



EDUCATION

Storage Network Infrastructure Design - Availability and Performance

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Abstract

- This session addresses those seeking an understanding of the concepts involved in designing a robust SAN. We will delve into different levels of complexity involved in designing a SAN, including issues such as fault tolerance and performance considerations throughout the SAN.
- The audience will leave with the ability to intelligently discuss the terms and concepts introduced during the session and make use of them to ensure their SANs are properly configured for their application and environment.

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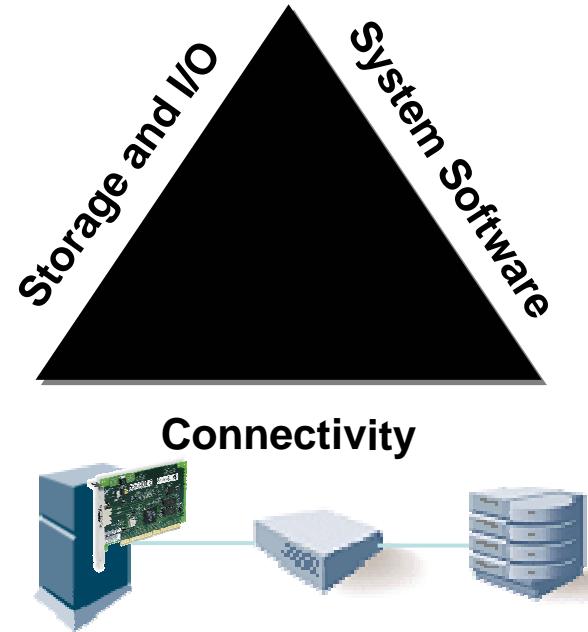
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Agenda

- Storage Network Design Overview
 - SAN Infrastructure Design
- Storage Network Infrastructure Design
 - Entry-level SANs
 - High performance and highly available SANs
 - Extended Distance SANs
 - Tools
- Summary
- Q&A / Feedback

SAN Infrastructure Design

- Connectivity Infrastructure
 - Networks, buses
 - Physical and logical connectivity elements
- Storage & I/O Infrastructure
 - Devices/subsystems
 - HBAs, NICs
 - Hubs, Switches & Directors
 - Routers, Gateways & Bridges
- System Software Infrastructure
 - File systems
 - Volume managers
 - Management software

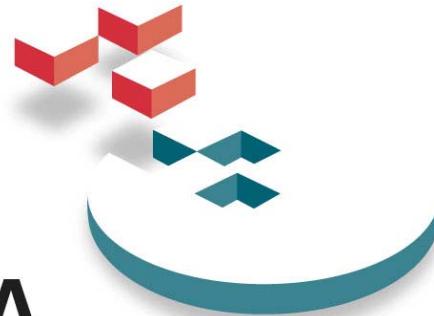


Availability for SANs

- First and foremost
 - Decide **WHAT** needs protection
 - Data is always the highest priority
 - Is the application really business-critical?
 - Determine how long an application can afford to be offline
 - Determine how many 9's of availability you really need
 - Can the application take advantage of high availability?
 - Can the storage being used provide these capabilities?
- Increased availability adds complexity – and cost
 - HBAs, Switches, Storage Systems
 - Application- and OS-specific components

Performance for SANs

- Performance Measures for SANs
 - Bandwidth
 - Latency and deterministic network behavior
 - Scalability
 - Quality of Service
- Tools



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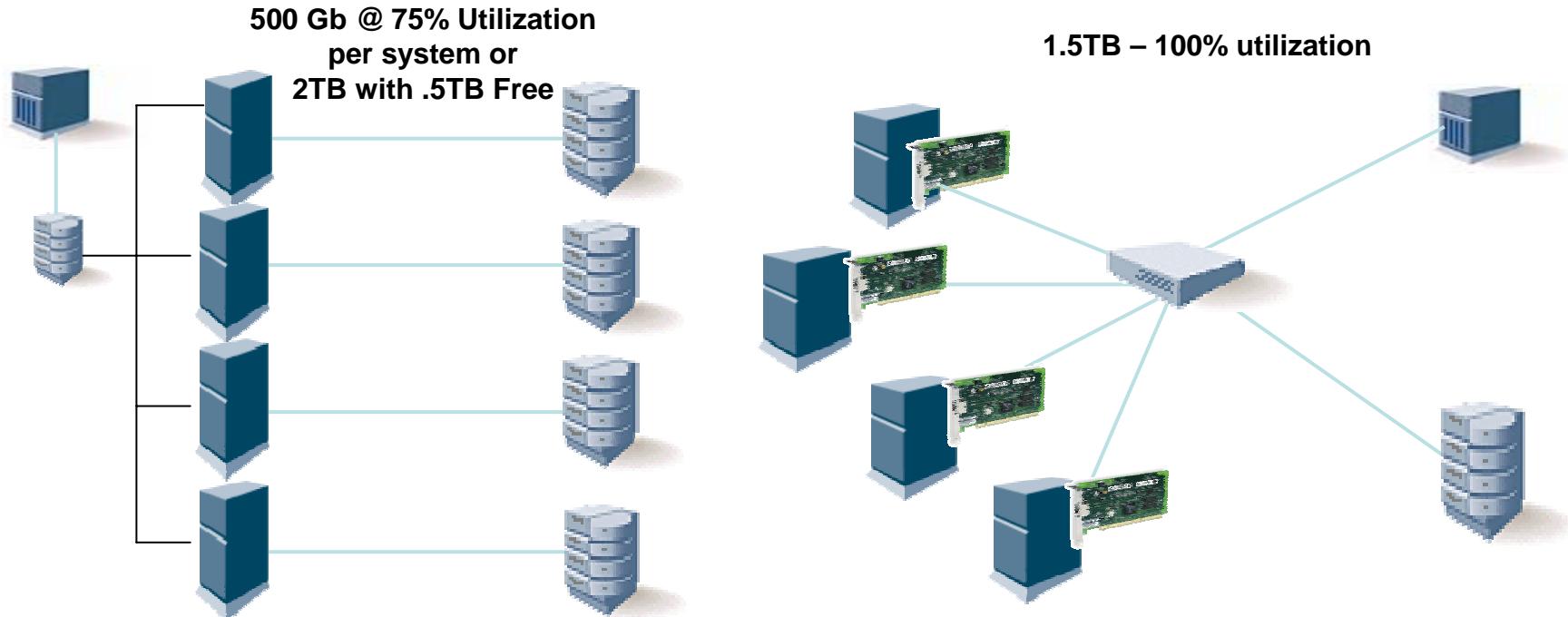
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Entry-level SANs

Storage Network Infrastructure Design Availability and Performance

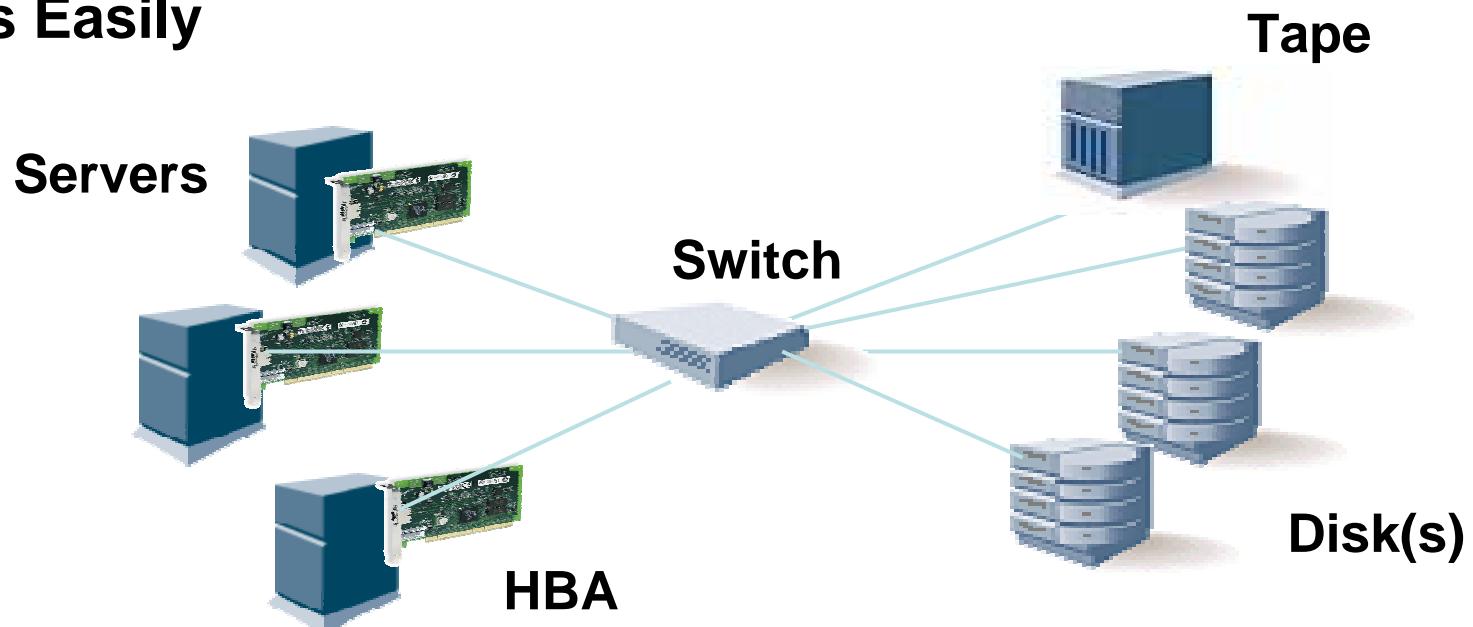
Solution - Storage Consolidation



- Multiple Servers use a single pool of disk and tape
 - Easier to manage (storage is centralized)
 - Less free disk space required

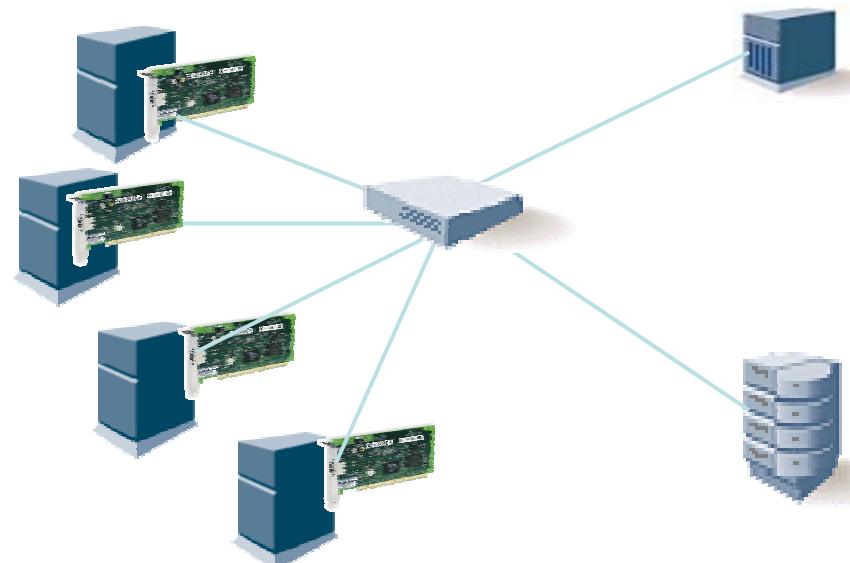
Solution - Backup/Restore

- Increase Performance
- Device Sharing
- Scales Easily



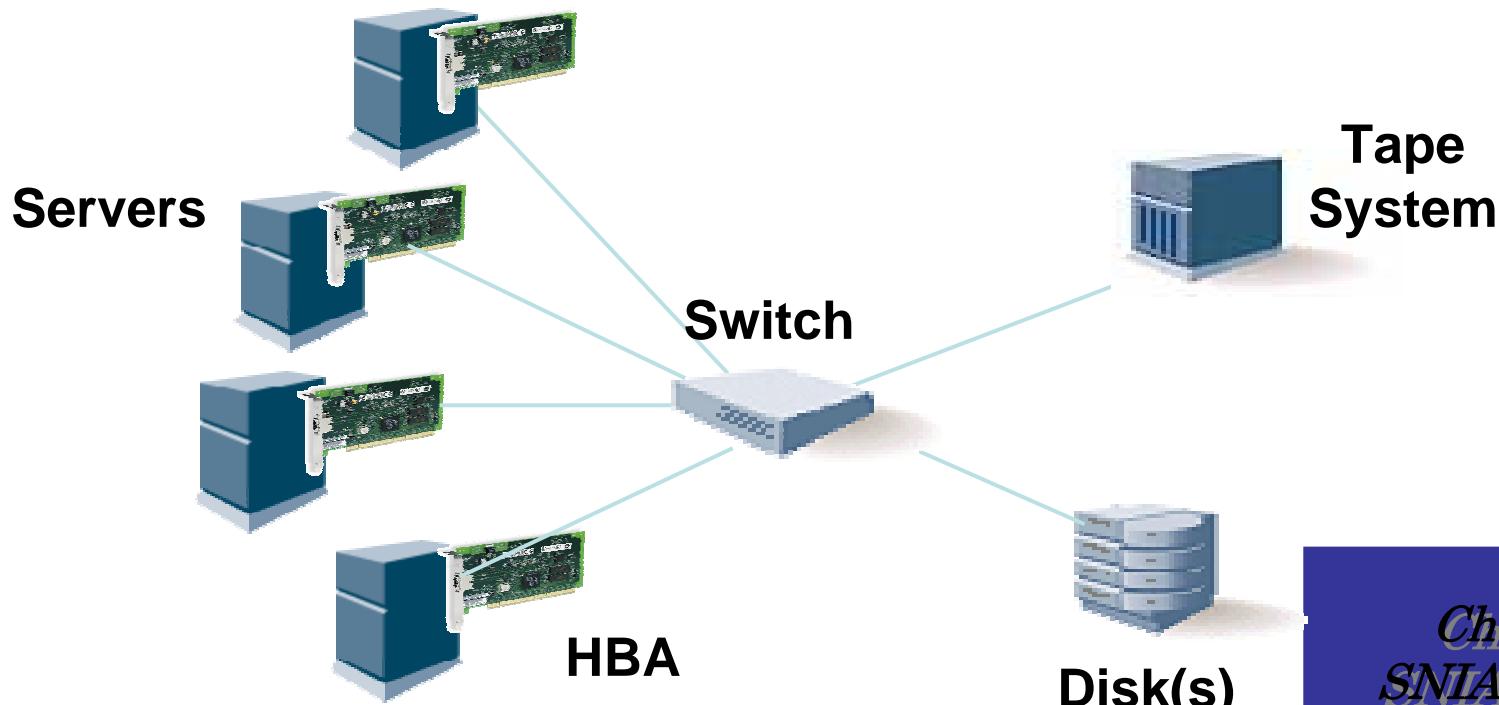
Availability – Entry Level

- Still need to protect the data
 - Backup / Restore
 - RAID
- Redundant components help
 - Fans
 - Power supplies
 - Clustering
 - HA Switches
 - Backup switches



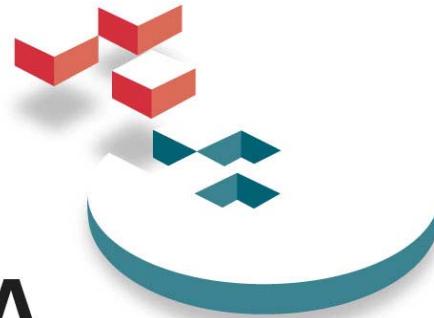
Bandwidth – Entry Level

- Consider fan-in /fan-out ratio
- Selection of device depends on bandwidth needs



*Check out
SNIA Tutorial:
Networking for
Storage
Professionals*





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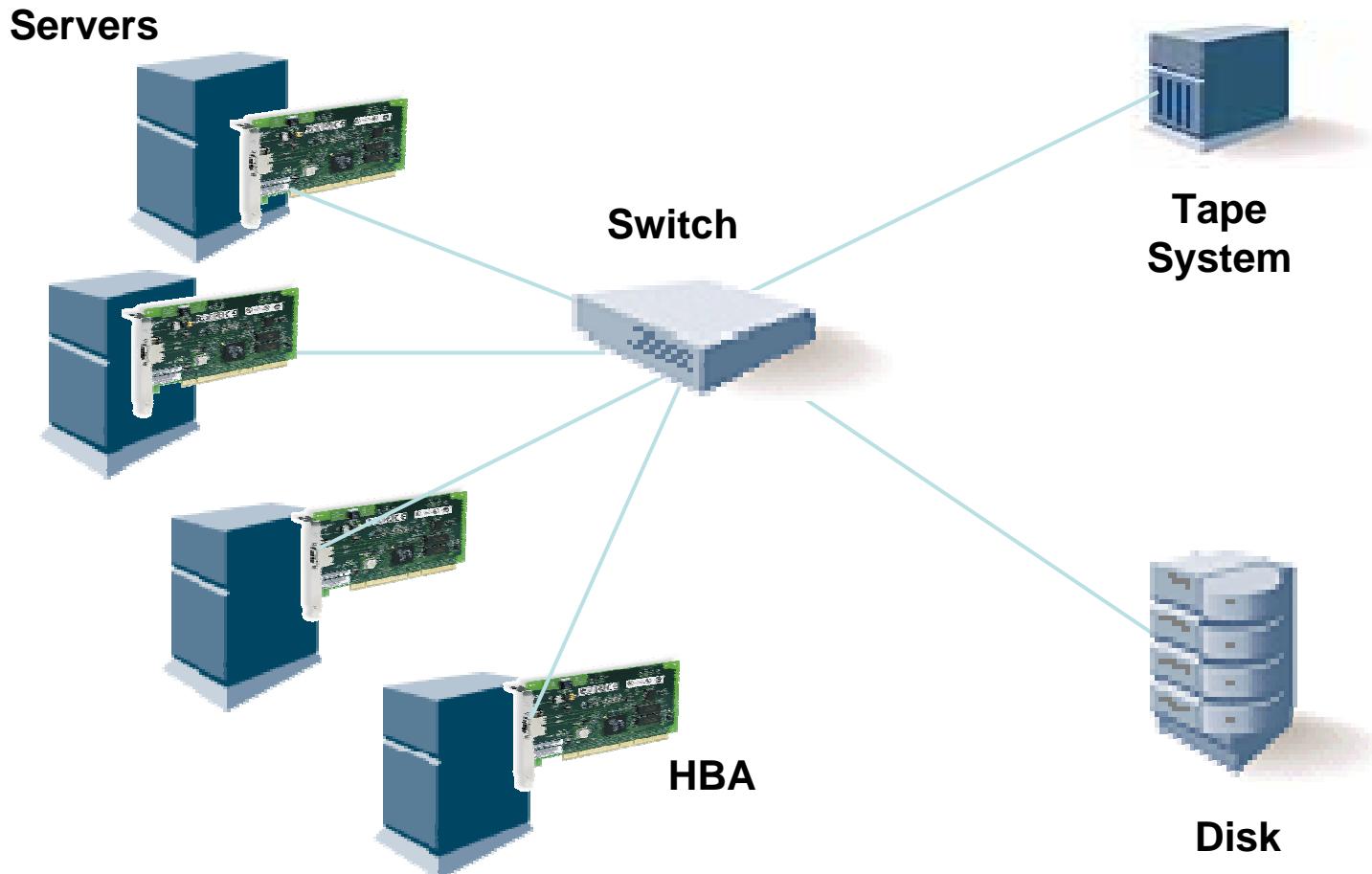
High Performance and Highly Available SANs

Storage Network
Infrastructure Design
Availability and Performance

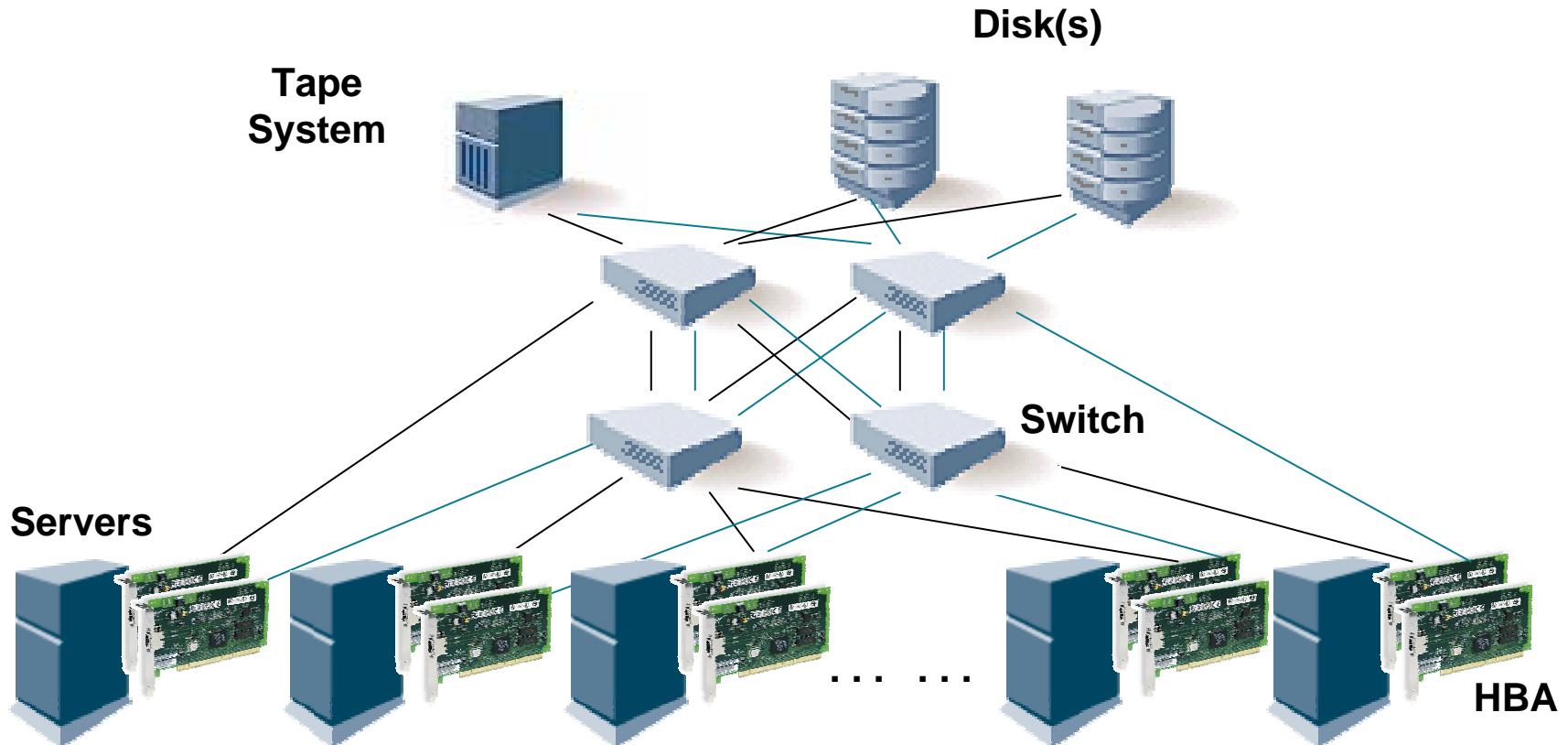
Definition

- Support multiple applications
- Support multiple platforms
- Highly available
 - May impact multiple areas in a company
 - OLTP systems
- May have high bandwidth and low latency needs
 - Applications such as video edition, CAD, or defense application

Before – Entry Level SAN

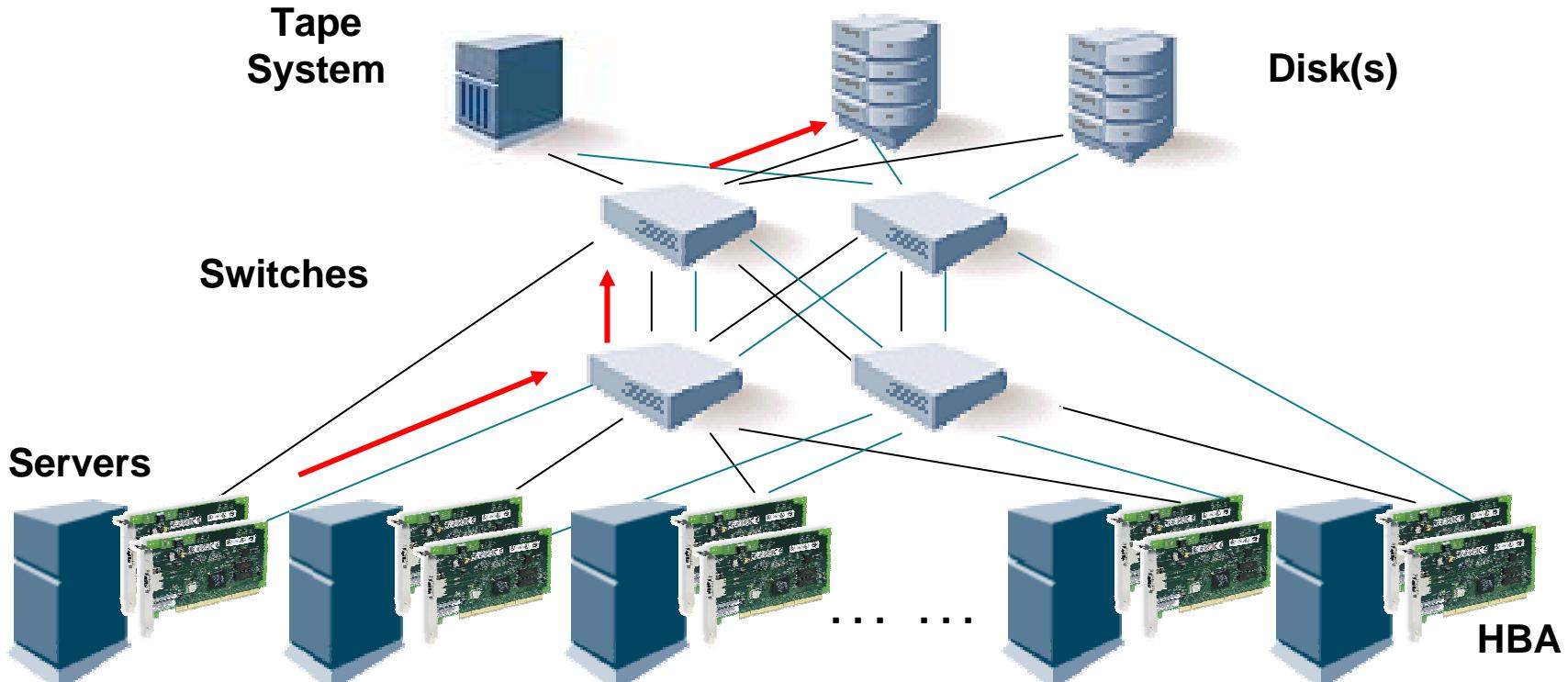


After – High Performance and Highly Available SAN



Bandwidth – High Performance and Highly Available SAN

- Design for specific application needs – consider QoS
- Make sure ISLs are not bottle necks

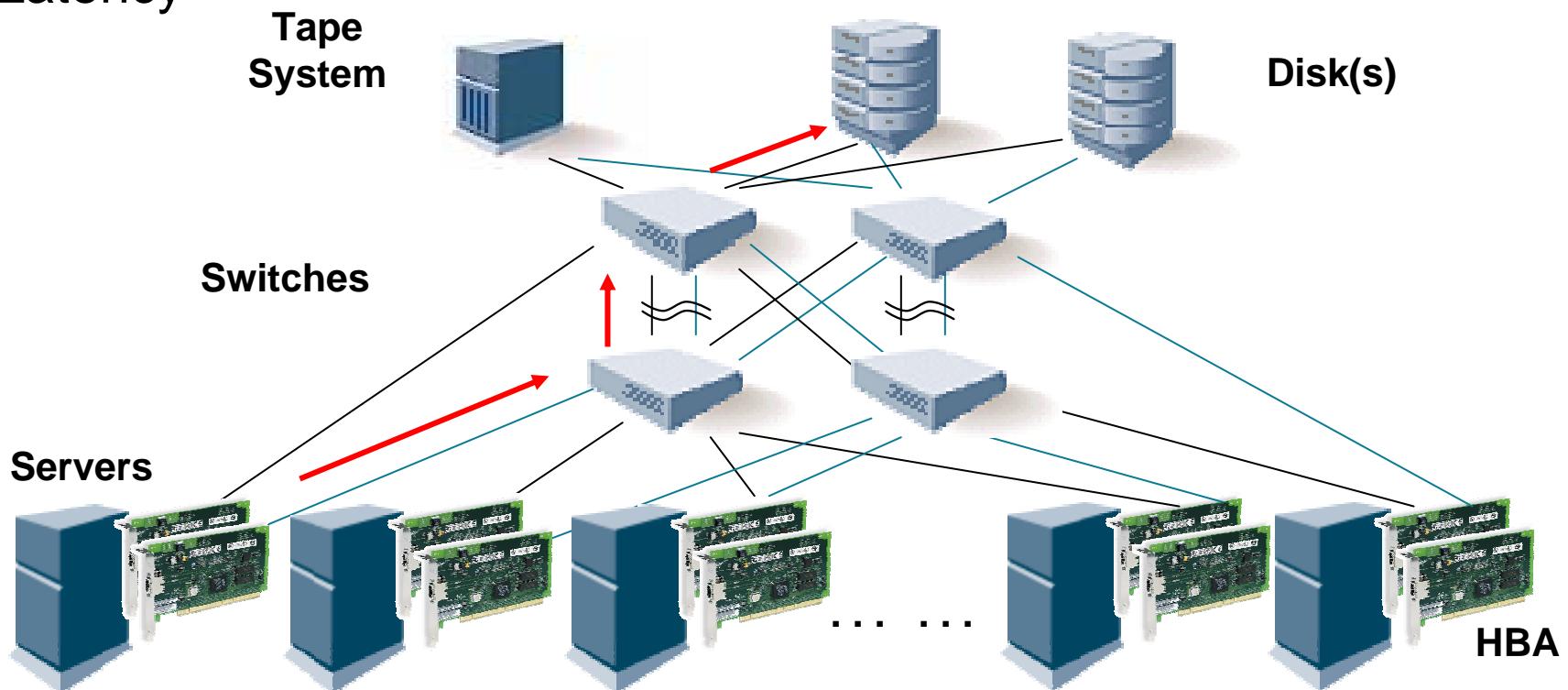


Latency

- Latency introduced:
 - Distance Latency
 - Equipment Latency
 - Retransmission Latency
 - Congestion
- Some applications are very sensitive to latency
 - Minimize through design
 - Minimize through management

Latency

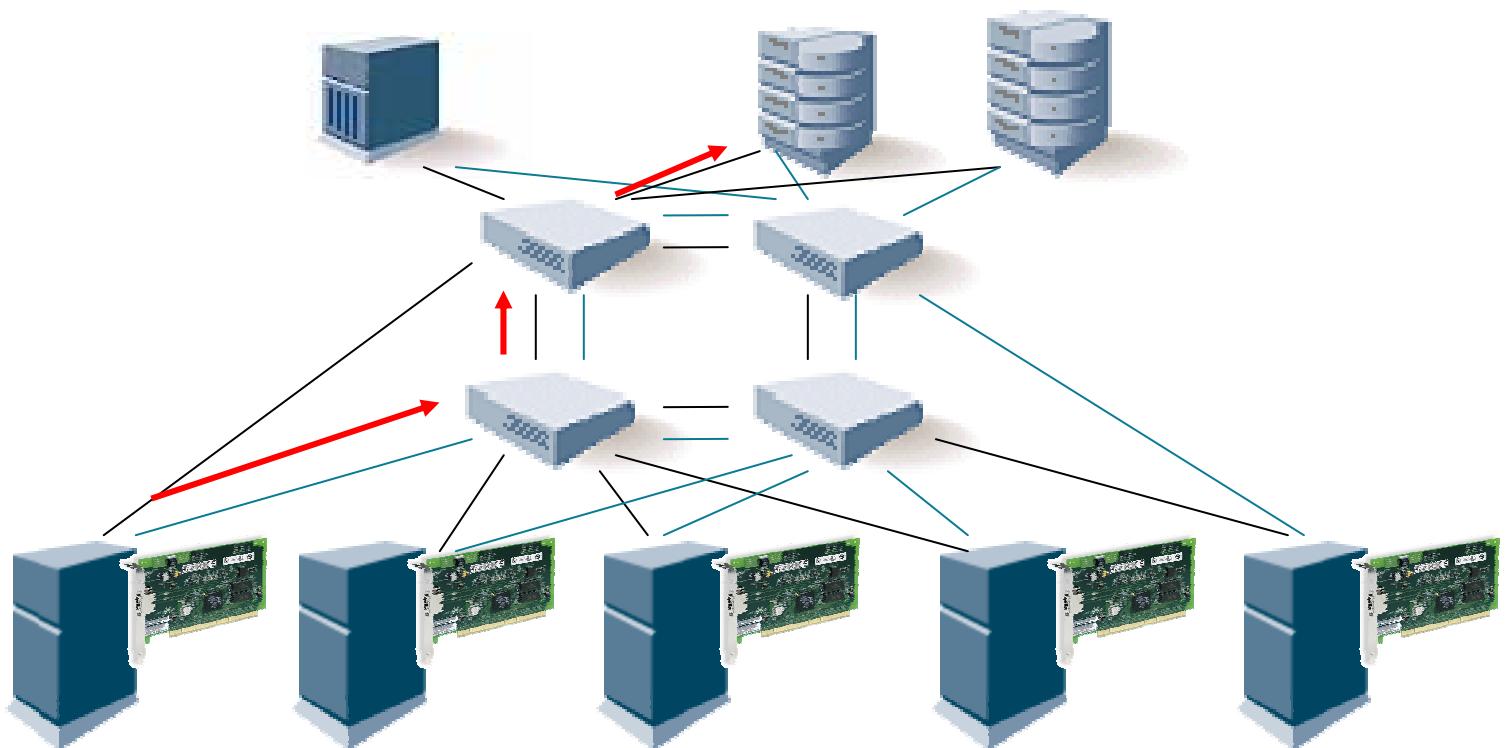
Distance Latency



Latency

Distance + Equipment Latency

Retransmission
Latency



Availability – High Performance and Highly Available SAN

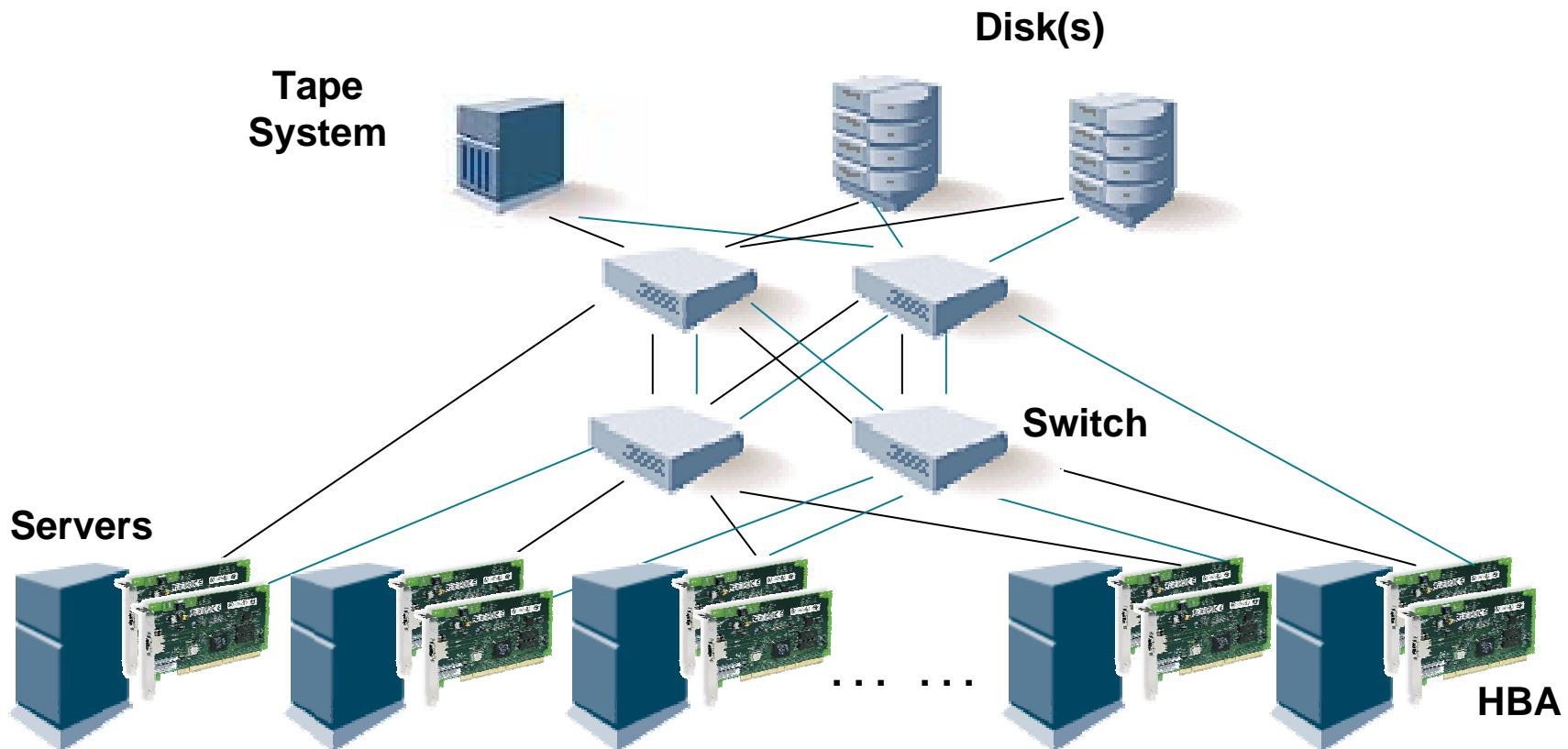


- Focus on the important pieces of data
- Redundancy adds cost
- Ensure no single point of failure exists in critical applications
- Understand single points of failure and their impact for less critical applications
- Should consider performance as well

Types of Multipathing

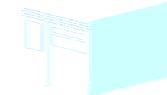
- Types of Failover
 - Clustering
 - By LUN or Volume
 - By Path
 - By Controller
 - By Channel
- Types of Load Balancing
 - Round Robin
 - Least Busy
 - Least Data
 - Data Striping
- Trunking

Availability -Multipathing



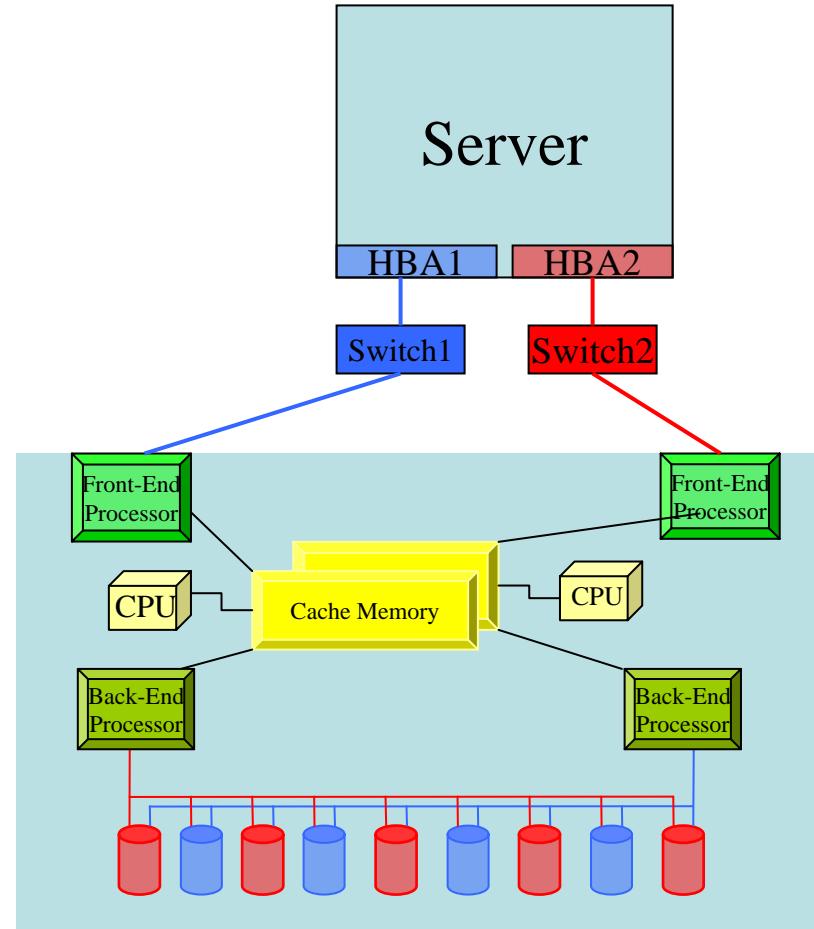
Types of External Storage

- NAS
 - Same basic principles apply
 - Can use existing IP network principles
- JBOD
 - Low cost
 - Requires additional components for high availability
- Storage Systems
 - Modular
 - Monolithic



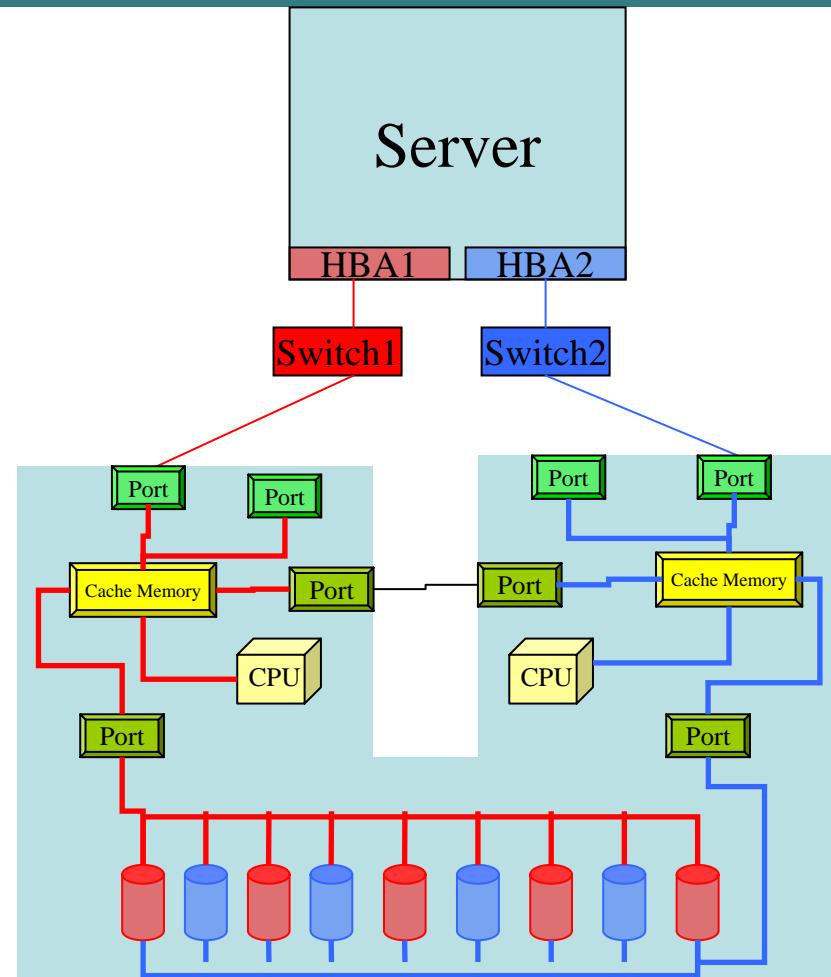
Monolithic Storage

- Large high performance controllers
- Cache-Centric
- Appear as a single logical image
- Many connection points
- Enables easy load balancing



Modular Storage

- Simpler high performance controllers
- Fewer connection points available
- Requires both load balancing and failover



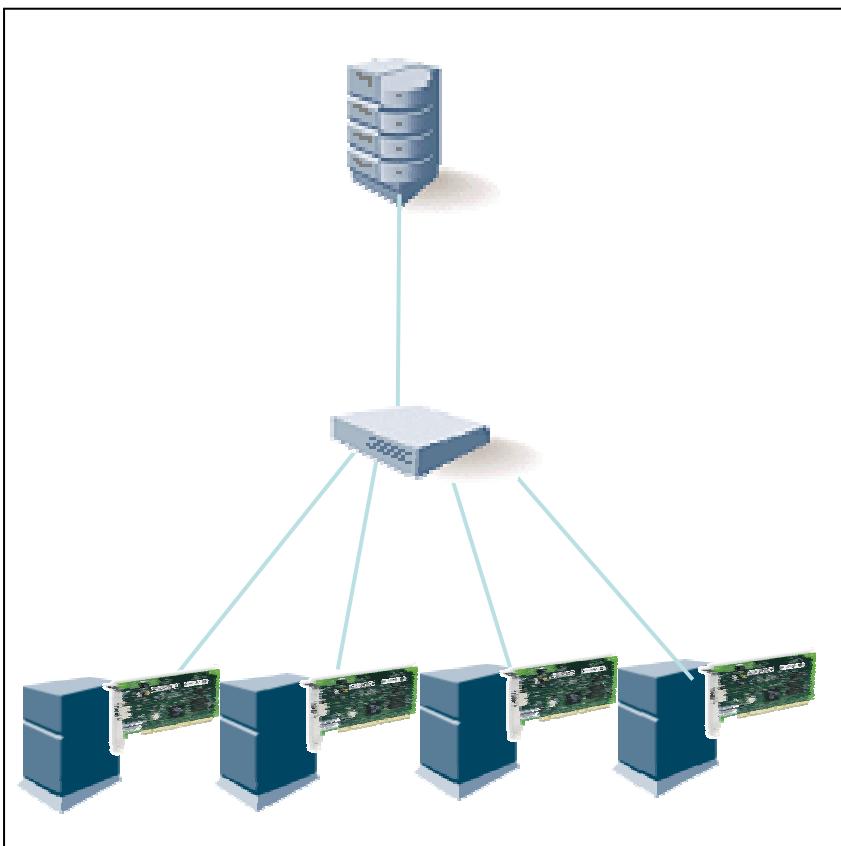
Scalability & Management

- How large can I grow my SAN? Consider:
 - Physical limits
 - Performance
 - Manageability
- As SANs grow
 - More devices, different applications
 - Difficult to form full picture of utilization
 - Difficulty identifying where the bottlenecks are
- What are other options besides extending the fabric
 - Building SAN islands

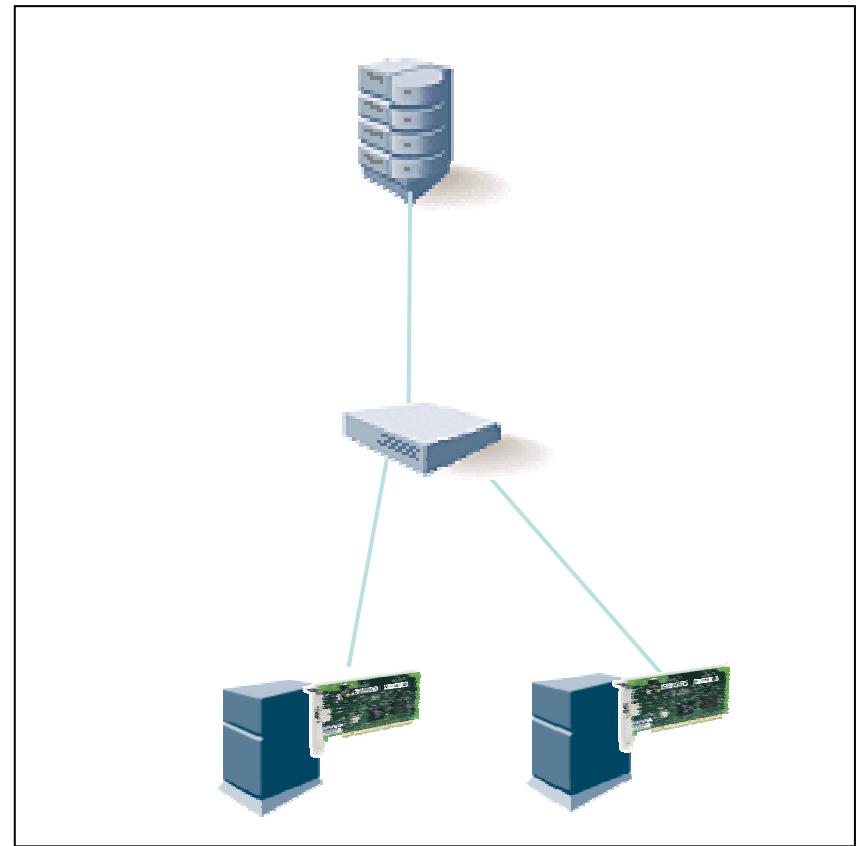


SAN Islands

SAN Island 1



SAN Island 2

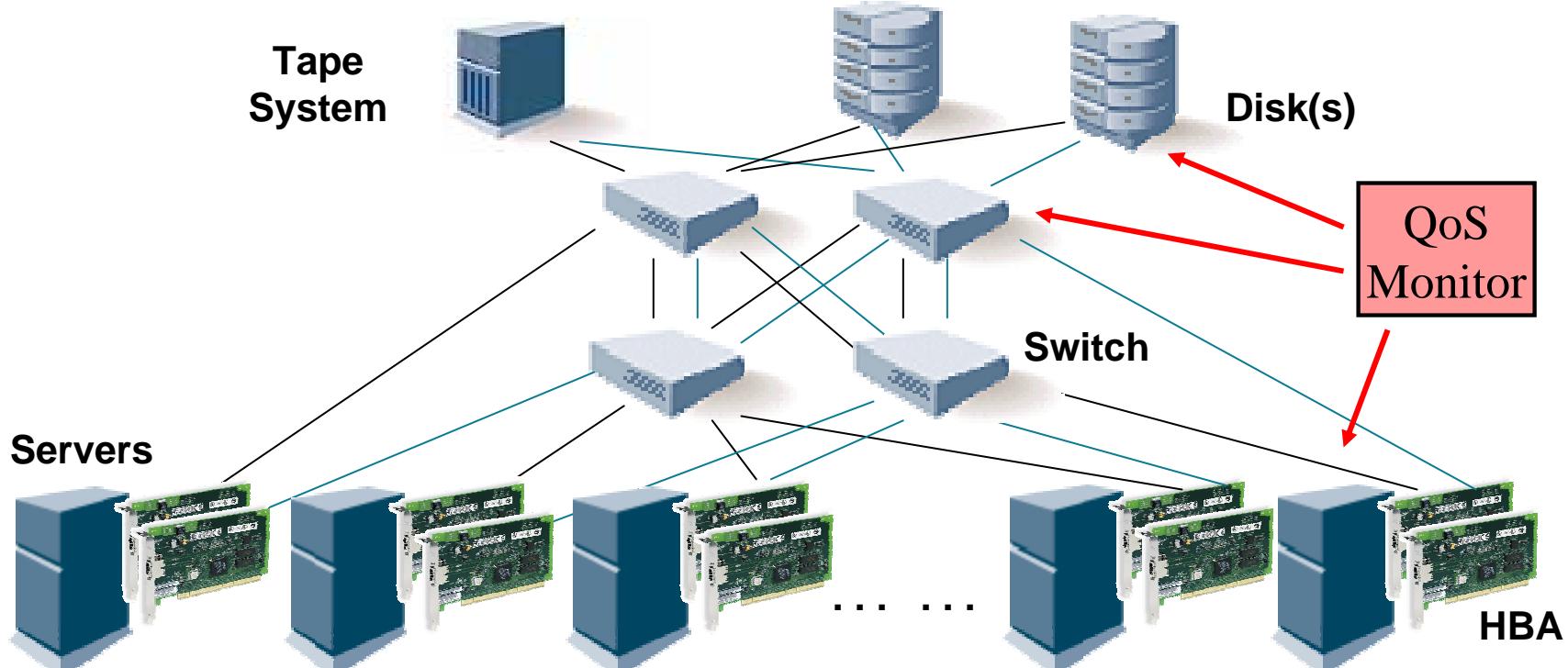


Quality of Service

- Why Quality of Service
- SLAs and QoS
 - Avg/Min/Max bandwidth
 - Avg/Max latency
 - By application
 - By devices (initiator and target pairs)
- Different ways of managing QoS
 - In-band/out of monitoring/management tools
 - Intelligent fabrics

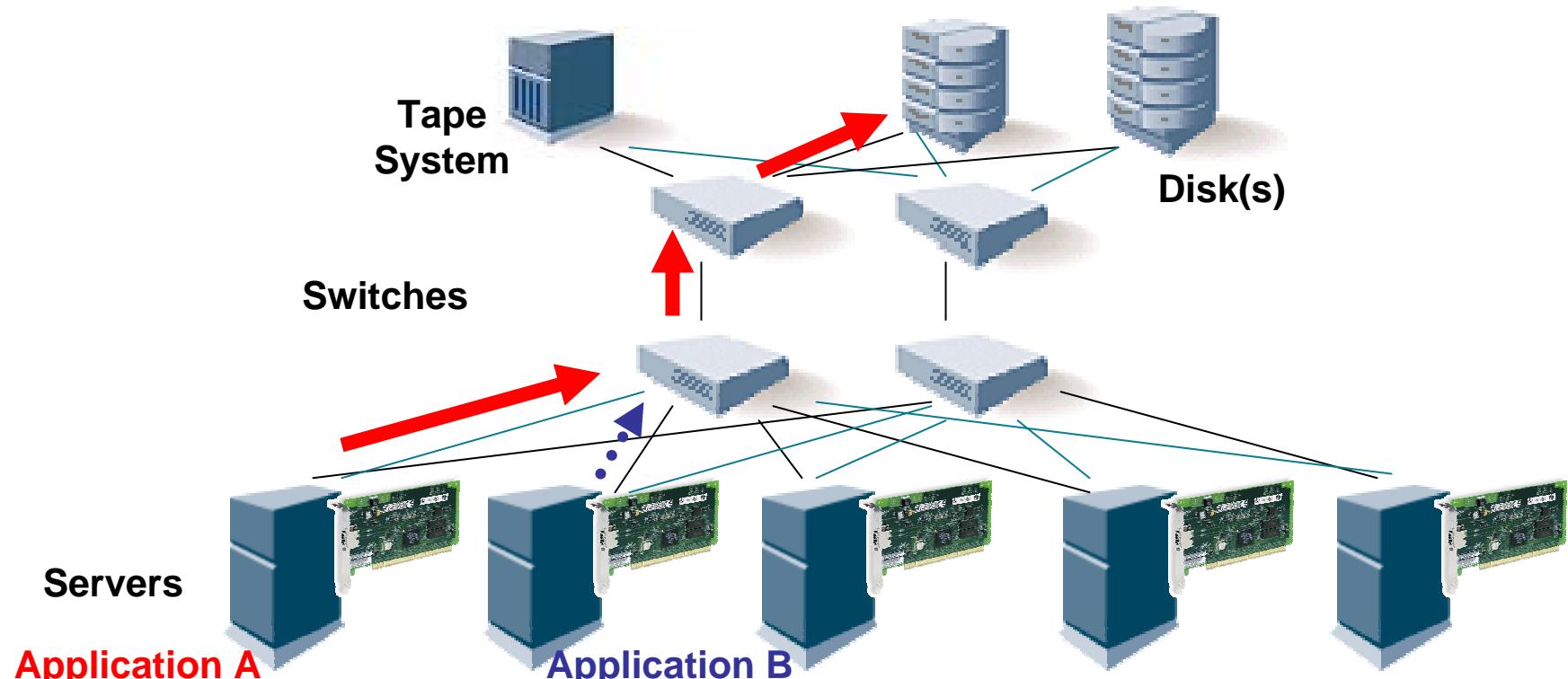
Implementing QoS - Monitoring

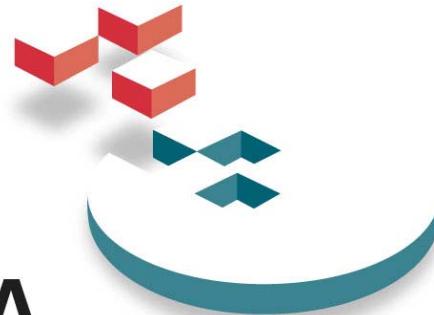
- Monitoring thresholds across the fabric
 - Signal alarms when thresholds crossed
 - Proactively make adjustments



Implementing QoS - Fabric

- Policy can be set to prefer one application over another





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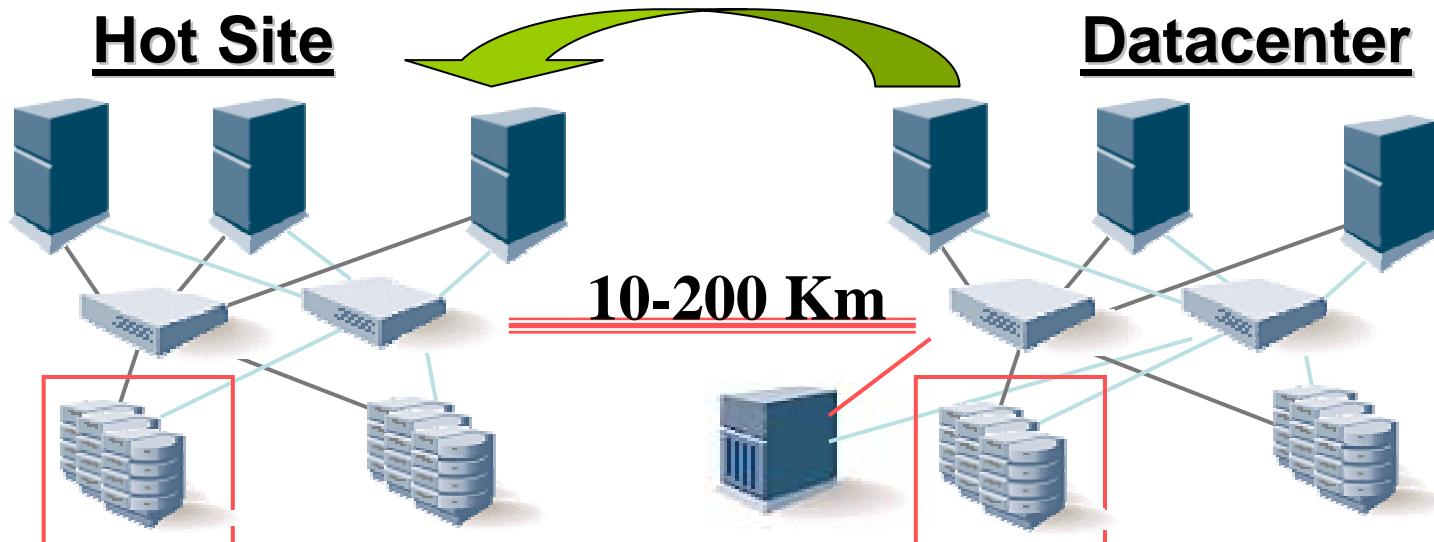
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Storage Wide Area Networks

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Infrastructure Design
Availability and Performance

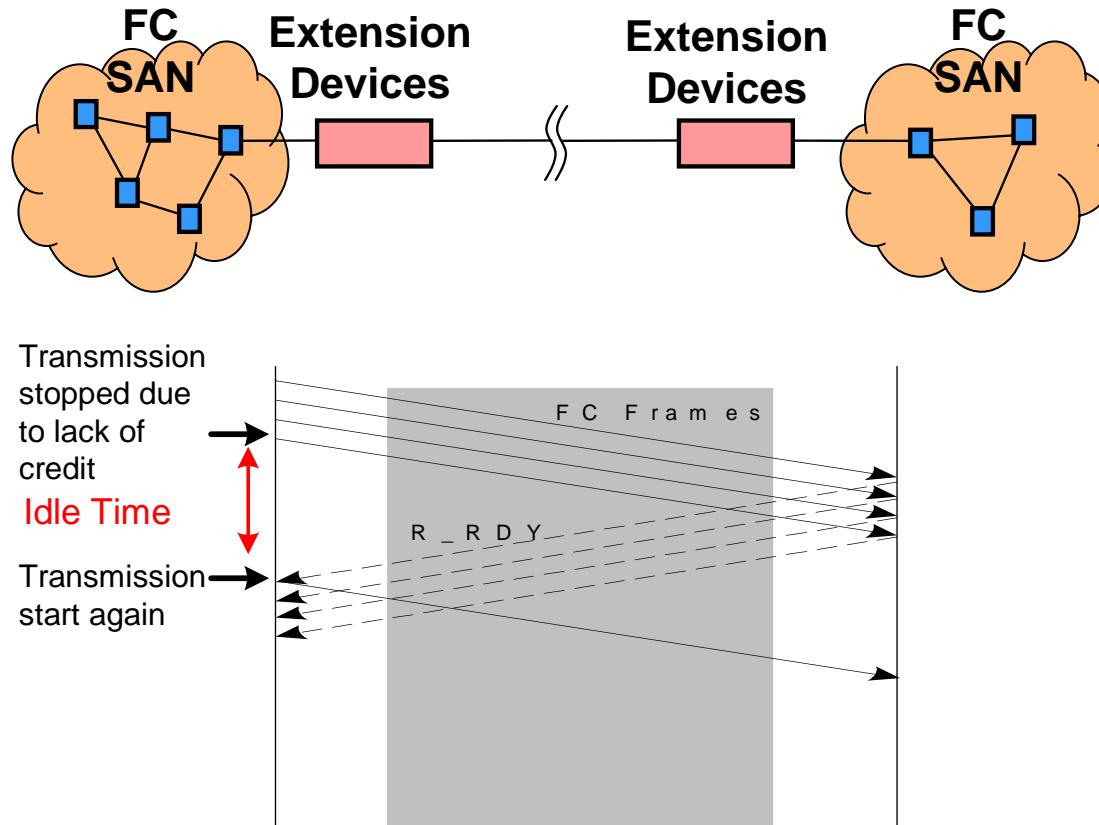
Metro Area Network Infrastructure

- Higher level of DR Protection
- Synchronous mirroring of data over distance
- Off-site backups
- Auto-failover if disruption is detected
- High availability environment



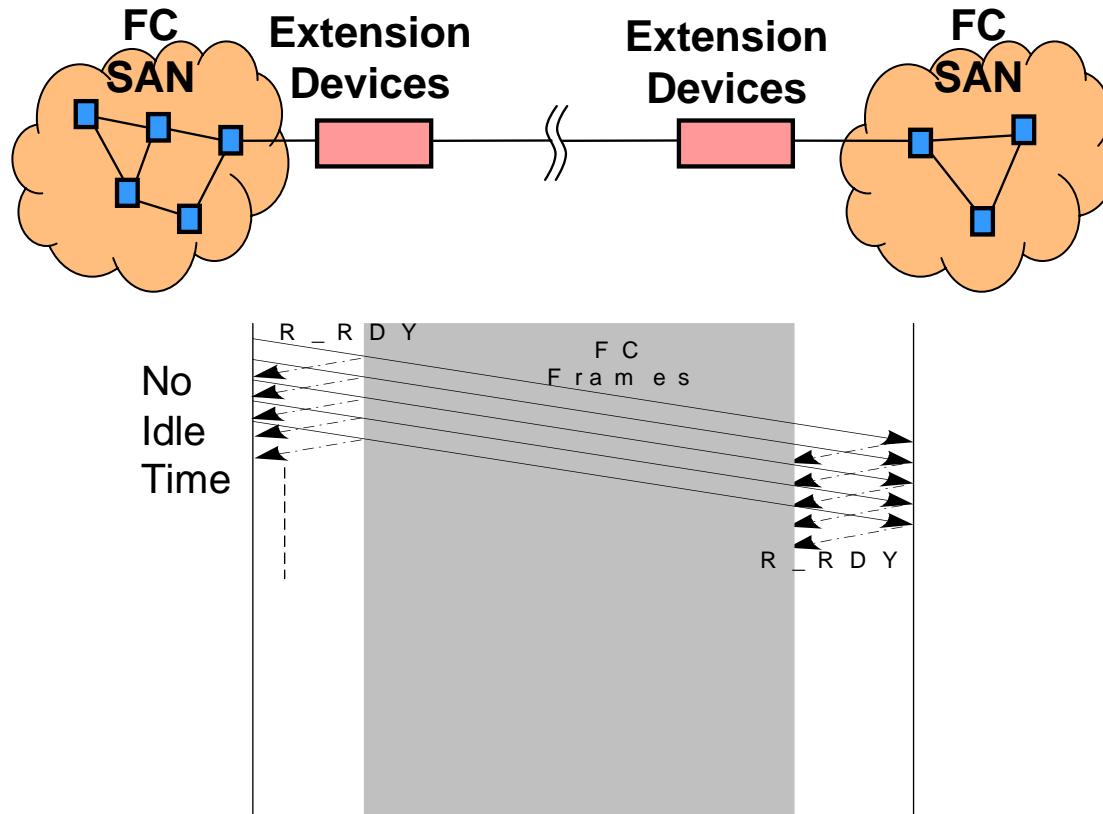
Bandwidth – Distance Extension

- Data drooping



Bandwidth – Distance Extension

- Credit Spoofing



Fabrics for Greater Distance

Metro Area Networks (MANs)

- Distances of <200Km
- CWDM/DWDM for >1Gb/s
- SONET/SDH for <1Gb/s
- IP/ATM for <50Mb/s
- Redundant paths
- Applications
 - Synchronous Mirroring
 - Backup and Archival
 - SAN island interconnection

Wide Area Networks (WANs)

- Distances of >200 Km
- SONET/SDH for >50Mb/s
- IP/ATM for <50Mb/s
- Applications
 - Asynch Replication
 - Backup and Archival
 - SAN island interconnection



Latency - Distance Considerations

Equipment latency

- FC Switch ~10 microseconds
- DWDM, SONET ~10 microsec
- Ethernet Switch ~100 microsec
- Router ~ >>milliseconds ++

Distance Latency

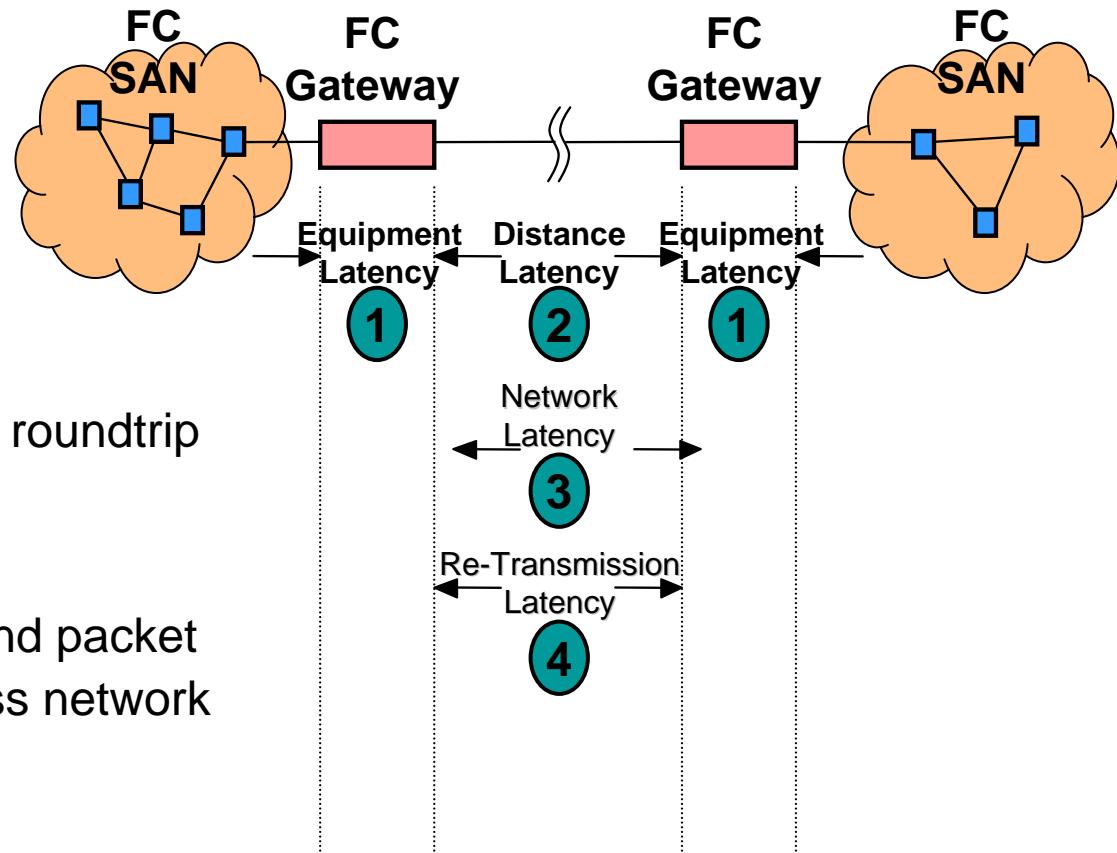
- 100 microsecond latency per km roundtrip

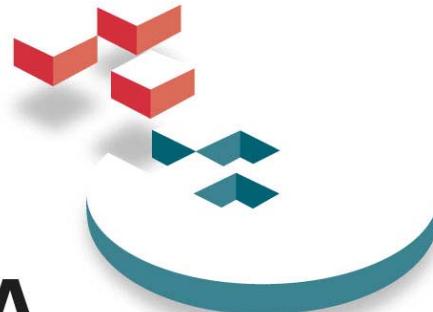
Network Latency

- # of hops in route
- Must plan for worst case route and packet reordering delay in connectionless network

Retransmission latency

- Impact of congestion;
 - packet discard, TCP/IP slow start





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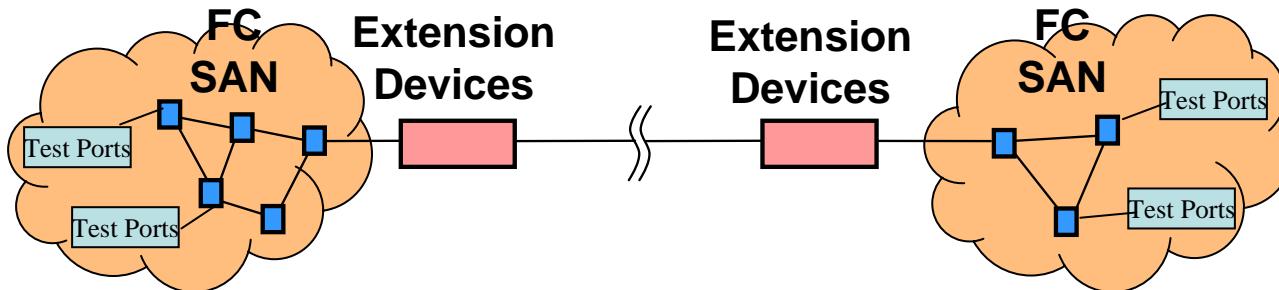
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Tools

Storage Network
Infrastructure Design
Availability and Performance

Tools

- Test before deployment



- Verify the bandwidth is as expected
- Verify the latency is as expected
- Verify the failover recovery time

- Performance Testing and Monitoring

- IOMeter,
- SANTester,
- Xgig and others...

Tools

- Benchmark tests
 - Transaction Processing Performance Council (TPC)
 - Storage Performance Council (SPC)
- SRM tools
 - StorEdge
 - StorageAuthority
 - ControlCenter and others...

Summary

- SAN's are scalable from smallest entry-level site to very large global SAN's
- End to end performance and availability is ultimately dependent on the overall storage network design
- As complexity creeps into the storage network, availability and performance become more important
 - Planning and testing are critical

Q&A / Feedback

- Please send any questions or comments on this presentation to SNIA:

track-networking@snia.org

**Many thanks to the following individuals
for their contributions to this tutorial.**

SNIA Education Committee

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