

For in-depth information on the Compaq *StorageWorks*™ SAN, consult our Web site at: www.compaq.com/products/StorageWorks/san/enterprise-san.html

Documents available at the Web site include:

- The Heterogeneous SAN Design Guide
- The Operating System Support Matrix
- SAN White Papers
- Product Announcements
- Press Releases

OVERVIEW

Storage Area Networks (SANs) are acknowledged industry-wide as the preferred solution to meet the challenges of rapid data growth and the need for more efficient data storage and management. Until now, support for SANs was limited to distinct SAN islands. Compaq's *StorageWorks* SAN is setting a new industry milestone by providing support to the Enterprise SAN. The larger SAN configurations are needed to solve today's most challenging problems. The Compaq *StorageWorks* SAN QuickSpecs provides an overview of the major SAN design considerations, the two Compaq approaches to SAN design, and a quick reference to the specific hardware components and operating systems supported. For access to the documents that provide more in-depth information on SAN design, please visit our Web site at: www.compaq.com/products/StorageWorks/san/enterprise-san.html.

BENEFITS OF SANS

Compaq *StorageWorks* SAN technology provides answers to the challenges facing businesses today. This well-designed SAN architecture:

- Reduces costs through server and storage consolidation and more efficient data management
- Supports today's heterogeneous corporate computing environments
- Allows pools of data, potentially a company's most valuable resource, to be shared over the enterprise and across distances
- Creates a more flexible IT infrastructure
- Supports business growth

KEY DESIGN CONSIDERATIONS

StorageWorks SANs can be configured to meet the needs of the business today as well as charting a course for the solutions of tomorrow. The flexibility of the Compaq *StorageWorks* SAN allows the needs of the business to shape the SAN solution. Careful attention to several key business needs allows the enterprise to develop a SAN architecture as unique as the business itself.

- Factors that need to be considered when designing a SAN include:
 - Connectivity levels
 - Scalability levels
 - Performance levels
 - Disaster tolerance
 - Backup and restore needs
 - Manageability needs
 - Physical layout of the enterprise
 - Availability levels
 - Type of data access required
 - Platform and Operating System support needed

COMPAQ *STORAGEWORKS* SAN DESIGN APPROACHES

Compaq SAN architecture allows the IT professional to design a SAN that can meet any demand by providing two approaches to SAN Design and implementation:

- **Custom SAN Topologies** based on qualified design rules. These design rules specify maximum limits and provide guidelines for developing custom design topologies that can be tailored to meet the unique and specific storage and access needs of the enterprise
- **Compaq-defined Topologies** that specify the arrangement of the Fibre Channel switches within the SAN fabric and are optimized for specific data access needs

COMPAQ *STORAGEWORKS* FABRIC DESIGN RULES THE ADVANTAGE OF FLEXIBILITY

The flexibility of the Compaq *StorageWorks* SAN is unparalleled, placing the power to build a storage infrastructure around the needs of the business directly in the hands of the business. The Compaq *StorageWorks* "Heterogeneous SAN Design Guide" describes fabric design configuration rules for heterogeneous SANs. These design rules allow the IT professional to create and modify a base configuration to fit the needs of the enterprise. These design rules allow the IT professional to create SANs that:

- Support the existing IT infrastructure, preserving investments in existing servers and storage
- Allow for non-disruptive integration into existing IT environments
- Provide the ideal mix of data access, fault tolerance, scalability, and performance based on the needs of the business

FABRIC DESIGN RULES

The Heterogeneous Design Guide provides the framework within which IT professionals can create custom configurations for the enterprise. Guidelines provided in the Heterogeneous Design Guide include:

General SAN Fabric Rules	Number of switches supported Types of switches supported Maximum number of hops supported Domain IDs and Worldwide Names needed Number of ISLs supported
General Fabric Performance Recommendations	Device connection recommendations to maximize performance

SAN Appliance Rules and Recommendations

SAN Fabric Zoning Rules	Zoning rules addressing different devices in a SAN Zoning rules addressing different hardware platforms in a SAN Zoning rules addressing different operating systems in a SAN Number of nodes or ports allowed in a SAN
SAN Component Interconnect Rules	E-Port interface for switch to switch connectivity F-Port interface for fabric attached devices like HBA's and storage devices Fiber Optic Interconnects/Distance rules Minimum allowable bend radius of fiber optic cable Maximum distance per cable segment between devices and switches Maximum distance per cable segment between devices and switches or switches and switches

Fiber Optical Cable Loss Budgets

Platform and Operating System Rules	Rules on mixing platforms on a single shared storage system Rules on zoning for different platforms in a heterogeneous SAN
Storage System Rules	Rules on specific platform and operating systems Rules on configuring storage connected to multiple different platforms and operating systems in a heterogeneous SAN

COMPAQ “DEFINED” SAN TOPOLOGIES THE ADVANTAGE OF SIMPLICITY

The Compaq *StorageWorks* SAN also provides the power of simplicity with four defined topologies. Based on the design rules outlined in the Heterogeneous SAN Design Guide, Compaq has developed four different SAN topologies that can be implemented to provide the ideal levels of data access and connectivity. The four defined SAN topologies are:

- Ring
- Cascaded
- Meshed
- Backbone

RING SAN: OPTIMAL FOR LOCAL ACCESS NEEDS

Description:

This topology is characterized by a continuous ring of switches connected together into a single fabric. Each switch is connected to the next switch on either side with the last switch in the ring connected back to the first.

Maximum Switches	8 in the ring, up to 20 with the branches
Available F-Ports	200 to 400
Maximum hop count	7
Data Access	
Local (One to One)	Highest data access
Centralized (Many to One)	Medium data access
Distributed (Many to Many)	Not recommended
Physical Layout	Inter-switch distances of up to 10 km
Availability Levels	Levels 1 through 4

Key Design Strengths

- Offers the same level of fabric resiliency as the mesh design with full fabric connectivity and at least two internal fabric paths or routes
- Well suited for situations where data access is localized, yet provides the benefits of SAN integration to the whole organization
- Scaling is easy and logical
- Centralized management and backup is supported
- Shared backup is supported
- Non-disruptive expansion is possible due to modular design
- Ring fabric can be pre-configured and installed before the server requirements are known
- Supports multiple fabrics for higher availabilities

CASCADED SAN: ACCOMMODATING GEOGRAPHICAL CONDITIONS

Description:

A string of switches or levels of switches connected together by one or more Inter-switch links (ISL). The switches are arranged in a linear array, each one connected to the switch that is next in line, or arranged in a vertical cascade with multiple levels off a single top switch.

Maximum Switches	20
Available F-Ports	200 to 400
Maximum hop count	7
Data Access	Optimal for local access
Local (One to One)	Highest data access
Centralized (Many to One)	Not recommended
Distributed (Many to Many)	Medium data access
Physical Layout	Inter-switch distances of up to 10 km
Availability Levels	Levels 1 through 4

CASCADED SAN: ACCOMMODATING GEOGRAPHICAL CONDITIONS *(continued)*

Key Design Strengths

- Well suited for applications where data access is local, yet provides the benefits of an integrated SAN across the organization
- Scales easily for additional connectivity
- Supports centralized management and backup
- Supports shared backup
- Provides highest performance when groups of servers and the storage being accessed can be connected to the same switches
- Supports multiple fabrics for higher availability
- Accommodates diverse geographic conditions

MESHED SAN: SATISFYING LOCAL AND REMOTE DATA ACCESS NEEDS

Description

Similar to a cascaded fabric, in a meshed fabric all switches are interconnected. However, this topology provides at least two paths or routes from any one switch to another switch in the fabric.

Maximum Switches	20
Available F-Ports	200 to 400
Maximum hop count	7
Data Access	Can be configured for many to many, local data access, or a mix. This topology is best suited to applications where the data access is a mix of local and distributed.
Local (One to One)	High data access
Centralized (Many to One)	Medium data access
Distributed (Many to Many)	High data access
Physical Layout	Inter-switch distances of up to 10 km
Availability Levels	Levels 1 through 4

Key Design Strengths

- Provides protection against link and switch port failures
- Ideal for situations where data access requirements are a mix of local and distributed
- Scales easily
- Supports centralized management and backup
- Supports shared backup
- Provides a level of fabric resiliency such that if a single ISL or ISL switch port interface fails, the fabric can automatically re-route data through an alternate path through other switches in the fabric.
- Supports multiple fabrics for higher availability

BACKBONE SAN: HIGHEST PERFORMANCE AND DISTRIBUTED ACCESS

Description

This topology is characterized by having one or more switches used to connect to other switches. These backbone switches act as routers with full bandwidth and redundant connectivity to all other switches. Servers and storage connections are concentrated on the edge switches. The edge switches on either tier can contain servers or storage or a mix.

Maximum Switches	20 with up to four switches dedicated as backbones
Available F-Ports	192-384
Maximum Hops	7

BACKBONE SAN: HIGHEST PERFORMANCE AND DISTRIBUTED ACCESS *(continued)*

Description *(continued)*

Data Access	Backbone topologies offer maximum flexibility for implementing mixed access types: local, distributed, centralized. It also offers the best many to many connectivity with evenly distributed bandwidth and redundant connectivity
Local (One to One)	Medium data access
Centralized (Many to One)	Highest data access
Distributed (Many to Many)	Highest data access
Physical Layout	Inter-switch distances of up to 10 km
Availability Levels	Levels 1 through 4

Key Design Strengths

- Highest fabric performance
- Best for "many-to-many" connectivity and evenly distributed bandwidth throughout the fabric
- Offers maximum flexibility for implementing mixed access types (local, distributed, and centralized)
- Supports centralized management and backup
- Well suited for situations where data traffic patterns may vary and may even be random at times but the underlying need is for full network many-to-many connectivity with high performance
- Supports all availability levels
- Provides an easy upgrade path from other SAN designs
- Efficient port expansion since new switches need only be connected to backbone switches
- When implemented with 2 backbone switches, provides a level of switch redundancy in a single fabric
- Well suited to take full advantage of expected future technological developments such as storage virtualization

COMPAQ SAN PLATFORM AND OPERATING SYSTEM SUPPORT

All of the Compaq SAN topologies support a heterogeneous mix of Compaq and Multi-vendor hardware platforms and operating systems.

The platforms and operating systems supported in the Compaq SAN are:

- Compaq Tru64 UNIX
- Microsoft Windows NT, Windows 2000, Datacenter
- Compaq OpenVMS
- Sun Solaris
- HP-UX
- Novell NetWare
- Redhat Linux
- SUSE Linux
- SGI IRIX
- IBM AIX

SUPPORTED CLUSTER PRODUCTS

The Compaq SAN also supports a range of cluster products including:

- Compaq Tru64 TruCluster
- HP MC/ServiceGuard
- VMS Clusters
- Microsoft Cluster Server (MSCS)
- Novell NetWare Clusters
- SUN Clusters

INTERCONNECTS AND COMPONENTS

Host Bus Adapters

The Fibre Channel Host Bus Adapters (HBA) supported in the Compaq heterogeneous open SAN are:

Host Bus Adapter	Operating System
Compaq 380574-001/KGPSA-BC	Windows NT, Windows 2000, Tru64 UNIX, OpenVMS
Compaq 168794-B21/KGPSA-CA	Tru64 UNIX, OpenVMS
Compaq 176479-B21/KGPSA-CB	Windows NT, Windows 2000
Compaq 120186-B21/291 (64-bit), 223180-B21/291 (32-bit)	Novell NetWare
Compaq 380575-001/SWSA4-SB (JNI FC-1063) 32-bit Sbus	Sun Solaris
Compaq 380576-001/SWSA4-PC (JNI FCI-1063) 32-bit PCI	Sun Solaris
Compaq 123503-001/SWSA4-SC (JNI FC64-1063) 64-bit Sbus	Sun Solaris
Compaq 167433-B21	Redhat, SUSE Linux x86/Alpha
Compaq 218409-B21	HP-UX
HP A3404A FC-AL HSC Bus, K Class	HP-UX
HP A3591A FC-AL HSC Bus, D Class	HP-UX
HP A3636A FC-AL HSC Bus, T Class	HP-UX
HP A3740A FC-AL PCI, L Class	HP-UX
HP A5158A FC-AL PCI A/L/V/N Class	HP-UX
QLogic 2200F/66SGI PCI-FC-1POPT PCI	IRIX
QLogic 2200F/66SGI XT-FC-1POPT XIO	IRIX

Note: The Compaq branded HBAs listed above are supplied with Compaq specific drivers and firmware. These are the only HBAs supported for the specified operating systems.

Fibre Channel Switches

The Compaq *StorageWorks* Fibre Channel switches supported in the Compaq heterogeneous open SAN are:

Product Name	6-3 Part Number	2-5-2 Part Number
Fibre Channel SAN Switch 8 Port	158222-B21	DS-DSGGB-AA
Fibre Channel SAN Switch 16 Port	158223-B21	DS-DSGGB-AB
Fibre Channel SAN Switch 8 Port-EL	176219-B21	DS-DSGGC-AA
Multiport upgrade for 8 Port-EL	207104-B21	QM-6KAAA-AB
Fibre Channel SAN Switch 16 Port-EL	212776-B21	DS-DSGGC-AB

Gigabit Interface Converters (GBIC)

Gigabit Interface Converters (GBIC)	Distance	Part Number
Short Wavelength	850 nm	380561-B21
Long Wavelength	1310 nm	127508-B21
Very Long Distance	1550 nm	230800-B21

Gigabit Link Modules (GLM)

Fiber Optical Cables	Length	Part Number
50/125 Multi-Mode	2 m	234457-B21
50/125 Multi-Mode	5 m	234457-B22
50/125 Multi-Mode	15 m	234457-B23
50/125 Multi-Mode	30 m	234457-B24
50/125 Multi-Mode	50 m	234457-B25
62.5/125 Multi-Mode		
9/125 Single-Mode		
Short wavelength	850 nm	30-50124-01

INTERCONNECTS AND COMPONENTS *(continued)*

Data Replication Manager (DRM) Interfaces/Transports

- Fibre channel connection via 50, 62.5 micron multi-mode, or 9 micron single-mode fiber optic cable
- Fibre channel connection via Wave Division Multiplexing (WDM) and Dense Wave Division Multiplexing (DWDM)

ATM over a single T1/E1 Wide Area Network

- ATM over multiple T1/E1 Wide Area Network (Inverse Multiplexing)
- ATM over T3/E3 Wide Area Network
- ATM over fractional and/or shared T3/E3 and OC3 Wide Area Network

SAN GLOSSARY

Arbitrated loop topology – A Fibre Channel topology that provides a (FC-AL) lower cost solution to attach multiple communicating ports in a loop.

Cascade – Connecting one switch to another switch for an inter-switch link

Dynamic load sharing – Automatically distributes traffic among multiple paths

Fabric – Single or Multiple Fibre Channel switches interconnected which use Fibre Channel methodology for linking nodes and routing frames in a Fibre Channel network

Fibre Channel – A high-speed serial transmission network technology. Three topologies: point to point, arbitrated loop, and switched

ISL (Inter Switch Link) – Connection between two switches.

Mesh – A cascading subset that defines the physical connections between switches where multiple switches are all connected to each other.

Node – The basic definition of a Fibre Channel device. A node may have one or two ports.

Port – The hardware entity within a node that performs data communications over the Fibre Channel link.

Storage Pool – A centralized resource of disk devices that can be allocated in an on-demand fashion.

Topology – The logical and/or physical arrangement of switches in a network

Zone – A logical or physical blockage creating a grouping of ports in a switch that is allowed to communicate with each other. Other elements not in the zone cannot communicate