Education

Benefits of Networked Storage: iSCSI & Fibre Channel SANs

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Abstract

Benefits of Networked Storage

This presentation outlines the benefits of networked storage, contrasting the different options. It then goes into detail, discussing both Fibre Channel and iSCSI-based SANs, including contemporary storage features.

The presentation then compares and contrasts where Fibre Channel and iSCSI fit in typical IT environments today.

Finally, emerging and future capabilities for both Fibre Channel and iSCSI are discussed, including the Fibre Channel roadmap, 10Gb Ethernet, and Fibre Channel over Ethernet

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- Storage Consolidation: Advantages of SANs
- Fibre Channel SANs today
- iSCSI-based SANs
- Typical SAN Deployments
  - Where IP Storage Fits
- What's Next
  - Fibre Channel Roadmap
  - Upcoming iSCSI Capabilities
  - 10Gb Ethernet & FCoE
- Summary

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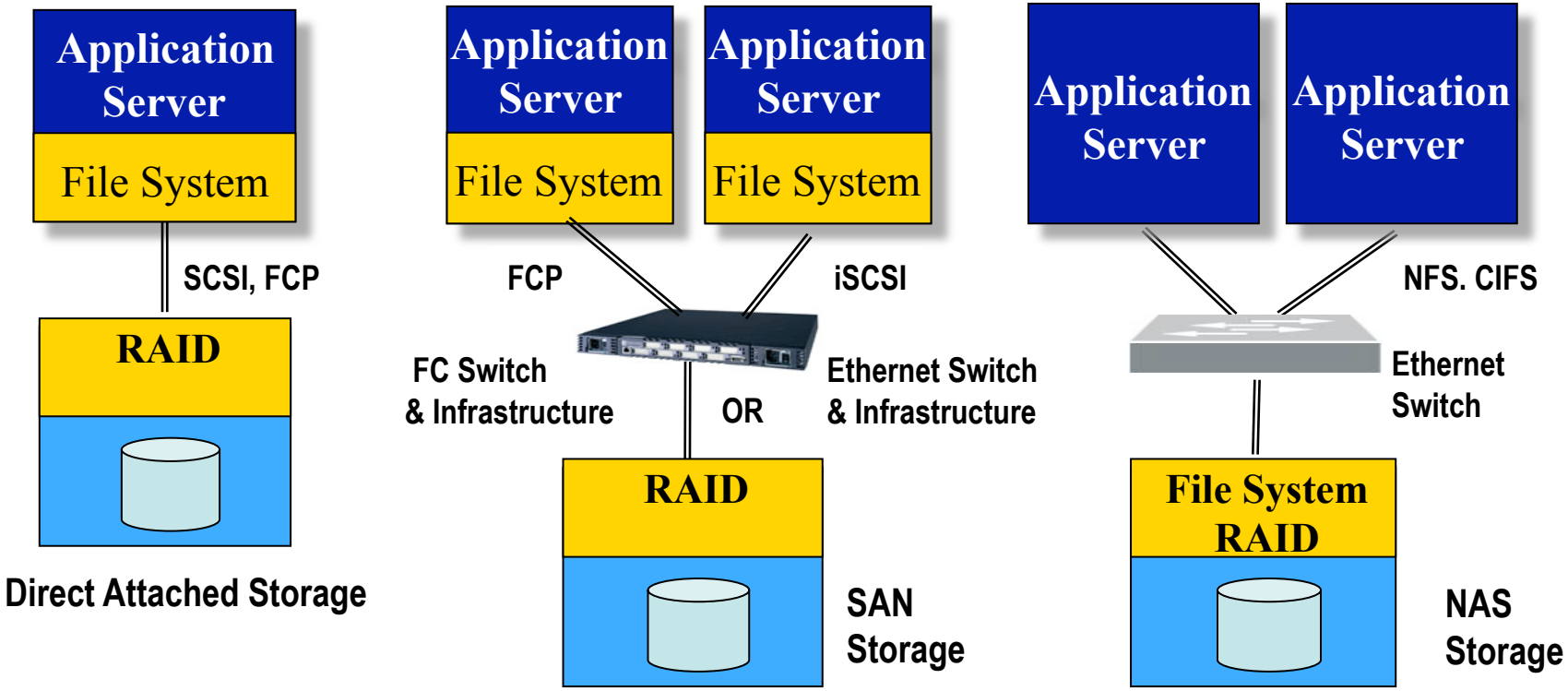
Storage Technologies



- Server-based data management
- No resource sharing
- No data sharing
- Works with all apps

- Server-based data management
- Resource sharing
- No data sharing
- Works with all apps

- Storage-based data management
- Resource sharing
- Data sharing
- Works with qualified apps

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What SANs Deliver

- Value of Storage Networking
  - Improved reliability and reduced cost of backup
  - Improved scalability of storage capacity and performance
  - Simplified storage provisioning
  - Improved data availability
- Top reasons for deploying a SAN
  - Back-up
  - Storage consolidation
  - Satisfy on-going demands for additional capacity
  - Performance
  - Disaster recovery
  - New project or application deployment

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What can FC provide today?

1. Flexible, Scalable relative to Topologies, Speed, Performance, Distance, Node connectivity and cost
2. Communication and Data Overhead (Framing, Data Communication, Latency, Efficiency, Routing Control, and Access Control),
3. Redundancy, Availability, and Failover,
4. Applicability in SAN with large IT User Base

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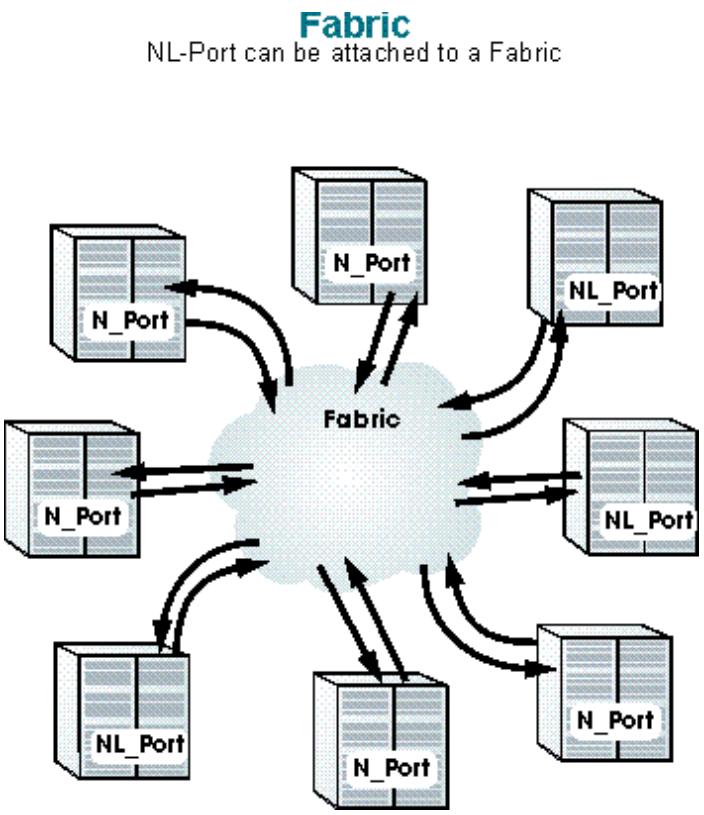
FC Topologies



Switched Fabric

Up to 2^24 ports in a switched interconnect

Multiple concurrent communications for high aggregate throughout

- **Fibre channel supports a 24-bit address space**
  - ✓Provides 2 ^24 addresses
  - ✓FC routing is done based on the **Domain ID portion of the NPort ID assigned on** login (24-bit addressing consisting of Domain ID, Area ID, and Device ID)
- **FC Device ports are uniquely identified by a WWPN (world wide port name or Identifier) Address lookup is provided by the Fabric Switch using the Name Server portion of Directory Services**

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Maximum Distance

Media Type	Transmitter	Speed	Distance	Variant
Electrical (Differential)	ECL/PECL	400 MB/s	0m – 10m (typical)	400-DF-EL-S
		200 MB/s	0m – 10m (typical)	200-DF-EL-S
		100 MB/s	0m – 30m (typical)	100-DF-EL-S
9 um. Single-Mode Fiber	1550 nm. Long wave Laser	400 MB/s	2m - >50km	400-SM-LL-V
		200 MB/s	2m - >50km	200-SM-LL-V
		100 MB/s	2m - >50km	100-SM-LL-V
	1300 nm. Long wave Laser	400 MB/s	2m - 2km	400-SM-LL-I
		200 MB/s	2m - 2km	200-SM-LL-I
		100 MB/s	2m - 10km	100-SM-LL-L
			2m - 2km	100-SM-LL-VI
50 um. Multi-Mode Fiber	850 nm. Short-wave Laser	400 MB/s	0.5m - 175m	400-M5-SN-I
		200 MB/s	0.5m - 300m	200-M5-SN-I
		100 MB/s	0.5m - 500m	100-M5-SN-I
62.5 um. Multi-Mode Fiber		400 MB/s	0.5m - 70m	400-M6-SN-I
		200 MB/s	0.5m - 150m	200-M6-SN-I
		100 MB/s	0.5m - 300m	100-M6-SN-I

- 2 Km distance with Multi- mode Fibre
- 10 Km distance with Single Mode Fibre
- 5000 Km distance with FC over IP

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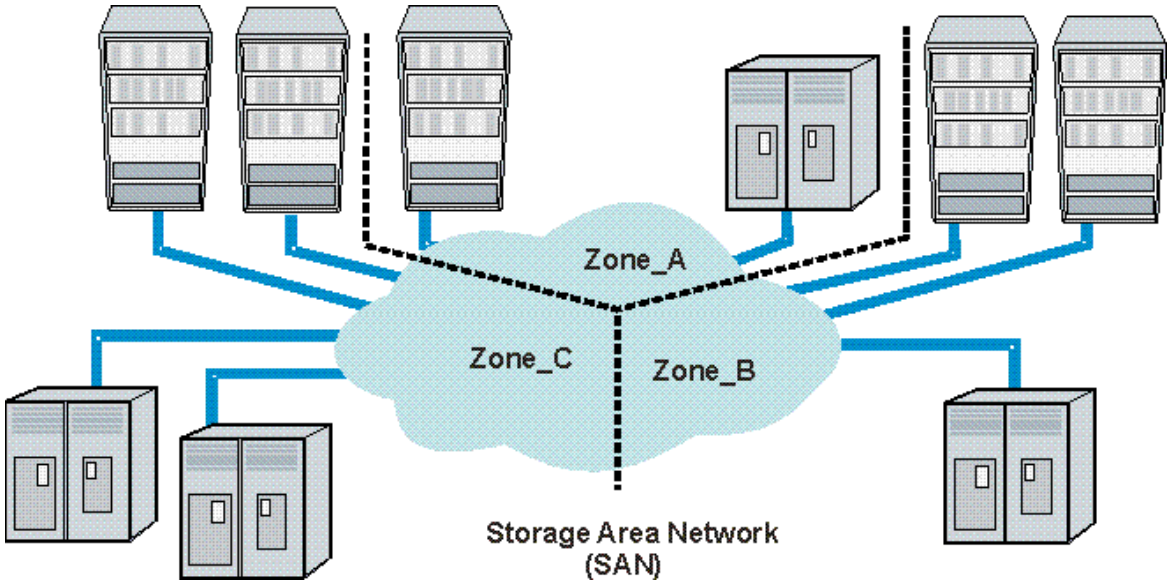
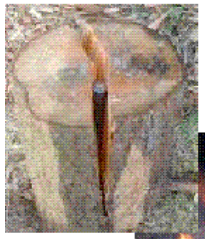
FC Access Control



Divide



and *conquer*

Provide Accessibility

Soft Zoning: Employs the Name Server to limit the information returned to an initiator in response to a query. Devices in the zone can be identified by World Wide Node Name, World Wide Port Name, or domain/ port of the switch the device is connected to.

Hard Zoning: Enforced by the Fabric. switches monitor the communications and block any frames that do not comply with the effective zone configuration. This blocking is performed at the transmit side of the port where the destination device is located.

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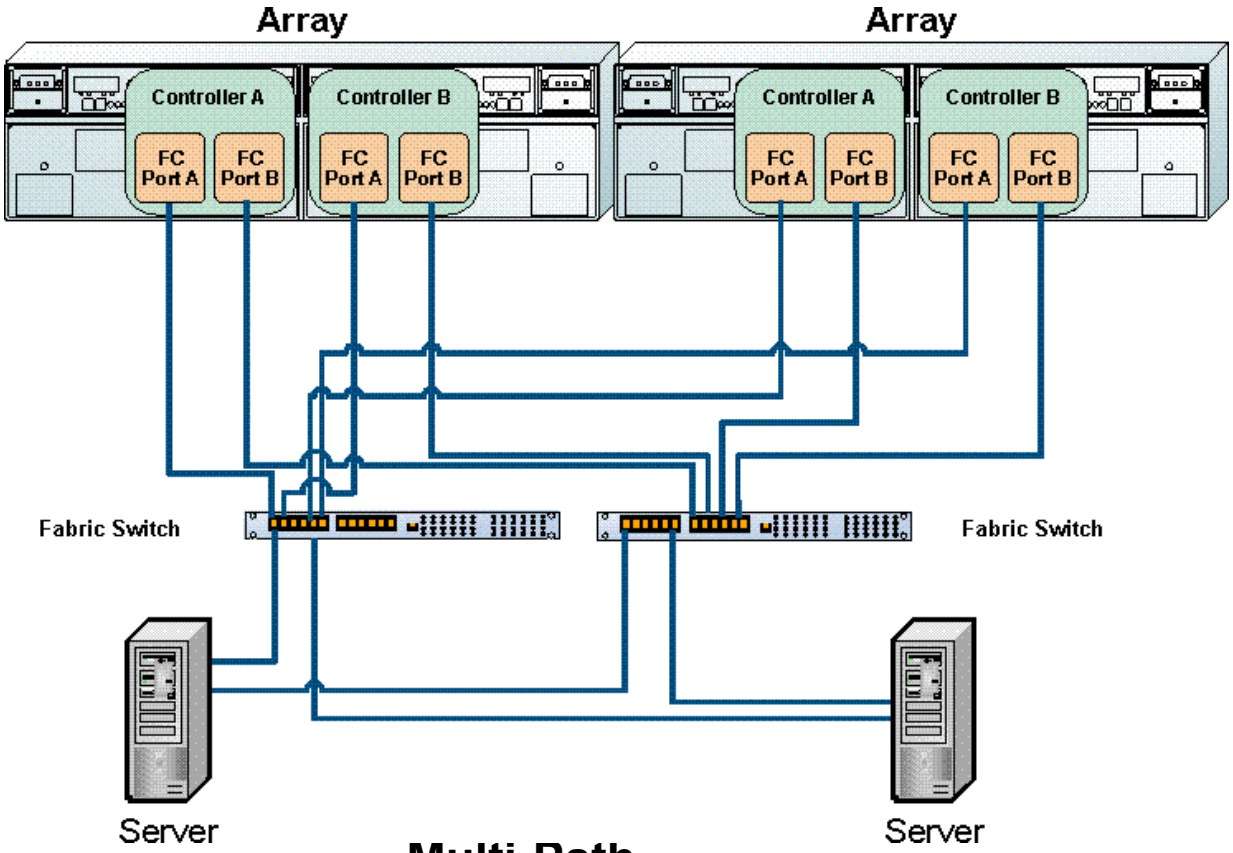
Redundancy, Availability, and Failover



- **Multi-Path**
- **Full Redundancy**
- **Path Failover**

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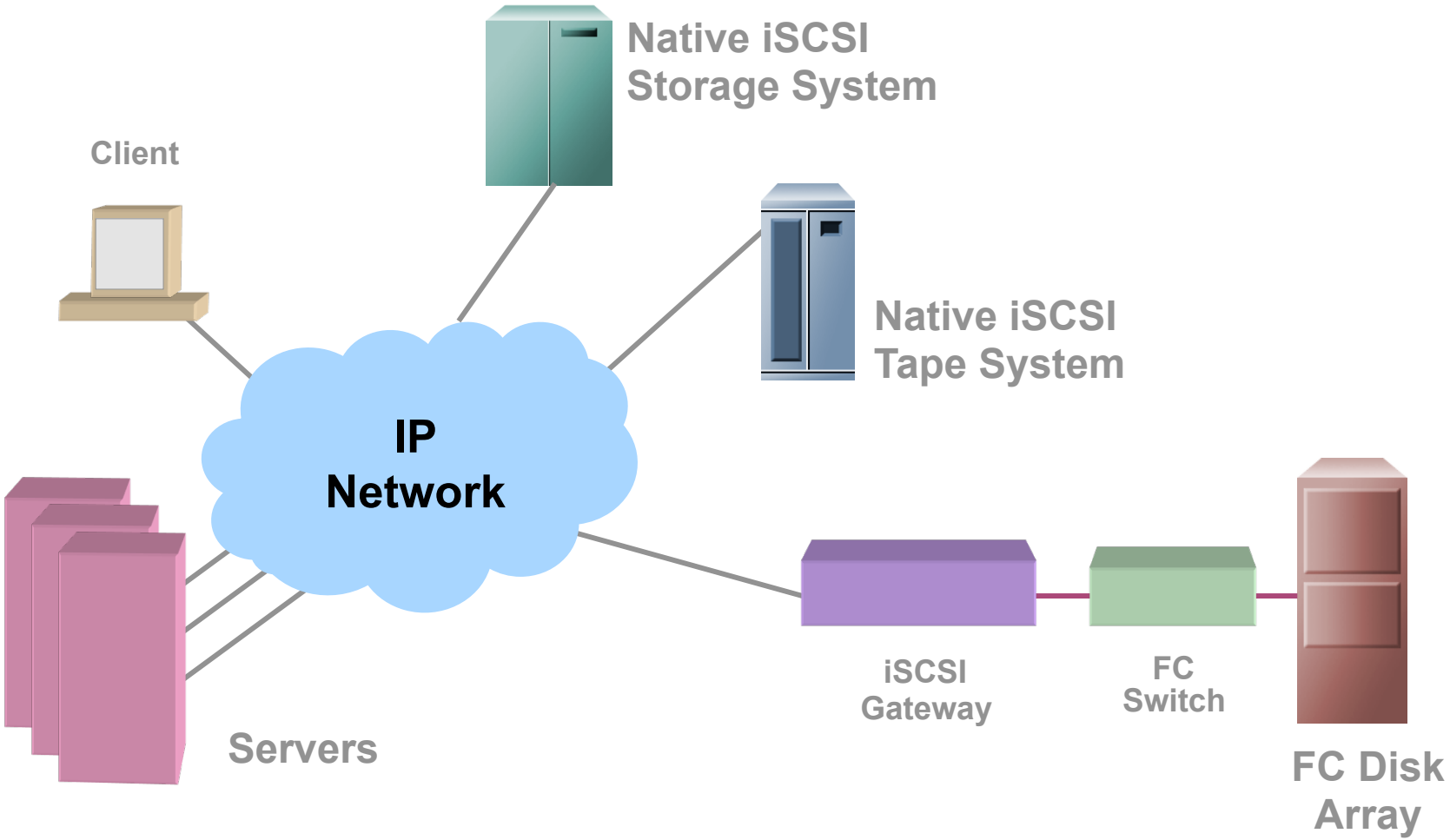
iSCSI SAN Options



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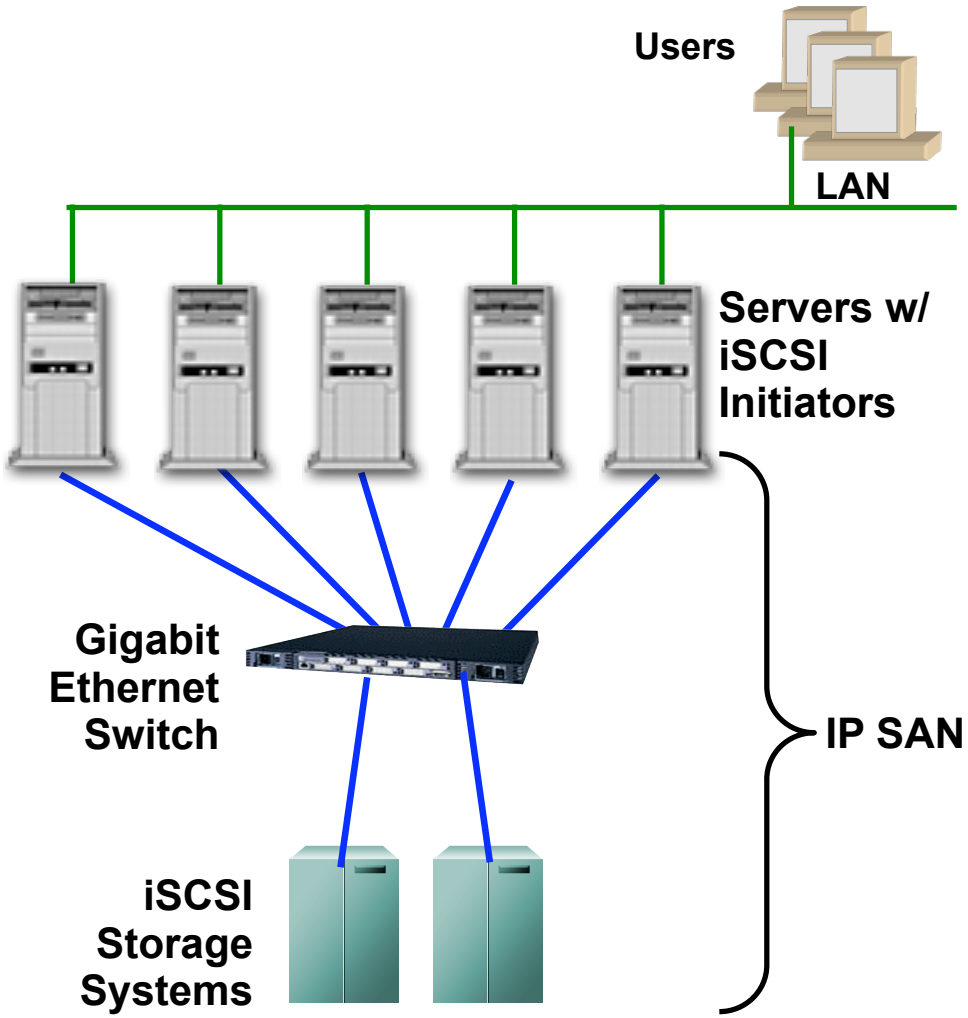
IP SAN Benefits



- Standard SAN storage
  - Block storage access
  - Supports all apps
  - Transparent migration from direct attached storage
- Lower TCO than FC
  - Zero host connection cost
  - Less costly infrastructure
  - Easier to manage
- Leverages IP Expertise
  - Expertise in existing staff
  - Robust well-understood management software
  - Easily enables remote integration of data assets

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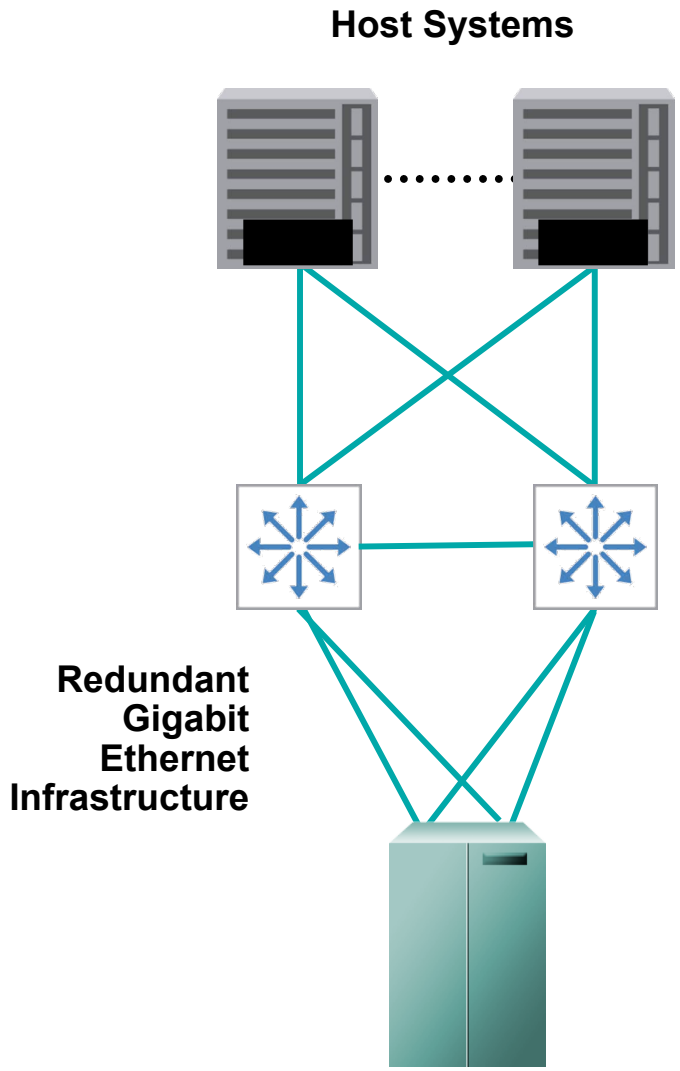
iSCSI Host Connectivity/Security



Connectivity:

- Gigabit Ethernet (10Gb emerging)
- Jumbo frames (recommended)
- Link aggregation (bandwidth)

Security:

- Host authentification (CHAP)
- Private network
  - Physical
  - VLAN (zoning)
- Array LUN masking
- Optional firewall
- Optional IPSec appliance

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IP SAN Host Support

OS	Initiator	Certified	Multi-pathing	Cluster
Windows Server System	Hardware, Software	☑	Trunking, MPIO, MCS	Yes
Sun microsystems	Hardware, Software	☑	Trunking, MPxIO	Yes
hp	Software	☑	PV Links	TBD
IBM	Software	☑	Trunking	TBD
redhat	Hardware, Software	☑	Trunking; MPIO	Yes
suse A NOVELL BUSINESS	Hardware, Software	☑	Trunking, MPIO	Yes
Novell NetWare	Software	☑	Trunking	Yes
vmware	Software	☑	Trunking	Yes

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I/O Performance Considerations

- Software iSCSI initiator + standard NIC
  - Host CPU overhead (up to 500MHz)
  - Low cost (free download)
  - Adequate for most mid-range applications
  - Most popular solution today (85% deployments)
- TCP Offload (TOE) NIC
  - Lower host CPU overhead
  - Uses OS-native iSCSI software initiator
- iSCSI HBA
  - Overhead similar to Fibre Channel HBA
  - Added services/options: boot from SAN, IPSec for security and Data Digest for higher data integrity

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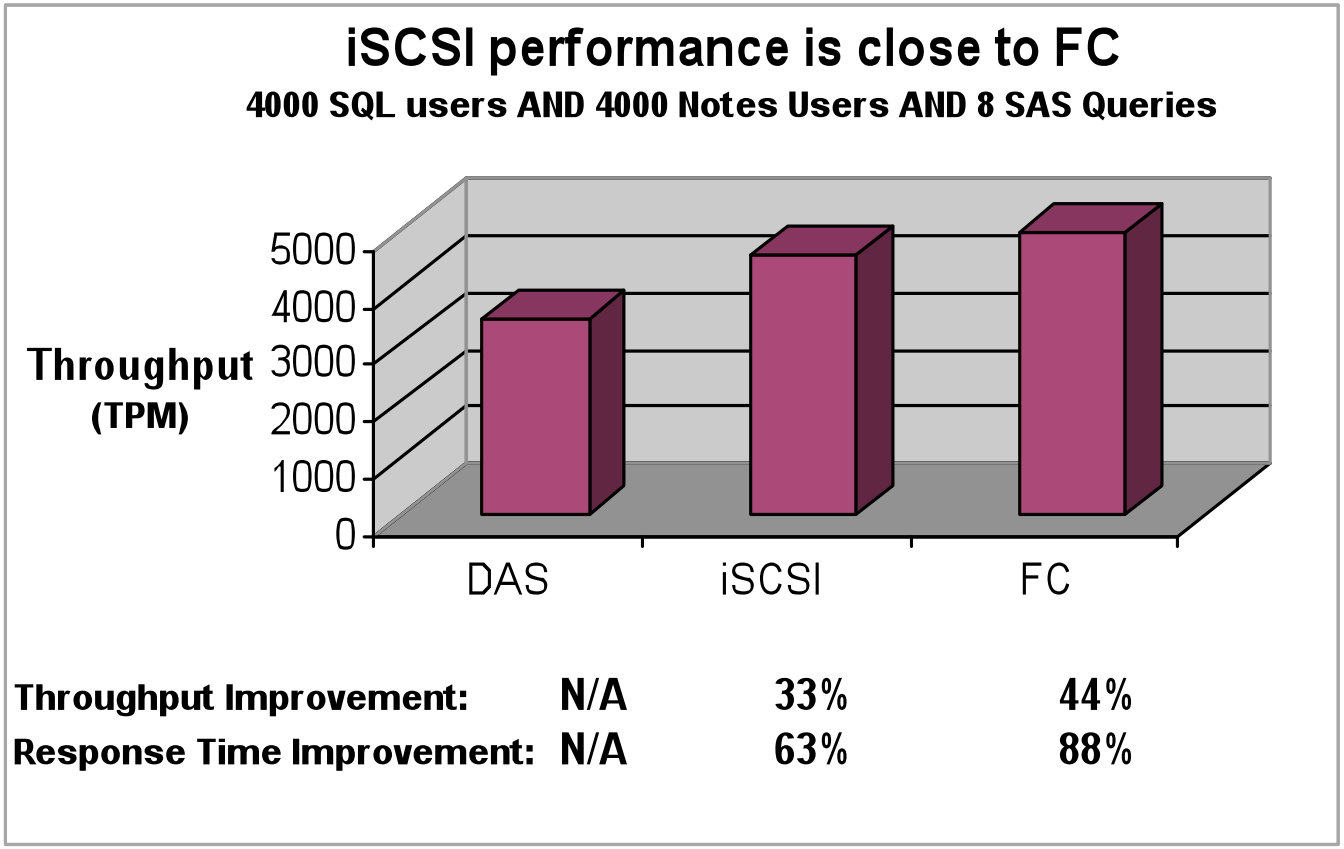
Application Performance

- Enterprise Strategy Group Validation study (4/04)



Throughput Improvement:	N/A	33%	44%
Response Time Improvement:	N/A	63%	88%

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Typical iSCSI Array Capabilities

- Basic storage considerations
  - Redundant components
  - Dual active controllers with failover
  - RAID
  - SATA drives; FC drives (often); SAS drives (emerging)
- Storage features
  - Point in time copies (Snapshot)
  - Network Boot
  - Multi-path I/O for High Availability
  - Remote data copy
  - Asynchronous mirroring for disaster recovery
- Growth/scalability/configurability
  - Capacity
  - Performance
  - Host integration

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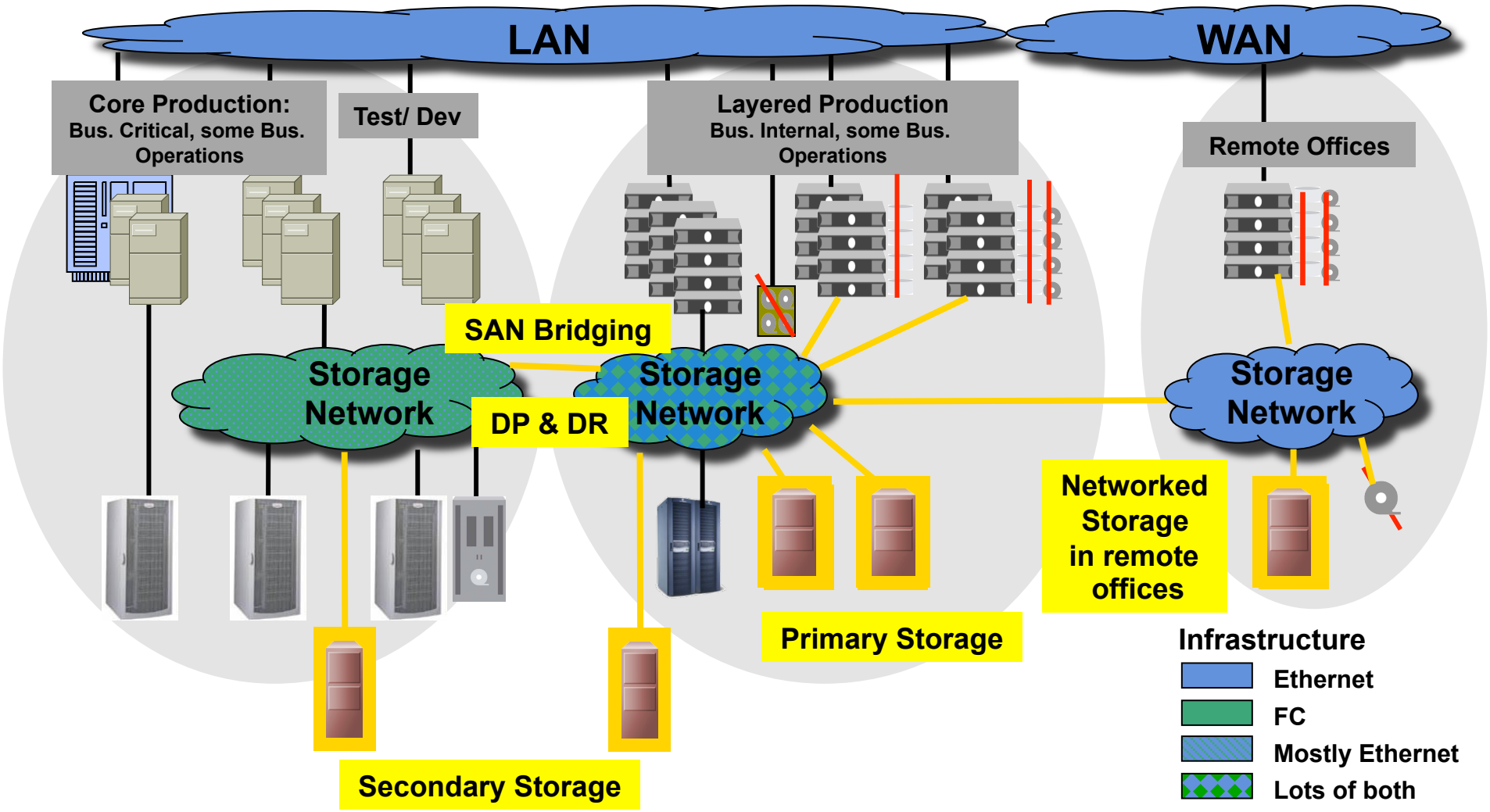
Where IP Storage Fits - Large Enterprise



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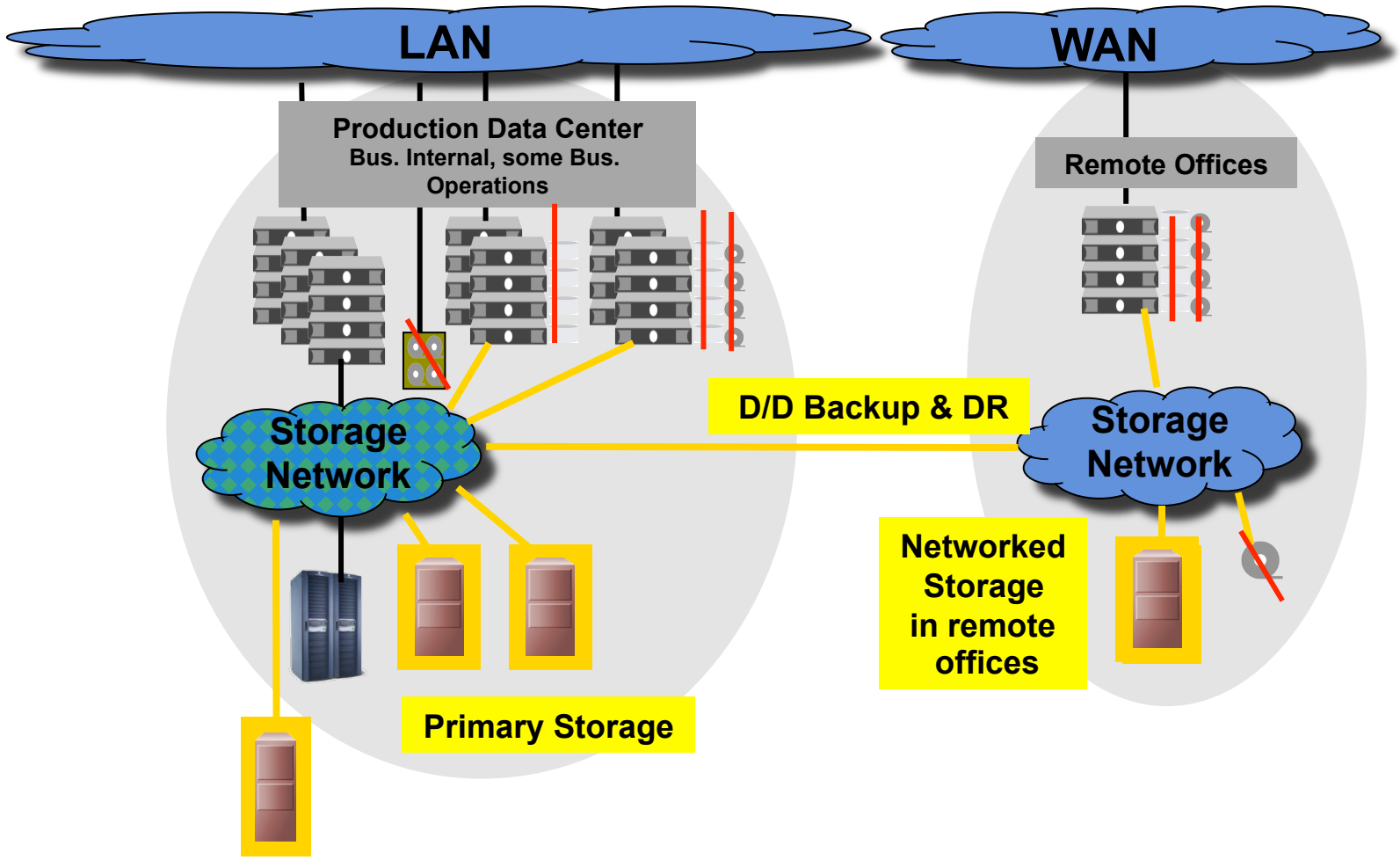
Where IP Storage Fits - Medium/Small Enterprise



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Fibre Channel Is Being Improved According To Real Customer Requirements

- New Fibre Channel Standards for
  - Management And Ease Of Use
  - Operational Flexibility and Scalability
  - Security

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Management Improvements

- **Fabric Device Management Interface**
  - HBA Information Can Be Retrieved From The Fabric
- **Fibre Channel Open Management**
  - SMI-S
  - SNMP MIB Development
- **Improvements to the Fabric Configuration Server**
  - Advanced Topology Discovery and Bulk Data Retrieval
- **Common Transport**
  - Session Semantics Have Been Added
- **Diagnostic Tools**
  - FC Trace Route and Ping

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Operational Flexibility

- **FAIS: Fabric Application Interface Specification**
  - Allows fabric to host certain applications
- **Event Server**
  - More Granular Event Registration
- **Virtual Channels**
  - Enables Traffic Differentiation On Links
- **Enhanced Commit Service**
  - Fabric Locking More Granular

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Operational Flexibility

- **Frame Tagging**
  - Enables Virtual Fabrics
- **Routing Architectures and Models**
  - Allows Devices On Distinct Fabrics To Communicate Without a Merge
- **FC-SATA: SATA Tunneling over FC**
  - Brings native tiered storage to FC
  - FC SATA: An FC-4 mapping of the Serial ATA storage interface protocol to Fibre Channel

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Operational Flexibility

What Is NPIV?

- Acronym for N-port ID virtualization.
- Additional attribute of an F-port.
- FLOGI request allocated the base PID 0xddaa00.
- FDISC(SID=0) requests allocate virtual PIDs: 0xddaa01, 0xddaa02, 0xddaa03 …
- Used by multiple virtual machines emulated on a physical machine.

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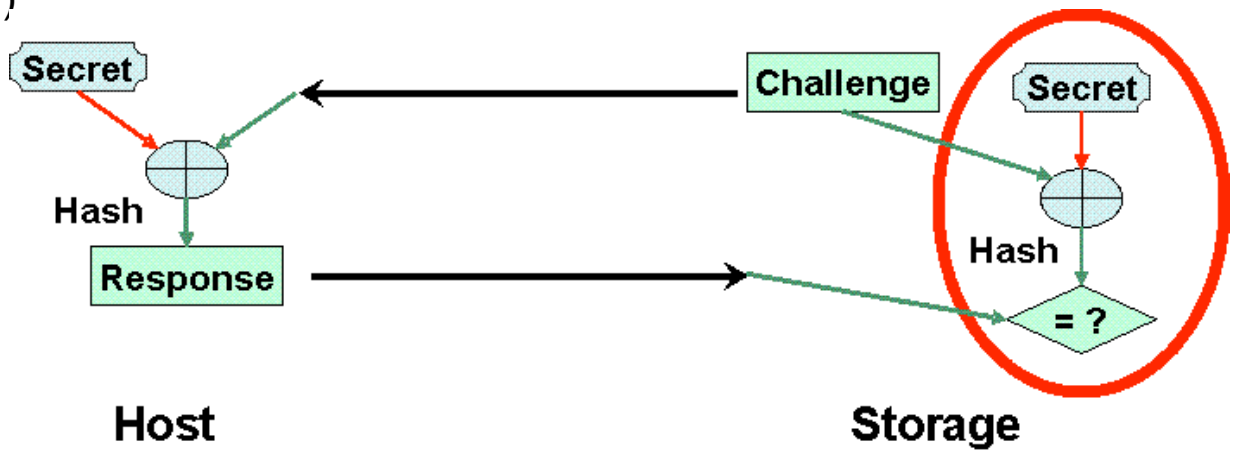
Security

- FC-SP Has Completed Letter Ballot and Will Soon Be A Standard
- Addresses
  - Infrastructure (Passwords, PKI, Secrets)
  - Authentication (FCAP, DH-CHAP, FCPAP)
  - Authorization (Security Policies)
  - Data Integrity (Hash, Keyed-Hash, Signatures, ESP)
  - Confidentiality (ESP)
  - Policy Distribution



Refer to SNIA FC-SP Tutorial

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FCIA "Condensed" Roadmap (Speed Gb/s)

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- **FC-Base2 (Edge, Backend, and ISL)**
  - *1GFC, 2GFC, 4GFC* shipping today
  - 8GFC Ships in 6-12 months
  - 16GFC, 32GFC, 64GFC, 128GFC
- **FC-Base10 (ISL)**
  - 10GFC shipping today
  - 20GFC ships in 6-12 months
  - 40GFC, 80GFC, 160GFC
    - 100GFC under study (leverage IEEE 802.3 work)
- **FC-BaseT (Edge)**
  - new 2006 standard for Ethernet RJ45 Cat5/6 copper)
  - 1GFC, 2GFC, 4GFCF, shipping today
  - 8GFC, 10GFC
    - 8GFC follows typical FC trend
    - 10G follows typical Ethernet trend

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IP Storage
What's New and Emerging

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- Mainstream iSCSI deployment in multi-OS host environments (Windows, Linux, Unix)
- Mainstream iSCSI deployment in virtual server environments (VMWare)
- Broad iSCSI deployment in small blade server environments
- iSCSI deployment in large grid (blade) scale-out environments with 10GbE backbone
- High performance environments with 10GbE
- New standards
  - FCoE
  - RDMA/10GE (DDR and RDMAP)
  - iSCSI Extensions for RDMA (iSER)

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10 Gb Ethernet Background

- High-speed networking solutions for LAN, MAN & WAN environments
- IEEE 802.3ae ratified 2002
  - Supports all layer 2, 3 and higher network services
- Optical and copper physical media supported
  - 10GBASE-E, 10GBASE-L, 10GBASE-S
  - 10GBASE-CX4; 10GBASE-T
- Requirements for proliferation
  - Affordable Price
  - Server architecture support
  - Standard TOE-supporting software architecture
  - Affordable TOE hardware

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10 Gb Ethernet Today

- Deployment/applications
  - MAN connectivity
  - SONET alternative in MAN
  - Backbone and port aggregation for 1Gb LANs
    - Driven by acceleration in 1Gb deployment over past 4 years
  - Storage over 10GbE
- Pricing
  - Greatly reduced pricing over past 4 years
  - Cost effective aggregation alternative to 10x 1Gb (2007)
- Architecture and System Support
  - High-speed I/O (PCI-X and PCI-express) now mainstream
  - Defacto standard software TOE support with “TCP Chimney”
  - 10Gb Ethernet connections available for storage products

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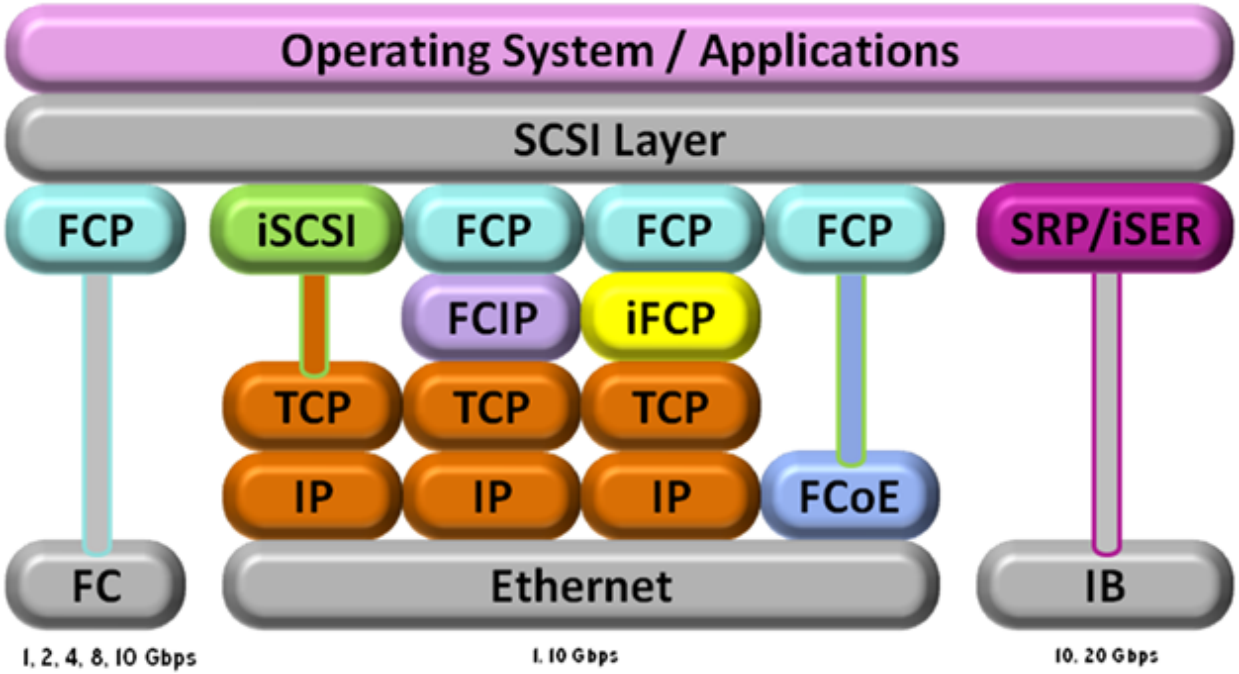
Fibre Channel over Ethernet (FCoE)



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Summary

- SAN solutions now have a broader range of appllcation and affordability than ever before
- Fibre Channel delivers sophisticated SAN solutions for Tier 1 and Tier 2 enterprise data centers
- iSCSI enables sophisticated SAN solutions for Tier 2 and Tier 3 enterprise data centers, and for Small/Medium enterprises
- Fibre Channel has an aggressive roadmap, addressing performance, manageability, operational flexibility and security
- iSCSI is rapidly expanding beyond the Windows storage consolidation market into heterogeneous, virtual server, blade and high performance environments
- 10Gb Ethernet is increasingly expected to play a major role for storage in the data center

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