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Storage over SONET → Delivering on the Promise of Cost-Effective Disaster Recovery and Business Continuity

Kirk Edwardson

Optical Storage Solutions Marketing
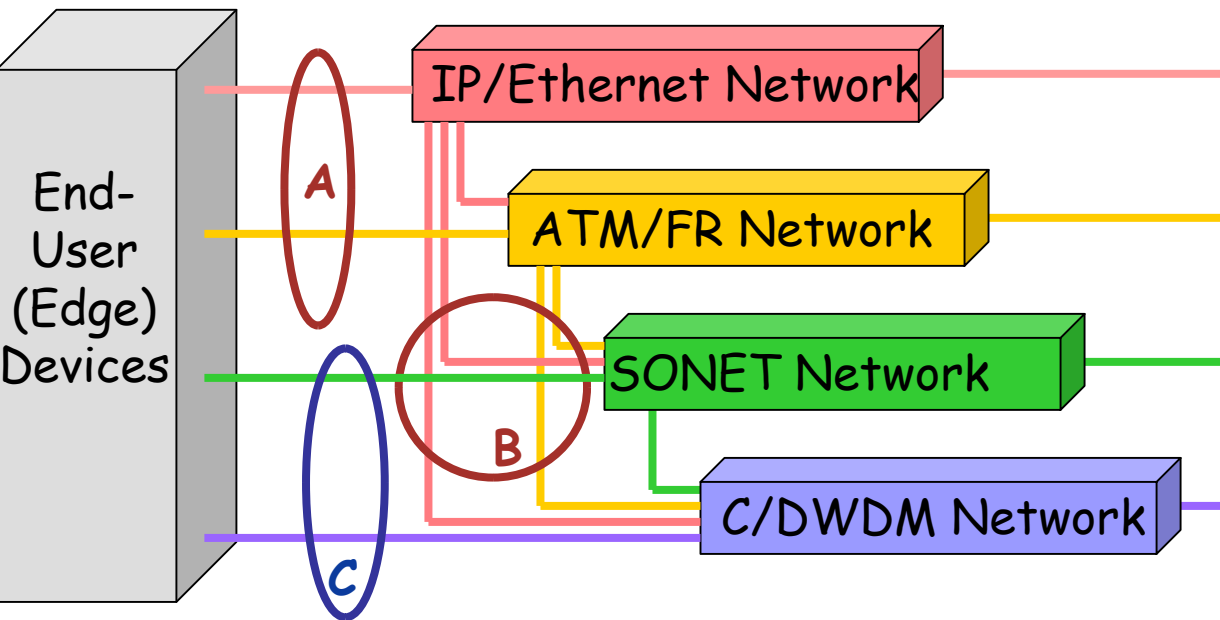
kirke@nortelnetworks.com

Agenda

- **Optical Networking Evolution & Overview**
- **Market Drivers**
- **Defining Storage Requirements**
- **Nortel Networks Optical Portfolio Storage Connectivity Strategy**
- **Choosing Between Private Build Networks & Carrier Services**
- **Wrapup & Questions**

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Optical Networking Evolution & Overview

The Evolution of Optical Networking

End-User (Edge) Devices

A

IP/Ethernet Network

ATM/FR Network

SONET Network

B

C/DWDM Network

C

- Before, data traffic was typically generated over interfaces to various networks (A), and then aggregated onto optical networks (B).

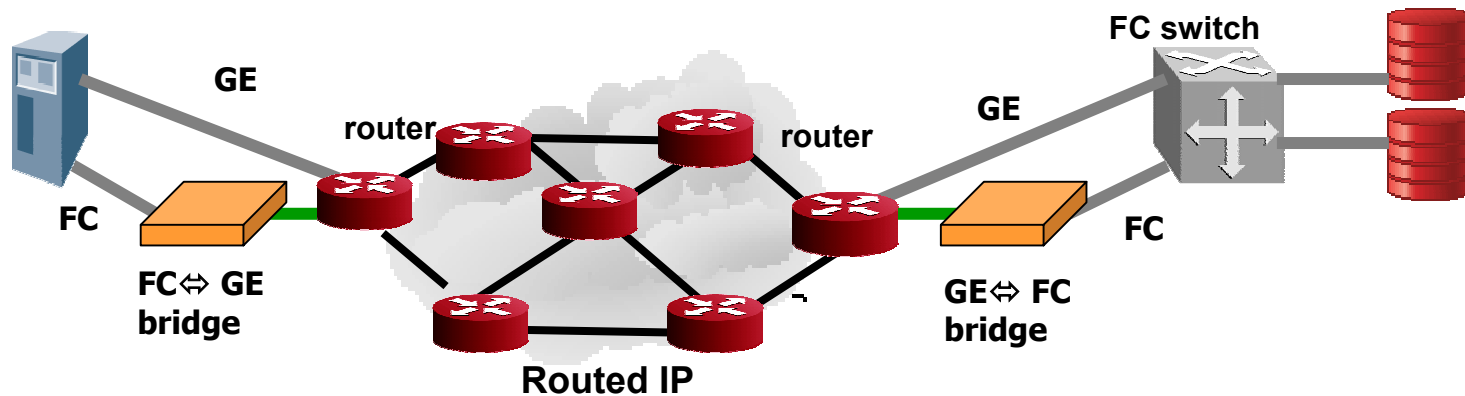- Today, end-users are benefiting from direct connection to optical networks (C).

Optical Networks Support Data Services Natively

SONET/SDH - Line Rates

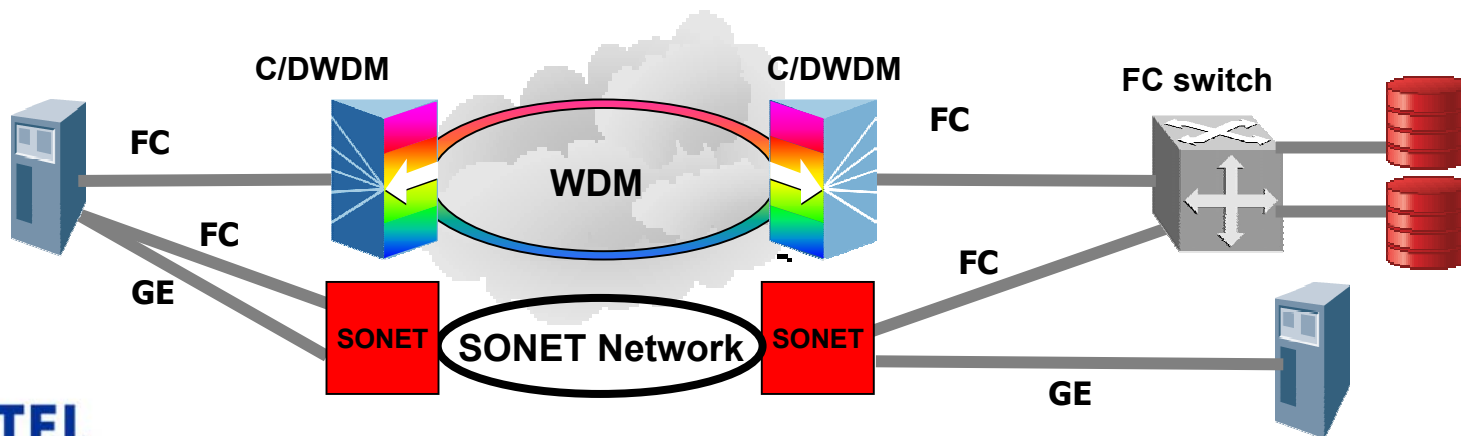| Optical Signals	SAN/LAN Service	Bit (Line) Rate
STS-1, OC-1 / STM-0	Sub-rate Ethernet	51.84 Mb/s (VC-3)
STS-3, OC-3 / STM-1	Fast Ethernet (100Mb/s)	155 Mb/s (VC-4)
STS-12, OC-12 / STM-4	ESCON (160 Mb/s)	622 Mb/s
STS-48, OC48 / STM-16	Fibre Channel (850 Mb/s) Fibre Channel (1.7 Gb/s) Gigabit Ethernet (1Gb/s)	2.5 Gb/s
STS-192, OC-192 / STM-64		10 Gb/s

Optical Line Rates Support Storage Traffic

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Deterministic or Non-deterministic Transport?

FC switch

GE

router

router

GE

FC⇔ GE bridge

FC

GE⇔ FC bridge

FC

Routed IP

IP Routers are non-deterministic → Ideal for high tolerance applications

Optical Networks are deterministic → Ideal for low tolerance applications

C/DWDM

C/DWDM

FC switch

FC

FC

WDM

FC

FC

GE

SONET

SONET Network

SONET

GE

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Market Drivers

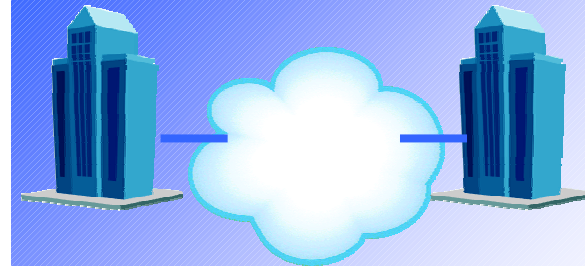# Enterprise Storage Challenges

Site Disaster

Evolving Storage Requirements

Equipment Failure

Safeguard Business Information

Lower IT TCO

Need cost effective networking solutions to protect business information and enable consolidation between data centers

Evolving Requirements

- **Average Data Centre**
  - **19.5Tb of online Storage**
  - **Quadrupling by 2007**
- **Requires Geographical Separation & MAN & WAN Distances**

→

Disaster Recovery Business Continuity

Regulatory Compliance

←

- **HIPAA**
- **Sarbanes-Oxley**
- **SEC**
- **FDA**

Digitization of Data

←

- **Paperless environments**
- **Electronic Processing & Exchange**
- **Electronic Client Records**

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Safeguard Business Information

Business	Segment	Average Hourly Impact
Brokerage operations	Finance	$6.5M
Credit card/sales	Finance	$2.6M
Pay-per-view	Media	$150K
Home shopping	Retail	$113K
Catalogue sales	Retail	$90K
Airline reservations	Transportation	$90K
Cell service activation	Communications	$41K
Tele-ticket sales	Media	$69K
Package-shipping	Transportation	$28K
ATM fees	Finance	$14.5K

Source: FCIA

Must Mitigate Risk of Unprotected Information

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TCO Challenges

Today

LAN

SAN
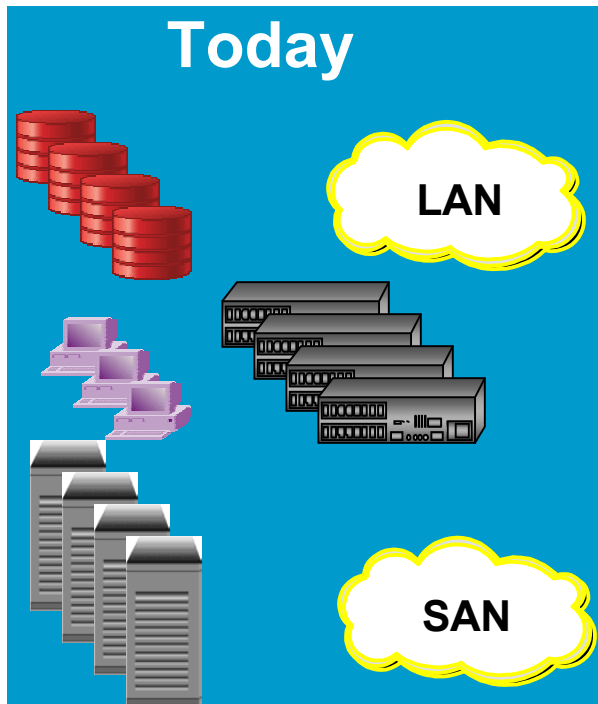
**Consolidation
Convergence
Scalability
Optical Economics
Resource Efficiency**

Tomorrow

LAN/SAN

How to get there from here?

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Defining Storage Requirements

Balancing Application Requirements

Data Loss Sensitivity

What is tolerance for data loss in event of disruption?

Recovery Time Sensitivity

How quickly do I need to recover from a disruptive event?

Application Response Time

What network performance do I require to meet application performance needs?

Optical Networking Delivers The Capabilities to Meet Your Diverse Requirements
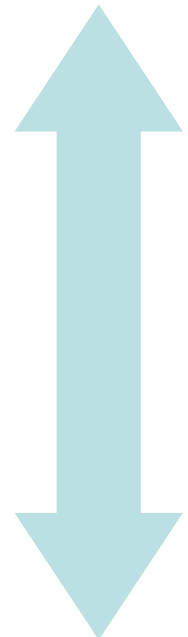
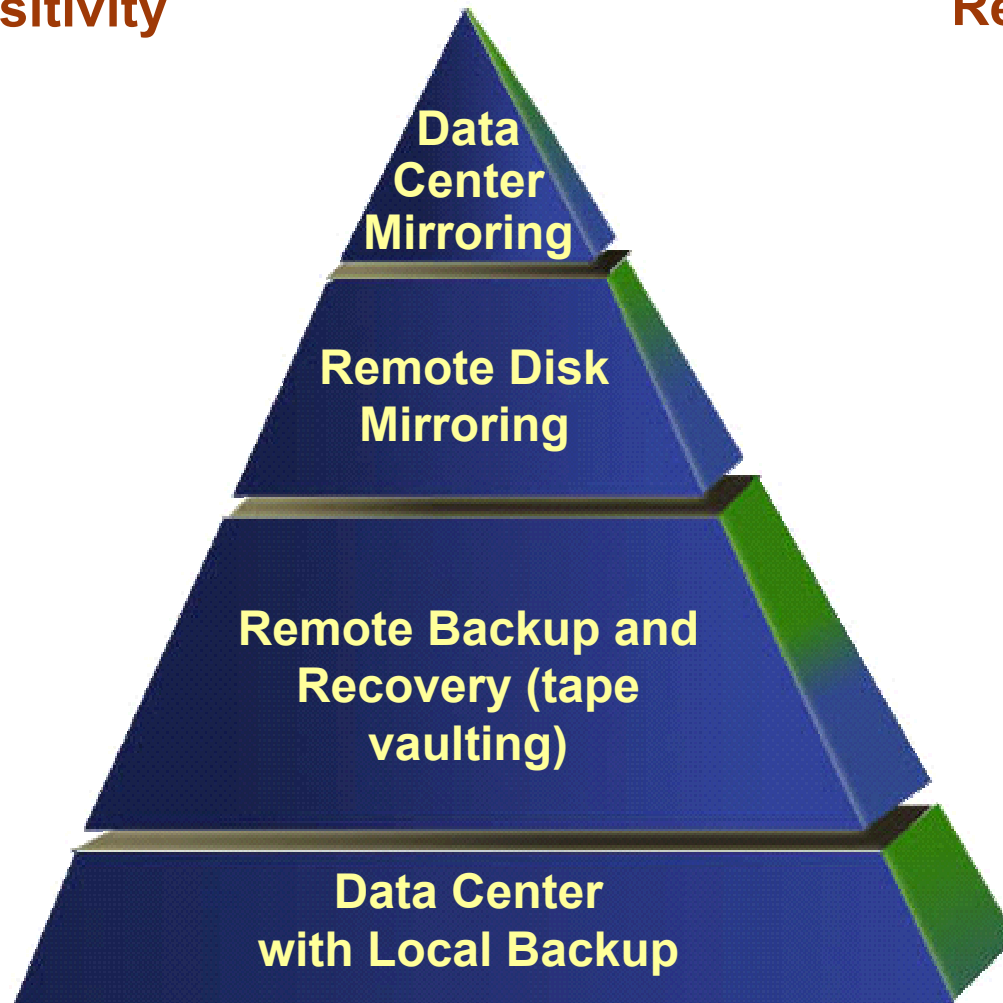# Application Sensitivity

Data Loss Sensitivity

Low Tolerance

High Tolerance

Recovery Time

Minutes

Hours

- Data Center Mirroring
- Remote Disk Mirroring
- Remote Backup and Recovery (tape vaulting)
- Data Center with Local Backup

Optical Networking Provides Flexibility to Meet Needs

Application Response Time

Size of Data Store	Data Loss Sensitivity	Recovery Time Sensitivity	Distance	B/W
200TB+	0-5 Min	5-30 Min	MAN	>4G
100TB+	0-5 Min	5-30 Min	MAN	1 to 4Gbps
20TB+	0-5 Min	5-30 Min	MAN	<1Gbps
<20TB	>30 Min	1-24 hours	WAN	<1Gbps

Optical Networking Provides Flexible Bandwidth Rates

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Connectivity Comparison

Application Requirement	Traditional Private Line, ATM & FR	Routed IP WAN Network	WDM Network	SONET/ SDH Network
Economics for Long Haul Distances	GOOD	GOOD	POOR	GOOD
Performance Characteristics (Latency, Jitter)	FAIR	POOR	GOOD	GOOD
Throughput	LOW Due to Adaptation	POOR Unpredictable	Full Rate FC-100 FC-200	Scalable by N x 50 Mbps
Economics for High Channel Counts / High Bandwidth	POOR	POOR	GOOD	POOR
Economics for Low Channel Counts / Low Bandwidth	POOR	AVERAGE	FAIR /w CWDM	GOOD
Performance Monitoring / SLA Statistics	GOOD	POOR	AVERAGE	GOOD
Flexibility to Provision and Scale	POOR	POOR	GOOD	GOOD
Protection and Restoration (<50 msec)	YES	NO	YES	YES
Infrastructure Security	GOOD	POOR	GOOD	GOOD
Available Now	YES	YES	YES	YES

Optical Networking Meets Stringent Application Requirements

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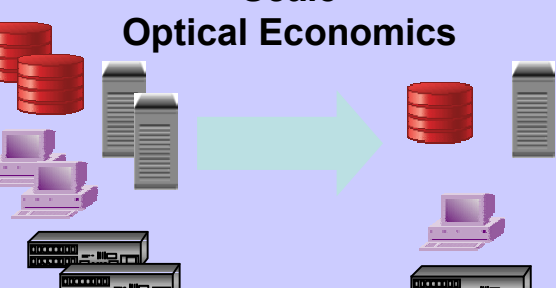
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Nortel Networks Optical Portfolio Storage Connectivity Strategy

Storage Networking Strategy

**Consolidation
Convergence
Scale
Optical Economics**

Reduce TCO

**Distance
Reliability
Security**

**Enable Business
Continuity &
Disaster Recovery**

**Drive End-to-End
Customer Solutions**

**Interoperable solutions harnessing flexible, innovative optical
networking over distance**

Driving End-to-End Solutions

Remote Backup / Restore

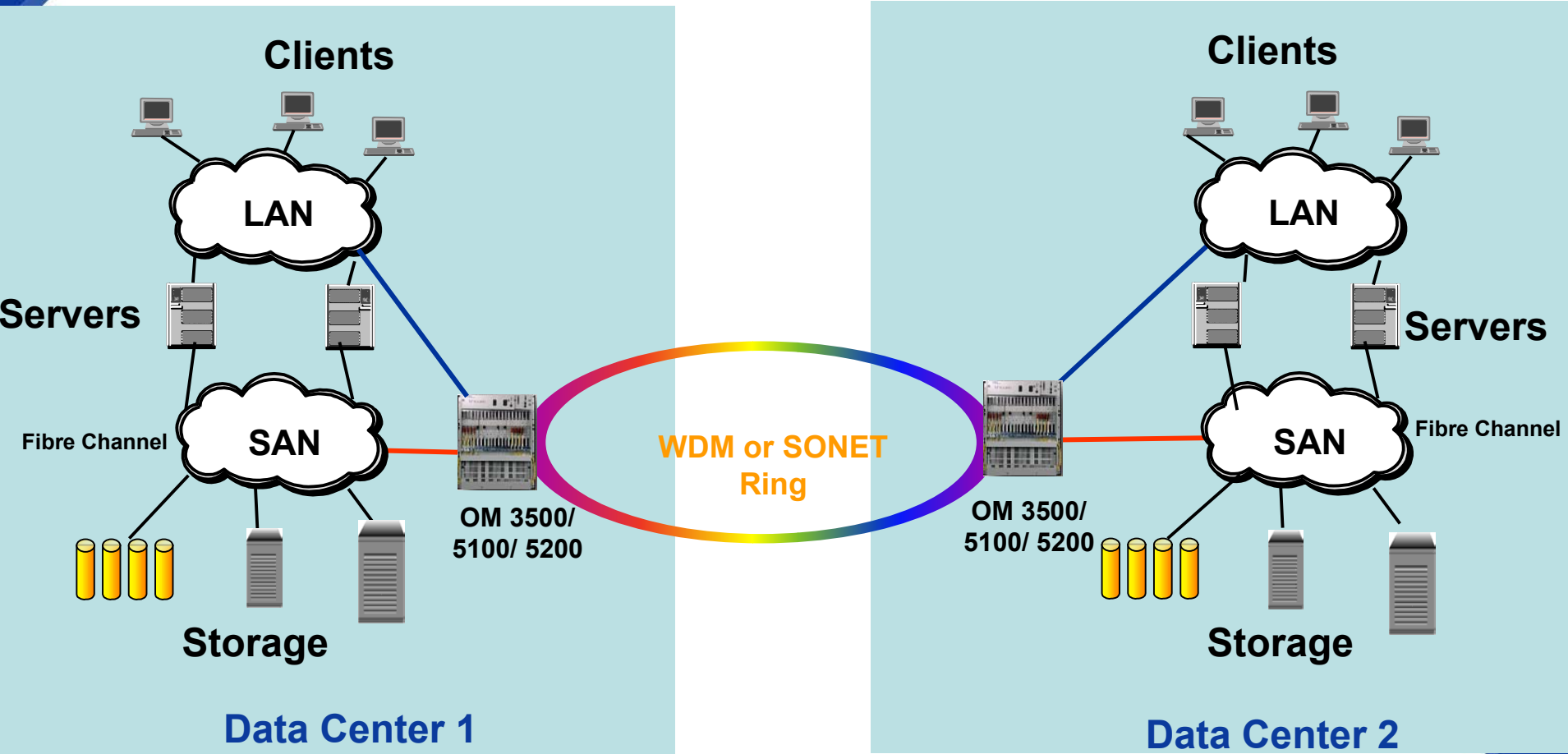**Maximum leverage of IT Resources**
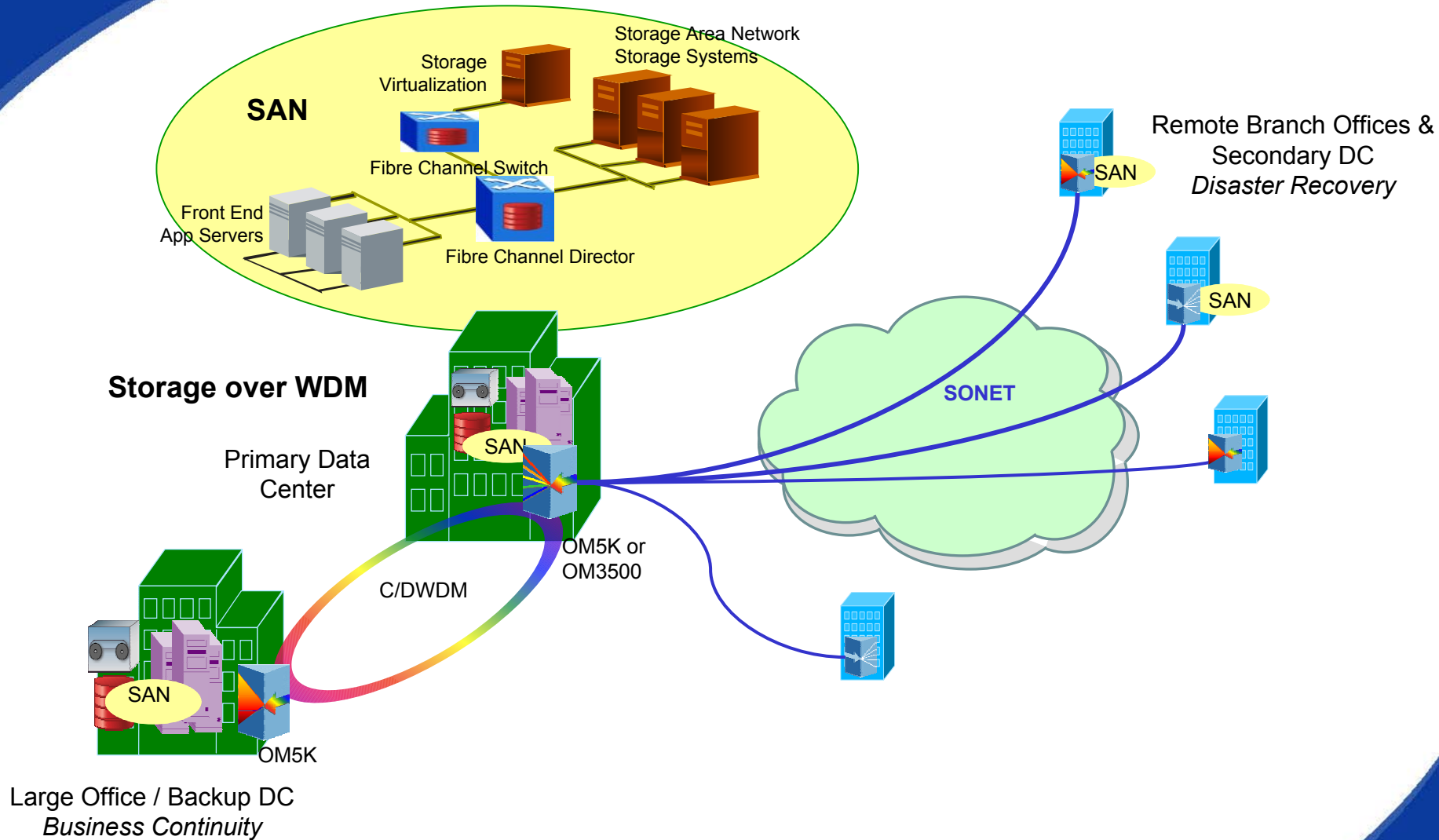
Storage Consolidation

Disaster Recovery

McDATA

hp

HITACHI DATA SYSTEMS

Brocade Fabric Aware

Server Consolidation

Safeguard Business Information

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Convergence Architecture View

Storage Extension Architecture View

SAN

Storage Area Network
Storage Systems

Storage
Virtualization

Fibre Channel Switch

Front End
App Servers

Fibre Channel Director

Storage over WDM

Primary Data
Center

SAN

OM5K or
OM3500

C/DWDM

SAN

OM5K

Large Office / Backup DC
Business Continuity

Remote Branch Offices &
Secondary DC
Disaster Recovery

SAN

SAN

SONET

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Value of End-to-End Solution

C/DWDM
SONET
Ring & Point-to-Point
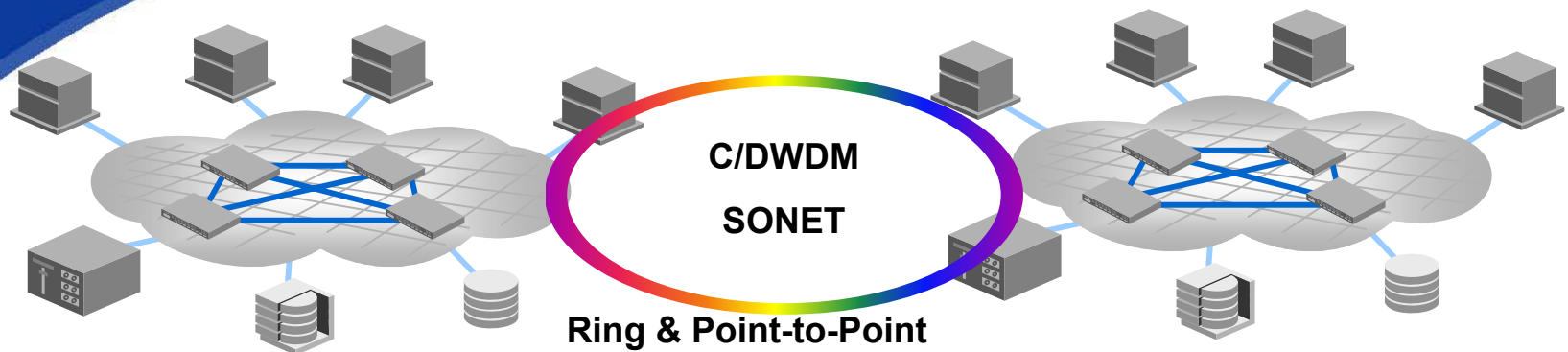
Pre-Qualified solutions
- **Worry-free deployment**

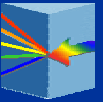## Enable Business Continuity & Disaster Recovery
- **Highly reliable infrastructure for BC/DR**
- **Real-time availability of critical business information at multiple locations in metro area**

Maximizing IT Infrastructure Leverage
- **Enables storage consolidation & utilization across distance**
- **Improved information flow = improved employee productivity**
- **Reduces resources required for infrastructure management**
- **Offers flexibility to support changing business requirements and new applications (voice, video, data)**

Qualified Best-in-Class Solutions from Industry Leaders

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Nortel Storage Connectivity Portfolio

	Protocols	Connectivity Modes	Networking Technology
Optical Metro 5200	FC, ESCON FICON, GbE,	Synchronous	DWDM CWDM SONET
Optical Metro 5100	FC, ESCON FICON, GbE,	Synchronous Asynchronous	CWDM SONET
Optical Metro 3500	FC, FICON, GbE,	Synchronous Asynchronous	SONET RPR

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OM3500 Storage Solution Values & Features

Optical Metro 3500 Multiservice Platform

GFP card

Lowering TCO
- GFP → Multi-service at full or sub rate
- VCAT for efficient SONET link utilization
- 2:1 Fiber Channel/GbE muxing
- App Convergence – Voice, LAN, SAN

Enabling BC
- FICON, Fiber Channel (up to 2G)
- Enhanced Performance Monitoring
- GFP supports FC over distance
- Customer separation
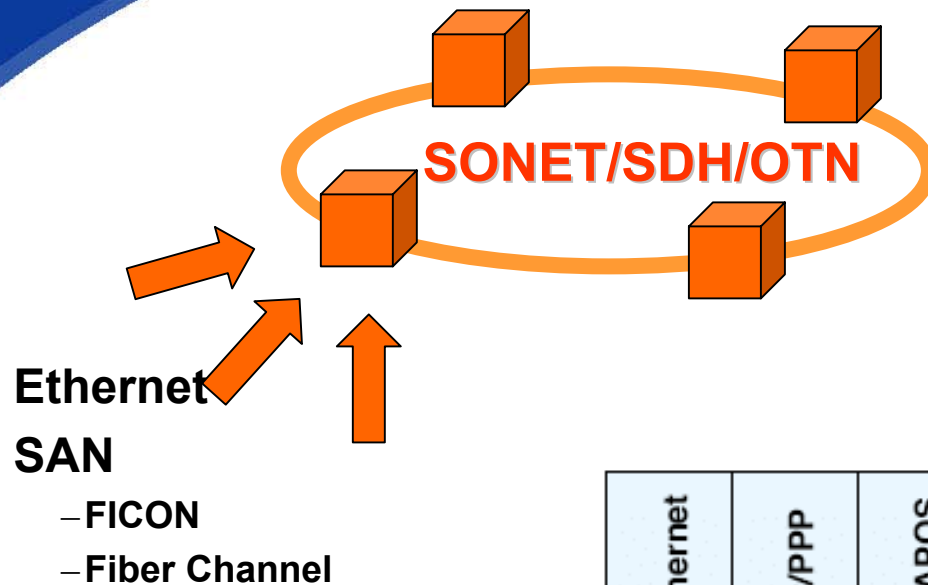- Flow Control and Buffer Credits for distance extension to 000's km with low latency

Driving End-to-End Solutions
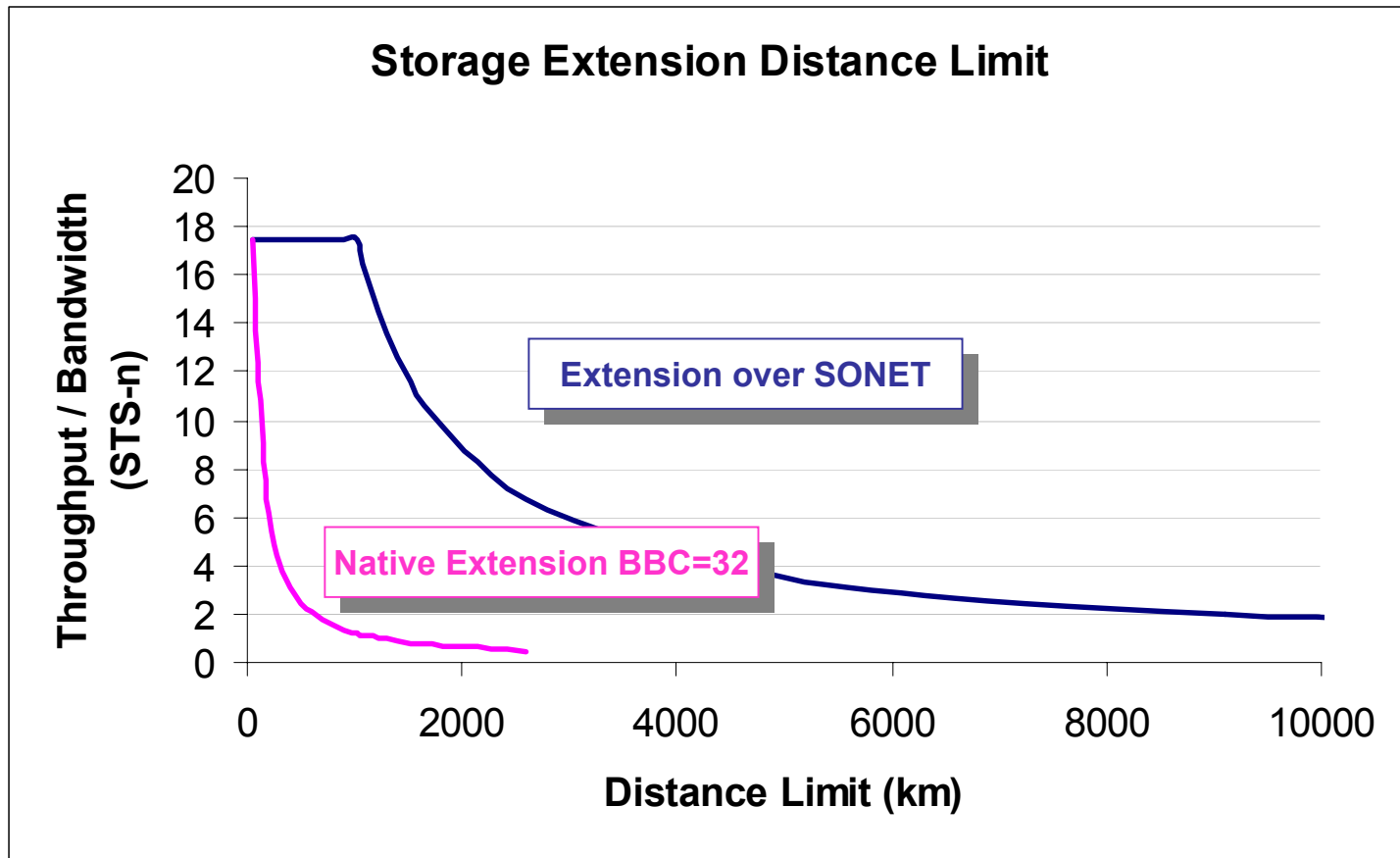- Best in class partner solutions available

Understanding GFP

SONET/SDH/OTN

Ethernet

SAN
- FICON
- Fiber Channel
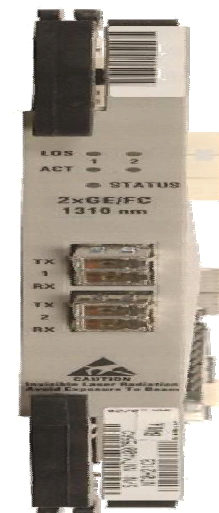
Ethernet	IP/PPP	MAPOS	RPR	FC	FICON	ESCON	Other Client Signals
GFP – Client Specific Aspects (Client Dependent)							
Frame Mapped						Transparent Mapped	
GFP – Common Aspects (Client Independent)							
SONET/SDH Path				OTN ODUk Path			

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The Economics of VCAT

Service	Contiguous concatenation (without VCAT)		Virtual Concatenation	
	used b/w	Fill rate	used b/w	Fill rate
Fast Ethernet (100 Mbps)	STS-3c	67%	STS-1-2v	100%
ESCON (160 Mbps)	STS-12c	27%	STS-1-4v	82%
Fiber Channel (850 Mbps)	STS-48c	35%	STS-3c-6v	95%
Fiber Channel (1.7 Gbps)	STS-48c	71%	STS-3c -12v	95%
Gigabit Ethernet (1 Gbps)	STS-48c	42%	STS-1-21v	95%
			STS-3c -7v	95%

Nortel Networks Storage Distance Extension

Storage Extension Distance Limit

Throughput / Bandwidth (STS-n) vs Distance Limit (km)

Extension over SONET

Native Extension BBC=32

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Choosing Between Private Build Networks and Carrier Services

Optical Private Build

Protected OC3 for LAN, SAN, VoIP
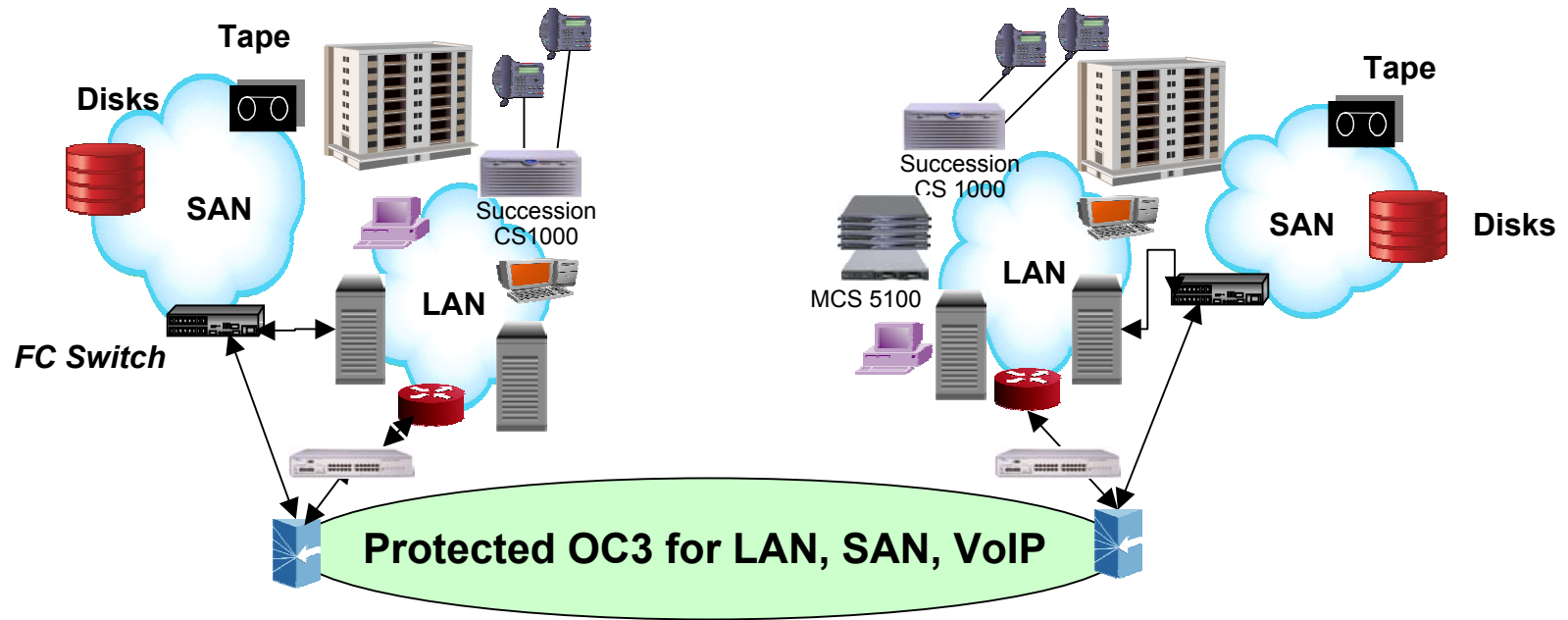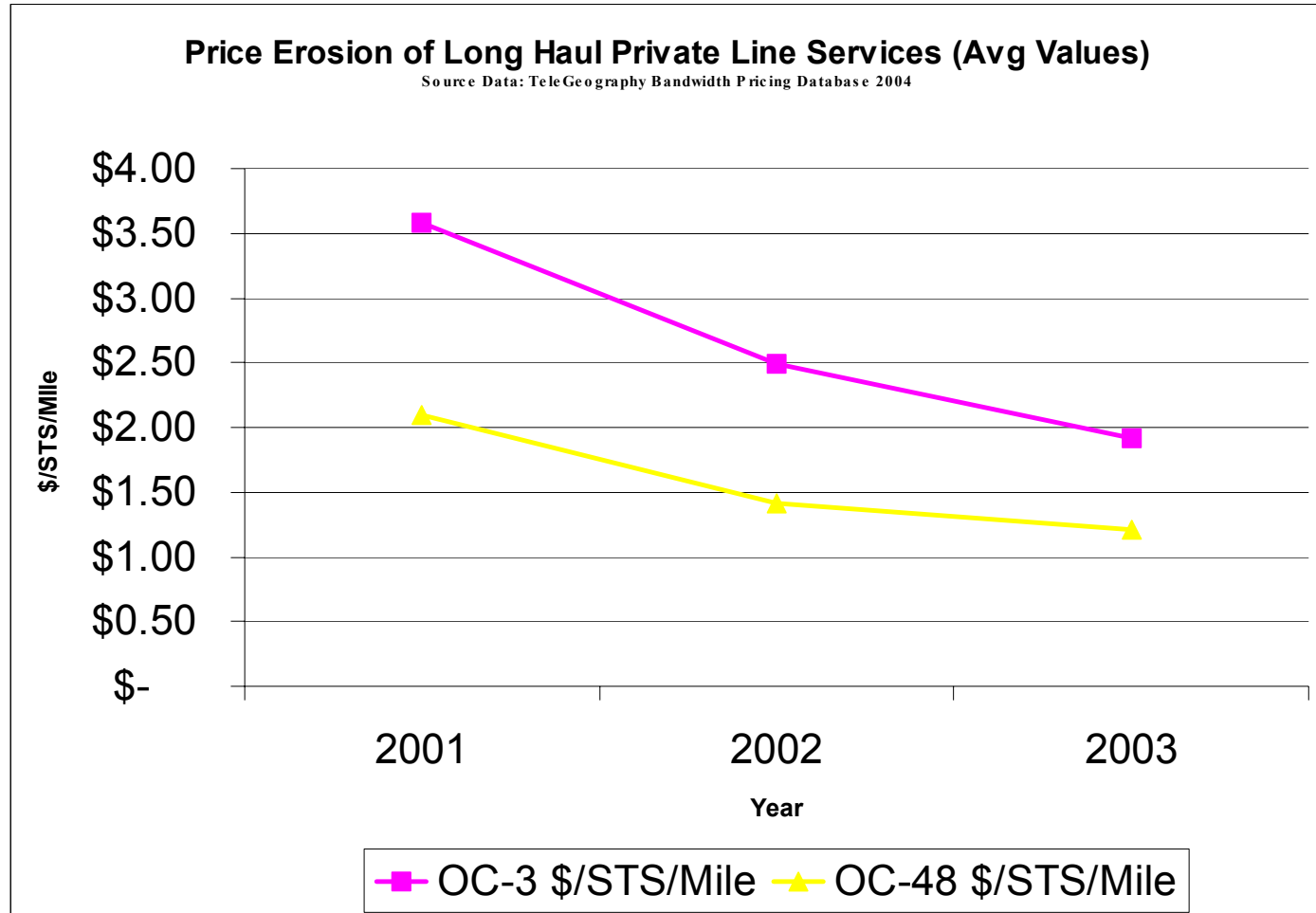
Optical Convergence Value
- 68% more bandwidth (155 Mbps vs 92 Mbps)
- 37% cost savings ($6500 vs $10300 diverse)
- Ability to allocate bandwidth between SAN and LAN

Carrier Affordability of SONET Services

Price Erosion of Long Haul Private Line Services (Avg Values)
Source Data: TeleGeography Bandwidth Pricing Database 2004

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Wrapup

Delivering on the Promise

Cost-Effective SONET

- Private build → converged networking
- Carrier Services → declining prices, ubiquitous availability
- GFP/VCAT → reduce TCO with efficient network utilization

Enabling Disaster Recovery & Business Continuity

- SONET as data service
- Extension to 000's km
- Deterministic optical networking

Driving Customer End-to-End Solutions

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