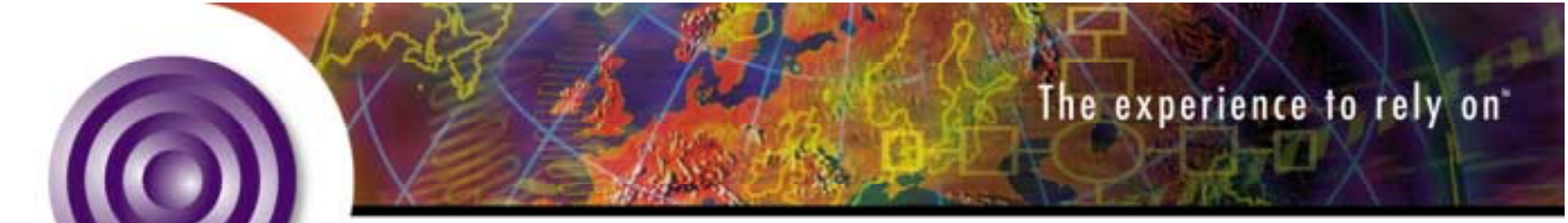

Enterprise SAN Fabrics
2001

Peter T. Dougherty
Director, Strategic Marketing
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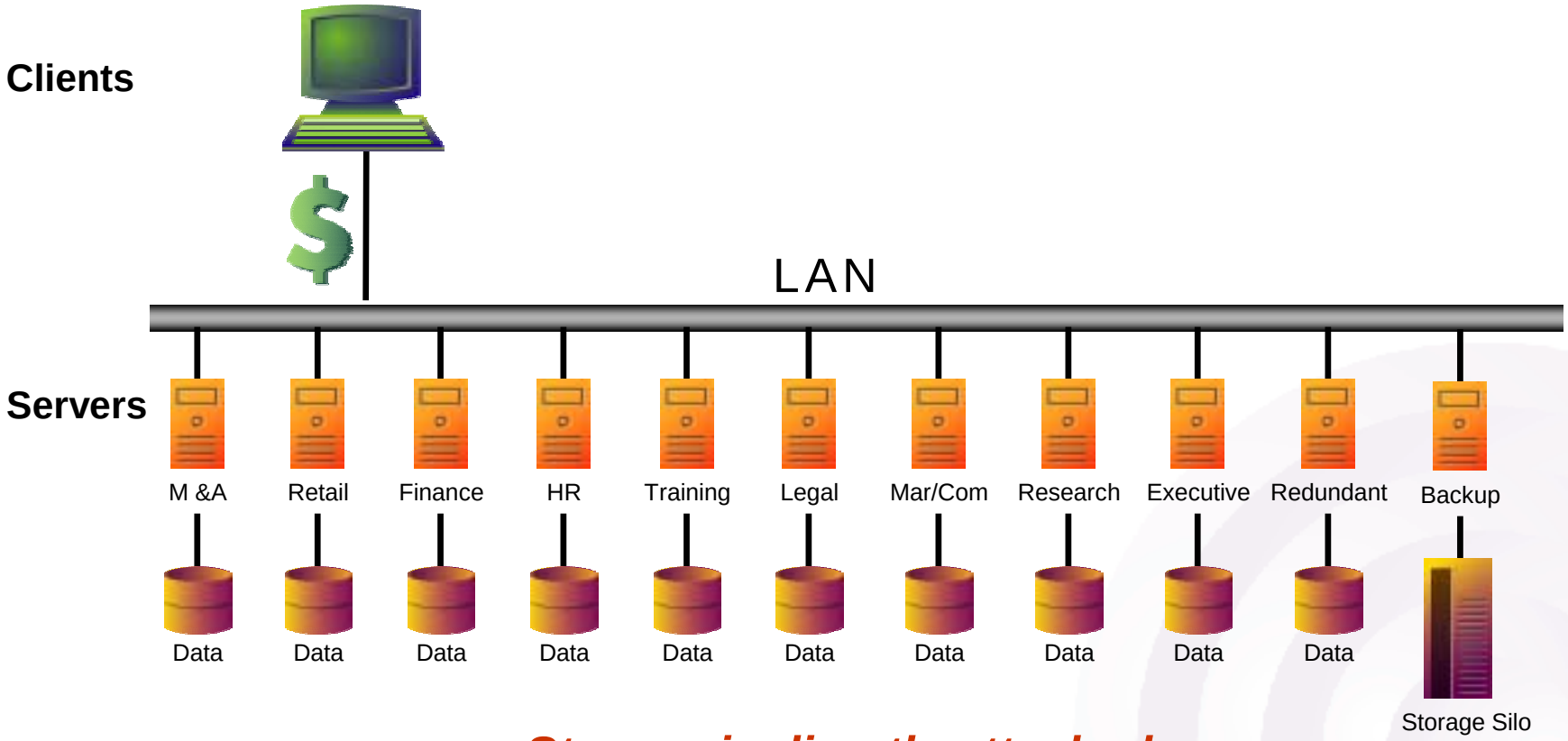
(pdougherty@mcdata.com)

Why Storage Area Networks?

- Information available anywhere, anytime
- Business continuance with 99.999% uptime
- Lower management costs
- Higher asset utilization
- More effective growth management
- Peak performance

Legacy Storage Architecture

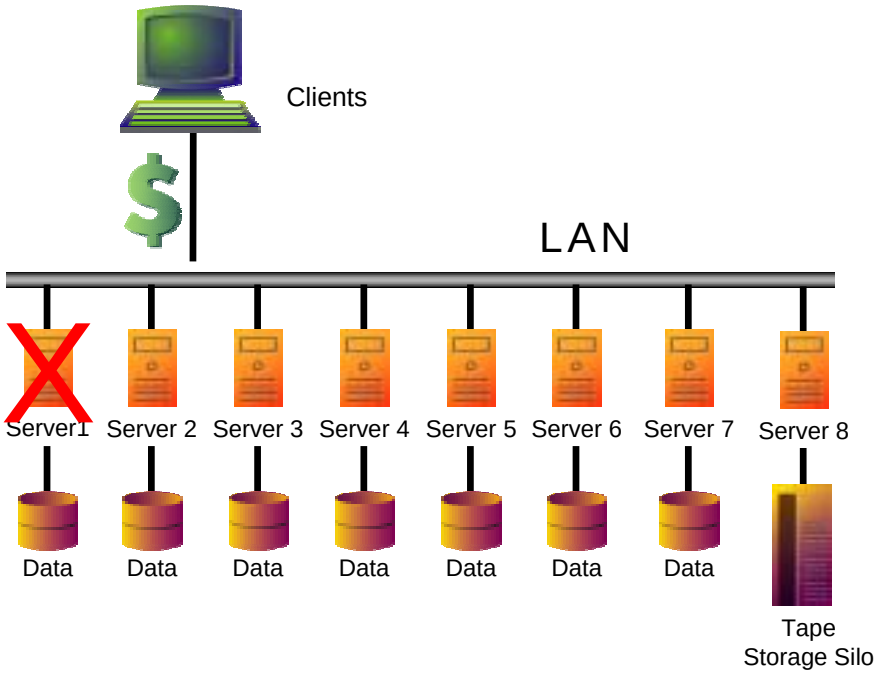
Example: Investment Bank



Storage is directly attached to specific group servers

Legacy Storage Issues

Example: Investment Bank

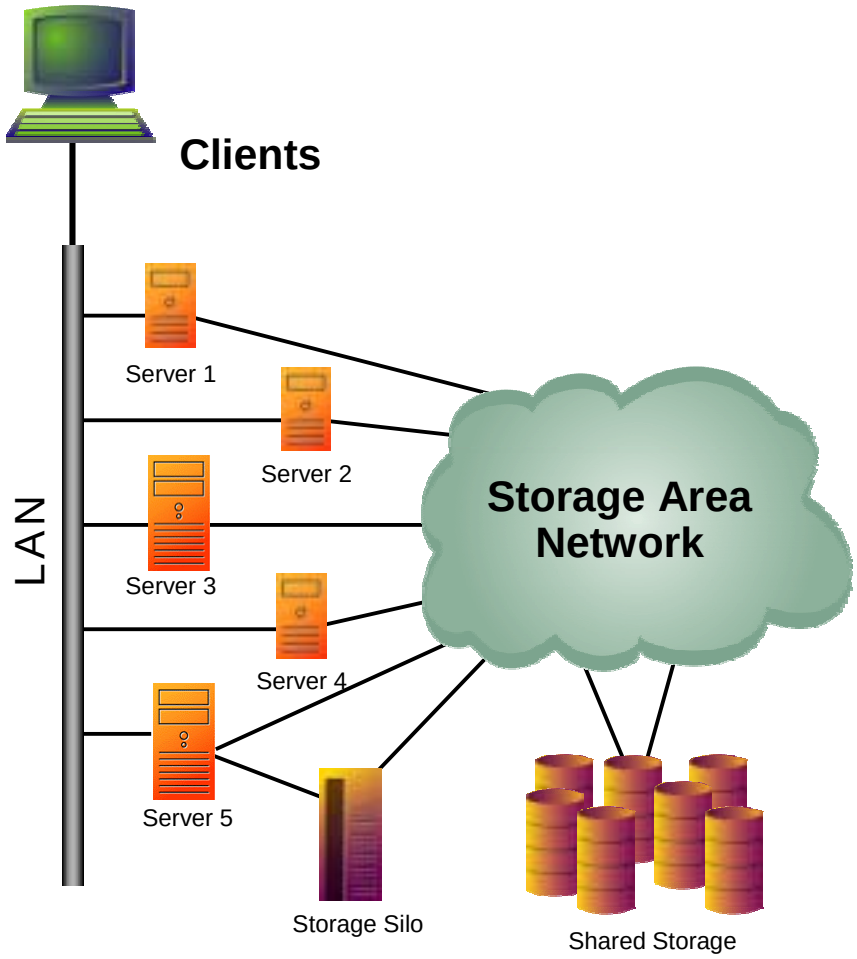


Direct attach storage model difficult to scale

- Lack of data availability
- Poor asset utilization
- Increased management
- Inability to share data
- Compromises disaster tolerance ability
- Performance degradation
- Distance limitations

Storage Area Networks (SAN)

Example: Investment Bank

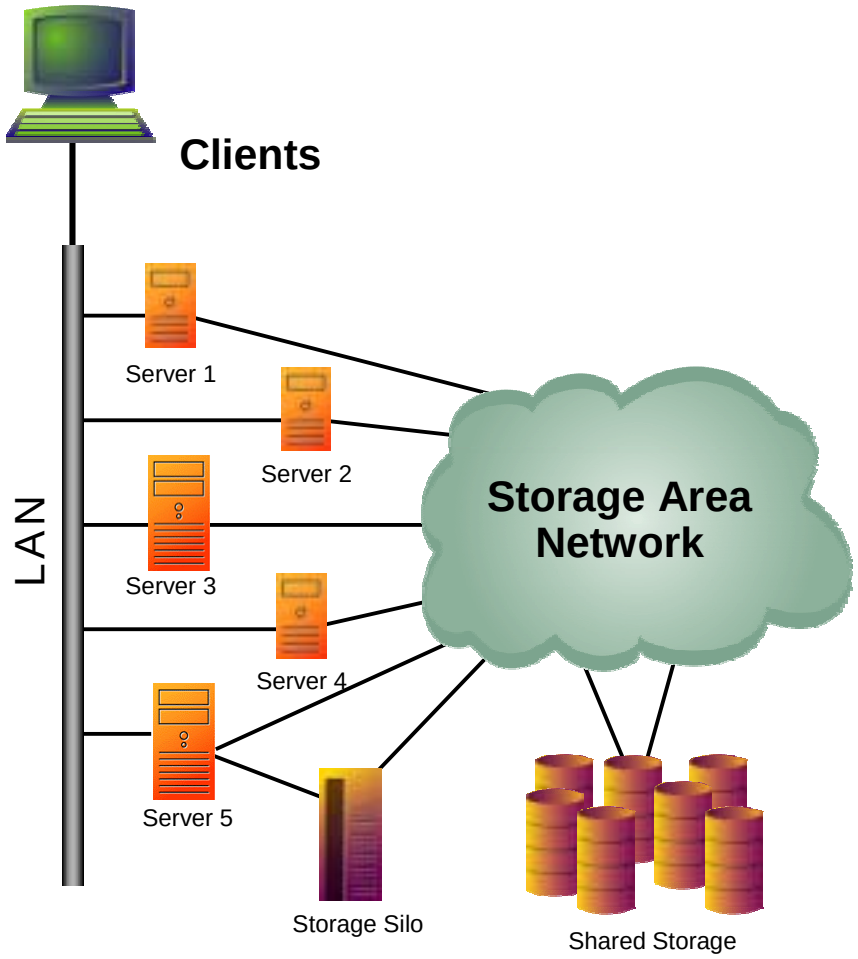


Proposed Infrastructure

- All data is replicated to a secondary onsite server
- Storage limitation is removed allowing for fewer amounts of servers
- SAN migrates data to near-line storage thereby freeing up valuable resources

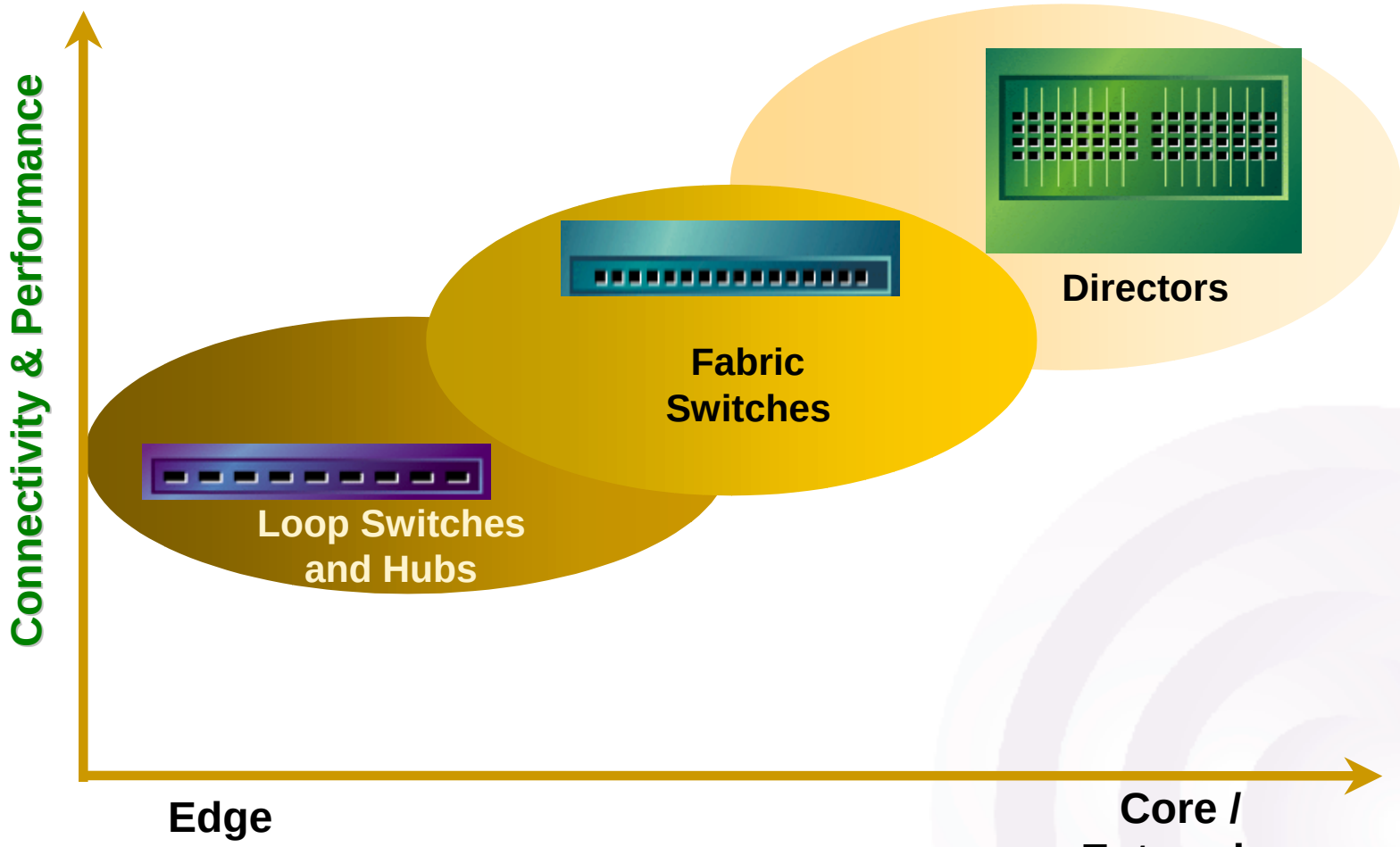
SAN Deployment

Example: Investment Bank



- Improved Performance
- Improved Availability
- Higher Asset Utilization
- Storage Consolidation
- Higher Scalability
- Easier Manageability

SAN Connectivity Options

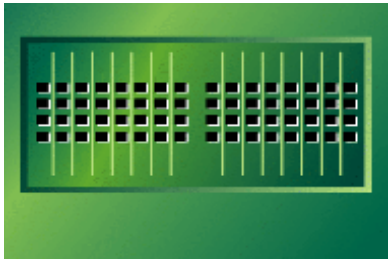


Fabric and Loop Switches

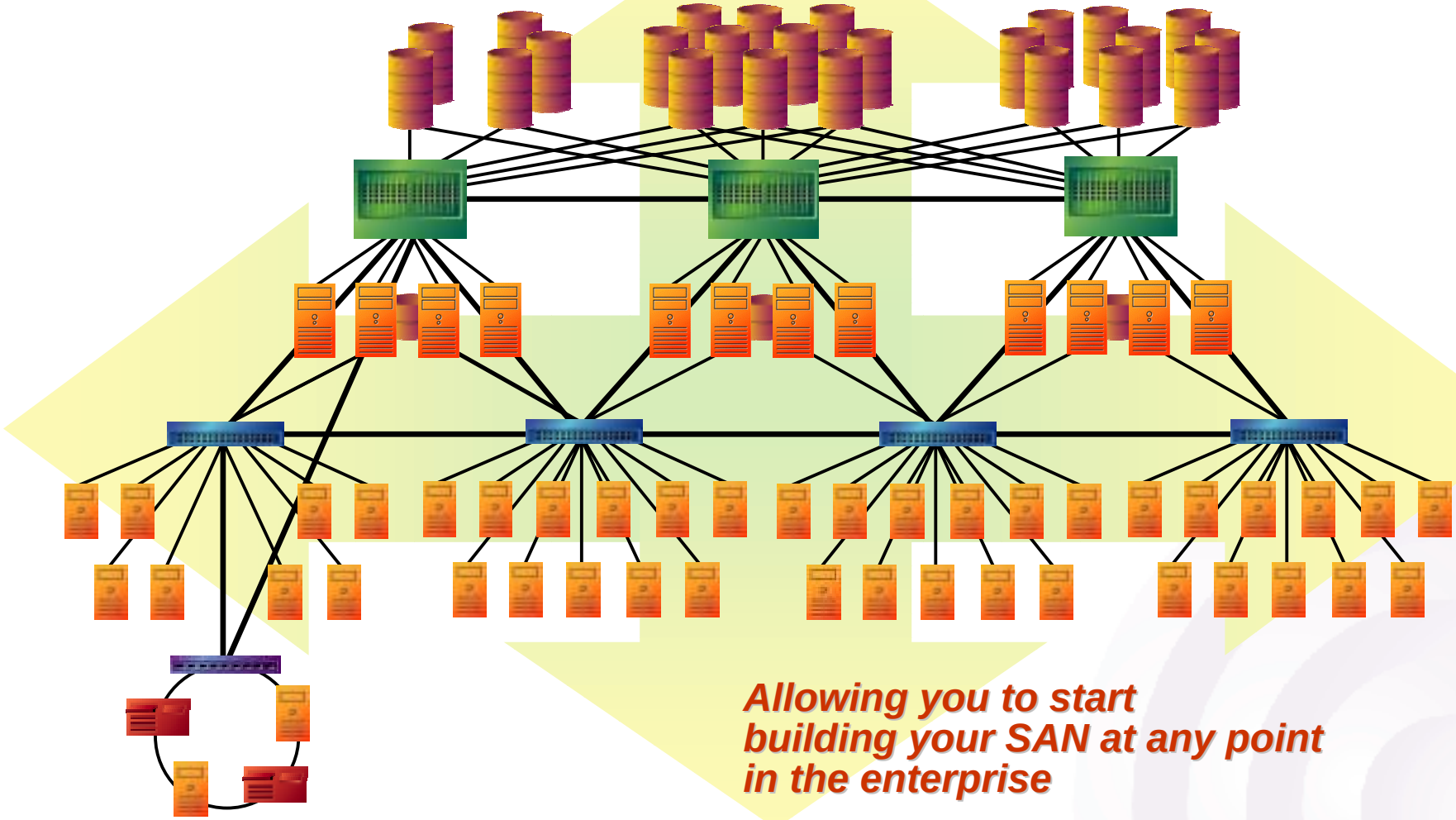
- Vendor-Specific
  - Wide range of fabric and loop switch products
- Availability
  - Fabric Switch: 99.9% (8.8 hours / year)
  - Loop Switch: 99.9% (8.8 hours / year)
- Any-to-Any Connectivity
  - Fabric Switch: 16 to 32 any-to-any ports
  - Loop Switch: 8+ ports, shared bandwidth
- Scalability
  - Fabric Switch: scales via ISLs
  - Loop Switch: limited to 126 nodes

Directors-Class Fibre Channel Switches

- Availability
  - Director: 99.999%
    <5 minutes of downtime per year
- Any-to-Any Connectivity
  - Director: large port count
    Modular growth via field replaceable port card
- Serviceability
  - Director: non-disruptive
    No downtime due to hardware and software service actions
- Scalability
  - Director: superior fabric scaling
    Provides the largest building block for core connectivity



Hierarchical Fabrics



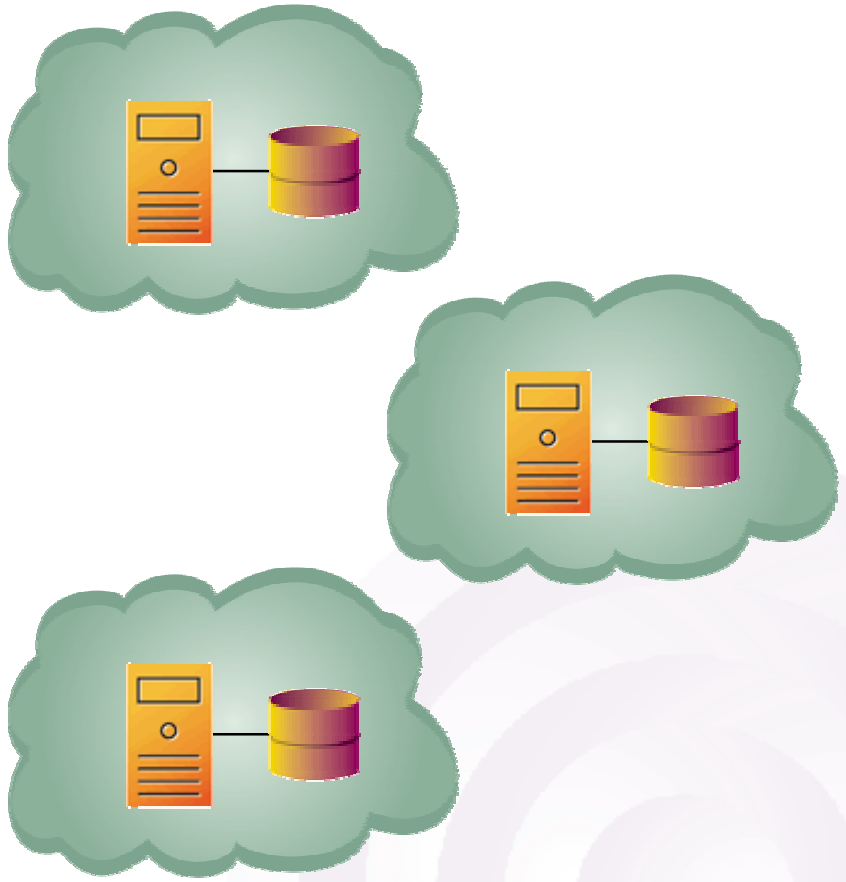
Allowing you to start building your SAN at any point in the enterprise

SAN Applications:

Disk Storage Consolidation

Problem:

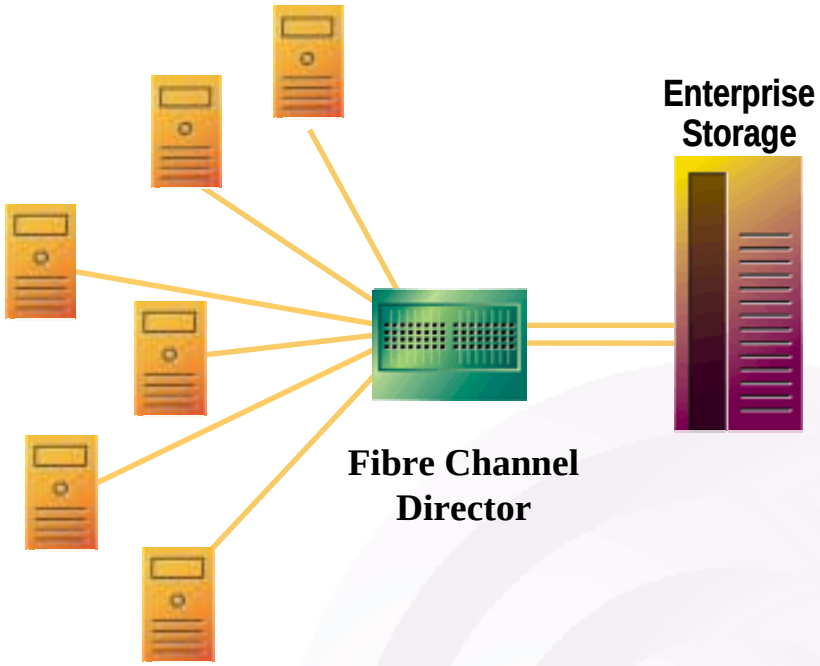
- Distributed servers and storage
- Separate storage management
- Fragmented disk environments -- separate islands of information
- High availability and server fault tolerance requirements



Disk Storage Consolidation

Solution:

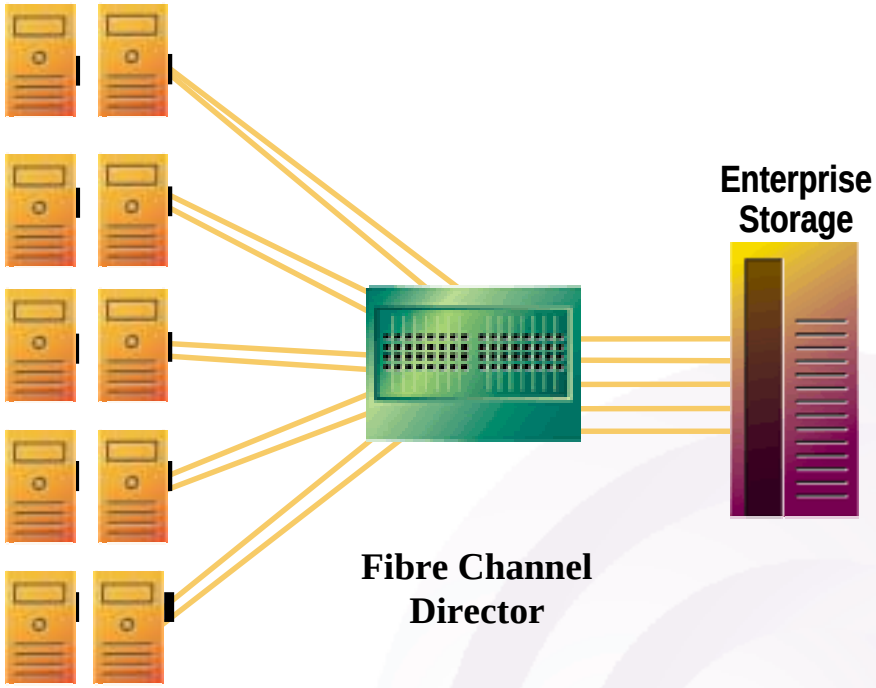
- Flexible connectivity/configuration
- Improved asset utilization
- Capacity on demand
- Enhanced manageability
- Lower operational costs



Server Consolidation

Solution:

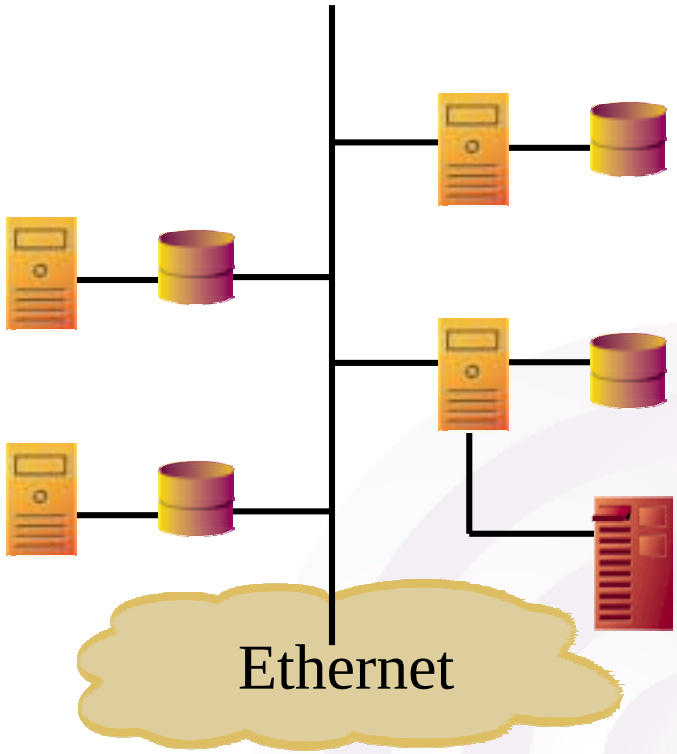
- Add Director / Switch
- Uses current equipment
- No need to purchase additional storage
- Fault-tolerant
- Dual-pathing



LAN-Free Backup and Restore

Problem:

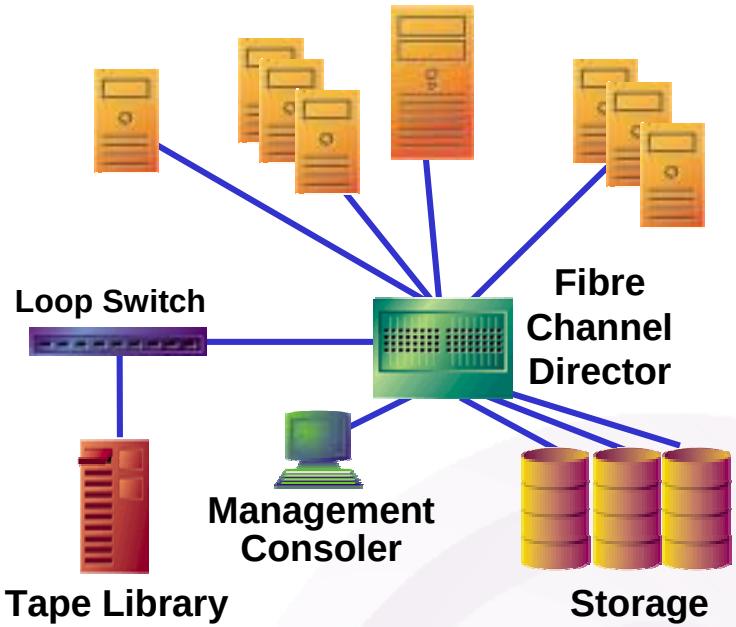
- Need to offload busy LANs and servers
- Shrink backup window
- Need rapid recovery solutions
- Isolated backup “islands”



LAN-Free Backup and Restore

Solution:

- Implement SAN based backup
- Share Enterprise class tape libraries
- High speed SAN data movement
- Minimal impact on production system
- Faster, more effective recovery process



Benefit:

- Reduced backup window
- Free LAN from backup traffic
- Faster, more effective recovery process

Deployment Examples:

Scenario One

Site Assessment

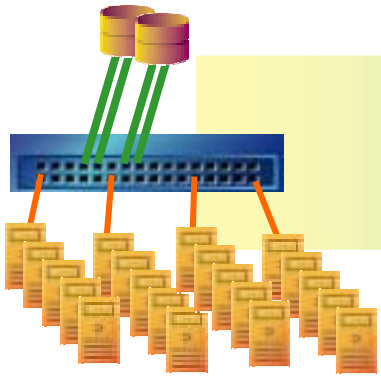
Port count needs	25 end connection ports initially
Growth	100% growth in ports 2nd year
Network type	meshed or SAN islands
Pathing connections	single
Performance needs	moderate
Availability needs	moderate
Current storage/backup	midrange RAID, may expand to tape backup

Scenario One

Option A

Initial Deployment

(1) 32-port Fabric Switch



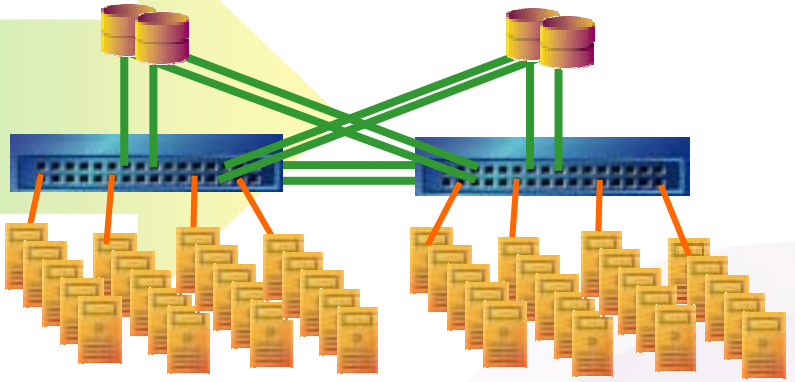
20 Servers

Key Attributes

- Full Any-to-any connectivity
- 8 Open ports
- Single point of failure
- 99.9 % availability

Year 2 Expansion Plan

(2) 32-port Fabric Switches



20 Servers **20 New Servers**

Key Attributes

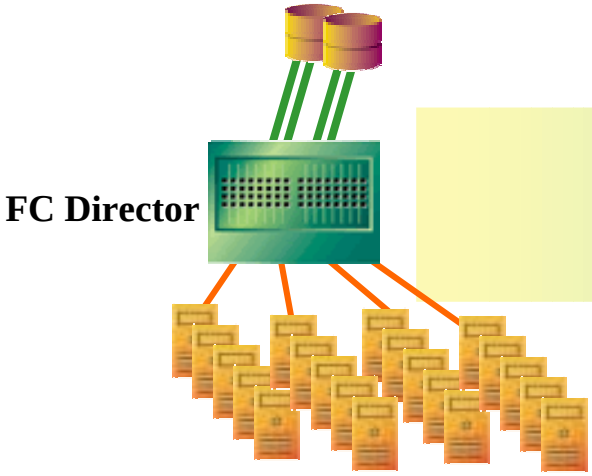
- Any-to-any connectivity
- 12 Open ports
- Can dual path some servers

Scenario One

Option B

Initial Deployment

(1) Director 32-port configuration



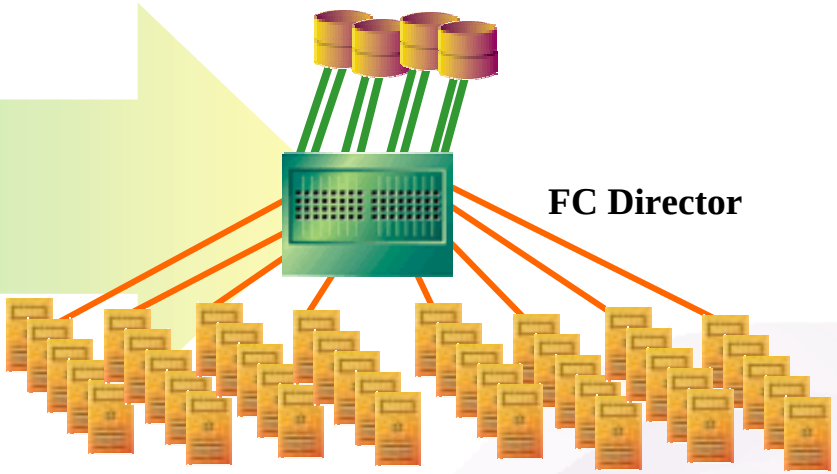
20 Servers

Key Attributes

- 99.999% availability
- Any-to-any connectivity

Year 2 Expansion Plan

(1) Director 64-port configuration



20 Servers **20 New Servers**

Key Attributes

- 99.999% availability
- Any-to-any connectivity
- 12 free ports

Scenario Two

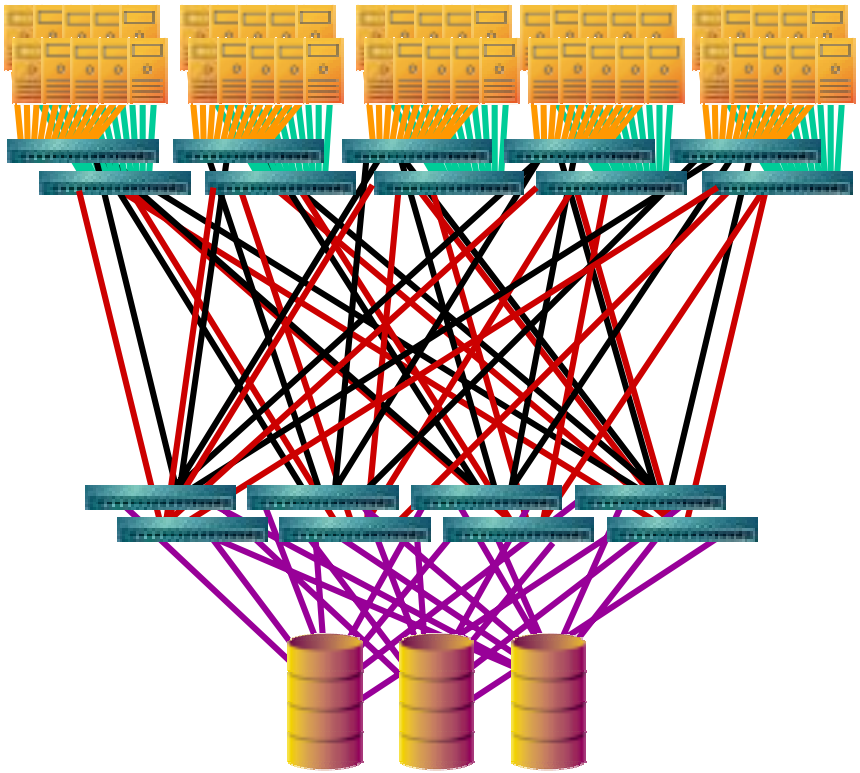
Site Assessment

Port count needs	120 end connection ports initially
Growth	100% growth in ports 2nd year
Network type	fully meshed
Pathing connections	dual
Performance needs	high
Availability needs	high
Current storage	enterprise-class RAID

Scenario Two

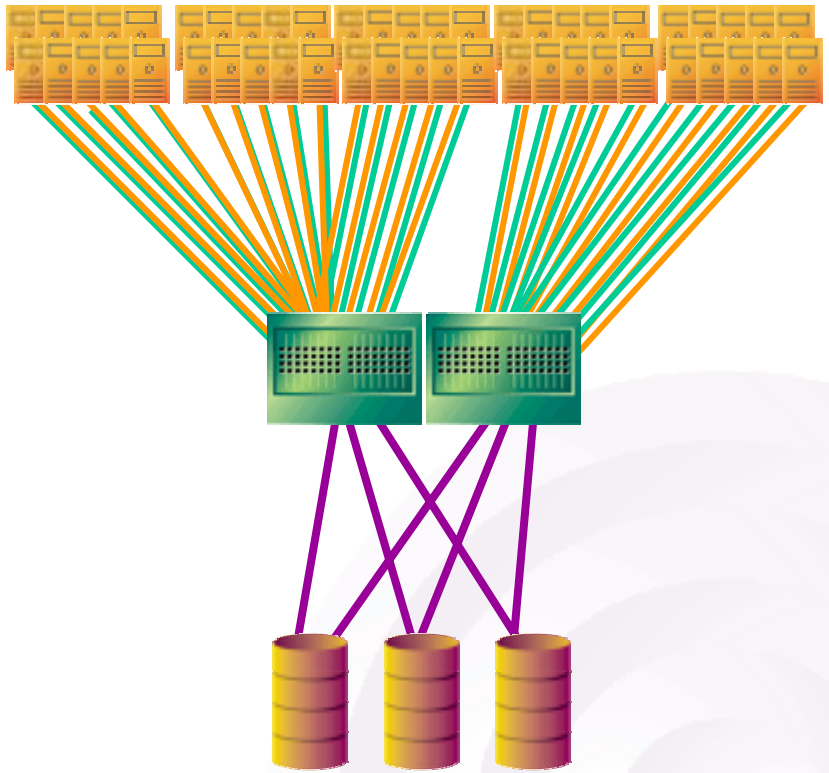
Adding the Devices

Switch Fabric



Enterprise Storage

Director Fabric



Enterprise Storage

Value Proposition —

Comparison

	Switches	Directors
Availability (Uptime)	approx 99.9%	99.999%
% Throughput affected by a failure	Up to 50%	0%
Management Complexity	18 Devices	2 Devices
Service Down Time	Replacement = 1 hour (best case)	0 minutes
Cost	$567,000	$491,000

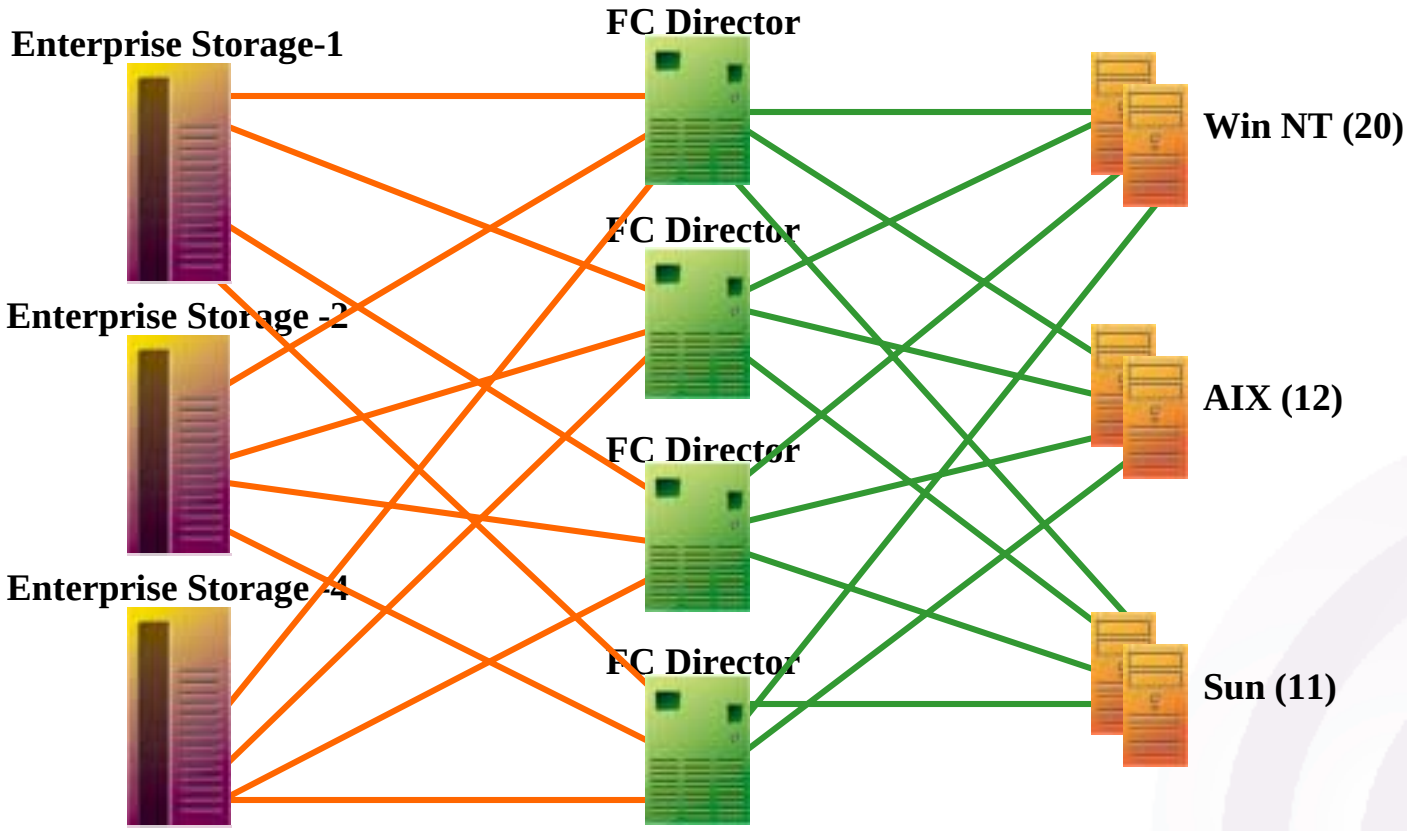
Scenario Three

Site Assessment

Implemented SAN	**90** end connection ports initially
Growth	100% growth in ports 2nd year
Network type	fully meshed
Pathing connections	dual
Performance needs	high
Availability needs	high
Current storage	enterprise-class RAID

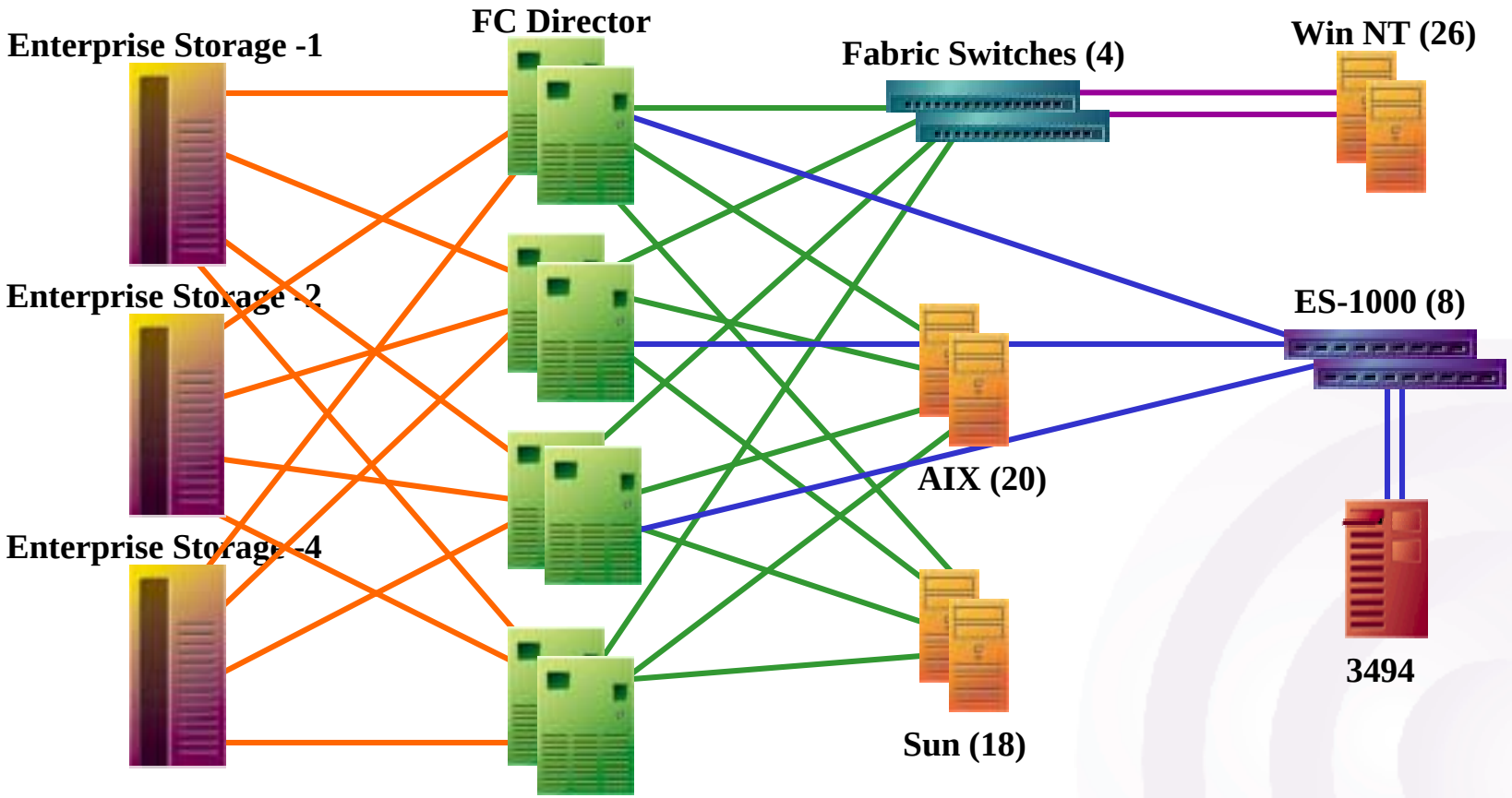
Large National Insurance Company

Phase 1 — Complete 2/01/01



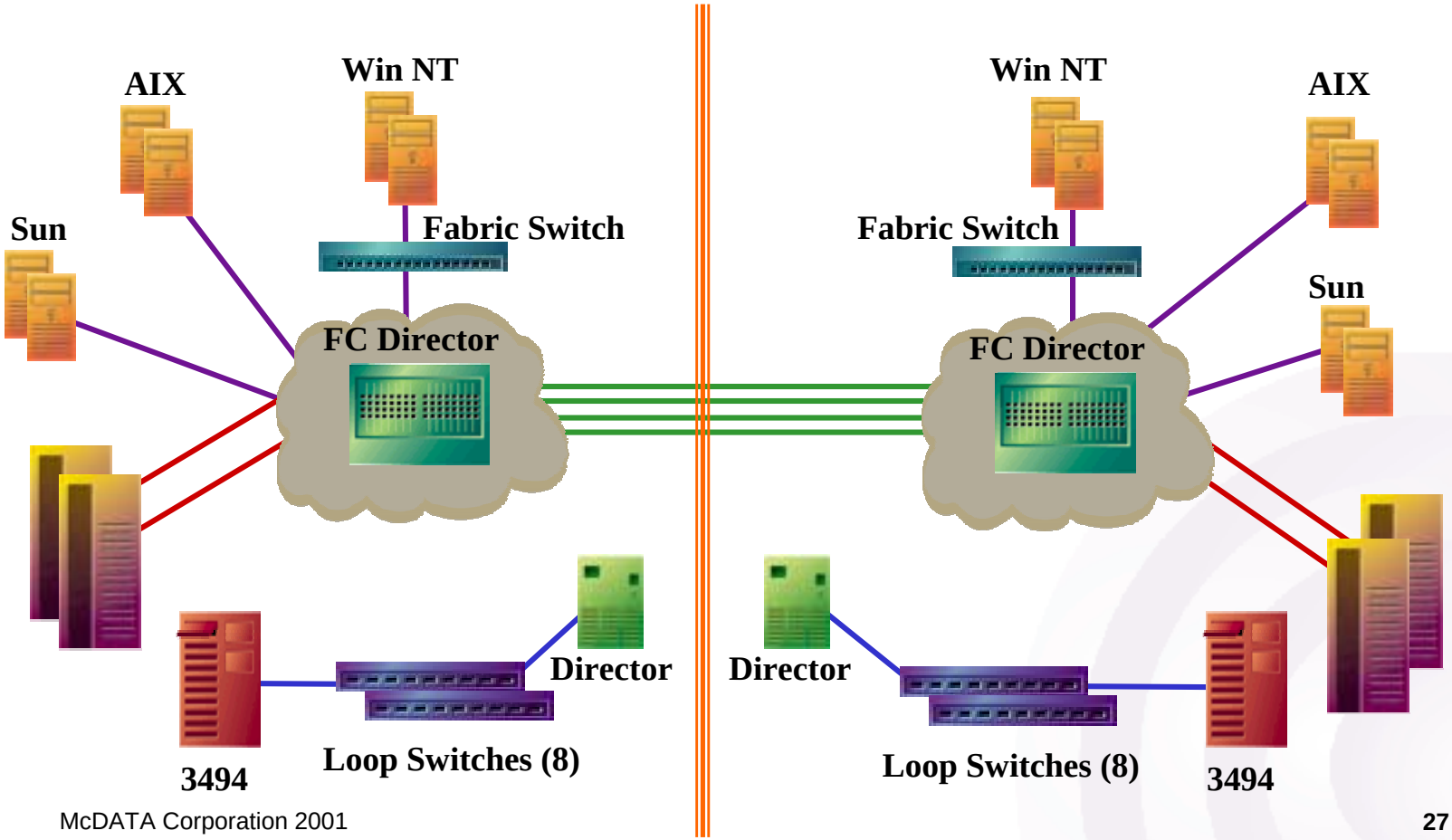
Large National Insurance Company

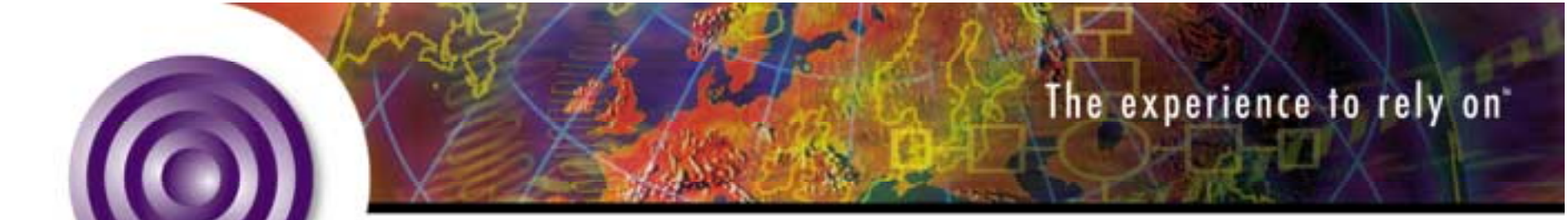
Phase 2 — Expand backbone, integrate SAN tape backup



Large National Insurance Company

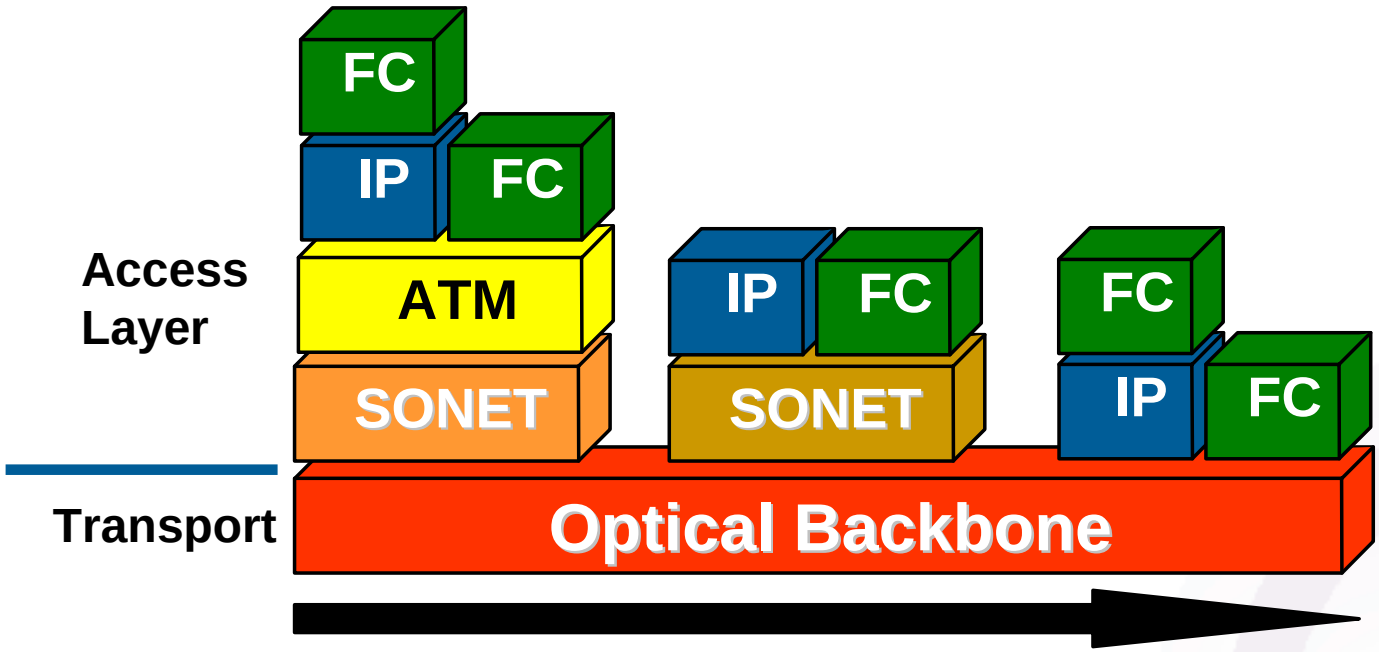
Phase 3 — Expand to all data center servers





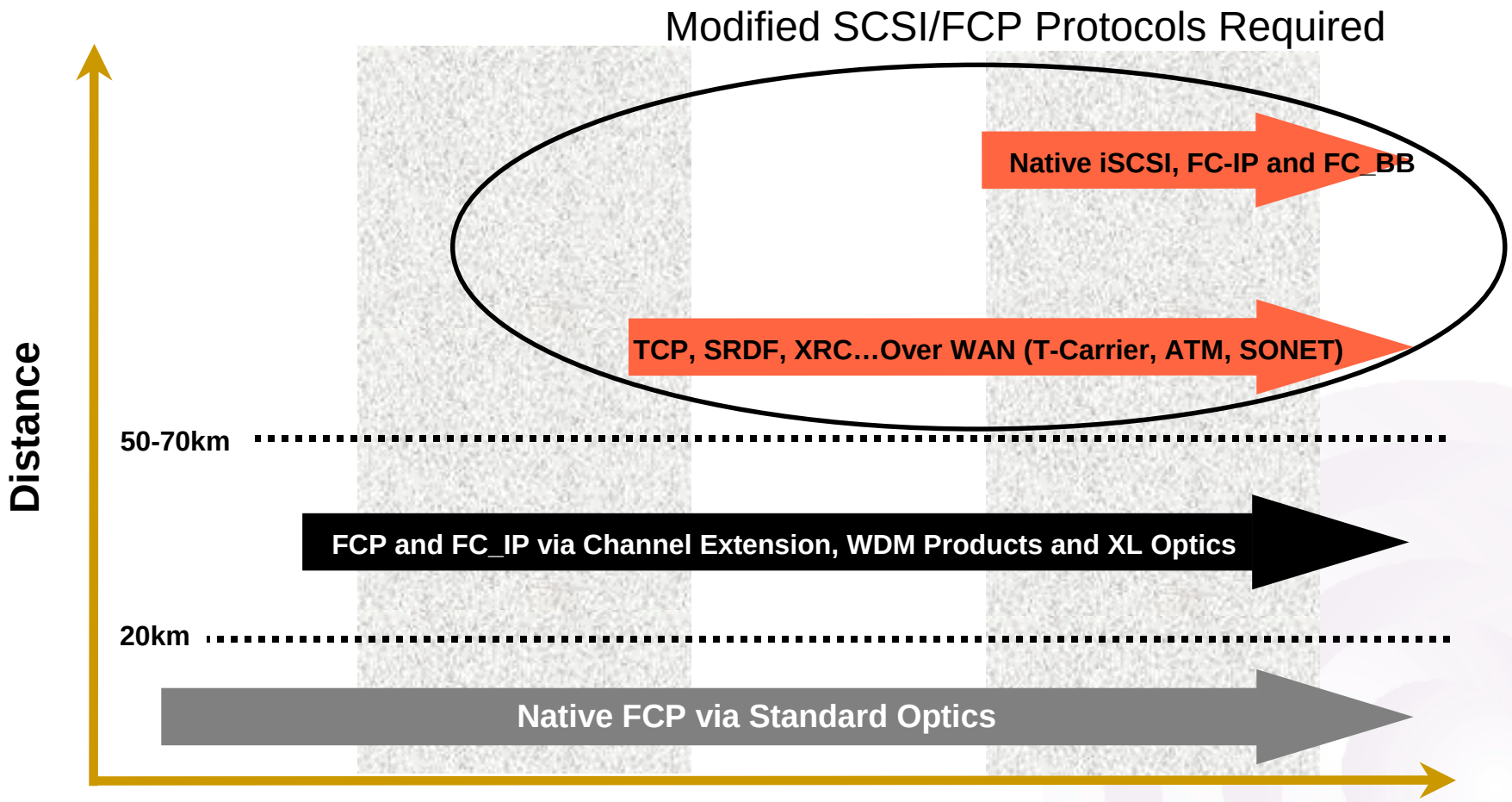
Advanced Topics:
Extended SAN Connectivity

Transport and Access Migration

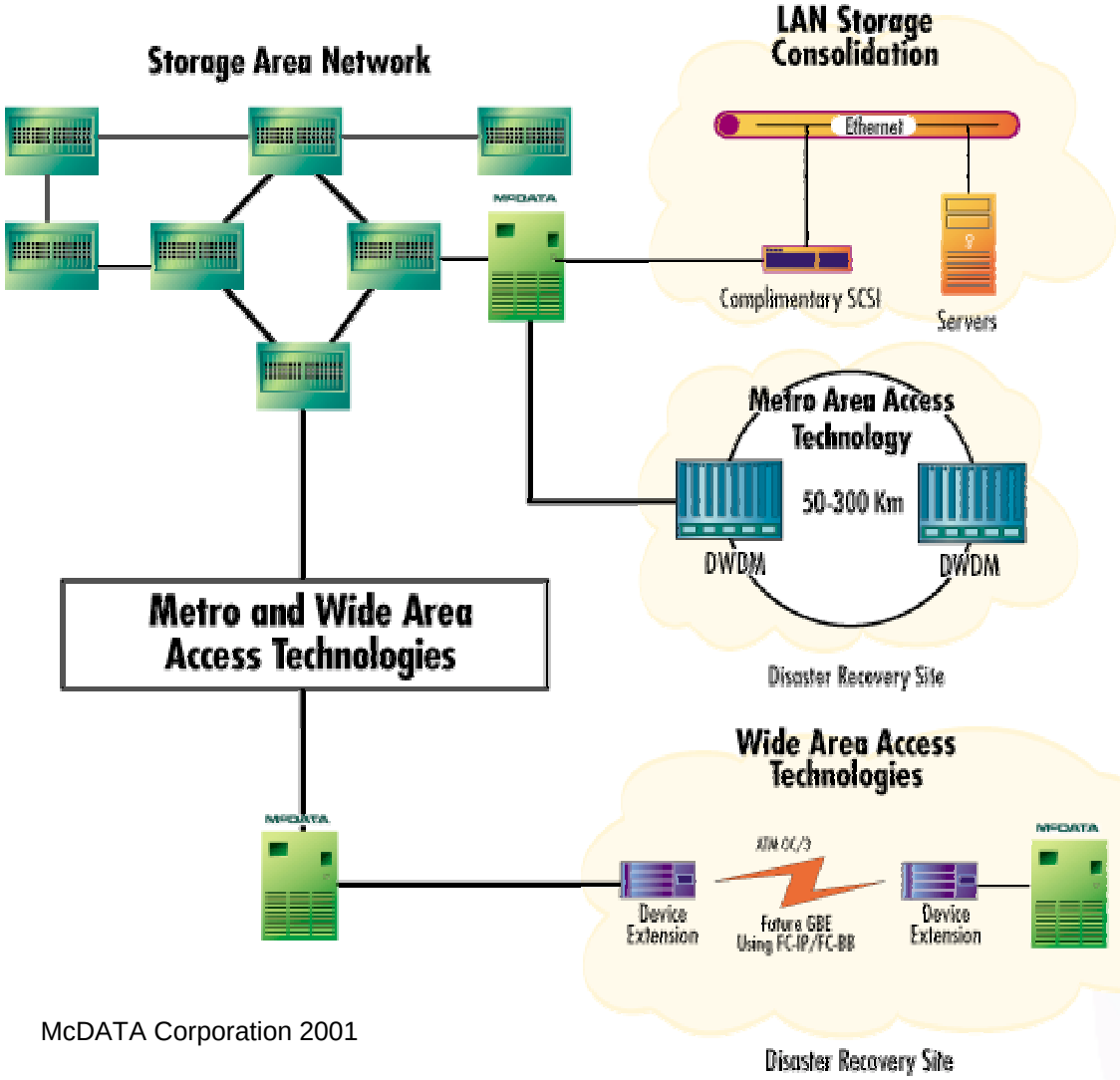


Lower Cost, Complexity, and Overhead

SAN Protocol Applicability



Connecting SAN-MAN and WAN to Open Storage

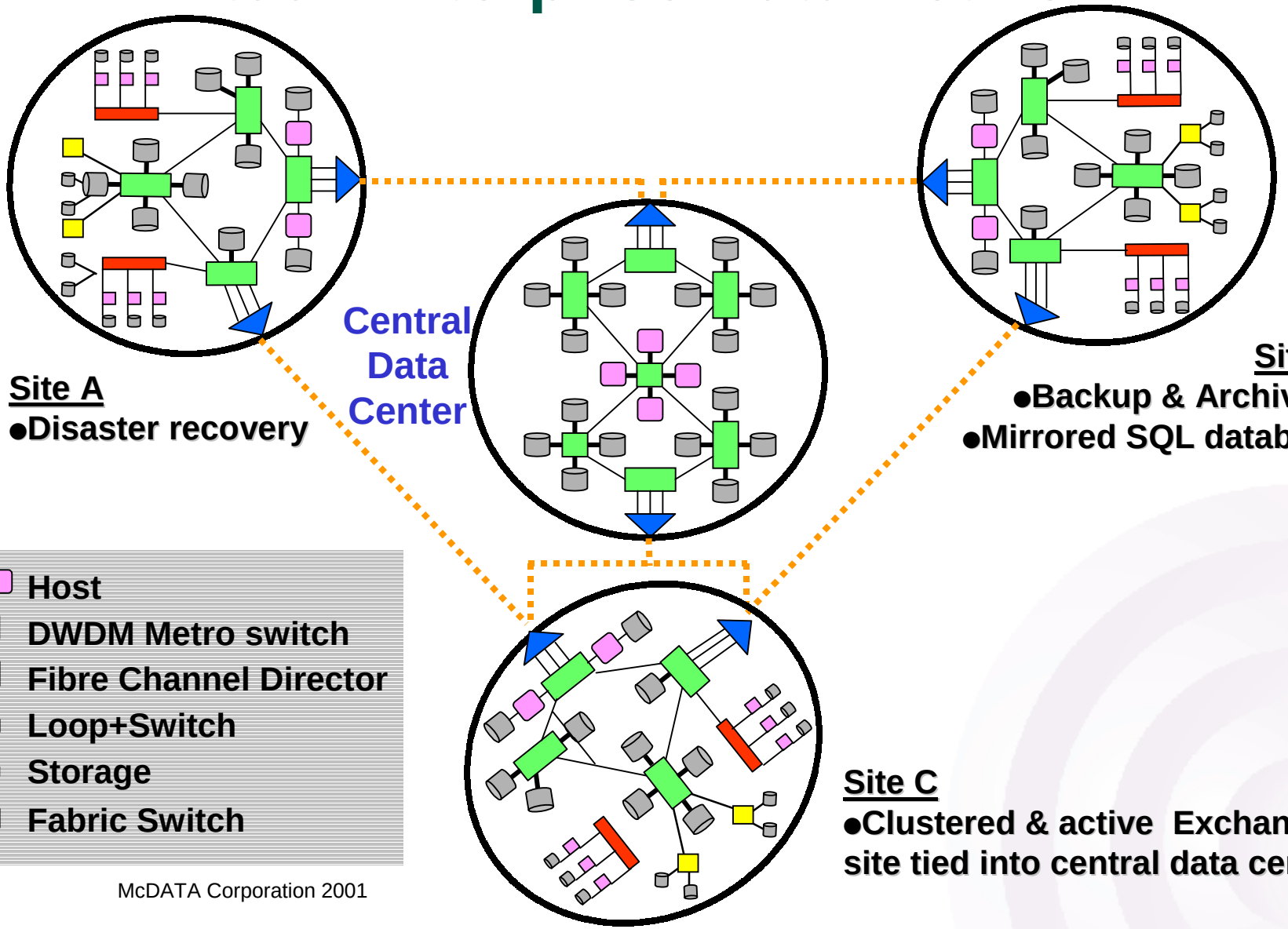


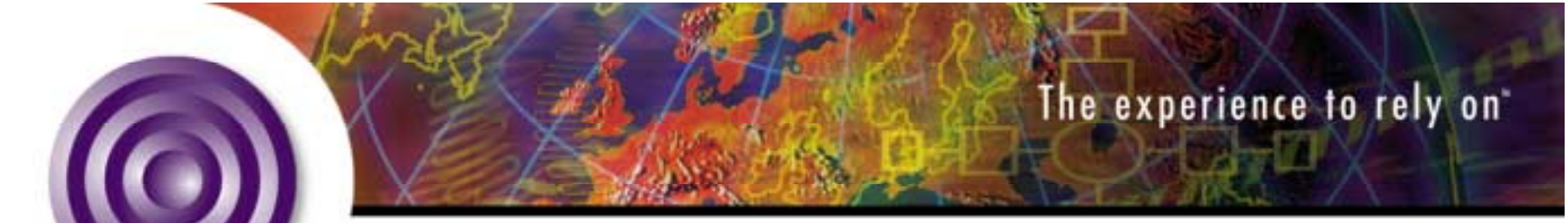
SAN-to LAN
- iSCSI

SAN-to MAN
- FC IP

SAN-to WAN
- Channel Extension
- DWDM

Virtual Enterprise Data Network





Advanced Topics:
SAN Security

Why SAN Security ?

- Growing number of nodes in Fabric
  - 1000's of ports in a Fabric (and growing!)
- Expanding SAN Business Models
  - xSP Environments
    - *Multiple clients under one SAN*
    - *Lots of storage dictates need security*
  - Storage Appliance Environments (Shift in Storage Management)
  - WAN Deployment
- Increased Fabric Services Functionality
  - Not just SNMP Monitoring
- Multiple Management Applications
  - Who Controls the SAN

Classes of SAN Security

- Security Techniques for Configuration
  - Guarding against unknown SAN H/W changes
  - Securing known configurations
- Server to Storage Access
  - Controlling what Storage a Server can access
  - Segregating SAN Resources
- Secure Fabric Servers access
  - Management Server
  - Name Server
  - Used by SAN Management Apps

SAN Configuration Security

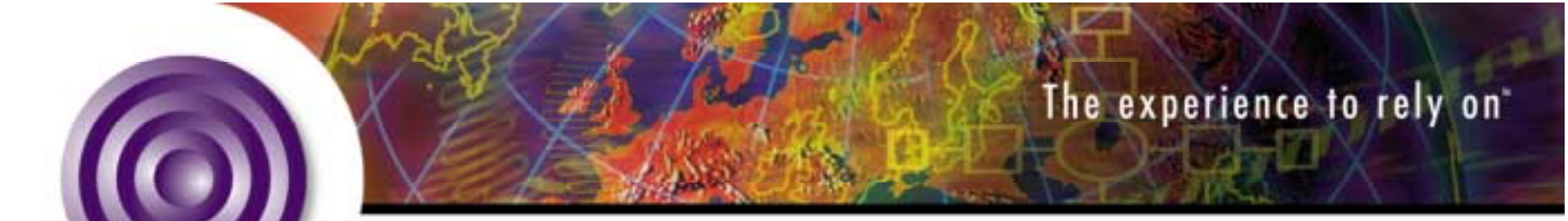
- Switch Port Binding
  - Guards against unauthorized Server attachment to a SAN
  - Only one configured WWN per port
- Fabric Membership Authorization
  - Protects against unauthorized Switches in a fabric
  - Only configured switches allowed in a fabric
- Port Type Configuration
  - Controls director's automatic port configuration
  - Configure switch port as:
    - *E_port only*
    - *G_port only*
    - *F_port only*

Server to Storage Security

- Zoning
  - Partitioning and Controlling Access to devices
  - Like VPN's
  - Organized as groups of WWN's in a zone
- Soft Zoning
  - Exposes selected views of name server entries to clients
  - Sometimes referred to as Simple Name Server Zoning
- Hard Zoning
  - Hardware enforcement of Soft Zoning
  - Enforced via route forwarding logic
  - Only frames within a zone are forwarded
- HBA Port Binding
  - Binds LUN's to a particular port
  - Enforced at HBA Driver

Fabric Server Authorization and Authentication

- Secure Access to All FC Servers
  - Grew out of increased Management Server functionality
  - Topology discovery
  - Unzoned Name Server
  - Fabric Zone Server
- Authentication built into protocol
  - New Security Header
  - Each client request has encrypted signature
  - Used to authenticate client
  - Signature is generated from MD-5



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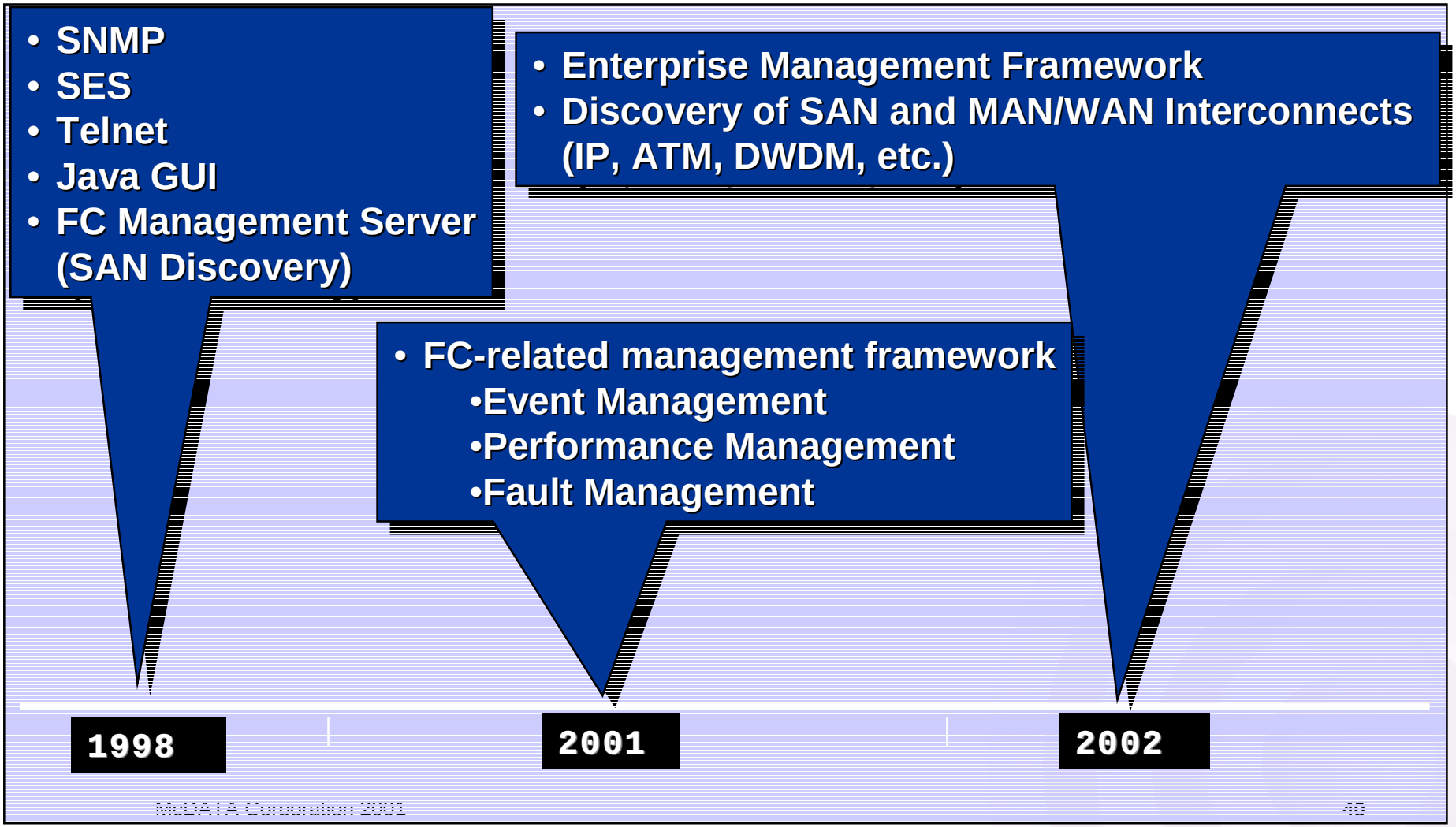
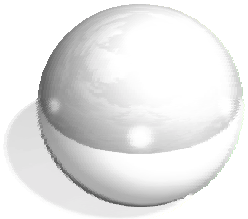
Advanced Topics:
SAN Management

Management Software Evolution



Management Software

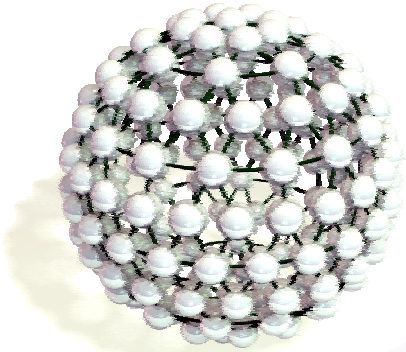
Embedded Web Server



Element Management

- Simplified, easy to use
- Configuration
- Break/Fix
- Zoning
- For small fabrics

Enterprise Fabric Manager

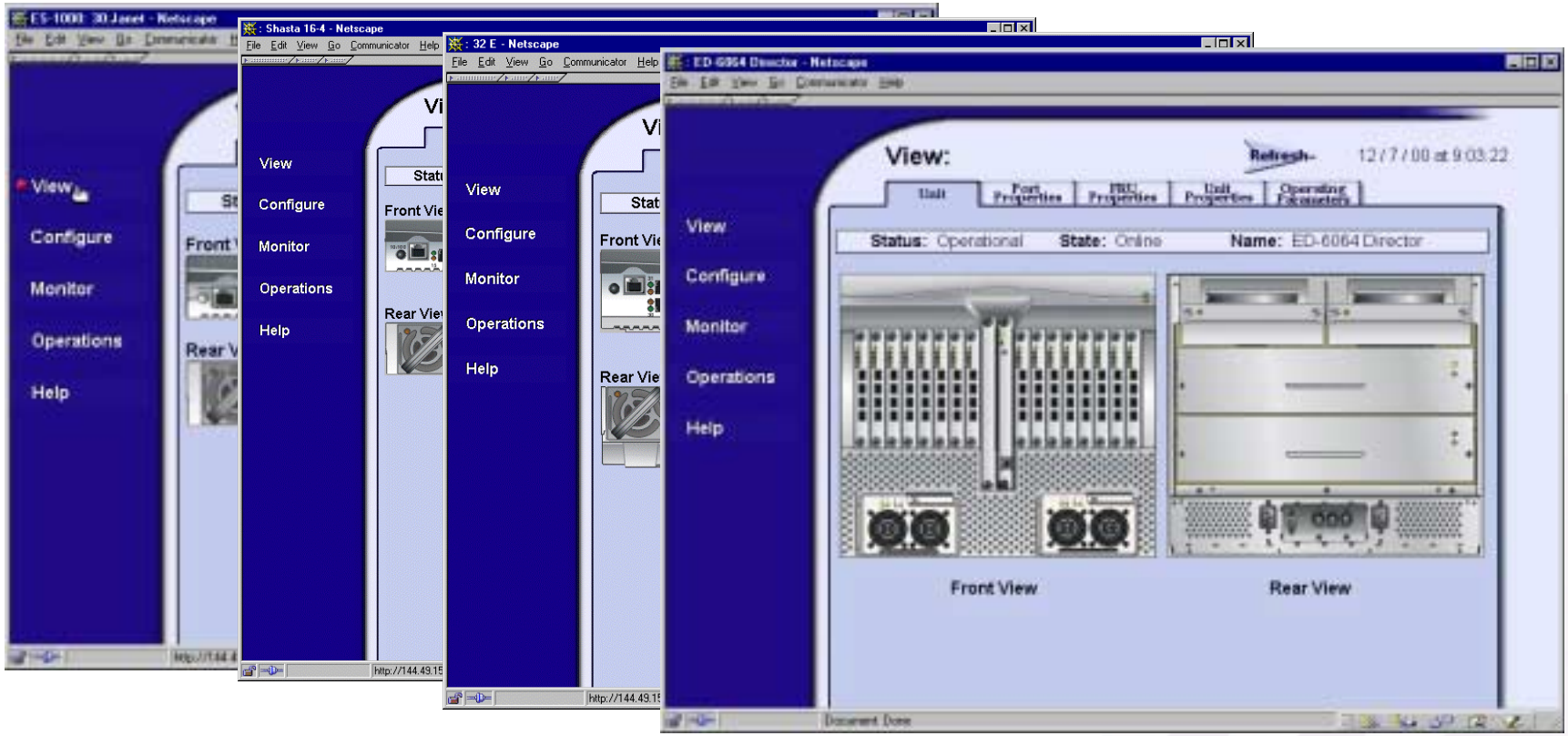


Fabric Management

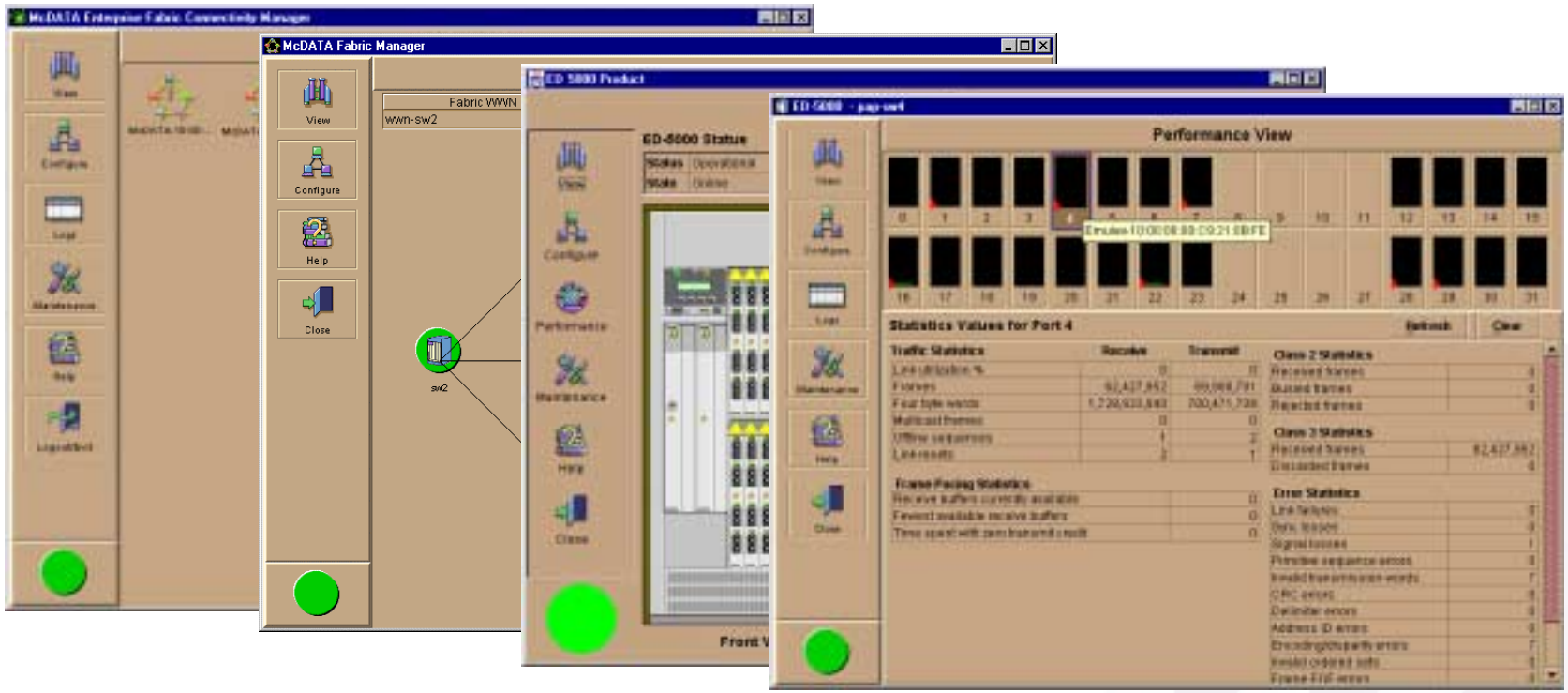
- Event Consolidation
- Scalable to large fabrics
- Highest level of management functionality

Element Management Software

Embedded Web Server



Fabric Management Software



Why Storage Area Networks

SAN's Are the "Network Behind the Network"

- SAN's Enable
  - Information available anywhere, anytime
  - Business continuance with 99.999% uptime
- SAN Benefits Include
  - Lower management costs
  - Higher asset utilization
  - More effective growth management
  - Peak performance

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The experience to rely on™