?

New nomenclature is introduced in the SE9990 with respect to Channel
Host Adapters (CHA) and Array Control Processors (ACPs)/Disk Adapters
(DKAs). Redundant pairs of CHA are now referred to as "Front End
Directors" (FED) and Redundant Pairs of ACP/DKA are now referred to as
"Back End Directors" (BED). Note: For clarification, the terms "ACP"
and "DKA" are synonymous.

17. What is "Shared Memroy"?

"Control Cache" is now known as "Shared Memory".

18. Will the 100% Data Availability Guarantee be available
the SE9990?

Yes

19. Can I attach the new disk array frames and disks for the SE9990 to my
existing SE9960, SE9970, SE9980 control frame?

No. The new disk array frames are only supported on the SE9990
control frame. The new SE9990 are not backward compatible with
SE9960, SE9970, SE9980.

20. Are the hard disk drives used in the SE9960, SE9910, SE9980, SE9970
the same as those used in the SE9990?

No. Hard disk drives from SE9960, SE9910, SE9980, SE9970 cannot be
used in a SE9990.

21. What is the minimum and maximum of hard disk drives (HDDs) and Spares
in a SE9990?

	HDDs	Spares
	----------	---------
SE9990 100 Entry	5 - 256	1-4
SE9990 600 Enhanced	97 - 512	1-8
SE9990 1100 High End	129 - 1152	1-16

Here is what is confusing. The Maintenace Manuals indicate that a maximum of 40 spares may be
configured. However, the configurator (PX Tool) allows you to
  only configure up to 16 spares. Therefore, for all practical purposes, figure on configuring up to 16
spares is the limit.

We are in communications with HDS to encourage them to change this. HDS's current rational is that few customers order more than 2-4 spares,
they're their PX Tool people are concerned that tool much extra equipment might automatically triggered to be ordered.
. However, input from the Sun field suggests that as the capacity of disk drives increases, and disk rebuild times will also increase. Under these
circumstances, the demand for 2 spares per disk box may increase. This has been communicated to HDS, and disucssions are underway.

–

22. How many servers can the SE9990 Support?

248 servers, based on the following assumptions: the SE9990 can
support up to 4 switches. Assuming four switches with 128 ports each, this provides 512 ports. However, to configure for redundancy,
this results in 256 ports being available.

However, for back end connectivity to storage, assume 8 ports are
consumed, which leaves 248 ports to support 248 servers.

23. How many Logical Devices does a SE9990 support?

16,384

24. How many ports are dedicated to internal storage?

128 ports are dedicated to internal storage.

25. How much aggregate system bandwidth does the SE9990 provide?

The aggregate system bandwidth is 81GB/sec. This composed of
68GB/sec *data* bandwidth, and 13GB/sec *control* bandwidth.
This adds up to 81GB/sec aggregate system bandwidth.

26. Are there standard and high performance Back End Directors?

No. There is only one type of Back End Director, and it has
one microprocessor per Fibre Channel Loop.

27. How does the virtualization of the SE9990 systems compare
to that of the SE6920 series?

The SE9990 system provides virtualization features via software that is embedded in the array. The SE6920 virtualization is enabled through hardware that sits between the host and array system.

28.How many hard disk drives can be contained in an SE9990 Integrated Disk Controller and Disk Array Frame Unit?

128 hard disk drives.

29. How many hard disk drives can be contained in an SE9990 Disk Array Frame Unit?

256 hard disk drives.

30. Why are there only 192 FC port available when I count 256 ports?

The remaining 64 ports are dedicated to back end ports for hard disk drives.

31.How many SE9990 Fibre SFP Transceivers are included with the Sun StorEdge 9990 Fibre Channel 8-Port (Expandable to 16-Port) Front End Director and Sun StorEdge 9990 Fibre Channel 16-Port (Expandable to 32-Port) Front End Director?

8 of the 16 available fibre channel ports of the SE9990 Fibre Channel 8-Port (Expandable to 16-Port) Front End Director come standard populated with SE9990 Fibre SFP Transceivers for Short Wavelength (multi-mode) and 16 of the 32 available fibre channel ports of the SE9990 Fibre Channel 16-Port (Expandable to 32-Port) Front End Director come standard populated with SE9990 Fibre SFP Transceivers for Short Wavelength (multi-mode). Each fibre channel port can control either SWL or LWL within the same channel adapter dependent upon the mode of the installed transceivers.

Product Details—Software

32. Aren't the storage area management (SAM) benefits of the StorEdge 9990 system similar to those obtained from the HiCommand® Suite of software?

The HiCommand Suite provides many of the management benefits of the **StorEdge** 9990 system. It works the same with **StorEdge** 9990 system as it does with all of the other Sun solutions. That is how Sun differs from other vendors—customers don't have to manage different storage systems with different sets of tools. The **StorEdge** 9990 system is the hardware foundation for tying together other storage devices. It provides a single view of all attached storage.

33. How does the StorEdge 9990 system add value to the HiCommand storage area management story?

Sun Microsystems storage area management story centers on common management. Rather than provide end-users with disparate interfaces for disparate platforms, essentially resulting in multiple islands of storage, Sun provides customers with the same software, the same management interfaces, and the same key tools to manage all of Sun storage systems from a single console. Through the standards-based HiCommand Suite, customers can manage a broad range of heterogeneous storage devices. The **StorEdge** 9990 system builds on this by allowing storage to be attached, pooled/virtualized and managed.

34. Will all current StorEdge 9900 Series software products work on the StorEdge 9990 system?

Yes. All of current SAM and Business Continuity products, including the Sun Data Retention Utility, will work from "day one."

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StorEdge 9990 Universal Replicator

The StorEdge 9990 Universal Replicator is intended for organizations that have enterprise-class heterogeneous data replication needs for business continuity or operational improvement requirements. All current copy products will work within a StorEdge 9900 series environment. When used in conjunction with the StorEdge 9990 system, the Universal Replicator becomes the first storage-based replication software component that provides server-free and application-transparent journal-based multi-target replication features for data from heterogeneous storage environments. And it does this in a way that accommodates both open and mainframe systems users and maximises the performance of the replication process.

The disk journalling and pull technology are the two key factors which differentiate Universal Replicator.

Disk journaling masks outages from the customer, and allows the customer to avoid re-synchs. Here is an example. If there is an outage of a telecommunications link, transactions continue to be written to the disk journal as if there is no telecommunications outage. When the telecommunications link is restored, transactions transmission resumes as if an outage did not occur.

Pull technology means that the intermediate site or remote site polls the central site to initiate data transmission. The polling by the remote site therefore off loads housekeeping chores from the central site in terms keeping track of what data needs to be transferred. Data will be transmitte according to the size of the available communications pipe. The communications pipe does not need to be sized for peak loads as is with TrueCopy.

36. How does Universal Replicator handle network-related outages?

When a replication network sustains a failure, even temporarily, the result may be a suspension of the replication process, immediately affecting an organization's recovery capabilities. Through its performance-optimized *disk journaling*, Universal Replicator will log changes and transmit later to the secondary site.

37. What are the business benefits of Universal Replicator?

It all begins with management. From now on, customers can more easily manage the complexity created by multiple, heterogeneous replication products. They can:

- Simplify replication processes across any distance, including "out of region," for all applications and stored resources.
- Better handle the impact of network outages.
- Improve the management of bandwidth.
- Participate in a high-availability environment while limiting the impact on production applications.
- Optimize personnel and skill sets for administrative productivity.
- Provide advanced recovery capabilities to one or more recovery sites in order to support critical business operations.

38. What is Sun Universal Volume Manager software?

Sun Universal Volume Manager provides the virtualization of a multi-tiered storage area network, comprising heterogeneous storage systems. It enables the operation of multiple storage systems connected to the 9990 system as if they were all in one system and provides common management tools and software. The shared storage pool, composed of external storage volumes, can be used with storage system-based software for data migration and replication, as well as any host-based application. Combined with Sun Volume Migrator (formerly CruiseControl), Universal Volume Manager provides an automated data lifecycle management solution across multiple tiers of storage. Tiered Storage Manager (TSM) can also be added to this combination. TSM can be viewed as Volume Migrator with policies added to it to facilitate automation of data to specific tiers and group of similar data.

39. What is Sun Virtual Partition Manager software?

Sun Virtual Partition Manager enables the logical partitioning of ports, cache, and disk capacity (parity groups) on 9990 system systems to create independently managed Virtual Private Storage Machines. These logical partitions allocate separate, independently managed, dedicated storage resources for specific users (servers, applications, etc.), and available only to those users.

Storage resources can be allocated based on business requirements and priorities and be re-assigned as needed. To the host, the partition appears as if it is its own storage system and can be managed as such. Administrators will have access to configure and manage resources within their assigned partitions. Overall system priorities, disk space and tiers of storage can be managed and used most efficiently based on business applications and requirements by allocating and adjusting resources to each partition.Access

control managed through four levels of system adminstrators, each with a different level of authority, from low to high.

40. What is Sun MyDomain™?

MyDomain is a key feature of HiCommand Device Manager software. It enables local administrators to allocate and manage Virtual Private Storage Machiness. This empowers distributed users to manage their own Virtual Machine resources without the burden of managing the physical storage resources.

41. Does StorEdge 9990 HiCommand Device software replace StorEdge 9990 Resource Manager and StorEdge 9990 SANtinel?

No. StorEdge 9990 HiCommand Device Manger provides another control point for configuring LUNs but needs the StorEdge 9990 Resource Manager and StorEdge 9990 SANtinel array resident microcode to perform LUN management functions.

42. When should StorEdge 9990 HiCommand be ordered?

StorEdge 9990 Remote Console-Storage Navigator is sufficient to manage a single storage system. When multiple systems are installed, HiCommand provides a central control point for managing the storage systems.

43. What languages will the StorEdge 9990 series software products in this announcement support?

English and Japanese are the only languages currently supported. Strategy for further localization is reviewed on a periodic basis.

44. What level of software warranty/support comes standard with the purchase of StorEdge 9990 Series software?

A Standard software warranty comes with the purchase of the StorEdge 9990 series software. This warranty covers 90 day defective media replacement only. To take advantage of StorEdge 9990 series software free updates and upgrades, customers must purchase the appropriate Sun S4 Maintenance contract. The recommended level of support for this product is Premium.

For more information regarding Sun Software support, please visit the following URL:
http://www.sun.com/service/support/software/index.html

Product Details—Externally Attached Storage Systems

44. What storage systems can be attached to the 9990 system at announcement?

Please go to SunWin and access the Feature Availablity Report (FAR) at token # 385413.

Go to the UVM Tab.

45. Will customers be able to attach non-disk storage devices (e.g., tape) to the 9990 system?

There are no plans at this time.

46. Why would a customer attach storage to a StorEdge 9990 system system instead of attaching it to a switch? What stops competitors from adding virtualization capability plus a switch and provide a similar functionality?

First, the 9990 system's virtualization capabilities go much further than a switch can by:

- supporting and virtualizing up to 32PB of attached storage
- enabling the creation of logical storage systems, dedicating cache, ports, and capacity for applications, servers, or groups of users to guarantee quality of service (QoS),

Second, virtualization within **StorEdge** 9990 system's controllers delivers improved performance and functionality through tight integration with physical storage operations and takes advantage of the controllers' redundancy and massive scalability.

Third, there is no need for another device to manage or introduce latencies, as it would when everything runs through a switch or a virtualization appliance.

There's a reason ESG says, putting virtualization in the storage system rather than in the switch "makes sense and we believe IT professionals will agree."

47. Will another vendor's call-home feature still work if it encounters some failed drives?

Yes, 9990 system doesn't do anything to interfere with this type of feature.

Positioning and Key Messages

48. What is the fundamental positioning of the StorEdge 9990 system? What are the key messages?

TheSE 9990 system is much more than just a bigger, faster successor to the StorEdge 9870 and 9980 systems. It provides the foundation not only for massive consolidation, but also for aggregation across heterogeneous storage systems. It also virtualizes heterogeneous storage systems into a 9990 system (built from Sun and non-Sun storage systems). The 9990 system delivers a ground-breaking combination of proven storage, software, and services far beyond anything competitors can provide today. This combination of the industry's highest performing and most scalable storage hardware, storage

management and data replication/movement software unifies data and storage services across its own storage and the storage of heterogeneous systems attached to it.

When complemented by services and solutions designed to realize its potential with a never before attainable level of best storage practices, 9990 system bridges the gap between IT and business requirements by optimizing application and related business performance, reducing management complexity, simplifying information access, and improving business continuity.

49. What is a key message against the competition, such as EMC.

The StorEdge 9990 represents a leapfrog beyond what the DMX product line from EMC can do.

50. How does the 9990 system support Data Lifecycle Management (DLM)/Information Lifecycle Management (ILM) and the challenges that customers face?

The 9990 system enables a tiered-storage environment through hosting other storage devices. And it provides data movement between the tiers, with Sun Copy-on-Write Snapshot, Sun ShadowImage™ In-System Replication for volume copies, Sun StorEdge 9900 TrueCopy Remote Replication, and Sun Cross-System Copy (formerly HiCopy) for tiered replication. Tying together various tiers of storage and allowing the data to move between those tiers is the foundation for a DLM solution.

Target Markets and Customers

51. Who are the target customers for the StorEdge 9990 system?

The target customers for the **StorEdge** 9990 system are the traditional enterprise-class storage customers. In fact, most are the companies listed in the Fortune 100 and Global 500. These customers have the largest, most complex storage infrastructures. These customers will typically be existing users of high-end enterprise storage and have at least one of the following requirements: improved/simplified storage area management, ability to match application requirements to storage attributes, including tiered storage deployment, more effective consolidation augmented by aggregation, simpler and more effective business continuity, and/or a storage utility enablement.

Selling the StorEdge 9990 system

52. How does storage consolidation differ between the StorEdge 9980 / 9970 and the StorEdge 9990 systems?

With major improvements in scalability and performance, customers can consolidate much more capacity onto a **StorEdge** 9990 system. Then, add aggregation to the equation with attachment of other storage devices and the **StorEdge** 9990 system takes consolidation to the next level -- aggregation. A **StorEdge** 9990 system presents all storage attached to it as if it were its own and makes data migration/movement a much easier process.

53. How does the 9990 system provide a base for storage consolidation and investment protection?

For customers with investments in older, but still functional storage, the 9990 system's unique ability to attach and virtualize external storage delivers operational savings while enabling consolidation/aggregation, migration of critical data to higher performance storage, and repurposing and extending the useful life of existing systems to protect investments.

54. How does the StorEdge 9990 system support a tiered storage infrastructure?

For customers running multiple applications with varying requirements, the 9990 system's unique ability to host tiered storage and enable virtual private storage reduces investment and operational costs by providing tiered storage within a single, centrally managed system.

55. With the price per MB declining, how is Sun Microsystems planning to sell the StorEdge 9990 system?

Sun Microsystems prices to value. The kinds of applications that the 9990 system is designed to serve are mission critical and at the core of transaction systems. Simplistic metrics like dollar per MB don't fit. The value is in improved response time, reduced latency, reduced management costs, vastly improved efficiency, etc. Sales of the 9990 system should be architected more like an infrastructure solution as opposed to a disk sale.

Competition

56. What about IBM's SAN Volume Controller?

IBM's SAN Volume Controller (SVC) is not a storage system, but rather a storage virtualization appliance. Yes, it allows a customer to virtualize. But 9990 system scales 16 times that of SVC. IBM recommends a phased approach to SVC implementation, one application at a time. This means double systems and all the complications that implies. How long must two storage management platforms run side-by-side before SVC consolidation benefits can be reaped?

57 How is 9990 system better than the EMC Symmetrix DMX?

First, just as a storage device, DMX doesn't come close to matching 9990 system's scalability (capacity and performance). Second, DMX is not a platform. It does not support the attachment of storage systems (EMC's or any other vendor's), does not provide logical partitioning of physical resources, and does not allow universal replication.

Service

59. How can Sun help me with the migration and ongoing support of the
SE9990?

Sun Professional Services can assist the customer in optimizing
storage investments and improving your operating efficiencies in the
data center. Sun storage consultants can help the customer implement a
comprehensive data migration plan that mitigates risk and ensures a
smooth, prompt and uninterrupted transition to new storage
equipment. Sun can also help implement TrueCopy and ShadowImage
software for specific customer environments. Other relevant Storage
Services include:

The following optional technical services are available:

-SAN Architecture and Implementation
-Data Migration and Replication
-Storage Assessment
-Capacity Planning
-Performance Tuning

The following optional business services are available:

-Storage Total Cost of Ownership (TCO)
-Enterprise Continuity

60. Is installation included in the price of Sun StorEdge 9990 System?
SE9990 product purchase includes Sun StorEdge(SM) 9990
Installation Service, (9990 Installation) a basic install offering,
for new system (minimum 1 controller unit) purchase. This installation
is
provided during normal business hours.* The official service listing,
including scope, tasks, deliverables and customer responsibilities for
this and other service programs for Sun contracted customers, is
maintained at:

    http://www.sun.com/service/servicelist/

StorEdge 9990 product purchases sold for installation into existing

SE9990 systems, i.e. incrementally-sold single drive canisters, also include installation, provided during normal business hours.* Sun reserves the right to require customer to perform installation activities for certain optional components should it be determined that Sun's presence on-site is not necessary, e.g. for very basic product upgrade purchases such as power cords.

SE9990 Installation does not include the installation of optional third-party SAN components. Installation of optional third-party SAN components may involve additional charges.

SE9990 installation does not include any consulting engagement services.
Customers are encouraged to utilize Sun Services consulting for SAN architecture and implementation engagements. Customers may also utilize Implementation Service for Sun StorEdge 9900 Series for implementation services that go beyond the basic installation provided by StorEdge 9990 Installation.

*If installation is performed outside of normal business hours, for customers in all geographys except United States, the customer should be charged a separate line item charge for the following part: EIS-9900. The extra charge for after-hours installations applies to initial controller purchases and to any add-on purchases to existing controller units.

If installation is performed outside of normal business hours, for customers in United States, the customer should be charged a separate line item charge for the following part: AR-99-INS-BAS2. The extra charge for after-hours installations applies to initial controller purchases and to any add-on purchases to existing controller units. Business

61. How are storage system trade-in values determined?

Sun works with customers on a case-by-case basis to understand a customer's current book value coupled with market values for older systems. Sun's upgrade sales reps then determine the appropriate value for the storage devices being traded for the StorEdge 9990. This amount can be used to purchase additional migration services or more storage capacity thereby extending the purchase budget.

Support Services

SunSpectrum Support Offerings

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

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. For more information on the SunSpectrum program offerings refer to the following URL:

`http://service.central/TS/ESP/SunSpectrum/Feature_Matrix/index.html`.

The Gold/Platinum levels of SunSpectrum support contracts are outlined below.

SunSpectrum Program Support

Program	Description
Mission-Critical SunSpectrum Platinum℠ Support	Designed to support client-server, mission critical solutions by focusing on failure prevention, rapid recovery and year round technical services planning. Support is provided 24 x 7.
Business-Critical SunSpectrum Gold℠ Support	Includes a complete package of proactive and responsive services for customers who require maximum uptime for their strategic business-critical systems. Support is provided 24 x 7.

SunSpectrum Instant Upgrades

Where available, customers will be able to upgrade the enhanced warranty offering to a SunSpectrum Platinum (SM) service contract which includes 2 hours (average response) on-site service. (Platinum service may not be available in all areas. Consult with an Sun Enterprise Services Sales Representative for details.)

For StorEdge 9990:

Part Number	Description
W9D-T10-9990-3P	3-year SunSpectrum Platinum℠ program upgrade for Sun StorEdge 9990 controller

Part Number	Description
W9D-T10-1DSK-3P	3-year SunSpectrum Platinum program upgrade for Sun StorEdge 9990 disk

Sun Software Standard Support (ST)

Extended local business hours coverage 12 hours a day, five days a week

- Four (4) hour telephone response time for urgent* issues during extended local business hours
- Two (2) authorized contacts
- Unlimited technical support incidents
- You rate the priority of your support requests
- Technical assistance from experienced support engineers
- Web-based incident submission and tracking through Sun's Online Support Center
- Software enhancement releases and patches
- 7x24 access to Sun's online technical knowledge database
- SunSpectrum InfoExpress newsletter

Optional Services:

- Dedicated or Assigned Service Account Manager
- Dedicated Technical Support Engineer
- Additional authorized contacts

Specific features and service options may not be available in all regions. Coverage hours and response times may vary by country or location. After hours support may not be available in your local language.

Sun Software Premium Support(PR)

- 7x24 online and telephone technical support
- Live call transfer for urgent issues
- Three (3) authorized contacts per eight hour shift
- Unlimited technical support incidents
- You rate the severity of your support requests
- Technical assistance from experienced support engineers
- Web-based incident submission and tracking through Sun's Online Support Center
- Software enhancement releases and patches
- 7x24 access to Sun's online technical knowledge database
- SunSpectrum InfoExpress newsletter
- Interoperability Support

Optional Services:

- Dedicated or Assigned Service Account Manager
- Dedicated Technical Support Engineer
- Additional authorized contacts

Specific features and service options may not be available in all regions. Coverage hours and response times may vary by country or location. After hours support may not be available in your local language.

Warranty Information

Pg 199, change:

Warranty Information

This information applies to Sun StorEdge 9990, 9980 and 9970 systems.

Pg 195, mid-page a typo   'geographys'

This information applies to Sun StorEdge 9990, 9980 and 9970 systems. This does not include   third-party switch, director or HBA products. These products, while related to the StorEdge 9900 Series products, have standalone product support information (warranty, W9D parts and pricing, installation policy, SunSpectrum pricing, etc.) that are unique to each of these products.

The official StorEdge 9900 Series warranty statements are maintained at Sun's external web site at www.sun.com/service/support/warranty.

Sun warranty on StorEdge 9900 Series products currently includes an enhanced warranty with:

   3 years coverage

   7 x 24 Same Day 4-hour* on-site response

   7 x 24 Phone Support.

   *average response times.

Installation Information

<Summary of installation charges for initial install and add on upgrades>

StorEdge 9990 :

For customers outside of United States:

Installation Charge	Normal Business Hour	After Hour
Base Charge	No charge, included with product purchase, order EIS-9990-NC	Extra charge required. Order EIS-9900 per event
1Disk charge	No charge, included with product purchase ,EIS-9900-1DSK-NC	No extra charge required

For customers in United States:

Installation Charge	Normal Business Hour	After Hour
Base Charge	No charge, included with product purchase	Extra charge required. Order AR-99-INS-BAS2 per install event
1 Disk charge	No charge, included with product purchase	No extra charge required

StorEdge 9990 product include Sun StorEdge (SM) 9900 Installation Service, (9900 Installation) a basic install offering, for new subsystem (minimum 1 control unit) purchases. This installation is provided during normal business hours.[1] 9900 Installation currently includes the high-level deliverables shown below. The official service listing, including scope, tasks, deliverables and customer responsibilities for this and other service programs for Sun contracted customers, is maintained at:

   http://www.sun.com/service/servicelist/

StorEdge 9990 product purchases sold for installation into existing 9990 systems, i.e. incrementally-sold single drive canisters and/or 4-disk canister groups, also include installation, provided during normal business hours.[1] Sun reserves the right to require customer to perform installation activities for certain optional components should it be determined that Sun's presence on-site is not necessary, i.e. for very basic product upgrade purchases such as power cords for which Sun's presence on-site is not required.

9900 Installation does not include the installation of optional third-party SAN components. Installation of optional third-party SAN components may involve additional charges.

9900 installation does not not include any consulting engagement services. Customers are encouraged to utilize Sun Services consulting for SAN architecture and implementation engagements. Customers may also utilize Implementation Service for Sun StorEdge 9900 Series for implementation services that go beyond the basic installation provided by 9900 Installation.

Sun StorEdge 9900 Installation Service currently includes the following high-level deliverables. See service listing for official scope, tasks, deliverables and customer responsibilities.

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[1] If installation is performed outside of normal business hours, for customers in all geographies except United States, the customer should be charged a separate line item charge for ONLY the following part: EIS-9900. The EIS-9900-4DISK charge does not apply in this scenario. The extra charge for after-hours installations applies to initial controller purchases and to any add-on purchases to existing controller units.

If installation is performed outside of normal business hours, for customers in United States, the customer should be charged a separate line item charge for ONLY the following part: AR-99-INS-BAS2. The AR-99-INS-PER-4DSK charge does not apply in this scenario. The extra charge for after-hours installations applies to initial controller purchases and to any add-on purchases to existing controller units.

Site Audit

    Review customer physical environment

    Document environmental states

Installation Planning

    Plan, confirm and schedule resources

    Plan and confirm delivery & install dates

    Create installation related documentation

Installation Specification

    Discuss customer-defined RAID, LUN, connectivity requirements

    Review remote monitoring requirements, including customer analog line

Statement of Installation

    Verify completion of pre-installation tasks

    Verify supported configuration

    Customer sign off to begin installation

Hardware and software installation

    Unpack 9900 components.

    Review packing list

    Install and configure HBA's in Sun servers

    Install Solaris patches, if applicable.

    Connect controllers, disk frames and StorEdge 9990 components

    Connect subsystem to host server(s)[2]

    Power up and verify functionality (diagnostic level.)

    Install remote console components into customer-supplied workstation

    Connect service processor to customer phone line.

    Install Sun StorEdge 9900 Remote Response components

    Install and configure Resource Manager components per customer definition

[2] Connection of 9900 subsystem to host(s) through switches may involve additional charges and strong recommendation to customer to utilize Sun Professional Services engagement.

Basic installation does not not include any consulting engagement services.

Customers are encouraged to utilize Sun Professional Services for SAN architecture and implementation engagements. Sun Support Services maybe utilized for the switch/Director installation (not architecture/implementation) on a time and material basis, depending on product complexity and local field office availability.

A GNSS TE (Global Network Storage Sales Technical Engineer) must recommend a SAN configuration and be approved by Storage Control Center via the QTF (Quote Tracking Form.). The configuration must be in accordance with the WWWW (What Works With What) matrix is posted at

  http://gnss.ebay/dscgi/ds.py/View/Collection-732

Configure disk groups, LUNs, port mapping per customer definition

Installation Verification

Verify Sun server host connections to LUNs

Verify Sun StorEdge 9900 Remote Response with remote support center

System Turnover

Installation review and customer sign off

Provide system reference documentation

SunSpectrum Instant Upgrade (W9D) and Sun StorEdge 9900 Remote Response

Where available, customers will be able to upgrade the enhanced warranty offering to a SunSpectrum Platinum (SM) service contract which includes 2 hours (average response) on-site service. (Platinum service may not be available in all areas. Consult with an Sun Enterprise Services Sales Representative for details.)

StorEdge 9900 Series customers are eligible to receive Sun StorEdge 9900 Remote Response service as long as product is maintained under Sun warranty or SunSpectrum Gold (SM) or SunSpectrum Platinum service. Access to Sun StorEdge Joint Support Center is provided for StorEdge 9900 Series customers whose products are maintained under Sun warranty or SunSpectrum service.

Questions and Answers

Q.

What is Sun Support Services policy on third-party servers connected to StorEdge 9900 Series products?

A.

StorEdge 9900 Series products are designed for attachment to Sun Solaris and other open systems (HP-UX, IBM AIX), non-UNIX (i.e. Linux,Windows) and mainframe server platforms. The details of these supported configurations are provided in the WWWW matrix.

Sun Support Services will diagnose and troubleshoot the 9900 up to the point of connection of 9900 to the host server if connected in these heterogeneous and multi-platform environments in accordance with the WWWW matrix. Sun does not provide third-party host server break-fix warranty or contract support.

Q.

What is Sun Support Services policy on StorEdge 9900 Series SAN support?

A.

Sun currently sells Brocade and McData switch and director products as external SAN interconnect in support of StorEdge 9900 Series products. The design of such a SAN must be in conformance with Sun configuration rules. These rules are developed by NWS, working in conjunction with its partners. The current rules are listed in the WWWW matrix mentioned above. SAN's not developed in accordance with these rules may result in switch-to-host, switch-to-storage or switch-to-switch connections which cannot be supported by Sun.

Sun highly recommends the use of Sun Professional Services or highly accredited channel partner with strong Sun storage expertise for the proper design and implementation of a Storage Area Network in order to properly translate customer requirements into a feasible and supportable SAN solution.

For all interconnect components not sold by Sun but listed in the WWWW matrix, Sun will support the 9900 subsystem connection(s) in that particular SAN environment, provided proper configuration rules are followed. Sun will not provide warranty (break-fix) support for any interconnect component not sold by Sun.

Q.

What are Sun Support Services capabilities across customers' heterogeneous operating system environments?

A.

Sun Support Services' operating system expertise is tops in Sun Solaris. In addition, Sun's Customer Care Centers provide support expertise for customer product connections involving qualified Sun storage products attached to non-Solaris hosts. This currently includes Windows 2000, Windows NT, Linux, IBM-AIX and HP-UX. The nature of this support expertise includes single path interoperability, dual path fail-over involving the Sun StorEdge Traffic Manager software, and the limited ability to re-create customer interoperability involving non-Solaris equipment operating within the approved configurations. (The ability to re-create customer interoperability configurations varies depending on supported geography.)

Sun does not provide break-fix support for non-Sun servers or HBAs, but does provide support for Sun storage connections into those hosts when operating within the approved configurations. Qualified and supported configurations can be found at:

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

Q.

How does Sun Support Services provide a compelling reason to repeatedly choose Sun StorEdge for data center storage?

A.

Sun Support Services provides true end-to-end support expertise across customers' storage environment, server environment and interconnect. This goes beyond what any storage-only vendor can provide. As an example, Sun has a highly trained and experienced group called Storage ACES which spans Sun Support Services, Sun Professional Services, sales and product engineering. This is a global Sun community which shares best practices in storage and storage networking, where storage does not equal storage alone. Some team members have spent their entire career in storage while others bring a wealth of expertise from server support perspective including boot disk, server/storage clustering, volume management and application support. All members are expected to have expertise that spans beyond pure storage.

Sun Support Services also provides a centralized means in each major geography to provide integrated pre-sales configuration verification, pre-installation and installation control, and post-sales engineering control for product configurations via Sun Storage Control Centers. These centers also provide a means to coordinate the receipt and   problem resolution dispatch for Sun StorEdge 9900 Remote Response, which is part of Sun Remote Services remote proactive, preemptive and preventive support.

Sun Support Services provides Sun StorEdge customers with exclusive access to the Sun StorEdge Joint Support Center. The StorEdge Joint Support Center provides co-dedicated Sun and Hitachi Data Systems server, storage and interconnect equipment as well as personnel to provide joint problem resolution for Sun StorEdge customers.

Sun Support Services provides Solution Centers, parts depots and field engineering offices worldwide. These Solution Centers are networked worldwide to form a tight knit of shared best practices and knowledge management to leverage Sun's experience and solutions across the world to local Sun customers.

Sun Support also provides expertise that spans to numerous third-parties via Sun Support's extensive network of vendor support agreements. This expertise is in the form of product and support knowledge across interconnect and interoperability of third-party   products with Sun storage and servers. SunSpectrum Gold and Platinum customers can also gain access to the VERITAS-Oracle-Sun Joint Esc1STtion Center (VOS JEC) and to Sun's Vendor Integration Program (SunVIP [SM].)

Q.

How does Sun Support compare against the competition in data center storage system support?

A.

Storage-only vendors do not have Sun's expertise of Sun field and in-house experts across Sun servers, non-Sun server attachments to Sun storage, Sun storage, non-Sun storage attachments to Sun servers, Fibre networking including SAN and server cluster interconnect, Ethernet management and Sun software including server applications and storage applications.

Only Sun StorEdge 9900 customers have access to the Sun StorEdge Joint Support Center, which provides co-dedicated Sun storage and server experts along with HDS storage experts to resolve complex issues across servers, storage and interconnect.

Only SunSpectrum Gold and Platinum customers have access to SunVIP and VOS JEC (VERITAS Oracle Sun Joint Esc1STtion Center.)

StorEdge 9990 Warranty Upgrade Part Numbers and Descriptions

StorEdge 9990 Controller

PART NUMBER	NOTE(S)
W9D-T10-9990-1P	1,2

STOREDGE 9990 CONTROLLER UPGRADE TO 1 YEAR OF PLATINUM SUPPORT.

W9D-T10-9990-2P   1,2

SE9990 CONTROLLER UPGRADE TO 2 YEARS OF PLATINUM SUPPORT.

W9D-T10-9990-3P   1,2

SE9990 CONTROLLER UPGRADE TO 3 YEARS OF PLATINUM SUPPORT.

StorEdge 9990 Disk

W9D-T10-1DSK-1P   1,2

SE9990 DISK UPGRADE TO 1 YEAR OF PLATINUM SUPPORT.

W9D-T10-1DSK-2P   1,2

SE9990 DISK UPGRADE TO 2 YEARS OF PLATINUM SUPPORT.

W9D-T10-1DSK-3P   1,2

SE9990 DISK UPGRADE TO 3 YEARS OF PLATINUM SUPPORT.

Ordering Notes

1) Order quantity "1" of 1-, 2-, or 3-year W9D part number for StorEdge 9990 controller unit, plus quantity "n" of same term W9D part number for StorEdge T10-1DSK, where "n" equals the number of disks being configured.

2)   The W9D part numbers for control unit and disk groups cover the StorEdge 9900 subsystem warranty upgrade, including all other StorEdge 9900 part numbers (i.e., cache memory, hot spares, channel adapters.)

This does not cover warranty upgrades for any Sun-sold switches or director products for SAN configurations. Appropriate W9D part numbers for SAN components must be ordered separately.

3)   Order quantity 1 of this part number for software support. See also Footnote 4 for raw capacity licensed products and Footnote 5 for usable capacity licensed products.

----------------------------EXAMPLES-------------------------------

CS Software description   CS part number   SS support part number

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SE9980/9970 Resource   T9-200041-01   T9-200041-1ST

Manager Complete Base   T9-200041-1PR

                    T9-200041-3ST

                    T9-200041-3PR

4)   Order quantity "n" of this part number where "n" = each raw TB of 9900 configured capacity (rounded up to nearest whole number) in this capacity range.

----------------------------EXAMPLE--------------------------------

To order support for SE9980/9970 Resource Manager Complete for SE9980

configured with 12.4 TB raw capacity. Order the following:

Tier   ES Support Part No. Qty

Tier 1 (1 TB)   T9-2000036-1ST   1

Tier 2 (2-6TB)   T9-2000037-1ST   5

Tier 3 (7-15TB)   T9-2000038-1ST   7

5)   Order quantity "n" of this part number where "n" = each usable TB of 9900 configured capacity (rounded up to nearest whole number) in this capacity range.

----------------------------EXAMPLE--------------------------------

To order support for SE9980/9970 ShadowImage In-System Replication for SE9980

configured with 5.4 TB usable capacity used for primary/secondary volumes.

Order the following:

Tier	ES Support Part No.	Qty
Tier 1 (1 TB)	T9-200015-1ST	1
Tier 2 (2-6TB)	T9-200016-1ST	5

ShadowImage In-System Replication usable capacity licensing for 9980/9970 is based on **total usable capacity of all primary and secondary volumes.**

True Copy Remote Replication usable capacity licensing for 9980/9970 is based on **total usable capacity of all primary logical devices and secondary logical devices in local 9980/9970 system**. Each 9980/9970 system running True Copy Remote Replication (local and remote system) requires its own True Copy Remote Replication license.

Extended Remote Copy usable capacity licensing for 9980/9970 is based on **total usable capacity of all the S/390 emulation source logical devices under XRC control** (i.e., only the source devices.) With XRC3, the remote subsystem does not require an XRC license.

Sun Educational Services

Sun StorEdge 9990 System Installation and Administration (NWS-3311)

This course is intended to provide students with the knowledge to successfully describe, install, configure, access, maintain, and diagnose the Sun StorEdge 9990 system. Students receive classroom training and hands-on experience with the Sun StorEdge 9990 system.

People who need product specific training on the Sun StorEdge 9990 system should consider taking this course.

Upon completion of this course, students should be able to:

• Describe the features, functions, components, and architecture of the Sun StorEdge 9990 system

• Describe virtualization strategies and implementation on the Sun StorEdge 9990 system

• Install the Sun StorEdge 9990 system hardware

• Attach production hosts to the Sun StorEdge 9990 system

• Configure storage on the Sun StorEdge 9990 system

• Maintain the Sun StorEdge 9990 system

• Diagnose Sun StorEdge 9990 system failures

• Perform system and network administration

• Administer storage with basic storage management software tools

For further information on this course, please visit the Sun Educational Services Web site at:

http://www.sun.com/service/suned/, or to order, please call: 1-800-422-8020

Sun Professional Services

Sun Professional Services

Sun StorageTek 99xx Implementation Service (not specific to the 9990 but for all flavors of 9900)

The Sun StorageTek 99xx Implementation Service includes:

Delivery of these services utilizing Suns proven repeatable AIM methodology which includes overall Project Management of the service delivery, Testing and Documentation of the customer solution, and Knowledge Transfer/Training on the solution to the customer.

- Storage Assessment Workshop to capture requirements of volumes, host connectivity (Solaris OS and non Solaris OS), and network infrastructure requirements

- Development of a detailed system Build Specification, Project Plan, and Test Procedures Plan

- Connection of Sun StorageTek 99xx system to the customers Fibre Channel switches

- Installation, Configuration, and Integration testing of the final implementation according to the accepted Test Procedures Plan

- Hand-over explaining the system's configuration as documented in the Build Specification

- Configuration of volumes for up to four (Solaris do we want to be limiting here? I believe we should include both Mainframe as well as all Open Systems OS's) OS hosts

- Software configuration and implementation (specified bundled software) where required, these services include but are not limited to:

  Replication/ Data Migration

  Disaster Recovery/ Business Continuity

Sun StorEdge 9990 Implementation Service

The Sun StorEdge 9990 Implementation Service includes:

- Storage Assessment Workshop to capture requirements of volumes, host connectivity (Solaris OS and non Solaris OS), and network infrastructure

- Development of a detailed system Build Specification and Test Procedures Plan

- Connection of Sun StorEdge 9990 system to Fibre Channel switches

- Installation testing of the final implementation according to the accepted Test Procedures Plan

- Hand-over explaining the system's configuration as documented in the Build Specification

- Configuration of volumes for up to four Solaris OS hosts

- Software configuration and implementation (specified bundled software)

Architecture and Implementation Services

Sun offers a wide variety of consultative services that help the customer architect storage systems into their existing storage infrastructures. TCO Study Assessments along with architecture workshops combine the customer's business and technical requirements to deliver an architectural document that addresses both aspects. These services are generally available as custom quote engagements and can easily be combined with other service offerings such as the Business Continuance, Disaster Recovery, Enterprise Continuity, or Security Assessment services.

Data Migration Services

Sun Professional Services offers an extensive array of data migration services starting at a fixed-price assessment through a custom-price data center migration strategy. Current migration practices can optimize the utilization and functionality of the Sun StorEdge 9990 system according to the customer's business drivers and objectives.

Backup and Restore Assessment

The Backup and Restore Assessment methodology delivers an assessment of an existing VERITAS NetBackup or Solstice Backup™ environment. The assessment helps ensure that the existing configuration and operational environment meet customer requirements. It reveals weaknesses or

shortcomings in the areas of server and client configurations. Additionally, it reviews the historical operations of the backup and restore environment to help ensure the problems are not recurring or unknown. Finally, the service reviews the system management processes and personnel to help ensure operational continuity of the environment.

Tape Library Implementation

The Tape Library Implementation service delivers a working Sun StorEdge robotic tape library backup system with the hardware and backup and monitoring software components integrated together. This provides customers with a platform that can be used to develop and implement their production backup and recovery policies.

Glossary

Term	Definition
Array	Storage system consisting of trays and controller units. Storage system consisting of a minimum of one controller unit. Also includes one or more slots to house disks drives.
Array hot-spare	Disk that serves as a hot-spare within an array. A reserve disk that can be made available to all virtual disks within an array.
Asymmetric volume access	A storage access method that provides multiple data paths to the same volume, but allows only a subset of data paths at a time to be active.
Auto-sensing	Automatically determining the type of device connected (N-port, NL-port, F-port, FL-port, or Fabric) and adapting the port speed and interface protocol to match.
Back-End Director	A pair of array control processors (ACPs).
Block or block size	Amount of data sent or received by the host per I/O operation. Atomic read/write operation to/from a disk. Size of data unit that is striped across disks.
Cache	DRAM-based staging area used to provide higher performance to applications for reads and writes. During reads, the controller unit tries to keep the latest and most often accessed data in cache and also tries to pre-stage cache with future data during sequential accesses. For writes, cache is used to provide delayed writes to the disks. This delays the parity calculations and disk writes during RAID 5 operations. More optimization and advanced staging algorithms thus provide better performance.
Cache hit	Read or write request for data that is already in cache. Therefore, a request can be serviced without needing to go to disk.
Chunk	A quantity of information that is handled as a unit by the host and disk device.
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	Sequentially mapping blocks on disks to a logical device. Two or more extents can be concatenated and accessed as a single logical device. Add extents to an existing volume.
Control path	The communications path used for system management information. Generally provided as an out-of-band connection over Ethernet.
Controller pair	Pair of controller units servicing a particular tray or group of trays.
Controller tray	A tray with one or more installed controller units.
Controller unit	The intelligence card that manages RAID functions and fail-over characteristics for an array or tray, or group of trays.
Copy-On-Write (COW)	The process that Sun StorEdge 9900 Copy-on-Write software uses to preserve point-in-time data when new data is written to disk. With each write, the system preserves the old data in snapshot reserve space, so that it can re-create the volume as it existed at the time of the snapshot.

Term	Definition
CRC error checking	Checking for frames that have been corrupted (some of the 1 bits changed to 0 bits, and vice versa), due to noise or collision.
DAS	Direct attach storage. Storage directly attached to servers or hosts (as opposed to SAN storage where storage is attached to a network of storage devices).
Data path	The path traveled by data packet — between the host processor and the disk.
Dedicated hot-spare	Disk that serves as a hot-spare to one, and only one, virtual disk in an array or tray.
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	Physical entity that stores data (as compared to a virtual disk, which is a logical grouping of disks or storage extents).
Disk Slot	Slots on trays that house physical disks.
DMP	VERITAS dynamic multi-pathing.
Drive depopulation	Drive depopulation allows additional spindles to be added to drive trays that are not fully populated with 14 drives.
Duplexed cache	Cache mirroring with duplicate data paths to and from the cache. See *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.
E-Port	An expansion port connecting two fabric switches.
ESCON	Enterprise System Connection. An IBM protocol used to link mainframes with peripherals and other mainframes at 10 to 17 Mbps over fiber optic cable.
Event	A change in the state of a managed object.
Expansion cabinet	An additional cabinet to expand the capacity of a storage system.
Expansion tray	A tray without an installed controller, used to expand the capacity of an array and/or storage system. Must be attached to a controller tray to function.
Extent	A set of contiguous blocks on a disk or disks with consecutive logical addresses. Extents can be smaller or larger than physical disks. On the Solaris OS, 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.
Fabric	A group of interconnections between ports that includes a fabric element. A collection of switches and the connections between them.
Fail-over	See *Path Fail-over and Recovery*
FC-AL	Fibre Channel arbitrated loop, a loop topology used with Fibre Channel.
Fiber	A wire or optical strand. Spelled *fibre* in the context of Fibre Channel.

Term	Definition
Fibre Channel	A set of standards for a serial I/O bus capable of transferring data between two ports up to 100 MB per second. Fibre Channel supports point-to-point, arbitrated loop, and switched topologies. Fibre Channel can be implemented with either optical fiber (note spelling) or copper.
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.
FICON	Short for *Fiber Connection*, or *Fiber Connectivity*, IBM's fiber optic channel technology that extends the capabilities of its previous fiber optic channel standard, ESCON. Unlike ESCON, FICON supports full duplex data transfers and enables greater throughput rates over longer distances. FICON uses a mapping layer that is based on technology developed for Fibre Channel and multiplexing technology, which allows small data transfers to be transmitted at the same time as larger ones.
Floating hot-spare	A drive that remains an active data drive after a RAID controller replaces a failed drive with it. A replacement drive now becomes the new hot-spare drive.
Front-end Director	A pair of channel host adapters (CHAs).
FRU	Field replaceable unit. A component that can be removed and replaced during service in the field.
F_Port	On a Fibre Channel switch, a port that supports an N_port.
GBIC	Gigabit interface converter. A standard form factor that provides a hot-plug connection into a Fibre Channel device.
G_Port	On a Fibre Channel switch, a port that supports either F_Port or E_Port functionality.
HBA	Host bus adapter.
Host ports	DSP ports attached to hosts or host-facing SAN ports. Any DSP port is capable of being either a host port or a storage port.
Hot-spare	Disk used by a controller unit to replace a failed disk.
Hot-swappable	A hot-swappable 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 configures 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.
In-band	Using the data path between a host(s) and a storage device to transport system management traffic.
Initiator	On a Fibre Channel network, typically a server or workstation that requests transactions of disk or tape targets. Servers can have one or more initiators.
I/O	Input/output.
I/O rate	A measure of a device's capacity to transfer data to and from another device within a given time period, typically as I/O operations per second.
IOPS	Input/output operations per second. A measure of I/O performance, this is commonly used to quote random I/O performance.

Term	Definition
IP	Internet protocol. A set of protocols developed by the United States Department of Defense to communicate between dissimilar computers across networks.
iSCSI	A protocol being ratified by the IETF for the transmission of SCSI commands and data blocks over TCP/IP networks .
LED	Light emitting diode.
LUN	Logical Unit as defined by SNIA. Defines a volume as it is mapped to particular host(s) or initiator(s). Distinguished from a volume in a sense that the same volume can represent a different LUN to different host(s) or initiator(s).
LUN mapping	Assigning volume permissions (read-only, read/write, or none) to a host or initiator.
LUN masking	A technique that prevents all but certain initiators from gaining access to a volume.
Management path	The out-of-band path that connects components of the system to the storage service processor.
Mirror	The process of performing write operations to multiple physical media as part of each host-acknowledged write operation in order to maintain data availability. Provides data integrity by keeping multiple copies of identical volume data.
Mirrored cache	Redundant copies of data residing in cache — the (write) data residing in cache that has not yet been written to the hard disks is duplicated for fail-over operation.
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.
Multi-pathing	Providing two or more physical paths to a given target or device.
NAS	Network Attached Storage. Network Attached Storage is a term for a conventional or proprietary server that provides file storage over a network using file access network protocols like NFS or CIFS.
Network terminal concentrator (NTC)	A modem connection point for the Sun StorEdge Remote Response service. Helps facilitate a point-to-point connection from a remote support center.
Non-disruptive	Does not prevent system or data access at any time during operation. Data path access is not sacrificed, and the host does not see any I/O failure (unless dual points of failure). May no longer a be an HA environment. Availability of management services not included.
Non-floating hot-spare	A drive that reverts back to hot-spare status after a failed drive has been replaced and the mirror re-silvered or the stripe rebuilt.
N_Port	A Fibre Channel port in a 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).
NTC	Network terminal concentrator — see above.

Term	Definition
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.
OLTP	On-line transaction processing.
Optical fiber	Any filament of fiber, made of dielectric material, that guides light.
Out-of-band	Using a path other than the data path to transport system management information. Connecting to a management port using an IP network, for example.
Partner group (or partner pair)	Two controller units providing redundant data and management paths and mirrored cache duplexing (which provide controller fail-over and path fail-over capability).
Path failure	The loss of a data or management path.
Path fail-over and recovery	The process of automatically moving traffic to a different path when a path either fails, or is re-instated.
Point-in-time copy	A frozen copy of a volume's data, as created when taking a snapshot.
Port	An access point on a device for attaching a link.
Primary volume	Used in the context of snapshots, the primary volume is the live data set from which the snapshot copy is made.
Profile	A set of attributes applied to a set of storage in a storage pool designed to help optimize that pool for a particular access pattern and/or level of data protection. Profiles are associated with storage pools to define the attributes of the pool.
Protocol	A convention for data transmission that defines timing, control, format, and data representation.
RAID	Redundant array of independent disks. A set of disk drives that appear to be a single logical disk drive to an application such as a database or file system. Different RAID levels provide different capacity, performance, availability, and cost characteristics.
RAID group	A set of disks running a RAID algorithm.
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 that is easily available elsewhere within the organization.
RAID 1+	RAID level 1 (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. 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 a storage pool. If one of the mirrored pair fails, the data from the other drive is used.

Term	Definition
RAID 5	RAID level 5, or striping with distributed parity. Both data and parity information are striped across the drives. Because of parity, if a single drive fails, data can be recovered from the remaining drives. Two drive failures cause all data to be lost. In other words, 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 6	RAID level 6, or striping with two sets of distributed parity for improved reliability and availability.
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.
Reconstruction	The process of rebuilding lost data on a replacement disk after a disk failure.
Redundancy	Duplication for the purpose of achieving fault tolerance. Refers to duplication or addition of components, data, and functions within the array.
Rolling snapshot pattern	The creation of a series of snapshots in which the oldest snapshot is replaced each time a new snapshot is taken. For example, a weekly rolling snapshot pattern would cause this Tuesday's snapshot to replace last Tuesday's snapshot, this Wednesday's snapshot to replace last Wednesday's snapshot, etc.
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 simplifying management across servers.
SCSI	Small computer systems interface. An ANSI standard for controlling peripheral devices by one or more host computers.
Serial transmission	Data communication mode where bits are sent in sequence in a single fiber.
SFC	See *Switch Fabric Cards.*
SFP	Small form pluggable.
SIO	See *Storage I/O Cards.*
Snapshot	A point-in-time copy of volume data, created using copy-on-write technology.
Snapshot reserve space	Disk space reserved for Copy-on-Write data.
Snapshot rollback	The process of applying saved changes from a snapshot copy to a primary volume. The most common application of this feature is to roll the primary volume back to the state it was in at the time the snapshot was taken.

Term	Definition
(Snapshot) update	Modify an existing snapshot to contain data currently in the primary volume. This feature is typically used when updating the oldest snapshot to be the newest in a rolling snapshot pattern. Note (for developers): The DSP refers to this operation as a snapshot "reset".
SNMP	Simple network management protocol. A simple protocol designed to allow networked entities (for example, hosts, routers) to exchange monitoring information.
SRC	See *Storage Resource Card.*
SVP	*See Storage Service Processor.*
Storage domain	A logical domain with its own storage, and its own management environment.
Storage extent	See *Extent.*
Storage pool	A collection of disks, virtual disks or storage extents, generally with common configuration, availability, and performance characteristics, that can be carved into volumes.
Storage profile	See *Profile*.
Storage Resource Cards (SRC)	Processing cards in the DSP, which mate with SIO cards.
Storage Service Processor (SVP)	The management device integrated into storage systems that provide unified management access to system components and remote management functionality.
Striping	Laying data out over a series of disks or virtual disks, allows multiple disk controllers to simultaneously access data, thus improving performance.
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.
Sun StorEdge Storage Pool Manager software	Uses virtualization capabilities of the Sun StorEdge 9990 system to simplify storage management, using storage pools and application-oriented storage profiles.
Switch	The name of an implementation of the fabric topology. A fabric element that implements a fabric. The fabric element that allows each port of a switch to be connected to any other port on that switch. A collection of switches implement a fabric and provide the network through which any device can communicate with any other device.
Symmetric volume access	A storage access method that provides multiple live data paths to the same volume.
Syslog	The internal log file maintained by Sun StorEdge 9990 arrays to track events and alerts as well as informational and notice messages. This log file can be sent periodically to a host server for evaluation using the syslogd(1M) function.
System management	The set of features and functions that allow the user to control a storage system.
Target	The recipient of initiator commands. For example, volumes are presented to initiators as targets.
Telemetry stream	Stream of data generated by monitoring agents.

Term	Definition
Throughput	A measure of sequential I/O performance, quoted as gigabytes per second (GB/sec.). See *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 per second (MB/sec.).
Tray	An enclosure containing disks.
Tray depopulation	Trays delivered without the full compliment of disks installed. Allows additional disks to be added to trays that are not fully populated.
Virtual disk	Any abstraction or collection of disks that appears as a single disk to the device mounting it.
Volume	A logical disk carved from a storage pool. A virtual disk comprised of raw storage extents into which a file system, a DBMS, or an application can place data. Can be a single physical disk or a virtual disk mapped from one or more underlying extents.
Warm boot device	Bootable on all supported HBAs with storage booted before server booting.
Zone or zoning	Provided by fabric switches, a function that allows segmentation of node by physical port, name, or address.

COLLATERAL

	SunWIN Token

Sun StorEdge 9990 System Just the Facts	417582
Sun StorEdge 9990 System What Works With What(WWWW)	417583
Sun StorEdge 9990 System Customer Presentation	417584
Sun StorEdge 9990 System Hardware Datasheet	417585
Sun StorEdge 9990 System Software Datasheet	417586
Sun StorEdge 9990 System Sales Guide	417591
Sun StorEdge 9990 System Technical Presentation	418662

WEB INFORMATION:

Internal

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http://onestop/storage/9900/index.shtml?menu

http://webhome.ebay/networkstorage/products/9900/index.html

http://webhome.ebay/networkstorage/products/datacenter/

http://webhome.ebay/networkstorage/solutions/consolidation.html

http://webhome.ebay/networkstorage/products/software

http://systems.corp/programs/datacenter/consolidation/

http://suncluster.eng/

External

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http://reseller.sun.com/products/storage/9960.html

http://reseller.sun.com/products/storage/9910.html

http://www.sun.com/storage/highend/

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