SAN 101

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SAN 101

This class will explain how Storage Area Networks (SANs) operate, the basic operation of fiber channel and the interoparability issues of managing multiple remote attached storage devices. We will also show the newest switch-to-switch break through on different switch vendors common on a fabric. We will describe how the emerging network storage protocols (iSCSI, IP over FC) interoperate and how you can build and manage them in an enterprise network, as well as how this SAN can and will be managed world-wide.

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What is a SAN?
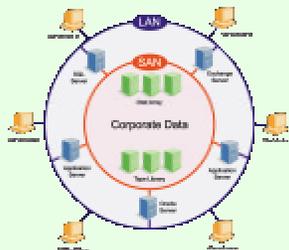
A network whose primary purpose is the transfer of data between computer systems and storage elements and among storage elements. Abbreviated SAN. A SAN consists of a communication infrastructure, which provides physical connections, and a management layer, which organizes the connections, storage elements, and computer systems so that data transfer is secure and robust. The term SAN is usually (but not necessarily) identified with block I/O services rather than file access services.

A storage system consisting of storage elements, storage devices, computer systems, and/or appliances, plus all control software, communicating over a network.

-SNIA Glossary

Storage Area Network
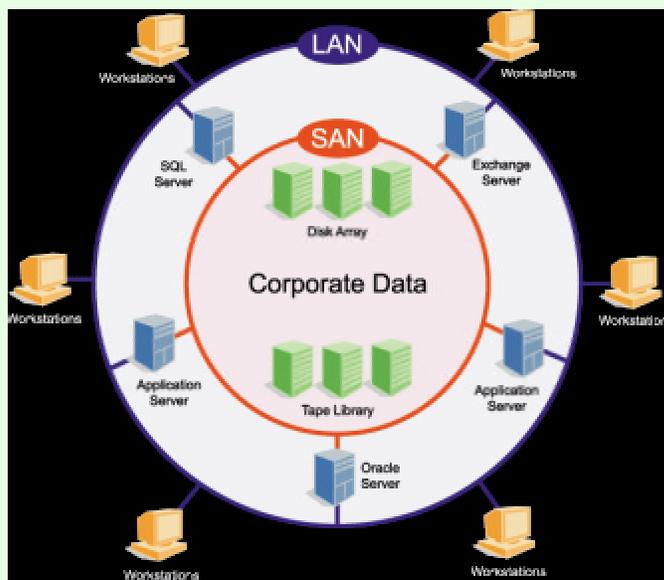
SAN Components

- Servers with Host Bus Adapters
- Storage Systems
  - RAID – Redundant Array of Inexpensive Disks
  - JBOD – Just a Bunch of Disks
  - Tape Drive or Library
  - Optical Storage
- Hubs and Switches
- Bridges
- Storage Area Network Management tools

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SAN Advantages

- Scalable
- Enhanced Device Connectivity
- Storage Consolidation
- LAN-free backup
- Serverless Backup
- Server Clustering
- Heterogeneous Data Sharing
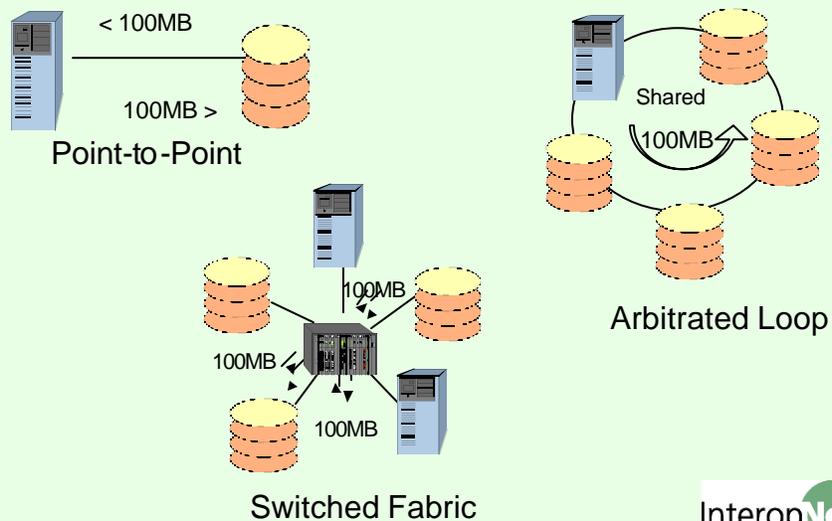- Disaster Recovery - Remote Mirroring

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Scalability and Performance

- Storage expansion
  - No impact on servers
- Server expansion
  - No impact on storage
- Load balancing
  - Active parallel paths
- Bandwidth on demand
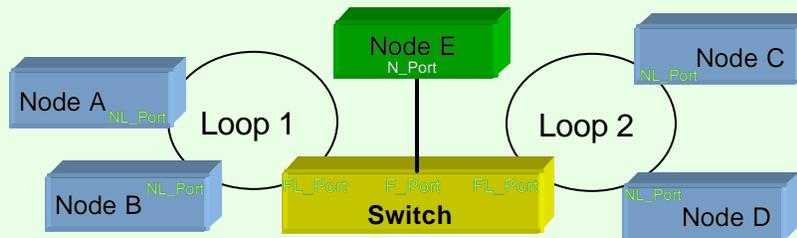 - Robust topology add more nodes to the fabric

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SAN Topologies

< 100MB

100MB >

Point-to-Point

Shared

100MB

Arbitrated Loop

100MB

100MB

100MB

Switched Fabric

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Mixing Loops and Fabrics

A fabric can connect multiple loops

Node E
N_Port

Node A
NL_Port

Loop 1

Node C
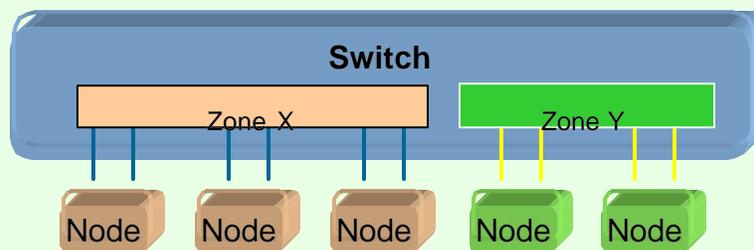NL_Port

Node B
NL_Port

FL_Port   F_Port   FL_Port
Switch

Loop 2

NL_Port
Node D

- A loop can have one and only one FL-Port
- A node can be either public or private
  - Private nodes communicate only within loop

Zoning

Zoning arranges FC connected devices into logical groups

Switch

Zone_X

Zone Y

Node   Node   Node   Node   Node

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Fibre Channel

A set of standards for a serial I/O bus capable of transferring data between two ports at up to 100 MBytes/second, with standards proposals to go to higher speeds. Fibre Channel supports point to point, arbitrated loop, and switched topologies. Fibre Channel was completely developed through industry cooperation, unlike SCSI, which was developed by a vendor and submitted for standardization after the fact.

-SNIA Glossary

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FC Frame Classes

- Class 1
  - Acknowledged Connection Service
  - Full bandwidth w/ guaranteed delivery
  - Dedicated path between ports
- Class 2
  - Acknowledged Connectionless Service
  - Independently switched frames
  - Non-dedicated path between ports
- Class 3
  - Unacknowledged Connectionless Service
  - Same as Class 2 without acknowledgements
    - Invalid frames are discarded.
    - ULP provides error correction/handling

How does Fibre Channel Compare?

	Fibre Channel	**Gigabit Ethernet**	**ATM**
Technology application	Storage, network, video, clusters	Network	Network, video
Topologies	point-to-point loop hub, switched	Point-to-point hub, switched	Switched
Baud rate	1.06 Gbps	1.25 Gbps	622 Mbps
Scalability to higher data rates	2.12 Gbps, 4.24 Gbps	Not defined	1.24 Gbps
Guaranteed delivery	Yes	No	No
Congestion data loss	None	Yes	Yes
Frame size	Variable, 0-2KB	Variable, 0-1.5KB	Fixed, 53B
Flow control	Credit Based	Rate Based	Rate Based
Physical media	Copper and Fiber	Copper and Fiber	Copper and Fiber
Protocols supported	Network, SCSI, Video	Network	Network, video

How Does FC Compare to SCSI?

	Fibre Channel	Fibre Channel AL	Parallel SCSI
Connections	16 Million	126	15
Distance	10km	10km	25m
Bandwidth	100 MB/sec Per connection	100 MB/sec Shared Bandwidth	160 MB/sec Shared Bandwidth
Hot Plug	Yes	Yes	No
Multiple Protocols	Yes	Yes	No

SAN Components

- Cables
- Interfaces/Adapters/HBAs
- Hubs
- Switches
- Bridges
- Storage Systems

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RAID

An acronym for Redundant Array of Independent Disks, a family of techniques for managing multiple disks to deliver desirable cost, data availability, and performance characteristics to host environments.
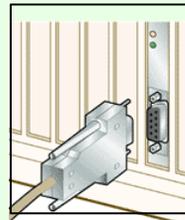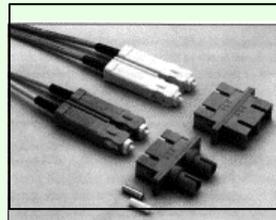
JBOD

Acronym for "Just a Bunch Of Disks." Originally used to mean a collection of disks without the coordinated control provided by control software; today the term JBOD most often refers to a cabinet of disks whether or not RAID functionality is present.
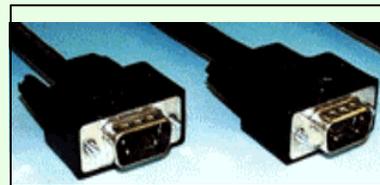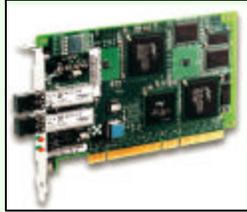
Cables
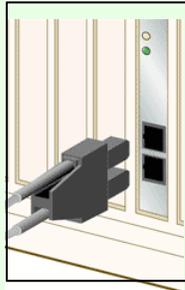
Fiber Optic

Copper

Host Bus Adapters & Interfaces

- PCI to FC Adapter
  - 32/64-bit, 33/66-MHz, PCI compliant
  - Other buses – SBUS, cPCI
  - 1 & 2 GB/sec FC performance

- Features
  - GigaBit Interface Converters
  - SNMP and MIB compliance
  - AL and Fabric login support
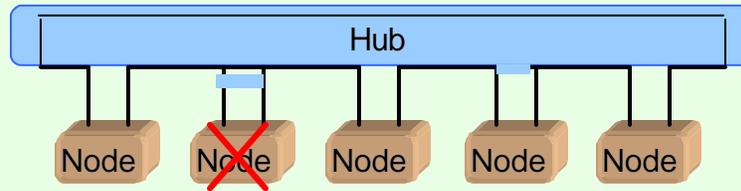 - Copper/optical media support

Multi-Port Fibre Channel Hubs

6 -16 ports, copper or optical GBIC's
Network management software
Supports FC-AL

Fibre Channel Hub

- Features
  - Zoning
  - Integrated SNMP and MIB-compliant management
  - Configuration management tools and utilization monitoring
  - Automated port isolation and device failover
  - Fabric upgradeability/integration

Fibre Channel Switch

- Multi-Port Fibre Channel Switches
  - 8 -16 ports (or more)
  - Copper or optical GBIC's
  - Fast, non-blocking, dedicated bandwidth
  - Special services (time, name, etc.)

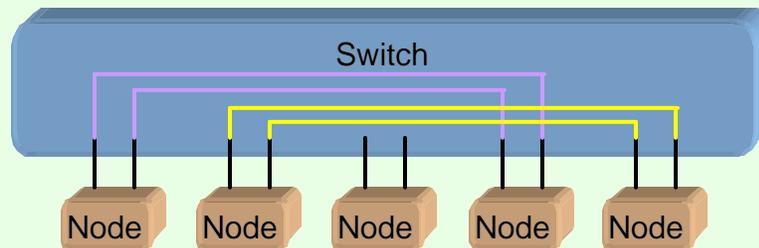# Fibre Channel Switch

Switch

Node   Node   Node   Node   Node

- Features
  - Zoning
  - Integrated SNMP and MIB-compliant management
  - Configuration management tools with utilization monitoring
  - Automated port and device fail-over

Bridges

CROSSROADS · 8000
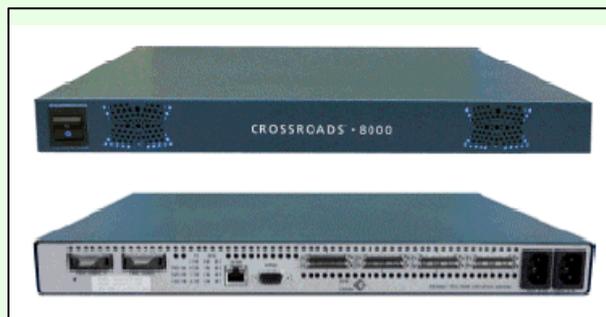
- FC-SCSI Router/Bridge
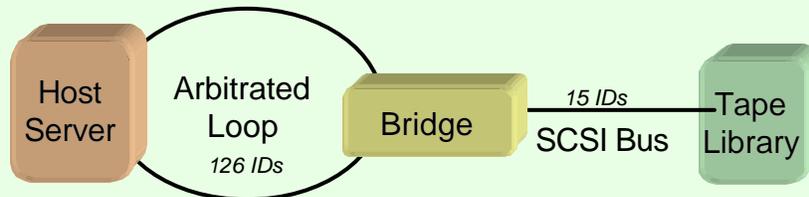 - Maps SCSI devices to devices within the FC-AL
  - Configurable mapping table
  - SNMP management

Bridges

Host Server — Arbitrated Loop *126 IDs* — Bridge — *15 IDs* SCSI Bus — Tape Library

- Features
  - Allow use of SCSI devices on a FC network
  - Allow use of Fibre Channel peripherals by SCSI-only hosts (running the router in "initiator" mode)
  - SNMP and MIB compliance
  - Available in multi-port units

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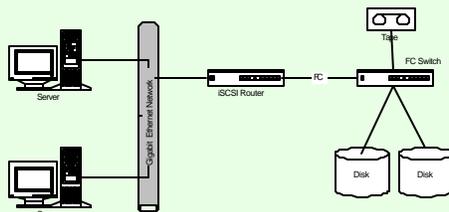# Tape Storage Systems

Courtesy of StorageTek

Courtesy of StorageTek

- Features
  - FC-attached to the SAN
  - High RPM, fibre or SCSI drives
  - SNMP and MIB-compliant
  - GUI configuration management tools with utilization monitoring

iSCSI

iSCSI is a SCSI transport protocol for mapping of block-oriented storage data over TCP/IP networks linking data storage facilities, developed by the Internet Engineering Task Force (IETF).

The iSCSI standards are being developed by the Internet Engineering Task Force and the draft specification is available at the IETF Web site http://www.ietf.org/.

Storage Over IP (SOIP)
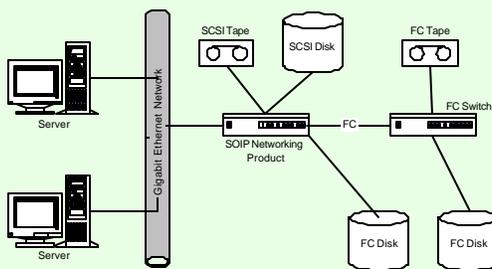
The SoIP Framework is an open, standards-based architecture for deploying native IP storage solutions using the IP Storage standards within the IETF IP Storage Working Group such as iSCSI and iFCP.

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Switch Interoperability

- Demonstration of open, standards-based Fabric Switch Interoperability
- ANSI NCITS T11 standards
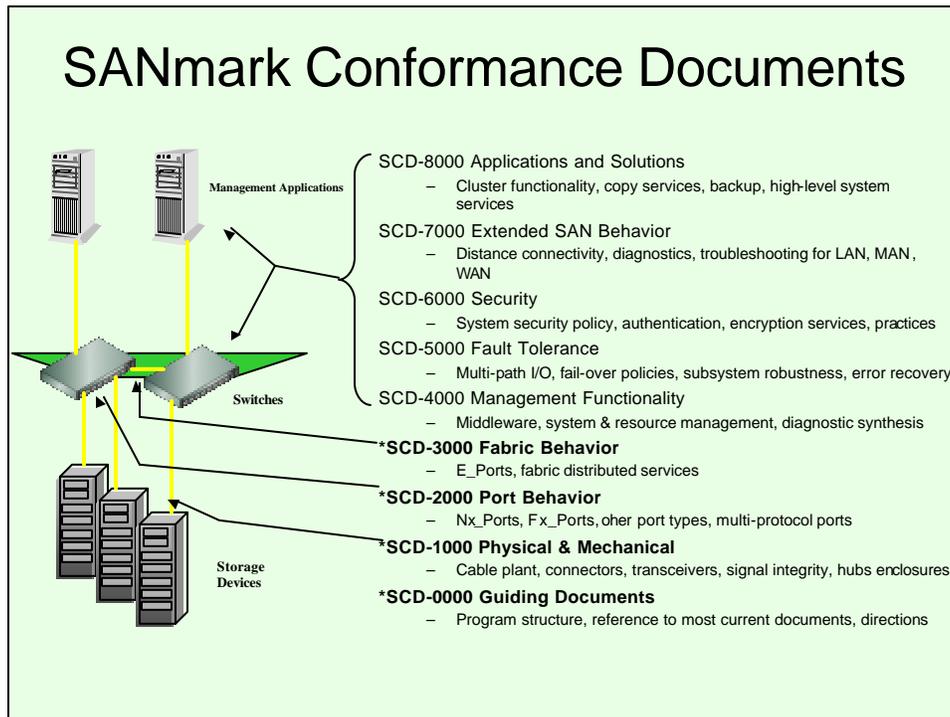 - Fibre Channel Switched Fabric-2 (FC-SW2)
  - Fibre Channel Methodologies for Interconnects (FC-MI)
- Multi vendor, heterogeneous Fibre Channel fabric based on E_Port connections
- Interoperability tested using SANmark test suite (SCD-3001)

SANmark Overview

- Comprehensive suite of standard conformance tests, from physical to application layer
- Developed by FCIA in cooperation with ANSI T11 and University of New Hampshire
- SANmark Conformance Documents specify test suites, procedures and supporting standards
- SANmark Architecture Levels divide functionality of entire I/O system, up to the application layer
  - Allows entire industry to participate in development of test suites and specifications
- SCD2003 defines NX_Port fabric attach
- SCD3001 defines E_Port switch interoperability

SANmark Conformance Documents

Management Applications

Switches

Storage Devices

SCD-8000 Applications and Solutions
– Cluster functionality, copy services, backup, high-level system services

SCD-7000 Extended SAN Behavior
– Distance connectivity, diagnostics, troubleshooting for LAN, MAN, WAN

SCD-6000 Security
– System security policy, authentication, encryption services, practices

SCD-5000 Fault Tolerance
– Multi-path I/O, fail-over policies, subsystem robustness, error recovery

SCD-4000 Management Functionality
– Middleware, system & resource management, diagnostic synthesis

*SCD-3000 Fabric Behavior
– E_Ports, fabric distributed services

*SCD-2000 Port Behavior
– Nx_Ports, Fx_Ports, oher port types, multi-protocol ports

*SCD-1000 Physical & Mechanical
– Cable plant, connectors, transceivers, signal integrity, hubs enclosures

*SCD-0000 Guiding Documents
– Program structure, reference to most current documents, directions

Thank You for Attending
This Session