

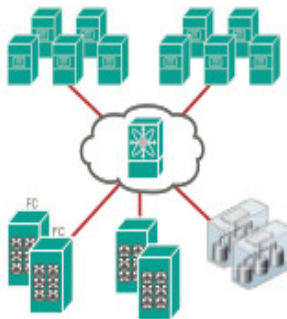


SAN Solution

- Roxana Diaz
- SE PS

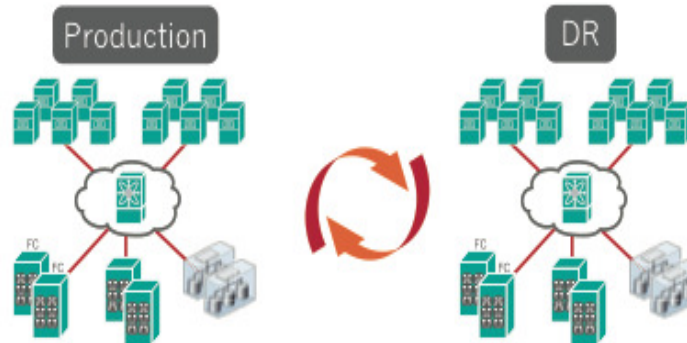


SAN Consolidation



- VSANs & SAN routing (IVR)
- Pools capacity, increases utilization
- Lowers TCO, preserves isolation

Business Continuance/Disaster Recovery



- FC/FICON extension
- FCIP and FC SAN extension
- Compression and encryption of in-flight data

SAN Security



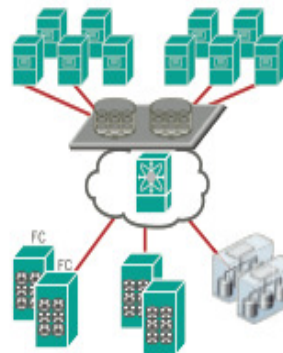
- Encryption of data-at-rest
- Link level FC encryption of ISLs
- Access Control, Authentication, and Authorization
- Addresses compliance and regulatory requirements

Services-Oriented SAN



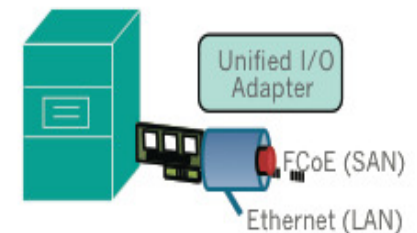
- Any protocol, any speed, any location, any device
- Seamless deployment
- Highly available, clustered solution

VM-Optimized Storage Networking



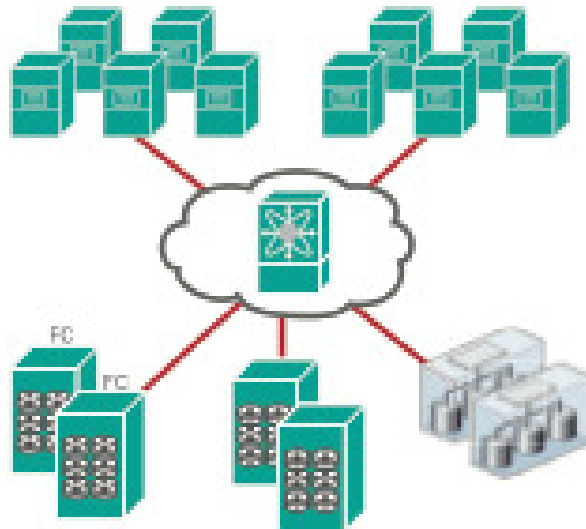
- VM-aware SANs
- VM Mobility, security, QoS
- Per VM policy, visibility

Unified Fabric (FCoE)



- Converged adapter (CNA)
- Simplified cabling & operations
- Reliable FC delivery

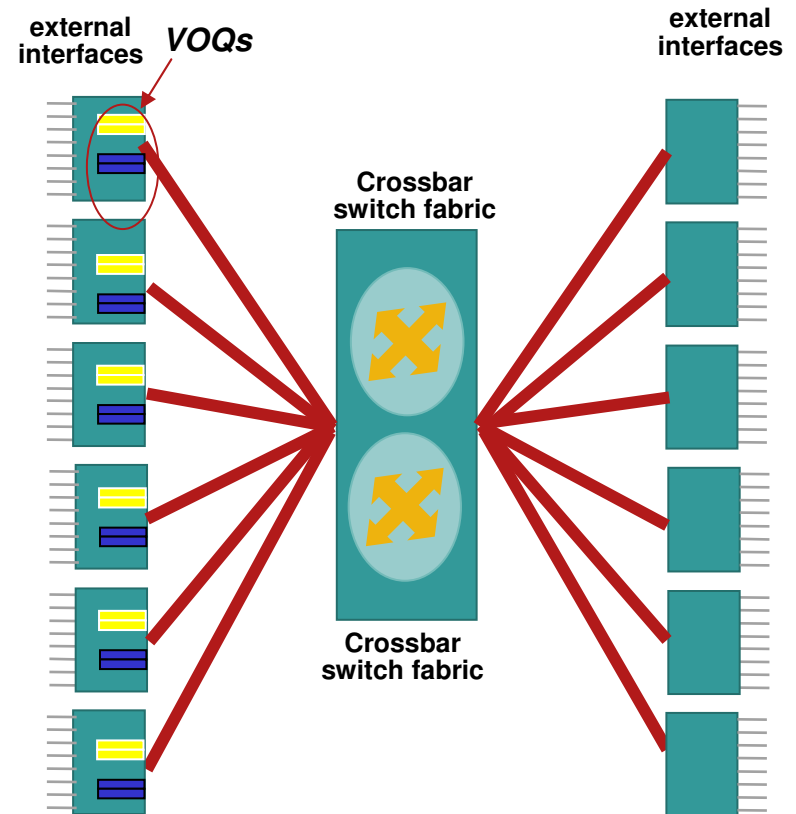
SAN Consolidation



- VSANs & SAN routing (IVR)
- Pools capacity, increases utilization
- Lowers TCO, preserves isolation

High-Performance MDS 9000 Family Switching Architecture

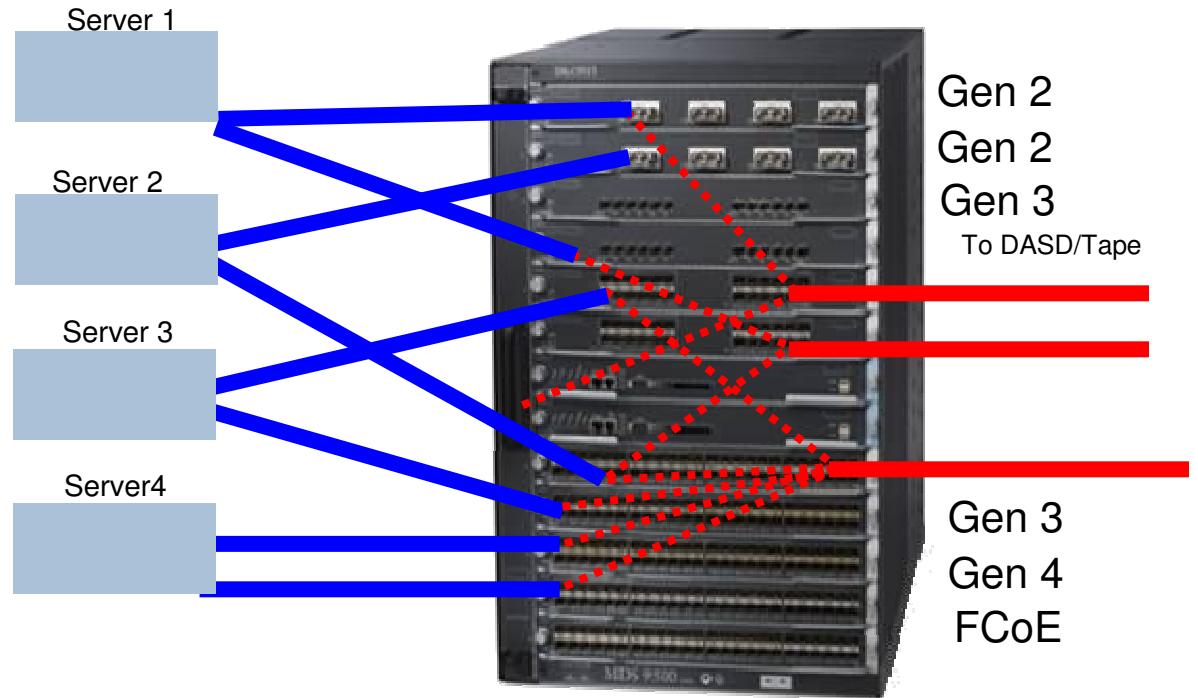
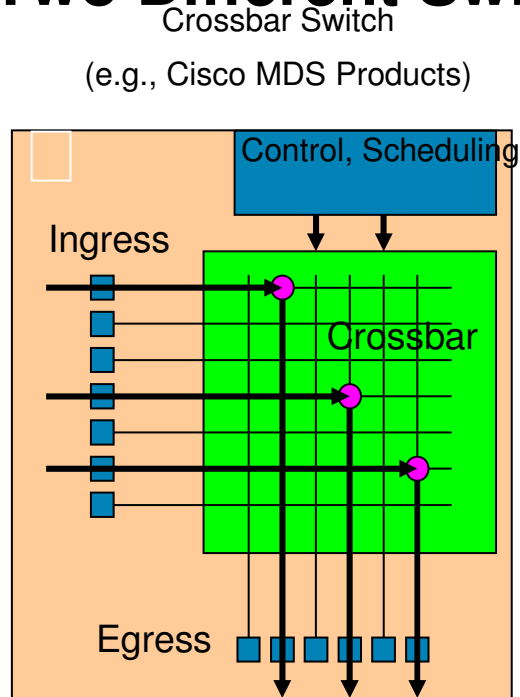
- Crossbar and arbiter architecture designed to provide the best performance in the most difficult traffic conditions
- Virtual Output Queues (VOQs) eliminate head-of-line blocking
- Even and predictable throughput and latency for many-to-one and many-to-few traffic conditions
- 100% wirespeed for both large and small frames
- Fair load-balancing for both large and small frames



Centralized Crossbar switch architecture

Blocking vs non-Blocking

Two Different Switch Architectures



Provides an extremely scalable, high-capacity switch fabric.

A temporary connection is established between and input and output port for the duration of the frame exchange

Uses Virtual Output Queues to completely eliminate blocking

Uses standing arbitration requests to paths that supports queue look-ahead, priority, and provides fair access.

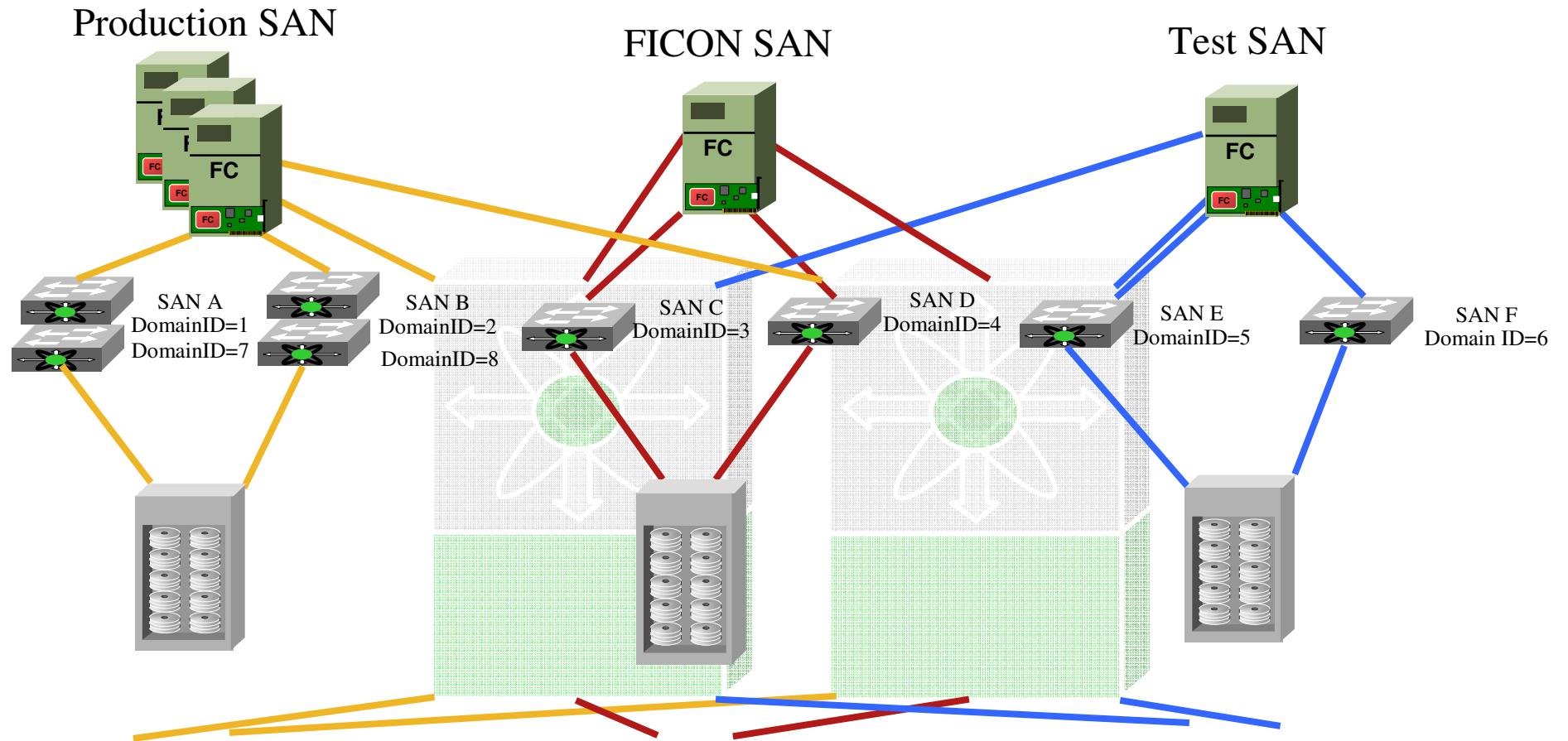
9513 AVERAGE LATENCY (Any-to-Any- port):

Small frames (60-byte): 5.3 - 5.9 microseconds

Large frames (2148-byte): 13-15 microseconds

- Any-to-any connectivity
- Same consistent performance
- Same consistent latency

Virtual SANs (VSANs)



Virtualizing the FC Fabric – The Full Solution

To build a cost saving fabric virtualization solution, 7 key services are required:

Virtual Fabric Attachment – the ability to assign virtual fabric membership at the port level

Multiprotocol Extensions – the ability to extend virtual fabric service to iSCSI, FCIP, FICON, FCoE, etc.

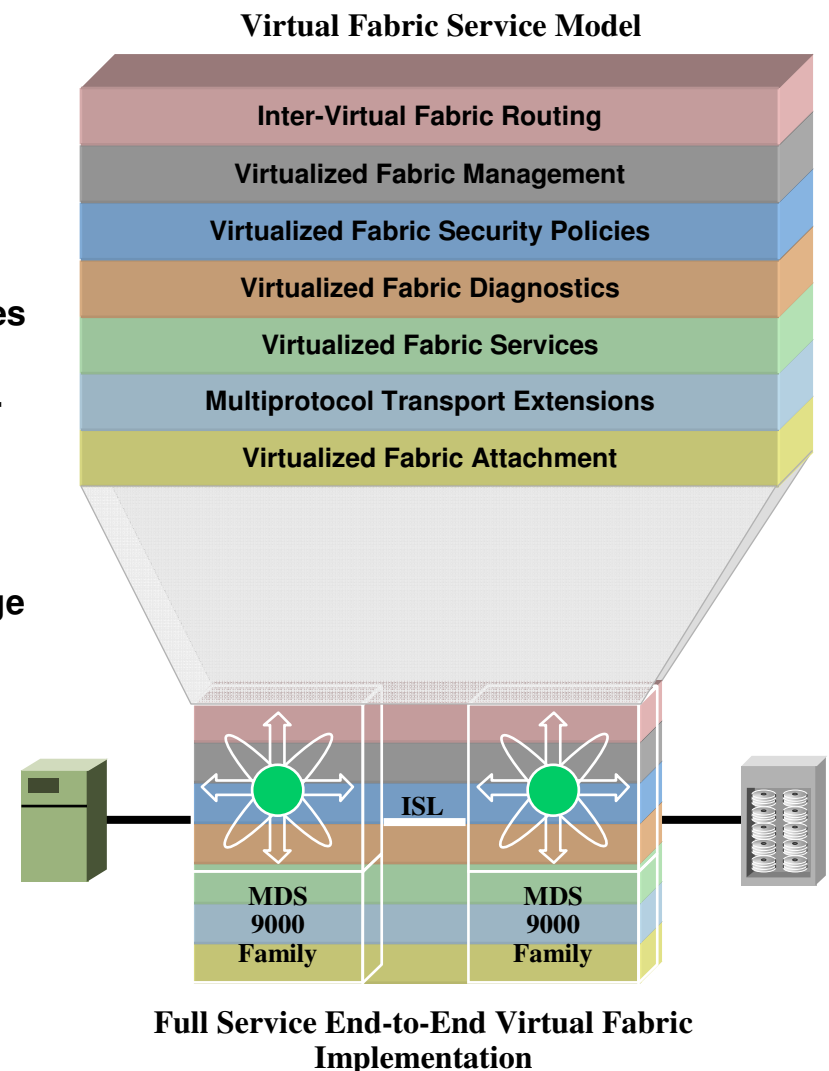
Virtual Fabric Services – the ability to create fabric services per virtual fabric (Login, Name, RSCNs, QoS, etc.)

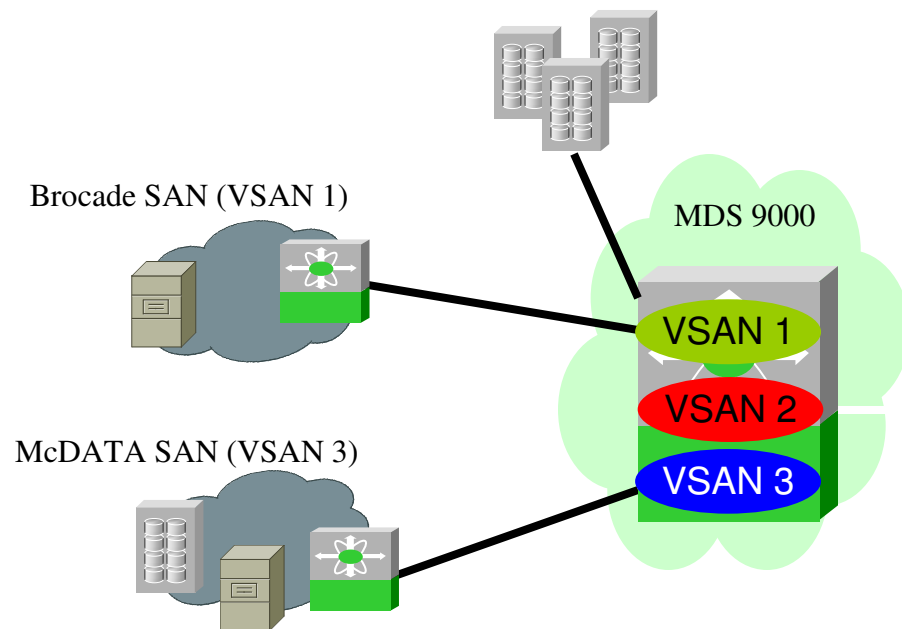
Virtual Fabric Diagnostics – the ability to troubleshoot per virtual fabric problems

Virtual Fabric Security – the ability to define separate security policies per virtual fabric

Virtual Fabric Management – the ability to map and manage virtual fabrics independently

Inter-Fabric Routing – the ability to provide connectivity across virtual fabrics – *without merging the fabrics*

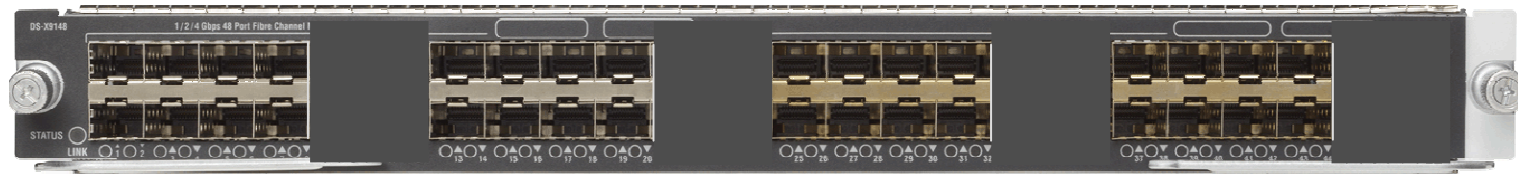




Solving Interop Issues

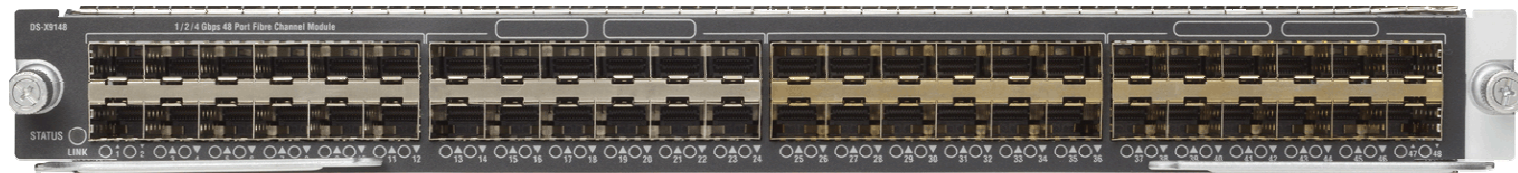
Performance 8G FC Switching Modules

256Gbps front-panel bandwidth and FC speed flexibility



32-port Performance 8G Fibre Channel Switching Module

- 32 ports at 8G FC full rate
- 24 ports at 10G FC full rate
- 36,000BB credits per card



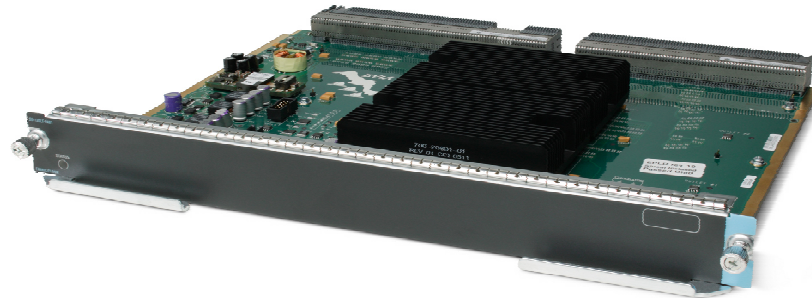
48-port Performance 8G Fibre Channel Switching Module

- 48 ports at 4G FC full rate, 1.5:1 oversubscribed @ 8G
- 24 ports at 10G FC full rate
- 36,000BB credits per card!

256Gbps/slot across crossbars

384Gbps/slot local switching

MDS 9513 Fabric3 Module



- **Increases active backplane bandwidth to 256-Gbps per slot**
 - Required only for 32-port and 48-port Performance 8G Modules
 - No switch reload required when migrating from Fabric2 to Fabric3

MDS 9148 - 48-port 8G FC Multilayer Fabric Switch

Front View



48 x 8G FC ports with line rate performance
Industry leading 1RU 8G FC density

Back View



Dual Power Supplies and Dual Fan Trays
For Enterprise-Class Availability

Platform

- Based on Cisco's System-on-a-Chip (SOC)
- 48 x 8G FC ports in 1 RU form-factor
- 8G line rate performance on all ports
- 3 base SKUs to choose from – 16p, 32p or 48p
- On-demand ports - 8-port license for growth
- "Towards the ports" airflow
- Redundant, hot-swappable power supplies and fan trays
- Less than 20" deep

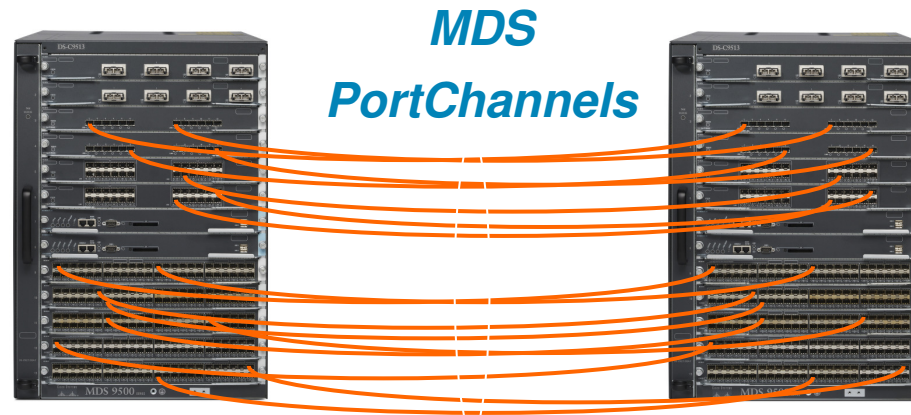
Powered by NX-OS Software

- Affordability without compromising functionality
- Ease-of-Use with Quick Configuration Wizard
- Industry-leading security for addressing compliance and regulation requirements
- Enterprise-class availability for increased business resilience, including ISSU
- Flexibility to grow with changing business needs
- "No hidden charges" for software license
- Inter-VSAN Routing enabled

HA - PortChannels

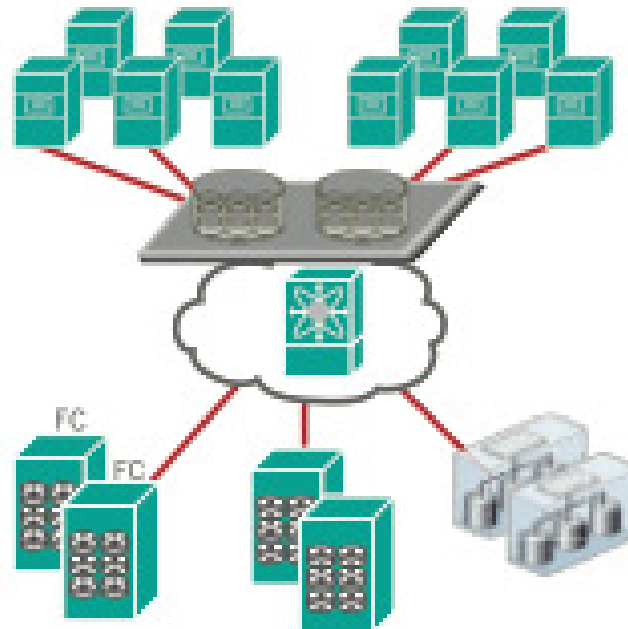
- Different Line Cards
 - Different ASICs
- Different Port-groups
 - Up to 16 ISL per PortChannel

*Multiple Failure Domains
Provide HA*



- One misbehaving link affects traffic only on that link, NOT entire trunk

VM-Optimized Storage Networking



- VM-aware SANs
- VM Mobility, security, QoS
- Per VM policy, visibility

Serial Crossbar – Allowing VM Mobility

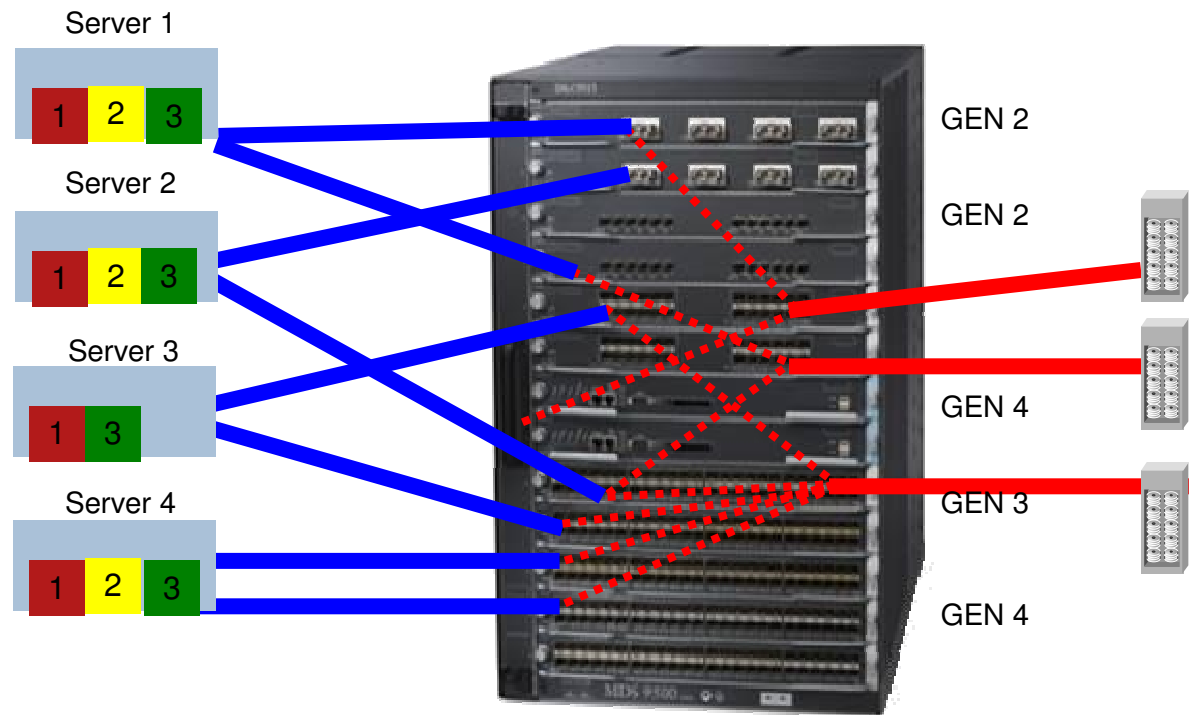
Crossbar Switch
(e.g., Cisco MDS Products)

- VM Mobility via MDS and VMotion
- App Out of memory
 - App Requires additional processing power
 - Hardware failure
 - SW Upgrade/patch

•No changes to zoning with mobility

•No performance penalty by moving across linecards

•Consistent latency



9513 AVERAGE LATENCY (Any-to-Any- port):

Small frames (60-byte): 5.3 - 5.9 microseconds
Large frames (2148-byte): 13-15 microseconds

- Any-to-any connectivity
- Same consistent performance
- Same consistent latency

VM-Aware SANs Management

Comprehensive VM-level Visibility

Data Center Network Manager admin Logout Download About Help

By Name

Dashboard Health Performance Inventory Reports Backup SME Admin

Host Enclosures (40 Items)

Hosts	VHosts	Name	OS	IP Address	#Port:	#VMs	VHost Name	VCluster	Rx+Tx
1		SJC-VIF4-01	VMware ESX 4.0.0 build-2	10.16.156.4	2	6/23	sjc-vif4-01.cisco.	SJC-VIF4	350MB
2		SJC-VIF4-02	VMware ESX 4.0.0 build-2	10.16.156.5	2	13/14	sjc-vif4-02.cisco.	SJC-VIF4	349MB
3		SJC-VIF4-03	VMware ESX 4.0.0 build-2	10.16.156.6	2	9/21	sjc-vif4-03.cisco.	SJC-VIF4	320MB
4		SJC-VIF4-04	VMware ESX 4.0.0 build-2	10.16.156.7	2	4/4	sjc-vif4-04.cisco.	SJC-VIF4	310MB
5		SJC-VIF4-05	VMware ESX 4.0.0 build-2	10.16.156.8	2	26/26	sjc-vif4-05.cisco.	SJC-VIF4	316MB
		build-2	VMware ESX 4.0.0 build-2	10.16.156.9	2	29/29	sjc-vif4-06.cisco.	SJC-VIF4	216MB
		build-2	VMware ESX 4.0.0 build-2	10.16.156.10	2	28/29	sjc-vif4-07.cisco.	SJC-VIF4	210MB
		build-2	VMware ESX 4.0.0 build-2	10.16.156.11	2	28/28	sjc-vif4-08.cisco.	SJC-VIF4	211MB
9		SJC-VIF4-09	VMware ESX 4.0.0 build-2	10.16.156.12	2	28/30	sjc-vif4-09.cisco.	SJC-VIF4	202MB
10		SJC-VIF4-10	VMware ESX 4.0.0 build-2	10.16.156.13	2	24/24	sjc-vif4-10.cisco.	SJC-VIF4	198MB
11		SJC-VIF4-11	VMware ESX 4.0.0 build-2	10.16.156.14	2	24/24	sjc-vif4-11.cisco.	SJC-VIF4	208MB

VM-level Drill Down

End-to-End Topology - SJC-VIF4-01

VM	Host Port	VSAN	Switch Interface	Fabric Name	Switch Interface	Zone	Storage Port	Service Profile
wcm-sjc-008, sve-prd-5, sve-prd-3, pel-sjc-004-s, ppt-sjc-001, esp-sjc-001	SJC-VIF4-01_HE	3121	sjc12-dcl01n-uc	Fabric_sjc12-dcl01r	sjc12-sangw-sw	Z-VSAN3121-SJC-V	SJC-VIF4-01_HBA2	com/cisco/dcbu/test
	SJC-VIF4-01_HE	3120	sjc12-dcl01n-uc	Fabric_sjc12-dcl01r	sjc12-sangw-sw	Z-VSAN3120-SJC-V	SJC-VIF4-01_HBA1	com/cisco/dcbu/test

Service Profile to Map Server to Physical Blade Server

24 Hours Latency - sjc-vif4-01.cisco.com

I/O Stats per Server

Latency (ms)

Time

Highest Disk Latency

Range Selector

VM-Aware SANs Management

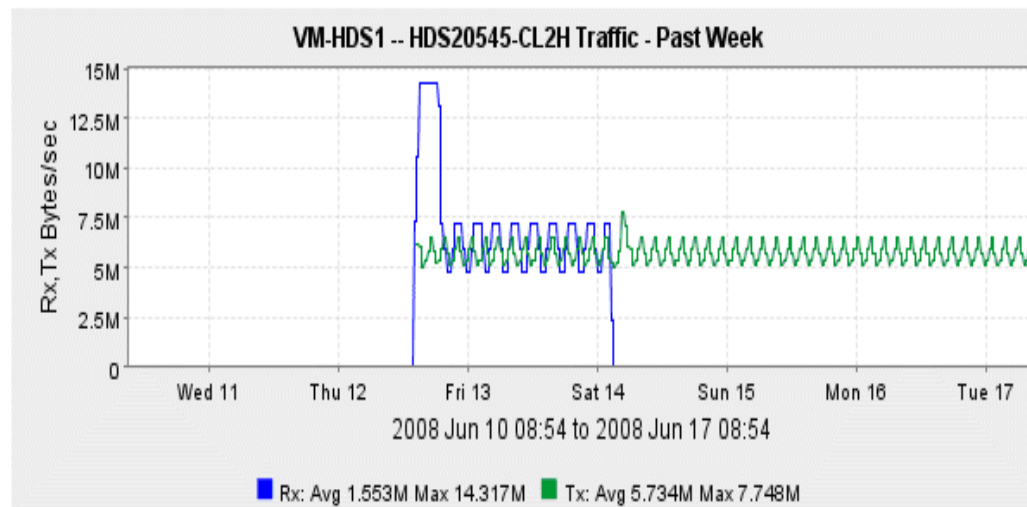
Performance Monitoring of an individual VM

Cisco Fabric Manager is the GUI-based management infrastructure for the Cisco MDS 9000 family SAN.

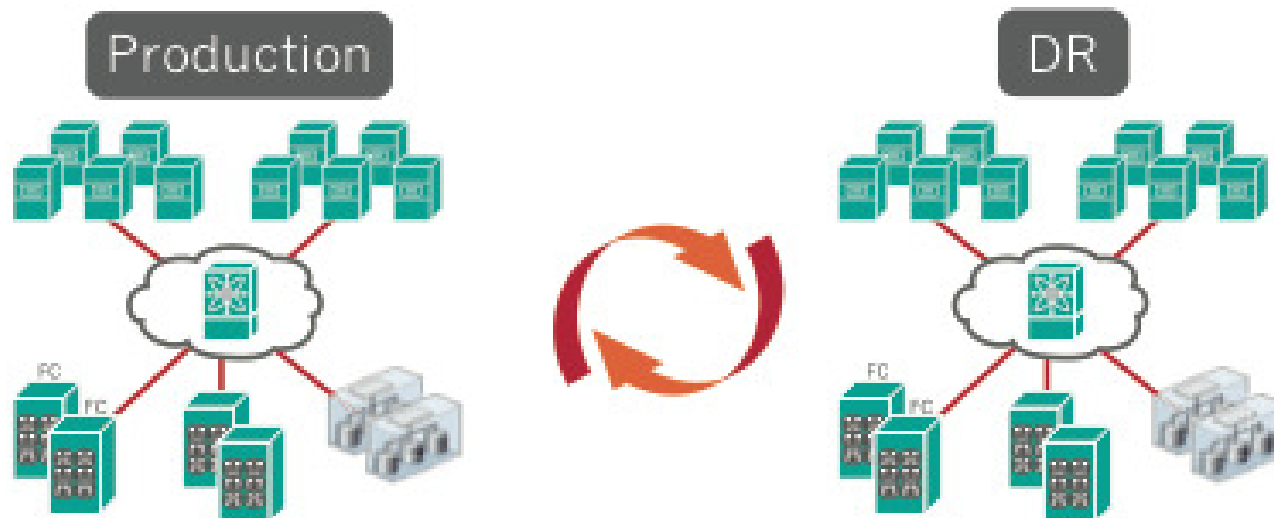
Cisco Fabric Manager provides a full set of tools for fabric configuration and performance monitoring.

The same performance monitoring capabilities available for the physical devices are available for individual VMs with NPIV or F-Port Trunking

Single monitoring point across the entire end-to-end storage infrastructure

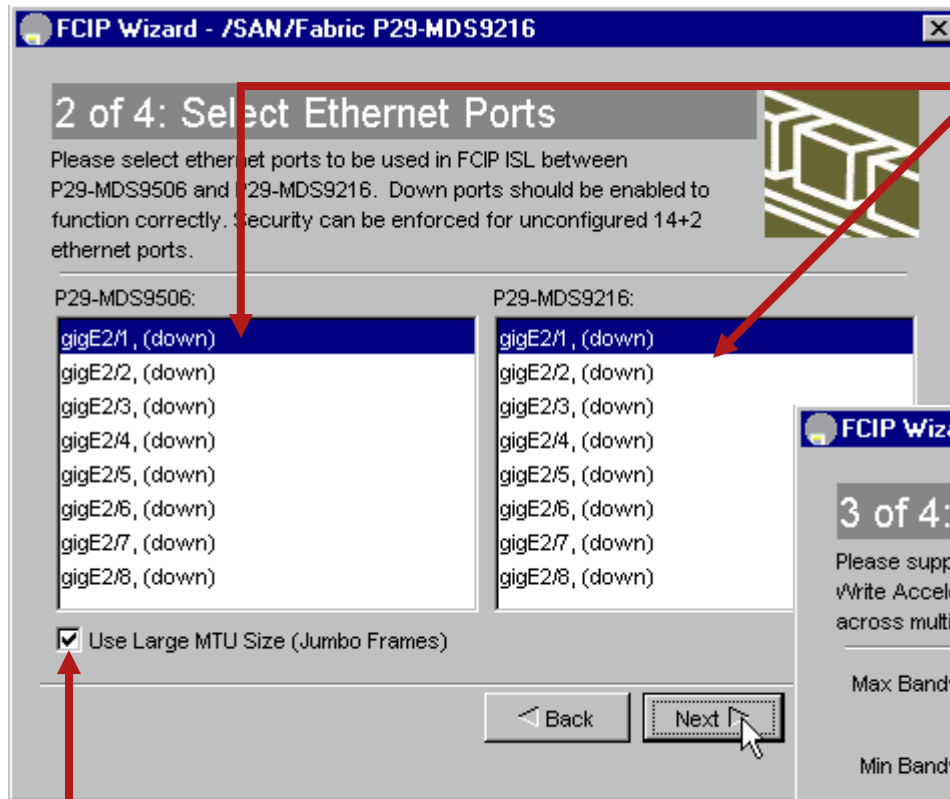


Business Continuance/Disaster Recovery



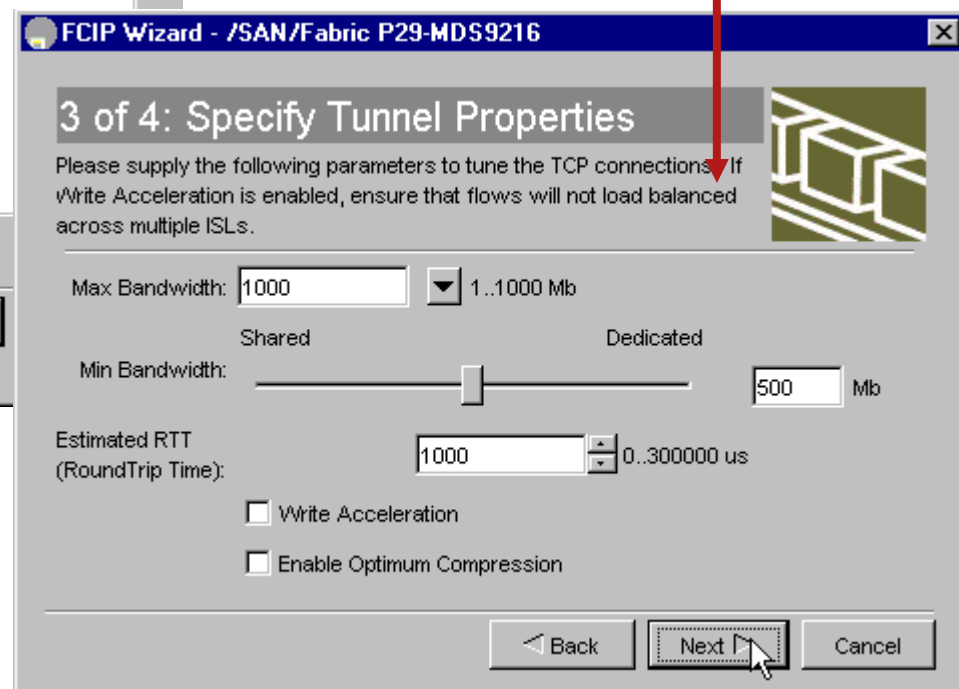
- FC/FICON extension
- FCIP and FC SAN extension
- Compression and encryption of in-flight data

Fabric Manager FCIP Wizard (Cont.)



■ Choose GbE ports from each switch

TCP Windowing parameters

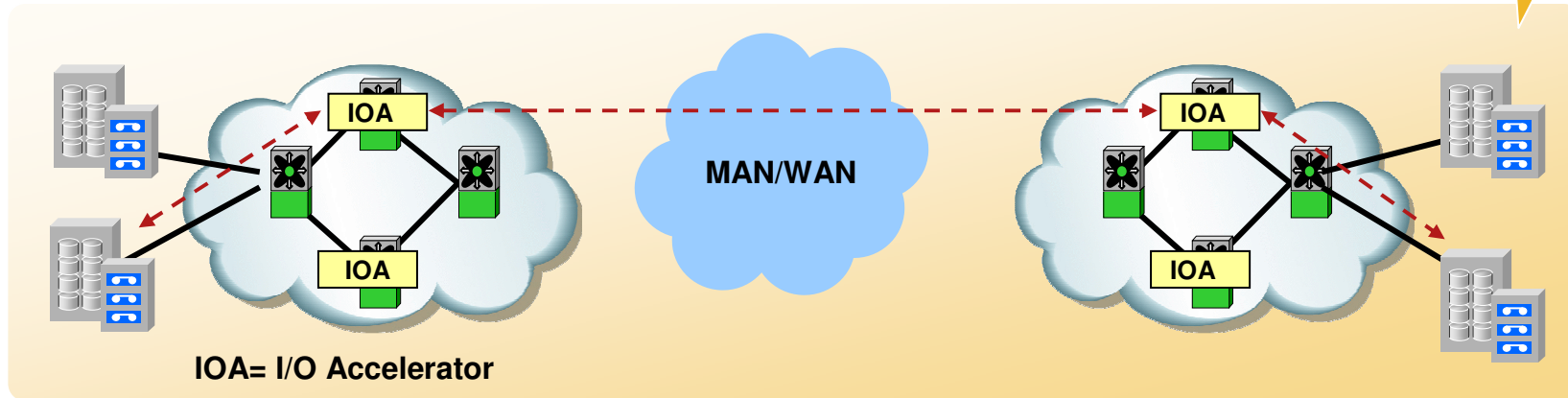


Sets MTU = 2300

I/O Accelerator (IOA)

Next Generation SAN Extension Solution

NX-OS 4.2



Unified Solution

- Single solution for both Disk and Tape I/O Acceleration

Flexible

- No-rewiring
- Extend IOA to any device in the SAN

Resilient

- PortChannels for Tape I/O Acceleration

Transport Agnostic

- Any transport protocol and interface – GE and FC

MDS-9222i & 18/4 Card

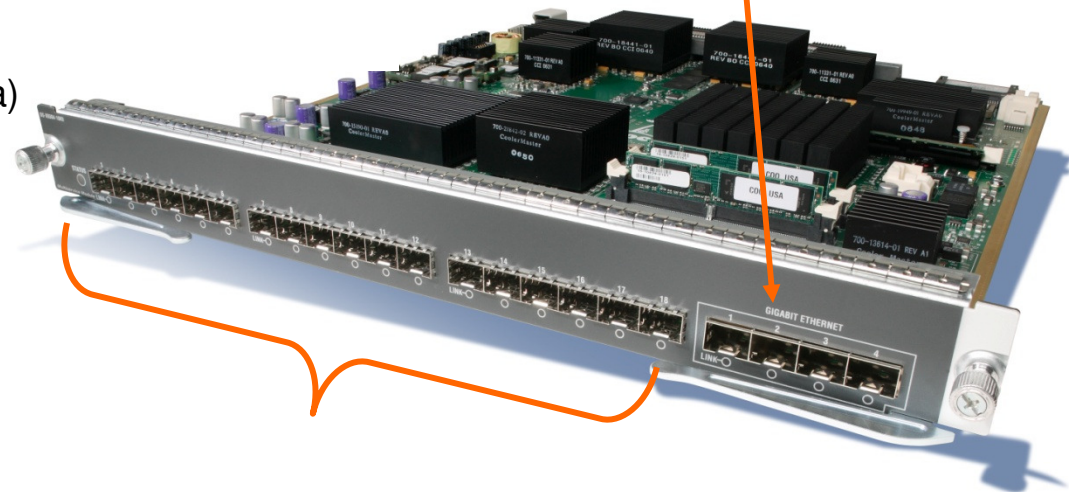


**Gig E
Interfaces**

**FC
interfaces**

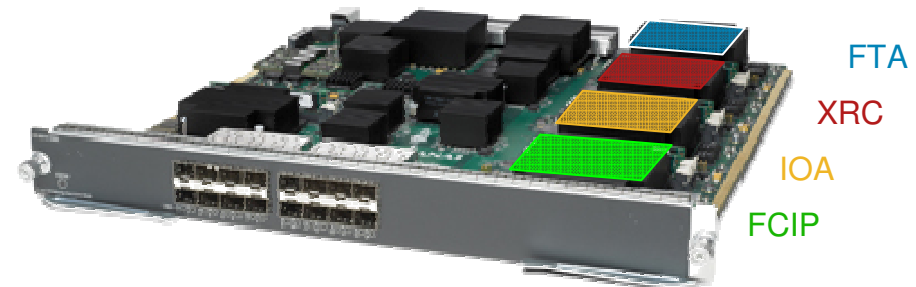
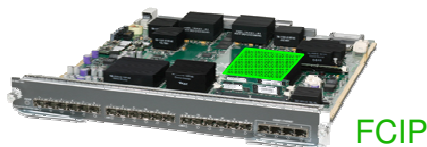
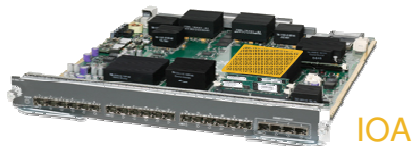
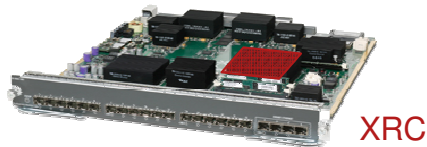
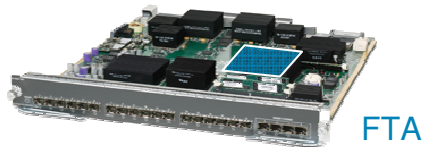
IP Storage Service features

- HW based Compression (4:1 of real data)
- HW based Encryption – IPsec
- Up to 16 tunnels per 4 ports, for FCIP
- IPv6 support
- FTA (Read and Write)
- XRC Acceleration



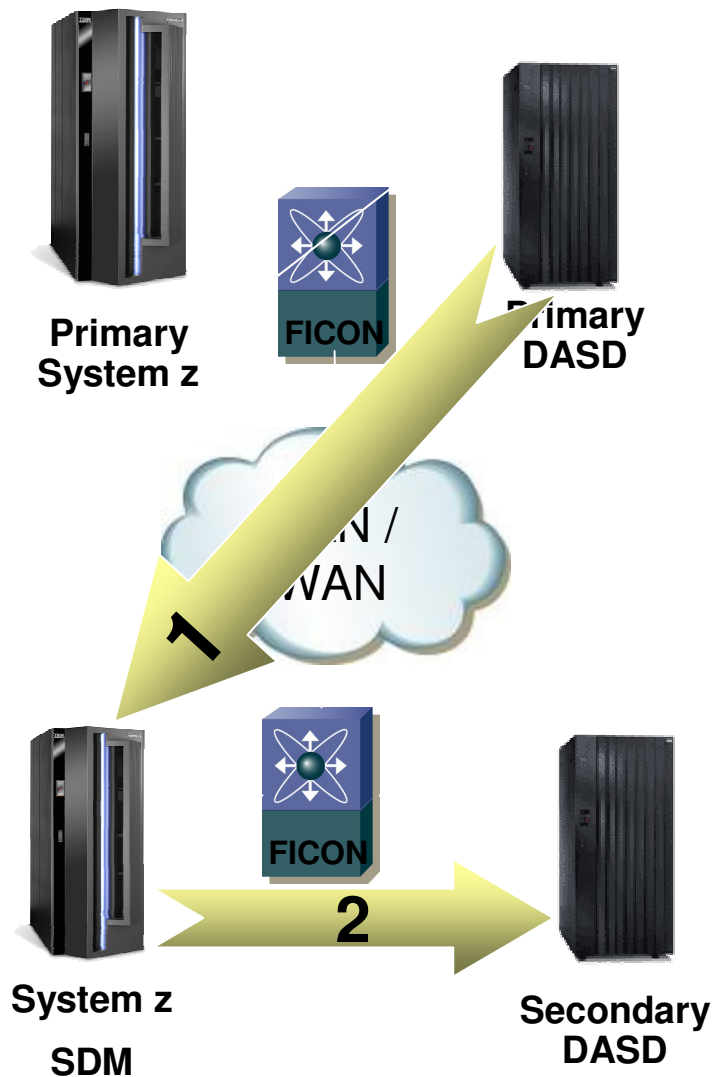
Consolidate and Scale Fabric Applications

- Four independent service engines
 - Four separate concurrent applications or..
 - Four times the performance/throughput
 - Saves valuable slots in the 9500 chassis
- Transparently deliver services to any port in the fabric
 - Host or target does not have to be directly attached
 - No SAN re-configuration, no re-wiring
 - Highly available with multi-module clustering, balancing
- FC speed agnostic
 - Any 4G, 8G, or 10G FC port can utilize services
 - 16 Gigabit Ethernet front panel ports for FCIP



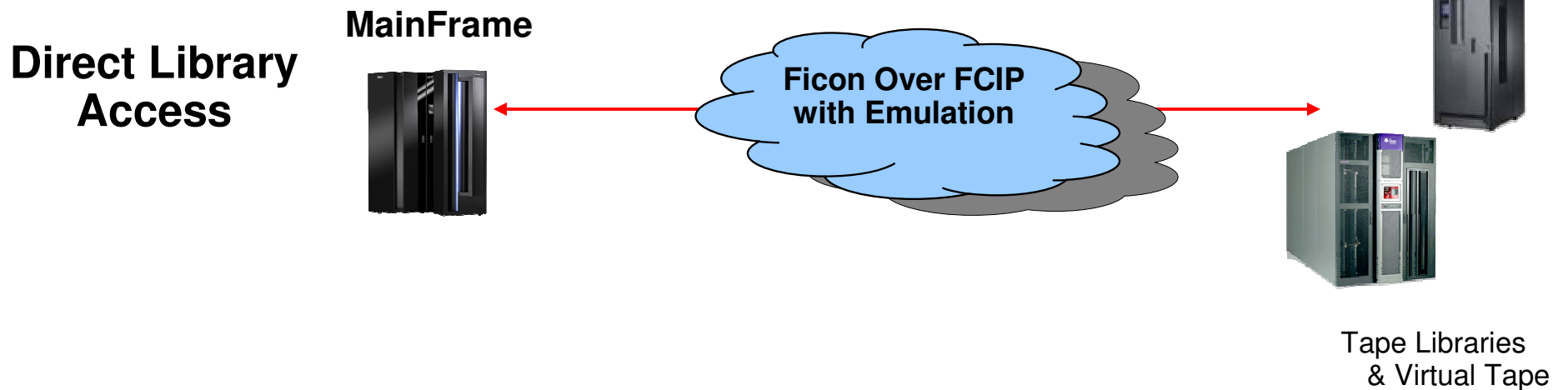
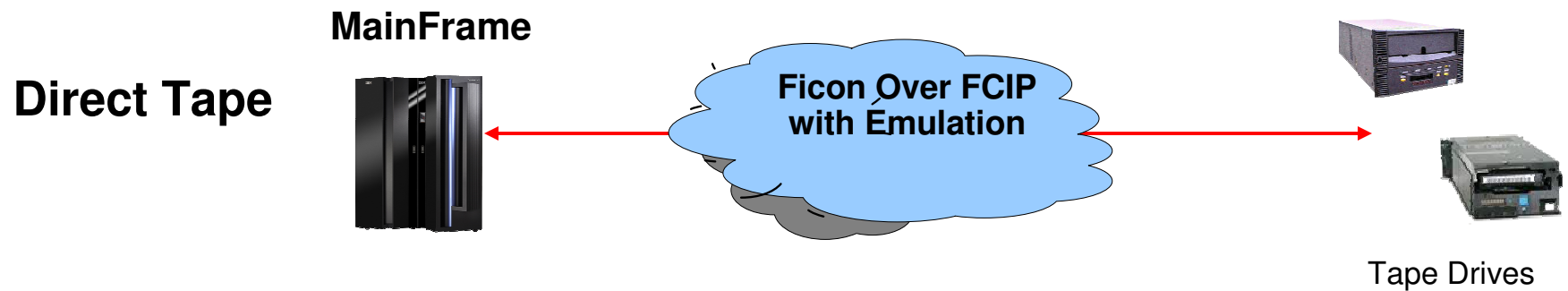
MDS 16-Port Storage Services Node (SSN-16)

FICON XRC Acceleration

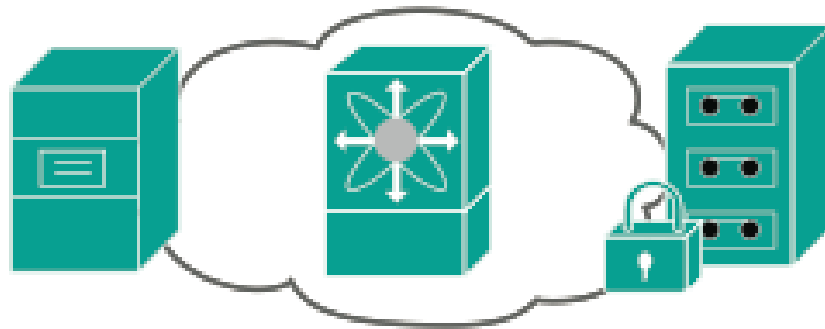


- XRC = eXtended Remote Copy
aka z/OS Global Mirror
- Mainframe-based replication SW
- Remote “System Data Mover” (z)
Reads data from remote primary DASD
Writes it to local secondary DASD
- Cisco feature reads ahead and buffers data at secondary site

FICON Tape Acceleration (FTA Read & Write)



SAN Security

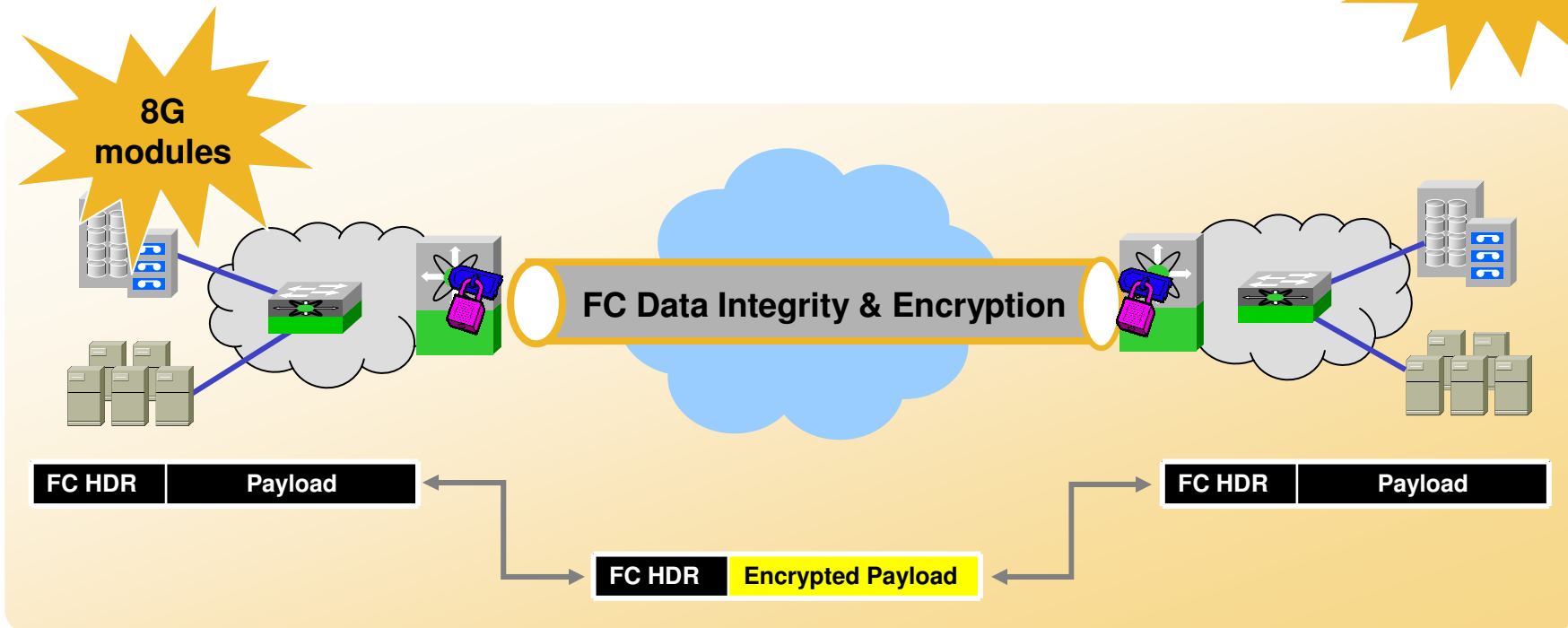


- Encryption of data-at-rest
- Link level FC encryption of ISLs
- Access Control, Authentication, and Authorization
- Addresses compliance and regulatory requirements

Cisco TrustSec FC Link Encryption

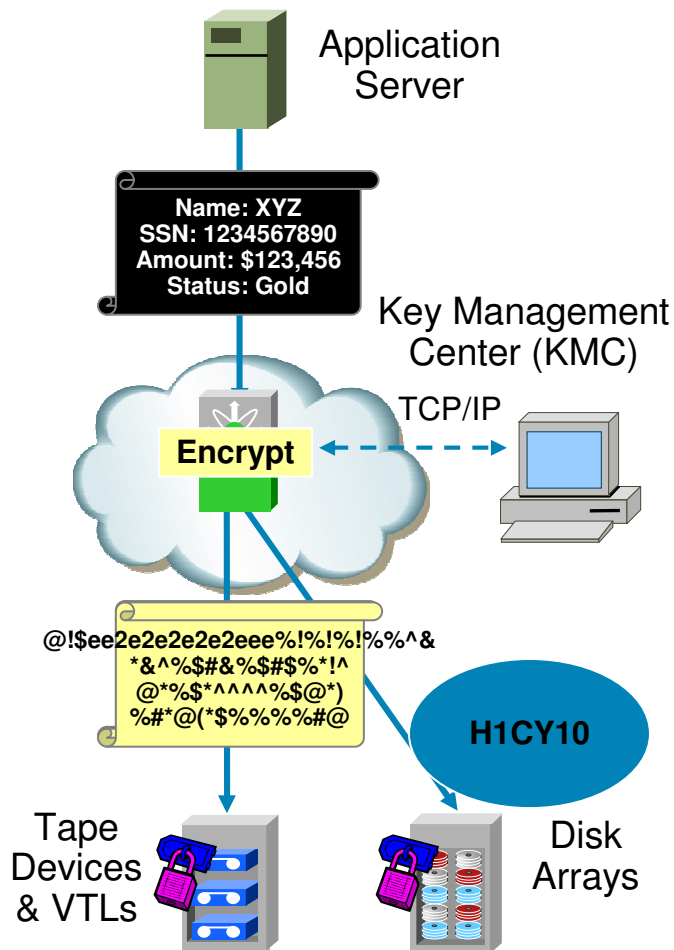
AES Level Encryption of Data in Flight

NX-OS 4.2



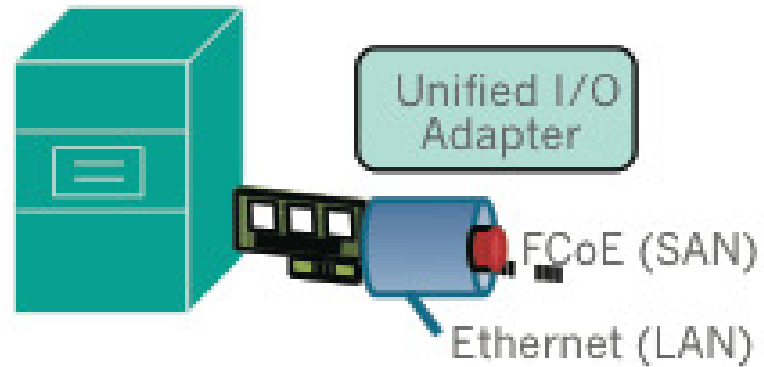
- Preserve integrity and confidentiality of FC traffic
- Integrated, high performance functionality
- No change to existing SAN, enable functionality only on edge switches
- Enabled with Enterprise License

Storage Media Encryption For Disk & Tape



- Encrypts storage media (data at rest)
 - Strong, Std. IEEE AES-256 encryption
 - Integrates as transparent fabric service
 - Handles traffic from any virtual SAN (VSAN) in fabric
- Supports heterogeneous, SAN attached disk arrays as well as tape devices and VTLs
 - Provides on-line disk data preparation
- Includes secure key management
 - Open API integrates with enterprise-wide, lifecycle key managers
- Compresses data
- Allows offline data recovery

Unified Fabric (FCoE)



- Converged adapter (CNA)
- Simplified cabling & operations
- Reliable FC delivery

8-Port 10G FCoE Module



8-Port 10G FCoE Module

Enables integration of existing FC infrastructure into Unified Fabric

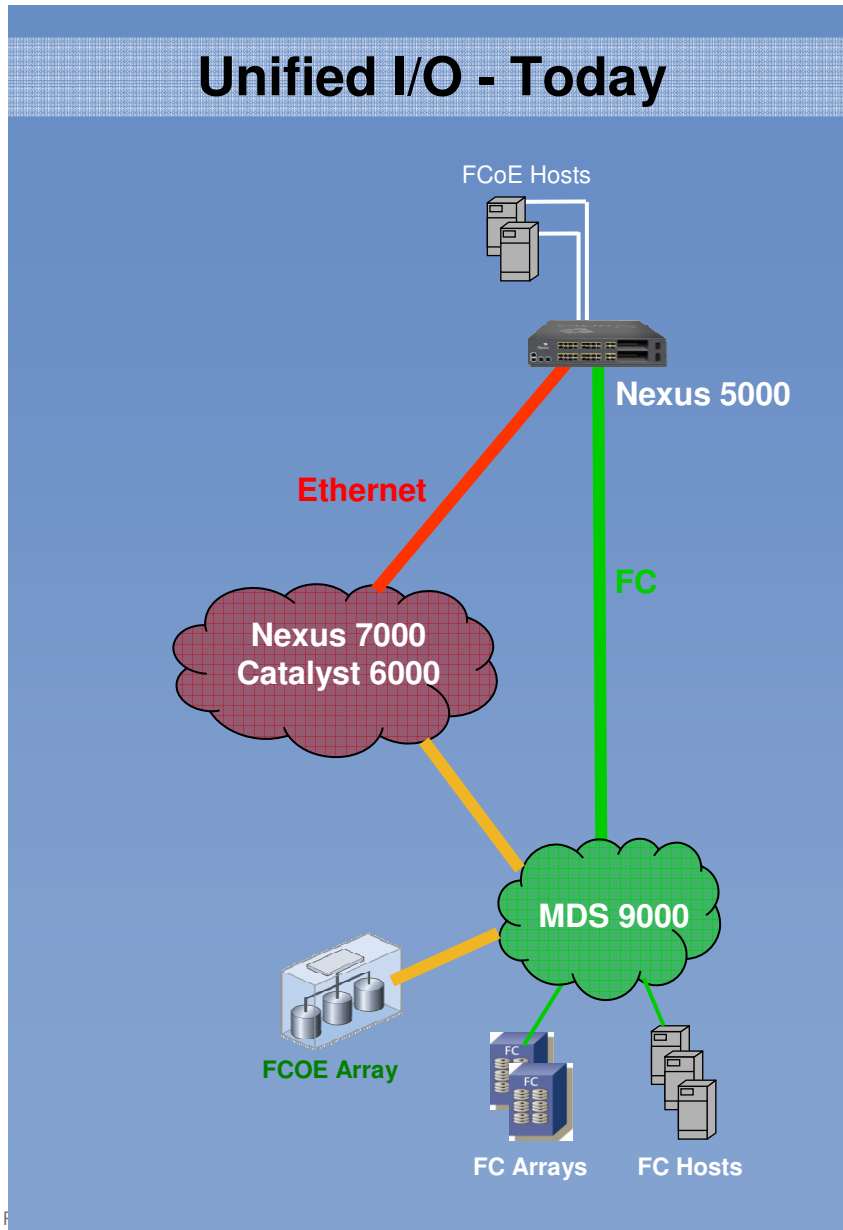
- 8 FCoE ports at 10GE full rate
- 80-Gbps front panel bandwidth
- SFP+ SR, LR, CX-1 optics support

FCoE connectivity from MDS 9500 Directors to:

- Nexus 5000 and Nexus 7000
- FCoE Storage Arrays

Unified Fabric Deployment Options

- Ethernet
- Fibre Channel
- DCB/CEE
- FCoE

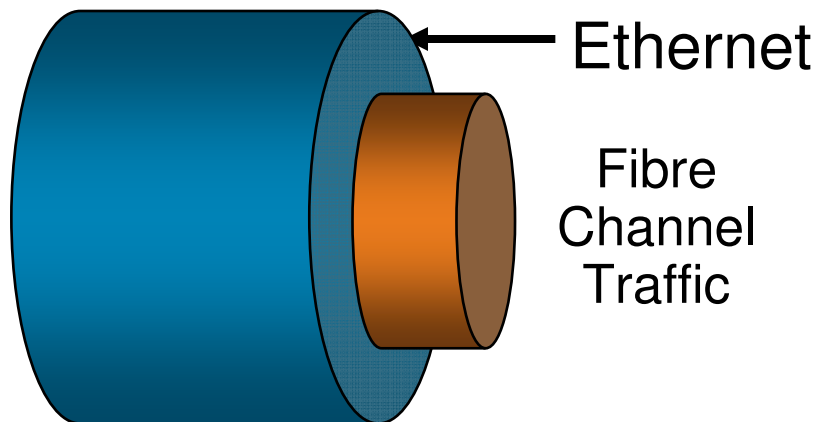


Converged Fabric Overview

Fibre Channel over Ethernet (FCoE)

FCoE

- Mapping of FC Frames over Ethernet
- Enables FC to Run on a Lossless Ethernet Network

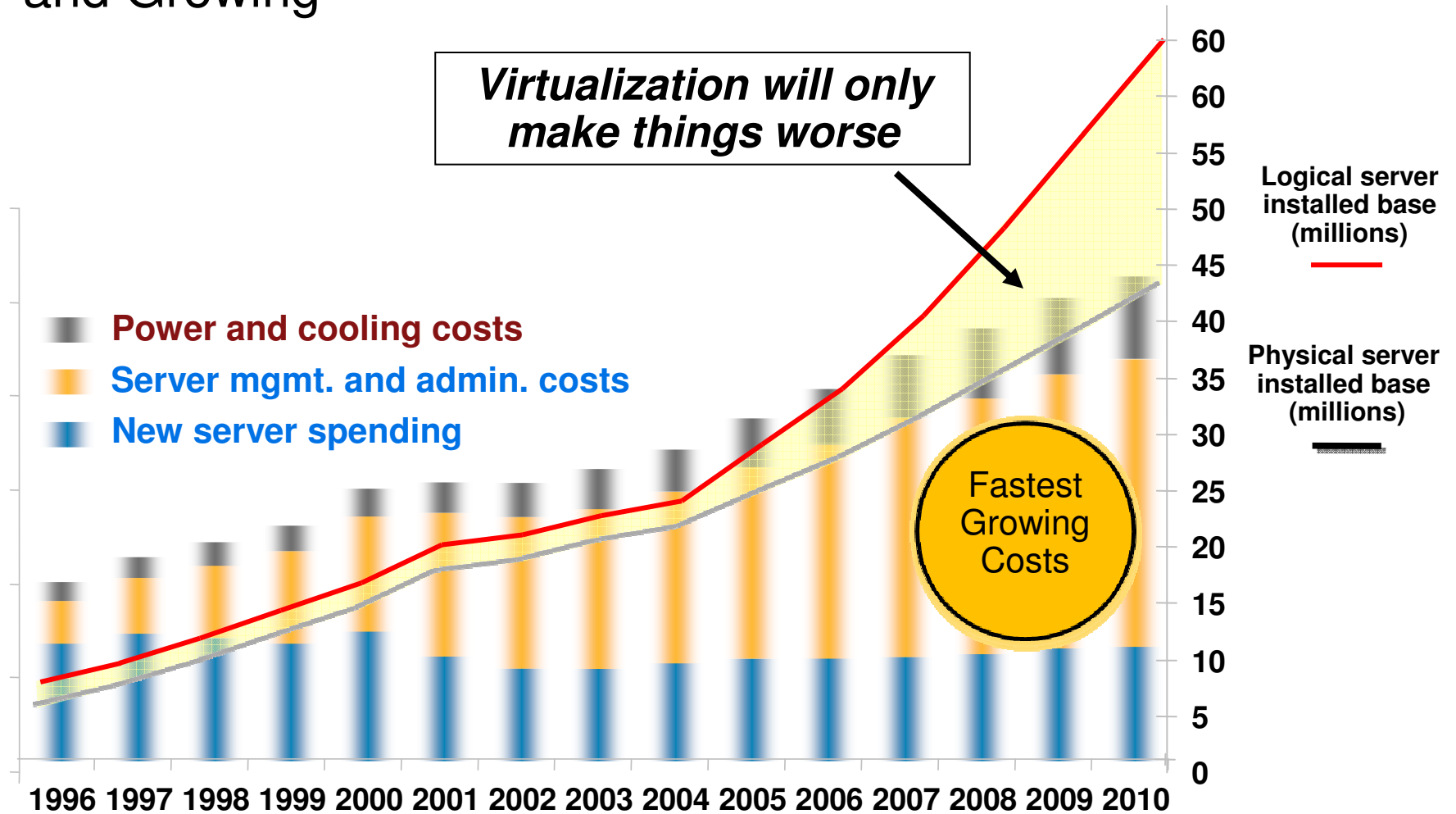


Benefits

- Fewer Cables
 - Both block I/O & Ethernet traffic co-exist on same cable
- Fewer adapters needed
- Overall less power
- Interoperates with existing SAN's
 - Management SAN's remains constant
- No Gateway

Data Center Infrastructure

Operations & Maintenance Now ~80% of IT Budgets and Growing



Source: IDC 2009

10 Gigabit Ethernet to the Server

Impacting DC access layer cabling architecture



Multicore CPU architectures

Virtual Machines driving Increased I/O bandwidth per server

increased business agility

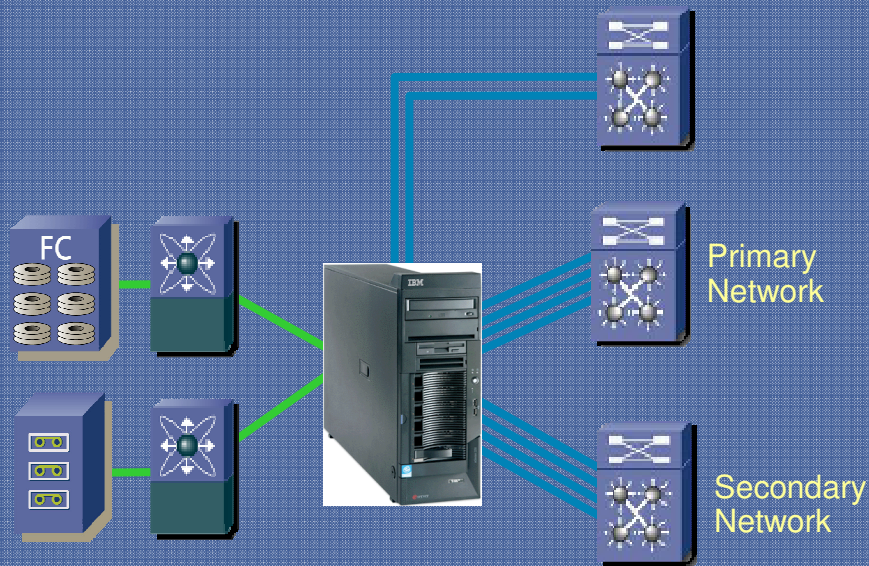
Increased network bandwidth demands

Consolidation of networks

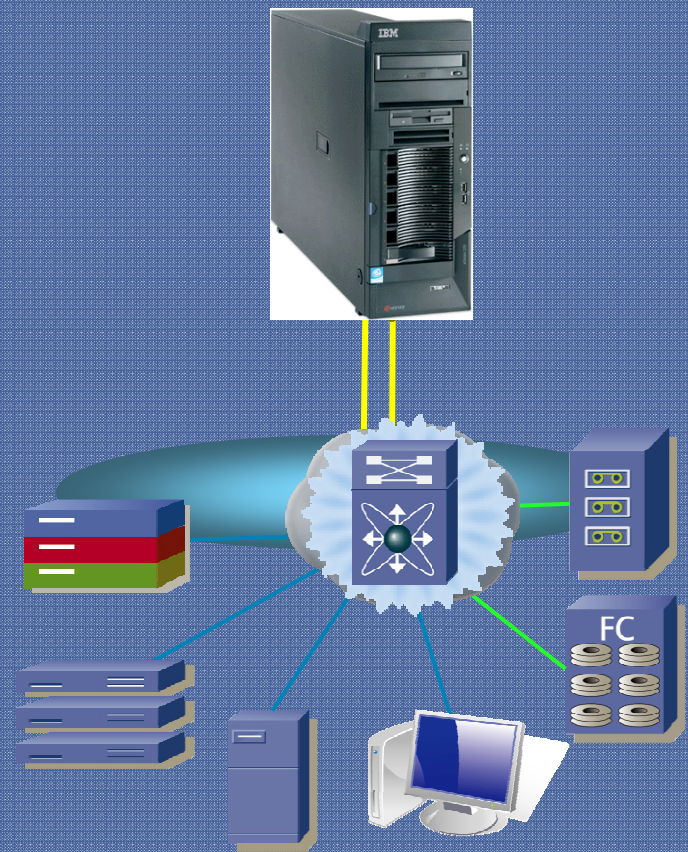
Segmentation & Converged Fabrics

Future Proofing - Network, Cable Plant

The Case for a Converged Data Center Fabric :



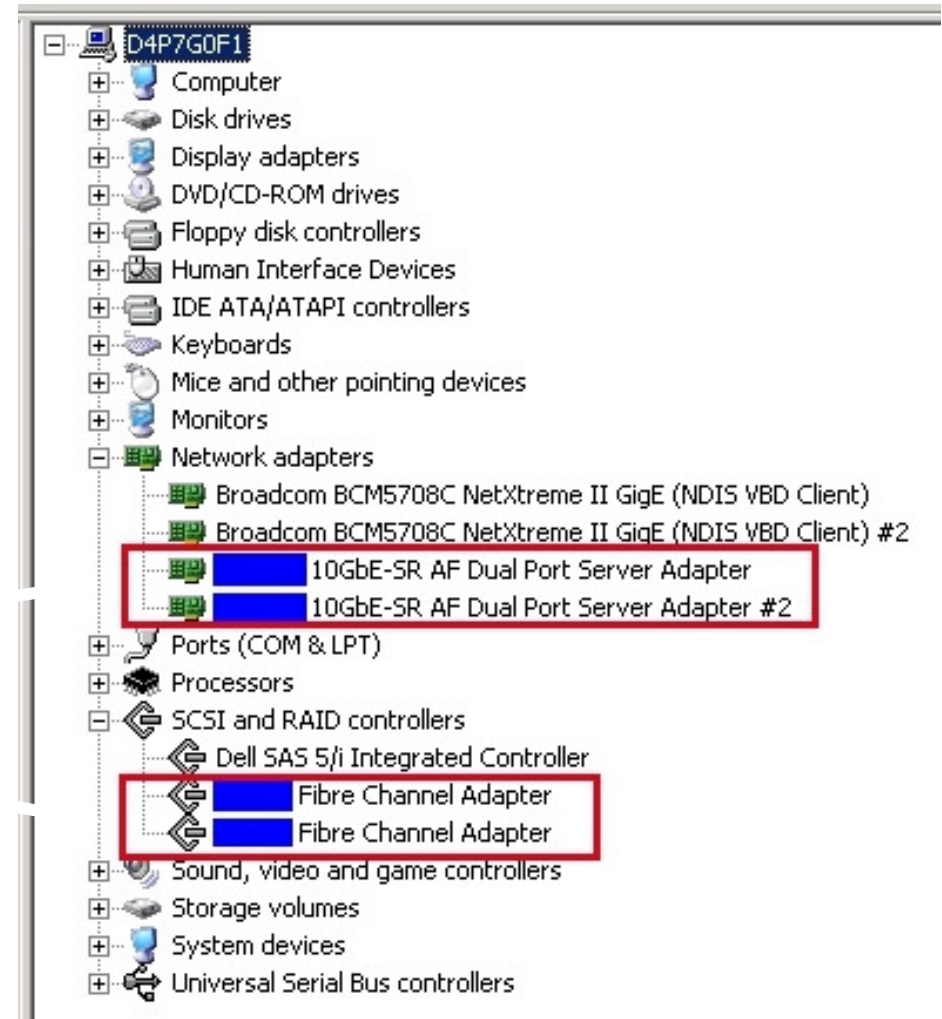
Complexity,
Cost, Power



Increased Efficiency,
Simpler Operations

View from Operating System

- CNAs are multi-function devices
- Standard drivers
- Same management
- Operating System sees:
 - Dual port 10 **Gigabit Ethernet** adapter
 - Dual Port **Fibre Channel** HBAs



FCoE Advantages

*FCoE is Fibre
Channel*

*Standard Approved
June 4th 2009*

Completely based on the
FC model

Same host-to-switch and switch-to-
switch behavior of FC

In order delivery or
FSPF load balancing

WWNs, FC-IDs, hard/soft
zoning, DNS, RSCN

Nexus 5000/2000 Product Line

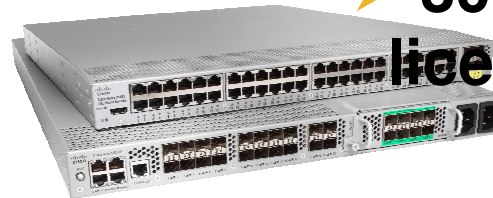
Proven Results !!!!

Aug 2009

Aug 2011

- 900+ customers
- 350,000+ 1GE ports sold
- 150,000+ 10GE ports sold
- 20% N5Ks have FCoE licenses attached

- 3500+ customers
- 5,000,000+ 1GE ports sold
- 2,000,000+ 10GE ports sold
- 30% N5Ks have FCoE licenses attached



Cost Effective 10G Server Connectivity Today



SFP+ USR – ‘Ultra Short Reach’

- 100M on OM3 fiber, 30M on OM2 fiber
- Support on all Cisco Catalyst and Nexus switches



SFP+ Direct Attach

- 1, 3, and 5 (7&10) Meter on active Twinax
- Support across all Nexus Switches

Introducing the Cisco Nexus 5000

Available through IBM!

**DISTRIBUTED
VIRTUAL
LINE CARDS**

**UNIFIED
LOSSLESS
FABRIC**

**VIRTUAL
SERVER
AWARENESS**

**WIRE-SPEED
10GE**

**LOW LATENCY
MULTIPATHING**



Cisco Nexus 5000 Server Access Switch

IBM part number:3722-S51

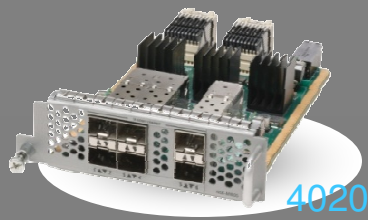
IBM part number:3722-S52



28-Port L2 Switch
20 fixed ports 10GE/FCoE/Data Center Ethernet
Line rate, non blocking 10GE
1 Expansion Module slot



56-Port L2 Switch
40 fixed ports 10GE/ FCoE/Data Center Ethernet
Line rate, non-blocking 10GE
Two Expansion Module slots



Ethernet
▪ 6 ports
10GE/FCoE/**Converged Enhanced Ethernet**



Ethernet + Fibre Channel
▪ 4 Ports
10GE/FCoE/**Converged Enhanced Ethernet**
▪ 4 ports 1/2/4G FC



Fibre Channel
▪ 6 ports 2/4/8G FC

NX-OS, DC-NM and Fabric Manager

Next-Gen Nexus 5000 Series Switches

Top 3 Business Benefits

Reduced OPEX

Maintain the 'Pay as you Grow' Model

Built upon a proven and highly successful architecture

Reduced CapEX

Modular Architecture with reduced upfront investment

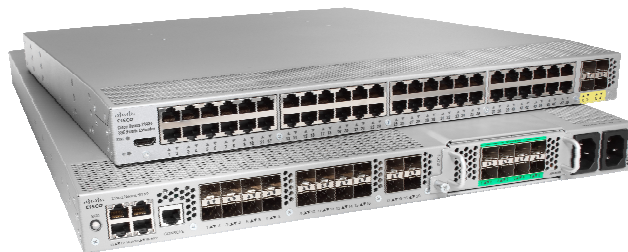
Optimized footprint provides ease of insertion across different environments

**Optimized
Total Cost of
Ownership (TCO)**

Investment Protection

Backwards compatible with existing distributed line cards

Industry-leading standards based platforms

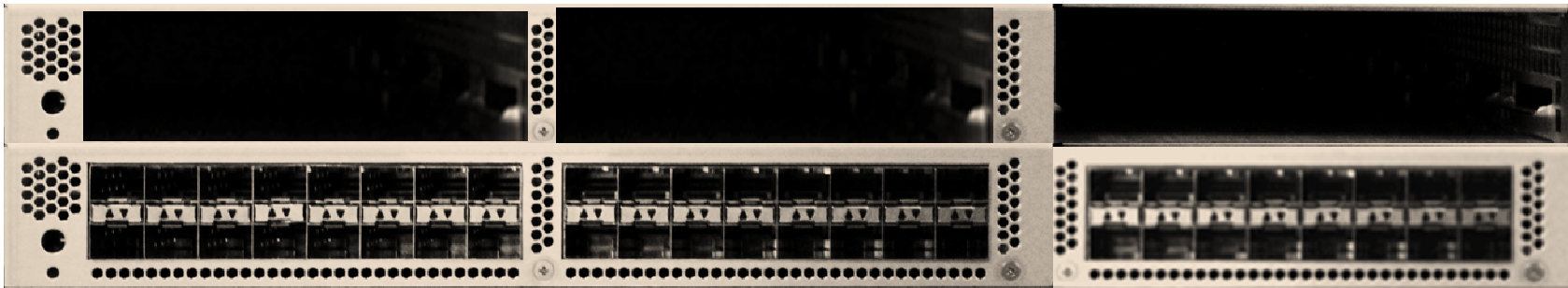


2nd Generation Nexus 5500 Switches

N5548 -



N5596 -



10GE Modules

- 16p CE/FCoE
- 8p CE/FCoE + 8p FC
- 16p CE/FCoE/FC
- 16p 10GT

40 GE Modules

- 4p 40GE (QSFP)

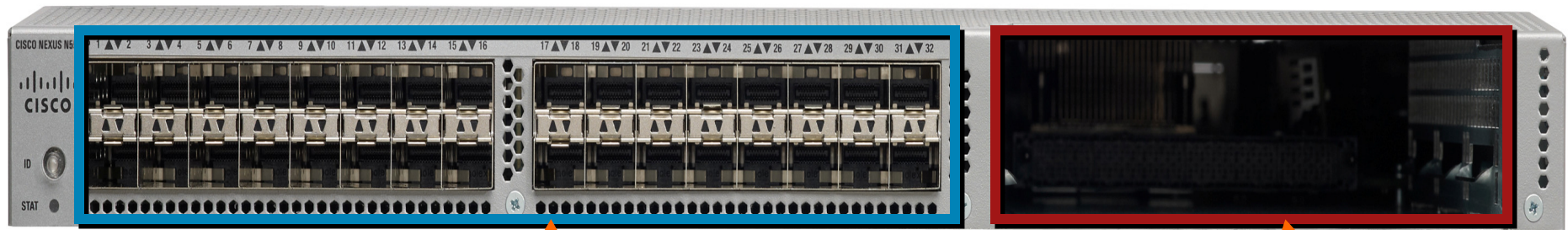
Layer 3 Modules 160G

- Daughter Card (N5548 only)
- Module (N5596 only)

Nexus 5548UP Rear Panel



All 48 ports are UNIFIED capable



32 x Fixed ports 1/10 GE or
1/2/4/8 FC

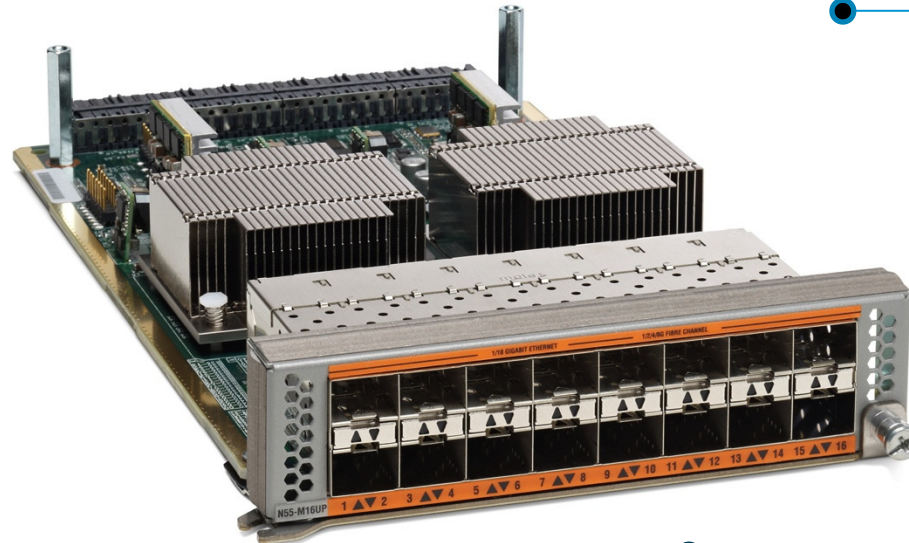
Expansion
Module

Fibre Channel

Full Support for
1/2/4/8G Native
Fibre Channel

Ethernet

Full Support for
1G/10G and
FCoE. Support for
FEX connectivity



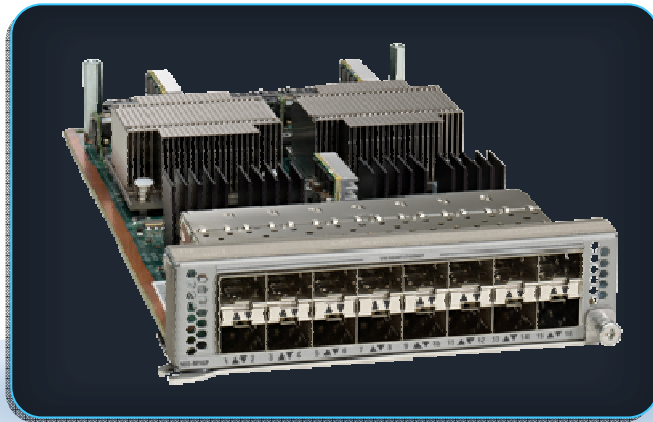
Unified

Flexibly provision any
port to inherit Ethernet,
Fibre Channel or
Ethernet Personalities

Unified Port Module

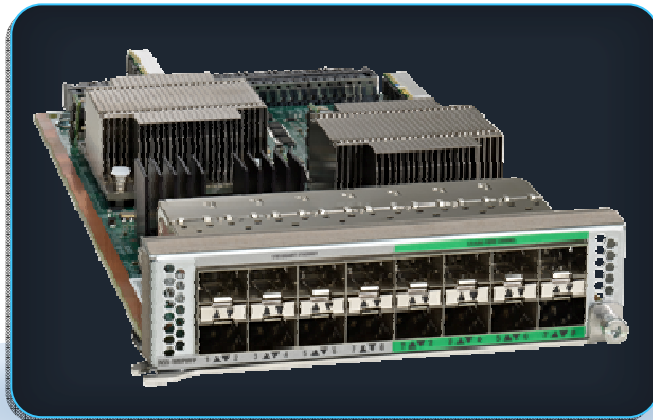
Generic Expansion Modules

Multiple Port Scalable Modules



10Gb Expansion Module

- 16p SFP+ Ethernet Ports
- All Ethernet Ports hardware capable of 1/10 Gigabit Ethernet *



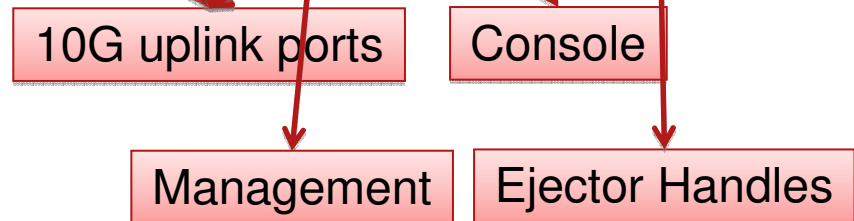
Mixed Port Type Module

- 8p SFP+ Ethernet Ports
- 8p Native FC Ports 8/4/2/1G
- All Ethernet Ports hardware capable of 1/10 Gigabit Ethernet *

Nexus 4001I Switch Module

- 14 x 10G downlinks & 6 x10G uplink
- Dual-mode all ports (1G/10G)
- RJ-45 Management interface
- RS-232 Console port
- high-speed slots (HSS) in BCH/BCH-T
- Max of Four 4001I per chassis
- Support CX1 SFP+, SR, LSR optics

- Supports FIP Snooping and Multi-hop FCoE



Key Benefits & Applications

Consistent Low-latency

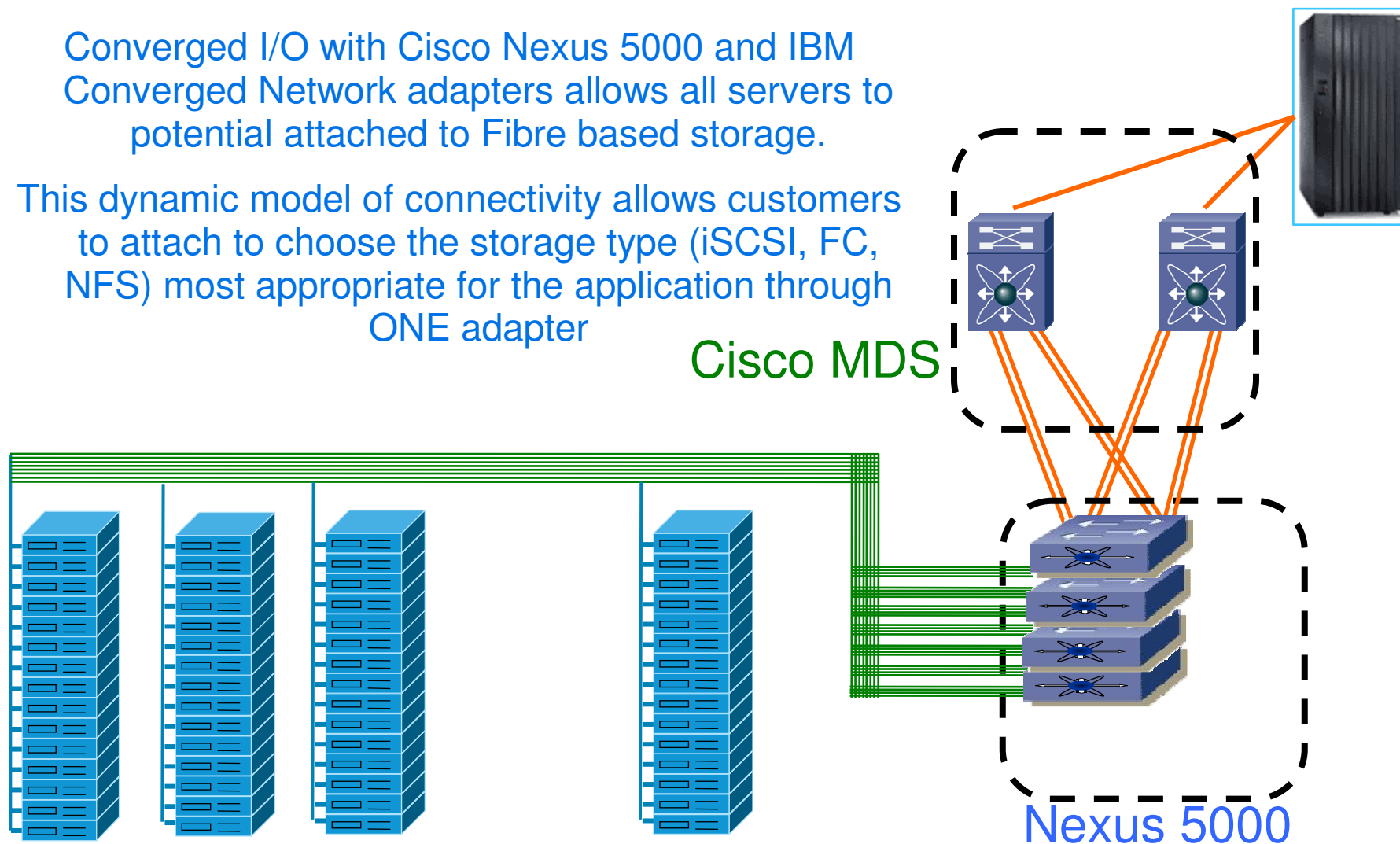
Consolidate Infrastructure w/ Unified IO

Scale Bandwidth with 10G & Multi-pathing

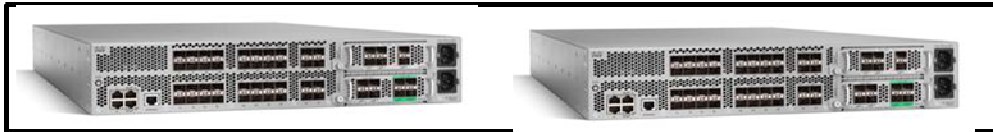
Converged I/O allows **ALL** servers to attach to Fibre Channel storage

Converged I/O with Cisco Nexus 5000 and IBM Converged Network adapters allows all servers to potentially attach to Fibre based storage.

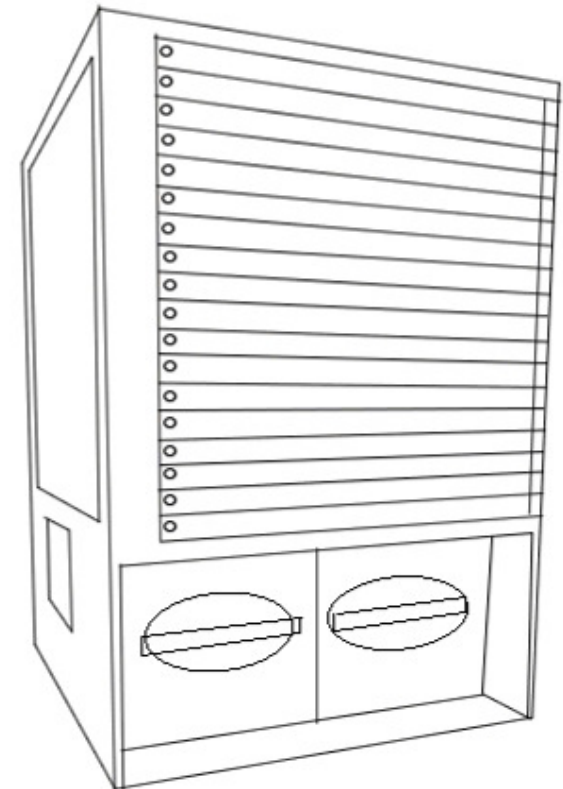
This dynamic model of connectivity allows customers to attach to choose the storage type (iSCSI, FC, NFS) most appropriate for the application through ONE adapter



Cisco Nexus 2000 Series Fabric Extender



Virtual Modular System



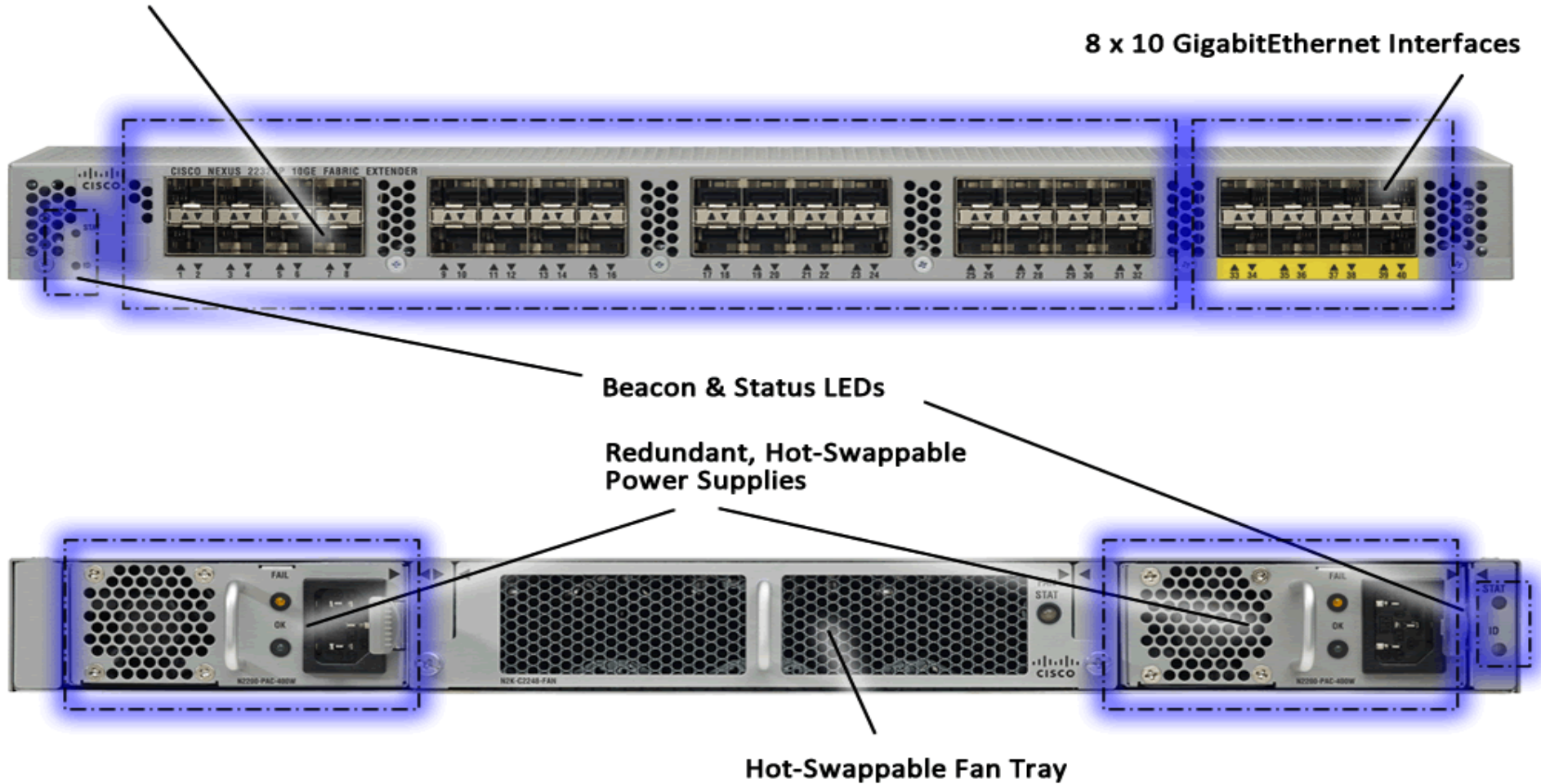
Nexus 2000 Fabric Extender



Cisco Nexus 2232PP Fabric Extender

32 x 10 GigabitEthernet (SFP+) & FCoE Interfaces

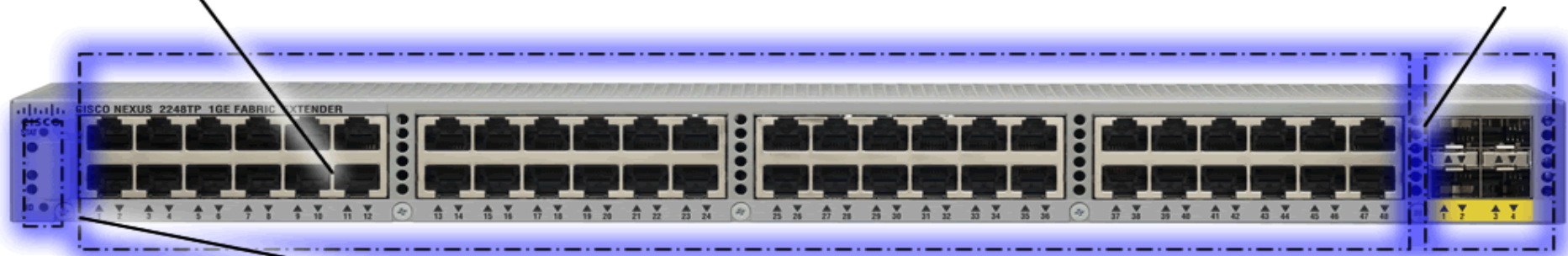
8 x 10 GigabitEthernet Interfaces



Cisco Nexus 2248T Fabric Extender

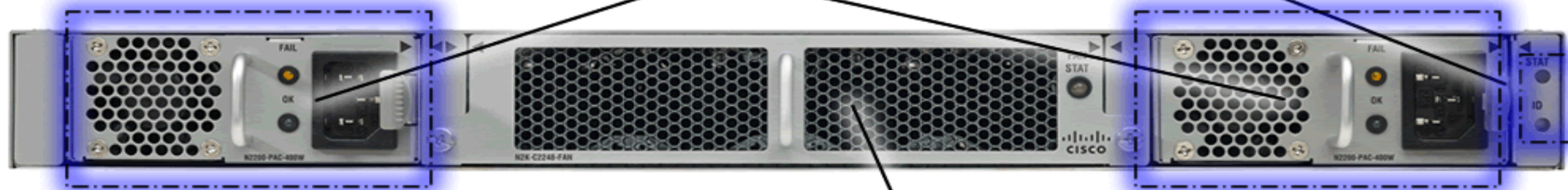
48 x 100/1000M (RJ45) Interfaces

4 x 10 GigabitEthernet Interfaces



Beacon & Status LEDs

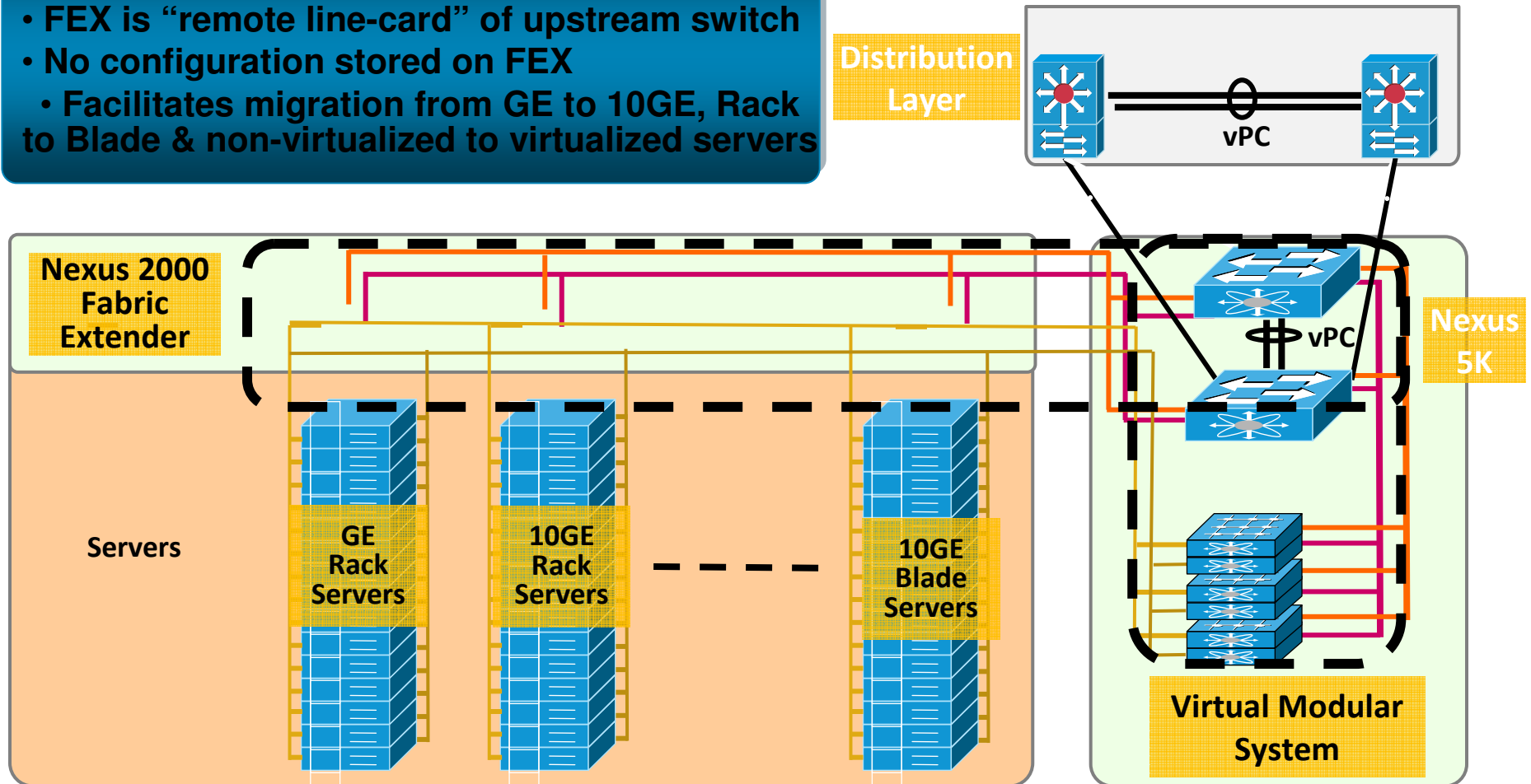
Redundant, Hot-Swappable Power Supplies



Hot-Swappable Fan Tray

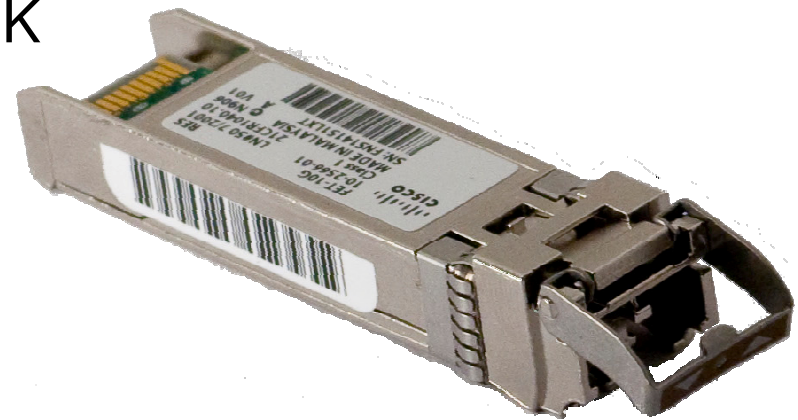
Fabric Extender: Virtual Modular System

- Nexus + FEX is a Virtual Chassis
- FEX is “remote line-card” of upstream switch
- No configuration stored on FEX
 - Facilitates migration from GE to 10GE, Rack to Blade & non-virtualized to virtualized servers

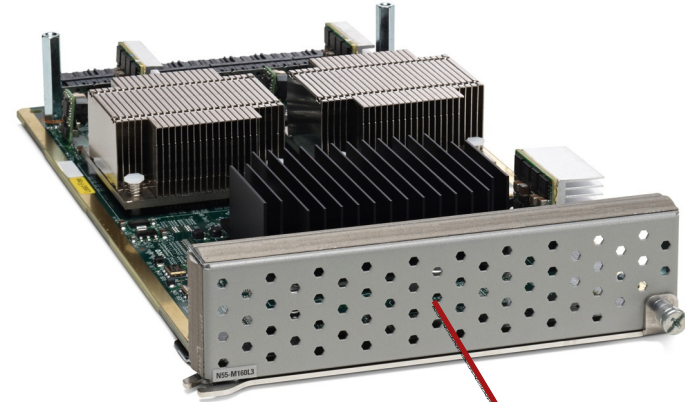
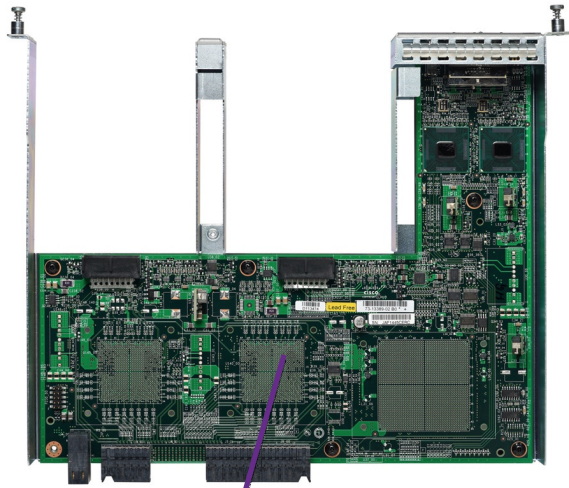


Fabric Extender Transceiver (FET)

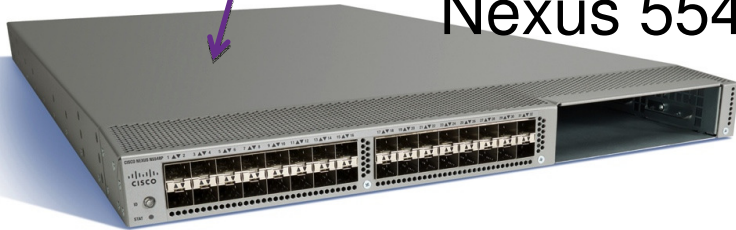
- Cost-effective transceiver to interconnect Nexus 2K & Nexus 5K
- SFP+ form-factor
- Cable Type: MMF
- Reach of 100M with OM3 fiber
- Incompatible with SR optics
- Used for N2K interconnect only
- Low power & latency
- Available in bundle solutions



Hardware PID	Description
N2K-C2248TF-1GE	N2K-C2248TP-1GE/8 FET for N2K-toN5K interconnect
N2K-C2232PF-10GE	N2K-C2232PP-10GE/16 FET for N2K-toN5K interconnect



Nexus 5548P
Nexus 5548UP



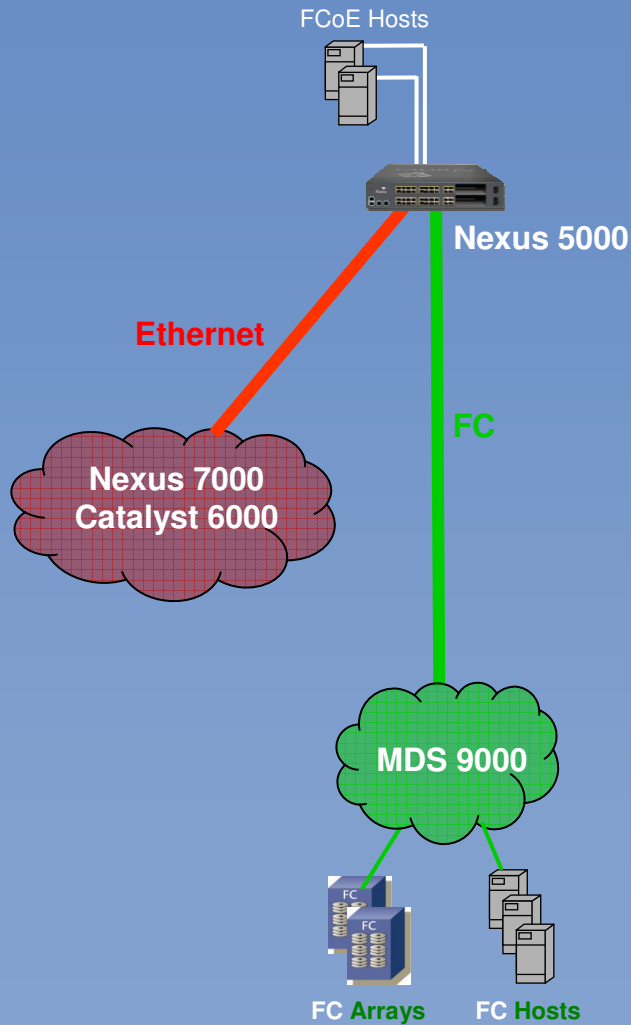
Nexus 5596UP

Nexus 5500 Layer 3 Modules – Available via IBM in Fall of 2011

Unified Fabric Deployment Options



Unified I/O - 2010



Unified Fabric - 2011

