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Server and Storage Consolidation with iSCSI Arrays

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Server & Storage Consolidation with iSCSI

This session will appeal to IT managers, administrators and architects interested in best practices and deployment considerations of storage consolidation solutions available with iSCSI-based systems today.

This presentation, an update to a very popular SNIA Tutorial, outlines the benefits of networked storage, contrasting deployment models. . After a summary of iSCSI-based SAN benefits, the presentation provides a detailed description of iSCSI SAN configurations, capabilities, options and best practices. As iSCSI has a natural affinity to virtualization, it also covers virtual server environments. Finally, the presentation describes typical deployment scenarios, and emerging developments, including higher speed Ethernet and FCoE.

Contents

◆ **Storage Consolidation with iSCSI SANs**
- Advantages of networked storage
- iSCSI SAN benefits

◆ **iSCSI –based Storage Area Networks**
- Host connectivity and security
- Boot from SAN
- High availability
- Quality of service
- iSCSI performance

◆ **Deployments and Futures**
- Typical array capabilities
- Server virtualization with iSCSI
- Typical deployment scenarios
- Emerging new capabilities

◆ **Summary**

Why Move to Networked Storage

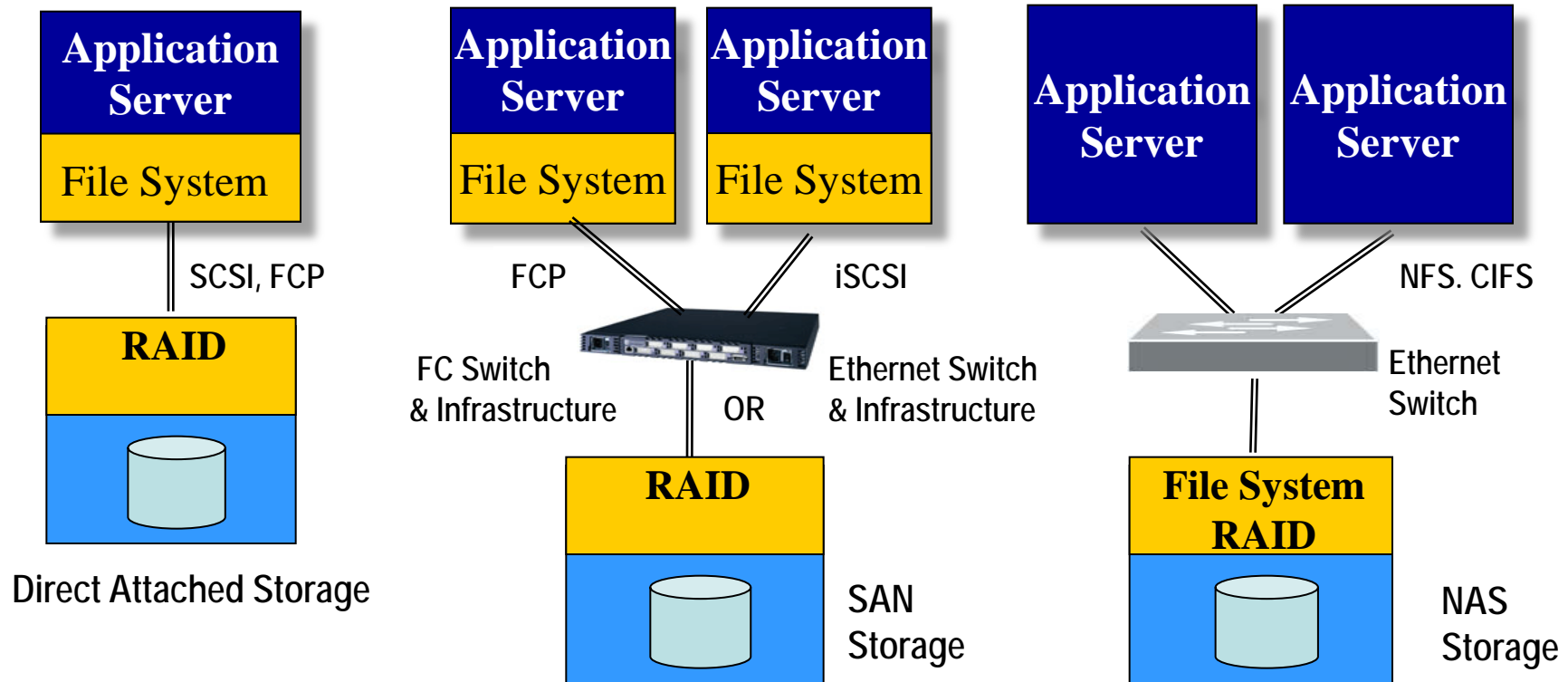- **Value of Storage Networking**
  - Improved reliability and reduced cost of backup
  - Improved scalability of storage capacity and performance
  - Simplified storage provisioning
  - Improved data availability

- **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
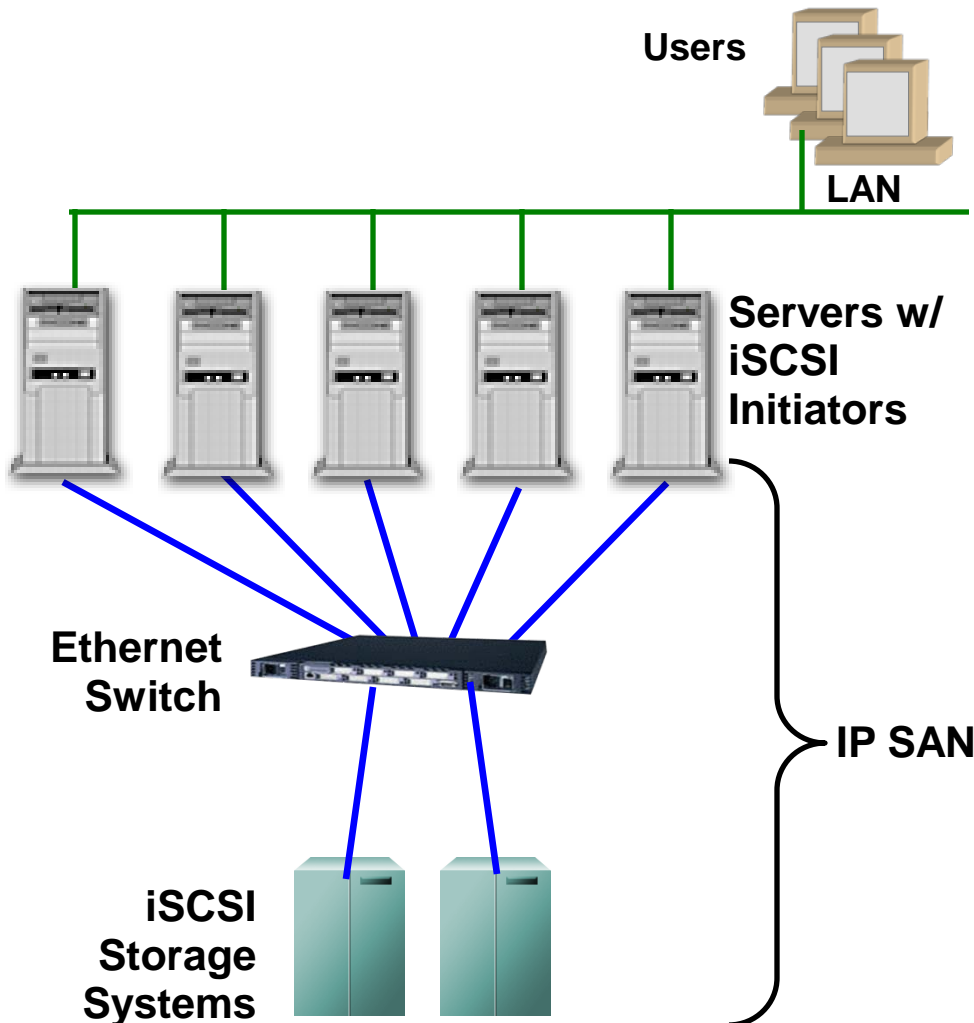
Storage Technologies Compared

Application Server	Application Server	Application Server	Application Server	Application Server
File System	File System	File System		

SCSI, FCP

FCP

iSCSI

NFS. CIFS

RAID

FC Switch & Infrastructure

OR

Ethernet Switch & Infrastructure

Ethernet Switch

RAID

File System RAID

Direct Attached Storage

SAN Storage

NAS Storage

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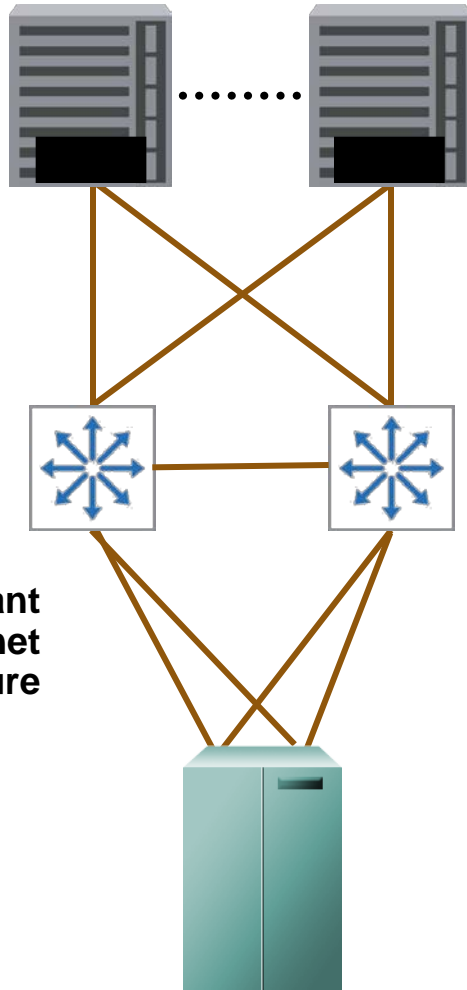- **Works with all apps**

- **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**

iSCSI SAN Benefits

Users

LAN

Servers w/ iSCSI Initiators

Ethernet Switch

IP SAN

iSCSI Storage Systems

❯ 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

Server & Storage Consolidation with iSCSI Arrays

iSCSI Host Connectivity/Security

Host Systems

**Redundant
Ethernet
Infrastructure**

Connectivity:

▸ **1 Gb or 10Gb Ethernet**

▸ **Jumbo frames (recommended)**

▸ **Link aggregation or MPIO or Multi-Connection Sessions (bandwidth and/or availability)**

Security:

▸ **Host authentication (CHAP)**

▸ **Private network**

　　　▸ **Physical**

　　　▸ **VLAN (zoning)**

▸ **Array LUN masking**

▸ **Optional IPSec**

▸ **Optional key management**

Server & Storage Consolidation with iSCSI Arrays
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iSCSI Host Support

OS	Initiator	Certified	Multi-pathing	Cluster
Windows Server System	Hardware, Software	☑	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

iSCSI Boot From SAN

- ✓ **Simplify Server Hardware Upgrades/Repurposing**

- ✓ **Easy to configure temporary or test servers**

- ✓ **Simplify Server OS Imaging**

- ✓ **Simplify disk drive replacement**

- ✓ **Centralize storage monitoring and management**

- ✓ **Boot from iSCSI HBA or from native OS initiator**

- ✓ **Industry standard implementation of iBFT**

- ✓ **Removes spinning media from server**

  — **Important for power saving strategies and reduced maintenance**

iSCSI Boot with S/W Initiators

Boot Parameters transferred via Network

Ethernet
Switch

DHCP Server
PXE Server

Int13

UNDI

NIC

iBF
Table

Boot
Manager/
Kernel

iSCSI Software
Initiator

TCP/IP

Network Stack

NIC drivers

Boot Disks

Storage Array

iSCSI : High Availability Options

MPIO

```
        Pseudo
         Disk
        /      \
   Disk #1    Disk #2
      |          |
    iSCSI      iSCSI
  Session #1  Session #2
      |          |
  Connection  Connection
     #1          #2
```

MCS

```
         Disk
          |
        iSCSI
       Session
        /    \
  Connection  Connection
     #1          #2
```

Quality of Service Policies

Host Systems

Partitioned Intelligent Storage Subsystem

A — OLTP Server

B — Customer Web Catalog Server

C — Corporate Email Server

D — Corporate File Server

- QoS Mechanisms:
  IEEE 802.1p/Q, IETF DiffServ, IETF MPLS, IETF RSVP
- DCB – Data Center Bridging

Storage Network

OLTP Server — A

Customer Web Catalog Server — B

Corporate Email Server — C

Corporate File Server — D

Traffic Prioritization Engine

Incoming Traffic			Outgoing Priority		
First In	D	Corporate File Server	OLTP Server	A	High Priority
	B	Customer Web Catalog	Customer Web Catalog	B	
	C	Corporate Email Server	Corporate Email Server	C	
Last In	A	OLTP Server	Corporate File Server	D	Low Priority

◆ iSCSI Protocol is not limited in performance, only by underlying bus speed

  ◆ iSCSI operates at 10Gig Wire Speed today with software initiators

  ◆ HBAs may reduce CPU utilization for some workloads

  ◆ Performance scales with Ethernet speeds 10 Gb, 40 Gb, and up

Filesystem
Volume Manager
Class/Disk
Port Driver

OS {
iSCSI Software
TCP Offload
NDIS MINIPORT
HW {
RSS | LRO LSO

OS {
iSCSI Software
TCP Chimney
NDIS MINIPORT
HW {
RSS | LRO LSO

iSCSI HBA miniport
iSCSI HBA
} H W

10 Gigabit Ethernet

- IEEE 802.3ae ratified 2002
- Broadly deployed in inter-switch links
- Host-side proliferation now happening
  - Affordable Price
  - Server I/O architecture support
  - Standard component on commodity servers
  - Offload built into on-board components, supported by operating systems
- Deployment/applications
  - Backbone and port aggregation for 1Gb LANs
  - File and block storage over 10GbE

The Multi-Core factor

- Multi-Core changes the game
  - Multi-core Processors scale iSCSI software initiator performance
  - Performance is no longer limited by processing power of HBA engine
  - iSCSI Digest Offload directly to CPU hardware instruction set

Typical iSCSI Array Capabilities

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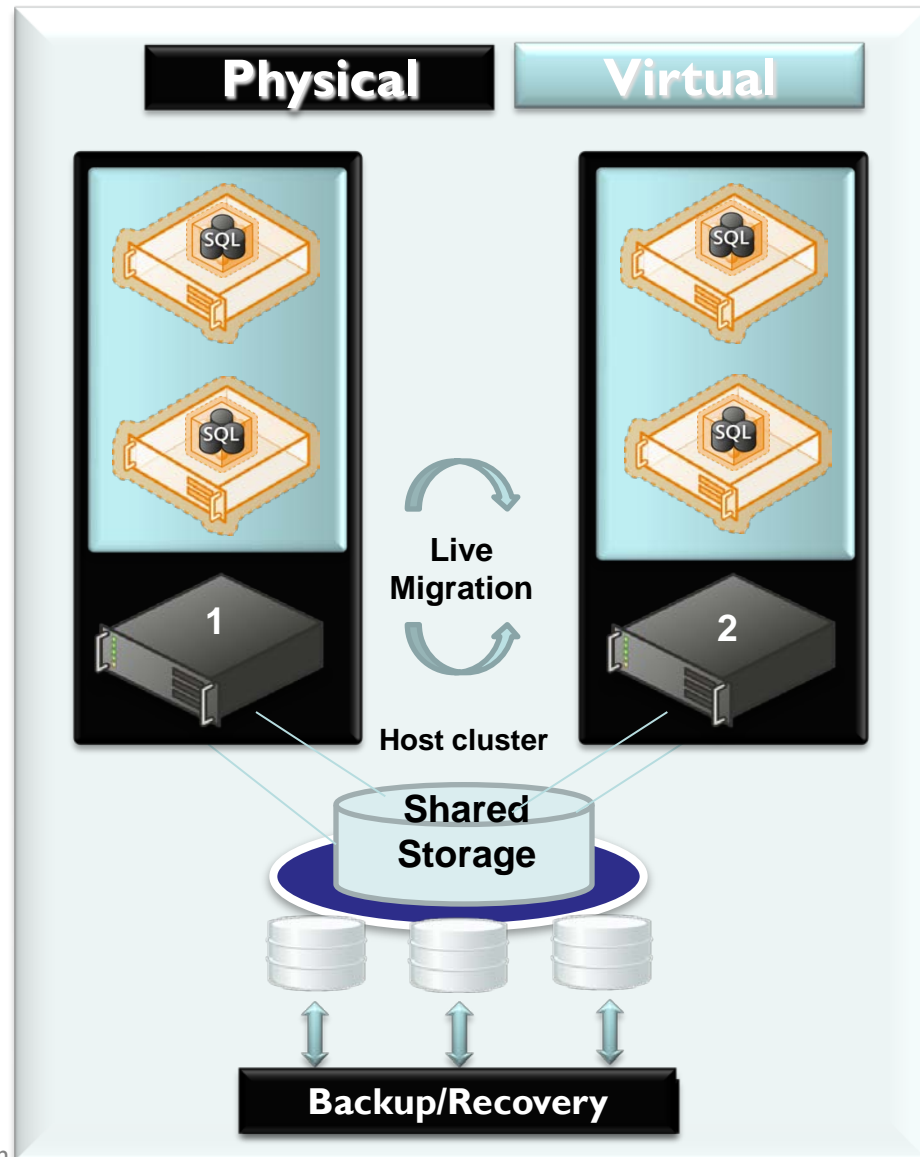 - Capacity
  - Performance
  - Host integration

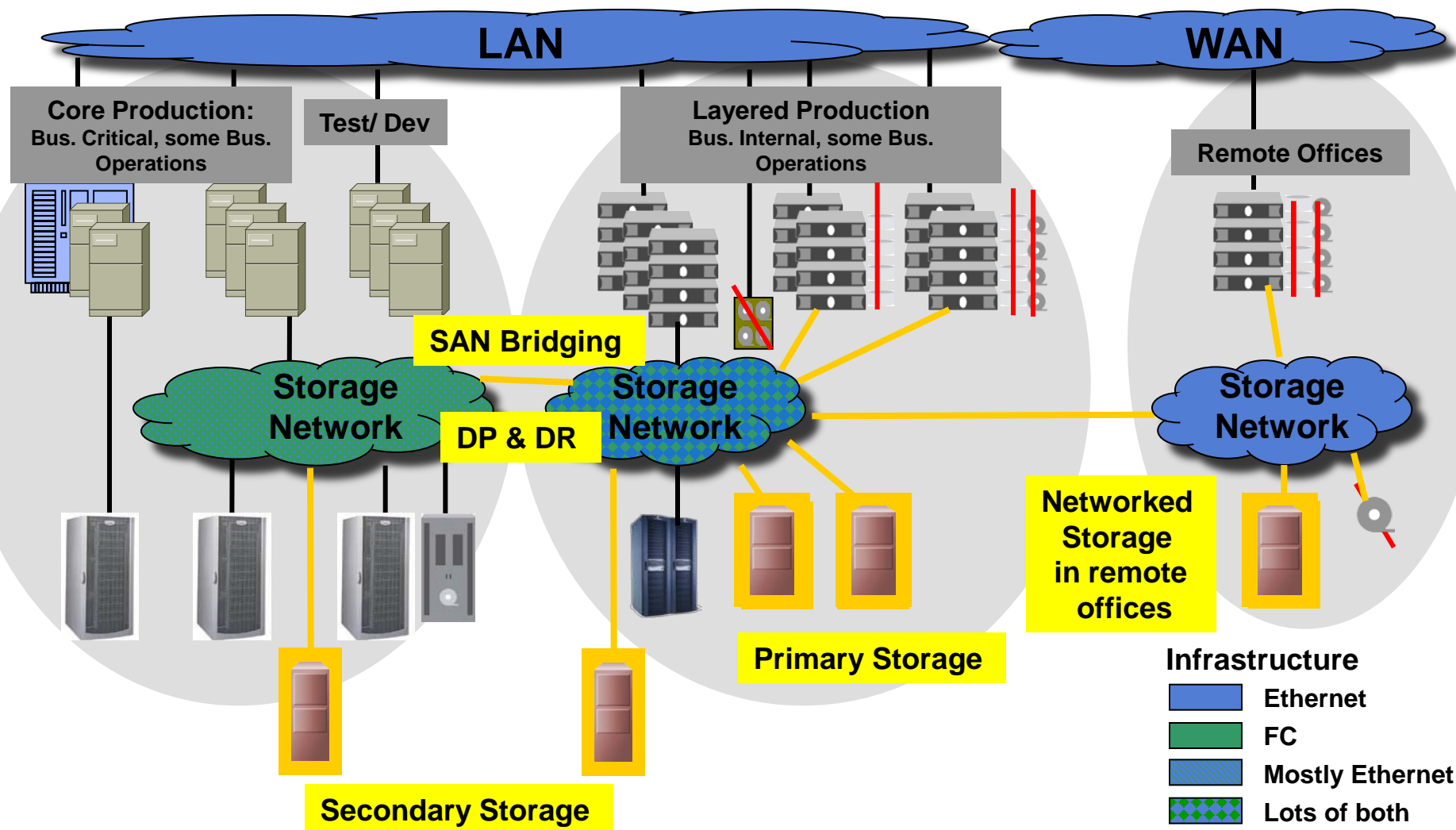# Server and Storage Virtualization offer VM mobility

Scenario Description:

•Manage high availability with multipathing and Live migration for planned downtime situations, such as hardware and software maintenance

•Failover individual virtual machines (VMs) to other hosts within a

•Use iSCSI software initiator within the guest connected to iSCSI storage to provide guest clustering

•Nodes in cluster can be active-active
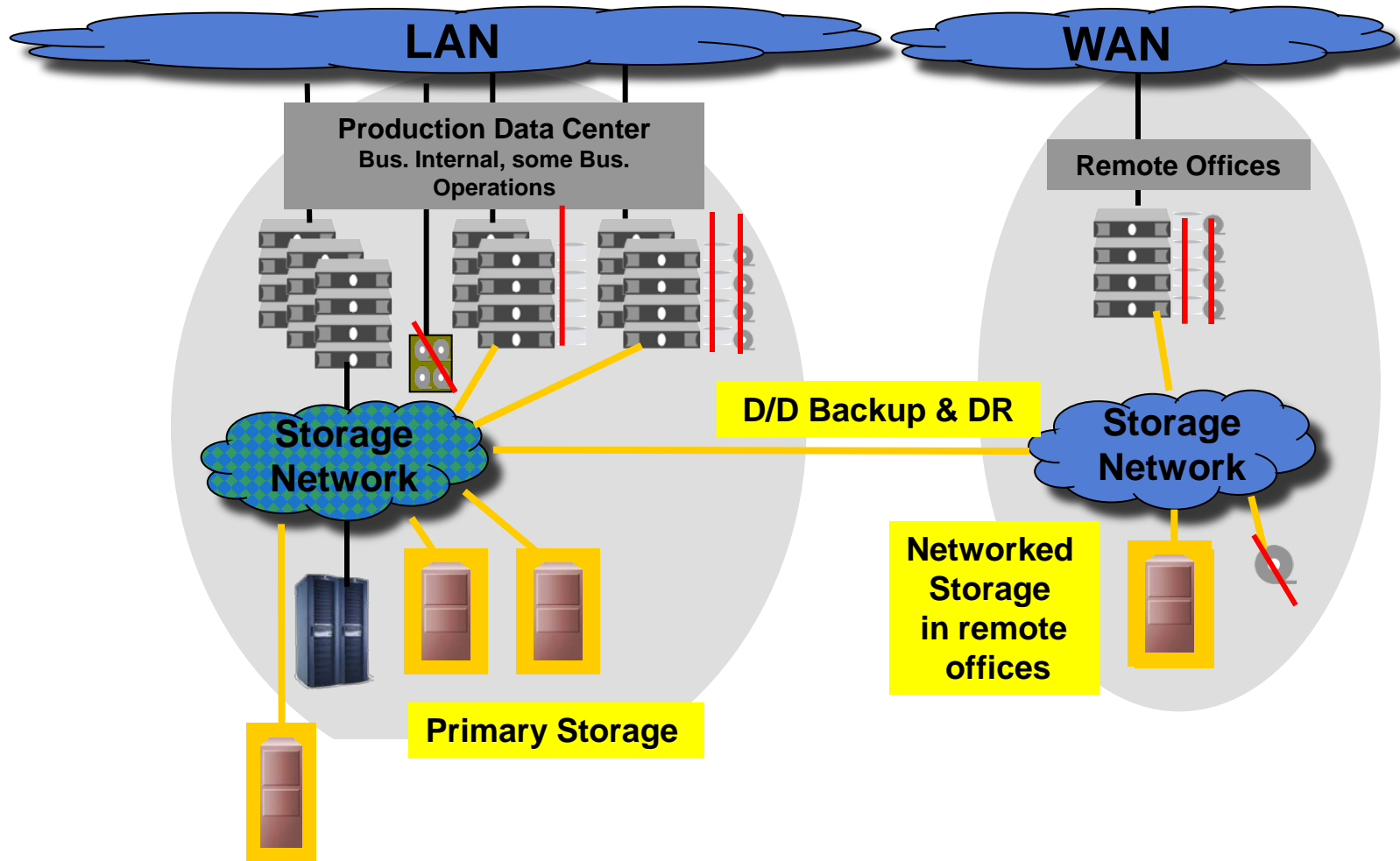
Virtualization Benefits:

•Less downtime and loss of service for failover with Live Migration.

•Server Virtualization combined with storage virtualization

•Improve availability with less complexity

•Better server utilization due to consolidation

•Seamless backup and recovery

•Management efficiency

Physical | Virtual

Live Migration

Host cluster

Shared Storage

Backup/Recovery

Where iSCSI-based Storage Fits – Large Enterprise

LAN

WAN

Core Production:
Bus. Critical, some Bus.
Operations

Test/ Dev

Layered Production
Bus. Internal, some Bus.
Operations

Remote Offices

SAN Bridging

Storage Network

DP & DR

Storage Network

Storage Network

Networked Storage in remote offices

Primary Storage

Secondary Storage

Infrastructure

	Ethernet
	FC
	Mostly Ethernet
	Lots of both

Where iSCSI-based Storage Fits – Medium/Small Enterprise

LAN

WAN

Production Data Center
Bus. Internal, some Bus.
Operations

Remote Offices

D/D Backup & DR

Storage Network

Storage Network

Networked Storage in remote offices

Primary Storage

US Core Data Center

Microsoft Exchange & SQL Server

Secondary Storage

GbE Switch

iSCSI

iSCSI Storage Arrays

London

Windows Servers

GbE Switch

iSCSI

iSCSI Storage Array

Australia Backup/DR Site

Application
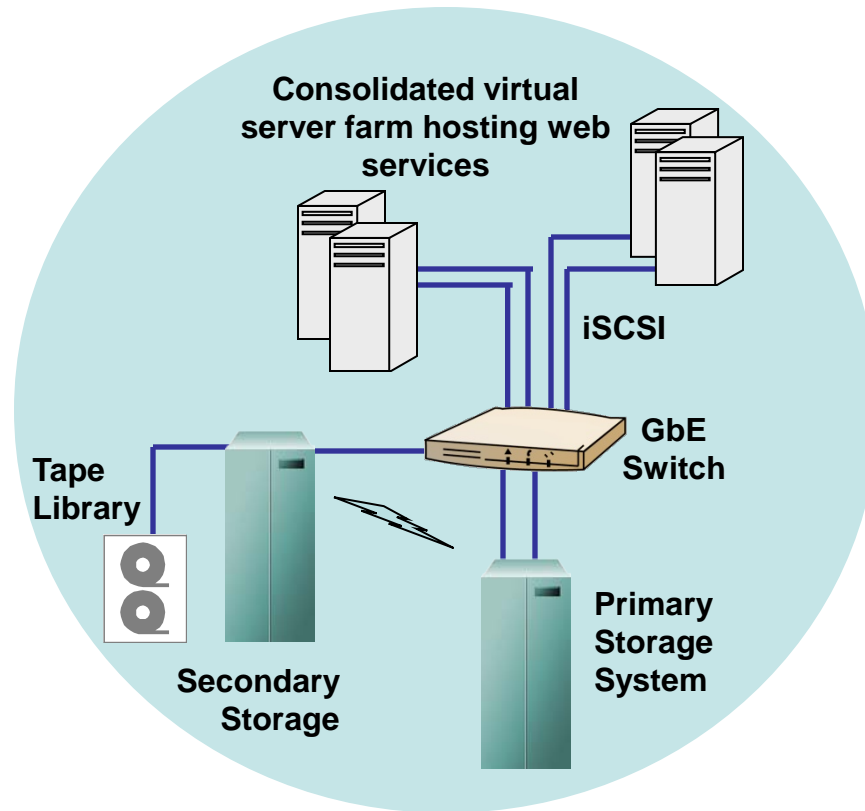- *SQL Server databases*
- *Microsoft Exchange*

Pain Points
- *Challenge to meet SLAs with direct attached storage environment*
- *Affordable SAN storage for SQL Server databases*
- *Affordable DR solution*

Solution
- *IP SAN in each location*
- *Multiple snapshot backups per day to US core data center*
- *Async mirror to DR site*

Benefits
- *High performance solution*
- *Simple, cost-effective storage network*
- *DR between existing data centers*
- *Enhanced ability to meet demanding airline customer SLAs*

Case Study

Consolidated virtual server farm hosting web services

iSCSI

GbE Switch

Tape Library

Secondary Storage

Primary Storage System

> ◆ **Application**
> - ◆ *Web hosting services*
>
> ◆ **Pain Points**
> - ◆ *Rapid growth*
> - ◆ *Outgrowing "green" data center*
> - ◆ *Very poor server utilization*
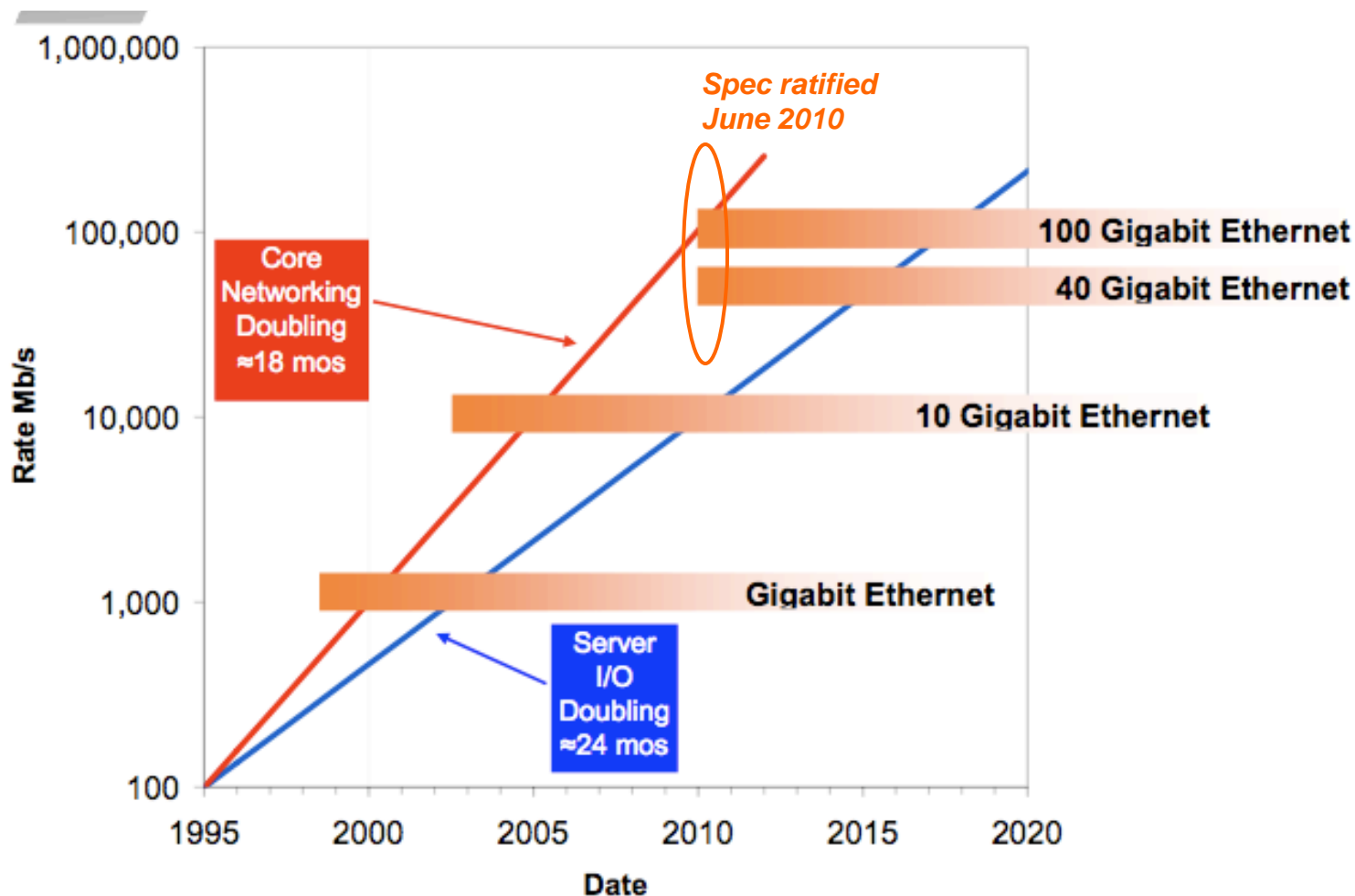> - ◆ *Disruptive backup process*
>
> ◆ **Solution**
> - ◆ *Virtual servers w/ IP SAN*
> - ◆ *Disk-to-disk backup for HA and DR*
>
> ◆ **Benefits**
> - ◆ *Virtual server environment provides the flexibility to host additional clients and increase revenue potential.*
> - ◆ *Server and storage consolidation reduced data center power consumption by 60 percent.*
> - ◆ *Replacement of 120 white box servers with four SMP servers reduced cooling costs and data center footprint.*
> - ◆ *Cost savings and cost avoidance enabled pursuit of additional environmental conservation solutions.*
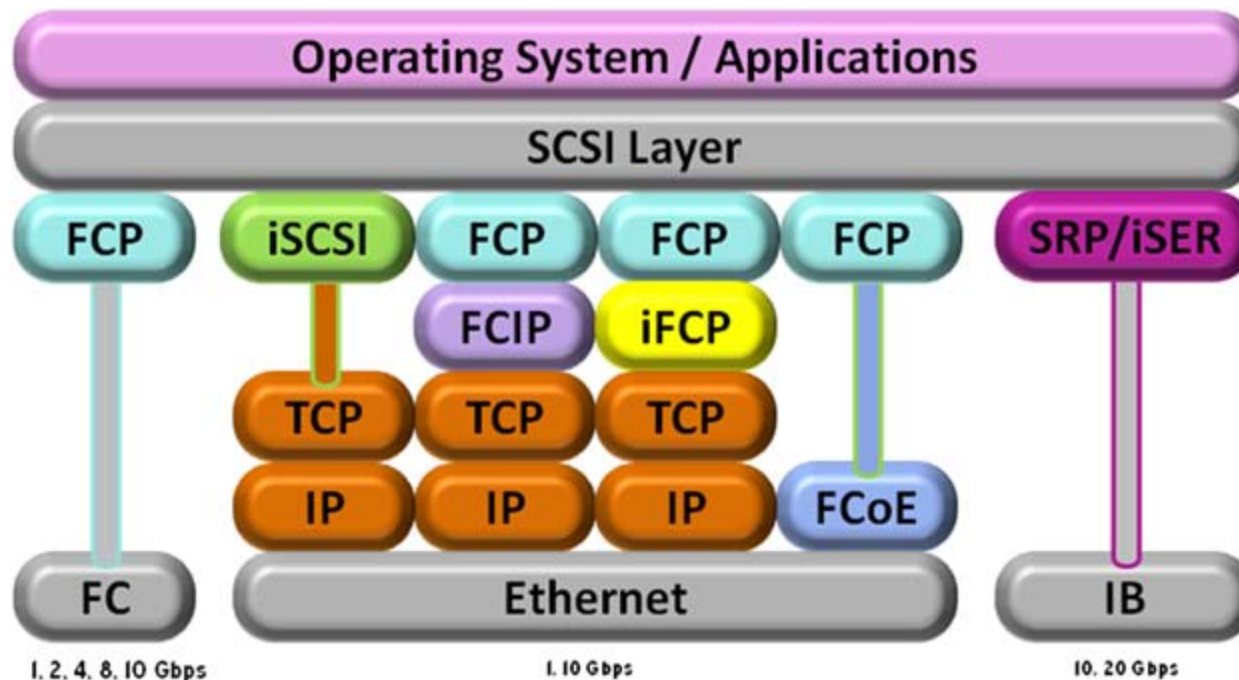
Futures: Ethernet beyond 10Gb

Source: John D'Ambrosia, Force 10 Networks
Chair, IEEE P802.3ba Task Force; Ethernet Alliance

Fibre Channel over Ethernet

- –An Extension of Fibre Channel onto a 10Gb Ethernet network
- –FCoE is a direct mapping of Fibre Channel over Ethernet
- –TCP/IP is not required and not present for FCoE
- –Preserves ops, control and management environments for the FC layer

IEEE 802.1 DCB Protocol Status

◆ FCoE requires "lossless" Ethernet

  ◆ Possible with Ethernet plus some extensions

◆ Data Center Bridging benefits iSCSI and FCoE

  ◆ Ensures Storage IO receives priority over lower priority traffic

◆ The IEEE 802.1 DCB WG is defining these extensions

  ◆ Priority-based Flow Control (PFC): 802.1Qbb

  ◆ Enhanced Transmission Selection (ETS): 802.1Qaz

    › Including DCBX (DCB eXchange protocol)

  ◆ Congestion Notification (CN): 802.1Qau

◆ Standards-compliant products shipping now

◆ FCoE I/O Consolidation requirements:

  ◆ PFC is required,

  ◆ ETS is highly recommended,

  ◆ CN is optional (not required for initial FCoE deployments)

◆ DCB required for multiprotocol support (FCoE and TCP/IP)

Summary - iSCSI Storage

- Sophisticated storage consolidation solutions for low-end and mid-range server environments

- Takes advantage of existing IT knowledge base

- Provides simpler, more affordable SAN infrastructure

- Improves data availability and performance

- Integrates distributed data and resources

- Solutions are deployed in many thousands of companies around the world

- Ultimately provides one technology for connecting clients, servers & storage devices

Q&A / Feedback

◆ Please send any questions or comments on this presentation to SNIA: trackstorage@snia.org

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

SNIA Education Committee

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