Switching Innovations

Virtual Espresso Webinar
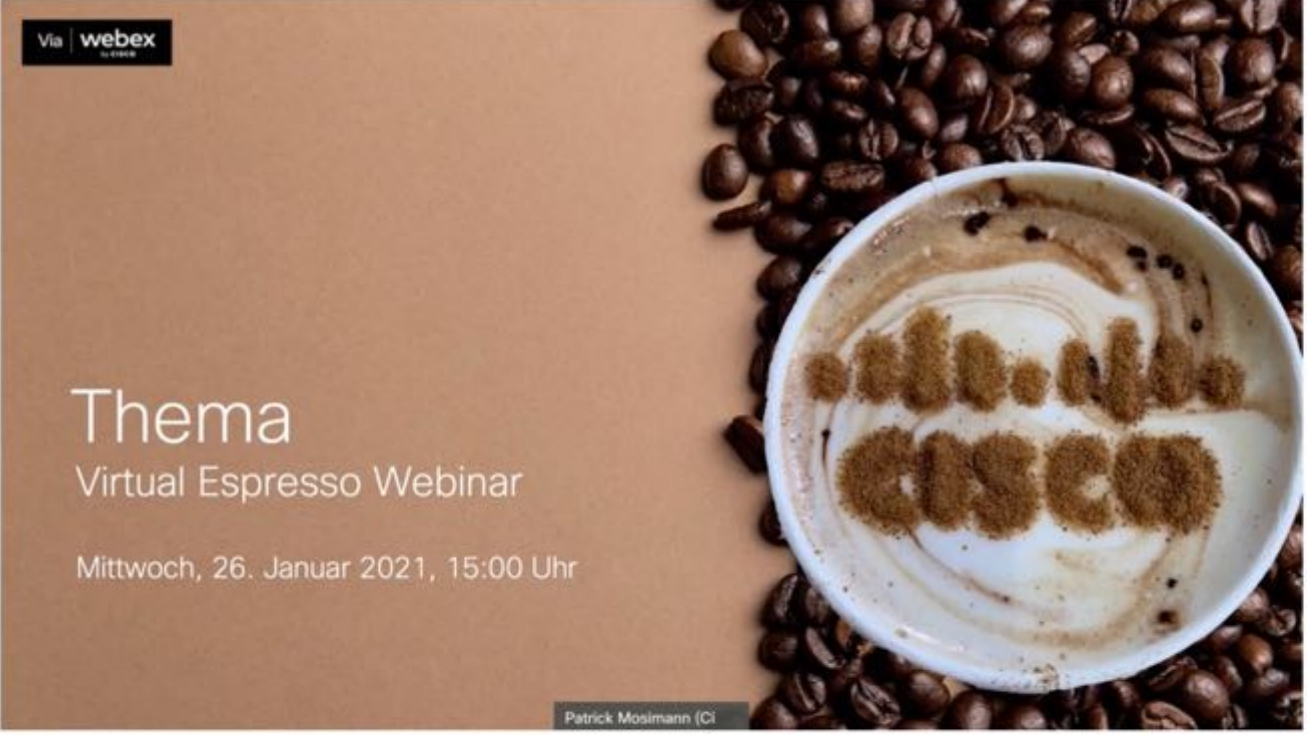
Mittwoch, 9. März 2022, 15:00 Uhr

👉 please utilise the Q&A function to get your question answered

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Catalyst Full-Stack Switching overview

Corinne Rümmeli, Technical Solutions Specialist
Patrick Mosimann, Technical Solutions Architect

9. März 2022
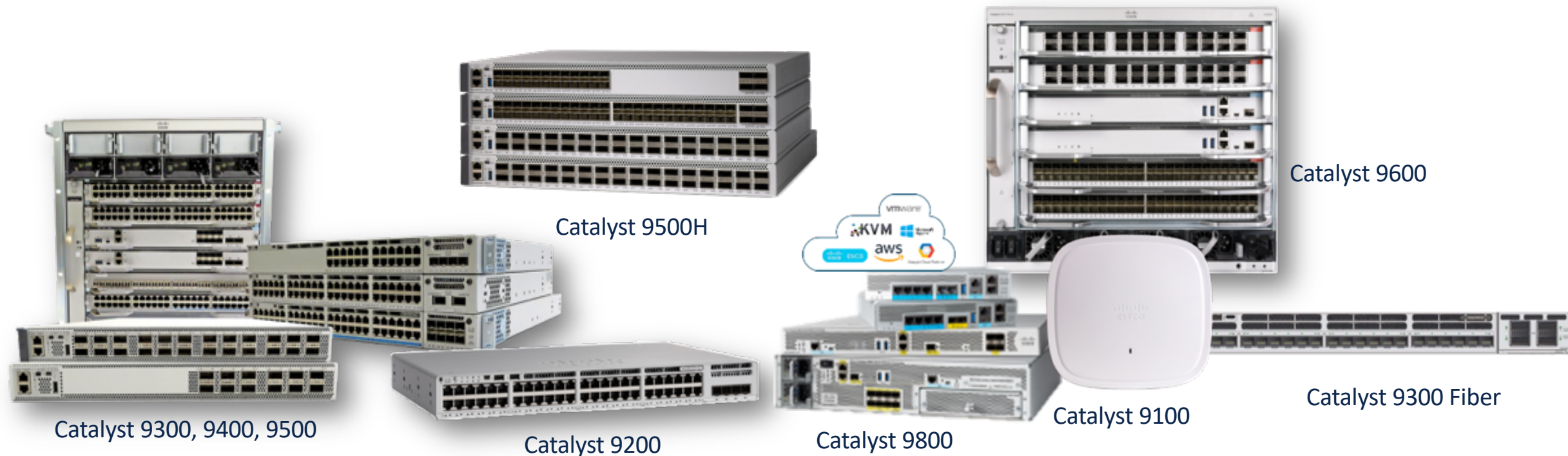
Catalyst 9500H

Catalyst 9600

Catalyst 9300, 9400, 9500

Catalyst 9200

Catalyst 9800

Catalyst 9100

Catalyst 9300 Fiber

2017   2018   2019   2020   2021

Hot Patching

SD-AVC

App Hosting

SDA Extension

Software Defined Access

Smart Buildings

End Point Analytics

Encrypted Traffic Analytics

AVB & PTP

Stackwise Virtual

BGP EVPN

SD-Bonjour

2017   2018   2019   2020   2021

Catalyst 9000X – Expanding industry leadership
Adding the "X factor" to the industry's leading switching family

Catalyst 9000 switching platform

Cisco ASIC

Open Cisco IOS® XE

Catalyst 9300X models

Catalyst 9300 Series

Catalyst 9200 Series

Catalyst 9400X models

Catalyst 9400 Series

Catalyst 9500X model

Catalyst 9500 Series

Catalyst 9600X models

Catalyst 9600 Series

Catalyst 2960-X/XR

Catalyst 3650/3850

Catalyst 4500-E Series

Catalyst 4500-X

Catalyst 6840-X/6880-X

Catalyst 6500-E/6807-XL

Access switching
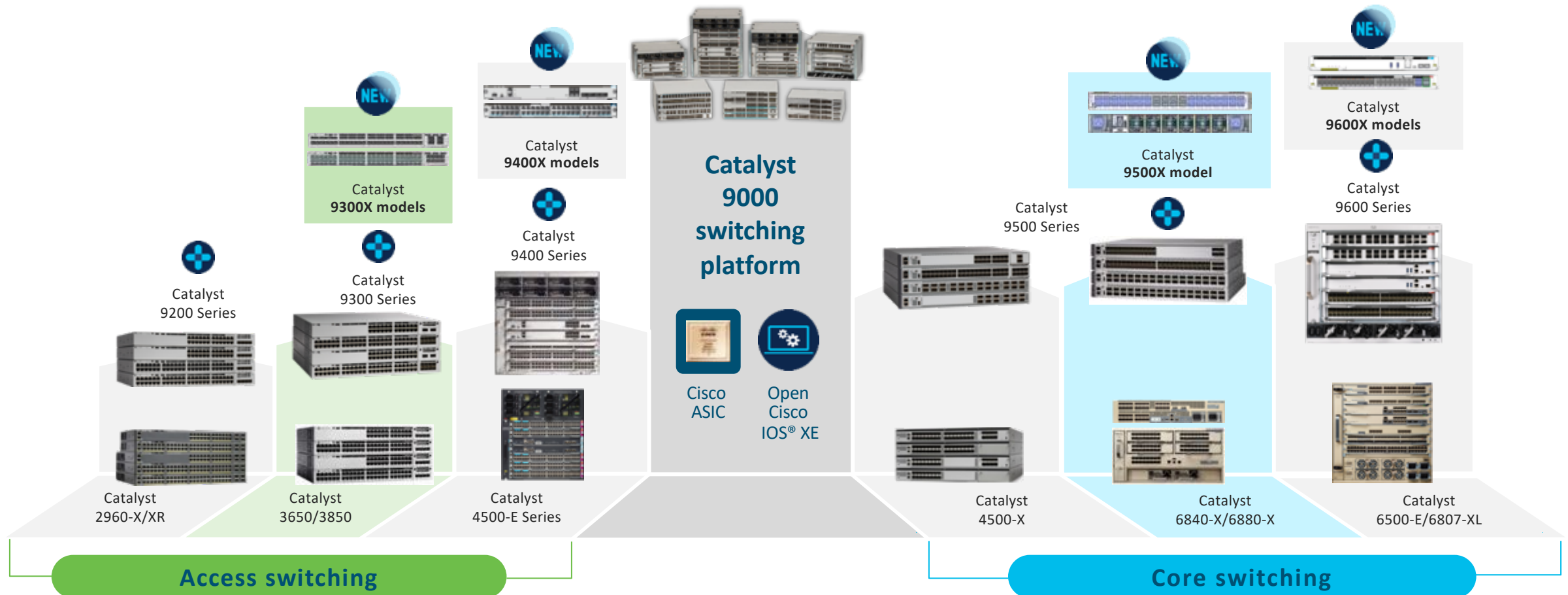
Core switching

Agenda

- Access:
  - C9300-X
  - C9400-X
- Distribution/Core
  - C9500-X
  - C9600-X

Access

Enterprise Access Trends

Higher mGig Port Density

Higher and Flexible Uplink Bandwidth

Higher UPOE+ Port Density

UHigher 10G Port Density

Wifi6E Deployments with mGig

Smart Buildings with 90W

Server Connectivity – 10G BaseT
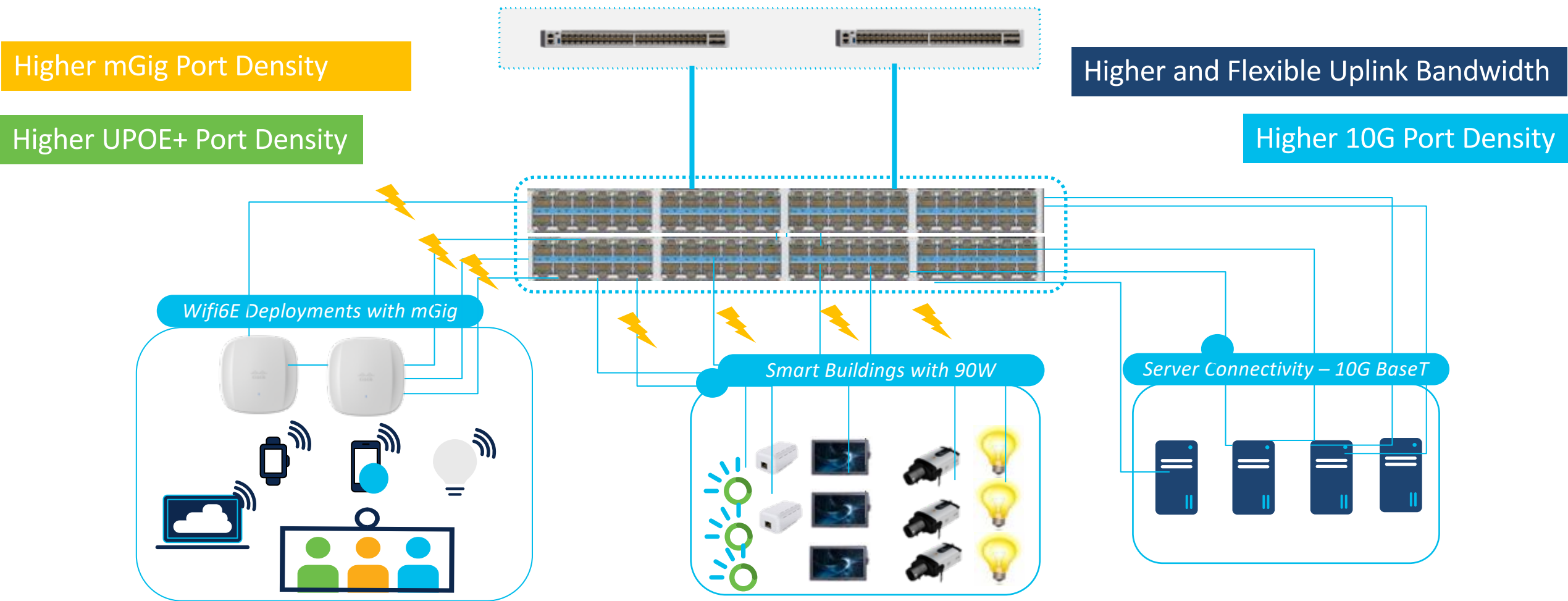
New Access requirements for Future Campus

Introducing
Catalyst 9300X

Catalyst 9300X – New High Performance Access Switch
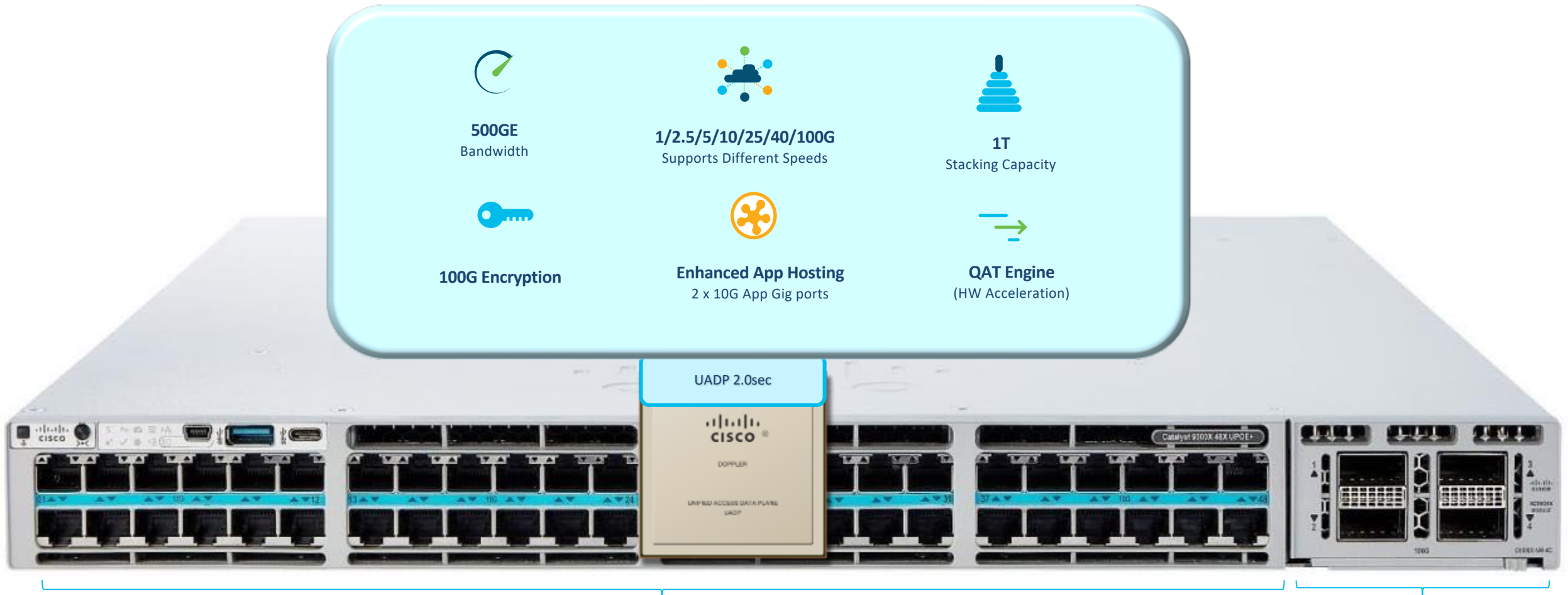
500GE
Bandwidth

1/2.5/5/10/25/40/100G
Supports Different Speeds

1T
Stacking Capacity

100G Encryption

Enhanced App Hosting
2 x 10G App Gig ports

QAT Engine
(HW Acceleration)

UADP 2.0sec

48 x mGig-10G + 90W UPOE+

Flexible Uplink Options

Investment Protection with Catalyst 9300X

External Storage (240GB SSD)

Redundant Fans

Redundant Power

Data Stack Cables

Stackpower Cables

Optional Power Supplies (AC+DC)

Common Components and Stacking Backward Compatible with Catalyst 9300
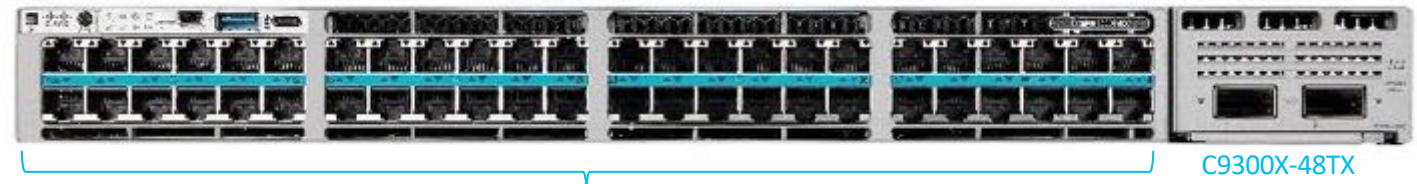
Catalyst 9300X Multigigabit Models

Orderable

48x 100M/1G/2.5G/5G/10G ports with **UPOE+**

C9300X-48HX

Orderable

48x 100M/1G/2.5G/5G/10G ports **Data Only**

C9300X-48TX
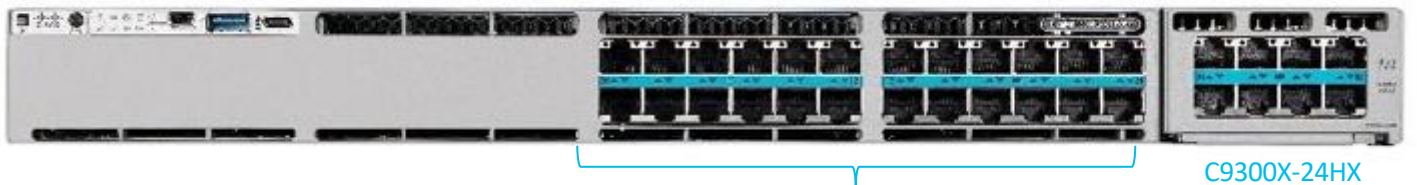
Roadmap CY22

36x 100M/1G/2.5G/5G with **UPOE+**   12x 100M/1G/2.5G/5G/10G with **UPOE+**

C9300X-48HXN

Roadmap CY22

24x 100M/1G/2.5G/5G/10G ports **with UPOE+**

C9300X-24HX

448 mGig Ports with 8-Member Stack

Highest Multigigabit Ports in the Industry with Standalone and StackWise-1T

Highest 90W UPOE+ Density in the Industry

FYI

Standalone

StackWise

36 Ports of 90W
UPOE+ x 8 = 288

48 Ports of 60W
UPOE+ x 8 =384
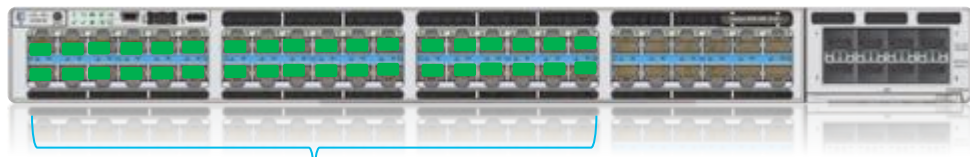
8 Members

36 Ports of 90W UPOE+ or 48 Ports of 60W UPOE
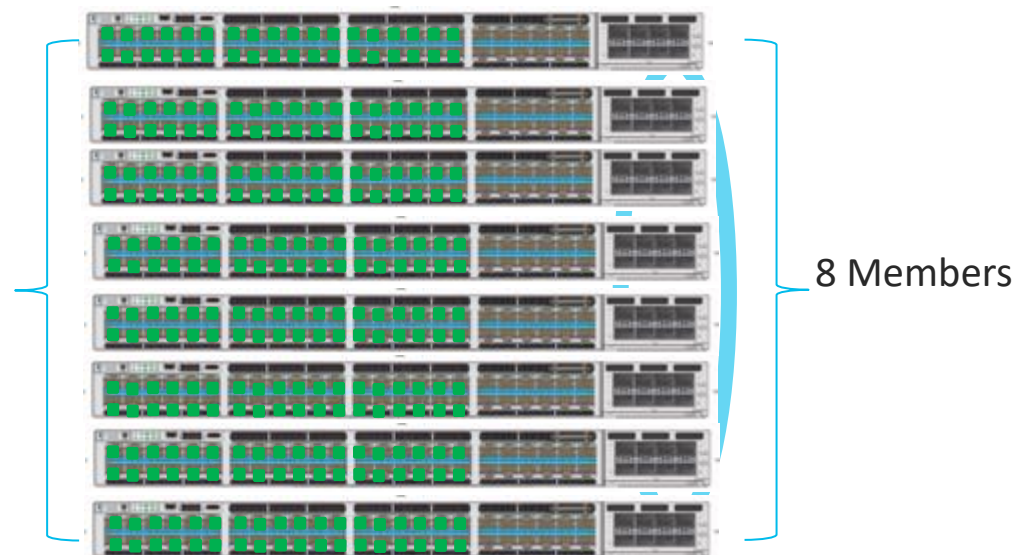
* With Stackpower, configure 4 x 2 members for getting desired PoE Port Density

36 ports of 90W or 48 ports of 60W
with 2 x 1900W AC PS/Switch

288 ports of 90W or 384 Ports of 60W
with 2 x 1900W AC PS/Switch

Highest and Flexible Speed Uplink Options in the Industry

100/40G Modular Uplinks

Roadmap CY22

Orderable

C9300X-NM-4C

*Not Supported on 9300-12Y

4 x 100/40G* QSFP

C9300X-NM-2C

2 x 100/40G QSFP

Multigigabit Uplinks

10/25 G Modular Uplinks

Roadmap CY22

Orderable

C9300X-NM-8M

8 x 10G-mGig

** Last 4 ports disabled on C9300X-48HXN

C9300X-NM-8Y

8 x 25/10/1G**

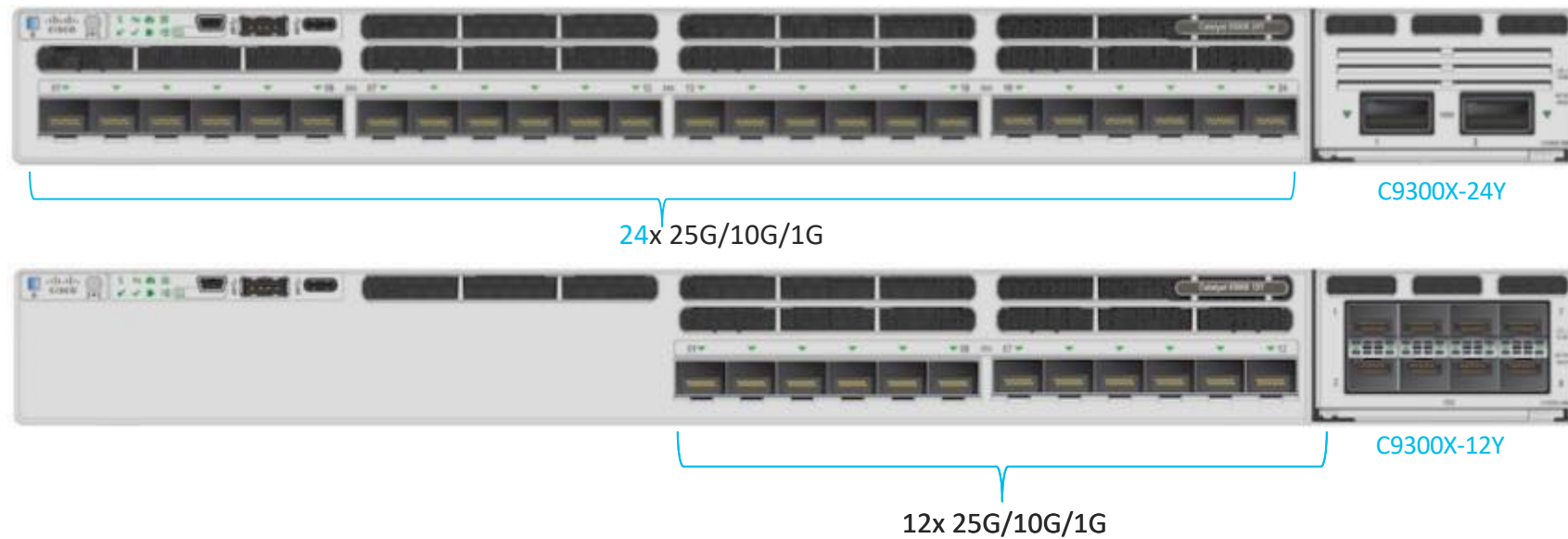## C9300X-Only Uplink modules Enabling High Speed and Port Density

Catalyst 9300X
High-Speed Fiber

Catalyst 9300X High-Speed Fiber

C9300X-24Y

24x 25G/10G/1G

C9300X-12Y

12x 25G/10G/1G

Stackable with
C9300/C9300X

3850 10G Fiber Replacement

Collapsed Access

FTTD

Servers

Bringing Stackable High-Speed fiber to the Access

Cisco Catalyst 9300 Series
Extended C9300 Family with C9300X Platform

C9300 SKUs with Modular Uplinks

1G Copper ports with PoE/UPOE/UPOE+

48/24 ports **Data** 1G

48/24 ports **UPOE** 1G

48/24 ports **PoE**+ 1G

48/24 ports **UPOE**+ 1G

2-4x Scale/Buffer

48/24 ports UPOE 1G – **9300B**

Multigigabit Models with UPOE

48/24 ports mGig

1G Fiber Models

48/24 ports SFP 1G

C9300 Only Modular Uplinks

4x Multigigabit

4x 1G SFP

8x 1/10G SFP/SFP+

2x 1/10/25 G SFP/SFP+

2x 40G QSFP

C9300X SKUs with Modular Uplinks

High Density Multigigabit Models with UPOE+

Orderable

C9300X-48HX

C9300X-48TX

C9300X-48HXN

Roadmap CY22

C9300X-24HX

1/10/25G Fiber Models

C9300X-24Y

C9300X-12Y

C9300X Only Modular Uplinks

Roadmap CY22

4x 40/100G

2x 40/100G

8x 10/25G

8x mGig

StackWise and StackPower Cables
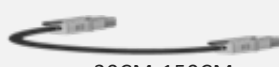
Platinum rated power supplies

Modular Fans

Common Components

50CM-1M-3M

30CM-150CM

315W AC

715W AC/DC

1100W AC

1900WAC

C9300 / C9300X App Hosting

Enhanced Application Hosting Infrastructure on C9300X

2 Cores (4 vCPU)

Docker

App

External Storage

USB 3.0 240G

8G RAM

AppGig Ports **2 x 10G**

ASIC

1 Core (2 vCPU)

X86 App1

ThousandEyes

4G RAM

AppGig Ports **1 x 10G**

ASIC

1 Core (2 vCPU)

X86 App2

DNA

4G RAM

AppGig Ports **1 x 10G**

ASIC
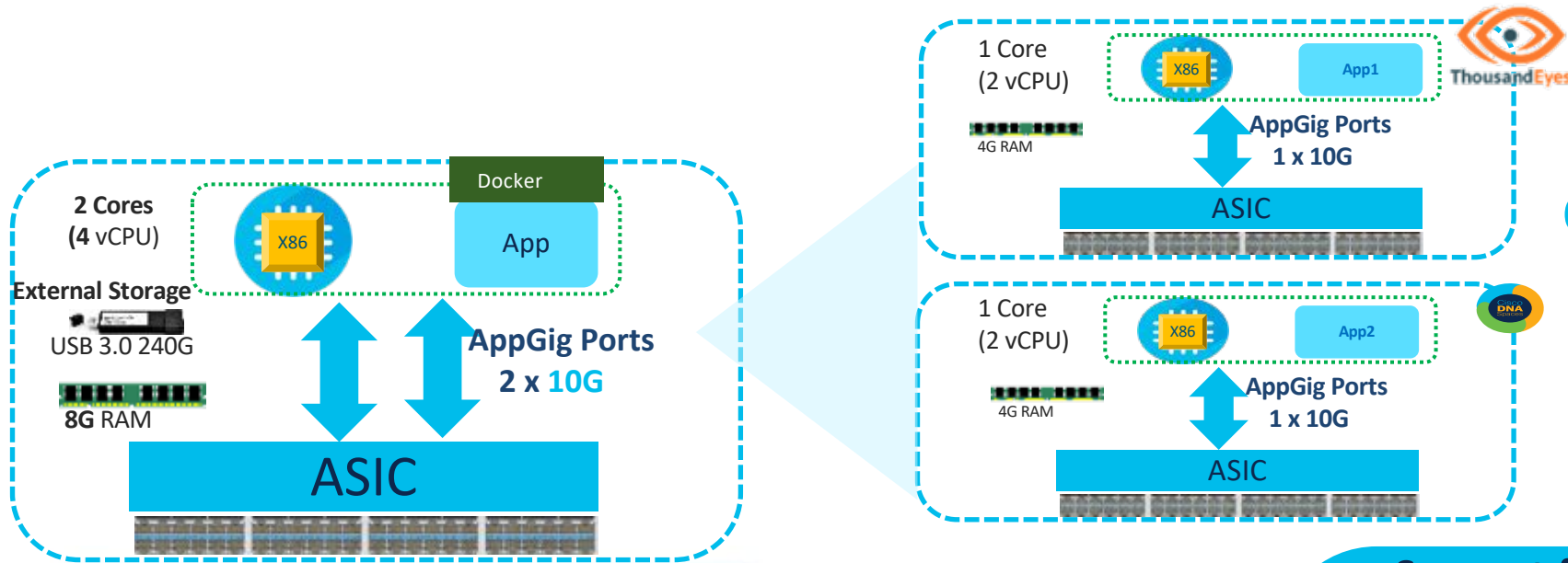
Cisco Signed Applications
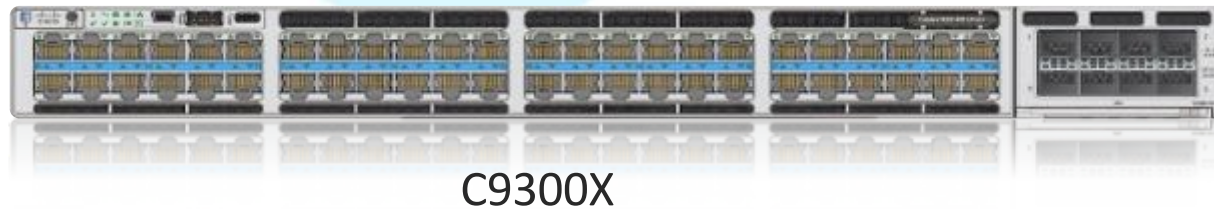
C9300X

Support for Multiple Docker applications
With Additional RAM Memory and 2 x AppGigabit Ports, multiple Cisco Signed performance savvy Applications can be hosted on C9300X

Hardware Acceleration and Security
QAT is a special engine on the x86 CPU which helps in accelerating the performance of Applications

ASAc Firewall hosted on C9K Switches
Bringing Cisco EN and Security solutions together for improved Operations

Roadmap CY22

Cisco DNA Center

- App Deployment
- App Lifecycle Management
- Networking to App

CDO
Cisco Defense Orchestrator

- Deploy & Manage sec policies
- Config and Audit logging
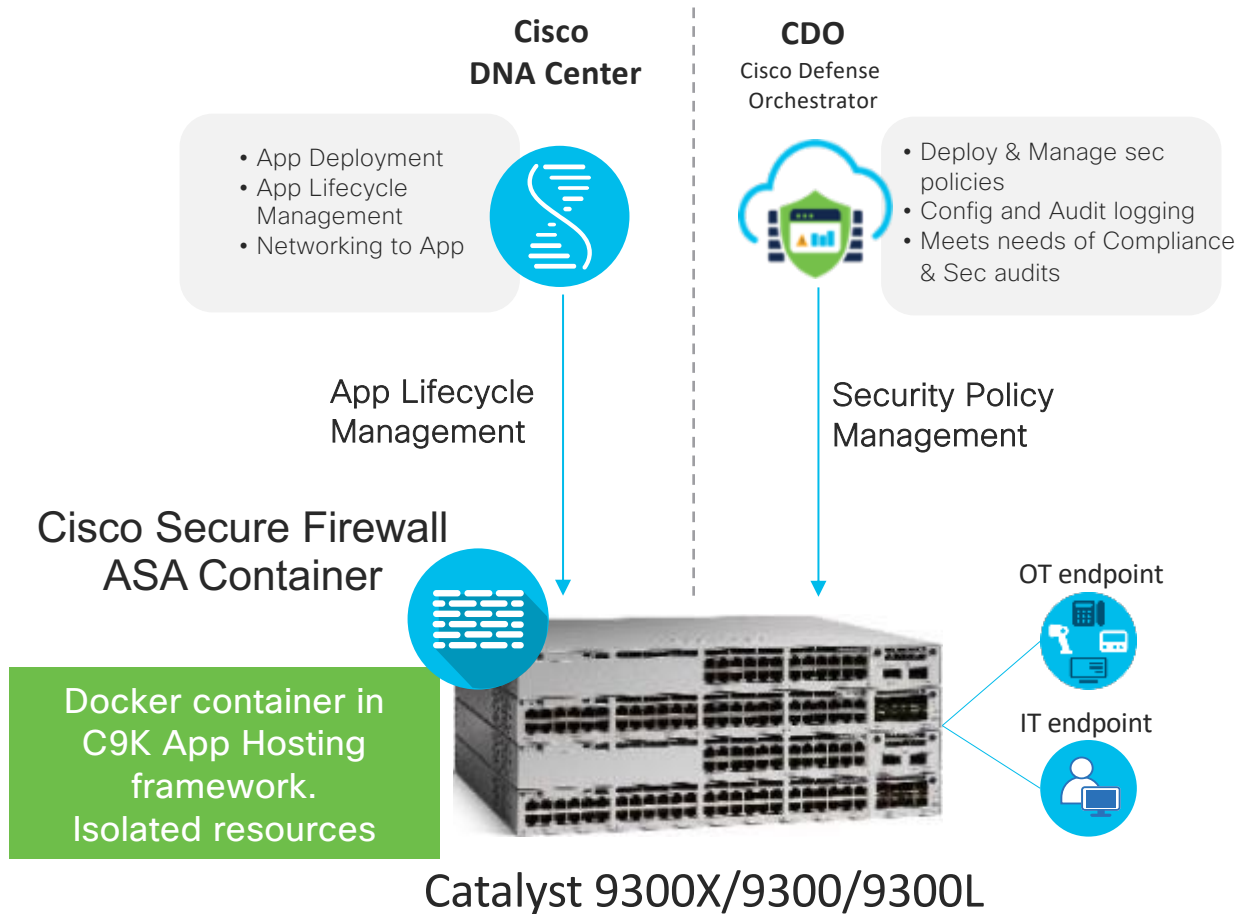- Meets needs of Compliance & Sec audits

App Lifecycle Management

Security Policy Management

Cisco Secure Firewall ASA Container

OT endpoint

IT endpoint

Docker container in C9K App Hosting framework. Isolated resources

Catalyst 9300X/9300/9300L

Use Case
- Stateful inspection of OT traffic at the Edge
  - No need of Physical Firewall
  - No need to change network architecture
  - No waste of network bandwidth
  - Automation to scale operations

- Powerful Stateful Inspection Firewall

- Separation of SecOps and NetOps

- L3 Firewall

- Support for SGT

- Expected throughput: 1 Gbps Firewall

C9300 / C9300X IPSEC

Catalyst 9300X – Purpose built for the **New Edge**

100G L3 HW Encryption

128 tunnels
256 SA's
+ 128 rekey SA

Cisco Catalyst 9300X

Encryption	Authentication
AES-128-CBC	HMAC/SHA1
AES-128/256-GCM	GMAC
Tunnel Mode	
Encapsulation - ESP	
IKEv2	

Static Virtual Tunnel Interface

IPv4/IPv6

OSPF/BGP

PBR + Set Interface *

NAT Traversal *

Multicast Routing*

L3 segmentation over IPSEC*

L2 Extension over IPSEC*

* Roadmap

Catalyst 9300X – Purpose built for the **New Edge**
Secure connectivity to anywhere

Secure Web Usage & Control
Faster time to Deployment
Lower TCO
Investment protection

Secure Tunnels

Remote Branch

Cisco Catalyst 9300X

Site-to-Cloud
Standards based IPSEC for secure Direct Internet Access & Cloud Native Workloads

Branch/Campus/DC

COLO Regional Point-of-Presence

Secure Tunnels

Up to 100G low latency
IPsec Encryption
Unicast & Multicast* Routing
L3 Segmentation & L2 Extension*

Remote Branch

Cisco Catalyst 9300X

Site-to-Site
100G Line-rate IPsec encryption with low latency forwarding

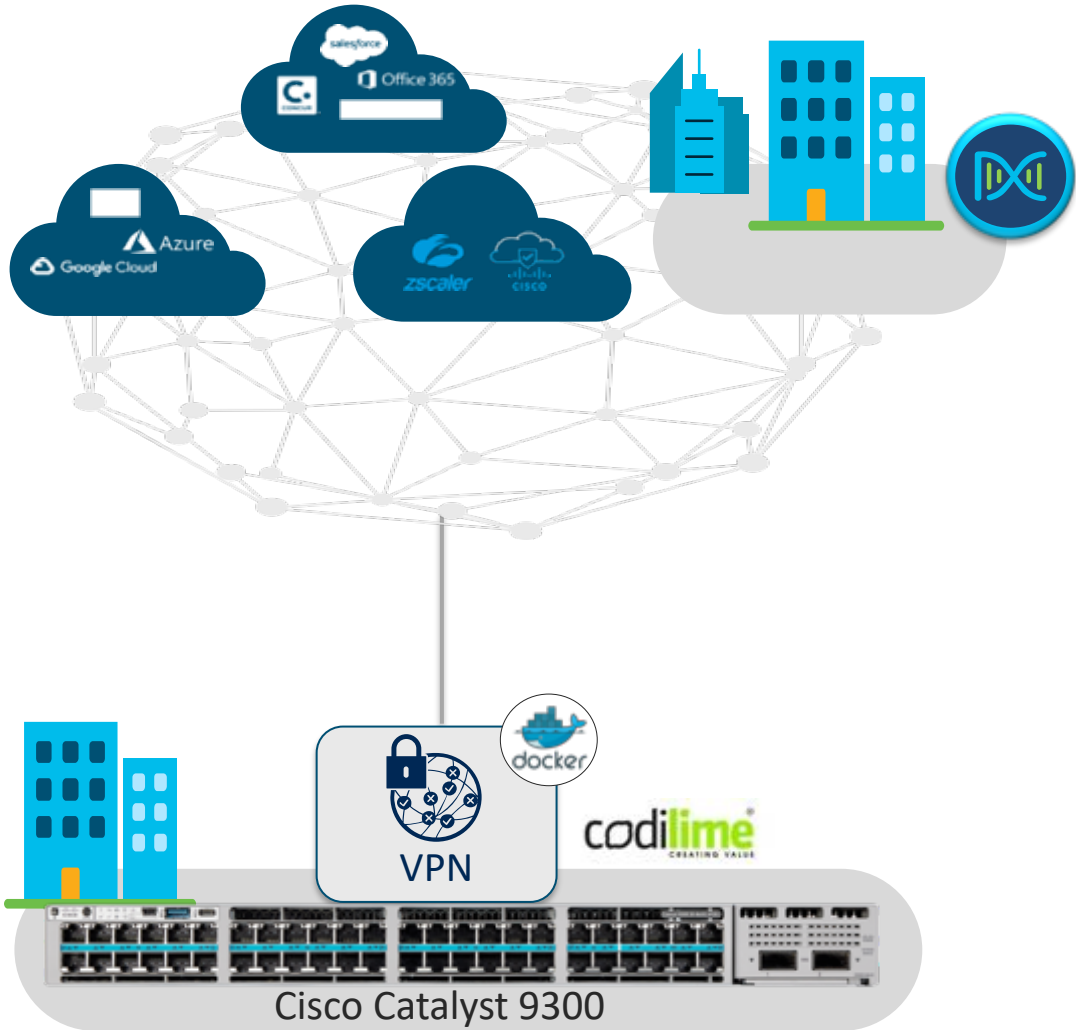* Roadmap

New IPSEC App enabled via App-Hosting
Purpose built for IPSEC

- ✓ VPN Application hosted on Cat9k
- ✓ Runs in Docker container
- ✓ Web UI for IPSEC config
- ✓ Life Cycle Management via DNA Center
- ✓ HW & SW IPSEC - C9300X
- ✓ SW IPSEC - C9300/9300L
- ✓ Will be available on Devnet

VPN

Cisco Catalyst 9300

CODILIME
CREATING VALUE

- Minimal resources required
  - 1 CPU core
  - < 1 GB memory
- 200–500M throughput
- QAT for higher throughput*

Open Source

IPSEC VPN

strongSwan

Routing

FRROUTING

Expands IPSEC capabilities to all 9300 models at lower throughput

* On 9300X Models

Introducing
Catalyst 9300LM

Cisco Catalyst 9300LM Series
Fixed uplink replacement for Catalyst 3650-mini

Roadmap CY22

8 mGig Ports, 4x25G Uplink

48 Port mGig UPOE

4x25G Uplink

48 Port 1G UPOE

4x25G Uplink

48 Port 1G Data

4x25G Uplink

24 Port 1G UPOE

Cisco Catalyst 9000 leadership
Same UADP performance as C9300L
Cisco IOS® XE Software
SD-Access
x86 CPU and containers
Encrypted Traffic Analytics (ETA)
AES-256/MACsec-256
Trustworthy systems
Cisco StackWise-720*/320
IEEE1588 and AVB
NBAR2
Perpetual/Fast PoE
Model-driven programmability
Patching/GIR
Streaming telemetry
NEBS L3 Certified

UADP 2.0

Multicore X86 CPU

Open IOS XE

USB type-A Front Panel SSD*

Stackable with C9300L

mGig

802.3bt Type-3

25G — **25G Ready**

Modular fans*

Modular Stacking

Higher-efficiency AC and DC power supplies

600W AC   **715W DC**   **1000W AC**

19.2 inches

Catalyst C9300L

12-13.2 inches

Catalyst C9300LM

Platform Depth <14 inches		
	AC PSU	DC PSU
UPOE	13.2 in	12.8 in
Data	12.4 in	12.0 in

Note: *Data SKU utilize fixed fans

Introducing

Catalyst 9400X

Cisco Catalyst 9400X
New Supervisor 2/2XL powered by Cisco UADP 3.0sec ASIC

Sup1-XL Feature Parity at FCS Exceptions (Roadmapped)
- StackWise Virtual
- Perpetual and Fast PoE
- MACsec HA on LC
- MACsec XPN Support on SUP
- Auto Neg on Passive cable

UADP 3.0sec

UADP 2.0XL

Up to 240G bandwidth

1/2.5/5/10/25/40G Supports Different Speeds

Forwarding + ACL Scale
Up to 96K MACs
Up to 64K Routes

Up to 32 MB (2 x 16MB) packet buffer

Sup-1/1XL

240/120/80Gbps/Slot with Sup-1XL (4/7/10 Slot Chassis)
80Gbps/Slot with Sup-1 (All Chassis)

NEW
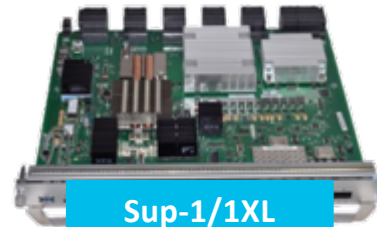
Sup-2/2XL

480Gbps/Slot with Sup-2XL
240Gbps/Slot with Sup-2

Up to 1.6T Bandwidth

1/2.5/5/10/25/40/100G Supports Different Speeds

Increased Forwarding + ACL Scale
Up to **128K MACs***
Up to **256K Routes***

Up to 36 MB Unified packet buffer

Up to 100G Encryption
IPSec*, WAN-MACsec*

Customizable Templates for higher Scale*

* Hardware Capable, Software Support not committed

Unmatched Flexibility

Maximum Investment Protection

100G Leadership in Access

Same Series, Chassis options – New SUPs and Line cards

Same Chassis with New Supervisors and Line cards

C9400X-SUP-2XL — Shipping

C9400X-SUP-2 — Shipping

C9400-LC-48HX — Sup2/2XL required — Roadmap CY22

C9400-LC-48XS — Sup2/2XL required — Roadmap CY22

C9400-LC-48HN — Shipping — Shipping

Note: Same Supervisor model required in Dual SUP/SSO configuration
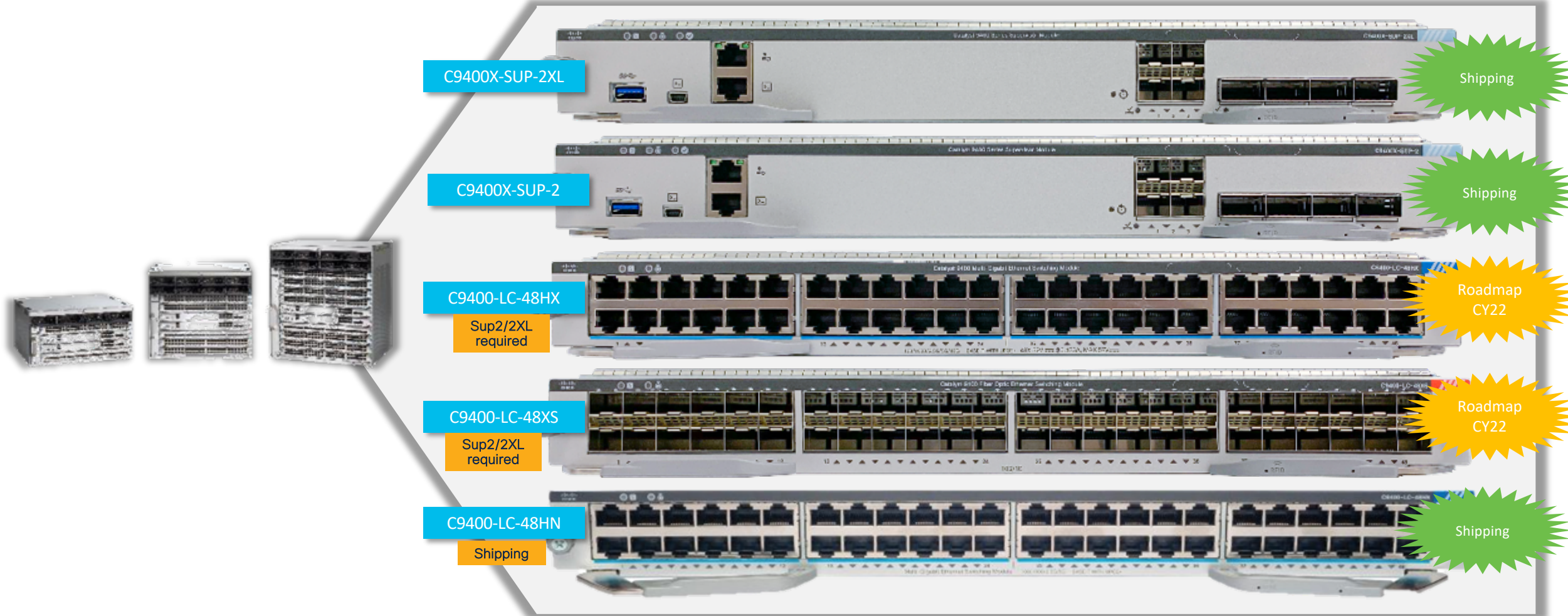
Bandwidth Boost with Gen2 Supervisors

	Type	Cisco C9400 SUP 1/1XL			Cisco C9400X SUP2	Cisco C9400X SUP2XL
		C9404R	C9407R	C9410R	C9404R/C9407R/C9410R	C9404R/C9407R/C9410R
C9400-LC-48HX (New)	UPOE+	–	–	–	240	**480**
C9400-LC-48XS (New)	Fiber	– (Not Supported)	–	–	240	**480**
C9400-LC-48UX	UPOE	80 / 240	80 / 120	80	240	240
C9400-LC-24XS	Fiber	80 / **240**	80 / 120	80	**240**	**240**
C9400-LC-48HN	UPOE+	80 / 120	80 / 120	80	**240**	**240**

Bandwidth in Gbps   **Bold** indicates Line Rate

3x Bandwidth Uplift for Gen1 LCs (**80G -> 240G**) on **10 Slot Chassis w/ SUP2XL**
2x Bandwidth Uplift for Gen1 LCs (**120G -> 240G**) on **7 Slot Chassis w/ SUP2XL**

Concurrent 60W/90W POE Port Density with C9400-LC-48HX

With **3200W** Power Supply in Combined Mode(Fully loaded PSUs):

C9410

C9407

C9404

	C9404	C9407	C9410
Total Ports	**96 ports**	240 ports	384 ports
UPOE + 90W	**96 ports** (Fully loaded chassis)	**226 ports** (Up to 4 fully loaded LCs + 34 Ports)	**224 ports** (Up to 4 fully loaded LCs + 32 Ports)
UPOE 60W	**96 ports** (Fully loaded chassis)	**240 ports** (Fully loaded chassis)	**336 ports** (Up to 7 fully loaded LCs)

Distribution / Core

Addressing the Campus Core + Edge Market

More than just "Speeds & Feeds"

System Capacity

- **Higher Port Speeds**
  enabling newer Ethernet speeds and types, such as 50G SFP and 400G QSFP

- **More Access Bandwidth**
  higher density of 802.11ac moving to 11ax, HD Video (1080p) moving to UHD (4K)

- **Non-Blocking**
  Core needs non-blocking (1:1) performance

System Scale

- **High-Scale Routing**
  support for full IPv4 and IPv6 Internet + LAN + VRF routing

- **Flexible Transport Options**
  support for MPLS-VPN, SD-Access and BGP-EVPN with 4K VRFs

- **Centralized Wireless**
  support for high MAC and ARP/NDP scale

Port Density

- **More Uplinks**
  support for multiple QSFP uplinks, with LR/ZR optics for redundant edge connections

- **More Downlinks**
  support for hundreds of SFP ports/breakouts

- **Port Options**
  mix of SFP & QSFP ports, at various interface speeds

QoS & Buffers

- **Low-Latency Buffers**
  support for local optimized low-latency shared memory

- **High-Bandwidth Memory**
  support large buffers for micro-burst & congestion

- **Virtual Output Queuing**
  eliminate head-of-line blocking, with dedicated output queues for every egress port

Flexibility

- **Programmable ASIC**
  Enable new features and encapsulations

- **Model-driven Microcode**
  hardware functions use model-driven APIs

- **App Hosting Infra**
  support Docker applications

- **System-level HA**
  L2/L3 redundancy with Stackwise Virtual and GIR

Core + Edge

Core + Distro

Extending Cisco Catalyst 9500 & 9600 Series
Powered by Cisco Silicon One™ Q200 ASIC

NEW

C9500 & C9600-SUP1
(w/ UADP 3.0)

Optimized for Features

✓ **Speed**
- 1/10 & 25G SFP
- 40 & 100G QSFP

✓ **Scale**
- Upto 128K MACs
- Upto 256K Routes
- 108MB Buffers (3x 36MB)

✓ **Services**
- L2/L3 Routing, MPLS
- LAN MACsec, Netflow, NAT
- Custom ASIC Templates
- Campus Fabric (SDA & EVPN)

Double Existing Throughput

WAN MACsec, 1588v2 PTP

C9600X-SUP-2
C9600-LC-40YL4CD

10^x Routing & MPLS Scale

C9500X-28C8D

80MB Low-Latency + 8GB High-BW Buffers

50GE, 400GE, Coherent DWDM

C9500X & C9600X-SUP2
(w/ S1 Q200)

Optimized for Scale

✓ **Speed**
- 10/25G & **50G** ** SFP
- 40/100G & **200** **/400G QSFP

✓ **Scale**
- Upto **256K MACs**
- Upto **2M Routes**
- **80MB + 8GB Buffers**

✓ **Services**
- L2/L3 Routing, MPLS/TE
- LAN & **WAN-MACSec** *, Netflow, NAT**
- Custom ASIC Templates
- Campus Fabric (SDA & EVPN**)

Maximum Investment Protection   **400G Leadership in Campus**   **Unmatched Flexibility**

* Targeted 17.8.1
** Hardware capable. Software roadmap

Catalyst 9000 Series – Common Building Blocks

x86

Programmable x86 Multi-Core CPU

Application Hosting
Secure Containers

UPDATED

Open IOS XE® Polaris

Model-Driven APIs
Modular Patching

NEW

CISCO
Silicon One™
Q200   ©2020

Cisco Silicon One™ Q200 ASIC

Programmable Pipeline
Flexible Tables

Same IOSXE image for both UADP* and Silicon One C9K platforms

* C9200 uses IOSXE Lite

Introducing

Catalyst 9500X

Catalyst 9500 Series

Extending High-Performance Fixed Core with a Performance-Optimized Edge Switch

Non-XL Scale

Catalyst 9500H
(UADP 3.0)

C9500-32C / C9500-32QC

C9500-48Y4C / C9500-24Y4C

XL Scale

NEW

Catalyst 9500X
(S1 Q200)

C9500X-28C8D

Core, Edge, DCI, Colo

Total Capacity

3.2 Tbps
32 x 100G or
48 x 25G + 4 x 100G

2x

Total Capacity

6.0 Tbps
36 x 100G or
28 x 100G + 8 x 400G

Cisco Catalyst C9500X-28C8D
High-level overview

Console management
USB-C

Cisco LAN and WAN MACsec
Line-rate network encryption

Intel® 2.43-GHz x86 CPU
32-GB DDR4 DRAM
16-GB flash
8-GB HBM deep buffering

Cisco Silicon One™ Q200
12.8T ASIC

On-box application hosting
(2x resources, QAT)
2x 10G KR

Built-in RFID
(passive)

14 nonblocking 40/100G
QSFP28 ports

8 nonblocking 40/100/200/400G
QSFP-DD ports

14 nonblocking 40/100G
QSFP28 ports

USB 3.0 port,
RJ-45 management

240-, 480-, or 960-GB
M2 SATA SSD storage

Cisco® Trust Anchor Technologies
Strong mitigation against man-in-the-middle
attacks on software and firmware

5 standalone fans – N+1 redundancy
Reverse airflow – port side intake
Forward airflow – port side exhaust

Power supply unit (PSU)
Single PSU for both airflow directions
Redundant 1+1 1500W AC/DC
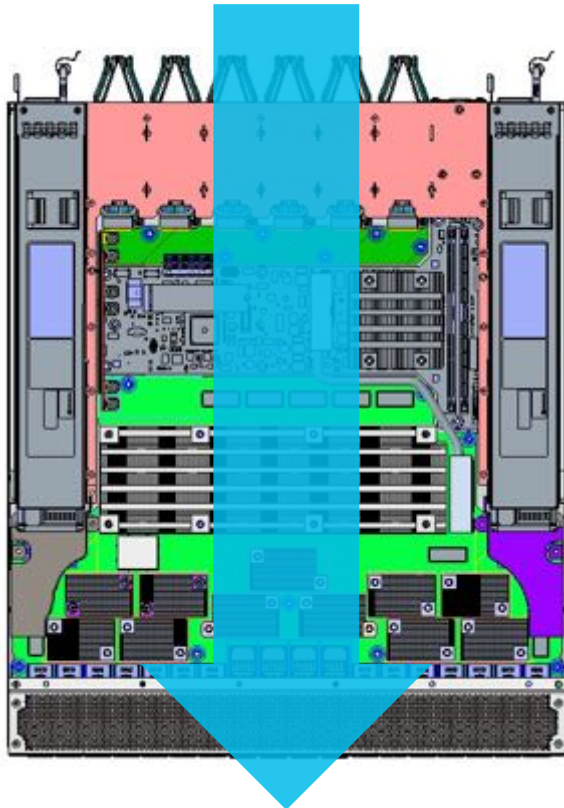
C9500X – Reversible Airflow
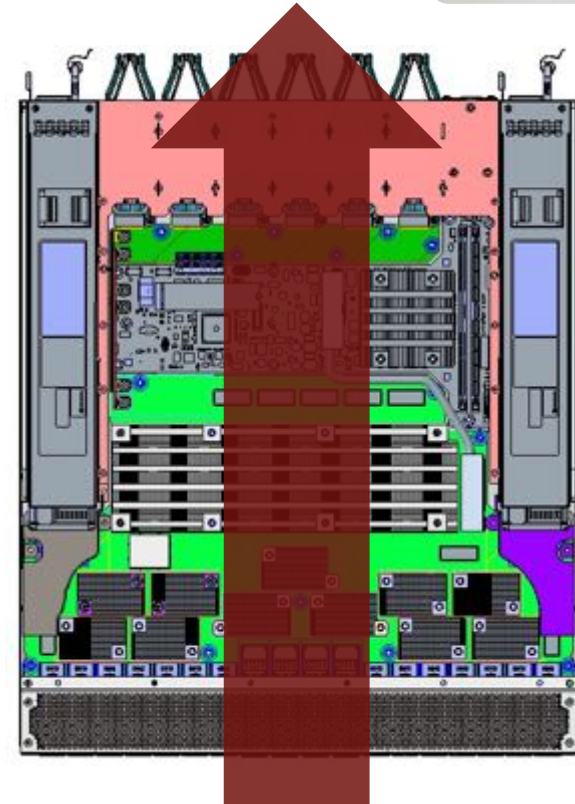

Back to Front
Port-side Exhaust

- Color of Fan Unit handle/latch represents direction of airflow
- Different Fan PIDs for different airflow directions
  - **Royal Blue** – **Back to Front**
  - **Burgundy** – **Front to Back**
- All Fans must be the same color (direction) to work correctly

Front to Back
Port-side Intake

Single **1500W AC/DC PSU** with **Cisco Grey** latch for both airflow directions

Introducing

Catalyst 9600X

Catalyst 9600 Series

Extending Modular Core with a Performance-Optimized Supervisor & Cards

UADP 3.0

SSD

Fan-Tray

PSU

SiliconOne Q200

Supervisor 1

Total Capacity

4.8 Tbps

Slot B/W

1.2 Tbps
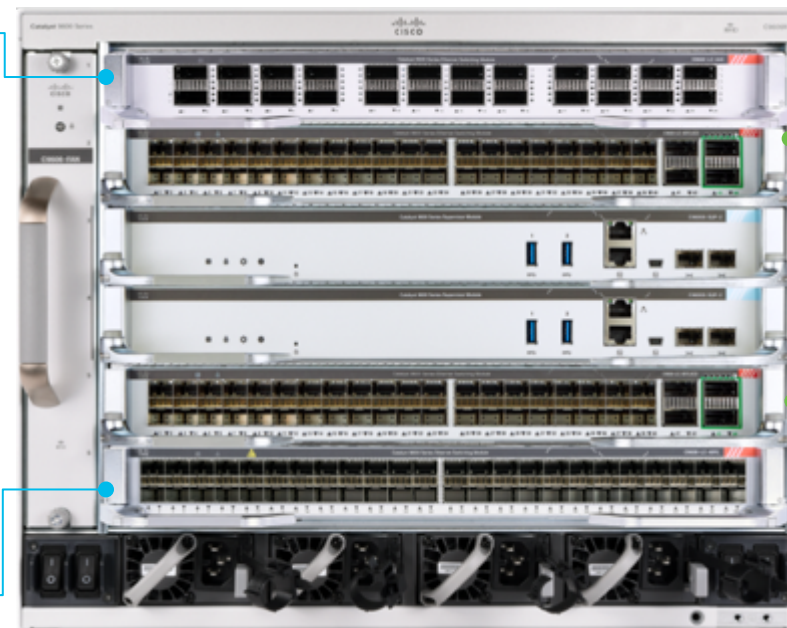
Gen1
1.2T /slot

Gen1
1.2T /slot

Gen2
3.2T /slot

Gen2
3.2T /slot

NEW

Supervisor 2

Total Capacity

12.8 Tbps

Slot B/W

3.2 Tbps

3x

400G

40x 1/10/25/50G + 2x 200G + 2x 400G

NEW

Catalyst 9600X:
Introducing the first 400G line card in campus

Shipping

Catalyst® 9606R

C9600-LC-24C
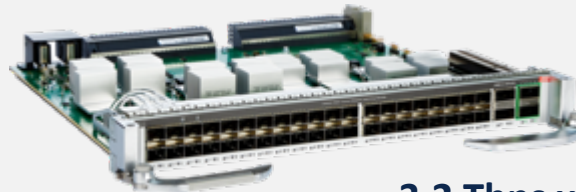
C9600-LC-48YL

C9600-LC-48S

C9600-LC-48TX
(Multigigabit)

Combo line card

NEW

C9600-LC-40YL4CD

40x SFP56 +
2x QSFP56 + 2x QSFP-DD

3.2 Tbps with SUP-2
1.2 Tbps with SUP-1

Provides for **uplink requirement** without using additional slot

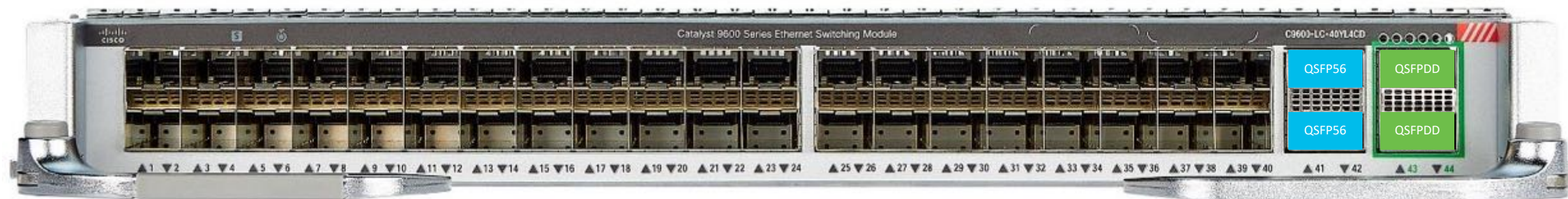**Dual-personality line card**

Flexible speed support

Lower total BoM cost, save on additional line cards

C9600-LC-40YL4CD Ports and Speeds Support

with **Sup2**: **3.2Tbps**

40x 10/25/50*GE + **2**x 40/100/200*GE + **2**x 40/100/200*/400GE
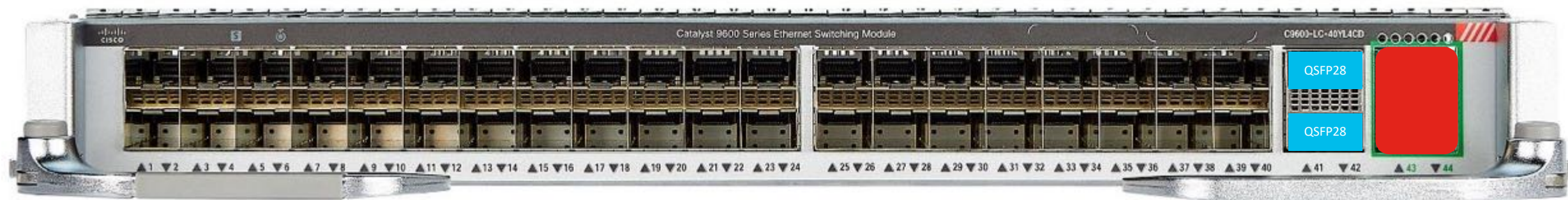
IOS-XE 17.7.1

with **Sup1**: **1.2Tbps**

40x 1/10/25GE + **2**x 40/100GE

IOS-XE 17.8.1

* Roadmap (not committed).

Catalyst 9600 line card and supervisor support matrix

	SUP-1	SUP-2
C9600-LC-24C	✔️ 24x 40G or 12x 100G	✅ 24x 40G and **100G** (No MACsec)
C9600-LC-48YL	✔️ 48x 1/10G and 25G	✅ 48x 10/25G and **50G**[*] (No MACsec, no 1G)
C9600-LC-48TX	✔️ 48x 1/2.5/5G and 10G (Multigigabit)	✅ 48x 10G (No MACsec, no 1/2.5/5G)
C9600-LC-48S	✔️ **48**x **1G SFP**	❌
C9600-LC-40YL4CD	✔️ 40x 1/10G and 25G + 2x 40G and 100G	✅ 40x 10/25G and **50G**[*] + 2x 40/100G and **200G**[*] + 2x 40/100**/200G**[*] and **400G** MACsec and **WAN MACsec** (no 1G)

SUP-2 does not support speeds of 1G or below

If 1G downlinks are required, position SUP-1

Introducing

Cisco Silicon One™

Cisco Silicon One™

Switching Silicon

- **High Throughput**
  extremely fast hardware-based L2-L4 forwarding and services (measured in Terabits per second)

- **Optimized Scale**
  optimized for Campus LAN environments with moderate IP & MAC scale (10s-100s of thousands)

- **Low Latency**
  extremely low hardware-based system latency (measured in Nanoseconds & Microseconds)

- **Streamlined Buffering**
  shallow buffering systems to reduce latency, with very high throughput

Silicon One™
Q200
©Cisco 2020

039

Routing Silicon

- **Flexible Features**
  complex, stateful L3-L7 forwarding and services (measured in Gigabits per second)

- **Massive Scale**
  optimized for WAN/SP environments with very high IP scale (100s of thousands - millions)

- **Mixed Interfaces**
  support for Ethernet, Serial, Cellular and other types and speeds in a single system

- **Deeper Buffering**
  deep buffers to accommodate different speeds, bursts and different flow patterns

Cisco Silicon One Bringing Switching and Routing convergence

Cisco Silicon One™ Q200

Industry leading Switching and Routing Silicon

12.8T BW

8.1 Bpps

8G HBM for deep buffers

10M IPv4 or 5M IPv6 route scale

Fully P4 Programmable Pipeline

50G PAM4 Serdes

Cisco Silicon ONE Q200

Industry Leading

12.8T System on Chip

First 7nm ASIC providing lowest watts/GE power consumption
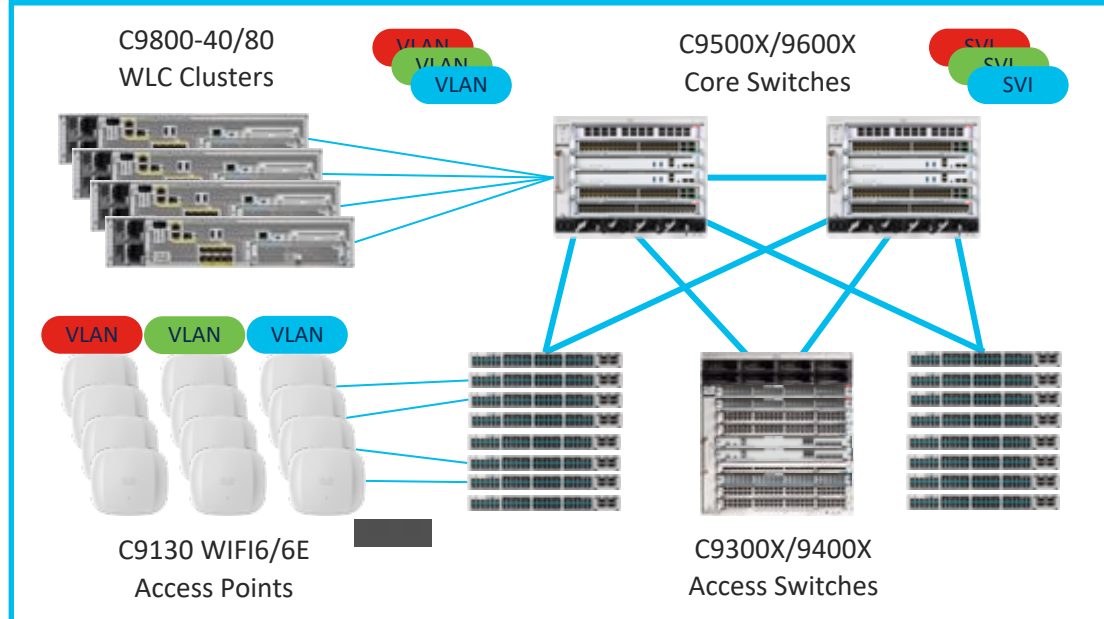
Fully P4 programmable enabling feature velocity

Multi slice architecture for flexibility and scale

Routing Capabilities with Switching Power and Performance

Why bigger L2 & L3 in Campus Core?

Central Wireless

C9800-40/80
WLC Clusters

VLAN
VLAN
VLAN

C9500X/9600X
Core Switches

SVI
SVI
SVI

VLAN
VLAN
VLAN

C9130 WIFI6/6E
Access Points

C9300X/9400X
Access Switches

Internet & Edge Routing

ISP, WAN, DCI

ISP   WAN

DC 1   DC 2

BGP + MPLS or VRF-Lite

BGP + MPLS or VRF-Lite

C9500X/9600X
Edge Switches

BGP + MPLS or VRF-Lite

Edge

BGP + MPLS or VRF-Lite

OSPF, IS-IS or EIGRP

Core

C9K
Campus Switches

Distro

Access

WLCs (Clusters) connected centrally to Core

- 32K Clients = 32K IPv4 + 96K IPv6 = ~128K
- 802.1Q trunks from WLC to Core
- Wireless LANs (VLANs) carried over trunk
- SVIs reside on Core (1st Hop L3 Gateway)
- Core must resolve all MAC & ARP/NDP
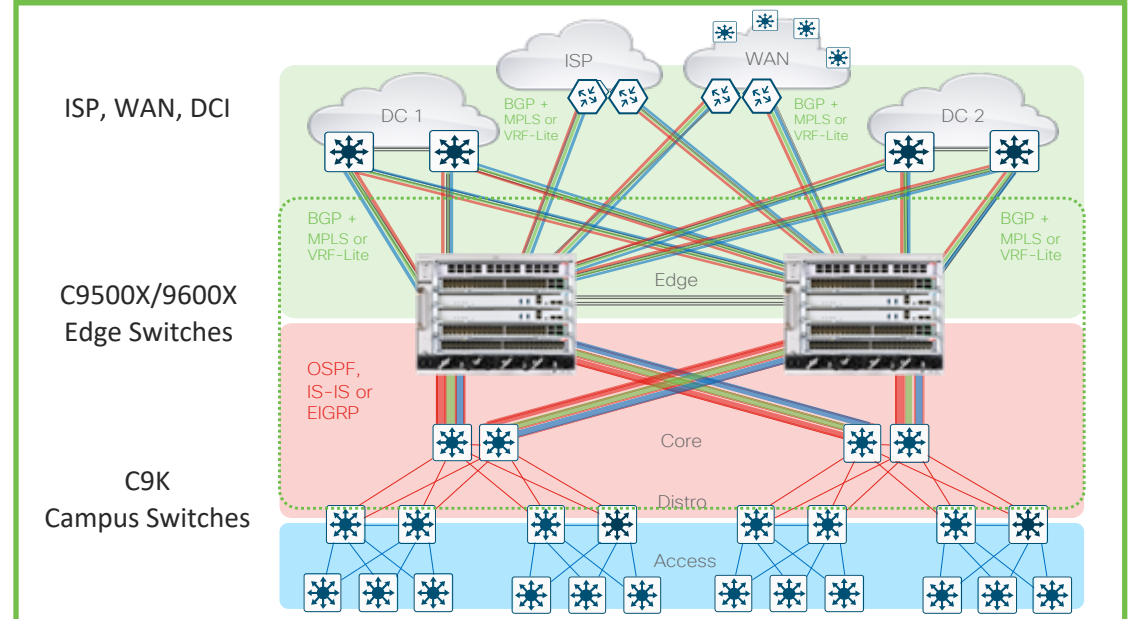
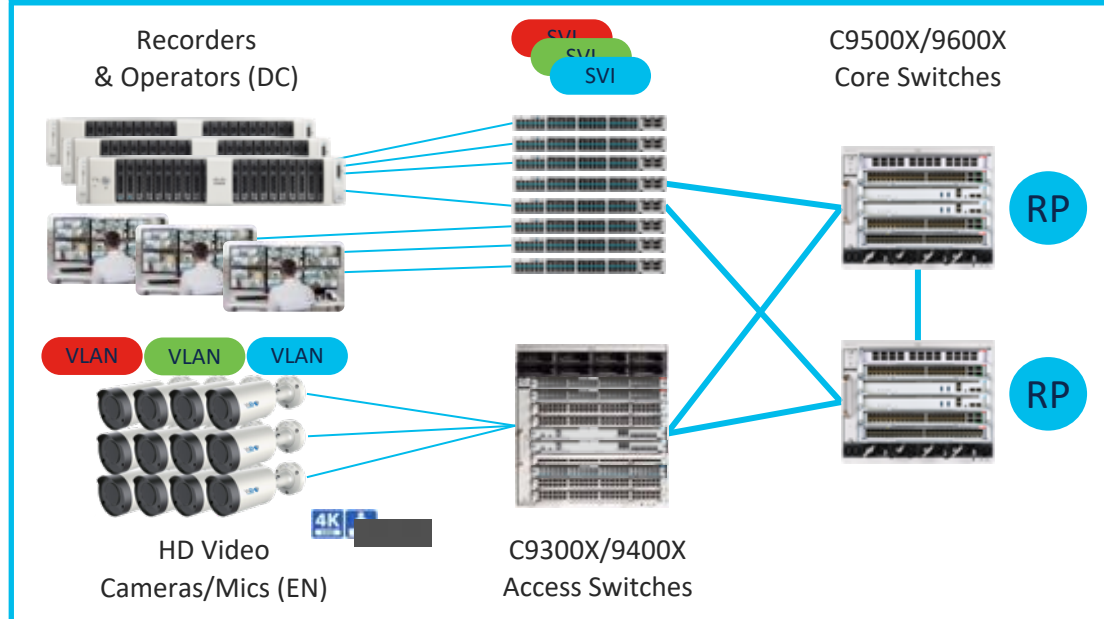## Core connected to Internet Service Provider

- Current Internet Tables: ~850K IPv4, ~50K IPv6
- 2x Neighbors, MP-BGP peering, BFD, NSF, GIR

Core connected to Enterprise MAN / WAN

- 1000 per VRF x ~1000 VRF = ~1M routes
- 8x Neighbors, IGP, BGP, MPLS, SDA/EVPN, QinQ
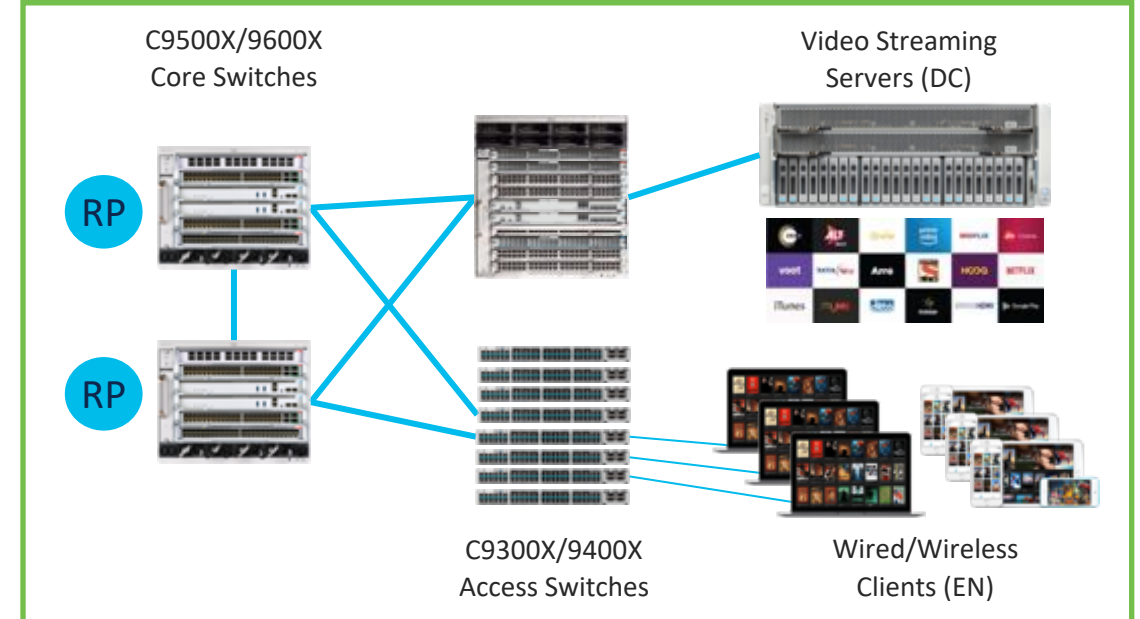
Why flexible Multicast in Campus Core?

Voice & Video Surveillance

Recorders & Operators (DC)

SVI
SVI
SVI

C9500X/9600X Core Switches

RP

RP

VLAN VLAN VLAN

HD Video Cameras/Mics (EN)

C9300X/9400X Access Switches

Geo-separated distribution of real-time Audio/Video

- 10,000's of HD Cameras / Microphones
- 100-1000's of Receivers (Recorders & Operators)
- Different locations of Recorders & Operators
- IPv4 & IPv6 PIM-SM and Bidir PIM
- Multicast VPN (Rosen, mLDP) for Security

Streaming & On-Demand

C9500X/9600X Core Switches

Video Streaming Servers (DC)

RP

RP

C9300X/9400X Access Switches

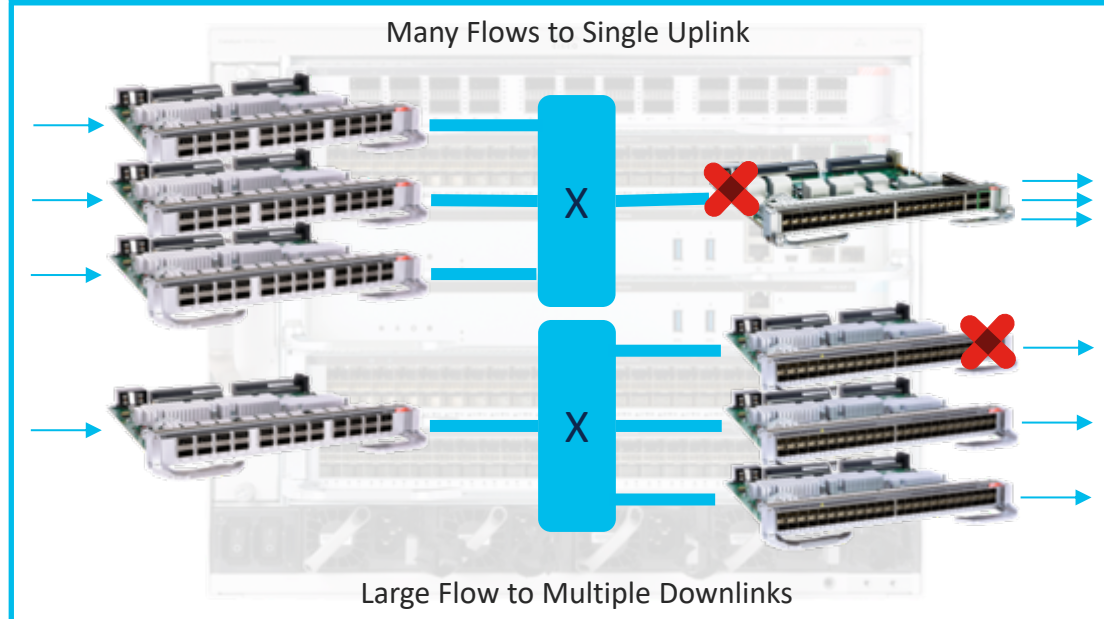Wired/Wireless Clients (EN)

Massive scale & performance for VOD Streaming

- 10,000's of Receivers (wired & wireless)
- 100-1000's of On-demand Videos
- Special QoS queueing & buffering for A/V data
- IPv4 & IPv6 PIM-SM and PIM-SSM
- IGMPv3 & MLDv2 and explicit host-tracking

Why VoQ QoS in Campus Core?

No Head-of-Line Blocking

Many Flows to Single Uplink

Large Flow to Multiple Downlinks
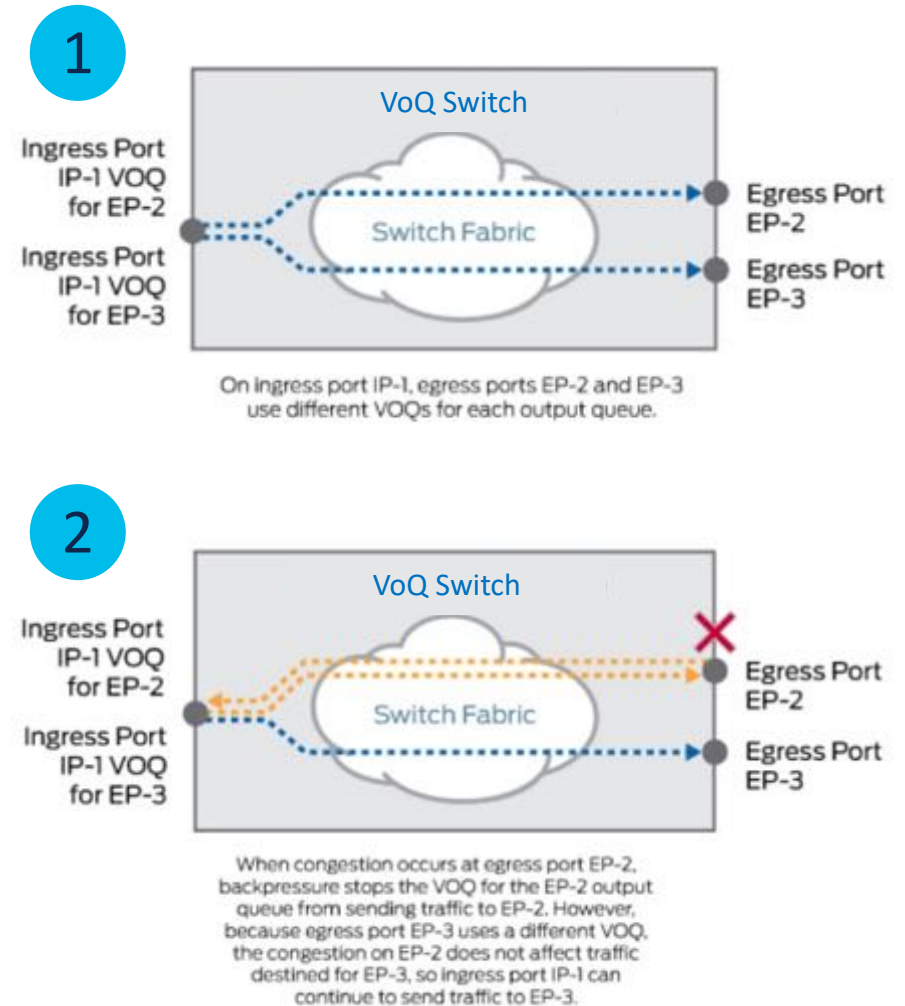
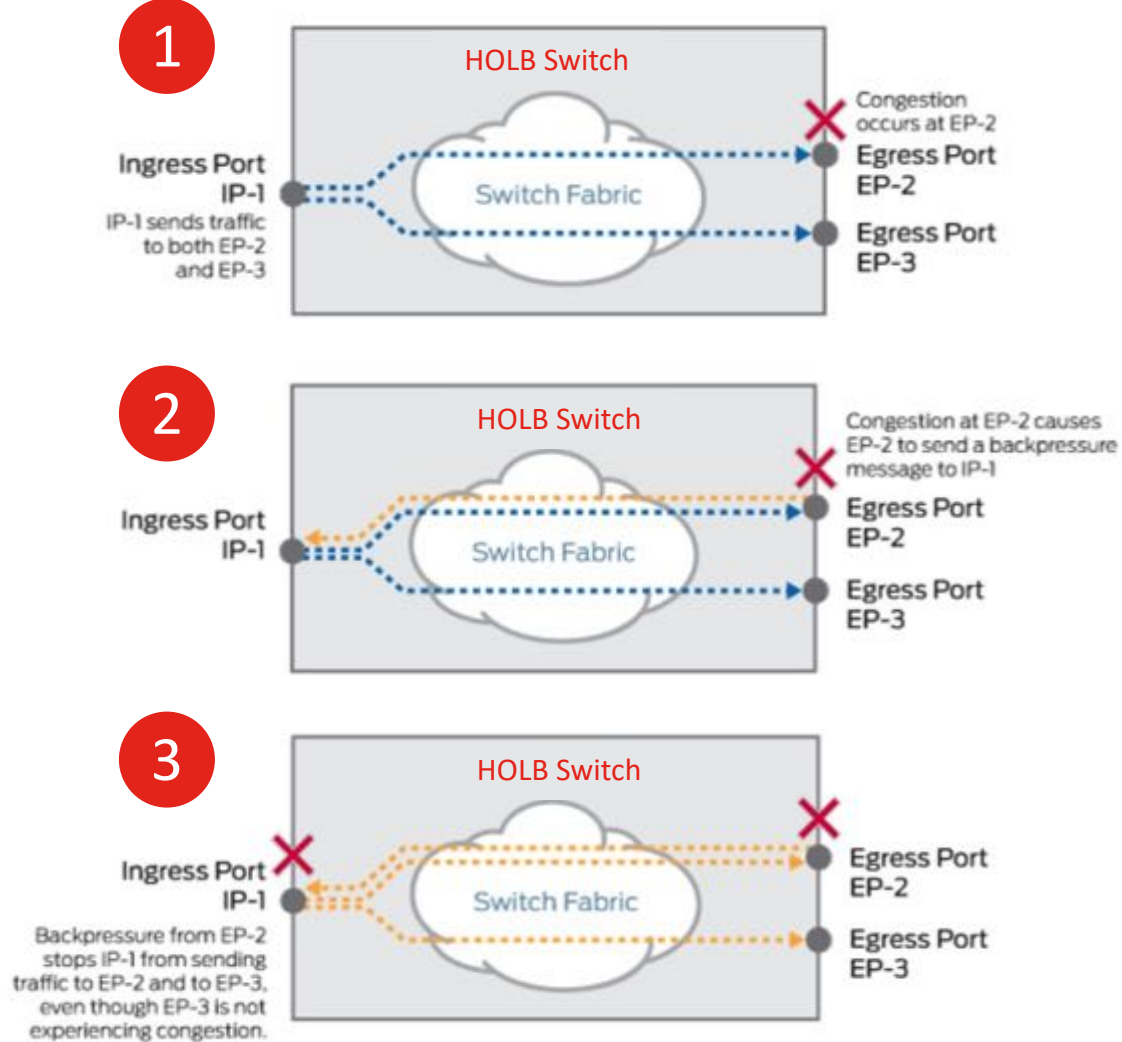**Many Flows to a Single Uplink**
- Common on (expensive) WAN/Edge uplinks
- Even if bandwidth available, buffers can fill up

Large Flow to Multiple Downlinks
- Common for Multicast & Broadcast traffic
- One slow receiver can penalize other ports

Why VoQ Architecture?

Virtual Output Queueing – Egress Optimized

Why VoQ QoS in Campus Core?

No Head-of-Line Blocking

Many Flows to Single Uplink

Large Flow to Multiple Downlinks

Local vs. HBM Buffers

Guaranteed Delivery & Burst Absorption

8GB HBM

Video
Voice
Control
Transfer
Scavenger

80MB SMS

Low-Latency & Priority Queuing

Many Flows to a Single Uplink

- Common on (expensive) WAN/Edge uplinks
- Even if bandwidth available, buffers can fill up

Large Flow to Multiple Downlinks

- Common for Multicast & Broadcast traffic
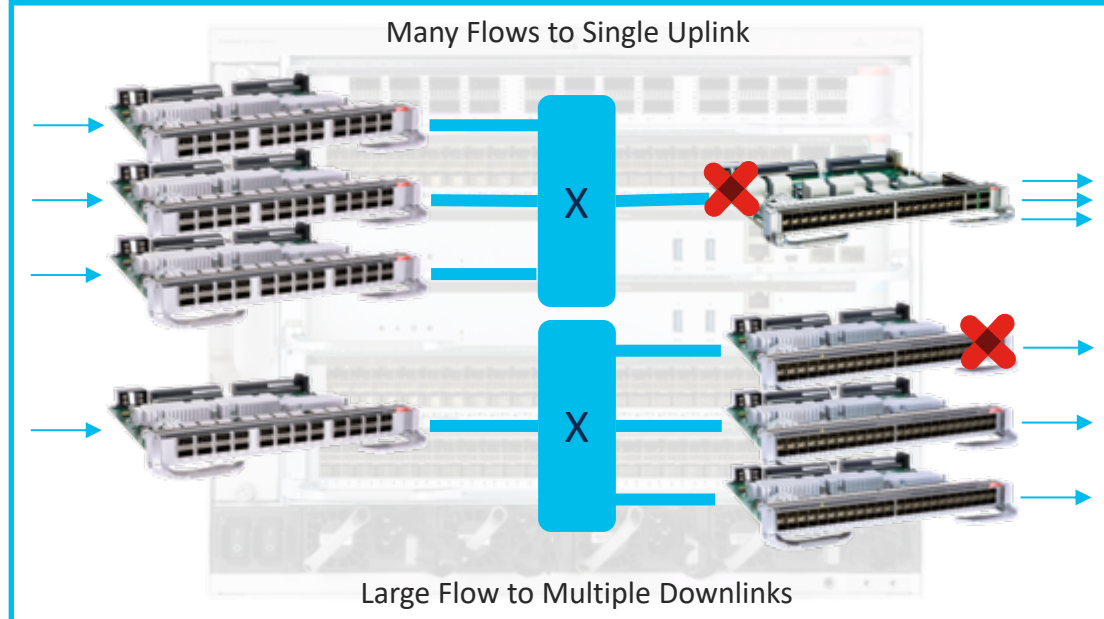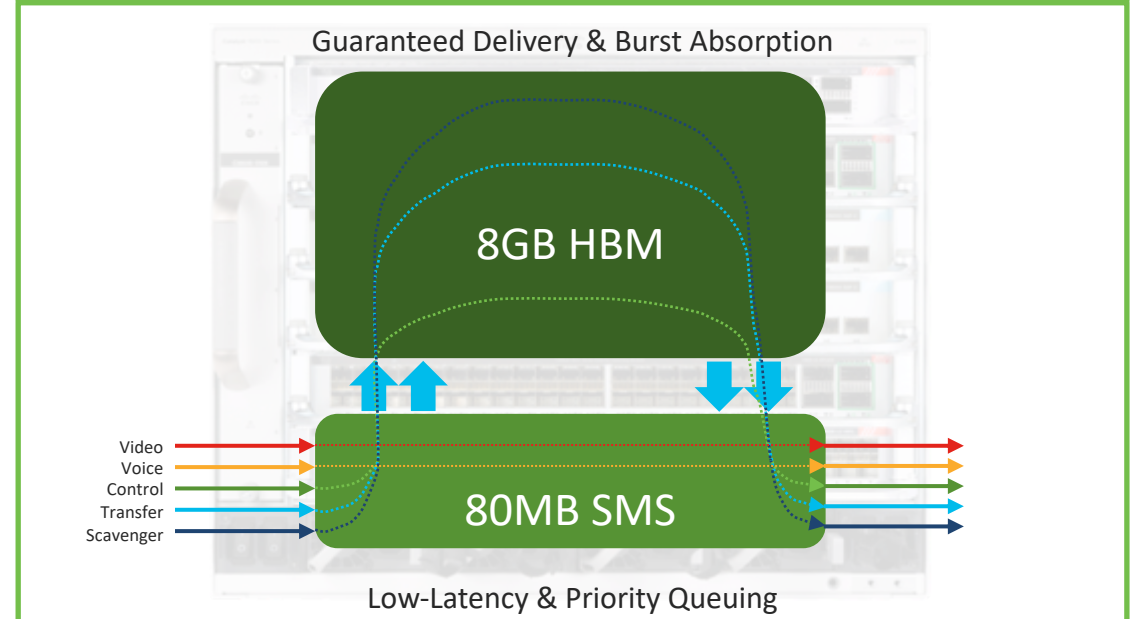- One slow receiver can penalize other ports
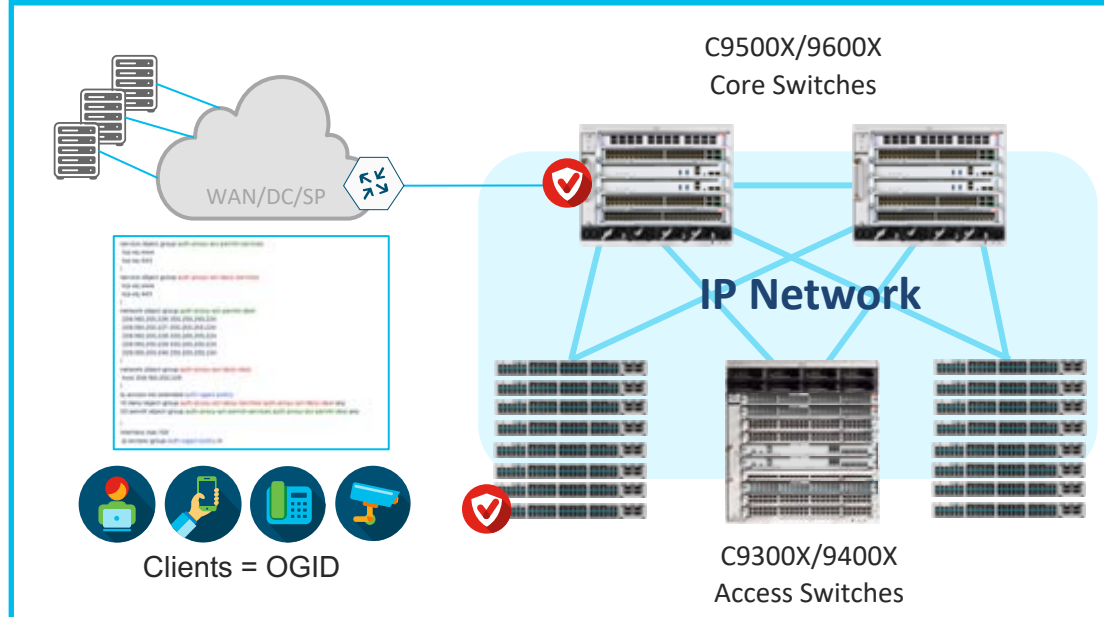
Low-Latency Local Shared Memory Buffers

- Voice & Video are very latency-sensitive
- Multiple levels of Strict Priority Queuing

Deep High-Bandwidth Memory Buffers

- Guarantee delivery of session-oriented flows
- Reserve buffers to absorb occasional bursts

Why OGACL/SGACL in Campus Core?

Object-Group ACLs for IP

C9500X/9600X
Core Switches

WAN/DC/SP

IP Network

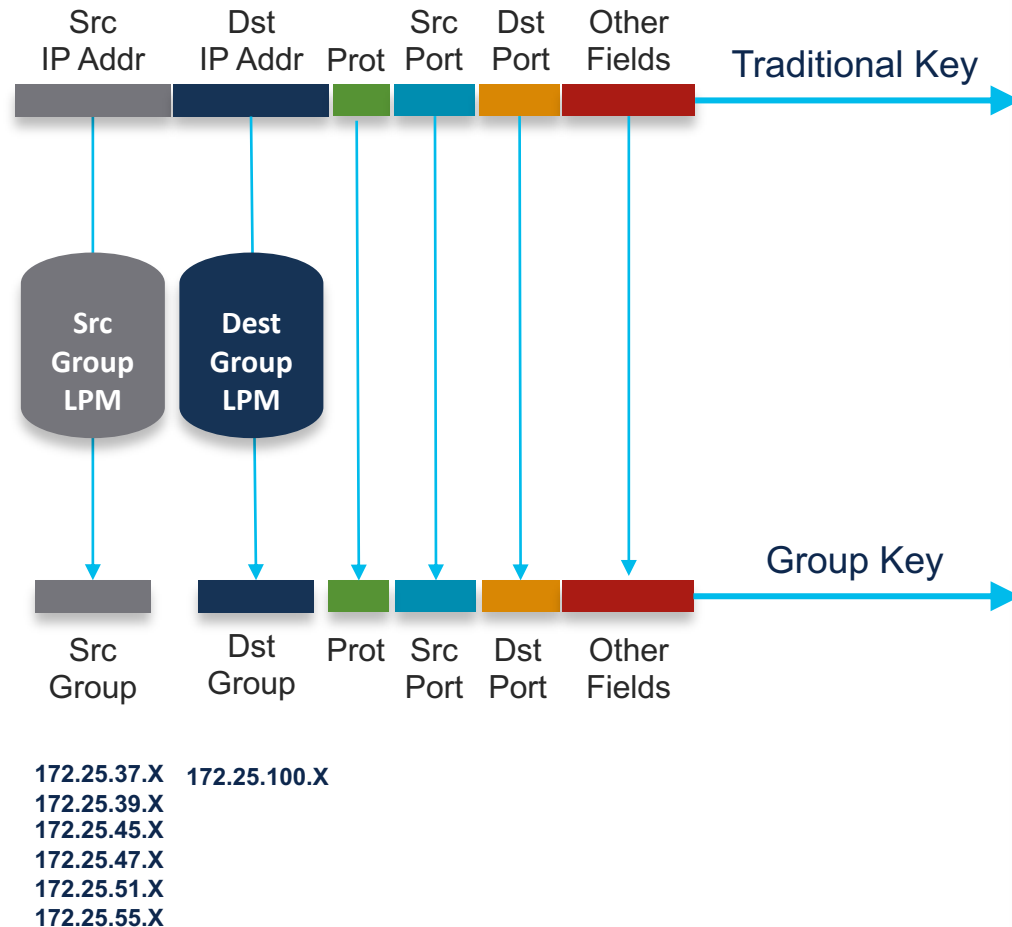Clients = OGID

C9300X/9400X
Access Switches

Object-Groups map IP/mask to Labels in CEM

- User defines IP/masks to simple OG name
- OGID labels are stored in Exact Match table

OGACL ACEs take minimal space in ACL TCAM

- Only the Permit/Deny ACEs in TCAM
- OGACLs with same ACEs can reuse entries

Traditional ACL vs Group-Based ACL

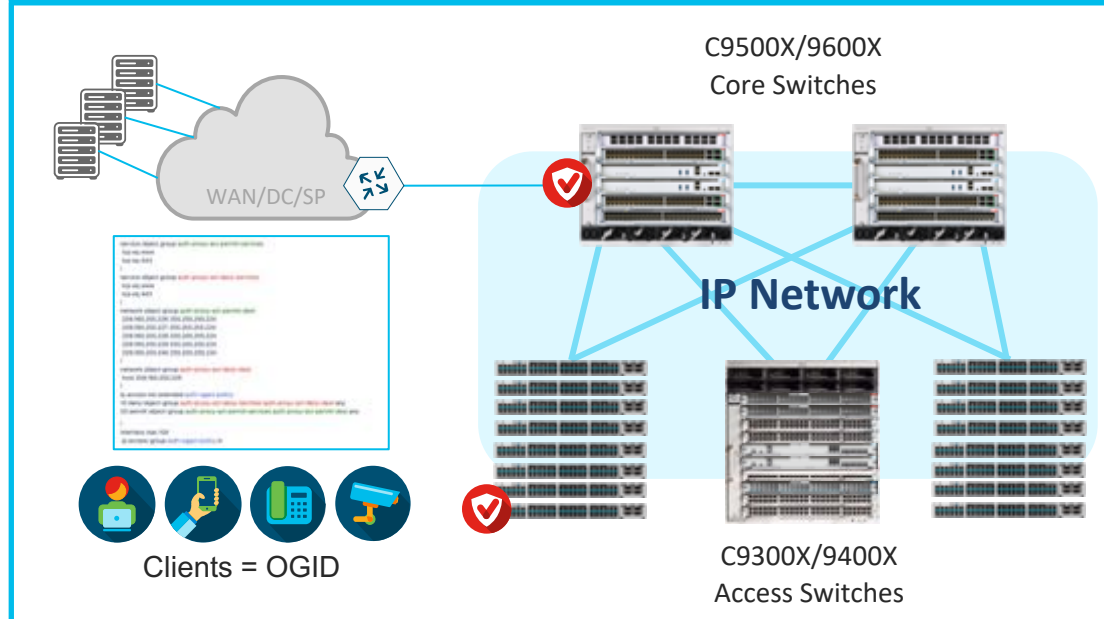**Traditional ACL**: One TCAM entry per ACL entry

| Src IP Addr | Dst IP Addr | Prot | Src Port | Dst Port | Other Fields |

Traditional Key →

perrmit udp 172.25.37.0/24 any 172.25.100.0/24 any
perrmit udp 172.25.39.0/24 any 172.25.100.0/24 any
perrmit udp 172.25.45.0/24 any 172.25.100.0/24 any
perrmit udp 172.25.47.0/24 any 172.25.100.0/24 any
perrmit udp 172.25.51.0/24 any 172.25.100.0/24 any
perrmit udp 172.25.55.0/24 any 172.25.100.0/24 any
Free
Free

Src Group LPM · **Dest Group LPM**

| Src Group | Dst Group | Prot | Src Port | Dst Port | Other Fields |

Group Key →

Object Group ACL: One TCAM entry per group-combo

permit udp object-group G1 any object-group G2 any
Free
Free
Free
Free
Free
Free

172.25.37.X
172.25.39.X
172.25.45.X
172.25.47.X
172.25.51.X
172.25.55.X

172.25.100.X

Why OGACL/SGACL in Campus Core?

Object-Group ACLs for IP

C9500X/9600X
Core Switches

WAN/DC/SP

IP Network

Clients = OGID

C9300X/9400X
Access Switches

Scalable-Groups for SDA

C9500X/9600X
CP/Border Nodes

WAN/DC/SP

SDA Fabric

Clients = SGT

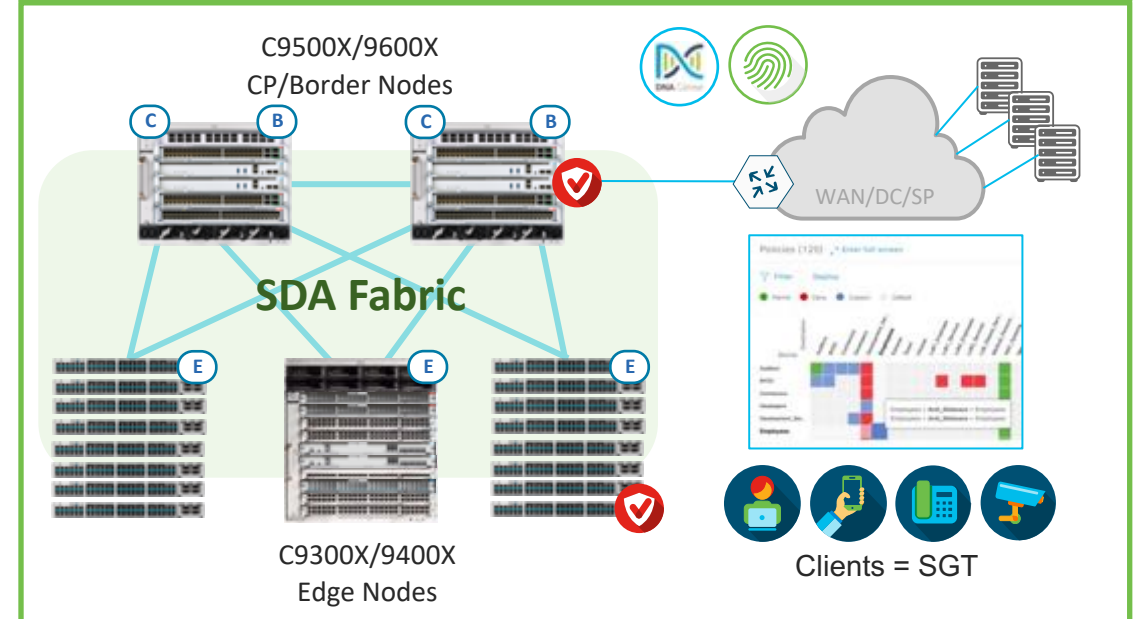C9300X/9400X
Edge Nodes

Object-Groups map IP/mask to Labels in CEM

- User defines IP/masks to simple OG name
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OGACL ACEs take minimal space in ACL TCAM

- Only the Permit/Deny ACEs in TCAM
- OGACLs with same ACEs can reuse entries

Scalable-Groups map IP/mask to Labels in CEM

- ISE/DNAC defines IP/masks to simple SG name
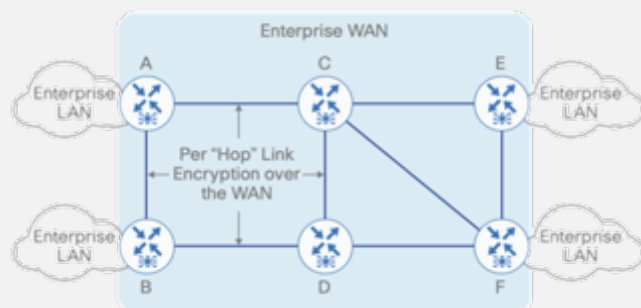- SGT labels are stored in Exact Match table

SGACL ACEs take minimal space in ACL TCAM

- Only the Permit/Deny ACEs in TCAM
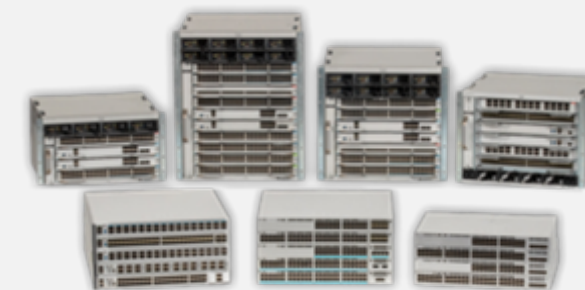- SGACLs with same ACEs can reuse entries

LAN & WAN MACsec overview
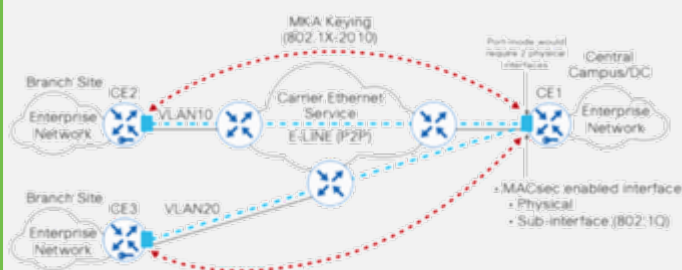## Enabled in hardware on Catalyst 9000 Switches

MACsec

- **Hop-by-Hop encryption**
- Directly connected **Layer 2 links only**
  - 802.1ae
- Secure direct P2P links between Campus, MAN or DC
- 256/128-bit AES encryption

Supported on **all Catalyst® 9000** models
All ports and speeds simultaneously

WAN MACsec*

- **End-to-End encryption**, across Layer 2 Ethernet WAN service
  - 802.1q ClearTag
  - **Point-to-Point** or **Point-to-Multipoint**
- Secure Site-to-Site interconnect, DCI, storage replication
- 256/128-bit AES encryption

Catalyst 9600X   Industry First   **Catalyst 9500X**

Supported on **Silicon One™** platforms*
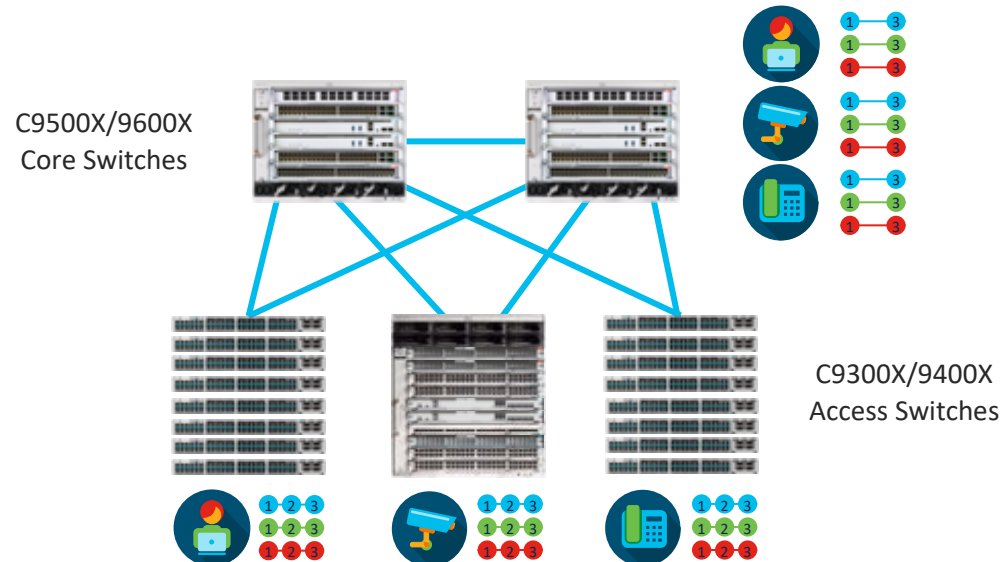All ports/speeds (up to 400G) simultaneously

Catalyst 9400X

Catalyst 9300X

Roadmap for Catalyst 9300X & 9400X
Aggregate speed up to 100G

* Requires IOSXE 17.8.1 and HSEC key ($1 PID).

Why Sampled FNF in Campus Core?

ID @ Access – Monitor @ Core

C9500X/9600X
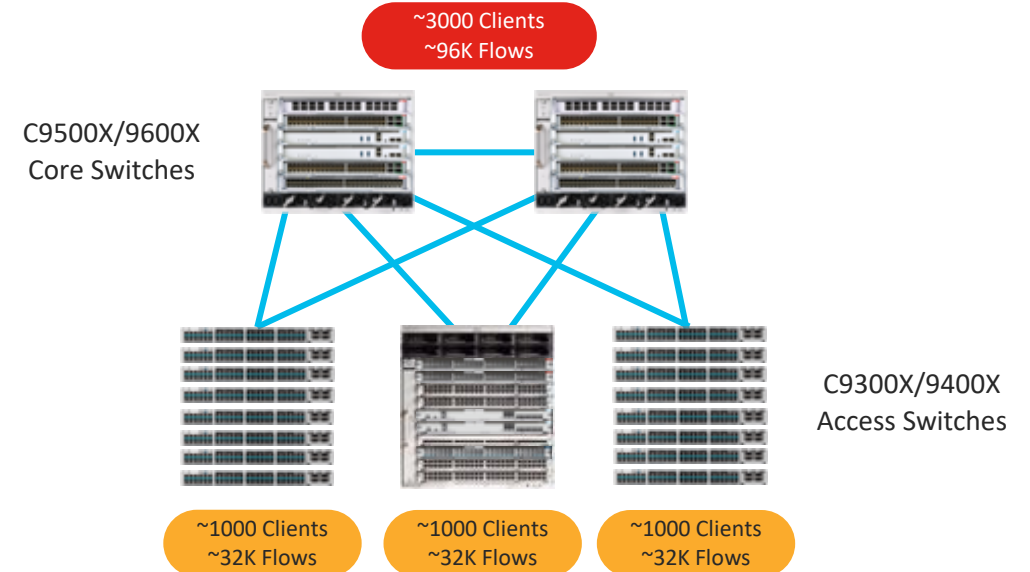Core Switches

C9300X/9400X
Access Switches

Detailed (1:1) flow identification at the Access

- Better to ID flows as they enter the network
- Full accounting of every client/flow (ETA/AVC)

Aggregate (1:1K) monitoring of flows at the Core

- Just need to monitor the overall network usage
- Adjust sample rates to balance scale & load

Campus-wide Scale

~3000 Clients
~96K Flows

C9500X/9600X
Core Switches

C9300X/9400X
Access Switches

~1000 Clients
~32K Flows

~1000 Clients
~32K Flows

~1000 Clients
~32K Flows

Low-Moderate scale at the Access

- Fewer number of connected clients/flows
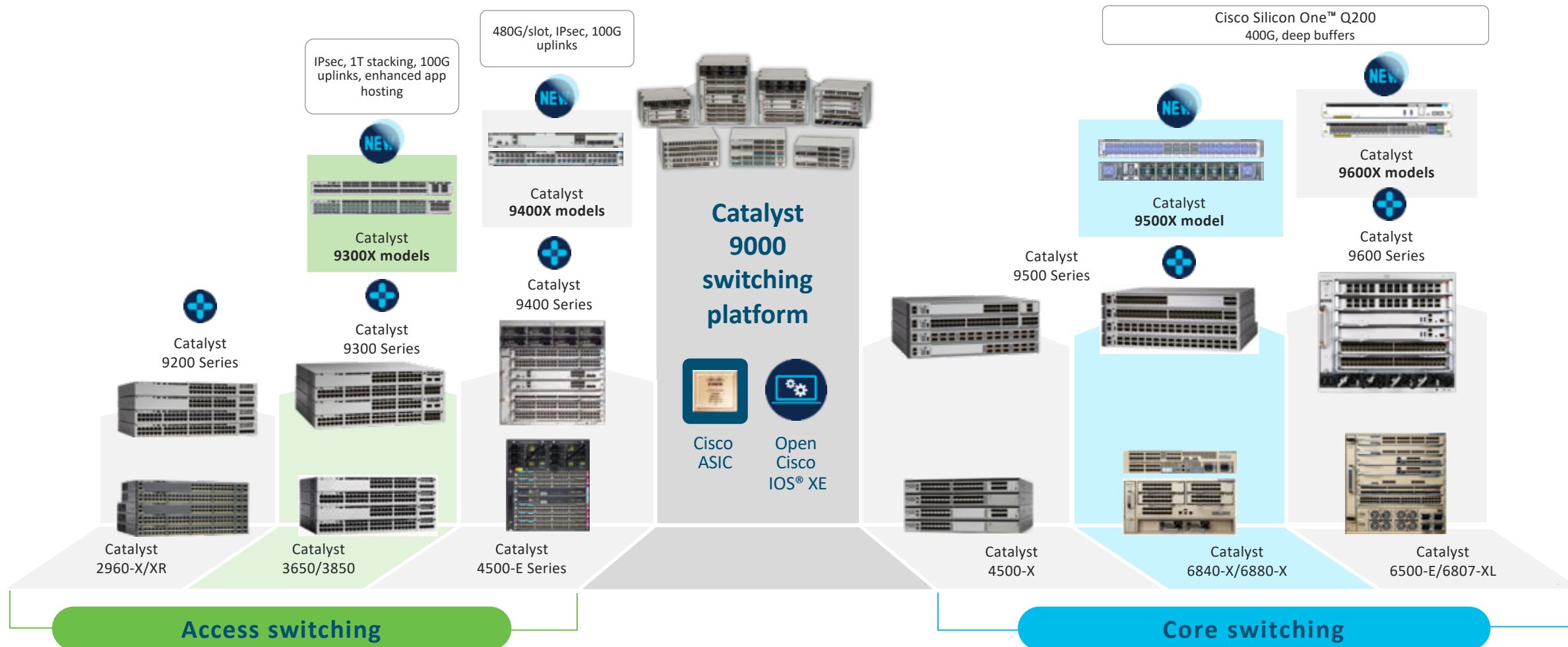- Average ~1K clients x ~32K flows per Access

Medium-High scale at the Core

- Need to aggregate all clients/flows [# Access x 32K]
- Adjust cache aging to increase overall scale

Summary

Catalyst 9000X – Expanding industry leadership
Adding the "X factor" to the industry's leading switching family

IPsec, 1T stacking, 100G uplinks, enhanced app hosting

480G/slot, IPsec, 100G uplinks

Cisco Silicon One™ Q200
400G, deep buffers

NEW

NEW

NEW

NEW

NEW

Catalyst **9300X models**

Catalyst **9400X models**

Catalyst
9600X models

Catalyst
9500X model

Catalyst 9000 switching platform

Cisco ASIC

Open Cisco IOS® XE

Catalyst 9200 Series

Catalyst 9300 Series

Catalyst 9400 Series

Catalyst 9500 Series

Catalyst 9600 Series

Catalyst 2960-X/XR

Catalyst 3650/3850

Catalyst 4500-E Series

Catalyst 4500-X

Catalyst 6840-X/6880-X

Catalyst 6500-E/6807-XL

Access switching

Core switching

Fragen?

OUTLOOK Upcoming Virtual Espresso

- Blog:
  http://cs.co/vEspresso

- Topics:
  - 23.03.2022: WiFi Innovations
  - 06.04.2022: Routing Innovations
  - 24.04.2022: DevNet Use Cases
  - 18.05.2022: Secure Network Analytics

dankä villmal
grazie mille
merci beaucoup
grazia fitg
thank you

CISCO