Cisco Nexus 2000 Product Family

Fabric Extensibility with Simplified Management

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Agenda

- Fabric Extender overview
- Nexus 2000 Product Family update
- Nexus B22 Fabric Extender Products update
- Nexus 2000 Fabric Extender Technical update – How it works, Features, Topologies

Cisco Nexus 2K Architecture
Simplified Operations and Lower Cost

Single Point of Management

Modular Switch
Fixed backplane

=

Single Point of Management

Cross-bar & Supervisor

Nexus 5500 Platform

+

Fabric Extenders
(Remote Line Cards)

Nexus 2000 Platform

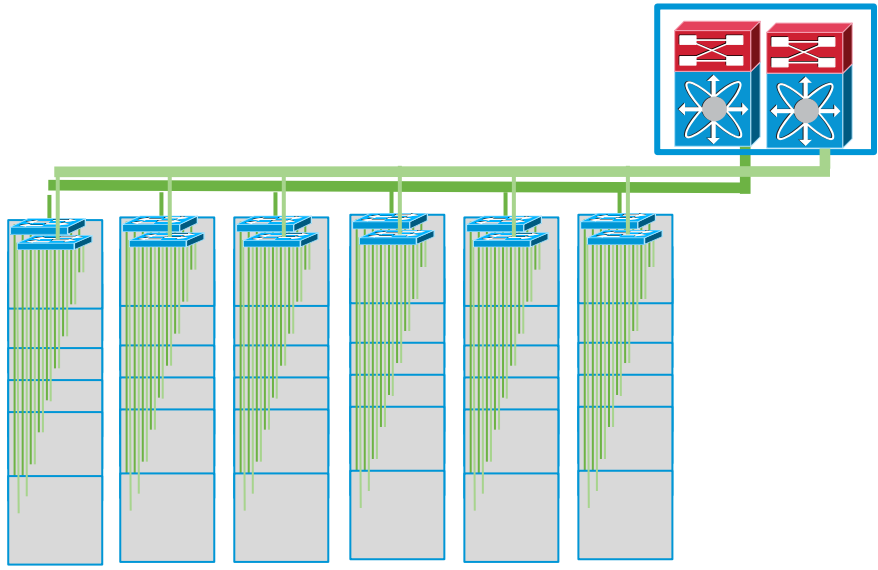
Distributed Modular Chassis
10Gb Ethernet for the Backplane

Typical Data Center Access Layer Options

Top of Rack (ToR)

Cost effective in term of cabling

Local copper cabling host/ToR switches
Fiber uplinks from ToR switches
Future Proofed for transition from 1G to 10G to 40G to 100G

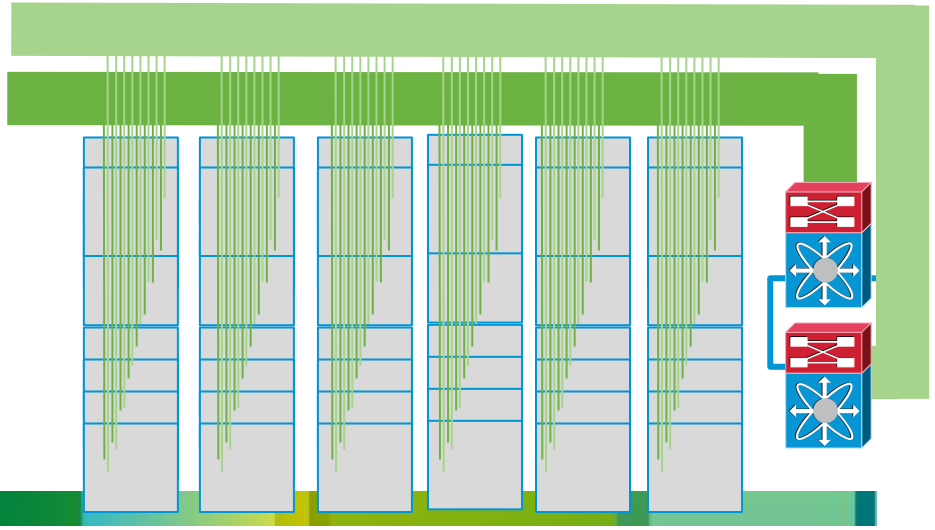


End of Row (EoR)

Simple management, efficient

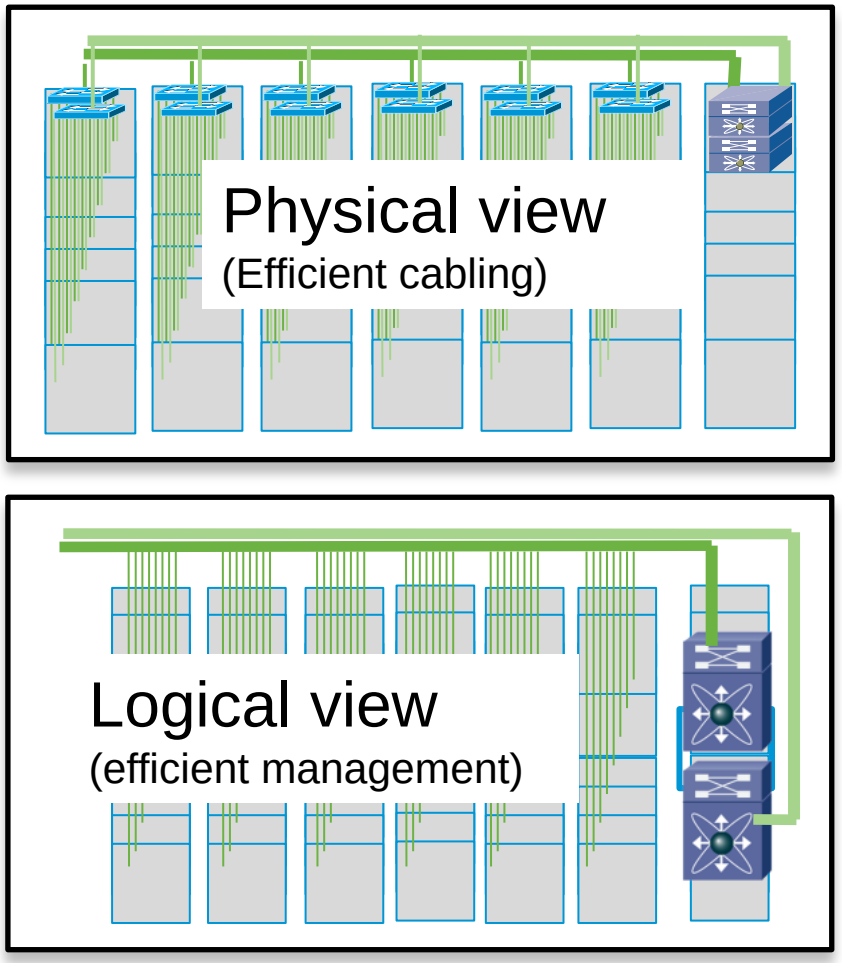
Copper/Fiber cabling from hosts to EoR switches

Fewer devices to manage, to upgrade
One single point of policy enforcement
One single point for troubleshooting
No Layer 2 interconnect (no STP)



Fabric Extender
Solution benefits

- Operational simplicity
- Cost effective solution
- Cabling simplicity
- Architecture flexibility
- Policy consistency across large number of ports
- Highly scalable platform with predictable low latency
- NX-OS Feature richness



Fabric Extender architecture: Operational simplicity at scale for POD access designs

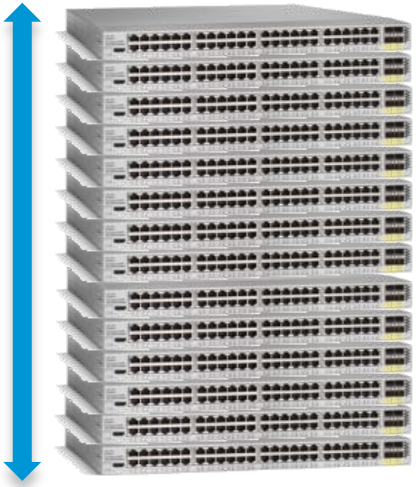
FEX Scalability

Cisco Nexus® 5000

Cisco Nexus® 7000

+

24xFEX

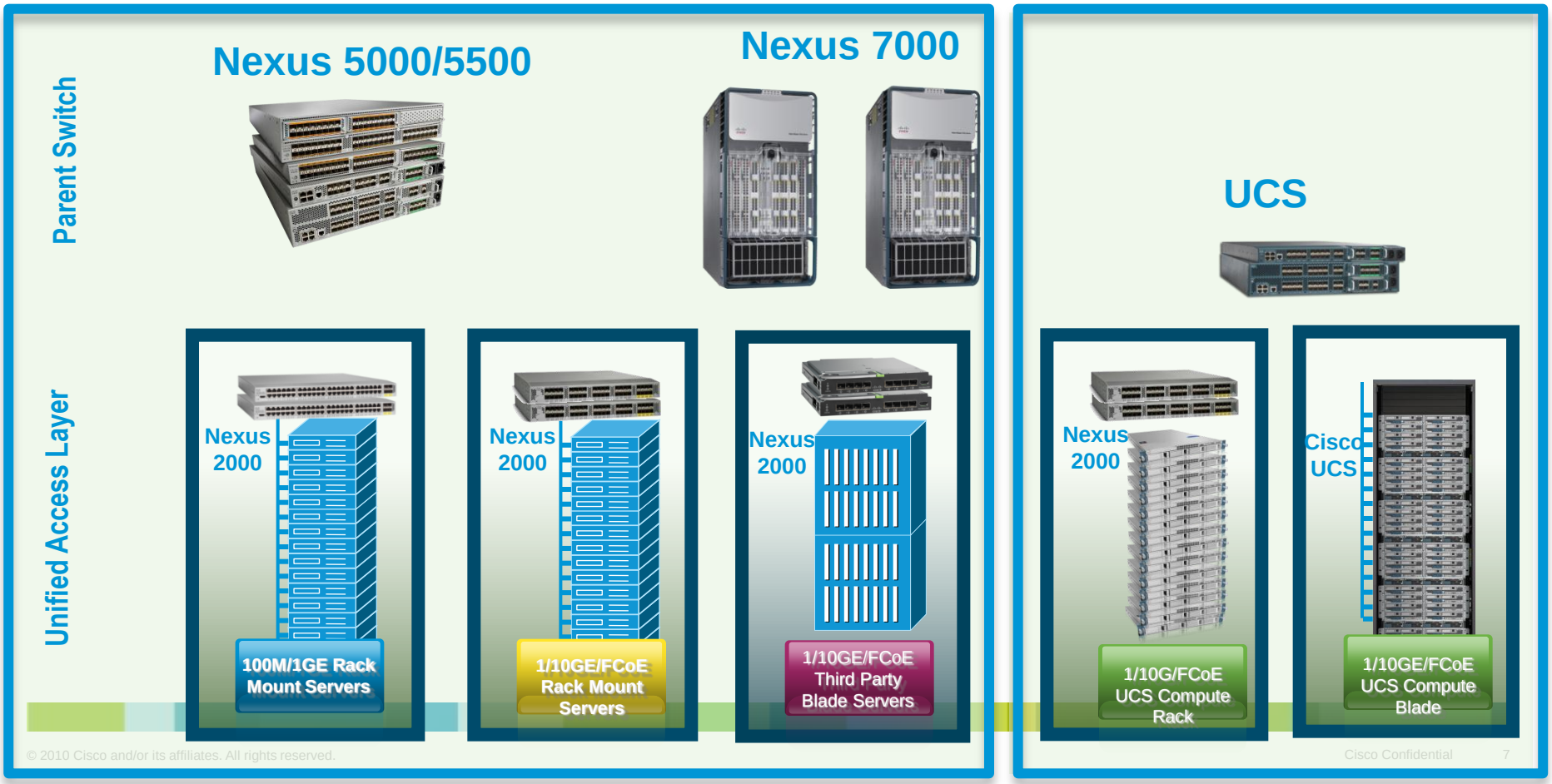


Cisco Nexus® 2000 FEX

- Support for Nexus 5000 and Nexus 7000
- Up to 24 FEX per N5K parent switch
- Up to 48 FEX per N7K parent switch
- Up to 2048 1GE interfaces managed through upstream parent switch
- Up to 1536 10GE interfaces managed through upstream parent switch

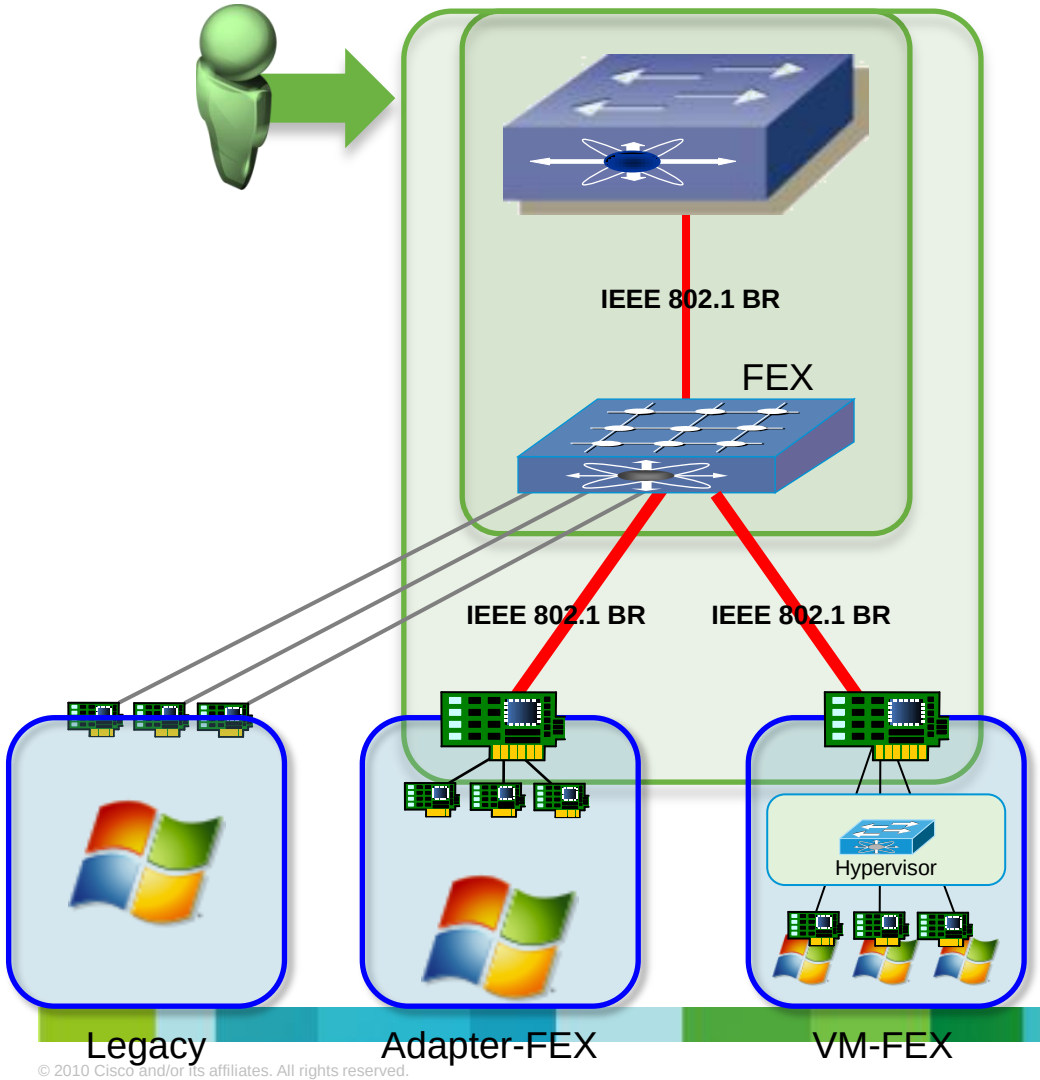
Fabric Extender Overview

Unified access platform for any POD designs *- across rack, blade, 100M, 1G, 10G, FCoE, copper, Fiber, ToR and EoR architectures, Layer 2/Layer 3 solutions, traditional or virtualized workloads*



Fabric Extender Evolution

Distributed Modular System to the ToR, server and Virtual Machine



One Network

Parent Switch to Application

FEX Architecture

- **Consolidates** network management
- FEX managed as line card of parent switch

Adapter FEX

- **Consolidates** multiple 1Gb interface into a single 10Gb interface
- Extends network into server

VM FEX

- **Consolidates** virtual and physical network
- Each VM gets a dedicated port on switch

Cisco Nexus 2000 Product Family
Momentum and Evolution

N5K parent
vPC
FEX
Simplified operations

ISSU
100M/1G/10G
FCoE

FEX Pre-provisioning
Port profiles
N7K parent switch
FEX scaling
N5500 parent

10GT on FEX

Adapter FEX
VM FEX
32MB buffer on
Gig FEX
Fabric Path
B22 FEX

eVPC
vPC+
UCS FI as parent
switch
FEX scaling

1HCY09 | 1HCY10 | 2HCY10 | 1HCY11 | 2HCY11 | CY12

N2K-C2148T-1GE
48 host ports 1GT (4 10GE uplinks)

N2K-C2232PP-10GE
32 host ports 1/10GE/FCoE (8 10GE uplinks)

N2K-C2248TP-1GE
48 host ports 100/1GT (4 10GE uplinks)

FET-10G
Fabric Extender Transceiver

N2K-C2224TP-1GE
24 host ports 100/1GT (2 10GE uplinks)

N2K-C2232TM-10GE
32 host ports 1/10GBASE-T (uplink module with 8 10GE ports)

N2K-C2248TP-E-1GE
48 host ports 100/1GT (4 10GE uplinks)

B22HP FEX
16 1/10GE host ports (8 10GE uplinks)

N2K-C2232TM-E-10GE
32 host ports 1/10GBASE-T (uplink module with 8 10GE ports)

B22F FEX
16 1/10GE host ports (8 10GE uplinks)

Nexus 2000 Fabric Extenders

Nexus Fixed switching continuous Market leadership

- ✓ **13,000 Customers since FCS**
- ✓ **#1 Markets Share Data Center Ethernet**
- ✓ **# 1 Market Share FCoE SAN Switching**
- ✓ **3000 Channel Partners**
- ✓ **10,000+ FEX Customers**

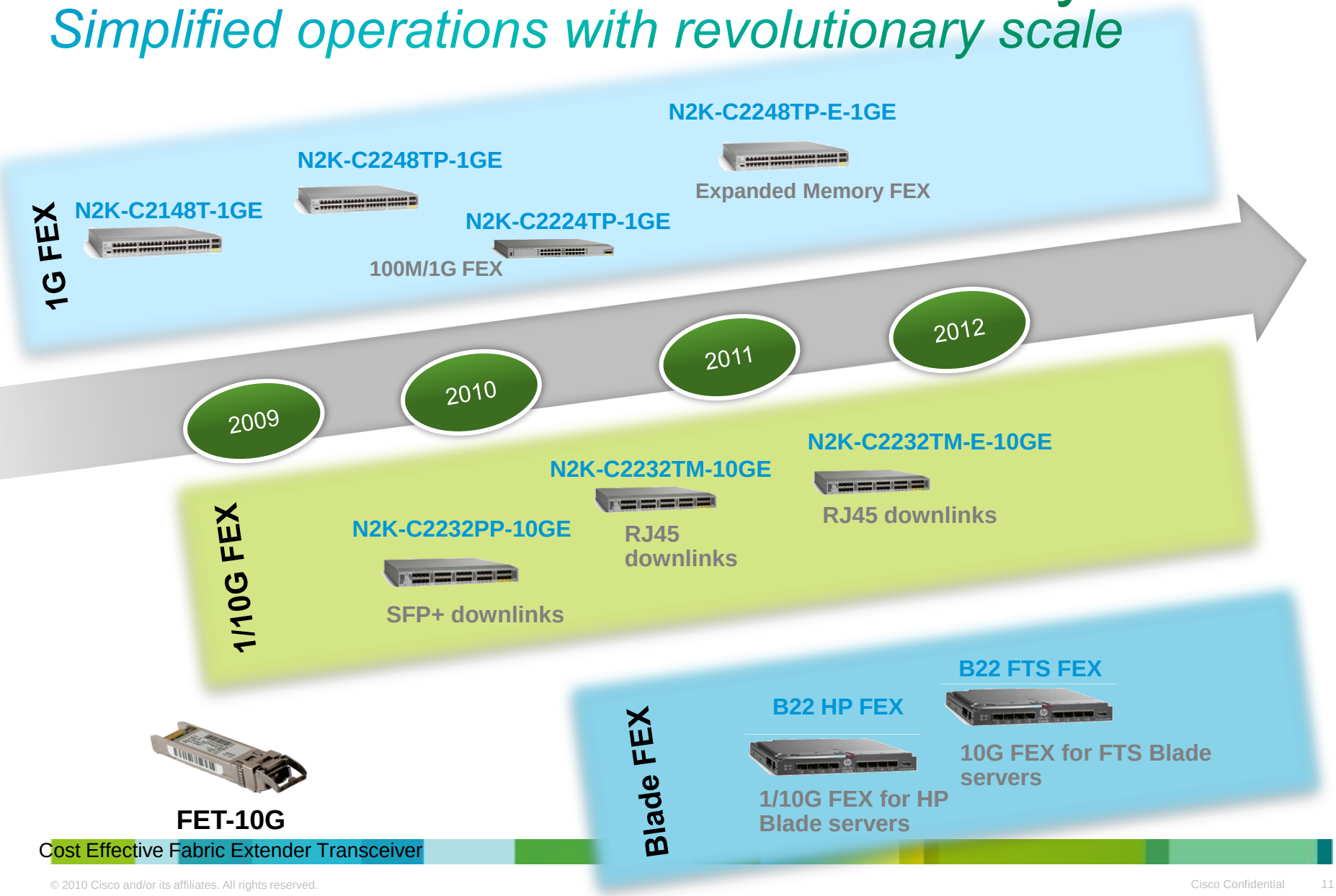
John Chambers:
"Our Nexus 5K and 2K switching had another good quarter - up more than 24% YoY"

http://www.cisco.com/go/nexus2000

Segment	Nexus 2000 Customer name
Education	Apollo Group, Chinese University of Hong Kong
Finance	Creval, Northern Trust Bank
Entertainment/ Media	Mediapro
Healthcare	University Health System, Caretech, Seattle Children's Hospital, Wellmont Health System, Salem Hospital
Gov/Federal	CA Dept of Water Resources, 5th Signal Command
Manufacturing	BMW
Service Provider	Alibaba Group, Cervalis, BRZ, NRB, Termark, Iron Mountain Inc.,Tencent, ONET .pl
Professional Services	Capgemini, Cassidi Turley
Eng/Industrial	Ausenco
Energy	ENI S.P.A.
Technology/IT	Travelport

Cisco Nexus 2000 Product Family

Simplified operations with revolutionary scale



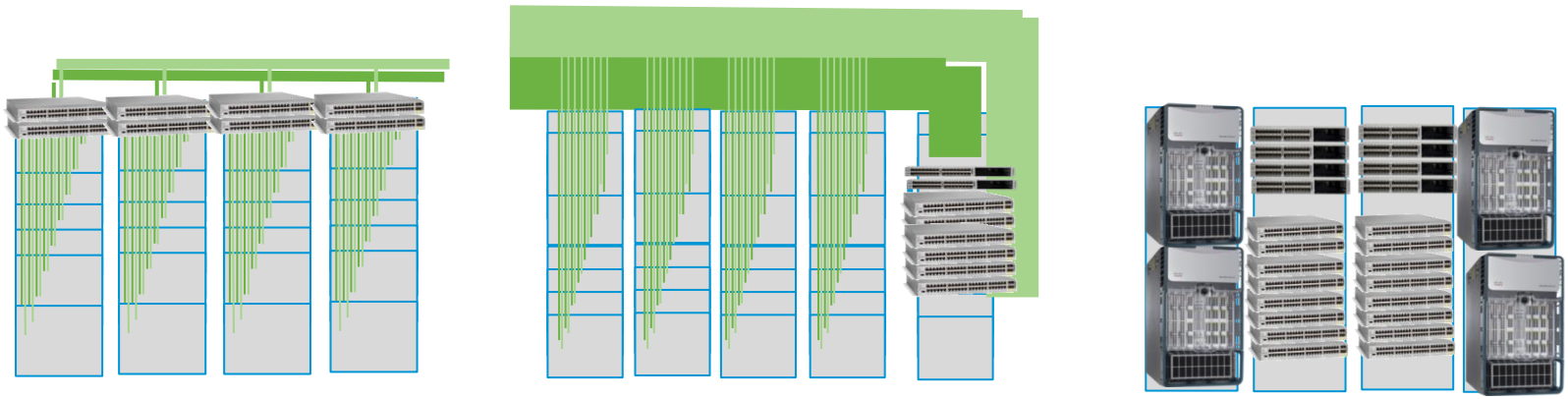
FEX connectivity options

Network-Facing Interface Options

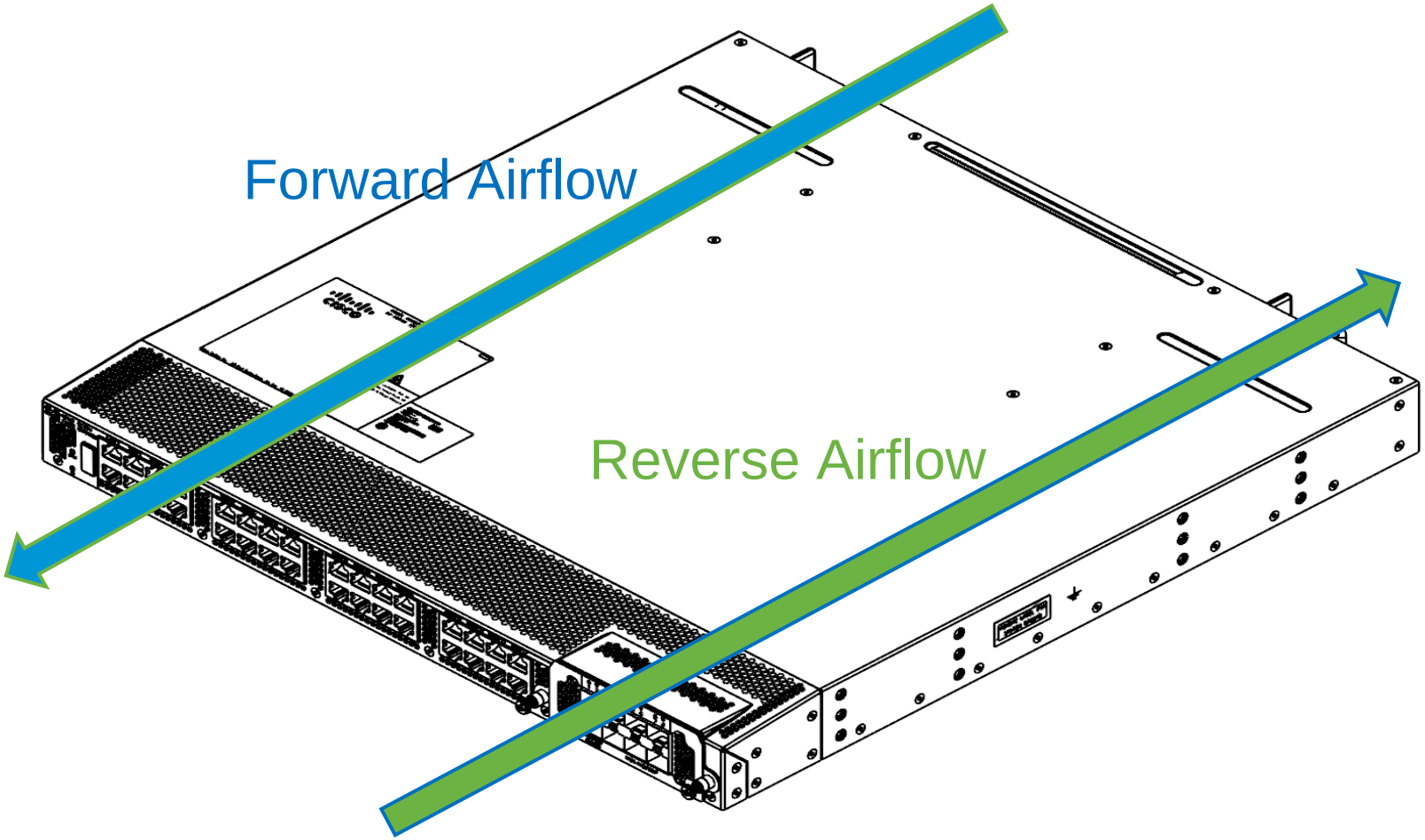
Host-Facing Interface Options	10G SFP
100BASE-T	Nexus 2248TP-E Nexus 2224TP Nexus 2248TP
1000BASE-T	Nexus 2248TP-E Nexus 2232TM-E Nexus 2248TP
1/10G SFP+	Nexus 2232PP
10GBASE-T	Nexus 2232TM-E Nexus 2232TM

FEX airflow

- FEX supports both forward airflow and reversed airflow
- Forward airflow (Power supply side intake): Optimized for Top of Rack configurations.
- Reversed airflow (Port side intake): Flexible airflow for different deployment scenario including network rack configurations



Cisco Nexus 2200 Mechanicals
Reversible Airflow



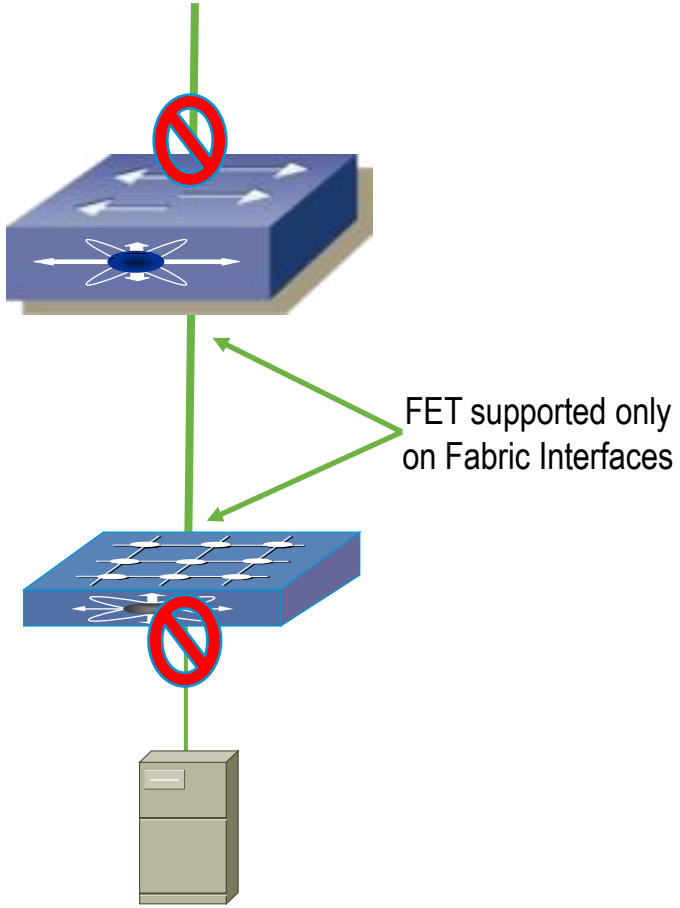
- Forward airflow = Power side intake
- Reversed airflow = Port side intake

Cisco Nexus 2000
Airflow & Power Support Matrix

	Nexus 2000	Hardware Availability	Software Availability
Front-to-Back Airflow (Port side exhaust), AC Power	Nexus 2148T Nexus 2200 Series	Today	All
Back-to-Front Airflow (Port side intake), AC Power	Nexus 2200 Series	Q2CY11	N5000: NX-OS 5.0 N7000: NX-OS 6.1
Front-to-Back Airflow (Port side exhaust), DC Power	Nexus 2200 Series	Q2CY11	N5000: NX-OS 5.0 N7000: NX-OS 6.1
Back-to-Front Airflow (Port side intake), DC Power	Nexus 2200 Series except 10GBASE-T	Q2CY12	N5000: NX-OS 5.1(3)N2 N7000: NX-OS 6.1

Nexus 2000
Fabric Extender Transceiver (FET)

- Cost-effective transceiver to interconnect Nexus 2000 and Nexus 5000 and 7000 parent switch (only supported on FEX Fabric interfaces)
- SFP+ form-factor
- Multimode fiber (MMF)
- FET with OM3 MMF can operate up to 100m
- FET with OM2 MMF can operate up to 20m
- FET with 62.5/125um MMF can operate up to 10m
- Approximately 1 watt (W) per transceiver
- Incompatible with SR optics



Fabric Extender 1/10GE
Transceiver supported

Host Interfaces Types	PID
Twinax (10G)	SFP-H10GB-CU1M, SFP-H10GB-CU3M, SFP-H10GB-CU5M, SFP-H10GB-ACU7M, SFP-H10GB-ACU10M
SFP+	SFP-10G-SR, SFP-10G-LR, SFP-10G-ER
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 (3km distance limit between N5K/N2K) SFP-10G-ER (3km distance limit between N5K/N2K)
Twinax	SFP-H10GB-CU1M, SFP-H10GB-CU3M, SFP-H10GB-CU5M, SFP-H10GB-ACU7M, SFP-H10GB-ACU10M




Fabric Extender 100M/1GE
Nexus 2248TP-E-1GE Overview

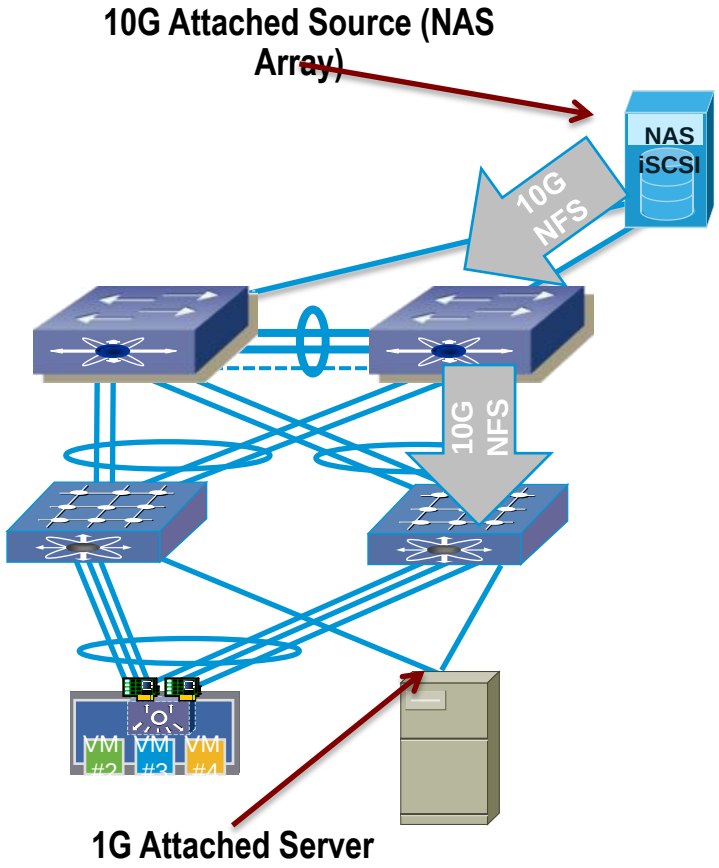
- 48 ports 100M/1GBase-T Enhanced Fabric Extender
  - 48x 100/1000M host/downlink interfaces
  - 4x 10GE on network/uplink interfaces
  - 32MB shared buffer
  - Upstream N5K or N7K parent switch supports various FEX (mix-and-match)
  - Choice of airflow and AC/DC power

- Design scenario:
  - High density 100M/1G access
  - Cost effective 100M/1G solution
  - Virtualization
  - Buffer optimized for specific Data Center workloads such as Big Data, Hadoop and Distributed Storage

Key differences from N2248TP:
- Optimized Buffers
- Enhanced counters

Nexus 2248TP-E
32MB Shared Buffer

- Speed mismatch between 10G NAS and 1G server requires QoS tuning
- ***Nexus 2248TP-E*** utilizes a 32MB shared buffer to handle larger traffic bursts
- Hadoop, NAS, are examples of bursty applications
- You can control the queue limit for a specified Fabric Extender for egress direction (from the network to the host)




```
N5548-L3(config-fex)# hardware N2248TPE queue-limit 4000000 rx
N5548-L3(config-fex)# hardware N2248TPE queue-limit 4000000 tx

N5548-L3(config)#interface e110/1/1
N5548-L3(config-if)# hardware N2248TPE queue-limit 4096000 tx
```

Tune 2248TP-E to support a extremely large burst (Hadoop, AVID, …)

Nexus 2248TP-E
Buffer Allocations

```
N5596-L3-2(config-if)# sh queuing interface e110/1/1
Ethernet110/1/1 queuing information:
  Input buffer allocation:
  Qos-group: 0
  frh: 2
  drop-type: drop
  cos: 0 1 2 3 4 5 6
  xon        xoff       buffer-size
  ---------+---------+-----------
  0          0          65536

  Queueing:
  queue     qos-group     cos             priority  bandwidth mtu
  --------+-------------+---------------+---------+---------+
  2         0             0 1 2 3 4 5 6    WRR        100       9728

  Queue limit: 2097152 bytes

  Queue Statistics:
  ---+---------------+----------+----------+---------+-----------+-----
  Que|Received /     |Tail Drop |No Buffer |MAC Error |Multicast  |Queue
  No |Transmitted    |          |          |          |Tail Drop  |Depth
  ---+---------------+----------+----------+---------+-----------+-----
  2rx|         5863073|         0|         0|         0|     -     |    0
  2tx|    426378558047|  28490502|         0|         0|          0|    0
  ---+---------------+----------+----------+---------+-----------+-----

  <snib>
```

Ingress queue limit(Configurable)

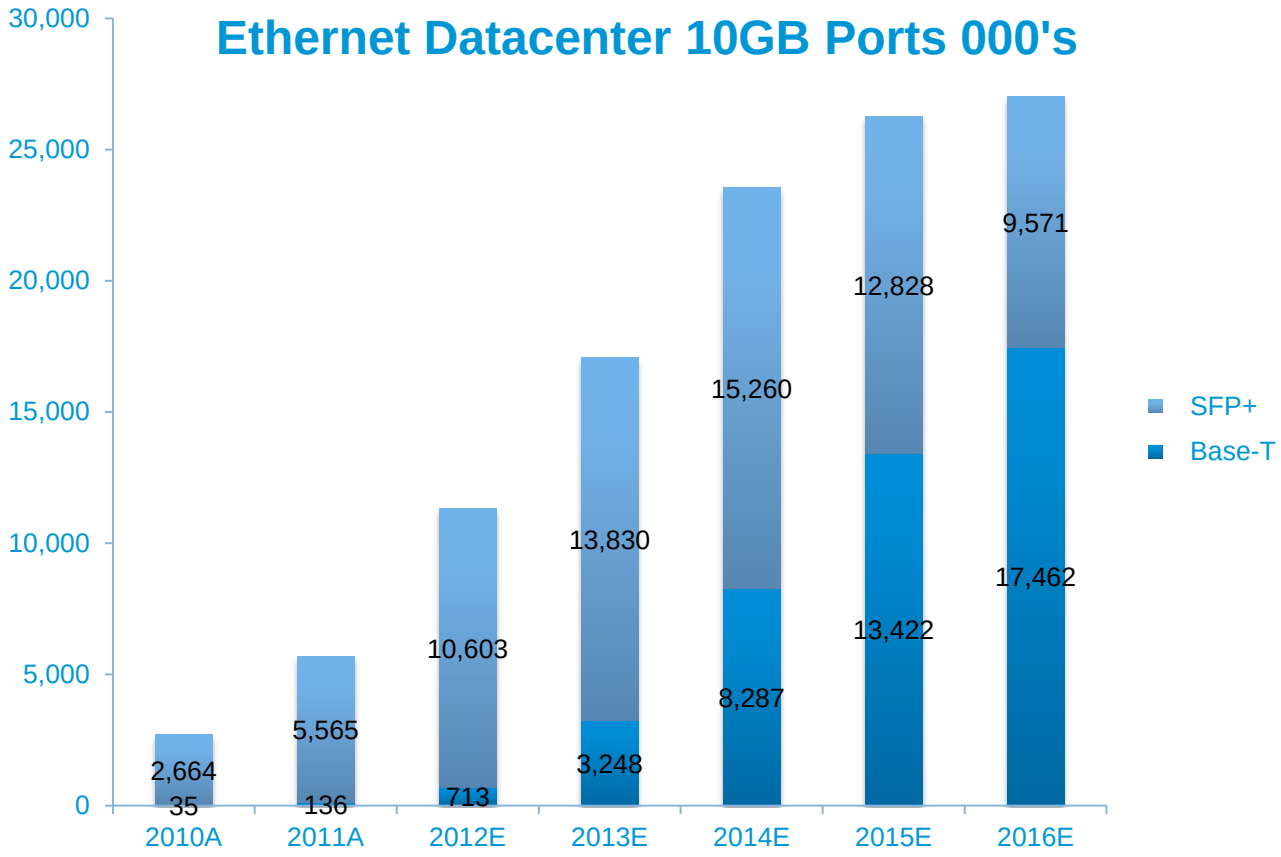
Egress queues:
CoS to queue mapping
Bandwidth allocation
MTU

Egress queue limit(Configurable)

Per port per queue counters

Drop due to oversubscription

Ethernet Evolution
10GBASE-T



Source: Crehan Research (Q1CY12)

10GBASE-T Key Benefits:

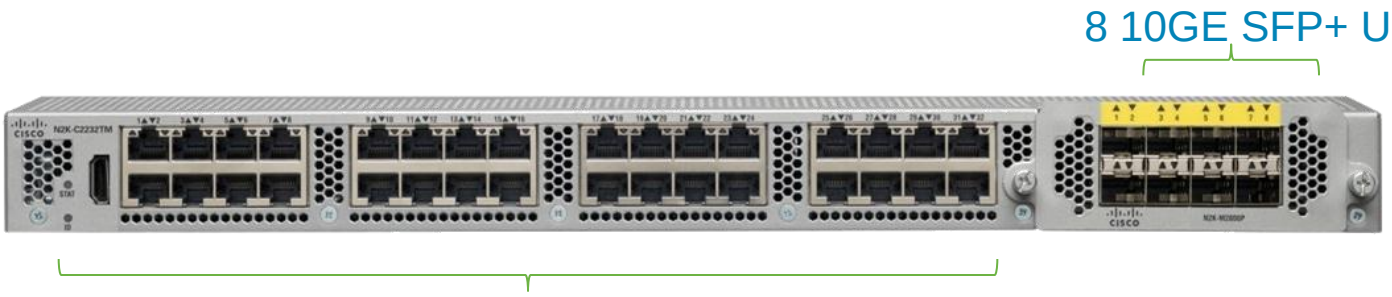
- 10 Gigabit bandwidth requirements for 1 Gig NIC consolidation at the server access and virtual environments
- Ease of 1GBASE-T to 10GBASE-T migration
- Flexible, scalable cabling with standard RJ-45 connector, at distances up to 100m
- Reuse of existing structured cabling
- Economics of 1Gigabit Ethernet versus 10 Gigabit Ethernet
- Prepare for Server LOM

10GBASE-T is fast growing

Introducing 2232TM-E

Shipping!

- What is same as 2232TM?
  - Form Factor, ports, power supplies, etc.
  - Cabling options and distance supported
  - Port to port latency
- What is different?
  - A newer and better 10GBase-T PHY (40nm)
  - Better BER characteristics expected – qualification underway
  - Reduction in power consumption



Nexus 2232TM-E 10GBASE-T

- IEEE 802.3.an standard
- Structured Copper Cabling with RJ45 connectors
- Supports 10Gbps throughput for up to 100 meters or 330 feet
- Leverages Category 6, Category 6A, and Category 7 type cabling

	Technology	Cable	Distance	PHY Power (each side)	Transceiver Latency
2232PP	SFP+ CU Copper	Twinax	1-10m	0.1-1W	~0.25µs
2232TM	10GBASE-T – 65nm	Cat6a/7 Cat6a/7	100m 30m	~6.2W ~4.5W	~3µs ~3µs
2232TM-E	10GBASE-T – 40nm	Cat6a/7 Cat6a/7	100m 30m	~3.9W ~3.3W	~3µs ~3µs

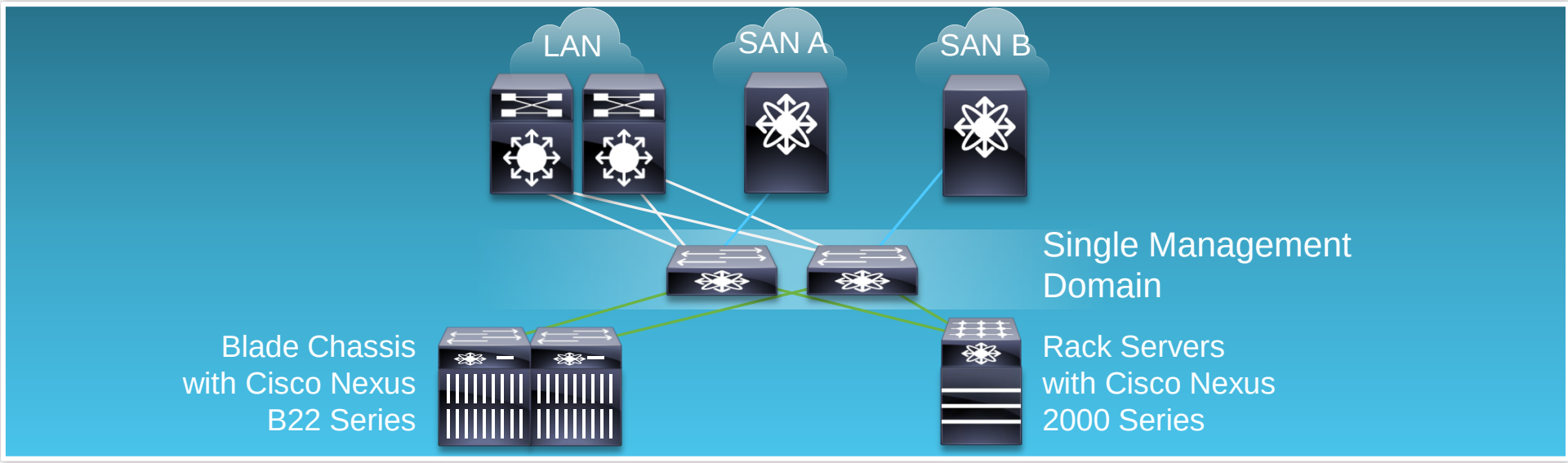
Cisco Nexus 2000 Fabric Extender (FEX)

	100M/1GE platform		*1/10GE platform*		
					
Model	**Nexus 2248TP**	**Nexus 2248TP-E**	**Nexus 2232PP**	**Nexus 2232TM**	**Nexus 2232TM-E**
Product Shipping	Yes (Q2CY10)	Yes (Q4CY11)	Yes (Q2CY10)	Yes (Q3CY11)	Yes (Q3CY12)
Form Factor	1 RU	1 RU	1 RU	1 RU	1 RU
Uplink Ports	4x 10GbE SFP+	4x 10GbE SFP+	8x 10GbE SFP+	8x 10GbE SFP+	8x 10GbE SFP+
Uplink Transceivers Supported	Copper CX-1 (passive): 1m, 3m, 5m. Copper CX1 (active): 7m, 10m Optical: FET, SR, LR, ER				
Host Facing Ports	48x 100/1000BASE-T RJ45	48x 100/1000BASE-T RJ45	32x SFP/SFP+ (1/10G)	32x 1/10GBASE-T RJ45	32x 1/10GBASE-T RJ45
FCoE	N/A	N/A	Yes (with N5K)	No	Capable
Buffer	Ingress buffer (Host→ Network/H2N): 480KB per port group (8) Egress buffer (N2H): 800KB per port group (8)	32MB shared buffer	Ingress buffer (Host→ Network /H2N): 1280KB per port group (8) Egress buffer (N2H): 1280KB per port group (8)	Ingress buffer (Host→ Network /H2N): 1280KB per port group (8) Egress buffer (N2H): 1280KB per port group (8)	Ingress buffer (Host→ Network /H2N): 1280KB per port group (8) Egress buffer (N2H): 1280KB per port group (8)
Typical Power	95W	95W	210W	280W@30M, 350W@100M	210W@30M, 240W@100M
Enhanced Counters	Standard	Enhanced	Standard	Standard	Standard
Parent Switch	Nexus 5K, Nexus 7K	Nexus 5K, Nexus 7K	Nexus 5K, Nexus 7K, UCS FI	Nexus 5K, Nexus 7K	Nexus 5K

Cisco Nexus B22 Use Case
Legacy Blade and Rack Server Footprint

Customer Desires a Cisco Unified Fabric

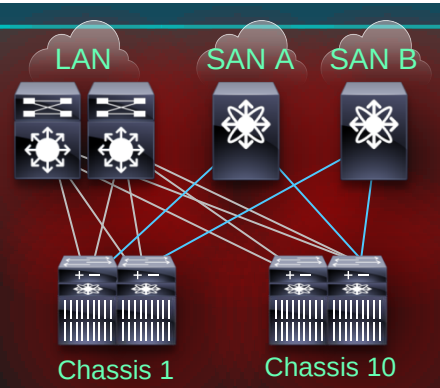
- Consolidation of switch modules and cabling
- Network management point consolidation and consistency with rack servers
- Nexus Fabric Visibility within Blade Chassis
- Require end-to-end FCoE and/or FabricPath



Blade Server Connectivity Evolution

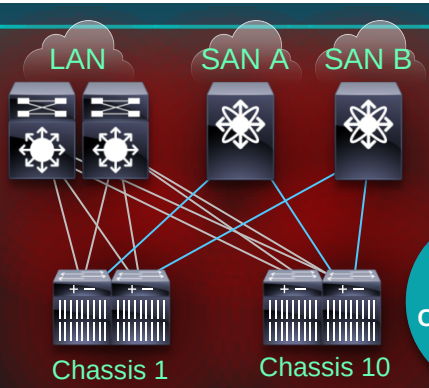
BEFORE

Legacy Ethernet and FC Blade Switches



Server and Access Layer Mgmt Points	Network Devices	40–20 LAN & 20 SAN
	Server Mgmt Devices	20

Legacy Converged Blade Switches

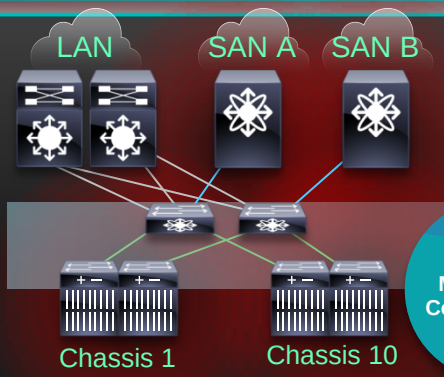


33% Mgmt Point Consolidation

Server and Access Layer Mgmt Points	Network Devices	20
	Server Mgmt Devices	20

AFTER

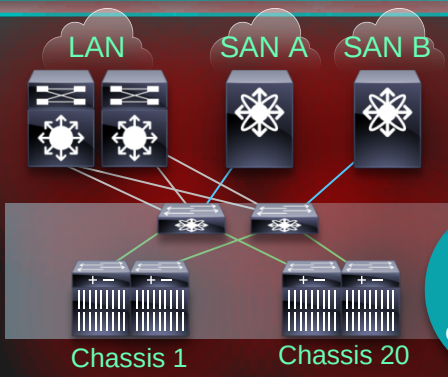
B22 Series Blade Fabric Extenders



66% Mgmt Point Consolidation

Server and Access Layer Mgmt Points	Network Devices	2
	Server Mgmt Devices	20

Cisco UCS



97% Server and Network Mgmt Point Consolidation

Server and Access Layer Mgmt Points	Network Devices	2
	Server Mgmt Devices	

Cisco Nexus B22 Fabric Extenders

FEX Connectivity for the Blade Server Ecosystem

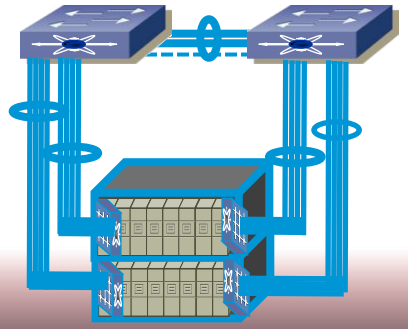
Shipping!

FEATURES

- Extends FEX connectivity into blade chassis
- Cisco Nexus 5000 Switch is a single management point for all the blade chassis I/O modules
- End-to-end FCoE support

BENEFITS:

- 50% decrease in blade chassis I/O modules
- 66% decrease in blade management points
  - Blade & rack networking consistency
- Increased network resiliency



DC Design Details – Blade Chassis
Nexus B22HP Fabric Extender

Hot-plug redundant fans

Eight interconnect bays usable for B22 FEX – 10/1G & FCoE

Network and serial connectors

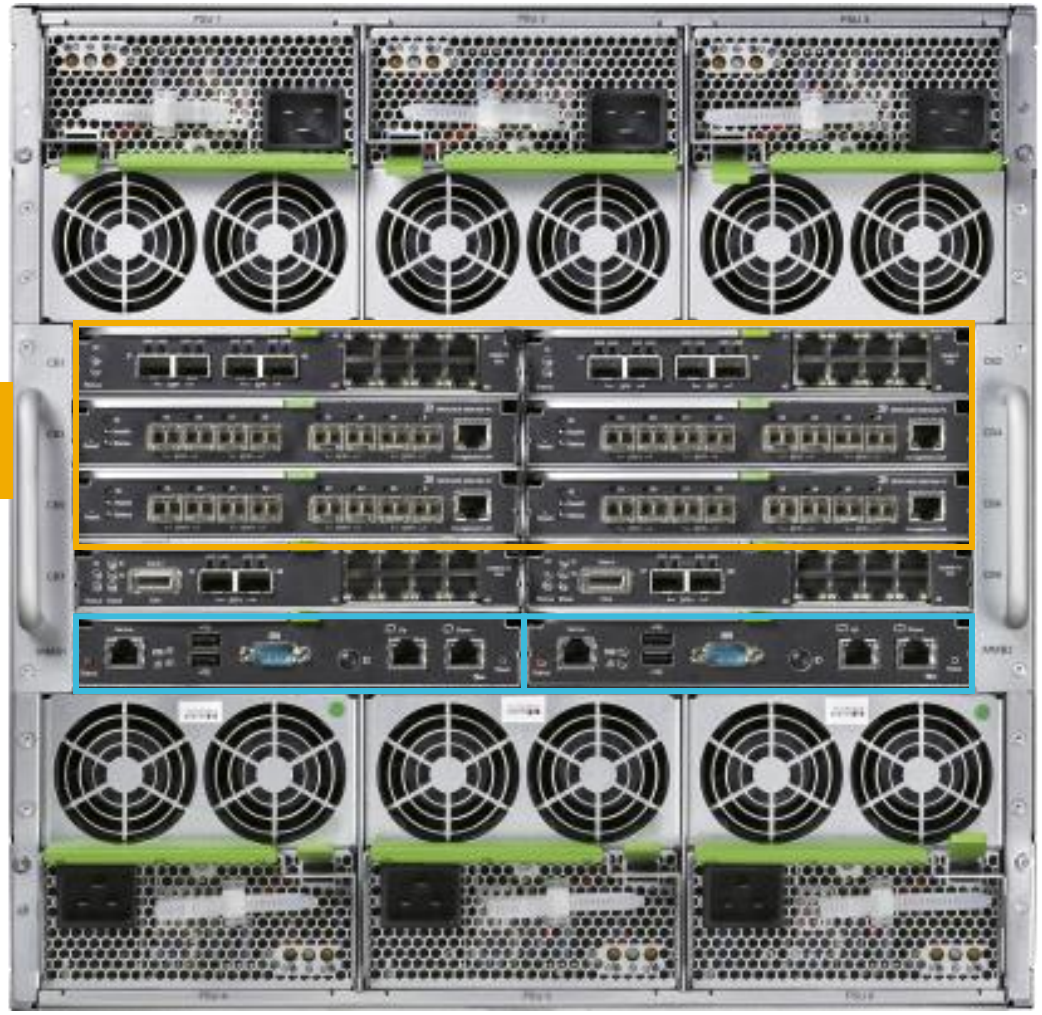
Enclosure links

Redundant Onboard Administrators

3+3 C19 cords

DC Design Details – Blade Chassis
Fujitsu BX900 Connection Blade Bays – Rear View

Eight Connection Blade bays



Redundant MMB

Nexus B22 Management

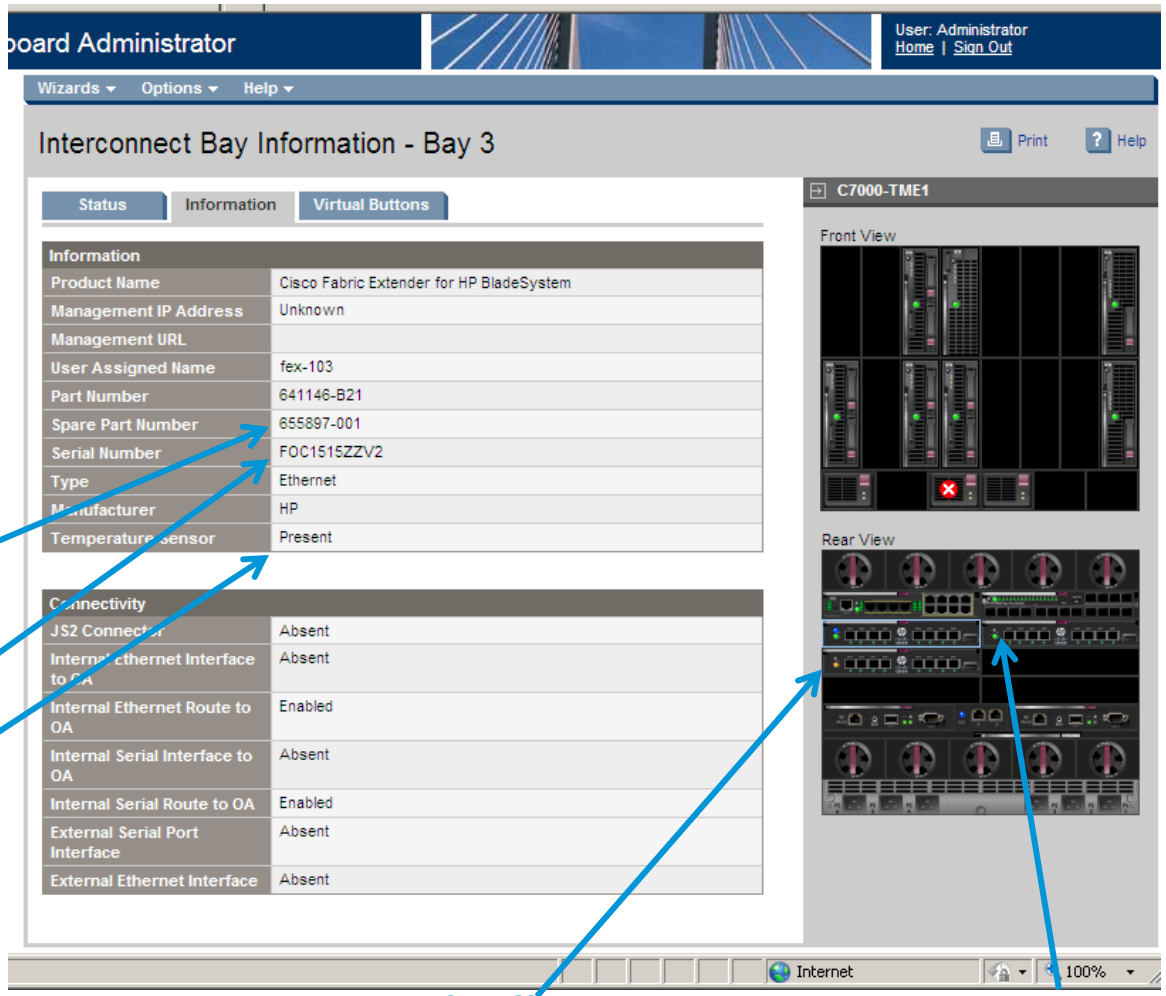
- FEX is logically a line card of the parent switch
- Clear responsibility and roles between compute and network
  - Server team: Install, powerup and keep the B22 cool
  - Network team: Configure and run the network
- Server facing interfaces are managed as ports of the parent switch
- Parent switch is responsibility and managed by the network team
- Policies, profiles, and traffic management
- Add compute without adding network management points

Nexus B22HP – Compute Admin Role

- Cisco Fabric Extender Installation Procedure
  - Insert into the I/O Module bay in chassis
  - Attach the cables to the parent switch
  - Ensure port LEDs are lit
  - All Done

Nexus B22HP Compute Viewpoint

- Just like any other IOM
- Standard IOM information



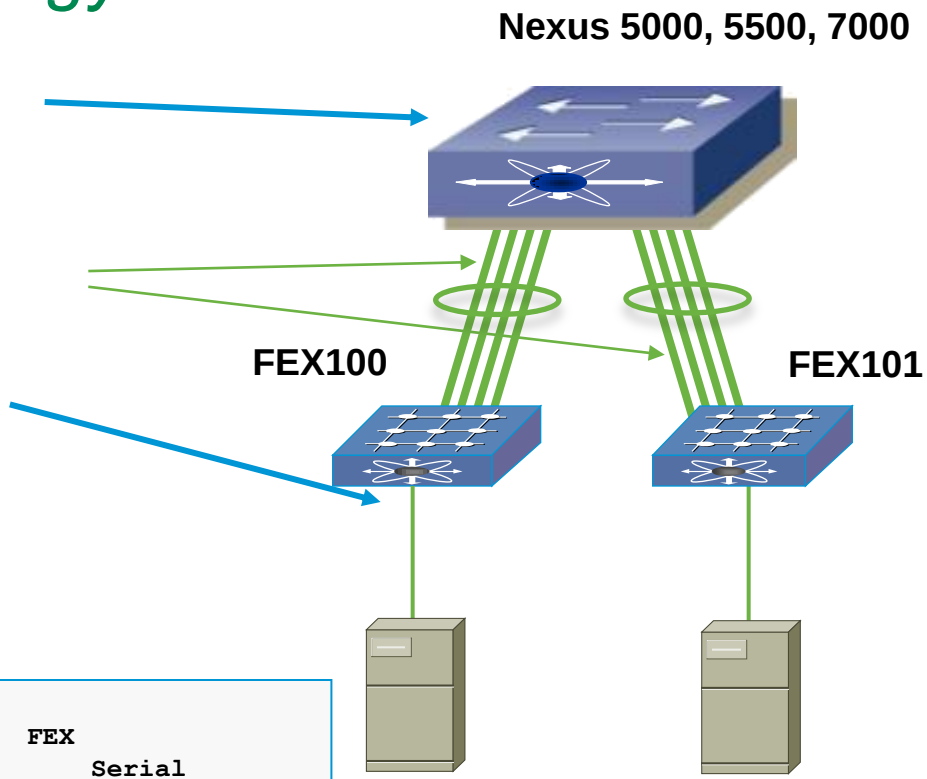
Nexus B22HP – Network Admin Role

- Logically define the fex
- Configure the fabric links
- Configure the Server facing interfaces
- All Done

```
N5548-1# configure terminal
N5548-1(config)# feature fex
N5548-1(config)# fex 104
N5548-1(config-if)# interface port-channel 4
N5548-1(config-if)# switchport mode fex-fabric
N5548-1(config-if)# fex associate 104
N5548-1(config-if)# interface ethernet 1/1
N5548-1(config-if)# switchport mode fex-fabric
N5548-1(config-if)# fex associate 104
N5548-1(config-if)# channel-group 4
N5548-1(config-if)# interface ethernet 1/2
N5548-1(config-if)# switchport mode fex-fabric
N5548-1(config-if)# fex associate 104
N5548-1(config-if)# channel-group 4
```

Cisco Nexus 2000 Fabric Extender
Fabric Extender Terminology

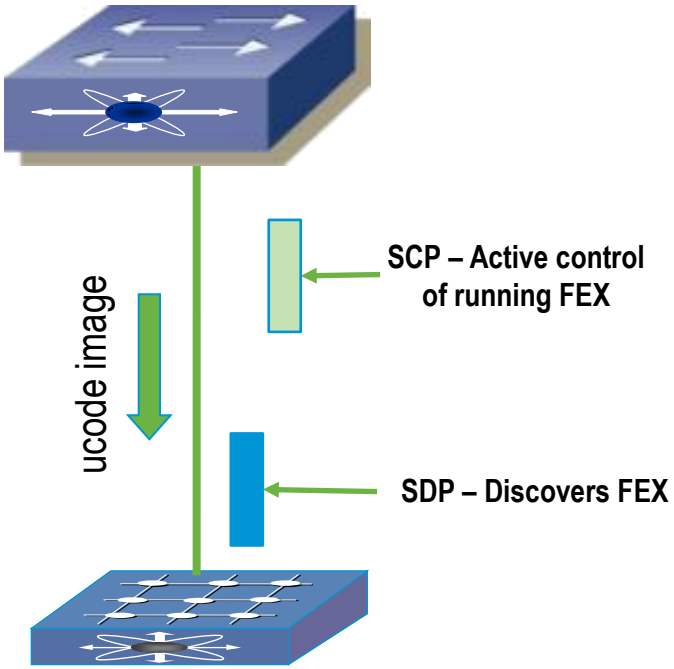
- **Parent Switch:** Acts as the combined Supervisor and Switching Fabric for the virtual switch
- **Fabric Links**: Extends the Switching Fabric to the remote line card
- **Host Interfaces** (HIF)
- Fabric connectivity between Nexus 5000 and Nexus 2000 (FEX) can leverage either **pinning** or **port-channels**




```
dc11-5020-1# show interface fex-fabric
     Fabric      Fabric       Fex                 FEX
Fex  Port      Port State    Uplink    Model          Serial
--------------------------------------------------------------
100   Eth1/17        Active      1    N2K-C2148T-1GE  JAF1311AFLL
100   Eth1/18        Active      2    N2K-C2148T-1GE  JAF1311AFLL
100   Eth1/19        Active      3    N2K-C2148T-1GE  JAF1311AFLL
100   Eth1/20        Active      4    N2K-C2148T-1GE  JAF1311AFLL
101   Eth1/21        Active      1    N2K-C2148T-1GE  JAF1311AFMT
101   Eth1/22        Active      2    N2K-C2148T-1GE  JAF1311AFMT
```

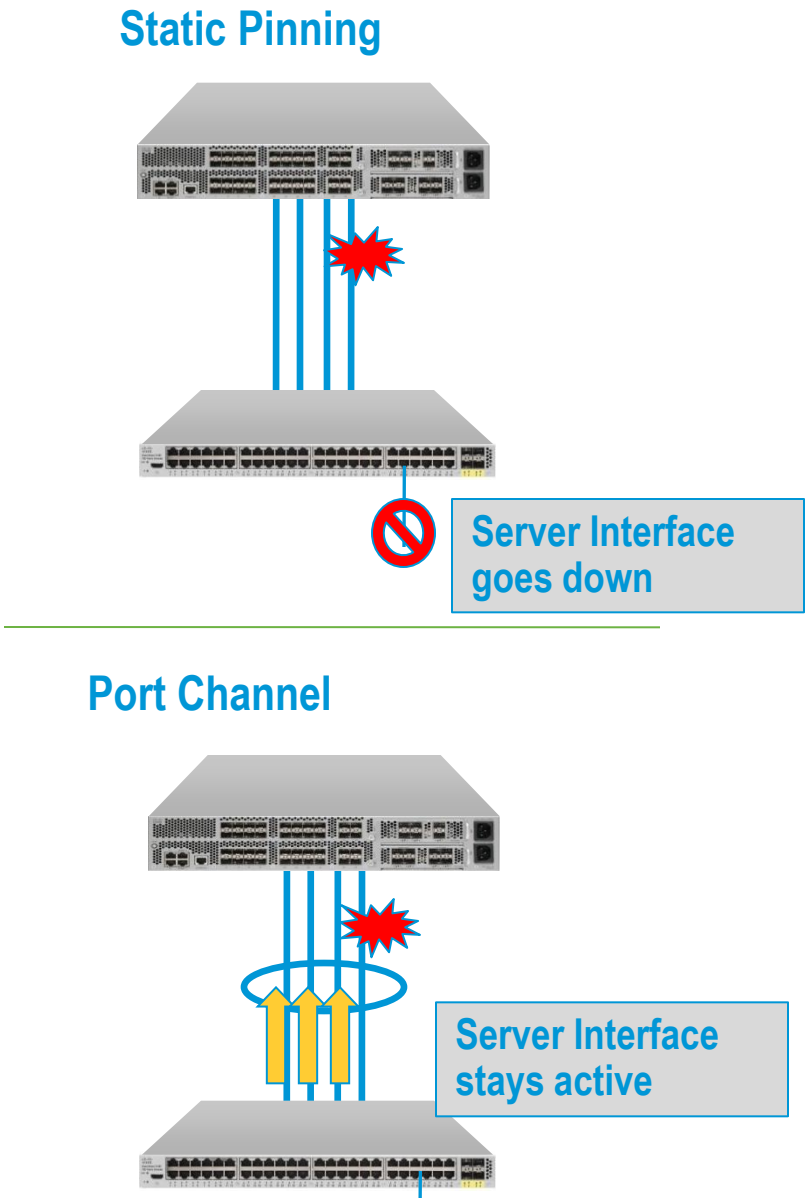
Nexus 2000 Fabric Extender
Inband Management Model – Line Card Model

- Fabric extender is discovered by switch using an L2 Satellite Discover Protocol (SDP) that is run on the uplink port of fabric extender
- NX5K checks software image compatibility, assign an IP address and upgrade the fabric extender if necessary
- N5K pushes programming data to Fabric Extender
- Satellite Control Protocol (SCP) used to manage the running state of the line card



Fabric Extender
Fabric Modes

- Fabric Extender associates (pins) a server side (1GE) port with an uplink (10GE) port
- Server ports are either individually pinned to specific uplinks (static pinning) or all interfaces pinned to a single logical port channel
- Behavior on FEX uplink failure depends on the configuration
- Static Pinning – Server ports pinned to the specific uplink are brought down with the failure of the pinned uplink
- Port Channel – Server traffic is shifted to remaining uplinks based on port channel hash



Nexus 2000 Fabric Extender
Configuring the Fabric Extender

- Two step process
  - Define the Fabric Extender (100-199) and the number of fabric uplinks to be used by that FEX

```
Nexus-5548# switch# configure terminal
switch(config)# fex 100
switch(config-fex)# pinning max-links 4
```

  - Configure Nexus 5000 ports as fabric ports and associate the desired FEX

```
Nexus-55548# switch# switch# configure terminal
switch(config)# interface ethernet 1/1
switch(config-if)# switchport mode fex-fabric
switch(config-if)# fex associate 100
. . .
<repeat for all 4 interfaces used by this FEX>
```

Nexus 2000 Fabric Extender

Fabric Extender ports are Nexus parent switch ports

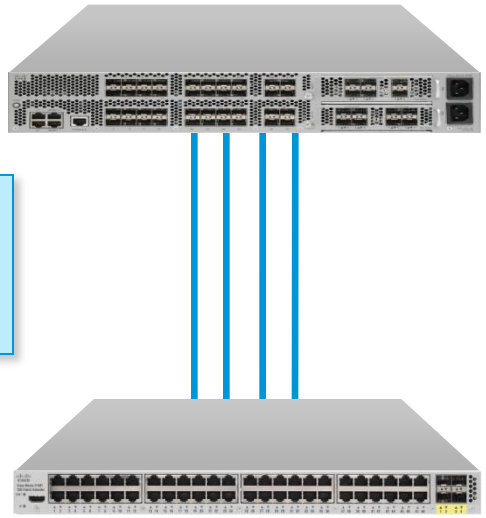
```
Nexus5548# show run interface 1/3

interface Ethernet1/3
  switchport mode fex-fabric
  fex associate 100


Nexus5548# show interface brief


Interface                 Status     IP Address         Speed    MTU    Port
                                                                        Channel
--------------------------------------------------------------------------------
Ethernet100/1/1           up         --                 --       1500   --
Ethernet100/1/2           notConnect --                 --       1500   --
Ethernet100/1/3           notConnect --                 --       1500   --
Ethernet100/1/4           notConnect --                 --       1500   --
Ethernet100/1/5           notConnect --                 --       1500   --
Ethernet100/1/6           notConnect --                 --       1500   --
Ethernet100/1/7           notConnect --                 --       1500   --
Ethernet100/1/8           up         --                 --       1500   --
Ethernet100/1/9           up         --                 --       1500   --
```

Fabric Extender
Static Pinning

- Static Pinning associates (maps) specific server ports to specific fabric links
- Need to ensure that the ***same*** number of Ethernet ports are assigned as fex-fabric ports as defined in the 'max-links' parameter for that Fabric Extender

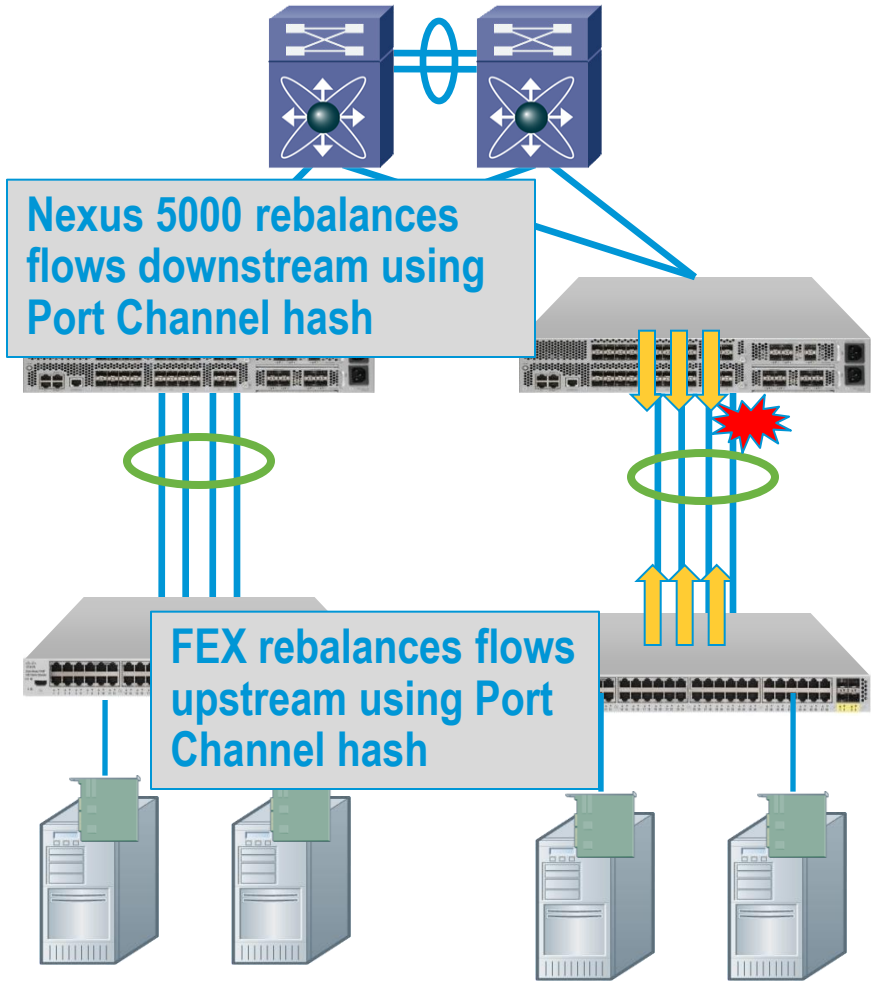
```
interface Ethernet1/1
  switchport mode fex-fabric
  fex associate 100

interface Ethernet1/2
  switchport mode fex-fabric
  fex associate 100

interface Ethernet1/3
  switchport mode fex-fabric
  fex associate 100

interface Ethernet1/4
  switchport mode fex-fabric
  fex associate 100

!
fex 100
  pinning max-links 4
  description Rack_100
```

Ports Are Configured as Fabric and Associated with a Specific Fabric Extender



Fabric Extender
Uplink Failure – Port Channel

- When configured as a port channel a failure of a Fabric Extender to Nexus 5000 uplink will not trigger a change to server port
- The logical uplink that the server port is pinned to remains up (the port channel)
- Upstream and downstream traffic will both be redistributed on a per flow basis across the remaining links in the bundle



Fabric Extender
Port Channel Configuration

```
interface port-channel1
  switchport mode fex-fabric
  description Fabric Extender 100
  fex associate 100

interface Ethernet1/1
  switchport mode fex-fabric
  description Member of Fabric Extender 100 Etherchannel Link
  channel-group 1
  fex associate 100

interface Ethernet1/2
  switchport mode fex-fabric
  description Member of Fabric Extender 100 Etherchannel Link
  channel-group 1
  fex associate 100

interface Ethernet1/3
  switchport mode fex-fabric
  description Member of Fabric Extender 100 Etherchannel Link
  channel-group 1
  fex associate 100

interface Ethernet1/4
  switchport mode fex-fabric
  description Member of Fabric Extender 100 Etherchannel Link
  channel-group 1
  fex associate 100

fex 100
  pinning max-links 1
  description Fabric Extender 100 - Using Etherchannel 1
```

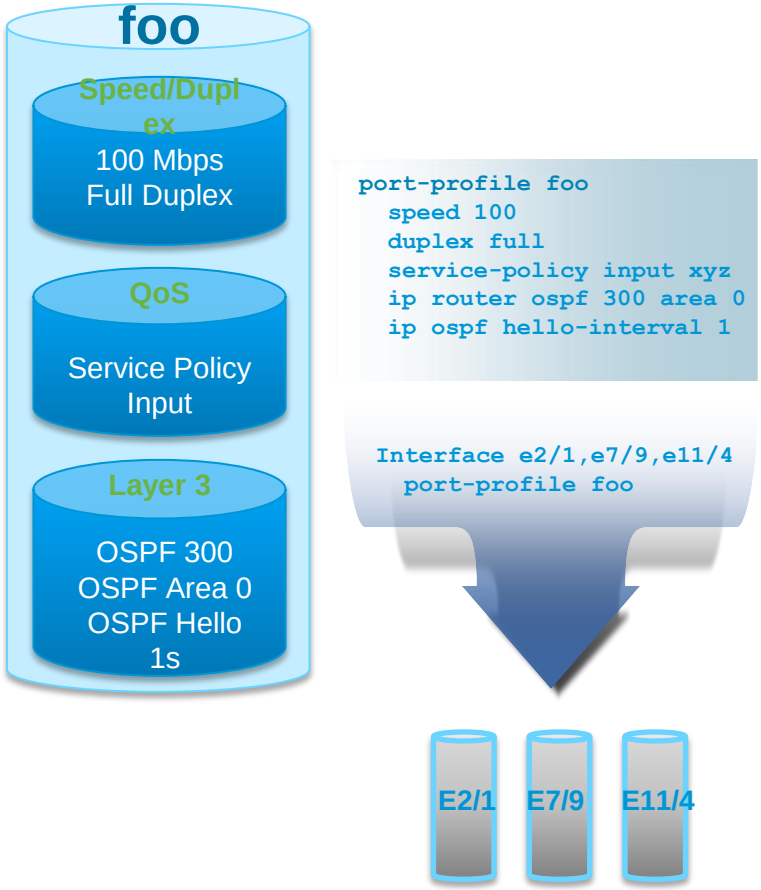
Configure the Physical Ports as Members of the Fabric EtherChannel

Configure the Port Channel and Its Members to be Associated with a Specific Fabric Extender

Policy in the Virtualized Access Switch
Nexus Port Profiles

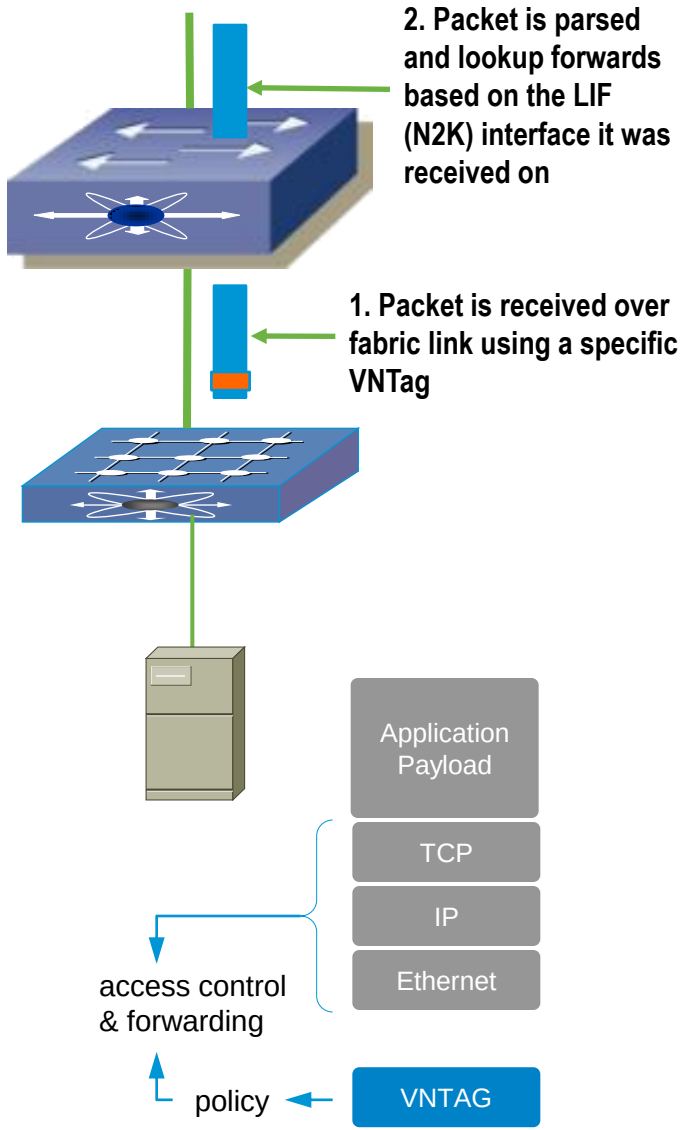
- Port Profiles enable the application of common configuration across groups of ports
- A port-profile can inherit attributes from other port-profiles (nested profiles)
- A change to a port-profile automatically updates configuration of all member ports
- Any interface command available on a Nexus interface can be a part of a port-profile
  e.g. ACL, L3, VLAN, etc.
- Configuration precedence/order:

  Default config. < Port-profile < Manual config.



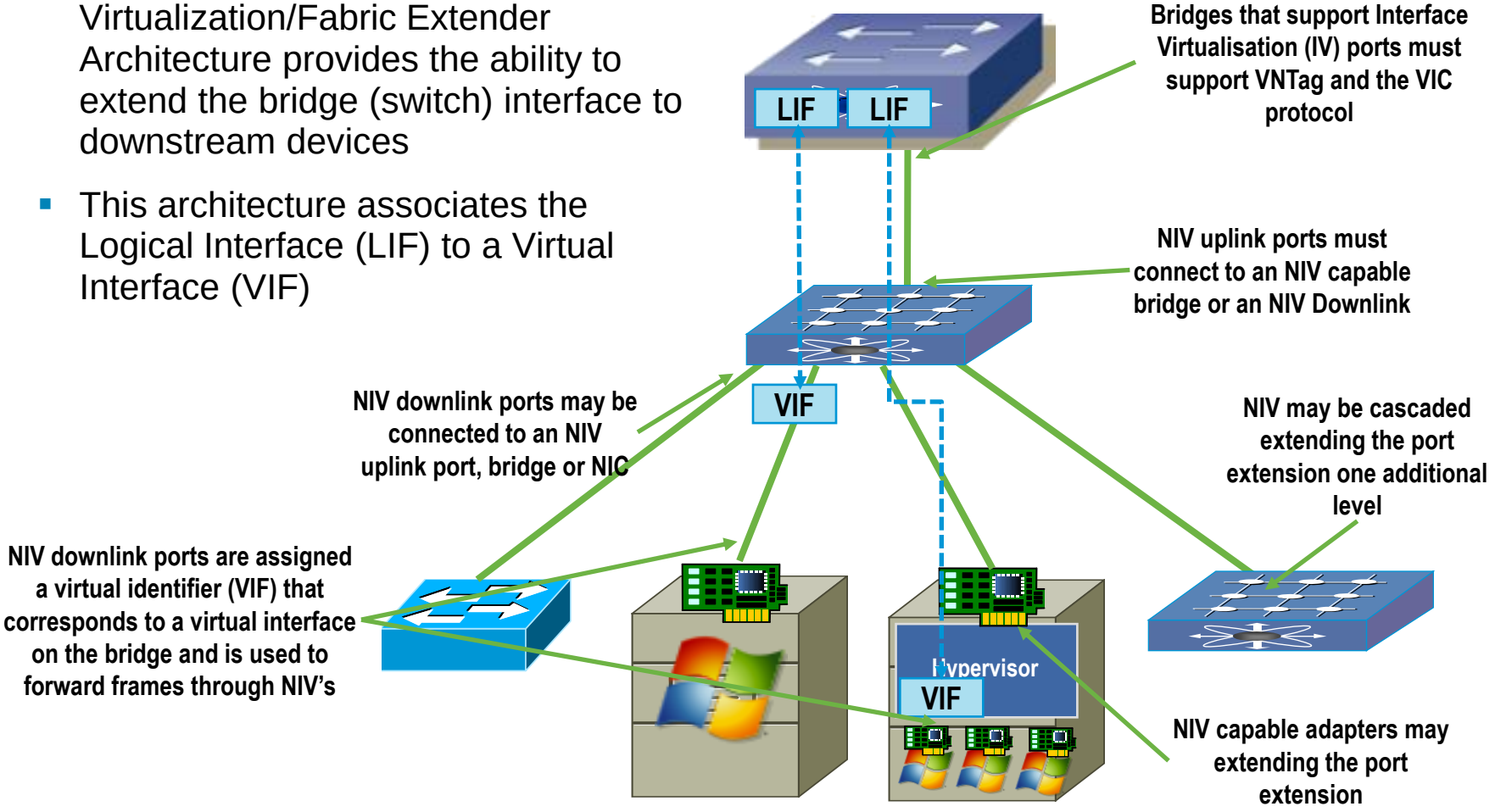
Nexus 2000 Fabric Extender
VNTag - Internal Fabric Framing

- Nexus 5000/7000 ingress processing on fabric ports
- UPC extracts VNTAG which identifies the Logical Interface (LIF) corresponding to the physical HIF on the actual Nexus 2000
- Ingress policy based on physical Nexus 5000/7000 port and LIF
  - Access control and forwarding based on frame fields and virtual interface (LIF) policy
  - Physical link level properties (e.g. MACSEC, …) are based on the Nexus 5000/7000 port
- Forwarding selects destination port(s) and/or destination virtual interface(s)



Nexus 2000 Fabric Extender
Fabric Extender Technology

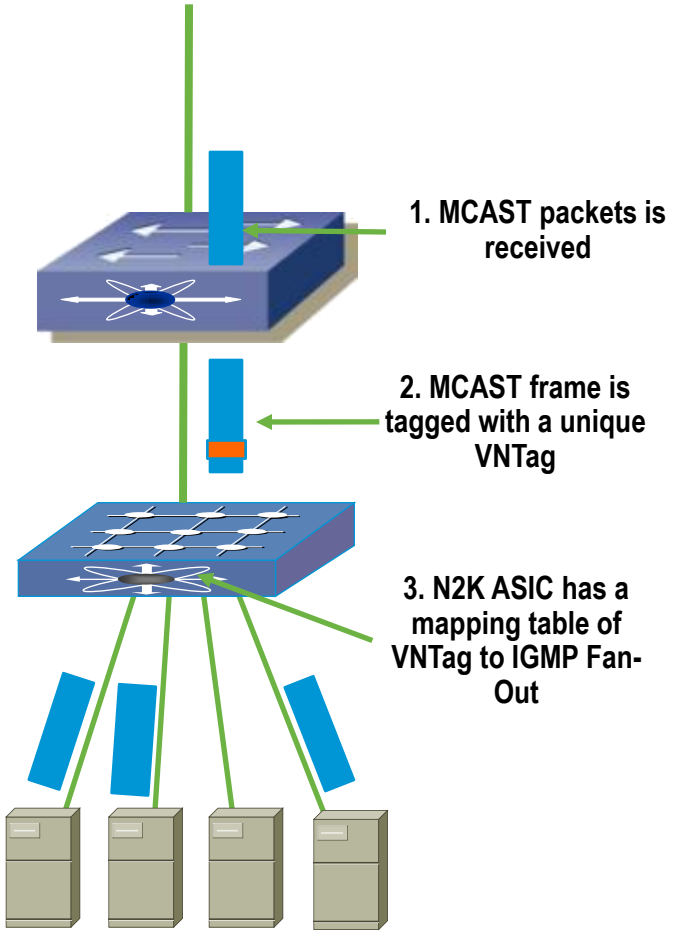
- The Network Interface Virtualization/Fabric Extender Architecture provides the ability to extend the bridge (switch) interface to downstream devices
- This architecture associates the Logical Interface (LIF) to a Virtual Interface (VIF)



Note: Not All Designs Supported in the NIV Architecture Are Currently Implemented

Nexus Virtualized Access Switch
Nexus 2000 Multicast Forwarding

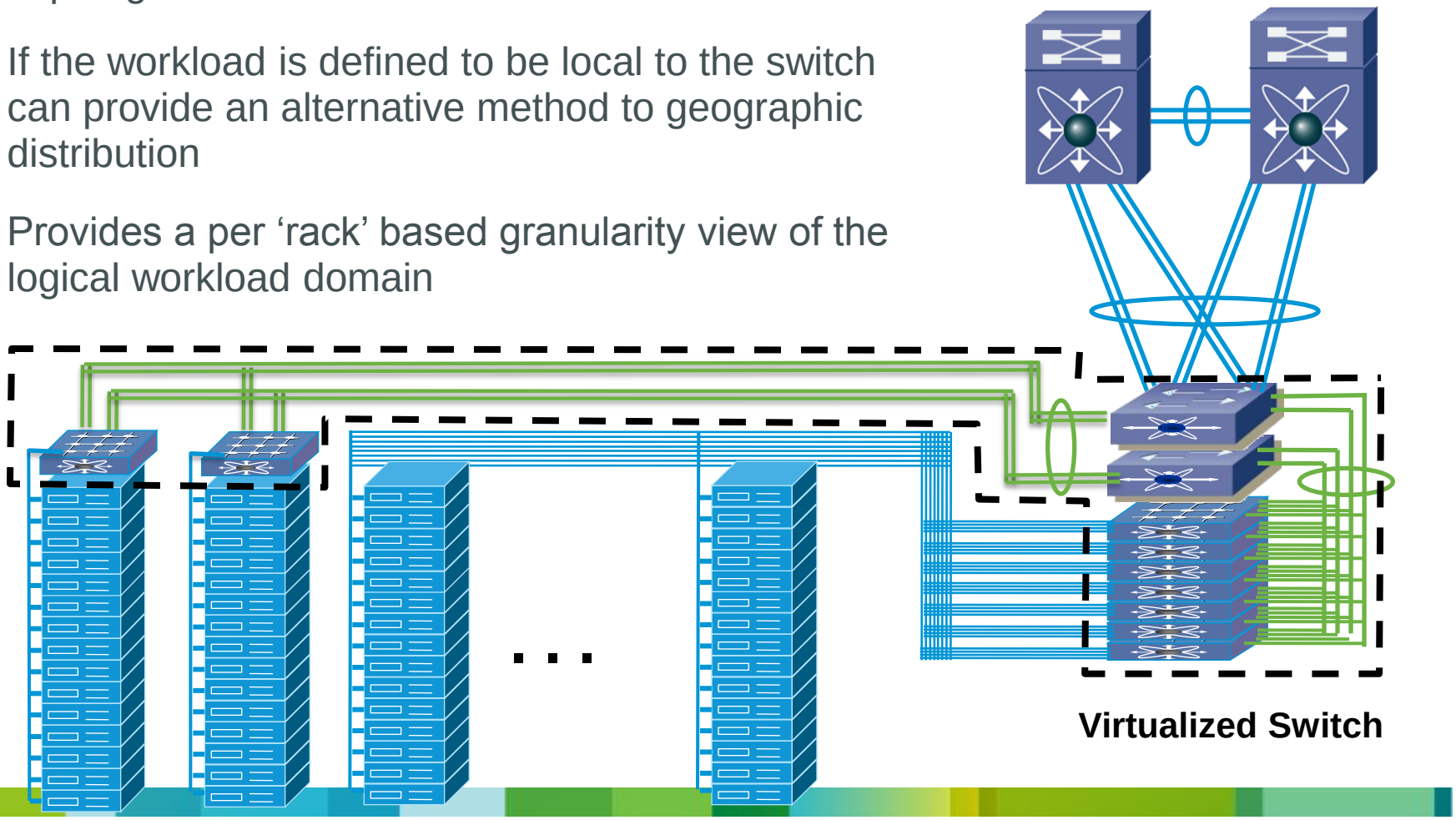
- Nexus 2000 supports egress based Multicast replication
- Each fabric link has a list of VNTag's associated with each Multicast group
- A single copy of each multicast frame is sent down the fabric links to the Nexus 2000
- Extended Multicast VNTag has an associated flooding fan-out on the Nexus 2000 built via IGMP Snooping
- Nexus 2000 replicates and floods the multicast packet to the required interfaces
- Note: When the fabric links are configured using static pinning each fabric link needs a separate copy of the multicast packet (each pinned group on the Nexus 2000 replicates independently)
- Port Channel based fabric links only require a single copy of the multicast packet



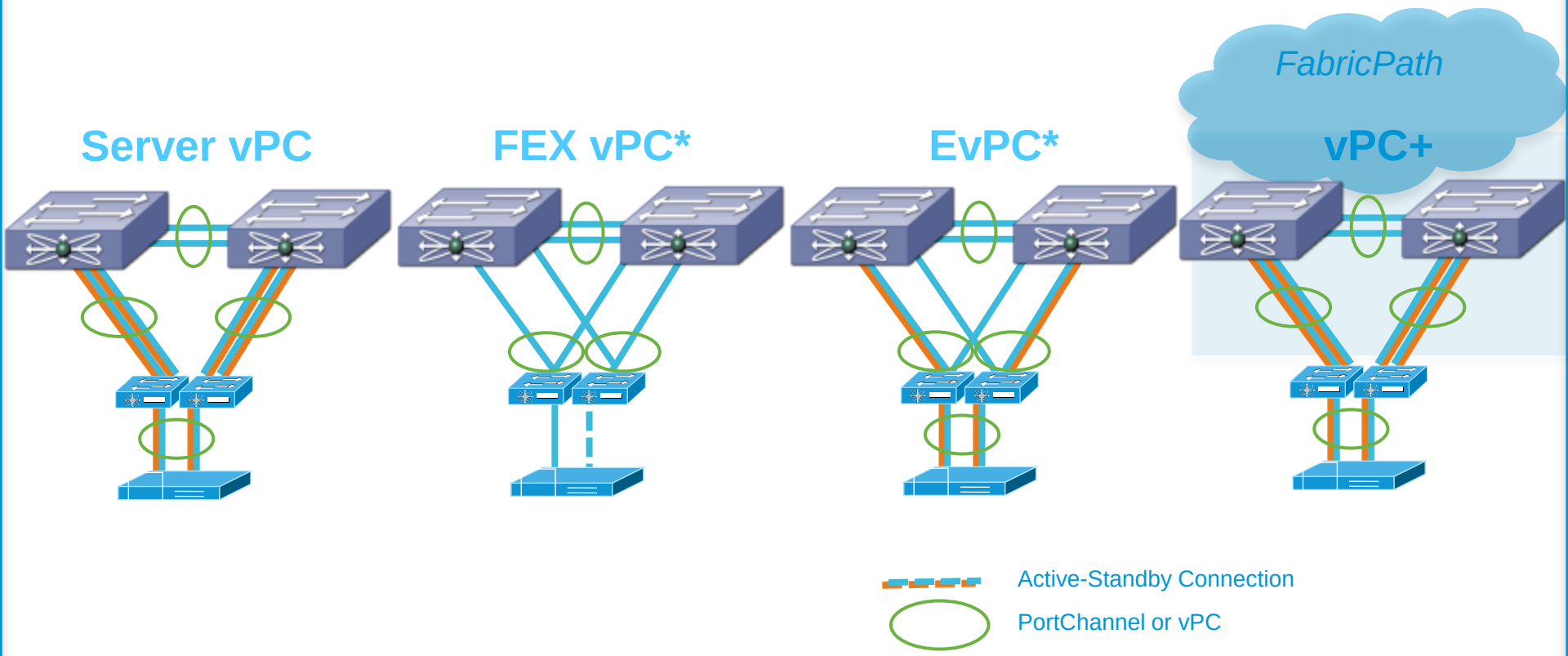
Building an Efficient DC Fabric to Scale

Scaling Up and Distributing the Workload Domain

- De-Coupling of the Layer 1 and Layer 2/3 Topologies
- If the workload is defined to be local to the switch can provide an alternative method to geographic distribution
- Provides a per ‘rack’ based granularity view of the logical workload domain

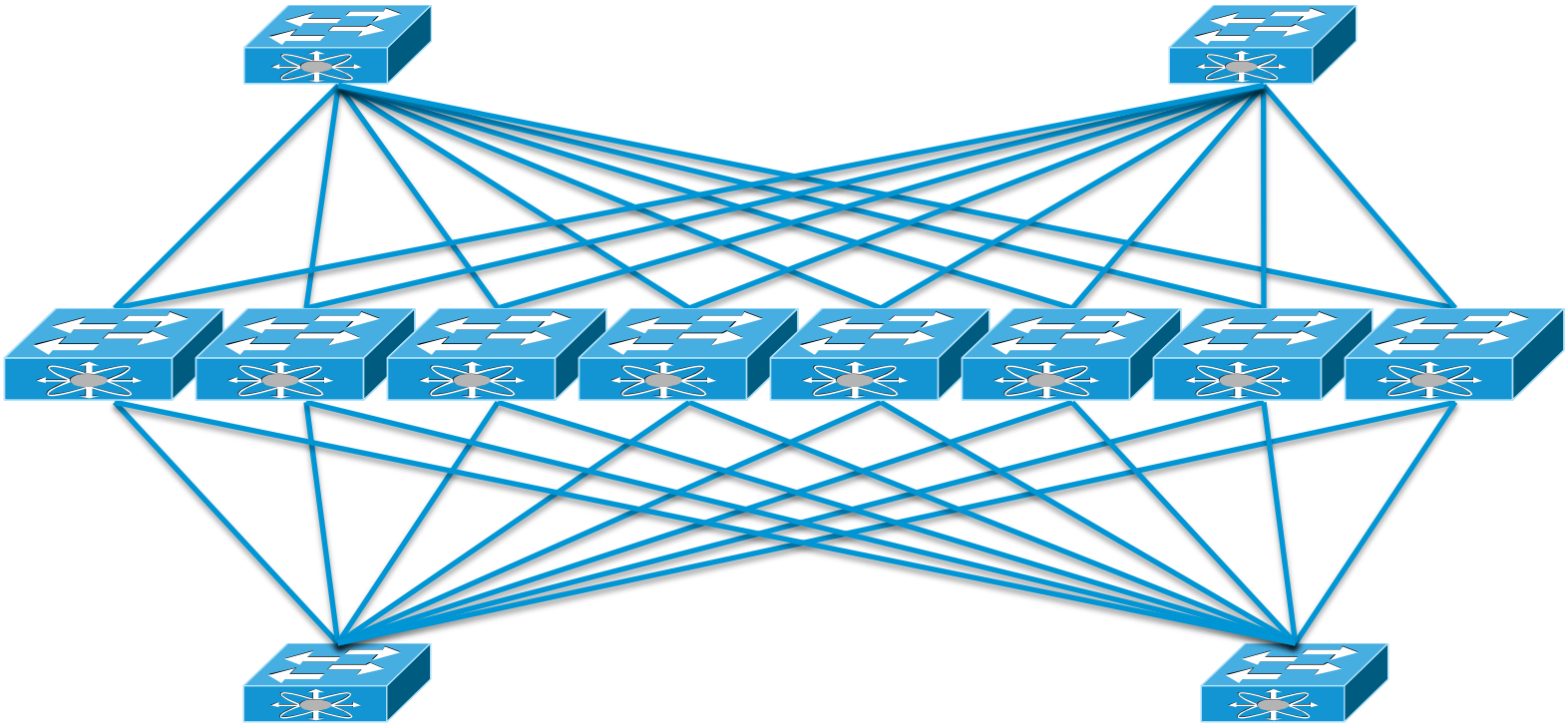


Fabric Extender Deployment Options



**All topologies supported with both N5K and N7K parent switch except FEX vPC and EvPC (supported with N5K only)*

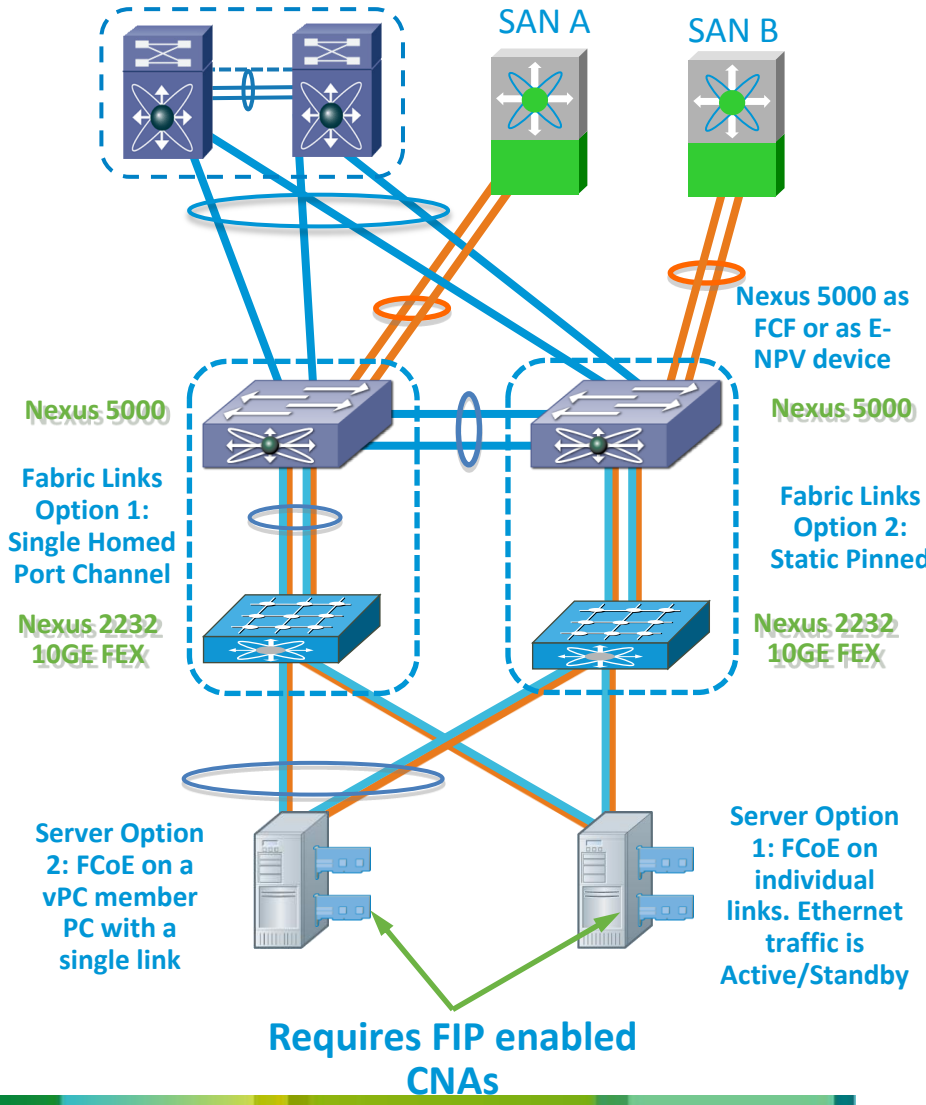
Cisco Fabric Path



- Eliminates reliance on STP for loop avoidance
- “Fat-Tree” Spine-Leaf Topologies
- All paths active – up to 16 forwarding paths
- Compatibility with STP and VPC-enabled topologies

Fabric Extender 1/10GE
FCoE / Unified Fabric

- N2232PP is the ideal platform for 1G to 10G to FCoE migration
  - Servers connect to FEX 2232 over 10Gig FCoE
  - FCoE license needed on N5K only, N2232PP extends the number of ports with 10G/FCoE
  - Combines advantages of N2K ToR CAPEX/OPEX benefits with FCoE CAPEX/OPEX benefits
- Reduces adapters, cables, power at the server/access layer
- The next evolution of Fibre Channel/iSCSI, allowing SAN access to the economies of scale and roadmap of Ethernet without sacrificing capability



Cisco Nexus 2000 Series
Support Matrix

	N5K Support	N7K Support
Parent Switch/Linecard	Nexus 5000/5500 platforms	N7K-M132XP-12, N7K-M132XP-12L N7K-F248XP-25 N7K-M2224XP-23L
Number of FEX supported	24 (Nexus 5500 L2), 16 (Nexus 5500 L3), 12 (Nexus 5000)	48 FEX per N7K with Sup2E, 32 FEX per N7K
Number of servers per Distributed Modular System	1152 1GE servers, 768 10GE servers	2048 1GE servers, 1536 10GE servers
N2K-C2148T-1GE	✓	No
N2K-C2248TP-1GE	✓	✓
N2K-C2224TP-1GE	✓	✓
N2K-C2248TP-E-1GE	✓	✓
N2K-C2232PP-10GE	✓	✓
N2K-C2232TM-10GE	✓	✓
N2K-C2232TM-E-10GE	✓	Future
FET on Fabric links	✓	✓

Nexus 2000 Product Family Resources

- Nexus 2000 Series, Nexus B22 Series, Fabric extender Technology websites:
  - http://www.cisco.com/go/nexus2000
  - http://www.cisco.com/go/b22fex
  - http://www.cisco.com/go/fex
- Nexus 2000 Series, Nexus B22 Series datasheets:
  - http://www.cisco.com/en/US/products/ps10110/products_data_sheets_list.html
- White papers and Deployment Guide
  - http://www.cisco.com/en/US/products/ps10110/prod_white_papers_list.html
- Adapter FEX, VM-FEX
  - http://www.cisco.com/en/US/netsol/ns1118/index.html
  - http://www.cisco.com/en/US/netsol/ns1124/index.html
- Nexus 2000, Nexus B22 installation guide
  - http://www.cisco.com/en/US/products/ps10110/prod_installation_guides_list.html

Thank you.