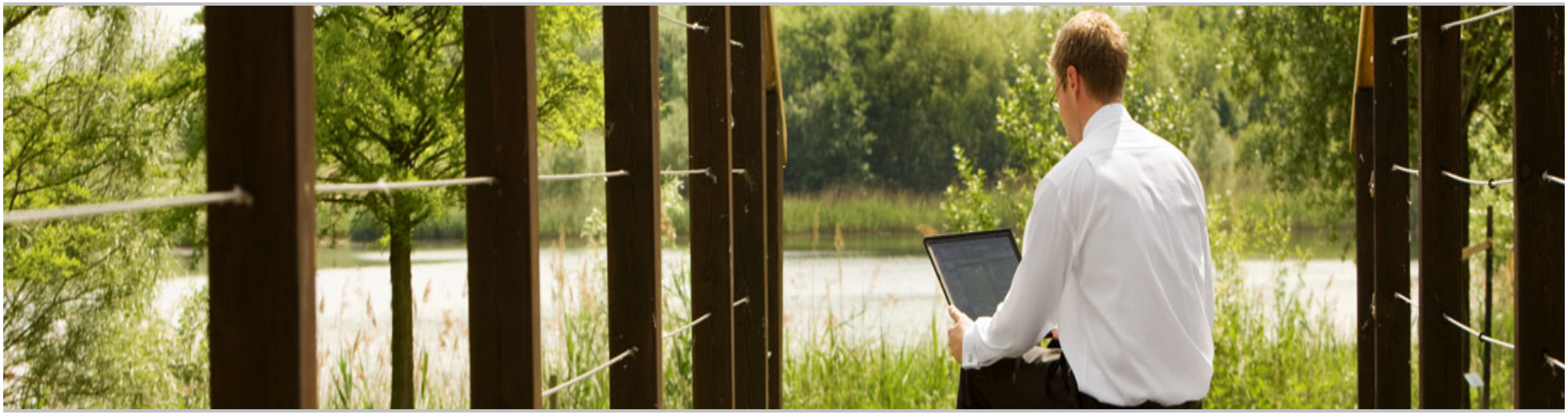


Nexus Tech Update

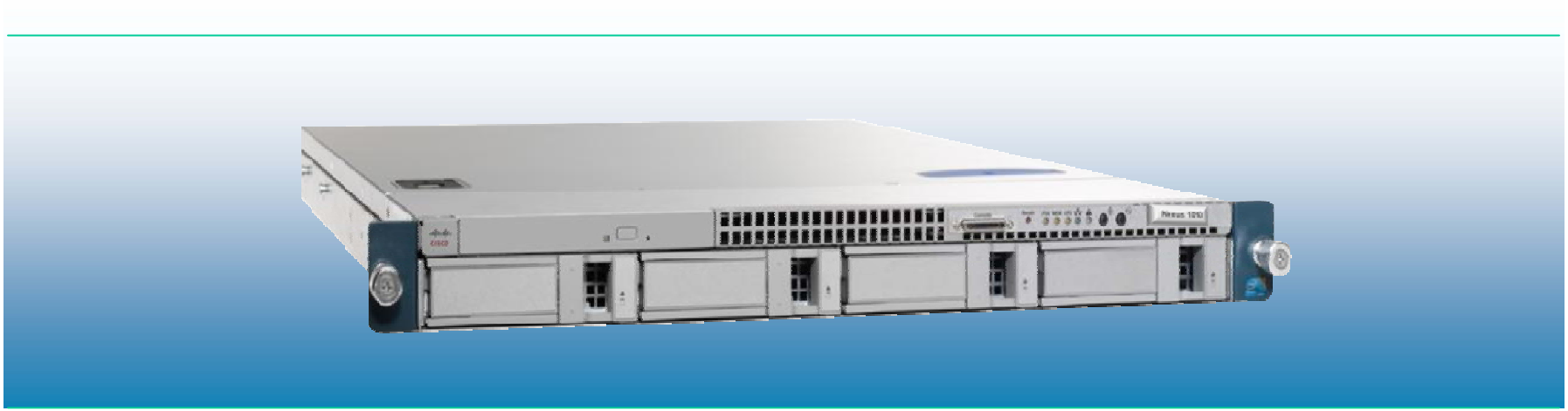
24 og 26 August 2010

Ib Hansen

ibhansen@cisco.com

Agenda

- Nexus 1000
  - Nexus 1010
  - NAM til Nexus 1010
- Nexus 2000
  - Nexus 2224 og 2248
  - Nexus 2232
  - FET
- Nexus 5000
  - Software update
  - Opkobling af Bladecentre med Pass Through moduler
  - Nexus 2000 / 5000 Bundles
- Nexus 7000
  - Software update
    - OTV
    - Fabric Path
  - F-Serie liniekort



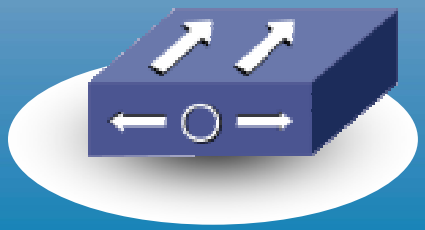
Nexus 1000V update

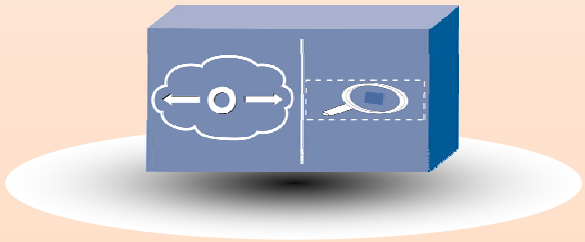
What Is the Nexus 1010?

- Allows network administrators to manage the Nexus 1000V supervisor like a standard Cisco switch, with all the same 1000V features
- Launching pad for future virtualized services (DCNM, security, etc.)
- Supported by CiscoWorks LAN Management Solution (LMS)
- The Nexus 1010 is a networking appliance to host four Nexus 1000V virtual supervisor modules (VSM)
- $24,995 per appliance (inc. 32 1000V licenses till 12/31/10)
- Available April/May 2010

Feature Comparison

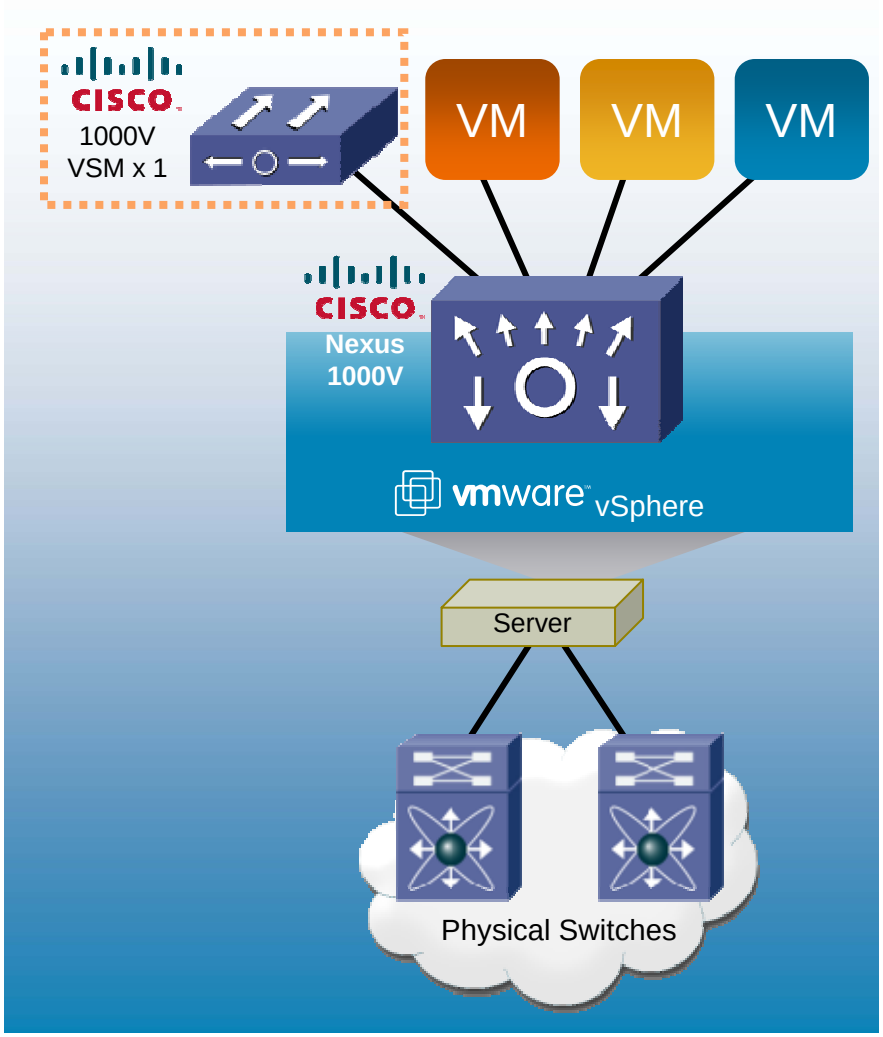
VSM on Virtual Machine	VSM on Nexus 1010
	Dedicated services appliance (NAM, etc.)
	Installation like a standard Cisco switch
	Network Team manages the switch hardware
64 hosts per VSM	64 hosts per VSM, 4 VSMs, 256 hosts in total
NX-OS high availability of VSM	NX-OS high availability of VSM
VEM running on vSphere 4 Enterprise Plus	VEM running on vSphere 4 Enterprise Plus
Nexus 1000V features and scalability	Nexus 1000V features and scalability



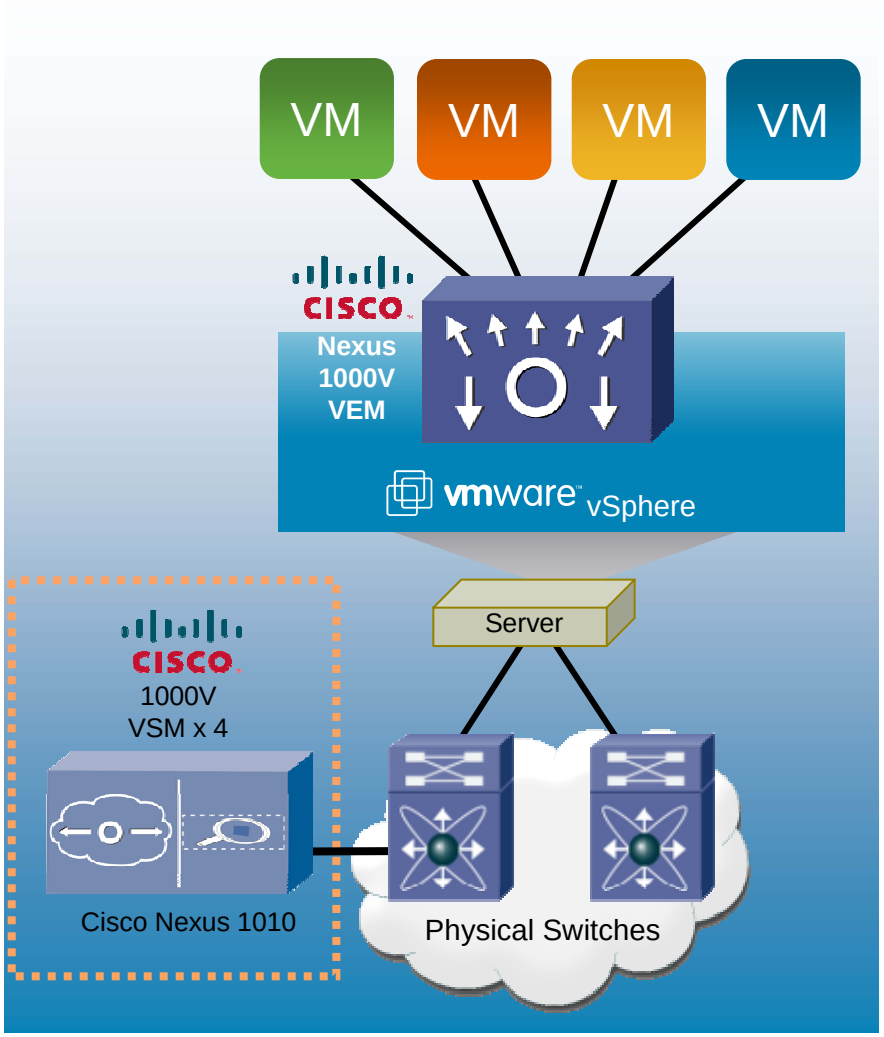


Architecture Comparison

VSM on Virtual Machine



VSM on Nexus 1010



Nexus 1010 Hardware Configuration

Based on the UCS C200 Physical Appliance

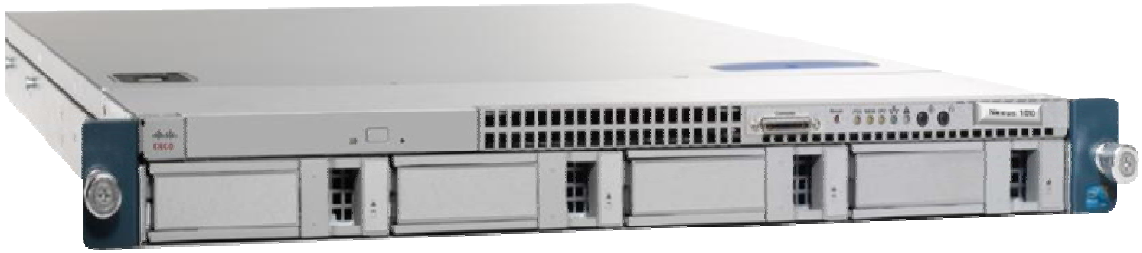
- 2* Intel X5650- 2.66GHz, 6 core
- 4* 4 GB RDIMMs RAM
- 2* 500GB SATA-II HDD
- 1* Broadcom Quadport GbE 5709 NIC Card
- 1* Serial Port
- 1* Rail-Kit

More information on the Nexus 1010

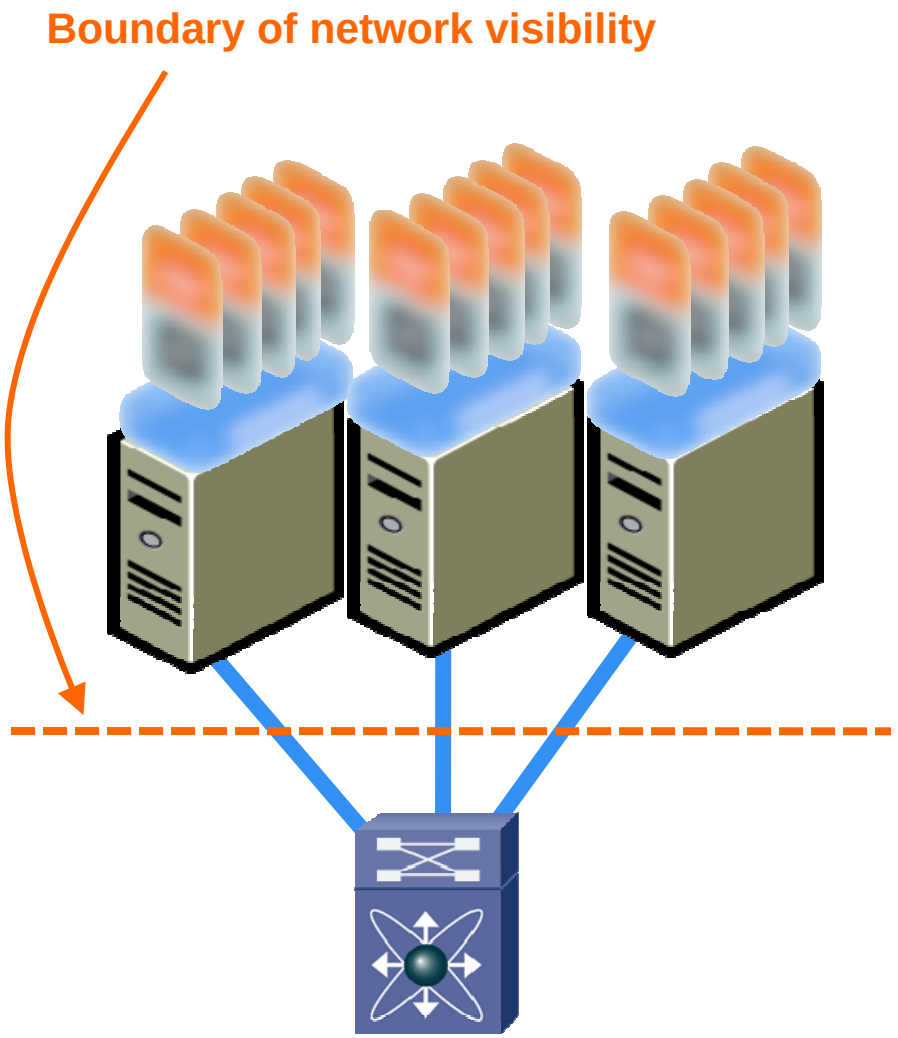
SKUs

	SKU	List Price
Nexus 1010 Appliance	N1K-C1010	$24,995
SASU Service on 32 1000V licenses (optional)	CON-SNT-N1010	$5,568
Smartnet Service on 1010 Appliance (optional)	CON-SAU-VLCPU	$290

- **Announcing NAM for Nexus 1010**



Management Challenges
Demands Deeper Visibility and Intelligent Analytics

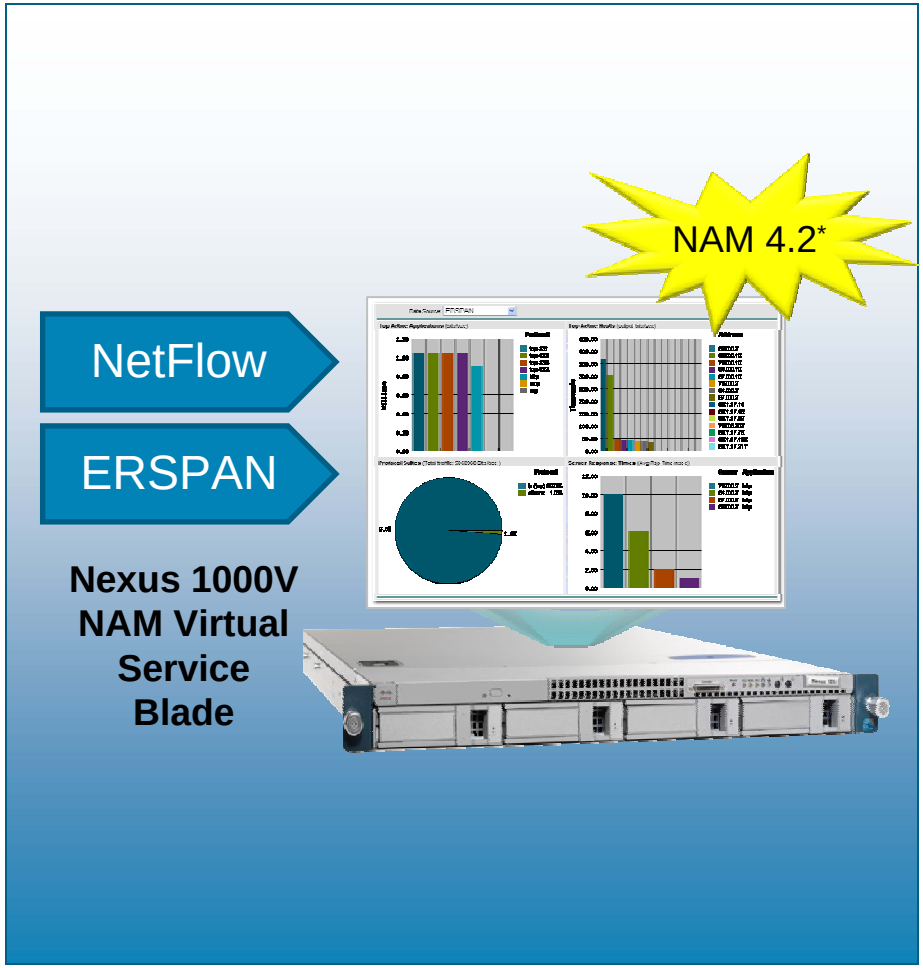


- Lack of visibility into network behavior at the VM level
- Lack of performance visibility into cross-VM interactions
- Lack of network and end-user experience perspective in resource scaling decisions
- Need for operational consistency and continuity across physical and virtual network

NAM Virtual Service Blade on Nexus 1010

Features:

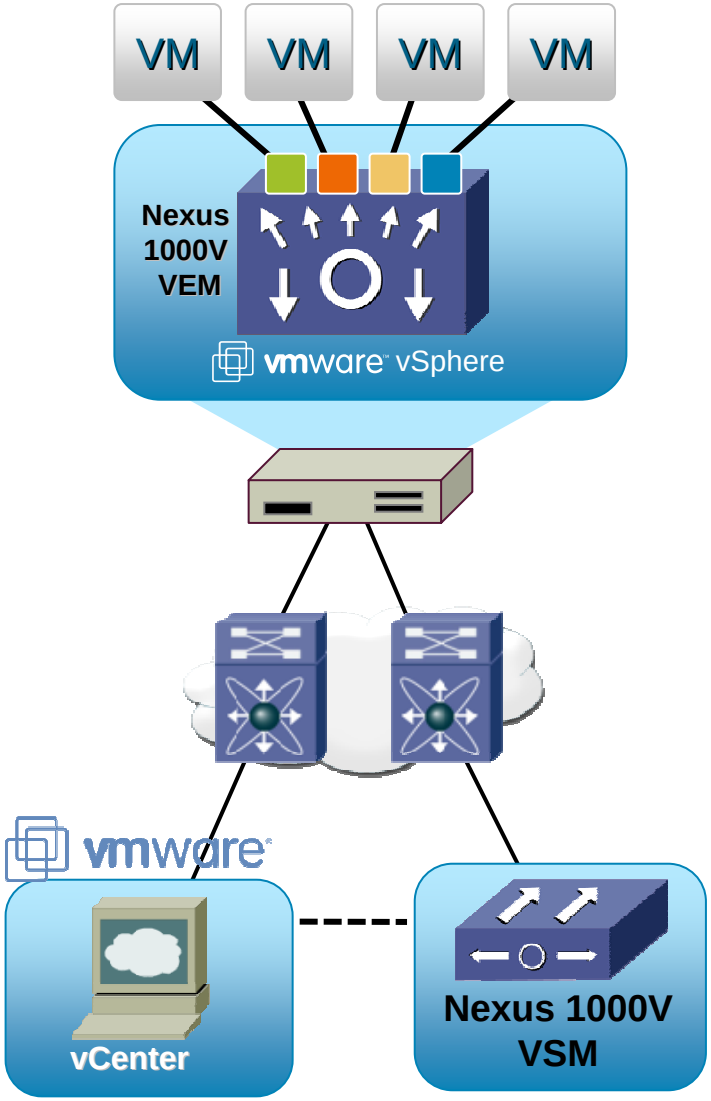
- Traffic Analysis
- Application Response Time
- VM-Level Statistics
- Open Northbound interface
- Uninterrupted by vMotion



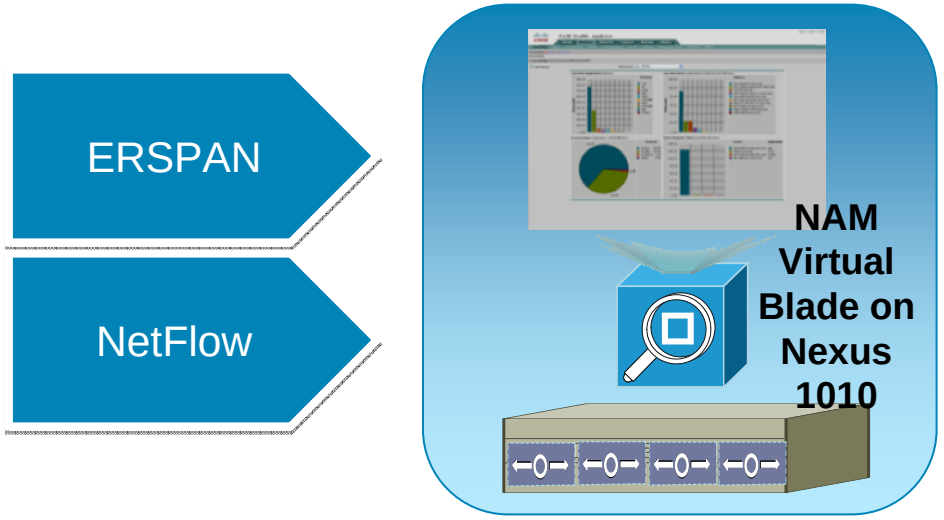
* **Availability in Q2 CY2010**

NAM Virtual Blade on Nexus 1010

Optimize Application Performance and Network Resources



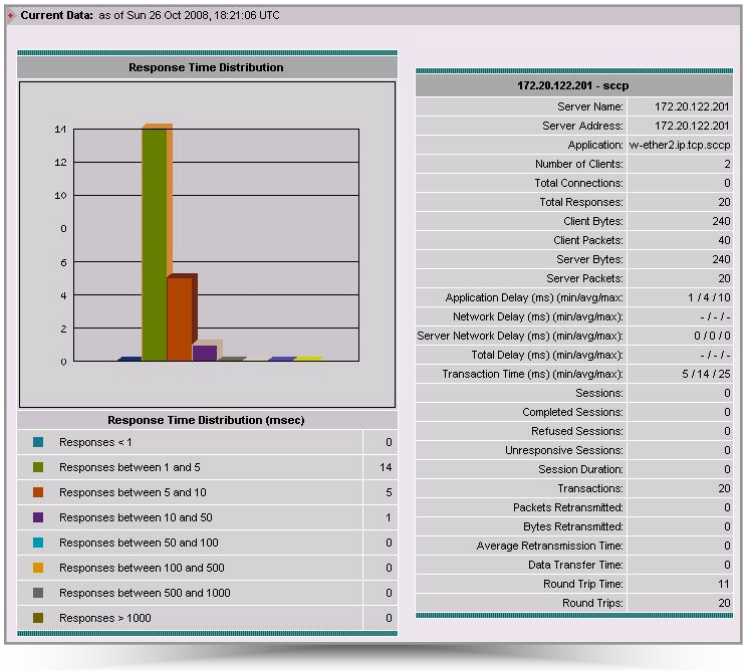
- Application Performance Monitoring
- Traffic Analysis and Reporting
  - Applications, Host, Conversations, VLAN, QoS, etc.
  - Per-application, per-user traffic analysis
- View VM-level Interface Statistics
- Packet Capture and Decodes
- Historical Reporting and Trending



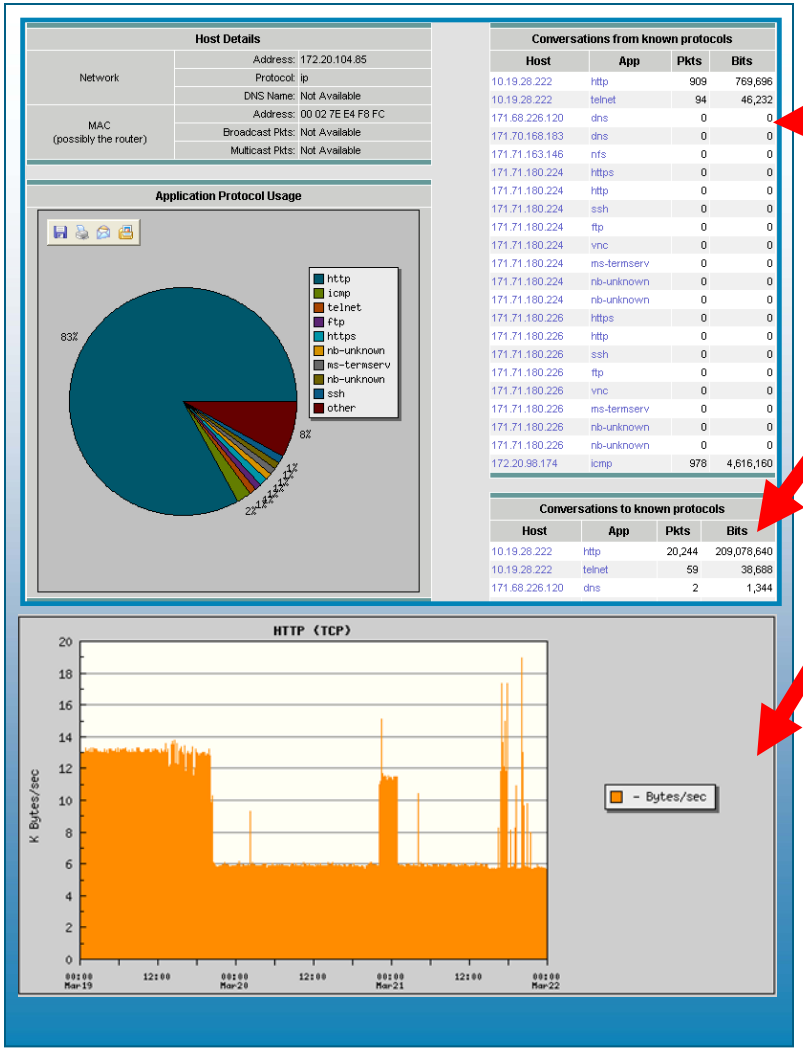
Intelligent Application Performance
Applications Response Time Analysis

- Comprehensive transaction- and session- based statistics (more than 45 metrics)
- Measure transaction response time for communication across virtual machines
- Assess the impact on application performance due to IT changes such as virtual machine migration, port profile updates, and so on

- Data-transfer time
- Transaction time
- Connection duration
- Number of bytes and packets retransmitte
- Retransmission delay
- Acknowledgement delay
- Number of open connections
- Number of closed connections
- Number of refused connections
- Number of unresponsive connections



Traffic Analysis: Applications, Host, Conversations



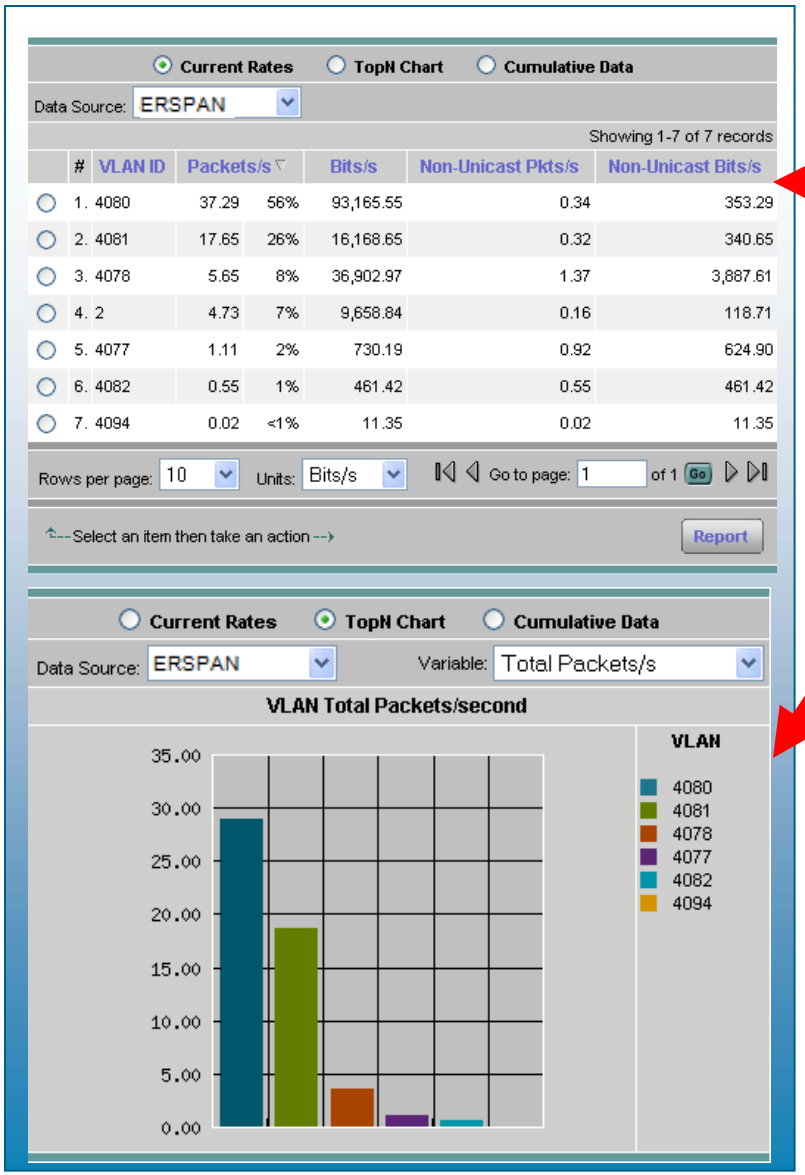
Features:

- Per-host/VM application traffic analysis
- Cross-VM/Host conversation analysis
- Top N and traffic trends analysis

Benefits:

- Assess bandwidth/network resources used by the application and the VMs
- Identify anomalous traffic behavior to address potential application performance issues

Traffic Analysis: VLAN



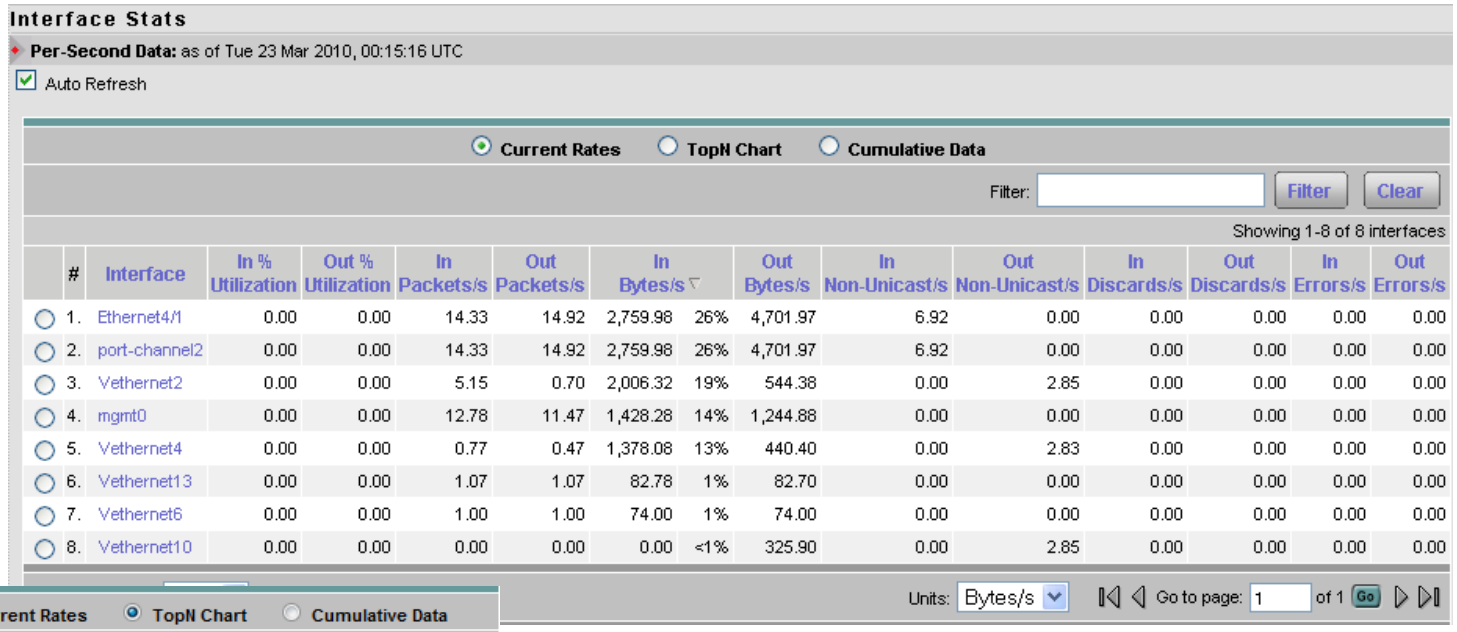
Features:

- Assess resource usage patterns by VLAN ID
- Monitor traffic statistics for a given VLANs
- Identify Top N VLANs by traffic statistics

Benefits:

- Analyze traffic on VLANs (Unicast versus non-unicast traffic)
- Detect incorrect VM assignments based on the traffic visibility

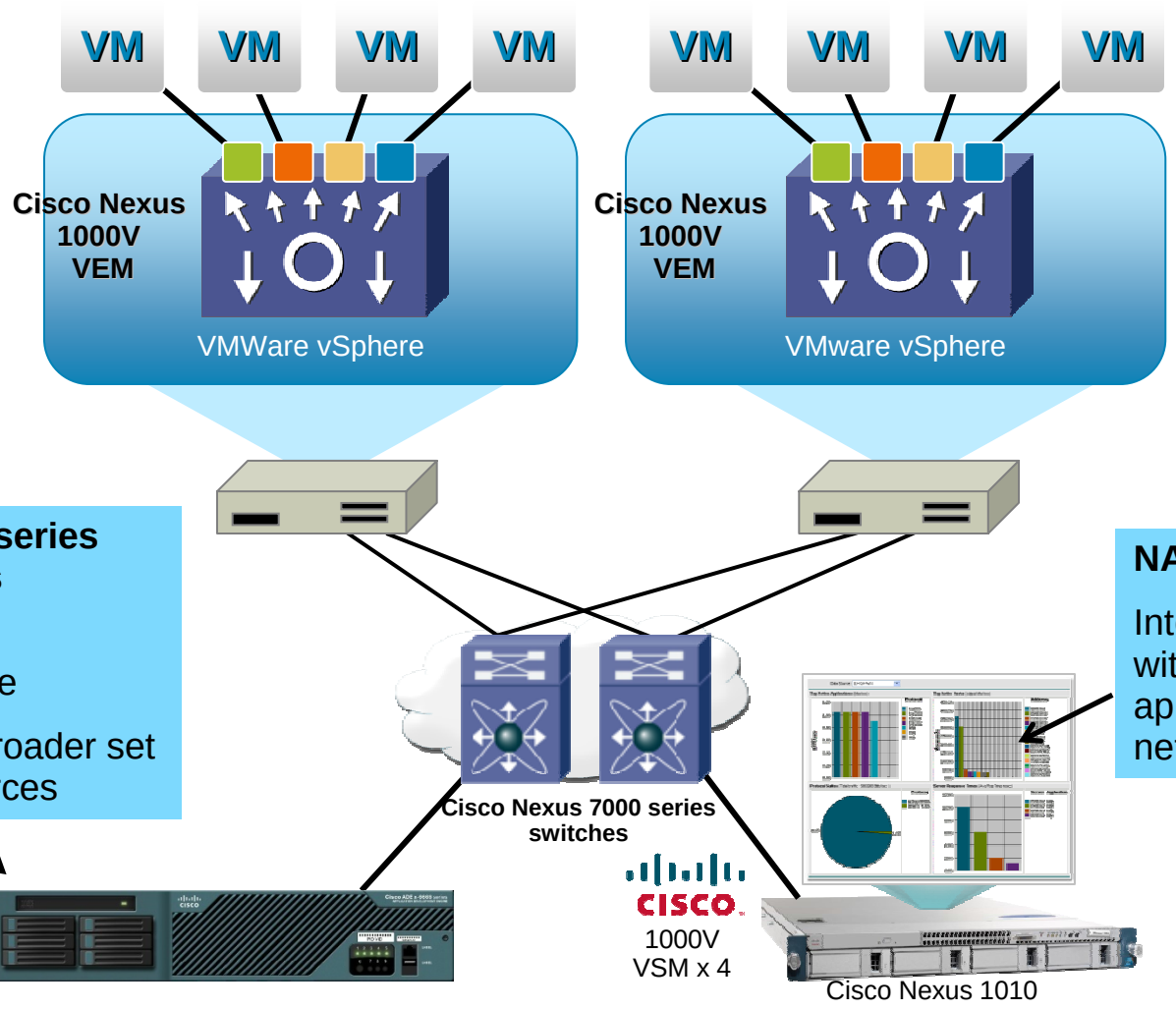
Interface Monitoring



- View traffic statistics on all interfaces
- Drill-down into an interface to obtain more details including TopN applications, hosts, and conversation

Deployment Options in Virtual DC Access

In conjunction with Nexus 7K as the Upstream Switch



NAM 2200 series Appliances

Multi-Gig Performance

Leverage broader set of data sources

NAM VSB

Integrated Solution with Nexus 1010 appliance reduces network footprint

Cisco NAM Product Information

- NAM Virtual Service Blade for Nexus 1010
  - http://www.cisco.com/en/US/products/ps10846/index.html
- Cat6500 NAM
  - http://www.cisco.com/en/US/products/hw/modules/ps2706/ps5025/index.html
- NAM 2200 series Appliances
  - http://www.cisco.com/en/US/products/ps10113/index.html
- ISR NAM
  - http://www.cisco.com/en/US/products/ps7176/index.html
- NAM Virtual Blade for WAAS
  - http://www.cisco.com/en/US/products/ps10506/index.html

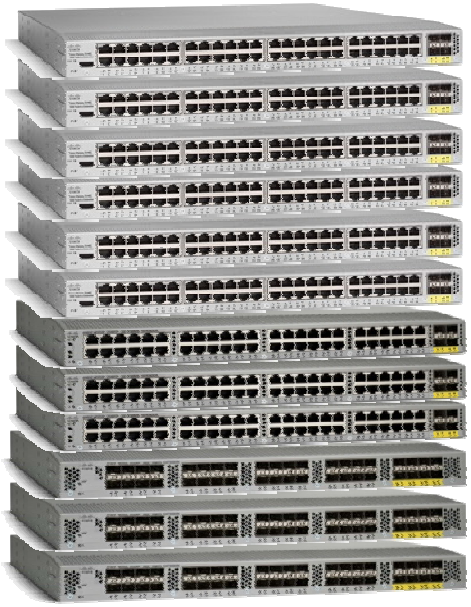
Nexus 2224,2248 og 2232 Fabric Extenders

Cisco Nexus 2000 Series Fabric Extender

Cisco Nexus Parent Switch

+

Nexus 2000 Fabric Extender



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Virtual Modular System

Virtual Modular System supports up to 2 Nexus 5K + 12 Fabric Extenders
Up to 576 GbE ports or 384 10GbE ports per Virtual Modular System

FEX: Enabling Unified Server Architecture

- **Architectural Flexibility**

  Rack or Blade servers (with pass through) or UCS

  100M to 1GE to 10GE to FCoE

- **Highly Scalable Server Access**

  Up to 384 Lossless 10GE/FCoE ports or 576 100/1000
  ports per management domain for Nexus

- **Simplified Operations**

  Single point of mgmt & policy enforcement

  Plug-and-play mgmt with auto-configuration

- **Increased Business Agility & Resilience**

  Increased resilience for server connectivity with ISSU & VPC

  VM aware network services

  Quick expansion of network capacity with ToR Nexus 2000

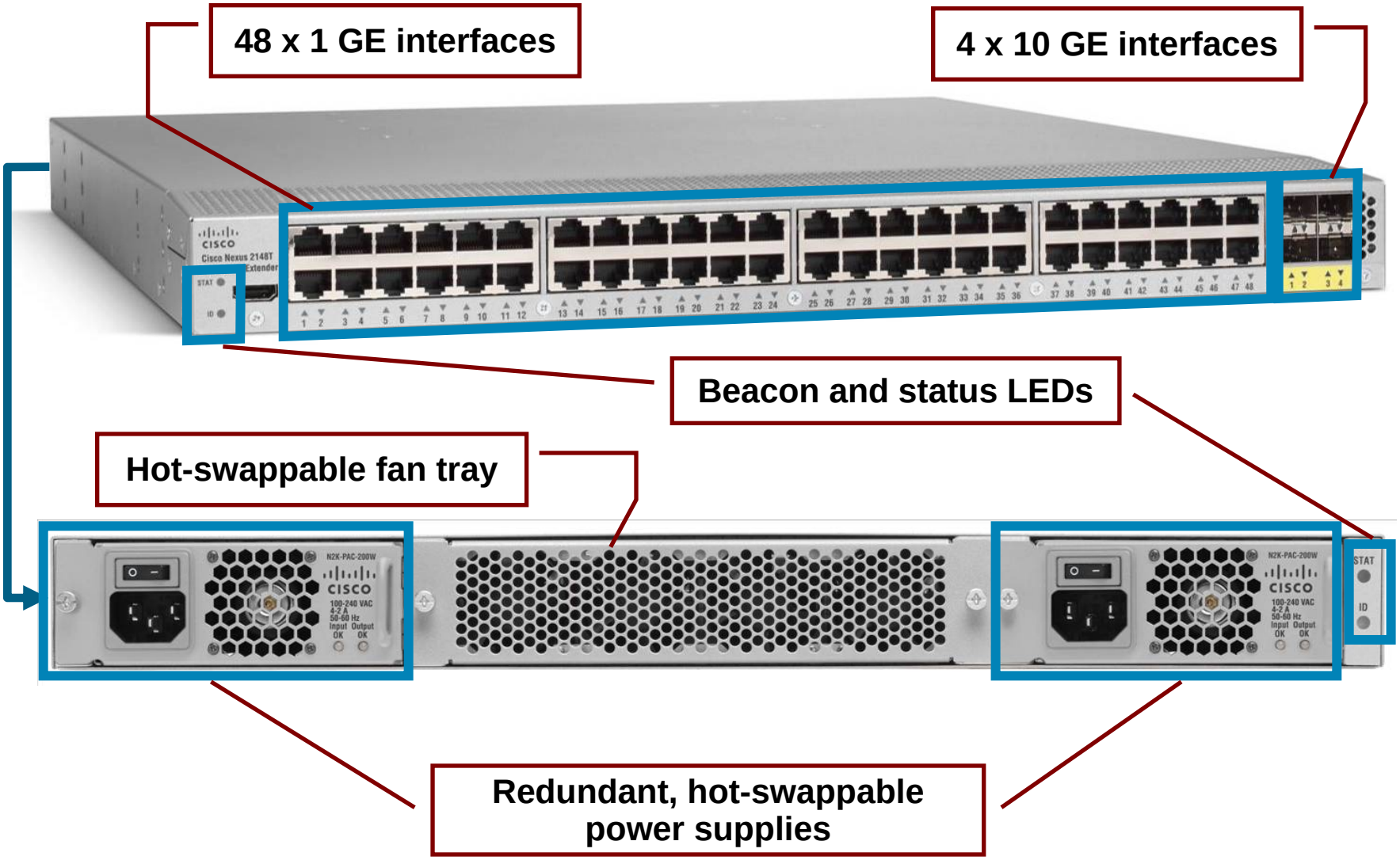
Lower TCO:

Reduced cabling up to 70%
Reduced power & cooling up to 30%
Reduced CAPEX up to 40%

Cisco Nexus 2000 Fabric Extender (FEX)
Platform Update

Model	Nexus 2148T	Nexus 2224TP	Nexus 2248TP	Nexus 2232PP-10G
Product Shipping	Yes (Q1CY09)	No (Q3CY10)	Yes (Q2CY10)	Yes (Q2CY10)
Form Factor	1 RU	1 RU	1 RU	1 RU
Uplink Ports	4 x 10GbE SFP+	2 x 10GbE SFP+	4 x 10GbE SFP+	8 x 10GbE SFP+
Uplink Transceivers Supported	Copper CX-1 (passive): 1m, 3m, 5m. Optical: FET (Nexus 2200 platforms), SR, LR [distance limited to 300m]			
Host Facing Ports	48 x 1GbE RJ45 (note: 1000BaseT only)	24 x 100/1000Base-T RJ45	48 x 100/1000Base-T RJ45	32 x SFP/SFP+ (1/10G) (note: 1GE SFP support in 4.2(1)N2(1))
FCoE	N/A	N/A	N/A	Yes
Dimensions	1.72 x 17.3 x 20.0 in	1.72 x 17.3 x 17.7in	1.72 x 17.3 x 17.7in	1.72 x 17.3 x 17.7 in
Operational Power	165W	95W	110W	270W
Supports FET	No	Yes	Yes	Yes
Multiple PortChannel member ports on a FEX	Not Supported	Yes	Yes	Yes
Scalability	576 GbE Ports per N5K (12 FEX)	288 GbE Ports per N5K (12 FEX)	576 GbE Ports per N5K (12 FEX)	384 1/10GbE Ports per N5K (12 FEX)

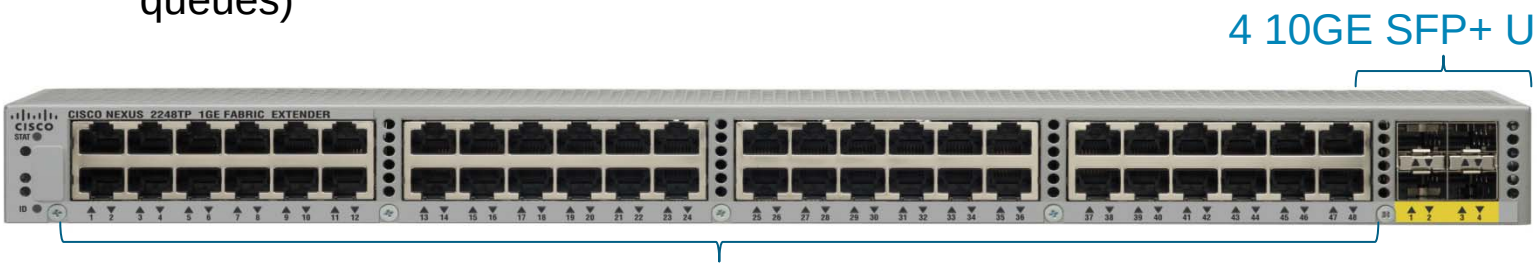
Nexus 2148T Fabric Extender
1GE Connectivity



Nexus 2248TP-GE Overview

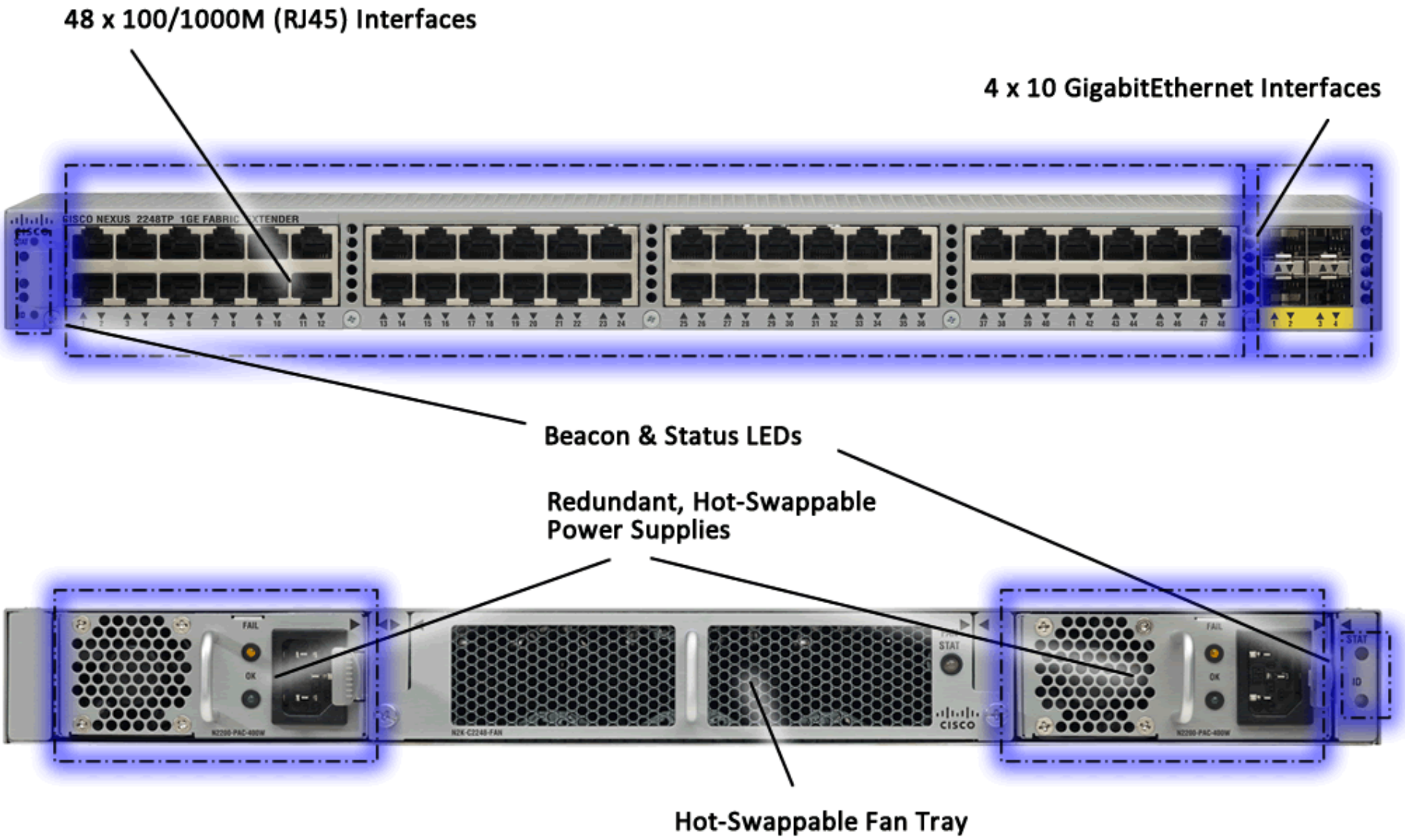
- FEX-1GE Fabric Extender
  - 48x 100/1000M host/downlink interfaces
  - 4x 10GE on network/uplink interfaces
  - Works with N5020/N5010
  - Upstream N5K supports various FEX (mix-and-match)
  - Front-to-back airflow
  - Host port-channel support
  - 6 user-defined QoS queues (8 QoS queues)

- Design scenario:
  - High density 100M/1G access
  - Cost effective 100M/1G solution
  - High Performance Compute
  - Virtualization



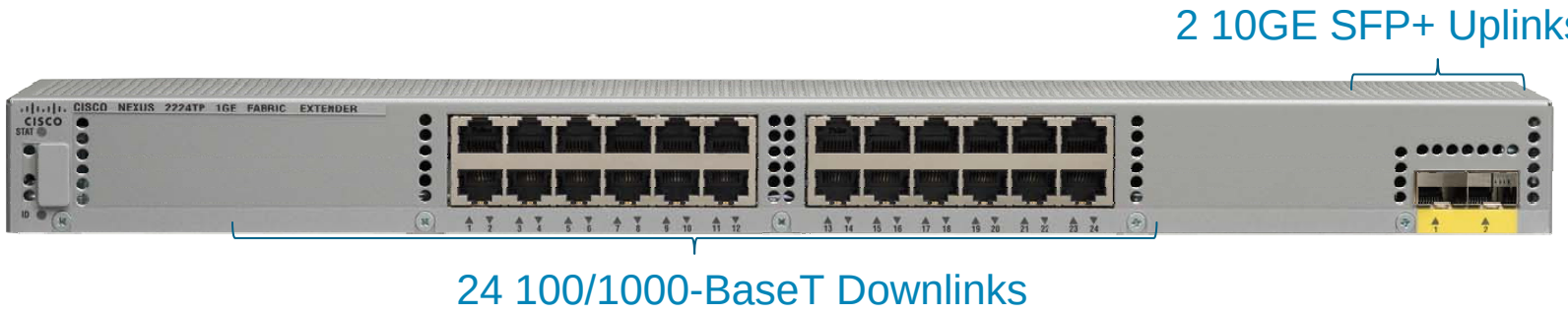
NX-OS 4.2(1)N1(1) Release

New Hardware – C2248TP 100/1000 Fabric Extender



Fabric Extender 1GE Nexus 2224TP Overview

- 24 ports 100M/1G-BaseT Fabric Extender
  - 24x 100M/1G BaseT host interfaces
  - 2x 10GE on network interfaces
  - Works with N5020P/N5010P
  - Upstream N5K supports various FEX (mix-and-match)
  - Front to back airflow
  - Supported in NXOS 4.2(1)N2(1)
- Design scenario: low port density 1G access
  - Low density server rack
  - Mixed 100M/1G/10G rack environments
  - Out Of Band Management connectivity



Nexus 2224TP Ordering information

- Solutions:

  N2224TP

  N2224TP/FET

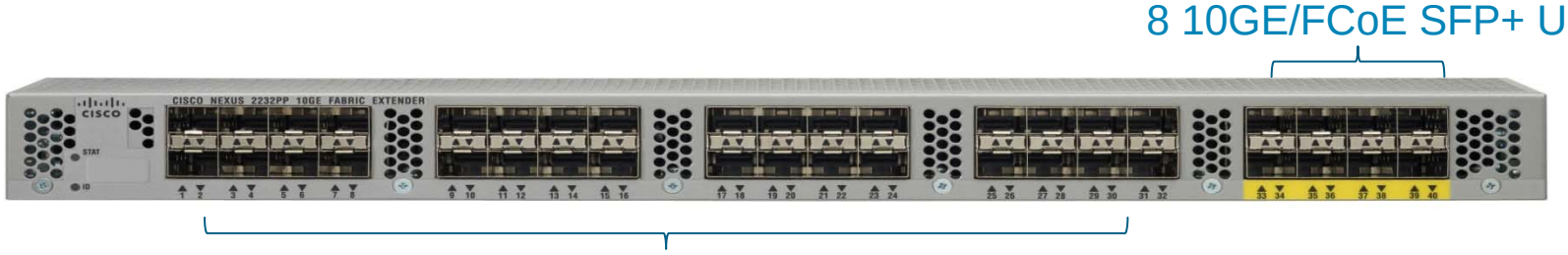
  Note: There will be no N5K/N2K/FET bundle

Hardware PID	Description	List Price
N2K-C2224TP-1GE	24x100M/1000-BaseT + 2x10GE SFP+	$7,000
N2K-C2224TF-1GE	24x100M/1000-BaseT + 2x10GE (includes 4 FET)	$8,000

Fabric Extender 1/10GE
Nexus 2232PP – Introducing 1G support

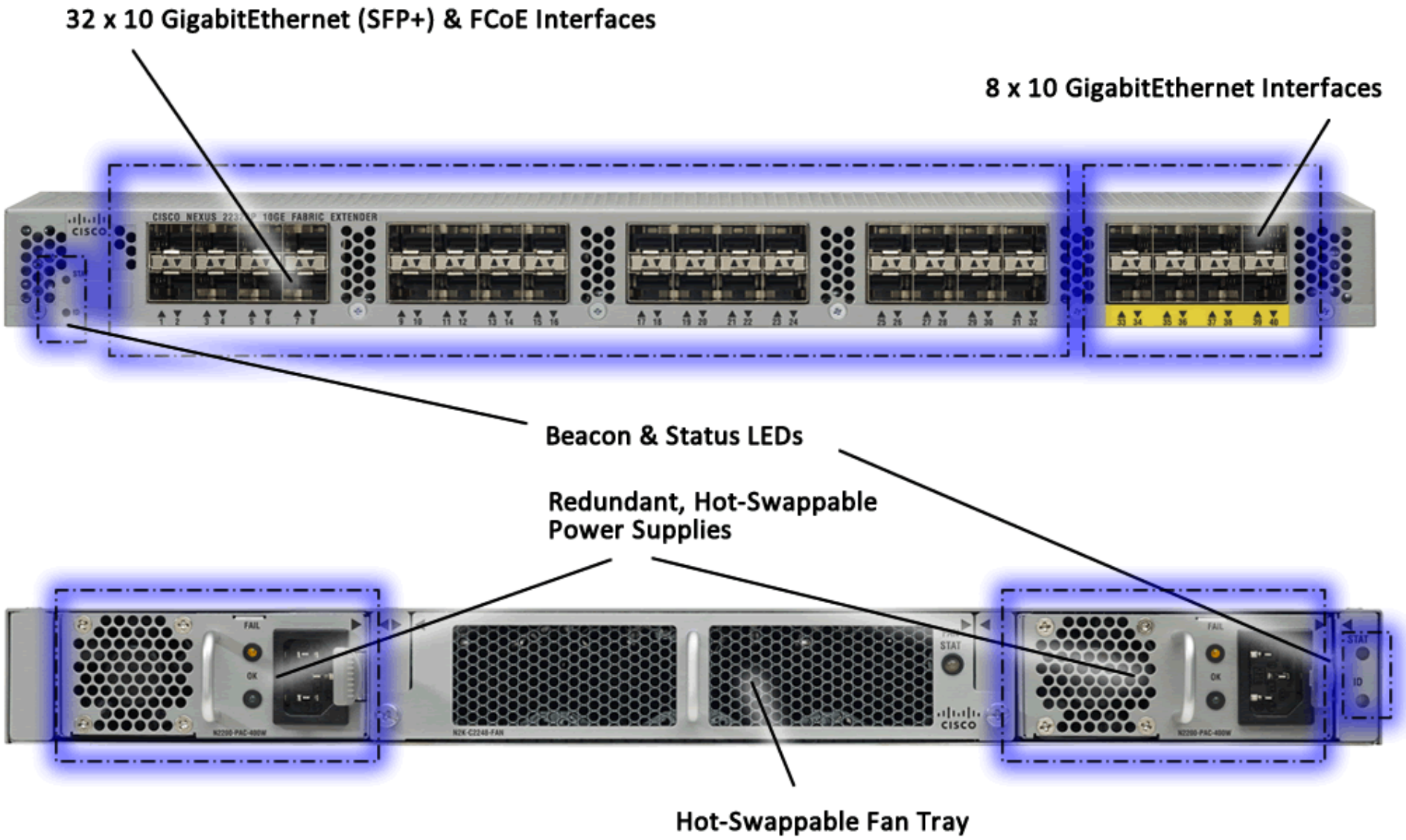
- 1GE/10GE/FCoE Fabric Extender
  - 32x 1/10GE host interfaces (1GE support in NXOS 4.2(1)N2(1))
  - 8x 10GE on network interfaces
  - Support for DCB and FCoE
  - SFP/SFP+ interfaces
  - Works with N5020P/N5010P
  - Upstream N5K supports various FEX (mix-and-match)
  - Front-to-back airflow

- Design scenarios:
  - 1G to 10G migration
  - Consolidation, Unified Fabric
  - High Performance, Low latency
  - Cost effective solutions with Direct attach Copper (CX1) in rack
  - Virtualized environments

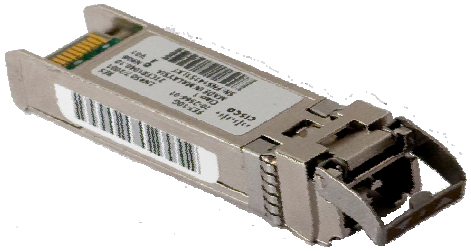


NX-OS 4.2(1)N1(1) Release

New Hardware – C2232PP 10G/FCoE Fabric Extender



Fabric Extender Transceiver



- Cost-effective transceiver to interconnect Nexus 2200 Platforms & Nexus 5K
- SFP+ form-factor
- Multimode fiber (MMF)
- Reach: 25m (OM2) 100m (OM3)
- Approximately 1 watt (W) per transceiver
- Incompatible with SR optics
- Used for N2K interconnect

- Available in bundle solutions with N2K

N2K-C2248TP-1GE	Nexus 2248TP
N2K-C2248TF-1GE	Nexus 2248TP with 8 FET

N2K-C2224TP-1GE	Nexus 2224TP
N2K-C2224TF-1GE	Nexus 2224TP with 4 FET

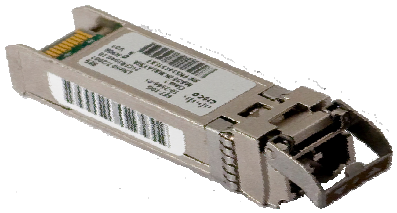
N2K-C2232PP-10GE	Nexus 2232PP
N2K-C2232PF-10GE	Nexus 2232PP with 16 FET

- Spare available for RMA

Fabric Extender 10GE Transceiver supported

Host Interfaces Types	PID
Twinax (10G)	SFP-H10GB-CU1M, SFP-H10GB-CU3M, SFP-H10GB-CU5M
SFP+	SFP-10G-SR, SFP-10G-LR
SFP-Copper	GLC-T, SFP-GE-T
SFP-Fiber	GLC-SX-MM, GLC-SX-SM, SFP-GE-S, SFP-GE-L

Fabric Interfaces	PID
FET	FET-10G
SFP+	SFP-10G-SR, SFP-10G-LR (300m distance limit between N5K/N2K)
Twinax	SFP-H10GB-CU1M, SFP-H10GB-CU3M, SFP-H10GB-CU5M

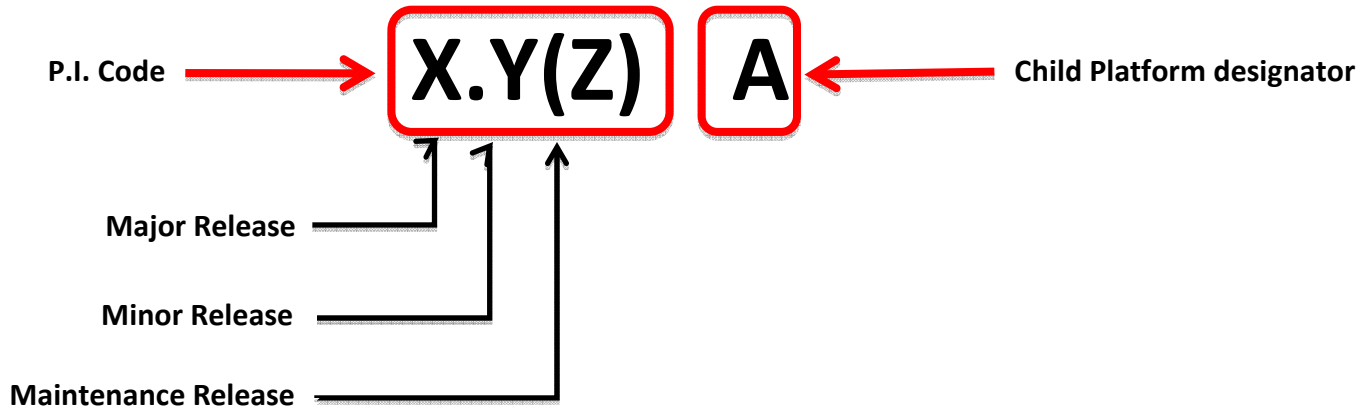


Nexus 5000 Software Update

4.2(1)N1(1) - (Dee Why)

NX-OS Release Numbering
Overview

Each NX-OS software release is uniquely to allow easy identification of Platform Independent (P.I.) code base and the platform on which it is running.



Major release - A major release introduces significant new features, functions, or platforms

Feature/Minor release - Each major release consists of multiple feature releases. Each feature release enhances a major release

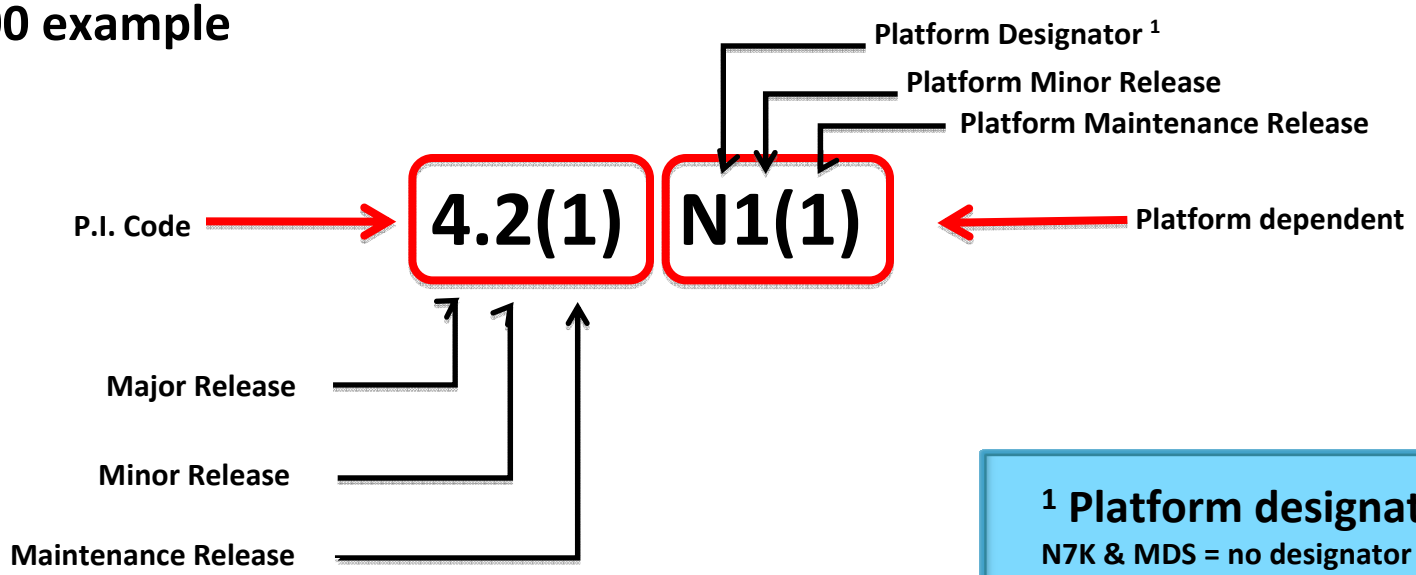
Maintenance Releases - A maintenance release primarily resolves product defects in a feature release. Helping ensure that each maintenance release addresses product defects preserves the integrity and stability of a minor release. Few or no new features are added in a maintenance release.

P.I. Code – Indicates version number of platform independent code base.

Platform Designator – Designates releases with platform specific modifications. N5K, N1KV, Nexus Blades, UCS have their own designators. No designator indicates N7K or MDS.

NX-OS Release Numbering
Example

Nexus 5000 example



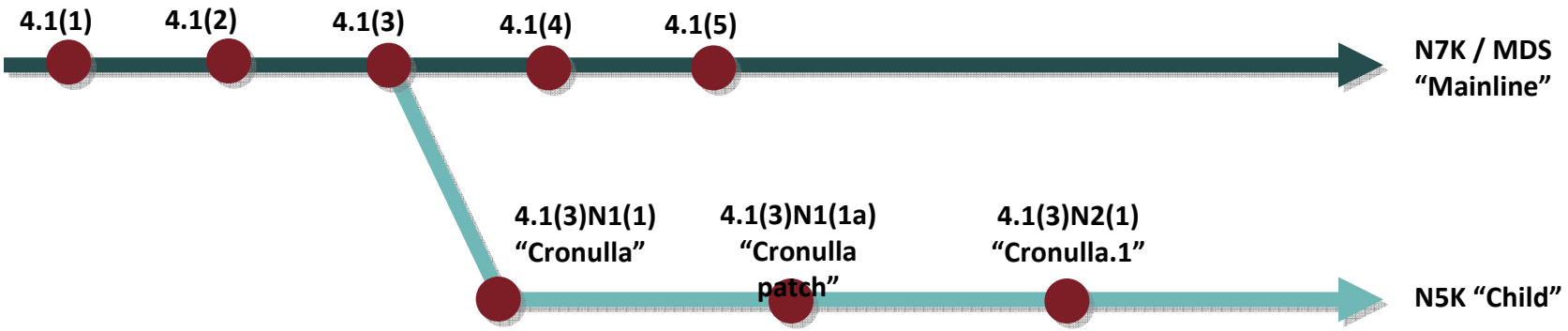
[1] Platform designators
N7K & MDS = no designator
N5K & UCS = N
N4K = E
N1KV = S

In the example above

- The platform independent (P.I.) numbering indicates the P.I. code is 4.2(1)
- All features, functions and fixes that are in the 4.2(1) P.I. code are available to the platform team
- The platform dependent (P.D.) numbering indicates platform and the minor/maintenance release (as applicable)

NX-OS Release Train
Explained

Nexus 5000 release train view



From the above example

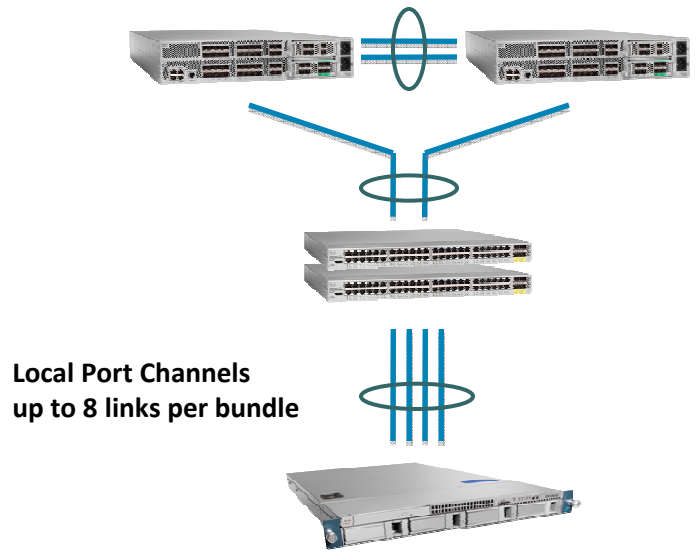
- The platform independent (P.I.) code is 4.1(3) with all features, functions and fixes available
- Platform dependent (P.D.) train is designed for platform specific changes or features (e.g. device drivers)
- The P.D. train is not designed for the introduction of new features P.I. features
- New P.I. features should be introduced in the P.I. code

NX-OS 4.2(1)N1(1) Release

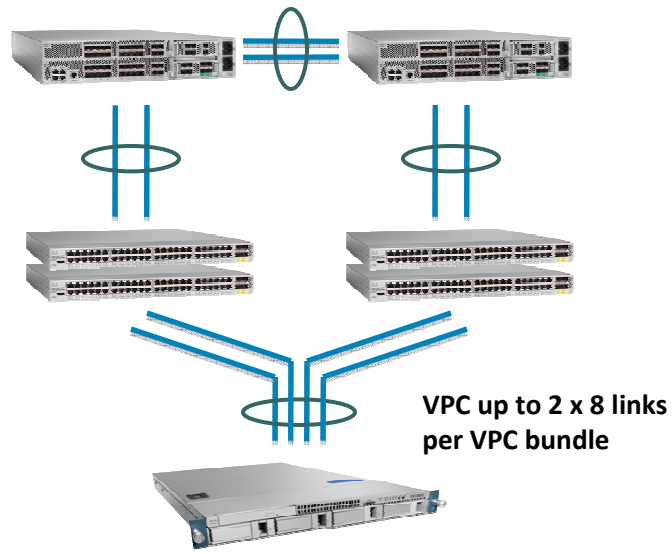
New Hardware – Additional Designs with new FEXs (non-FCoE)

Since the new Fabric Extenders allow for local port channel capabilities, it is now possible to have multiple active forwarding links from the server in either regular port channels or via VPC configurations…

FEX Active-Active



FEX Straight-Through

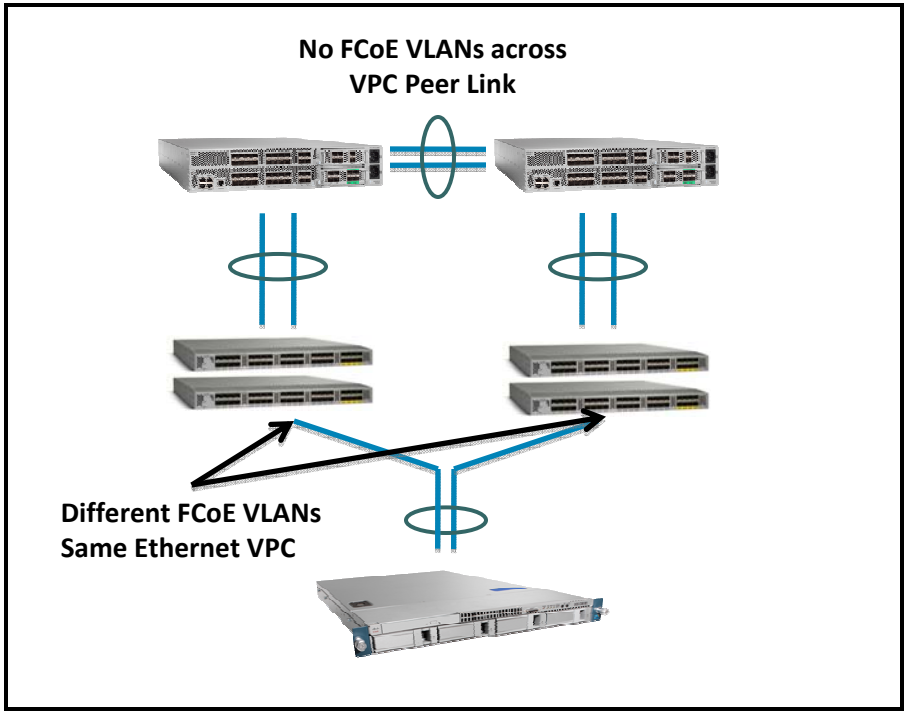


NX-OS 4.2(1)N1(1) Release

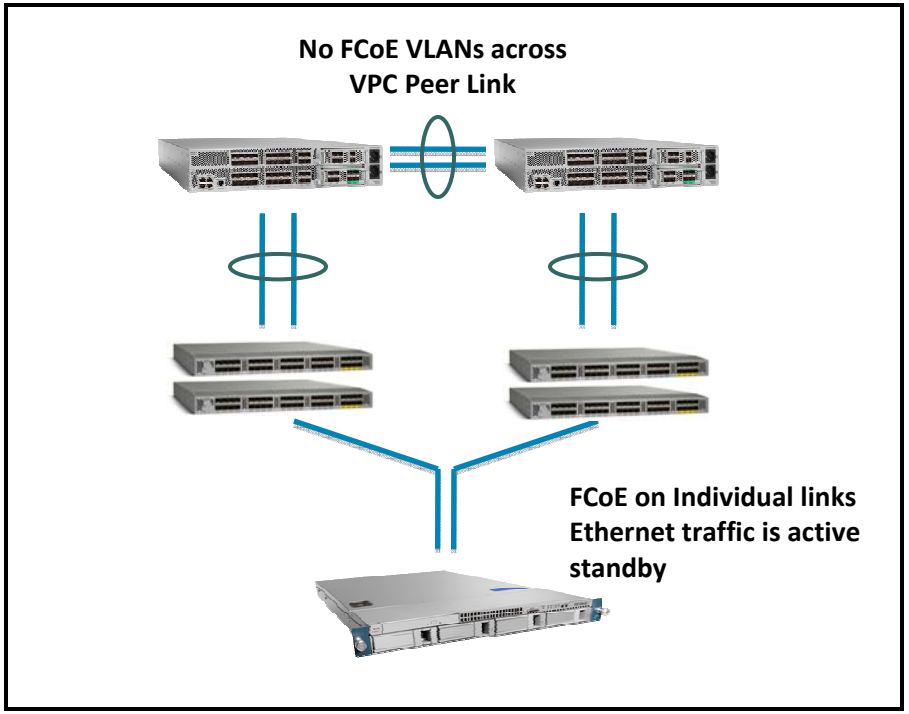
New Hardware – Additional Designs with new FEXs (FCoE)

In VPC enabled topologies in order to ensure correct forwarding behavior for SAN traffic specific design and forwarding rules must be followed. Different FCoE VLANs are used across different host-facing VPCs. VPC Peer link must not carry FCoE VLAN…

FEX Straight-Through with VPC



FEX Straight-Through with NIC Teaming



NX-OS 4.2(1)N1 Release

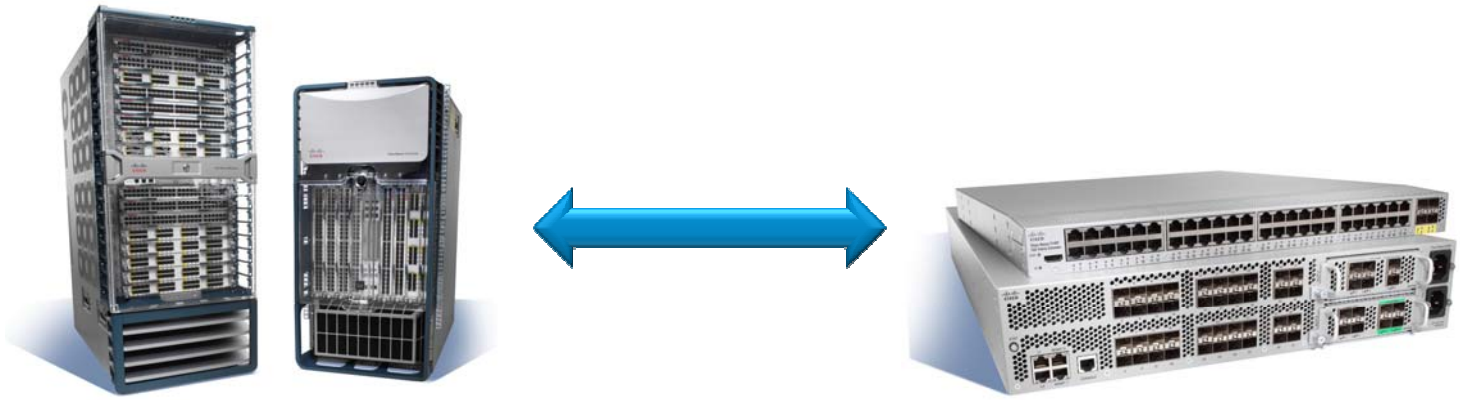
New Software – In-Service Software Upgrade (ISSU)

Starting from NX-OS 4.2(1)N1(1) release, the Nexus 5000 adopts the In-Service Software Upgrade (ISSU) functionality, allowing it to perform a non-disruptive upgrade of kickstart, system and bios/bootloader images on the Nexus 5000, as well as the image on the FEXs…

Supported hardware includes the base Nexus 5000 platforms (N5010, N5020), all Expansion modules (M1600, M1404, M1008, M1060) and all FEXs (N2148T, N2248T, N2232P)

Nexus 5000 ISSU
Differences from Nexus 7000

Although the high-level steps associated with ISSU is common between both the Nexus 5000 and Nexus 7000 platforms, the 2 platforms differ in key fundamental ways. The Nexus 5000 supports a single "supervisor" ISSU architecture and performs a stateful restart of the entire operating system upon execution, whilst leaving data plane forwarding intact…

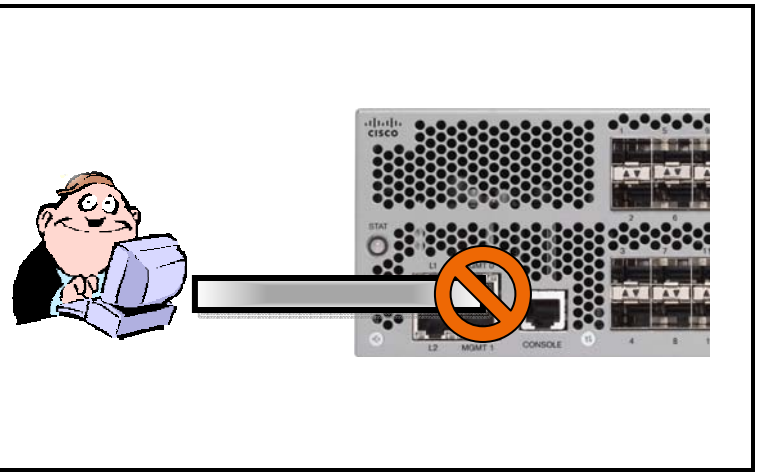


During this time, control plane functions of the switch undergoing ISSU are temporarily suspended, and configuration changes disallowed. The control plane will be brought online again within 80 seconds to allow protocol communications again.

Nexus 5000 ISSU
Preconditions

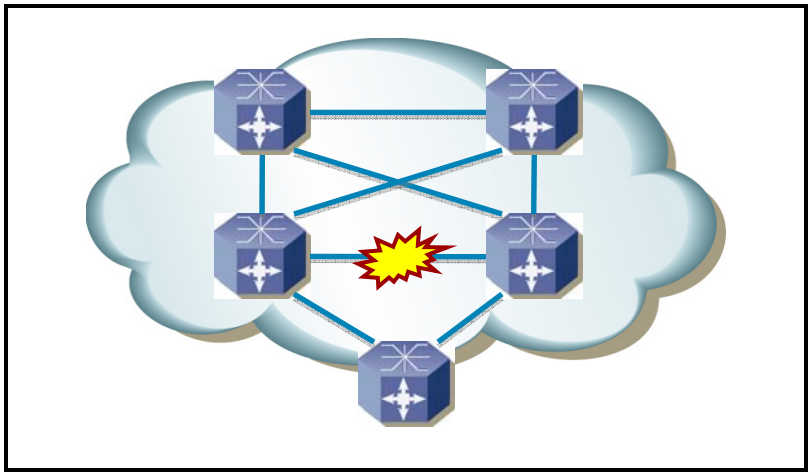
The ISSU process is executed through the installer, and certain conditions must be satisfied before it can proceed.

Restriction on Configuration changes



CLI and SNMP config change requests are denied during ISSU operations

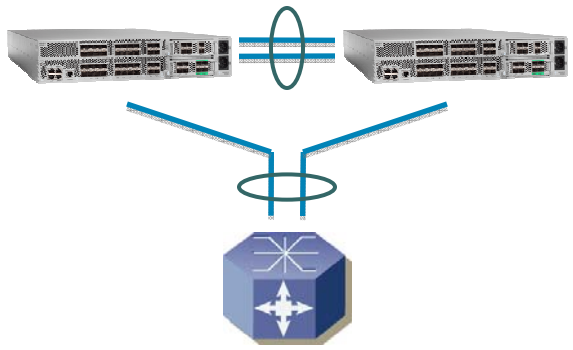
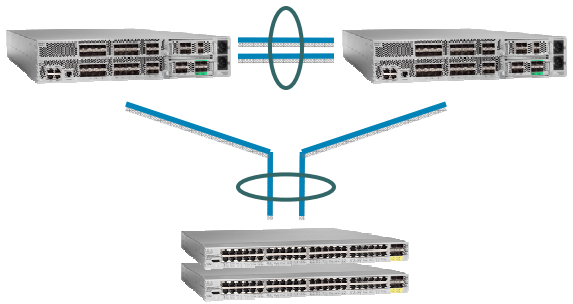
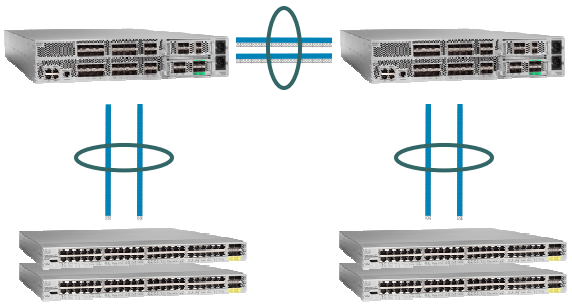
Restriction on Topology Changes



Network/Topology changes like STP, FC Fabric changes that affect zoning, FSPF, domain manager, Module insertion are not expected during ISSU operation

Nexus 5000 ISSU
VPC Topologies

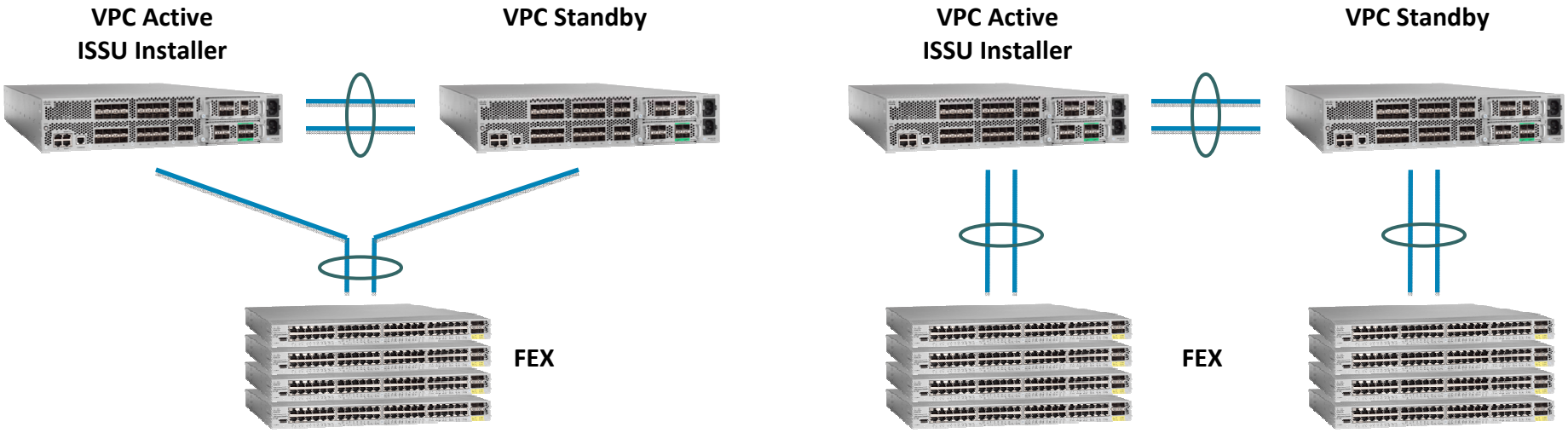
VPC topologies are fully supported with ISSU. Three types of VPC topologies are supported with 4.2(1)N1(1) release for the Nexus 5000 and Nexus 2000 FEX.

Blade or Access Switch	FEX Active-Active	FEX Straight-Through
		

Throughout the ISSU process, VPC roles will remain intact and the MCEC Manager (MCECM) is responsible for coordinating this process. It is the peer switch's responsibility to hold onto its state until ISSU process is complete

Nexus 5000 ISSU
FEX Upgrade Model

ISSU on the Nexus 5000 supports the non-disruptive upgrade of attached FEX modules. The 4.2(1)N1(1) release supports non-disruptive upgrades with rolling upgrades of FEX. A CLI option has been included to support simultaneous FEX upgrade disruptively…



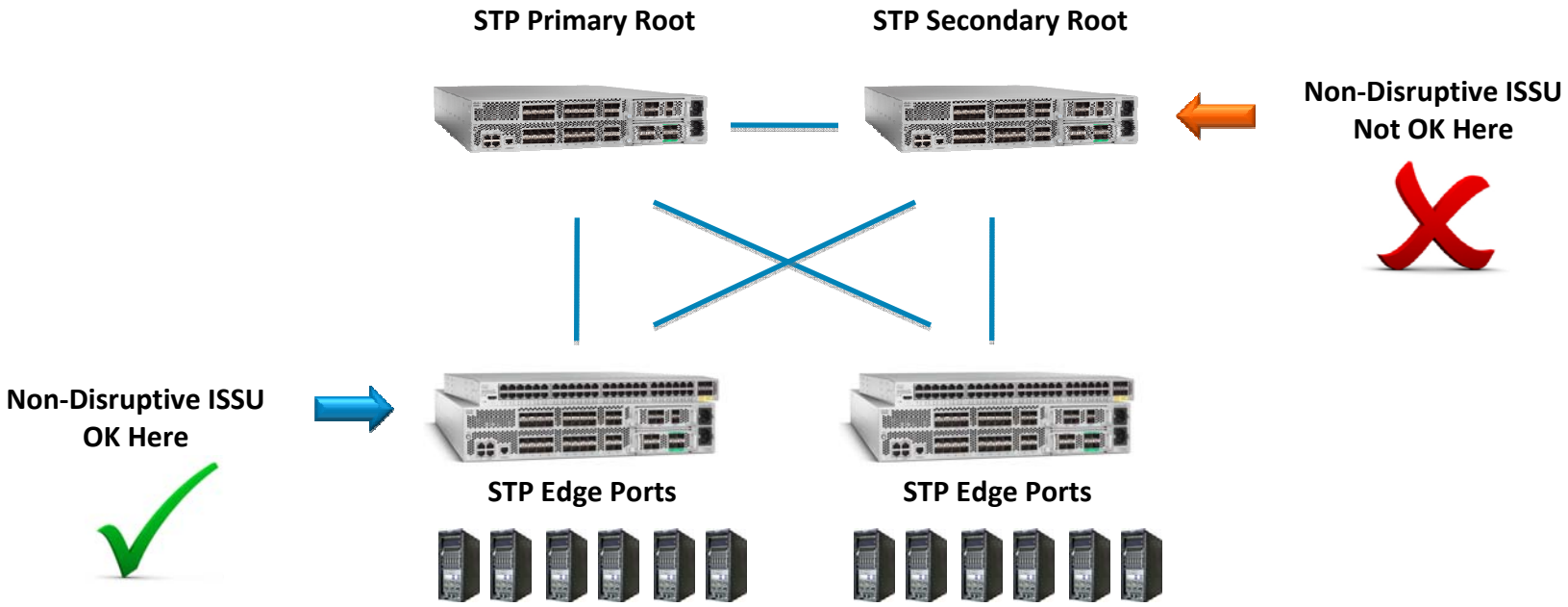

```
N5000# install all force kickstart bootflash:n5000-uk9-kickstart.4.2.1.N1.latest.bin
system bootflash:n5000-uk9.4.2.1.N1.latest.bin
```

In VPC topologies, the active/primary VPC switch role will be responsible for the upgrade of all FEXs in the topology

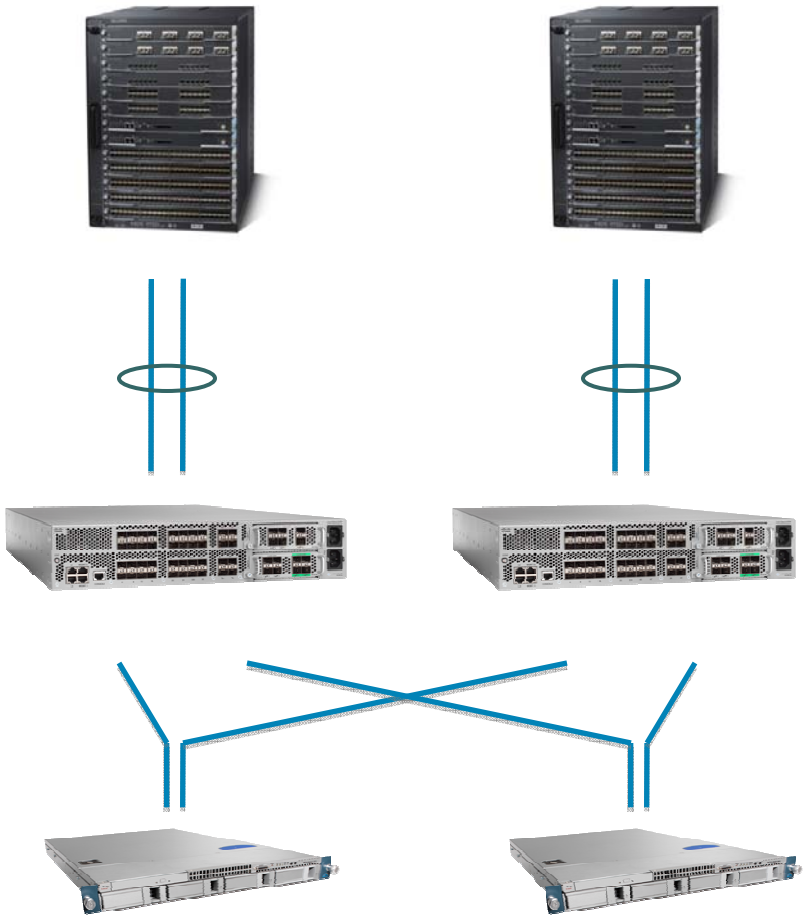
Nexus 5000 ISSU
STP Topologies

There are some restrictions that need to be placed on Ethernet STP topologies if a non-disruptive ISSU process is required:

1. **The Nexus 5000/2000 switch undergoing ISSU must be a leaf on the spanning tree. The switch should not be a root switch or have any designated non-edge ports in the STP topology**
2. **Bridge Assurance must be disabled for non-disruptive ISSU**



NX-OS 4.2(1)N1(1) Release
New Software – F_Port Trunking and F_Port Channeling

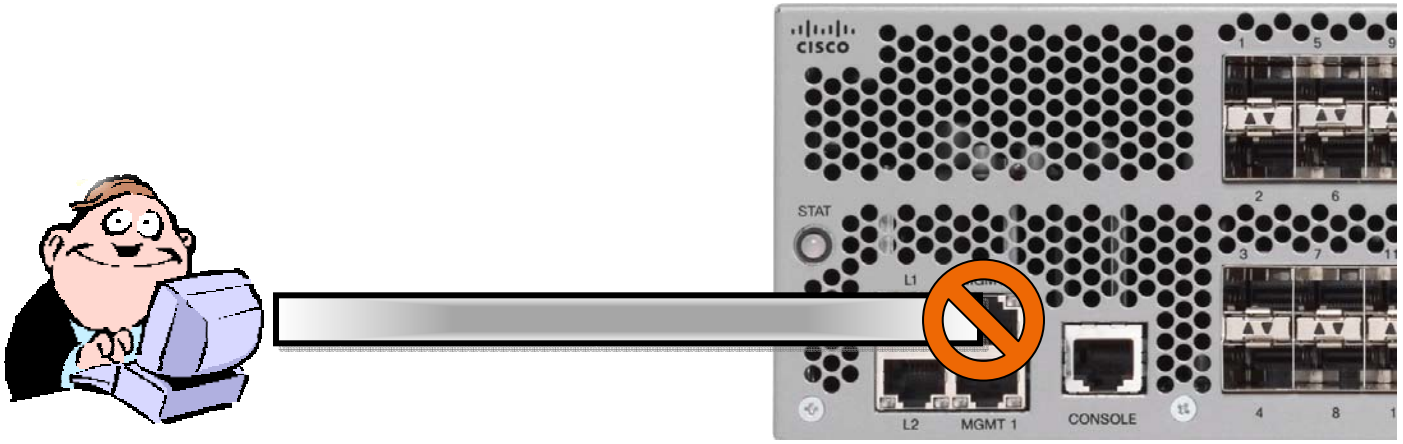


- Nexus 5000 access switches operating in NPV mode
- With NX-OS release 4.2(1)N1(1) Nexus 5000 supports F-Port Trunking and Channeling on the links between an NPV device and upstream FC switch (NP port -> F port)
- F_Port Trunking: Better multiplexing of traffic using shared links (multiple VSANs on a common link)
- F_Port Channeling: Better resiliency between NPV edge and Director Core
  - No host re-login needed per link failure
  - No FSPF recalculation due to link failure
- Simplifies FC topology (single uplink from NPV device to FC director)

NX-OS 4.2(1)N1(1) Release

New Software – ACLs for SNMP Communities

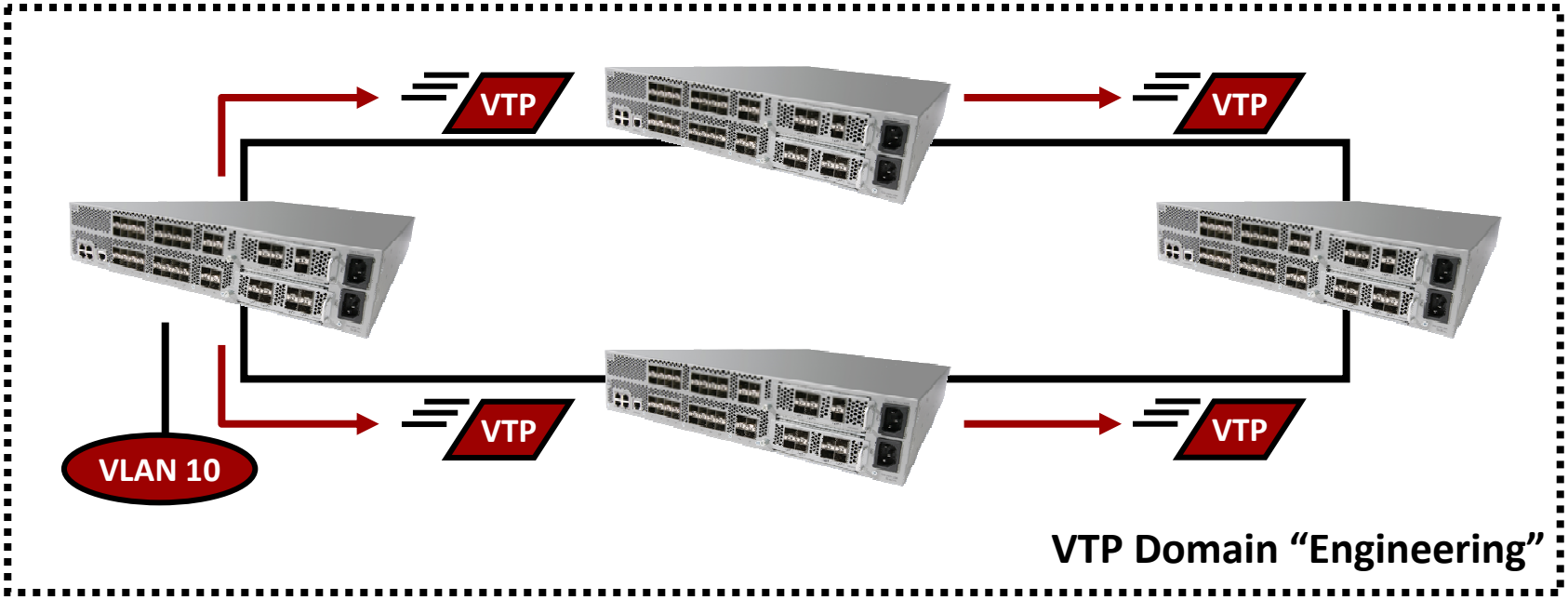
Prior to 4.2(1)N1(1) release, users were unable to apply ACLs to filter traffic on an SNMP community. With this release onwards, SNMP ACLs can be applied to filter SNMP traffic…




```
N5000(config)# snmp-server community RW ?
  <CR>
  group    Group to which the community belongs
  ro       Read-only access with this community string
  rw       Read-write access with this community string
  use-acl  Acl name to filter snmp requests
```

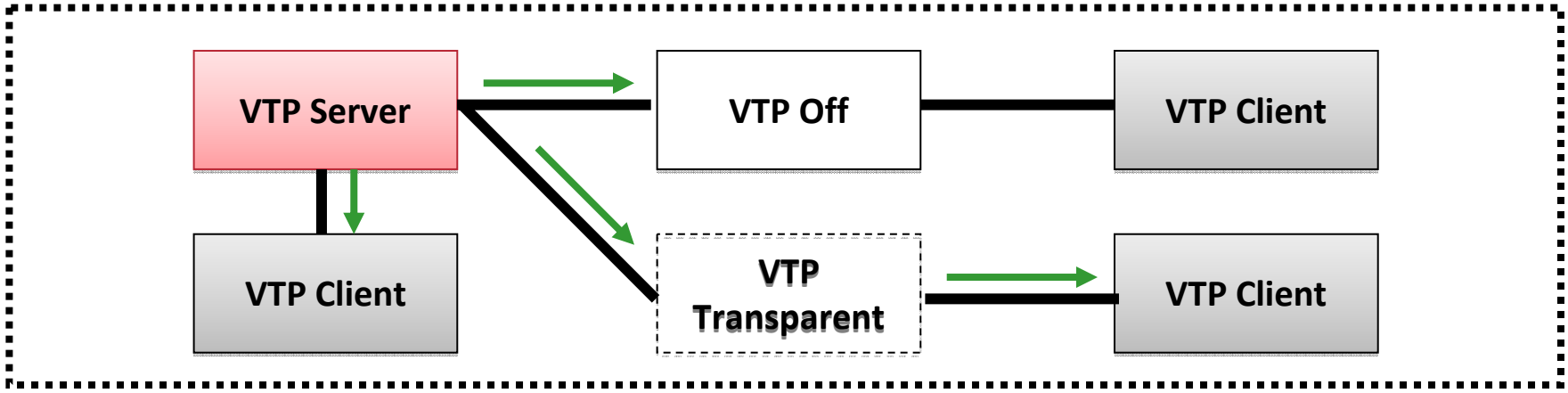
NX-OS 4.2(1)N1(1) Release
New Software – VTP Transparent Mode

VTP is a layer 2 protocol that enables switches to exchange and maintain consistent VLAN information amongst a group of switches. VTP allows the creation, deletion and renaming of VLANs for switches in the same VTP domain.



NX-OS 4.2(1)N1(1) Release
New Software – VTP Transparent Mode

Cisco supports multiple different modes of VTP, including VTP Client, Server, Transparent and Off. NX-OS release 4.2(1)N1(1) supports Transparent mode as well as Off (default). VTP Transparent mode allows VTP PDUs to pass through without installing VLANs into the VLAN database…




```
brawong-n5020-2(config)# feature vtp
brawong-n5020-2(config)# vtp mode transparent
```

NX-OS 4.2(1)N1(1) Release
New Software – Error Disable Recovery

NX-OS release 4.2(1)N1(1) adds additional error-disable recovery mechanisms in line with that which is supported on the Nexus 7000 platform…

```
N5000(config)# errdisable recovery cause ?
  all                Enable timer to recover from all causes
  bpduguard          Enable timer to recover from BPDU Guard error disable
                     state
  failed-port-state  Enable timer to recover from stp set port state failure
  link-flap          Enable timer to recover from linkstate flapping
  pause-rate-limit   Enable timer to recover from pause rate limit error
                     disabled state
  udld               Enable timer to recover from udld error disabled state
```

NX-OS 4.2(1)N1(1) Release

New Software – Enhanced Scalability for FEX Interfaces

NX-OS 4.2(1)N1(1) release increases the scalability of the number of Host Interfaces (HIFs) supported on the Fabric Extenders to 576 (with 12 FEXs). This has been made possible by offloading handling of protocol processing to the local CPU on the Nexus 2000…

Version	FEX Straight-Through	FEX Active-Active
4.1(3)N2(1)	576	480
4.2(1)N1(1)	576	576

NX-OS 4.2(1)N1(1) Release

New Software – Enhanced Scalability for Logical Ports

NX-OS 4.1(3)N2(1) release increases the scalability of the platform by increasing the number of STP logical ports supported across a Nexus 5000/Nexus 2000 combination. STP logical ports are calculated based on the total number of ports, taking into account all VLANs allowed on those ports…

Feature	4.1(3)N2(1)	4.2(1)N1(1)
STP Logical Ports	3,600	12,000

```
N5000# sh spanning-tree summary totals
Switch is in rapid-pvst mode
Root bridge for: none
Port Type Default                         is disable
Edge Port [PortFast] BPDU Guard Default   is disabled
Edge Port [PortFast] BPDU Filter Default  is disabled
Bridge Assurance                          is enabled
Loopguard Default                         is disabled
Pathcost method used                      is short

Name                   Blocking Listening Learning Forwarding STP Active
---------------------- -------- --------- -------- ---------- ----------
5 vlans                       0         0        0         50         50
```

Blade Switch Access Solution using HP's 10Gb Pass-Thru Module

May 2010

Introduction to HP 10G Pass-Thru

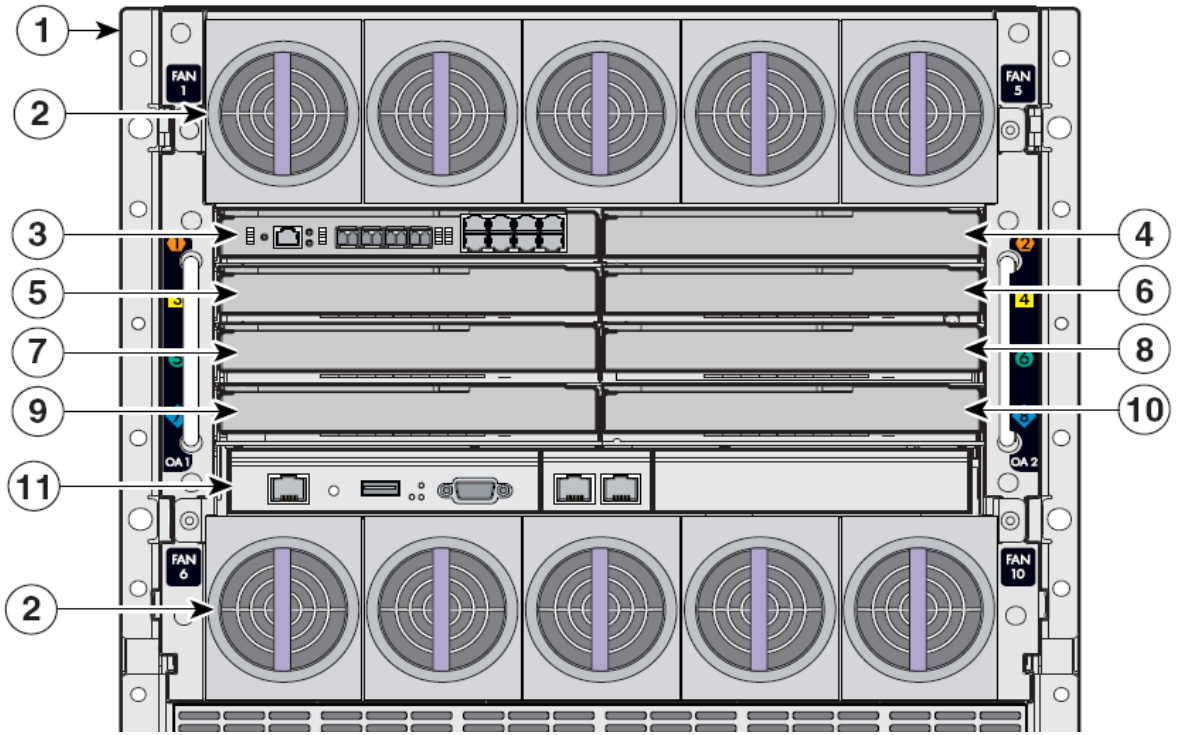
HP 10GbE Pass-Thru Module designed to provide unmanaged 1:1 low latency connections

- 16 direct server to network connections
- Auto-sense 1Gb or 10Gb operation on a port by port basis
- Supports standard Ethernet as well as Converged Enhanced Ethernet
- Supports all NICs and mezzanine adapters including Flex-10 NICS
- No management required
- Module performance monitored by the On-Board Administrator
- Front panel or OA access for service and test

HP 10Gb Pass-Thru Specifications

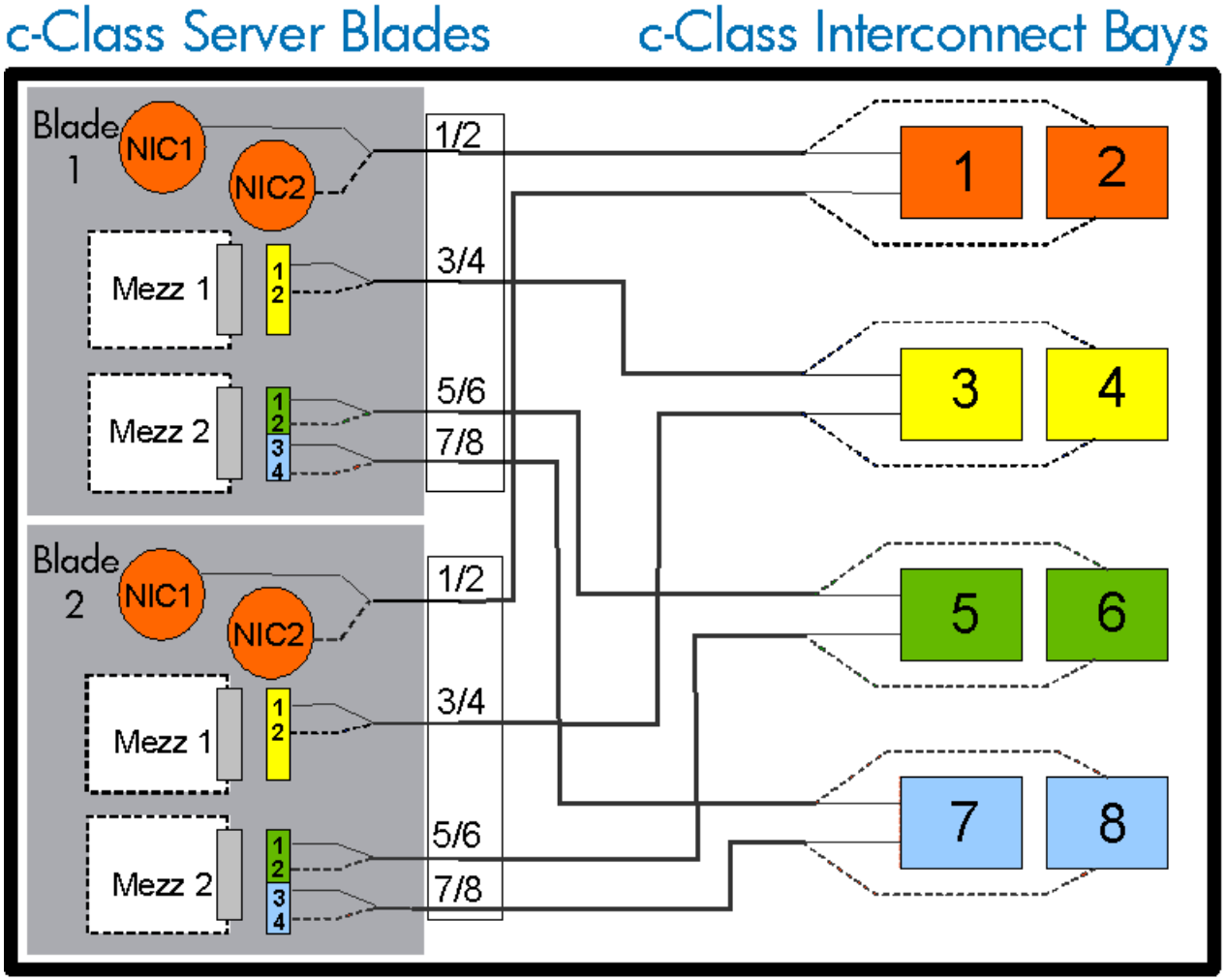
Attribute	Specification
Blade Type	Single bay
Performance	16 x 16 10GbE pass through Wire speed throughput
Port Configuration	16 internal 1G/10G downlinks 16 1 G/10G uplinks supporting SFP/SFP+ optics Mini USB configuration/Management port
Media Types	HP 1Gb SX SFP - 453151-B21 HP 1Gb RJ-45 SFP - 453154-B21 HP SFP+ SR- 455883-B21 HP SFP+ LR - 455886-B21 HP SFP+ LRM - 455889-B21 1 Meter DAC HP p/n 487654-001 3 Meter DAC HP p/n 487657-001 5 Meter DAC HP p/n 537965-001 7 Meter DAC HP p/n 487660-001
Protocols Supported	Ethernet CEE
Max Modules per Chassis	8
Warranty	1 year

HP c-Class c7000 enclosure



1	Blade enclosure rear view	**7**	Interconnect module bay 5
2	Blade enclosure fans	**8**	Interconnect module bay 6
3	Interconnect bay 1 with switch module installed	**9**	Interconnect module bay 7
4	Interconnect module bay 2	**10**	Interconnect module bay 8
5	Interconnect module bay 3	**11**	Onboard Administrator module
6	Interconnect module bay 4		

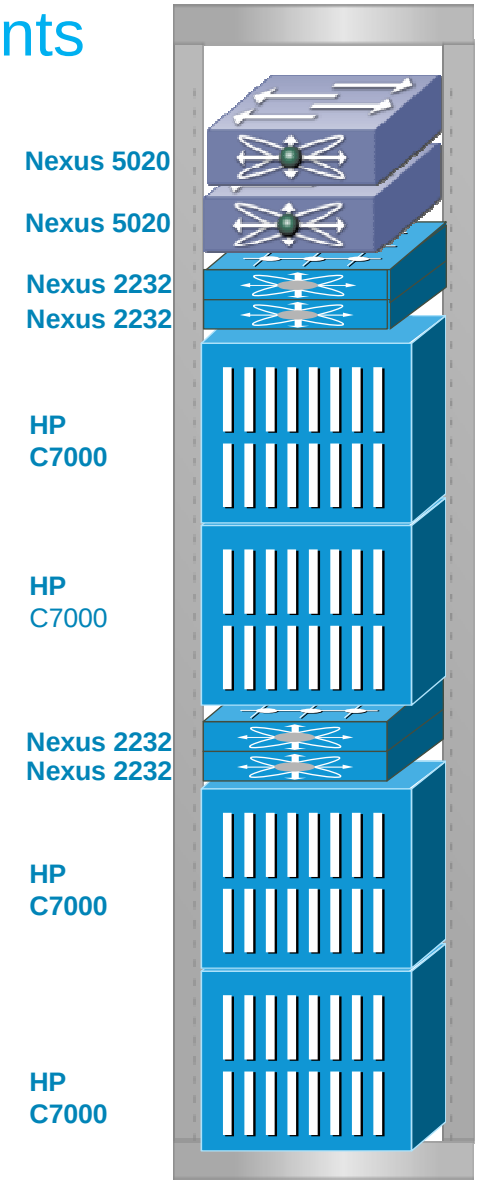
HP c7000 I/O port mapping
Half Height Servers



Nexus 2232 + Pass-Thru Architecture

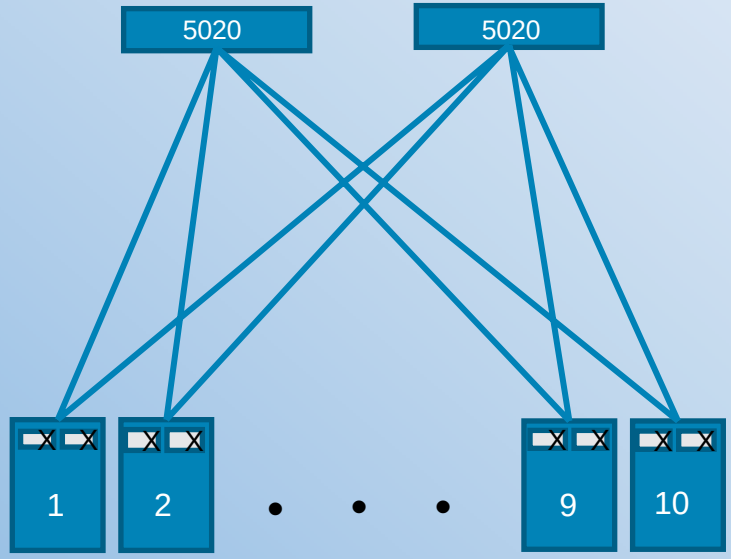
Simple & Scalable HP Blade Server Environments

- **Simplicity**
  - Zero configuration within blade chassis; No Server Admin training
  - Dramatically fewer network elements to manage
  - Network visibility to the server/VM & Superior trouble shooting
- **Flexibility**
  - Ethernet, Unified Fabric & VM Server access (& phased migration)
  - Consistent server access architecture for blade & rack mount servers across DC and with single server POD
  - TOR or EOR access model & benefits of both
- **Advanced Network Capability**
  - Field validated FCoE & DCB support
  - Transparent support for server virtualization via VNLink
  - Data Center Class NX-OS design & In Service Software Upgrades (ISSU)
  - Comprehensive L2 feature set including vPC



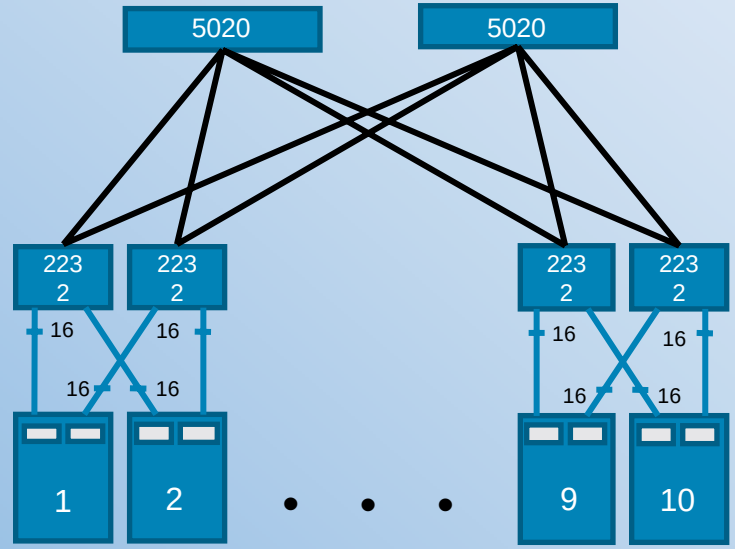
Fewer Network Elements - Ethernet

Flex 10 Virtual Connect Topology



10 Chassis/160 Servers/4:1 Oversubscription

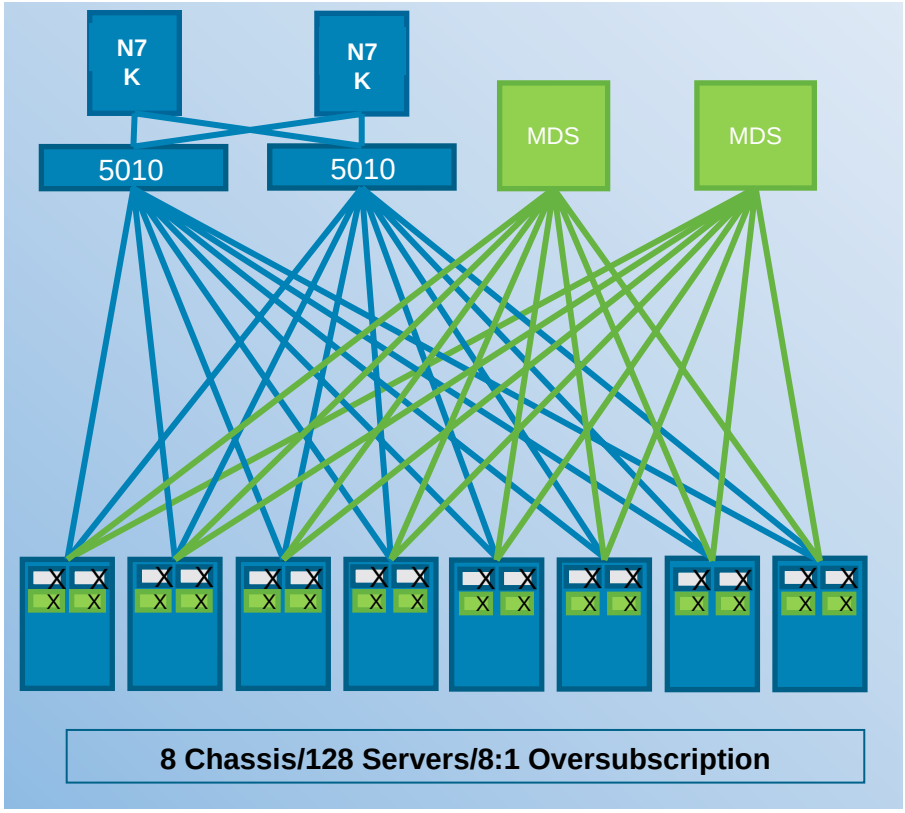
Pass Through to Nexus 2232 Topology

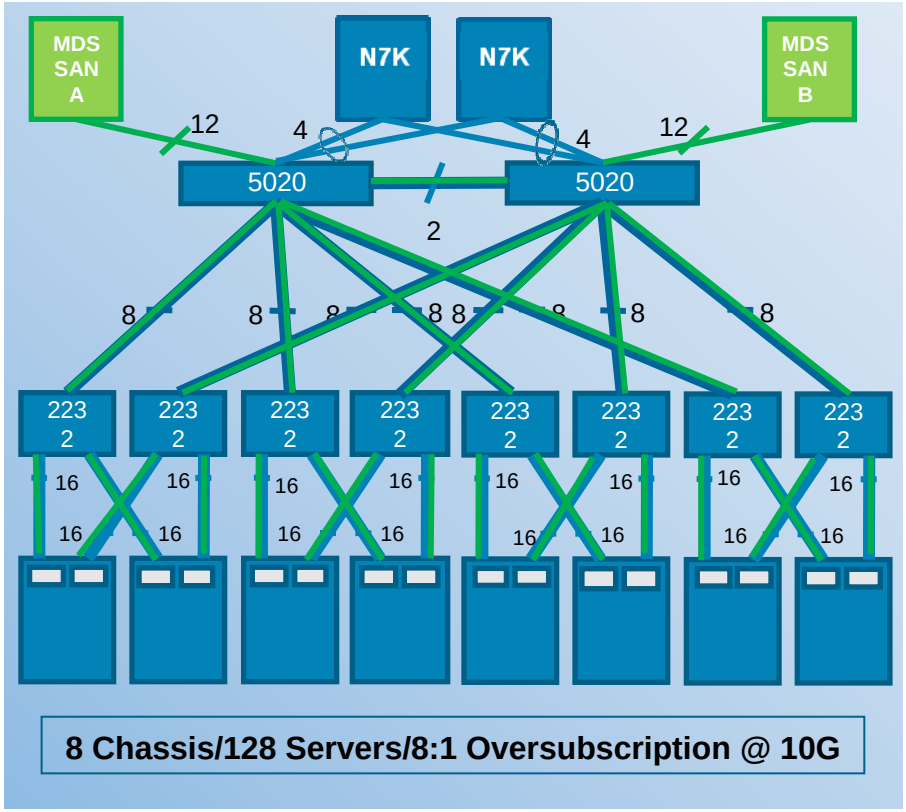


10 Chassis/160 Servers/4:1 Oversubscription

	Ethernet Switches	List Price per Chassis	I/O Power per Chassis
Pass-Thru	2		120 W
Virtual Connect	22		120 W

Fewer Network Elements – Unified I/O





	Unified Fabric Switches	List Price per Chassis	I/O Power per Chassis
Pass-Thru	4		120 W*
Virtual Connect	36		240 W

** Assuming Unified Fabric deployment within chassis*

Management Comparison

HP Upgrade Process

1. Verify new firmware is supported with all other I/O modules in the chassis
2. Upload firmware to HPOA module
3. Download firmware to all FLEX-10 modules in chassis
4. Serially upgrade each FLEX-10 module (Disruptive NO ISSU) – Note: Have seen in customer sites during upgrade process has caused loops
5. Repeat these steps for every chassis

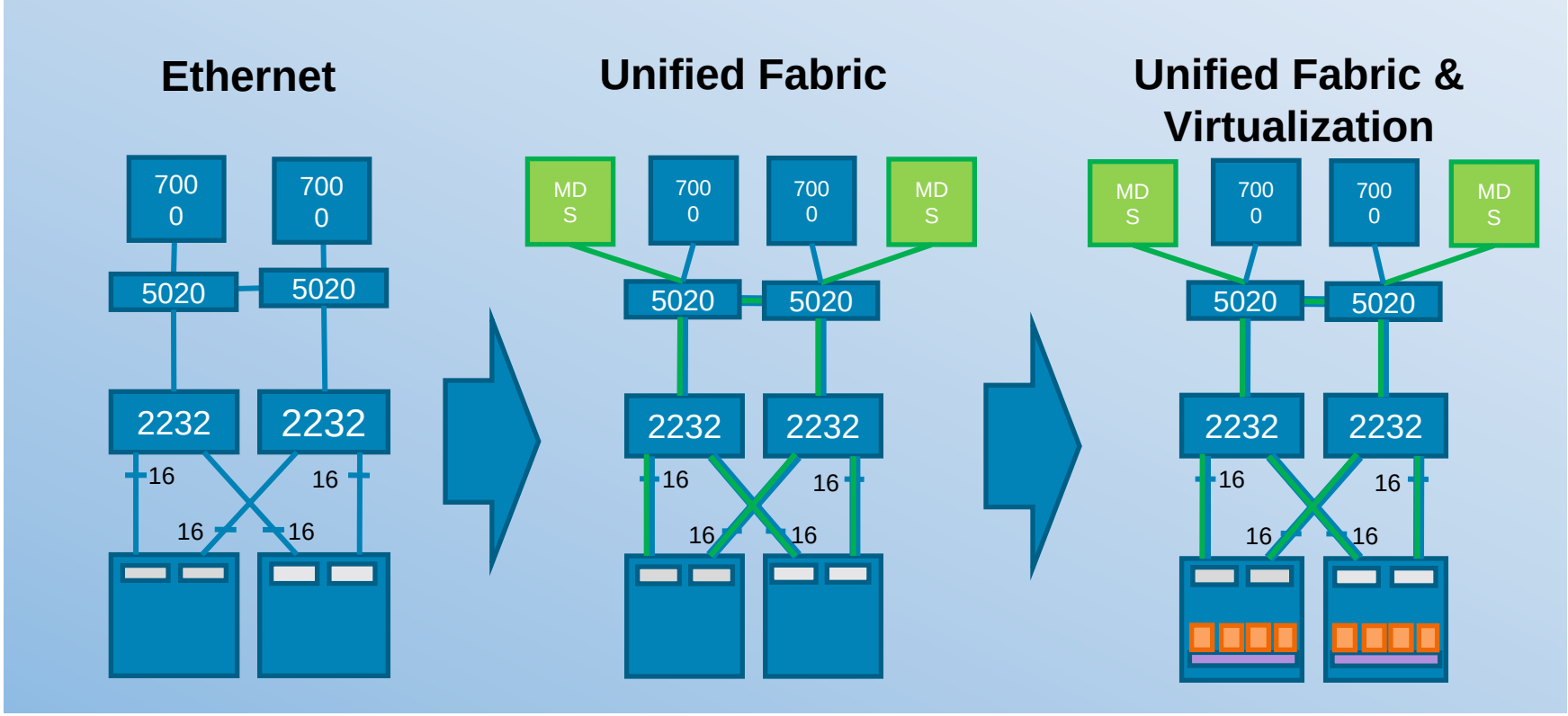
Ethernet = 40 steps
Ethernet + Fibre Channel = 64 steps

Cisco Upgrade Process

1. Upload code to Nexus 5000
2. Execute “install all <kickstart system>… Upgrade of Nexus 5000 and Nexus 2000 (In-Service Software Upgrade) provides non-disruptive upgrade

Ethernet = 2 steps
FCoE = 2 steps

Seamless Migration Path

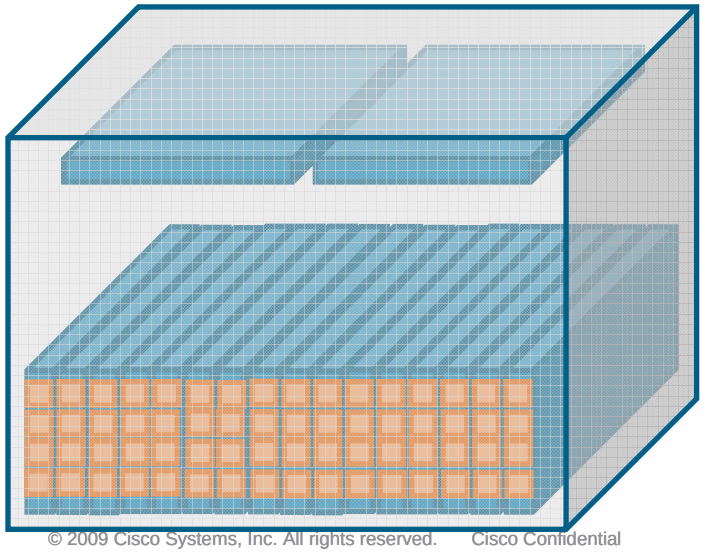


	10Gb Pass Through	Flex-10 Virtual Connect
1/10GbE Support	Yes	Yes
Unified Fabric Support	Yes	HW Upgrade Required
VNLink SW Support	Yes	Minimal
VNLink HW Support	Yes	HW Upgrade Required

Transparent verses Black Box

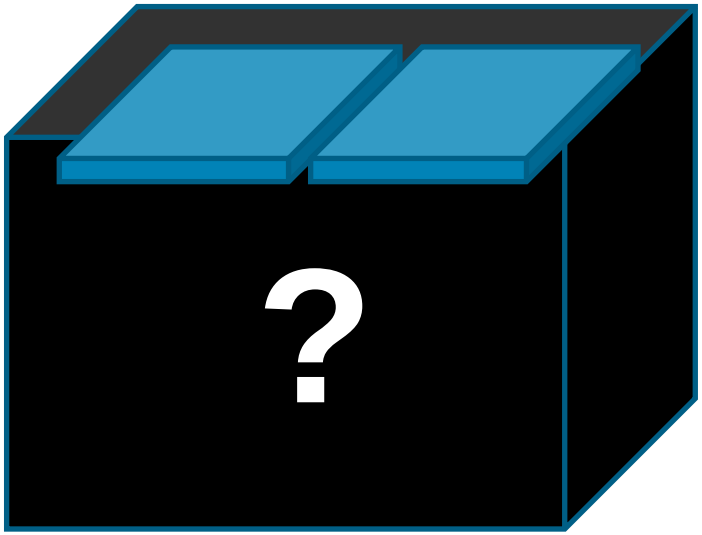
Pass-Thru = Transparency

- Full visibility to all Servers, NICs, Virtual Machines & Switches via aggregation switches
- Enables delivery of full Nexus value proposition
- Enables comprehensive troubleshooting



Virtual Connect = Black Box

- No visibility to Servers, NICs, Virtual Machines or Switches or NICs via aggregation switch
- Major elements of Nexus value proposition blocked eg. FCoE, VNLink
- Extremely limited troubleshooting capabilities



Troubleshooting Comparison

Pass Through = Transparency*

- show interface counters
- show mac-address-table
- show cdp neighbors
- show spanning-tree
- monitor session (SPAN)
- debug *
- TACACS+/RADIUS security
- show hardware
- show diagnostics
- show logging
- rmon
- SNMP MIBs
- Open XML API

Virtual Connect = Black Box

- Basic Views of link status
- Limited “SPAN”

Network Functionality Comparison

Capability	Benefit	HP 10GbE Pass-Thru with Cisco Nexus	HP Virtual Connect Flex-10
Modular, Fault tolerant Operating System	Highly Available Network	Yes	No
1 /10 GbE Support	Seamless Migration	Yes	Yes
Unified Fabric Support	CapEx Reduction	Yes	HW Upgrade Required
VN-Link Support	Secure, VM switching	SW or HW	SW only; Minimal
Quality of Service (QoS)	Segmentation	Yes	Egress only
Network Monitoring	Resolve network issues	Yes	Minimal
In-Service Software Upgrade (ISSU)	Highly available Network	Yes	No
Cisco Trusted Security (CTS)	Hop-by-hop encryption	Yes	No
Virtual Port Channel (vPC)	Active-Active Server Connection	Yes	No
Comprehensive Layer 2 feature set	Standardize based L2 Networking	Yes	No

VMware: Do you really need multiple NICs?

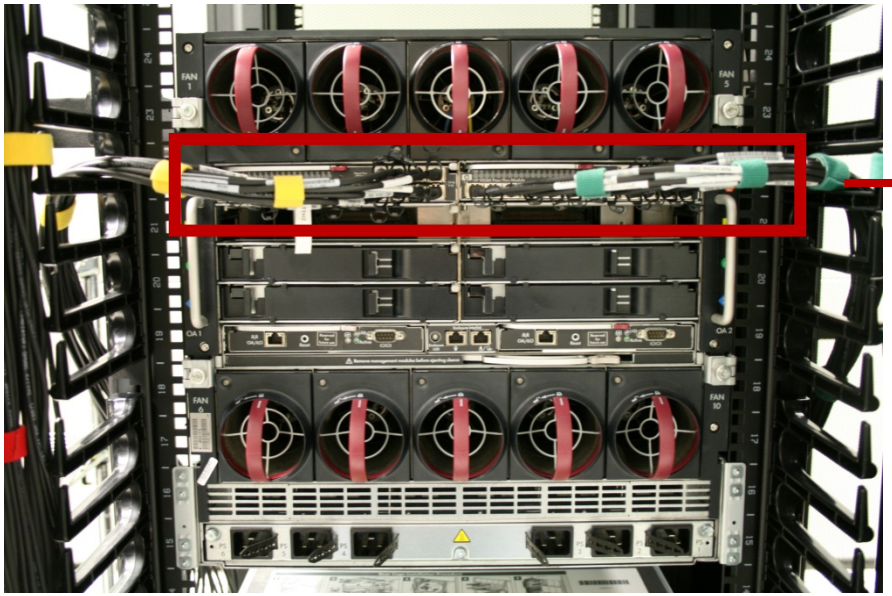
- An ESX Server does *not* need multiple NICs
  - It needs to assure bandwidth and security for different traffic types: vmkernel, vMotion, SAN (FC/FCoE, iSCSI, NFS)
    - This was usually done by having dedicated GE NICs
  - It needs a design which provides redundancy for key services
- With advent of 10GE and specifically CEE, a 2 NIC design is perfectly valid
- ***Look for upcoming VMware & Cisco co-authored 10Gb Design Best Practices whitepaper***

Pass-Thru Counterpoints

Issue	Response
Too Many Cables	• Nexus Value Proposition • Future Proof Design • Fewer Elements to Mange • Design requires only local and static cable configurations
Lower Chassis Density per Rack	• 48 RU racks can support 4 chassis • 42 RU racks can support 3 chassis
Higher Solution Cost	Position new FEX/Nexus 5020 bundle
2232 Oversubscription too high for FCoE	Support for IEEE's DCB standard ensures no packet drop
Need multiple physical interfaces for VMotion and VConsole traffic	See VMware 10G best practice design
Need Address Virtualization	FlexAttach from Cisco enables virtualization of WWNs

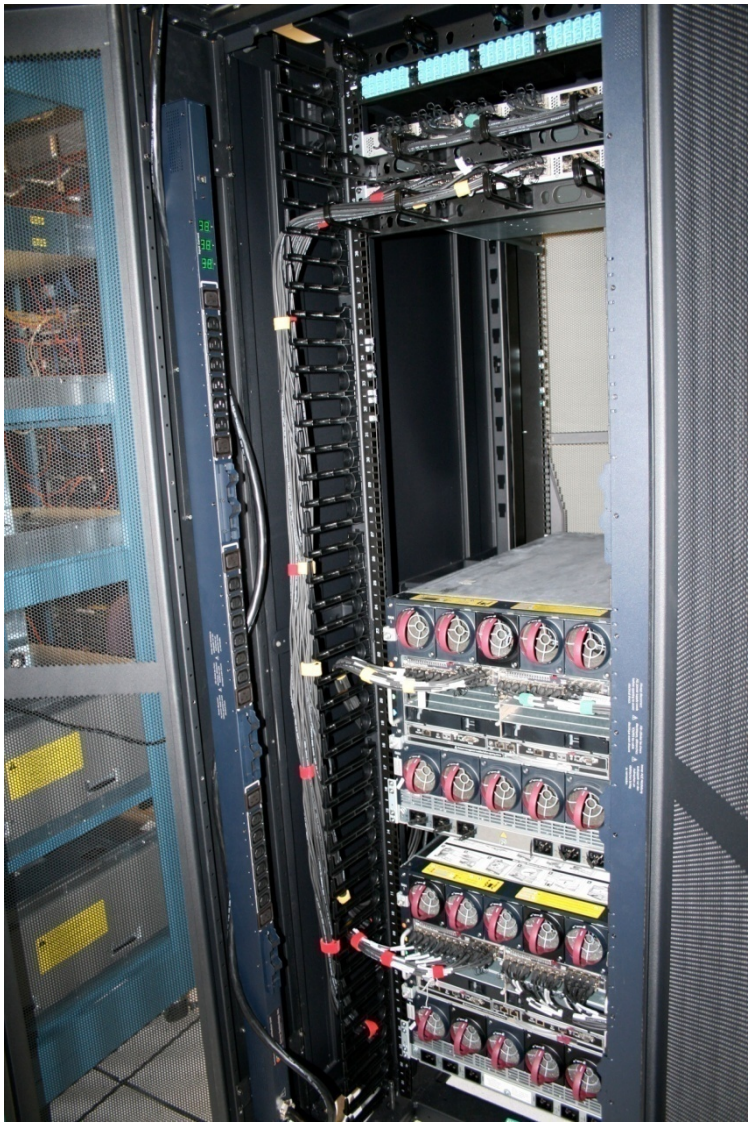
Physical Cabling within a Rack (1)

2 x Nexus 2232 FEX Modules aggregating 2 x c7000 chassis with 2 x HP Pass Through Modules each



2 x HP 10Gb Pass Through Modules occupying I/O slots 1 & 2 of c7000 chassis

Physical Cabling with a Rack (2)



2 x Nexus 2232

2 x c7000 chassis with 2 x HP 10Gb Pass Through Modules per chassis aggregated by 2 x Nexus 2232 FEX Modules

2 x c7000 chassis

Nexus 5000 / 2000 Bundles Simplified

4 Types of Bundles

Types	Bundle Type	Comments
Type 1	Nexus 5K-2K Ethernet Only Bundles	Includes both Nexus 5000 and 2000 SKUs. Ethernet Only
Type 2	Nexus 5K Unified Fabric Bundles	Includes Nexus 5000 SKUs only along with FCoE Licenses
Type 3	Nexus 2K Only Bundles	Includes Nexus 2200 SKUs only along with the FET transceivers
Type 4	UCS C-Series Bundles	Includes Nexus 5010, C-Series, QLogic CNA, and Broadcom CNA SKUs

Type 1: Nexus 5K-2K Ethernet Only Bundles

3 Dimensions: Host Port Density, Host Interface Speeds, 5K-2K Interconnect Types

Valid till end of Q4FY10

128 Ports

SR Interconnect	Twinax Interconnect	FET Interconnect
		N5020P-4N2232PF-B $85,500

1G Hosts

100M/1G Hosts

1/10G Hosts

192 Ports

SR Interconnect	Twinax Interconnect	FET Interconnect
N5010P-N2K-BE $70,000 (28% off)	N5010P-N2K-BEC $55,000 (21% off)	
N5010P-N2248TP-BE $70,000 (23% off)	N5010P-4N2248TP-B $46,000 (16% off)	N5010P-4N2248TF-B $53,000

1G Hosts

100M/1G Hosts

1/10G Hosts

288 Ports

SR Interconnect	Twinax Interconnect	FET Interconnect
N5020P-N2K-BE $105,000 (32% off)	N5020P-N2K-BEC $82,500 (27% off)	
N5020P-N2248TP-BE $105,000 (28% off)	N5020P-6N2248TP-B $69,000 (24% off)	N5020P-6N2248TF-B $79,500

1G Hosts

100M/1G Hosts

1/10G Hosts

Type 2: Nexus 5K-2K Unified Fabric Bundles

3 Dimensions: Deployment Purpose, FC Speed, N5K Chassis Type

Valid till end of Q4FY10

	Lab Bundles	Regular Bundles
4G Native FC Modules	✓	✗
8G Native FC Modules	✗	✓
Smartnet Discount	✗	✓
Unlimited Time	✗	✓

Nexus 5010 Chassis

Lab Bundle	Regular Bundle
N5K-C5010P-LAB-S $23,300 (40% off)	
	N5K-C5010P-B-S $23,300 (40% off)

4G Native FC

8G Native FC

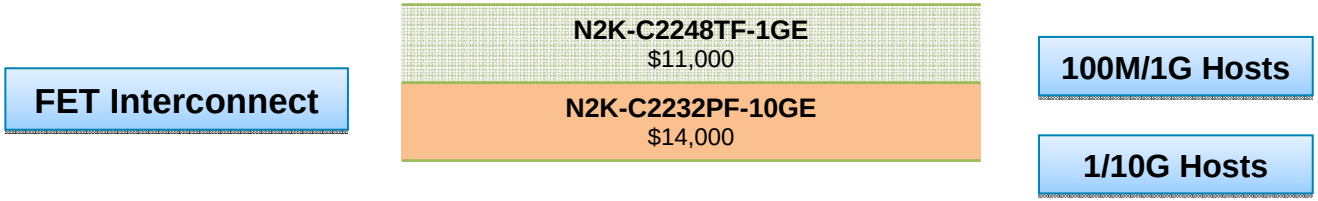
Nexus 5020 Chassis

Lab Bundle	Regular Bundle
N5K-C5020P-LAB-S $45,000 (40% off)	
	N5K-C5020P-B-S $45,000 (40% off)

4G Native FC

8G Native FC

Type 3: Nexus 2K-Only Bundles



N2K-C2248TF-1GE	
Product ID	**Qty**
N2K-C2248TP-1GE	1
FET-10G	8

N2K-C2232PF-10GE	
Product ID	**Qty**
N2K-C2232PP-10GE	1
FET-10G	16

- ✓ **No limits on the number of units**
- ✓ **Normal customer discounts and DSAs applicable**
- ✓ **Kit orderable April 2010**
- ✓ **No time limit**

Type 4: UCS C-Series Bundles

2 Dimensions: UCS C-Series Server Type, 10GE CNA Vendor

	Broadcom	QLogic
R210	**5R210N-N5K-5B-1** $92,000	**5R210N-N5K-5Q-1** $95,000
R250	**5R250N-N5K-5B-1** $178,000	**5R250N-N5K-5Q-1** $180,000

Each bundle comes with ……

(5) UCS C-Series Servers + **(5) Converged Network Adapters** + **(1) Nexus 5010P-LAB-S Bundle**

R210 or R250

QLOGIC or BROADCOM.

- ✓ Qualifies for UCS Partner Pricing
- ✓ Bundles Eligible for VIP
- ✓ Valid until end of Q4FY10

N5K-C5010P-LAB-S

Go Back

Product ID	Qty
N5K-C5010P-BF	1
SFP-H10GB-CU5M	4
SFP-10G-SR	2
DS-SFP-FC4G-SW	2
N5010-SSK9	1
N5K-M1008	1
N5K-PAC-550W	2

N5K-C5020P-LAB-S

Product ID	Qty
N5K-C5020P-BF	1
SFP-H10GB-CU5M	16
SFP-10G-SR	4
DS-SFP-FC4G-SW	4
N5020-SSK9	1
N5K-M1008	1
N5K-PAC-750W	2

N5K-C5010P-B-S

Go Back

Product ID	Qty
N5K-C5010P-BF	1
SFP-H10GB-CU5M	4
SFP-10G-SR	2
DS-SFP-FC8G-SW	2
N5010-SSK9-LAB	1
N5K-M1060-LAB	1
N5K-PAC-550W	2

N5K-C5020P-B-S

Go Back

Product ID	Qty
N5K-C5020P-BF	1
SFP-H10GB-CU5M	16
SFP-10G-SR	4
DS-SFP-FC8G-SW	4
N5020-SSK9-LAB	1
N5K-M1060-LAB	1
N5K-PAC-750W	2

N5010P-N2K-BE

Product ID	Qty
N5K-C5010P-BF	1
N5K-PAC-550W	2
N2K-C2148T-1GE	4
SFP-10G-SR	20
N2K-PAC-200W	4
N5KUK9-413N1.1	1
Regionalized Power Cords	10

N5010P-N2248TP-BE

Go Back

Product ID	Qty
N5K-C5010P-BF	1
N5K-PAC-550W	2
N2K-C2248TP-1GE	4
SFP-10G-SR	20

N5020P-N2K-BE

Product ID	Qty
N5K-C5020P-BF	1
N5K-PAC-750W	2
N2K-C2148T-1GE	6
N2K-PAC-200W	6
SFP-10G-SR	30
N5KUK9-413N1.1	1
Regionalized Power Cords	14

N5020P-N2248TP-BE

Go Back

Product ID	Qty
N5K-C5020P-BF	1
N5K-PAC-750W	2
N2K-C2248TP-1GE	6
SFP-10G-SR	30

N5010P-N2K-BEC

Go Back

Product ID	Qty
N5K-C5010P-BF	1
N5K-PAC-550W	2
N2K-C2148T-1GE	4
N2K-PAC-200W	4
SFP-10G-SR	4
SFP-H10GB-CU5M	8
N5KUK9-413N1.1	1
Regionalized Power Cords	10

N5010P-4N2248TP-B

Go Back

Product ID	Qty
N5K-C5010P-BF	1
N5K-PAC-550W	2
N2K-C2248TP-1GE	4
Optics, Twinax, or FET Options	

N5020P-N2K-BEC

Go Back

Product ID	Qty
N5K-C5020P-BF	1
N5K-PAC-750W	2
N2K-C2148T-1GE	6
N2K-PAC-200W	6
SFP-10G-SR	6
SFP-H10GB-CU5M	12
N5KUK9-413N1.1	1
Regionalized Power Cords	14

N5020P-6N2248TP-B

Go Back

Product ID	Qty
N5K-C5020P-BF	1
N5K-PAC-750W	2
N2K-C2248TP-1GE	6
Optics, Twinax, or FEX Options	

N5020P-4N2232PF-B

Go Back

Product ID	Qty
N5K-C5020P-BF	1
N5K-PAC-750W	2
N2K-C2232PP-10GE	4
FET-10G	64

N5010P-4N2248TF-B

Go Back

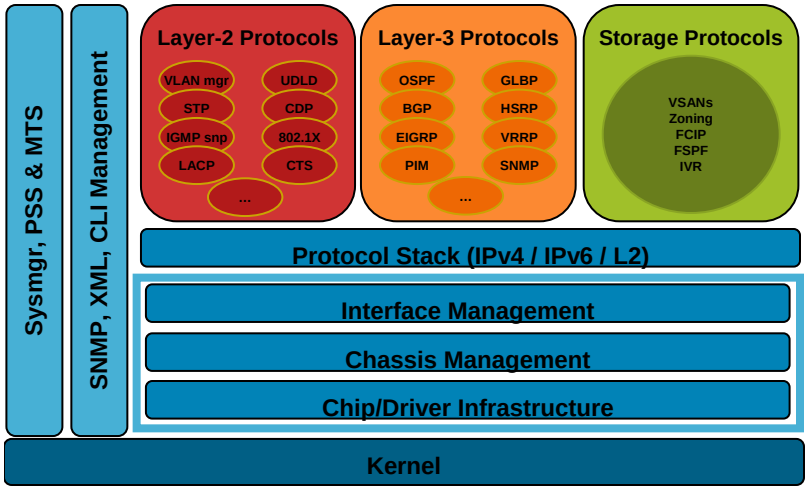
Product ID	Qty
N5K-C5010P-BF	1
N5K-PAC-550W	2
N2K-C2248TP-1GE	4
FET-10G	32

N5020P-6N2248TF-B

Product ID	Qty
N5K-C5020P-BF	1
N5K-PAC-750W	2
N2K-C2248TP-1GE	6
FET-10G	48

Cisco NX-OS Update and Strategy

NX-OS Value Proposition



- **Robust and Flexible Operating System across Cisco Data Center platforms**
  - Run across Nexus products and MDS
  - Designed for SAN and LAN environments
- **Hitless In-Service Software Upgrade allows greater flexibility in planned and unplanned changes**
  - OS upgrade/downgrade with 0 packet loss
- **Modular Operating System is able to recover more gracefully in case of failure**
  - Multi-threaded, Real time, Control Plane and Data Plane Separation, and stateful process restart
- **Fully Redundant Hardware works – customers are adopting dual supervisors**

Cisco NX-OS & Nexus Product Portfolio

Broad Platform Support & Wide Customer Adoption

Nexus 7000 Technology Update

Nexus Key Technology Investments

- OTV
- Nexus 2000 Architectures
- L2MP
- Virtual Networking
- Network Management
- FCoE
- L3, Ipv6, Multicast

Overlay Transport Virtualization

Technology Pillars

OTV is a “MAC in IP” technique fo
supporting Layer 2 VPNs
OVER ANY TRANSPORT.

Dynamic Encapsulation

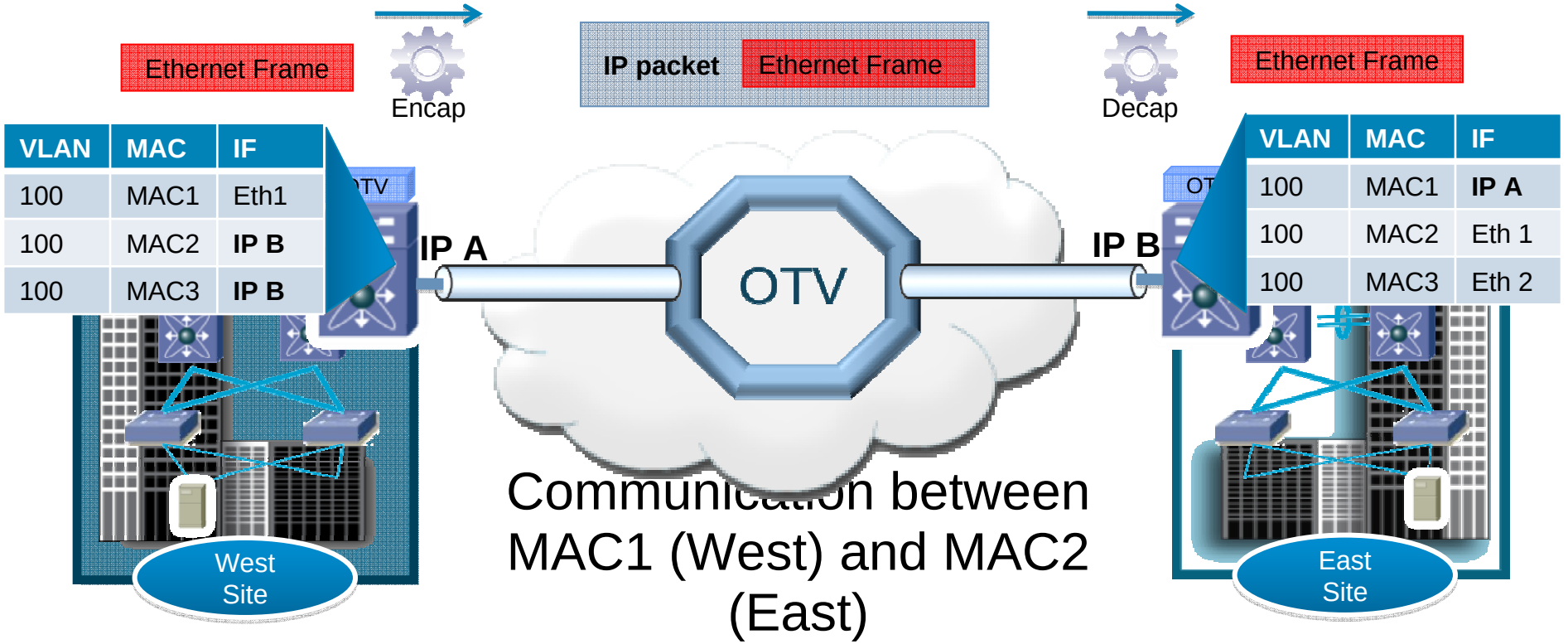
- No Pseudo-Wire State Maintenance
- Optimal Multicast Replication
- Multi-point Connectivity

Protocol Learning

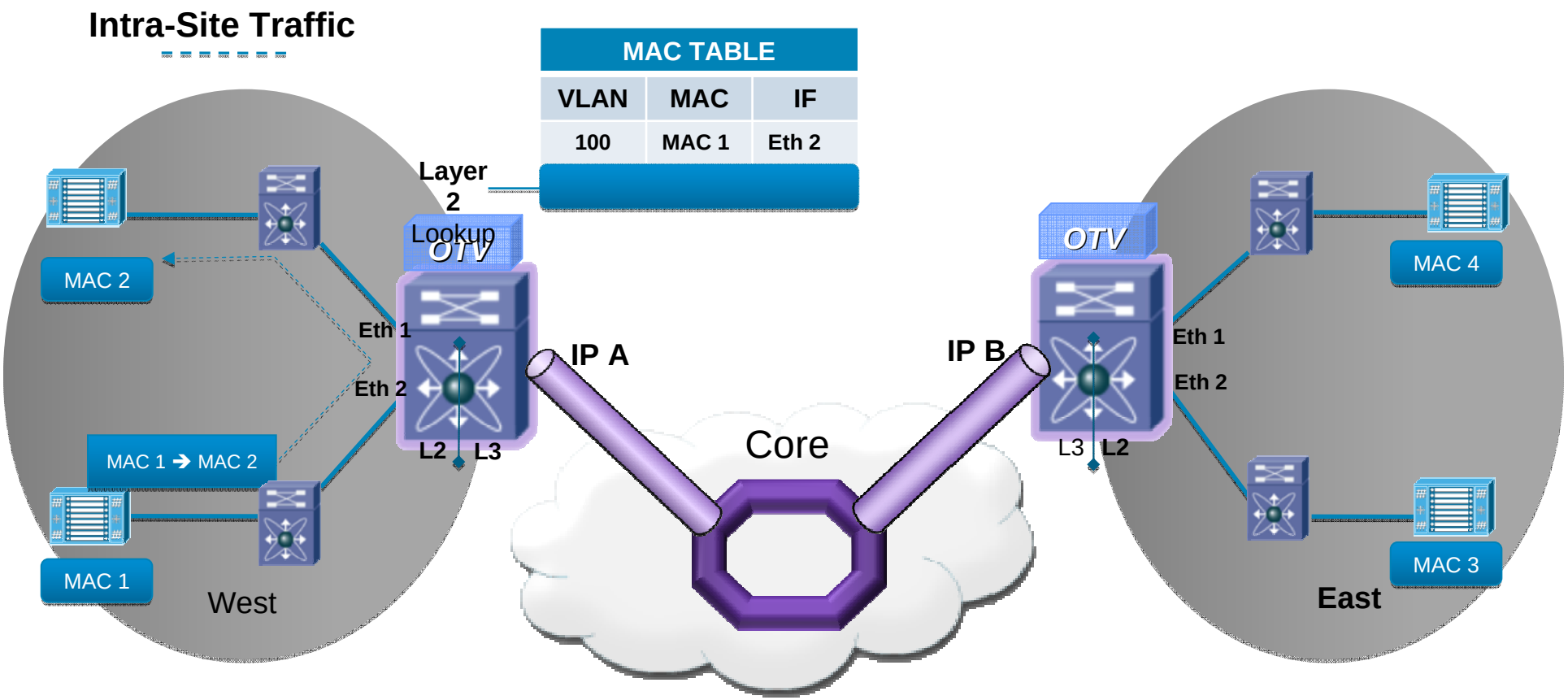
- Built-in Loop Prevention
- Preserve Failure Boundary
- Seamless Site Addition/Removal

OTV at a Glance

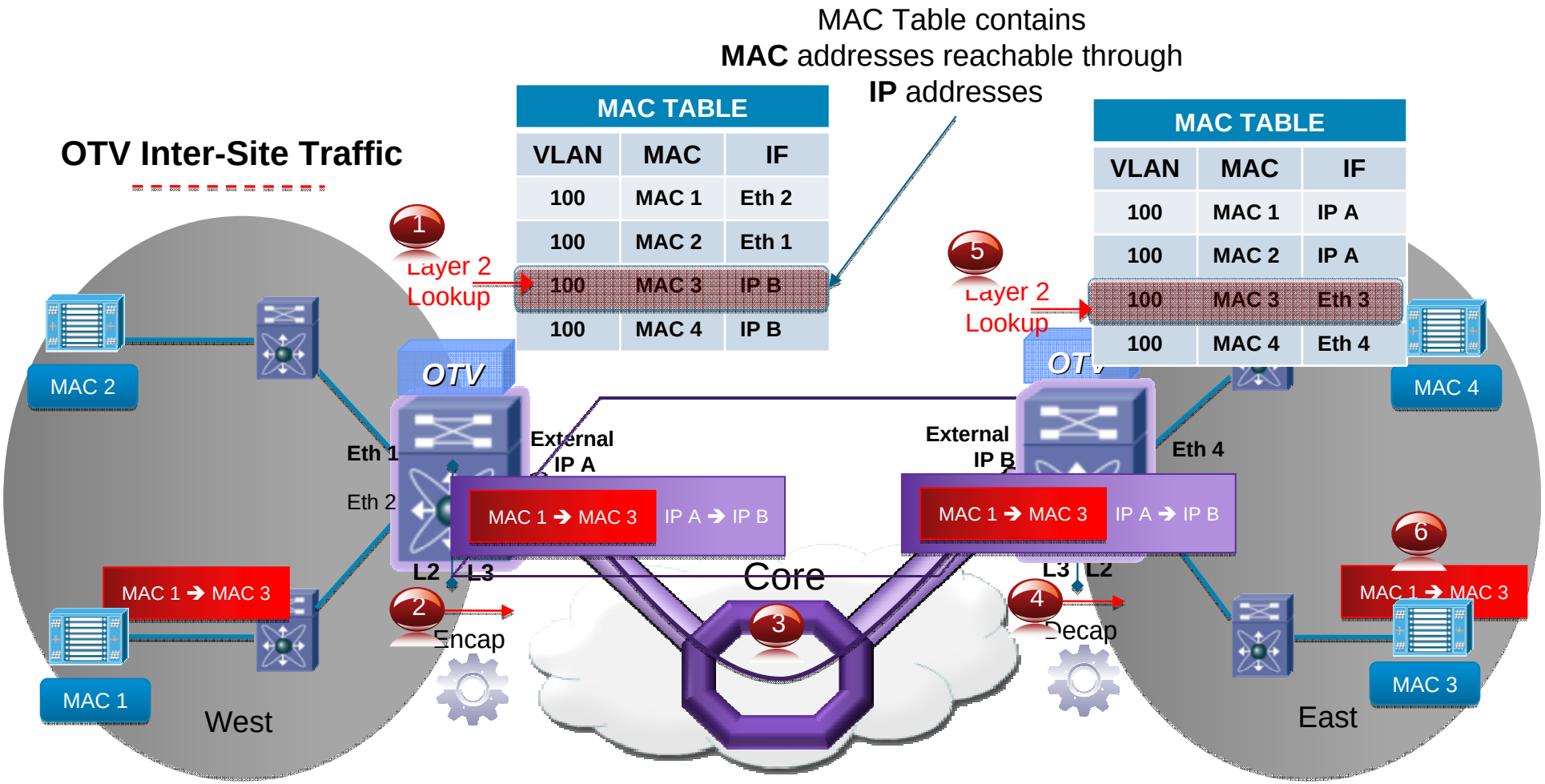
- Ethernet traffic between sites is encapsulated in IP: “MAC in IP”
- Dynamic encapsulation based on MAC routing table
- No Pseudo-Wire or Tunnel state maintained



OTV Data Plane: Unicast



OTV Data Plane: Unicast



- No Pseudo-Wire state is maintained.
- The encapsulation is done based on a Layer 2 destination lookup.

OTV News and Additional Information

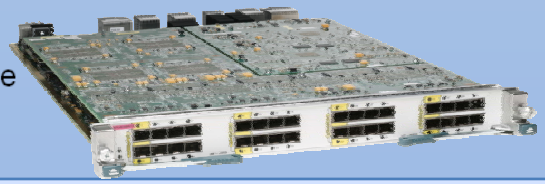
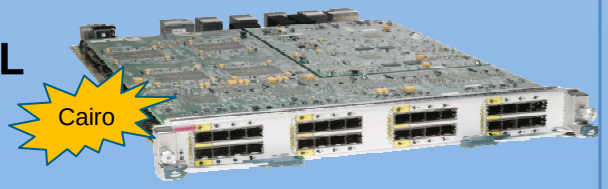
- **OTV Selected for Best of Interop 2010 Finalist!**

Cisco Nexus 2000 Fabric Extender (FEX)
Platform Update

Model	Nexus 2148T	Nexus 2248TP	Nexus 2232PP-10G
Product Shipping	Yes	Q2CY10	Q2CY10
Form Factor	1 RU	1 RU	1 RU
Uplink Ports	4 x 10GbE SFP+	4 x 10GbE SFP+	8 x 10GbE SFP+
Uplink Transceivers Supported	Copper CX-1 (passive): 1m, 3m, 5m. * Optical: SR, LR [distance limited to 300m]		
Host Facing Ports	48 x 1GbE RJ45 (note: 1000BaseT only)	48 x 100/1000Base-T RJ45	32 x SFP+ (10G) (note: hw capable of 1GE SFP)
FCoE	No	No	Yes (N5K, N7K w/ D2**)
Dimensions	1.72 x 17.3 x 20.0 in	1.72 x 17.3 x 17.7in	1.72 x 17.3 x 17.7 in
Operational Power	165W	110W	270W
Multiple PortChannel member ports on a FEX	Not Supported	Yes	Yes
Supported on N5K	Today	Q2CY2010	Q2CY2010
Supported on N7K	No	Cairo NX-OS w/ N7K-M132XP-12(L)	Q4CY2010

* N7K-M132XP -12 supports SR, LR only. Does not support Passve CX-1
N7K-M132XP-12L will support Passive CX-1
** N7K M1 modules don't support FCoE, will be enabled w/ FEX on D2 modules CY2011

N7K Parent Switch modules with N2K FEX support

N7K Parent Switch I/O Module	FEX / vnTag support	Optics/Transceivers supported on N7K + N2K combination
N7K-M132XP-12 32-port SFP+ M1 I/O module 	✓	**Passive CX-1 SFP+** (1m/3m/5m): **No** **Active CX-1 SFP+** (7m/10m): **Yes** **SR SFP+** (MMF): **Yes** – OM1 26m OM3 100m **LR SFP+** (SMF): **Yes** – up to 10km **LRM SFP+**: **No** **FET SFP+** (MMF): **Yes** – OM2 25m OM3 100m
N7K-M108X2-12L 8-port X2 M1 I/O module 	✗	*FEX not supported*
N7K-M132XP-12L 32-port SFP+ M1 XL I/O module 	✓	**Passive CX-1 SFP+** (1m/3m/5m): **Yes** **Active CX-1 SFP+** (7m/10m): **Yes** **SR SFP+** (MMF): **Yes** – OM1 26m OM3 100m **LR SFP+** (SMF): **Yes** – up to 10km **LRM SFP+**: **No** **FET SFP+** (MMF): **Yes** – OM2 25m OM3 100m
N7K-D1 series 32-port D1 I/O module 	✗	*FEX not supported*

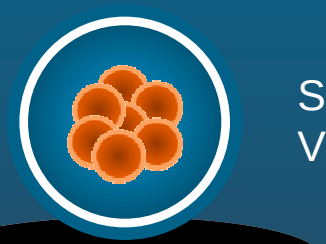
Cisco FabricPath
Nexus 7000 & NX-OS Innovations

Nikhil Kelshikar, Product Manager
Marty Ma, Technical Marketing Engineer
Errol Roberts, Distinguished Systems Engineer

http://www.cisco.com/go/nexus7000

Evolving Applications Impact Data Center and Beyond

Emerging Challenges



Sophisticated Virtualization

Application Complexity

Cloud Computing and XaaS

Impact

Network/ Storage

- Higher I/O requirements
- Greater east-west bandwidth
- Rapid provisioning/

Physical Infrastructure

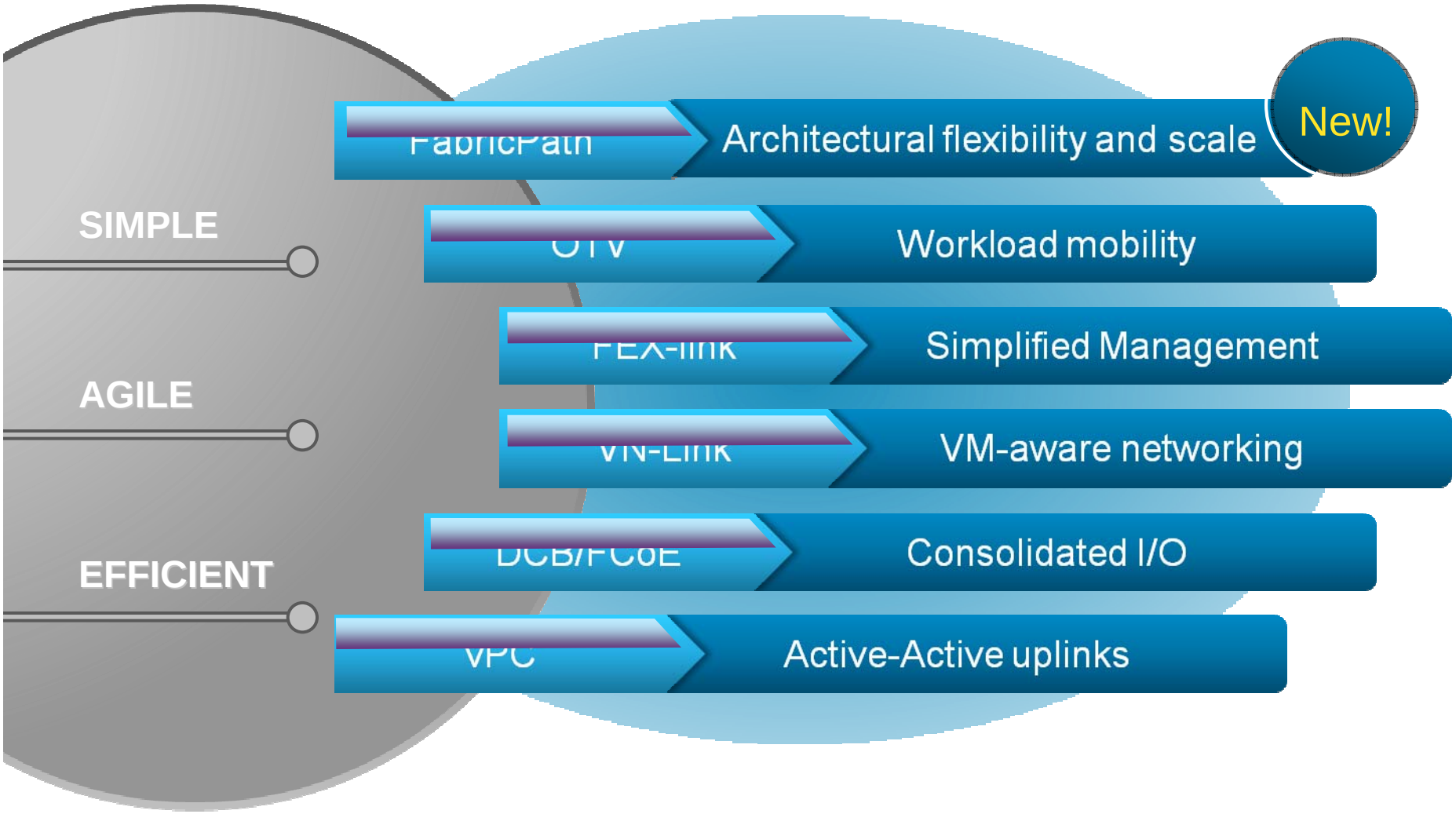
- 10G ready wiring
- Server/cabling density

Application Performance

- WAN optimization
- Application Acceleration

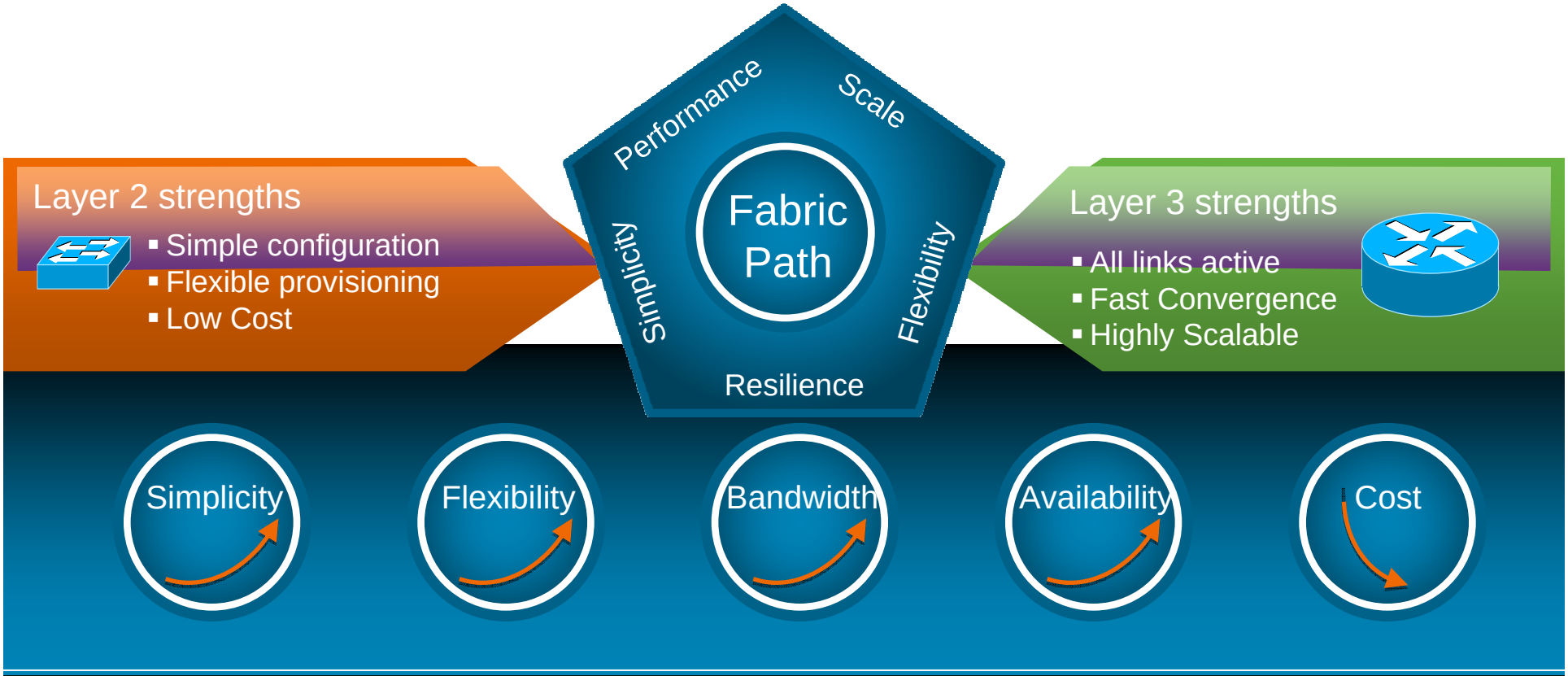
Cisco Unified Fabric Evolution

Continued Architectural Innovation



Introducing Cisco FabricPath

An NX-OS Innovation Enhancing L2 with L3



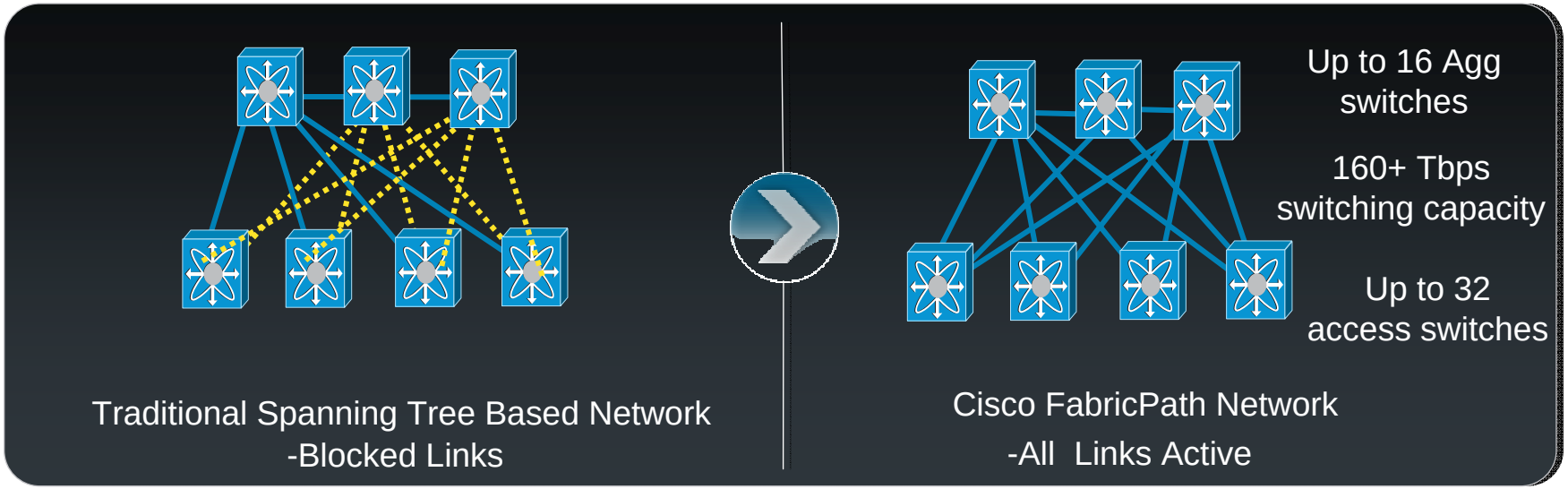
"The FabricPath capability within Cisco's NX-OS offers dramatic increases in network scalability and resiliency for our service delivery data center. FabricPath extends the benefits of the Nexus 7000 in our network, allowing us to leverage a common platform, simplify operations, and reduce operational costs."

Mr. Klaus Schmid, Head of DC Network & Operating,
T-Systems International GmbH

T · · Systems · · ·
Business flexibility

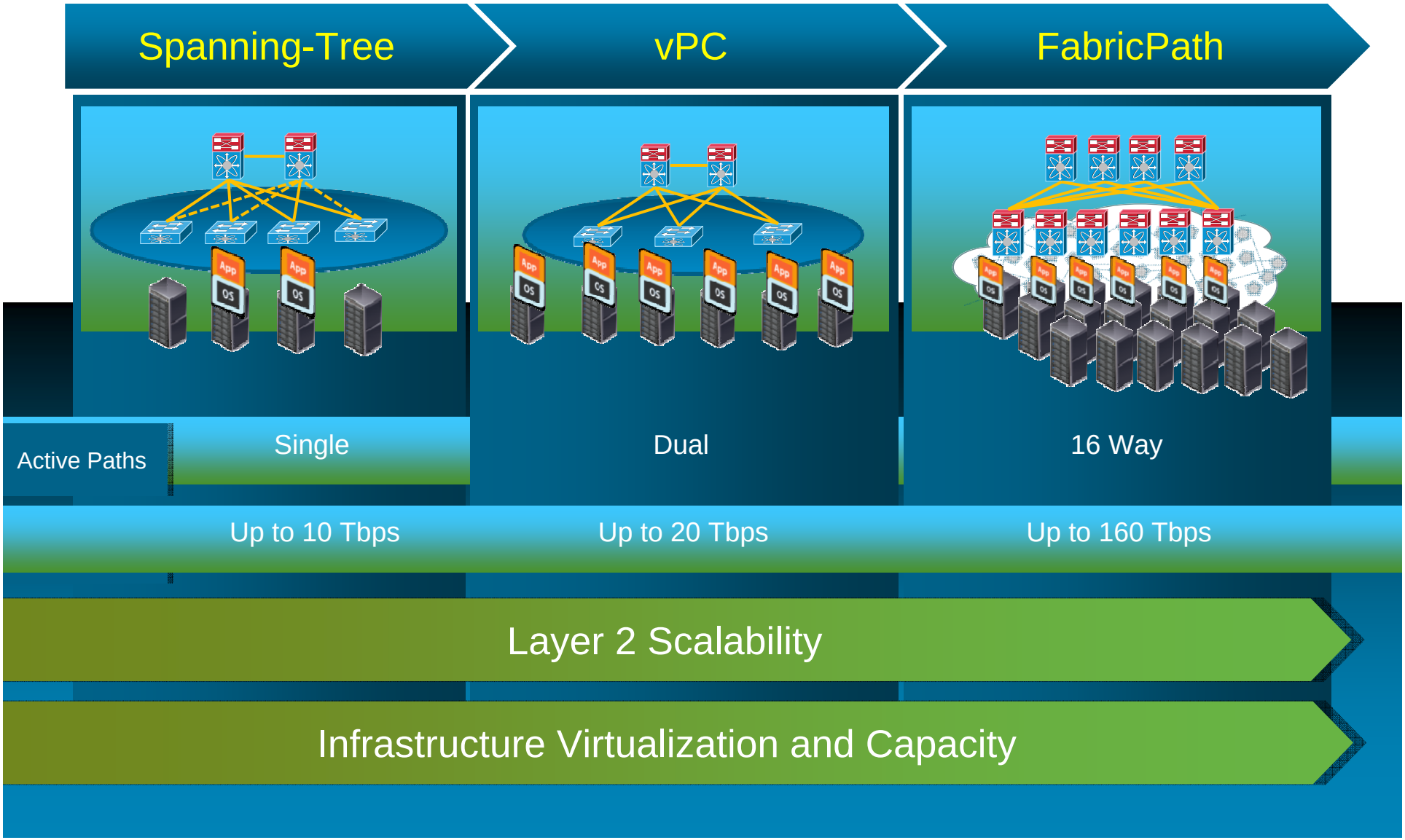
Cisco FabricPath

Scaling and Simplifying Layer 2 Ethernet Networks



- Eliminate Spanning tree limitations
- Multi-pathing across all links, high cross-sectional bandwidth
- High resiliency, faster network re-convergence
- Any VLAN, any where in the fabric eliminate VLAN Scoping

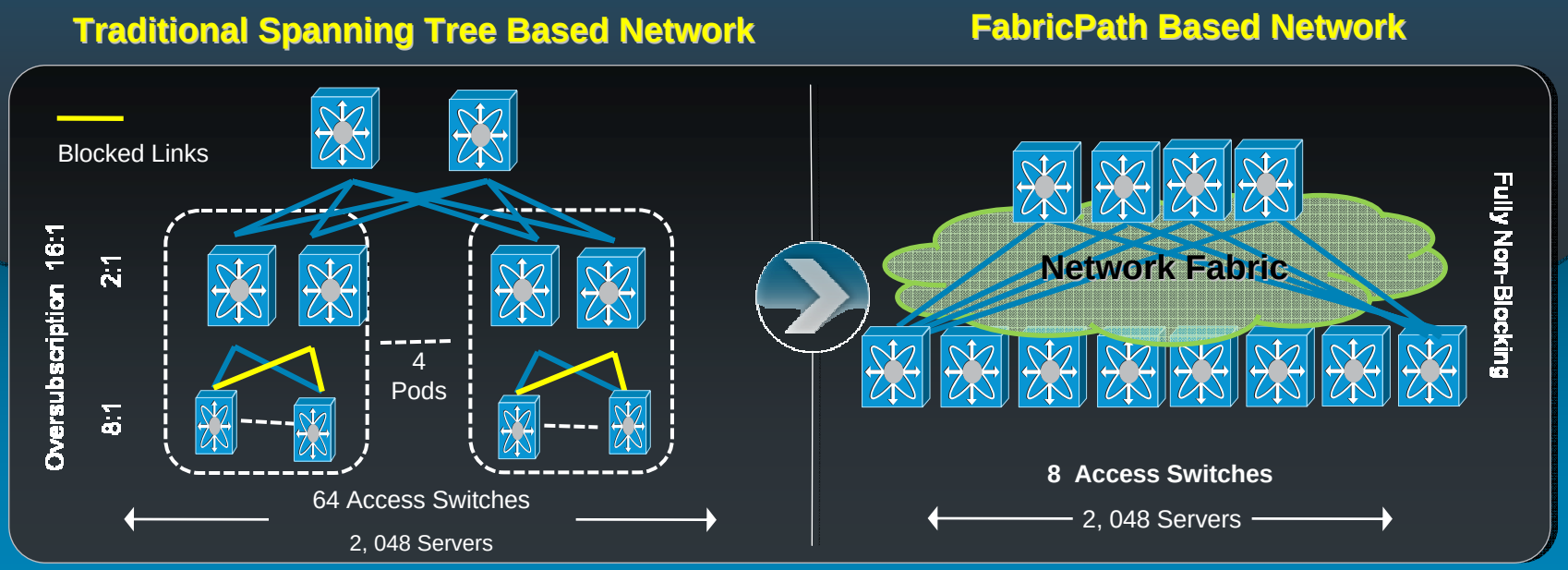
Architecture Flexibility Through NX-OS



#1: Scaling Bandwidth with FabricPath

Example: 2,048 X 10GE Server Design

- 16X improvement in bandwidth performance
- From 74 managed devices to 12 devices
- 2X+ increase in network availability
- Simplified IT operations



Nexus 7000 F-Series Module

High Performance 10GbE supporting Unified Fabrics

- Scalable 512 ports per system,
- High-performance 320 Gbps switching capacity
- Low Latency 5µs port to port latency
- Standards Based TRILL and DCB support
- Flexible 1G and 10G autosensing
- Energy Efficient ~10W per 10GbE port

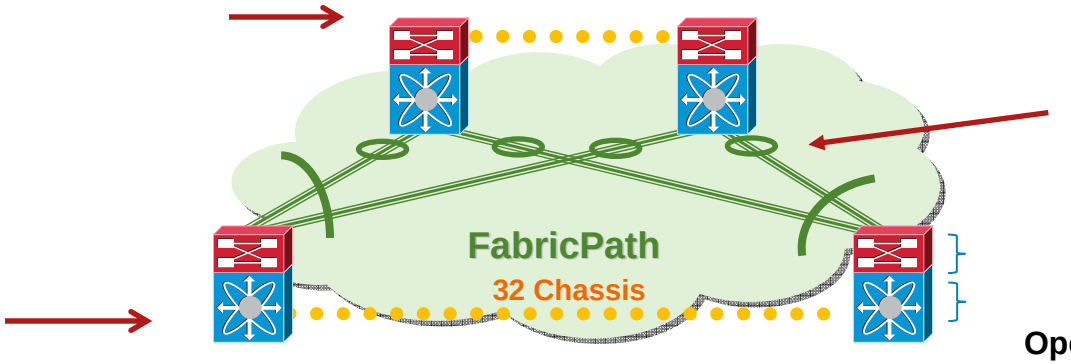
32-Port 1/10 GbE for server access and aggregation

"The F-Series modules on the Cisco Nexus 7000 series are currently deployed in LLNL's high performance computing infrastructure, offering us a high density 10GE and low latency networking solution. This technology has enabled LLNL to build large storage network fabrics to support the world class supercomputing systems vital to the laboratory's national security research and development missions"

Matt Leininger, Deputy for Advanced Technology Projects at Lawrence Livermore National Laboratory

University of California
Lawrence Livermore National Laboratory

Use Case: High Performance Compute
Building Large Scalable Compute Clusters



HPC Requirements

- HPC Clusters require high-density of compute nodes
- Very low over-subscription
- Low Latency from server to server

FabricPath Benefits for HPC

- FabricPath enables building a high-density fat-tree network
- Fully non-blocking with FabricPath ECMP & port-channels
- Minimize switch hops to reduce server to server latencies

Services Rich Platform (M Series Modules)

32-Port 10GbE Module

SFP+ SR, LR, and ER

Integrated L2 / L3 Forwarding Engine

128K FIB TCAM

80 Gbps per slot

Fabric Extender Support

8-Port 10GbE Module

X2 Optics – SR, LR, ZR. xWDM

Integrated L2 / L3 Forwarding Engine

Upto 1 Million Prefix

80 Gbps per slot, 120 MPPS

48-port 10/100/1000

RJ-45 Copper

Integrated L2 / L3 Forwarding Engine

128K FIB TCAM

46 Gbps per slot

48-port 1 Gigabit SFP Module

SX, LX, ZX, T and xWDM

Integrated L2 / L3 Forwarding Engine

128K - 1M Prefix

46 Gbps per slot

Nexus 7000 Deployment Flexibility

Operational Consistency Reduces TCO

DC Core
L3 Routing
HA with ISSU
M

Campus Core
L3 Routing
HA with ISSU
M

DC Aggregation
vPC FabricPath
VDC
M
F

Data Center Interconnect
OTV
M

DCAccess
1/10GE Density
M
F

Scalable DC & HPC
FabricPath
F

Reduced Costs with Common Sparing & Operations

Long Term Investment Protection

Considerations for Mixing I/O Modules

M-Series & F-Series Interoperability

- Two possible scenarios:
  - M1 and F1 modules combined in a single VDC
  - M1 and F1 modules isolated in separate VDCs
- Both scenarios fully supported
  - Which to use depends on customer requirements
- Mixed chassis useful when Layer 3 forwarding and advanced services such as NetFlow required
- M1 and F1 modules have different capabilities
- Three most important considerations:
  - Forwarding: Layer 3 versus Layer 2 (unicast and multicast)
  - Table sizes: MAC table, classification ACL entries
  - FabricPath capability and interoperation
- Additional interactions exist for NetFlow, SPAN, EtherChannel, VLANs, VPC, CoPP/rate limiting, etc.