

Sun StorEdge™ 9900 Series

Just the Facts

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TABLE OF CONTENTS

Positioning.....	7
Market Overview	7
A Very Brief Background on Architecture	9
Introduction.....	10
Key Features, Functions, Benefits	13
Product Family Placement.....	14
Key Messages.....	14
Top Three key messages:.....	14
sub-messages:.....	14
Management Software	16
Data Management	16
Storage Management	16
Target Users.....	16
Target Markets	17
Target Applications	17
Target Business Problems.....	18
Selling Highlights	19
Market Value Propositions	19
Competitive Comparisons.....	25
Major Weaknesses of the EMC Symmetrix 8000	26
Response to EMC Response - Lets keep the facts straight.....	27
Major Weaknesses of the IBM Shark/Compaq Red Shark.....	35
Major strengths of the Sun StorEdge™ 9900 Series	36
Software Name Cross-Matrix Grid	37
Selling the Sun StorEdge™ 9900 Series.....	38
Storage Challenges.....	38
Cost of Data Loss.....	38
Target Markets and Customers for Sun StorEdge™ 9900 Series	40
E-Business.....	40
Storage Consolidation and SANs	40
Business Intelligence.....	41
Managing Performance and Capacity.....	41

SSPs, ASPs, ISPs	41
Key Industries.....	42
Retail	42
Financial/Insurance.....	42
Healthcare Management	43
Telecommunications.....	43
Field Strategy – Competing with the Monoliths	44
Size up your prospect.....	44
The 800 Pound Gorilla.....	44
If you can't fix it, feature it.....	44
Your Strategy – preempt Their “Cookbooks”	44
Paint the Picture of What Customers Can Expect.....	44
Be Responsive and Forthright Throughout	45
Once the RFQ hits the street.....	45
It's not over until it's over	46
Conclusion	46
Enabling Technology	47
Features Overview	47
Hardware Features	47
Firmware Features.....	48
Software Features	49
Cache Control Algorithms.....	50
Control Unit (CU) Images, LVIs, LUNs	52
CU Images	52
Logical Volume Images (LVIs)	52
Logical Units (LUs)	52
Overview of System Architecture	53
Frame Configuration	53
Physical Configuration	55
Basic Architecture	56
Backend Architecture	57
External Host Interface Connectivity.....	59
LUNS Per Port	59
Host Connectivity Options	59
Array Control Processors.....	64

RAID 1+	67
RAID 5.....	67
Cross-Bar Switching.....	68
Cache Memory.....	68
Control Memory	69
Achieving True Scalability	70
System Administration	71
Reliability, Availability, Serviceability (RAS).....	72
Overview.....	72
Storage Clusters.....	77
Nonvolatile Shared Memory.....	77
Nonvolatile Duplex Cache.....	77
Multiple Data and Control Paths	78
Redundant Power Supplies	78
Client-Host Interface Processors (CHIPs) and Channels	78
Array Control Processors (ACPs).....	78
Array Frame	79
Disk Array Groups	80
Sequential Data Striping	81
Intermixing RAID Types, Drive Types, and Device Emulation.....	82
Service Processor (SVP)	82
Alternate Pathing.....	83
Specifications	84
System Specifications	84
Control Frame Specifications	85
Disk Drive Specifications	85
Physical Specifications	86
Data and Storage Management Software.....	86
Performance.....	87
General	87
Benchmark Results	88
Workload Configuration	88
Throughput Configuration	88
I/O Configuration.....	89
Key Findings	89

Workload Configuration	89
Throughput Configuration	89
I/O Configuration	89
RAID Performance	90
Requirements and Configuration	91
System Requirements	91
Multi-Platform Compatibility	91
Important Support Information	91
What Works With What – Sun StorEdge™ 9900 Series Compatibility Matrices	92
Host Operating System Compatibility	92
HA Clustering: Fail-Over and Alternate Path Compatibility	93
Host Server Compatibility	94
HBA Compatibility	95
Hub Compatibility	98
Switch Compatibility	99
Software Administration	105
Data Management Software	105
Sun StorEdge™ 9900 ShadowImage Software for S/390®	112
Sun StorEdge™ 9900 ShadowImage Software for Open Systems	113
Storage Management Software	120
Sun StorEdge™ 9900 Resource Manager	120
Sun StorEdge™ 9900 FlashAccess Software	120
Sun StorEdge™ 9900 Graph-Track Software	121
Sun StorEdge™ 9900 LUN Manager Software	122
Sun StorEdge™ 9900 Virtual Logical Volume Image Software	123
Sun StorEdge™ 9900 Prioritized Port Control Software	124
Sun StorEdge™ 9900 Parallel Access Volumes Software	124
Sun StorEdge™ 9900 LUN Size Expansion Software	124
Sun StorEdge™ 9900 CruiseControl Software	125
Sun StorEdge™ 9900 SANtinel Software	126
Ordering Information	128
Software Licenses	128
Software License and Maintenance Part Numbers	129
Shipping Configurations	132
Sun StorEdge™ 9910 System	133

Sun StorEdge™ 9960 System.....	134
Warranty Upgrade Part Numbers.....	136
Hardware Component SKUs.....	137
Sun StorEdge 9960 System	137
Sun StorEdge 9910 System	143
Sun StorEdge™ 9900 Software License SKUs	146
Brocade Switch SKUs.....	150
Jaycor (JNI) HBA SKUs	150
Warranty, Service, and Support	151
Warranty and Installation	152
Warranty	152
Sun StorEdge™ 9910 and Sun StorEdge™ 9960 systems.....	152
Warranty Upgrade Part Numbers.....	153
Brocade switch products for Sun StorEdge™ 9900 Series	153
JNI host bus adapter products for Sun StorEdge™ 9900 Series	154
Installation	154
Other Collateral.....	155
FAQs.....	156
Appendix A: Glossary	170
Appendix B: Commonly Misused Storage Terms	182
Appendix C: Calculating Lost Sales Worksheet.....	184
1. Calculating Lost Sales.....	184
2. Calculating Lost Productivity	184
3. Calculating Company Image Cost.....	184
4. Calculating Total Yearly Cost.....	185
Appendix D: Business Continuity Questionnaire.....	186
Appendix E: Enterprise Server, Storage & Tape Systems Summary.....	188

POSITIONING

Market Overview

With no tolerance for error, today's economy is highly volatile and dynamic and businesses are faced with fierce global competition. The strategic use of technology as a competitive edge may help businesses to achieve one-to-one marketing with fluid workforce dynamics. System capacity and performance planning has become extremely difficult - customers drop-in at all hours and thousands drop-in unexpectedly resulting in wildly fluctuating capacity demands. Information is power and business continuance is mandatory - poor response time could kill a business that depends on the internet.

These extremely demanding market conditions make planning for bandwidth and storage requirements for internet applications extremely difficult. In addition, these applications are now accessed by mobile users, have interactive content, create highly unpredictable access patterns, and require dynamic load balancing and more bandwidth – the internet is truly an access-on-demand technology. Organizations are adopting a more centralized approach to storage and continuous operation management in order to provide better control of bandwidth allocation, sharable storage, lower management costs, and better resolution of performance bottlenecks.

All these demands on storage require development of disaster recovery plans as the value of the electronic commerce increases. Interestingly, it is estimated that no more than 15% of the companies doing electronic commerce have implemented any type of adequate backup and recovery plans for their Internet applications. (Source: *Storage Panorama 2000, Horison Information Strategies*).

The biggest threat to a business thriving on the internet is its own success. Users, partners, suppliers, and customers, along with the applications and databases to support the required transactions, all promise to push storage infrastructure to its limits. Today, more than ever, a storage system has to allow capacity expansion without compromising performance.

Any slowdown in performance – caused by bottlenecks, planned busy-outs, or unplanned outages – means data is not available, even if only for a few seconds. But during that time period, customers are out there waiting, just a mere click away from competitors.

Digital storage is growing at over 60% per year. For many companies, storage requirements are doubling or tripling every 3-6 months. The drivers of such rapid growth are data-intensive applications such as video mail, high-content business profiling, biometrics, security, and geographic information, to name a few. Multimedia applications combining video, voice, and text will drive storage requirements at an unprecedented pace during the next three years. Electronic security based on fingerprints, facial structure, retina, iris, voice or signature prints will drive exponential increases in storage requirements. (Source: *Storage Panorama 2000 - Fred Moore*.)

With the dramatic increases in storage requirements, the value of the data and non-stop access to the data is more important than ever before. Users are intolerant of any disruption of service or delay in obtaining results – instant gratification takes too long! The average user waits only eight seconds or less for a response before clicking away to another site. The need for highly available, scalable systems is a must.

The Sun StorEdge™ 9900 series is designed to provide truly bottleneck-free performance with truly non-disruptive service and is designed to handle the most demanding I/O workloads.

Consolidation of storage systems onto Sun StorEdge™ 9900 series storage systems considerably simplifies storage management tasks. Scaling – increasing overall system performance as more capacity is added – provides extremely cost-effective full system utilization without performance degradation, so there is no need to forklift in a new system every time a few terabytes is exceeded.

The top industries for Sun StorEdge™ 9900 series are:

- Aerospace
- Transportation
- Banking
- Computer and Data Services
- Point of Sales
- Healthcare
- Insurance
- Financial/Securities
- Telecommunications
- Manufacturing
- Education
- Government

In today's connected economy, the ability to share and exploit information is key to the enterprise's success. Sharing information with suppliers and customers leads to new levels of supply chain efficiency and relationship management. Sharing information within an enterprise helps enable savings through duplication avoidance and empowers the transformation of information into knowledge which can then be acted on. Usually, by exploiting information, sales hit ratios can be improved through one-to-one marketing. Data warehousing/data mining-based business intelligence provides the means. In e-commerce, the information collected about a transaction is often more important than the transaction itself. Some e-tailers provide purchase recommendations when you visit their websites. Others have gone a step further by personalizing web pages based on customer information. This capability is not exclusive to e-tailers. Supermarket loyalty cards attempt to gather the same kind of information in a more traditional industry. Data warehousing/data mining-based applications help you make better decisions about marketing, sales and product strategies. Companies lacking such capability of information exploitation places them at a significant competitive disadvantage.

A Very Brief Background on Architecture

The base characteristics of cache-centric storage are very large data caching and multiple direct connectivity. Cache-centric storage was originally developed for (IBM) MVS. Since the data format and physical attachments (ESCON, FICON) exhibited high localities of reference (i.e., >90% cache hits), and the MVS operating system itself assisted with the caching within the storage system, fixed-bus architectures (SCSI, SSA, e.g.) performed adequately in these environments. Compare this to the small-cache/distributed array approach where the base characteristic is a fixed-block data format which exhibits poor locality of reference (i.e., the caching is done in the host) – the open host operating system provides no assists for storage subsystems. Although the Sun StorEdge™ 9900 series systems are cache-centric, they utilize a non-blocking FC cross-bar switching architecture – essentially a SAN inside the box, to they act like a distributed array system in a SAN.

The cache-to-LUN assignment in a fixed-bus cache-centric storage box is in reality a Hobson's choice for open system servers - you either have to assign dedicated cache/LUN, in which case you waste cache (because busy LUNs need more cache, and non-busy LUNs need less cache); or, you dynamically assign the cache/LUN, in which case the greater the workload, the greater the overhead (overhead is non-productive work) which means significantly decreased bandwidth efficiency. The Sun StorEdge™ 9900 series has automatic volume reassignment.

Aside from cache management, perhaps the biggest disadvantage of fixed-bus cache-centric storage boxes used on open systems is performance. Open systems utilize the cache available in the host server to stage I/Os. By combining a maximum of 512 backend drives, 64 internal switched paths, and sophisticated caching and RAID algorithms, the Sun StorEdge™ 9960 system provides a maximum internal throughput of 6.4GB/sec and a maximum internal IOPS of 155,000.

Introduction

The Sun StorEdge™ 9900 Series is for customers who require the extreme in non-disruptive service: install-and-forget extreme availability storage. With a uniquely flexible fabric switching design, the Sun StorEdge™ 9900 Series enables multiple data and LUN path resiliency necessary for seamlessly running concurrent MVS, UNIX®, and Windows host platforms. The Sun StorEdge™ 9900 Series provides host-less data transfer, data exchange, data replication, and disaster recovery functionality.

The data center storage system of choice for customers who require extreme levels of availability, performance, scalability, and manageability, Sun StorEdge™ 9900 Series systems combine a revolutionary fibre-channel (FC) switched non-blocking architecture with sophisticated RAS functionality is designed to provide truly non-disruptive performance and availability. This innovative switching architecture provides higher levels of resiliency, bandwidth throughput, and I/O throughput than the older monolithic fixed SCSI bus or fixed serial loop architectures still in use from other vendors.

These highly intelligent data center storage systems provide best-of-breed storage for glass house environments and feature a new switched architecture designed to provide increased levels of resiliency, bandwidth, and IOPS over the older fixed-bus/hub architectures still sold in the market today. The Sun StorEdge™ 9900 series brings data center heterogeneity, connectivity, availability, resiliency, reliability, serviceability, performance, and manageability to Sun's large enterprise and glass house customers who prefer to share data by consolidating storage from multiple disparate hosts onto a single storage platform.

The Sun StorEdge™ 9900 series is designed for non-stop operation and continuous access to all user data. To achieve non-stop customer operation, the Sun StorEdge™ 9900 series is designed for online feature upgrades and online software and hardware maintenance. With centralized local or remote monitoring, control, configuration, and diagnosis functionality, the Sun StorEdge™ 9900 series systems are designed to simplify even the fastest-growing storage environment. Supported by a worldwide network of mission-critical solution centers, customers receive virtually instant, one-call service no matter where they are located.

There are two Sun StorEdge™ 9900 series products: The Sun StorEdge™ 9960 system and the Sun StorEdge™ 9910 system:



Sun StorEdge™ 9910 System and Sun StorEdge™ 9960 System


Sun StorEdge 9960 System

- Multiple Frames
- 32GB max. cache
- 32 channels-ports max.
- 512 HDDs or 126 array groups
- 37+TB max raw capacity
- 1 - 4 ACP Pairs
- 27.5TB useable RAID 5 capacity



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TARGET APPLICATIONS
Data Center – Shared applications from multiple disparate open systems and/or mainframe hosts

TARGET OPERATING SYSTEMS
Open System UNIX, Open System Windows, Mainframe

TARGET USE
Multiple hosts, high performance enterprise-critical applications

SCALABLE IN FIVE DIMENSIONS

- Extreme availability – Bullet proof, worry-free, everything hot-replaceable/installable and duplexed + bullet proof data protection software for true disruption-free operation
- Extreme resiliency – 64 separate data and control I/O paths
- Extreme performance – Non-blocked FC switch architecture easily takes on heavy loads
- Extreme connectivity – Interfaces to a wide variety of multiple hosts
- Extreme manageability – Centrally configure, monitor, control, fix locally or remotely

POSITIONING – KEY USER BENEFITS

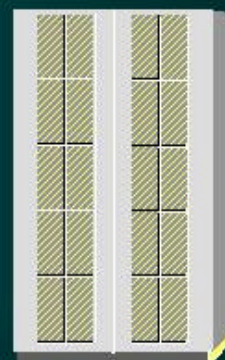
- Best overall TCO for centralized storage consolidation
- Best data and data access protection for multiple disparate host environments
- Truly bottleneck-free, non-disruptive operation for use in heterogeneous environments


FC Switched Host-Independent Storage System

- Advanced server-less off-site data replication, PIT copy, and disaster recovery
- Data center-class components, advanced RAID 5, global non-floating hot sparing
- Everything duplexed and hot-swap/redundant with battery-backed 32GB cache
- Up to 37TB raw capacity and 6.4GB/sec throughput
- 32 ESCON, 32 FC, or 192 FC switch host connections

Sun StorEdge 9910 System

- Single Cabinet
- 16GB max cache
- 24 channels-ports max.
- 48 HDDs or 11 array groups
- 3+TB max raw capacity
- 1 ACP Pair
- 2.4TB useable RAID 5 capacity



SATELLITE DATA CENTER		TARGET APPLICATIONS Remote/Satellite Data Center – Off-site repository for key data
		TARGET OPERATING SYSTEMS Open System UNIX, Open System Windows, Mainframe
		TARGET USE Use in place of SE9960 when faced with space constraints or when distributing risk
		SCALABLE IN FIVE DIMENSIONS <ul style="list-style-type: none"> • Extreme availability – Bullet proof, worry-free, everything hot-replaceable/installable and duplexed + bullet proof data protection software • Extreme resiliency – 32 separate data and control I/O paths • Extreme performance – Non-blocked FC switch architecture easily takes on heavy loads • Extreme connectivity – Interfaces to a wide variety of multiple hosts • Extreme manageability – Centrally configure, monitor, control, fix locally or remotely
		POSITIONING – KEY USER BENEFITS <ul style="list-style-type: none"> • Low TCO for satellite sites with heterogeneous requirements • Data and data access protection for multiple disparate host environments • Non-disruptive operation for use in heterogeneous environments
	FC Switched Host-Independent Storage System <ul style="list-style-type: none"> • Advanced server-less off-site data replication, PIT copy, and disaster recovery • Data center-class components, advanced RAID 5, global non-floating hot sparing • Everything duplexed hot-swap redundant with battery-backed 16GB cache • Up to 3.5TB raw capacity and 3.2GB/sec throughput • 24 ESCON, 24 FC, or 144 FC switch host connections 	

Key Features, Functions, Benefits

The Sun StorEdge™ 9900 series storage system has extremely attractive features which make them the products of choice for data centers throughout the world.

Feature	Function	Benefit
<ul style="list-style-type: none"> Instant, point-in-time copies Non-disruptive scalability to 37-TB 	<ul style="list-style-type: none"> Real-time analysis of customer behavior Power to resolve complex queries No impact on production systems 	Fast, Reliable Business Intelligence
<ul style="list-style-type: none"> Copy-based, disaster-tolerant solutions Off-site redundancy with data integrity Host-less "MIP-less" any-to-any copies 	<ul style="list-style-type: none"> Tapeless data vaulting ability User can define point-in-time copies Does not impact critical applications 	Business Continuance
<ul style="list-style-type: none"> Highly resilient switched fabric architecture Redundant, hot-swappable components Mirrored write cache with battery backup ECC memory "Call-home" maintenance service Host failover and alternate path support Non-disruptive microcode upgrades RAID 1+, RAID 5 support Point-in-time and remote copy software for data backup and rapid recovery GDPS support 	<ul style="list-style-type: none"> No single point of failure Protects data Protects access to data 	Virtually Instant Data Access
<ul style="list-style-type: none"> Simultaneously supports mainframe, Windows, and UNIX® hosts High-scaling cross bar switching architecture with 64 data and control I/O paths Highly intuitive management GUI allows customer control and configuration 	<ul style="list-style-type: none"> Ability to form centralized shared or non-shared storage pools Replacement of six or more competitive fixed-bus storage systems with one Sun StorEdge™ 9960 system Simplified approach to management reduces costs 	Storage Consolidation
<ul style="list-style-type: none"> Point-in-time copies for disaster recovery, tapeless data vaulting, data warehousing/data mining, or application testing Data movement and on-line data migration over virtually unlimited distances Sophisticated and scalable backup/restore functions Alternate path, Solaris-based clustering software support 	<ul style="list-style-type: none"> Ability to perform key data management tasks without impacting production Ability to update disparate databases without impacting production Ability to tailor key data protection methodologies to the unique IT needs of your business Helps to approach six sigma levels of continuous uptime 	Continuous Information Access
<ul style="list-style-type: none"> Supports information sharing in heterogeneous environments Non-disruptive performance-boosting features like on-the-fly optimization, cache tuning, LUN sizing, LUN carving, load balancing, dynamic path reconnect, and cache locking 	<ul style="list-style-type: none"> Optimized performance for mission-critical and mission-critical online applications Maximizes usage of virtually unparalleled scalability Allows fast data exchange among UNIX®, Windows, and S/390 platforms 	Accelerated Information Access
<ul style="list-style-type: none"> Full suite of management software Supports consistent procedures and policies for very large installations 	<ul style="list-style-type: none"> Makes it easy to plan and automate storage networks Provides event, performance, and configuration management 	Reduced Management Complexity

Product Family Placement

Sun is expanding its product lineup by joining forces with Hitachi to offer the Sun StorEdge™ 9900 series, optimized for storage consolidation and enterprise SAN applications in high-end, glass house data centers. These powerful and intelligent host-independent data center storage systems deliver heterogeneity for both open systems and mainframe environments along with extreme levels of availability, reliability, resiliency, connectivity, and performance.

Sun StorEdge™ T3 arrays are Sun's most successful arrays ever. They excel in midrange and enterprise applications in distributed environments outside the glass house. The characteristics, which make the Sun StorEdge™ T3 array so popular are its cost-effective 3-way linear scalability of capacity, performance, and availability in real-world applications ranging from web and email to data warehousing.

The Sun StorEdge™ 9900 series augments the current Sun StorEdge™ product family, which can now fulfill Sun's customers' requirements from the smallest to the largest applications.

Key Messages

TOP THREE KEY MESSAGES:

- Sun customers are demanding data center-class storage solutions from Sun, and we are responding to their needs by enhancing our Sun StorEdge™ product family with the addition of the Sun StorEdge™ 9900 series
- The Sun StorEdge™ 9900 series represents leadership in the data center segment
- Sun now offers a more comprehensive storage product line giving customers one throat to choke for virtually all their storage needs, from the workgroup up to the data center.

SUB-MESSAGES:

- **Protect your Business with Extreme Availability.** The Sun StorEdge™ 9960 and 9910 systems are for customers who require the extreme in non-disruptive service: install-and-forget, worry-free, extreme availability storage. Your business stays up and running smoothly and efficiently.
- **Consolidate with Confidence (Storage Consolidation).** Designed for modern IT environments with enterprise-critical requirements, the Sun StorEdge™ 9900 series is used to consolidate multiple platforms onto a single host-independent storage system, which significantly lowers total cost of ownership. (With its uniquely flexible fabric switching design, the Sun StorEdge™ 9990 series enables multiple data and LUN path resiliency necessary for seamlessly running concurrent MVS, UNIX®, and Windows host platforms).
- **You're in Control.** Easy to operate and control, Sun StorEdge™ 9900 series significantly simplifies storage management tasks, which significantly lowers total cost of ownership. So you can focus on growing your business instead of wasting time and money over your out-of-control ever-expanding IT infrastructure. Make your life easier and get your life back.
- **No matter where you are, we have you covered.** We offer prompt worldwide support and services from mission-critical service centers, seamless integrated solutions for your company's unique local or global needs, global storage labs, and thousands of engineers worldwide
- **Protect Your Business.** The Sun StorEdge™ 9900 series is designed to provide disaster recovery and remote site replication to protect your valuable data and your access to that data during critical and non-critical periods alike.
- **Spend IT Wisely.** The Sun StorEdge™ 9900 series is designed to perform and not fail for years to come; moreover, inherently high scalability keeps up with your ever-changing business requirements, which means you will obtain maximum asset optimization and ROI.

- **One-Stop Shop.** Sun is now your one-stop storage shop for your heterogeneous environment comprised of UNIX®, Windows, and/or S/390 host platforms.
- **Grow with Us.** The Sun StorEdge™ 9900 series can be quickly and easily adapted to your changing business IT requirements by providing flexible, scalable, predictable, high-speed I/O performance across your enterprise as you add storage capacity.
- **Keep it Up.** The Sun StorEdge™ 9900 series provides extreme availability, reliability, manageability, connectivity, and performance for consolidating the storage requirements of your UNIX®, Windows, and/or S/390 host platforms.
- **Easy, Convenient Management.** One console to locally or remotely monitor, control, and diagnose your Sun StorEdge™ 9960 and Sun StorEdge™ 9910 no matter what the host platform from wherever you are in the world.
- **Storage Made Simple.** Automatic tuning software and intelligent learning algorithms make your job even easier.
- **Your Storage Doesn't Have to Cost so Much.** Using the Sun StorEdge™ 9960 system for storage consolidation may significantly lower your total cost of ownership in consolidation multi-host consolidation environments compared to a dispersed storage approach or to cache-centric competitive fixed-bus systems.
- **Every Bottleneck Costs You Money.** The Sun StorEdge™ 9900 series has highly scalable performance designed to easily keep up with the constantly changing demands of your growing business without bogging down.
- **Get Connected.** Direct-attach or SAN-attach open system and/or mainframe host connectivity and functionality provides up to 32 DAS-connected hosts or up to 192 SAN-connected hosts and allows simultaneous sharing of applications from multiple hosts

Management Software

There are ten software packages available for use on the Sun StorEdge™ 9900 series storage systems:

DATA MANAGEMENT

- Copy, Disaster Recovery, Backup/Restore:
 - Sun StorEdge™ 9900 Multi-Platform Backup/Restore Software
 - Sun StorEdge™ 9900 Dynamic Link Manager Software
 - Sun StorEdge™ 9900 Extended Remote Copy Software
 - Sun StorEdge™ 9900 ShadowImage Software
 - Sun StorEdge™ 9900 TrueCopy Software
- Information Sharing and Exchange:
 - Sun StorEdge™ 9900 RapidXchange Software

STORAGE MANAGEMENT

- Sun StorEdge™ 9900 Resource Manager Software Suite includes:
 - Sun StorEdge™ 9900 FlashAccess Software
 - Sun StorEdge™ 9900 Graph-Track Software
 - Sun StorEdge™ 9900 LUN Manager Software
 - Sun StorEdge™ 9900 Virtual Logical Volume Image Software
 - Sun StorEdge™ 9900 Prioritized Port Control Software
 - Sun StorEdge™ 9900 LUN Size Expansion Software
- Sun StorEdge™ 9900 CruiseControl Software
- Sun StorEdge™ 9900 SANtinel Software
- Sun StorEdge™ 9900 Parallel Access Volumes Software

For a detailed description of these programs, please refer to the **Software Administration** section of this document.

Target Users

The primary customers for the Sun StorEdge™ 9900 series are Sun network storage direct accounts, storage-only resellers, solution resellers, OEMs, distributors, and system remarketers. Sun StorEdge™ 9900 series systems meet or exceed user needs, as shown in the table below.

Individual User	Buying Influence Needs
MIS manager	FC switching technology investment in the future
Procurement	Investment protection in existing and future products
Developer	Standards compliance for implementation of FC products
Systems administrator	Flexible management in both software and hot-swap components
Operations	Extreme availability, allowing efficient system operation for storage consolidation
End user	Extreme performance, resulting in quick I/O response across multiple shared applications

Target Markets

The Sun StorEdge™ 9900 series is well suited for the capacity, availability, connectivity, performance, and manageability requirements of enterprise data centers. Strategic uses for this high-end host-independent storage system within the manufacturing, government, finance, and entertainment industries include, but are not limited to, those shown in the table below.

Industry/Customer	Key Features to Highlight
Disaster recovery	Remote host-less data mirroring across any distance
Workgroup storage	Can support massive amounts of centralized, consolidated pooled workgroup storage
Data center storage	Extremely continuous, truly non-disruptive performance, even in a SAN environment
Technical computing	Extreme performance data storage consolidation for large engineering design projects
Scientific computing	Extremely high 6.4GB/sec internal bandwidth for data capture, retrieval and storage

The Sun StorEdge™ 9900 series is targeted to data centers which do not tolerate any disruption of service.

Targeted groups within these market segments are:

- F1000 customers moving to storage area networks (SANs)
- Existing Sun enterprise-class storage customers in high-growth businesses

Target Applications

- Service providers (e-mail, v-mail, static/dynamic web servers, e-commerce)
- Enterprise and data center (OLTP, DSS)
- Technical and scientific applications (high-performance computing)
- Image capture and retrieval applications such as medical imaging and high-performance data acquisition
- Video streaming applications
- Enterprise-critical SANs with multi-path fail-over, off-site data replication, and/or disaster recovery requirements
- Host-independent open systems/mainframe storage consolidation platform
- Data sharing between disparate database systems
- Server-less backup/restore, data replication

Target Business Problems

In today's economy, administrators and managers face a whole laundry list of business-related problems related to storage which the Sun Series 9900 storage systems may help solve:

- The need to improve profitability by lowering the cost per transaction
- The need for instant access to their data
- The need to deliver non-stop instantaneous access to their mission-critical information, to manage it on a global basis, and to keep it safe from any unexpected human or natural disaster
- The need to deliver bottleneck-free access to their data because they can't afford to be down, disrupted, or busy for even a few seconds
- The need for an intelligent storage system which is dynamically adaptable, scalable, expandable, and will be ready and available no matter when it is needed
- The need for extreme availability (install-and-forget bulletproof) storage
- The need for a safe method which allows for storage consolidation
- The need for a simple and easy way to cost-effectively (e.g., centrally) manage consolidated or very large open systems and/or mainframe storage
- A way to move data across disparate platforms
- The need for truly non-disruptive and continuous access to data
- The need to withstand multiple simultaneous failures
- The need for multi-path host fail-over and HA clustering support
- The need to protect the business via implementation of disaster recovery policies and procedures
- The need to protect valuable information via the implementation of remote data replication
- The need for highly granular data management (e.g., LUN sizing and carving; RAID level mixing and setting)
- The need for storage and LUN expansion/reconfiguration
- The need for centralized, seamless non-interruptive support with single point monitoring
- The need to receive daily status reports
- The need for remote monitoring, diagnosis, and proactive break/fix storage (e.g., call home capability)
- The need for worldwide support no matter where they are
- The need to exceptionally handle Open System workloads
- The need to exceptionally handle MVS (mainframe) workloads
- The need to easily and effectively keep up with growing user workload demands
- The need to effectively match storage to their applications' workload requirements and to their business's needs
- The need to simultaneously connect storage to multiple disparate host platforms
- They want to focus on their business, not on IT – they want Sun to focus on their IT for them
- The need to actually/really/truly lower their out-of-control storage costs over time
- The need to finally seize control of their run-away storage costs
- The need to keep their data safe from corruption (data integrity)
- The need to keep their competitors at bay
- The need to ensure their company has the IT infrastructure in place to support their strategic initiatives which will determine their success in the New Economy

SELLING HIGHLIGHTS

Market Value Propositions

Value Proposition

The Sun StorEdge™ 9900 series may help customers save huge amounts of money on both acquisition and ownership costs. The larger the required usable capacity, the more they will save:

Proof Points

- Sun StorEdge™ 9900 series support a RAID 5 which is the performance equivalent of mirrored HDD in virtually all real-world situations. With RAID 5, for every four HDDs, three drives generate usable online capacity, whereas with mirroring, only two HDDs generate usable online capacity. ***The use of RAID 5 over mirroring results in a savings of 25% of the price of the drives right off the top.***
- Sun StorEdge™ 9900 series segregate data from control I/O in the cache and on the data paths; provide advanced caching algorithms; provide a non-blocking switching FC architecture with 64 separate data paths; and provide several performance-boosting tools. As a result, the Sun StorEdge™ 9900 series scales positively – as more capacity is added, the overall performance (GB/sec and IOPS) is actually increased. A Sun Storage 9960 system has 32 direct host ports (FC, ESCON, or a combination of the two) and in addition can support as many as 192 switched hosts in a SAN environment. A Sun Storage 9960 system can support a full configuration of 512 drives (about 37TB of raw capacity, or around 27TB of usable RAID 5 capacity). By contrast, traditional fixed-bus architectures hold fewer drives and are negative scaling – i.e., as more capacity is added, overall performance decreases. ***The use of performance-enhanced non-blocking fabric switching architecture allows full use of a fully configured Sun StorEdge™ 9900 series system, , resulting in smaller foot print, significant cost savings, and more efficient operation since fewer storage systems are required. Fewer SW licenses. Superfluous HW component purchases, installations, and management are kept to a minimum.***
- Sun StorEdge™ 9900 series a highly intuitive-to-use GUI providing unparalleled user management capabilities from a centralized location, local or remote. The end user can monitor, reconfigure/configure, and performance tune this system on the fly, without disruption of production service. Other cache-centric boxes require an SE to come out from the system vendor to make even the most minor of changes with a service charge assessed for the time spent. ***The unique ability to self-manage the Sun StorEdge™ 9900 series may result in dramatic cost savings in service charges alone (the more rapid the data center requires changes the storage, the more money which will be saved).***

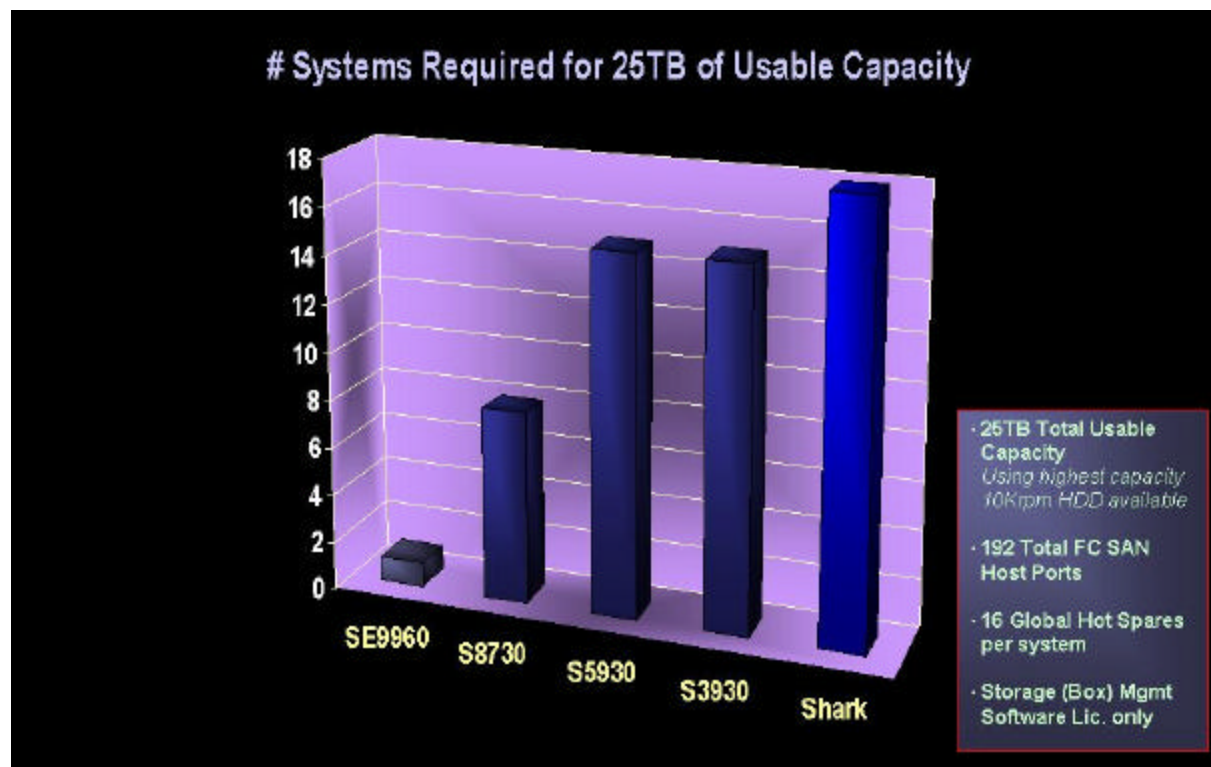
Value Proposition

Since competitive fixed-bus cache-centric monolithic boxes cannot be utilized in full configuration, a single Sun StorEdge™ 9900 series can replace three or more of these products, saving valuable floor space, lowering both hardware component and software licensing acquisition costs, and eliminating hidden backend costs with its intuitive configuration management software:

- One Sun StorEdge™ 9960 system can actually scale to a full configuration
- One Sun StorEdge™ 9960 system can replace three or more current-generation fixed-bus monoliths
- One Sun StorEdge™ 9960 system can replace as many as 25 older-generation fixed-bus monoliths

Proof Points

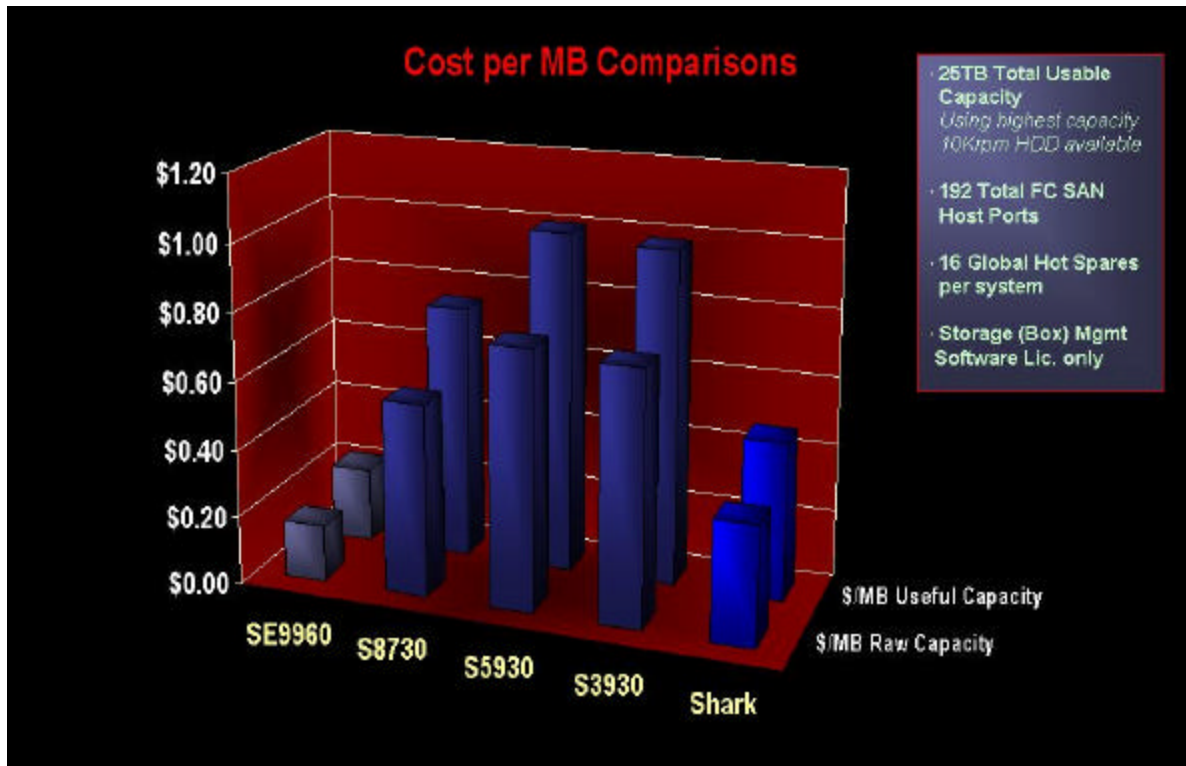
- When acquiring a storage system, don't get fooled by price per raw. Always ask what is the cost of the USABLE storage capacity and USABLE cache because they are what you actually use. Every system has overhead, so paying for overhead is unavoidable. However, the trick is to find the system with the least overhead – i.e., the system with the most effective use of storage capacity, cache utilization, bandwidth performance, and I/O performance. The Sun StorEdge™ 9900 series is extremely effective, utilizing far less overhead than the competition, which is why a single Sun StorEdge™ 9960 storage system is the equivalent of so many of those competitive boxes:



- Using fewer boxes to generate the desired usable capacity means significant savings on the front end (when the equipment is purchased). Having to buy fewer boxes also means dramatic floor space savings, time savings (management), and savings from reduced hidden backend costs:



- Examine the numbers in the chart below closely. Because it is so effective, the Sun StorEdge™ 9960 system will ALWAYS have the least discrepancy between RAW cost per MB and USABLE cost per MB compared to competitive fixed-bus offerings. Interestingly, after adjusting for the competition's huge discounting (as much as 80% off list) and you will find that the RAW cost per MB for a competitive set up is LESS than the RAW cost per MB of the Sun StorEdge™ 9960 system! However, when looking at the USABLE cost per MB, the truth comes out – the system TOTAL RAW SYSTEM COST REQUIRED to generate the desired total usable storage capacity is ALWAYS far less with the Sun StorEdge™ 9960 system! So, don't let the competition succeed in tricking you – and your customer - into a RAW cost per MB comparison: you will lose. THIS IS THE BIG SECRET THE COMPETITION DOES NOT WANT YOU TO KNOW ABOUT:



Value Proposition

Sun gives you one-stop shop, single-source, one throat to choke from the storage to the host to the application itself.

Proof Points

- Sun takes a holistic approach to your business, providing Sun provides servers, services, software, storage systems, workstations, networking, and entire business solutions to cover the corporate gamut from departments up through the data center
- One call into Sun for support
- Integration, support, and services on our Solaris™ host platforms

Value Proposition

Sun will assist in helping you run your business more smoothly because Sun will help you meet your Service Level Agreements (i.e., application availability) across your enterprise

Proof Points

- Because Sun is a one-stop shop for IT infrastructure, Sun can provide application availability, which storage-only vendors cannot because they only provide one piece of the overall infrastructure

Value Proposition

Sun can help your business increase its productivity (revenue), efficiency (time), and competitiveness

Proof Points

- Because Sun can provide true application availability, your backend business processes can be made to run more smoothly which in turn can help your organization to be more efficient and productive to better compete in today's economy

Value Proposition

Sun recognizes you have your own set of unique needs, concerns, and hot buttons, so Sun will work closely with you and your staff to fully understand your business and how it works and then recommend the right solution for the job

Proof Points

- No two businesses are alike and no one product or solution can do it all, so Sun provides a wide range of products and services which can be tailored to your own unique needs

Value Proposition

Sun will help to architect a storage infrastructure which meets your needs for performance, availability, manageability, and overall cost of ownership

Proof Points

- The Sun StorEdge™ family is now the most flexible and robust it has ever been, and Sun can provide from a single internal disk drive all the way up to a full-blown non-stop data center solution for your organization – one which balances your performance, availability, and manageability requirements with your IT budget and with your business process needs

Value Proposition

Sun helps you (the IT manager) take back control over runaway storage growth and get your life back!

Proof Points

- With the ability to consolidate more storage than on fixed-bus systems and control it yourself from one convenient location, the extreme-availability, extreme-reliability, extremely-resilient, extreme-performing, extreme-connectivity, and extremely manageable Sun StorEdge™ 9900 series is designed to provide you with smooth, truly non-disruptive operation

Competitive Comparisons

There are two primary storage systems which will compete head-to-head against the Sun StorEdge™ 9900 series, both of which the Sun StorEdge™ 9900 series has a huge competitive edge against: EMC Symmetrix 8000 and IBM Shark ESS 2105/Compaq Red Shark.

The Sun StorEdge™ 9900 series takes on both the EMC Symmetrix and the IBM Shark systems head on and beats them at their own game. The Sun StorEdge™ 9900 series leapfrogs these systems with far more power, far more scalability, and far more connectivity than the fixed SCSI bus EMC Symmetrix and the SSA loop IBM Shark/Compaq Red Shark with its state-of-the-art non-blocking FC switched architecture.

Three tables follow on the following pages – one for EMC Symmetrix weaknesses, one for IBM Shark weaknesses, and one for Sun StorEdge™ 9900 series strengths.

MAJOR WEAKNESSES OF THE EMC SYMMETRIX 8000

Area Weak In	Major Weakness
Data Protection	DataReach (data exchange SW) requires DB/2 database to be taken off line which means all DB/2 activity must be stopped; and, this process bypasses all MVS and DB/2 security and integrity safeguards
Performance	<p>Data and control I/O are shared in cache and on the SCSI buses resulting in effective system utilization of only 55% worst case to 70% best case</p> <p>40MB/sec SCSI disk drives; larger SCSI HDDs are only 7200rpm</p> <p>HDDs have dual ports but are only active/passive</p> <p>Cache is not tunable, manually or automatically</p> <p>EMC InfoMover (data movement SW) uses Symmetrix cache, forcing Symmetrix to administer both data migration and its primary objective of handling user data</p>
Prevention of Data Loss	<p>Cache not mirrored or duplexed</p> <p>Business Continuance Volumes (BCVs) are not RAID protected</p> <p>Backup batteries are not hot-swappable and require 4-hour charging period, leaving contents of cache vulnerable to a power cycle during this period</p>
Scalability	<p>Only holds 384 HDDs max (half of which are required for mirroring) and the box is not capable of supporting a fully loaded configuration</p> <p>Fixed SCSI bus architecture (negative scaling – as more capacity is added, performance declines)</p> <p>Severely limited bandwidth, IOPS, and scalability: Average capacity per Symmetrix box is only 1-1.2TB (online capacity); every new box requires more hardware and software licenses</p>
System Availability	<p>No “lights-out” call-home capability – during power loss, box cannot call home and tell EMC it is down</p> <p>Microcode cannot be hot replaced without busying out ports</p> <p>Cache 0 board contains all the control information (e.g., drive tables), so it is not hot replaceable</p>
High Total Cost of Ownership	<p>Cache is only 45% usable under heavy loads, and on average is only 70% usable = wasted money (cache is very expensive)</p> <p>HDDs are off-the-shelf Seagate HDDs – they are NOT high-end drives designed specifically for high-end systems</p> <p>Many hidden service charges: Customer cannot manage box – every time a change is required, a charge is assessed because EMC SE must make a service call</p> <p>No array controllers, so is limited to RAID 1 (JBOD mirroring) only which means 50% of HDDs must be used for overhead (RAID S is marketed but not used due to max throughput of only 1MB/sec and extraordinarily long reconstruct times when HDD fails)</p>

RESPONSE TO EMC RESPONSE - LETS KEEP THE FACTS STRAIGHT.

Our unprecedented agreement brings to data center-class customers what they did not have prior: A single data center integrated solution tested, certified, and supported by Sun AND HDS through jointly-established enterprise-critical service and support centers throughout the world which can provide true application availability so they can not only meet their service level agreements, they can do so in the most cost-effective and efficient manner possible!

Customers who chose to go with EMC were in for an ugly surprise later on down the road – they soon discovered a problem, with no easy path to resolution. (What is the problem?)Finger pointing was abundant and they found it took weeks or even months to resolve the problem, if ever.

This frustrating issue was even further compounded in the Sun environment, where neither Sun or EMC could provide support for the other's products.

EMC indicates HDS has been unable to break single digit market share. Well, HDS recognized it had a race car it couldn't get out of the garage. And Sun recognized it had a garage but no race car. So, these two technology giants got together to join forces. Now, that wicked-fast race car is out of the garage and on the road taking the industry by storm.

The Sun/Hitachi/HDS agreement makes it possible for Sun to deliver data center solutions with the best of breed products allowing HDS more global product coverage. Which leaves EMC very concerned indeed spitting along with its compact car.

Unlike the Sun/Hitachi/HDS agreement which fosters cooperation, HP chose an OEM agreement with Hitachi which created severe limitations in joint sales, marketing, development, and support with HDS, Hitachi's critical non-Japan marketing and sales arm. While HP has indeed been successful in its own backyard – on HP 9000 servers – it has not been successful anywhere else. Our distribution will be successful no matter which platform is involved because we are working with Hitachi and WITH HDS and not against them – their sales people receive compensation when they sell a system (but not when HP sells one). In fact, the HDS sales force is extremely excited about this deal!

Sun has steadily brought products to market to solve many problems in the industry:

- We acquired Encore from which we have released our data services software (Sun StorEdge™ Instant Image and Sun StorEdge Network Data Replicator).
- We purchased RedCape which led to the creation of the industry standard Jiro - the foundation for policy automation of the future.
- We purchased Maxstrat which led to the Sun StorEdge™ T3 array which has seen significant rise in sales and meets the open systems workgroup-midrange-distributed networking requirements of enterprises all over the world. This fully fibre RAID storage system uses a non-blocking architecture to provide massive rack-and-stack scalability. Today, we have customers who have absolutely scaled to over a hundred TB, demonstrating the market's acceptance Sun StorEdge™ T3 arrays.
- We purchased HighGround a true Open Systems Storage Resource Management solution, which helps EMC customers see they have purchased far more hardware and software than needed if they had gone with a more effective platform to meet their storage demands.
- Our purchase of LSC has enabled us to aggregate file systems for our customers who desire large amounts of storage and the requisite management of that storage through hierarchical processes and policies.
- And now we carry the HDS Lightning 9900 systems, which are recognized the world over as the premier data center storage solutions, bar none. Which enables Sun to deliver the ultimate in data center storage with extreme availability, performance, connectivity, manageability, and scalability, fully integrated, serviced, and supported by Sun.

We find it humorous indeed that EMC is using unsubstantiated numbers to try and hold their position. We, on the other hand, prefer to let our products and services speak for themselves because after all, isn't the end user of this stuff much more concerned with what it will do for him in his particular unique situation?

EMC is very, very good at defocusing from the real issue – who can provide the most cost-effective system that meets the customers' Service Level Agreements. Because EMC CANNOT meet customers' SLAs, EMC likes to throw up Fear, Uncertainty, and Doubt (spell out FUD). Fact is, Sun has the superior products, solutions, and services! That's what customers want and that's what customers care about!

Sun storage solutions enable customers to achieve the optimum balance of budget, availability, performance, manageability, and scalability as required by their unique applications. EMC can't do this. Ask EMC how many Symmetrix boxes it would take to handle an IT environment which required 100TB of open systems/mainframe storage which combined heavy OLTP, DSS, Email, Vmail, dynamic web, and static web use! Then compare that to our new Sun StorEdge™ 9900 series. EMC want customer to think in \$/MB; Sun wants customers to think TCO!

EMC would like everyone to believe that one company can do it all. Well, one company can't as EMC continues to prove every day. Customers want tested, certified, supported systems they can trust with one place to call for support. Customers buying this solution will rest easy and sleep at night. Sun/Hitachi/HDS can provide this level of comfort around the world and EMC cannot because EMC continues to choose to be a proprietary island unto itself.

Sun is doing what it does best: Delivering on scalable, integrated solutions which yield continuous real-time availability to any customer, no matter how unique the IT environment and business. We have partnered with many companies to get where we are today, and we will continue to do so in the future.

At the end of the day, which would you rather buy? Products from a myriad of different vendors with the contingent finger pointing and invariable integration nightmares? Or a pre-tested, pre-integrated seamless solution with superior technology offering the very best in application availability and global support with one place to call and THREE industry giants standing together to ensure it all just works? Customers want their work lives to be easier! They want to work smarter, not harder!

Now is the time to move away from over-priced junk and out of the money pit it fosters! Its time to replace EMC!

Now, let's take apart the EMC response piece by piece:

EMC: *Today's storage agreement between Sun Microsystems and Hitachi offers absolutely nothing new for customers. There are no new products, capabilities, features, or functions -- just a new distribution channel for a product that has been unable to break single digits in market share on its own or with the help of HP.*

THE RIGHT SOLUTION FOR THE JOB.

The HDS Lightning 9900 hardware and software products combine to provide an established, best-in-the-world data center-class storage systems. Sun could have chosen to partner with EMC and their Symmetrix products, but the fixed-bus architecture and high-overhead management cannot scale in a SAN environment and represents a significantly higher cost of ownership than the Sun StorEdge™ 9900 series. In fact, this is why HP dropped EMC and went with HDS.

Moreover, and perhaps more significantly, this new alliance combines two global leading technology companies together. Through our partnership, Sun and HDS will work closely to deliver the best support, service and products in the industry to our customers.

We are certifying a new data center storage system like none other on Sun platforms. We are delivering to our customers exactly what they have been asking for: the assurance these products work well together and deliver the level of APPLICATION availability today's economy demands.

With no tolerance for error, today's economy is highly volatile and dynamic and businesses are faced with fierce global competition. The strategic use of technology as a competitive edge can help businesses to achieve one-to-one marketing with fluid workforce dynamics. System capacity and performance planning has become extremely difficult - customers drop-in at all hours and thousands drop-in unexpectedly resulting in wildly fluctuating capacity demands. Information is power and business continuance is mandatory - poor response time can cripple a business that depends on the internet.

No one company can do it all. The delivery of guaranteed service level agreements can only be achieved through a joint efforts such as between Sun and HDS, Sun and Oracle, Sun and VERITAS, and our many other partners.

EMC: *Sun's storage strategy will do more to confuse customers and create channel conflict than to help customers manage their increasingly large information volumes. The Sun-HDS partnership joins a long line of anti-EMC alliances and acquisitions in recent years. The others have all failed to materialize in any market success or simply died -- IBM/STK, HP/HDS, IBM/Compaq, Sun/Encore, Sun/MaxStrat (T3), Dell/ConvergeNet. Every one of these clumsyriages was hailed as the next EMC killer and every one of them has failed to gain market share.*

LET THE MARKET SPEAK FOR ITSELF.

This alliance is not confusing, in fact it is incredibly clear and has been structured to ensure customers have a direct line for support of the products and a clear line as to how to order it.

The reason Sun chose the HDS over EMC is because the EMC products do not meet the stringent requirements of today's storage customers – today, more than ever, performance needs to be addressed as a subset of availability.

Any slowdown in performance – caused by bottlenecks, planned busy-outs, or unplanned outages – means data is not available, even if only for a few seconds. But during that time period, customers are out there waiting, just a mere click away from competitors.

Digital storage is growing at over 60% per year. For many companies, storage requirements are doubling or tripling every 36 months. The drivers of such rapid growth are data-intensive applications such as video mail, high-content business profiling, biometrics, security, and geographic information, to name a few. Multimedia applications combining video, voice, and text will drive storage requirements at an unprecedented pace during the next three years. Electronic security based on fingerprints, facial structure, retina, iris, voice or signature prints will drive exponential increases in storage requirements. (Source: Storage Panorama 2000 - Fred Moore.)

With the dramatic increases in storage requirements, the value of the data and non-stop access to the data is more important than ever before. Users are intolerant of any disruption of service or delay in obtaining results – instant gratification takes too long! The average user waits only eight seconds or less for a response before clicking away to another site. The need for highly available, scalable systems is a must.

Again, Sun needed a product to fill the needs of the high-end data center market. We looked at the EMC Symmetrix and the HDS Lightning 9900. We chose the HDS Lightning 9900 due to the following reasons:

Performance – The Sun StorEdge™ 9900 series uses a non-blocking FC switched architecture and can produce 6.4GB/sec of bandwidth. The EMC Symmetrix uses a fixed-bus SCSI architecture produces less than 1GB/sec of bandwidth.

Availability – The Sun StorEdge™ 9900 series uses high-spec components, on-the-fly component and microcode updating, cache-free data movement, separate power boundaries, continuous-destage cache duplexing, and sophisticated algorithms to provide truly non-disruptive performance around the clock. The EMC Symmetrix uses off-the-shelf components, port-busy-out microcode updating, service-disrupting component and microcode installs/replacements, cache-dependent data movement, destage-when-full parity cache, power-shared components, and superfluous overhead which results in many unacceptable bottlenecks and disruptions of service.

Resiliency – The Sun StorEdge™ 9900 series provides 64 internal switched data paths and a dual-ported, bi-directional backend with performance-boosting features to provide non-disruptive performance through unplanned situations. The EMC Symmetrix uses only four fixed-bus data paths and an active/passive backend which results in poor performance under heavy loads and during unplanned situations.

Manageability – The Sun StorEdge™ 9900 series provides a highly intuitive GUI which allows the user to monitor, configure, manage, tune, diagnose, and fix the system to match the unique workload requirements of his or her IT environment. The EMC Symmetrix requires EMC to manage it and requires complicated code manipulation to make changes.

Scalability – As capacity is added to the Sun StorEdge™ 9900 series, bandwidth is increased due to its non-blocking switched architecture and fibre-to-fibre front-to-back technology; in fact, the Sun StorEdge™ 9900 series can support a full maximum configuration of 512 HDDs, 32GB of cache, and 32 DAS or 192 SAN connected hosts. The EMC Symmetrix, on the other hand, can handle about 4TB of raw capacity (that's 2TB of usable online data due to mirroring) before another box has to be forklifted in, in spite of the fact it has 384 drive bays.

Total Cost of Ownership

The Sun StorEdge™ 9900 series may very well help you save hundreds of thousands or even millions of dollars (the larger the required capacity, the more we can save you) on the overall cost of storage ownership for your data center.

Proof Points

- 1) Sun StorEdge™ 9900 series support a RAID 5 which is the performance equivalent of mirrored HDD in virtually all real-world situations. With RAID 5, for every four HDDs, three drives generate usable online capacity, whereas with mirroring, only two HDDs generate usable online capacity. The use of RAID 5 over mirroring results in a savings of 25% of the price of the drives right off the top.
- 2) Sun StorEdge™ 9900 series segregate data from control I/O in the cache and on the data paths; provide advanced caching algorithms; provide a non-blocking switching FC architecture with 64 separate data paths; and provide several performance-boosting tools. As a result, the Sun StorEdge™ 9900 series scales positively – as more capacity is added, the overall performance (GB/sec and IOPS) is actually increased. A Sun StorEdge™ 9960 system has 32 direct host ports (FC, ESCON, or a combination of the two) and in addition can support as many as 192 switched hosts in a SAN environment. A Sun StorEdge™ 9960 system can support a full configuration of 512 drives (about 37TB of raw capacity, or around 27TB of usable RAID 5 capacity). By contrast, traditional fixed-bus architectures hold fewer drives and are negative scaling – i.e., as more capacity is added, overall performance decreases. The use of performance-enhanced non-blocking FC switching architecture results in being able to use the Sun StorEdge™ 9900 series in a fully configured configuration, which in turn means a significant cost and operational savings because fewer storage systems are required, so fewer SW licenses and superfluous HW components need to be purchased, installed, and managed.
- 3) Sun StorEdge™ 9900 series a highly intuitive-to-use GUI providing unparalleled user management capabilities from a centralized location, local or remote. The end user can monitor, reconfigure/configure, and performance tune this system on the fly, without disruption of production service. Other cache-centric boxes require an SE to come out from the system vendor to make even the most minor of changes with a service charge assessed for the time spent. The unique ability to self-manage the Sun Storage 9900 series can result in thousands and thousands of dollars saved in service charges alone (the more rapid the data center requires changes the storage, the more money which will be saved).

EMC: *It is well known that Sun's "enterprise storage" offering - the StorEdge "T3" - has met with little success after only one year in the marketplace.*

Success is in the eye of the beholder.

Actually, the Sun StorEdge™ T3 array has been selling extremely well at the enterprise level. In the down economy we are facing today, Sun StorEdge™ T3 array sales and revenue are growing steadily. Sun StorEdge™ T3 enterprise array sales grew 53% over the previous quarter.

EMC products did not see anywhere near that kind of growth. In fact, because we continue to successfully steal business from EMC at large accounts, EMC has been forced to reduce its personnel. Sun has not and in all likelihood will not need to take such drastic measures which eventually hurt the customer because a RIF usually results in fewer resources to provide support and services.

The Sun StorEdge™ T3 array, not unlike the EMC Clariion, is an open systems storage subsystem and is designed and targeted for use in enterprise environments with those requirements. For enterprise environments with data centers, where availability, connectivity, manageability, and availability requirements are vastly different, Sun now has the Sun StorEdge™ 9900 series to meet – and far exceed - those needs as well.

EMC: *The T3 was launched with great fanfare in June of 2000 as a high-end enterprise product allegedly able to scale beyond EMC's high-end Symmetrix offerings. Sun's Ed Zander said, "We're going to let the numbers speak for themselves when the market share data rolls in." Here's what the numbers said: Sun keeps losing market share in the only storage market where it sells, its own SUN Solaris server base. (According to Gartner Dataquest, Sun's share of the external storage market for SUN Solaris operating systems was 31.2% in 2000, down from 34.9% in 1999.) Sun customers have had the option to purchase HDS storage all along, and did not. According to Gartner Dataquest, EMC had 40.7% of the external storage systems market for Solaris in 2000, while SUN had only 31.2% of the market, and HDS had a mere 4.1%, down from 5.8% in 1999.*

Better lying through statistics.

First of all, EMC cites success in the "external storage market for Solaris" when in fact the segment cut by Dataquest is external RAID storage, which is only one piece of the overall Solaris storage market, ignoring internal storage and host-attached external JBOD storage. Adding all the storage segments together, Sun is not only the market choice on Solaris but the market choice among all of UNIX®:

- Ranked Number One in UNIX storage supplier revenue by both Gartner/Dataquest and IDC (third year in a row for both firms)
- Ranked Number One in UNIX® terabytes and units shipped by IDC
- Ranked Number One in Host-Attached External storage by Gartner/DQ

IDC rankings are attributable to market report published in February 2001: 2000 Disk Storage Systems Forecast and Analysis, 1999-2004 (Authors: Charlotte Rancourt and Eric Sheppard) Gartner rankings are attributable to a report due to be released next week: 2001 Market Statistics Report by Roger Cox

Next, the Sun StorEdge™ T3 array is used in the open systems market and the EMC Symmetrix is used in the mainframe market – two vastly different segments with vastly different requirements. As such, any comparison between the two is invalid at best, the only purpose of which is to confuse people and distract them from the real issue, which is who has the best solution to meet the needs of enterprises facing the stringent demands of today's economy.

And finally, this new relationship provides what was lacking in the past – the blending of two global technology leaders collaborating on integration, service, and support all over the planet.

EMC: *There HDS Lightning will be SUN's sixth different, incompatible storage architecture in five years -- RSM 2000 (Symbios Logics OEM), A7000 (Encore acquisition), A2500 (Sun Photon), A3500 (LSI Logic OEM), T3 (MaxStrat acquisition), StorEdge 9900 (HDS OEM). This is the ultimate in customer disrespect and a closed, proprietary approach -- no backward compatibility, no smooth upgrades, only forklifts.*

The stringent needs of the high-end data center market require the best possible solution.

The Sun StorEdge™ 9900 series is an enhancement to the Sun StorEdge™ family of storage system products; as such, there are no backward compatibility issues. It is not a replacement product. As stated previously, but worth repeating, the Sun StorEdge™ 9900 series was added to our family to address the high end data center segment which includes mainframe attach.

Sun and HDS are working together to provide our customers with the services they require – data migration off of EMC Symmetrix, smooth data and storage management, and the ability to do more work with far less overhead.

Again, we looked at the EMC Symmetrix and decided it was too slow, had serious service disruption problems, and was far too costly for our customers – in all good conscience, Sun could not take on such an out-of-date product and expect to maintain the long term relationships with our customers which we have worked so hard to build over the years.

EMC: *Today's Wall Street Journal ad states: "With Sun you can choose from the massive scalability of the Sun StorEdge T3 enterprise array to the extreme availability and performance of the new 9900 series." Again, Sun will be offering radically different storage architectures requiring completely different skill sets to manage. In an era of cost containment, customers will be hard-pressed to strap together two storage architectures to achieve the basic requirements of scalability, availability and performance.*

This agreement introduces significant confusion for the customer. Sun customers are now faced with a fragmented, poorly integrated offering - storage, software, and services - that are being delivered by different companies. What software will Sun customers be offered? SUN has its own storage software, as does HDS. Sun is an IBM competitor, yet HDS licenses IBM software for certain functionality. How will customers know which is the best choice?

The pot calling the kettle black.

Actually, EMC offers two disparate and radically different storage architectures which require completely different skill sets to manage – the Symmetrix and Clariion. One product (Symmetrix) addresses the cache-centric mainframe-attached market and the other (Clariion) addresses the cache-distributed open system market:

Cache-centric, storage was originally developed for (IBM) MVS, wherein the data format and physical attachments (ESCON, FICON) exhibit high localities of reference (i.e., >90% cache hits), and the MVS operating system itself assists with the caching within the cache-centric storage system.

Compare this to the small-cache/distributed array approach (i.e., the Sun StorEdge™ T3 array or EMC Clariion), the basic characteristics of which are a fixed-block data format which exhibits poor locality of reference (i.e., the caching is done in the host), where the various host operating systems provide no assists for storage subsystems.

Sun now provides our customers the best of both worlds and the choice of which storage management and data management will be right for them in their own unique environments to match the unique demands of their respective business climates.

Put more succinctly, different workload demands require different storage systems.

How will service and support be provided? Will Sun provide direct support, or will HDS? Both vendors have different service models and approaches.

Providing unprecedented levels of support and service means true application availability.

Sun, Hitachi, and HDS, working closely together as a single entity, jointly provide seamless support and services for the Sun StorEdge™ 9900 series systems under the Sun flag. There really is no confusion; the support model is as simple as it gets: no finger pointing, no different service model approaches, one call does it all, one throat to choke: Sun. We also support Solaris servers, Solaris operating system, and switches. EMC cannot possibly deliver the levels of support that the Sun/HDS alliance can.

Application availability is offered on Sun host platforms in the data center.

EMC: *Will HDS ensure complete interoperability with all Sun servers, all Sun OS revision, all Sun cluster software, etc? This takes time and resources to do properly.*

Highly integrated solutions for smooth trouble-free operation.

Actually, yes. Sun, Hitachi, and HDS will ensure interoperability and both companies will stand behind it.

Every Bottleneck Costs You Money. The Sun StorEdge™ 9900 series provides seamless integration with Sun servers, the Solaris operating system, Sun HA clustering middleware, and Sun storage and data management software to keep your growing business up and running smoothly and efficiently.

EMC: *EMC has invested \$2 Billion in interoperability testing - Sun and HDS have not come close to this level of investment. It would take a lot of R&D and a long time for the HDS storage product to achieve the same level of interoperability and integration that EMC has designed into Symmetrix already.*

Turbo charge a snail, you still have a snail.

Actually, the Sun StorEdge™ 9900 series provides the very level of interoperability and integration which EMC describes. This is one of the key reasons why Sun chose Hitachi/HDS over EMC. The HDS Lightning 9900 had the first GDPS (Geographically Dispersed Parallel Sysplex) installation in the world, and it was part of the first successful multi-protocol SAN installation as well.

There are many Solaris customers already using this product who are extremely happy and satisfied because it has saved them hundreds of thousands of dollars in operational costs over the EMC Symmetrix.

One of the reasons EMC has to spend so much money on R&D is because they support non-essential platforms. Another reason is because the Symmetrix does not utilize the more updated technology like intelligent RAID controllers, caching algorithms, RAID algorithms, fibre channel, switching, and cache-independent data movement to name a few. As such, much more money and resources are required to keep this "turbo-charged" snail afloat.

Sun could have gone with the EMC turbo charged snail approach, but in the final analysis, a turbo charged snail is still a snail. So, Sun went with the new technology offered by the HDS Lightning 9900 system which Sun found to be vastly superior in virtually every feature and function over the EMC Symmetrix box, especially in the most important area of all: overall cost of ownership savings, which is a function of time (increased levels of efficiency) and actual dollars (increased levels of productivity).

EMC: *The biggest loser may be Hewlett-Packard, which sells the identical HDS product as its high-end storage offering. The Sun deal further dilutes HP's differentiation. It also raises questions about Hitachi's sincerity and commitment to a partner (HP) that represents more than a third of HDS' total revenue.*

No matter where you are, we have you covered.

HDS, Hitachi, and Sun have created a unique partnership in the storage industry where we are working closely together to provide industry-leading products and solutions which are tightly integrated, qualified, and certified while delivering worldwide service and support to back them up.

By contrast, the Hitachi/HP OEM deal (note the omission of HDS in this equation) resulted in a less than optimal relationship between HDS and HP where they wound up competing for the same customers. As such, HP does not receive any support or help from HDS, which is a very important distinction because HP has continued to struggle without HDS's mainframe expertise and integration expertise on the open systems side, so HP support for their XP512 product is weak and customers recognize this.

By contrast, the Sun/Hitachi/HDS deal is a joint sales, support and development partnership where we openly and freely collaborate together to provide the optimal service and support model to best meet the data center requirements of our customers. BOTH Hitachi and HDS are strongly committed to Sun and BOTH have a significant vested interest in seeing this alliance succeed and vice-versa.

Together, Sun Hitachi and HDS offer:

- Prompt worldwide support and services from enterprise-critical service centers
- Seamless integrated solutions which match your company's unique local or global needs
- Global storage labs
- Thousands of engineers worldwide

MAJOR WEAKNESSES OF THE IBM SHARK/COMPAQ RED SHARK

Area Weak In	Major Weakness
Performance	Only 192MB (384MB mirrored) NVS cache – all write activity must pass through 192MB of NVS cache; NVS cache effectiveness is about 1MB/HDD
	Maximum throughput per loop is only 260MB/sec – system has very slow overall performance
	Only two data paths per 8-drive array group – each DA (disk array) group bottlenecks quickly around 60MB/sec
	SSA loops and HDDs are uni-directional – reads are in one direction and writes are in the other
	Cache is not tunable, manually or automatically
	System is really two RS/6000 PCI servers (RISC servers are designed to perform calculations, not I/O)
	Only four PCI 133MHz buses per machine and PCI buses choke I/O performance (due to master/slave bridging)
	Using more than 2 aliases leads to complete system saturation – Even when using Parallel Access Volumes
	FC host connections to SSA architecture requires FC-SSA bridging which results in even more overhead
	Scalability
Only 16 FC host connections; only 8 ESCON host connections recommended	
System Availability	Eight HDDs per array group – requires long reconstruction time when HDD fails
	A failed HDD can cause adapter to reroute data in other direction, affecting performance
	Installing an HA requires bay shutdown
	A double path failure can render entire system useless
High Total Cost of Ownership	Small write cache; large RAID groups; slow drive, cache, and data path performance limit system to only about 1TB of data before another must be forklift added for the next TB of storage capacity
	Data and control I/O are shared in cache and on the SSA loops resulting in effective system utilization of only 55% worst case to 70% best case

MAJOR STRENGTHS OF THE SUN STOREEDGE™ 9900 SERIES

Area Strong In	Major Strength
EXTREME AVAILABILITY & CONTINUOUS SERVICE	<p>No front-end (cache) or back-end (disk) choke points</p> <p>No single point of failure – all HW components are completely hot-replaceable and hot-installable, even cache</p> <p>High-end spec HDDs are designed specifically for this rigid system and are bi-directional and dual-ported with dual segmented cache buffers for simultaneous reads and writes</p> <p>Truly non-disruptive microcode and cache updates do not require halting production</p> <p>Mainframe and open systems based data management services</p> <p>Continuous cache destage and split-write cache queuing</p> <p>Non-disruptive performance-boosting features like on-the-fly optimization, cache tuning, LUN sizing, LUN carving, load balancing, dynamic path reconnect, and cache locking</p> <p>64 data paths provide 6.4GB/sec bandwidth and extreme system resiliency (losing a single data path means losing 1/64 of bandwidth)</p> <p>Truly non-disruptive host-less backup, data movement, data exchange, and data replication</p> <p>“Lights out” call-home with hierarchical alert paging</p> <p>Centralized monitoring, control, configuration, diagnosis, and fix from anywhere – locally or remotely</p> <p>BCVs are always RAID protected</p> <p>3-Phase power with separate power boundaries for every duplexed HW component provide extreme protection against power loss, surges, and cycles</p>
EXTREME DATA PROTECTION	Duplexed hot-swap/redundant cache
EXTREME PERFORMANCE & SCALABILITY	<p>Non-blocking fabric switching architecture and front to back fibre data paths increase performance as HDDs, ACPs, and cache are added (positive scaling)</p> <p>System can handle all 512 HDDs (16 of which are non-floating global dynamic hot spares)</p>
EXTREMELY LOW OVERALL TOTAL COST OF OWNERSHIP	<p>Highly flexible and easily customer configurable to match to application workloads</p> <p>Extreme SAN connectivity – only cache-centric storage system which allows up to 192 host connections (6:1 fan-out)</p> <p>RAID 5 or RAID 1+ gives customers a choice of HDD protection</p> <p>No hidden service charges: Customer easily can manage the system through a highly intuitive GUI – can result in a savings of thousands of dollars a year, depending upon how rapidly the storage requirements change</p>

SOFTWARE NAME CROSS-MATRIX GRID

It is easy to become confused as to which Sun StorEdge™ 9900 series software package functionally lines up with its EMC or IBM counterpart. Here is a quick-reference grid to help out:

DESCRIPTION	Sun StorEdge™ 9900 Series	EMC Symmetrix 8000	IBM Shark ESS 2105
HW-Based, Asynchronous Real-Time Copy with Time Stamping	TrueCopy	N/A	N/A
GDPS (Geographically Dispersed Parallel Sysplex)	Yes	N/A	Yes
Multi-Platform Data Sharing	RapidXchange	InfoMover	InfoSpeed/PDM
Multi-Platform Data Movement/Exchange	RapidXchange	SRDF	InfoSpeed/PDM
Point-In-Time Copy	ShadowImage TrueCopy	TimeFinder	FlashCopy
Mirror Data to Remote Facility	TrueCopy	SRDF	PPRC
Software-Based Remote Copy	Extended Remote Copy	Announced, Never Delivered	XRC
Storage Management	Resource Manager	ControlCenter Suite	StorWatch ESS Specialist
Performance Management	CruiseControl FlashAccess TPF/MPLF Graph Track	Symmetrix Optimizer Symmetrix Disk Reallocation Symmetrix Database Tuner Workload Analyzer SymmEnabler	StorWatch ESS Expert Data Path Optimizer PAV/MA Priority I/O Queuing StorWatch DFSMSshm Monitor
Support for PAV/MA	Yes	Yes	Yes
Configuration	LUN Manager VLVI Manager LUSE	Symmetrix Manager	StorWatch ESS Specialist Custom Volumes
Security	SANtinel	Volume Logix ESN Manager	Tivoli SANergy Tivoli Storage Network Manager
Fail-Over	Dynamic LUN Manager	Power Path	N/A
Cache Locking	FlashAccess	N/A	N/A
Multi-Platform Backup/Restore	Multi-Platform Backup/Restore	CopyCross Fastrax	Tivoli Data Protection Tivoli Storage Network Manager StorWatch DFSMSshm Monitor
Call Home	Yes	Yes	Yes

SELLING THE SUN STOREEDGE™ 9900 SERIES

Storage Challenges

Information is the pulse of today's business – and the demand for information is growing exponentially. Companies are experiencing information growth of well over 100% each year – and this trend will continue. As a result, storage requirements are doubling annually.

Every company's challenge is to add storage to meet the demands of their business, while delivering an always-available environment operating at peak efficiency. As day-to-day storage requirements grow, so do the associated management costs and complexities. The deployment of new business applications which leverage the Internet, rich media, data warehousing and data mining technologies are over-taxing the existing infrastructure. Failure to implement a solution that enables the company to control the current growth trend can threaten their most valuable asset – their information. The inability to access information quickly can significantly impact their business. The success of these businesses depends on the ability to control, protect, and transform ever-expanding volumes of data into accessible, sharable information – whenever and wherever it's needed. They need an intelligent information infrastructure that dynamically adapts and grows in parallel with their business.

The connected economy is information-intensive. Maintaining an uninterrupted flow of information is essential for success, as illustrated below.

Cost of Data Loss

The cost of business interruptions can be devastating to an enterprise and, if one lasts too long, can result in the enterprise ceasing to exist. Of course, not all applications are so critical that an interruption can lead to the cessation of a business. It is important, then, to evaluate exactly how critical an application is to the viability of an enterprise, and consider disaster protection investments accordingly.

Exactly how much does computer downtime and computer data loss cost business?

Business	Average Hourly Impact
Retail Brokerage	\$6.5 million
Credit Card Sales Authorization	\$2.6 million
Home Shopping Channels	\$110,000
Airline Reservation Centers	\$90,000
Package Shipping Services	\$28,250
Manufacturing Industry	\$26,761
Banking Industry	\$17,093
Transportation Industry	\$9,435

Source: *Contingency Planning Research & Strategic Research Corporation*

Since most businesses experience two hours of downtime per week, those are incredible numbers. Here are some more eye-opening facts about data loss and the life of business:

- Most companies value 100MB of data at more than \$1 million (*McGladrey and Pullen*)
- 43% of lost or stolen data is valued at \$5M (*McGladrey and Pullen*)
- 43% of companies experiencing disasters never reopen, and 29% close within two years. (*McGladrey and Pullen*)
- It is estimated that 1 out of 500 data centers will have a severe disaster each year. (*McGladrey and Pullen*)

- 40% of respondents to a computer security survey had detected and verified incidents of computer crime during the previous year. (*NCSA Annual Worry Report*)
- Computer crimes cost firms who detect and verify incidents of computer crime between \$145M and \$730M annually. (*NCSA Annual Worry Report*)

A company which has experienced a computer outage lasting more than ten days will never fully recover financially. Fifty percent will be out of business within five years. (*Disaster Recovery Planning: Managing Risk & Catastrophe in Information Systems* by Jon Toigo)

Sun solutions, leveraging the Sun StorEdge™ 9900 series data center storage systems, take application level availability to higher levels by minimizing backup windows via very fast recovery should an unplanned service outage occur.

Target Markets and Customers for Sun StorEdge™ 9900 Series

E-BUSINESS

Today's economy is driven by the internet and the corresponding IT infrastructures which make around-the-clock business possible. This combination has caused intense competition and exacerbated the need to expedite delivery of products and services while increasing productivity and lowering costs.

E-business is here to stay – Economics and competitive pressures have forced every traditional “brick and mortar” company to adopt and implement an e-business strategy, while e-companies are forcing new business models. The requirements dictate 24x7x365 availability, continuous data growth (digital data is growing at a rate of 60% a year) with high levels of integrity and security, and data mining capabilities to expand the customer base. With the improved connectivity afforded by SANs, better and faster access to data will yield better customer profiles and facilitate more focused sales and marketing strategies.

Key Applications

- Business-to-Business and Business-to-Consumer software packages
- Very large DSS databases
- Data warehousing/data mining
- OLTP-style Web based applications

Key Storage Solution Requirements

- Ability to pool large quantities of data
- 7x24x365 availability
- High performance for fast transactions
- Scalability (adding capacity increases overall I/O performance)
- Any server to any storage system connection capability through SANs
- Rapid recovery/restart of logical applications after crashes or database meltdowns

STORAGE CONSOLIDATION AND SANs

Efforts to reduce the complexity and the cost of storage management is driving storage consolidation and the rapid acceptance of SAN implementation. The benefits of storage consolidation are quite clear – more efficient use of storage, fewer disruptions of service, easier data sharing, and lower management costs. SANs provide the same benefits, plus the enhanced performance of a high-speed storage-only network, centralized management, and the promise of data access from any server to any storage device.

Key Storage Solution Requirements

- High availability
- Scalability
- Services for planning and deployment of consolidated storage and SANs
- Centralized management
- Responsive service and support to ensure maximum uptime
- Automated management and self-tuning

BUSINESS INTELLIGENCE

The ability to improve sales hit ratios through one-to-one marketing is at the core of data warehousing/data mining-based business intelligence. In e-commerce, the information collected about a transaction is more important than the transaction itself. For example, with information collected from an individual's purchases, suggestions can be made regarding similar products or related services upon a customer's next website visit. This capability is not specific to e-tailers. Supermarket loyalty cards gather the same kind of information, for example.

Key Storage Solution Requirements

- Capacity
- Scalability
- Performance to house TB of data
- The ability to resolve and return answers to complex queries

MANAGING PERFORMANCE AND CAPACITY

Customer data is growing exponentially with the increase in business-to-business and business-to-customer transactions. In addition, the unprecedented and unpredictable nature of storage performance requirements only accentuate the e-tailer's management predicament. The goal is to maintain consistent performance despite spikes in user demand or increases in capacity.

Key Storage Solution Requirements

- ◆ Scalability
- ◆ Capacity growth with (planned or unplanned) disruption
- ◆ Automated performance tuning

SSPs, ASPs, ISPs

Many enterprises find it cost effective to outsource IT functions to Storage Service Providers (SSPs), Application Service Providers (ASPs), and/or Internet Service Providers (ISPs). In addition, a number of companies provide the applications and infrastructure for web-based software services, such as supply chain management, financials outsourcing, and commodity trading by way of example. All of these "emerging" companies have extraordinary storage needs and require extremely high Service Level Agreements (SLAs).

Key Storage Solution Requirements

- 24x7x365 operations
- Performance and scalability to handle spikes in demand
- Service and support for storage deployment and production maintenance

Key Industries

Some of the likely customers for the Sun StorEdge™ 9900 series include:

RETAIL

In this market, storage systems are used both at the transaction level and at headquarters where store data is collected and consolidated. At the transaction level, revenue and product inventory data is collected through Point-of-Sales (POS) systems and stored in small, distributed storage subsystems. At headquarters, consolidated data is consolidated and collected by Enterprise Resource Planning (ERP) systems to track product sales and inventory for re-ordering. This data is also used for data warehousing/data mining applications.

All retail is transaction-based. OLTP applications (POS and ERP) and inventory tracking are its lifeblood. Data warehousing/data mining is used to enable better targeted sales and marketing activities and customer loyalty programs. Supply chain management for just-in-time delivery and real-time analysis are crucial to the survival of many retailers.

Key Applications

- E-Commerce
- Data warehousing / data mining
- ERP
- Customer Relationship Management (CRM)

Key Storage Solution Requirements

- High availability
- Scalability and capacity
- Fast response time for web sales support
- Responsive service and support to ensure maximum uptime

FINANCIAL/INSURANCE

Financial markets are consolidating through mergers and acquisitions. The drive to lower costs is driving transaction automation and Web-based e-commerce. A leading example is the average cost per transaction at a typical bank: \$1.07 at the branch, \$0.68 by telephone, \$0.27 by ATM, and \$0.10 via the Internet. Data warehousing/data mining applications enable financial firms to better target high-value services and cross-sell their products.

HEALTHCARE MANAGEMENT

This industry is consolidating to achieve economies of scale and reduced costs. Its primary twin goals are to deliver excellent patient care while reduce costs. Healthcare management firms benefit from E-commerce, data warehousing/data mining, and OLTP applications. E-commerce, Internet/Intranet/Extranet combine to help reduce costs and expedite deliveries through electronic purchasing. Data warehousing/data mining allow analysis of patient records and optimization of treatment plans. OLTP applications enable healthcare management firms to hold down costs through just-in-time deliveries.

There is also a drive in the healthcare field to digitalize all patient records, including X-rays and CAT scans, to better track patient care and build databases of best case practices for patient treatment. The typical healthcare IT environment consists of multiple distributed servers, running large customer, product, and prescription databases, as well as imaging to incorporate paper-based records into patient databases.

Key Applications

- E-Commerce
- Data warehousing/data mining
- Imaging
- OLTP

Key Storage Solution Requirements

- High availability
- Scalability for growing databases
- Remote monitoring capabilities for distributed systems

TELECOMMUNICATIONS

This industry is in constant change as players try to become one-stop providers to consumers. This has led to a number of mergers and acquisitions. Data warehousing/data mining applications play a big role in helping telecommunications companies expand their service offerings and roll out programs. Billing and bill processing is an area where telecommunications companies are looking to cut costs. So, they need electronic alternatives to paper-based billing.

Key Applications

- E-Commerce for customer ordering and payments of services
- Data warehousing to maintain growing customer databases
- Data mining to design new services that will keep current customers and attract new ones

Key Storage Solution Requirements

- High availability
- Large capacity and scalability
- Real-time service and support

Field Strategy – Competing with the Monoliths

The following is a guide for strategic philosophy and a roadmap you can use for anticipating competitive tactics from EMC, IBM, and Compaq and how to use them to your advantage.

SIZE UP YOUR PROSPECT

- Identify the evaluation/decision process and people
- Look for people who:
 - Dislike “slick” sales reps
 - Are less influenced by marketing hype
 - Can’t be “bought”
 - Love technology
 - Want a level playing field for comparison
 - Will largely evaluate on technical merits

THE 800 POUND GORILLA

- In spite of their weak products, never take EMC or IBM for granted
- Spoken or not, they will be a competitor in virtually every deal
- Better to acknowledge and subtly/truthfully disparage them
- Paint them (accurately) as the “marketing” leader with good products; but Sun as the clear architectural and solution leader with the ability to deliver on SLAs
- Don’t be drafted into a technical dispute – avoid FUD; however, be prepared to fully discuss in detail the technical merits of the Sun StorEdge™ 9900 series versus the EMC Symmetrix and the IBM Shark/Compaq Red Shark fixed bus boxes

IF YOU CAN’T FIX IT, FEATURE IT.

- Fact – Both EMC and IBM have many direct/indirect “feet on the street” as does Sun
- Fact – They are relentless marketing/sales machines
- Fact - They have huge shares in their respective markets
- Fact – We have great products
- Position Sun as the clear architectural choice, using a “just the facts” approach vs. IBM’s and EMC’s “reputation sale”

YOUR STRATEGY – PREEMPT THEIR “COOKBOOKS”

- Both EMC and IBM conduct very effective, predictable campaigns
- We’ve see their campaigns; the prospect may or may not have
- Spoil the effect by customizing your presentation to your customer’s unique environment, concerns, and needs, educating the prospect and subtly/accurately trivializing their approach; then, when they behave as predicted, the results will be:
 - The prospect not being “wowed” or confused
 - A confirmation Sun information is reliable and trustworthy

PAINT THE PICTURE OF WHAT CUSTOMERS CAN EXPECT

- They may try to preempt the process through upper management while discrediting the IT manager/director and his or her staff
- They may position themselves as having no competition

- They may be light on feature/function; heavy on reputation/ROI
- They may attempt to avoid a discussion of technology (architecture) as long as possible
- Remind prospects these are tactics and a “show” designed to “wow” them
- They may be very aggressive, “schmooze” and press for a quick sale
- They will be very expensive, unless they think the purchasing decision is not going to go their way, then they will start to drop their hardware pricing (EMC will switch from Symmetrix to the much less expensive Clariion in pure open systems cases!)
- They will often propose “apples to oranges” comparisons by comparing to older models or by using their own home-grown (biased) benchmark
- If EMC is told that they lost, you will feel their wrath:
 - Hordes will descend on upper management
 - Prices will be slashed
 - Evaluators will be disparaged
 - Process will be preempted

BE RESPONSIVE AND FORTHRIGHT THROUGHOUT

- We have to be the absolute antithesis of EMC and IBM where they attempt FUD tactics
- We are the good guys with the interest in the customer’s business and needs
- We must establish a long-term working relationship by establishing our credibility via our knowledge, our passion, and the facts
- We must understand the customer’s business objectives
- We must understand the customer’s processes and policies
- We must determine who the decision makers are
- Try to get assurance the decision will not be preempted
- Provide detailed justification for a Sun decision:
 - The Sun StorEdge™ 9900 series provides just as much, if not more, RAS
 - The Sun StorEdge™ 9900 series provides just as much, if not more, performance
 - The Sun StorEdge™ 9900 series provides just as much, if not more, manageability
- Anticipate paperwork ahead of time – review contracts early and thoroughly (watch out for EMC-specific or IBM-specific features/functionalities)

ONCE THE RFQ HITS THE STREET

- EMC will follow the script and the hordes will descend (so will IBM)
- Remind prospects that they should be/are prepared for this
- Remind them EMC is preempting their process and all of their time consuming evaluation work
- Remind them to look for the hidden costs
- Remind them that one Sun StorEdge™ 9960 system is the equivalent of at least six EMC Symmetrix or IBM Shark boxes which saves significant money due to the fact that superfluous hardware and unnecessary software licenses aren’t needed with the scalable one-system approach we have (and, with RAID 5, even more savings are to be had over EMC Symmetrix RAID 1)

IT'S NOT OVER UNTIL IT'S OVER

- Prospects can and will disappoint you:
 - They talk partnership but they act on price
 - They talk process but they will allow preemption from above
 - EMC and IBM are viewed as the safe (and, when they virtually give their hardware away, as the less expensive) decisions
- To combat this scenario:
 - Follow the approaches herein
 - Anticipate the competition and prepare the prospect
 - Take their “sizzle” out of the equation by preempting it or analyzing it with the facts
 - Act appropriately, professionally, and knowledgeably – and take the time to share that knowledge with the prospect and show him or her how the Sun StorEdge™ 9900 series fits into the IT environment and helps to deliver on SLAs
 - When the going gets tough, don't let your champions fold
 - Get the contracts approved and signed
 - Talk about performance as a subset of RAS – i.e., a system that is bottlenecked (choked) looks like it is unavailable (down) to the end users who are trying to access it – the Sun StorEdge™ 9900 series provides the ability to perform far more work with far less initial hardware and software acquisition costs with the ability to replace at least six Symmetrix or Shark boxes with one easy-to-manage storage system (the larger the TB requirements, the less need there is to lower pricing!)

CONCLUSION

- We can and we will win deals because we have the best products, solutions, people and approach and many prospects are sick In particular of EMC's antics and want to award the business to us and will award it now that we are carrying the Sun StorEdge™ 9900 series; HOWEVER, don't take for granted that just because we now have a far superior product to address the needs of the data center, we will win automatically - expect EMC and IBM to fight back with everything they have.
- Remember:
 - Neither EMC or IBM is incompetent
 - EMC and IBM will significantly lower their hardware pricing to win deals; they may even give away services to win deals (but they will pick up margin on the backend on services and software, as well as follow-on hardware business where they won't be as price friendly)
- On the other hand, we will:
 - Be fully prepared and run a great campaign
 - Coach and mentor the prospect along the way so the prospect can make a fully informed, intelligent, and willful purchasing decision which is in the best interests of his or her company
 - Identify and engage all levels of the appropriate people within the purchasing decision chain (e.g., CEO, CIO/CTO, CFO, LOB, IT manager/director)

Please refer to:

Appendix C: Calculating Lost Sales Worksheet

Appendix D: Business Continuity Questionnaire

Appendix E: Enterprise Server, Storage & Tape Systems Summary

ENABLING TECHNOLOGY

Features Overview

In today's Net economy, instant access to data require extremely fast response and non-stop continuous availability with no disruptions of service are key to any company's survival. The competition is a mere click away, and, in general, if customers have to wait much longer than five seconds for requested data, they in all likelihood will be gone and not return for years to come. Sun understands this market dynamic. As a result, Sun is now selling the Sun StorEdge™ Series 9900, which is designed to provide customers with the IT muscle to deliver information continuously, where and when they need it, without disruption.

HARDWARE FEATURES

Data center-class drives - High-throughput bi-directional active/active 10K RPM FC drives with dual segmented cache buffering, redundant pathing, dynamic path reconfiguration, and provide the utmost in reliability – so they rarely if ever fail.

Load-sharing/Load balancing power supplies – Help ensure robust operation so overloading the storage system is not possible even if it is expanded to its maximum capacity; balancing the current load evenly across the power supplies is designed to extend their life expectancy.

Segregated data and control cache - Control data is overhead (non-productive work); mixing it with I/O data (productive work) significantly slows the storage system down (by as much as 45% under extremely heavy workloads) - not the case with Lightning, which provides a separate area in cache to handle storage administrative tasks away from cache provided for processing users' I/O (e.g., record retrievals, record updates, file requests, data streaming).

Non-dedicated dynamic read/write cache - Uses as much cache as available; no waste (no paying for something you don't need or use); adjusts to varying workloads to optimize performance whether performing heavy reads, or heavy writes, or heavy reads and heavy writes.

Dynamic global non-floating hot sparing - Automatically grabs a hot spare when needed without operator intervention; once failed drive has been replaced, hot spare reverts back to its original location (no guessing where your hot spares are); keeps costs down because any hot spare can be used to hot-replace any failed drive anywhere in the system; provides a higher level of availability because you don't have to count on a dedicated hot spare to be there for a pre-assigned array group.

Adjustable, non-dedicated BCVs - Drives can be dynamically assigned as Business Continuance Volumes and then changed back to production volumes as needed, and vice-versa. And, BCVs can be designated as RAID 1+ or as RAID 5 volumes and re-configured at a later date as needed.

No single point of failure - Every active hardware component (the power supplies, the cooling fans, the batteries, the cache boards, the host interface boards, the array processor boards) is duplicated, hot-swap/redundant, and fault-tolerant.

Highly resilient multi-path switched fibre architecture - Performance actually improves with each additional host interface, unlike competitive systems which slow down with each additional host; no more bus-bound performance walls to hit.

Duplexed write cache with hot-swap/redundant battery backup - Data not yet written to disk is always protected from any unplanned contingency.

RAID 1+ and/or RAID 5 arrays within the same system - Extreme flexibility allows the storage system to be matched to the workloads.

Industry's only switched fabric architecture – Virtually unmatched performance and capacity.

Up to 6.4GB/sec internal system bandwidth - 64 separate switched internal data paths at 100MB/sec bandwidth each; virtually no bottlenecks when properly configured.

Up to 64 separate switched internal data paths - The world's first high-resiliency storage system with 64 separate switched internal data paths; if a path is lost, only 1/64th of the system is affected, so there is no disruption in service because no bottlenecks occur in the event of a failed path.

Fully addressable 32GB data cache - Extremely fast and intelligent caching algorithms.

Simultaneous transfers from up to 32 separate hosts - No waiting; maintain the levels of performance you expect from previously installed host systems.

Fibre Channel and ESCON server connections - provides connections to many different host servers.

Support for SANs, Fibre Channel Switched, Fibre Channel Arbitrated Loop, and point-to-point configurations - Connect any way you need it; shared pooling and better utilization of storage resources for improved performance, better security, and higher availability over traditional cache-centric systems still using older fixed-bus architectures. SANs also place new demands on storage systems: switches allow more hosts, possibly hundreds of hosts, to access storage ports, and you need a storage system that won't bog down under the stress. Connect the Sun StorEdge™ 9900 series system to as many as 192 hosts in a SAN environment using a six-to-one fan-out ratio.

FIRMWARE FEATURES

LBA - Record and Logical Block Address (LBA) level caching

Intelligent Learning Algorithm - Monitors data access patterns and dynamically alters staging criteria to help ensure the highest possible hit ratios for randomly accessed data

Non-disruptive microcode updates - During routine maintenance, the system remains up and fully operational, unlike some of the other systems which must be taken off line (creating a disruption in service) or which remain online but must busy-out a port. (NOTE: Two HBAs per host required.)

Split-queue write cache - The write area of cache is split into two queues, so when data is written into cache, it is written twice (mirrored) - once into the top of one queue, and once into the bottom of the other queue. When the data is written to disk, it is pushed out of one queue immediately upon receipt new data, and bumped up one level in the other queue. This way, new data is placed in one queue for immediate destage to disk, while at the same time is left in the other queue in the event it needs to be quickly accessed again - performance is improved in such a case because the backend (i.e., the disk drives) do not have to be accessed to retrieve the requested data.

Non-disruptive expansion to over 37TB raw capacity - Add disk drives, cache, array control processors, control host interface processors seamlessly without any disruption to service (i.e., production I/O).

Superior RAID 5 performance - Utilizing advanced RAID algorithms provides high-speed data and I/O transfers providing equivalent performance of competitive RAID 1 or RAID 10 (1+0) offerings at significantly reduced cost over mirrored configurations.

SOFTWARE FEATURES

Sun StorEdge™ 9900 CruiseControl Software - Monitors, analyzes, and automatically performance tunes (or recommends tuning options) by identifying optimal placement of logical volumes to balance activity with decision inputs that include: logical device busy, path busy, physical disk performance, access patterns, and RAID type.

Sun StorEdge™ 9900 Dynamic Link Manager Software – Provides automatic load balancing, path failover, and recovery capabilities in the event of path failure. Helps ensure no single path becomes overworked, while others are under utilized. Automatically allocating information to an alternate data path eliminates the threat of application failure. Increases information availability across the enterprise by maximizing complete utilization of all paths available. LUNs can be accessed through two separate paths.

Sun StorEdge™ 9900 FlashAccess Software - Lock LUNs into cache for significantly enhanced performance. Part of Resource Manager.

Sun StorEdge™ 9900 Graph-Track Software - Displays real-time or historical performance data in a Windows 98, Windows NT, or Windows 2000 PC attached to the Sun StorEdge™ 9900 series. Part of Resource Manager.

Sun StorEdge™ 9900 Extended Remote Copy Software - Synchronous remote copy over extended distances using extenders (S/390)

Sun StorEdge™ 9900 LUN Manager Software - Manage multiple virtual LUNs; define, configure, add, delete, resize, and assign LUNs to specific paths; and maintain open systems LUNs without vendor; assign multiple paths to a single LUN. Part of Resource Manager.

Sun StorEdge™ 9900 LUN Size Expansion - Dynamic LUN creation/expansion. Part of Resource Manager.

Sun StorEdge™ 9900 Multi-Platform Backup/Restore Software - Open systems backup using mainframe hardware

Sun StorEdge™ 9900 Prioritized Port Control Software - Allows administrators to assign higher priority to specific ports enabling faster access. Priority is assigned by port. Part of Resource Manager.

Sun StorEdge™ 9900 RapidXchange Software - Sharing or moving data between multiple disparate heterogeneous host applications

Sun StorEdge™ 9900 Resource Manager Software Suite- Provides truly non-disruptive microcode updates; online verify, data assurance code, and error correction code. Includes Sun StorEdge™ 9900 Graph-Track Software, Sun StorEdge™ 9900 FlashAccess Software, Sun StorEdge™ 9900 LUN Manager Software, Sun StorEdge™ 9900 VLVI, Sun StorEdge™ 9900 LUSE, and Sun StorEdge™ 9900 Prioritized Port Control software.

Sun StorEdge™ 9900 SANTinel Software - Utilizing World Wide Names, controls host access to Sun StorEdge™ 9900 series LUNs in open systems, multi-platform SAN environments, enabling administrators to restrict server access to specific LUNs and protect data from unauthorized access.

Sun StorEdge™ 9900 ShadowImage Software - Point-in-time LUN duplication (image snapshot) for non- disruptive, real-time copies for backups, application testing, and data

warehousing/data mining activities. Includes Command Control Interface (CCI); used to create batch streams.

Sun StorEdge™ 9900 TrueCopy Software – Host-less asynchronous or synchronous remote copy: Continuously update and maintain reliable data copies at a secondary site asynchronously from one Sun StorEdge™ 9900 series to another. Includes Command Control Interface (CCI); used to create batch streams.

Sun StorEdge™ 9900 Virtual Logical Volume Image Software - Permits users to configure logical volumes with capacities as small as a single cylinder and as large as a full 3390-9 image; volume size is determined in cylinder increments. Part of Resource Manager.

Operating System Support - MVS, S/390, Sun Solaris, Microsoft Windows NT, Microsoft Windows 2000, Novell NetWare, Linux, HP-UX, IBM AIX, Compaq TRU64, and SGI IRIX.

Open systems host failover support - HP MC/Serviceguard, IBM HACMP, VCS (Solaris), Sun Cluster, Windows NT MSCS, Windows 2000 MSCS, Compaq TruCluster, Novell Cluster Services, VMS Cluster, and Sequent Cluster Control.

Cache Control Algorithms

The Sun StorEdge™ 9900 series places all read and write data in cache, and 100% of cache memory is available for read operations. The amount of fast-write data in cache is dynamically managed by the cache control algorithms to provide the optimum amount of read and write cache, depending on the workload read and write I/O characteristics. The algorithms for internal cache control used by the Sun StorEdge™ 9900 series include the following:

Destage Algorithm. Cache destages to disk in 16K segments (4 x 16KB = 64KB) Cache destages a slot at a time in 64KB blocks.

Dynamic Duplex Cache. The duplex write cache is the area of cache that is dynamically allocated for write operations. The duplex write line is the amount of duplex write cache expressed as a percentage of total cache. The amount of fast-write data stored in cache is dynamically managed by the cache control algorithms to provide the optimum amount of read and write cache based on workload I/O characteristics. The default dynamic write line setting allows up to 50% of cache to be allocated to fast-write data. If the dynamic write line limit is reached, the Sun StorEdge™ 9900 series sends DASD fast-write delay or retry indications to the host until the appropriate amount of data can be destaged from cache to the disks to make more cache slots available. Cache is ECC protected. There are four 16KB segments in a slot (64KB block per cache slot). Four blocks equal 256KB stripe size for RAID 5 writes.

ECKD. The Sun StorEdge™ 9900 series supports S/390 Extended Count Key Data (ECKD) commands for specifying cache functions.

Intelligent Learning Algorithm. Identifies random and sequential data access patterns and selects the amount of data to be “staged” (read from disk into cache). The amount of data staged can be a record, partial track, full track, or even multiple tracks, depending on the data access patterns.

Least-Recently-Used (LRU) Algorithm. When a read hit or write I/O occurs in a non-sequential operation, the least-recently-used (LRU) algorithm marks the cache segment as most recently used and promotes it to the top of the appropriate LRU list. In a sequential write operation, the data is destaged by priority, so the cache segment marked as least-recently used is immediately available for reallocation, since this data is not normally accessed again soon.

Sequential Prefetch Algorithm. Used for sequential-access commands or access patterns identified as sequential by the Intelligent Learning Algorithm. The sequential prefetch algorithm directs the ACPs to prefetch up to one full RAID stripe (24 tracks) to cache ahead of the current access. This allows subsequent access to the sequential data to be satisfied from cache at host channel transfer speeds.

Control Unit (CU) Images, LVIs, LUNs

CU IMAGES

The Sun StorEdge™ 9900 series supports 3990-3 and 3990-6E CU images (emulation types). The Sun StorEdge™ 9900 series is configured with one logical CU image for each 256 devices (one storage system ID for each 64 or 256 devices) to provide a maximum of sixteen CU images per system. (NOTE: The S/390® data management features of the Sun StorEdge™ 9900 series may have restrictions on CU image compatibility. For further information on CU image support, please contact your storage account representative.)

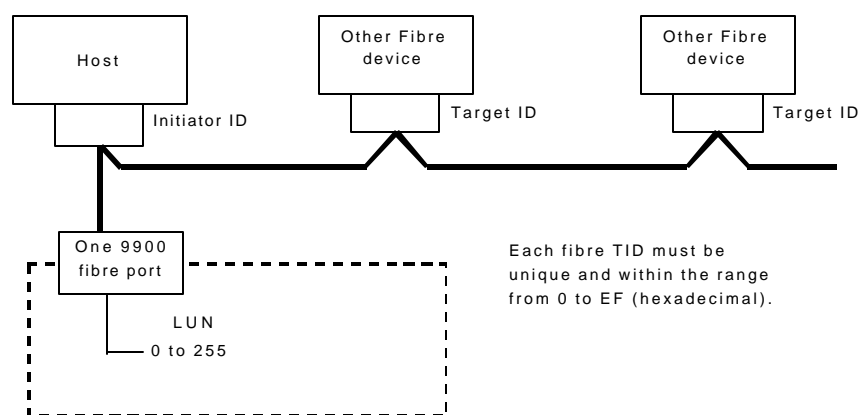
LOGICAL VOLUME IMAGES (LVIs)

The Sun StorEdge™ 9900 series the following S/390® LVI types: 3390-1, -2, -3, -3R, and -9 and 3380-E, -J, and -K. The Sun StorEdge™ 9900 series also supports the following Open LVI types: OPEN-3, OPEN-8, OPEN-9, OPEN-e and OPEN-k. (NOTE: The LVI configuration of the system depends on the RAID implementation and physical disk drive capacity per array domain.)

LOGICAL UNITS (LUs)

The Sun StorEdge™ 9900 series supports 2.461-GB OPEN-3 LUs, 7.347-GB OPEN-8, 1.874-GB OPEN-K, 7.384-GB OPEN-9 and 14.568-GB OPEN-E LUs. The Sun StorEdge™ 9900 series also provides the capability to configure “expanded-size” LUs which can range in size from 3.748 to 524.448 GB. Each LU is identified by fibre-channel port ID and LUN number.

Each FC port has addressing capabilities of up to 256 LUNs.

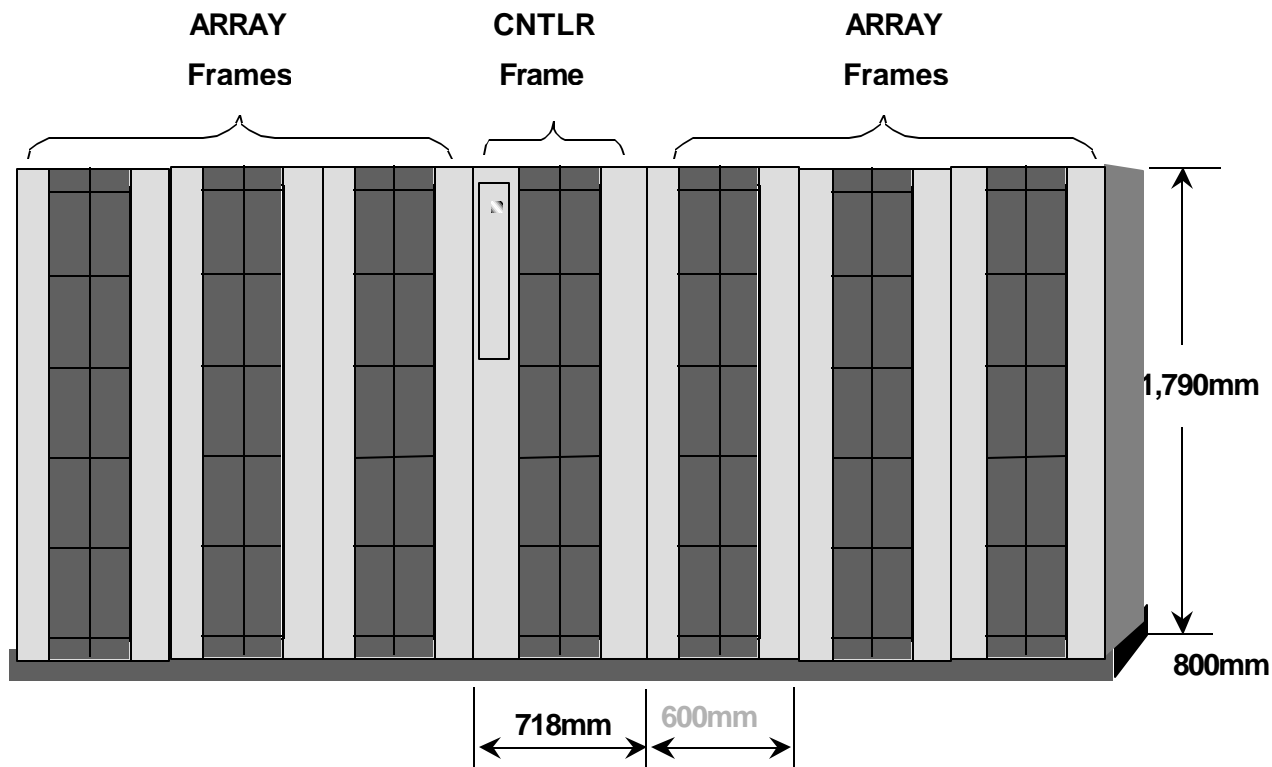


OVERVIEW OF SYSTEM ARCHITECTURE

This section provides an overview of the system architecture of the Sun StorEdge™ 9960 system.

Frame Configuration

A fully configured Sun StorEdge™ 9960 system consists of one control frame and six array frames. Each array frame is 600mm wide.



The Sun StorEdge™ 9960 system includes the following major components:

- One controller frame, which contains the control and operational components of the system.
- Up to six disk array frames, which contain the storage components (disk drive arrays) of the system.
- The service processor (SVP) which is located on the control frame. The SVP can only be used by authorized systems personnel.
- The Remote Console PC which is attached to the Sun StorEdge™ 9960 system(s) via the internal LAN.

The Sun StorEdge™ 9960 system control frame contains the control and operational components. The control frame is fully redundant and has no active single point of failure – all components can be repaired or replaced without interrupting access to user data. The key features and components of the control frame are:

- Non-volatile duplex shared memory
- Non-volatile duplex cache memory
- Multiple data and control paths
- Client-host interface processors (CHIPs) and channel adapters
- Array control processors (ACPs)

Shared Memory

Shared memory is duplexed (written twice) and nonvolatile (contents are held by battery for seven days) and is used to store cache directories and disk control information.

Cache Memory

Cache memory is duplexed (written twice) and nonvolatile (contents are held by battery for 48 hours) and consists of 128MB DRAM DIMMs.

Multiple data and control paths

Data paths consist of cache switches which are implemented between the channel adapters and the cache units and between the disk adapters and the cache. Each adapter is connected to the cache through a hot line. Cache switches perform access to the cache by switching the path between each disk adapter and the cache memory which allows data transfer up to 3.2GB/sec between each disk adapter and the cache memory.

Control paths are similarly implemented, with a transfers up to 3.2GB/sec between adapters and shared memory. Each adapter is connected to shared memory through a 2-path hot line.

Client-host interface processors (CHIPs) and channel adapters (CHAs)

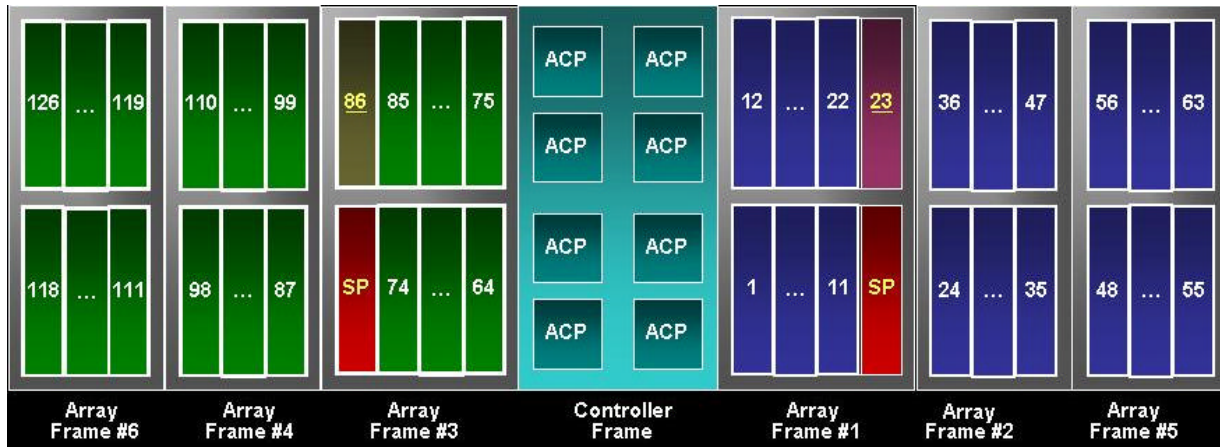
The channel adapter is a PCB which controls data transfer between the upper host and cache memory. Available as either a serial (ExSA - serial/ESCON) CHA for mainframe or a fibre (FC-AL or FC switched) CHA for open systems.

Array control processors (ACPs) and Disk Adapters (DKAs)

The disk adapter is a PCB which controls data transfer between the drives and cache memory. Four ports per PCB are mounted. Ports are controlled by their respective dedicated microprocessors with data transfer occurring concurrently between four ports and disk drives individually. Added in increments of two units, the dual-ported DKA connects to allow access to a single disk drive from two individual PCBs so if a failure occurs in one DKA or its FC interface, the other PCB can still access drive data.

Physical Configuration

There is a maximum of 126 Array Groups per Sun StorEdge™ 9960 system. Each array group utilizes exactly four drives (3+1 for RAID 5 or 2+2 for RAID 1+). Each Sun StorEdge™ 9960 system supports up to 16 non-floating global dynamic hot spares.



Note that Array Group positions #233 & #86 provide dual function capabilities:

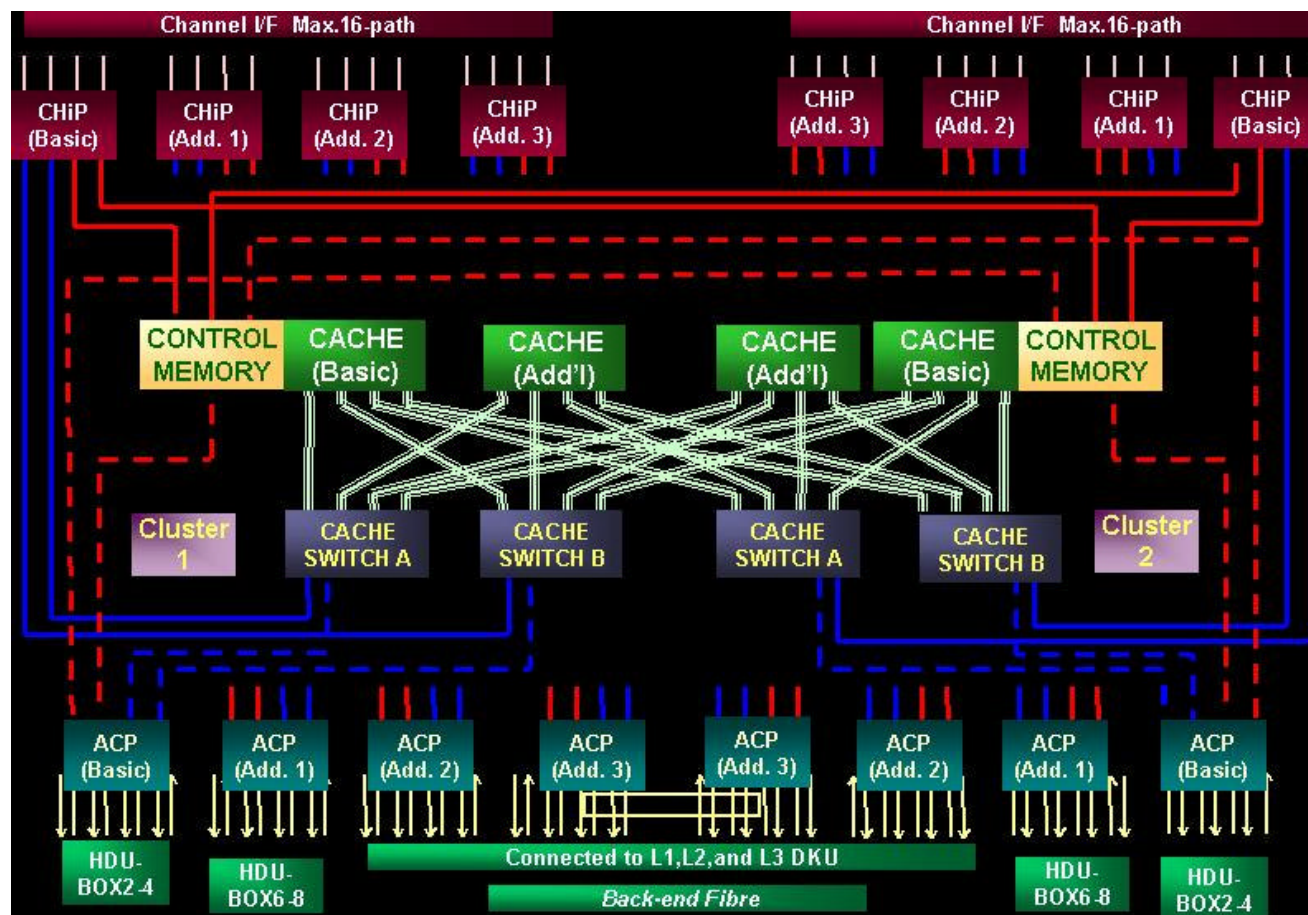
- Array Group #23: Data or spares 5-8 if single-sided configuration, or spares 9-12 if double-sided configuration
- Array Group #86: Data or spares 13-16

Basic Architecture

Unprecedented Internal Bandwidth

At the core of the Sun StorEdge™ 9900 series is its non-blocking FC switching architecture, which replaces the traditional shared bus backbone of today's cache-centric storage systems. Shared buses can lead to bottlenecks as data from servers, cache, and disks travel over the same internal medium. In contrast, the switch-based architecture of the Sun StorEdge™ 9900 series is non-blocking and avoids the data path contention of shared bus systems. Providing the ability to scale to enormous capacities without performance degradation, this network of interconnected high-speed links to system components provides an unequalled internal aggregate bandwidth of 6.4GB/s – 3.2GB/se for data transfer and 3.2GB/s for separate internal control information transfer. As a result, the Sun StorEdge™ 9960 system scales linearly as storage is added to accommodate growth.

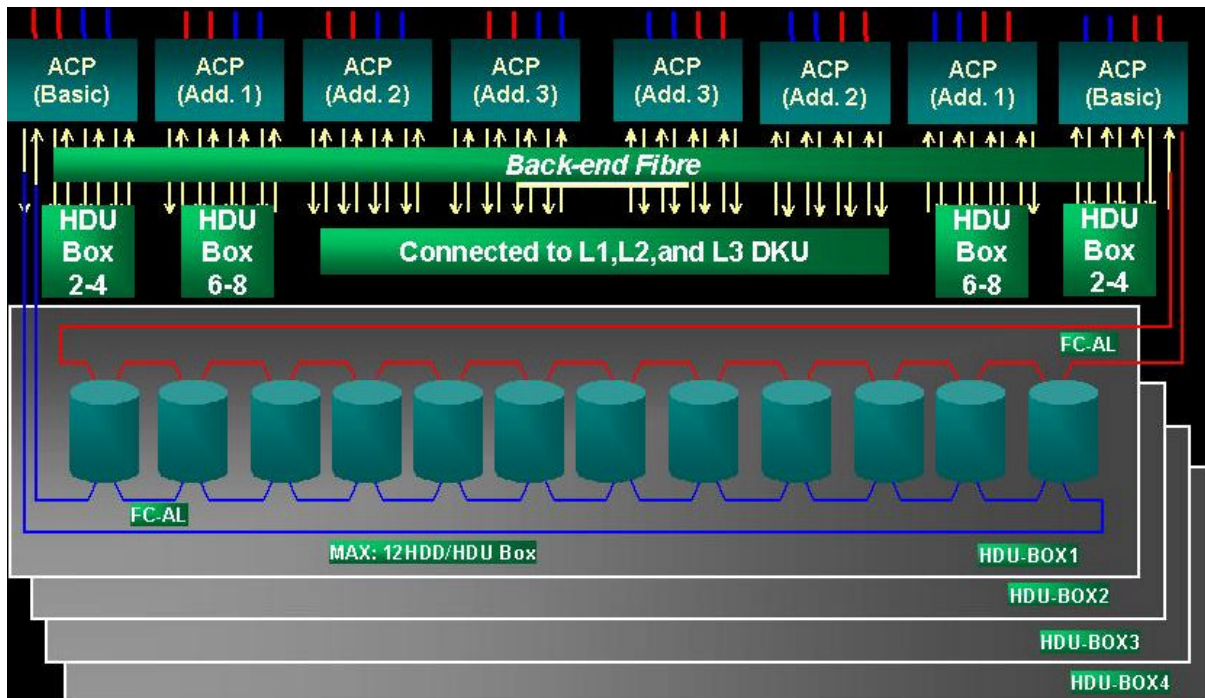
The Sun StorEdge™ 9900 series internal architecture employs a crossbar spread across four components which interconnect cache (data and control) with front-end server interfaces (CHiPS – Client/Host Interface Processors) and back-end disk interfaces (ACPs – Array Control Processors). In the Sun StorEdge™ 9900 series switched fabric, 64 point-to-point connections replace the shared buses of current storage systems, helping to enable the Sun StorEdge™ 9900 series to achieve up to 6.4GB/s of raw internal bandwidth. Which is four-to-six times the throughput of the nearest fixed-bus cache-centric monolithic competitor. What's more, the Sun StorEdge™ 9900 series helps to enable consistent, bottleneck-free performance as capacity is increased to as much as 37TB (raw capacity).



With this platform, Sun can deliver storage-based solutions which help enable customers to conduct business like never before. These high-end storage solutions include, but are not limited to, business continuity, business intelligence, and E-business. In addition, Sun can help customers reduce complexity and IT costs through simplified storage and data management. Sun can support its existing customers as well as SSPs (Storage Service Providers) and ASPs (Application Service Providers).

Backend Architecture

The drives are Hitachi OEM data center-spec FC-AL bi-directional dual-ported 10Krpm disks. Each drive is attached to two FC loops, with up to 32 drives per two FC loops, providing total system expansion to 512 disk drives.



The back-end performance of the Sun StorEdge™ 9900 series is enhanced with dual ported/dual active Fibre Channel disk drive technology. These three-inch form factor, high-density disk drives are specially designed and built by Hitachi Ltd. for the Sun StorEdge™ 9900 series. They are available in capacities of 18GB or 72GB, each spinning at 10,025 RPM. The internal transfer rates with these disks are approaching 60MB/s. Higher sectors per physical track means less head movement and more data transferred per rotation, even when compared to faster-RPM disks.

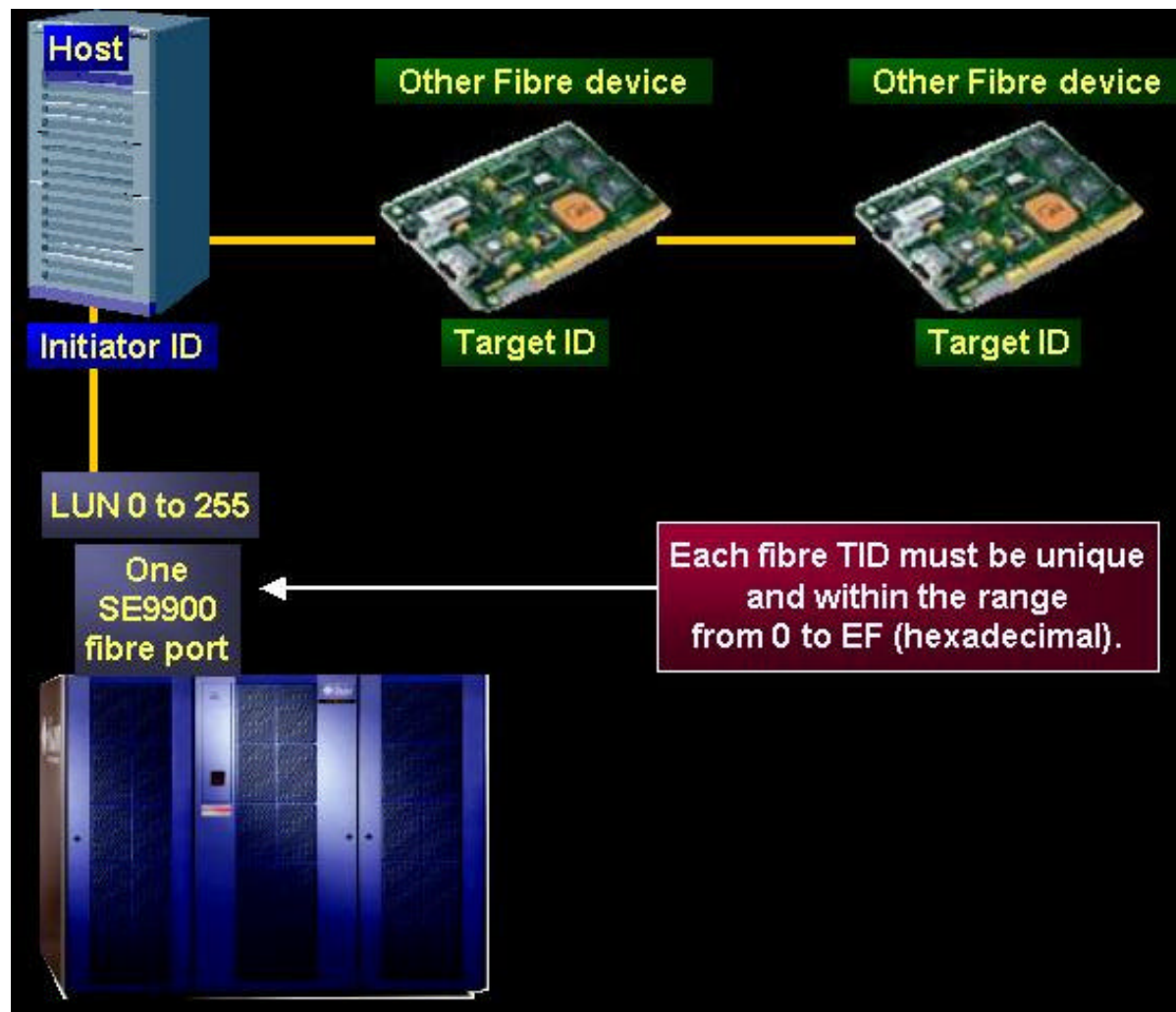
The dual ported/dual active drives, combined with the technology built into the ACP pair, allows the back end of the Sun StorEdge™ 9900 series to use all eight FC-AL paths in an ACP pair for optimal performance while maintaining optimal and fault tolerance. However, no one disk or array group can use both paths simultaneously. The ACPs monitor the activity and the utilization of the paths. Based on this information, the ACPs determine the best path to use for accessing a disk. One array group cannot use all eight FC-AL paths attached to it simultaneously, but many busy array groups on an ACP pair will utilize all eight paths on the ACP pair.

The Sun StorEdge™ 9900 series also support Command-Tag Queuing (CTQ) to the back-end drives. This capability greatly improves the performance of the back end by offloading much of the seek optimization functions to the disk drives themselves, allowing for more concurrent back-end I/O operations to occur.

External Host Interface Connectivity

LUNS PER PORT

The Sun StorEdge 9960 system supports a maximum of 32 fibre-channel ports. Each fibre-channel port is assigned a unique target ID number (from 0 to EF). The Sun StorEdge 9960 system can address up to 256 LUNs per port:



HOST CONNECTIVITY OPTIONS

Mainframe. The Sun StorEdge™ 9900 series can be configured with Extended Serial Adapter (ExSA is compatible with the ESCON protocol) channel ports for connection to S/390 mainframe hosts. When ExSA channel interfaces are used, the Sun StorEdge™ 9900 series can provide up to sixteen logical control unit (CU) images and up to 4,096 logical device addresses. Each physical ExSA channel interface supports up to 256 logical paths providing a maximum of 8,192 logical paths per Sun StorEdge™ 9900 series system.

The Sun StorEdge™ 9900 series can be configured with multiple concurrent LVI formats, including 3390-1, -2, -3 or -3R, -9 and 3380-E, -J, -K. In addition to full System-Managed

Storage (SMS) compatibility, the Sun StorEdge™ 9900 series also provides the following functionality in the S/390 environment:

- Sequential data striping.
- Cache fast write (CFW) and DASD fast write (DFW).
- Enhanced dynamic cache management.
- Concurrent copy.
- Sun StorEdge™ 9900 TrueCopy Software can be used for data backup, disaster recovery planning, and/or data duplication. Remote copy operations are completely non-disruptive, allowing the primary LVIs/LUs to remain online and available for read and write operations.
- Transaction Processing Facility (TPF)/Multi-Path Locking Facility (MPLF) support.

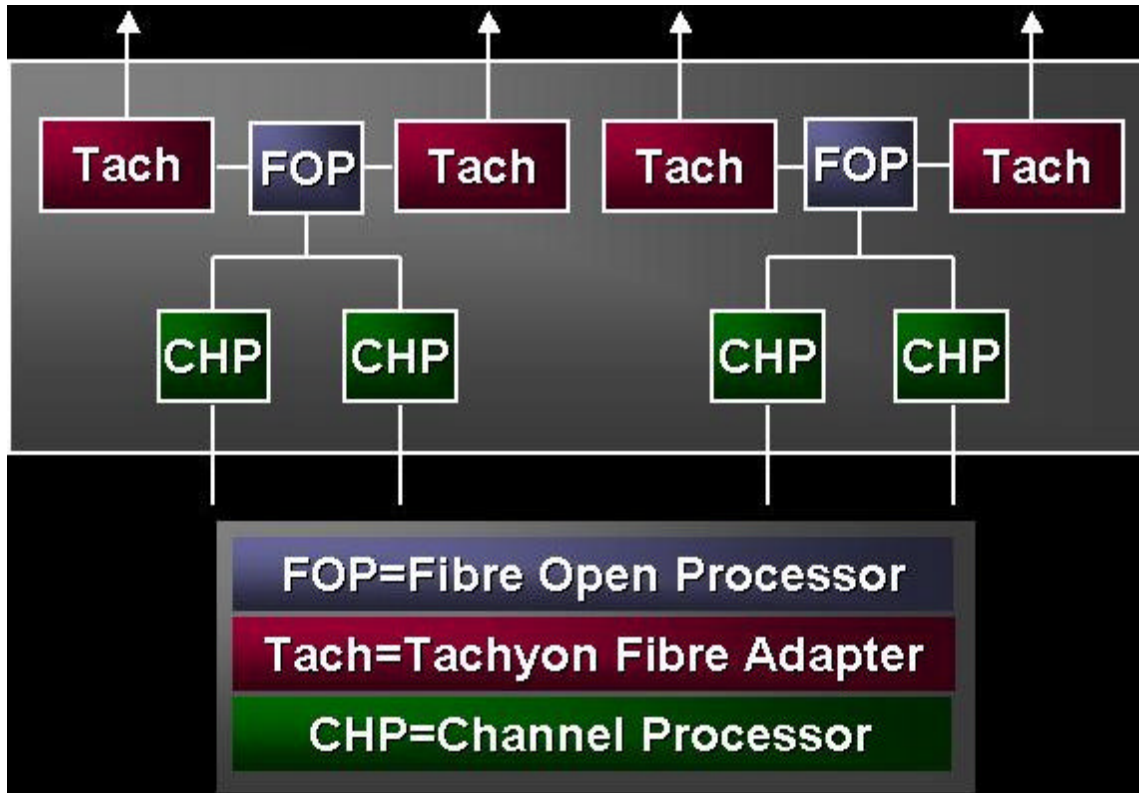
ExSA (Serial/ESCON). A Sun StorEdge™ 9960 system supports a maximum of 32 ExSA serial channel interfaces (compatible with ESCON protocol). The channel interface cards are available in four or eight ports per CHIP pair and provide data transfer speeds of up to 17MB/sec. Each ExSA channel can be connected to a single processor or logical partition (LPAR), or serial channel directors and/or shared serial channels can be used for dynamic path switching. ExSA Extended Distance Feature (XDF) is also supported.

Open Systems. A Sun StorEdge™ 9960 system can also be configured with up to 32 fibre-channel ports for connection to open-system hosts. The type of host platform determines the number of LUs that may be connected to each port. Fibre channel provides data transfer rates of up to 100MB/sec. The Sun StorEdge™ 9900 series supports fibre-channel arbitrated loop (FC-AL) and fabric fibre-channel topologies. The Sun StorEdge™ 9900 series supports short wavelength and long wavelength non-OFC (non-open fibre control) optical interfaces, multimode optical cables, and gigabit link modules (GLMs) as well as high-availability fibre-channel configurations using hubs and switches.

The fibre PCBs are available in either four or eight ports per CHIP pair, and each port is capable of operating at data transfer speeds of up to 100MB/sec. Using shortwave fibre cards, Sun StorEdge™ 9900 series systems can be located up to 500 meters (2,750 feet) from an open-system host. Using longwave fibre cards, Sun StorEdge™ 9900 series systems can be located up to 10 kilometers from an open-system host.

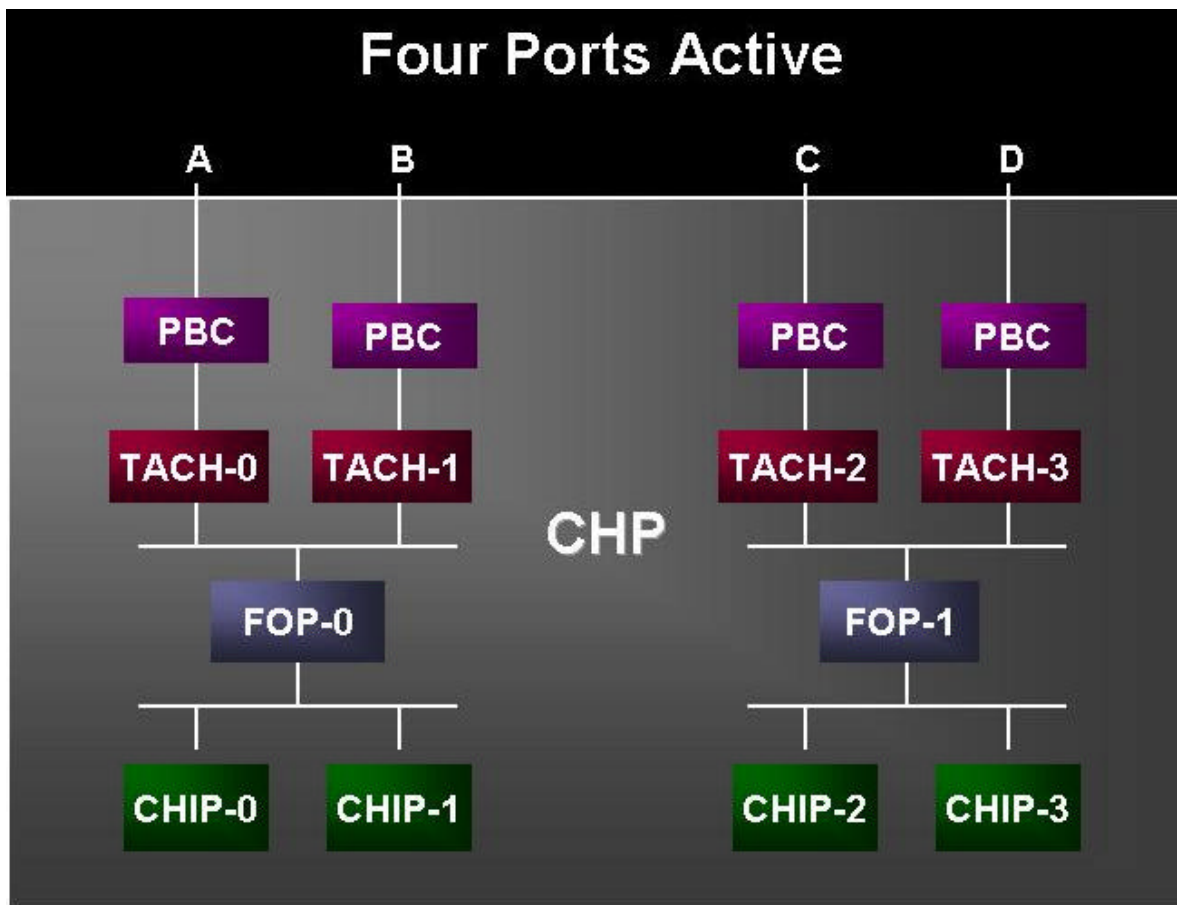
Multi-Platform. The Sun StorEdge™ 9900 series system can be configured with both ExSA and fibre-channel ports for connection to both mainframe and open-system hosts. The Sun StorEdge™ 9900 series also supports concurrent attachment to multiple open-system platforms.

Standard performance mode 4-Port Fibre Adapter:



	# of Cards	# of Interfaces	# of Concurrent I/Os	Max Xfer Rate MB/sec
8-port Escon	4	32	32	10/17 ea.
4-port Fibre	4	16	16	100 ea.
8-port Fibre	4	32	32	100 ea.
4-port Ficon	4	16	16	100 ea.

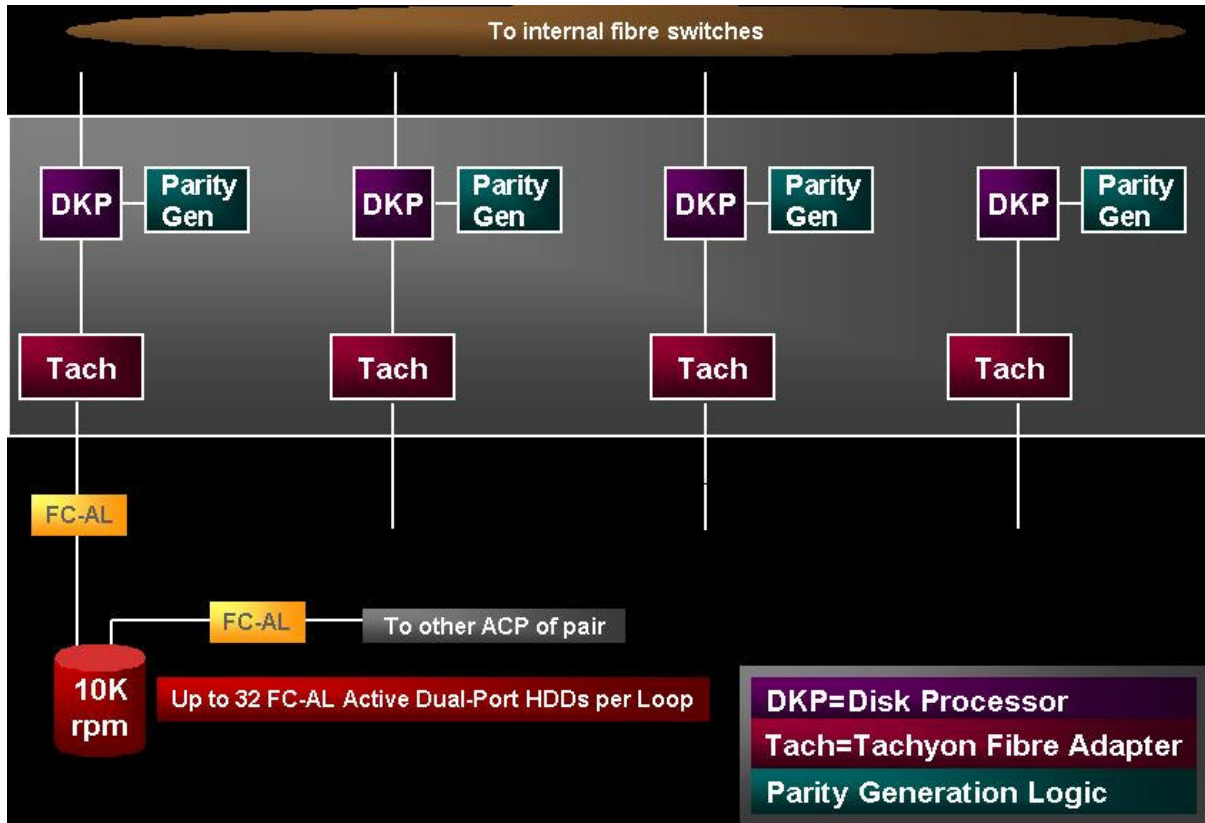
In Normal mode or Standard mode, the 4 ports are usable with 2 CHiPs and 1 FOP available per port.



With the Prioritized Port Control feature, the system administrator can assign performance limitations to an individual port/server.

There is no cache partitioning (i.e., no static cache allocation), although this feature does act like a caching control mechanism in that dynamic control is based on preset use thresholds in order to prevent a “run away” LUN from flooding or over-running the system cache. This is a dynamic feature in that if the throughput of the system requires throttling of a port, the control is active; otherwise, on a “non-busy” system, or during slow periods, the control is inactive.

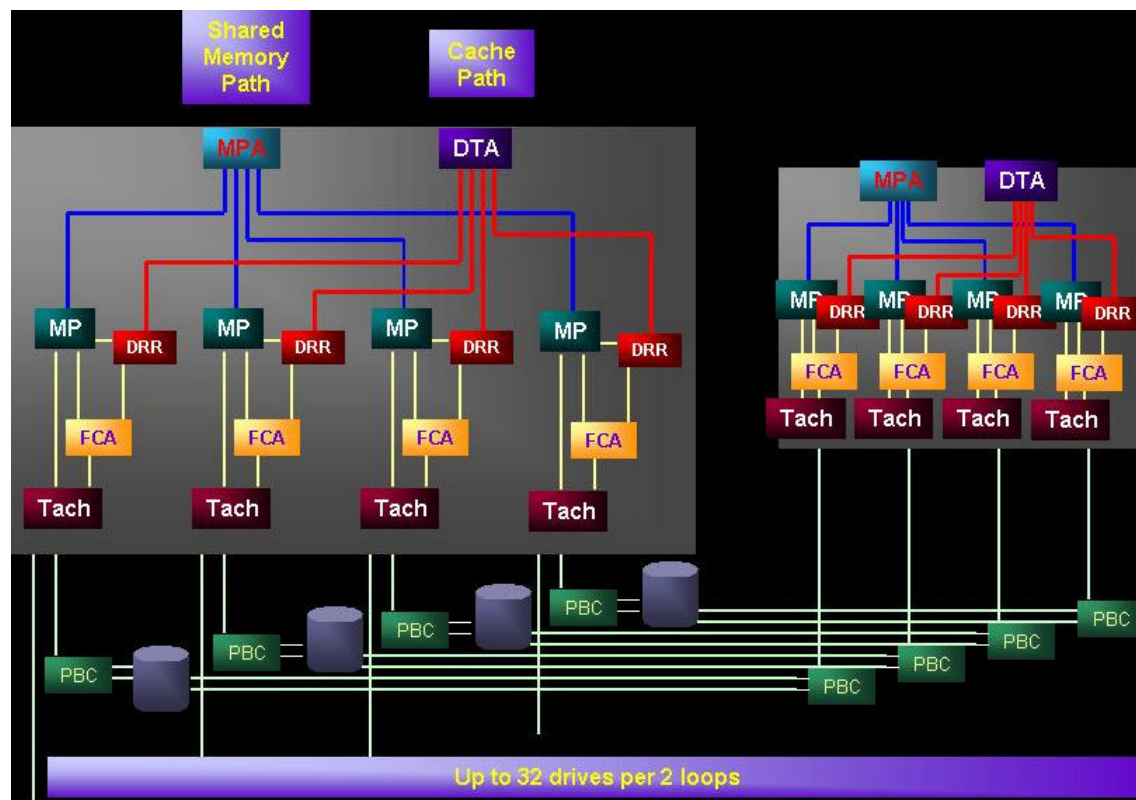
Array Control Processors



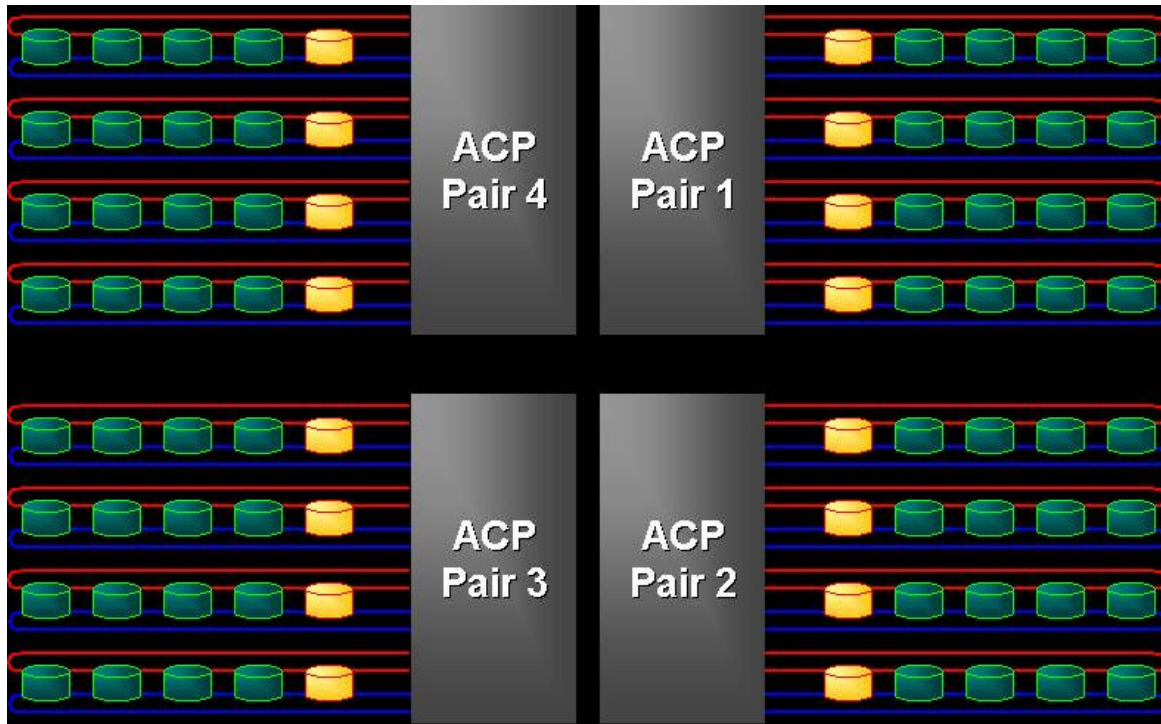
Each ACP pair has eight FC-AL ports for 800MB/sec throughput. The system's four ACPs provide a total throughput of 3.2GB/s to the back-end FC drives. There are 32 x 80MHz Intel 80960HDs processors and 32 Data Regenerator and Recovery (DRR) circuits, one per path each to provide extremely fast RAID-5+ random write performance to the backend HDDs.

Each FC-AL path is driven by a Tachyon Fibre Channel chip.

Two ACPs form an ACP pair. An ACP pair provides 8 FC-AL paths to a disk group, either RAID 5 or RAID 1+. MPA = Micro Processor Adapter; DTA = Data Adapter; MP = Micro Processor; FCA = Fibre Channel Adapter; PBC = Printed Board Circuit (AKA PCB); DRR = Data Regenerator and Recovery (RAID 5 parity circuits)



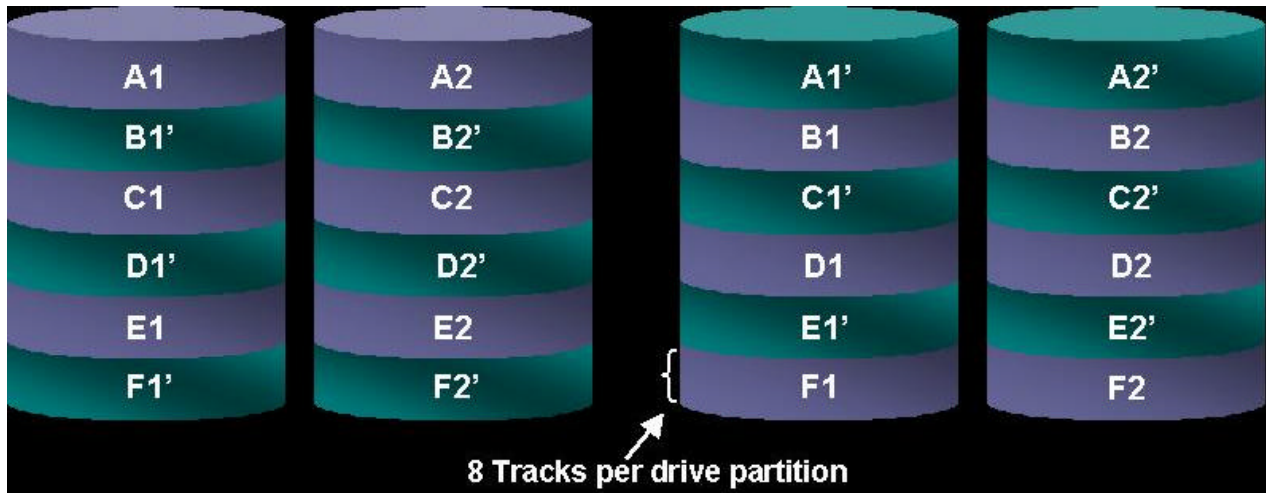
The new high-performance back-end drives are attached via Fibre Channel–Arbitrated Loops (FC-AL). Eight 100MB/s FC-ALs connect array groups to dual ported drives for each ACP pair. With four configured ACP pairs installed (at 800MB/s per ACP pair), that's 3.2GB/s total back-end bandwidth to the physical drives. Each FC-AL path is driven with a dedicated processor and a data recovery and regeneration (DRR) circuit.



RAID 1+

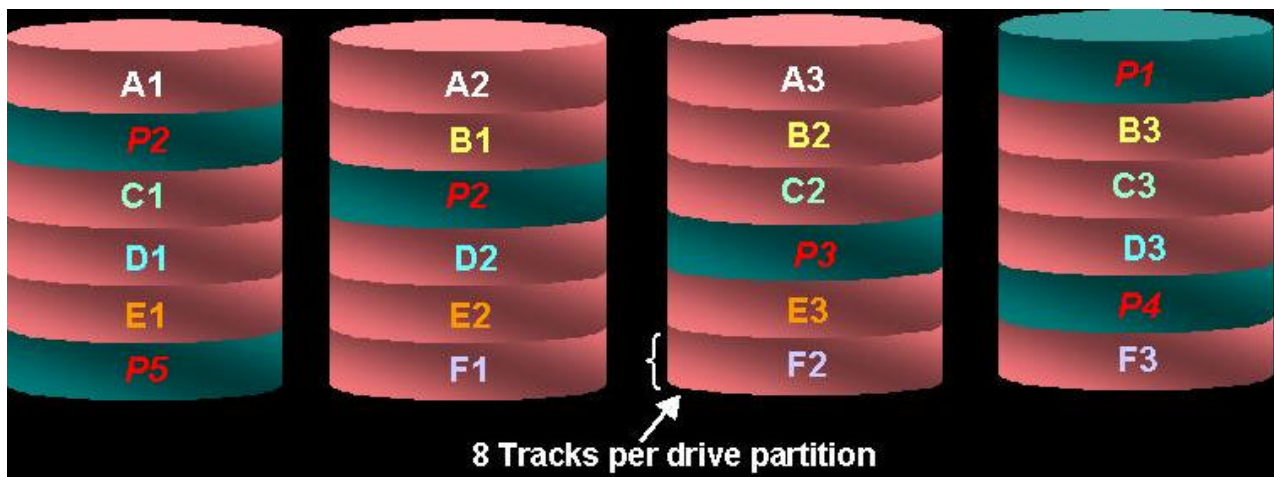
Alternating striping then mirroring. Each drive in the array has alternating primary blocks and secondary blocks. In the case of the Sun StorEdge™ 9900 series, a RAID 1+ array group is always exactly four drives. This allows for the loss of any two drives in the array, no matter their proximity, with no loss of data.

RAID-1+ is a 2Data + 2Data disk arrangement (four disks total) in a RAID-1+0 configuration with a twist — a rotating copy — this particular . This has several performance and reliability benefits over conventional RAID-1 or RAID-1+0 that will be discussed in a subsequent white paper.



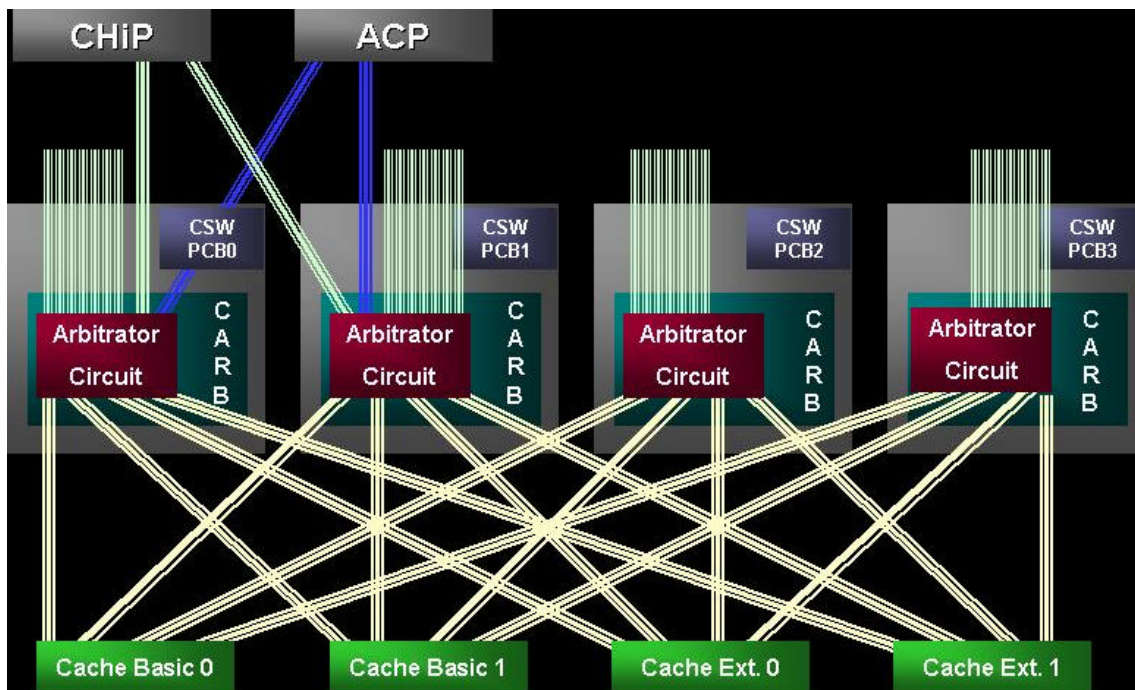
RAID 5

Striping (interleaved block I/O) with rotated parity. Standard RAID 5 layout on S/390:



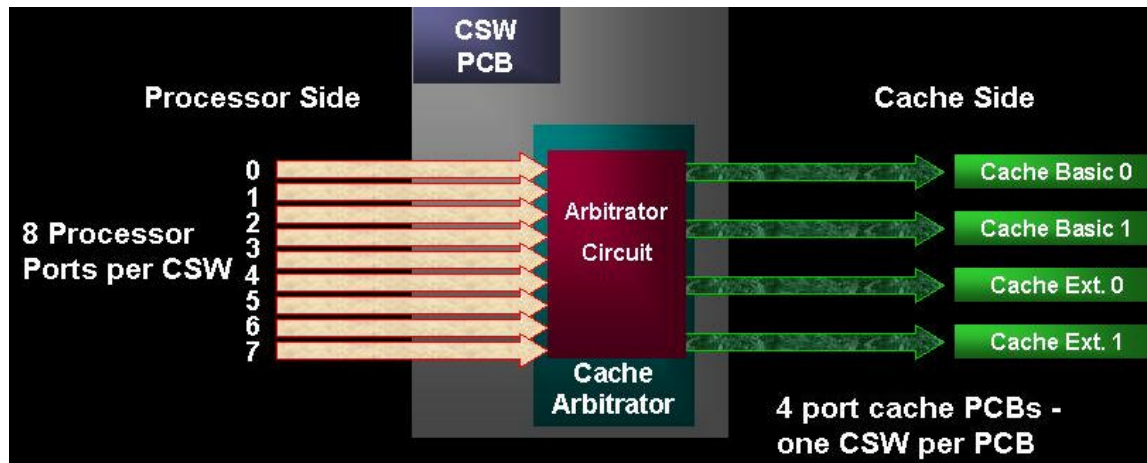
Cross-Bar Switching

The CSW is a specially designed crossbar switch which functions as a combination multiplexer, path arbitrator, and non-blocking network switch. The CSW functions as a multiplexer by providing eight paths into the processor side of each switch and four paths to the cache modules (8-to-4 routing). In all, there are 32 paths at the processor side of the fabric network and 16 paths to the cache modules from the cache side of the fabric network. The CSW's Cache Memory Arbitrator (CARB) handles path arbitration — the access and addressing to and from the cache modules. The CARB is a Large Scale Integrated Circuit (LSI) designed to control the path switching of the microprocessors (MP) of the Channel (CHTs) and Fibre Array Control Processors (FACPs). Each CSW has 8 x 16 bit (+ 2 parity) ports for MP access, and 4 x 16 bit (+ 2 parity) for cache PCB access. The CSW also manages the non-blocking paths between the processors to and from the cache.



CACHE MEMORY

The paths connecting the processors through the data adapters to the CSW and the CSW to the cache modules are each 16 bits wide, plus two bits for parity. The bandwidth of each path is 200MB/s. This is the data transfer rate of a 16-bit-wide path (parallel, not serial) clocked at 100MHz (16 bits at 100MHz equals 200MB/s). As mentioned, there are 32 paths from the processor components of the Sun StorEdge™ 9960 system (ACPs and CHIPs) to the ports of the CSWs. This equals 6.4GB/s (32 paths at 200MB/s) of bandwidth to the processor side of the switched fabric (when all 16 component modules are installed). The bandwidth between the cache side of the switched fabric and the cache modules is 3.2GB/s (16 paths at 200MB/s) total. This bandwidth will always be 3.2GB/s as long as the four CSWs and the four cache modules are installed and functioning.



When considering the organization of cache-centric fixed-bus storage architectures, the number of processor operations which can be simultaneously present on the buses is equal to the number of buses used to communicate between the processors and cache and control memory. With a 4-bus architecture, where control and data are shared on the same buses, that number is four, for example. On the Sun StorEdge™ 9960 system, with its non-blocking switched fabric topology connecting the processors to cache, that number is 16 – which is the total number of paths between the CSW and the cache module ports.

CONTROL MEMORY

The internal network of the Sun StorEdge™ 9900 series also handles the exchange of control information between the processors and control memory. The control memory contains metadata about the system — information about the status, location, and configuration of the cache, the data in the cache, and the actual configuration of the system, as well as other information related to the operational state of the storage system. There are two control memory areas, which are mirrored images of each other. Essentially, control information is handled out-of-band from data, both through a separate memory area and a network.

The internal control memory network is a much simpler network design than the internal cache memory network. In the control memory network, every connection is a point-to-point connection, while the cache memory network (data paths) uses switched fabric topology for its interconnecting network. Also, the internal control memory network uses narrower paths and more of them.

The internal control memory network paths connect the processors to the control memory; there are 64 x 4-bit paths connecting the processors to the control memory. The 4-bit paths combine into their full 8-bit (plus a parity bit) paths. All the ports to the control memory comprise in a “split” configuration – control memory is duplexed just like cache memory. This path topology is used to facilitate this duplexed architecture.

Either way, the bandwidth is calculated in the internal control memory network, the total bandwidth is 3.2GB/s when all of the processor modules are installed. For example, 4 bits clocked at 100MHz equals 50MB/s per path. When multiplied by 64 ports, that equals 3.2GB/s; when clocking the full 8-bit path at 100MHz multiplied by the combined 32 ports of the control memory “pair,” that rate also equals 3.2GB/s.

ACHIEVING TRUE SCALABILITY

With its non-blocking switching architecture, the Sun StorEdge™ 9900 series scales well beyond the capabilities of cache-centric fixed-bus architecture boxes like no other enterprise storage system built to date. Basically, the more components of this architecture which are added to it, the faster it becomes. As more backend capacity, caching, and host connectivity ports are added to the Sun StorEdge™ 9900 series, the aggregate overall performance increases. For example, the full 6.4GB/sec internal bandwidth of the Sun StorEdge™ 9960 system is reached when all 16 modules (CHIPS and ACPs) are installed and functioning.

This is the essence of scalability: When incremental workloads are added to the existing workload set of a Sun StorEdge™ 9900 series, no workload group suffers performance degradation as a result of sharing internal resources and bandwidth. For more information, please see the **Performance** section of this document for a series of tests which proves this point (by measuring the effects of one workload on another when sharing only the controller, this scalability phenomenon can be readily observed).

System Administration

There are ten software packages available for use on the Sun StorEdge™ 9900 series storage systems:

Data Management

- Copy, Disaster Recovery, Backup/Restore:
 - Sun StorEdge™ 9900 Multi-Platform Backup/Restore Software
 - Sun StorEdge™ 9900 Dynamic Link Manager Software
 - Sun StorEdge™ 9900 Extended Remote Copy Software
 - Sun StorEdge™ 9900 ShadowImage Software
 - Sun StorEdge™ 9900 TrueCopy Software
- Information Sharing and Exchange:
 - Sun StorEdge™ 9900 RapidXchange Software

Storage Management

- Sun StorEdge™ 9900 Resource Manager Software Suite includes:
 - Sun StorEdge™ 9900 FlashAccess Software
 - Sun StorEdge™ 9900 Graph-Track Software
 - Sun StorEdge™ 9900 LUN Manager Software
 - Sun StorEdge™ 9900 Virtual Logical Volume Image Software
 - Sun StorEdge™ 9900 Prioritized Port Control Software
 - Sun StorEdge™ 9900 LUN Size Expansion Software
- Sun StorEdge™ 9900 CruiseControl Software
- Sun StorEdge™ 9900 SANtinel Software
- Sun StorEdge™ 9900 Parallel Access Volumes Software

For a detailed description of these programs, please refer to the **Software Administration** section of this document.

RELIABILITY, AVAILABILITY, SERVICEABILITY (RAS)

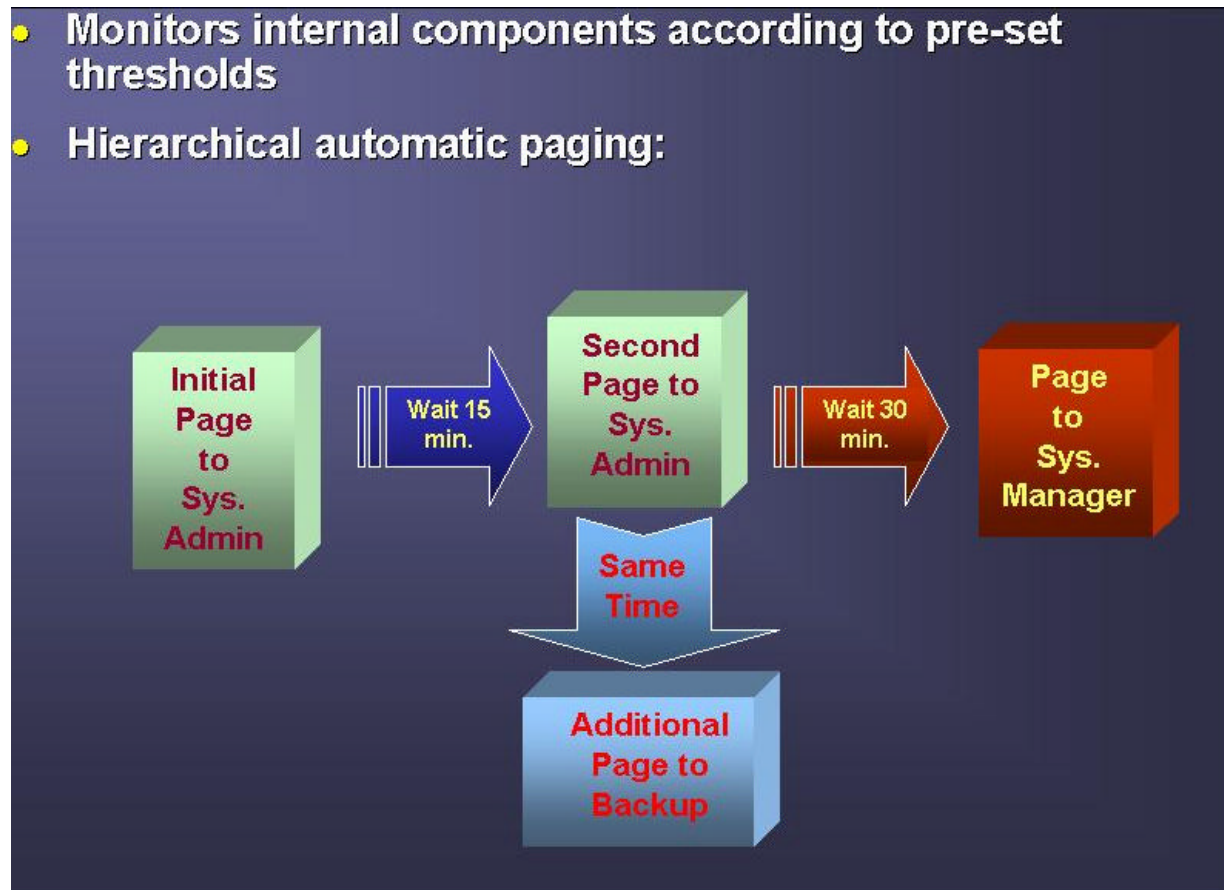
Overview

The Sun StorEdge™ 9900 series is not expected to fail in any way that would interrupt user access to data. The Sun StorEdge™ 9900 series can sustain multiple component failures and still continue to provide full access to all stored user data. Note: While access to user data is never compromised, under certain conditions, the failure of a key component can degrade performance.

The reliability, availability, and serviceability features of the Sun StorEdge™ 9900 series system include:

- **Full Fault Tolerance.** The Sun StorEdge™ 9900 series system provides complete fault-tolerant capability for all critical components. The disk drives are protected against error and failure by enhanced RAID technologies as well as dynamic scrubbing and sparing. The Sun StorEdge™ 9900 series utilizes component and function redundancy to provide full fault-tolerance for all other system components (microprocessors, control storage, control and data busses, power supplies, cooling fans, etc.). The Sun StorEdge™ 9900 series system has no active single point of component failure and is designed to provide continuous access to all user data.
- **Separate Power Supply Systems.** Each storage cluster is powered by a separate set of power supplies. Each set can provide power for the entire system in the unlikely event of power supply or circuit failure. The power supplies of each set can be connected across power boundaries so each set can continue to provide power if a power outage occurs. The Sun StorEdge™ 9900 series is designed to sustain the loss of multiple power supplies and still continue operation.
- **Dynamic Scrubbing and Sparing for Disk Drives.** The Sun StorEdge™ 9900 series uses special diagnostic techniques and dynamic scrubbing to detect and correct disk errors. Dynamic sparing is invoked automatically if needed. The Sun StorEdge™ 9900 series can be configured with up to 16 spare disk drives, and any spare disk can back up any other disk of the same capacity, even if the failed disk and spare disk are in different array domains (attached to different ACP pairs).
- **Dynamic Duplexed Cache.** The Sun StorEdge™ 9900 series cache is divided into two equal segments on separate power boundaries. The Sun StorEdge™ 9900 series places all write data in both cache segments with one internal write operation, so that the data is always duplicated (duplexed) across the power boundaries. If one copy of write data is defective or lost, the other copy is immediately destaged to disk. This “duplex cache” design helps ensure full data integrity in the unlikely event of a cache memory or power-related failure.
- **Remote Copy Features.** These data management features help enable the user to set up and maintain duplicate copies of S/390 and open-system data stored on the Sun StorEdge™ 9900 series over extended distances. In the event of a system failure or site disaster, the secondary copy of data can be invoked rapidly; allowing applications to be recovered with data integrity intact.

- Call Home Functionality.** A maintenance support tool monitors the operation of the Sun StorEdge™ 9900 series system, collects hardware status and error data, and transmits this data via modem to a regional systems support center. The systems support center analyzes the data and implements corrective action, if necessary. In the unlikely event of a component failure, the Sun StorEdge™ 9900 series calls the systems support center immediately to report the failure. Once set up, this automatic error/failure detection and reporting does not require any action on the part of the user. Most system problems can be identified and fixed prior to actual failure, and the advanced redundancy features help enable the system to remain operational even if one or more components fail. Note: Call home functionality does not have access to any user data stored on any Sun StorEdge™ 9900 series system. A dedicated RJ-11 analog phone line is required for this function.

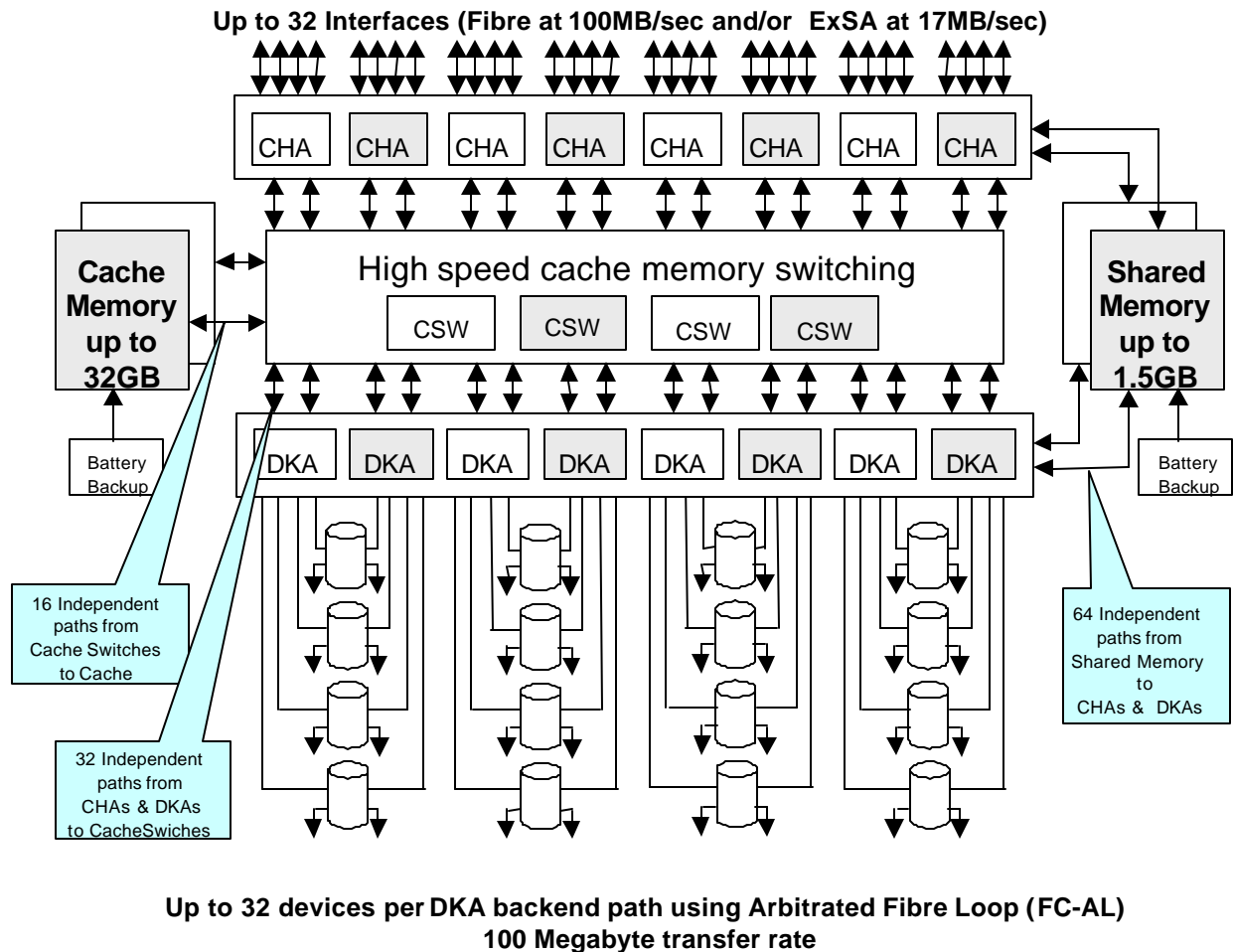


- Non-Disruptive Service and Upgrades.** All hardware upgrades can be performed non-disruptively during normal system operation. All hardware subassemblies can be removed, serviced, repaired, and/or replaced non-disruptively during normal operation. All microcode upgrades can be performed during normal system operations using the SVP or the alternate path facilities of the host.
- Error Reporting.** The Sun StorEdge™ 9900 series system reports service information messages (SIMs) to notify the user of errors and service requirements. SIMs can also report certain normal operational changes, such as remote copy pair status change. The SIMs are logged on the service processor (SVP) of the system and are also stored in the R-SIM log file on the Remote Console PC. SIMs are also reported to the systems support center via call home functionality.

- **Command Tag Queuing.** The Sun StorEdge™ 9900 series supports command tag queuing for open-system devices. Command tag queuing enables hosts to issue multiple disk commands to the fibre-channel adapter without having to serialize the operations. Instead of processing and acknowledging each disk I/O sequentially as presented by the applications, the Sun StorEdge™ 9900 series processes requests in the most efficient order to minimize head seek operations and disk rotational delay. (NOTE: The system queue depth parameter may need to be changed.)
- **Sun StorEdge™ 9900 Virtual Logical Volume Image Software.** The Virtual LVI/LUN (CVS) feature helps enable users to configure custom-size LVIs/LUs. This improves data access performance by reducing logical device contention as well as host I/O queue times, which can occur when several frequently accessed files are located on the same volume.
- **Sun StorEdge™ 9900 CruiseControl Software** monitors specific volumes and can schedule automatic relocation of poorly performing volumes to different volumes to optimize performance.
- **Sun StorEdge™ 9900 FlashAccess Software** helps enable the mainframe or open user to store specific high-usage data in cache memory. This software is designed to enhance data accessibility by helping to enable the cache-resident data to be available at host data transfer speeds for both read and write operations. Sun StorEdge™ 9900 FlashAccess software can be used in conjunction with Sun StorEdge™ 9900 Virtual Logical Volume Image software to provide even higher data access performance than when either of these features is used individually.
- **Sun StorEdge™ 9900 ShadowImage Software** allows the user to create up to three internal copies of S/390 volumes for a wide variety of purposes including application testing and offline backup, etc. When used in conjunction with Sun StorEdge™ 9900 TrueCopy software, Sun StorEdge™ 9900 ShadowImage software allows the user to maintain multiple copies of critical data at both the main and remote sites.
- **Sun StorEdge™ 9900 TrueCopy Software** helps enable the user to perform synchronous remote copy operations of S/390 volumes between Sun StorEdge™ 9900 series systems. These volumes can be Virtual LVIs, FlashAccess LVIs or standard LVIs. Sun StorEdge™ 9900 TrueCopy software also helps enable the user to perform remote copy operations of S/390 volumes between Sun StorEdge™ 9900 series systems. These volumes can be CVS volumes, Sun StorEdge™ 9900 FlashAccess software volumes, or standard volumes. The asynchronous remote copy feature uses time stamping, consistency groups, and record sets to help ensure the data sent to the secondary (remote) volumes is written in the same sequence as originally written to the primary volumes.
- **Sun StorEdge™ 9900 Extended Remote Copy Software** provides asynchronous remote copy operations for mainframe LVIs and is functionally compatible with IBM Extended Remote Copy (XRC). Sun StorEdge™ 9900 Extended Remote Copy Software uses the DFSMS data mover in an MVS environment and is completely non-disruptive, allowing the primary volumes to be online and available for read and write operations during all normal Sun StorEdge™ 9900 Extended Remote Copy Software operations.
- **Sun StorEdge™ 9900 LUN Manager Software** helps enable open-system users to define the fibre port-to-LUN mapping and configure fibre-channel arbitrated-loop (FC-AL) and fabric topologies. The LU Size Expansion (LUSE) feature enables open-system

users to create “expanded-size” LUs called LUSE devices. The LUSE devices can be as much as 36 times larger than standard fixed size LUs. This capability helps enable host access to the data stored on the Sun StorEdge™ 9900 series using fewer logical units.

- **Sun StorEdge™ 9900 SAnTinel Software** (LUN Security) allows open-system users to restrict LUN accessibility by an open-systems host using the open-systems host’s World Wide Name (WWN). The LDEV security feature allows mainframe users to restrict volume access by host operating systems based on node IDs and LPAR numbers.
- **Sun StorEdge™ 9900 RapidXchange Software** helps enable the data stored in the Sun StorEdge™ 9900 series to be shared by the mainframe and open-system applications.



- The shaded areas in the above drawing indicate components in Cluster 2. Clusters 1 and two have separate AC and DC power supplies.
- Channel adapter card (CHA) can contain either two or four client-host interface processors (CHIPs). The Sun StorEdge™ 9960 system supports up to eight CHAs.
- CSW is a Cache Switch card. There are four CSW cards per controller.
- The disk adaptor card (DKA) contains four array control processors (ACP). The Sun StorEdge™ 9960 system supports up to eight DKAs.
- Cache Memory is on four cards, and each Cache PCB is backed up by a separate battery. There are between two and four cards per controller.
- Shared Memory resides on the first two Cache PCBs, and has its own power sources and backup batteries.
- Shared Memory has independent address and data paths from the channel adapter card and the disk adapter PCBs.

Storage Clusters

Each control frame consists of two redundant controller halves called storage clusters. Each storage cluster contains all physical and logical elements (e.g., power supplies, CHAs, CHiPs, ACPs, cache, control storage) needed to sustain processing within the system. Both storage clusters should be connected to each host using an alternate path scheme, so that if one storage cluster fails, the other storage cluster can continue processing for the entire system.

Each pair of channel adapters is split between clusters to provide full backup for both front-end and back-end microprocessors. Each storage cluster also contains a separate, duplicate copy of cache and shared memory contents. In addition to the high-level redundancy that this type of storage clustering provides, many of the individual components within each storage cluster contain redundant circuits, paths, and/or processors to allow the storage cluster to remain operational even with multiple component failures. Each storage cluster is powered by its own set of power supplies, which can provide power for the entire system in the unlikely event of power supply failure. Because of this redundancy, a Sun StorEdge™ 9900 series system can sustain the loss of multiple power supplies and still continue operation.

Note: The redundancy and backup features of the Sun StorEdge™ 9900 series are designed to eliminate all active single points of failure, no matter how unlikely.

Nonvolatile Shared Memory

The nonvolatile shared memory contains the cache directory and configuration information for the Sun StorEdge™ 9900 series system. The path group arrays (e.g., for dynamic path selection) also reside in the shared memory. The shared memory is duplexed and each side of the duplex resides on the first two cache PCBs. The PCBs are in Cluster 1 and 2. Even though the shared memory resides on the cache cards, the shared memory has separate power supplies and separate battery backup. The basic size of the shared memory is 1.2GB and the maximum size is 1.5GB. The size of the shared memory storage is determined by the total cache size and the number of Logical Devices (LDEVs). The shared memory is protected by battery backup.

Nonvolatile Duplex Cache

The Sun StorEdge™ 9960 system can be configured with up to 32GB of cache (the minimum is 2GB). All cache memory in the Sun StorEdge™ 9900 series is nonvolatile, and each cache card is protected by its own 48-hour battery backup. The cache is divided into two equal areas (called cache A and cache B) on separate cards. Cache A is in cluster 1 and cache B is in cluster 2. The Sun StorEdge™ 9900 series places all read and write data in cache. Write data is normally written to both cache A and B with one CHiP write operation, so that the data is always duplicated (duplexed) across logic and power boundaries. If one copy of write data is defective or lost, the other copy is immediately destaged to disk. This “duplex cache” design helps ensure full data integrity in the unlikely event of a cache memory or power-related failure.

Note: Mainframe hosts can give special attributes (such as Cache Fast Write, or CFW) to write data, which will not allow write duplexing. This type of write data (typically a sort command) is not duplexed and is usually given a discard command at the end of the sort, so that the data will not be destaged to the disk drive.

Multiple Data and Control Paths

The Sun StorEdge™ 9900 series uses a state-of-the-art non-blocking fibre channel switching architecture which provides the Sun StorEdge™ 9900 series with multiple point-to-point data and command paths. Each data and command path is independent. The individual paths between cache and the channel or disk adapters are steered by high-speed cache switch PCBs. There are no common busses, which avoids the performance degradation and contention that can occur in bus architecture. All data stored in Sun StorEdge™ 9900 series is moved in and out of cache via the redundant paths.

Redundant Power Supplies

Each storage cluster is powered by its own set of redundant power supplies, and each power supply is able to provide power for the entire system, should it become necessary. Because of this redundancy, the Sun StorEdge™ 9900 series can sustain the loss of multiple power supplies and still continue operation. To make use of this capability, the Sun StorEdge™ 9900 series should be connected either to dual power sources or to different power panels, so if there is a power failure on one of the sources, the Sun StorEdge™ 9900 series can continue full operations using power from the alternate source.

Client-Host Interface Processors (CHIPs) and Channels

The channel adapters (CHAs) contain the front-end microprocessors, which process the channel commands from the host(s) and manage host access to cache. In the S/390 environment, the CHAs perform CKD-to-FBA and FBA-to-CKD conversion for the data in cache. The CHAs are available in pairs. Depending on the configuration, each CHA in a pair contains either two or four microprocessors and four buffers, which allow data to be transferred between the CHA and cache. Each CHA pair also supports either four or eight simultaneous data transfers to and from cache and four or eight physical connections to the host. Each CHA pair must be composed of the same type of PCBs (ExSA or Fibre). A Sun StorEdge™ 9960 system can be configured with up to four CHA pairs to support the desired interface type(s).

Array Control Processors (ACPs)

The Array Control Processors (ACPs) control the transfer of data between the disk drives and cache, which are installed in pairs for redundancy and performance. A Sun StorEdge™ 9960 system can be configured with up to four ACP pairs. All functions, paths, and disk drives controlled by one ACP pair are called an "array domain." The disk drives are connected to the ACP pairs by fibre cables using arbitrated loop (FC-AL). Each ACP (DKA) has four microprocessors and four independent fibre backend paths, and each fibre backend path can access up to 32 disk drives. Each Sun StorEdge™ 9960 system ACP (DKA) can access up to 128 disk drives using the four backend paths, and each disk drive is dual ported for performance and redundancy in case of a backend path failure. An array domain can contain a variety of LVI and/or LU configurations.

Each Sun StorEdge™ 9960 system ACP pair can support a maximum of 128 physical disk drives (in three array frames), including the dynamic spare disk drives. Each ACP pair contains eight buffers (one per fibre path) which support data transfer to and from cache. Each disk drive has a dual-port feature and can transfer data via either port. Each of the two paths shared by the disk drive is connected to a separate ACP in the pair to provide alternate path capability. Each ACP pair is capable of eight simultaneous data transfers to or from the disk drives.

Array Frame

The Sun StorEdge™ 9960 system array frames contain the physical disk drives, including the disk array groups and the dynamic spare disk drives. Each array frame has dual AC power plugs, which should be attached to two different power sources or power panels. A Sun StorEdge™ 9960 system can be configured with up to six array frames to provide a usable storage capacity of up to 27TB (37TB raw capacity).

Sun StorEdge™ 9900 series systems utilize 3-inch disk drives with fixed-block format, which are specifically designed for the large enterprise-systems market and meet much more demanding specifications than disk drives produced for the general array market. Sun StorEdge™ 9900 series systems offer either 18GB or 72GB disk drives. Disk drives of varying capacities can be attached to the same ACP pair, but all drives in an array group must have the same capacity.

The following table shows a comparison of drive specifications:

DRIVE COMPARISONS				
HDS Model	9200 Thunder		Sun StorEdge™ 9900 Series	
HDD Capacity	35.68GB	71.64GB	18.46GB	72.91GB
Vendor	Hitachi		Hitachi OEM	
Form Factor	3.5-inch		3.0-inch	
RPM	10K		10K	
Interface	200MB/ sec FC		100MB/ sec FC	
Buffer	4MB	4MB or 16MB	4MB	
Head Technology	MR		GMR	
Internal Xfer Rate, Inner	21.1MB/sec	26.7MB/sec	30.2MB/ sec	33.6MB/ sec
Internal Xfer Rate, Outer	36.8MB/sec	40.2MB/sec	45.6MB/ sec	56.6MB/ sec
Avg. Seek Time, Read	5.95ms	5.85ms	5.2ms	5.7ms
Avg. Seek Time, Write	6.65ms	6.35ms	6.0ms	6.5ms

Each Sun StorEdge™ 9900 series disk drive can be replaced non-disruptively on site. Sun StorEdge™ 9900 series systems utilize diagnostic techniques and background dynamic scrubbing that detect and correct disk errors. Dynamic sparing is invoked automatically if needed. For both RAID 5 and RAID 1+ array groups, any spare disk drive can back up any other disk drive of the same capacity anywhere in the system, even if the failed disk and the spare disk are in different array domains (attached to different ACP pairs). Sun StorEdge™ 9960 systems can be configured with a minimum of one and a maximum of sixteen spare disk drives. The standard configuration provides one spare drive for each drive capacity in the system. In the rare event of a drive failure, call home functionality detects failed disk drives and automatically notifies a systems support center so a service representative can be sent to replace the failed disk drive.

Note: Spare disk drives are used only as replacements and are not included in the storage capacity ratings of Sun StorEdge™ 9900 series.

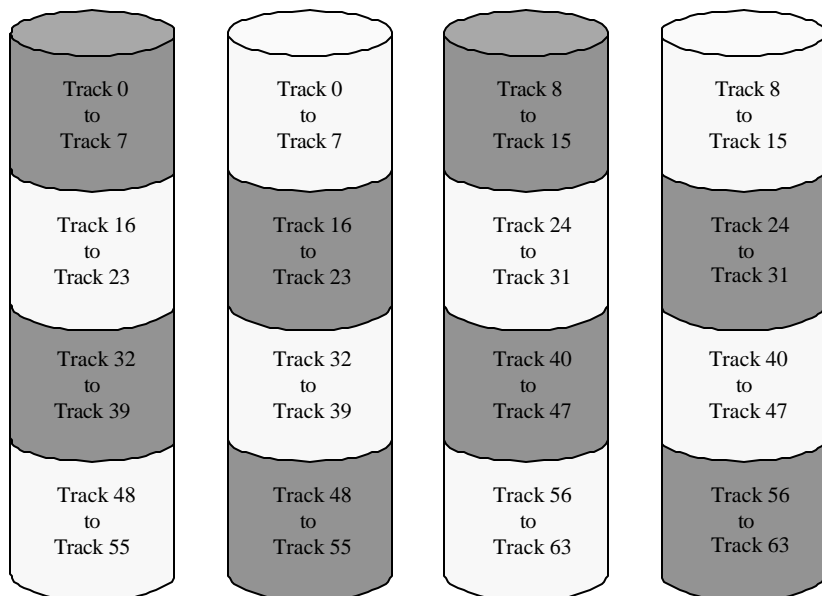
Disk Array Groups

The disk array group is the basic unit of storage capacity for the Sun StorEdge™ 9900 series. Each array group is attached to both ACPs of an ACP pair via eight fibre paths, which enables all disk drives in the array group to be accessed simultaneously by the ACP pair. All disk drives in an array group must have the same logical capacity. Each Sun StorEdge™ 9960 system array frame has two canister mounts, and each canister mount can have up to 48 physical disk drives.

The Sun StorEdge™ 9900 series supports both RAID 1+ and RAID 5 array groups:

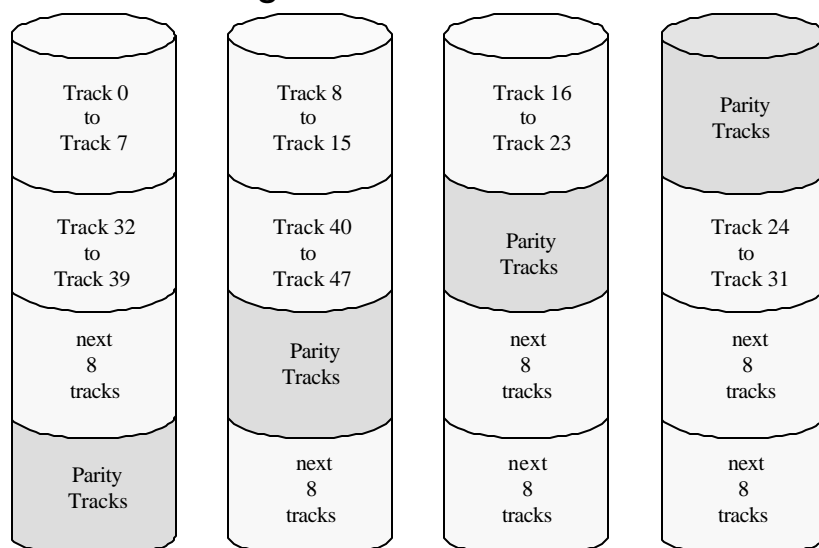
A RAID 1+ array group consists of four disk drives in a mirrored configuration. Data is striped to two drives and mirrored to the other 2 drives. The stripe consists of two data chunks. The primary and secondary stripes are toggled back and forth across the physical disk drives for high performance. Each data chunk consists of either 8 logical tracks (S/390) or 768 logical blocks (open systems). A failure in a drive causes the corresponding mirrored drive to take over for the failed drive.

RAID 1+0 Using 2D + 2D and S/390 LDEVs



A RAID 5 array group consists of four disk drives. The data is written across the four hard drives. The stripe consists of three data chunks and one parity chunk. Each chunk consists of either eight logical tracks (S/390) or 768 logical blocks (open systems). Data and parity are striped across each of the disk drives in the array group. The Logical Devices (LDEVs) are evenly dispersed in the parity group, so that the performance of each LDEV within the parity group is the same. The parity chunks are the exclusive OR (EOR) of the data chunks. The parity and data chunks rotate after each stripe. The total data in each stripe is either 24 logical tracks (8 tracks per chunk) for S/390, or 2304 blocks (768 blocks per chunk) for open systems. Each of these array groups can be configured as either 3380, 3390 or OPEN-x Logical Device Images (LVIs/LDEVs). All LDEVs in the parity group must be the same format (3380, 3390 or OPEN-x). For open systems, each LDEV must be mapped to a fibre address, so that it has a logical unit number.

RAID-5 using 3D + P and S/390® LDEVs



Sequential Data Striping

The enhanced RAID 5 implementation in the Sun StorEdge™ 9900 series system will attempt to keep write data in cache until parity can be generated without referencing old parity or data. This capability to write entire data stripes is usually achieved only in sequential processing environments, and will minimize the write penalty incurred by standard RAID 5 implementations. The device data and parity tracks are mapped to specific physical disk drive locations within each array group. Therefore, each track of an LVI or LU occupies the same relative physical location within each array group in the system.

Intermixing RAID Types, Drive Types, and Device Emulation

RAID 1+ & 5 Intermix. RAID 1+ and RAID 5 can co-exist in a Sun StorEdge™ 9900 series system but each ACP pair only uses one RAID type.

Hard Drive Type Intermix. Array groups of different style hard drives can exist anywhere in the Sun StorEdge™ 9900 series system. However, the parity group itself must consist of identical type member hard drives.

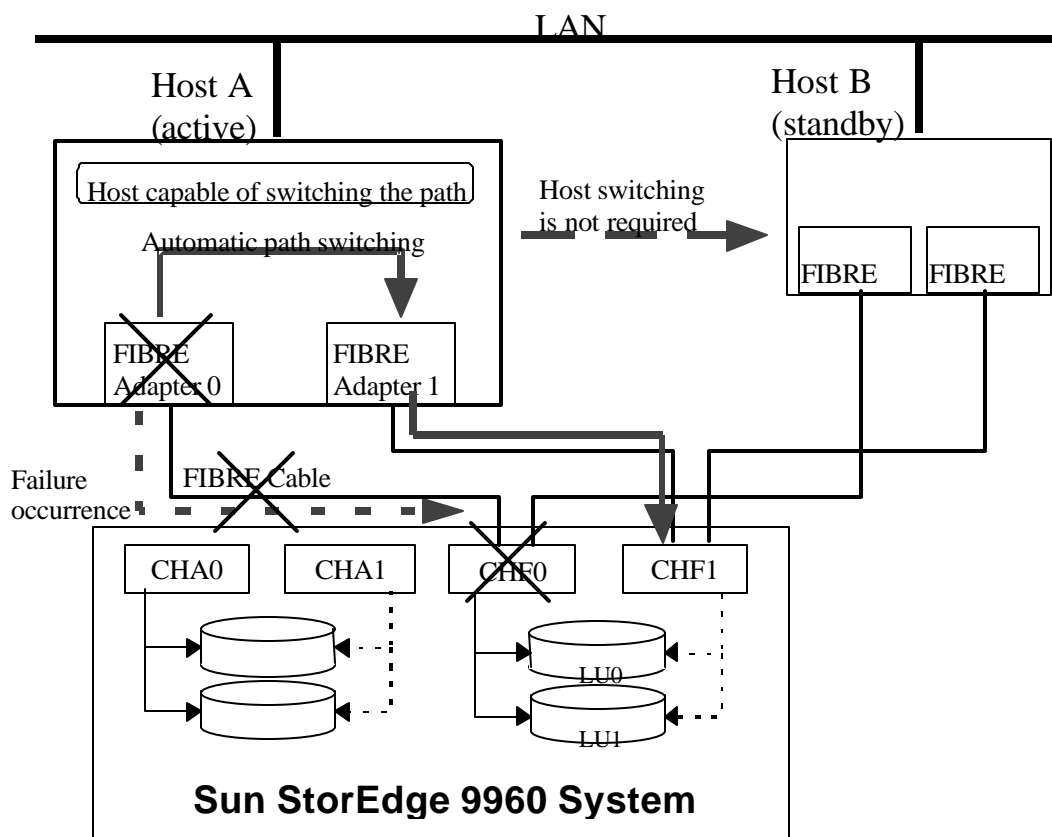
Device Emulation Intermix. The type of device emulation may also be intermixed.

Service Processor (SVP)

The Sun StorEdge™ 9900 series comes with a built-in laptop PC called the service processor (SVP). The SVP is integrated into the controller frame and can only be used by authorized service personnel, who can configure, maintain, and upgrade the Sun StorEdge™ 9900 series system. The SVP also collects performance data for all key components of the Sun StorEdge™ 9900 series system to help enable remote diagnostic testing and analysis. The call home function of the Sun StorEdge™ 9900 series stores the SVP performance data on the Remote Console PC and allows the user to view the data in graphical format and export the data for statistical analysis purposes. Note: SVPs do not have access to any user data stored on any Sun StorEdge™ 9900 series system.

Alternate Pathing

The Sun StorEdge™ 9900 series supports alternate pathing to help ensure the highest data availability. In open systems environments, alternate pathing can be achieved by host fail-over and/or I/O path fail-over middleware. The Sun StorEdge™ 9960 system provides up to 32 Fibre ports to accommodate alternate pathing for host attachment. The LUNs can be mapped for access from multiple ports and/or multiple target IDs. The number of connected hosts is limited only by the number of fibre-channel ports installed and the requirement for alternate pathing within each host. The Sun StorEdge™ 9900 series supports many industry-standard host fail-over and I/O path fail-over middleware products. If possible, attach the alternate path(s) to different channel card(s) than the primary path.



SPECIFICATIONS

Specifications for Sun StorEdge™ 9900 series are found in the following tables.

SYSTEM SPECIFICATIONS

Sun StorEdge	9960 System	9910 System
Frames		
Control frames per system	1	Integrated with array
Array frames per system	1 to 6	Integrated with control
System Capacity		
Maximum total raw capacity	37.3TB	3.5TB
Number of disk drives (with spares)	5 to 512	5 to 48
Hot spares (maximum)	16	4
Individual disk capacities		
3.0 inch form factor (10,025 RPM) FC	18GB, 72GB	18GB, 72GB
Maximum usable capacity for RAID-5		
Open Systems	27.5TB	2.4TB
S/390-compatible	25.7TB	2.3TB
Maximum usable capacity for RAID-1+		
Open Systems	18.4TB	1.6TB
S/390-compatible	17.2TB	1.5TB
Maximum number of RAID groups/system	126 (with 8 spares) 125 (with 12 spares) 124 (with 16 spares)	11 (with 4 spares)
Data Cache		
Maximum	32GB	16GB
Minimum	2GB	1GB
Increments	2GB	1GB
Control Memory (standard system ships with 1GB)	Up to 1.5GB	Up to 1.5GB
Logical Device Support	Up to 4,096	Up to 4,096

CONTROL FRAME SPECIFICATIONS

Sun StorEdge	9960 System	9910 System
Client-Host Interface Processors (CHIPs)		
Number of CHIP pairs	Up to 4	Up to 3
Simultaneous data transfers per CHIP pair	4 or 8	4 or 8
Physical interfaces per CHIP pair	4 or 8	4 or 8
Physical Interfaces per System		
Maximum	32 DAS; 192 (6:1 fan-out) SAN	24; 144 (6:1 fan-out) SAN
Extended Serial Adapters™††	0, 4, 8, 12, 16, 20, 24, 28, or 32	0, 4, 8, 12, 16, 20, or 24
Fibre channel (fiber-optic cable)	0, 4, 8, 12, 16, 20, 24, 28, or 32	0, 4, 8, 12, 16, 20, or 24
Logical Paths per System Extended Serial Adapters	Up to 8,192	Up to 6,144
Array Control Processor (ACP)		
Number of ACP pairs per system	1 to 4	1
Physical array paths per ACP pair	8	8
Maximum disks per array path	32	12
Simultaneous transfers per ACP pair		
To cache	8	4
To disk array	8	8
Transfer rates		
Per disk array path	Up to 100MB/sec	Up to 100MB/sec
Per ACP pair (to cache)	Up to 800MB/sec	Up to 400MB/sec
Switched fabric architecture max. raw internal bandwidth	6.4GB/sec	3.2GB/sec
† Available through RPQ only.		
†† Extended Serial Adapters are compatible with ESCON protocol.		

DISK DRIVE SPECIFICATIONS

Hard Disk Drives		
GMR (Giant Magnetoresistive) Head Technology	18.46 GB	72.91 GB
Rotation Speed	10,025RPM	
Form Factor	3.0 in.	
Actuator	Recoilless rotary	
Servo System	Digital	
Interface	FC-AL	
Internal Transfer Rates		
Inner Zone	30.2MB/sec	33.6MB/sec
Outer Zone	45.6MB/sec	56.6MB/sec
Average Seek Times		
Read	5.2ms	5.7ms
Write	6.0ms	6.5ms

PHYSICAL SPECIFICATIONS

	Sun StorEdge 9960	Sun StorEdge 9960	Sun StorEdge 9910
Physical Specifications	Control Frame	Array Frame (1 to 6)	Integrated Control Array Frame
Height	1,790mm (70.5 in.)	1,790mm (70.5 in.)	1,790mm (70.5 in.)
Width (w/ 2 side panels)	750mm (29.5 in.)	600mm (23.6 in.)	700mm (27.6 in.)
Depth	800mm (31.5 in.)	800mm (31.5 in.)	800mm (31.5 in.)
Weight	4.491kg (990.1 lbs)*	474.6kg (1,046.3 lbs)**	437.6kg (964.7 lbs)***
Heat	1.504kw (5,132.8 BTUs)*	3.45kw (11,774.0 BTUs)**	1.941kw (6,624.2 BTUs)***
Power	1.611kva*	3.736kva**	2.183kva***
* One controller, 16GB cache, 2 ACP pairs, 16 Fibre ports using -phase power			
** One disk array frame, 96 disk drives, 4,530GB raw capacity using 47GB hard disk drives, 173GB spare, 4.6033 TB 3-phase power			
*** One full system, 16GB cache, 1 ACP pair, 24 Fibre ports, and 48 disks, 47GB, 1x72GB spare raw capacity 2.4TB single phase power			

DATA AND STORAGE MANAGEMENT SOFTWARE

Data and Storage Management Software	
Copy, Disaster Recovery, Backup/Restore	Management
Sun StorEdge™ 9900 Multi-Platform Backup/Restore	Sun StorEdge™ 9900 Resource Manager includes:
Sun StorEdge™ 9900 Dynamic Link Manager	✓ Sun StorEdge™ 9900 FlashAccess
Sun StorEdge™ 9900 Extended Remote Copy	✓ Sun StorEdge™ 9900 GraphTrack
Sun StorEdge™ 9900 ShadowImage	✓ Sun StorEdge™ 9900 LUN Manager
Sun StorEdge™ 9900 TrueCopy	✓ Sun StorEdge™ 9900 Virtual Logical Volume Image
	✓ Sun StorEdge™ 9900 Prioritized Port Control
Information Sharing and Exchange	✓ Sun StorEdge™ 9900 LUN Size Expansion
Sun StorEdge™ 9900 RapidXchange	Sun StorEdge™ 9900 CruiseControl
	Sun StorEdge™ 9900 SANtinel
	Sun StorEdge™ 9900 Parallel Access Volumes
Items highlighted are Warranted and Supported by Sun when Sold by Sun and attached to a Sun StorEdge™ 9900 series storage product only. All other items have been qualified, but are warranted and supported by their respective manufacturer.	

PERFORMANCE

General

The Sun StorEdge™ 9900 series provides the following non-disruptive performance-boosting features:

- Automatic on-the-fly volume optimization - moving a data set from a hot spot volume to another less busy volume
- Automatic on-the-fly cache allocation – The Sun StorEdge™ 990 series fully addresses all 32GB of cache and has all 32GB usable for reads or writes.
- Record and Logical Block Address (LBA) level caching
- Intelligent Learning Algorithm - Monitors data access patterns and dynamically alters staging criteria to help ensure the highest possible hit ratios for randomly accessed data
- Non-disruptive microcode updates - During routine maintenance, the system remains up and fully operational, unlike some cache-centric systems which must be taken off line (creating a disruption in service) or which remain online but must busy-out a port (requires 2 HBAs per host).
- Split-queue write cache - The write area of cache is split into two queues, so when data is written into cache, it is written twice (mirrored) - once into the top of one queue, and once into the bottom of the other queue. When the data is written to disk, it is pushed out of one queue immediately upon receipt new data, and bumped up one level in the other queue. This way, new data is insured of being placed in one queue for immediate destage to disk, while at the same time is left in the other queue in the event it needs to be quickly accessed again - performance is improved in such a case because the backend (i.e., the disk drives) do not have to be accessed to retrieve the requested data.
- LUN sizing – On-the-fly LUN expansion and contraction allows for LUN sizes to change to match changing application requirements
- LUN carving – Spreading out LUNs helps increase access performance
- Automatic load balancing – Provides the ability to evenly share workloads across multiple devices
- Intelligent automatic dynamic path reconnect – Provides the ability to access a drive via an alternate data path in the event the initial access path was busy; when DPR is used, the next time the path is accessed, the algorithm tries the last successful path first
- Cache locking feature (FlashAccess) – This is a manual feature which allows the administrator to lock frequently-used data into cache and read it at cache speeds. A single volume (a database index, for example) can become really "hot" and generate extremely slow disk response times due to overload, causing an entire operation to lag. FlashAccess can be used to solve this particular problem by locking the entire volume in cache. In one instance, a 900ms response time was boosted down a mere 3ms even during peak I/O.
- Advanced RAID algorithms provides high-speed data and I/O transfers.

In the real world, many installations of the Sun StorEdge™ 9900 series will involve sharing transaction- and transfer- intensive applications (e.g., OLTP and DSS, respectively) so there will be a mix of 18GB (for OLTP) and 72GB (for DSS) drives within the system; the number for each capacity drive will be determined by the online capacity requirements for that particular customer.

OLTP consists of small block random IO. Block sizes (the amount of data transferred in a burst) are usually either 2KB or 8KB. DSS consists of large block sequential I/O. Block sizes are 32KB or higher. Because array groups are kept to four (3+1) and LUs can span as many array groups a necessary, the RAID stripe size in does not have to be changed in the Sun StorEdge™ 9900 series to match to these two extremes of workload examples.

Benchmark Results

A NOTE ON CONFIGURING FOR PERFORMANCE

To configure a Sun StorEdge™ 9960 system for maximum backend performance, use all four ACP pairs and all six array frames and spread the drives across the ACPs by evenly distributing them across the six array frames.

Ideally, load the frames with the maximum of HDDs to ensure you have enough backend to drive. However, if you are using a number of HDDs which will fit into two array frames or less, and you want to keep costs down, then still use four ACP pairs but use only two array frames, insuring one is on the right side, and the other is on the left side of the controller frame. With, say for example, 96 HDDs, that's still a high \$/MB, but at least it's the optimal balance between price and performance for that particular configuration.

Minimally, don't use less than 48 HDDs for a performance configuration with four ACP pairs and two array frames (one Right Frame and one Left Frame); even so, \$/MB is considerably higher than with fully configured frames. With anything less than 48 (say, for example, 24 HDDs), there would not be enough on the backend to drive it to the full bandwidth.

If your customer has hard raw TB capacity requirements which will remain under 3.5TB for at least a year, you may want to consider going with the Sun StorEdge™ 9910 system and receive great performance for less cost. Over 3.5TB raw capacity, go with the dual-frame Sun StorEdge™ 9960 system setup described above. (Don't forget - while the Sun StorEdge™ 9910 system cannot be expanded into an Sun StorEdge™ 9960 system, another Sun StorEdge™ 9910 system – or even a Sun StorEdge™ 9960 system – can always be dropped into the existing SAN at a later date, so there will be no loss of investment made on the original Sun StorEdge™ 9910 system. It may be practical to play “budget bingo” in this manner if there are stringent financial requirements which need to be met.

The end user should always, always be provided in full detail with the tradeoffs between bandwidth and cost, and, in the end, it should be the customer who makes the final, but informed, decision as to which system to buy.

WORKLOAD CONFIGURATION

Testing of a Sun StorEdge™ 9960 system (RAID 5) compared it to a fixed SCSI bus architecture cache-centric monolithic storage system (RAID 5). The results were impressive.

Under heavy loads wherein an OLTP application (Single node RISC Oracle RDBMS running off 48 10K+rpm spindles with 2KB I/O block) and a DSS application (2-node clustered RISC Oracle OPS 600M row table full parallel table scan running off 64 10K+rpm spindles with 256KB I/O block) were run concurrently, the SCSI system choked OLTP by 63% (from no load when the DSS application was not running) and choked DSS by 30% (from no load when the OLTP application was not running).

The OLTP/DSS bench test was then run on the Sun StorEdge™ 9960 system using 10Krpm spindles. Not only did the OLTP TPM increase over the SCSI box, but it remained constant under heavy load (i.e., concurrent DSS load), achieving an extremely impressive OLTP TPM improvements of 96% over the SCSI box under heavy load and 24% OLTP TPM improvement under no load. DSS results were just as impressive, with the Sun StorEdge™ 9960 system achieving DSS MB/sec increases of 83% under heavy load and 44% under no load over the SCSI bus system.

THROUGHPUT CONFIGURATION

Six servers (two quad CPU workgroup RISC, two dual CPU enterprise RISC, and two quad CPU mid-range Intel) with two FC HBAs each (12 FC connections) connected to a Sun StorEdge™ 9960 system using two 8-port switches. Iogen (UNIX®) and iometer (Windows NT)

generated the loads. A sequential read of 256,000 blocks was performed from the backend (disks) as opposed to being performed on the front end (cache) – this was not a cache test, which is useless in the real world in any case. Each LUN was assigned to its own RAID pack (i.e., array group); 192 10Krpm drives (48 RAID packs) were used with 16GB of cache and four Array Control Processors (ACPs).

The first quad CPU workgroup RISC server sustained a 167MB/sec transfer rate. Total throughput for the Sun StorEdge™ 9960 at this point is **167MB/sec**.

The second quad CPU workgroup RISC server sustained a 167MB/sec transfer rate. Total throughput for the Sun StorEdge™ 9960 at this point is now exactly double at **334MB/sec**.

The first dual CPU enterprise RISC server sustained a 152MB/sec transfer rate (NOTE: Slower I/O is not due to storage system, but rather due to this server using older, slower HBAs). Total throughput for the Sun StorEdge™ 9960 at this point is now at **486MB/sec**.

The second dual CPU enterprise RISC server also sustained a 152MB/sec transfer rate. Total throughput for the Sun StorEdge™ 9960 at this point is now at **638MB/sec**.

The Windows NT servers were able to sustain 33MB/sec each for a total of 66MB/sec. Total throughput for the Sun StorEdge™ 9960 at this point is now at **704MB/sec**.

I/O CONFIGURATION

Using the same six servers as in the throughput configuration described immediately above, the aggregate sustainable I/Os (backend disk, not front end cache) achieved by the Sun StorEdge™ 9960 system was **60,000 IOPS with more headroom to spare still left untapped**.

Key Findings

WORKLOAD CONFIGURATION

The mixed workload test proved out the exceptional scalability to be had from a Sun StorEdge™ 9960 system. Due to a substantial increase in I/O throughput, however, the Sun StorEdge™ 9900 series causes less idle time on the server. As a result, updating the database actually places more load on the server as was placed on the same server when it was connected to the SCSI box. As such, Sun recommends using fully loaded servers when connecting to a Sun StorEdge™ 9900 series so optimum performance is achieved (i.e., so the server can keep up with the storage).

THROUGHPUT CONFIGURATION

The aggregate throughput of the Sun StorEdge™ 9960 continually increased as host servers running their respective loads were added. Then, as more loads were added to those servers, the aggregate throughput of the Sun StorEdge™ 9960 increased even further. Under the heaviest of loads that these servers could muster, the Sun StorEdge™ 9960 system did not flatten out, indicating there was much more throughput yet to be obtained, but the system was server-bound.

I/O CONFIGURATION

The same trend found in the throughput configuration showed up in the I/O configuration in that the tests did not reach the upper bounds of the Sun StorEdge™ 9960 system. The configuration became server-bound, which means that if more servers had been added to this

configuration, the Sun StorEdge™ 9960 system would have been able to handle far more aggregate sustainable IOPS.

Again, it is worth repeating these IOPS were obtained from the backend – the disk drives – not out of cache (OLTP applications generate thousands of random IOPS which cause significantly lower hit ratios in cache than large sequential transfers as generated by DSS applications), so any OLTP which reads I/Os out of cache is invalid as a representative test of a real world OLTP configuration.

It is also noteworthy that out of a possible 512 drives, only 192 (38% - not even half of the total system' spindle capacity potential) were used for this test, so in the event more servers had been added and the upper boundary of sustainable IOPS in this particular Sun StorEdge™ 9960 system configuration were reached, simply adding more drives would have brought the system to the point where it would have left the configuration server bound yet again.

RAID Performance

Note the benchmarks described above were run using RAID 5, proving the Sun StorEdge™ 9900 series provides more than enough levels of performance while saving significant money because the 4-drive array group configuration of RAID 5 yields 25% more usable system capacity over a mirrored (RAID 1, RAID 10, RAID 1+, RAID 1+0, RAID 0+1) system.

REQUIREMENTS AND CONFIGURATION

System Requirements

MULTI-PLATFORM COMPATIBILITY

The Sun StorEdge™ 9900 series is compatible with most major open systems and mainframe host platforms.

IMPORTANT SUPPORT INFORMATION

The Sun StorEdge™ 9900 series storage products are initially available with a list of specifically supported JNI Host Bus Adapters (HBAs) and Brocade Fibre Channel Switches. These storage products, HBAs and Switches, when purchased from Sun only and configured per the Sun StorEdge™ 9900 series product compatibility matrix, will be supported per the terms of the respective Sun warranty or Service contract.

The JNI Host Bus Adapters and Brocade Fibre Channel Switches are qualified, at this time, only with the Sun StorEdge™ 9900 series storage products and cannot be utilized with any other Sun storage product unless specifically stated in the product support matrix.

We will be adding additional HBAs, Switches and other associated products for the Sun StorEdge™ 9900 as quickly as possible. In addition, we will be reviewing the applicability of qualifying similar HBAs, Switches and other associated products on additional Sun storage products.

We support the storage products and systems we sell when they are connected to the host platforms supported as referenced in the tables which follow. NOTE: The information contained in the tables below is very dynamic - For the latest information, please refer to GNSS website.

Sun recognizes the desire of customers to have a single service organization representing storage products, especially those products which are very similar. We are investigating the options associated with bringing previously purchased HDS storage products under the Sun service umbrella. In view of the complexity of this process we are unable to announce upgrade service options for HDS purchased storage products at this time, but Sun and HDS will work with each customers on an individual basis to address your requirements.

What Works With What – Sun StorEdge™ 9900 Series Compatibility Matrices

HOST OPERATING SYSTEM COMPATIBILITY

Operating System Compatibility	
Open systems	Mainframe
Compaq Tru64 UNIX (4.0f/g, 5.0a, 5.1)	OS/390
HP-UX (10.2, 11.0 32-bit, 11.0 64-bit), 11i	MVS/ESA®
IBM AIX (4.3.X)	MVS/XA®
Novell NetWare (5.0, 5.1)	TPF/MPLF
Red Hat Linux (6.2)	VM/ESA™
Sequent DYNIX/PTX (4.5.2, 4.7, 4.4.8)	VM/XA
SGI IRIX (6.5.11, 6.5.12, 6.5.8)	VM/HPO
Sun Solaris (2.6, 7 32-bit, 7 64-bit, 8)	VSE/ESA®
Microsoft Windows 2000 (Server Edition, Advanced Server Edition)	VSE/SP (4.1)
Microsoft Windows NT (Server 4.0, Server Enterprise Edition, Terminal Server Edition)	
DEC OpenVMS (7.2-1)	
Items highlighted are Warranted and Supported by Sun when Sold by Sun and attached to a Sun SE9900 series storage product only. All other items have been qualified, but are warranted and supported by their respective manufacturer.	

HA CLUSTERING: FAIL-OVER AND ALTERNATE PATH COMPATIBILITY

Host Failover and Alternate Path Compatibility		
Platform	Host Failover	Alternate Path
HP-UX 10.2, 11.0, 11i (LA)	MC/ServiceGuard A.10.xx, A.11.xx	HP-UX/Logical Volume Manager Dynamic Link Manager for HP 11.x 64bit only
Sun Solaris 2.6, 7, 8	VCS 1.1, 1.3 (Solaris 8 supports VCS 1.3 only)	VERITAS VxVM/DMP 3.0.2, 3.04, 3.1 Dynamic Link Manager
Sun Solaris 8	Sun Cluster 3.0	
IBM AIX 4.3.x	HACMP 4.3.1, 4.4	Dynamic Link Manager
Windows NT 4.0, EE, TSE	MSCS 1.0	Dynamic Link Manager
Windows 2000 Server, Advanced Server	MSCS 1.0	Dynamic Link Manager
Compaq Tru64 UNIX 4.0f/g, 5.0a, 5.1	TruCluster 1.6, 5.0a, 5.1 (OS vers. dependent for each vers.)	—
Novell NetWare 5.0, 5.1	Novell Cluster Services 1.0.1	—
Sequent DYNIX/PTX 4.5.2	Sequent Cluster Control 2.0.2	Sequent Multi Path 2.1.0
DEC OpenVMS 7.2-1	VMS Cluster 7.2-1	—
<p>Items highlighted are Warranted and Supported by Sun when Sold by Sun and attached to a Sun SE9900</p> <p>At this time (August 8, 2001):</p> <p>VCS with DMP for alternate path Supported</p> <p>Sun Cluster 3.0 and Solaris 8 (with Alternate Multi-Pathing) Supported on E450 and E3500, E4500, E5500, and E6500 servers</p> <p>Sun Cluster 2.2 Support of Sun Cluster 2.2 environments with legacy Sun Servers is under investigation.</p> <p>Sun Cluster 3.0 and DMP for alternate path Not Supported</p> <p>NOTE: The above is subject to change – On or after 8/21/01, please consult the Sun Cluster 3.0 Configuration Guide at suncluster@eng.</p>		

HOST SERVER COMPATIBILITY

Host Server HW Platform Compatibility	
Compaq	SGI
Compaq AlphaServer 1200	SGI Origin2000
Compaq AlphaServer ES40	SUN
HP	Sun Enterprise 10000
HP 9000 A-class	Sun Enterprise 6500
HP 9000 D-class	Sun Enterprise 5500
HP 9000 K-class	Sun Enterprise 4500
HP 9000 L-Class	Sun Enterprise 3500
HP 9000 N-class	Sun Enterprise 450
HP 9000 R-Class	Sun Enterprise 420R
HP 9000 T-Class	Sun Enterprise 250
HP 9000 V-class (2200/2250/2500)	Sun Enterprise 220R
IBM	Sun Ultra 1
IBM RS/6000 150	Sun Ultra 2
IBM RS/6000 43P	Sequent
IBM RS/6000 F50	Sequent NUMA-Q 2000
IBM RS/6000 S7	Mainframe
IBM RS/6000 S7A	IBM
IBM RS/6000 SP	Hitachi
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NOTE: The above is subject to change - please consult latest version on our website.	

HBA COMPATIBILITY

Host Bus Adapter Compatibility Matrix				
Operating System	PLATFORM	HBA	BUS I/F	DRIVER
HP-UX 10.20	T-class	A3636A	HSC	HP-UX Bundle
	R-class	A3591B	HSC	HP-UX Bundle
	K-class	A3404A	HSC	HP-UX Bundle
	D-class	A3591B	HSC	HP-UX Bundle
HP-UX 11.0	V-class	A3740A, A5158A	PCI	HP-UX (DART 48)
	T-class	A3636A	HSC	HP-UX (DART 48)
	R-class	A3591B	HSC	HP-UX (DART 48)
	K-class	A3404A	HSC	HP-UX (DART 48)
	D-class	A3591B	HSC	HP-UX (DART 48)
	L-class	A3740A, A5158A	PCI	HP-UX (DART 48)
	N-class	A3740A, A5158A	PCI	HP-UX (DART 48)
HP-UX 11i	N-class	A5158A	PCI	HP-UX Bundle
Windows NT EE, SP 4/5/6A (Max. 32 LUNs is supported)	WinNT PC	Emulex LP7000E	PCI	Mini port-V4.31
		Emulex LP8000	PCI	Mini port-V4.31 / Port 1.27a3
		Q-Logic QLA2100F	PCI	V7.05.02
		Q-Logic QLA2200F	PCI	V7.05.02
		HP D8602A	PCI	V2.07
Windows 2000	Win NT PC	Emulex LP8000	PCI	V5-4.41.a8
		Emulex LP8000	PCI	Port 1.27a5
		Q-Logic QLA2200F	PCI	V7.05.02
		HP D8602A	PCI	V2.7.0.0
IBM AIX 4.3.3 (32 bit)	RS/6000 43P	IBM 6227	PCI	AIX Bundle
	RS/6000 SP	IBM 6227	PCI	AIX Bundle
IBM AIX 4.3.3 (64 bit)	RS/6000 S7	IBM 6227	PCI	AIX Bundle
	RS/6000 SP	IBM 6227	PCI	AIX Bundle
Dynix/ptx 4.4.7, 4.4.8	NUMA-Q 2000	Sequent HBA	PCI	ptx/Hitachi-RAIDMP V2.1.1, ptx/Hitachi-RAIDMP V2.3.0 (Dynix 4.4.8)
Dynix/ptx 4.5.2	NUMA-Q 2000	Sequent HBA	PCI	ptx/Hitachi-RAIDMP V3.1.0
Novell NetWare 5.0	PC Server	Q-logic 2100F	PCI	V2.14g
		Emulex LP7000E	PCI	V1.22
		Emulex LP8000	PCI	V1.22
Novell NetWare 5.1	PC Server	Q-logic 2100F	PCI	V2.14g
		Emulex LP7000E	PCI	V1.22
		Emulex LP8000	PCI	V1.22
SGI IRIX 6.5.11 & 6.5.12, 6.5.8	Origin 2000	QLA2200F	PCI	Bundle
Linux RedHat 6.2	PC Server	Q-logic 2200F	PCI	V2.11
Digital UNIX Tru64 4.0f/G	Alpha Server 1200	KGPSA-BC	---	Bundle
Digital UNIX Tru64 5.0a	Alpha Server 1200	KGPSA-BC	--	Bundle
OpenVMS V7.2-1	Alpha Server ES40	KGPSA-BC	--	Bundle
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NOTE: The above is subject to change - please consult latest version on our website.				

Host Bus Adapter Compatibility Matrix (Continued)				
OS	PLATFORM	HBA	BUS I/F	DRIVER
Solaris 2.6	E250	Jaycor FCI-1063	PCI	V2.2.1. Hit 06.01, V2.5.9, V2.5.8 Hit07
	E450	Jaycor FCI-1063	PCI	V2.2.1. Hit 06.01, V2.5.9, V2.5.8 Hit07
		SUN X1057A	PCI	105356-05/09 / 105375-07/16
		SUN 6729A	PCI	107280-05 / 105356-12
	E220R	Jaycor FCI-1063	PCI	V2.2.1. Hit 06.01, V2.5.9, V2.5.8 Hit07
	E420R	Jaycor FCI-1063	PCI	V2.2.1. Hit 06.01, V2.5.9, V2.5.8 Hit07
	E3500	Jaycor FCI-1063	PCI	V2.2.1. Hit 06.01, V2.5.9, V2.5.8 Hit07
		Jaycor FC641063	SBus	V2.2.1. Hit 06.01 / F-code V13.3.5, V2.5.9 F-code V13.3.7, V2.5.8 Hit07
		Sun X6730A	SBus	105375-19
	E4500	Jaycor FCI-1063	PCI	V2.2.1. Hit 06.01, V2.5.9, V2.5.8 Hit07
		Jaycor FC641063	SBus	V2.2.1. Hit 06.01 / F-code V13.3.5, V2.5.9 F-code V13.3.7, V2.5.8 Hit07
		Sun X6730A	SBus	105375-19
		SUN X1057A	PCI	105356-05/09 / 105375-07/16
		SUN 6729A	PCI	107280-05 / 105356-12
		Emulex LP7000E	PCI	V3.38
	E5500	Jaycor FCI-1063	PCI	V2.2.1. Hit 06.01, V2.5.9, V2.5.8 Hit07
		Jaycor FC641063	SBus	V2.2.1. Hit 06.01 / F-code V13.3.5, V2.5.9 F-code V13.3.7, V2.5.8 Hit07
		Sun X6730A	SBus	105375-19
	E6500	Jaycor FCI-1063	PCI	V2.2.1. Hit 06.01, V2.5.9, V2.5.8 Hit07
		Jaycor FC641063	SBus	V2.2.1. Hit 06.01 / F-code V13.3.5, V2.5.9 F-code V13.3.7, V2.5.8 Hit07
		Sun X6730A	SBus	105375-19
	E10000	Jaycor FC641063	SBus	V2.2.1. Hit 06.01 / F-code V13.3.5, V2.5.9 F-code V13.3.7, V2.5.8 Hit07
	<p>IMPORTANT: Sun will only support and warrant Sun sold JNI HBAs when attached to a Sun SE9900 series storage product. All other HBAs listed as compatible with the Sun StorEdge 9900 series storage systems are supported and warranted by their respective ma</p> <p>Items highlighted are Warranted and Supported by Sun when Sold by Sun and attached to a Sun SE9900 series storage product only. All other items have been qualified, but are warranted and supported by their respective manufacturer.</p> <p>NOTE: The above is subject to change - please consult latest version on our website.</p>			

Host Bus Adapter Compatibility Matrix (Continued)				
OS	PLATFORM	HBA	BUS I/F	DRIVER
Solaris 7 (32/64 bit)	E250	Jaycor FCI-1063	PCI	V2.2.1. Hit 06.01, V2.5.9, V2.5.8 Hit07
		SUN 6729A	PCI	107292-06 / 107458-09 / 107474-01 / 107834-03
	E450	Jaycor FCI-1063	PCI	V2.2.1. Hit 06.01, V2.5.9, V2.5.8 Hit07
		SUN 6729A	PCI	107292-06 / 107458-09 / 107474-01 / 107834-03
	E220R	Jaycor FCI-1063	PCI	V2.2.1. Hit 06.01, V2.5.9, V2.5.8 Hit07
		SUN 6729A	PCI	107292-06 / 107458-09 / 107474-01 / 107834-03
	E420R	Jaycor FCI-1063	PCI	V2.2.1. Hit 06.01, V2.5.9, V2.5.8 Hit07
SUN 6729A		PCI	107292-06 / 107458-09 / 107474-01 / 107834-03	
Ultra1	Jaycor FC641063	SBus	V2.5.8 Hit 07 / F-code V13.3.7, V2.5.9 F-code V13.3.7, V2.5.8 Hit07	
GP7000	GP7B8FC1	PCI	Bundle	
E10K	Jaycor FC641063	SBus	V2.2.1. Hit 06.01 / F-code V13.3.5, V2.5.9 F-code V13.3.7, V2.5.8 Hit07	
Solaris 8	E3500	Jaycor FCI-1063	PCI	V2.5.8 Hit 07, V2.5.9, V2.5.8 Hit07
		Jaycor FC641063	SBus	V2.5.8 Hit 07 / F-code V13.3.7, V2.5.8 Hit07
	E4500	Jaycor FCI-1063	PCI	V2.5.8 Hit 07, V2.5.9, V2.5.8 Hit07
		Jaycor FC641063	SBus	V2.5.8 Hit 07 / F-code V13.3.7, V2.5.9 F-code V13.3.7, V2.5.8 Hit07
	E5500	Jaycor FCI-1063	PCI	V2.5.8 Hit 07, V2.5.9, V2.5.8 Hit07
		Jaycor FC641063	SBus	V2.5.8 Hit 07 / F-code V13.3.7, V2.5.9 F-code V13.3.7, V2.5.8 Hit07
	E6500	Jaycor FCI-1063	PCI	V2.5.8 Hit 07, V2.5.9, V2.5.8 Hit07
		Jaycor FC641063	SBus	V2.5.8 Hit 07 / F-code V13.3.7, V2.5.9 F-code V13.3.7, V2.5.8 Hit07
	E250	Jaycor FCE-6410	PCI	V4.0, V2.5.8 Hit07
		Emulex LP8000	PCI	V4.10G
	E450	Jaycor FCE-6410	PCI	V4.0, V2.5.8 Hit07
		Emulex LP8000	PCI	V4.10G
	E220R	Jaycor FCE-6410	PCI	V4.0, V2.5.8 Hit07
		Emulex LP8000	PCI	V4.10G
	E420R	Jaycor FCE-6410	PCI	V4.0, V2.5.8 Hit07
		Emulex LP8000	PCI	V4.10G
E10K	Jaycor FC641063	SBus	V2.2.1. Hit 06.01 / F-code V13.3.5, V2.5.9 F-code V13.3.7, V2.5.8 Hit07	
<p>IMPORTANT: Sun will only support and warrant Sun sold JNI HBAs when attached to a Sun SE9900 series storage product. All other HBAs listed as compatible with the Sun StorEdge 9900 series storage systems are supported and warranted by their respective ma</p> <p>Items highlighted are Warranted and Supported by Sun when Sold by Sun and attached to a Sun SE9900 series storage product only. All other items have been qualified, but are warranted and supported by their respective manufacturer.</p> <p>NOTE: The above is subject to change - please consult latest version on our website.</p>				

HUB COMPATIBILITY

Hub Compatibility Matrix					
Op. System	Host Bus Adapter	Supported Configuration	Cascade Level	Hub	Hub FW
HP-UX 10.20	T-class: A3636A	Server: Max.3 ports; SE9900: Max.6 ports	2	HP (Gadzoos) FC-AL HUB A3724A	Bundle
	R-class: A3591B				
	K-class: A3404A				
	D-class: A3591B				
HP-UX 11.0	V-class: A3740A	Server: Max.3 ports; SE9900: Max.6 ports	2	HP (Gadzoos) FC-AL HUB A3724A	Bundle
	V-class: A5158A				
	T-class: A3636A				
	R-class: A3591B				
	K-class: A3404A				
	D-class: A3591B				
	L-class: A3740A				
	L-class: A5158A				
	N-class: A3740A				
N-class: A5158A					
Windows NT EE, SP4/5/6A	WinNT PC: Emulex LP7000E	Server: Max.1 port (Max.2 for MSCS); SE9900: Max.4 ports	1	Emulex FC-AL HUB LH5000	Bundle
	WinNT PC: Emulex LP8000		1	Emulex FC-AL HUB LH5000	
	WinNT PC: Emulex LP8000		1	Vixel FC-AL HUB Rapport HUB	
	WinNT PC: HP D8602A		1	Vixel FC-AL HUB Rapport HUB	
	WinNT PC: Q-Logic QLA2100F		2	HP (Gadzoos) FC-AL HUB	
	WinNT PC: HP D8602A		2	HP (Gadzoos) FC-AL HUB	
Windows 2000	WinNT PC: Q-Logic QLA2100F	Server: Max.1 port (Max.2 for MSCS);	1	Vixel FC-AL HUB Rapport HUB	Bundle
	WinNT PC: HP D8602A		2	HP (Gadzoos) FC-AL HUB	
Solaris 2.6	Jaycor FCI-1063	Server: Max.3 ports; SE9900: Max.4 ports	1	Emulex FC-AL HUB LH5000	Bundle
	Jaycor FC641063		1	Emulex FC-AL HUB LH5000	
	Emulex LP7000		1	Emulex FC-AL HUB LH5000	
Solaris 7 (32 bit)	Jaycor FCI-1063	Server: Max.3 ports; SE9900: Max.4 ports	1	Emulex FC-AL HUB LH5000	Bundle
	Jaycor FC641063				
Solaris 7 (64 bit)	Jaycor FCI-1063	Server: Max.3 ports; SE9900: Max.4 ports	1	Emulex FC-AL HUB LH5000	Bundle
	Jaycor FC641063				
Solaris 8	Jaycor FCI-1063	Server: Max.3 ports; SE9900: Max.4 ports	1	Emulex FC-AL HUB LH5000	Bundle
	Jaycor FC641063				
<p>IMPORTANT: Sun will only support and warrant Sun sold JNI HBAs when attached to a Sun SE9900 series storage product. All other HBAs listed as compatible with the Sun StorEdge 9900 series storage systems are supported and warranted by their respective ma</p> <p>Items highlighted are Warranted and Supported by Sun when Sold by Sun and attached to a Sun SE9900 series storage product only. All other items have been qualified, but are warranted and supported by their respective manufacturer.</p> <p>NOTE: The above is subject to change - please consult latest version on our website.</p>					

SWITCH COMPATIBILITY

Switch Compatibility Matrix						
Op. System	HBA (Topology)	Switch Vendor	Port Topology	Supported Config.	Cascade Level	Switch FW
HP-UX 10.20	T-class: A3636A (EPL)	HP F-16	AL	Server: Max.6; SE9900 Max: 4	2	V1.6c2
		Brocade Silkworm 2800			2	V1.1.7 V2.2.2b
	R-class: A3591B (EPL)	HP F-16			2	V1.6c2
		Brocade Silkworm 2800			2	V1.1.7 V2.2.2b
	K-class: A3404A (EPL)	HP F-16			2	V1.6c2
		Brocade Silkworm 2800			2	V1.1.7 V2.2.2b
		Ancor SAN Box			1	V3.03.42 V3.04.20
	D-class: A3591B (EPL)	HP F-16			2	V1.6c2
		Brocade Silkworm 2800			2	V1.1.7 V2.2.2b
	HP-UX 11.0 (32 bit, 64 bit)	V-class: A3740A (EPL); A5158A			HP F-16	AL
HP F-16			2	V1.6c2		
Brocade Silkworm 2800		2	V1.1.7 V2.2.2b			
D-class: A3591B (EPL)		HP F-16	2	V1.6c2		
		Brocade Silkworm 2800	2	V1.1.7 V2.2.2b		
L-class: A3740A (EPL); A5158A (EPL)		HP F-16	2	V1.6c2		
		Brocade Silkworm 2800	2	V1.1.7 V2.2.2b		
N-class: A3740A (EPL); A5158A (EPL)		HP F-16	2	V1.6c2		
		Brocade Silkworm 2800	2	V1.1.7 V2.2.2b		
K-class: A3404A (EPL)		HP F-16	2	V1.6c2		
		Brocade Silkworm 2800	2	V1.1.7 V2.2.2b		
		Ancor SAN Box	1	V3.03.42 V3.04.20		
IMPORTANT:						
Sun will only support and warrant Sun sold Brocade 2400 8-port and Brocade 2800 16-port Silkworm switches when attached to a Sun SE9900 series storage product. All other switches listed as compatible with the Sun StorEdge 9900 series storage systems are						
Sun sold Brocade switches must be purchased in redundant configurations to ensure system availability and to avoid voiding the system warranty.						
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Switch Compatibility Matrix (Continued)									
Op. System	HBA (Topology)	Switch Vendor	Port Topology	Supported Config.	Cascade Level	Switch FW			
Windows NT EE, SP 4/5/6A	Emulex LP8000 (F-port)	HP F-16	FL	Server Max.6; SE9900 Max. 4	1	V1.6c2			
	Emulex LP7000E (F-port)								
	Q-Logic QLA2100F (FL-port)								
	Q-Logic QLA2200F (FL-port)								
	Emulex LP8000 (F-port)	ANCOR Gigworks MKII-16 (Single Stage)	FL or F					s02.03.01	
	Emulex LP7000E (F-port)								
	Q-Logic QLA2100F (FL-port)								
	Q-Logic QLA2200F (FL-port)								
	Emulex LP8000 (F-port)	Brocade Silksworm 1600	FL or F					V1.6	
	Emulex LP7000E (F-port)								
	Q-Logic QLA2100F (FL-port)								
	Q-Logic QLA2200F (FL-port)								
	Emulex LP8000 (F-port)	Brocade Silksworm 2800	FL or F					V1.1.7	
	Emulex LP7000E (F-port)								V2.2.2b
	Q-Logic QLA2100F (FL-port)								V1.1.7
	Q-Logic QLA2200F (FL-port)								V2.2.2b
	Emulex LP8000 (F-port)								V1.1.7
	Emulex LP7000E (F-port)								V2.2.2b
Emulex LP8000 (F-port)	Ancor SAN Box	FL or F			V3.03.42				
Emulex LP7000E (F-port)									
Emulex LP8000 (F-port)	McData ED5000	F			V3.04.20				
Windows 2000	Emulex LP8000 (F-port)	HP F-16	FL	Server Max.6; SE9900 Max. 4	1	V1.6c2			
	LP7000E (F-port)								
	Emulex LP8000 (F-port)	Brocade Silksworm 2800	FL or F					V1.1.7	
	LP7000E (F-port)								V2.2.2b
	Emulex LP8000 (F-port)	Ancor SAN Box	FL or F					V3.03.42	
	LP7000E (F-port)								V3.04.20

IMPORTANT:

Sun will only support and warrant Sun sold Brocade 2400 8-port and Brocade 2800 16-port Silksworm switches when attached to a Sun SE9900 series storage product. All other switches listed as compatible with the Sun StorEdge 9900 series storage systems are

Sun sold Brocade switches must be purchased in redundant configurations to ensure system availability and to avoid voiding the system warranty.

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Switch Compatibility Matrix (Continued)						
Op. System	HBA (Topology)	Switch Vendor	Port Topology	Supported Config.	Cascade Level	Switch FW
Solaris 2.6	Jaycor FCI-1063 (F-port) PCI	HP F-16	FL	Server: Max 6; SE9900: Max 4	1	V1.6c2
	Jaycor FC641063 (F-port) SBus	Brocade Silkworm 2400 8-port	FL or F	Server: Max 6; SE9900: Max 4	1	V2.2.2b
	Jaycor FC641063 (F-port) SBus	Brocade Silkworm 2800 16-port	FL or F	Server: Max 6; SE9900: Max 4	1	V1.1.7 V2.2.2b
	Jaycor FCI-1063 (F-port) PCI	McDATA ED5000	F	Server: Max 6; SE9900: Max 4	1	V01.03.00
	Jaycor FC641063 (F-port) SBus	ANCOR Gigworks MKII-16 (Single Stage)	FL or F	Server: Max 6; SE9900: Max 4	1	s02.03.01
Solaris 7 (32 bit)	Jaycor FCI-1063 (F-port) PCI	HP F-16	FL	Server: Max 6; SE9900: Max 4	1	V1.6c2
	Jaycor FC641063 (F-port) SBus	Brocade Silkworm 2400 8-port	FL or F			V2.2.2b
	Jaycor FC641063 (F-port) SBus	Brocade Silkworm 2800 16-port	FL or F			V1.1.7; V2.2.2b
	Jaycor FCI-1063 (F-port) PCI	McDATA ED5000	F			V01.03.00
	Jaycor FC641063 (F-port) SBus	ANCOR Gigworks MKII-16 (Sql. Stage)	FL or F			s02.03.01
Solaris 7 (64 bit)	Jaycor FCI-1063 (F-port) PCI	HP F-16	FL	Server: Max 6; SE9900: Max 4	1	V1.6c2
	Jaycor FC641063 (F-port) SBus	Brocade Silkworm 2400 8-port	FL or F			V2.2.2b
	Jaycor FC641063 (F-port) SBus	Brocade Silkworm 2800 16-port	FL or F			V1.1.7 V2.2.2b
	Jaycor FCI-1063 (F-port) PCI	McDATA ED5000	F			V01.03.00
	Jaycor FC641063 (F-port) SBus	ANCOR Gigworks MKII-16 (Single Stage)	FL or F			s02.03.01
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Switch Compatibility Matrix (Continued)						
Op. System	HBA (Topology)	Switch Vendor	Port Topology	Supported Config.	Cascade Level	Switch FW
Solaris 8	Jaycor FCI-1063 (F-port) PCI	HP F-16	FL	Server: Max 6; SE9900: Max 4	1	V1.6c2
	Jaycor FC641063 (F-port) SBus					
	Jaycor FCI-1063 (F-port) PCI	Brocade Silkworm 2400 8-port	FL or F			V2.2.2b
	Jaycor FC641063 (F-port) SBus					
	Jaycor FCI-1063 (F-port) PCI	Brocade Silkworm 2800 16-port	FL or F			V1.1.7
	Jaycor FC641063 (F-port) SBus					V2.2.2b
	Jaycor FCI-1063 (F-port) PCI	ANCOR SAN Box	FL or F			V3.03.42
	Jaycor FC641063 (F-port) SBus					V3.04.20
	Jaycor FCE-6410 (F-port) PCI	Brocade Silkworm 2400 8-port	FL or F			V2.2.2b
Jaycor FCE-6410 (F-port) PCI	Brocade Silkworm 2800 16-port	FL or F	V1.1.7			
						V2.2.2b
IBM AIX 4.3.3 (32 bit)	IBM 6227 (F-port)	HP F-16	FL	Server: Max. 3; SE9900: Max.2	1	V1.6c2
		Brocade Silkworm 2800	FL or F			V1.1.7
		ANCOR Gigworks MKII-16 (Single Stage)	FL or F			s02.03.01
		McDATA ED5000	F			V01.03.00
IBM AIX 4.3.3(64 bit)	IBM 6227 (F-port)	HP F-16	FL	Server: Max. 3; SE9900: Max.2	1	V1.6c2
		Brocade Silkworm 2800	FL or F			V1.1.7
		McDATA ED5000	F			V01.03.00
		ANCOR Gigworks MKII-16 (Single Stage)	FL or F			s02.03.01
		ANCOR SAN Box	FL or F			V3.03.42
						V3.04.20
DYNIX/ptx 4.5.2, 4.7, 4.4.8	SEQUENT HBA (F-port)	SEQUENT Switch	F	Server Max. 2; SE9900 Max. 3	1	V1.6
Tru64 4.0f/G	KGPSA-BC (F-port)	HP F-16	FL	Server Max. 1; SE9900 Max. 1	1	V1.6c2
Tru5.0a	KGPSA-BC (F-port)	Brocade Silkworm 2800	FL or F	Server Max. 1; SE9900 Max. 1	1	V1.1.7
						V2.2.2b
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SOFTWARE ADMINISTRATION

With the steady growth in end-user storage demands comes the growing need to centralize, consolidate, and share data on a single heterogeneous non-disruptive storage platform. In order to host enterprise-critical applications and practices, Sun customers require not only data center-class storage systems, they require the data and storage management software to run them. Sun StorEdge™ 9900 series high-end storage systems and Sun storage management software provide an ideal combination for customers with these demanding requirements. Sun StorEdge™ 9900 series data and storage management software is specific to Sun StorEdge™ 9900 series. Sun StorEdge™ software runs any storage system, distributed-cache or cache-centric. Sun customers now have one of the broadest choices in the market -- they can implement their storage infrastructures and will choose the best solution to fit their own unique needs.

The criteria for choosing the right solution should be based on a customer's specific IT environment and the workload performance and availability characteristics of the applications in that environment. In Sun server environments, Sun StorEdge™ management software provides a great solution that to support a customer's investment and choice in a distributed open storage environment. Sun StorEdge™ 9900 series software provides a unique, easy-to-use solution for a single, centralized consolidated storage platform simultaneously supporting storage, data, and application sharing between multiple disparate heterogeneous open systems and mainframe hosts.

This section describes the following aspects of storage and data management software administration for the Sun StorEdge™ Series 9900 systems:

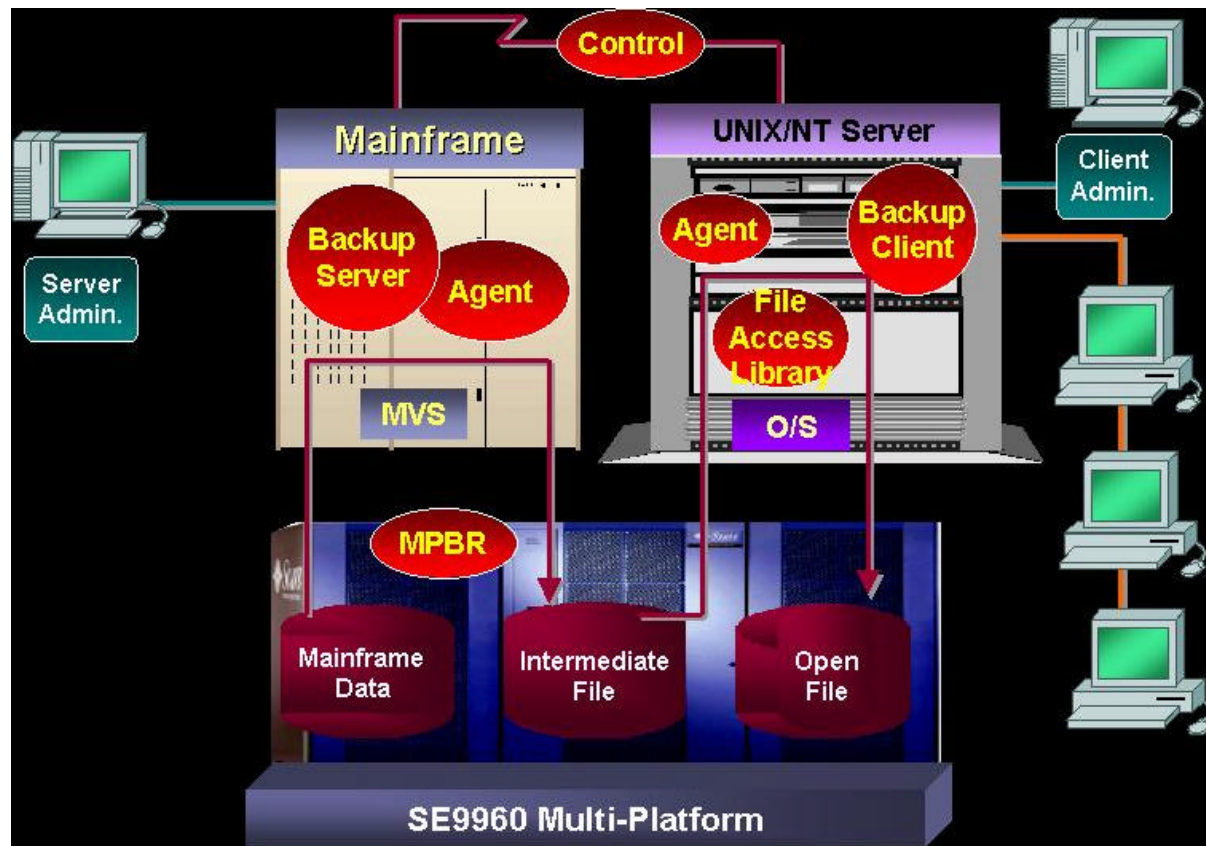
Data Management Software

SUN STOREDGE™ 9900 DYNAMIC LINK MANAGER SOFTWARE

Provides automatic load balancing, path failover, and recovery capabilities in the event of path failure. Helps ensure no single path becomes overworked, while others are under utilized. Automatically allocating information to an alternate data path eliminates the threat of application failure. Increases information availability across the enterprise by maximizing complete utilization of all paths available. LUNs can be accessed through two separate paths.

SUN STOREDGE™ 9900 MULTI-PLATFORM BACKUP/RESTORE SOFTWARE

Open systems backup using mainframe hardware. Allows implementation of mainframe-based backup procedures & standards for open-system data stored on Sun StorEdge™ 9900 series systems. Enables standard mainframe backup/restore utilities such as DFDSS, Fast Dump/Restore (FDR), and VSE FASTWRITE to perform volume-level backup & restore operations on OPEN-3 and OPEN-9 LUNs.



Using mainframe-based utilities, media, and high-speed backup devices, users can use the same procedures and achieve the same standards for both mainframe and open-system backup/restore operations. Before Multi-Platform Backup/Restore operations can begin, an offline utility such as ICKDSF must be used to create a volume table of contents (VTOC) to enable the mainframe host to use the OPEN-3 and OPEN-9 LUNs as 3390-3 and 3390-9 volumes which contain a single file. Supports only full-volume backup/restore operations.

SUN STOREDGE™ 9900 EXTENDED REMOTE COPY SOFTWARE

Synchronous remote copy over extended distances using channel extenders (S/390). Requires separate purchase of prerequisite mainframe kit, which includes S/390 Sun StorEdge™ 9900 software programs Sun StorEdge™ 9900 Virtual Logical Volume Image software, Sun StorEdge™ 9900 ShadowImage software, and Sun StorEdge™ 9900 Remote Copy software (synchronous and asynchronous).

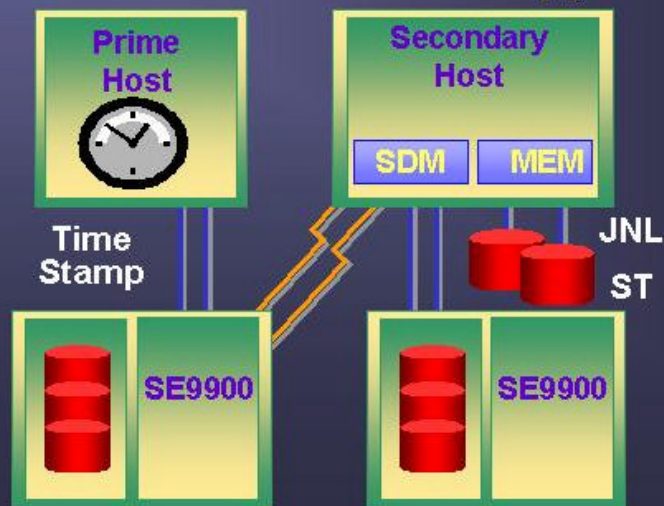
Sun StorEdge™ 9900 Extended Remote Copy software asynchronous is functionally compatible with IBM Extended Remote Copy (XRC). Sun StorEdge™ 9900 Extended Remote Copy software provides asynchronous Sun StorEdge™ 9900 TrueCopy software operations for maintaining duplicate copies of S/390 data for data backup purposes. Once established, Sun StorEdge™ 9900 Extended Remote Copy software operations continue unattended to provide continuous data backup. Sun StorEdge™ 9900 Extended Remote Copy software operations are non-disruptive and allow the primary Sun StorEdge™ 9900 Extended Remote Copy software volumes to remain online to the host(s) for both read and write I/O operations. For Sun StorEdge™ 9900 Extended Remote Copy software operations, there is no distance limitation between the primary and remote Sun StorEdge™ 9900 series. Sun StorEdge™ 9900 Extended Remote Copy software is also compatible with DFSMS data mover common to the XRC environment.

Sun StorEdge™ 9900 Extended Remote Copy software operations are performed in the same manner as XRC operations: The user issues standard XRC TSO commands from the mainframe host system console directly to the Sun StorEdge™ 9900 series system. The Remote Console PC is not used to perform Sun StorEdge™ 9900 Extended Remote Copy software extended remote copy operations. Sun StorEdge™ 9900 Extended Remote Copy software can be used as an alternative to Sun StorEdge™ 9900 TrueCopy software for mainframe data backup and disaster recovery planning. However, Sun StorEdge™ 9900 Extended Remote Copy software requires host processor resources which may be significant for volumes with high-write activity. The data mover utility may run in either the primary host or the optional remote host.

Remote Copy for long distances

- Less performance impact
- Copy maintained across multiple systems

Extended Remote Copy



QUICK COMPETITIVE COMPARISON

EMC SRDF Adaptive Copy - SRDF Adaptive Copy is NOT a disaster recovery solution; it is for data movement, e.g. data center moves. If a failure occurs during data move remote copy process, users can restart the job to recover their data. There must be some external means of validating the data to ensure that it was copied correctly, however. **Adaptive Copy is not sufficient for disaster recovery for two key reasons:** 1) There is no feedback mechanism to ensure records sent to the remote site arrived and/or were written. Also, there is no record sequence numbering system to ensure no missing records at the remote site. 2) It cannot coordinate updates of multiple remote volumes related to the same application. to ensure they are logically consistent; therefore, if the primary site has a rolling disaster, the volumes at the remote site are useless for disaster recovery.

EMC SRDF Multi-Hop - Never officially announced, Multi-Hop appears it provides adequate disaster recovery, but it's expensive, requiring up to 6 copies of data (2 at each of the 3 sites) and **TRIPLE** the # of EMC boxes! Multi-Hop consists of a 2-step, cascading remote copy: The 1st step is an SRDF synch. copy to a remote location within 40KM of the primary site ("closet site") - All closet site volumes are duplicated using TimeFinder. The TimeFinder BCV is used as a primary volume for another remote copy to a 3rd site (the "disaster recovery" site). This 2nd step may be either SRDF synch, semi-synch, or Adaptive Copy. All Multi-Hop mgmt. is controlled from the primary EMC box via Symmetrix Manager. Multi-Hop requires application. quiescing to create a point-in-time copy. **An Unannounced Version of**

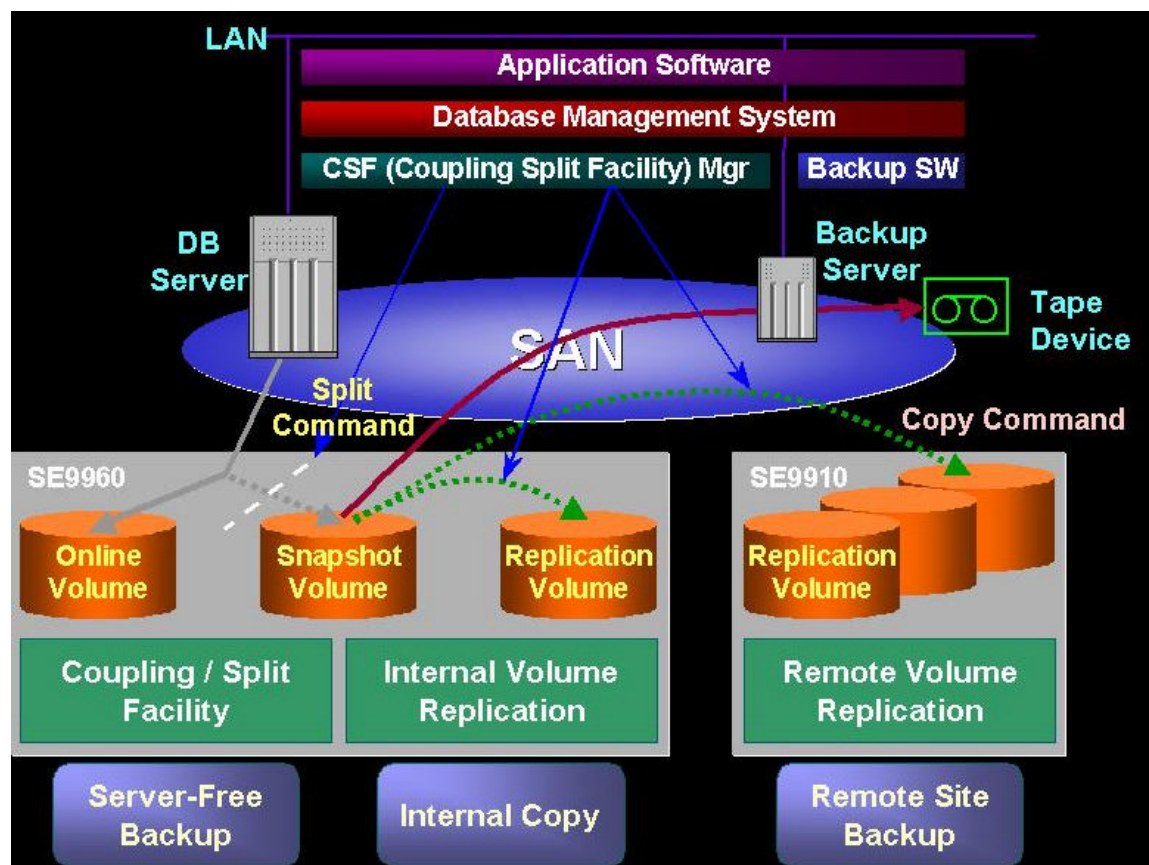
SRDF Asynchronous - Another unannounced product, a newer version of SRDF Asynch., which has consistency group capability. We understand it uses a host-resident program to provide a consistent time from the system timer, therefore it should have the ability to maintain consistency groups across multiple boxes. If this is all true, it should have capability similar to Sun StorEdge™ 9900 TrueCopy Software-asynch insofar as disaster recovery capability is concerned. Each consistency group will be limited to one target EMC box. Furthermore, our understanding is this new SRDF Asynch doesn't use the S/390 system timer or Sysplex timer. (Current indications are EMC is using a GPS receiver attached to

each box, which would mean it works in open system environments too.) The cost or reliability of EMC's external timer source could be a weak point in their implementation.

IBM PPRC - IBM PPRC is synchronous remote copy only, similar to Sun StorEdge™ 9900 TrueCopy Software-synch. Therefore it is subject to a distance limitation of approximately 40KM to avoid performance degradation. It is not a competitor to Sun StorEdge™ 9900 TrueCopy Software-asynch.

IBM Extended Remote Copy (XRC) - XRC is similar to Sun StorEdge™ 9900 Extended Remote Copy Software and provides the capability to copy data over long distances with minimal impact, plus very extensive capabilities to ensure data integrity at the remote site. XRC and Sun StorEdge™ 9900 Extended Remote Copy Software also include support for *consistency groups*. The user may specify a group of volumes to be members of a consistency group, and XRC will ensure that if there is a disruption in copying data to the remote site that all volumes of the consistency group will be updated to the same point in time, the latest time for which all updates for all volumes in the consistency group are available. The primary advantage of Sun StorEdge™ 9900 TrueCopy Software-asynch compared to XRC is that Sun StorEdge™ 9900 TrueCopy Software-asynch does not require host processing to accomplish the data movement. The XRC System Data Mover (SDM) requires either a separate host (with additional MVS license) or LPAR to manage the data movement from the primary site to the remote site, and it consumes a lot of processor resources. The additional cost is a major deterrent to widespread deployment of XRC. Also, it is proving complex and difficult to install and tune in large complexes. Sun StorEdge™ 9900 TrueCopy Software-asynch can handle a maximum of 1024 volumes on the same Sun StorEdge™ 9900 series system. XRC, on the other hand, can manage theoretically an unlimited number of volumes, although the SDM does have throughput limitations. (IBM may announce support for multiple SDMs running in separate LPARs.)

Using remote copy functionality with imaging functionality:



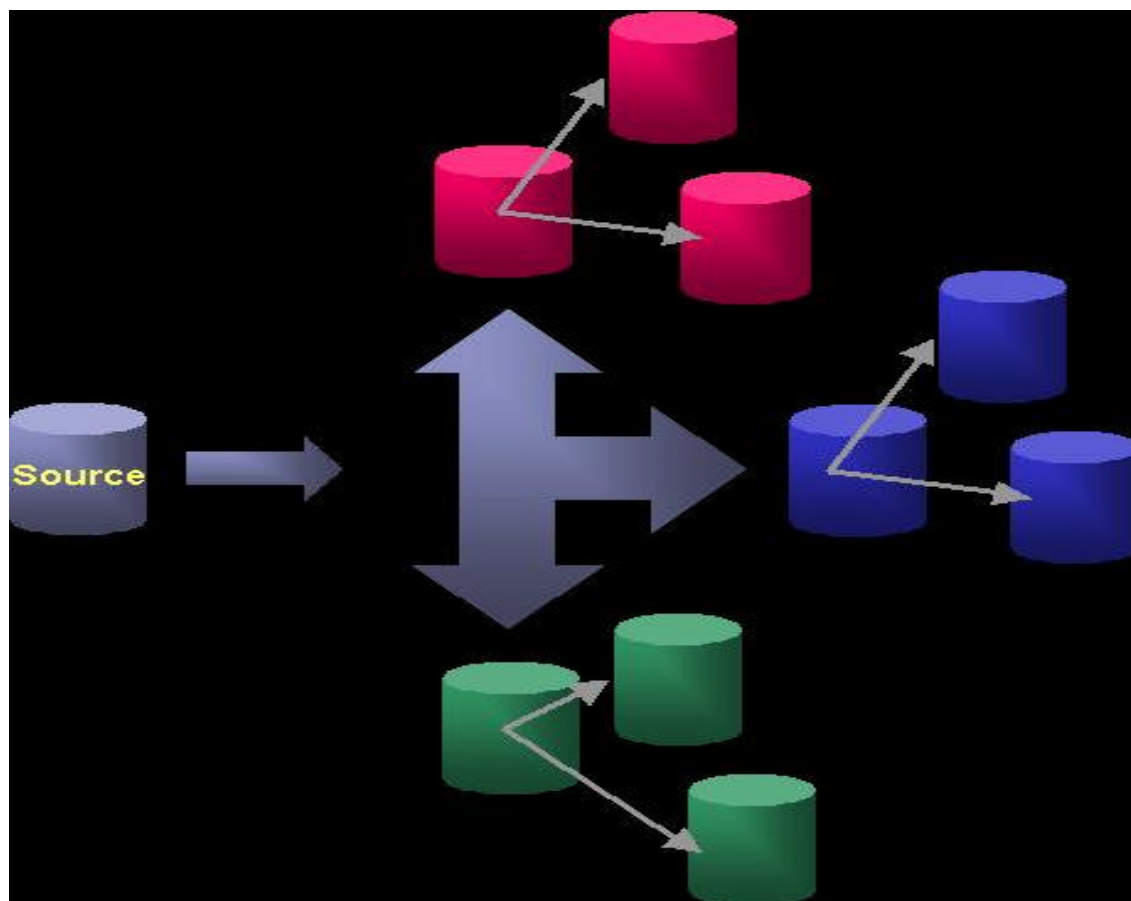
SUN STOREDGE™ 9900 SHADOWIMAGE SOFTWARE – GENERAL OVERVIEW

Point-in-time LUN duplication (image snapshot) for non-disruptive, real-time copies for backups, application testing, and data warehousing/data mining activities. Includes Command Control Interface (CCI) which is used to create batch streams.

Replicates large volumes of information within the Sun StorEdge™ 9900 series without impacting service levels, timing out, or affecting performance levels. The high-speed replication capability substantially reduces the backup window, allowing the business to stay online. ShadowImage further speeds duplication through a resynchronization capability that copies only data changed since the last data update.

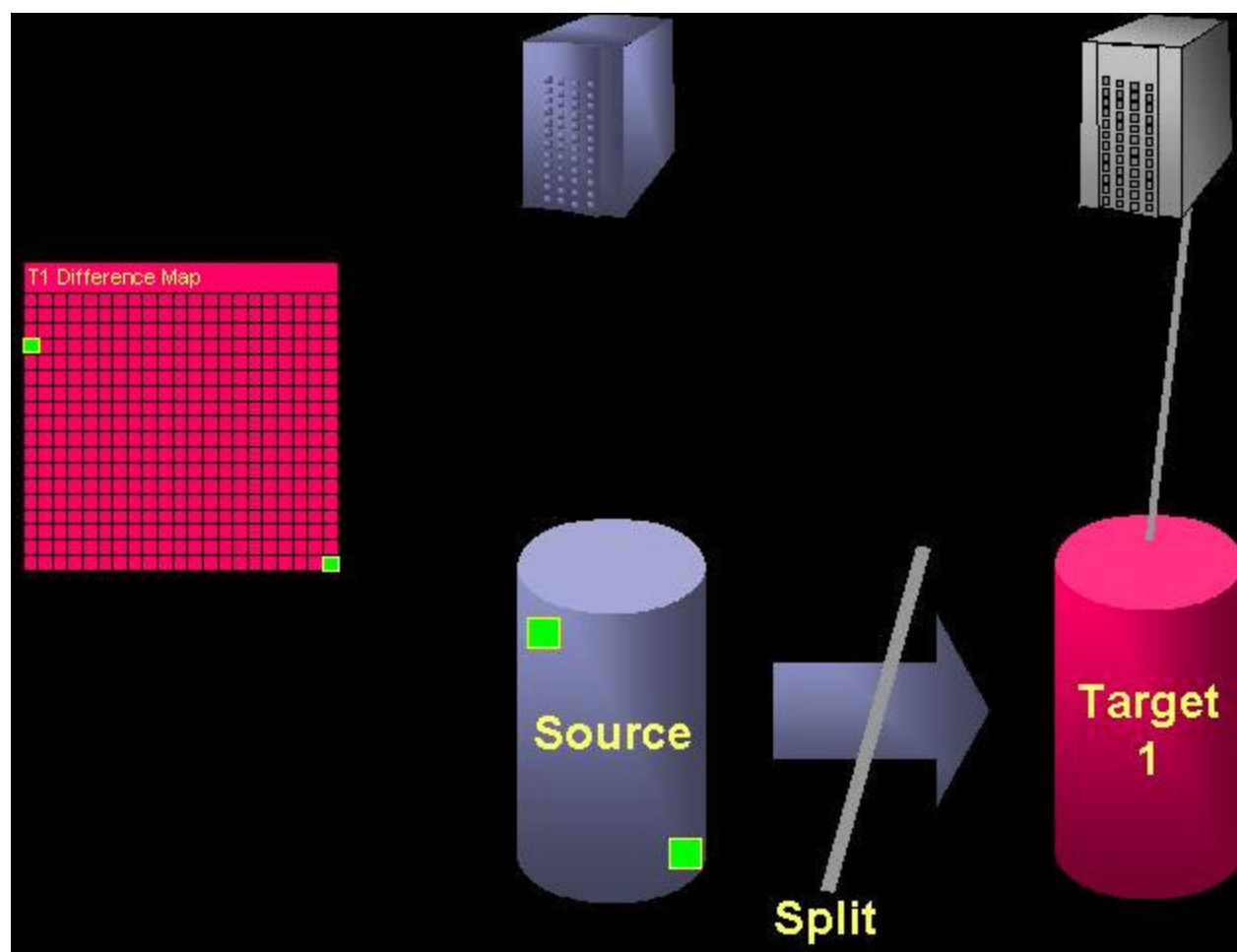
Open Sun StorEdge™ 9900 ShadowImage software maintains Sun StorEdge™ 9900 series-internal copies of open-system LUs for data backup or duplication. Up to 9 RAID-protected duplicate LUs can be created in a Sun StorEdge™ 9900 series system as the primary LU at hardware speeds. Once established, Open ShadowImage operations continue unattended to provide asynchronous internal data backup. Open ShadowImage operations are non-disruptive: the primary LU of each Open ShadowImage pair remains available to all hosts for both read and write operations. Resynchronous capability reduces duplication requirements and backup time, increasing user productivity. The open functionality of Sun StorEdge™ 9900 ShadowImage software supports reverse resynch for maximum flexibility. Also available for S/390 (part of the requisite mainframe kit).

Sun StorEdge™ 9900 ShadowImage software provides the function to make multiple copies of a LUN WITHIN the same storage system; Sun StorEdge™ 9900 TrueCopy software copies data from one storage system to another.



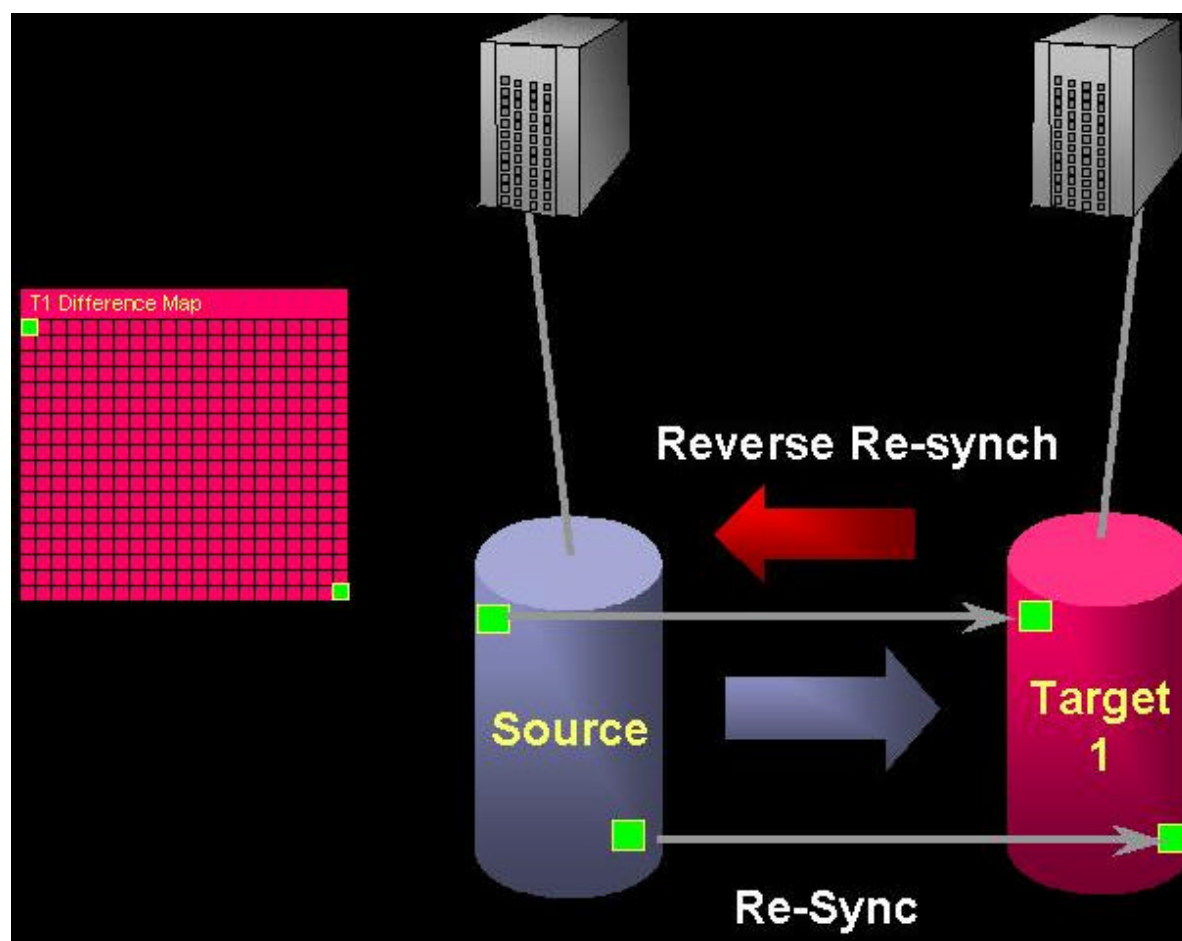
SUN STOREDGE™ 9900 SHADOWIMAGE SOFTWARE FOR S/390[®]

Helps enable the user to create high-performance copies of S/390 source LVIs for testing or modification while benefiting from full RAID protection for the Sun StorEdge™ 9900 ShadowImage software copies. The Sun StorEdge™ 9900 ShadowImage software copies can be available to the same or different logical partitions (LPARs) as the original volumes for read and write I/Os. Sun StorEdge™ 9900 ShadowImage software allows the user to create up to three copies of a single source LVI and to perform updates in either direction, either from the source LVI to the Sun StorEdge™ 9900 ShadowImage software copy or from the Sun StorEdge™ 9900 ShadowImage software copy back to the source LVI. When used in conjunction with Sun StorEdge™ 9900 TrueCopy software, Sun StorEdge™ 9900 ShadowImage software helps enable the user to maintain multiple copies of critical data at both primary and remote sites.



SUN STOREDGE™ 9900 SHADOWIMAGE SOFTWARE FOR OPEN SYSTEMS

Helps enable the system administrator to maintain system-internal copies of open-system LUs for purposes such as data backup or data duplication. The RAID-protected duplicate LUs (up to nine) are created within the same system as the primary LU at hardware speeds. Once established, Sun StorEdge™ 9900 ShadowImage software open operations continue unattended to provide asynchronous internal data backup. Sun StorEdge™ 9900 ShadowImage software open operations are fully non-disruptive: the primary LU of each Sun StorEdge™ 9900 ShadowImage software open pair remains available to all hosts for both read and write operations. Usability is further enhanced through a resynchronization capability which reduces data duplication requirements and backup time, thereby increasing user productivity. Sun StorEdge™ 9900 ShadowImage software open operations also support reverse resynchronization for maximum flexibility.



SUN STOREDGE™ 9900 TRUCCOPY SOFTWARE

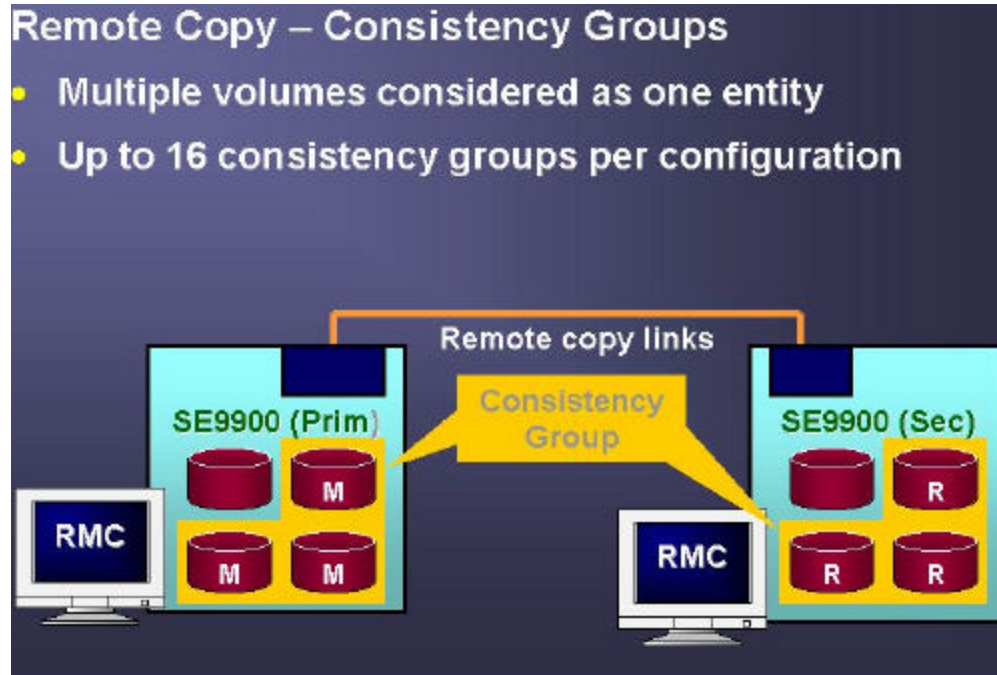
Host-less asynchronous or synchronous remote copy replicates information locally or remotely between Sun StorEdge™ 9900 series systems, via ESCON or FC interface. Continuously update and maintain reliable data copies at a secondary site asynchronously from one Sun StorEdge™ 9900 series to another. Includes Command Control Interface (CCI) which is used to create batch streams. Can also use extenders to synchronously remote copy over extended distances (S/390).

Maintains copies of data for backup or duplication purposes - Once established, Sun StorEdge™ 9900 TrueCopy software operations continue unattended, providing continuous, real-time data backup. Sun StorEdge™ 9900 TrueCopy software operations are non-disruptive and allow the primary remote copy volumes to remain online to all hosts for both read and write I/O operations.

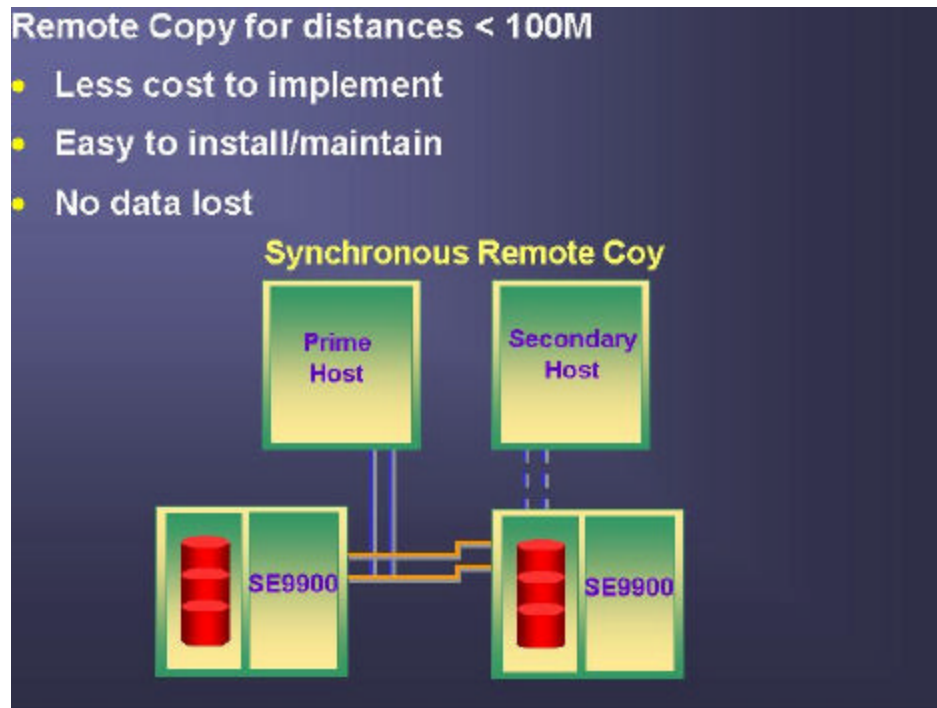
Sun StorEdge™ 9900 TrueCopy software copies data from one storage system to another. The Sun StorEdge™ 9900 series and the HDS Freedom Storage 7700E can copy to/from each other over ESCON links, but not FC links. A Sun StorEdge™ 9900 series can copy to/from another Sun StorEdge™ 9900 series using Sun StorEdge™ 9900 TrueCopy software over either an ESCON or FC link. ShadowImage is the function to make multiple copies of a LUN WITHIN the same storage system.

REMOTE COPY CONFIGURATIONS

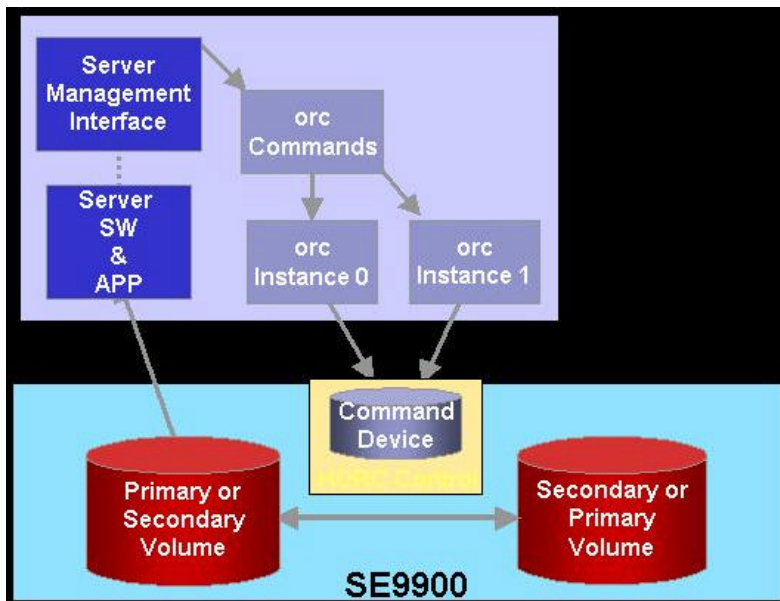
When using consistency groups, data integrity is insured over long distances:



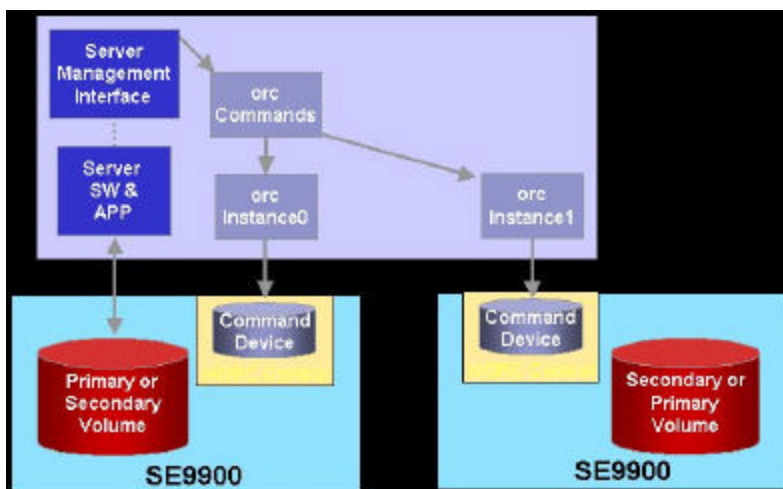
Synchronous copy can be achieved without extenders for distances less than 40Km:



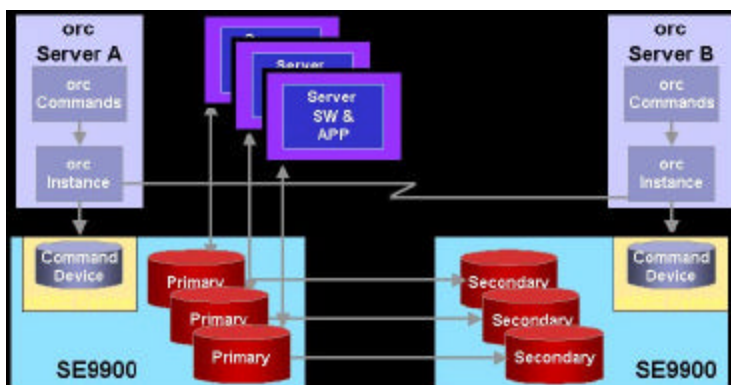
One server, one Sun StorEdge™ 9900 series system, and two open remote copy (orc) instances:



One server, two Sun StorEdge™ 9900 series systems, and two open remote copy instances:



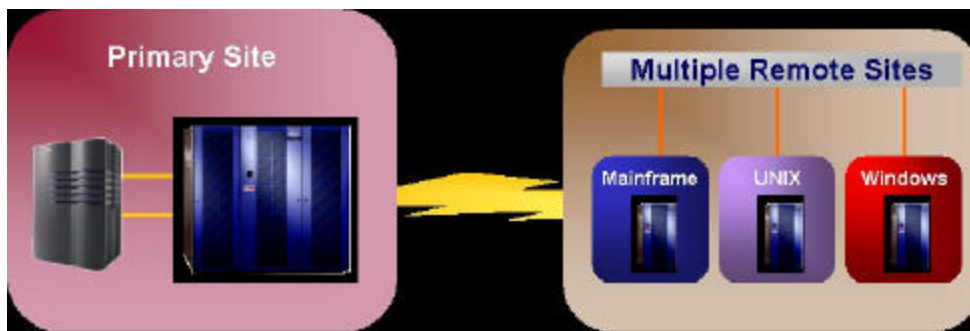
Two open remote copy servers controlling all open remote copy:



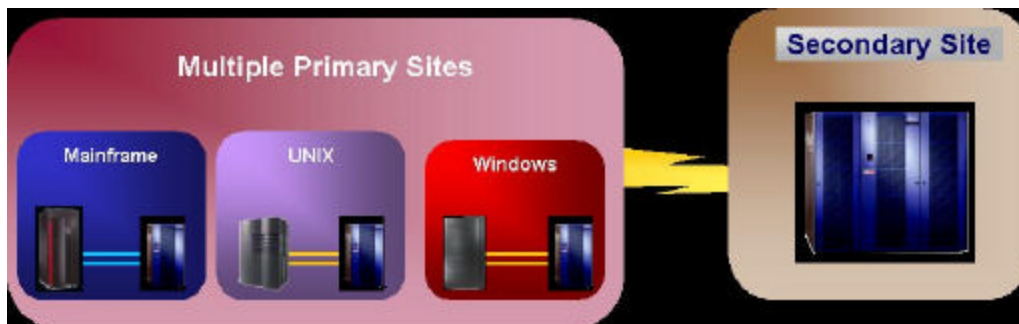
With the Sun StorEdge™ 9960 system, data can be replicated from a single primary site to a single remote site:



With a combination of Sun StorEdge™ 9960 systems and Sun StorEdge™ 9910 systems, data can be replicated from a single primary site to a several remote sites:



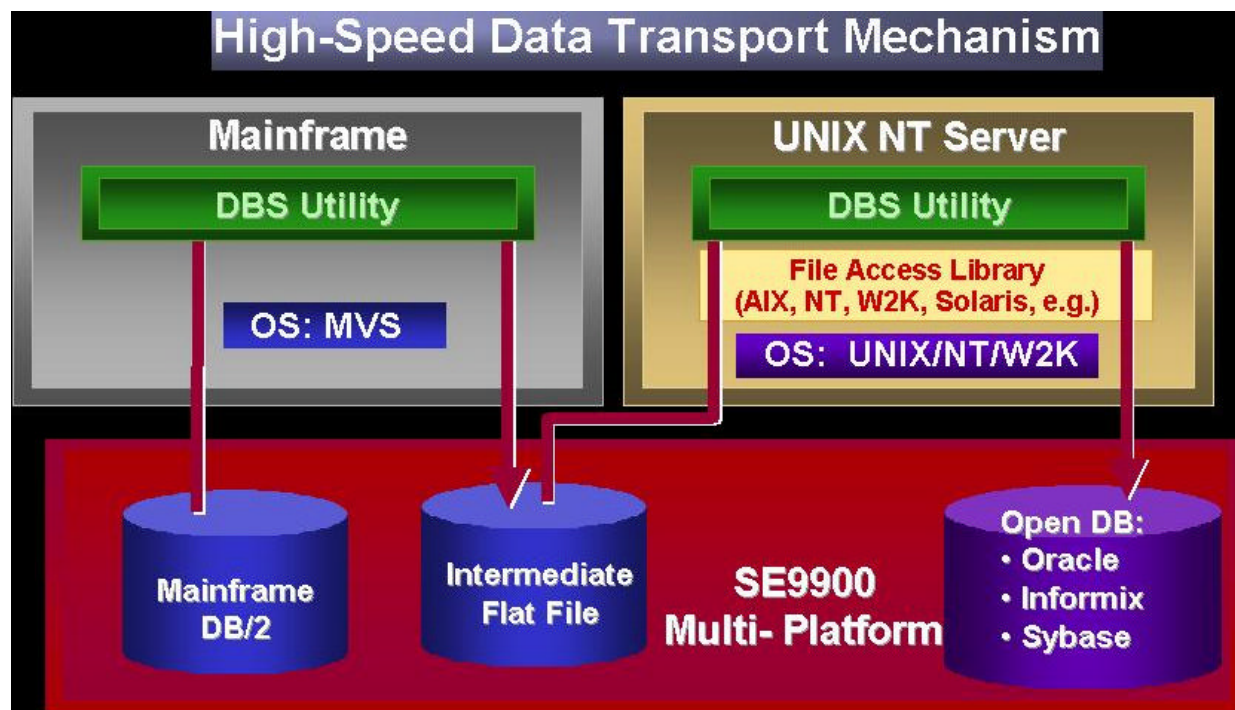
With a combination of Sun StorEdge™ 9960 systems and Sun StorEdge™ 9910 systems, data can be replicated from a several primary sites to a single remote site:



SUN STOREDGE™ 9900 RAPIDXCHANGE SOFTWARE

Shares or moves data between multiple disparate heterogeneous open and mainframe host applications. Delivers high-performance, high-reliability data exchange on a LOGICAL VOLUME level between multiple disparate heterogeneous host platforms. High-speed information transfer is achieved without placing additional demands on the network infrastructure or tape transport equipment.

Transfers data between S/390 and open-system platforms using ExSA (ESCON) channels, which enables high-speed data transfer without requiring network communication links or tape. Data transfer is performed via the Sun StorEdge™ 9900 RapidXchange software which are shared devices appearing to the mainframe host as 3390-3 LVIs and to the open-system host as OPEN-3 LUNs. To help provide the greatest platform flexibility for data transfer, these volumes are accessed using SCSI raw device mode.

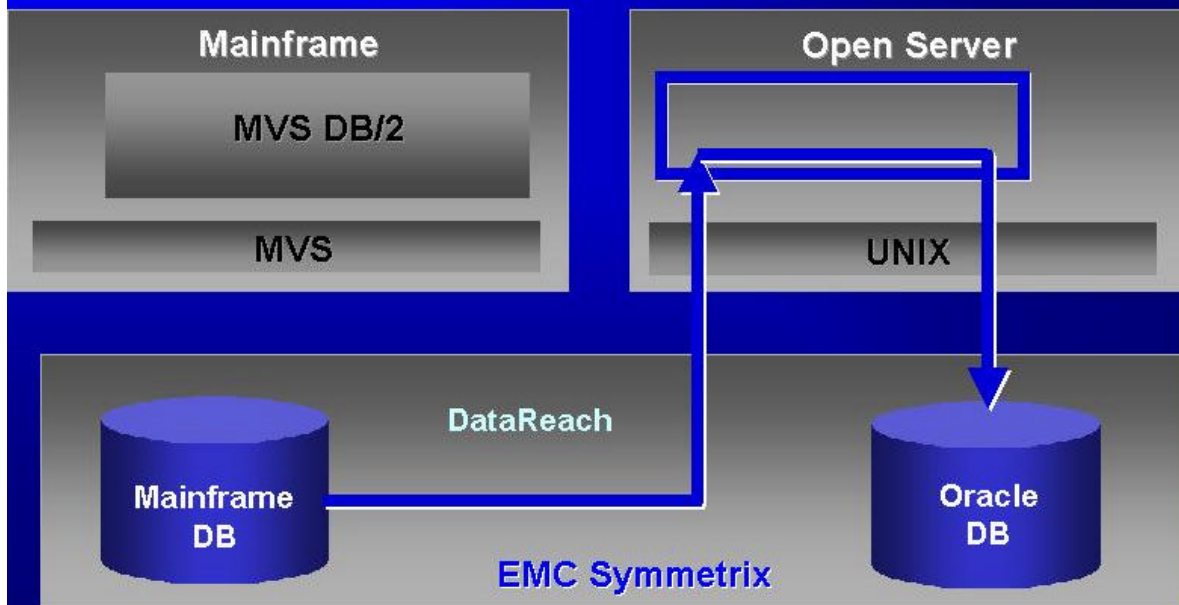


Sun StorEdge™ 9900 RapidXchange software allows the open-system host to read from and write to S/390 sequential datasets using the Sun StorEdge™ 9900 RapidXchange software volumes. The Sun StorEdge™ 9900 RapidXchange software volumes must be formatted as 3390-3A/B/C or 3380-KA/B/C LVIs. The -B LVIs are used for mainframe-to-open Sun StorEdge™ 9900 RapidXchange software, and the -A LVIs can be used for open-to-mainframe and/or mainframe-to-open Sun StorEdge™ 9900 RapidXchange software.

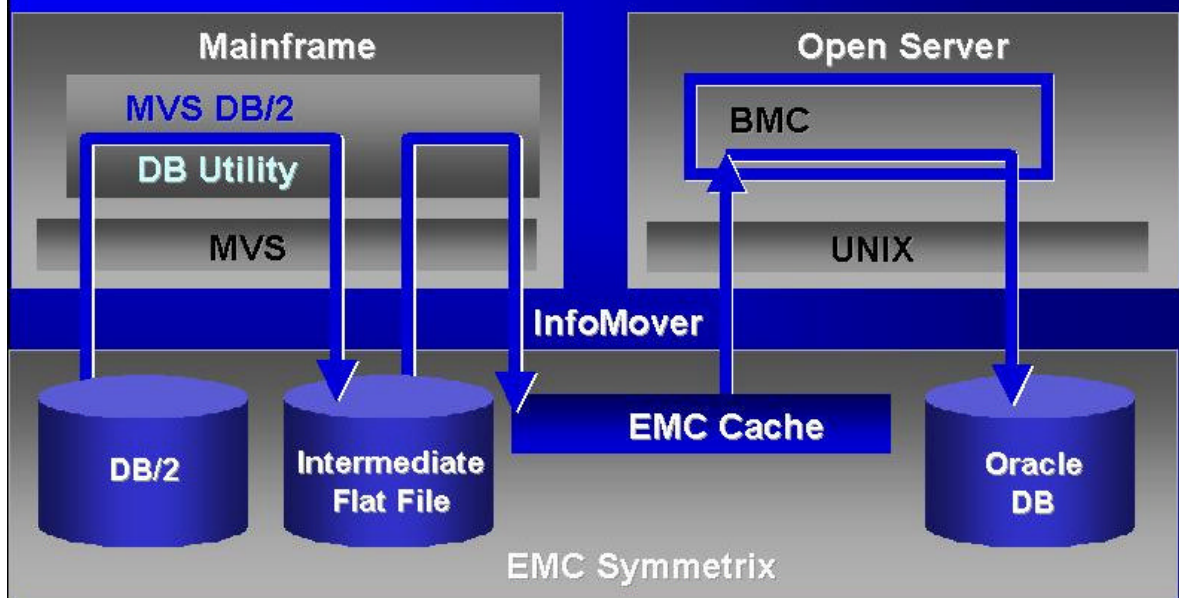
The open-system host can read from and write to individual S/390 datasets. The Sun StorEdge™ 9900 RapidXchange software is installed on the open-system host and includes the File Conversion Utility (FCU) and the File Access Library (FAL). FCU is a GUI which allows the user to set up and perform file conversion operations between S/390 sequential datasets and open-system flat files. The FAL is a library of C-language functions which allows UNIX® or Windows NT programmers to read from and write to S/390 sequential datasets on the Sun StorEdge™ 9900 RapidXchange software volumes.

By contrast, let's take a quick look at EMC DataReach and EMC InfoMover:

- 1. DB/2 database must be off line and all DB/2 application must be stopped
- 2. Bypasses all MVS and DB/2 security and integrity safeguards



Cache is used, forcing administration of both data migration and the primary objective of handling user data:



Storage Management Software

SUN STOREDGE™ 9900 RESOURCE MANAGER

Sun StorEdge™ 9900 Resource Manager software suite is required for each Sun StorEdge™ 9960 and Sun StorEdge™ 9910 storage system and consists of five software programs:

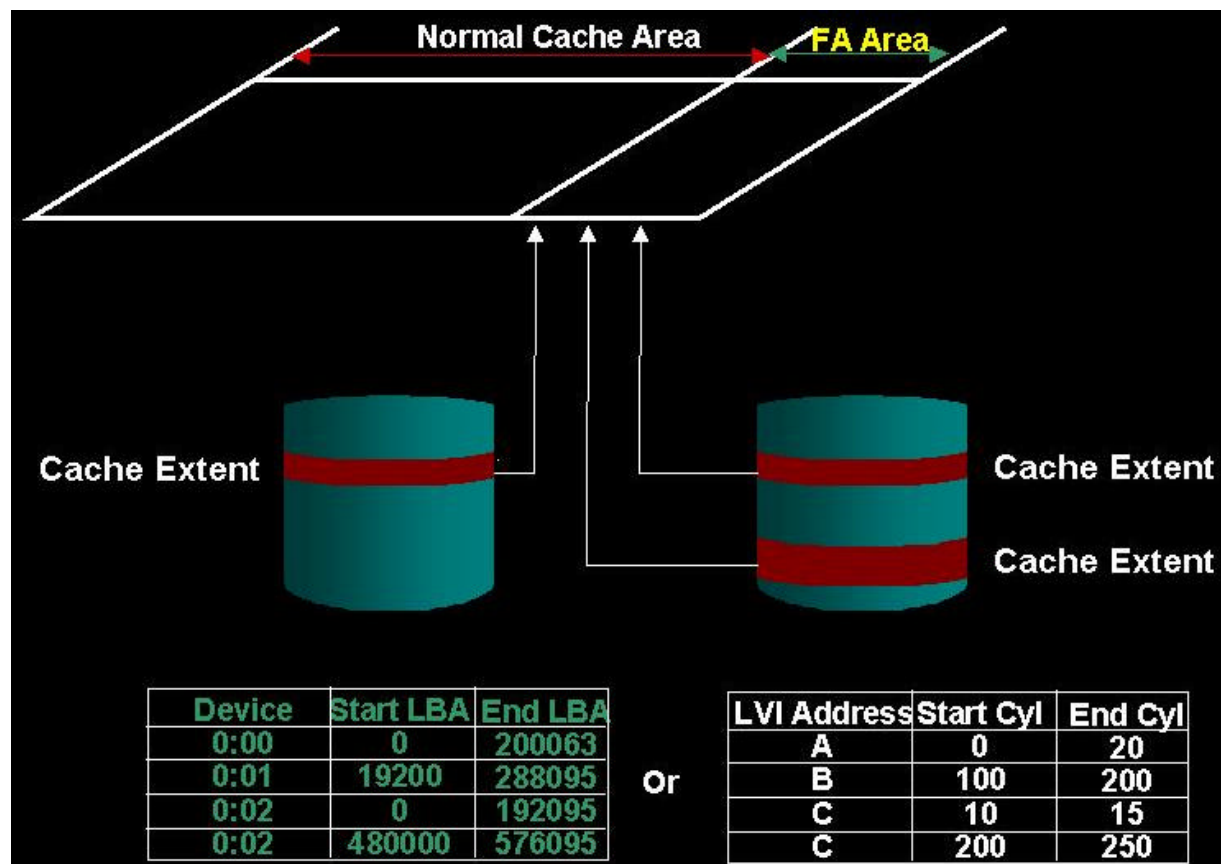
- Sun StorEdge™ 9900 FlashAccess Software
- Sun StorEdge™ 9900 Graph-Track Software
- Sun StorEdge™ 9900 LUN Manager Software
- Sun StorEdge™ 9900 Virtual Logical Volume Image Software
- Sun StorEdge™ 9900 Prioritized Port Control Software

The functions of these programs are described in detail below.

Sun StorEdge™ 9900 FlashAccess Software

Provides the ability to lock LUNs into cache for significantly enhanced performance. Part of the Sun StorEdge™ 9900 Resource Manager software suite.

This dynamic cache residence - or cache pinning – feature allows the system administrator to store specific data in cache memory, which thereby increases the data access speed for the cache-resident data by enabling read and write I/Os to be performed at host data transfer speeds.



The Sun StorEdge™ 9900 FlashAccess software cache areas (called cache extents) have the following parameters:

- Dynamic and can be added and deleted at any time.
- Sun StorEdge™ 9900 series support a maximum of 1024 addressable cache extents per LDEV, and up to 1,024 cache extents per system.
- Operations support both open volumes (OPEN-3/8/9/K/E) and mainframe volumes (3380-E/J/K, and 3390-1/2/3/3R/9). DCR will also support the use of LUSE and Virtual LVI/LUN volumes. Use in conjunction with Virtual LVI/LUN volumes will achieve better performance improvements than when either of these options is used individually.
- For mainframe volumes, cache extents must be defined on contiguous tracks, with a minimum size of one cache slot (or track) and a maximum size of one LDEV.
- If a user needs an entire mainframe volume in Sun StorEdge™ 9900 FlashAccess software, using a small Virtual LVI volume will use less cache.
- For open systems, cache extents must be defined in Logical Blocks using Logical Block Addresses (LBAs), with a minimum size of 96 LBAs. However, users will most likely assign the entire open system volume for Sun StorEdge™ 9900 FlashAccess software. To use less cache, the user may take advantage of the Virtual LUN option which allows the creation of small custom size volumes.
- The user has the option of pre-staging the data to the resident area. If pre-staging is not used, then the data will be loaded into cache when the first 'miss' occurs. If pre-staging is used, it may affect performance for a short time while reading the data into cache. Pre-staging should not be performed during peak activity.
- All write I/Os to Sun StorEdge™ 9900 FlashAccess software data are duplex writes, designed to provide full data integrity. The dynamic cache residence data remains fixed in cache until the user manually deletes it. Deletion of cache extents will de-stage any write data to the affected volume(s).

To initiate Sun StorEdge™ 9900 FlashAccess software, the user must first define to the hardware how much physical cache memory is available for Sun StorEdge™ 9900 FlashAccess software use. This cache memory is available for normal work until required by Sun StorEdge™ 9900 FlashAccess software to support a defined cache extent. A user defines a cache extent by LVI address and beginning/ending cylinder/head number (CCHH).

Sun StorEdge™ 9900 Graph-Track Software

Displays real-time or historical performance data in a Windows 98, Windows NT, or Windows 2000 PC attached to Sun StorEdge™ 9900 series. Part of the Sun StorEdge™ 9900 Resource Manager software suite.

Sun StorEdge™ 9900 Graph-Track software is the performance and usage monitoring utility for Sun StorEdge™ 9900 series systems. It runs on the remote console PC and can monitor as many as eight systems on the Sun StorEdge™ 9900 series-internal LAN. Sun StorEdge™ 9900 Graph-Track software monitors the hardware performance, cache usage, and I/O statistics of the attached systems and displays real-time and historical data as graphs highlighting key information such as peaks and trends. Sun StorEdge™ 9900 Graph-Track software displays the following data for each attached system:

- **System configuration.** Including controller name, serial number, controller emulation, channel address(s), cache size, SSIDs, and current duplex write line (DWL) status.

- **LDEV configuration.** Including total storage capacity and RAID implementation for each array domain; hard disk drive capacity; LDEV type (e.g., 3390-3R, OPEN-3); and LDEV IDs for each array group (also called parity group).
- **System usage.** Including percent busy versus time for the front-end microprocessors (called CHiPs) and back-end microprocessors (called ACPs).
- **Cache statistics.** Including amount of cache in use, and amount of write-pending data in cache.
- **I/O statistics.** At the system, array group, and logical device levels: I/O rates, read/write ratio, read hits and write hits, and backend transfer rates (drive-to-cache and cache-to-drive I/O rates).

In addition to displaying performance and usage data, Sun StorEdge™ 9900 Graph-Track software automatically manages the storage of the Sun StorEdge™ 9900 Graph-Track software data according to pre-defined user-specified preferences which allow the system administrator to perform the following important functions:

- Starting and stopping system and LDEV data collection for each system.
- Setting the Sun StorEdge™ 9900 Graph-Track software data sampling rate for each system (one, three, five, or fifteen minutes).
- Exporting Sun StorEdge™ 9900 Graph-Track software data for use in reports or in other data analysis programs.
- Purging (deleting) selected Sun StorEdge™ 9900 Graph-Track software data from the Sun StorEdge™ 9900 Graph-Track software database.
- Configuring the Sun StorEdge™ 9900 Graph-Track software database manager and automatic purge scheduler to control the contents and size of the Sun StorEdge™ 9900 Graph-Track software database.

Minimum hardware PC system requirements are 200MHz Pentium CPU; 32MB RAM; 20MB HD; VGA w/256 colors; 3.5-inch floppy; CD-ROM; Ethernet LAN card (3Com 3C509B); sound card & speaker (if R-SIM sound option used); Ethernet transceiver (AUI to BNC; Allied Telisis model AT-MX10 - If Sun StorEdge™ 9900 series is already on an internal Sun StorEdge™ 9900 series LAN, the transceiver is not required); Thinnet coaxial cable and two Thinnet BNC terminators - If the Sun StorEdge™ 9900 series is already on an internal Sun StorEdge™ 9900 series LAN, these are not required; two Thinnet BNC "T" connectors, female-male-female type - If the Sun StorEdge™ 9900 series is already on an internal Sun StorEdge™ 9900 series LAN, only one "T" connection is required; maximum total LAN cable length is 185m (607 feet); RMCMAIN (Remote Console) software install diskettes; RMCMAIN (Remote Console) and DKCMAIN (Disk Controller) software license keys for optional features.

Sun StorEdge™ 9900 LUN Manager Software

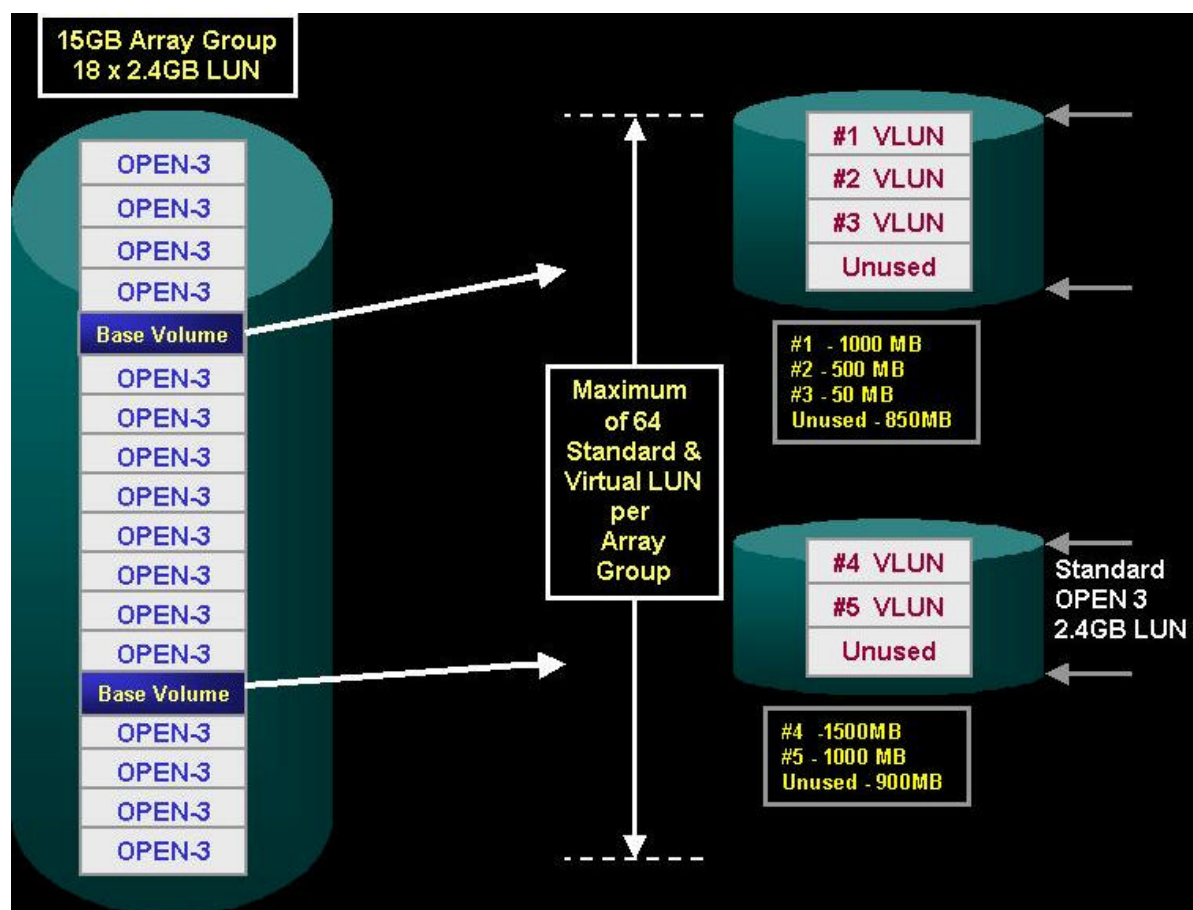
Provides the ability to manage multiple virtual LUNs. Allows the system administrator to define, configure, add, delete, resize, and assign LUNs to specific paths. Maintains open systems LUNs and can assign multiple paths to a single LUN. Part of the Sun StorEdge™ 9900 Resource Manager software suite.

Sun StorEdge™ 9900 Virtual Logical Volume Image Software

Permits users to configure logical volumes with capacities as small as a single cylinder and as large as a full 3390-9 image; volume size is determined in cylinder increments. Part of Sun StorEdge™ 9900 Resource Manager software suite (open systems) and the requisite mainframe kit (S/390).

Allows the user to convert fixed-size volumes into variable custom-sized volumes, which are created from one or more fixed-size volumes. Using the remote console PC, the user can configure custom-size volumes by assigning a logical address and a specific number of cylinders/tracks (S/390) or MB (open systems) to each custom LVI/LU.

Virtual LVI/LUN improves data access performance by reducing logical device contention as well as host I/O queue times, which can occur when several frequently accessed files are located on a single volume. Multiple LVI/LU types can be configured within each array group. Sun StorEdge™ 9900 Virtual Logical Volume Image software enables the user to more fully utilize the physical storage capacity of Sun StorEdge™ 9900 series systems, while reducing the amount of administrative effort required to balance I/O workloads. When used in conjunction with Sun StorEdge™ 9900 FlashAccess Software, the user can achieve even better data access performance than when either Sun StorEdge™ 9900 Virtual Logical Volume Image software or Sun StorEdge™ 9900 FlashAccess software is used alone.



Conceptual diagram of what VLVI can be used for. A user starts with a 9GB array group defined as 16 x -3 LVI. Two of the standard formatted LVI are converted to Base volume for use with VLVI. Each base volume is then carved up into smaller logical volume images based on the

user requirements. The first VLVI can maintain the same address as the base volume had or can be assigned any available address in the subsystem. Not all of the available from the base volume needs to be allocated. Additional VLVI's can be added non-disruptively without affecting the active ones.

WARNING: If a user chooses to delete a VLVI, ALL DATA ASSOCIATED WITH THAT LVI IS DELETED!

Sun StorEdge™ 9900 Prioritized Port Control Software

Allows administrators to set a higher priority which helps to enable faster access for production servers as opposed to development servers, e.g. Priority is assigned by port. Part of the Sun StorEdge™ 9900 Resource Manager software suite.

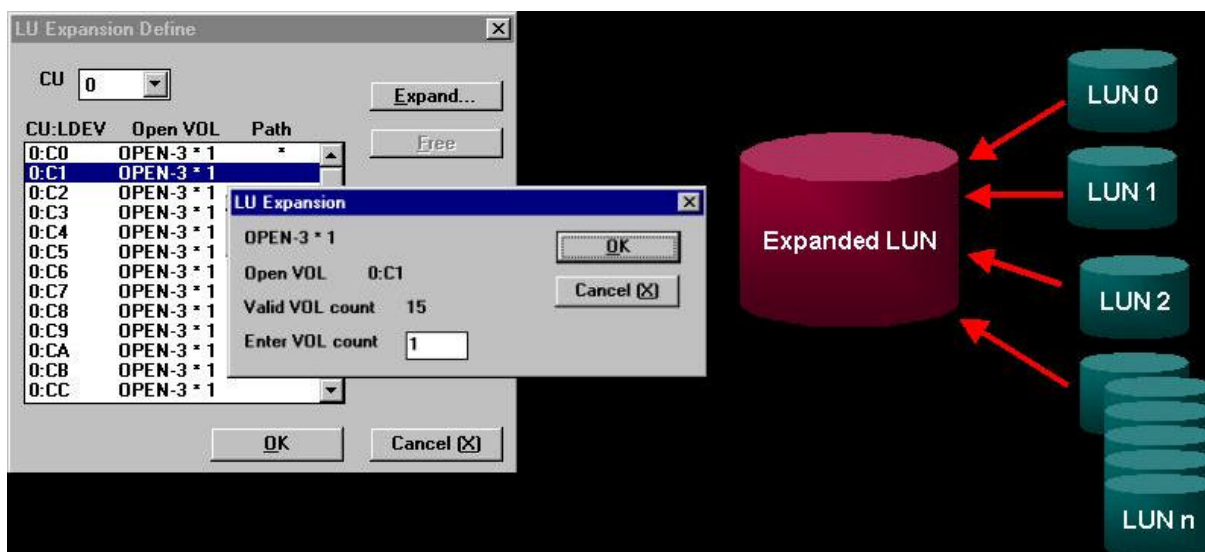
Sun StorEdge™ 9900 Parallel Access Volumes Software

Enables multiple applications running on an S/390 server to simultaneously access the same data set. Multiple Allegiance (MA) extends this concept to applications running on different S/390 servers. Together, PAV and MA reduce queuing, which results in significantly reduced batch times and lightning-fast response times in high-transaction environments. (S/390 only)

Sun StorEdge™ 9900 LUN Size Expansion Software

Dynamic LUN creation/expansion. Part of the Sun StorEdge™ 9900 Resource Manager software suite.

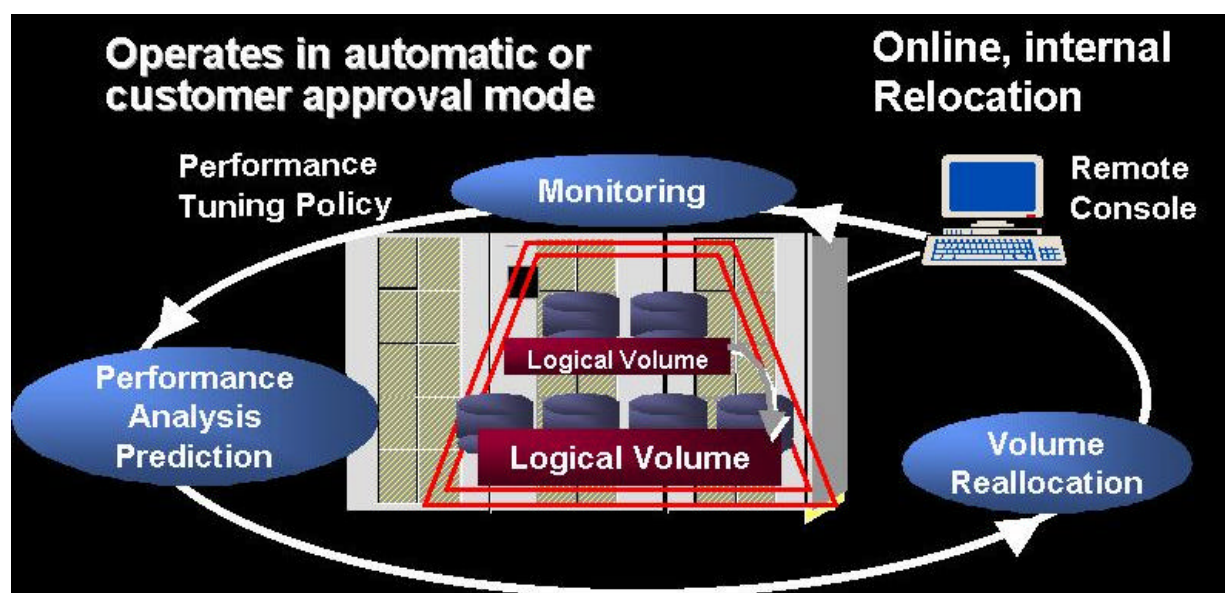
Allows users to create virtual LUs larger than standard OPEN LUs by expanding the size of a selected LU **up to 36 times** its normal size. The maximum size depends on the type of configuration. For example, you can expand an OPEN-9 LU to a maximum size of 265 GB (7.3 GB x 36). This capability helps enable open-system hosts to access the data on the entire Sun StorEdge™ 9900 series system using fewer logical units. **LUSE allows those host operating systems with restrictions on the number of LUNs per interface to access larger amounts of data.**



Sun StorEdge™ 9900 CruiseControl Software

Monitors, analyzes, and automatically performance tunes (or recommends tuning options to the administrator) the Sun StorEdge™ 9900 series; moves logical volumes to help eliminate "hot-spots," provides load balancing, and maintains predetermined performance levels.

Helps enable optimized data storage & retrieval. Analyzes detailed usage information on Sun StorEdge™ 9900 series resources and automatically tunes the Sun StorEdge™ 9900 series by migrating logical volumes within the Sun StorEdge™ 9900 series according to detailed user-specified parameters. Resolves bottlenecks of activity and optimizes volume allocation. Operation is completely non-disruptive: data being migrated remains online to all hosts for read and write I/O operations throughout the entire volume migration process. Also supports manual volume migration operations and can estimate performance improvements prior to migration to assist the administrator tuning the Sun StorEdge™ 9900 series for a particular environment.



Sun StorEdge™ 9900 CruiseControl software provides the following major benefits:

- Load balancing of system resources.** Balancing resource utilization can significantly improve system performance. The data provided by Sun StorEdge™ 9900 CruiseControl software helps enable the system administrator to optimize several areas of performance, including front-end and back-end processor usage as well as the allocation of logical volumes to physical drives and RAID level.
- Optimizing disk drive access patterns.** Collects and analyzes detailed information on disk drive access patterns and can migrate volumes to optimize host access to the data stored on the Sun StorEdge™ 9900 series system. For example, RAID 1+ technology may provide better performance than RAID 5 under certain operational conditions, and one disk drive type may provide better performance than another for certain types of access. Sun StorEdge™ 9900 CruiseControl software helps enable the user to fine-tune the logical volume allocation of the Sun StorEdge™ 9900 series system to optimize host access to data.

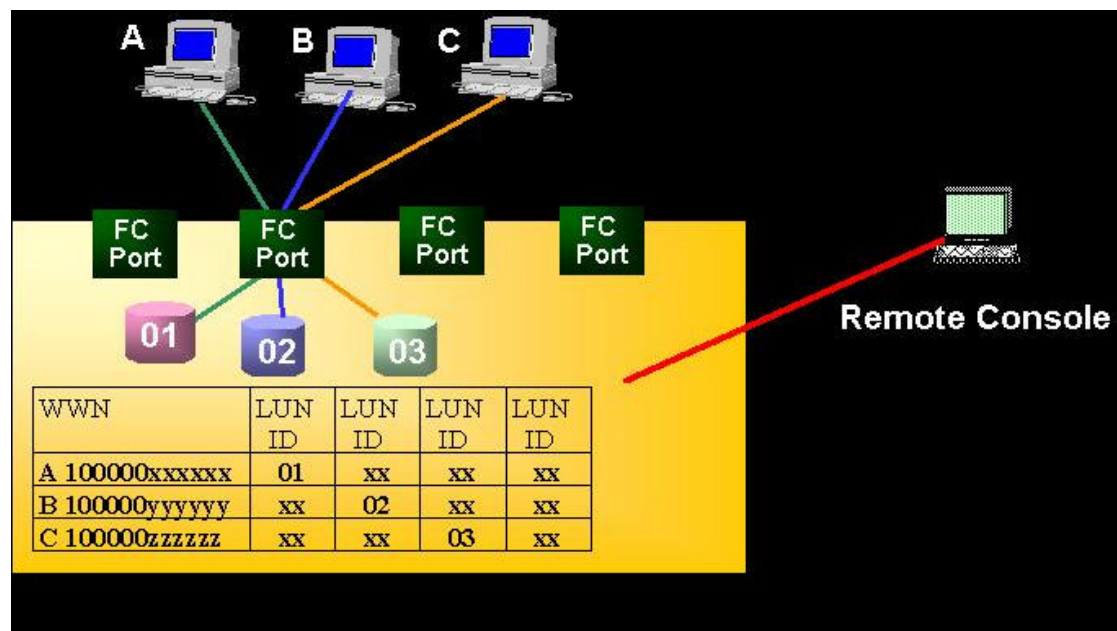
- Intelligent reallocation.** Operations take into account the RAID level and physical HDD performance of each parity group, helping to enable reallocation of logical volumes and optimization with respect to both RAID level and HDD type. The proper combination of RAID level and HDD type for the logical volumes can significantly improve system performance for a particular workload. In addition to RAID level and HDD type, tuning plans are also based on logical device usage, back-end path usage, and disk drive access patterns. Sun StorEdge™ 9900 CruiseControl software also applies detailed user-specified criteria, including maximum disk utilization for each class of installed HDD, the range of data, which parity drives will be included, and the schedule of automatic migration operations.

Sun StorEdge™ 9900 SAnTinel Software

Utilizing World Wide Names, controls host access to Sun StorEdge™ 9900 series LUNs in open systems, multi-platform SAN environments, helping to enable administrators to restrict server access to specific LUNs and protect data from unauthorized access.

Allows restricted LU accessibility to an open-systems host using open-systems host's World Wide Name (WWN). Set an LU to communicate only with one or more specified WWNs, allowing limited access to that LU to specified open-system host(s). Prevents other open-systems hosts from either seeing the secured LU or accessing the data contained on it. The LUN security software for remote console PC enables configuration.

LUN security can be activated on any installed fibre channel port, and be turned on or off at the port level. If the user disables LUN security on a particular port, that LU will not be restricted to a particular host or group of hosts; if the user enables LUN Security on a particular port, that port will be restricted to a particular host or group of hosts.



Users can assign a WWN to as many ports as they want and they can assign more than one WWN to each port. Users can also change the WWN access for any port without disrupting the settings of that port.

Because up to 128 WWNs can access each port and the same WWNs may go to additional ports within the same system, LUN security software allows users to create LU and WWN

groups, so they can more easily manage the Sun StorEdge™ 9900 series system. An LU group allows users to assign specified LUs to a single group name. A WWN group allows users to assign up to 128 WWNs to a single group. A WWN group gives every host in the specified WWN group access to the specified LU or group of LUs.

ORDERING INFORMATION

Software Licenses

There are three categories for Sun StorEdge™ 9900 series software licenses:

1) Controller-Based Total Usable Capacity

One license required per controller frame. Licensed per the total usable capacity of the controller; licenses are purchased in 1TB total usable capacity increments. (Usable capacity is the total logical capacity of all logical devices being copied, adjusted for RAID architecture specific factors - i.e., RAID 5 or RAID 1+).

- Sun StorEdge™ 9900 Extended Remote Copy Software and Sun StorEdge™ 9900 TrueCopy Software
 - Usable capacity includes the capacities of the main volumes (M-VOLs) and remote volumes (R-VOLs) residing within a controller frame. Any secondary controller frame or frames housing the related R-VOLs and/or M-VOLs within the logical volume pairs must also be licensed
- Sun StorEdge™ 9900 ShadowImage Software
 - Usable capacity includes only the capacities of the source volumes; the capacity of the target volumes is ignored

2) Controller-Based Total Raw Capacity

One license required per controller frame. Licensed per the total raw capacity of the controller; licenses are purchased in 1TB total raw capacity increments.

Raw (or physical) capacity is the total unformatted capacities of all the disk drives in all the array groups in the system – including (pre-V05 microcode) / excluding (V05 microcode and later) – hot spares. Each array group contains four drives; drives have nominal (actual) capacities of 18GB (18.463 GB) and 72GB (72.914 GB). All drives in an array group must have the same capacity.

- Sun StorEdge™ 9900 Resource Manager Software Suite (includes Sun StorEdge™ 9900 FlashAccess Software; Sun StorEdge™ 9900 Graph-Track Software; Sun StorEdge™ 9900 LUN Manager Software; Sun StorEdge™ 9900 Virtual Logical Volume Image; Sun StorEdge™ 9900 Prioritized Port Control Software; Sun StorEdge™ 9900 LUN Size Expansion)
- Sun StorEdge™ 9900 CruiseControl Software
- Sun StorEdge™ 9900 SANtinel Software
- Sun StorEdge™ 9900 Parallel Access Volumes
- Sun StorEdge™ 9900 Multi-Platform Backup/Restore Software

3) Server or Operating System-Based

Licensing is capacity-independent. (Capacity-independent indicates the software license is not related to the storage capacity of the system; also, the processing capacity of the servers is irrelevant.)

- Sun StorEdge™ 9900 RapidXchange Software (One license required per host server running the software. Purchased on the number of servers which will be running the software.)
- Sun StorEdge™ 9900 Dynamic Link Manager Software (One license per operating system. Purchased on the number of operating systems per system which will be running the software. So, for example, a single Sun StorEdge 9900 series system attached to, say, ten WNT servers

and ten Sun Solaris servers would be required to purchase two Sun StorEdge 9900 Dynamic Link Manager Software licenses. Or, two Sun StorEdge 9900 series systems, each attached to, say, five WNT servers and five Sun Solaris servers - same total servers as in the prior example - would be required to purchase four Sun StorEdge 9900 Dynamic Link Manager Software licenses.)

Controller-Based		Server-Based	OS-Based
Total Raw Capacity	Total Usable Capacity	Number of Hosts	Number of Host OS
One license required per controller frame. Licensed per the total raw capacity of the controller; licenses are purchased in 1TB total raw capacity increments:	One license required per controller frame. Licensed per the total usable capacity of the controller; licenses are purchased in 1TB total usable capacity increments:	Licensing is capacity-independent. One license required per host server running the SW. Purchased on the number of servers which will be running the SW.	Capacity-independent. System lic., 1 lic./op. sys; e.g., a system w/ 10 Solaris servers must purchase 1 lic. Purchased on the # of OS per system which will be running the SW.
Sun StorEdge 9900 Multi-Platform Backup/Restore	Sun StorEdge 9900 Extended Remote Copy	Sun StorEdge 9900 RapidXchange	Sun StorEdge 9900 Dynamic Link Manager
Sun StorEdge 9900 CruiseControl	Sun StorEdge 9900 TrueCopy		
Sun StorEdge 9900 SAnTinel	Sun StorEdge 9900 ShadowImage		
Sun StorEdge 9900 Parallel Access Volumes			
Sun StorEdge 9900 Resource Manager			
Includes: Sun StorEdge 9900 FlashAccess; Sun StorEdge 9900 GraphTrack; Sun StorEdge 9900 LUN Manager; Sun StorEdge 9900 Virtual Logical Volume Image; Sun StorEdge 9900 Prioritized Port Control; Sun StorEdge 9900 LUN Size Expansion			

For all Sun StorEdge™ 9900 series controller-based software, each Sun StorEdge™ 9900 software license is priced by the TB; the more TB purchased, the less the price per TB moving up the TB hierarchy; licensing is tiered and purchased in the aggregate.

Here are some examples to illustrate this:

- For 3TB: (1 x 1TB Lic.) + (2 x 2-3TB Lic.)
- For 5TB: (1 x 1TB Lic.) + (2 x 2-3TB Lic.) + (2 x 4-7TB Lic.)
- For 6TB: (1 x 1TB Lic.) + (2 x 2-3TB Lic.) + (3 x 4-7TB Lic.)
- For 7TB: (1 x 1TB Lic.) + (2 x 2-3TB Lic.) + (4 x 4-7TB Lic.)
- For 8TB: (1 x 1TB Lic.) + (2 x 2-3TB Lic.) + (4 x 4-7TB Lic.) + (1 x 8-15TB Lic.)
- For 16TB: (1 x 1TB Lic.) + (2 x 2-3TB Lic.) + (4 x 4-7TB Lic.) + (8 x 8-15TB Lic.) + (1 x 16-31TB Lic.)

NOTE: When purchasing Sun StorEdge™ 9900 series controller-based software licenses, always round up to the nearest TB; so, for example, 5.2TB = 6TB for software licensing purposes.

Software License and Maintenance Part Numbers

The following software maintenance part numbers (far right column) match up to the software license part numbers (middle column):

Software Product Description	Product - Marketing Part#	ES - Marketing Part# (Mo. Maint.)
Sun StorEdge™ 9900 TrueCopy Software Base Lic.	XT8-044-100242-01	XT8-100242-01
Sun StorEdge™ 9900 TrueCopy Software 1TB Lic.	XT8-044-100235-01A	XT8-100235-01A
Sun StorEdge™ 9900 TrueCopy Software 2-3TB Lic.	XT8-044-100236-01B	XT8-100236-01B
Sun StorEdge™ 9900 TrueCopy Software 4-7TB Lic.	XT8-044-100237-01C	XT8-100237-01C
Sun StorEdge™ 9900 TrueCopy Software 8-15TB Lic.	XT8-044-100238-01D	XT8-100238-01D
Sun StorEdge™ 9900 TrueCopy Software 16-31TB Lic.	XT8-044-100239-01E	XT8-100239-01E
Sun StorEdge™ 9900 TrueCopy Software 32-63TB Lic.	XT8-044-100240-01F	XT8-100240-01F
Sun StorEdge™ 9900 TrueCopy Software Trial License	XT8-044-100241-01	XT8-100241-01
Sun StorEdge™ 9900 ShadowImage Software Base	XT8-044-100034-01	XT8-100034-01
Sun StorEdge™ 9900 ShadowImage Software 1TB Lic.	XT8-044-100203-01A	XT8-100203-01A
Sun StorEdge™ 9900 ShadowImage Software 2-3TB Lic.	XT8-044-100204-01B	XT8-100204-01B
Sun StorEdge™ 9900 ShadowImage Software 4-7TB Lic.	XT8-044-100205-01C	XT8-100205-01C
Sun StorEdge™ 9900 ShadowImage Software 8-15TB Lic.	XT8-044-100206-01D	XT8-100206-01D
Sun StorEdge™ 9900 ShadowImage Software 16-31TB Lic.	XT8-044-100207-01E	XT8-100207-01E
Sun StorEdge™ 9900 ShadowImage Software 32-63TB Lic.	XT8-044-100208-01F	XT8-100208-01F
Sun StorEdge™ 9900 ShadowImage Software Trial License	XT8-044-100145-01	XT8-100145-01
Sun StorEdge™ 9900 Resource Manager Software Base	XT8-044-100040-01	XT8-100040-01
Sun StorEdge™ 9900 Resource Manager Software 1TB Lic.	XT8-044-100209-01A	XT8-100209-01A
Sun StorEdge™ 9900 Resource Manager Software 2-3TB Lic.	XT8-044-100210-01B	XT8-100210-01B
Sun StorEdge™ 9900 Resource Manager Software 4-7TB Lic.	XT8-044-100211-01C	XT8-100211-01C
Sun StorEdge™ 9900 Resource Manager Software 8-15TB Lic.	XT8-044-100212-01D	XT8-100212-01D
Sun StorEdge™ 9900 Resource Manager Software 16-31TB Lic.	XT8-044-100213-01E	XT8-100213-01E
Sun StorEdge™ 9900 Resource Manager Software 32-63TB Lic.	XT8-044-100214-01F	XT8-100214-01F
Sun StorEdge™ 9900 Resource Manager Software Trial License	XT8-044-100132-01	XT8-100132-01
Sun StorEdge™ 9900 SANtinel Software Base	XT8-044-100250-01	XT8-100250-01
Sun StorEdge™ 9900 SANtinel Software 1TB Lic.	XT8-044-100243-01A	XT8-100243-01A
Sun StorEdge™ 9900 SANtinel Software 2-3TB Lic.	XT8-044-100244-01B	XT8-100244-01B
Sun StorEdge™ 9900 SANtinel Software 4-7TB Lic.	XT8-044-100245-01C	XT8-100245-01C
Sun StorEdge™ 9900 SANtinel Software 8-15TB Lic.	XT8-044-100246-01D	XT8-100246-01D
Sun StorEdge™ 9900 SANtinel Software 16-31TB Lic.	XT8-044-100247-01E	XT8-100247-01E
Sun StorEdge™ 9900 SANtinel Software 32-63TB Lic.	XT8-044-100248-01F	XT8-100248-01F
Sun StorEdge™ 9900 SANtinel Software Trial License	XT8-044-100249-01	XT8-100249-01

Software Product Description	Product - Marketing Part#	ES - Marketing Part# (Mo. Maint.)
Sun StorEdge™ 9900 CruiseControl Software Base	XT8-044-100269-01	XT8-100269-01
Sun StorEdge™ 9900 CruiseControl Software 1TB Lic.	XT8-044-100262-01A	XT8-100262-01A
Sun StorEdge™ 9900 CruiseControl Software 2-3TB Lic.	XT8-044-100263-01B	XT8-100263-01B
Sun StorEdge™ 9900 CruiseControl Software 4-7TB Lic.	XT8-044-100264-01C	XT8-100264-01C
Sun StorEdge™ 9900 CruiseControl Software 8-15TB Lic.	XT8-044-100265-01D	XT8-100265-01D
Sun StorEdge™ 9900 CruiseControl Software 16-31TB Lic.	XT8-044-100266-01E	XT8-100266-01E
Sun StorEdge™ 9900 CruiseControl Software 32-63TB Lic.	XT8-044-100267-01F	XT8-100267-01F
Sun StorEdge™ 9900 CruiseControl Software Trial License	XT8-044-100268-01	XT8-100268-01
Sun StorEdge™ 9900 Multi-Platform Backup and Restore Software Base	XT8-044-100078-01	XT8-100078-01
Sun StorEdge™ 9900 Multi-Platform Backup and Restore Software 1TB Lic.	XT8-044-100227-01A	XT8-100227-01A
Sun StorEdge™ 9900 Multi-Platform Backup and Restore Software 2-3TB Lic.	XT8-044-100228-01B	XT8-100228-01B
Sun StorEdge™ 9900 Multi-Platform Backup and Restore Software 4-7TB Lic.	XT8-044-100229-01C	XT8-100229-01C
Sun StorEdge™ 9900 Multi-Platform Backup and Restore Software 8-15TB Lic.	XT8-044-100230-01D	XT8-100230-01D
Sun StorEdge™ 9900 Multi-Platform Backup and Restore Software 16-31TB Lic.	XT8-044-100231-01E	XT8-100231-01E
Sun StorEdge™ 9900 Multi-Platform Backup and Restore Software 32-63TB Lic.	XT8-044-100232-01F	XT8-100232-01F
Sun StorEdge™ 9900 Multi-Platform Backup and Restore Software Trial License	XT8-044-100113-01	XT8-100113-01
Sun StorEdge™ 9900 Extended Remote Copy Software Base	XT8-044-100233-01	XT8-100233-01
Sun StorEdge™ 9900 Extended Remote Copy Software 1TB Lic.	XT8-044-100197-01A	XT8-100197-01A
Sun StorEdge™ 9900 Extended Remote Copy Software 2-3TB Lic.	XT8-044-100198-01B	XT8-100198-01B
Sun StorEdge™ 9900 Extended Remote Copy Software 4-7TB Lic.	XT8-044-100199-01C	XT8-100199-01C
Sun StorEdge™ 9900 Extended Remote Copy Software 8-15TB Lic.	XT8-044-100200-01D	XT8-100200-01D
Sun StorEdge™ 9900 Extended Remote Copy Software 16-31TB Lic.	XT8-044-100201-01E	XT8-100201-01E
Sun StorEdge™ 9900 Extended Remote Copy Software 32-63TB Lic.	XT8-044-100202-01F	XT8-100202-01F
Sun StorEdge™ 9900 Dynamic Link Manager Software for Solaris	XT8-044-100275-01	XT8-100275-01
Sun StorEdge™ 9900 Dynamic Link Manager Software for Win NT/W2K	XT8-044-100273-01	XT8-100273-01
Sun StorEdge™ 9900 Dynamic Link Manager Software for HP-UX	XT8-044-100276-01	XT8-100276-01
Sun StorEdge™ 9900 Dynamic Link Manager Software for AIX	XT8-044-100274-01	XT8-100274-01
Sun StorEdge™ 9900 PCAnywhere CD ROM	T8-IP1000-2CD	T8-IP1000-2CD
Sun StorEdge™ 9900 Hi-Track SW Diskette	T8-IP0810	T8-IP0810
Sun StorEdge™ 9900 Microcode Kit	T8-041-100034-01	T8-MC100034-01
Brocade Web Tools Software	XT8-SW200007-02	XT8-200007-02
Brocade Quickloop Software	XT8-SW200008-02	XT8-200008-02
Brocade Fabric Watch	XT8-SW228001-01	XT8-228001-01
Sun StorEdge™ 9900 RapidXchange Software Base License	XT8-044-100234-01	XT8-100234-01
Sun StorEdge™ 9900 RapidXchange Software Trial License	XT8-044-100260-01	XT8-100260-01

Software Product Description	Product - Marketing Part#	ES - Marketing Part# (Mo. Maint.)
Mainframe Connection Lic Kit	XT8-044-100289-01	XT8-100289-01
Sun StorEdge™ 9900 Parallel Access Volumes Software 1TB Lic.	XT8-044-100251-01A	TBD
Sun StorEdge™ 9900 Parallel Access Volumes Software 2-3TB Lic.	XT8-044-100252-01B	TBD
Sun StorEdge™ 9900 Parallel Access Volumes Software 4-7TB Lic.	XT8-044-100253-01C	TBD
Sun StorEdge™ 9900 Parallel Access Volumes Software 8-15TB Lic.	XT8-044-100254-01D	TBD
Sun StorEdge™ 9900 Parallel Access Volumes Software 16-31TB Lic.	XT8-044-100255-01E	TBD
Sun StorEdge™ 9900 Parallel Access Volumes Software 32- 63TB Lic.	XT8-044-100256-01F	TBD
Sun StorEdge™ 9900 Parallel Access Volumes Software Base Lic	XT8-044-100258-01	TBD
Sun StorEdge™ 9900 Parallel Access Volumes Software Trial Lic	XT8-044-100257-01	TBD
Sun StorEdge™ 9900 Product Documentation Library	XT8-041-100029-01	XT8-100029-01

Shipping Configurations

The Sun StorEdge™ 9900 series product is a "configure to order" product. Both the Sun StorEdge™ 9960 system and the Sun StorEdge™ 9910 system consist of a listing of components which, when configured by a configuration tool, create a Sun StorEdge™ 9900 series product.

Due to the timing and complexity of the StorEdge™ 9900 series product, the Sun WebDesk configuration tool will not be available with the StorEdge™ 9900 series product for an extended period of time. During the interim time period, a separate configuration tool, unique to the SE9000 series products, has been developed. This tool is currently available through your local Storage TE, initially on a limited basis, and expanding as additional user seats become available. Please refer to the GNSS web site for any updates regarding expanded configuration tool availability.

Please refer to the switch compatibility matrix, found in this document and on the GNSS website. Please note Sun will only support and warrant 8-port and 16-port Brocade switches at this time when they are purchased in redundant configuration to help ensure system availability and to avoid voiding the system warranty.

SUN STOREDGE™ 9910 SYSTEM

A Sun StorEdge™ 9910 system consists of a combined disk controller (DKC) and DKU. The DKU consists of four Hard Disk Units (HDUs), each of which holds 12 drives for a total disk drive capacity of 48 drives.

A fully configured Sun StorEdge™ 9910 system consists of 16GB cache, 1.5GB control memory, four array control processor pairs, two cache board pairs, 24 channel ports (FC, ESCON, or FC/ESCON host connections), and 48 x 72GB drives (11 array groups with four global hot spares) concurrently running up to 4,096 logical volumes.

Power: For the Sun StorEdge™ 9910 system, only single phase power is available.

NOTE

There are two kits for the Sun StorEdge SE9910 system:

- DKC-F415I-1UC.P (USA single phase)
- DKC-F415I-1EC.P (Europe single phase)

The connector for these power kits is either 60Hz or 50Hz. The 60Hz kit (for US, Canada, some Latin America Countries) has a Russel & Stoll crimp tag attached; the 50Hz kit (Europe, Japan, Brazil, etc.) has a bigger cable with no connector because there's no common standard for connectors.

SUN STOREDGE™ 9960 SYSTEM

A Sun StorEdge™ 9960 system consists of a disk control frame (DKC) and from one to six array frames (DKUs).

The control frame contains the array control processors, the cache memory, the switched cross-bar caching circuitry, the intelligent firmware (microcode), the control memory, the client-host interface processors, the service processor, power supplies, and the control panel.

An array frame contains the array groups which consist of four drives each, the drive platforms, power supplies, and cooling fans.

A fully configured Sun StorEdge™ 9960 system with one control frame and six array frames consists of 32GB cache, 1.5GB control memory, four array control processor pairs, two cache board pairs, 32 channel ports (FC, ESCON, or FC/ESCON host connections), and 512 x 72GB drives (126 array groups with eight global hot spares) concurrently running up to 4,096 logical volumes.

WARNING

AC POWER: For the Sun StorEdge™ 9960 system, it is mandatory to choose between single phase and 3-phase power; there is no default – if the AC power configuration is not indicated, no Sun StorEdge™ 9960 system can be ordered. This is because the Sun StorEdge™ 9960 systems are extremely difficult to field upgrade from one AC type to the other (due to the wiring differences of where power is drawn from, they are different boxes).

NOTE: There are four kits for the Sun StorEdge SE9960 system:

- DKU-F405I-1UC.P (USA single phase)
- DKU-F405I-1EC.P (Europe single phase)
- DKU-F405I-3UC.P (USA 3-phase)
- DKU-F405I-3EC.P (Europe 3-phase)

The connector for these power kits is either 60Hz or 50Hz. The 60Hz kit (for US, Canada, some Latin America Countries) has a Russel & Stoll crimp tag attached; the 50Hz kit (Europe, Japan, Brazil, etc.) has a bigger cable with no connector because there's no common standard for connectors.

The Base Sun StorEdge™ 9960 system Control Frame Includes:***One ACP Pair***

Configurator calls an ACP pair “Additional Disk Adapter” which is really two ACPs. There are four ACP pairs max. in a fully configured system.

A NOTE ON CONFIGURING FOR PERFORMANCE

To configure a Sun StorEdge™ 9960 system for maximum backend performance, use all four ACP pairs and all six array frames and spread the drives across the ACPs by evenly distributing them across the six array frames.

Ideally, load the frames with the maximum of HDDs to ensure you have enough backend to drive. However, if you are using a number of HDDs which will fit into two array frames or less, and you want to keep costs down, then still use four ACP pairs but use only two array frames, insuring one is on the right side, and the other is on the left side of the controller frame. With, say for example, 96 HDDs, that's still a high \$/MB, but at least it's the optimal balance between price and performance for that particular configuration.

Minimally, don't use less than 48 HDDs for a performance configuration with four ACP pairs and two array frames (one Right Frame and one Left Frame); even so, \$/MB is considerably higher than with fully configured frames. With anything less than 48 (say, for example, 24 HDDs), there would not be enough on the backend to drive it to the full bandwidth.

If your customer has hard raw TB capacity requirements which will remain under 3.5TB for at least a year, you may want to consider going with the Sun StorEdge™ 9910 system and receive great performance for less cost. Over 3.5TB raw capacity, go with the dual-frame Sun StorEdge™ 9960 system setup described above. (Don't forget - while the Sun StorEdge™ 9910 system cannot be expanded into an Sun StorEdge™ 9960 system, another Sun StorEdge™ 9910 system – or even a Sun StorEdge™ 9960 system – can always be dropped into the existing SAN at a later date, so there will be no loss of investment made on the original Sun StorEdge™ 9910 system. It may be practical to play “budget bingo” in this manner if there are stringent financial requirements which need to be met.

The end user should always, always be provided in full detail with the tradeoffs between bandwidth and cost, and, in the end, it should be the customer who makes the final, but informed, decision as to which system to buy.

One Cache Board Pair

Configurator calls a Cache Board Pair “Additional Cache Board” which is really two Cache Boards. There are two Cache Board Pairs max. in a fully configured system. Cache boards do NOT contain any cache memory, which must be ordered separately.

1GB Shared (Control) Memory

GB is the default.

A Base Sun StorEdge™ 9960 system Array Frame Includes:***One Platform for Canister Mount***

Holds 48 HDDs. There are two Canister Mount Platforms max. per array frame (12 max. in a fully configured system).

One Hot Spare HDD

The Configurator defaults the capacity of this HDD to match the largest HDD in the system. So, if a system is ordered with 18GB and 72GB HDDs, a 72GB HDD is used for the default host spare; if a system is ordered with all 72GB HDDs, a 72GB HDD is used for the default host

spare; or, if a system is ordered with all 18GB HDDs, a 18GB HDD is used for the default host spare.

NOTE: There are six Array Frames max. in a fully configured system.

WARRANTY UPGRADE PART NUMBERS

The following are the CORRECT warranty upgrade part numbers and pricing for the Sun StorEdge 9910 system and the Sun StorEdge 9960 system. They are NON-DISCOUNTABLE:

Part Number	Monthly	3-Year Term
W-T8_9910-3P	\$ 248	\$ 8,928
W-T8_9960-3P	\$ 411	\$14,796
W-T8_DGRP-3P	\$ 13	\$ 468

. . . They REPLACE the following which were previously communicated:

Part Number	Monthly	3-Year Term
W9D-T8_9910-3P	\$354	\$12,744
W9D-T8_9960-3P	\$587	\$21,132
W9D-T8_DGRP-3P	\$19	\$684

These changes were necessary because the W9D pricing structure was put on hold across ES.

Hardware Component SKUs

SUN STOREDGE 9960 SYSTEM

Sun StorEdge 9960 System			
Short Description	Long Description	Marketing Part #	Mfg. Part #
AC Box Kit for Single Phase	Single phase AC power supply necessary when Sun StorEdge 9960 System disk unit (DKU-405I) is used as a single phase disk controller.	T8-DKU-F405I-1PS	596-3189-01 370-4560-01
Pwr Cable Kit-Single Phase USA	AC power cable for USA. Necessary when single phase Sun StorEdge 9960 System disk unit is shipped to USA.	T8-DKU-F405I-1UC	596-3190-01 370-4561-01
Pwr Cable Kit-Single Phase Eur	AC power cable for Europe. Necessary when single phase Sun StorEdge 9960 System disk unit is shipped to Europe.	T8-DKU-F405I-1EC	596-3191-01 370-4562-01
Pwr Cable Kit-3 Phase mdl USA	AC power cable for USA. Necessary when 3 phase Sun StorEdge 9960 System disk unit is shipped to USA.	T8-DKU-F405I-3UC	596-3192-01 370-4563-01
Pwr Cable Kit-3 Phase mdl Eur	AC power cable for Europe. Necessary when 3 phase Sun StorEdge 9960 System disk unit is shipped to Europe.	T8-DKU-F405I-3EC	596-3193-01 370-4564-01
Platform for Canister Mount	Platform for Canister Mount. One set can be attached to Sun StorEdge 9960 System disk unit (DKU405I) and can contain the disk drive canisters.	XT8-DKU-F405I-B4	596-6095-01 370-4565-01
Platform for Canister Mount	Platform for Canister Mount. One set can be attached to Sun StorEdge 9960 System disk unit (DKU405I) and can contain the disk drive canisters.	T8-DKU-F405I-B4	596-3194-01 370-4565-01
SE9960 Disk array frame unit	Sun StorEdge 9960 System Disk array frame unit which can contain up to 96 disk drives. Includes one set of platform for cannister mounts for disk drive canisters. AC power cable and AC power supplier not included. Dimensions of frame : Height: 70.5", Width: 23.6" and Depth: 31.5"	T8-DKU405I-14	596-3195-01 370-4566-01
DEV I/F Cable 2 (DKU-DKU)	2 device interface cables for connecting disk unit to disk unit	XT8-DKU-F405I-EXC	595-6097-01 370-4567-01
DEV I/F Cable 2 (DKU-DKU)	2 device interface cables for connecting disk unit to disk unit (Sun StorEdge 9960 System)	T8-DKU-F405I-EXC	596-3196-01 370-4567-01
DEV I/F Cable 1 (DKC-L1 DKU)	16 device interface cables for connecting the disk controller to L1 disk unit.	XT8-DKC-F410I-L1C	595-6098-01 370-4568-01
DEV I/F Cable 1 (DKC-L1 DKU)	16 device interface cables for connecting the disk controller to L1 disk unit.	T8-DKC-F410I-L1C	596-3197-01 370-4568-01
AC Box Kit for 3 Phase	AC power for 3 phase, necessary when Sun StorEdge 9960 System disk unit (DKU-4050I) is used as 3 phase disk controller.	T8-DKU-F405I-3PS	596-3198-01 370-4569-01
Cache Memory Module (1024MB)	1024MB cache memory module that plugs into cache memory card to extend cache memory capacity. This is composed of 128Mbit DRAM. The cache memory is nonvolatile memory (power backed up by a battery for 48 hours) expandable from 1GB up to 32GB, and write data is duplicated so that data loss is not caused even when a failure of one component occurs in power supply or an interface card.	XT8-DKC-F410I-1024	595-6099-01 370-4570-01
Cache Memory Module (1024MB)	1024MB cache memory module that plugs into cache memory card to extend cache memory capacity. This is composed of 128Mbit DRAM. The cache memory is nonvolatile memory (power backed up by a battery for 48 hours) expandable from 1GB up to 32GB, and write data is duplicated so that data loss is not caused even when a failure of one component occurs in power supply or an interface card.	T8-DKC-F410I-1024	596-3199-01 370-4570-01
ESCON Cable 122M/400FT (Riser)	1 ESCON Cable (Prerequisite Mainframe Connection) 122M/400FT (Riser)	XT8-106734437	595-6101-01 370-4572-01
Fibre Cable for Tachyon -122m	1 Fibre Cable for Tachyon - 122m	XT8-JZ-050SS122	595-6103-01 370-4574-01
Fibre Cable for Tachyon - 61m	1 Fibre Cable for Tachyon - 61m	XT8-JZ-050SS061	595-6104-01 370-4575-01
Fibre Cable for Tachyon -31m	1 Fibre Cable for Tachyon - 31m	XT8-JZ-050SS031	595-6105-01 370-4576-01

Sun StorEdge 9960 System			
Short Description	Long Description	Marketing Part #	Mfg. Part #
Fibre Cable for Tachyon -13m	1 Fibre Cable for Tachyon - 13m	XT8-JZ-050SS013	595-6106-01 370-4577-01
Plenum Fibre Cable -100M	1 Plenum Fibre Cable for Tachyon, 100 Meters	XT8-JZ-050SS100PC	595-6107-01 370-4578-01
Plenum Fibre Cable - 50M	1 Plenum Fibre Cable for Tachyon, 50 Meters	XT8-JZ-050SS050PC	595-6108-01 370-4579-01
Plenum Fibre Cable -25M	1 Plenum Fibre Cable for Tachyon, 25 Meters	XT8-JZ-050SS025PC	595-6109-01 370-4580-01
Plenum Fibre Cable - 20M	1 Plenum Fibre Cable for Tachyon, 20 Meters	XT8-JZ-050SS020PC	595-6110-01 370-4581-01
Plenum Fibre Cable -15M	1 Plenum Fibre Cable for Tachyon, 15 Meters	XT8-JZ-050SS015PC	595-6111-01 370-4582-01
Plenum Fibre Cable -10M	1 Plenum Fibre Cable for Tachyon, 10 Meters	XT8-JZ-050SS010PC	595-6112-01 370-4583-01
Plenum Fibre Cable - 5M	1 Plenum Fibre Cable for Tachyon, 5 Meters	XT8-JZ-050SS005PC	595-6113-01 370-4584-01
Plenum Fibre Cable - 2M	1 Plenum Fibre Cable for Tachyon, 2 Meters	XT8-JZ-050SS002PC	595-6114-01 370-4585-01
ESCON Cable 13M/42.6FT (Rsr)	1 ESCON Cable 13M/42.6FT (Riser)	XT8-106734353	595-6115-01 370-4586-01
ESCON Cable 31M/101.7FT (Rsr)	1 ESCON Cable 31M/101.7FT (Riser)	XT8-106734379	595-6116-01 370-4587-01
ESCON Cbl 46M(RPQ)/151FT (Rsr)	1 ESCON Cable 46M(RPQ)/151FT (Riser)	XT8-106734387	595-6117-01 370-4588-01
ESCON Cable 61M/200FT (Rsr)	1 ESCON Cable 61M/200FT (Riser)	XT8-106734395	595-6118-01 370-4589-01
ESCON Cable 22M/72FT (Rsr)	1 ESCON Cable 22M/72FT (Riser)	XT8-106734361	595-6119-01 370-4590-01
SE9960 Additional Disk Adapter	Additional disk adapters for 8-path connection between Sun StorEdge 9960 System disk controller (DKC410I) and Sun StorEdge 9960 System disk unit (DKU405I)	XT8-DKC-F410I-100	595-6120-01 370-4591-01
SE9960 Additional Disk Adapter	Additional disk adapters for 8-path connection between Sun StorEdge 9960 System disk controller (DKC410I) and Sun StorEdge 9960 System disk unit (DKU405I)	T8-DKC-F410I-100	596-3200-01 370-4591-01
SE9960 Additional Cache Board	Attaches to the Sun StorEdge 9960 System disk controller (DKC410I). Includes two additional cache interface cards and two battery assemblies. Necessary for addition of cache capacity of more than 8GB or 16GB. This addition provides the optimum cache memory performance. (Standard on the Sun StorEdge 9960 System)	XT8-DKC-F410I-20	595-6122-01 370-4592-01
SE9960 Additional Cache Board	Attaches to the Sun StorEdge 9960 System disk controller (DKC410I). Includes two additional cache interface cards and two battery assemblies. Necessary for addition of cache capacity of more than 8GB or 16GB. This addition provides the optimum cache memory performance. (Standard on the Sun StorEdge 9960 System)	T8-DKC-F410I-20	596-3201-01 370-4592-01
Additional Power Supply	Additional power supply necessary for the addition of a 3rd channel adapter (interface card).	XT8-DKC-F410I-80	595-6123-01 370-4593-01
Additional Power Supply	Additional power supply necessary for the addition of a 3rd channel adapter (interface card).	T8-DKC-F410I-80	596-3202-01 370-4593-01
SE9900 PCAnywhere CD ROM	PCAnywhere CD ROM. Software function is to manage servers and provide helpdesk support remotely.	T8-IP1000-2CD	596-3252-01 370-4624-01
SE9900 Ethernet Thinnet Cable	Ethernet Thinnet Cable	T8-IP0809-100	596-3203-01 370-4594-01

Sun StorEdge 9960 System			
Short Description	Long Description	Marketing Part #	Mfg. Part #
SE9900 Hi-Track SW Diskette	Hi-Track Software Diskette: CD Rom containing software for remote support access. "Calls home" in event of a system incident requiring support intervention.	T8-IP0810	596-3253-01 370-4653-01
SE9900 Hi-Trk Ethernet Cnct Kt	Hi-Track Ethernet Connect Kit	T8-IP0806-1	596-3204-01 370-4595-01
SE9900 Hi-Track PCMCIA Mdm Kit	Hi-Track PCMCIA Modem Kit	T8-IP0807-4	596-3205-01 370-4596-01
SE9900 SNMP Support Kit	Consists of USB LAN port and 64MB flash memory card. Required to install the disk controller software / Simple Network Management Protocol (SNMP) Agent (P-242R-J4B41-E). Standard with Sun StorEdge 9960 System and Sun StorEdge 9910 System.	T8-DKC-F410I-SNMP	596-3254-01 370-4654-01
SE9900 Product Doc Library	SE9900 Product Documentation Library: CD ROM containing Sun StorEdge 9960 System and Sun StorEdge 9910 System hardware specifications.	XT8-041-100029-01	596-3206-01 370-4597-01
SE9900 Microcode Kit	SE9900 Microcode Kit consists of a CD ROM containing the functional software for the Sun StorEdge 9960 System and Sun StorEdge 9910 System.	T8-041-100034-01	596-3207-01 370-4598-01
4 HDD Canisters - 18GB	Four 18GB disk drive canisters to be mounted on Sun StorEdge 9960 System disk array frame unit (DKU405I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I)	XT8-DKU-F405I-18J4	595-6124-01 370-4599-01
4 HDD Canisters - 18GB	Four 18GB disk drive canisters to be mounted on Sun StorEdge 9960 System disk array frame unit (DKU405I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I)	T8-DKU-F405I-18J4	596-3208-01 370-4599-01
4 HDD Canisters - 73GB	Four 73GB disk drive canisters to be mounted on Sun StorEdge 9960 System disk array frame unit (DKU405I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I)	XT8-DKU-F405I-72J4	595-6125-01 370-4600-01
4 HDD Canisters - 73GB	Four 73GB disk drive canisters to be mounted on Sun StorEdge 9960 System disk array frame unit (DKU405I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I)	T8-DKU-F405I-72J4	596-3209-01 370-4600-01
1 HDD Canister - 18GB	One 18GB disk drive canister to be mounted on Sun StorEdge 9960 System disk array frame unit (DKU405I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I)	XT8-DKU-F405I-18J1	595-6126-01 370-4601-01
1 HDD Canister - 18GB	One 18GB disk drive canister to be mounted on Sun StorEdge 9960 System disk array frame unit (DKU405I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I)	T8-DKU-F405I-18J1	596-3210-01 370-4601-01
1 HDD Canister - 73GB	One 73GB disk drive canister to be mounted on Sun StorEdge 9960 System disk array frame unit (DKU405I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I)	XT8-DKU-F405I-72J1	595-6127-01 370-4602-01
1 HDD Canister - 73GB	One 73GB disk drive canister to be mounted on Sun StorEdge 9960 System disk array frame unit (DKU405I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I)	T8-DKU-F405I-72J1	596-3211-01 370-4602-01
Shared Memory Module (256MB)	256MB shared memory module that plugs into cache memory card to extend shared memory. This is composed of 128Mbit of DRAM. The shared memory is nonvolatile memory (power backed up by a battery for 7 days). Used to store cache directories and disk control information. Capacity of shared memory varies with the capacity of cache memory mounted and the storage capacity.	XT8-DKC-F410I-S256	595-6128-01 370-4603-01
Shared Memory Module (256MB)	256MB shared memory module that plugs into cache memory card to extend shared memory. This is composed of 128Mbit of DRAM. The shared memory is nonvolatile memory (power backed up by a battery for 7 days). Used to store cache directories and disk control information. Capacity of shared memory varies with the capacity of cache memory mounted and the storage capacity.	T8-DKC-F410I-S256	596-3212-01 370-4603-01

Sun StorEdge 9960 System			
Short Description	Long Description	Marketing Part #	Mfg. Part #
Serial 4-Port Adapter	This model is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides serial 2 port adapters for channel portion of both storage clusters (two ports for each storage cluster).	XT8-DKC-F410I-4S	595-6129-01 370-4604-01
Serial 4-Port Adapter	This model is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides serial 2 port adapters for channel portion of both storage clusters (two ports for each storage cluster).	T8-DKC-F410I-4S	596-3213-01 370-4604-01
Serial 8-Port Adapter	This model is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides serial 4 port adapters for channel portion of both storage clusters (four ports for each storage cluster).	XT8-DKC-F410I-8S	595-6130-01 370-4605-01
Serial 8-Port Adapter	This model is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides serial 4 port adapters for channel portion of both storage clusters (four ports for each storage cluster).	T8-DKC-F410I-8S	596-3214-01 370-4605-01
Fibre 4-Port Adapter for SWL	This adapter is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides Fibre 2-port adapters with short wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (two ports for each storage cluster). Optical interfaces are non-OFC.	XT8-DKC-F410I-4GS	595-6131-01 370-4606-01
Fibre 4-Port Adapter for SWL	This adapter is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides Fibre 2-port adapters with short wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (two ports for each storage cluster). Optical interfaces are non-OFC.	T8-DKC-F410I-4GS	596-3215-01 370-4606-01
Fibre 4-Port Adapter for LWL	This adapter is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides Fibre 2-port adapters with long wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (two ports for each storage cluster). Optical interfaces are non-OFC.	XT8-DKC-F410I-4GL	595-6132-01 370-4607-01
Fibre 4-Port Adapter for LWL	This adapter is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides Fibre 2-port adapters with long wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (two ports for each storage cluster). Optical interfaces are non-OFC.	T8-DKC-F410I-4GL	596-3216-01 370-4607-01
Fibre 8-Port Adapter for SWL	This adapter is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides Fibre 4-port adapters with short wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (four ports for each storage cluster). Optical interfaces are non-OFC.	XT8-DKC-F410I-8GS	595-6133-01 370-4608-01

Sun StorEdge 9960 System			
Short Description	Long Description	Marketing Part #	Mfg. Part #
Fibre 8-Port Adapter for SWL	This adapter is attached to the the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides Fibre 4-port adapters with short wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (four ports for each storage cluster). Optical interfaces are non-OFC.	T8-DKC-F410I-8GS	596-3217-01 370-4608-01
Fibre 8-Port Adapter for LWL	This adapter is attached to the the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides Fibre 4-port adapters with long wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (four ports for each storage cluster). Optical interfaces are non-OFC.	XT8-DKC-F410I-8GL	595-6134-01 370-4609-01
Fibre 8-Port Adapter for LWL	This adapter is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides Fibre 4-port adapters with long wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (four ports for each storage cluster). Optical interfaces are non-OFC.	T8-DKC-F410I-8GL	596-3218-01 370-4609-01
Fibre 8-Port Adptr-SW rem copy	This adapter is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) and provides Fibre 4-port adapters with short wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (four ports for each storage cluster). Optical interfaces are non-OFC. For remote copy.	XT8-DKC-F410I-8GSE	595-6135-01 370-4610-01
Fibre 8-Port Adptr-SW rem copy	This adapter is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) and provides Fibre 4-port adapters with short wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (four ports for each storage cluster). Optical interfaces are non-OFC. For remote copy.	T8-DKC-F410I-8GSE	596-3219-01 370-4610-01
SE9960 Disk Controller Frame	Sun StorEdge 9960 System Disk controller frame includes disk controller which supports RAID 5/RAID 1. Consists of two storage clusters (controller logic) without cache memory module and shared memory module (includes one ACP). AC power cable and AC power supplier not included. Frame dimensions: Height: 70.5", Width: 29.5", Depth: 31.5"	T8-DKC410I-5	596-3220-01 370-4611-01
HDS Logo for Sun SE9900 Series	HDS Logo for the Sun SE9900 Series.	T8-041-100028-01	596-3221-01 370-4612-01
DEV I/F Cable 0 (DKC-R1 DKU)	8 device interface cables for connecting disk controller (2nd disk adapter pair) to DKU-F405I-B4 of R1 disk unit.	XT8-DKC-F410I-R1C	595-6136-01 370-4613-01
DEV I/F Cable 0 (DKC-R1 DKU)	8 device interface cables for connecting disk controller (2nd disk adapter pair) to DKU-F405I-B4 of R1 disk unit.	T8-DKC-F410I-R1C	596-3222-01 370-4613-01
Pwr Cable Kit-Single Phase Eur	AC power cable for Europe, necessary when Sun StorEdge 9960 System disk controller (DKC415I) is shipped to Europe.	T8-DKC-F410I-1EC	596-3223-01 370-4614-01
Pwr Cable Kit-Single Phase USA	AC power cable for USA, necessary when Sun StorEdge 9960 System disk controller (DKC415I) is shipped to USA.	T8-DKC-F410I-1UC	596-3224-01 370-4615-01
AC Box Kit for Single Phase	Single phase AC power supplier necessary when Sun StorEdge 9960 System disk controller (DKC-410I) is used as a single phase disk controller.	T8-DKC-F410I-1PS	596-3225-01 370-4616-01
Plenum SC to LC Cable, 25M	1 Plenum SC to LC 2Gb Fibre Channel Cable, 25M	XT8-JZ-050SL025PC	596-3262-01 370-4656-01
Plenum LC to LC Cable, 25M	1 Plenum LC to LC 2Gb Fibre Channel Cable, 25M	XT8-JZ-050LL025PC	596-3263-01 370-4657-01

Sun StorEdge 9960 System			
Short Description	Long Description	Marketing Part #	Mfg. Part #
Serial Cable 61M/200FT (Plenum)	1 Serial Cable (Pre-requisite Mainframe Connection) 61M/200FT (Plenum)	XT8-106734395PC	595-6100-01 370-4571-01
Serial Cable 122M/400FT (Plenum)	1 Serial Cable (Pre-requisite Mainframe Connection) 122M/400FT (Plenum)	XT8-106734437PC	595-6102-01 370-4573-01
Serial Cable 7M/22.9FT (Plenum)	1 Serial Cable (Pre-requisite Mainframe Connection) 7M/22.9FT (Plenum)	XT8-106734346PC	595-6183-01 370-4658-01

SUN STOREDGE 9910 SYSTEM

Sun StorEdge 9910 System			
Short Description	Long Description	Marketing Part #	Mfg. Part #
Cache Memory Module (1024MB)	1024MB cache memory module that plugs into cache memory card to extend cache memory capacity. This is composed of 128Mbit DRAM. The cache memory is nonvolatile memory (power backed up by a battery for 48 hours) expandable from 1GB up to 32GB, and write data is duplicated so that data loss is not caused even when a failure of one component occurs in power supply or an interface card.	XT8-DKC-F410I-1024	595-6099-01 370-4570-01
Cache Memory Module (1024MB)	1024MB cache memory module that plugs into cache memory card to extend cache memory capacity. This is composed of 128Mbit DRAM. The cache memory is nonvolatile memory (power backed up by a battery for 48 hours) expandable from 1GB up to 32GB, and write data is duplicated so that data loss is not caused even when a failure of one component occurs in power supply or an interface card.	T8-DKC-F410I-1024	596-3199-01 370-4570-01
SE9900 PCAnywhere CD ROM	PCAnywhere CD ROM. Software function is to manage servers and provide helpdesk support remotely.	T8-IP1000-2CD	596-3252-01 370-4624-01
SE9900 Hi-Track PCMCIA Mdm Kit	Hi-Track PCMCIA Modem Kit	T8-IP0807-4	596-3205-01 370-4596-01
SE9900 Hi-Trk Ethernet Cnct Kt	Hi-Track Ethernet Connect Kit	T8-IP0806-1	596-3204-01 370-4595-01
SE9900 Ethernet Thinnet Cable	Ethernet Thinnet Cable	T8-IP0809-100	596-3203-01 370-4594-01
SE9900 Hi-Track SW Diskette	Hi-Track Software Diskette: CD Rom containing software for remote support access. "Calls home" in event of a system incident requiring support intervention.	T8-IP0810	596-3253-01 370-4653-01
SE9900 SNMP Support Kit	Consists of USB LAN port and 64MB flash memory card. Required to install the disk controller software / Simple Network Management Protocol (SNMP) Agent (P-242R-J4B41-E). Standard with Sun StorEdge 9960 System and Sun StorEdge 9910 System.	T8-DKC-F410I-SNMP	596-3254-01 370-4654-01
SE9900 Microcode Kit	SE9900 Microcode Kit consists of a CD ROM containing the functional software for the Sun StorEdge 9960 System and Sun StorEdge 9910 System.	T8-041-100034-01	596-3207-01 370-4598-01
4 HDD Canisters - 18GB	Four 18GB disk drive canisters to be mounted on Sun StorEdge 9960 System disk array frame unit (DKU405I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I)	XT8-DKU-F405I-18J4	595-6124-01 370-4599-01
4 HDD Canisters - 18GB	Four 18GB disk drive canisters to be mounted on Sun StorEdge 9960 System disk array frame unit (DKU405I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I)	T8-DKU-F405I-18J4	596-3208-01 370-4599-01
4 HDD Canisters - 73GB	Four 73GB disk drive canisters to be mounted on Sun StorEdge 9960 System disk array frame unit (DKU405I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I)	XT8-DKU-F405I-72J4	595-6125-01 370-4600-01
4 HDD Canisters - 73GB	Four 73GB disk drive canisters to be mounted on Sun StorEdge 9960 System disk array frame unit (DKU405I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I)	T8-DKU-F405I-72J4	596-3209-01 370-4600-01
1 HDD Canister - 18GB	One 18GB disk drive canister to be mounted on Sun StorEdge 9960 System disk array frame unit (DKU405I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I)	XT8-DKU-F405I-18J1	595-6126-01 370-4601-01
1 HDD Canister - 18GB	One 18GB disk drive canister to be mounted on Sun StorEdge 9960 System disk array frame unit (DKU405I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I)	T8-DKU-F405I-18J1	596-3210-01 370-4601-01
1 HDD Canister - 73GB	One 73GB disk drive canister to be mounted on Sun StorEdge 9960 System disk array frame unit (DKU405I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I)	XT8-DKU-F405I-72J1	595-6124-01 370-4602-01
1 HDD Canister - 73GB	One 73GB disk drive canister to be mounted on Sun StorEdge 9960 System disk array frame unit (DKU405I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I)	T8-DKU-F405I-72J1	596-3211-01 370-4602-01

Sun StorEdge 9910 System			
Short Description	Long Description	Marketing Part #	Mfg. Part #
Shared Memory Module (256MB)	256MB shared memory module that plugs into cache memory card to extend shared memory. This is composed of 128Mbit of DRAM. The shared memory is nonvolatile memory (power backed up by a battery for 7 days). Used to store cache directories and disk control information. Capacity of shared memory varies with the capacity of cache memory mounted and the storage capacity.	XT8-DKC-F410I-S256	595-6128-01 370-4603-01
Shared Memory Module (256MB)	256MB shared memory module that plugs into cache memory card to extend shared memory. This is composed of 128Mbit of DRAM. The shared memory is nonvolatile memory (power backed up by a battery for 7 days). Used to store cache directories and disk control information. Capacity of shared memory varies with the capacity of cache memory mounted and the storage capacity.	T8-DKC-F410I-S256	596-3212-01 370-4603-01
Serial 4-Port Adapter	This model is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides serial 2 port adapters for channel portion of both storage clusters (two ports for each storage cluster).	XT8-DKC-F410I-4S	595-6129-01 370-4604-01
Serial 4-Port Adapter	This model is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides serial 2 port adapters for channel portion of both storage clusters (two ports for each storage cluster).	T8-DKC-F410I-4S	596-3213-01 370-4604-01
Serial 8-Port Adapter	This model is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides serial 4 port adapters for channel portion of both storage clusters (four ports for each storage cluster).	XT8-DKC-F410I-8S	595-6130-01 370-4605-01
Serial 8-Port Adapter	This model is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides serial 4 port adapters for channel portion of both storage clusters (four ports for each storage cluster).	T8-DKC-F410I-8S	596-3214-01 370-4605-01
Fibre 4-Port Adapter for SWL	This adapter is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides Fibre 2-port adapters with short wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (two ports for each storage cluster). Optical interfaces are non-OFC.	XT8-DKC-F410I-4GS	595-6131-01 370-4606-01
Fibre 4-Port Adapter for SWL	This adapter is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides Fibre 2-port adapters with short wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (two ports for each storage cluster). Optical interfaces are non-OFC.	T8-DKC-F410I-4GS	596-3215-01 370-4606-01
Fibre 4-Port Adapter for LWL	This adapter is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides Fibre 2-port adapters with long wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (two ports for each storage cluster). Optical interfaces are non-OFC.	XT8-DKC-F410I-4GL	595-6132-01 370-4607-01

Sun StorEdge 9910 System			
Short Description	Long Description	Marketing Part #	Mfg. Part #
Fibre 4-Port Adapter for LWL	This adapter is attached to the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides Fibre 2-port adapters with long wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (two ports for each storage cluster). Optical interfaces are non-OFC.	T8-DKC-F410I-4GL	596-3216-01 370-4607-01
Fibre 8-Port Adapter for SWL	This adapter is attached to the the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides Fibre 4-port adapters with short wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (four ports for each storage cluster). Optical interfaces are non-OFC.	XT8-DKC-F410I-8GS	596-6133-01 370-4608-01
Fibre 8-Port Adapter for SWL	This adapter is attached to the the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides Fibre 4-port adapters with short wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (four ports for each storage cluster). Optical interfaces are non-OFC.	T8-DKC-F410I-8GS	596-3217-01 370-4608-01
Fibre 8-Port Adapter for LWL	This adapter is attached to the the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides Fibre 4-port adapters with long wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (four ports for each storage cluster). Optical interfaces are non-OFC.	XT8-DKC-F410I-8GL	596-6134-01 370-4609-01
Fibre 8-Port Adapter for LWL	This adapter is attached to the the Sun StorEdge 9960 System disk controller frame unit (DKC410I) or Sun StorEdge 9910 System integrated controller and disk array frame unit (DKC415I) and provides Fibre 4-port adapters with long wavelength laser diode connected to multi-mode type fibre-optical cable for channel portion of both storage clusters (four ports for each storage cluster). Optical interfaces are non-OFC.	T8-DKC-F410I-8GL	596-3218-01 370-4609-01
SE9910 Disk Controller Frame	Sun StorEdge 9910 System Disk controller frame includes disk controller which supports RAID 5/RAID 1. Consists of two storage clusters (controller logic) without cache memory module and shared memory module (includes one ACP). AC power cable not included. Frame dimensions: Height: 70.5", Width: 27.6", Depth: 31.5".	T8-DKC415I-5	596-3226-01 370-4651-01
Pwr Cable Kit-Single Phase USA	AC power cable for USA, necessary when Sun StorEdge 9910 System disk controller (DKC415I) is shipped to USA.	T8-DKC-F415I-1UC	596-3226-01 370-4615-01
Pwr Cable Kit-Single Phase Eur	AC power cable for Europe, necessary when Sun StorEdge 9910 System disk controller (DKC415I) is shipped to Europe.	T8-DKC-F415I-1EC	596-3223-01 370-4614-01

Sun StorEdge™ 9900 Software License SKUs

Software Licenses			
Short Description	Long Description	Marketing Part #	Mfg. Part #
SE9900 TrueCopy Software Base Lic	Base license for TrueCopy software. Includes TrueCopy documentation. The Sun Remote Copy and Remote Copy for Open systems (SRC/ SORC) feature enables the user to perform synchronous TrueCopy operations between Sun StorEdge 9900 Series systems. The asynchronous SARC/SORCA feature enables the user to perform asynchronous TrueCopy operations between Sun StorEdge 9900 Series systems. SRC, SARC, SORC and SORCA can be used to maintain copies of data for backup or disaster recovery.	XT8-044-100242-01	791-4520-01 370-4449-01
SE9900 ShadowImage Software Base Lic	Base license for ShadowImage software. Includes ShadowImage documentation. Sun (Open) Multiple RAID Coupling Facility (SOMRCF/SMRCF); ShadowImage. Make multiple copies of data within the same storage system (up to 9 with open, up to 3 with IBM System/390 architecture (S390).Availability of added copies eliminates the need to quiesce (stop) applications to perform backup. Added testing and data protection can eliminate backup windows.	XT8-044-100034-01	791-4521-01 370-4450-01
SE9900 Resource Mgr Base Lic	Base license for Resource Manager software. Includes Resource Manager documentation. Server based system management utilities. Provides user with GUI or CLI based control of system.	XT8-044-100040-01	791-4522-01 370-4451-01
SE9900 SANtinel Software Base Lic	Base license for Sun SANtinel software. Includes SANtinel documentation. ZAM - Zone Allocation Manager, or LUN Security Restricts server access to only LUNs in pre-defined 'zones'. Commonly used to allow NT servers to access only their designated LUNs. 'Zoning' at the storage level is simplest to administer.	XT8-044-100250-01	791-4523-01 370-4452-01
SE9900 CruiseControl Software Base Lic	Base license for CruiseControl software. Includes CruiseControl documentation. The CruiseControl feature enables you to optimize your data storage and retrieval on the Sun StorEdge 9900 Series system. CruiseControl analyzes detailed information on the usage of Sun StorEdge 9900 Series system resources and tunes the Sun StorEdge 9900 Series automatically by migrating logical volumes within the system according to detailed user-specified parameters.	XT8-044-100269-01	791-4524-01 370-4453-01
SE9900 SMBR Base Lic	Base license for Sun Multiplatform Backup/Restore (Multi-Platform Backup & Restore) software. Includes Multi-Platform Backup & Restore documentation. The Multi-Platform Backup & Restore feature allows the user to implement mainframe-based backup procedures and standards for the open-system data stored on the multiplatform 9900 system. Multi-Platform Backup & Restore supports only full-volume backup/restore operations. Works with RapidXchange to fully automate the back up process.	XT8-044-100078-01	791-4525-01 370-4454-01
SE9900 TrueCopy Software 1TB Lic.	License key and software certificate for TrueCopy, 1 TB configuration.	XT8-044-100235-01A	850-7972-01 370-4455-01
SE9900 TrueCopy Software 2-3TB Lic.	License key and software certificate for TrueCopy, 2 to 3 TB configurations.	XT8-044-100236-01B	850-7973-01 370-4456-01
SE9900 TrueCopy Software 4-7TB Lic.	License key and software certificate for TrueCopy, 4 to 7 TB configurations.	XT8-044-100237-01C	850-7974-01 370-4457-01
SE9900 TrueCopy Software 8-15TB Lic.	License key and software certificate for TrueCopy, 8 to 15 TB configurations.	XT8-044-100238-01D	850-7975-01 370-4458-01
SE9900 TrueCopy Software 16-31TB Lic.	License key and software certificate for TrueCopy, 16 to 31 TB configurations.	XT8-044-100239-01E	850-7976-01 370-4459-01
SE9900 TrueCopy Software 32-63TB Lic.	License key and software certificate for TrueCopy, 32 to 63 TB configurations.	XT8-044-100240-01F	850-7977-01 370-4460-01
SE9900 SXRC 1TB Lic.	License key and software certificate for Sun extended remote copy (SXRC), 1 TB configuration. Requires Mainframe Connection Kit and	XT8-044-100197-01A	850-7978-01 370-4461-01

	TrueCopy		
Software Licenses			
Short Description	Long Description	Marketing Part #	Mfg. Part #
SE9900 SXRC 2-3TB Lic.	License key and software certificate for Sun extended remote copy (SXRC), 2 to 3TB configurations. Requires Mainframe Connection Kit and TrueCopy	XT8-044-100198-01B	850-7979-01 370-4462-01
SE9900 SXRC 4-7TB Lic.	License key and software certificate for Sun extended remote copy (SXRC), 4 to 7TB configurations. Requires Mainframe Connection Kit and TrueCopy	XT8-044-100199-01C	850-7980-01 370-4463-01
SE9900 SXRC 8-15TB Lic.	License key and software certificate for Sun extended remote copy (SXRC), 8 to 15TB configurations. Requires Mainframe Connection Kit and TrueCopy	XT8-044-100200-01D	850-7981-01 370-4464-01
SE9900 SXRC 16-31TB Lic.	License key and software certificate for Sun extended remote copy (SXRC), 16 to 31TB configurations. Requires Mainframe Connection Kit and TrueCopy	XT8-044-100201-01E	850-7982-01 370-4465-01
SE9900 SXRC 32-63TB Lic.	License key and software certificate for Sun extended remote copy (SXRC), 32 to 63TB configurations. Requires Mainframe Connection Kit and TrueCopy	XT8-044-100202-01F	850-7983-01 370-4466-01
SE9900 ShadowImage Software 1TB Lic.	License key and software certificate for ShadowImage, 1 TB configuration.	XT8-044-100203-01A	850-7984-01 370-4467-01
SE9900 ShadowImage Software 2-3TB Lic.	License key and software certificate for ShadowImage, 2 to 3 TB configurations.	XT8-044-100204-01B	850-7985-01 370-4468-01
SE9900 ShadowImage Software 4-7TB Lic.	License key and software certificate for ShadowImage, 4 to 7 TB configurations.	XT8-044-100205-01C	850-7986-01 370-4469-01
SE9900 ShadowImage Software 8-15TB Lic	License key and software certificate for ShadowImage 8 to 15 TB configurations.	XT8-044-100206-01D	850-7987-01 370-4470-01
SE9900 ShadowImage Software 16-31TB Lic	License key and software certificate for ShadowImage 16 to 31 TB configurations.	XT8-044-100207-01E	850-7988-01 370-4471-01
SE9900 ShadowImage Software 32-63TB Lic	License key and software certificate for ShadowImage, 32 to 63 TB configurations.	XT8-044-100208-01F	850-7989-01 370-4472-01
SE9900 Resource Mgr 1TB Lic.	License key and software certificate for Resource Manager, 1 TB configuration.	XT8-044-100209-01A	850-7990-01 370-4473-01
SE9900 Resource Mgr 2-3TB Lic	License key and software certificate for Resource Manager, 2 to 3 TB configurations.	XT8-044-100210-01B	850-7991-01 370-4474-01
SE9900 Resource Mgr 4-7TB Lic	License key and software certificate for Resource Manager, 4 to 7 TB configurations.	XT8-044-100211-01C	850-7992-01 370-4475-01
SE9900 Resource Mgr 8-15TB Lic	License key and software certificate for Resource Manager, 8 to 15 TB configurations.	XT8-044-100212-01D	850-7993-01 370-4476-01
SE9900 Res Mgr 16-31TB Lic	License key and software certificate for Resource Manager, 16 to 31 TB configurations.	XT8-044-100213-01E	850-7994-01 370-4477-01
SE9900 Res Mgr 32-63TB Lic.	License key and software certificate for Resource Manager, 32 to 63 TB configurations.	XT8-044-100214-01F	850-7995-01 370-4478-01
SE9900 CruiseControl Software 1TB Lic.	License key and software certificate for CruiseControl, 1 TB configuration.	XT8-044-100262-01A	850-7996-01 370-4479-01
9900 CruiseControl Software 2-3TB Lic.	License key and software certificate for CruiseControl, 2 to 3 TB configurations.	XT8-044-100263-01B	850-7997-01 370-4480-01
SE9900 CruiseControl	License key and software certificate for CruiseControl, 4 to 7 TB configurations.	XT8-044-100264-01C	850-7998-01 370-4481-01

Software 4-7TB Lic			
SE9900 CruiseControl Software 8-15TB Lc	License key and software certificate for CruiseControl, 8 to 15 TB configurations.	XT8-044-100265-01D	850-7999-01 370-4482-01
Software Licenses			
Short Description	Long Description	Marketing Part #	Mfg. Part #
SE9900 CruiseControl Software 16-31TB Lc	License key and software certificate for CruiseControl, 16 to 31 TB configurations.	XT8-044-100266-01E	852-0001-01 370-4483-01
SE9900 CruiseControl Software 32-63TB Lc	License key and software certificate for CruiseControl, 32 to 63 TB configurations.	XT8-044-100267-01F	852-0002-01 370-4484-01
SE9900 SANTinel Software 1TB Lic.	License key and software certificate for SANTinel, 1 TB configuration.	XT8-044-100243-01A	852-0003-01 370-4485-01
SE9900 SANTinel Software 2-3TB Lic.	License key and software certificate for SANTinel, 2 to 3 TB configurations.	XT8-044-100244-01B	852-0004-01 370-4486-01
SE9900 SANTinel Software 4-7TB Lic.	License key and software certificate for SANTinel, 4 to 7 TB configurations.	XT8-044-100245-01C	852-0005-01 370-4487-01
SE9900 SANTinel Software 8-15TB Lic	License key and software certificate for SANTinel, 8 to 15 TB configurations.	XT8-044-100246-01D	852-0006-01 370-4488-01
SE9900 SANTinel Software 16-31TB Lic	License key and software certificate for SANTinel, 16 to 31 TB configurations.	XT8-044-100247-01E	852-0007-01 370-4489-01
SE9900 SANTinel Software 32-63TB Lic	License key and software certificate for SANTinel, 32 to 63 TB configurations.	XT8-044-100248-01F	8502-0008-01 370-4490-01
SE9900 SMBR 1TB Lic.	License key and software certificate for Multi-Platform Backup & Restore, 1 TB configuration.	XT8-044-100227-01A	852-0009-01 370-4491-01
SE9900 SMBR 2- 3TB Lic.	License key and software certificate for Multi-Platform Backup & Restore, 2 to 3 TB configurations.	XT8-044-100228-01B	852-0010-01 370-4492-01
SE9900 SMBR 4- 7TB Lic.	License key and software certificate for Multi-Platform Backup & Restore, 4 to 7 TB configurations.	XT8-044-100229-01C	852-0011-01 370-4493-01
SE9900 SMBR 8- 15TB Lic.	License key and software certificate for Multi-Platform Backup & Restore, 8 to 15 TB configurations.	XT8-044-100230-01D	852-0012-01 370-4494-01
SE9900 SMBR 16- 31TB Lic.	License key and software certificate for Multi-Platform Backup & Restore, 16 to 31 TB configurations.	XT8-044-100231-01E	852-0013-01 370-4495-01
SE9900 SMBR 32- 63TB Lic.	License key and software certificate for Multi-Platform Backup & Restore, 32 to 63 TB configurations.	XT8-044-100232-01F	852-0014-01 370-4496-01
9900 SXRC Base Lic	Base license for Sun extended remote copy (SXRC) software. Includes SXRC documentation. The SXRC asynchronous TrueCopy feature of the Sun StorEdge 9900 Series system is functionally compatible with IBM Extended TrueCopy (XRC). SXRC provides asynchronous TrueCopy operations for maintaining duplicate copies of S/390 data for data backup purposes. SXRC is also compatible with the DFSMS data mover that is common to the XRC environment. Requires Mainframe Connection Kit and TrueCopy.	XT8-044-100233-01	791-4526-01 370-4497-01
SE9900 DLM for Solaris	Sun StorEdge 9900 Series Dynamic Link Manager for Solaris. Server based software that automatically redirects data to the same LUN via one or more alternate paths in case a path has failed or is busy. Balances workload to ensure utilization of all I/O bandwidth.	XT8-044-100275-01	791-4530-01 370-4631-01
SE9900 DLM for Win NT/W2K	Sun StorEdge 9900 Series Dynamic Link Manager for Win NT/W2K. Server based software that automatically redirects data to the same LUN via one or more alternate paths in case a path has failed or is busy. Balances workload to ensure utilization of all I/O bandwidth.	XT8-044-100273-01	791-4531-01 370-4632-01
SE9900 DLM for HP- UX	Sun StorEdge 9900 Series Dynamic Link Manager for HP-UX. Server based software that automatically redirects data to the same LUN via one or more alternate paths in case a path has failed or is busy.	XT8-044-100276-01	791-4532-01 370-4633-01

	Balances workload to ensure utilization of all I/O bandwidth.		
SE9900 DLM for AIX	Sun StorEdge 9900 Series Dynamic Link Manager for AIX. Server based software that automatically redirects data to the same LUN via one or more alternate paths in case a path has failed or is busy. Balances workload to ensure utilization of all I/O bandwidth.	XT8-044-100274-01	791-4533-01 370-4634-01
SE9900 RapidXchange Software Base Lic	Sun StorEdge 9900 Series RapidXchange software License. Sun Multiplatform Data Exchange (SMDE). Facility to transfer data among OS/390, UNIX® and Windows NT/2000.	XT8-044-100234-01	852-0026-01 370-4642-01
Software Licenses			
Short Description	Long Description	Marketing Part #	Mfg. Part #
SE9900 RapidXchange Software Trial Lic	Sun StorEdge 9900 Series RapidXchange Trial License. Sun Multiplatform Data Exchange (SMDE). Facility to transfer data among OS/390, UNIX® and Windows NT/2000.	XT8-044-100260-01	852-0027-01 370-4643-01
SE9900 CruiseControl Software Trial Lic	Sun StorEdge 9900 Series CruiseControl Trial License.	XT8-044-100268-01	852-0029-01 370-4645-01
SE9900 SANTinel Software Trial Lic	Sun StorEdge 9900 Series SANTinel Trial License.	XT8-044-100249-01	852-0030-01 370-4646-01
SE9900 Resource Mgr Trial Lic	Sun StorEdge 9900 Series Resource Manager Trial License.	XT8-044-100132-01	852-0031-01 370-4647-01
SE9900 ShadowImage Software Trial Lic	Sun StorEdge 9900 Series ShadowImage Trial License.	XT8-044-100145-01	852-0032-01 370-4648-01
SE9900 TrueCopy Software Trial Lic	Sun StorEdge 9900 Series TrueCopy Trial License.	XT8-044-100241-01	852-0033-01 370-4649-01
SE9900 SMBR Trial Lic	Sun StorEdge 9900 Series Multi-Platform Backup & Restore Trial License.	XT8-044-100113-01	852-0034-01 370-4650-01
Mainframe Connection Lic Kit	Mainframe Connection License Kit	XT8-044-100289-01	

Brocade Switch SKUs

Brocade Switches, GBICs, and Software			
Short Description	Long Description	Marketing Part #	Mfg. Part #
Brocade Silkworm 2402- 8 port	Brocade Silkworm 2402 includes single 8-Port switch, Dual Power supplies, SWL GBICs	XT8-BR-2402-0013	595-6054-01 370-4504-01
Brocade Silkworm 2802-16 port	Brocade Silkworm 2802 includes single 16-Port switch, Dual Power supplies, SWL GBICs	XT8-BR-2802-0008	595-6055-01 370-4505-01
Brocade Web Tools Software	Brocade Web Tools Software	XT8-SW200007-02	791-4535-01 370-4628-01
Brocade Quickloop Software	Brocade Quickloop Software	XT8-SW200008-02	791-4536-01 370-4629-01
Brocade Silkworm Rck Mount Kit	Brocade Silkworm Rack Mount Kit	XT8-XBR-000016	595-6058-01 370-4508-01
BROC Fibre Optic SW Laser GBIC	Brocade Fibre Optic Short Wave Laser GBIC	XT8-XBR-000025	595-6061-01 370-4511-01
BROC Fibre Optic LW Laser GBIC	Brocade Fibre Optic Long Wave Laser GBIC	XT8-XBR-000011	595-6062-01 370-4512-01
Brocade Fabric Watch	Fabric Watch is an optional Storage Area Network (SAN) software monitor for Brocade SilkWorm switches running Fabric OS 2.2 or higher.	XT8-SW228001-01	791-4537-01 370-4630-01

Jaycor (JNI) HBA SKUs

JNI Host Bus Adapters			
Short Description	Long Description	Marketing Part #	Mfg. Part #
JNI 32-bit PCI Adapter Non-OFC	JNI 32-bit PCI Adapter Non-OFC S/W Interface	XT8-FCI-1063-N	595-6068-01 370-4517-01
JNI 64-bit SBus Adapter Non-OFC	JNI 64-bit SBus Adapter Non-OFC S/W Interface	XT8-FC64-1063-N	595-6069-01 370-4518-01
JNI 64-bit PCI Adapter Non-OFC	JNI 64-bit PCI Adapter Non-OFC S/W Interface	XT8-FCE-6410-N	595-6070-01 370-4519-01
JNI 64-bit PCI	JNI 64-bit PCI S/W Emerald Dual Port 66 Mhz	XT8-FCE2-6412-N	595-6181-01 370-4626-01
JNI 64-bit SBUS Non-OFC	JNI 64-bit SBUS Non-OFC SW interface	XT8-FCE1063-N	595-6182-01 370-4627-01

WARRANTY, SERVICE, AND SUPPORT

The SunSpectrumSM program is an innovative and flexible service offering that allows customers to choose the level of service best suited to their needs, ranging from mission-critical support for maximum solution availability to backup assistance for self-support customers. The SunSpectrum program provides a simple pricing structure in which a single fee covers support for an entire system, including related hardware and peripherals, the SolarisTM Operating Environment software, and telephone support for SunTM software packages. The majority of Sun'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.

The four levels of SunSpectrum support contracts are outlined below.

Program	Description
Mission-Critical SunSpectrum Platinum SM 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 SM 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.
System Coverage SunSpectrum Silver SM Support	Combines the service expertise, responsive on-site support and technical support by telephone and SunSolve SM CD/on-line services. Support is provided 8 a.m. to 8 p.m. Mon. through Fri.
Self-Directed SunSpectrum Bronze SM Support	Provided for customers who rely primarily upon their own in-house service capabilities. Enables customers to deliver high quality service by giving them access to UNIX [®] expertise, Sun certified replacement parts, software releases and technical tools. Support is provided 8 a.m. to 5 p.m. Mon. through Fri.

Warranty and Installation

WARRANTY

Warranty on Sun StorEdge™ 9900 series includes:

- 3 years coverage
- 7 x 24 Same Day 4-hour (average response times) on-site response
- 7 x 24 Phone Support.

IMPORTANT: Switches must be purchased in redundant configuration to ensure system availability and to avoid voiding the system warranty.

IMPORTANT: As of this writing, other than Brocade 8- and 16-port switches, switches listed as compatible with the Sun StorEdge™ 9900 series storage systems are supported and warranted by their respective manufacturers.

IMPORTANT: As of this writing, Sun will only support and warrant JNI HBAs at this time. All other HBAs listed as compatible with the Sun StorEdge™ 9900 series storage systems are supported and warranted by their respective manufacturers.

Sun will be adding additional HBAs, switches, and other associated products for the Sun StorEdge™ 9900 series as quickly as possible. In addition, Sun will be reviewing the applicability of qualifying similar HBAs, switches, and other associated products on additional Sun storage products.

Warranty on Sun StorEdge™ 9900 software is 90 days. To extend maintenance coverage beyond the initial warranty period, please refer to the **Software License and Maintenance Part Numbers** section.

SUN STOREDGE™ 9910 AND SUN STOREDGE™ 9960 SYSTEMS

Sun warranty on Sun StorEdge™ 9910 and Sun StorEdge™ 9960 Systems will include an enhanced warranty including:

- 3 years coverage
- 7 x 24 Same Day 4-hour* on-site response
- 7 x 24 Phone Support.

*average response times

Purchasers of Sun StorEdge™ 9900 series are also entitled to receive three years coverage for Sun StorEdge™ 9900 series Remote Response, a 24x7 remote support and monitoring service.

IMPORTANT: ArrayStart installation service is not included with the purchase of a Sun StorEdge™ 9900 series product. ArrayStart installation service must be ordered separately and is a required purchase in order to receive any warranty and Sun StorEdge™ 9900 series Remote Response service. The following Sun Enterprise Services part numbers apply:

- AR-99-INS-BAS2 Order quantity 1 for each Sun StorEdge™ 9900 series installed
- AR-99-INS-PER-4DSK Order quantity 1 for each group of 4 disks installed

NOTE: Where available, customers will be able to upgrade the enhanced warranty offering to a SunSpectrumSM Platinum service contract which includes **two hours** (average response) on-site service. Platinum service may not be available in all countries – please consult with a Sun Enterprise Services Sales Representative for details.

WARRANTY UPGRADE PART NUMBERS

The following are the CORRECT warranty upgrade part numbers and pricing for the Sun StorEdge 9910 system and the Sun StorEdge 9960 system. They are NON-DISCOUNTABLE:

Part Number	Monthly	3-Year Term
W-T8_9910-3P	\$ 248	\$ 8,928
W-T8_9960-3P	\$ 411	\$14,796
W-T8_DGRP-3P	\$ 13	\$ 468

. . . They REPLACE the following which were previously communicated:

Part Number	Monthly	3-Year Term
W9D-T8_9910-3P	\$354	\$12,744
W9D-T8_9960-3P	\$587	\$21,132
W9D-T8_DGRP-3P	\$19	\$684

These changes were necessary because the W9D pricing structure was put on hold across ES.

BROCADE SWITCH PRODUCTS FOR SUN STOREEDGE™ 9900 SERIES

Sun customers purchasing Brocade switches for Sun StorEdge™ 9900 series from Sun will receive the following warranty:

- 2 years coverage
 - ✓ 1st year standard business hours M-F next business day (average response times) on-site response and standard business hours M-F telephone support
 - ✓ 2nd year parts-only 15-day return-to-factory response and standard business hours M-F telephone support

Where available, customers will be able to upgrade the warranty offering to a SunSpectrumSM Platinum, Gold, or Silver service contract.

IMPORTANT: Brocade Fibre Channel Switches must be purchased in redundant configuration to ensure system availability and to avoid voiding the system warranty.

IMPORTANT: Installation is not included with the Brocade products. Sun Enterprise Services will perform installations of these products on a time and material basis at customer request.

IMPORTANT: Brocade Fibre Channel Switches are qualified, at this time, only with the Sun StorEdge™ 9900 series storage products and cannot be utilized with any other Sun storage product unless specifically stated in the product support matrix.

IMPORTANT: The Sun StorEdge™ 9900 series storage products are initially available with 8-port and 16-port Brocade Fibre Channel Switches. These switches, when purchased from Sun only and configured per the Sun StorEdge™ 9900 series product compatibility matrix, will be supported per the terms of the respective Sun warranty or Service contract.

JNI HOST BUS ADAPTER PRODUCTS FOR SUN STOREEDGE™ 9900 SERIES

Sun customers purchasing JNI HBAs for Sun StorEdge™ 9900 series from Sun will receive the following warranty:

- Warranty will match the warranty offering of the Sun server in which the HBA(s) are installed

IMPORTANT: Installation is not included with the JNI products. Sun Enterprise Services will perform installations of these products on a time and material basis at customer request or as part of a Sun server installation service.

IMPORTANT: SunSpectrumSM offerings do not exist for HBAs. Instead, a Spectrum service for the associated server is necessary to cover the HBA.

IMPORTANT: The Sun StorEdge™ 9900 series storage products are initially available with JNI Host Bus Adapters (HBAs). These HBAs, when purchased from Sun only and configured per the Sun StorEdge™ 9900 series product compatibility matrix, will be supported per the terms of the respective Sun warranty or Service contract.

IMPORTANT: JNI Host Bus Adapters are qualified, at this time, only with the Sun StorEdge™ 9900 series storage products and cannot be utilized with any other Sun storage product unless specifically stated in the product support matrix.

INSTALLATION

ArrayStart installation service is not included with the purchase of a Sun StorEdge™ 9900 series product. ArrayStartSM installation service must be ordered separately and is a required purchase in order to receive any warranty and Sun StorEdge™ 9900 series Remote Response service.

The following ES part numbers apply:

- AR-99-INS-BAS2 Order quantity 1 for each Sun StorEdge™ 9900 series installed
- AR-99-INS-PER-4DSK Order quantity 1 for each group of 4 disks installed

OTHER COLLATERAL

Sun StorEdge™ 9900 Series Intro

Sun StorEdge™ 9900 Series Technical Overview Presentation

Sun StorEdge™ 9900 Series Brief Product Overview Presentation

Sun StorEdge™ 9960 Series Value Proposition Presentation

Sun StorEdge™ 9900 Series Customer Presentation

Sun StorEdge™ 9900 Series / Sun StorEdge™ T3 Array Positioning Presentation

Sun StorEdge™ 9900 Series Data Sheet

Sun StorEdge™ 9900 Series PocketFacts

Using ShadowImage to Perform Backup/Restore with Oracle

Mister Cynic's Guide to Storage Benchmarks

How Mister Cynic Drives EMC Crazy

Mister Cynic Explains EMC RAID-S

Mister Cynic Takes You Into the Bowels of the EMC Symmetrix 8000

Mister Cynic Sells Against EMC

Mister Cynic's Shark Repellant Guide

A Brief Introduction to Databases

FAQs

NOTE: Internal Sun StorEdge™ 9900 series FAQs can be found behind the firewall at the GNSS website.

Q: When configuring the Sun StorEdge™ 9960 system, the configurator provides the minimum number of ACP pairs to support the required capacity. This results in up to 128 disks (9.3TB raw) behind one ACP pair before configuring additional array processor channels, which only utilizes 25% of the potential performance capacity of the system. This configuration is fine for archiving, but not so for applications where performance matters. (This is not an issue on the Sun StorEdge™ 9910 systems, which only have one and only one ACP pair.) What's up?

A: When considering configuring the Sun StorEdge™ 9960 system for performance . . .

To configure a Sun StorEdge™ 9960 system for maximum backend performance, use all four ACP pairs and all six array frames and spread the drives across the ACPs by evenly distributing them across the six array frames.

Ideally, load the frames with the maximum of HDDs to ensure you have enough backend to drive. However, if you are using a number of HDDs which will fit into two array frames or less, and you want to keep costs down, then still use four ACP pairs but use only two array frames, insuring one is on the right side, and the other is on the left side of the controller frame. With, say for example, 96 HDDs, that's still a high \$/MB, but at least it's the optimal balance between price and performance for that particular configuration.

Minimally, don't use less than 48 HDDs for a performance configuration with four ACP pairs and two array frames (one Right Frame and one Left Frame); even so, \$/MB is considerably higher than with fully configured frames. With anything less than 48 (say, for example, 24 HDDs), there would not be enough on the backend to drive it to the full bandwidth.

If your customer has hard raw TB capacity requirements which will remain under 3.5TB for at least a year, you may want to consider going with the Sun StorEdge™ 9910 system and receive great performance for less cost. Over 3.5TB raw capacity, go with the dual-frame Sun StorEdge™ 9960 system setup described above. (Don't forget - while the Sun StorEdge™ 9910 system cannot be expanded into an Sun StorEdge™ 9960 system, another Sun StorEdge™ 9910 system – or even a Sun StorEdge™ 9960 system – can always be dropped into the existing SAN at a later date, so there will be no loss of investment made on the original Sun StorEdge™ 9910 system. It may be practical to play “budget bingo” in this manner if there are stringent financial requirements which need to be met.

The end user should always, always be provided in full detail with the tradeoffs between bandwidth and cost, and, in the end, it should be the customer who makes the final, but informed, decision as to which system to buy.

Q: What hardware should we sell to our customers for the Sun StorEdge™ 9900 series remote console?

A: None. The SVP (Service Processor) is a notebook PC and is included with every control frame.

Q: HDS offers a 2-hour response on their Lightning 9900 storage system. Does Sun offer a similar response on its Sun StorEdge™ 9900 series?

A: Yes. Where available, customers will be able to upgrade the enhanced warranty offering to a Sun Spectrum (SM) Platinum service contract which includes two hours (average response) on-site service. (**NOTE:** Platinum service may not be available in all countries. Please consult with a Sun Enterprise Services Sales Representative for details.)

Q: What, exactly, does the term "non-blocking" as relates to the Sun StorEdge™ 9900 series architecture mean? I have seen it used all over various documents.

A: As we use "non-blocking," the term has four prongs:

First, There are 64 separate any-to-any FC I/O paths in the Sun StorEdge™ 9960 system - 32 front and 32 back; 32 for control I/O and 32 for data I/O (non-blocking prong I).

Second, data and control I/O are segregated from each other, so data and control I/O don't interfere with one another as they are passed within the system - i.e., one is not blocked by the other (non-blocking prong II).

Third, the architecture uses four FC caching crossbar switches, which sit between the front (host) end and the back (disk) end. If a path is busy, data is simply routed to a non-busy path - i.e., I/O is not blocked from being processed because an I/O path is busy (non-blocking prong III).

And finally, the disk array controllers provide loops in such a way that every disk on the back end has two bi-directional active/active ports. A dual segmented cache buffer on each disk sits between the two ports on the disk and two ports on the array processors (one port per array processor in an array processor pair). This way, each disk can simultaneously read and write data in and out of its buffer and can process I/O to or from either port at any point in time. So, if one port on a disk is busy - or a port on an array control processor is busy for that matter - I/O can still be processed on the other port, read or write - either direction (non-blocking prong IV).

Now, compare this to the EMC Symmetrix SCSI fixed-bus architecture:

- I. Only four separate buses/IO paths (i.e., data cannot traverse between the buses - they are not any-to-any), so the four buses quickly get full and when they are full, subsequent I/O must wait for the buses to clear because it has nowhere else to go (I/O is blocked).
- II. Data and control I/O are shared on those four buses, not segregated. So, data (i.e., production) I/O must wait for control (e.g., configuration, housekeeping) I/O to clear before it can pass when the buses are under heavy load (I/O is blocked).
- III. Data - and Control - I/Os all must pass through their own dedicated directors, so again, if one director is busy and another is not, traffic on the busy director cannot be off-loaded to the under utilized director (I/O is blocked and cannot be relieved).
- IV. Disk drives are dual-ported but only one port is active (active/standby), so if a drive port is busy, the I/O being processed blocks subsequent incoming I/O from being processed.

Q: The Hub and the Switch Compatibility Matrices list, for example, "Server: max 3 ports; 9900: max 4 ports" - Does this mean up to three server connections and four Sun StorEdge™

9900 series connections on the same hub? And the four Sun StorEdge™ 9900 series connections can be all the same Sun StorEdge™ 9900 series or four different Sun StorEdge™ 9900 series or any combination?

A: Basically, any combination of the number of indicated hosts and the number of indicated storage ports. So, for example, three host servers and four Sun StorEdge™ 9900 series four ports can be three host servers or one host server with three HBAs (or other combination of three host HBA ports) plus all four on a single Sun StorEdge™ 9900 series, two on one Sun StorEdge™ 9900 series and two on another, or four on four separate Sun StorEdge™ 9900 series. Same for switches, although we require dual redundant switches so as not to void the warranty.

Q: What is the difference between the USA and Eur power kits?

A: There are four power kits for the Sun StorEdge SE9960 system and two power kits for the Sun StorEdge SE9910 system:

- For SE9960: DKU-F405I-1UC.P (USA single phase)
- For SE9960: DKU-F405I-1EC.P (Europe single phase)
- For SE9960: DKU-F405I-3UC.P (USA 3-phase)
- For SE9960: DKU-F405I-3EC.P (Europe 3-phase)
- For SE9910: DKC-F415I-1UC.P (USA single phase)
- For SE9910: DKC-F415I-1EC.P (Europe single phase)

The connector for these power kits is either 60Hz or 50Hz. The 60Hz kit (for US, Canada, some Latin America Countries) has a Russel & Stoll crimp tag attached; the 50Hz kit (Europe, Japan, Brazil, etc.) has a bigger cable with no connector because there's no common standard for connectors.

Q: How do I know whether to order single-phase or three-phase power for Sun StorEdge™ 9960 systems?

A: It depends on the customer's environment and requirements. Both are available; however, 3-phase is what is stocked - single phase is by RPQ only and will have a lead time because single phase is rarely, if ever, ordered. Note that there is no upgrade available for converting from single to three phase or vice-versa; as such, it is a mandatory requirement that AC power be specified when ordering a Sun StorEdge™ 9960 system before it can be shipped. (Sun StorEdge™ 9910 system is available with single phase power only.)

Q: How is Sun StorEdge™ 9900 software purchased?

A: There are three categories for Sun StorEdge™ 9900 series software licenses:

- **Controller-Based Total Usable Capacity** - One license required per controller frame. Licensed per the total usable capacity of the controller; licenses are purchased in 1TB total usable capacity increments.
- **Controller-Based Total Raw Capacity** - One license required per controller frame. Licensed per the total raw capacity of the controller; licenses are purchased in 1TB total raw capacity increments.

- **Server or Operating System-Based** - Licensing is capacity-independent. (Capacity-independent indicates the software license is not related to the storage capacity of the system; also, the processing capacity of the servers is irrelevant.)
 - **Server-Based** - One license required per host server running the software. Purchased on the number of servers which will be running the software.
 - **Operating System-Based** - One license per operating system. Purchased on the number of operating systems per system which will be running the software. So, for example, a single Sun StorEdge 9900 series system attached to, say, ten WNT servers and ten Sun Solaris servers would be required to purchase two Operating System-Based licenses.

Q: Which Sun StorEdge™ 9900 software packages fall under which license categories?

A:

- Controller-Based Total Usable Capacity - Sun StorEdge™ 9900 Extended Remote Copy Software, Sun StorEdge™ 9900 ShadowImage Software, and Sun StorEdge™ 9900 TrueCopy Software
- Controller-Based Total Raw Capacity - Sun StorEdge™ 9900 Resource Manager Software Suite (includes Sun StorEdge™ 9900 FlashAccess Software; Sun StorEdge™ 9900 Graph-Track Software; Sun StorEdge™ 9900 LUN Manager Software; Sun StorEdge™ 9900 Virtual Logical Volume Image; Sun StorEdge™ 9900 Prioritized Port Control Software; Sun StorEdge™ 9900 LUN Size Expansion), Sun StorEdge™ 9900 CruiseControl Software, Sun StorEdge™ 9900 SANTinel Software, Sun StorEdge™ 9900 Parallel Access Volumes, and Sun StorEdge™ 9900 Multi-Platform Backup/Restore Software
- Server-Based - Sun StorEdge™ 9900 RapidXchange Software
- Operating System-Based - Sun StorEdge™ 9900 Dynamic Link Manager Software

Q: How is Sun StorEdge™ 9900 software priced?

A: For all Sun StorEdge™ 9900 series controller-based software, each Sun StorEdge™ 9900 software license is priced by the TB; the more TB purchased, the less the price per TB moving up the TB hierarchy; licensing is tiered and purchased in the aggregate; here are some examples to illustrate this:

- 1) For 3TB: (1 x 1TB Lic.) + (2 x 2-3TB Lic.)
- 2) For 5TB: (1 x 1TB Lic.) + (2 x 2-3TB Lic.) + (2 x 4-7TB Lic.)
- 3) For 6TB: (1 x 1TB Lic.) + (2 x 2-3TB Lic.) + (3 x 4-7TB Lic.)
- 4) For 7TB: (1 x 1TB Lic.) + (2 x 2-3TB Lic.) + (4 x 4-7TB Lic.)
- 5) For 8TB: (1 x 1TB Lic.) + (2 x 2-3TB Lic.) + (4 x 4-7TB Lic.) + (1 x 8-15TB Lic.)
- 6) For 16TB: (1 x 1TB Lic.) + (2 x 2-3TB Lic.) + (4 x 4-7TB Lic.) + (8 x 8-15TB Lic.) + (1 x 16-31TB Lic.)

NOTE: When purchasing Sun StorEdge™ 9900 series controller-based software licenses, always round up to the nearest TB; so, for example, 5.2TB = 6TB for software licensing purposes.

Q: What is included in the base Sun StorEdge™ 9960 system Control Frame?

A: The Base Sun StorEdge™ 9960 system Control Frame Includes:

One ACP Pair; Configurator calls an ACP pair “Additional Disk Adapter” which is really two ACPs. There are four ACP pairs max. in a fully configured system.

One Cache Board Pair; Configurator calls a Cache Board Pair “Additional Cache Board” which is really two Cache Boards. There are two Cache Board Pairs max. in a fully configured system. Cache boards do NOT contain any cache memory, which must be ordered separately.

1GB Shared (Control) Memory – 1GB is the default.

Q: What is included in the base Sun StorEdge™ 9960 system Array Frame?

A: A Base Sun StorEdge™ 9960 system Array Frame Includes:

One Platform for Canister Mount (holds 48 HDDs). There are two Canister Mount Platforms max. per array frame (12 max. in a fully configured system).

One Hot Spare HDD. The Configurator defaults the capacity of this HDD to match the largest HDD in the system. So, if a system is ordered with 18GB and 72GB HDDs, a 72GB HDD is used for the default host spare; if a system is ordered with all 72GB HDDs, a 72GB HDD is used for the default host spare; or, if a system is ordered with all 18GB HDDs, a 18GB HDD is used for the default host spare.

Q: When can I expect Sun Cluster 3.0 support for Sun StorEdge™ 9900 series?

A: Sun StorEdge™ 9900 series is supported with Sun Cluster 3.0 now.

Q: What are the supported configurations?

A: The key components supported with Sun StorEdge™ 9900 series and Sun Cluster 3.0 are:

Storage: Sun StorEdge™ 9960 system or Sun StorEdge™ 9910 system

HBA: Jaycor (JNI)

Connectivity: Direct Attach

Servers: Sun Enterprise 450, Sun Enterprise 3500-6500 (SBus only)

Solaris: 2.8

Volume Manager: 3.1

Cluster software: Sun Cluster 3.0 7/01

Q: When will the configuration guide be updated with the supported configurations?

A: The Sun StorEdge™ 9900 series is currently not price listed. The supported configurations will be added to the Sun Cluster 3.0 configuration guide on August 21, 2001 when the Sun StorEdge™ 9900 series become available on Sun's pricelist.

Q: What are the plans for support of Sun Fire servers with Sun StorEdge™ 9900 series with Sun Cluster 3.0? What are the plans for support of Brocade Switches with Sun StorEdge™ 9900 series with Sun Cluster 3.0?

A: Sun Cluster engineering is already qualifying Sun StorEdge™ 9900 series with Sun Fire systems. These include both direct attached configurations and those using the Brocade switches. Stay tuned for the updates on qualifications and roadmaps.

Q: What are the plans to support Sun Cluster 2.2 with Sun StorEdge™ 9900 series?

A: Sun Cluster 3.0 is the current generation technology and the Clustering solution of the choice for your customer. Sun Cluster 2.2 is an older generation product in the sustaining mode. Currently, the support of some legacy systems using Solaris 2.6 is being investigated.

Q: The Sun StorEdge™ 9900 series support JNI HBA and Brocade switches, neither of which has been supported by Sun Cluster in the past. Will they be supported in Sun Cluster configurations?

A: Network Storage has identified JNI HBA and Brocade Switches as the most suitable hardware components for use with the Sun StorEdge™ 9900 series. We intend to follow exactly the same strategy in Sun Cluster. Sun StorEdge™ 9900 series are supported with Sun Cluster 3.0 using JNI HBAs. The qualification of Brocade Switches is underway.

Q: My customer has Hitachi Lightning 9900 systems and would like to use them with Sun Cluster 3.0 - is that configuration supported?

A: We do not intend to support Hitachi Lightning 9900 products with Sun Cluster 3.0. We will support only Sun StorEdge™ 9900 series with Sun Cluster 3.0.

Sun Enterprise Services is working on a plan to help enable customers to upgrade their HDS Lightning 900 systems to Sun StorEdge™ 9900 series. Customers who choose to do so would then be able to obtain support for Sun Cluster 3.0.

Q: My customer has already expressed his interest in using Sun StorEdge™ 9900 series with Sun Cluster 3.0? Where should I go for more information?

A: Special configuring and quoting processes have been established to support sales activities prior to Sun price listing the Sun StorEdge™ 9900 series on August 21, 2001. Please refer to <http://gnss.ebay> for the contacts. For any Sun Cluster-specific, please contact Sun Cluster Product Marketing

Q: Optimized for Sun Cluster 3.0 -- will this only be a Sun PS deal?

A: No. Trained and authorized channel partners will be part of this too.

Q: If it's "optimized" for Sun Cluster 3.0, is it SUPPORTED and if so by whom?

A: Sun Cluster 3.0 (with specified Sun servers) and the Sun StorEdge™ 9900 series are fully supported by Sun.

Q: Where do the leads from the "Contact Me" button go?

A: To the local channel partner and Sun storage sales rep.

Q: What is the channel availability?

A: At GA (8/21/01), but you can take orders now for it.

Q: When will it appear on the config guide?

A: At GA (8/21/01).

Q: Warranty period?

A: Warranty on Sun StorEdge™ 9900 series products includes:

- 3 years coverage
 - 7 x 24 Same Day 4-hour (average response times) on-site response
 - 7 x 24 Phone Support.
-

Q: Installs included?

A: No. They are a required separate purchase item, though. ArrayStart for Sun StorEdge™ 9900 series installation service is not included with the hardware product purchase. ArrayStart for Sun StorEdge™ 9900 series installation service must be ordered separately and is a required purchase in order to receive product warranty and Sun StorEdge™ 9900 series Remote Response service.

The following ES part numbers apply:

- ✓ AR-99-INS-BAS2Order quantity 1 for each 99x0 system installed.
- ✓ AR-99-INS-PER-4DSKOrder quantity 1 for each group of 4 disks installed.

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

Brocade switch products for Sun StorEdge™ 9900 series:

Sun customers purchasing Brocade switches for Sun StorEdge™ 9900 series will receive the following warranty:

- ✓ 2 years coverage
- ✓ 1st year standard business hours M-F next business day (average response times) on-site response
- ✓ Standard business hours M-F telephone support
- ✓ 2nd year parts-only 15-day return-to-factory response
- ✓ Standard business hours M-F telephone support

Installation is not included with the Brocade products. Sun Enterprise Services will perform installations of these products on a time and material basis at customer request.

Where available, customers will be able to upgrade the warranty offering to a Sun Spectrum (SM) Platinum, Gold or Silver service contract.

JNI host bus adapter products for Sun StorEdge™ 9900 series:

Sun customers purchasing JNI HBAs for Sun StorEdge™ 9900 series will receive the following warranty:

Warranty will match the warranty offering of the Sun server in which the HBA(s) are installed.

Installation is not included with the JNI products. Sun Enterprise Services will perform installations of these products on a time and material basis at customer request or as part of a Sun server installation service.

Sun Spectrum offerings do not exist for HBAs. Instead, a Spectrum service for the associated server is necessary to cover the HBA.

The Sun StorEdge™ 9900 series storage products are initially available with a list of specifically supported JNI Host Bus Adapters (HBAs) and Brocade Fibre Channel Switches. These Storage products, HBAs and Switches, when purchased from Sun only and configured per the 9900 series product support matrix, will be supported per the terms of the respective Sun warranty or Service contract.

The JNI Host Bus Adapters and Brocade Fibre Channel Switches are qualified, at this time, only with the Sun StorEdge™ 9900 series storage products and cannot be utilized with any other Sun storage product unless specifically stated in the product support matrix.

Sun will be adding additional HBAs, Switches and other associated products for the Sun StorEdge™ 9900 as quickly as possible. In addition, NWS will be reviewing the applicability of qualifying similar HBAs, Switches and other associated products on additional Sun storage products.

Q: RSCOPE?

A: Required. (See previous question.)

Q: Is it integrated with other Sun StorEdge™ software (Component Manager, InstantImage, SNDR, etc.)?

A: Compatible with:

- ✓ Sun StorEdge™ InstantImage
- ✓ Sun StorEdge™ SNDR
- ✓ Sun Cluster 3.0
- ✓ Sun Quick File System (QFS)
- ✓ Sun Storage Archive Manager File System (SAM-FS)
- ✓ HighGround Storage Resource Manager (SRM)

Not compatible with:

- ✓ Sun StorEdge™ Component Manager

Q: When will SKUs and pricing be available?

A: At GA (8/21/01), but you can place orders now, as they are available through your assigned storage SE; a list of storage SEs can be found at the gnss.ebay website. Use you normal process for financing and pricing.

Q: Supported configs?

A: Sun StorEdge™ 9960 system, Sun StorEdge™ 9910 system with either the Sun StorEdge™ 9900 series 18GB or the Sun StorEdge™ 9900 series 72GB HDDs or a combination of the Sun StorEdge™ 9900 series 18GB or the Sun StorEdge™ 9900 series 72GB HDDs.

Q: How do we and when can we order?

A: You can order now through your through your assigned storage SE; a list of storage SEs can be found at the gnss.ebay website. Use you normal process for financing and pricing.

Q: What category?

A: Pricing Category P.

Q: Any certifications?

A: Yes. Please refer to Sun StorEdge™ 9900 “What works with what” matrices on the GNSS website – An operating system, a clustering, a host server platform, an HBA, a Hub, and a Switch matrix are provided.

Q: How does maintenance work on this product?

A: Sun handles all maintenance and break/fix from the local mission-critical support centers; HDS will provide assistance when needed.

Q: When will Sun Store have it?

A: At GA (8/21/01)

Q: How do we drop an Sun StorEdge™ 9900 series into an existing T3/QLogic switch SAN; in other words, how do we configure, install, and support the Sun StorEdge™ T3 array and the Sun StorEdge™ 9900 series on the same SAN? (An existing Sun StorEdge™ T3 array/Brocade SAN will use different Brocade FW from what is supported on the Sun StorEdge™ 9900 series switch matrix.)

A: At this time an Sun StorEdge™ 9900 series cannot be attached to a Sun StorEdge™ T3 array/Qlogic SAN. Testing is currently underway for this configuration.

Q: Why is are Sun StorEdge™ 9900 series products referred to as “storage systems” and Sun StorEdge™ T3 array products referred to as “array subsystems?”

A: Because the Sun StorEdge™ 9900 series storage systems are completely host independent – all their functionality runs inside the box. Sun StorEdge™ T3 array subsystems are host dependent – their functionality requires a host to run.

Q: Are the disk drives used in the HDS 9200 Thunder and Sun StorEdge™ T3 arrays the same disk drives used in the Sun StorEdge™ 9900 Series?

A: No - the Sun StorEdge™ 9900 series uses HDDS specifically manufactured for and used in the Sun StorEdge™ 9900 series storage system. These HDDs are 3.0-inch form-factor drives (18GB and 72GB 10Krpm 100MB/sec active/active bi-directional dual-ported with segmented cache buffers). Data centers cannot tolerate even a single drive failure, so these drives have over three times the reliability as standard drives used in distributed arrays and the EMC Symmetrix. These drives are more expensive and almost never fail.

By contrast, the HDS Thunder 9200 and Sun StorEdge™ T3 array products use standard HDDs from Hitachi, Seagate, and/or IBM. These HDDs are standard form-factor 3.5-inch drives (36GB and 72GB 10Krpm 200MB/sec active/active bi-directional dual-ported).

Q: What are the differences between ShadowImage and TrueCopy?

A: TrueCopy is a new name for Remote Copy. It copies data from one storage system to another. The Sun StorEdge™ 9900 series and the HDS Freedom Storage 7700E can copy to/from each other over ESCON links, but not FC links. A Sun StorEdge™ 9900 series can copy to/from another Sun StorEdge™ 9900 series using TrueCopy over either an ESCON or FC link. ShadowImage is the function to make multiple copies of a LUN WITHIN the same storage system.

Q: How many physical cache slots are in the Sun StorEdge™ 9960?

A: There are four cache slots, each capable of holding 8GB of memory, for a total of 32GB. High performance cache capability consisting of four cache cards will be standard on these systems.

Q: What are the cache increments and rules for the Sun StorEdge™ 9960?

A: Cache increments will be on a 2GB basis with a 2GB base. All the cache boards must be upgraded with an equal amount of memory cards.

Q: What is the bandwidth of the cache?

A: The cache bandwidth is 3.2GB/s, 800MB/s per cache module.

Q: What is the amount of cache per actuator buffer?

A: 4MB.

Q: Does control I/O get directed through the same switch as data I/O? Or is there a separate switch for control I/O, or does it bypass a switch altogether and just travel over a bus?

A: Control I/O uses dedicated paths not shared with the data I/O. The paths to control memory do NOT use switches -- they are point-to-point connections only. There are in reality four switches, versus one big one. Logically they operate as one.

Q: How do UNIX®/NT SCSI-only servers attach to the Sun StorEdge™ 9900 Series?

A: SCSI-only servers may be connected to BigFish using any certified FC to SCSI gateway.

Q: How many logical paths does the Sun StorEdge™ 9900 series support per ESCON adapter?

A: Each ESCON interface supports up to 256 logical paths --maximum of 8,192 per Sun StorEdge™ 9900 series storage system.

Q: What are the basic maximum feed-and-speed differences between the Sun StorEdge™ 9910 system and the Sun StorEdge™ 9960 system?

A: Here is a handy quick-reference grid showing the key differences:

METRIC	Sun StorEdge™ 9960 System	Sun StorEdge™ 9910 System
Max. Configuration	1 Control Frame + 6 Array Frames	One Integrated Control/Array Frame
Max. Raw Storage	37TB	3.5TB
Max. Internal Bandwidth	6.4GB/sec	3.2GB/sec
Max. Data Cache	32GB	16GB
Max. Control Memory	1.5GB	1.5GB
Max. CHIPS	FOUR	THREE
Max. Host Interfaces	32 (FC or ESCON)	24 (FC or ESCON)
Max. ACP Pairs	FOUR	ONE
Max. Data Disks	496	44
Max. Hot Spares	16	4
Max. S/390 Logical Paths/ per ESCON interface	8,192/256	6,144/256
Available HDD Capacities	18GB, 72GB	18GB, 72GB

Q: Is Sun StorEdge™ 9910 upgradeable to Sun StorEdge™ 9960?

A: No. Sun StorEdge™ 9910 is a self-contained control/disk frame and is not upgradeable to Sun StorEdge™ 9960 configuration.

Q: Which host platforms does the Sun StorEdge™ 9900 series support?

A: Open systems - Sun Solaris/Sun Enterprise, IBM AIX/IBM RS6000, IBM AIX/IBM SP, HP-UX/HP 9000, MS Windows NT/Intel, MS Windows 2000/Intel, Novell NetWare/Intel, Red Hat Linux/Intel, SGI IRIX/SGI Origin 2000, Compaq Tru64 UNIX®/Compaq AlphaServer, Sequent DYNIX/PTX, DEC OpenVMS/DEC VAX.

Mainframe - MVS (OS/390, MVS/ESA, MVS/XA, TPF/MPLF, VM/ESA, VM/XA, VM/HPO, VSE/ESA, VSE/SP)/S390.

Q: When is/was full GA?

A: August 21, 2001

Q: What types of interfaces will be available for Sun StorEdge™ 9900 Series products?

A: ESCON and FC (FC-AL, FC, FC Switch)

Q: What is the mainframe kit and what's in it?

A: The mainframe kit contains S/390 base software and is required to connect the Sun Series 9900 to mainframes. Software included is S/390 versions of ShadowImage, VLVI, Extended Remote Copy Synchronous and Extended Remote Copy Asynchronous.

Q: Is Sun Cluster supported?

A: Yes, both Sun Cluster 2.2 and 3.0 are supported using specific Sun servers. Supported configurations are constantly being added, so please check with your Sun storage sales representative for details on which configurations are supported.

Q: Why are there "only" 32 front-end paths?

A: There is an almost unlimited amount of Sun StorEdge™ 9900 series connectivity - the 32 ports are highways into and out of Sun StorEdge™ 9900 series, each connecting at 100MB/s in FC mode. With a six-to-one fan-out ratio, when you use switches to connect Sun StorEdge™ 9900 series to hosts with FC HBAs, you can actually connect as many as 192 hosts into a single Sun StorEdge™ 9960! (144 for a Sun StorEdge™ 9910!)

Q: Will Sun StorEdge™ 9900 products be available for connection to all Sun servers? When?

A: Within 90 days of GA.

Q: Does the Sun StorEdge™ 9900 series segregate data from control I/O in its cache and on its data paths?

A: Data and Control I/O are indeed segregated in cache and are indeed on separate paths in the Sun StorEdge™ 9900 series. There are as many Control I/O paths as there are Data paths, and they are the same speed.

Q: Are Sun StorEdge™ 9900 series products customer-installable?

A: No, but they are customer-manageable and configurable through a highly intuitive GUI

Q: Are all Sun StorEdge™ 9900 series software products included in the agreement for distribution by Sun and are these compatible with Sun offerings?

A: All Sun StorEdge™ 9900 series software products can be sold by Sun.

They will only work on Sun StorEdge™ 9900 series, though.

Q: If I have a question, who do I call ?? Sun or HDS?

A: Sun!

Q: What message will we use to integrate current "modular" with new monolithic?

A: Basically, they serve different customer needs. Moreover, Sun StorEdge™ 9900 series is NOT a monolithic shared bus system; rather, it is a non-blocking fabric switching system with over 6X the bandwidth of competitive cache-centric monolithic systems!

Q: Can the Sun StorEdge™ 9900 series coexist with existing Sun StorEdge™ array products on the same Sun server?

A: Yes, just not on the same HBA (FC loop).

Q: Why do we have a Sun Spectrum Silver pricing in the Product Intro when the Warranty for the Sun StorEdge 9900 series is similar to the Sun Spectrum Gold level warranty – why don't we have the Sun Spectrum Platinum level upgrade in the product intro?

A: The Sun Spectrum Silver service pricing which is in the Product Intro is POST Warranty. The Presto! process requires Sun Spectrum Silver pricing be entered – there were no other choices as to the levels selected. There is a planned change to the Presto! process to fix this.

APPENDIX A: GLOSSARY

Alert

A message or log that a computing element generates as the result of an error event collection and analysis. An alert indicates that there is a need to perform some service action and can be sent by a variety of methods to operations personnel.

Asynchronous

Asynchronous communication (as in asynchronous remote copy) occurs when the transmission of data between two devices is not synchronized with a clocking scheme or other technique. The sender can send data at any time and the receiver can accept information when it becomes available. Synchronous communication is an exactly timed stream of bits when the start of a character is located by using a clocking mechanism such as bipolar encoding. Asynchronous and synchronous transmissions are used extensively in the mainframe terminal environment.

Asynchronous Remote Copy

Used to copy mainframe data from one storage system to another over channel extenders available from McDATA, CNT and INRANGE. Records are time-stamped to insure data is not lost or out of order. Since the transmission is asynchronous, data can be transmitted over unlimited distances.

Availability

In computer science, availability refers to the degree to which a system or resource is capable of performing its normal function.

b

Abbreviation for "bit" where 8 "bits" comprise a byte.

B

Abbreviation for "Byte" or the equivalent of one character in text.

BCV

Business Continance Volume is a term used in EMC's scheme for disaster recovery.

BIN File

BIN files are changed by EMC service reps only and are not believed to be non-disruptively changed. In order to make a volume a BCV volume, a BIN file change must be made. It is known that recovery from BIN file errors in Symmetrix have taken as long as 48 hours.

Business Interruption

Any event, whether anticipated (e.g., public service strike) or unanticipated (e.g., blackout) which disrupts the normal course of business operations at a corporate location.

Cache

Can be either on-chip memory circuits in a microprocessor (e.g. L2 processor cache), a reserved section of main memory (system or server cache), or an independent high-speed disk storage device (e.g., a hard disk). Two types of caching are commonly used in personal computers: Memory caching and disk caching. Disk caching can dramatically improve the performance of applications, because accessing a byte of data in RAM can be thousands of

times faster than accessing a byte on a hard disk. When data is found in the cache, it is called a cache hit, and the effectiveness of a cache is judged by its hit rate.

CKD

Count Key Data (CKD) is an ESA/390-architecture term for a logical device that specifies the format of and access mechanisms for the logical data units on a mainframe disk storage device. The logical data unit is a track that can contain one or more records, each consisting of a count field (Count), a key field (Key -optional), and a data field (Data - optional).

Client/Server Architecture

Client/Server Architecture is a network architecture in which each computer or process on the network is either a client or a server. Servers are powerful computers or processes dedicated to managing disk drives (file servers), printers (print servers), or network traffic (network servers). Clients are PCs or workstations on which users run applications. Clients rely on servers for resources, such as files, devices, and even processing power.

Cold site

An alternate facility that is void of any resources or equipment except air-conditioning and raised flooring. Equipment and resources must be installed in such a facility to duplicate the critical business functions of an organization. Cold-sites have many variations depending on their communication facilities, UPS systems, or mobility.

Consistency Groups

Both EMC's SRDF and open SRDF employ a technique of suspending multiple volumes at the same time that is known as Consistency Groups. The technique is part of the EMC disaster recovery scheme and is controversial as to the level of validity of the Point in Time copy that is generated.

CVS

Customized Volume for open systems.

DASD

An IBM-coined acronym that means Direct Access Storage Device.

Data Availability

Data availability refers to the degree to which a computer system is capable of providing data to users.

Data Copy

A term that refers to remote copy, data duplication, and data migration.

Data Duplication

Software that duplicates data as in remote copy or Point-in-Time (PiT) snapshots. Data duplication is differentiated from data migration in that with data duplication, at the end of the process there are two copies of data and with data migration, there is only one copy.

Data Migration

Software that migrates data from one storage device to another. This feature is different from data duplication in that at the end of the process there is only one copy of data.

Disaster Recovery

The practice of planning for disaster avoidance and restoration of services after a disaster. The level of preparedness to respond to an interruption in services by implementing a disaster recovery plan to restore an organization's critical business functions.

DR

Disaster Recovery.

Downtime

A planned or unplanned interruption in system availability. Planned downtime is usually for scheduled system maintenance and unplanned downtimes usually include business interruptions or disasters.

DSS

Decision Support Systems is a term referring to computer systems used in the areas of business intelligence such as data warehousing, data mining, OLAP, and others.

Duplexing

Term to describe the process of duplicating the same data (mirroring) and data pathing. Can only be hardware based. See also **Mirroring**.

Dynamic Link Manager

Server-based software utilities which enhance RAID systems by providing automatic error recovery from server-to-RAID channel connection failures. This product allows systems administrators to take advantage of the multiple paths on Sun StorEdge™ 9900 series systems by adding redundant connections. Supported platforms include IBM AIX, Sun Solaris, Windows NT, and Windows 2000.

Dynamic Optimization

The automatic on-the-fly (i.e., non-disruptive) movement of the content of a logical volume to another logical volume to eliminate "hot spots" and provide load balancing to maintain predetermined performance levels.

ECC

Error Correction Code. A protection scheme typically used in memory and array systems to insure that data which arrives at the target is the same as the data which was sent from the source.

Electronic Vaulting

The transfer of data to an offsite storage facility via a communication link rather than via portable media. Typically electronic vaulting is used for batch or journaled updates to critical files to supplement full backups taken periodically.

ESA/390

Enterprise Systems Architecture/390. Often abbreviated S/390 ESA/390 is an IBM architecture for mainframe computers and peripherals. Processor systems that follow this architecture include the IBM ES/9000 family.

ESCON

Enterprise Systems Connection architecture is an IBM mainframe ESA/390 computer peripheral interface or connection between two mainframes for data exchange. The I/O interface utilizes

ESA/390 logical protocols over a serial interface that configures attached units to a communication fabric. ESCON is based on networking technology. ESCON provides direct channel-to-channel connections between mainframe systems over fiber-optic links at distances up to 60 kilometers or 35 miles. ESCON also provides a way for communication controllers and other devices to share a single channel to a mainframe.

ESCON Director

An I/O interface switch that allows the interconnection of multiple ESCON interfaces in a distributed-star topology.

Extended Remote Copy

IBM XRC-compatible host-based software asynchronous remote copy. Using System Data Mover software, it guarantees data integrity for dependent write applications.

Fail-Over

Host or controller fail-over is the routing of all transactions to a second host, controller, or data path when the first host, controller, or data path fails.

Fast Write

A write operation at cache speed not involving transfer of data to disk. The system writes the data directly to nonvolatile cache. The data is then de-staged (written to disk) when system resources are available to complete the transfer. Fast write reduces the time an application must wait for the I/O operation to complete.

FC

Fibre Channel

FDDI

Fiber Distributed Data Interface. A LAN standard using fiber-optic media capable of data rates up to 100Mb/se over distances up to 100km. An FDDI network is a token-based logical ring.

FlashAccess

Sun StorEdge™ 9900 series software which allows specified (usually high access) data sets to be "pegged" or "pinned" (i.e., permanently placed in cache memory) so they are not managed by LRU algorithms. Can be used for either S/390 or open systems. Allows the creation, deletion, and monitoring of data pinned in cache.

Fibre Channel

ANSI standard designed to provide high-speed data transfers between computers and storage. Fibre channel makes use of a circuit/packet switched topology capable of providing multiple simultaneous point-to-point connections between devices. Fibre Channel is widely deployed in SAN implementations today. Fibre channel can be deployed in point-to-point, arbitrated loop (FC-AL), or switched topologies. Fibre channel nodes log in with each other and the switch to exchange operating information on attributes and characteristics. This information includes port names and port IDs and is used to establish interoperability parameters.

File Backup

The practice of copying a file stored on disk to tape is referred to as file backup. This is done in case the active file is damaged or lost. Backup is considered "local copy" as opposed to "remote copy" because typically, the tape device is located within the same facility as the disk device – the tape cartridges are then manually transported to another site.

Gigabyte

1024 Megabytes, abbreviated “GB” (NOTE: Gb is the abbreviation for Gigabit, which is eight times less than a GB.)

GraphTrack

Sun StorEdge™ 9900 series software which provides a highly robust set of system and network management utilities and provides graphical reports for performance and availability and configuration management.

GUI

Graphical User Interface – what the end user sees and utilizes to control software applications.

Hot Site

An alternate facility containing the equipment and resources to recover business functions which may be affected by the occurrence of a disaster or business interruption. Hot-sites may vary in type of facilities offered (such as data processing, communication, or any other critical business functions needing duplication). Location and size of the hot-site will be proportional to the equipment and resources needed. Similar terms include backup site; recovery site; recovery center; and alternate processing site.

InstantSplit

Enhancement to ShadowImage providing multiple copies of data against which new applications can be tested or data mining queries can be run. With InstantSplit and the bottleneck-free performance of the Sun StorEdge™ 9900 series, applications can be deployed much faster.

I/O

Input/Output – the reading and writing of data out of and into an I/O device.

I/O Device

An addressable read and write unit, such as a disk drive or magnetic tape.

I/O Interface

An interface which allows a host to perform read and write operations with its associated peripheral devices.

LAN

Local Area Network. High-traffic configuration used to pass data to and from users to and from systems,

LU or LUN

Logical Unit or Logical Unit Number. SCSI term for a logical disk drive.

Logical Volume (LV)

The storage medium associated with a logical disk drive. A logical volume typically resides on one or more storage devices. A host system sees a logical volume as a physical volume although a logical volume does not actually directly correlate with a physical disk drive.

LPAR

Logical Partition. IBM ESA/390 term for a set of functions which create the programming environment defined by the ESA/390 architecture. ESA/390 architecture uses this term when more than one LPAR is established on a processor. An LPAR is conceptually similar to a virtual

machine environment except the LPAR is a function of the processor. Also, the LPAR does not depend on an operating system to create the virtual machine environment.

LUN Manager

Software utility allowing for complete systems management of LUNs.

LUSE

The LUN Size Expansion feature of the Sun StorEdge™ 9900 series which allows standard size LUNs to be combined together to create larger LUNs.

MIB

Management Information Base is a set of standards for detailed system information reported to a control console for SNMP compliance. Its intent is to provide common metrics for heterogeneous computer systems.

Mirrored Pair

Two disk drives or cache segments containing the exact same data. The operating system software sees a mirrored pair as one entity and can read data from either device in the pair. RAID 1, RAID 1+, RAID 10, and RAID 1+0 are all examples of mirrored disk pair implementations.

Mirroring

Term to describe the process of writing the same data twice to two volumes. Can be hardware or software based. See also **Duplexing**.

MPLF

The Sun StorEdge™ 9900 series supports IBM's Multiple Path Locking Facility (MPLF) locking facility for IBM's highest performance transaction processing operating system, TPF. In either native TPF mode or under VM, MPLF provides extremely high performance record-level locking.

N+1

Term used to describe a particular form of redundancy. N is the number of primary devices – drives or power supplies in most cases – that provide the thing being delivered (data or wattage, respectively). 1 is the number of devices used to generate protection. So, in a 3+1 RAID 5, three HDDs are logically used for online capacity and one is logically used for parity generation. In a 2+1 power supply configuration, two supplies are used to generate the requisite system wattage and the third is used as a standby to provide backup in case of a failure of one of the primary two supplies.

Non-Blocking Architecture

Internal pathing design which provides multiple, redundant, paths between the storage ports, multiple cache nodes, and multiple disk Array Control Processors (ACPs). Each path runs at 100MB/s, permitting the Sun StorEdge™ 9900 series to scale up to 6.4GB/sec of system bandwidth (throughput). Six-to-eight times the internal bandwidth of shared fixed-SCSI bus storage systems. For redundancy and performance, this architecture consists of four cache switches cross-connected to four cache modules and two control memory banks. The control memory banks contain addressing and control information and are also cross-connected to front-end storage ports and back-end disk array ports. By contrast, a SCSI bus or SSA loop architecture blocks – or prevents – the free flow of data.

NVM or NVS

Non-Volatile Memory Non-Volatile Storage is a term used to refer to battery-backed RAM (cache) so the data which has been written to cache but not yet destaged (written to) disk will not be lost in the event of power failure.

NVRAM

Non-Volatile Random Access Memory such as static RAM will not lose data in the event that power is lost to the memory chips. Battery backup is not necessary because the data is hard-coded onto NVRAM.

Off-Site Storage Facility

A secure location, remote from the primary location, at which backup hardware, software, data files, documents, equipment, or supplies are stored.

Online

Term used to describe the part of a system which is available to users. For storage, the part of the total disk or cache capacity that is available to store data, with the remaining part being the part of the total disk or cache capacity used for redundancy, which can be used either for mirroring or parity.

Open Asynchronous Remote Copy

Hardware-based utility providing asynchronous remote copy capability for open system computers. This allows remote copies over virtually unlimited distances. Supported open operating systems include HP-UX, IBM AIX, Sun Solaris, Digital UNIX®, Sequent DYNIX/ptx, SGI IRIX, NCR, UNIX SVR4, Windows NT, and Windows 2000.

Open Remote Copy

A synchronous hardware-based remote copy utility for open system computers. Requires the use of ESCON channels. Supported open operating systems include HP-UX, IBM AIX, Sun Solaris, Digital UNIX®, Sequent DYNIX/ptx, SGI IRIX, NCR, UNIX® SVR4, Windows NT, and Windows 2000.

Open ShadowImage

Point-in-Time (PiT) copy capability allowing data replication and fast resynchronization of logical volumes for open system computers. Nine copies of a logical volume may be maintained within the same Sun StorEdge™ 9900 series system.

Open System

A system whose characteristics comply with defacto standards made available throughout the industry, and therefore can be connected to other systems complying with the same standards.

Operating System (OS)

Performs system-level basic tasks such as recognizing input from a keyboard, sending output to the display screen, keeping track of files and directories on the disk and controlling peripheral devices such as disk drive and printers or a mouse. The OS acts as a traffic cop and schedules the various programs for the computer to execute. The OS is also responsible for security, ensuring that unauthorized users do not access the system. Operating systems can be classified as follows: 1) Single or Multi User – allows one (single) or two or more (multi) users to run programs at the same time. 2) Multi-processing – supports running a program on more than one CPU. 3) Multi-tasking – allows more than one program to run concurrently. 4) Single or Multi Threaded – Only one part of a program can run at any one point in time (single) or

different parts of a program can run concurrently (multi). 5) Real Time – Usually a stripped down OS which responds to input instantly.

Overhead

Non-productive work. I/O used for control information to manage file or index tables, e.g.

Parity

A data-checking scheme used to ensure the integrity of the data. RAID implementation uses parity to recreate data if a disk drive fails. Can also be used to protect cache.

PiT Copy

Point-in-Time copy. A copy of data taken at a specific point in time. PiT copies are used in many ways including backups and checkpoints. ShadowImage and InstantImage are examples of PiT programs.

PPRC

Peer-to-Peer Remote Copy. IBM term referring to the function of a storage controller that maintains a consistent copy of a logical volume on the same controller or on another controller. Access to the remote controller occurs over an ESCON I/O interface or a network. All modifications to the primary logical volume are also performed to the secondary logical volume. The user can request the controller perform the modifications synchronously (before the controller completes the modification of the primary copy).

PTAM

Pick-up Truck Access Method is a "tongue-in-cheek" acronym used in disaster recovery referring to accessing data by physically getting a backup tape from a remote storage facility.

RAID

Redundant Array of Independent Disks. RAID is used to increase the availability of disk arrays by providing redundancy either through complete duplication of the data (RAID 1 or RAID 10) or through construction of parity data for each data stripe in the array (RAID 3 or RAID 5, e.g.). The Sun StorEdge™ 9900 series RAID 5 algorithms enable faster performance than EMC Symmetrix RAID 1 or RAID "S" or IBM Shark/Compaq Red Shark. The Sun StorEdge™ 9900 series also offers RAID 1+. The EMC Symmetrix does not offer RAID 5 or RAID 10. The IBM Shark/Compaq Red Shark does not offer RAID 1 or RAID 10.

RAID 0

Striping at the block level across all the drives in the array group with no redundancy or parity. File "X" is interleaved at the block level across all the HDDs in the array group. Primary use is video streaming apps where redundancy is not needed.

RAID 1

JBOD mirroring; i.e., no striping; paired HDDs; file "X" resides on the primary HDD and a copy of "file x" resides on the secondary HDD in the mirrored pair. Primary use is transactions where redundancy is needed.

RAID 3

Three data HDDs and one parity HDD. Striping at the bit level across the three drives in the data array group with the fourth drive generating parity. File "X" is interleaved at the bit level across the three HDDs in the data group. Primary use is video streaming apps where redundancy is needed.

RAID 5

Striping at the block level across all the drives in the array group with parity interleaved across all the drives in the array group. File "X" is interleaved at the block level across all the HDDs in the array group. Primary use is generally for most everything.

RAID 10

Generic term for either RAID 1+0 or RAID 0+1.

RAID 0+1

Striping then mirroring. The full stripe (at the block level) is mirrored to another full stripe. Losing two HDDs in one stripe does not cause data loss, but losing one HDD in one stripe and another HDD in the other does cause complete data loss in the entire array. HDD proximity does not determine data loss.

RAID 1+

Alternating striping then mirroring. Each drive in the array has alternating primary blocks and secondary blocks. In the case of the Sun StorEdge™ 9900 series, a RAID 1+ array group is always exactly four drives. This allows for the loss of any two drives in the array, no matter their proximity, with no loss of data.

RAID 1+0

Mirroring then striping. Block level striping with mirrored blocks residing on adjacent HDDs in the array. HDD proximity can determine data loss because losing two adjacent HDDs causes data loss, but losing any two non-adjacent HDDs does not cause data loss.

RAID Controllers

Hardware implementation of RAID levels which provides a highly optimized scheme for performing RAID configurations on storage systems. EMC Symmetrix cannot perform striping because it does not have RAID controllers inside the box; IBM Shark/Compaq Red Shark perform RAID 5 because they do.

RapidXchange

Provides for the file conversion and exchange of data between S/390 and open systems hosts. Provides file access library software for open systems hosts and runs on the following host servers: IBM AIX, Sun Solaris, HP-UX, Compaq Tru64 UNIX®, Sequent DYNIX/ptx, SGI IRIX, NCR UNIX® SVR4, Windows NT, and Windows 2000.

Multi-platform resource sharing is built right into the Sun StorEdge™ 9900 series. Users can share resources between UNIX®- or Windows NT/2000-based servers and S/390 mainframe platforms. Sharing resources across heterogeneous platforms lowers total cost of ownership, provides a centralized point for data management, and simplifies the management of heterogeneous systems.

Recovery Time

The period from the onset of a disaster to the recovery of critical functions.

Remote Copy

Generically term for software or hardware utilities which provide the capability to copy data from one online volume to remote volumes. Sun StorEdge™ 9900 series can perform remote copy functionality without impacting (i.e., disrupting) production or service. Synchronous techniques

are used for short distances (typically less than 25 miles) and asynchronous techniques over LAN/WAN/MAN are used for longer distances at any distance.

Remote Copy Links

This term refers to the links used between storage systems for the movement of data. Links are either direct-connect ESCON or network links (e.g., T1, T3, A™). For direct connect ESCON there is a limit of 43km (25 miles); however newer technologies, such as the Nortel OPTERA™ product are allowing direct fibre connect over longer distances.

Resource Manager

Suite of management software which includes GraphTrack, Virtual Logical Volume Image (VLVI) Manager, FlashAccess, LUN Manager, and Prioritized Port Control.

SAN

Storage Area Network. SANs connect storage systems and servers together through Fibre Channel or Ethernet switches. The major benefits of SANs include outboard backup, sharing of resources, pooling, and reduced cost of storage management. Storage Area Networks are really high-speed sub-networks of shared devices. A SAN architecture works in a way that makes all storage available to all servers on in the SAN. Because stored data does not reside directly on any of a network's servers, server power is utilized for business applications.

SANTinel

Software controlling host access to Sun StorEdge™ 9900 series LUNs in open systems or SAN environments.

SCSI

Small Computer System Interface. Intelligent bus-level interface defining a standard I/O bus and a set of high-level I/O commands. There are currently many types of SCSI defined by different clock speeds and bus widths. The major variations of SCSI bus and clocking are standard 5MB/sec, (Fast/Narrow 10MB/sec and Fast/Wide 20MB/sec), Ultra SCSI (Fast/Narrow 20MB/sec and Fast/Wide 40MB/sec), LVDS (Low Voltage Differential SCSI at 80MB/sec), 160M 160MB/sec, and the upcoming 320M 320MB/sec. Command sets are defined by SCSI 1, SCSI 2, SCSI 3, and the upcoming SCSI 4. FC protocol encompasses SCSI commands.

ShadowImage

Point-in-Time (PiT) software copy utility which creates up to ten copies of a volume within one Sun StorEdge™ 9900 series system, or up to 20 across multiple Sun StorEdge™ 9900 series systems. Either GUI or CCI control data replication and fast resynchronization of logical volumes. Available for open systems or mainframe environments.

Snapshot

A term referring to a copy of a file system at a certain point in time. Snapshots are used for backup and recovery. A snapshot is a point in time copy. A snapshot can either be an image or an increment of a file.

SNMP

Simple Network Management Protocol used for communication between simple, server-resident SNMP agents that respond to network administration requests from simple-to-sophisticated SNMP manager tools running on remote workstations.

Stripe

In RAID terminology, a stripe is when data is read or written in parallel to or from multiple disks instead of reading or writing all data to one disk. Striping provides much higher performance through its parallel design. A stripe *interleaves* data across a set of drives either at the bit or the block level or a stripe may refer to parity rotated across a set of drives as in RAID 5.

SWAN

Storage Wide Area Network. SWANs are interconnected SANs over long distances. They are made possible by Fibre Channel and ESCON extenders.

Synchronous

Synchronous communications occurs when the transmission of data between two devices is synchronized with a clocking scheme or other technique. The sender and receiver need to synchronize with one another before data is sent.

In synchronous communication the bit stream and the clock pulse are synchronized by a special bit transition pattern in the digital signal creating an exactly timed stream of bits from the sending device to the receiving device. An example of such a mechanism is bipolar encoding. Synchronous communication is either character or bit oriented. Character oriented synchronous transmissions are used to send blocks of characters such as found in ASCII files. Bit oriented synchronous communication is used primarily for the transmission of binary data.

TB

A Terabyte (TB) equals 1024 Gigabytes. Tb refers to Terabit and is not currently used.

TPF

Transaction Processing Facility or TPF is IBM's highest performance transaction processing software environment. TPF is used by many of the world's largest Customer Reservation Systems such as SABRE and by the world's largest financial institutions. TPF uses a high performance record-locking scheme called MPLF.

VLVI

Virtual Volume Image. VLVI Manger is a software utility which allows for configuration of RAID configurations, create, delete, verify, rebuild, tune, and abort operations.

Volume

An ESA/390 term for the information recorded on a single disk unit or recording medium. Indirectly, a volume can refer to the unit of recording medium itself. On a non-removable medium storage device such as a disk drive, the terms may also refer, indirectly, to the storage device that is associated with the volume. When a user stores multiple volumes on a single storage medium transparent to the program, the volumes are referred to as logical volumes.

WAN

Wide Area Networks are networks of computers geographically dispersed and connected by radio waves, telephone lines, satellites, or high-speed fibre optic backbones.

Warm Site

An alternate-processing site which is only partially equipped (As compared to Hot Site which is fully equipped).

XRC

Extended Remote Copy is IBM's implementation of a software asynchronous Remote Copy technique that preserves data integrity.

APPENDIX B: COMMONLY MISUSED STORAGE TERMS

FCAL CONTROLLER CARD VS. FCAL CONTROLLER

Technically, there is no such thing as the former; the latter refers to the intelligent control circuitry on the FCAL drive.

HBA VS. CONTROLLER

A SCSI or FCAL Host Bus Adapter (HBA) is not really a controller - the control circuitry resides on the drive. In the case of hardware RAID arrays, there is a RAID controller which resides in the drive tray and the HBA is used to drive the controller which handles the RAID functions such as caching, striping, and the like.

Many people improperly use the term "controller" when what they really mean is "host bus adapter." The intelligence for SCSI and FCAL resides on the drive itself, and the adapter card (i.e., the HBA) merely acts as a conduit for data flow.

By comparison, in ATA technology, the intelligence resides on the ATA controller and the drive is "dumb" (i.e., no intelligence). With HBAs, that's reversed - i.e., the PCI (or cPCI or SBus or HSC) card is "dumb" and the drives are "intelligent." An HBA connected directly to one or more SCSI (or FCAL) drives is a JBOD (Just A Bunch of Disks).

HOT SWAP VS. HOT PLUG

Hot Swap refers to the system having duplicate components which are removable and replaceable while power is on such that the system continues operation during removal and replacement; Hot Plug refers to an individual component's capability to be part of a hot swap system - i.e., the component by itself is hot plug, but in order for it to be hot swap, it must be part of a system with that capability. Hot swap requires extra circuitry to insure non-disruptive operation and must be supported by the operating system.

LOAD SHARING VS. LOAD BALANCING

These terms get mixed up when they are use to apply to power supplies. Load Sharing is the ability of two or more power supplies to distribute the system's wattage (i.e., the power load); Load Balancing (or Current Sharing) is the ability of those power supplies to distribute it evenly.

MIRRORING VS. DUPLEXING

Mirroring is the duplication of JBODs; Duplexing is the duplication of JBODs plus the duplication of the entire data path from the host to the drives.

PCI RAID CONTROLLER CARD

Used on Intel-based servers, this card combines HBA with RAID controller circuitry and is used to connect to JBODs, turning them into a hardware RAID array. This kind of array configuration is known as a Host Bus Array; by comparison, an array with the RAID controller circuitry residing in the external drive enclosure connected to an HBA inside the host is known as a Hub Array.

RAID 1 VS. RAID 0

RAID 1 is mirrored JBOD drives requiring paired drives, and RAID 0 is striped drives with no redundancy requiring at least two drives on up (since RAID is an acronym for "Redundant Arrays of Independent Drives" technically, RAID 0 is really an "AID" since there is no redundancy).

RAID 1 VS. RAID 1+0

RAID 1 is mirroring without striping, requires even numbered pairs of drives, and the files reside in their entirety on the primary drive and are mirrored to the secondary mirrored drive (note: mirroring allows for spanning.) RAID 1+0 is mirrored striping which occurs at the block level, requires a minimum of two drives (even or odd numbers are allowed).

SCALABILITY VS. EXPANDABILITY

Expandability refers to the ability to grow the overall capacity of a storage system by adding more drives; Scalability refers to the ability to expand capacity while either maintaining present levels of performance (as in the case when additional capacity is added due to the addition of more users) or increasing performance (as in the case where more horsepower is needed from an existing database application, e.g.).

SCSI CONTROLLER CARD VS. SCSI CONTROLLER

Technically, there is no such thing as the former; the latter refers to the intelligent control circuitry on the SCSI drive.

STRIPING VS. SPANNING

Striping is interleaving files at the bit or the block level (RAID level dependent) across two or more drives; Spanning is what occurs when a JBOD drive cannot contain an entire file – the first part of the file resides on the first primary drive, with the remainder of the file residing on the next primary drive (spanning requires at least four mirrored drives – two primary and two secondary).

APPENDIX C: CALCULATING LOST SALES WORKSHEET

Not all interruptions threaten the life of the enterprise or the life of a human being (911 services). However, some industries are far more sensitive to computer-system-related business interruptions than others. For example, it costs less for an hour of downtime for an A™ than it costs for a packing and shipping center. And it costs far more for a credit card sales authorization center to be down for an hour than it does for a catalog sales center. Imagine the impact on a retailer or on an e-tailer! Below are some worksheets you can use when working with a customer to underscore this concept.

1. CALCULATING LOST SALES

DESCRIPTION	Example	Your Prospect
Sales per year	\$93,000,000	
Divided by number of employees	600	
=Revenue/employee per year	\$155,000	
Divided by hours system is used per year (assuming 40 hrs/week)	2080	
= Revenue/employee per hour	\$75	
Multiplied by the number of employees	600	
= Total employee revenue per hour	\$45,000	
Multiplied by hours of system downtime per year	36	
= Amount of lost sales per year	\$1,620,000	

2. CALCULATING LOST PRODUCTIVITY

1. Calculating Lost Productivity

DESCRIPTION	Example	Your Prospect
Average pay per employee per hour	\$15	
Multiplied by the number of employees	600	
=Total employee pay per hour	\$9,000	
Multiplied by hours of system downtime per year	36	
= Amount of lost productivity per year	\$324,000	

3. CALCULATING COMPANY IMAGE COST

DESCRIPTION	Example	Your Prospect
Sales per year	\$93,000,000	
Multiplied by .001	\$93,000	
Multiplied by the number of days of system downtime (36 hours of downtime divided by 8 - assuming normal system operation shift)	4.5	
= Company image cost per year	\$418,500	

4. CALCULATING TOTAL YEARLY COST

DESCRIPTION	<i>Example</i>	<i>Your Prospect</i>
Lost Sales +	<i>\$1,620,000</i>	
Lost Productivity +	<i>\$ 324,000</i>	
Company Image Cost	<i>\$ 418,500</i>	
= Total cost due to system downtime per year	<i>\$2,362,500</i>	

The "Scale of 9's" is an accepted measure of computer system availability. This scale is used to classify computer system availability into ten levels, based on the number of "nines" in the availability equation. As shown in the illustration below, for example, a Level 2 computer system is available 99% of the time in an average year with an expectancy of 1% downtime per year. This 1% translates into **87.6 hours** of unplanned downtime. This is far greater than a Level 7 computer system with unplanned downtime of **3 seconds per year**. Typically, fully fault tolerant computers exhibit the availability of level 5.

Level	% Availability	% Downtime	Downtime
1	90%	10%	876 hours
2	99.0%	1%	87.6 hours
3	99.9%	.1%	8.76 hours
4	99.99%	.01%	52.56 minutes
5	99.999%	.001%	5.25 minutes
6	99.9999%	.0001%	31.54 seconds
7	99.99999%	.00001%	3.15 seconds
8	99.999999%	.000001%	.31 seconds
9	99.9999999%	.0000001%	.03 seconds

Sun provides backup and restore solutions to help reduce the total cost of ownership. Sun StorEdge™ 9900 series storage systems help enterprises to reduce downtime, to rapidly restore data, and to recover applications.

APPENDIX D: BUSINESS CONTINUITY QUESTIONNAIRE

Here is a questionnaire which can be used as a starting point for assessing an enterprise's IT environment and its ability to prevent - and recover from - interruptions of its computer systems.

1. Is your enterprise interested in:

- Real time Remote Copy for disaster recovery?
- PiT copies for backups, application testing, data warehousing?
- Data migration services for new equipment acquisition or Data Center Consolidation?

2. What does your enterprise do today for:

- Backup?
- Disaster recovery?
- Data migration?

3. Does your enterprise have a long-term relationship with a DR provider e.g. Comdisco, Sungard, IBM BRS?

4. Does your enterprise have an alternate facility of its own or are you thinking of building one?

- What is the location in relation to the primary site (distance)?
- What data communication linkages presently exist or will exist in the near future (i.e., telephone lines - type, number - etc.)?

5. For Disaster Recovery, please rank what is most important to you on a scale of 1-10 (1=not important at all and 10 = Critically important)

- No impact to performance at primary location.
- Data integrity/consistency
- Ease of use
- Cost of solution
- Distance limitations

6. At your primary data center, what type of natural disaster could impact a potential backup data center within a 40km (25 miles) radius?

- Earthquake
- Flood
- Hurricane
- Tornado
- Other (please specify)

7. What other types of outages are you concerned about

- Sabotage
- Human error
- Software/application errors

- 8. What is your Recovery Time Objective (RTO) for mission critical applications following a disaster? e.g., What is the allowable time to re-establish your systems so that these applications are on-line again?**
 - Under 5 minutes
 - 5 minutes - 2 hours
 - 2-8 hours
 - 8-24 hours
 - More than 24 hours
- 9. What is your Recovery Point Objective (RPO) for mission critical applications following a disaster? E.g. how much data can your business afford to lose, once these applications are re-established?**
 - Zero to a few transactions
 - Under 2 hours of transactions
 - 2-8 hours of transactions
 - 24-48 hours of transactions
 - More than 48 hours of transactions
- 10. Do you have a need for planned outage support, where you may have a building shutdown and need to move critical applications for short periods of time?**
- 11. For PiT copies (Backups), can you take an application outage and for how long?**
- 12. Do you have a batch window problem? If yes, is it due to any of the following:**
 - Before and after backup times?
 - The length of the batch cycle itself, possibly storage performance issues?
 - Application problems during cycle?
- 13. Do you require copies of production data made on a frequent basis for test databases, data warehousing applications, etc.?**
- 14. Do you migrate or move data around for performance on a frequent basis?**
- 15. 15) What software do you currently have installed that is being used for DR, backups, etc?**
 - VERITAS?
 - Innovation Products (FDR ADR.)?
 - DFSMS?
 - BMC utilities?
 - TDMF?
 - Oracle Hot Backup?
 - Informix?
 - DB2?
 - Sybase?

APPENDIX E: ENTERPRISE SERVER, STORAGE & TAPE SYSTEMS SUMMARY

KEY CUSTOMER CONTACTS

Please complete the table below of key client contacts. Each client may or may not have a person in each role. These positions are instrumental in any kind of enterprise solution.

Position	Contact Name	Contact Phone Number
CEO		
CIO		
CTO (Chief Technology Officer)		
Data Center Manager		
Networking Manager		
Server Manager		
Desktop Manager		
Storage/SAN Manager		

ANNUAL EXPENDITURES

What are the annual budgets for Storage, Backup, Unix systems and services?

DATA CENTERS

Please describe the client's Data Centers

Data Center	City	Network Topology	# of Servers	Disk Capacity
Data Center #1				
Data Center #2				
Data Center #3				

UNIX® SERVER ENVIRONMENT

Please provide as much data as you can in the following areas:

- ◆ Is there a Unix strategy today? If so, what is the strategy and what are the standards?
 - IBM RS/6000
 - HP 9000
 - Sun Enterprise
 - Others
 - Combination

- ◆ Are there any standards set in this area? If so, please describe:

- ◆ What are the annual expenditures in the Unix area?

SERVER ENVIRONMENT

Please list the number of servers in each category and as many OS levels as you can.

Server Platforms	Number of Each	OS Revision Levels
NT / Windows 2000		
Netware		
HP 9000 (HP-UX)		
IBM RS/6000 (AIX)		
SUN (Solaris)		
Others (MVS, VM, VM S, etc...)		

STORAGE ENVIRONMENT

Please list the Storage components and the number of gigabytes of each as well as any growth patterns that you are aware of.

Storage Type/Vendor	Storage (GB)	Expected Growth Rate (%/yr)
Direct Attached (Server Internal and External)		
NAS Appliance		
EMC Symmetrix		
EMC Clariion		
IBM Shark / Compaq Red Shark		
HDS 7700E / HP XP256		
HDS 9900 / HP XP512		
HDS 9200		
Sun T3		
Compaq StorageWorks		
Others		

STORAGE AREA NETWORK

Please provide as much data as you can in the following areas:

- ◆ Is there a SAN in place today? If Yes, please describe vendors. (i.e. software environment, hubs, switches, SCSI to Fiber)

Are there any plans in the immediate or near term to deploy SAN technology? Please describe:

- ◆ Are you aware of the potential benefits associated with a SAN?

APPLICATION ENVIRONMENT

What are the key applications running in the client environment and what platforms do they run on?

Application	Platform and OS	Mission Critical (Yes / No)
MS Exchange		
Oracle		
MS SQL Server		
Informix		
Sybase		
IBM DB2		
IBM UDB		
ERP (e.g., SAP, Peoplesoft, Baan)		
CRM (e.g., Siebel)		
Novell Groupwise		
File and Print		
Lotus Notes		
Others (Please List)		

DISASTER RECOVERY STRATEGY

Please provide as much data as you can in the following areas:

- ◆ Is there a server-based high-availability strategy for any of the above applications/servers (i.e. clustering with server fail-over)? If Yes, please describe:
- ◆ Is there a storage-based high-availability strategy for any of the above applications/servers (i.e. disk fail-over, etc.)? If Yes, please describe:
- ◆ Is there a disaster recovery or business continuance strategy in place or planned? If Yes, please describe:
- ◆ Has this been reviewed/and or tested recently?

BACKUP ENVIRONMENT

Please provide as much data as you can in the following areas:

- ◆ Is there an Enterprise Backup solution in place? Does it include backup for clients (desktops, laptops, etc.)? Please describe:
- ◆ Do you have needs for an automated tape library? Please expand:
- ◆ What tape formats do you currently have deployed? (e.g., 4mm, 8mm, DLT, AIT, 3590, etc)

- ◆ Do you plan to move to Super-DLT or LTO tape?
- ◆ Please describe any server-based backup or workgroup based backup being used:
- ◆ What backup software is currently being used?
 - Legato
 - CA Arcserve
 - VERITAS Netbackup
 - VERITAS BackupExec (formerly Seagate)
 - IBM/Tivoli Storage Manager (formerly ADSM)
 - EMC's EDM
 - Other

◆ Does the client plan on keeping this software solution?

◆ What is the current level of satisfaction with present backup methods?

◆ Please describe the current backup window, server downtime requirements, etc?

- ◆ What is the current backup process?
 - Full Backups (frequency/duration)
 - Incremental (frequency/duration)

Please Describe:

◆ What is the current restore process?

◆ What are the customer restore requirements? How long does a complete restore take (by server or storage subsystem)?

◆ Has the restore process been tested? Please describe: