

Sun StorEdge™ 9970 and 9980 Systems

Just the Facts

Version 1.0



Sun Microsystems Proprietary — Confidential: Need-to-Know

Revision History

Last update: 07/18/02

Copyrights

© 2002 Sun Microsystems, Inc. All rights reserved.

Sun, Sun Microsystems, the Sun logo, Sun StorEdge, and Solaris are trademarks or registered trademarks of Sun Microsystems, Inc., in the United States and other countries. UNIX is a registered trademark in the United States and other countries, exclusively licensed through X/Open Company, Ltd. Hitachi Data Systems is registered with the U.S. Patent and Trademark Office as a trademark and service mark of Hitachi, Ltd. The Hitachi Data Systems logotype is a trademark and service mark of Hitachi, Ltd. Freedom Storage, Lightning 9900, ShadowImage, CruiseControl, Dynamic Link Manager, Extended Remote Copy, Multi-Platform Backup/Restore, RapidXchange, Performance Monitor, Remote Console/Storage Navigator, Parallel Access Volumes/Multiple Allegiance, Priority Access, SANtinel, HiCommand, and Resource Manager are trademarks of Hitachi Data Systems Corporation Information subject to change without notice.

All SPARC trademarks are used under license and are trademarks or registered trademarks of SPARC International, Inc. in the United States and other countries. Products bearing SPARC trademarks are based upon an architecture developed by Sun Microsystems, Inc.

UNIX is a registered trademark in the United States and other countries, exclusively licensed through X/Open Company, Ltd.



Sun Microsystems Proprietary/Confidential: Sun Employees Only - Need-to-Know

Table of Contents

Product Positioning.....	1
Introduction.....	1
Virtualization Capabilities.....	1
Sun StorEdge 9980 System.....	2
Sun StorEdge 9970 System.....	2
Product Family Placement.....	2
Product Demand History.....	3
Key Features and Benefits.....	4
Availability Dates.....	5
Target Markets and Users.....	5
Installation.....	6
Warranty.....	7
Service & Support.....	8
Professional Services.....	9
Supported Server and SAN Configurations.....	9
Sun StorEdge 9910 and 9960 Systems EOL Plans.....	9
Sun StorEdge 9960 Systems Upgrade Strategy.....	10
Disruptive Upgrade.....	10
Non-disruptive Upgrade.....	10
Selling Highlights.....	11
Market Value Proposition.....	11
Competition.....	13
EMC.....	14
IBM.....	15
HP.....	15
Overview of the Sun StorEdge 9970 and 9980 Systems.....	16
Key Features of the Sun StorEdge 9970 and 9980 systems.....	16
Continuous Data Availability.....	17
Connectivity.....	17
S/390 Compatibility and Functionality.....	17
Open Systems Compatibility and Functionality.....	18
Software Products and Service Offerings.....	18
System Scalability.....	20
Reliability, Availability, and Serviceability.....	21
System Architecture and Components.....	23
Overview.....	23
Components of the Controller Frame.....	27
Storage Clusters.....	27
Nonvolatile Shared Memory.....	28
Nonvolatile Duplex Cache.....	28
Multiple Data and Control Paths.....	28
Redundant Power Supplies.....	28
Channel Adapters and CHiPs.....	29
Channels.....	30
Array Control Processors (ACPs).....	30
Array Frame.....	32
Disk Array Groups.....	33
Sequential Data Striping.....	34
Intermix Configurations.....	35
RAID-1 & RAID-5 Intermix.....	35



Hard Disk Drive Intermix.....	35
Device Emulation Intermix.....	36
Service Processor (SVP).....	36
Sun StorEdge Remote Console – Storage Navigator.....	36
Functional and Operational Characteristics.....	38
NEW Sun StorEdge 9970 and 9980 systems Features and Capabilities.....	38
I/O Operations.....	38
Cache Management.....	39
Algorithms for Cache Control.....	39
Write Pending Rate.....	39
Control Unit (CU) Images, LVIs, and LUs.....	39
CU Images.....	39
Logical Volume Image (LVIs).....	40
Logical Unit (LU) Type.....	40
Open Systems Features and Functions.....	42
Failover and SNMP Support.....	42
Share-Everything Architecture.....	42
Data Management Functions.....	42
Sun StorEdge 9900 TrueCopy Software.....	44
Sun StorEdge 9900 TrueCopy Software – S/390.....	45
Sun StorEdge 9900 ShadowImage Software.....	45
Sun StorEdge 9900 ShadowImage Software – S/390.....	45
Command Control Interface (CCI).....	46
Sun StorEdge 9900 Extended Remote Copy Software.....	46
Sun StorEdge 9900 RapidXchange Software.....	46
Sun StorEdge 9900 Multiplatform Backup/Restore Software.....	47
Sun StorEdge 9900 HiCommand Software.....	47
Sun StorEdge 9900 LUN Manager Software.....	47
LU Size Expansion (LUSE).....	47
Sun StorEdge 9900 Virtual LVI/LUN Software.....	48
Sun StorEdge 9900 FlashAccess Software.....	48
Sun StorEdge 9900 Cache Manager Software (S/390).....	48
Sun StorEdge 9900 SANtinel Software.....	48
Sun StorEdge 9900 SANtinel Software – LDEV Security.....	49
Sun StorEdge 9900 Parallel Access Volume Software.....	49
Sun StorEdge 9900 Dynamic Link Manager (SDLM).....	49
Sun StorEdge 9900 Performance Monitor Software.....	49
Sun StorEdge 9900 Priority Access Software.....	50
Sun StorEdge 9900 CruiseControl Software.....	50
Sun StorEdge 9900 Graph-Track Software.....	50
Sun StorEdge 9900 Remote Console – Storage Navigator Software.....	51
Configuring and Using the Sun StorEdge 9970 and 9980 Systems.....	52
Open Systems Configuration.....	52
Configuring the Fibre Channel Ports.....	52
Virtual LVI/LUN Devices.....	53
LU Size Expansion (LUSE) Devices.....	53
Open Systems Operations.....	53
Command Tag Queuing.....	53
Host/Application Failover Support.....	53
Path Failover Support.....	53
SIM Reporting.....	54
SNMP Remote System Management.....	54
Control Panel.....	55
Emergency Power-Off (EPO).....	57



Planning for Installation and Operation.....	58
User Responsibilities and Safety Precautions.....	59
Safety Precautions.....	59
Dimensions, Physical Specifications, and Weight.....	60
Service Clearance, Floor Cutout, and Floor Load Rating Requirements.....	62
Electrical Specifications and Requirements for Three-Phase Systems.....	68
Power Plugs for Three-Phase.....	68
Features for Three-Phase.....	70
Current Rating, Power Plugs, Receptacles, and Connectors for Three-Phase (60 Hz only).....	71
Input Voltage Tolerances for Three-Phase.....	71
Cable Dimensions for 50-Hz Three-Phase Systems.....	72
Electrical Specifications and Requirements for Single-Phase Systems.....	72
Power Plugs for Single-Phase.....	72
Features for Single-Phase.....	76
Current Rating, Power Plugs, Receptacles, and Connectors for Single-Phase (60 Hz only).....	76
Input Voltage Tolerances for Single-Phase.....	77
Cable Dimensions for 50-Hz Single-Phase Systems.....	77
Cable Requirements.....	78
Device Interface Cable.....	79
Channel Specifications and Requirements.....	79
Environmental Specifications and Requirements.....	80
Temperature and Humidity Requirements.....	80
Loudness.....	80
Air Flow Requirements.....	81
Vibration and Shock Tolerances.....	81
Appendix A: Acronyms and Abbreviations.....	82
Appendix B: Unit Conversions.....	86



List of Figures

Figure 1	Sun StorEdge 9900 Series Shipments by Capacity Range.....	3
Figure 2	Sun StorEdge 9900 Series Shipments – Ports per Capacity Range.....	4
Figure 3	Sun StorEdge 9980 System’s Switched Fabric Architecture.....	24
Figure 4	Sun StorEdge 9980 System Frames.....	25
Figure 5	Sun StorEdge 9970 System Frame.....	26
Figure 6	Conceptual Sun StorEdge 9980 System’s ACP Array Domain.....	31
Figure 7	Sample RAID-1 Layout.....	33
Figure 8	Sample RAID-5 Layout (Data Plus Parity Stripe).....	34
Figure 9	Sample Hard Disk Drive Intermix.....	35
Figure 10	Sample Device Emulation Intermix.....	36
Figure 11	Example of Remote Console PC and SVP Configuration.....	37
Figure 12	Fibre Channel Device Addressing.....	41
Figure 13	Fibre Port-to-LUN Addressing.....	52
Figure 14	Alternate Pathing.....	54
Figure 15	Sun StorEdge 9980 Control Panel.....	55
Figure 16	Emergency Power-Off (EPO).....	57
Figure 17	Physical Overview of Sun StorEdge 9980 System.....	58
Figure 18	Physical Overview of the Sun StorEdge 9970 System.....	59
Figure 19	Sun StorEdge 9980 DKC and DKU Physical Dimensions.....	60
Figure 20	Sun StorEdge 9970 Physical Dimensions.....	61
Figure 21	Sun StorEdge 9980 DKC Service Clearance and Floor Cutout.....	63
Figure 22	Sun StorEdge 9980 DKU Service Clearance and Floor Cutout.....	64
Figure 23	Sun StorEdge 9980 System Service Clearance and Floor Cutouts – Minimum Configuration.....	65
Figure 24	Sun StorEdge 9980 System Service Clearance and Floor Cutouts – Maximum Configuration.....	66
Figure 25	Sun StorEdge 9970 System Service Clearance and Floor Cutout – All Configurations.....	67
Figure 26	Power Plugs for Three-Phase Sun StorEdge 9980 Disk Array Unit (Europe).....	68
Figure 27	Power Plugs for Three-Phase Sun StorEdge 9980 Disk Array Unit (USA).....	69
Figure 28	Power Plugs for Three-Phase Sun StorEdge 9970 System (Europe).....	69
Figure 29	Power Plugs for Three-Phase Sun StorEdge 9970 System (USA).....	70
Figure 30	Cable Dimensions for 50-Hz Three-Phase Systems.....	72
Figure 31	Power Plugs for Single-Phase Sun StorEdge 9980 Controller (Europe).....	73
Figure 32	Power Plugs for Single-Phase Sun StorEdge 9980 Controller (USA).....	73
Figure 33	Power Plugs for a Single-Phase Sun StorEdge 9980 Disk Array Unit (Europe).....	74
Figure 34	Power Plugs for a Single-Phase Sun StorEdge 9980 Disk Array Unit (USA).....	74
Figure 35	Power Plugs for a Single-Phase Sun StorEdge 9970 System (Europe).....	75
Figure 36	Power Plugs for a Single-Phase Sun StorEdge 9970 System (USA).....	75
Figure 37	Cable Dimensions for 50-Hz Single-Phase Systems.....	77
Figure 38	Sun StorEdge 9980 System Layout and Device Interface Cable Options.....	79



List of Tables

Table 1	Sun StorEdge 9900 Series Feature Comparison.....	2
Table 2	Hardware Competitive Features.....	13
Table 3	Software Competitive Features.....	14
Table 4	Sun/HP Competitive Features.....	15
Table 5	Program Products.....	18-20
Table 6	Channel Adapter Specifications.....	29
Table 7	ACP Specifications.....	31
Table 8	Disk Drive Specifications.....	32
Table 9	Device Numbers for Each CU.....	40
Table 10	Capacities of Standard LU Types.....	40
Table 11	Data Management Functions for Open-System Users.....	43
Table 12	Data Management Functions for S/390 Users.....	44
Table 13	9980 Control Panel.....	56
Table 14	Sun StorEdge 9980 Physical Specifications.....	61
Table 15	Sun StorEdge 9970 System Physical Specifications.....	62
Table 16	Floor Load Rating and Required Clearances for Sun StorEdge 9980 System Minimum Configuration.....	65
Table 17	Floor Load Rating and Required Clearances for Sun StorEdge 9980 System Maximum Configuration.....	66
Table 18	Floor Load Rating and Required Clearances for Sun StorEdge 9970 System.....	67
Table 19	Sun StorEdge 9980 and 9970 System Three-Phase Features.....	70
Table 20	Current Rating, Power Plug, Receptacle, and Connector for Three-Phase Sun StorEdge 9970 and 9980 systems.....	71
Table 21	Input Voltage Specifications for Three-Phase AC Input.....	71
Table 22	Cable Dimensions for 50-Hz Three-Phase Systems.....	72
Table 23	Sun StorEdge 9970 and 9980 Systems Single-Phase Features.....	76
Table 24	Current Rating, Power Plug, Receptacle, and Connector for Single-Phase Sun StorEdge 9970 and 9980 systems.....	76
Table 25	Input Voltage Specifications for Single-Phase Power.....	77
Table 26	Cable Dimensions for 50-Hz Single-Phase Systems.....	77
Table 27	Cable Requirements.....	78
Table 28	Open Systems Channel Specifications.....	79
Table 29	Mainframe Channel Specifications.....	80
Table 30	Temperature and Humidity Requirements.....	80
Table 31	Internal Air Flow.....	81
Table 32	Vibration and Shock Tolerances.....	81
Table 33	Unit Conversions for Standard (U.S.) and Metric Measures.....	86



Product Positioning

Introduction

The Sun StorEdge™ 9970 and 9980 systems provide high-speed response, continuous data availability, scalable connectivity, and expandable capacity for both open systems and S/390 environments. The Sun StorEdge 9970 and 9980 systems are designed for use in 7x24 data centers that demand high-performance, non-stop operation and are compatible with industry-standard software and supports concurrent attachment to multiple host systems and platforms. The Sun StorEdge 9970 and 9980 systems use and improve upon the key characteristics of Sun StorEdge™ 9910 and 9960 storage systems to achieve higher levels of performance and connectivity. The advanced components, functions, and features of the Sun StorEdge 9970 and 9980 systems represent an integrated approach to data retrieval and storage management.

The Sun StorEdge 9970 and 9980 storage systems can operate with multi-host applications and host clusters, and is designed to handle very large databases as well as data warehousing and data mining applications that store and retrieve terabytes of data. The storage systems can be configured for open systems servers, mainframe servers, and multiplatform operations.

The Sun StorEdge 9970 and 9980 storage systems provide many benefits and advantages as well as advanced new features for the user, including more than doubling the scalability from the Sun StorEdge 9960 system in both capacity and performance. The system supports an intermix of Fibre Channel, ESCON, and FICON host attachment for heterogeneous environments, and will introduce an enhanced design which provides high performance, high reliability, and high scalability in storage-area network (SAN) environments. The new Java™ based user interface makes accessing, configuring, managing, and using the Sun StorEdge 9970 and 9980 products easier than ever. The Sun StorEdge™ 9900 HiCommand software licensed product also supports these products for maximum flexibility in configuration and management. The Sun StorEdge 9970 and 9980 storage systems are designed to meet customers' evolving and increasing needs for data storage and retrieval in the 21st century.

Virtualization Capabilities

When connected to heterogeneous hosts, array systems from most vendors require a separate port connection for each host type. This is because different hosts require a specific response in return to a SCSI inquiry. Even with 24 to 32 ports available, this restriction can cause major difficulties in configuring storage consolidation (particularly in HA environments).

The Sun StorEdge 9970 and 9980 systems have implemented a novel virtualization architecture that allows multiple host types to use the same physical port. By identifying the host type by its WWN, the Sun StorEdge 9970 and 9980 systems return the correct SCSI response to each host. Groups of hosts, created via Host Storage Domains, can be assigned volumes that can be shared. Access to volumes is controlled by Sun StorEdge™ 9900 SANtinel software and can restrict access to host groups or a specific host WWN.

Using host groups is a powerful tool to enable large SANs to be configured to heterogeneous hosts.

Sun StorEdge 9980 System

The Sun StorEdge 9980 system provides extreme levels of performance and capacity for large data center environments. This highly available and massively scalable storage system has a base configuration



Sun Microsystems Proprietary/Confidential: Sun Employees Only - Need-to-Know

consisting of two frames: the Control Frame, which contains the cache and switch modules, host and drive interfaces, disk array processors, and the service processor; and up to four Array Frames, each supporting up to 256 disk drives and redundant power supplies. Additional Array Frames allow the Sun StorEdge 9980 system to expand to 1024 drives, providing up to 74.7 TB of raw storage. Physical interfaces can scale to 32 separate Fibre Channel, ESCON, and FICON host connections, and as many as 4096 hosts can be accommodated by using SAN switches. The system's virtualization capabilities help enable storage consolidation, which helps to reduce TCO by enabling connections to multiple hosts and allows for more flexibility in configuring your SAN infrastructure. The storage system is easy to operate and control and helps to simplify your data management. Software is available to support key storage applications typically used in data center environments, including path management, real time replication, and remote mirroring for disaster recovery.

Sun StorEdge 9970 System

The Sun StorEdge 9970 system is ideal for data center environments requiring high density storage in a small footprint. This storage system is a single-frame configuration that scales to 9.3 TB of raw storage and offers virtualization, allowing for extreme storage consolidation, simplified management, and maximum utilization. Fibre Channel, ESCON, and FICON interfaces can be grown to 24 physical connections. Only six square feet of floor space is required to install this high-density storage system.

Product Family Placement

The Sun StorEdge 9970 and 9980 storage systems are second-generation designs of the unique switched-fabric architecture pioneered in the Sun StorEdge 9910 and 9960 storage systems. This architecture optimizes the system's performance and allows bottleneck-free scalability. This next generation of switched architecture builds upon the world-class data center architecture of the Sun StorEdge 9910 and 9960 systems. By doubling the number of data paths between cache switches and increasing the clock speed over 60%, the total aggregate bandwidth has been increased to nearly 10X the competition.

The following table summarizes the features of each product.

	9910	9960	9970	9980
Maximum Capacity in TBs (73GB drives)	3.5	37.4	9.3	74.7
Maximum Number of Drives	48	512	128	1024
Maximum Number of Frames	1	7	1	5
Supported Drives in GBs ¹	18, 73, 181	18, 73, 181	36, 73	36, 73
Maximum Cache Size in GBs	16	32	32	64
Bandwidth Capability	3.2	6.4	7.5	15
Maximum LUNs	4096	4096	8192	8192
Channel Interfaces				
FC (2Gb/second)	24	32	24	32
ESCON	24	32	24	32
FICON	12	16	24	32

Notes:

1. The 36 GB drives are 15K RPM, 73 GB drives are 10K RPM, and the 181 GB drives are 7200 RPM
2. The data for random reads is typically are not in cache and must read from the drives.

Table 1 Sun StorEdge 9900 Series Feature Comparison



Product Demand History

On the first generation Sun StorEdge 9910 and 9960 systems, installations with minimal floor space and having smaller capacity requirements were intended customers for the single cabinet Sun StorEdge 9910 system while the Sun StorEdge 9960 system was applicable to applications requiring the capability to scale capacity beyond 3.5 TBs and 24 interfaces, the maximum capabilities of the Sun StorEdge 9910 system. Figures 1 and 2 show historical shipping data. It shows that over 90% of the installations ordered were less than 10 TBs of raw capacity and that the number of fibre channel interfaces ordered was less than 20. If requirements continue this trend, this data indicates that most customers will be satisfied by the Sun StorEdge 9970 system.

The Sun StorEdge 9970 system is similar to the Sun StorEdge 9910 system in that the controller and disk drives are contained in a single cabinet, however it is not intended to be a replacement product for the Sun StorEdge 9910 system. The Sun StorEdge 9970 system will supersede the Sun StorEdge 9960 system over time and the Sun StorEdge 9980 system will satisfy customers that have capacity and interface requirements beyond the capabilities of the SE9970 and performance requirements beyond the Sun StorEdge 9960 system.

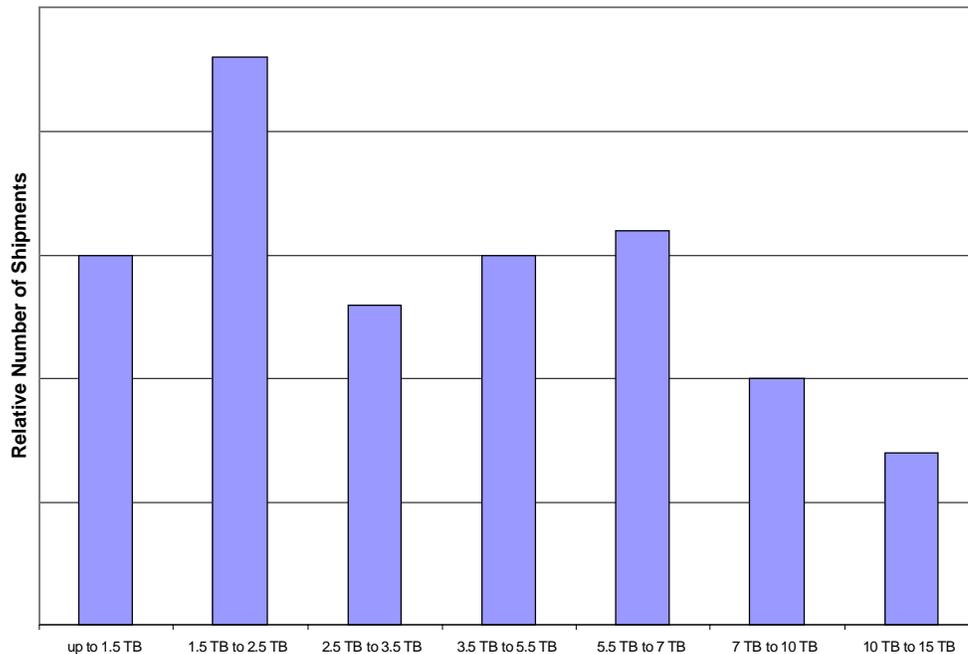


Figure 1 Sun StorEdge 9900 Series Shipments by Capacity Range



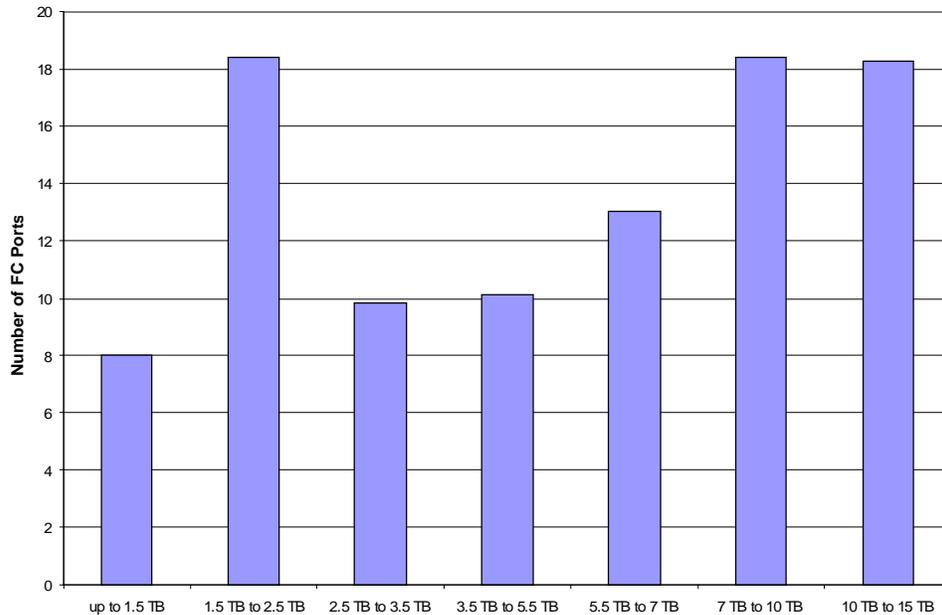


Figure 2 Sun StorEdge 9900 Series Shipments – Ports per Capacity Range

Key Features and Benefits

- *Instant access to data around the clock:*
 - Highly resilient multi-path fibre architecture.
 - Fully redundant, hot-swappable components and non-disruptive system microcode updates.
 - Global dynamic hot sparing.
 - Dual port Fibre Channel disk drives.
 - Duplexed write cache with battery backup.
 - Sun StorEdgeSM Remote Response service “call-home” maintenance system.
 - RAID-1 and/or RAID-5 array groups within the same system.
- *Unmatched performance*
 - Multiple point-to-point data and control paths.
 - Up to 15-GB/sec internal system bandwidth (Sun StorEdge 9980 system).
 - Fully addressable 64-GB data cache; separate 3-GB control cache.
 - Simultaneous transfers from up to 32 separate hosts.
 - Extremely fast and intelligent cache algorithms.
- *Non-disruptive capacity growth:*
 - Expansion to over 74 TB raw capacity (Sun StorEdge 9980 system).
 - Up to 1024 high-throughput (10K and 15K RPM) Fibre Channel, dual-active disk drives.



- *Extensive connectivity and resource sharing:*
 - Concurrent operation of UNIX[®]-based, Windows-based, Linux, NetWare, and S/390 host systems.
 - Fibre Channel, ESCON, and FICON server connections.
 - Fibre Channel switched, arbitrated loop, and point-to-point configurations.
 - Virtual assist simplifies SAN connections
 - Storage blade architecture supports future interfaces as they become popular

Availability Dates

The Sun StorEdge 9970 and 9980 systems will begin shipping on May 7, 2002. The FICON channel adapter will GA on June 20, 2002.

Target Markets and Users

The Sun StorEdge 9900 series product family include high-end storage systems designed to deliver extreme high availability, scalable capacity growth, heterogeneous connectivity (including mainframe), and the highest levels of performance when compared to similar capabilities such as the EMC Symmetrix and IBM ESS Shark storage products.

Protect your Business with Extreme Availability: The Sun StorEdge 9970 and 9980 systems series are ideal for customers who require the extreme in non-disruptive service – worry-free always-available storage. Business will never stop due to storage failure.

Consolidate with Confidence: Many customers have storage islands in their IT environments due to their heterogeneous operating environments. The cost of supporting these islands can be expensive when considering software and hardware vendor maintenance costs, implementing multiple data replication and backup strategies, and ensuring support personnel are trained on various systems. The Sun StorEdge 9970 and 9980 systems support an impressive list of servers and operating systems to allow the consolidation of distributed storage.

Storage that Grows with your Customer: A storage solution needs to be flexible to satisfy the changing requirements of your customer. New or growing business demands will require additional servers and storage capacity. Business mergers and remote data centers may need robust high-performance data transmission. The Sun StorEdge 9970 and 9980 systems have the capability to grow with your customer. Capacity, performance, connectivity, and imbedded storage management are among the tools available to assist your customer.

Robust Control and Monitor Software: Easy to operate and administer, the Sun StorEdge 9970 and 9980 systems can greatly simplify storage management task, thereby reducing administration overhead and related costs. A broad set of flexible, integrated tools address every aspect of storage management. The customer can focus on their business and not on their storage.



Installation

Sun StorEdge 9970 and 9980 systems will include Sun StorEdge Installation service, (Sun StorEdge 9900 Installation service) a basic install offering, for new subsystem (minimum 1 Sun StorEdge 9970 and 9980 system's control unit) purchases. Sun StorEdge Installation service currently includes the high-level deliverables shown below. The official service listing, including scope, tasks, deliverables and customer responsibilities for this and other service programs for Sun contracted customers, is maintained at: <http://www.sun.com/service/servicelist/>

Sun StorEdge Installation service includes installation of all Sun-sold Sun StorEdge 9970 or 9980 systems' components sold with the controller unit. This does not include the installation of optional third-party SAN components. Installation of optional third-party SAN components may involve additional charges.

Installation of optional Sun StorEdge 9970 and 9980 systems' hardware components that are not sold with a new control unit will include Sun StorEdge Installation service or, at Sun's sole discretion, a subset of Sun StorEdge 9900 Installation service deliverables required to provide basic installation service. Customer responsibilities to receive basic installation are unchanged from those listed in the official Sun StorEdge Installation service listing.

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

- **Site Audit**
 - Review customer physical environment
 - Document environmental states
- **Installation Planning**
 - Plan, confirm and schedule resources
 - Plan and confirm delivery & install dates
 - Create installation related documentation
- **Installation Specification**
 - Discuss customer-defined RAID, LUN, connectivity requirements
 - Review remote monitoring requirements, including customer analog line
- **Statement of Installation**
 - Verify completion of pre-installation tasks
 - Verify supported configuration
 - Customer sign off to begin installation
- **Hardware and Software Installation**
 - Sun StorEdge™ Unpack 9900 series components.
 - Review packing list
 - Install and configure HBA's in Sun servers
 - Install Solaris patches, if applicable.
 - Assist customer with installation of HBA's in non-Sun servers
 - Connect controllers, disk frames and Sun StorEdge 9900 series' components
 - Connect subsystem to host server(s)*
 - Power up and verify functionality (diagnostic level.)
 - Install remote console components into customer-supplied workstation



- Connect service processor to customer phone line
 - Install Sun StorEdge 9900 Remote Response service components
 - Install and configure Resource Manager components per customer definition
 - Configure disk groups, LUNs, port mapping per customer definition
 - **Installation Verification**
 - Verify host connection to LUNs (Sun servers only)
 - Help customer verify host connection to LUNs (non-Sun servers)
 - Verify Sun StorEdge Remote Response service with remote support center
 - **System Turnover**
 - Installation review and customer sign off
 - Provide system reference documentation
- * Connection of Sun StorEdge 9900 series to host(s) through switches may involve additional charges and strong recommendation to customer to utilize Sun Professional Services engagement. Basic installation does not include any consulting engagement services.

Warranty

The official Sun StorEdge 9970 and 9980 systems and third-party warranty statements are maintained at Sun's external web site at www.sun.com/service/support/warranty.

Sun warranty on Sun StorEdge 9970 and 9980 systems include an enhanced warranty with 3 years coverage. This includes:

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

* Average response time.

StorEdge 9900 series software is covered by a standard 90-day defective media and installation warranty. Purchasers of Sun StorEdge 9970 and 9980 systems are also entitled to receive:

- 3 years coverage for Sun StorEdge Remote Response service, a 24x7 remote support and monitoring service.

Sun warranty on Sun-sold Brocade, McData and InRange third-party switch and Director components provides 2 years coverage.

- 1st year standard business hours M-F next business day* 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

* Average response time.

Installation is not included with third-party products. Customers are encouraged to utilize Sun PS for SAN architecture and implementation engagements. Sun Support Services may be utilized for the switch installation (not architecture/implementation) on a time and material basis.



Sun Microsystems Proprietary/Confidential: Sun Employees Only - Need-to-Know

All Sun StorEdge 9900 series hardware components*, including disk groups, disk spares, port interface boards, disk frames, etc., receive the remaining warranty term of the Sun StorEdge 9910, 9960, 9970 or 9980 system's control unit to which they are attached. The maximum warranty period of any given control unit is 3 years.

If non-control unit components are purchased from Sun and attached to an existing installed control unit, the warranty period of the control unit is not affected. The warranty period of the non-control unit new components assumes the remaining warranty period of the attached control unit.

If existing installed base non-control unit components such as disk groups are attached to a new control unit purchased from Sun, the warranty period of the new control unit is reduced to match the remaining warranty period of the disk groups. Customers will have the option to keep the three-year warranty on new controller unit by purchasing warranty extensions on installed-base disk groups, which are attached to the new controller unit. Contact local Enterprise Services sales representative for more information.

Sun reserves the right to monitor disk group serial numbers and control unit serial numbers for tracking purposes and entitlement via Sun StorEdge Remote Response service.

* Sun StorEdge 9900 series hardware components do not include third-party SAN components. These components have standalone product warranties which are not associated with Sun StorEdge 9900 series product warranty.

Service & Support

Sun StorEdge Remote Response service for Sun StorEdge 9900 series storage systems is a remote support solution that proactively identifies operational anomalies to help prevent them from becoming business problems. Through around-the-clock monitoring, connectivity with Sun and remote support, Sun StorEdge Remote Response service helps you maximize customers' storage system's availability. It's a world-class service for customers' critical business data, helping to pre-empt serious problems so that you can get the most of customers' investment in storage.

Alerts generated by customers' storage system are tracked and managed by Sun engineers at a Sun Solution Center. Sun engineers are storage experts with a deep understanding of the technology and extensive experience in resolving complex END-TO-END issues. Through ongoing training and a powerful knowledgebase, Sun engineers have access to the latest technical solutions. Sun's state-of-the-art solution centers are located in North America, Europe and Asia. To help ensure uninterrupted data and application uptime, it's crucial that Sun StorEdge Remote Response service is continually activated. To sustain remote connectivity, Sun monitors customers' storage system's heartbeat and automatically attempts to re-establish contact if the connection is lost.

Sun StorEdge Remote Response service assists in problem diagnosis and resolution without the need for on-site service. If hardware repair is deemed necessary, a Sun engineer can immediately initiate a service request. If customers Sun StorEdge 9900 series storage solution is under warranty or covered by a Sun SpectrumSM support contract, Sun will dispatch a field engineer to customers location to replace failed components. This tightly linked process of problem identification, diagnosis and resolution can save time and reduce business risk.



Professional Services

Basic installation does not include any consulting engagement services.

Sun Professional Services provides a comprehensive set of consulting services to fully exploit the capability of these new models. Sun Storage Practice consultants can help customize both hardware and software features to best meet the specific needs of various environments. Consultants can assist with or manage complete storage consolidation initiatives, and plan and implement data migration from existing storage devices to the new Sun StorEdge 9970 and 9980 systems.

- Assessment
- Capacity Planning
- SAN Architecture & Design
- Hardware & Software Implementation
- Data Migration
- Backup/Restore
- Performance

Supported Server and SAN Configurations

The most recent qualified and supported configurations with Sun hosts and Sun supplied switches and director products are listed in the Sun StorEdge 9970 and 9980 systems What Works With What.

The WWW for Sun StorEdge 9970 and 9980 products is available from SunWIN token #344150.

Sun StorEdge 9910 and 9960 Systems EOL Plans

The Sun StorEdge 9960 system is also appropriate for customers who are "OK" with SAN islands. i.e. the capability to route multiple OS's through a single physical port isn't important or relevant to their environment.

The Sun StorEdge 9910 and 9960 systems remains the best solution for customers who focus on acquisition cost. With the April 9, 2002 price reductions, the Sun StorEdge 9910 and 9960 systems will have a significantly lower entry point than the Sun StorEdge 9970 and 9980 systems. The Sun StorEdge 9960 system is a very competitive offering when going against heavily discounted EMC Symmetrix bids - do not use the Sun StorEdge 9970 and 99780 systems for such deals. The Sun StorEdge 9960 system dramatically outperforms the EMC Symmetrix 8830 and should warrant a price premium.

While Sun has been shipping the Sun StorEdge 9910 and 9960 systems since August of 2001, the 9960 and 9910 have been available since June of 2000 and February of 2001 respectively. The Sun StorEdge 9910 and 9960 systems will be announced End of Life on August 6, 2002 and continue to be available to order into late November 2002. Upgrade components for the Sun StorEdge 9910 and 9960 systems will be available through June of 2003. Refurbished upgrade components will be sold as availability permits after June.



Sun StorEdge 9960 Systems Upgrade Strategy

Customers with a StorEdge 9960 system can upgrade their system to a Sun StorEdge 9980 system to save their investment in disk array frames. As the array frames need to be physically detached from the Sun StorEdge 9960 system's controller frame and attached to the Sun StorEdge 9980 system's controller frame, there are disruptive and non-disruptive methods of conducting the upgrade.

Disruptive Upgrade

The following steps should be followed:

1. Halt all host operations using the Sun StorEdge 9960 system. Before shutdown, copy the system configuration onto a floppy disk using the Sun StorEdge 9960 system SVP. Correctly shutdown the Sun StorEdge 9960 system.
2. Disconnect all the array frames cables from the Sun StorEdge 9960 system's controller.
3. Unplug power and remove the bolts joining controller to the Array frames.
4. Remove the Sun StorEdge 9960 system's controller and widen the space between the frames to make space for the new Sun StorEdge 9980 system's controller.
5. Install the new Sun StorEdge 9980 system's controller by connecting it to the Sun StorEdge 9900 series' frames.
6. Reconnect power cables and move fibre channel, ESCON, and FICON connections from the Sun StorEdge 9960 system to the Sun StorEdge 9980 system.
7. Install the new interface cables from the left/right array frame into the Sun StorEdge 9980 system's controller.
8. Power up the configuration (maintenance mode)
9. Copy the old configuration from the floppy disk into the SVP.
10. Reboot the Sun StorEdge 9980 system's controller.
11. Reconnect all the channel cables.
12. Resume operation from the hosts.

Non-disruptive Upgrade

This scenario assumes that the Sun StorEdge 9980 system will have a spare disk controller frame that can be used during the upgrade:

1. Replicate Fibre Channel, ESCON, and FICON connections to the Sun StorEdge 9960 system on the Sun StorEdge 9980 system.
2. Using Sun StorEdge 9900 TrueCopy software, replicate the data on one disk controller frame on the Sun StorEdge 9960 system to the spare frame on the Sun StorEdge 9980 system.
3. Configure the volumes on the Sun StorEdge 9980 system and direct hosts to access these volumes from the Sun StorEdge 9980 system.
4. Move the disk controller frame connection (the one that was copied) from the Sun StorEdge 9960 system to the Sun StorEdge 9980 system.
5. Using Sun StorEdge 9900 TrueCopy software, replicate the data on the next disk controller frame on the Sun StorEdge 9960 system to the frame that was just moved.
6. Configure the volumes on the Sun StorEdge 9980 system and direct hosts to access these volumes from the Sun StorEdge 9980 system.
7. Continue steps 4 through 6 as needed until all frames are connected to the Sun StorEdge 9980 system.



Selling Highlights

Market Value Proposition

Storage Consolidation

- Ability to form centralized storage pools
- Replacement of multiple storage systems with one Sun StorEdge™ 9900 series
- Simplified management for reduced costs

Business Continuity

- 100% data availability through built-in redundancy, online component replacement, and mirroring
- Copy-based, disaster-tolerant solutions
- Off-site redundancy with data integrity
- “MIP-less” any-to-any copies, anywhere and any time
- User-defined point-in-time copies for disaster recovery, tapeless data vaulting, data warehousing/mining, or application testing
- Minimal impact on critical applications
- Real-time data movement and on-line data migration over virtually unlimited distances
- Host failover alternate path High Availability clustering support for open systems

Continuous Information Access

- No single point of failure
- Highly resilient switched fabric architecture
- Redundant, hot-swappable components
- Duplexed write cache with battery backup
- ECC protected memory
- “Call-home” maintenance service
- Host failover and alternate path support
- Non-disruptive microcode upgrades
- RAID 1+and RAID 5 support
- Point-in-time and remote copy software for rapid data backup and recovery
- Geographically Dispersed Parallel Sysplex (GDPS) support



Instant Information Access

- Switched-fabric architecture enables bottleneck-free scalability
- Many performance-enhancing features for optimized operations
- Extreme scalability provides highly effective I/O efficiencies
- Supports information sharing in heterogeneous environments
- Allows data exchange among open systems and mainframe platforms

Fast, Reliable Business Intelligence

- Instant, point-in-time copies
- Real-time analysis of customer behavior
- Power to resolve complex queries
- Non-disruptive scalability to 74.7 TBs of raw capacity
- Minimal impact on production systems



Competition

Datacenter-class products are offered by IBM, EMC, and HP. The following tables compare the features of the IBM and EMC products.

	Sun StorEdge 9980 System	IBM Shark ESS2105-F20	EMC Symmetrix 8830	Sun StorEdge 9970 System	IBM Shark ESS2105-F10	EMC Symmetrix 8530
Architecture	Fully switched fabric	Dual SMP cluster-each with quad bus	Quad-bus/shared-bus	Fully switched fabric	Dual SMP clusters-each with quad bus	Quad-bus/shared-bus
Storage System Partitioning	Yes	No	No	Yes	No	No
Max. internal bandwidth	15 GB/s	1.1 GB/s	1.6 GB/s	7.5 GB/s	1.1 GB/s	1.6 GB/s
Max. raw capacity (73 GB HDD's)	74.6 TB	27.9 TB	28 TB	9.3 TB	4.6 TB	7 TB
Max. # HDD's	1024	384	384	128	64	96
Max. cache	64 GB	32 GB	65 GB	32 GB	32 GB	65 GB
Max. concurrent cache transfers	32	8	16	16	8	16
Mirrored cache	Yes	No	No	Yes	No	No
Connectivity (Max.)						
FC	32	16	96	24	16	72
SCSI	No	32	32	No	32	24
ESCON	32	32	32	24	32	24
FICON	32 (Q4FY02)	16	16	24 (Q4FY02)	16	12
Physical Specifications						
Dimensions (HxWxD) cm	DKC 186x78.2x80 DKU 186x75x80	191.3x294x 90.9	190.3x174.5x92.5	186x78.2x80	191.3x138.3x90.9	187x61.6x 92.5
TB/m² (max. # 73 GB HDD's)	24.66	10.48	17.35	14.87	3.66	12.29

Table 2 Hardware Competitive Features



	Sun StorEdge 9900 Series	IBM Shark ESS2105	EMC Symmetrix 8X30
Remote Maintenance	Sun StorEdge 9900 Remote Response Software	ESS Master Console	OnAlert
P-I-T Copy	Sun StorEdge 9900 ShadowImage Software	FlashCopy	TimeFinder
Remote Data Replication	Sun StorEdge 9900 TrueCopy Software Synchronous Base Asynchronous	PPRC Base N/A	SRDF Base Asynchronous
Automated Workload Balance/Tuning	Sun StorEdge 9900 Performance Monitor, CruiseControl, Priority Access Software	ESS Expert/Perf Monitor N/A N/A	Symmetrix Optimizer Optimizer Workload Analyzer Volume Copy Pacing ResourcePak Ext S/390
Heterogeneous Data Sharing	Sun StorEdge 9900 RapidXchange Software	TDMF	SRDF/DM
Virtualization Assist	Host Storage Domain Sun StorEdge 9900 SANtinel and Priority Access Software	N/A	N/A
Path Balance/Failover	Sun StorEdge 9900 Dynamic Link Manager Software	Subsystem Device Driver	PowerPath

Table 3 Software Competitive Features

EMC

The EMC Symmetrix is known as the product for information consolidation for the most demanding enterprise environments -- Industry leader of centralized, sharable, bet-your-business availability enterprise storage for storage consolidation of your data center from multiple heterogeneous hosts onto a single storage system.

Major EMC Symmetrix Weaknesses:

- 11 year old fixed bus SCSI architecture with "negative scaling" -- as capacity (or load) increases, performance declines
- 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
- 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
- No array controllers, so is limited to RAID 1 (JBOD mirroring) 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)
- 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
- Only holds 384 HDDs max. (half of which are required for mirroring) and the box is not capable of supporting a fully loaded configuration
- Cache is only 45% usable under heavy loads, and on average is only 70% usable = wasted money (cache is very expensive)



IBM

Major IBM Shark Weaknesses:

- A single HDD failure can take down entire SSA loop
- A double path failure renders the entire system useless
- Only 192MB (384MB mirrored) NVS cache - all write activity must pass through 192MB of NVS cache
- 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)

HP

Sun/HDS/HP Storage Offerings:

Sun is capable of providing a complete end-to-end solution with servers, disk, tape, switches, HBA's, software, professional and support services. HP has an OEM relationship with Hitachi Ltd. (Sun has an enhanced distribution/reseller agreement with HDS). The particulars of these different relationships are illustrated in the following table:

Product	Sun	HP
Unique Microcode	No	Yes
Same Management Software	Yes	No
Sun™ Cluster Certification	Yes	No
Mainframe Support	Sun/HDS	HP
NT Support	Sun/HDS	HP
Solaris™ Support	Sun	HP
HP-UX Support	Sun/HDS	HP
Joint Support Centers	Yes	No
Joint Certification Centers	Yes	No

Table 4 Sun/HP Competitive Features



Overview of the Sun StorEdge 9970 and 9980 Systems

Key Features of the Sun StorEdge 9970 and 9980 systems

The second generation Sun StorEdge 9900 series provides high-speed response, continuous data availability, scalable connectivity, and expandable capacity for both open systems and S/390 environments. The Sun StorEdge 9970 and 9980 systems are designed for use in 7x24 data centers that demand high-performance, non-stop operation. The Sun StorEdge 9970 and 9980 systems are compatible with industry-standard software and supports concurrent attachment to multiple host systems and platforms. The advanced components, functions, and features of the Sun StorEdge 9970 and 9980 systems represent an integrated approach to data retrieval and storage management.

The Sun StorEdge 9970 and 9980 systems can operate with multihost applications and host clusters, and are designed to handle very large databases as well as data warehousing and data mining applications that store and retrieve terabytes of data. The Sun StorEdge 9970 and 9980 systems can be configured for all-open, all-mainframe, and multiplatform operations.

The Sun StorEdge 9970 and 9980 systems provide many benefits and advantages as well as advanced new features for the user, including double or more scalability from the 9900 in both capacity and performance. The system supports an intermix of Fibre Channel, ESCON, and FICON host attachment for heterogeneous environments, and will introduce an enhanced design which provides high performance, high reliability, and high scalability in storage-area network (SAN) environments. The Sun StorEdge 9970 and 9980 system's new Java™ based user interface makes accessing, configuring, managing, and using the Sun StorEdge 9970 and 9980 systems easier than ever. The Sun StorEdge 9900 HiCommand software licensed product also supports the new Sun StorEdge 9970 and 9980 Storage Systems for maximum flexibility in configuration and management. The Sun StorEdge 9970 and 9980 systems is designed to meet customers' evolving and increasing needs for data storage and retrieval in the 21st century.

- *Instant access to data around the clock:*
 - Highly resilient multi-path fibre architecture.
 - Fully redundant, hot-swappable components and non-disruptive system microcode updates.
 - Global dynamic hot sparing.
 - Duplexed write cache with battery backup.
 - Sun StorEdge Remote Response “call-home” maintenance system.
 - RAID-1 and/or RAID-5 array groups within the same system.
- *Unmatched performance and capacity:*
 - Multiple point-to-point data and control paths.
 - High internal system bandwidth: 15GB/s on the Sun StorEdge 9980 system and 7.5GB/s on the Sun StorEdge 9970 system
 - Fully addressable 64-GB data cache; separate 3-GB control cache.
 - Extremely fast and intelligent cache algorithms.
 - Non-disruptive expansion to over 74 TB raw capacity (Sun StorEdge 9980 system).
 - Simultaneous transfers from up to 32 separate hosts (Sun StorEdge 9980 system).
 - Up to 1024 high-throughput (10K or 15K rpm) Fibre Channel, dual-active disk drives.



- *Extensive connectivity and resource sharing:*
 - Concurrent operation of UNIX based, Windows-based, Linux, NetWare, and S/390 host systems.
 - Fibre Channel, ESCON and FICON server connections.
 - Fibre Channel switched, arbitrated loop, and point-to-point configurations.

Continuous Data Availability

The Sun StorEdge 9970 and 9980 systems are designed for nonstop operation and continuous access to all user data. To achieve nonstop customer operation, the Sun StorEdge 9970 and 9980 systems accommodate online feature upgrades and online software and hardware maintenance. See page 21 for further information on the reliability and availability features of the Sun StorEdge 9970 and 9980 systems.

Connectivity

The Sun StorEdge 9970 and 9980 systems support concurrent attachment to S/390 mainframe hosts and open-system (UNIX-based and/or PC-server) platforms. The Sun StorEdge 9970 and 9980 systems can be configured with the following port types to support all-open, all-mainframe, and multiplatform configurations:

- **Fibre Channel.** When Fibre Channel interfaces are used, the Sun StorEdge 9970 and 9980 systems can provide up to 32 ports for attachment to UNIX[®]-based and/or PC-server platforms. The type of host platform determines the number of logical units (LUs) that may be connected to each port. Fibre Channel connection provides data transfer rates of up to 200 MB/sec (2 Gbps). The Sun StorEdge 9970 and 9980 systems support Fibre Channel arbitrated loop (FC-AL) and fabric Fibre Channel topologies as well as high-availability (HA) Fibre Channel configurations using hubs and switches.
- **ESCON.** When ESCON channel interfaces are used, the Sun StorEdge 9970 and 9980 systems can provide up to 32 logical control unit (CU) images and 8192 logical device (LDEV) addresses. Each physical channel interface supports up to 256 logical paths providing a maximum of 8192 logical paths per system. ESCON connection provides transfer rates of up to 17 MB/sec.
- **FICON.** When FICON channel interfaces are used, the Sun StorEdge 9970 and 9980 systems can provide up to 32 logical control unit (CU) images and 8192 logical device (LDEV) addresses. Each physical FICON channel interface supports up to 512 logical paths providing a maximum of 8192 logical paths per system. FICON connection provides transfer rates of up to 100 MB/sec (1Gbps).

S/390 Compatibility and Functionality

The Sun StorEdge 9970 and 9980 systems support 3990-6, 3990-6E, and 2105 controller emulations and can be configured with multiple concurrent logical volume image (LVI) formats, including 3390-3, 3390-3R, 3390-9, and larger. In addition to full System-Managed Storage (SMS) compatibility, the Sun StorEdge 9970 and 9980 systems also provide the following functionality in the S/390 environment:

- Sequential data striping,
- Cache fast write (CFW) and DASD fast write (DFW),
- Enhanced dynamic cache management,
- Multiple Allegiance support,
- Concurrent Copy (CC) support,
- Enhanced CCW support,
- Priority I/O queuing,
- Parallel Access Volume (PAV) support, and
- Transaction Processing Facility (TPF)/Multi-Path Locking Facility (MPLF) support.



Open Systems Compatibility and Functionality

The Sun StorEdge 9970 and 9980 systems support multiple concurrent attachments to a variety of host operating systems (OS) and is compatible with most Fibre Channel host bus adapters (HBAs). The number of logical units (LUs) that may be connected to each port is determined by the type of host platform being attached. The Sun StorEdge 9970 and 9980 systems support the following platforms are supported.

- Sun Solaris OS
- IBM AIX OS
- HP-UX OS
- Compaq Tru64 UNIX OS
- SGI IRIX OS
- Microsoft Windows NT OS
- Microsoft Windows 2000 OS
- Novell NetWare OS
- Red Hat Linux OS

The Sun StorEdge 9970 and 9980 systems provide enhanced dynamic cache management and supports command tag queuing and multi-initiator I/O. Command tag queuing (see page 53) enables hosts to issue multiple disk commands to the Fibre Channel adapter without having to serialize the operations. The Sun StorEdge 9970 and 9980 systems operate with industry-standard middleware products providing application/host failover capability, I/O path failover support, and logical volume management. The Sun StorEdge 9970 and 9980 systems also support the industry-standard simple network management protocol (SNMP) for remote system management from the open-system host.

The Sun StorEdge 9970 and 9980 systems can be configured with multiple concurrent logical unit (LU) formats (e.g., OPEN-3, -9, -E, -L). The user can also configure custom-size volumes using the Virtual LVI/LUN and LU Size Expansion (LUSE) features of the Sun StorEdge 9970 and 9980 systems (see page 42).

Software Products and Service Offerings

The Sun StorEdge 9970 and 9980 systems provide many advanced features and functions that increase data accessibility, help enable continuous user data access, and deliver enterprise-wide coverage of on-line data copy/relocation, data access/protection, and storage resource management. Sun StorEdge 9900 software solutions provide a full complement of industry-leading copy, availability, resource management, and exchange software to support business continuity, database backup/restore, application testing, and data mining.

Contact Sun Professional Services for a current description of offered services.

Function	Description	See Page:
Data Replication:		
Sun StorEdge 9900 TrueCopy (TC) and TrueCopy – S/390 (TC390) software	Enables the user to perform remote copy operations between Sun StorEdge 9970 and 9980 systems (and 9900) systems in different locations. TrueCopy provides synchronous and asynchronous copy modes for S/390 and open-system data.	44 45
Sun StorEdge 9900 ShadowImage (SI) and ShadowImage – S/390 (SI390) software	Allows the user to create internal copies of volumes for a wide variety of purposes including application testing and offline backup. Can be used in conjunction with TrueCopy to maintain multiple copies of critical data at both the primary and secondary sites.	45

Table 5 Program Products



Function	Description	See Page:
Data Replication (Cont.):		
Sun StorEdge 9900 TrueCopy (TC) and TrueCopy – S/390 (TC390) software	Enables the user to perform remote copy operations between Sun StorEdge 9970 and 9980 systems (and 9900) systems in different locations. TrueCopy provides synchronous and asynchronous copy modes for S/390 and open-system data.	44 45
Sun StorEdge 9900 ShadowImage (SI) and ShadowImage – S/390 (SI390) software	Allows the user to create internal copies of volumes for a wide variety of purposes including application testing and offline backup. Can be used in conjunction with TrueCopy to maintain multiple copies of critical data at both the primary and secondary sites.	45
Command Control Interface (CCI)	Enables open-system users to perform TrueCopy and ShadowImage operations by issuing commands from the host to the Sun StorEdge 9970 and 9980 systems. The CCI software supports scripting and provides failover and mutual hot standby functionality in cooperation with host failover products.	46
Sun StorEdge™ 9900 Extended Remote Copy (XRC) software	Provides compatibility with the IBM® Extended Remote Copy (XRC) S/390 host software function, which performs server-based asynchronous remote copy operations for mainframe LVIs.	46
Data Sharing and Backup/Restore:		
Sun StorEdge™ 9900 RapidXchange software	Enables users to transfer data between S/390 and open-system platforms using the ESCON and/or FICON channels, which provides high-speed data transfer without requiring network communication links or tape.	46
Sun StorEdge™ 9900 Multiplatform Backup/Restore (MBR)	Allows users to perform mainframe-based volume-level backup and restore operations on the open-system data stored on the multiplatform Sun StorEdge 9970 and 9980 systems.	47
Resource Management:		
Sun StorEdge™ 9900 HiCommand software	Enables users to manage the Sun StorEdge 9970 and 9980 systems and perform functions (e.g., LUN Manager, SANtinel) from virtually any location via the HiCommand™ Web Client, command line interface (CLI), and/or third-party application.	47
Sun StorEdge™ 9900 LUN Manager software	Enables users to configure the Sun StorEdge 9970 and 9980 systems Fibre Channel ports for operational environments (e.g., arbitrated-loop (FC-AL) and fabric topologies, host failover support).	47
Sun StorEdge™ 9900 LU Size Expansion (LUSE) software	Enables open-system users to create expanded LUs which can be up to 36 times larger than standard fixed-size LUs.	47
Sun StorEdge™ 9900 Virtual LVI (VLVI) and Virtual LUN (VLUN) software	Enables users to configure custom-size LVIs and LUs which are smaller than standard-size devices.	48
Sun StorEdge™ 9900 FlashAccess (Flash) software	Enables users to store specific high-usage data directly in cache memory to provide virtually immediate data availability.	48
Sun StorEdge 9900 SANtinel and SANtinel – S/390 software	Allows users to restrict host access to data on the Sun StorEdge 9970 and 9980 systems system. Open-system users can restrict host access to LUs based on the host's World Wide Name (WWN). S/390 mainframe users can restrict host access to LVIs based on node IDs and logical partition (LPAR) numbers.	48
Sun StorEdge™ 9900 Priority Access software	Allows open-system users to designate prioritized ports (e.g., for production servers) and non-prioritized ports (e.g., for development servers) and set thresholds and upper limits for the I/O activity of these ports.	49

Table 5 Program Products (Cont.)



Function	Description	See Page:
Resource Management (Cont.):		
Sun StorEdge™ 9900 Parallel Access Volume (PAV) software	Enables the S/390 host system to issue multiple I/O requests in parallel to single LDEVs in the Sun StorEdge 9970 and 9980 systems system. PAV provides compatibility with the IBM® Workload Manager (WLM) host software function and supports both static and dynamic PAV functionality.	49
Sun StorEdge™ 9900 Dynamic Link Manager software	Provides automatic load balancing, path failover, and recovery capabilities in the event of a path failure.	49
Storage Utilities:		
Sun StorEdge™ 9900 CruiseControl software	Monitors system and volume activity and performs automatic relocation of volumes to optimize performance.	49
Sun StorEdge™ 9900 Graph-Track software	Provides detailed information on the I/O activity and hardware performance of the Sun StorEdge 9970 and 9980 systems. Graph-Track displays real-time and historical data in graphical format, including I/O statistics, cache statistics, and front-end and back-end microprocessor usage.	50

Table 5 Program Products (Cont.)

System Scalability

The architecture of the Sun StorEdge 9970 and 9980 systems accommodate scalability to meet a wide range of capacity and performance requirements. The Sun StorEdge 9980 system storage capacity can be increased from a minimum of 108 GB user or 144 GB raw (one four-drive RAID-5 parity group, 36-GB HDDs) to a maximum of 55 TB user or 74 TB raw (254 four-drive RAID-5 parity groups, 73-GB HDDs). The Sun StorEdge 9980 system cache can be configured from 4 GB to 64 GB in increments of 4 GB. The Sun StorEdge 9970 system cache can be configured from 2 GB to 32 GB in increments of 2 GB. All disk drive and cache upgrades can be performed without interrupting user access to data and with minimal impact on system performance.

The Sun StorEdge 9970 and 9980 systems can be configured with the desired number and type of front-end client-host interface processors (CHIPs). The CHIPs reside on the channel adapters, which are installed in pairs. Each channel adapter pair offers eight host connections. The Sun StorEdge 9980 system can be configured with up to four channel adapter pairs to provide up to 32 paths to attached host processors. The Sun StorEdge 9970 system can support three channel adapter pairs and 24 paths.

The ACPs are the back-end processors that transfer data between the disk drives and cache. Each ACP pair is equipped with eight device paths. The Sun StorEdge 9980 system can be configured with up to four pairs of array control processors (ACPs), providing up to thirty-two concurrent data transfers to and from the disk drives. The Sun StorEdge 9970 system can be configured with one or two pairs of ACPs, providing up to sixteen concurrent data transfers to and from the disk drives.

The Sun StorEdge 9970 system can support up to a combined total of four channel adapter pair features and ACP pair features. Thus if three channel adapter features with a total of 24 host interfaces are configured, one ACP pair must be configured. If two channel adapter features with a total of 16 host interfaces are configured, one or two ACP pairs may be configured. Due to the very high bandwidth of the ACP pairs in the Sun StorEdge 9970 system, it is anticipated that one ACP pair will be sufficient for most Sun StorEdge 9970 system's applications.



Reliability, Availability, and Serviceability

The Sun StorEdge 9970 and 9980 systems are not expected to fail in any way that would interrupt user access to data. The Sun StorEdge 9970 and 9980 systems 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, the failure of a key component can degrade performance.)

The reliability, availability, and serviceability features of the Sun StorEdge 9970 and 9980 systems include:

- **Full fault-tolerance.** The Sun StorEdge 9970 and 9980 systems provide full fault-tolerance capability for all critical components. The system is protected against disk drive error and failure by enhanced RAID technologies and dynamic scrubbing and sparing. The Sun StorEdge 9970 and 9980 systems use component and function redundancy to provide full fault-tolerance for all other system components (microprocessors, control storage, power supplies, etc.). The Sun StorEdge 9970 and 9980 systems have no active single point of component failure and are 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 failure. The power supplies of each set can be connected across power boundaries, so that each set can continue to provide power if a power outage occurs. The Sun StorEdge 9970 and 9980 systems can sustain the loss of multiple power supplies and still continue operation.
- **Uninterruptable power supply (UPS).** The Sun StorEdge 9970 and 9980 systems support connection to a UPS to provide additional battery backup capability (see page 77).
- **Dynamic scrubbing and sparing for disk drives.** The Sun StorEdge 9970 and 9980 systems use special diagnostic techniques and dynamic scrubbing to detect and correct disk errors. Dynamic sparing is invoked automatically if needed. The Sun StorEdge 9980 system can be configured with up to sixteen spare disk drives, and any spare disk can back up any other disk of the same speed (RPMs) and the same or less capacity, even if the failed disk and spare disk are in different array domains (attached to different ACP pairs).
- **Dynamic duplex cache.** The cache in the Sun StorEdge 9970 and 9980 systems is divided into two equal segments (clusters) on separate power boundaries. The Sun StorEdge 9970 and 9980 systems places all write data in both cache segments with one internal write operation, so the data is always duplicated (duplexed) across power boundaries. Before an acknowledgment is returned to the host performing a write, data must be written to both caches and then compared. This assures that two exact copies of the data are stored on the battery-protected cache. If one copy of write data is defective or lost, the other copy is immediately destaged to disk. This duplex design helps ensure full data integrity in the event of a cache or power failure. In the event of power failure, batteries will retain cache data for a minimum of 48 hours.
A separate duplexed shared memory is used to retain information necessary to manage the cache and to hold the system configuration. Separate data paths are used to access cache and shared memory. A battery also retains the share memory's contents for 7 days in the event of a power failure.
- **Remote copy features.** The Sun StorEdge TrueCopy and Extended Remote Copy (XRC) software data movement features enable the user to set up and maintain duplicate copies of S/390 and open-system data 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.
- **Sun StorEdge Remote Response service.** The Sun StorEdge Remote Response service maintenance support tool monitors the operation of the Sun StorEdge 9970 and 9980 systems at all times, collects hardware status and error data, and transmits this data via modem to the Sun Support Centers. The Support Center analyzes the data and implements corrective action as needed. In the unlikely event of a component failure, Sun StorEdge Remote Response service calls the Sun Support Center



immediately to report the failure without requiring any action on the part of the user. Sun StorEdge Remote Response service allows most problems to be identified and fixed prior to actual failure, and the advanced redundancy features enable the system to remain operational even if one or more components fail. (**Note:** Sun StorEdge Remote Response service does not have access to any user data stored on the Sun StorEdge 9970 and 9980 systems. The tool requires a dedicated RJ-11 analog phone line.)

- **Nondisruptive service and upgrades.** All hardware upgrades* can be performed nondisruptively during normal system operation. All hardware subassemblies can be removed, serviced, repaired, and/or replaced nondisruptively during normal system operation. All system microcode upgrades can be performed during normal operations using the SVP or the alternate path facilities of the host.

* With one exception: In a Sun StorEdge 9970 system, it is possible to attach both sets of 64 disk drives to a single ACP pair. If two ACP pairs are used, the first 64 drives are connected to the first ACP pair, and the second 64 drives are connected to the second ACP pair. If you want to add a second ACP pair to an existing single-ACP-pair Sun StorEdge 9970 system, a service interruption will be required to disconnect any disk drives in the second set of 64 drive locations from the first ACP pair, and to reconnect them instead to the newly installed second ACP pair.

- **Error Reporting.** The Sun StorEdge 9970 and 9980 systems system report service information messages (SIMs) to notify users of errors and service requirements. SIMs can also report normal operational changes, such as remote copy pair status change. The SIMs are logged on the Sun StorEdge 9970 and 9980 systems service processor (SVP), reported directly to the mainframe and open-system hosts, and reported to Sun via Sun StorEdge Remote Response service.



System Architecture and Components

Overview

Figure 3 shows the switched fabric architecture of the Sun StorEdge 9970 and 9980 systems RAID system. The “front end” of the Sun StorEdge 9970 and 9980 systems includes the hardware and software that transfers the host data to and from cache memory, and the “back end” includes the hardware and software that transfers data between cache memory and the disk drives.

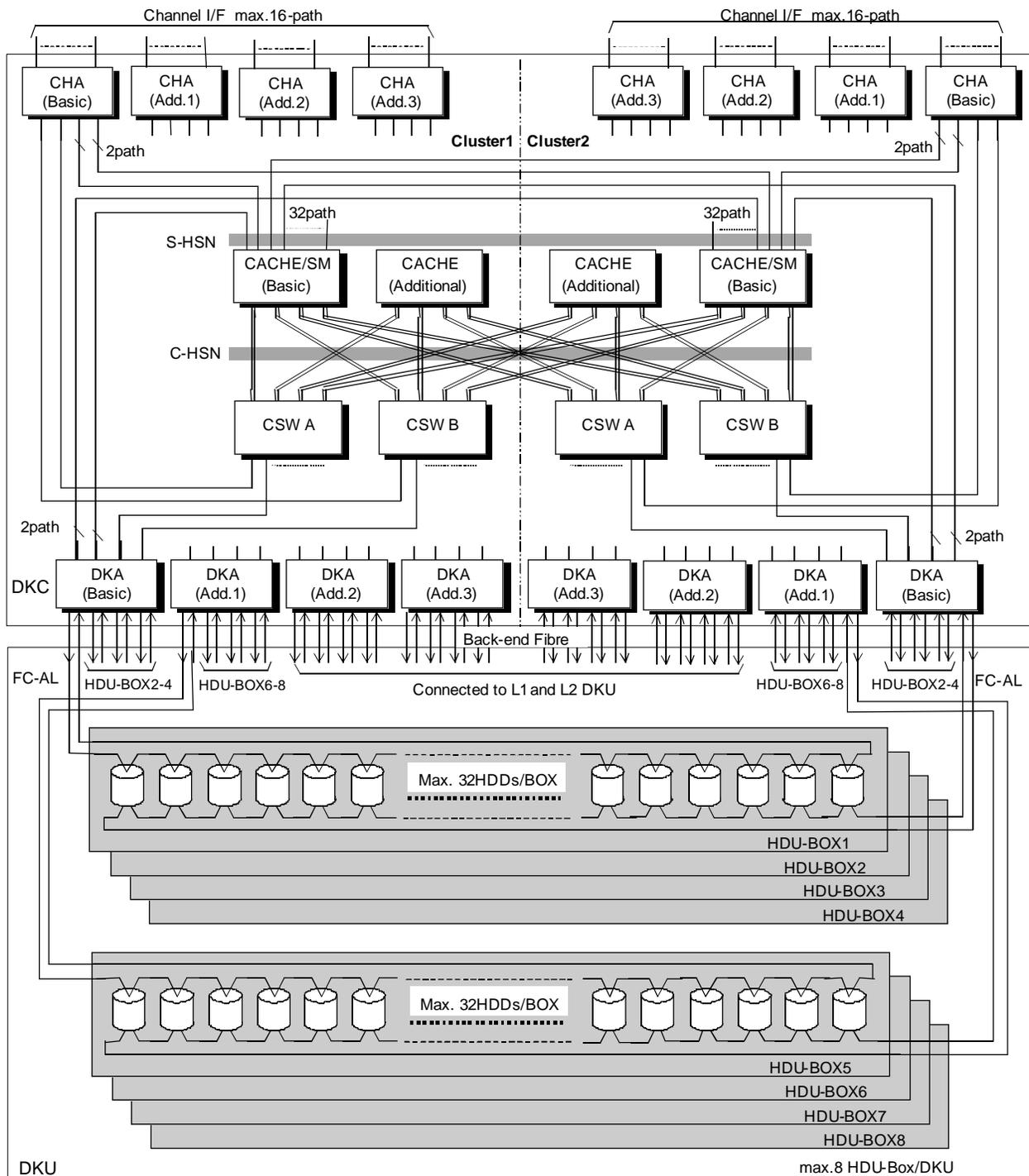
Front End: The Sun StorEdge 9970 and 9980 systems front end is entirely resident in the Sun StorEdge 9970 system’s frame and the Sun StorEdge 9980 system’s disk controller (DKC) frame and includes the client-host interface processors (CHIPs) that reside on the channel adapter boards. The CHIPs control the transfer of data to and from the host processors via the channel interfaces (e.g., Fibre Channel, ESCON, FICON) and to and from cache memory via independent high-speed paths through the cache switches (CSWs).

- Each channel adapter board contains four CHIPs, and the channel adapter boards are installed in pairs, for a total of eight host interfaces per feature. The Sun StorEdge 9980 system supports up to four pairs of channel adapter boards (four sets of eight CHIPs) for a maximum of 32 host interfaces, and the Sun StorEdge 9970 system supports up to three pairs of channel adapter boards to provide a maximum of 24 host interfaces.
- The Sun StorEdge 9980 system’s controller contains four cache switch (CSW) cards, and the Sun StorEdge 9970 system’s controller contains two CSW cards.
- Cache memory in the Sun StorEdge 9980 system resides on four cache cards, and cache memory in the Sun StorEdge 9970 system resides on two cards. Cache memory is backed up by battery. An additional battery must be configured on Sun StorEdge 9980 systems with over 32 GB of cache memory. On Sun StorEdge 9900 series, cache is only used to retain user data.
- Shared memory (minimum 2 GB) resides on the first two cache cards and is provided with its own power sources and backup batteries. Shared memory also has independent address and data paths from the channel adapter and disk adapter boards. Meta-data is retained in shared memory and is used to manage the contents of the cache and retain system information.
- On a Sun StorEdge 9980 system, 32 data paths exist between the channel adapter boards and the cache switches cards providing a maximum available data throughput of 15.9 GBps. Since these paths are created when boards are installed, the 15.9 GBps throughput represents a fully loaded system. On a Sun StorEdge 9970, 16 data paths exist providing a 7.9 GBps maximum throughput.

Back End: The Sun StorEdge 9970 and 9980 systems back end is controlled by the array control processors (ACPs) that reside on the disk adapter boards in the Sun StorEdge 9970 and 9980 systems controller frame. The ACPs control the transfer of data to and from the disk arrays via high-speed fibre (100 MB/sec or 1 Gbps) and then to and from cache memory via independent high-speed paths through the CSWs.

- The disk adapter board (DKA) contains four ACPs, and the DKAs are installed in pairs. The Sun StorEdge 9980 system supports from one to four DKA pairs for a maximum of 32 ACPs. The Sun StorEdge 9970 system supports one or two DKA pairs for a maximum of sixteen ACPs.





S-HSN: Shared Memory Hierarchical Star Net
 C-HSN: Cache Memory Hierarchical Star Net
 CSW: Cache Switch

Max. 4 DKUs/Subsystem
 In the maximum configuration of the subsystem,
 up to 64 HDDs can be connected through one FC -AL.

Figure 3 Sun StorEdge 9980 System's Switched Fabric Architecture



The Sun StorEdge 9980 system (see Figure 4) includes the following major components:

- One controller frame containing the control and operational components of the system.
- Up to four disk array frames containing the storage components (disk drive arrays) of the system.
- The service processor (SVP) (see page 36). The Sun StorEdge 9970 and 9980 system's SVP is located in the controller frame and can only be used by authorized support personnel. The SVP provides the Remote Console functionality (see page 36).

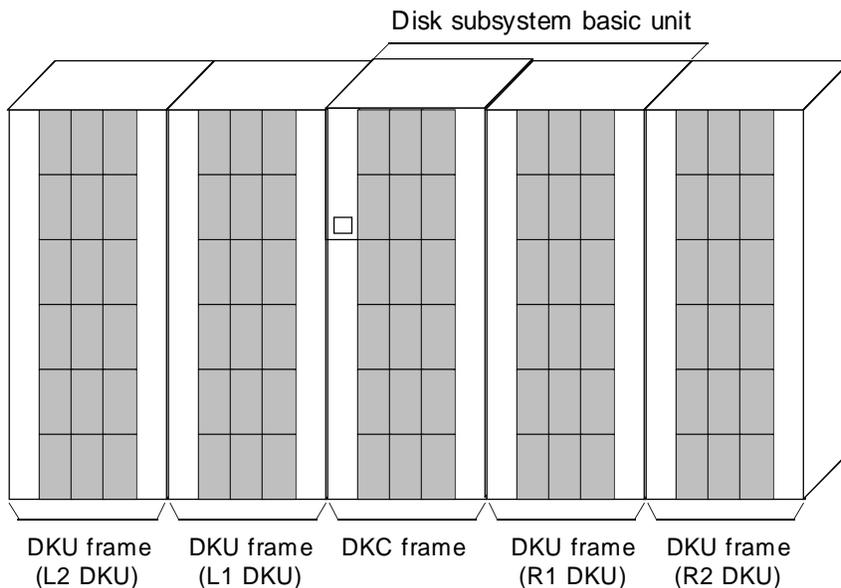


Figure 4 Sun StorEdge 9980 System Frames

Sun StorEdge Sun StorEdge 9980 base configuration:

- An Array Storage Controller Frame
- One Storage Array Frame with a mounting platform supporting 256 disks (zero disks included)
- Four Cache cards and 4GB cache
- 2GB Control Memory
- One Array Control Processor (ACP) pair
- One Service Processor (SVP)
- Cache batteries
- Controller to 1st right frame interface cables



The Sun StorEdge 9970 system (see Figure 5) includes the following major components:

- One frame containing the controller and disk components of the system.
- The service processor (SVP) (see page 36). The Sun StorEdge 9970 and 9980 systems SVP is located in the controller frame and can only be used by authorized support personnel. The SVP provides the Remote Console functionality (see page 36).

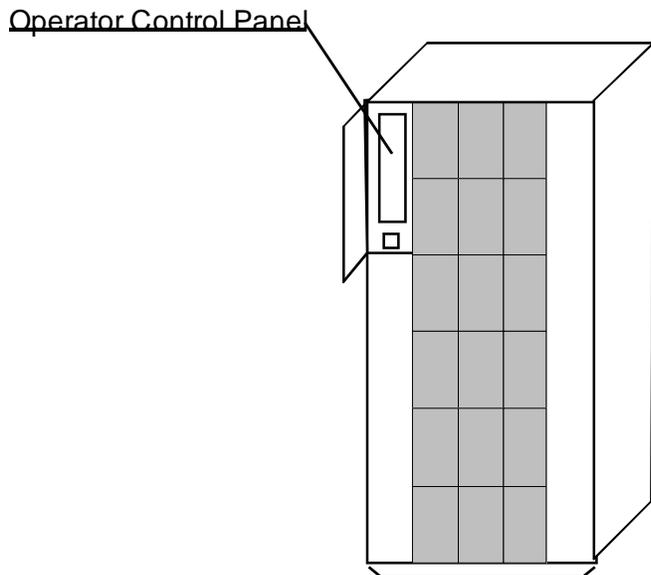


Figure 5 Sun StorEdge 9970 System Frame

Sun StorEdge 9970 system base configuration:

- An Array Storage Controller/Disk Frame
- Mounting platform supporting 128 disks (zero disks included)
- Two cache cards and 2GB cache
- 2GB Control Memory
- One Service Processor (SVP)
- Cache batteries
- Note - the Sun StorEdge 9970 system base configuration does NOT include an ACP pair



Components of the Controller Frame

The Sun StorEdge 9970 and 9980 systems controller frame contains the control and operational components of the system. For the Sun StorEdge 9970 system, the controller frame also contains the disk array components. The Sun StorEdge 9970 and 9980 systems controllers are fully redundant and has no active single point of failure. All controller frame components can be repaired or replaced without interrupting access to user data. The key features and components of the controller frame are:

- Storage clusters (see page 27),
 - Nonvolatile duplex shared memory (see page 28),
 - Nonvolatile duplex cache memory (see page 28),
 - Multiple data and control paths (see page 28),
 - Redundant power supplies (see page 28),
 - Channel adapters (Fibre Channel, ESCON, or FICON) (see page 29),
 - Channels (see page 30), and
 - ACPs (see page 30).

Storage Clusters

Each controller frame consists of two redundant controller halves called storage clusters. Each storage cluster contains all physical and logical elements (e.g., power supplies, channel adapters, 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, the Sun StorEdge 9970 and 9980 systems can sustain the loss of multiple power supplies and still continue operation. In addition, the Sun StorEdge 9970 and 9980 systems support connection to a UPS to provide additional battery backup capability (see page 77).

Note: The redundancy and backup features of the Sun StorEdge 9970 and 9980 systems eliminate all active single points of failure, no matter how unlikely, to provide an additional level of reliability and data availability.



Nonvolatile Shared Memory

The nonvolatile shared memory contains the cache directory and configuration information for the Sun StorEdge 9970 and 9980 systems. 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 cards, which are in clusters 1 and 2. Even though the shared memory resides on the cache cards, the shared memory has separate power supplies and separate seven-day battery backup. The basic size of the shared memory is 2 GB, and the maximum size is 3 GB. The size of the shared memory storage is determined by the total cache size and the number of logical devices (LDEVs). Any required increase beyond the base size is automatically shipped and configured during the upgrade process. The shared memory is protected by battery backup.

Nonvolatile Duplex Cache

The Sun StorEdge 9980 system can be configured with up to 64 GB of cache (increments of 4 GB), and the Sun StorEdge 9970 system can be configured with up to 32 GB of cache (increments of 2 GB). All cache memory in the Sun StorEdge 9970 and 9980 systems is nonvolatile and is protected by 48-hour battery backup. The cache in the Sun StorEdge 9970 and 9980 systems are 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 9970 and 9980 systems 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. Before an acknowledgment is returned to the host performing a write, data must be written to both caches and then compared. This creates two exact copies of the data are stored on the battery-protected cache. If one copy of write data is defective or lost, the other copy is immediately destaged to disk. This “duplex cache” design ensures full data integrity in the unlikely event of a cache memory or power-related failure.

Note: Mainframe hosts can specify special attributes (e.g., cache fast write (CFW) command) to write data (typically sortwork data) without write duplexing. This data 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 drives..

Multiple Data and Control Paths

The Sun StorEdge 9970 and 9980 systems uses an advanced second generation switched fabric architecture that utilizes multiple point-to-point data and command paths in order to provide redundancy and improve performance. Each data and command path is independent. The individual paths between the channel or disk adapters and cache are steered by high-speed cache switch cards. The Sun StorEdge 9970 and 9980 systems does not have any common buses, thus eliminating the performance degradation and contention that can occur in a bus architecture. All data stored on the Sun StorEdge 9970 and 9980 systems is moved into and out of cache via the redundant high-speed 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, if necessary. Because of this redundancy, the Sun StorEdge 9970 and 9980 systems can sustain the loss of multiple power supplies and still continue operation. To make use of this capability, the Sun StorEdge 9970 and 9980 systems should be connected either to dual power sources or to different power panels, so if there is a failure on one of the power sources, the Sun StorEdge 9970 and 9980 systems can continue full operations using power from the alternate source.

The Sun StorEdge 9970 and 9980 systems also support connection to a UPS to provide additional battery backup capability (see page 77).



Channel Adapters and CHiPs

The channel adapter boards contain the front-end microprocessors (CHiPs) which process the channel commands from the host(s) and manage host access to cache. In the S/390 environment, the CHiPs perform CKD-to-FBA and FBA-to-CKD conversion for the data in cache. Channel adapter boards are installed in pairs. Each channel adapter board has four channel interfaces, which can all transfer at once, independently. Each channel adapter board pair is composed of one type of channel interface (e.g., ESCON, FICON, or Fibre Channel). Fibre Channel adapters and FICON-channel adapters are available in both shortwave (multimode) and longwave (single-mode) versions. The Sun StorEdge 9970 and 9980 systems can be configured with multiple channel adapter pairs to support various interface configurations. Table 6 lists the channel adapter specifications and configurations and the number of channel connections for each configuration.

Note: The Sun StorEdge CruiseControl and Graph-Track products (see page 42) allow users to collect and view usage statistics for the CHiPs in the Sun StorEdge 9970 and 9980 systems.

Parameter	Specification for Sun StorEdge 9980 system	Specification for Sun StorEdge 9970 system
Number of channel adapter pairs	1, 2, 3, or 4	1, 2, or 3
Simultaneous data transfers per CHA pair S/390 Open Systems	8 ESCON 8 Fibre Channel	
Maximum transfer rate: ESCON FICON Fibre Channel	17 MB/sec 100 MB/sec (1 Gbps) 200 MB/sec (2 Gbps)	
Physical interfaces per CHA pair	8 ESCON 8 FICON 8 Fibre Channel	
Maximum physical interfaces per system ESCON FICON Fibre Channel	32 0, 8, 16, 24, or 32 0, 8, 16, 24, or 32 0, 8, 16, 24, or 32	24 0, 8, 16, or 24 0, 8, 16, or 24 0, 8, 16, or 24
Logical paths per FICON port	512	
Logical paths per ESCON port	256	
Maximum logical paths per system	8192	6144
Maximum LUs per Fibre Channel port	512	
Maximum LVIs/LUs per system	8192	8192
Maximum World Wide Names (WWNs) per Fibre Channel port	128	
Maximum number of WWNs per system	32 x 128 = 4096	24 x 128 = 3072

Table 6 Channel Adapter Specifications



Channels

The Sun StorEdge 9970 and 9980 systems supports all-open system, all-mainframe, and multiplatform operations and offers the following types of host channel connections:

- **Fibre Channel.** The Sun StorEdge 9980 system supports up to 32 Fibre Channel ports, and the Sun StorEdge 9970 supports up to 24 Fibre Channel ports. The fibre ports are capable of data transfer speeds of 200 MB/sec (2 Gbps). The Sun StorEdge 9970 and 9980 systems Fibre Channel cards have eight ports per pair of channel adapter boards. The Sun StorEdge 9970 and 9980 systems support shortwave (multimode) and longwave (single-mode) versions of Fibre Channel adapters. When configured with shortwave Fibre Channel cards, the Sun StorEdge 9970 and 9980 systems can be located up to 500 meters (2750 feet) from the open-system host(s). When configured with longwave Fibre Channel cards, the Sun StorEdge 9970 and 9980 systems can be located up to ten kilometers from the open-system host(s).
- **ESCON.** The Sun StorEdge 9980 system supports a maximum of 32 ESCON channel interfaces and the Sun StorEdge 9970 system supports a maximum of 24 ESCON interfaces. The Sun StorEdge 9970 and 9980 system's ESCON channel interface cards provide data transfer speeds of up to 17 MB/sec and have a total of eight ports per pair of channel adapter boards. Each ESCON channel can be directly connected to a CHPID or to a serial channel director. Shared serial channels can be used for dynamic path switching. The Sun StorEdge 9970 and 9980 systems also support the Extended Distance Feature (XDF).
- **FICON.** The Sun StorEdge 9980 system supports* up to 32 FICON ports, and the Sun StorEdge 9970 supports up to 24 FICON ports. FICON ports are capable of data transfer speeds of up to 100 MB/sec (1 Gbps). FICON features, available in both shortwave (multimode) and longwave (single mode) versions, have a total of 8 FICON host interfaces per pair of FICON channel adapter cards. The Sun StorEdge 9970 and 9980 systems support shortwave (multimode) and longwave (single-mode) versions of FICON channel adapters. When configured with shortwave FICON-channel cards, the Sun StorEdge 9970 and 9980 systems can be located up to 500 meters (2750 feet) from the open-system host(s). When configured with longwave FICON-channel cards, the Sun StorEdge 9970 and 9980 systems can be located up to ten kilometers from the open-system host(s).

Array Control Processors (ACPs)

The ACPs, which control the transfer of data between the disk drives and cache, are installed in pairs for redundancy and performance. Figure 6 illustrates a conceptual ACP pair domain. The Sun StorEdge 9980 system can be configured with up to four ACP pairs, and the Sun StorEdge 9970 system can be configured with one or two ACP pairs. All functions, paths, and disk drives controlled by one ACP pair are called an "array domain." An array domain can contain a variety of LVI and/or LU configurations.

The disk drives are connected to the ACP pairs by fibre cables using an arbitrated-loop (FC-AL) topology. Each ACP has four microprocessors and four independent fibre backend paths. ACPs are installed in pairs. Each dual-ported Fibre Channel disk drive is connected via its two ports to each ACP in a pair via separate physical paths for reasons of performance and redundancy. Each Sun StorEdge 9980 system's fibre backend path can access up to 64 disk drives (64 drives \times 4 pairs of paths = 256 disk drives per ACP pair). Each Sun StorEdge 9970 system's fibre backend path can access up to 32 disk drives (32 drives \times 4 pairs of paths = 128 disk drives per ACP pair). In a Sun StorEdge 9970 system with two ACP pairs, each fibre backend path can access up to 16 disk drives (16 drives \times 4 pairs of paths = 64 drives per ACP pair).

Table 7 lists the ACP specifications. Each Sun StorEdge 9980 system's ACP pair can support a maximum of 256 physical disk drives (in two array frames), including dynamic spare disk drives. Each ACP pair contains eight buffers (one per fibre path) that 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.

Note: The Sun StorEdge 9900 CruiseControl and Graph-Track software products (see page 42) allow users to collect and view usage statistics for the ACPs in the Sun StorEdge 9970 and 9980 systems.

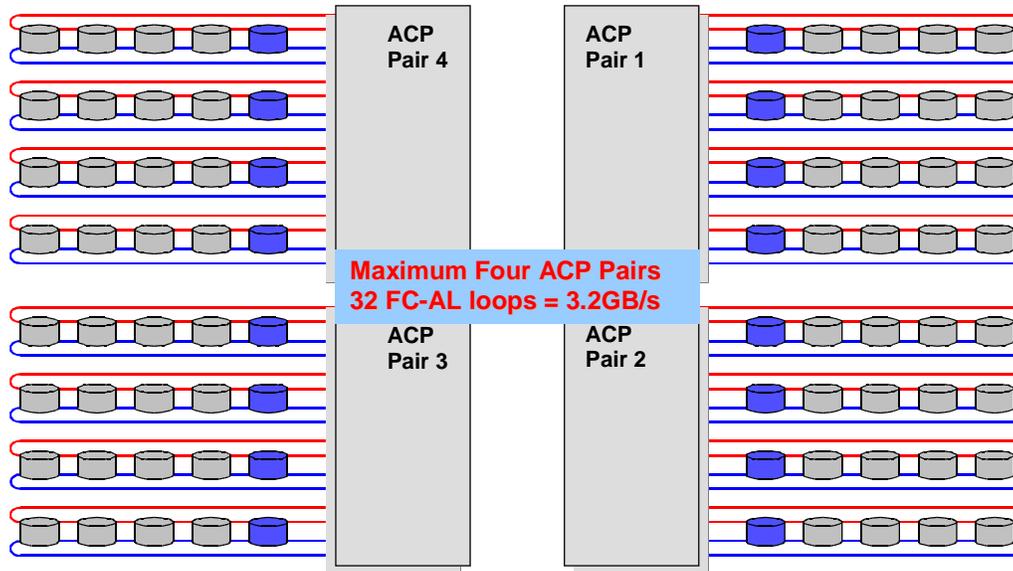


Figure 6 Conceptual Sun StorEdge 9980 System's ACP Array Domain

Description	Specification for Sun StorEdge 9980 system	Specification for Sun StorEdge 9970 system
Number of ACP pairs	1, 2, 3 or 4	1 or 2
Backend paths per ACP pair	8	
Backend paths per system	8, 16, 24 or 32	8 or 16
Array group (or parity group) type per ACP pair	RAID-1 and/or RAID-5	
Hard disk drive type per ACP pair ^[1]	36 GB, 73 GB	
Logical device emulation type within ACP pair	3390-x and OPEN-x ^[2]	
Backend array interface type	Fibre Channel arbitrated loop (FC-AL)	
Backend interface transfer rate (burst rate)	100 MB/sec (1 Gbps)	
Maximum concurrent backend operations per ACP pair	8	
Maximum concurrent backend operations per system	32	8 or 16
Switched fabric architecture internal bandwidth	15 GB/sec	7.5 GB/sec

Notes:

1. All hard disk drives (HDDs) in an array group (also called parity group) must be the same type.
2. 3390-3 and 3390-3R LVIs cannot be intermixed in the same Sun StorEdge 9970 and 9980 systems.

Table 7 ACP Specifications



Array Frame

The Sun StorEdge 9980 systems' 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. The Sun StorEdge 9970 and 9980 systems also support connection to a UPS to provide additional battery backup capability. The Sun StorEdge 9980 system can be configured with up to four array frames to provide a raw storage capacity of up to 74 TB. The Sun StorEdge 9970 system combines the controller and disk array components in one physical frame to provide a raw storage capacity of up to 9 TB. When configured in four-drive RAID-5 parity groups, $\frac{3}{4}$ of the raw capacity is available to store user data, and $\frac{1}{4}$ of the raw capacity is used for parity data.

The Sun StorEdge 9970 and 9980 systems use disk drives with fixed-block-architecture (FBA) format. The currently available disk drives have capacities of 36 GB and 73 GB. All drives in an array group must have the same rotation speed and the same capacity. The 36-GB and 73-GB HDDs can be attached to the same ACP pair. The Sun StorEdge 9980 system also supports 181 GB capacity drives when array frames from a Sun StorEdge 9960 system are connected because of an upgrade. Table 8 provides the disk drive specifications.

Each disk drive can be replaced nondisruptively on site. The Sun StorEdge 9970 and 9980 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 rotation speed and the same or lower capacity anywhere in the system, even if the failed disk and the spare disk are in different array domains (attached to different ACP pairs). The Sun StorEdge 9980 system can be configured with a minimum of one and a maximum of sixteen spare disk drives. The Sun StorEdge 9970 system can be configured with a minimum of one and a maximum of four spare disk drives. The standard configuration provides one spare drive for each type of drive installed in the system. The Sun StorEdge Remote Response service monitoring and reporting tool detects disk drive failures and notifies the Sun Support Center automatically, and a service representative is sent to replace the disk drive.

Note: The spare disk drives are used only as replacements and do not add to the raw capacity of the system.

Parameter	Disk Drive Capacity	
	73 GB	36 GB
Formatted capacity (GB)	72.91	35.76
Platter diameter	3 inches	2.5 inches
Physical tracks per physical cylinder (user area) (number of heads)	10	8
Physical disk platters (user area) (numbers of disks)	5	4
Sector length (byte)	520(512)	520(512)
Seek time (ms) (Read/Write)	Minimum	0.5/0.7
	Maximum	11.0/12.0
	Average	4.9/5.7
Revolution speed (rpm)	10,025	14,904
Average latency time (ms)	2.99	2.01
Internal data transfer rate (MB/sec)	44.2 to 74.0	68.5 to 88.3
Maximum interface data transfer rate (MB/sec)	100	100

Table 8 Disk Drive Specifications



Disk Array Groups

The disk array group is the basic unit of storage capacity for the Sun StorEdge 9970 and 9980 systems. 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 array frame has two canister mounts, and each canister mount can have up to 128 physical disk drives.

The Sun StorEdge 9970 and 9980 systems support both RAID-1 and RAID-5 array groups. Figure 7 illustrates a sample RAID-1 layout. A RAID-1 array group consists of two pair of disk drives in a mirrored configuration, regardless of disk drive capacity. Data is striped to two drives and mirrored to the other two 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 eight 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. Although the RAID-5 implementation is appropriate for many applications, the RAID-1 option on the Sun StorEdge 9970 and 9980 systems is ideal for workloads with low cache-hit ratios.

RAID-1 using 2D + 2D and S/390® LDEVs

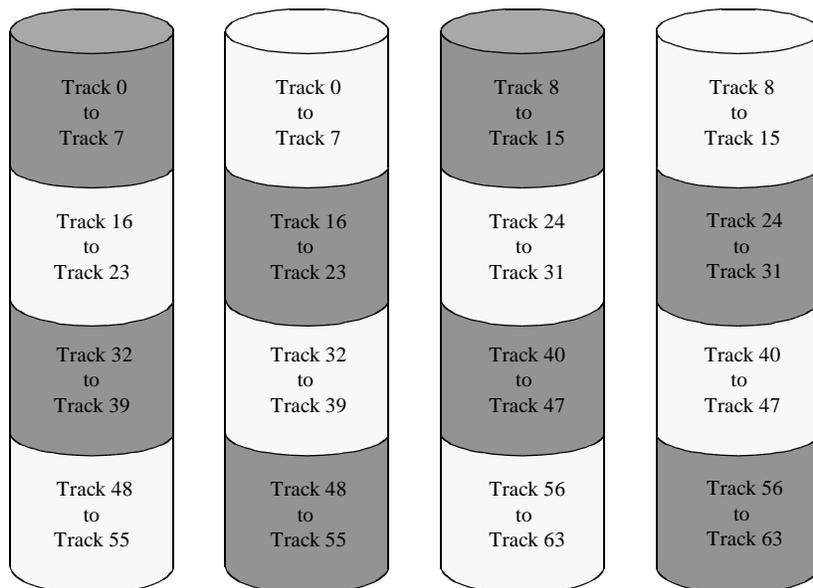


Figure 7 Sample RAID-1 Layout

A RAID-5 array group consists of four disk drives. The data is written across the four hard drives in a stripe that has three data chunks and one parity chunk. Each chunk contains either eight logical tracks (S/390) or 768 logical blocks (open systems). The enhanced RAID-5+ implementation in the Sun StorEdge 9970 and 9980 systems minimizes the write penalty incurred by standard RAID-5 implementations by keeping write data in cache until an entire stripe can be built and then writing the entire data stripe to the disk drives.



Figure 8 illustrates RAID-5 data stripes mapped over four physical drives. Data and parity are striped across each of the disk drives in the array group (hence the term “parity group”). The logical devices (LDEVs) are evenly dispersed in the array group, so that the performance of each LDEV within the array group is the same. Figure 8 also shows the parity chunks that 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 (eight tracks per chunk) for S/390 data, or 2304 blocks (768 blocks per chunk) for open systems data. Each of these array groups can be configured as either 3390-x or OPEN-x logical devices. All LDEVs in the array group must be the same format (3390-x or OPEN-x). For open systems, each LDEV is mapped to a SCSI address, so that it has a TID and logical unit number (LUN).

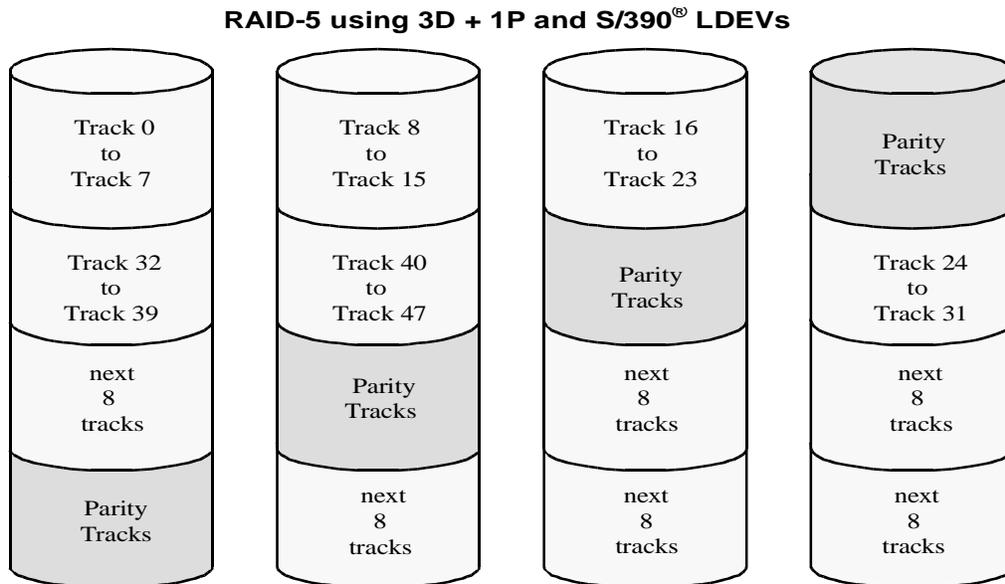


Figure 8 Sample RAID-5 Layout (Data Plus Parity Stripe)

Note: The Sun StorEdge 9900 CruiseControl and Graph-Track software products (see page 42) allow users to collect and view detailed usage statistics for the disk array groups in the Sun StorEdge 9970 and 9980 systems.

Sequential Data Striping

The Sun StorEdge 9970 and 9980 systems enhanced RAID-5+ implementation attempts to keep write data in cache until parity can be generated without referencing old parity or data. This capability to write entire data stripes, which is usually achieved only in sequential processing environments, minimizes 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 LDEV occupies the same relative physical location within each array group in the system.



Intermix Configurations

RAID-1 & RAID-5 Intermix

RAID technology provides full fault-tolerance capability for the disk drives of the Sun StorEdge 9970 and 9980 systems. The Sun StorEdge 9970 and 9980 systems supports RAID-1, RAID-5, and intermixed RAID-1 and RAID-5 configurations, including intermixed array groups within an array domain. The cache management algorithms (see page 39) enable the Sun StorEdge 9970 and 9980 systems to stage up to one full RAID stripe of data into cache ahead of the current access to allow subsequent access to be satisfied from cache at host channel transfer speeds.

Hard Disk Drive Intermix

Figure 9 illustrates an intermix of hard disk drive types. All hard disk drives in one array group (parity group) must be of the same capacity and type. The 36-GB and 73-GB HDDs can be attached to the same ACP pair.

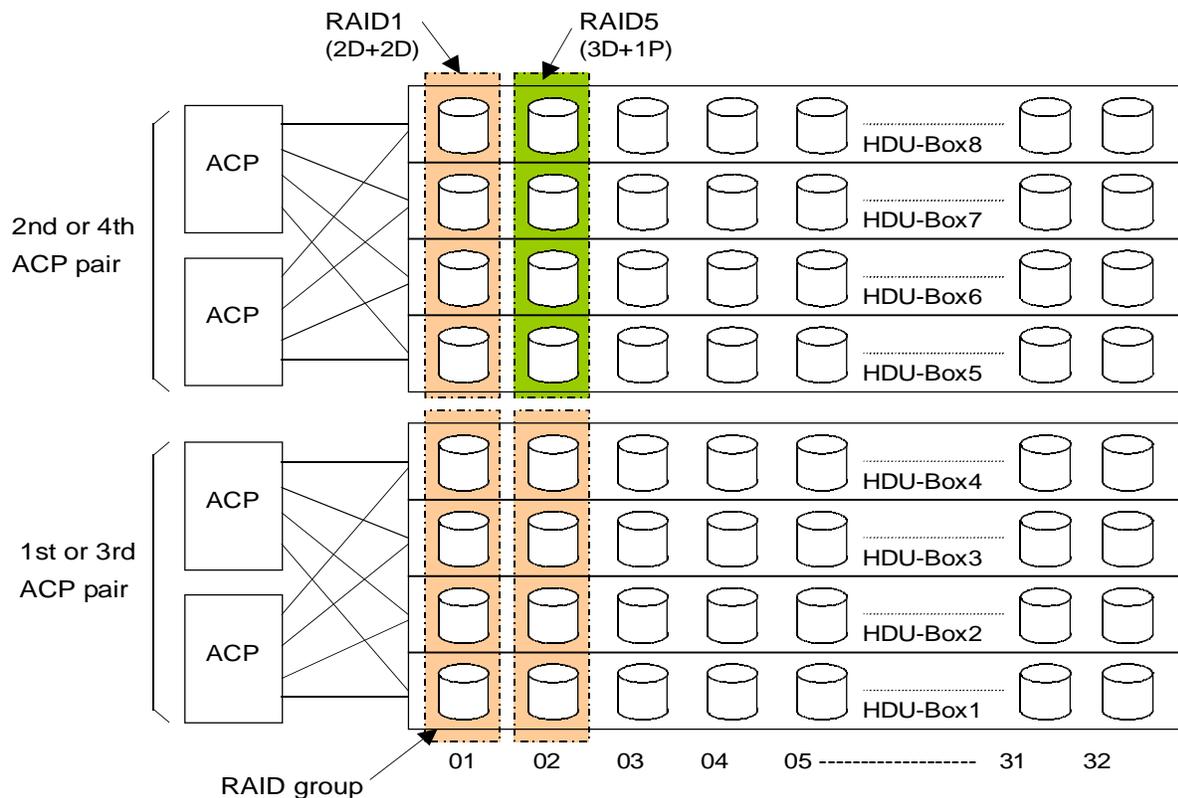


Figure 9 Sample Hard Disk Drive Intermix



Device Emulation Intermix

The Sun StorEdge 9970 and 9980 systems supports an intermix of different device emulations (e.g., 3390-x LVIs, OPEN-x LUs) on the same ACP pair. Figure 10 illustrates an intermix of device emulation types. The only requirement is that the devices within each array group must have the same type of track geometry or format, as follows:

- 3390-3 and 3390-9 can be intermixed within an array group.
- OPEN-3, -9, -E, and -L can be intermixed within an array group with the following restriction: OPEN-L devices can only be configured on array groups of 73-GB HDDs.

Note: The Sun StorEdge 9980 and 9970 systems may support different device emulations and intermix configurations.

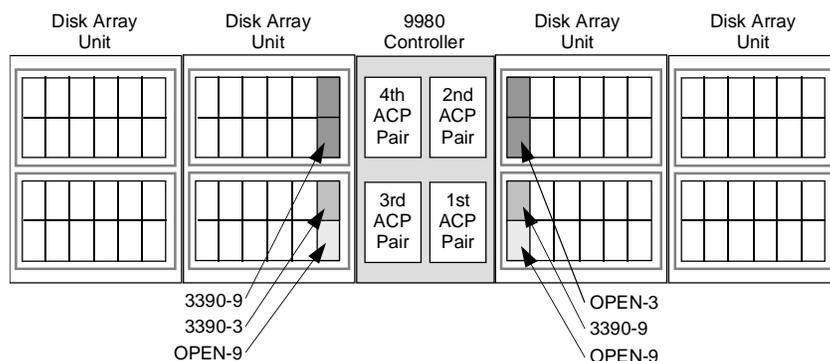


Figure 10 Sample Device Emulation Intermix

Service Processor (SVP)

The Sun StorEdge 9970 and 9980 systems include 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 support personnel. The SVP enables configuration, maintenance, and upgrade the Sun StorEdge 9970 and 9980 systems. The SVP also collects performance data for all key components of the Sun StorEdge 9970 and 9980 systems to enable diagnostic testing and analysis.

Note: The SVP does not have access to any user data stored on the Sun StorEdge 9970 and 9980 systems.

The Sun StorEdge 9970 and 9980 systems Remote Console functionality is provided by the SVP. The Sun StorEdge 9900 Graph-Track software product (see page 50) stores the SVP performance data and allows users to view the data in graphical format and export the data for statistical analysis.

Sun StorEdge Remote Console – Storage Navigator

The Sun StorEdge 9970 and 9980 systems' Sun StorEdge 9900 Remote Console – Storage Navigator software is provided as a Java applet program that can execute on any machine that supports a Java Virtual Machine (JVM). The Remote Console PC hosts the Remote Console Java applet program and is attached to the Sun StorEdge 9970 and 9980 system(s) via a TCP/IP local-area network (LAN). When a Remote Console accesses and logs into the desired SVP, the Remote Console applet is downloaded from the SVP to the Remote Console, runs on the web browser of the Remote Console PC, and communicates



with the attached Sun StorEdge 9970 and 9980 systems via a TCP/IP network. Figure 11 shows an example of Remote Console and SVP configuration.

Two LANs can be attached to the Sun StorEdge 9970 and 9980 systems: the Sun StorEdge 9970 and 9980 systems' internal LAN (private LAN), which is used to connect the SVP(s) of multiple systems, and the user's intranet (public LAN), which allows you to access the Remote Console functions from individual Remote Console PCs. The Remote Console communicates directly with the service processor (SVP) of each attached system to obtain system configuration and status information and send user-requested commands to the system. The Sun StorEdge 9970 and 9980 systems' Remote Console Java applet program is downloaded to the Remote Console (web client) from the SVP (web server) each time the Remote Console is connected to the SVP. The Remote Console Java applet program runs on Web browsers, such as Internet Explorer and Netscape Navigator, which run under the Windows and Solaris operating systems to provide a user-friendly interface for the Sun StorEdge 9970 and 9980 systems' Remote Console functions.

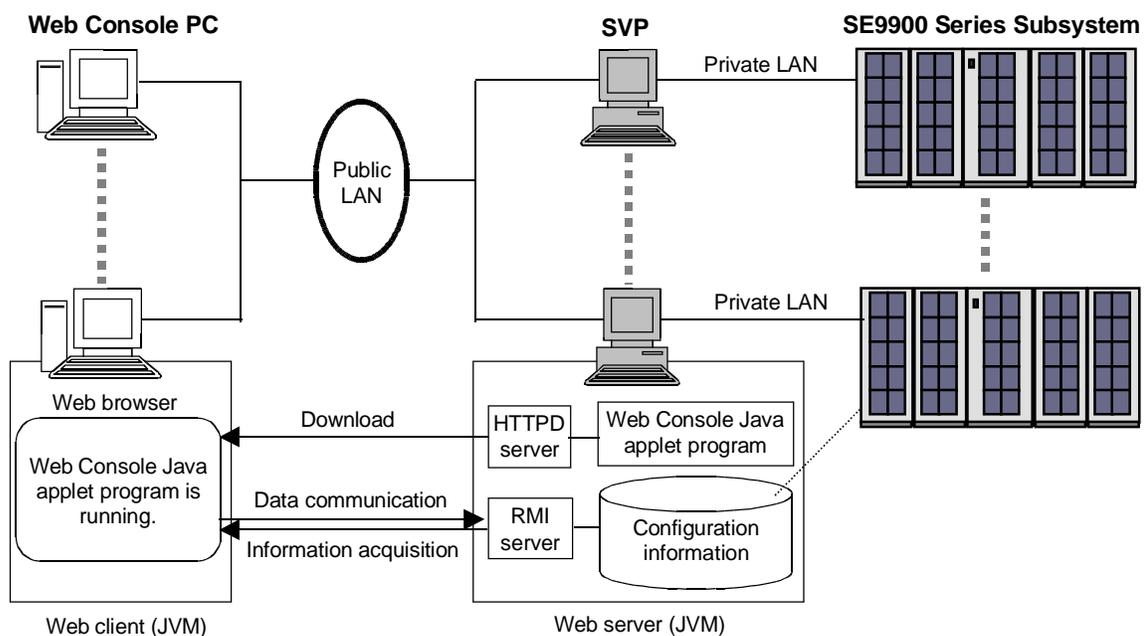


Figure 11 Example of Remote Console PC and SVP Configuration



Functional and Operational Characteristics

NEW Sun StorEdge 9970 and 9980 Systems Features and Capabilities

The Sun StorEdge 9970 and 9980 systems offer the following new or improved features and capabilities which distinguish this model from the Sun StorEdge 9910 and 9960 systems:

- Thirty-two (32) logical control unit (CU) images (16 for the Sun StorEdge 9910 and 9960).
- Up to 8192 device addresses (4096 for the Sun StorEdge 9910 and 9960).
- Up to 64 GB cache memory for the Sun StorEdge 9980 system (32 GB for Sun StorEdge 9960 system) and 32 GB for the Sun StorEdge 9970 system (16 GB for Sun StorEdge 9910 system).
- Up to 1024 HDDs (512 HDDs in the Sun StorEdge 9960 system).
- Up to 512 LUNs per Fibre Channel port (256 for the Sun StorEdge 9910 and 9960 systems).
- Internal bandwidth increased by over three times relative to the Sun StorEdge 9910 and 9960 systems.
- Disk drives of 36-GB 15K RPM and 73-GB 10K RPM capacities (15K RPM drives were not available on the Sun StorEdge 9910 and 9960 systems).
- Support for low profile 1-inch high disk drives reduces footprint
- Virtualization assist providing easier connectivity in SAN environments.
- Interface blade architecture provides investment protection as new interfaces become dominant in the market

I/O Operations

The Sun StorEdge 9970 and 9980 systems' I/O operations are classified into three types based on cache usage:

- **Read hit:** For a read I/O, when the requested data is already in cache, the operation is classified as a read hit. The CHIP searches the cache directory, determines that the data is in cache, and immediately transfers the data to the host at the channel transfer rate.
- **Read miss:** For a read I/O, when the requested data is not currently in cache, the operation is classified as a read miss. The CHIP searches the cache directory, determines that the data is not in cache, disconnects from the host, creates space in cache, updates the cache directory, and requests the data from the appropriate ACP pair. The ACP pair stages the appropriate amount of data into cache, depending on the type of read I/O (e.g., sequential).
- **Fast write:** All write I/Os to the Sun StorEdge 9970 and 9980 systems are fast writes, because all write data is written to cache before being destaged to disk. The data is stored in two cache locations on separate power boundaries in the nonvolatile duplex cache (see page 28). As soon as the write I/O has been written to cache, the Sun StorEdge 9970 and 9980 systems notify the host that the I/O operation is complete, and then destages the data to disk.



Cache Management

Algorithms for Cache Control

The Sun StorEdge 9970 and 9980 systems 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 9970 and 9980 systems include the following:

- **Intelligent Learning Algorithm.** The 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 (modified).** When a read hit or write I/O occurs in a nonsequential 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.** The sequential prefetch algorithm is 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.

Note: The Sun StorEdge 9970 and 9980 systems support S/390 extended count key data (ECKD) commands for specifying cache functions.

Write Pending Rate

The write pending rate is the percent of total cache used for write pending data. 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. Sun StorEdge 9900 CruiseControl and Graph-Track software allow users to collect and view the write-pending-rate data and other cache statistics for the Sun StorEdge 9970 and 9980 systems.

Note: If the write pending limit is reached, the Sun StorEdge 9970 and 9980 systems send 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.

Control Unit (CU) Images, LVIs, and LUs

CU Images

The Sun StorEdge 9970 and 9980 systems support the following logical CU images (emulation types): 3990-6, 3990-6E, and 2105. The Sun StorEdge 9970 and 9980 systems is configured with one logical CU image for each 256 devices (one storage system ID (SSID) for each 64 or 256 LDEVs) to provide a maximum of 32 CU images per system. The S/390 data management features of the Sun StorEdge 9970 and 9980 systems may have restrictions on CU image compatibility. The FICON channel interface requires 2105-F20 emulation.



Logical Volume Image (LVIs)

The Sun StorEdge 9970 and 9980 systems support the following S/390 LVI types: 3390-3, -3R, and -9. The LVI configuration of the system depends on the RAID implementation and physical disk drive capacities. The Sun StorEdge 9970 and 9980 systems' LDEVs are accessed using a combination of CU number (0-F) and device number (00-FF), as shown in Table 9. See page 52 for further information on LVI configurations.

CU Number	Device Numbers	CU Number	Device Numbers
0	0:00 to 0:FF	8	8:00 to 8:FF
1	1:00 to 1:FF	9	9:00 to 9:FF
2	2:00 to 2:FF	A	A:00 to A:FF
3	3:00 to 3:FF	B	B:00 to B:FF
4	4:00 to 4:FF	C	C:00 to C:FF
5	5:00 to 5:FF	D	D:00 to D:FF
6	6:00 to 6:FF	E	E:00 to E:FF
7	7:00 to 7:FF	F	F:00 to F:FF

Table 9 Device Numbers for Each CU

Logical Unit (LU) Type

The Sun StorEdge 9970 and 9980 systems currently support the following LU types: OPEN-3, OPEN-9, OPEN-E, and OPEN-L. Table 10 lists the capacities for each standard LU type.

LU Type	OPEN-3	OPEN-9	OPEN-E	OPEN-L
Capacity (GB)	2.461	7.384	14.568	36.450

Table 10 Capacities of Standard LU Types

The Sun StorEdge 9970 and 9980 systems also allow users to configure custom-size LUs which are smaller than standard LUs as well as size-expanded LUs which are larger than standard LUs. LU Size Expansion (LUSE) volumes can range in size from 4.92 GB (OPEN-3*2) to a maximum of 1312 GB (OPEN-L*36). Each LU is identified by target ID (TID) and LU number (LUN) (see Figure 12). Each Sun StorEdge 9970 and 9980 systems' Fibre Channel port supports addressing capabilities for up to 256 LUNs when not using LUN Security and up to 512 LUNs when using LUN Security.



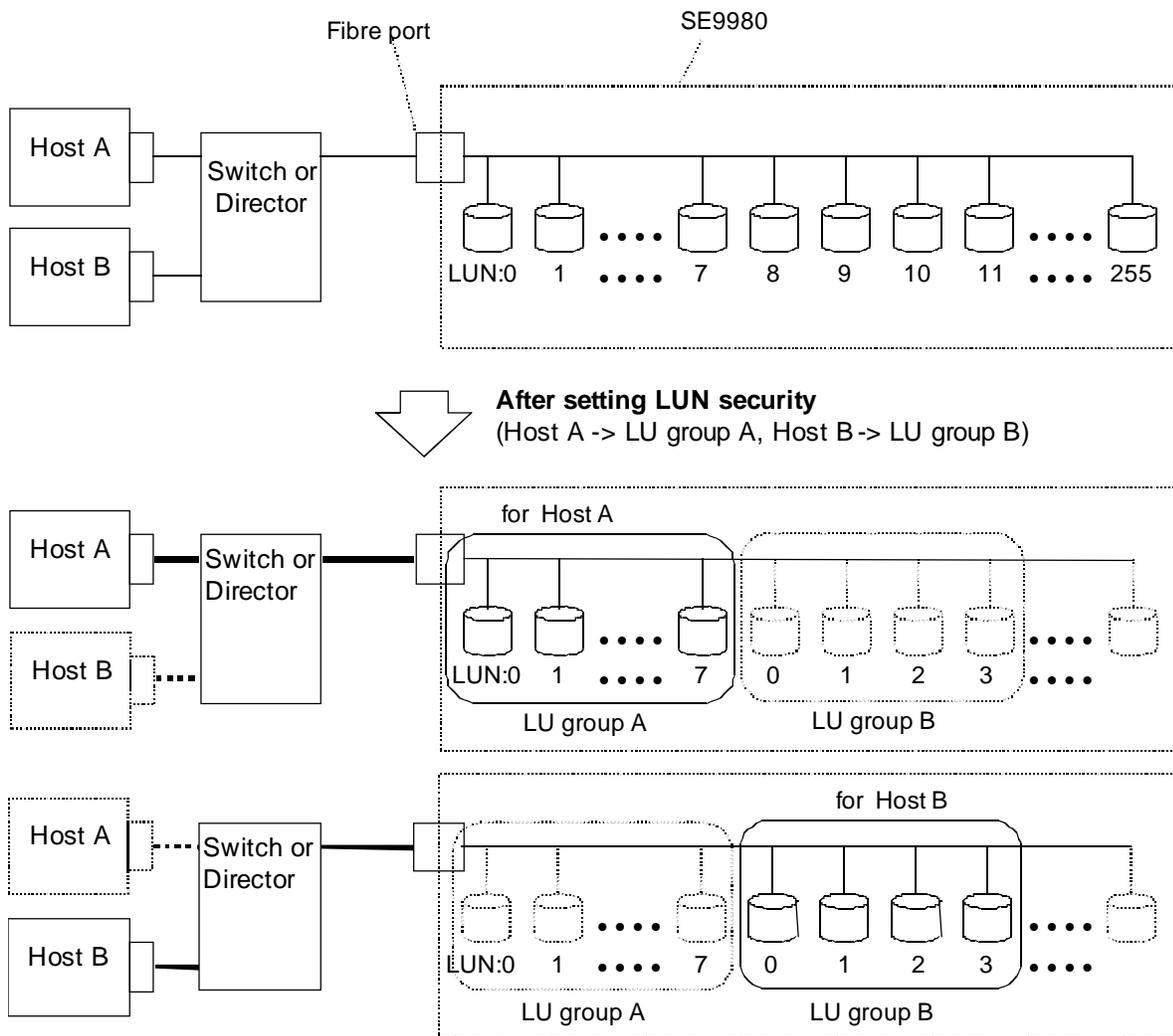


Figure 12 Fibre Channel Device Addressing



Open Systems Features and Functions

The Sun StorEdge 9970 and 9980 systems offer many features and functions specifically for the open systems environment. The Sun StorEdge 9970 and 9980 systems supports multi-initiator I/O configurations in which multiple host systems are attached to the same Fibre Channel interface. The Sun StorEdge 9970 and 9980 systems also support important open-system functions such as Fibre Channel arbitrated-loop (FC-AL) and fabric topologies, command tag queuing, multi-initiator I/O, and industry-standard middleware products which provide application and host failover, I/O path failover, and logical volume management functions. In addition, several program products and services are specifically for open systems. See page 42 for more information.

Failover and SNMP Support

The Sun StorEdge 9970 and 9980 systems support industry-standard products and functions which provide host and/or application failover, I/O path failover, and logical volume management (LVM), including Sun StorEdge™ Traffic Manager software, Sun™ Cluster 3.x, Sun StorEdge™ Dynamic Link Manager software, VERITAS Cluster Server, VERITAS Volume Manager/DMP, TruCluster, HP MC/ServiceGuard, HACMP, Novell Cluster Server, Microsoft Cluster Server.

The Sun StorEdge 9970 and 9980 systems also support the industry-standard simple network management protocol (SNMP) for remote system management from the UNIX/PC server host. SNMP is used to transport management information between the Sun StorEdge 9970 and 9980 systems and the SNMP manager on the host. The SNMP agent for the Sun StorEdge 9970 and 9980 systems sends status information to the host(s) when requested by the host or when a significant event occurs.

Share-Everything Architecture

The Sun StorEdge 9970 and 9980 systems' global cache provides a "share-everything" architecture that enables any Fibre Channel port to have access to any LU in the system. In the Sun StorEdge 9970 and 9980 systems, each LU can be assigned to multiple Fibre Channel ports to provide I/O path failover and/or load balancing (with the appropriate middleware support) without sacrificing cache coherency. The LUN mapping can be performed by the user using the LUN Manager Remote Console software, or by your Sun support personnel.

Data Management Functions

The Sun StorEdge 9970 and 9980 systems provide features and functions that increase data availability and improve data management. Table 11 and Table 12 list the data management features that are currently available for the Sun StorEdge 9970 and 9980 systems.



Feature Name	Controlled by:		Licensed Software?
	Remote Console?	Host OS?	
Replication:			
TrueCopy (page 44)	Yes	Yes	Yes
ShadowImage (page 45)	Yes	Yes	Yes
Command Control Interface (CCI) (page 46)	No	Yes	Yes
Backup/Restore and Sharing:			
RapidXchange (page 46)	No	Yes	Yes
Multiplatform Backup/Restore (page 47)	No	Yes	Yes
Resource Management:			
HiCommand (page 47)	Yes	No	Yes
Remote Console – Storage Navigator (page 51)	Yes	No	Note 1
LUN Manager (page 47),	Yes	No	Note 1
LUSE (page 47)	Yes	No	Note 1
Virtual LUN (page 48)	Yes	No	Note 1
FlashAccess (page 48)	Yes	Yes	Note 1
SANtinel (page 48)	Yes	No	Note 1
Performance Management:			
Graph-Track (page 50)	Yes	No	Note 1
Performance Monitor (page 49)	Yes	No	Yes
Priority Access (page 50)	Yes	No	Yes
CruiseControl (page 50)	Yes	No	Yes
Alternate Path Control:			
Sun StorEdge Dynamic Link Manager (page 49)	No	Yes	Yes

Notes: The Sun StorEdge 9900 Resource Manager for Open Systems (used only on the Sun StorEdge 9970 and 9980) includes this software.

Table 11 Data Management Functions for Open-System Users



Feature Name	Controlled by:		Licensed Software?
	Remote Console?	Host OS?	
Replication:			
TrueCopy – S/390 (page 45)	Yes	Yes	Yes
ShadowImage – S/390 (page 45)	Yes	Yes	Yes
Extended Remote Copy (XRC) (page 46)	No	Yes	No
Backup/Restore and Sharing:			
RapidXchange (page 46)	No	Yes	Yes
Resource Management:			
Remote Console – Storage Navigator (page 51)	Yes	No	Note 2
Virtual LVI (page 48)	Yes	No	Note 2
Cache Manager (page 48)	Yes	Yes	Note 2
SANtinel – S/390 (page 48)	Yes	No	Note 2
Parallel Access Volume (PAV) (page 49)	Yes	Yes	Yes
Performance Management:			
Graph-Track (page 50)	Yes	No	Note 2
Performance Monitor (page 49)	Yes	No	Yes
Priority Access (page 50)	Yes	No	Yes
CruiseControl (page 50)	Yes	No	Yes

Notes: The Sun StorEdge 9900 Resource Manager software for S/390 Environments (used only on the Sun StorEdge 9970 and 9980 systems) includes this software.

Table 12 Data Management Functions for S/390 Users

Sun StorEdge 9900 TrueCopy Software

Sun StorEdge™ 9900 TrueCopy software allows open-system users to perform synchronous or asynchronous remote copy operations between Sun StorEdge 9970 and 9980 systems. The user can create, split, and resynchronize LU pairs. Sun StorEdge 9900 TrueCopy software also supports a “takeover” command for remote host takeover (with the appropriate middleware support). Once established, Sun StorEdge TrueCopy software operations continue unattended and provide continuous, real-time data backup. Remote copy operations are nondisruptive and allow the primary Sun StorEdge 9900 TrueCopy software volumes to remain online to all hosts for both read and write I/O operations. Sun StorEdge 9900 TrueCopy software operations can also be performed between Sun StorEdge 9910, 9960, 9970 and 9980 systems.

Sun StorEdge 9900 TrueCopy software supports Fibre Channel interface connections between the main and remote Sun StorEdge 9970 and 9980 systems. For Fibre Channel connection, Sun StorEdge 9900 TrueCopy software operations can be performed across distances of up to 30 km (18.6 miles) using single-mode longwave optical fibre cables in a switch configuration. Long-distance solutions are provided, based on user requirements and workload characteristics, using approved channel extenders and communication lines.

Improved performance through updated delta copy technique - a single track may now be sent as the delta copy to the replica site.



Sun StorEdge 9900 TrueCopy Software – S/390

Sun StorEdge 9900 TrueCopy software – S/390 allows S/390 users to perform synchronous or asynchronous remote copy operations between Sun StorEdge 9970 and 9980 systems. Sun StorEdge 9900 TrueCopy software – S/390 can be used to maintain copies of data for backup or duplication purposes. Once established, TC390 operations continue unattended and provide continuous, real-time data backup. Remote copy operations are nondisruptive and allow the primary Sun StorEdge 9900 TrueCopy software volumes to remain online to all hosts for both read and write I/O operations.

Sun StorEdge 9900 TrueCopy software – S/390 also supports both ESCON and Fibre Channel interface connections between the main and remote Sun StorEdge 9970 and 9980 systems. Remote copy operations can also be performed between Sun StorEdge 9910, 9960, 9970 and 9980 systems.

Sun StorEdge 9900 ShadowImage Software

Sun StorEdge™ 9900 ShadowImage software allows open-system users to maintain system-internal copies of LUs for purposes such as data backup or data duplication. The RAID-protected duplicate LUs (up to nine) are created within the same Sun StorEdge 9970 and 9980 systems as the primary LU at hardware speeds. Once established, Sun StorEdge 9900 ShadowImage software operations continue unattended to provide asynchronous internal data backup. Sun StorEdge 9900 ShadowImage software operations are nondisruptive; the primary LU of each ShadowImage pair remains available to all hosts for both read and write operations during normal operations. Usability is further enhanced through a resynchronization capability that reduces data duplication requirements and backup time, thereby increasing user productivity. Sun StorEdge 9900 ShadowImage software also supports reverse resynchronization for maximum flexibility.

Sun StorEdge 9900 ShadowImage software operations can be performed in conjunction with Sun StorEdge 9900 TrueCopy software operations (see page 44) to provide multiple copies of critical data at both primary and remote sites. Sun StorEdge 9900 ShadowImage software also supports the Sun StorEdge 9900 Virtual LVI/LUN and FlashAccess software features of the Sun StorEdge 9970 and 9980 systems, ensuring that all user data can be duplicated by Sun StorEdge 9900 ShadowImage software operations.

Improved performance through updated delta copy technique – a single track may now be sent as the delta copy to the copy volume.

Sun StorEdge 9900 ShadowImage Software – S/390

Sun StorEdge 9900 ShadowImage software – S/390 allows S/390 users to create high-performance copies of 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 perform updates in either direction, either from the source LVI to the ShadowImage copy or from the copy back to the source LVI. When used in conjunction with either Sun StorEdge 9900 TrueCopy software – S/390 or XRC, Sun StorEdge 9900 ShadowImage software – S/390 allows users to maintain multiple copies of critical data at both primary and remote sites. Sun StorEdge 9900 ShadowImage software also supports the Sun StorEdge 9900 Virtual LVI/LUN and FlashAccess software features, ensuring that all user data can be duplicated by Sun StorEdge 9900 ShadowImage software operations.



Command Control Interface (CCI)

Command Control Interface (CCI) allows users to perform Sun StorEdge 9900 TrueCopy and ShadowImage software operations on the Sun StorEdge 9970 and 9980 systems by issuing commands from the UNIX®/PC server host to the Sun StorEdge 9970 and 9980 systems. The CCI software interfaces with the system software and high-availability (HA) software on the UNIX®/PC server host as well as the Sun StorEdge 9900 TrueCopy and ShadowImage software on the Sun StorEdge 9970 and 9980 systems. The CCI software provides failover and other functions such as backup commands to allow mutual hot standby in cooperation with the failover product on the UNIX®/PC server (e.g., MC/ServiceGuard, FirstWatch, HACMP).

CCI also supports a scripting function that allows users to define multiple Sun StorEdge 9900 TrueCopy and/or ShadowImage software operations in a script (text) file. Using CCI scripting, you can set up and execute a large number of Sun StorEdge 9900 TrueCopy and/or ShadowImage software commands in a short period of time while integrating host-based high-availability control over remote copy operations.

Sun StorEdge 9900 Extended Remote Copy Software

The Sun StorEdge™ Extended Remote Copy (XRC) software asynchronous remote copy feature of the Sun StorEdge 9970 and 9980 systems is functionally compatible with IBM Extended Remote Copy (XRC). Extended Remote Copy provides asynchronous remote copy 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 nondisruptive 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 limit between the primary and remote disk systems. Sun StorEdge 9900 Extended Remote Copy software is also compatible with the DFSMS Data Mover that is 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 directly to the Sun StorEdge 9970 and 9980 systems. The Remote Console software is not used to perform Sun StorEdge 9900 Extended Remote Copy software operations. Sun StorEdge 9900 Extended Remote Copy software can be used as an alternative to Sun StorEdge 9900 TrueCopy software – S/390 for mainframe data backup and disaster recovery planning. However, Sun StorEdge 9900 Extended Remote Copy software requires host processor resources that 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.

Sun StorEdge 9900 RapidXchange Software

Sun StorEdge™ 9900 RapidXchange software enables the user to transfer data between S/390 and open-system platforms using the ESCON channels. Sun StorEdge 9900 RapidXchange software enables high-speed data transfer without requiring network communication links or tape. Data transfer is performed via the RapidXchange volumes, which are shared devices that appear to the S/390 host as 3390-3 LVIs and to the open-system host as OPEN-3 LUs. To provide the greatest platform flexibility for data transfer, the RapidXchange volumes are accessed from the open-system host 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 RapidXchange volumes. The RapidXchange volumes must be formatted as 3390-3A/B/C LVIs. The -A LVIs can be used for open-to-mainframe and/or mainframe-to-open Sun StorEdge 9900 RapidXchange software, the -B LVIs are used for mainframe-to-open Sun StorEdge 9900 RapidXchange software, and the -C LVIs are used for open-to-mainframe Sun StorEdge 9900 RapidXchange software. Sun StorEdge 9900 RapidXchange software also supports OPEN-x-



RapidXchange devices to provide open-to-open Sun StorEdge 9900 RapidXchange software operations for all-open Sun StorEdge 9970 and 9980 systems.

The Sun StorEdge 9900 RapidXchange software enables the open-system host to read from and write to individual S/390 datasets. The software is installed on the open-system host and includes the File Conversion Utility (FCU) and the File Access Library (FAL). FCU 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 that allows open-system programmers to read from and write to S/390 sequential datasets on the RapidXchange volumes.

Sun StorEdge 9900 Multiplatform Backup/Restore Software

Sun StorEdge™ 9900 Multiplatform Backup/Restore software allows the user to implement mainframe-based backup procedures and standards for the open-system data stored on the multiplatform Sun StorEdge 9970 and 9980 systems. Sun StorEdge 9900 Multiplatform Backup/Restore software allows standard mainframe backup/restore utilities such as DFDSS, Fast Dump/Restore (FDR), and VSE FASTWRITE to perform volume-level backup and restore operations on OPEN-3 and OPEN-9 LUs. Using these mainframe-based utilities as well as mainframe-based media and high-speed backup devices, the user can use the same procedures and achieve the same standards for both mainframe and open-system backup/restore operations. Before Sun StorEdge 9900 Multiplatform Backup/Restore software 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-x LUs as mainframe volumes, which contain a single file. Sun StorEdge 9900 Multiplatform Backup/Restore software supports only full-volume backup/restore operations.

Sun StorEdge 9900 HiCommand Software

Sun StorEdge™ 9900 HiCommand software provides a consistent, easy to use, and easy to configure set of interfaces for managing Sun storage products including the Sun StorEdge T3 array and Sun StorEdge 9910, 9960, 9970, and 9980 systems. Sun StorEdge 9900 HiCommand software provides a web interface for real-time interaction with the storage arrays being managed, as well as a command line interface (CLI) for scripting. Sun StorEdge 9900 HiCommand software gives storage administrators easier access to the existing system configuration, monitoring, and management features such as Sun StorEdge 9900 LUN Manager, SANtinel, TrueCopy, and ShadowImage software.

Sun StorEdge 9900 HiCommand software enables users to manage the Sun StorEdge 9970 and 9980 systems and perform functions from virtually any location via the HiCommand Web Client, HiCommand command line interface (CLI), and/or third-party application. Sun StorEdge 9900 HiCommand software displays detailed information on the configuration of the storage arrays added to the Sun StorEdge 9900 HiCommand software system and allows you to perform important operations such as adding and deleting volume paths, securing logical units (LUs), and managing data replication operations.

Sun StorEdge 9900 LUN Manager Software

Sun StorEdge™ 9900 LUN Manager software enables users to set and define the port modes for Fibre Channel ports and to set the fibre topology (e.g., FC-AL, fabric).

LU Size Expansion (LUSE)

The LUSE (LU Size Expansion) feature allows users to create virtual LUs that are 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 × 36). This capability allows open-system hosts to access the data on the entire Sun



StorEdge 9970 and 9980 systems using fewer logical units. LUSE allows host operating systems that have restrictions on the number of LUs per interface to access larger amounts of data.

Sun StorEdge 9900 Virtual LVI/LUN Software

Sun StorEdge™ 9900 Virtual LVI/LUN software allows users to convert fixed-size volumes into several smaller variable custom-sized volumes. Using the Sun StorEdge 9900 Remote Console – Storage Navigator software, users can configure custom-size volumes by assigning a logical address and a specific number of cylinders/tracks (for S/390 data) or MB (for open systems data) to each custom LVI/LU.

Sun StorEdge 9900 Virtual LVI/LUN software can improve 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 LVI/LUN software allows the user to more fully utilize the physical storage capacity of the Sun StorEdge 9970 and 9980 systems, while reducing the amount of administrative effort required to balance I/O workloads. When Sun StorEdge 9900 Virtual LVI/LUN software is 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 LVI/LUN or FlashAccess software is used alone.

Sun StorEdge 9900 FlashAccess Software

Sun StorEdge™ 9900 FlashAccess software allows users to store specific data in cache memory. Sun StorEdge 9900 FlashAccess software increases the data access speed for the cache-resident data by enabling read and write I/Os to be performed at front-end host data transfer speeds. The Sun StorEdge 9900 FlashAccess software cache areas (called cache extents) are dynamic and can be added and deleted at any time. The Sun StorEdge 9970 and 9980 systems supports up to 1024 addressable cache extents.

Sun StorEdge 9900 FlashAccess software operations can be performed for open-system LUs (e.g., OPEN-3, OPEN-9) as well as S/390 LVIs (e.g., 3390-3, 3390-9), including custom-size volumes. Use of Sun StorEdge 9900 FlashAccess software in conjunction with the Sun StorEdge 9900 Virtual LVI/LUN software feature will achieve better performance improvements than when either of these options is used individually.

Sun StorEdge 9900 Cache Manager Software (S/390)

The Sun StorEdge™ 9900 Cache Manager allows you to specify the data to be placed into cache by CCHH, VTOC, VTOC index, VVDS (VSAM volume dataset) or the extent of the dataset area. Sun StorEdge 9900 Cache Manager software also has the functionality to have data removed from cache may be specified by dataset name, VTOC, VTOC Index, VSAM volume dataset (VVDS), or by volume.

Sun StorEdge 9900 SAnTinel Software

Sun StorEdge™ 9900 SAnTinel software allows users to restrict LU accessibility to an open systems host using the host's World Wide Name (WWN). You can set an LU to communicate only with one or more specified WWNs, allowing you to limit access to that LU to specified open-system host(s). This feature prevents other open systems hosts from either seeing the secured LU or accessing the data contained on it. The SAnTinel Remote Console software enables you to configure Sun StorEdge 9900 SAnTinel software operations on the Sun StorEdge 9970 and 9980 systems.

Sun StorEdge 9900 SAnTinel software can be activated on any installed Fibre Channel port, and can be turned on or off at the port level. If you enable SAnTinel on a particular port, that port will be restricted to



a particular host or group of hosts. You can assign a WWN to as many ports as you want, and you can assign more than one WWN to each port. You can also change the WWN access for any port without disrupting the settings of that port.

Sun StorEdge 9900 SAnTinel Software – LDEV Security

Sun StorEdge 9900 SAnTinel software – LDEV Security allows users to restrict S/390 host access to the logical devices (LDEVs) on the Sun StorEdge 9970 and 9980 systems. Each LDEV can be set to communicate only with user-selected host(s). Sun StorEdge 9900 SAnTinel software – LDEV Security prevents other hosts from seeing the secured LDEV and from accessing the data contained on the secured LDEV Sun StorEdge 9900 Priority Access software.

Sun StorEdge 9900 Priority Access (PA) software allows open-system users to designate prioritized ports (e.g., for production servers) and non-prioritized ports (e.g., for development servers) and set thresholds and upper limits for the I/O activity of these ports. PA enables users to tune the performance of the development server without affecting the production server's performance.

Sun StorEdge 9900 Parallel Access Volume Software

Sun StorEdge™ 9900 Parallel Access Volume (PAV) software allows the S/390 host system to issue multiple I/O requests in parallel to single logical devices (LDEVs) in the Sun StorEdge 9970 and 9980 systems. PAV can provide substantially faster host access to the S/390 data stored in the Sun StorEdge 9970 and 9980 systems. The Workload Manager (WLM) host software function enables the S/390 host to utilize the PAV functionality of the Sun StorEdge 9970 and 9980 systems system. The Sun StorEdge 9970 and 9980 systems support both static and dynamic PAV functionality.

Sun StorEdge 9900 Dynamic Link Manager (SDLM)

Sun StorEdge™ 9900 Dynamic Link Manager (SDLM) software, which resides on the host server, uses redundant paths between the host server and Sun StorEdge 9900 series products to enhance performance and data availability. At least two paths between a server and an array are configured through different HBAs, switches, and channel host to provide total redundancy. Sun StorEdge 9900 Dynamic Link Manager software will balance the I/O load on these paths to avoid congestion and if a path failure is detected, all I/O will be diverted to an alternate path. Specific Sun StorEdge 9900 Dynamic Link Manager software implementations are required for each operating system. The Sun StorEdge Traffic manager software provides similar functionality with Sun platforms.

Sun StorEdge 9900 Performance Monitor Software

This software monitors disk subsystem and allows the user to obtain statistics about resources in the disk subsystem and statistics about workloads on disk and ports. If the system encounters some problem (for example, server hosts suffer delayed response time), Sun StorEdge™ 9900 Performance Monitor software may help detect the cause of the problem. This software is a prerequisite for Sun StorEdge 9900 CruiseControl and Priority Access software.

Sun StorEdge 9900 Priority Access Software

Allows open systems users to designate prioritized ports, or WWN's, (e.g. for production servers) and non-prioritized ports (e.g. for development servers) and set thresholds and upper limits for the I/O activity of these ports, or WWN's. Sun StorEdge 9900 Performance Monitor software is a prerequisite to Sun StorEdge™ 9900 Priority Access software.



Sun StorEdge 9900 CruiseControl Software

Sun StorEdge™ 9900 CruiseControl software enables users to optimize their data storage and retrieval on the Sun StorEdge 9970 and 9980 systems. Sun StorEdge 9900 CruiseControl software analyzes detailed information on the usage of Sun StorEdge 9970 and 9980 systems resources and tunes the Sun StorEdge 9970 and 9980 systems automatically by migrating logical volumes within the system according to detailed user-specified parameters. Sun StorEdge 9900 CruiseControl software tuning operations can be used to resolve bottlenecks of activity and optimize volume allocation. Sun StorEdge 9900 CruiseControl software operations are completely nondisruptive – the data being migrated can remain online to all hosts for read and write I/O operations throughout the entire volume migration process. Sun StorEdge 9900 CruiseControl software also supports manual volume migration operations and estimates performance improvements prior to migration to assist you in tuning the Sun StorEdge 9970 and 9980 systems for your operational environment. Sun StorEdge 9900 Performance Monitor software is a prerequisite to Sun StorEdge 9900 Priority Access software.

Sun StorEdge 9900 CruiseControl software provides the following major benefits for the user:

- Load balancing of system resources.
- Optimizing disk drive access patterns.
- Analysis of system usage using GraphTool (provided with Sun StorEdge 9900 CruiseControl software).

Sun StorEdge 9900 Graph-Track Software

Sun StorEdge™ 9900 Graph-Track software allows users to monitor and collect detailed system performance and usage statistics for the Sun StorEdge 9970 and 9980 systems. Sun StorEdge 9900 Graph-Track software can monitor as many as 32 systems on the Sun StorEdge 9970 and 9980 systems' 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 that highlight 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), SSIDs, and cache size.
- 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.
- System usage, including percent busy versus time for the front-end microprocessors (CHIPs) and back-end microprocessors (ACPs).
- Cache statistics, including percent cache in use and percent write-pending data in cache.
- I/O statistics at the system, array group, and LDEV levels: I/O rates, read/write ratio, read and write hits, 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 manages the collection and storage of the Sun StorEdge 9900 Graph-Track software data automatically according to user-specified preferences. GT also allows the user to export Sun StorEdge 9900 Graph-Track software data for use in reports or in other data analysis programs.



Sun StorEdge 9900 Remote Console – Storage Navigator Software

The software consists of a group of Java applet programs. The Sun StorEdge 9970 and 9980 system's Service Processor (SVP) is the notebook computer inside each system, which uses Java Virtual Machine (JVM) to function as a web server. The Sun StorEdge™ 9900 Remote Console – Storage Navigator software functions as a web client. Each time you log onto the Remote Console and connect to the SVP, a Java applet program is downloaded from the SVP to the Remote Console. The Remote Console communicates directly with the SVP of each attached system to obtain system configuration and status information and to send user-requested commands to the system. The Web Client Java applet program runs on a web browser to provide a user-friendly interface for the Sun StorEdge 9980/9970 Web Client functions.



Configuring and Using the Sun StorEdge 9970 and 9980 Systems

Open Systems Configuration

After physical installation of the Sun StorEdge 9970 and 9980 systems have been completed, the user configures the Sun StorEdge 9970 and 9980 systems for open-system operations with assistance as needed from the Sun support representative.

Configuring the Fibre Channel Ports

The LUN Manager Remote Console software enables users to configure the Fibre Channel ports for the connected operating system and operational environment (e.g., FC-AL or fabric).

The Sun StorEdge 9980 system supports a maximum of 32 Fibre Channel ports, and the Sun StorEdge 9970 supports up to 24 Fibre Channel ports. Each Fibre Channel port is assigned a unique target ID (from 0 to EF). Each Sun StorEdge 9970 and 9980 systems' Fibre Channel port supports addressing capabilities for up to a total of 512 LUNs across up to 128 host groups, each with its own LUN 0 and its own host mode. Each host group may have up to 256 LUNs. Multiple host groups are supported using LUN Security. Figure 13 illustrates fibre port-to-LUN addressing.

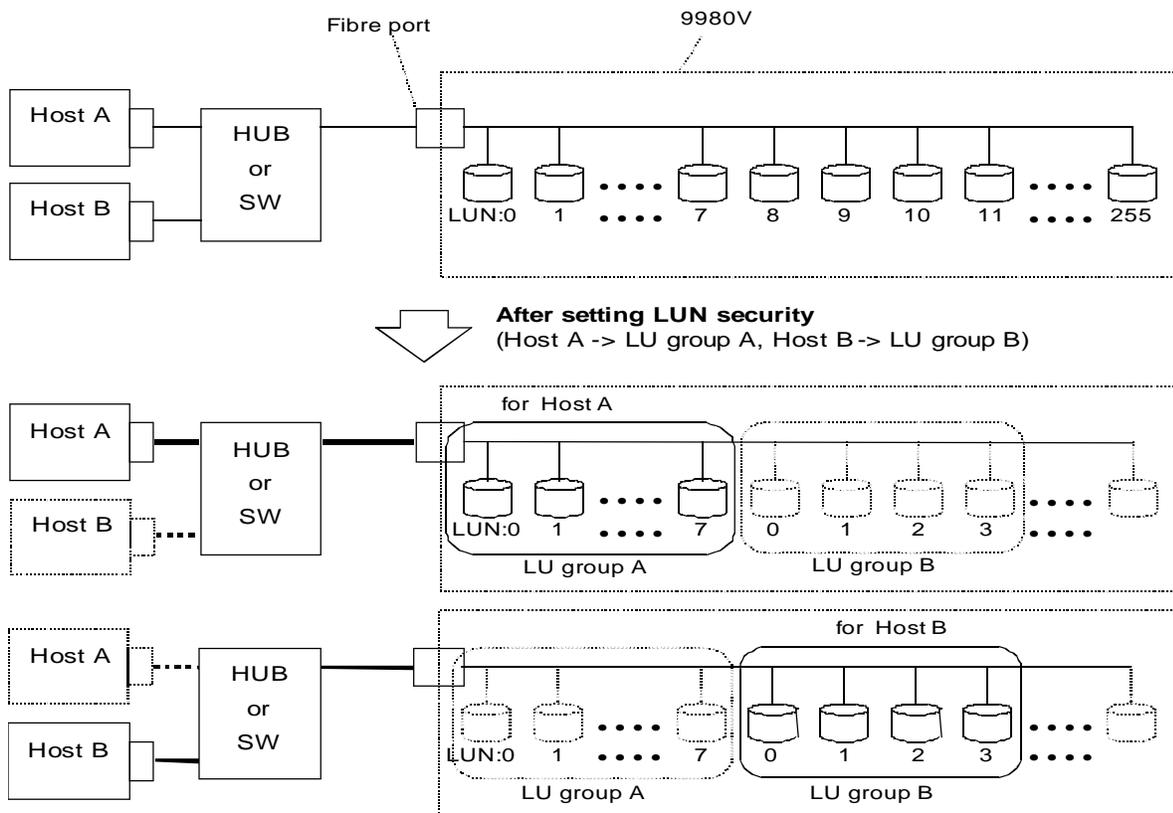


Figure 13 Fibre Port-to-LUN Addressing



Virtual LVI/LUN Devices

The Virtual LVI/LUN Remote Console software enables users to configure custom-size LUs which are smaller than standard-size LUs. Open-system users define Virtual LVI/LUN devices by size in MB (minimum device size = 35 MB). S/390 mainframe users define Virtual LVI/LUN devices by number of cylinders.

LU Size Expansion (LUSE) Devices

The LUSE function (included in the Volume Manager Remote Console software) enables users to configure size-expanded LUs which are from 2 to 36 times larger than standard-size LUs. LUSE devices are identified by the type and number of LUs which have been joined to form the LUSE device. For example, an OPEN-9*36 LUSE device is composed of 36 OPEN-9 LUs.

Open Systems Operations

Command Tag Queuing

The Sun StorEdge 9970 and 9980 systems support 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 9970 and 9980 systems process requests in the most efficient order to minimize head seek operations and disk rotational delay.

Note: The queue depth parameter may need to be adjusted for the Sun StorEdge 9970 and 9980 systems devices. Please refer to the appropriate Sun StorEdge 9970 and 9980 systems configuration guide for queue depth requirements and instructions on changing queue depth and other related system and device parameters.

Host/Application Failover Support

The Sun StorEdge 9970 and 9980 systems support many industry-standard products which provide host and/or application failover capabilities (e.g., HP MC/ServiceGuard, VERITAS Cluster Server, HACMP, Microsoft Cluster Server, Novell Cluster Server, Sun Cluster 3.0, TruCluster).

Path Failover Support

The user should plan for path failover (alternate pathing) to ensure the highest data availability. In the open-system environment, alternate pathing can be achieved by host failover and/or I/O path failover software. The Sun StorEdge 9970 and 9980 systems provide up to 32 fibre ports to accommodate alternate pathing for host attachment. Figure 14 shows an example of alternate pathing. The LUs 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. If possible, the alternate path(s) should be attached to different channel card(s) than the primary path.

The Sun StorEdge 9970 and 9980 systems support industry-standard I/O path failover products, including Sun Traffic Manager, Sun StorEdge Dynamic Link Manager, and VERITAS Volume Manager/DMP. Sun StorEdge Traffic Manager and Sun StorEdge Dynamic Link Manager provides load balancing in addition to path failover.



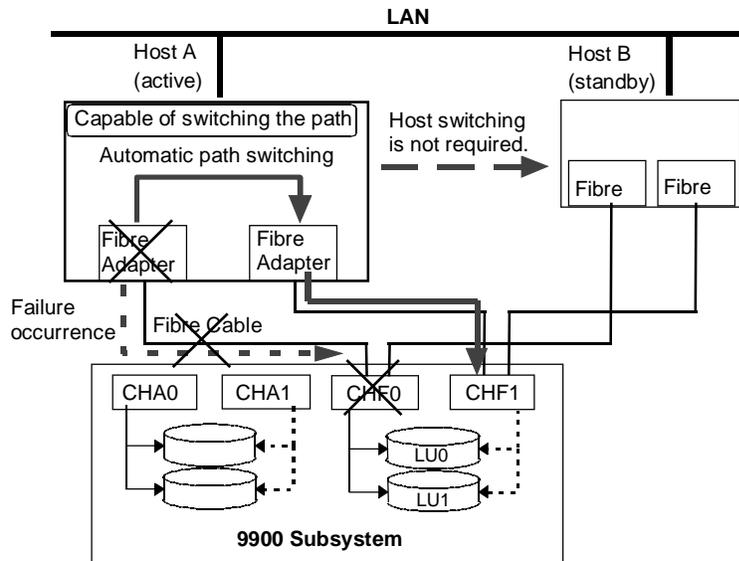


Figure 14 Alternate Pathing

SIM Reporting

The Sun StorEdge 9970 and 9980 systems log all SIMs on the SVP. When the user accesses the Sun StorEdge 9970 and 9980 systems using the Remote Console software, the SIM log is displayed. This enables open-system users to monitor Sun StorEdge 9970 and 9980 systems' operations from any Remote Console PC. The Remote Console software allows the user to view the SIMs by date/time or by controller.

SNMP Remote System Management

The Sun StorEdge 9970 and 9980 systems support the industry-standard simple network management protocol (SNMP) for remote system management from the UNIX®/PC server host. SNMP is used to transport management information between the Sun StorEdge 9970 and 9980 systems and the SNMP manager on the host. The SNMP agent on the Sun StorEdge 9970 and 9980 systems send status information to the host(s) when requested by a host or when a significant event occurs. Notification of error conditions is made in real time, providing UNIX®/PC server users with the same level of monitoring and support available to S/390 mainframe users. The SIM reporting via SNMP enables users to monitor the Sun StorEdge 9970 and 9980 systems without having to check the Remote Console for SIMs.



Control Panel

Figure 15 shows the Sun StorEdge 9980 operator control panel. The Sun StorEdge 9970 control panel is the same except that the channel interfaces are A-M (not A-R). Table 13 describes the items on the operator control panel. To open the control panel cover, push and release on the point marked PUSH.

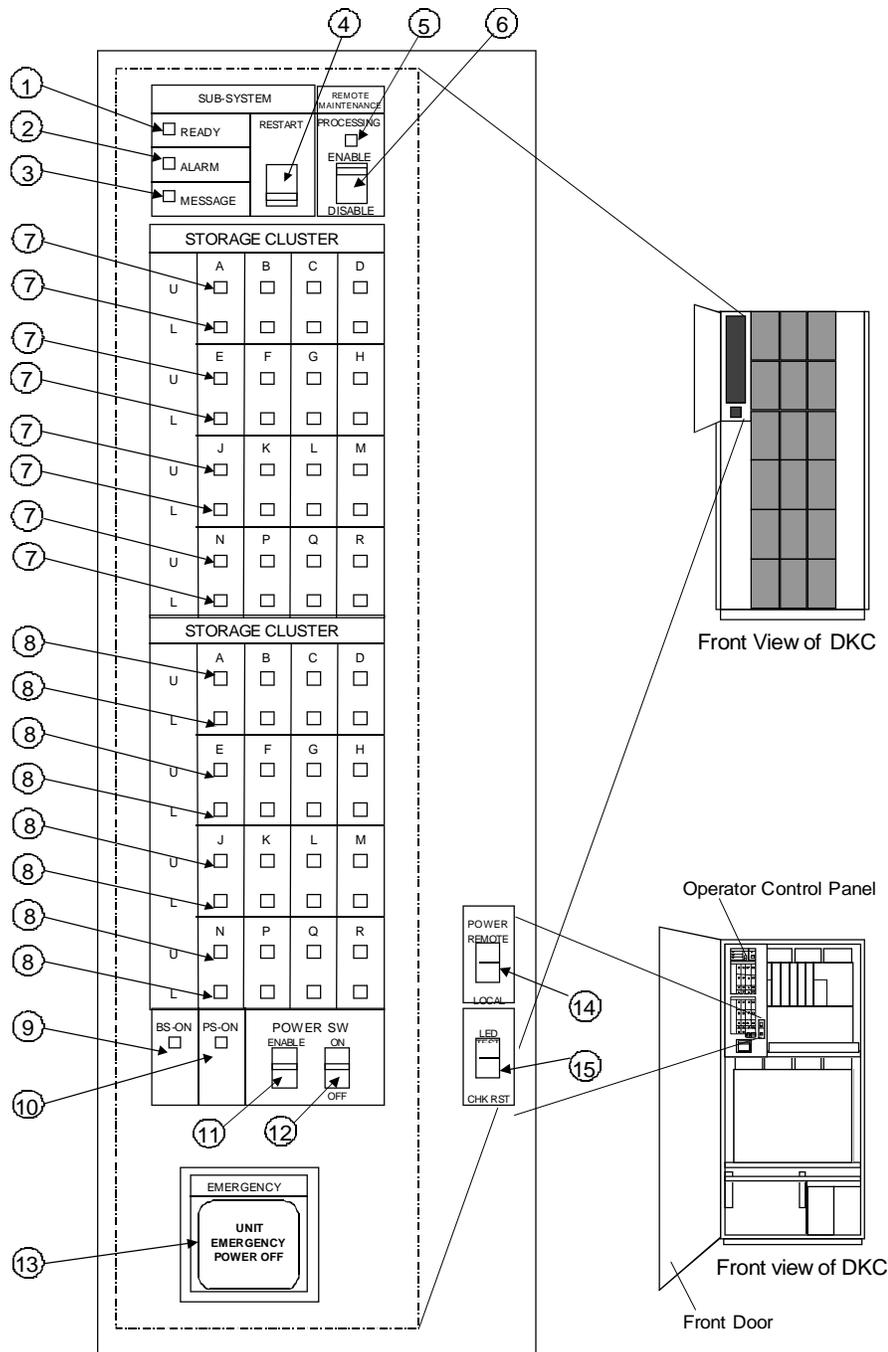


Figure 15 Sun StorEdge 9980 Control Panel



Item	Name	Type	Description
1	System READY	LED (Green)	When lit, indicates that input/output operation on the channel interface is possible. Applies to both storage clusters.
2	System ALARM	LED (Red)	When lit, indicates that low DC voltage, high DC current, abnormally high temperature, or a failure has occurred. Applies to both storage clusters.
3	System MESSAGE	LED (Amber)	On: Indicates that a SIM (message) was generated from either of the clusters. Applies to both storage clusters. Blinking: Indicates that the SVP failure has occurred.
4	System RESTART	Switch	Used to unfence a fenced drive path and to release the Write Inhibit command. Applies to both storage clusters.
5	REMOTE MAINTENANCE PROCESSING	LED (Amber)	When lit, indicates that remote maintenance activity is in process. If remote maintenance is not in use, this LED is not lit. Applies to both storage clusters.
6	REMOTE MAINTENANCE ENABLE/DISABLE	Switch	Used for remote maintenance. While executing remote maintenance (the REMOTE MAINTENANCE PROCESSING LED in item 5 is blinking), when switching from ENABLE to DISABLE, remote maintenance is interrupted. If the remote maintenance function is not used, this switch is ineffective. Applies to both storage clusters.
7	STORAGE CLUSTER 1 CHANNEL A-R* ENABLE U: Upper L: Lower	LED (Green)	On: Indicates some of the logical paths are established. Fast blinking (Only Serial Channel): Indicates that the corresponding channel paths are executing the channel command. Slow blinking: Indicates none of the logical path is established. Off: Indicates that the corresponding channel paths are not enabled. When the 16-port CHA is installed, LED of the L side is effective.
8	STORAGE CLUSTER 2 CHANNEL A-R* ENABLE U: Upper L: Lower	LED (Green)	On: Indicates some of the logical paths are established. Fast blinking (Only Serial Channel): Indicates that the corresponding channel paths are executing the channel command. Slow blinking: Indicates none of the logical path is established. Off: Indicates that the corresponding channel paths are not enabled. When the 16-port CHA is installed, LED of the L side is effective.
9	BS-ON	LED (Amber)	Indicates input power is available.
10	PS-ON	LED (Green)	Indicates that system is powered on. Applies to both storage clusters.
11	POWER SW ENABLE	Switch	Used to enable the POWER SW ON/OFF switch. To enable the POWER SW ON/OFF switch, turn the POWER SW ENABLE switch to the ENABLE position.
12	POWER SW ON / OFF	Switch	Used to power system on/off. This switch is valid when REMOTE/LOCAL switch (item 14) is set to LOCAL. Applies to both storage clusters.
13	EMERGENCY POWER OFF (EPO)	1-Way Locking Switch	Used to shut down power to both storage clusters in an emergency.
14	REMOTE/LOCAL	Switch	REMOTE position: System is powered on/off by instructions from CPU. LOCAL position: System is powered on/off via the POWER SW ON / OFF switch. Applies to both storage clusters.
15	LED TEST/CHK RESET	Switch	LED TEST position: The LEDs on Control Panel go on. CHK RESET position: The PS ALARM and TH ALARM are reset.

- The Sun StorEdge 9970 system has channel interfaces A-M.



Table 13 9980 Control Panel



Emergency Power-Off (EPO)

The disk system EMERGENCY POWER OFF (EPO) switch is located on the operator control panel (see Figure 16). Use this switch only in case of an emergency.

To power off the disk system in case of an emergency:

1. Open the operator control panel cover by pushing on the point marked PUSH.
2. Pull the emergency power-off switch (see Figure 16) up and then out towards you as illustrated on the switch.
3. Call the technical support center. The EPO switch must be reset by service personnel before the disk system can be powered on again.

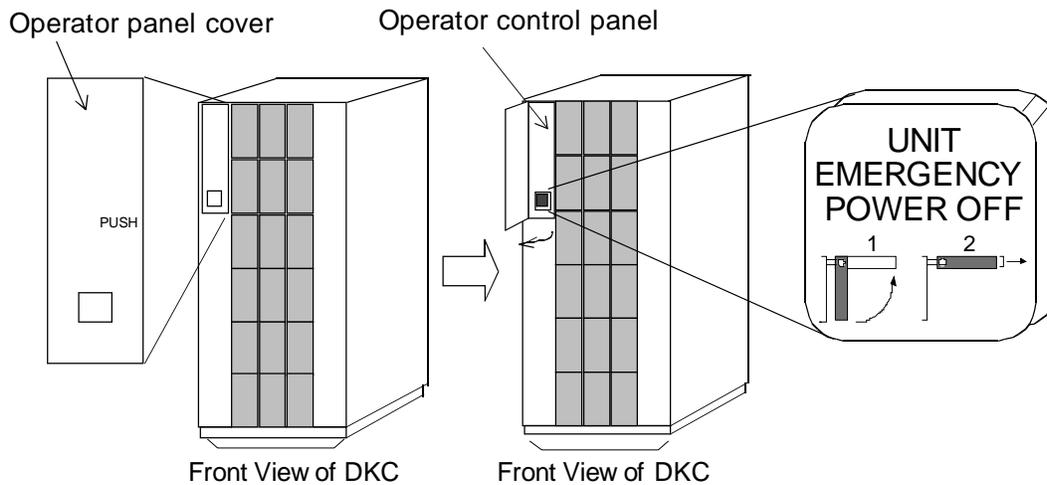


Figure 16 Emergency Power-Off (EPO)



Planning for Installation and Operation

This chapter provides information for planning and preparing a site before and during installation of the Sun StorEdge 9970 and 9980 systems. Please read this chapter carefully before beginning your installation planning. Figure 17 shows a physical overview of the Sun StorEdge 9980 system. Figure 18 shows a physical overview of the Sun StorEdge 9970 system.

Note: The general information in this chapter is provided to assist in installation planning and is not intended to be complete. Installation and maintenance documents used by Sun support personnel contain complete specifications. The exact electrical power interfaces and requirements for each site must be determined and verified to meet the applicable local regulations.

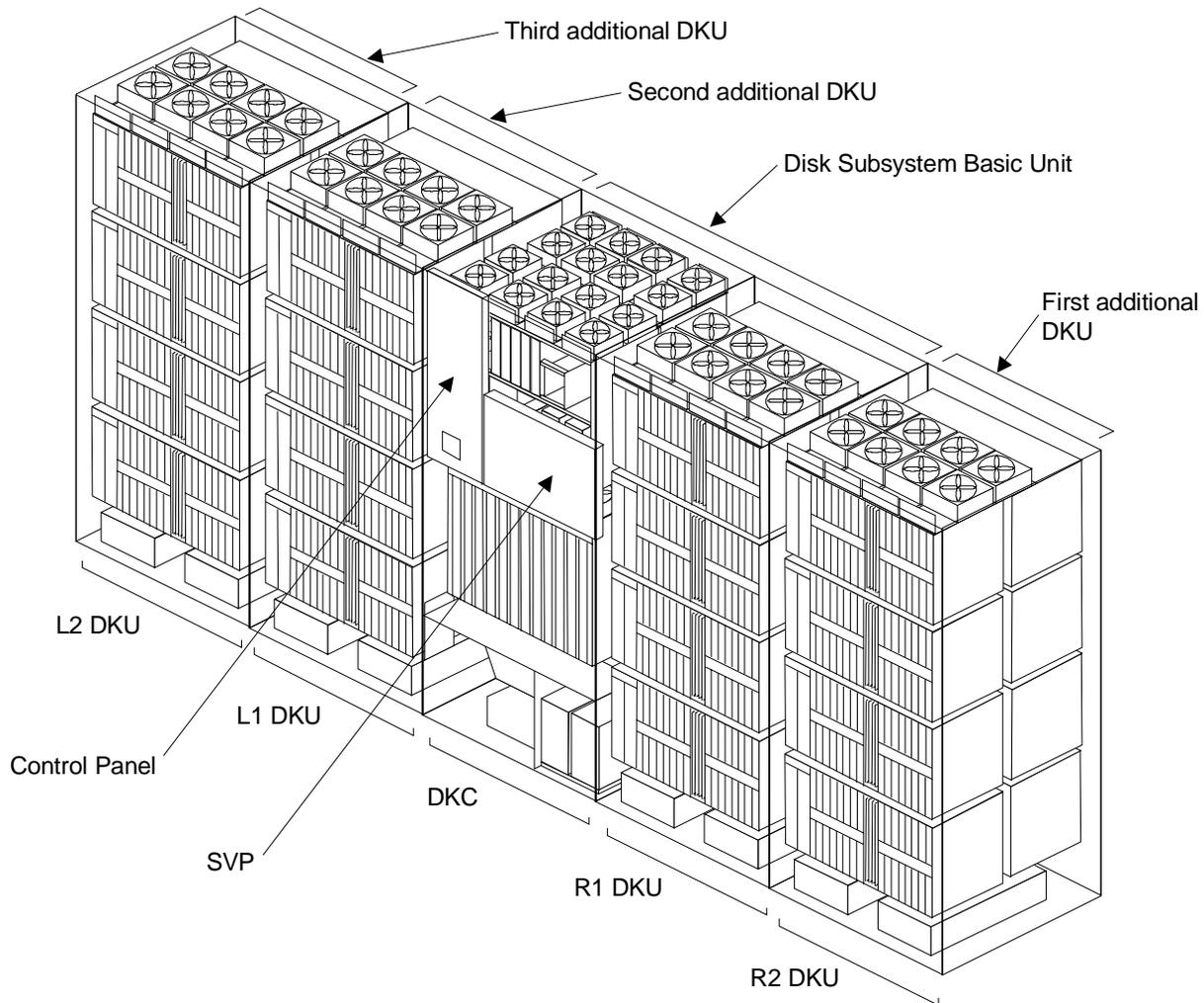


Figure 17 Physical Overview of Sun StorEdge 9980 System



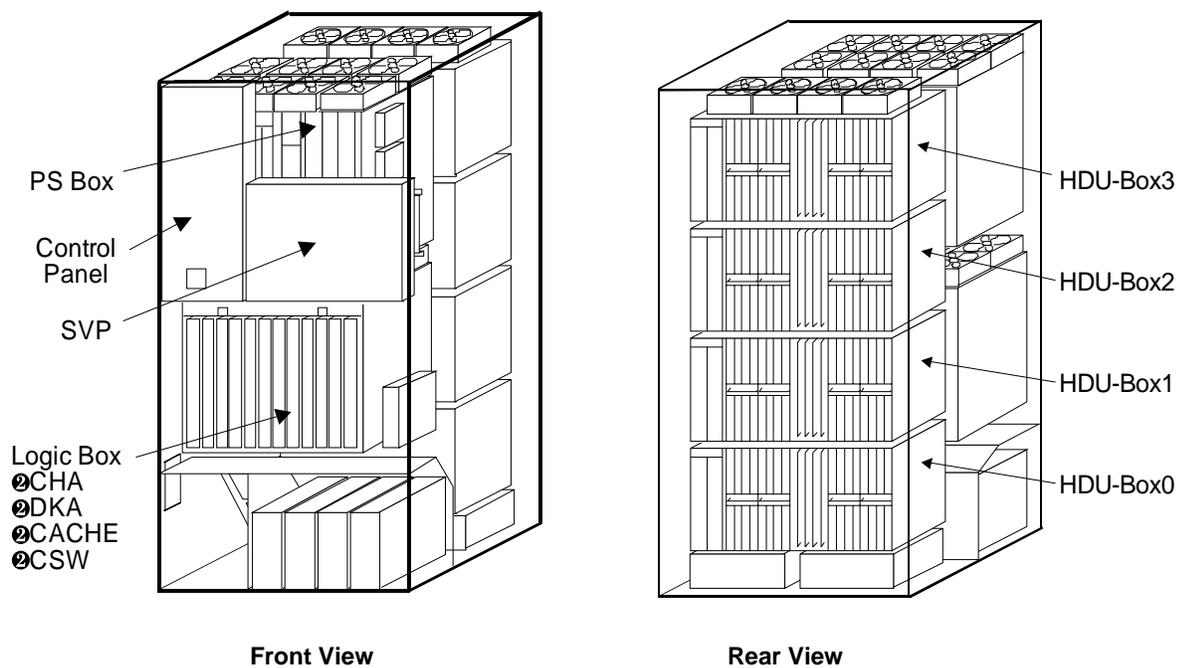


Figure 18 Physical Overview of the Sun StorEdge 9970 System

User Responsibilities and Safety Precautions

Before the Sun StorEdge 9970 and 9980 systems arrive for installation, the user must provide the following items to ensure proper installation and configuration:

- Physical space necessary for proper system function and maintenance activity
 - Electrical input power
 - Connectors and receptacles
 - Air conditioning
 - Floor ventilation areas (recommended but not required)
 - Cable access holes
 - RJ-11 analog phone line (for Sun StorEdge 99x0 Remote Response support)

Safety Precautions

For safe operation of the Sun StorEdge 9980 and 9970 disk systems, please observe the following precautions:

- Use the systems with the front and rear doors closed. The doors are designed for safety and protection from noise, static electricity, and EMI emissions.
- Make sure that all front and rear doors are closed before operating the system. The only exceptions are during the power-up or power-down processes. Perform only the procedures described in this manual when the front and rear doors must be opened for operation.
- Before performing power-down or power-up, make sure that the disk system is not undergoing any maintenance and is not being used online.



- Do not place objects on top of the frames, as this is where air is exhausted. This interferes with the flow of cooling air.
- For troubleshooting, perform only the instructions described in this manual. If you need further information, please contact Sun maintenance personnel.
- In case of a problem with the system, please report the exact circumstances surrounding the problem and provide as much detail as possible to expedite problem isolation and resolution.

Dimensions, Physical Specifications, and Weight

Figure 19 and Figure 20 show the physical dimensions of the Sun StorEdge 9980 and 9970 systems. Table 14 and Table 15 lists the physical specifications of the Sun StorEdge 9980 and 9970 systems.

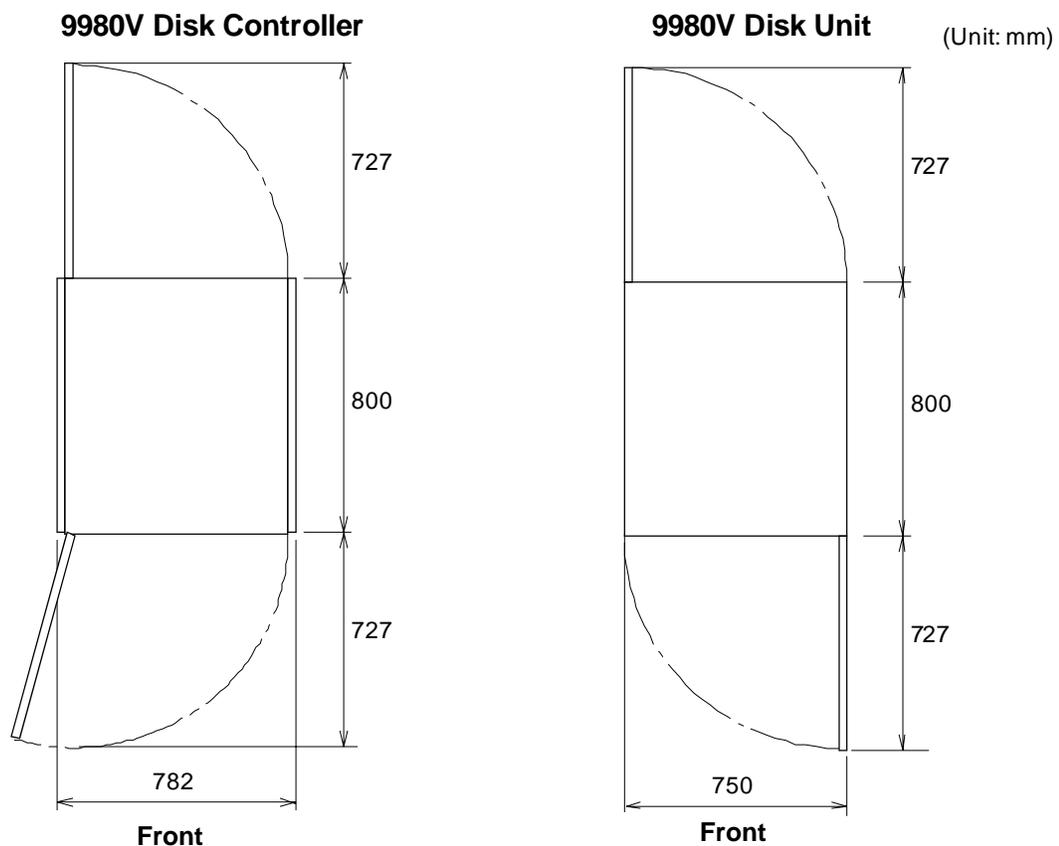


Figure 19 Sun StorEdge 9980 DKC and DKU Physical Dimensions



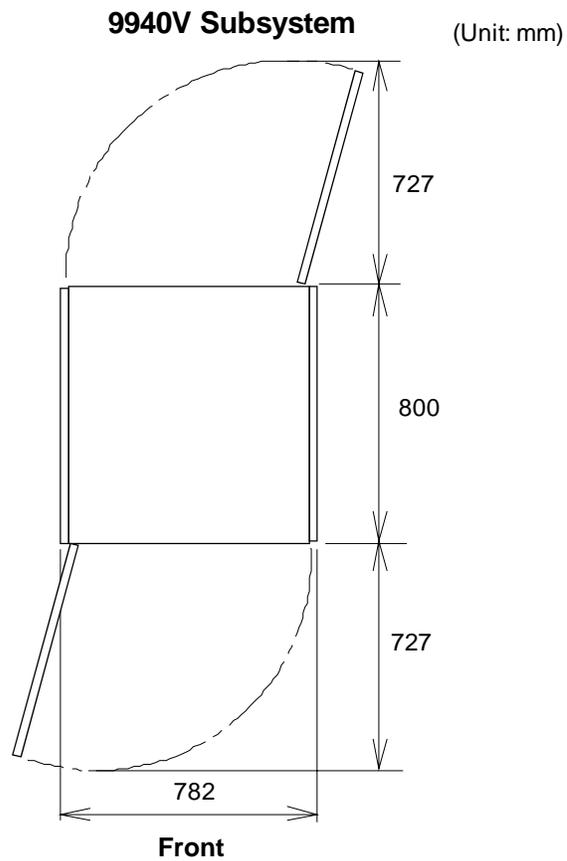


Figure 20 Sun StorEdge 9970 Physical Dimensions

Item		Sun StorEdge 9980 Controller (DKC)	Sun StorEdge 9980 Disk Unit (DKU)
Weight (kg)		553	755
Heat Output (kW)		2.17	6.61
Power Consumption (kVA)		2.31	7.16
Air Flow (m ³ /min.)		18	32
Dimensions (mm)	Width	782 ^{*6}	750
	Depth	800	800
	Height	1860	1860

Notes: 1: This includes the thickness of side covers (16 mm x 2).

Table 14 Sun StorEdge 9980 Physical Specifications



Item		
Weight (kg)		776
Heat Output (kW)		4.52
Power Consumption (kVA)		4.87
Air Flow (m ³ /min.)		25
Dimensions (mm)	Width	782 ¹
	Depth	800
	Height	1860

Notes: 1: This includes the thickness of side covers (16 mm x 2).

Table 15 Sun StorEdge 9970 System Physical Specifications

Service Clearance, Floor Cutout, and Floor Load Rating Requirements

This section specifies the Sun StorEdge 9970 and 9980 system's service clearance requirements (a + b) based on the floor load rating and the clearance (c).

- Figure 21 shows the service clearance and floor cutout for the Sun StorEdge 9980 disk controller (DKC) frame. Figure 22 shows the service clearance and floor cutout for the Sun StorEdge 9980 disk unit (DKU) frame.
- Figure 23 shows the service clearance and floor cutouts for the Sun StorEdge 9980 system minimum configuration (one DKC, one DKU). Table 16 shows the floor load rating requirements for the Sun StorEdge 9980 system minimum configuration.
- Figure 24 shows the service clearance and floor cutouts for the Sun StorEdge 9980 system maximum configuration (one DKC, four DKUs). Table 17 shows the floor load rating requirements for the Sun StorEdge 9980 system maximum configuration.

- Figure 25 shows the service clearance and floor cutouts for the Sun StorEdge 9970 system (all configurations). Table 18 shows the floor load rating requirements for the Sun StorEdge 9970 system.

Note: The service clearance is required for service work. Do not use this space for storage of any article to prevent damage.

Note: Actual clearances for installation should be decided after consulting with construction specialist responsible for installation building, as clearances could vary depending on the size/layout of the system and building conditions.

Note: When various configurations of systems are arranged in a row, use the clearance values based on the maximum system configuration.

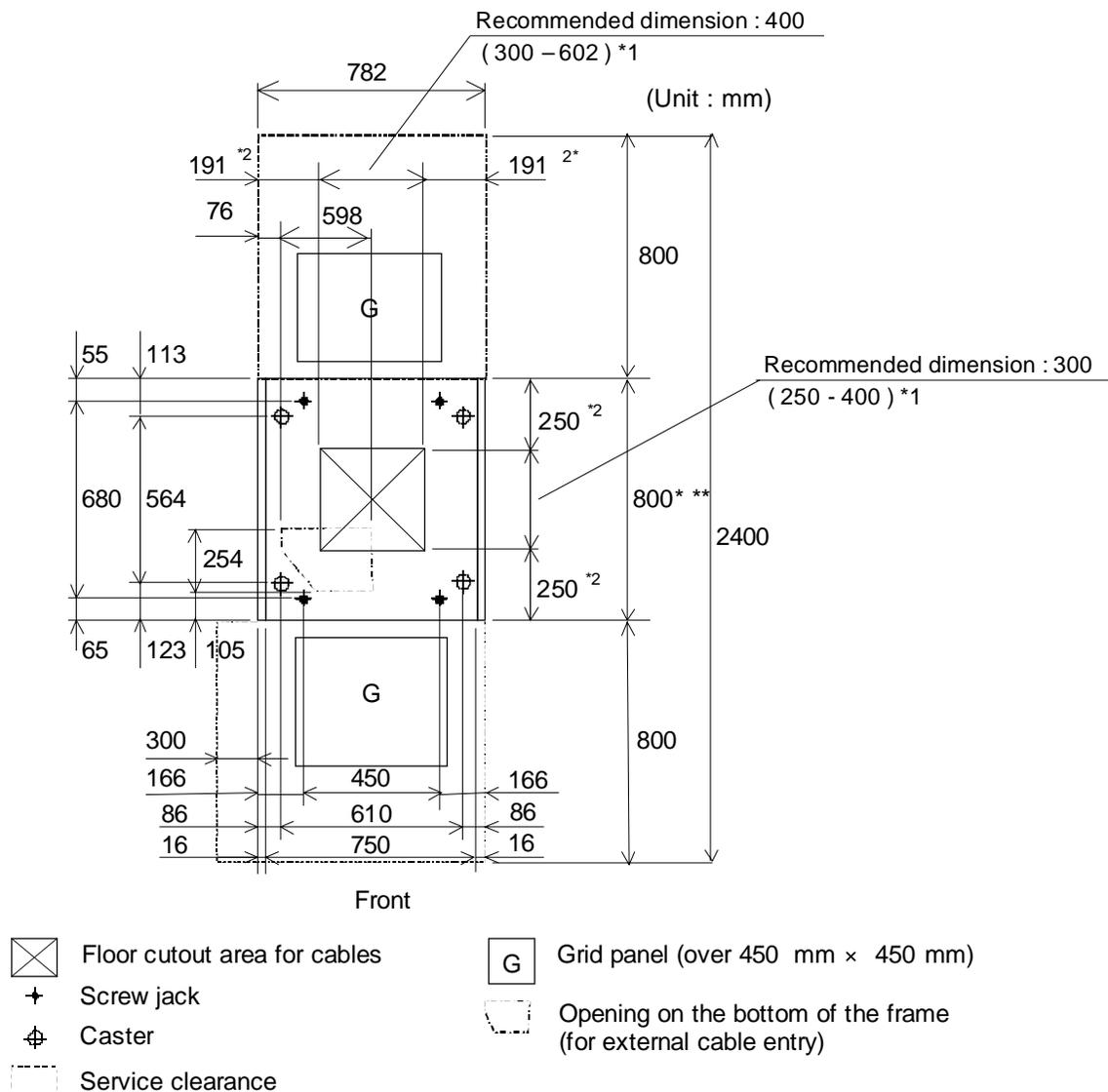
Note: For efficient maintenance operations, it is recommended that clearance (c) be made as large as possible.

The following formula can be used to calculate floor loading to ensure that the weight of all equipment to be installed is adequately supported. Total area is defined as machine area plus half the service clearance.

$$\frac{\text{machine weight} + (15 \text{ lb/ft}^2 \times 0.5 \text{ service clearance}) + (10 \text{ lb/ft}^2 \times \text{total area})}{\text{total area}}$$



The additional weight of the raised floor and the weight of the cables is 10 lb/ft² (50 kg/m²) uniformly across the total area used in the calculations. When personnel and equipment traffic occur in the service clearance area, a distributed weight of 15 lb/ft² (75 kg/m²) is allowed. This distributed weight is applied over half of the service clearance area up to a maximum of 760 mm (30 inches) from the machine.



*1 Values in parentheses show the allowable range of the floor cutout dimension. The floor cutout should be in the center of the DKC. In case that the floor cutout is in the right position for the external cable work and is within the allowable range, the cutout position may be off-center. In this case, check the relation between the positions of the cutout and the opening on the bottom of the frame. If the floor cutout width is more than 552 mm, be careful about the restriction of the movable direction so that the caster wheels do not fall down into the cutout.

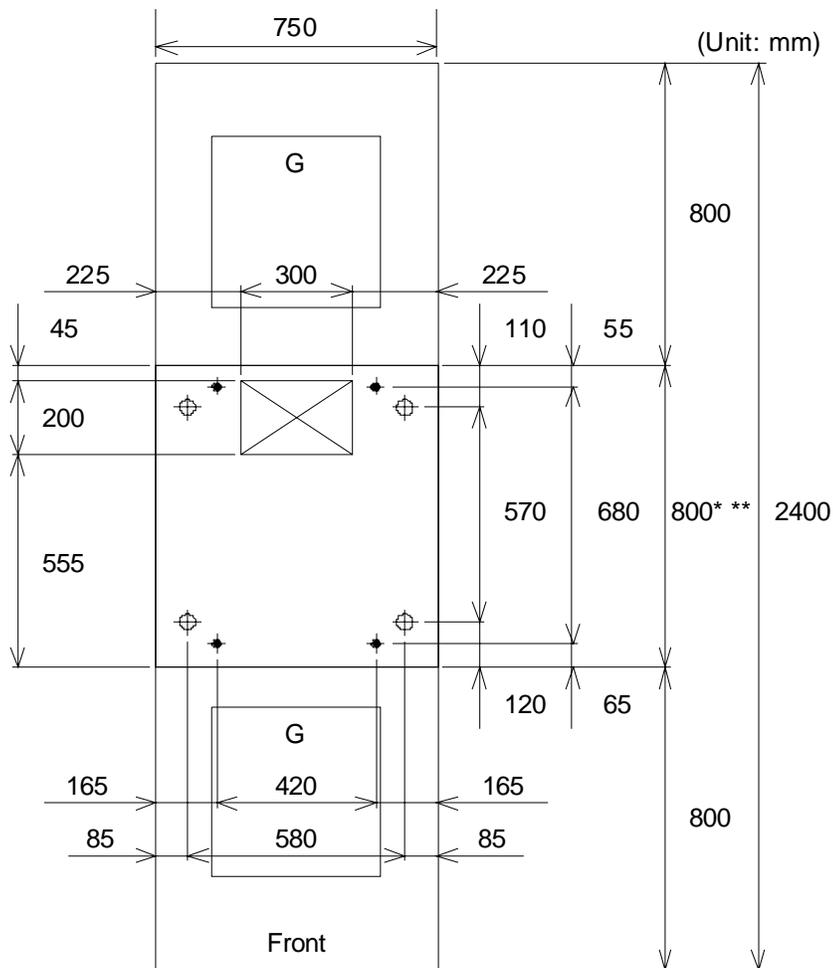
*2 These dimensions vary with the floor cutout dimension.

* The thickness of the door is different in the FRONT (35 mm) than in the REAR (25 mm).

** Overhang of the MOSAIC (LOUVER) of the FRONT DOOR (7 mm) is not included.

Figure 21 Sun StorEdge 9980 DKC Service Clearance and Floor Cutout





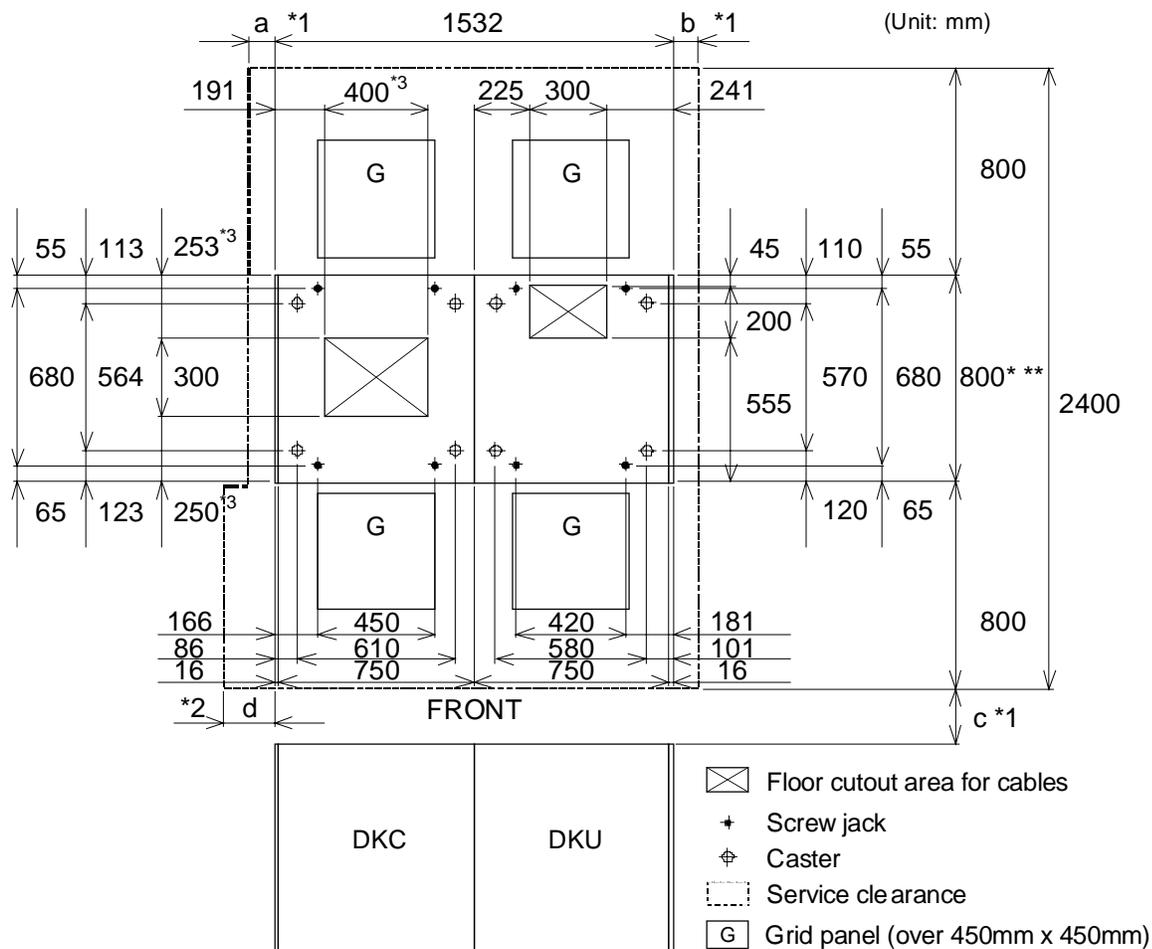
-  Floor cutout area for cables
-  Screw jack
-  Caster
-  Service clearance
-  Grid panel (over 450mm x 450mm)

*: The thickness of the door is different in the FRONT (35 mm) than in the REAR (25 mm).

** : Overhang of the MOSAIC (LOUVER) of the FRONT DOOR (7 mm) is not included.

Figure 22 Sun StorEdge 9980 DKU Service Clearance and Floor Cutout





*1 Clearance (a+b) depends on the floor load rating and clearance ©. Floor load rating and required clearances are in Table 16.

*2 Clearance (d) must be over 0.3 m so as to open the DKC front door (refer to Figure 21). In case that clearance (d) is less than clearance (a), give priority to clearance (a).

*3 See Figure 21 for details on the DKC floor cutout.

* The thickness of the door is different in the FRONT (35 mm) than in the REAR (25 mm).

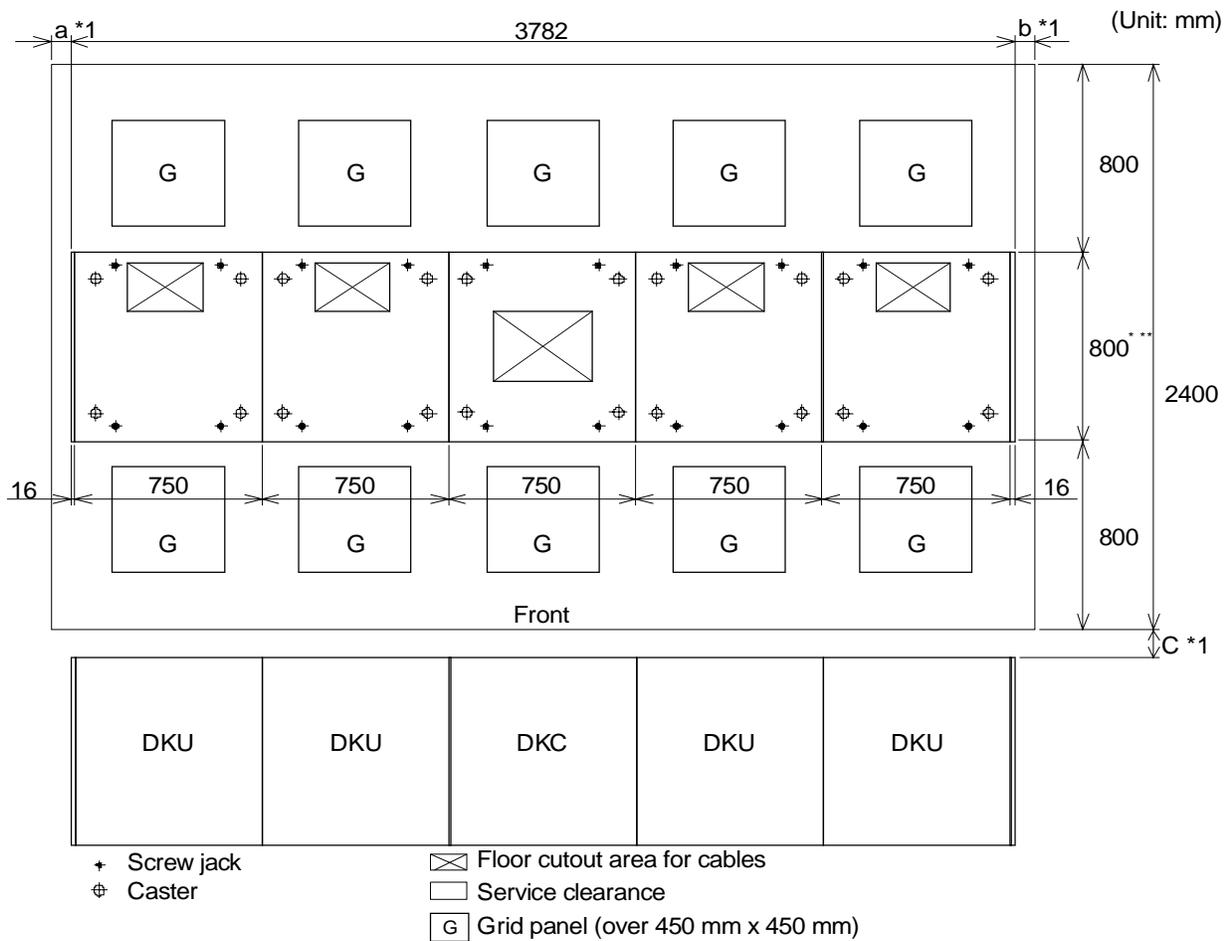
** Overhang of the MOSAIC (LOUVER) of the FRONT DOOR (7 mm) is not included.

Figure 23 Sun StorEdge 9980 System Service Clearance and Floor Cutouts – Minimum Configuration

Floor Load Rating kg/m ² (lb/ft ²)	Required Clearance (a+b) in meters				
	Clearance (c) in meters (feet)				
	c = 0	c = 0.2 (0.66)	c = 0.4 (1.31)	c = 0.6 (1.97)	c = 1.0 (3.28)
500 (102.4)	0.6	0.4	0.2	0	0
450 (92.2)	0.9	0.7	0.4	0.3	0
400 (81.9)	1.4	1.0	0.8	0.6	0.3
350 (71.7)	2.0	1.6	1.3	1.0	0.7
300 (61.4)	3.0	2.5	2.1	1.8	1.3

Table 16 Floor Load Rating and Required Clearances for Sun StorEdge 9980 System Minimum Configuration





* The thickness of the door is different in the FRONT (35 mm) than in the REAR (25 mm).

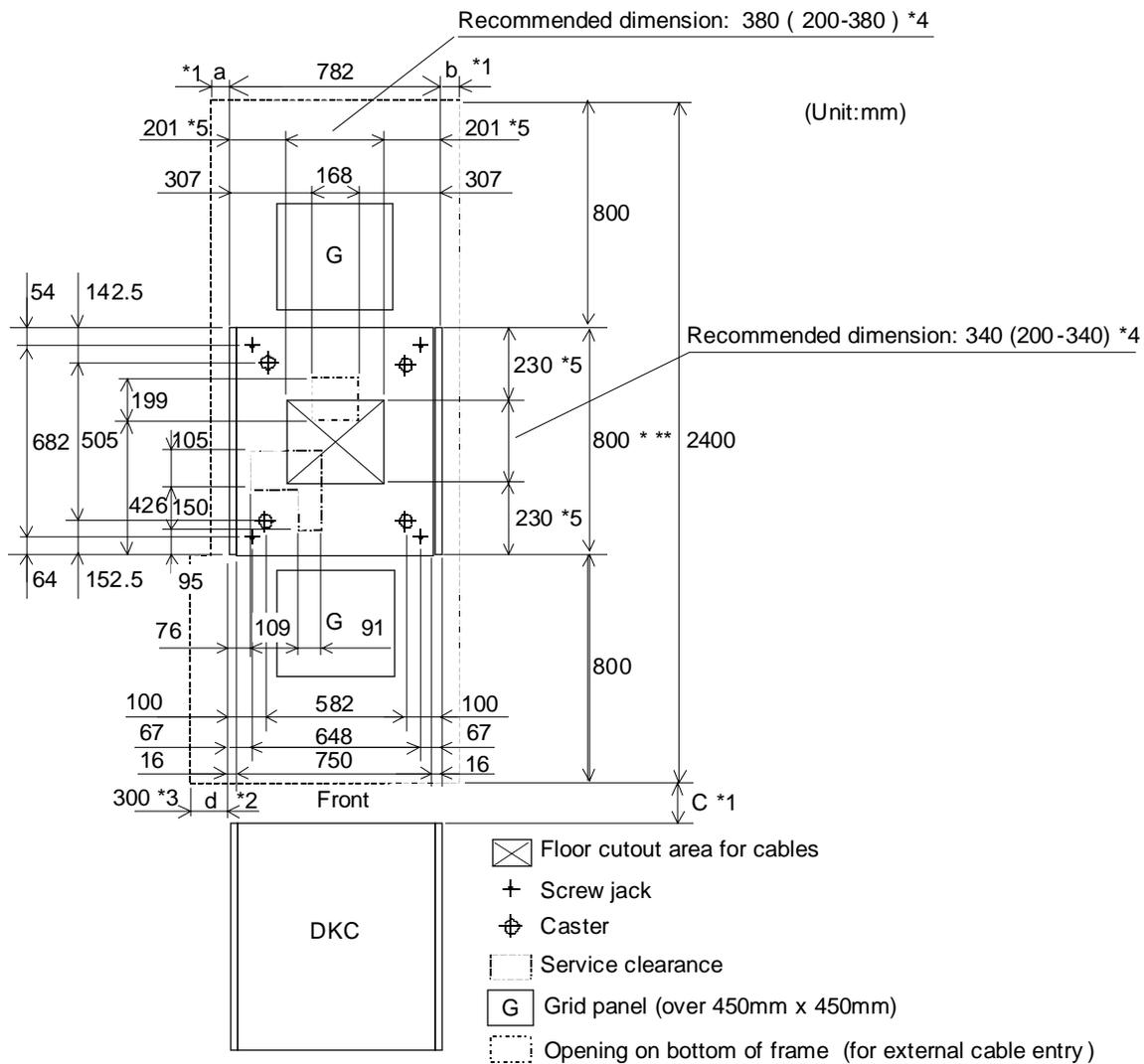
** Overhang of the MOSAIC (LOUVER) of the FRONT DOOR (7 mm) is not included.

Figure 24 Sun StorEdge 9980 System Service Clearance and Floor Cutouts – Maximum Configuration

Floor Load Rating kg/m ² (lb/ft ²)	Required Clearance (a+b)				
	Clearance (c) in meters (feet)				
	c = 0	c = 0.2 (0.66)	c = 0.4 (1.31)	c = 0.6 (1.97)	c = 1.0 (3.28)
500 (102.4)	1.9	1.2	0.8	0.3	0
450 (92.2)	2.7	2.0	1.4	1.0	0.2
400 (81.9)	3.9	3.1	2.4	1.8	1.0
350 (71.7)	5.6	4.6	3.7	3.1	2.0
300 (61.4)	8.3	6.9	5.9	5.0	3.7

Table 17 Floor Load Rating and Required Clearances for Sun StorEdge 9980 System Maximum Configuration





*: The thickness of the door is different in the FRONT (35 mm) than in the REAR (25 mm).

** : Overhang of the MOSAIC (LOUVER) of the FRONT DOOR (7 mm) is not included.

Figure 25 Sun StorEdge 9970 System Service Clearance and Floor Cutout – All Configurations

Floor Load Rating kg/m ² (lb/ft ²)	Required Clearance (a+b)				
	Clearance (c) in meters (feet)				
	c = 0	c = 0.2 (0.66)	c = 0.4 (1.31)	c = 0.6 (1.97)	c = 1.0 (3.28)
500 (102.4)	0.6 m (2 ft)	0.3 m (1 ft)	0.1 m (.3 ft)	0	0
450 (92.2)	0.8 m (2.6 ft)	0.5 m (1.6 ft)	0.3 m (1 ft)	0.1 m (.3 ft)	0
400 (81.9)	1.0 m (3.3 ft)	0.7 m (2.3 ft)	0.5 m (1.6 ft)	0.3 m (1 ft)	0
350 (71.7)	1.4 m (4.6 ft)	1.0 m (3.3 ft)	0.7 m (2.3 ft)	0.5 m (1.6 ft)	0.2 m (0.66 ft)
300 (61.4)	2.0 m (6.6 ft)	1.5 m (4.9 ft)	1.1 m (3.6)	0.9 m (3 ft)	0.5 m (1.6 ft)

Table 18 Floor Load Rating and Required Clearances for Sun StorEdge 9970 System



Electrical Specifications and Requirements for Three-Phase Systems

The Sun StorEdge 9980 and 9970 systems support three-phase and single-phase power. This section applies to three-phase systems. For electrical specifications and requirements for single-phase systems, please see page 72.

Power Plugs for Three-Phase

- Figure 26 illustrates the power plugs for a three-phase Sun StorEdge 9980 disk array unit (Europe).
- Figure 27 illustrates the power plugs for a three-phase Sun StorEdge 9980 disk array unit (USA).
- Figure 28 illustrates the power plugs for a three-phase Sun StorEdge 9970 system (Europe).
- Figure 29 illustrates the power plugs for a three-phase Sun StorEdge 9970 system (USA).

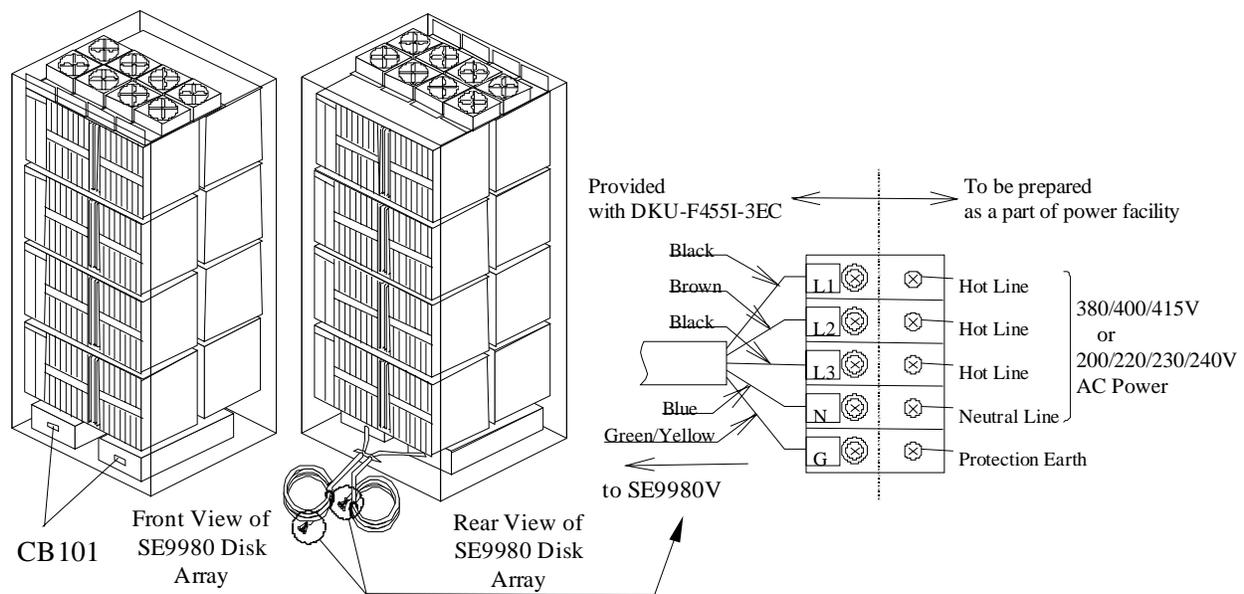


Figure 26 Power Plugs for Three-Phase Sun StorEdge 9980 Disk Array Unit (Europe)



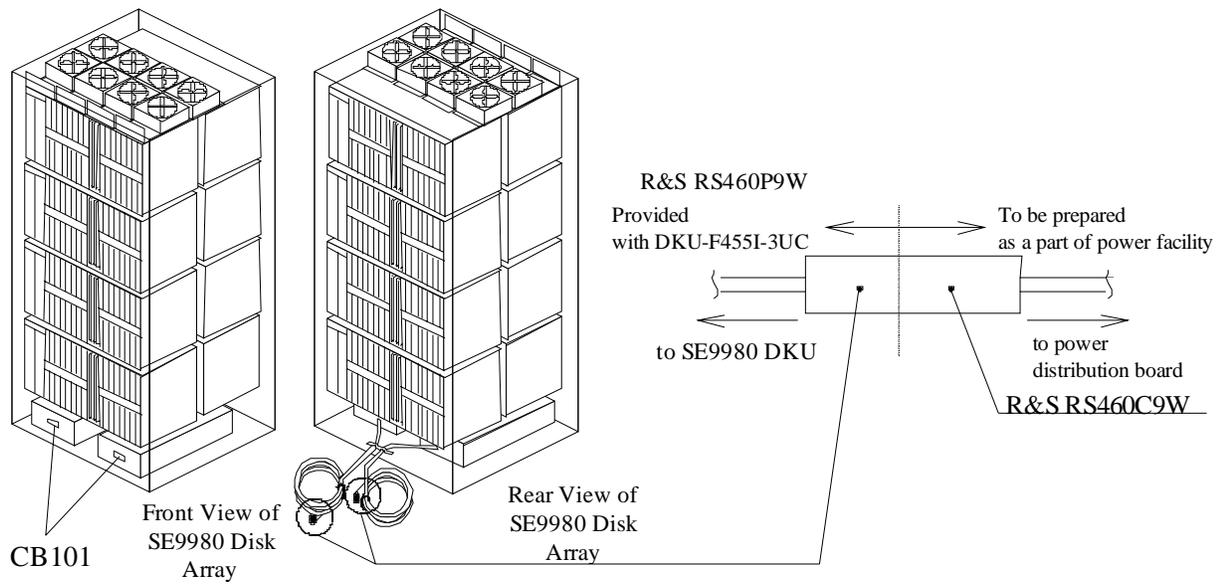


Figure 27 Power Plugs for Three-Phase Sun StorEdge 9980 Disk Array Unit (USA)

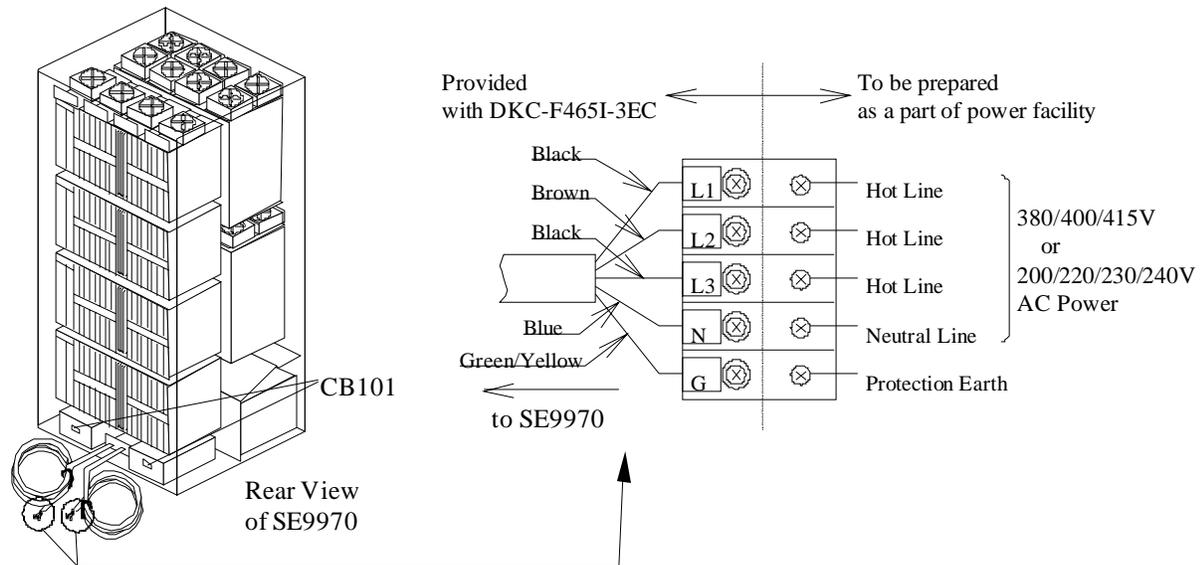


Figure 28 Power Plugs for Three-Phase Sun StorEdge 9970 System (Europe)



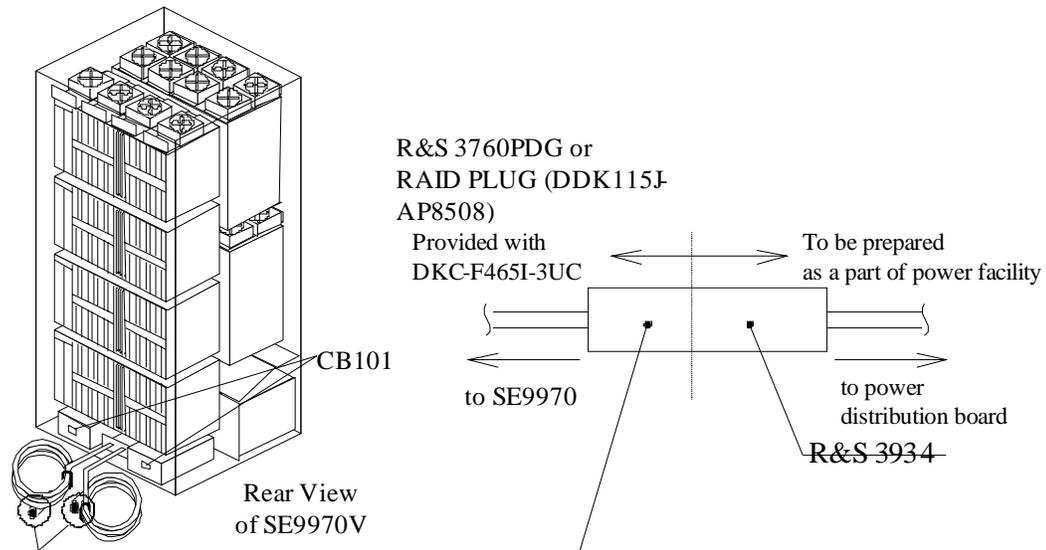


Figure 29 Power Plugs for Three-Phase Sun StorEdge 9970 System (USA)

Features for Three-Phase

Table 19 lists the features for three-phase Sun StorEdge 9980 and 9970 systems.

Model	Frame	Feature Number	Description	Comments
9980	Controller	T9-DKC-F460I-3PS	Breaker Box Kit for Three-Phase	For three-phase power, the controller frame receives its input power from the first disk array frame. All controller single-phase features must be removed to allow three-phase power for the controller.
	Disk Array	T9-DKU-F455I-3PS	AC Box Kit for Three-Phase	Consists of two AC boxes.
	Disk Array	T9-DKU-F455I-3EC	Power Cable Kit for Three-Phase	50 Hz for Europe
	Disk Array	T9-DKU-F455I-3UC	Power Cable Kit for Three-Phase	60 Hz for USA
9970	The 9970 consists of a single frame.	T9-DKC-F465I-3PS	AC Box Kit for Three-Phase	Consists of two AC boxes.
		T9-DKU-F465I-3EC	Power Cable Kit for Three-Phase	50 Hz for Europe
		T9-DKU-F465I-3UC	Power Cable Kit for Three-Phase	60 Hz for USA

Table 19 Sun StorEdge 9980 and 9970 System Three-Phase Features



Current Rating, Power Plugs, Receptacles, and Connectors for Three-Phase (60 Hz only)

Table 20 lists the current rating and AC power cable plug, receptacle, and connector requirements (part number or equivalent) for three-phase 60-Hz systems. In a three-phase Sun StorEdge 9980 system the controller frame (DKC) receives its AC input power from the first disk array frame (DKU) via internal cabling, so the system will not require any customer outlets for the controller frame. The user must supply all power receptacles and connectors for 60-Hz systems. Russell & Stoll type (R&S) connectors are recommended for 60-Hz systems. Equivalent connectors are available from Hubbell Incorporated.

Note: Each Sun StorEdge 9980 disk array frame requires two power connections for power redundancy. It is strongly recommended that the second power source be supplied from a separate power boundary to eliminate source power as a possible single (nonredundant) point of failure.

Note: If you are planning to provide power using 3/4-inch diameter flexible conduit, consider using box-type receptacle connectors. In some cases, inline connectors may be used with 3/4-inch flexible conduit if the appropriate adapter is available from the connector vendor.

Item	9970	9980 DKC	9980 DKU
Base Unit	T9-DKC465I-5	T9-DKC460I-5	T9-DKU455I-18
Circuit Current Rating	30 A	(from DKU)	60 A
Power Feature(s) Required	T9-DKC-F465I-3PS T9-DKC-F465I-3UC	T9-DKC-F460I-3PS	T9-DKU-F455I-3PS T9-DKU-F455I-3UC
60-Hz Power Plug (or equiv.) (included with the product)	R&S 3760PDG, or DDK 115J-AP8508	N/A	R&S RS460P9W
Box-Type Receptacle (or equiv.) (not provided)	R&S 3754	N/A	R&S RS460R9W
Box for Receptacle	Included	N/A	R&S JB6-B125
20-Degree Angle Adapter for Box (optional)	N/A	N/A	R&S AA6L
Inline Connector (or equiv.) (not provided)	R&S 3934	N/A	R&S RS460C9W

Note: For information on power connection specifications for locations outside the U.S., contact the Sun Support Center for the specific country.

Table 20 Current Rating, Power Plug, Receptacle, and Connector for Three-Phase Sun StorEdge 9970 and 9980 systems

Input Voltage Tolerances for Three-Phase

Table 21 lists the input voltage tolerances for the three-phase Sun StorEdge 9980. Transient voltage conditions must not exceed +15-18% of nominal and must return to a steady-state tolerance within of +6 to -8% of the normal related voltage in 0.5 seconds or less. Line-to-line imbalance voltage must not exceed 2.5%. Nonoperating harmonic contents must not exceed 5%.

Frequency	Input Voltages (AC)	Wiring	Tolerance (%)
60 Hz \pm 0.5 Hz	200V, 208V, or 230V	Three-phase, three wire + ground	+6% / -8%
50 Hz \pm 0.5 Hz	200V, 220V, 230V, or 240V	Three-phase, three wire + ground	+6% / -8%
50 Hz \pm 0.5 Hz	380V, 400V, or 415V	Three-phase, four wire + ground	+6% / -8%

Note: For Sun StorEdge 9980 DKU, distribution board with circuit breaker or equivalent is rated 60 amps. For Sun StorEdge 9970 DKC, distribution board with circuit breaker or equivalent is rated 30 amps.
This unit does not apply to IT power system.

Table 21 Input Voltage Specifications for Three-Phase AC Input



Cable Dimensions for 50-Hz Three-Phase Systems

Table 22 and Figure 30 show the data required for 50-Hz three-phase cable installations.

Model	Power Cable			Terminal		Screw Size
	Outer Sheath Overall Diameter	Insulator Outer Diameter	Electric Wire Cross-Section Area	"Internal Diameter"	"External Diameter"	
	A	B	C	D	E	
T9-DKU-F455I-3EC	24.0-30.5 mm	6.6 mm	10.0 mm ²	6.4 mm	12.0 mm	M6
T9-DKC-F465I-3EC	18.0-24.5 mm	5.2 mm	6.0 mm ²	6.4 mm	12.0 mm	M6

Table 22 Cable Dimensions for 50-Hz Three-Phase Systems

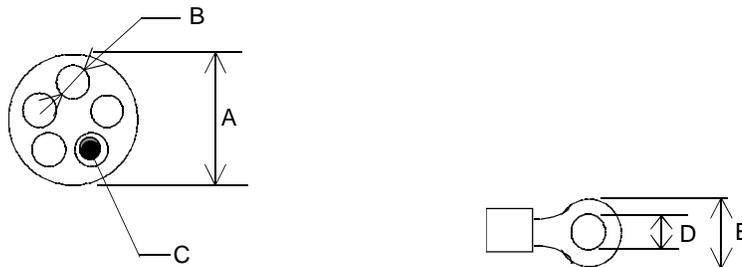


Figure 30 Cable Dimensions for 50-Hz Three-Phase Systems

Electrical Specifications and Requirements for Single-Phase Systems

Power Plugs for Single-Phase

- Figure 31 illustrates the power plugs for a single-phase Sun StorEdge 9980 controller (Europe).
- Figure 32 illustrates the power plugs for a single-phase Sun StorEdge 9980 controller (USA).
- Figure 33 illustrates the power plugs for a three-phase Sun StorEdge 9980 disk array unit (Europe).
- Figure 34 illustrates the power plugs for a three-phase Sun StorEdge 9980 disk array unit (USA).
- Figure 35 illustrates the power plugs for a three-phase Sun StorEdge 9970 system (Europe).
- Figure 36 illustrates the power plugs for a three-phase Sun StorEdge 9970 system (USA).

For information on UPS configurations, please contact your Sun team.



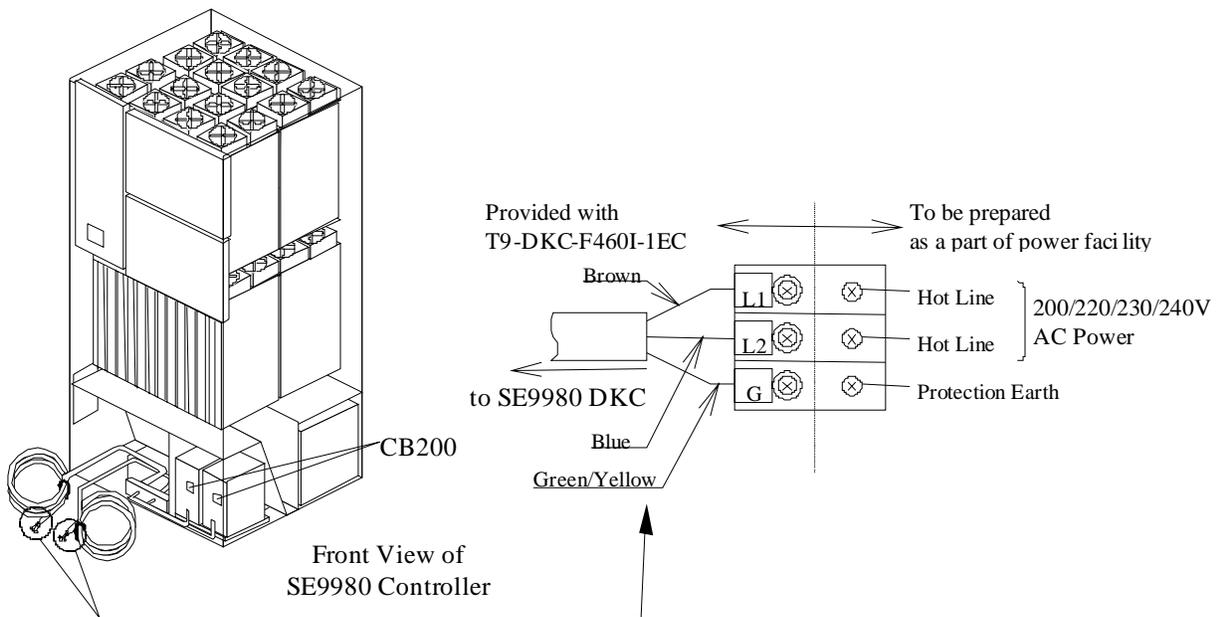


Figure 31 Power Plugs for Single-Phase Sun StorEdge 9980 Controller (Europe)

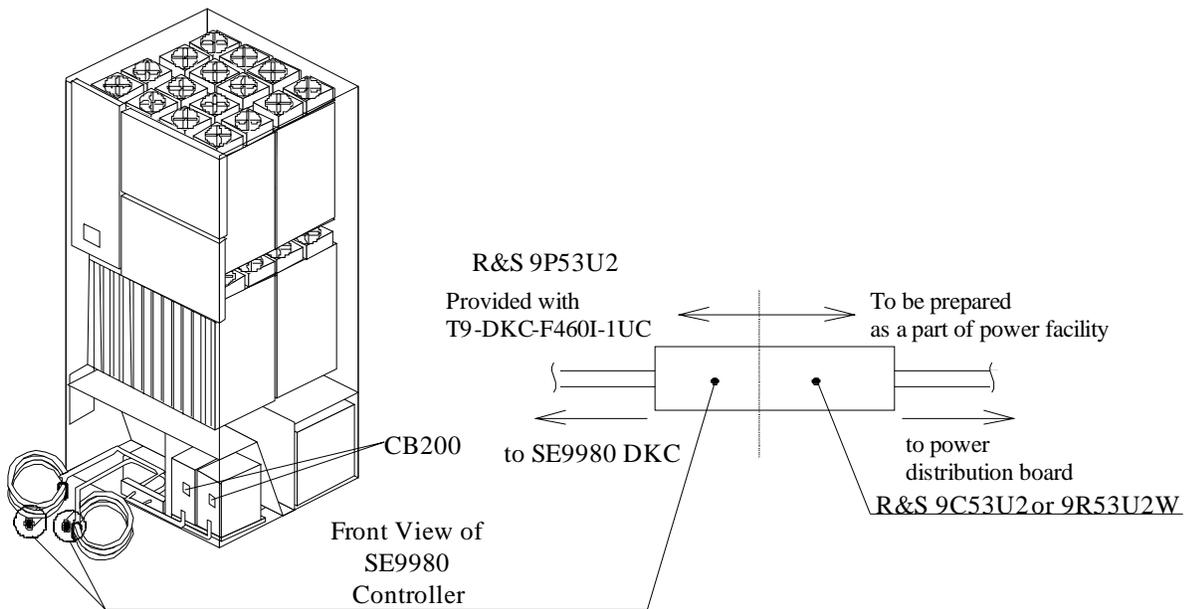


Figure 32 Power Plugs for Single-Phase Sun StorEdge 9980 Controller (USA)



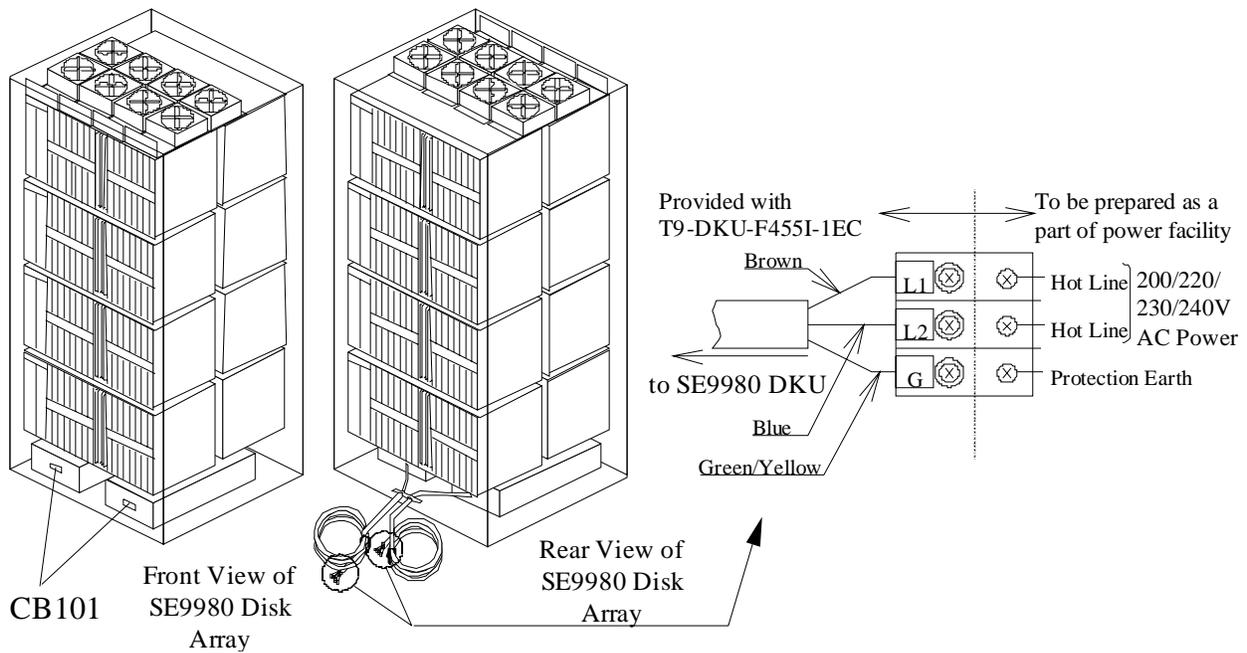


Figure 33 Power Plugs for a Single-Phase Sun StorEdge 9980 Disk Array Unit (Europe)

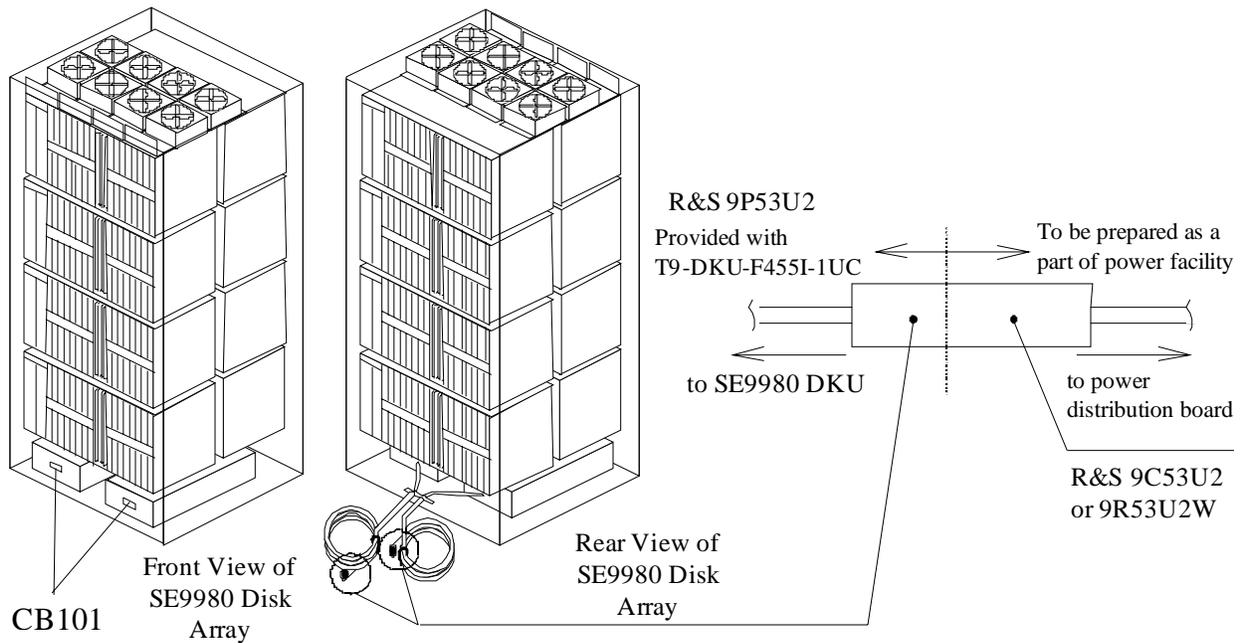


Figure 34 Power Plugs for a Single-Phase Sun StorEdge 9980 Disk Array Unit (USA)



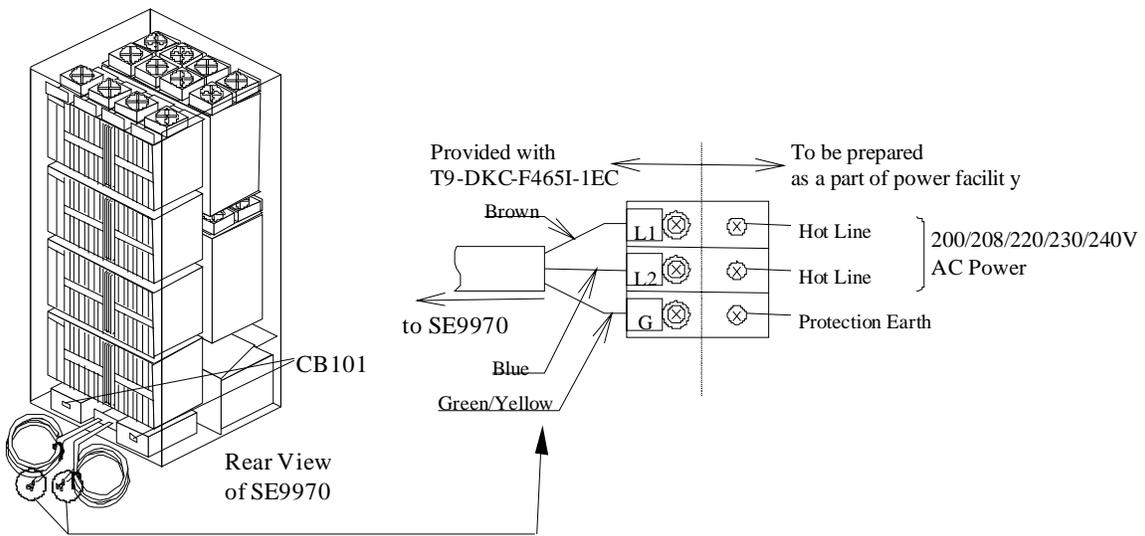


Figure 35 Power Plugs for a Single-Phase Sun StorEdge 9970 System (Europe)

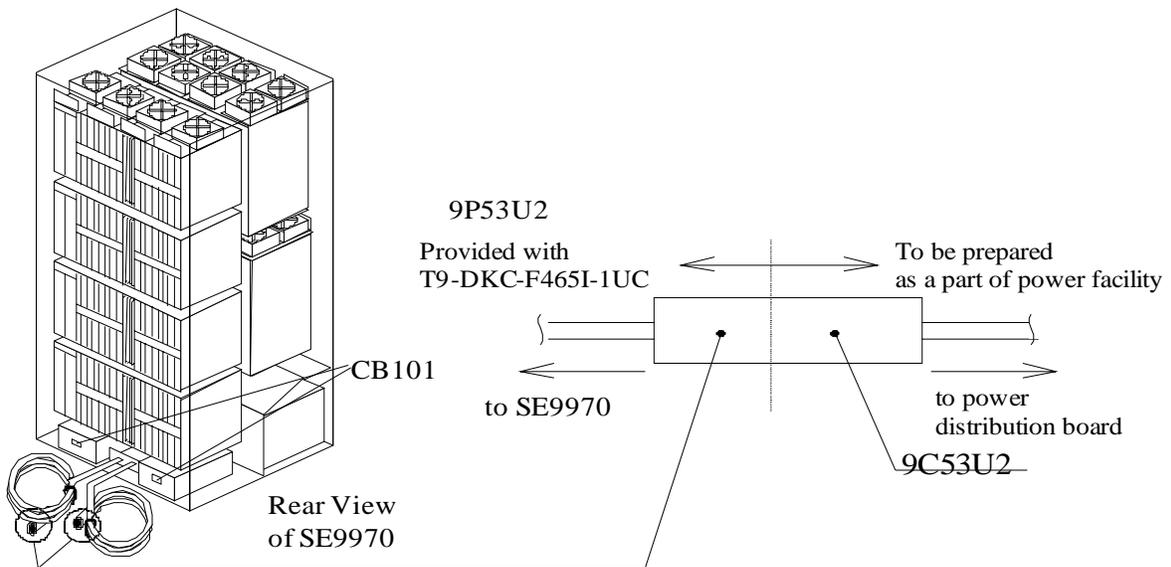


Figure 36 Power Plugs for a Single-Phase Sun StorEdge 9970 System (USA)



Features for Single-Phase

Table 23 lists the features for single-phase Sun StorEdge 9980 and 9970 systems.

Model	Frame	Feature Number	Description
9980	Controller	T9-DKC-F460I-PS	AC Box Kit for Single Phase
		T9-DKC-F460I-EC	Power Cable Kit for Single Phase, 50 Hz for Europe
		T9-DKC-F460I-UC	Power Cable Kit for Single Phase, 60 Hz for USA
	Disk Array	T9-DKU-F455I-1PS	AC Box Kit for Single Phase
		T9-DKU-F455I-1EC	Power Cable Kit for Single Phase, 50 Hz for Europe
		T9-DKU-F455I-1UC	Power Cable Kit for Single Phase, 60 Hz for USA
9970	The 9970 consists of a single frame.	T9-DKC-F465I-1EC	Power Cable Kit for Single Phase, 50 Hz for Europe
		T9-DKC-F465I-1UC	Power Cable Kit for Single Phase, 60 Hz for USA

Table 23 Sun StorEdge 9970 and 9980 Systems Single-Phase Features

Current Rating, Power Plugs, Receptacles, and Connectors for Single-Phase (60 Hz only)

Table 24 lists the current rating and power cable plug, receptacle, and connector requirements (part number or equivalent) for single-phase 60-Hz systems. Each disk array frame (DKU) and controller frame (DKC) has two input power cables with R&S FS 3720 plugs. The user must supply the outlets for the plugs.

Note: Each Sun StorEdge 9980 system's disk array frame requires two power connections for power redundancy. It is strongly recommended that the second power source be supplied from a separate power boundary to eliminate source power as a possible single (nonredundant) point of failure.

Note: If you are planning to provide power using 3/4-inch diameter flexible conduit, consider using box-type receptacle connectors. In some cases, inline connectors may be used with 3/4-inch flexible conduit if the appropriate adapter is available from the connector vendor.

Item	9970	9980 DKC	9980 DKU
Circuit Current Rating	50 A	40 A	50 A
Feature(s) Required	T9-DKC-F465I-1PS T9-DKC-F465I-1UC	T9-DKC-F460I-1PS T9-DKC-F460I-1UC	T9-DKU-F455I-1PS T9-DKU-F455I-1UC
60-Hz Power Plug (or equiv.) Included with the product.	R&S 9P53U2	R&S 9P53U2	R&S 9P53U2
Box-Type Receptacle (or equiv.) (not provided)	R&S 9R53U2W	R&S 9R53U2W	R&S 9R53U2W
Box for Receptacle	R&S 3781A	R&S 3781A	R&S 3781A
Inline Connector (or equiv.) (not provided)	R&S 9C53U2	R&S 9C53U2	R&S 9C53U2

Table 24 Current Rating, Power Plug, Receptacle, and Connector for Single-Phase Sun StorEdge 9970 and 9980 systems



Input Voltage Tolerances for Single-Phase

Table 25 lists the input voltage tolerances for the single-phase Sun StorEdge 9970 and 9980 systems. Transient voltage conditions must not exceed +15-18% of nominal and must return to a steady-state tolerance of between +6 and -8% of the normal related voltage in 0.5 seconds or less. Line-to-line imbalance voltage must not exceed 2.5%. Nonoperating harmonic contents must not exceed 5%.

Frequency	Input Voltages (AC)	Wiring	Tolerance(%)
60 Hz \pm 0.5 Hz	200V, 208V or 230V	Single-phase, two wire + ground	+6% or -8%
50 Hz \pm 0.5 Hz	200V, 220V, 230V or 240V	Single-phase, two wire + ground	+6% or -8%

Note: For Sun StorEdge 9980 DKC, distribution board with circuit breaker or equivalent is rated 40 amps.
 For Sun StorEdge 9980 DKU, distribution board with circuit breaker or equivalent is rated 50 amps.
 For Sun StorEdge 9970, distribution board with circuit breaker or equivalent is rated 50 amps.

Table 25 Input Voltage Specifications for Single-Phase Power

Cable Dimensions for 50-Hz Single-Phase Systems

Table 26 and Figure 37 show the data required for 50-Hz single-phase cable installations.

Model	Power Cable			Terminal		Screw Size
	Outer Sheath Overall Diameter	Insulator Outer Diameter	Electric Wire Cross-Section Area	"Internal Diameter"	"External Diameter"	
	A	B	C	D	E	
T9-DKU-F455I-1EC	20.0-25.5 mm	6.6 mm	10.0 mm ²	6.4 mm	12.0 mm	M6
T9-DKC-F460I-1EC	20.0-25.5 mm	6.6 mm	10.0 mm ²	6.4 mm	12.0 mm	M6
T9-DKC-F465I-1EC	20.0-25.5 mm	6.6 mm	10.0 mm ²	6.4 mm	12.0 mm	M6

Table 26 Cable Dimensions for 50-Hz Single-Phase Systems

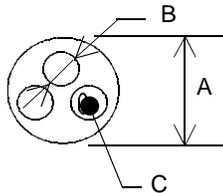


Figure 37 Cable Dimensions for 50-Hz Single-Phase Systems



Cable Requirements

Table 27 lists the cables required for the Sun StorEdge 9980 control frame. These cables must be ordered separately, and the quantity depends on the type and number of channels and ports. ESCON, FICON, Fibre Channel cables are available.

Cable	Function/Description
PCI cable	Connects Sun StorEdge 9970 and 9980 systems to CPU power control interface.
FICON interface cables	Connects mainframe host systems, channel extenders, or FICON directors to Sun StorEdge 9970 and 9980 systems' ports. Single mode cables: <ul style="list-style-type: none"> ■ Yellow in color with SC- and LC-type connectors. ■ 8-10 micron. Most common is 9-micron singlemode. Multimode cables: <ul style="list-style-type: none"> ■ Orange cables with SC and LC-type connectors. ■ 50/125 micron and 62.5 micron multimode.
ESCON interface cables	Connects mainframe host systems, channel extenders, or ESCON directors to Sun StorEdge 9970 and 9980 systems' ports. Multimode cables: <ul style="list-style-type: none"> ■ Commonly called jumper cables. ■ Use LED light source. ■ Plug directly on CHA cards. ■ Orange cables with black duplex connectors. ■ Contain 2 fibers (transmit and receive). ■ 62.5 micron (up to 3 km per link). ■ 50 micron (up to 2 km per link). Mono/Single mode cables: <ul style="list-style-type: none"> ■ Required on XDF links between ESCDs or IBM® 9036 ESCON remote control extenders. ■ Use laser light source. ■ Yellow in color with gray duplex connectors. ■ 8-10 micron. Most common is 9 micron.
Fibre cables	Connects open-system host to Sun StorEdge 9970 and 9980 systems' ports. Fibre cable types are 50 / 125 micron or 62.5 / 125 micron multimode. SC-type (standard) connector is required for 1 Gbps port. LC-type (little) connector is required for 2 Gbps port.
Phone cable with RJ11 connector	Connects phone line to Sun StorEdge 9970 and 9980 systems' SVP for Remote Response.
10/100 BaseT (Cat 5) cable with RJ45 connector	Connects Remote Console PC to Sun StorEdge 9970 and 9980 systems. Can also be used for connecting multiple Sun StorEdge 9970 and 9980 systems together (daisy-chain).
10Base2 cable (RG58) with BNC connector	Connects Remote Console PC to Sun StorEdge 9970 and 9980 systems, and allows connection to multiple Sun StorEdge 9970 and 9980 systems (up to 8) without using a hub. Requires a transceiver.

Table 27 Cable Requirements



Device Interface Cable

Figure 38 shows the relationship between the Sun StorEdge 9980 system layout and the device interface cable options.

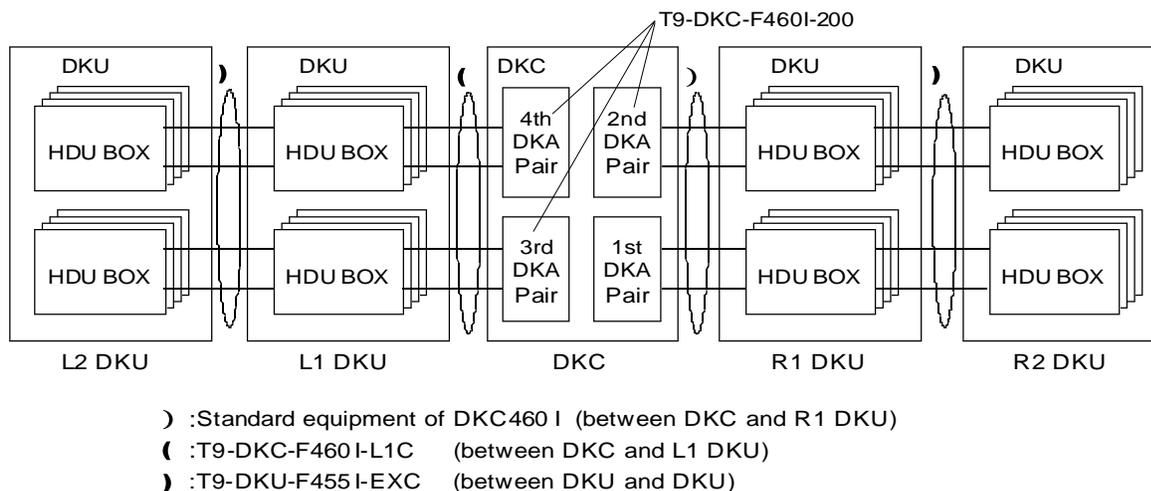


Figure 38 Sun StorEdge 9980 System Layout and Device Interface Cable Options

Channel Specifications and Requirements

Table 28 lists the specifications for each Sun StorEdge 9970 and 9980 systems' open systems channel option. Table 29 lists the specifications for each Sun StorEdge 9970 and 9980 systems mainframe channel option. Each Sun StorEdge 9980 system can support up to eight channel adapters and 32 interface ports. Each Sun StorEdge 9970 system can support up to six channel adapters and 24 interface ports. Each channel adapter feature consists of a pair of cards.

Note: The 8HSE port is applicable for Sun StorEdge 9900 TrueCopy software – S/390.

Note: Additional power supply is needed on the Sun StorEdge 9980 if the total number of channel adapter options and disk adapter options is four or more.

Item	Fibre Short Wave 2 Gbps 8-port	Fibre Long Wave 2 Gbps 8-port
Option name	8HSE	8HLE
Host interface	FCP	FCP
Data transfer rate (MB/s)	100 / 200	100 / 200
Number of options installed	1 / 2 / 3 / 4	1 / 2 / 3 / 4
Number of PCBs installed	2 / 4 / 6 / 8	2 / 4 / 6 / 8
Number of ports / system	8 / 16 / 24 / 32	8 / 16 / 24 / 32
Maximum cable length	500 m / 300 m ^{*2}	10 km

Note: *1: Indicates when 50 / 125-mm multi-mode fiber cable is used. If 62.5 / 125-mm multi-mode fiber cable is used, maximum length is decreased to 300 m.

*2: Indicates when 50 / 125-mm multi-mode fiber cable is used. If 62.5 / 125-mm multi-mode fiber cable is used, 500 m (100 MB/s) and 300 m (200 MB/s) are decreased to 300 m and 150 m respectively.

Table 28 Open Systems Channel Specifications



Sun Microsystems Proprietary/Confidential: Sun Employees Only - Need-to-Know

Item	Serial 8-port	Mainframe Fibre	
		Short-Wave 8-Port	Long-Wave 8-Port
Option name	8S	8MS	8ML
Host interface	ESCON	FICON	FICON
Data transfer rate (MB/s)	17	100	100
Number of options installed	1 / 2 / 3 / 4	1 / 2 / 3 / 4	1 / 2 / 3 / 4
Number of PCBs installed	2 / 4 / 6 / 8	2 / 4 / 6 / 8	2 / 4 / 6 / 8
Number of ports / system	8 / 16 / 24 / 32	8 / 16 / 24 / 32	8 / 16 / 24 / 32
Maximum cable length	3 km	500 m ^{**1}	10 km

Note: 1: Indicates when 50 / 125-mm multi-mode fiber cable is used. If 62.5 / 125-mm multi-mode fiber cable is used, maximum length is decreased to 300 m.

Table 29 Mainframe Channel Specifications

Environmental Specifications and Requirements

Temperature and Humidity Requirements

Table 30 lists the temperature and humidity requirements for the Sun StorEdge 9970 and 9980 systems. The recommended operational room temperature is 70–75°F (21–24°C). The recommended operational relative humidity is 50% to 55%.

Parameter	Operating ^{*1}		Non-Operating ^{*2}		Shipping & Storage ^{*3}	
	Low	High	Low	High	Low	High
Temperature °F (°C)	60 (16)	90 (32)	14 (-10)	109 (43)	5 (-25)	140 (60)
Relative Humidity (%) ^{*4}	20 - 80		8 - 90		5 - 95	
Max. Wet Bulb °F (°C)	79 (26)		81 (27)		84 (29)	
Temperature Deviation °F (°C) /hour	18 (10)		18 (10)		36 (20)	

- Note:** 1. Environmental specification for operating condition should be satisfied before the disk system is powered on. The maximum temperature of 90°F (32°C) should be strictly satisfied at the air inlet portion of the system. The recommended temperature range is 70-75°F (21-24°C).
 2. Non-operating condition includes both packing and unpacking conditions unless otherwise specified.
 3. During shipping or storage, the product should be packed with factory packing.
 4. No condensation in or around the drive should be observed under any conditions.

Table 30 Temperature and Humidity Requirements

Loudness

The acoustic emission values [loudness in dB(A)] for a maximum Sun StorEdge 9980 system configuration (one DKC, four DKUs) are:

- Front/rear = 60 dB(A)
- Both sides = 60 dB(A)

Note: These values were extrapolated from the values for one DKC and one DKU.



Air Flow Requirements

The Sun StorEdge 9970 and 9980 systems are air cooled. Air must enter the system through the air flow intakes at the sides and bottoms of the frames and must be exhausted out of the top, so it is very important that the air intakes and outlets remain clear. It is recommended that under-floor air cooling has a positive pressure and meets the specifications listed in Table 31. For systems located at elevations from 3000 to 7000 feet (900 to 2100 meters) above sea level, decrease the maximum air temperature by two degrees for each 1000 feet (300 meters) above 3000 feet (900 meters).

Note: The air flow requirements for Sun StorEdge 9970 and 9980 systems are greater than those for the Sun StorEdge 9910 and 9960 systems.

System Type	System Configuration	Air Flow (m ³ /min)	Air Flow (ft ³ /min)
Sun StorEdge 9980	Controller Frame (all configurations)	18	636
	Array Frame (all configurations)	32	1131
Sun StorEdge 9970	All configurations	25	883

Table 31 Internal Air Flow

Vibration and Shock Tolerances

Table 32 lists the vibration and shock tolerance data for the Sun StorEdge 9970 and 9980 systems. The Sun StorEdge 9970 and 9980 systems can be subjected to vibration and shock up to these limits and still perform normally. The user should consider these requirements if installing the Sun StorEdge 9970 and 9980 systems near large generators located on the floor above or below the Sun StorEdge 9970 and 9980 systems. Generators or any other source of vibration, if not insulated or shock-mounted, can cause excessive vibration that may affect the system.

Condition	Operating	Nonoperating	Shipping or Storage
Vibration *1	0.01" (0.25 mm), 5~10 Hz 0.05 g, 10~300 Hz	0.1" (2.5 mm), 5~10 Hz 0.5 g, 10 to 70 Hz 0.002" (0.05 mm), 70~99 Hz 1.0 g, 99 to 300 Hz	0.5 g, 15 min. *2 At four most severe resonance frequencies between 5 and 200 Hz
Shock	---	8 g, 15 ms	Horizontal: Incline Impact 4 ft (1.22 m) *3 Vertical: Rotational Edge 0.3 ft (0.1 m) *4

Note: *1. The vibration specifications apply to all three axes.

*2. See ASTM D999-91 Standard Methods for Vibration Testing of Shipping Containers.

*3. See ASTM D5277-92 Standard Test Methods for Performing Programmed Horizontal Impacts Using an Inclined Impact Tester.

*4. See ASTM D1083-91 Standard Test Methods for Mechanical Handling of Unitized Loads and Large Shipping Cases and Crates.

g = acceleration equivalent to gravity (9.8 m/sec²)

Table 32 Vibration and Shock Tolerances



Appendix A: Acronyms and Abbreviations

ACP	array control processor
ASTM	American Society for Testing and Materials
BS	basic (power) supply
BSA	bus adapter
BTU	British thermal unit
°C	degrees centigrade/Celsius
ca	cache
CFW	cache fast write
CH	channel
CHA	channel adapter
CHP	channel processor or channel path
CHIP	client-host interface processor
CHPID	channel path identifier
CKD	count key data
CL	cluster
CPU	central processing unit
CSA	Canadian Standards Association
CSW	cache switch
CU	control unit
CVS	custom volume size
DASD	direct access storage device
dB(A)	decibel (A-weighted)
DFDSS	Data Facility Dataset Services
DFSMS	Data Facility System Managed Storage
DFW	DASD fast write
DKA	disk adapter
DKC	disk controller
DKU	disk unit
dr	drive
DSF	Device Support Facilities
DTDS+	Disaster Tolerant Disk System Plus
ECKD	Extended Count Key Data
EOF	end of field
EPO	emergency power-off
EREP	Error Reporting
ESA	Enterprise Systems Architecture
ESCON	Enterprise System Connection (IBM® trademark for optical channels)
FAL	File Access Library (part of the RapidXchange software)
FBA	fixed-block architecture
FC	Fibre Channel



FC-AL	Fibre Channel arbitrated loop
FCC	Federal Communications Commission
FCU	File Conversion Utility (part of the RapidXchange software)
FDN	Freedom Data Networks
FDR	Fast Dump/Restore
FICON	Fiber Connection (IBM® trademark for fiber connection technology)
F/M	format/message
FWD	fast wide differential
<i>g</i>	acceleration of gravity (9.8 m/s ²) (unit used for vibration and shock)
Gb	gigabit
GB	gigabyte
Gbps, Gb/s	gigabit per second
GLM	gigabyte link module
GUI	graphical user interface
HACMP	High Availability Cluster Multi-Processing
HBA	host bus adapter
HCD	hardware configuration definition
HCPF	Hitachi Concurrent Processing Facility
HSN	Hierarchical Star Network
Hz	Hertz
ICKDSF	A DSF command used to perform media maintenance
IDCAMS	access method services (a component of Data Facility Product)
IML	initial microprogram load
in.	inch(es)
IO, I/O	input/output (operation or device)
IOCP	input/output configuration program
JCL	job control language
kB	kilobyte
kcal	kilocalorie
kg	kilogram
km	kilometer
kVA	kilovolt-ampere
kW	kilowatt
LAN	local area network
lb	pound
LD	logical device
LDEV	logical device
LED	light-emitting diode
LPAR	logical partition
LCP	link control processor, local control port
LRU	least recently used
LU	logical unit
LUN	logical unit number, logical unit



LVI	logical volume image (also called device emulation)
LW	long wavelength
m	meter
MB	megabyte
MBR	Multiplatform Backup/Restore
MIH	missing interrupt handler
mm	millimeter
MP	microprocessor
MPLF	Multi-Path Locking Facility
MR	magnetoresistive
ms, msec	millisecond
MVS	Multiple Virtual Storage (including MVS/370, MVS/ESA, MVS/XA)
NAS	network-attached storage
NVS	nonvolatile storage
OEM	original equipment manufacturer
OFC	open fibre control
ORM	online read margin
OS	operating system
P/DAS	PPRC/dynamic address switching (an IBM S/390 host software function)
PAV	Hitachi Parallel Access Volume
PC	personal computer system
PCI	power control interface
PPRC	Peer-to-Peer Remote Copy (an IBM S/390 host software function)
PS	power supply
R&S	Russell&Stoll
RAB	RAID Advisory Board
RAID	redundant array of independent disks
RAM	random-access memory
RC	reference code
RISC	reduced instruction-set computer
R/W	read/write
S/390	IBM System/390 architecture
SAN	storage-area network
SCSI	small computer system interface
sec.	second
seq.	sequential
SGI®	Silicon Graphics, Inc.
SIM	service information message
SMS	System Managed Storage
SNMP	simple network management protocol
SSID	storage system identification
SDLM	Sun StorEdge Dynamic Link Manager
SVP	service processor



SW	short wavelength
TB	terabyte
TC	Hitachi TrueCopy
TCA	Hitachi TrueCopy Asynchronous
TC390	Hitachi TrueCopy – S/390
TC390A	Hitachi TrueCopy – S/390 Asynchronous
TID	target ID
TPF	Transaction Processing Facility
TSO	Time Sharing Option (an IBM® System/370 operating system option)
UCB	unit control block
UIM	unit information module
UL	Underwriters' Laboratories
µm	micron, micrometer
UPS	uninterruptable power supply
VA	volt-ampere
VAC	volts AC
VDE	Verband Deutscher Elektrotechniker
VM	Virtual Machine (an IBM S/390 system control program)
VOLID	volume ID
volser	volume serial number
XRC	Extended Remote Copy (an IBM S/390 host software function)
VSE	Virtual Storage Extension (an IBM S/390 operating system)
VTOC	volume table of contents
W	watt
WLM	Workload Manager (an IBM S/390 host software function)
XA	System/370 Extended Architecture
XDF	Extended Distance Feature (for ESCON channels)
XRC	Extended Remote Copy



Appendix B: Unit Conversions

Table 33 provides unit conversions for the standard (U.S.) and metric measurement systems.

From	Multiply By:	To Get:
British thermal units (BTU)	0.251996	Kilocalories (kcal)
British thermal units (BTU)	0.000293018	Kilowatts (kW)
Inches (in)	2.54000508	Centimeters (cm)
Feet (ft)	0.3048006096	Meters (m)
Square feet (ft ²)	0.09290341	Square meters (m ²)
Cubic feet per minute (ft ³ /min)	0.028317016	Cubic meters per minute (m ³ /min)
Pound (lb)	0.4535924277	Kilogram (kg)
Kilocalories (kcal)	3.96832	British thermal units (BTU)
Kilocalories (kcal)	1.16279 × 10 ⁻³	Kilowatts (kW)
Kilowatts (kW)	3412.08	British thermal units (BTU)
Kilowatts (kW)	859.828	Kilocalories (kcal)
Millimeters (mm)	0.03937	Inches (in)
Centimeters (cm)	0.3937	Inches (in)
Meters (m)	39.369996	Inches (in)
Meters (m)	3.280833	Feet (ft)
Square meters (m ²)	10.76387	Square feet (ft ²)
Cubic meters per minute (m ³ /min)	35.314445	Cubic feet per minute (ft ³ /min)
Kilograms (kg)	2.2046	Pounds (lb)
Ton (refrigerated)	12,000	BTUs per hour (BTU/hr)
Degrees Fahrenheit (°F)	subtract 32, then multiply result by 0.555556	Degrees centigrade (°C) °C = (°F - 32) × 0.555556
Degrees centigrade (°C)	multiply by 1.8, then add 32 to result	Degrees Fahrenheit (°F) °F = (°C × 1.8) + 32
Degrees Fahrenheit per hour (°F/hour)	0.555555	Degrees centigrade per hour (°C/hour)
Degrees centigrade per hour (°C/hour)	1.8	Degrees Fahrenheit per hour (°F/hour)

Table 33 Unit Conversions for Standard (U.S.) and Metric Measures

