

The background is a vibrant, abstract graphic. It features a central bright white light source from which numerous colorful rays emanate, creating a sunburst or starburst effect. The rays transition through a spectrum of colors including yellow, orange, red, and various shades of blue and green. Overlaid on this are several large, semi-transparent, wavy shapes in similar color tones, giving the overall image a sense of motion and energy.

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The bridge to possible

Nexus 9000 Architecture

Nemanja Kamenica
Technical Marketing Engineer
BRKDCN-3939

CISCO *Live!*

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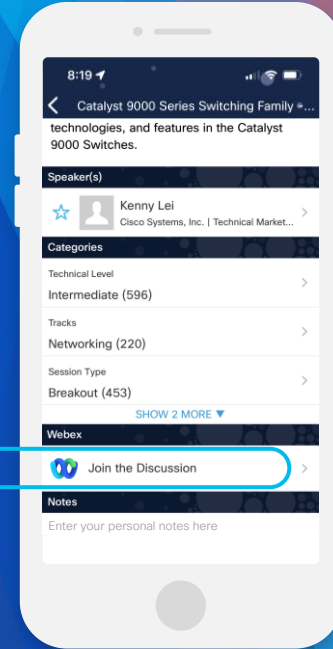
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Session Abstract

This session presents an in-depth study of the architecture of the latest generation of Nexus 9000 modular and top-of-rack data center switches. Topics include forwarding hardware, switching fabrics, and other physical design elements, as well as a discussion of key hardware-enabled features and capabilities that combine to provide high-performance data center network services.

What This Session Covers

- Latest generation of Nexus 9000 switches with Cloud Scale ASICs
- Nexus 9500 modular switches with Cloud Scale linecards
- Nexus 9300 Cloud Scale top-of-rack (TOR) switches
- System and hardware architecture, key forwarding functions, packet walks

Not covered:

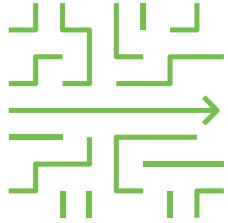
- First generation Nexus 9000 ASIC/platform architectures
- Nexus 9500 merchant-silicon based architectures
- Other Nexus platforms
- Catalyst 9000 platform



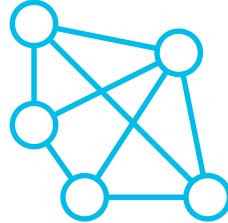
Agenda

- Data Center and Silicon Strategy
- Cloud Scale ASIC Architecture
- Cloud Scale Switching Platforms
- Packet Walks
- Key Takeaways

Cisco Data Center Network Strategy



Operational
Simplicity



Sustainable
Data Center
Networking



Networking
for AI/ML

Nexus 9000 Cloud Scale Switching Portfolio

Key Elements of the Data Center Strategy

Nexus 9300-FX/FX2/FX3, GX/GX2 and 9408

Premier TOR platforms

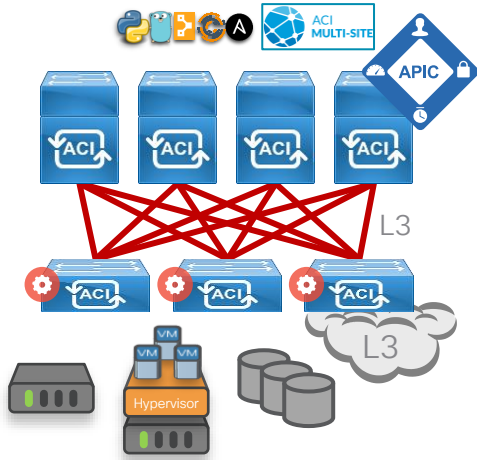


Nexus 9500 with X9700-FX and X9700-GX Modules

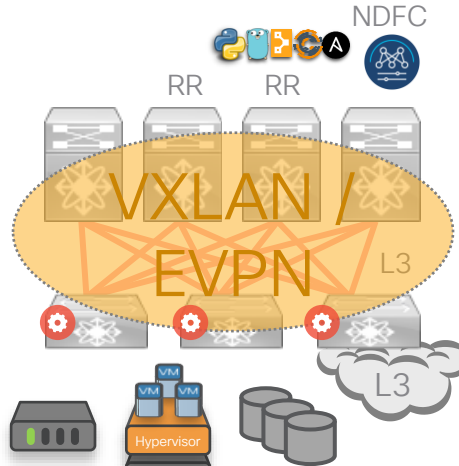
Flagship switching modules for Nexus 9500 modular chassis



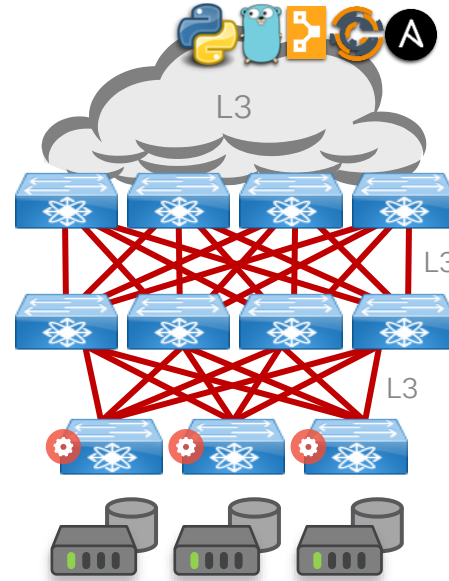
Building Data Center Fabrics with Nexus 9000



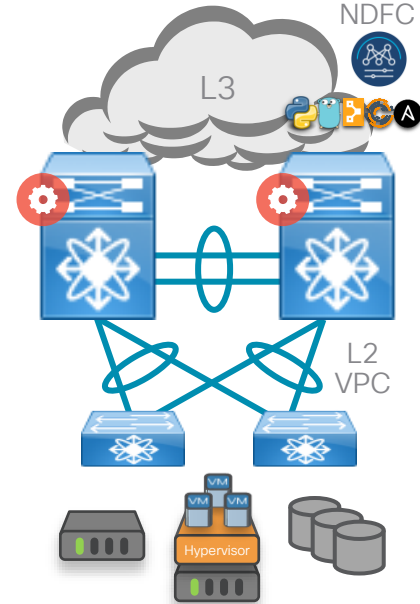
ACI – Turnkey Fabric



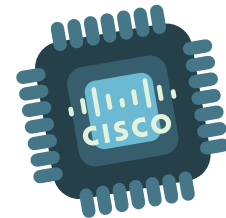
Standalone –
Programmable Fabric with
VXLAN+EVPN



Standalone –
Programmable IP Network



Standalone – Traditional
Data Center Network



Why Custom Silicon?

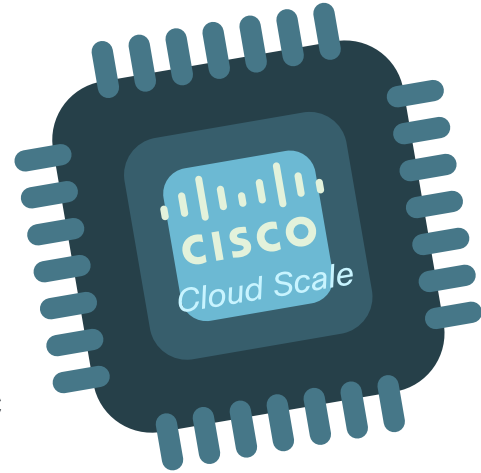
- Cisco competitive advantage – vehicle for differentiating innovations
 - ACI policy model + congestion-aware flowlet switching
 - Flexible forwarding tiles
 - Single-pass tunnel encapsulations
 - In-built encryption technologies
 - Intelligent buffers
 - Streaming hardware telemetry
- Tight integration between hardware / software / marketing / sales / support
- Closely aligns hardware designs with software innovations, strategic product direction, competitive differentiators, serviceability

Agenda

- Data Center and Silicon Strategy
- Cloud Scale ASIC Architecture
- Cloud Scale Switching Platforms
- Packet Walks
- Key Takeaways

Cisco Cloud Scale ASIC Family

- **Ultra-high port densities** → Reduces equipment footprint, enables device consolidation, denser fabric designs
- **Multi-speed 100M/1/10/25/40/50/100G/400G** → Flexibility and future proofing
- **Rich forwarding feature-set** → ACI, Segment Routing, single-pass L2/L3 VXLAN routing
- **Flexible forwarding scale** → Single platform, multiple scaling alternatives
- **Intelligent buffering** → Shared egress buffer with dynamic, advanced traffic optimization
- **In-built analytics and telemetry** → Real-time network visibility for capacity planning, security, and debugging



Key Cloud Scale Family Members



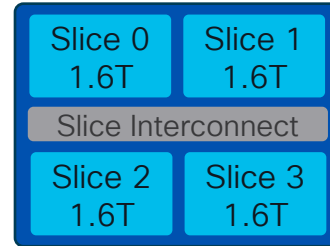
LS25600GX2A – 64 x 400G

25.6T chip – 4 slice pairs of 8 x 400G
9300-GX2A TORs; 9408 centralized modular TOR



LS12800GX2B – 32 x 400G

12.8T chip – 2 slice pairs of 8 x 400G
9300-GX2B TOR



LS6400GX – 16 x 400G

6.4T chip – 4 slices of 4 x 400G
X9700-GX modular linecards; 9300-GX TORs



LS3600FX2 – 36 x 100G

3.6T chip – 2 slices of 18 x 100G with MACSEC
9300-FX2 TORs

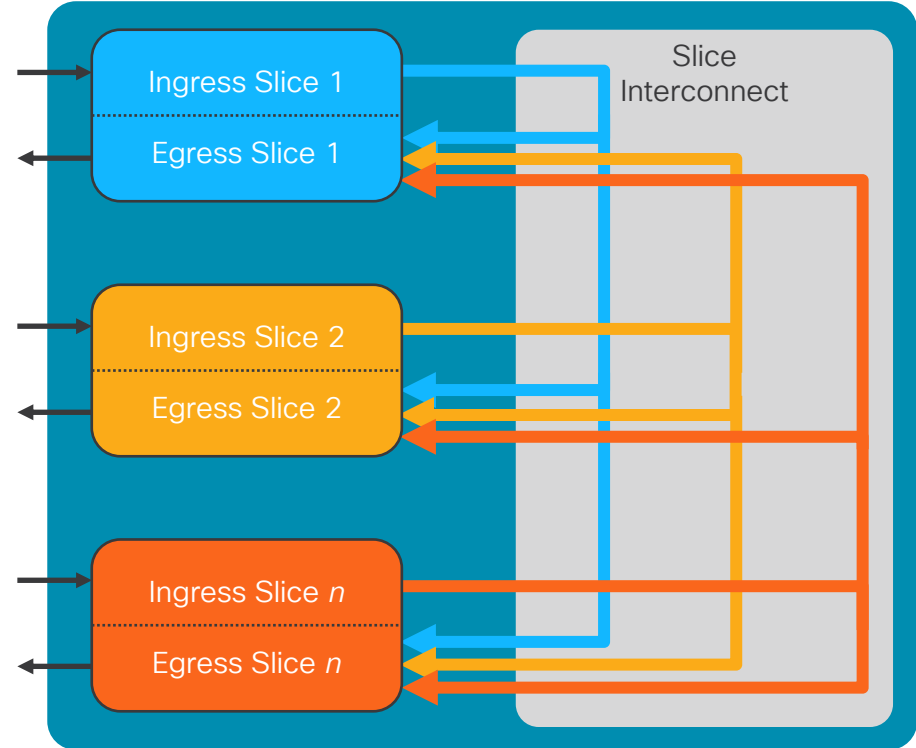


LS1800FX/FX3 – 18 x 100G

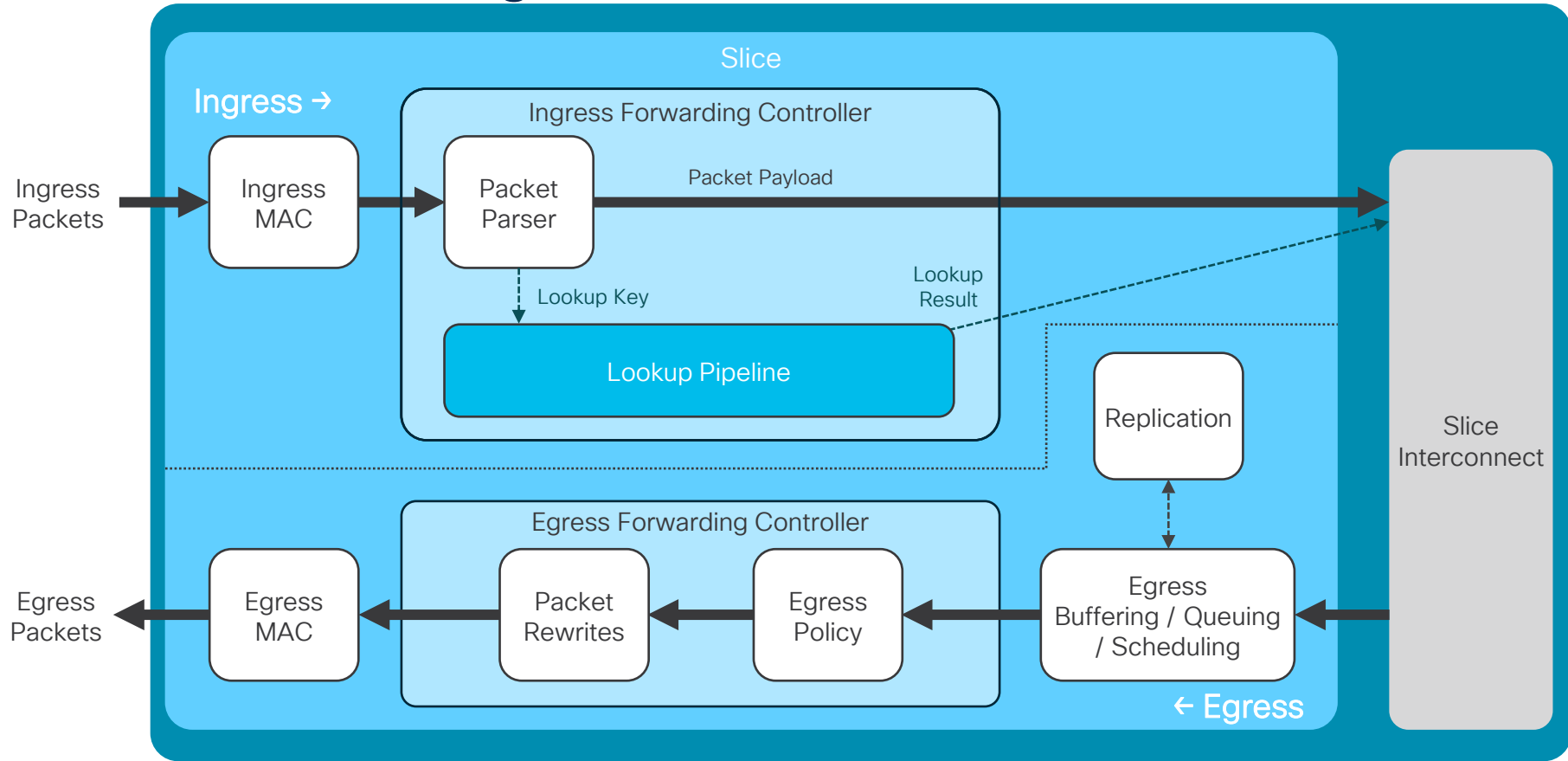
1.8T chip – 1 slice of 18 x 100G with MACSEC
X9700-FX modular linecards; 9300-FX/FX3 TORs

What Is a “Slice”?

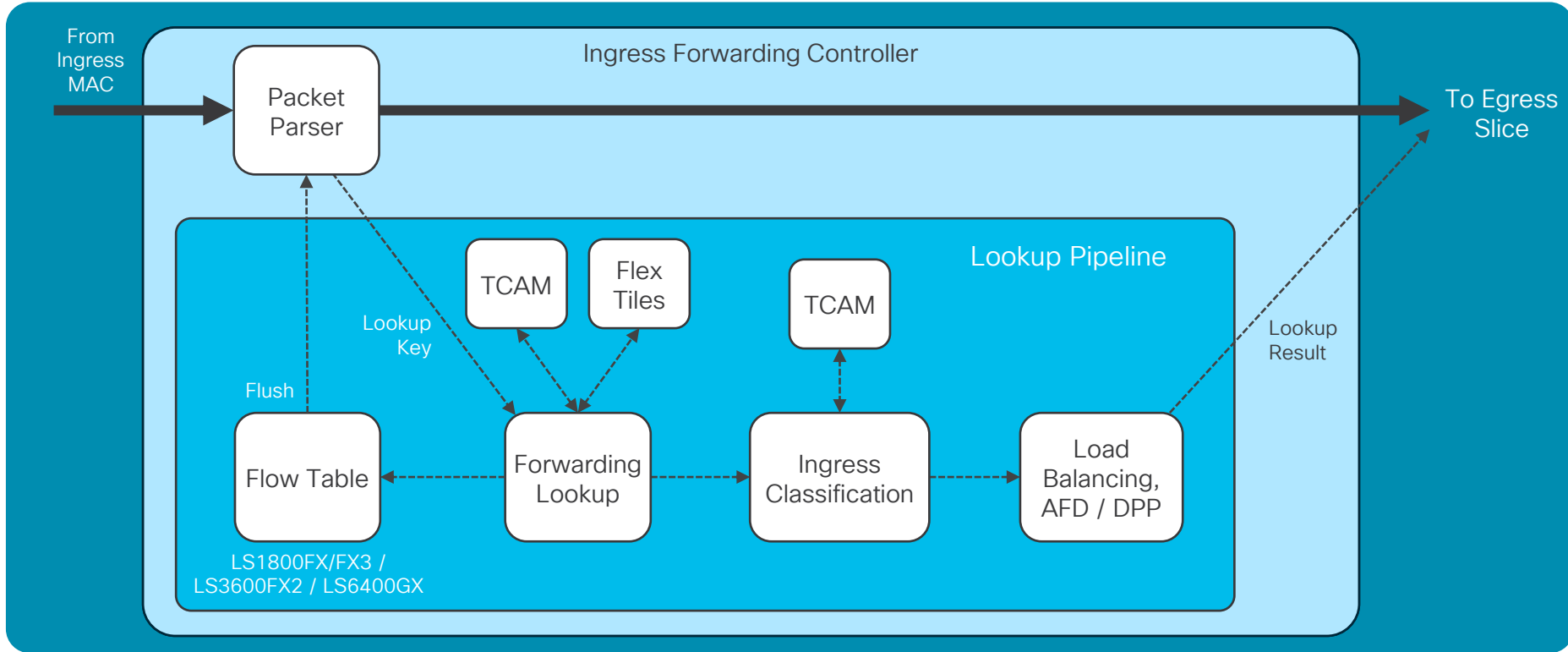
- Self-contained forwarding complex controlling subset of ports on single ASIC
- Separated into Ingress and Egress functions
- Ingress of each slice connected to egress of all slices
- Slice interconnect provides non-blocking any-to-any interconnection between slices



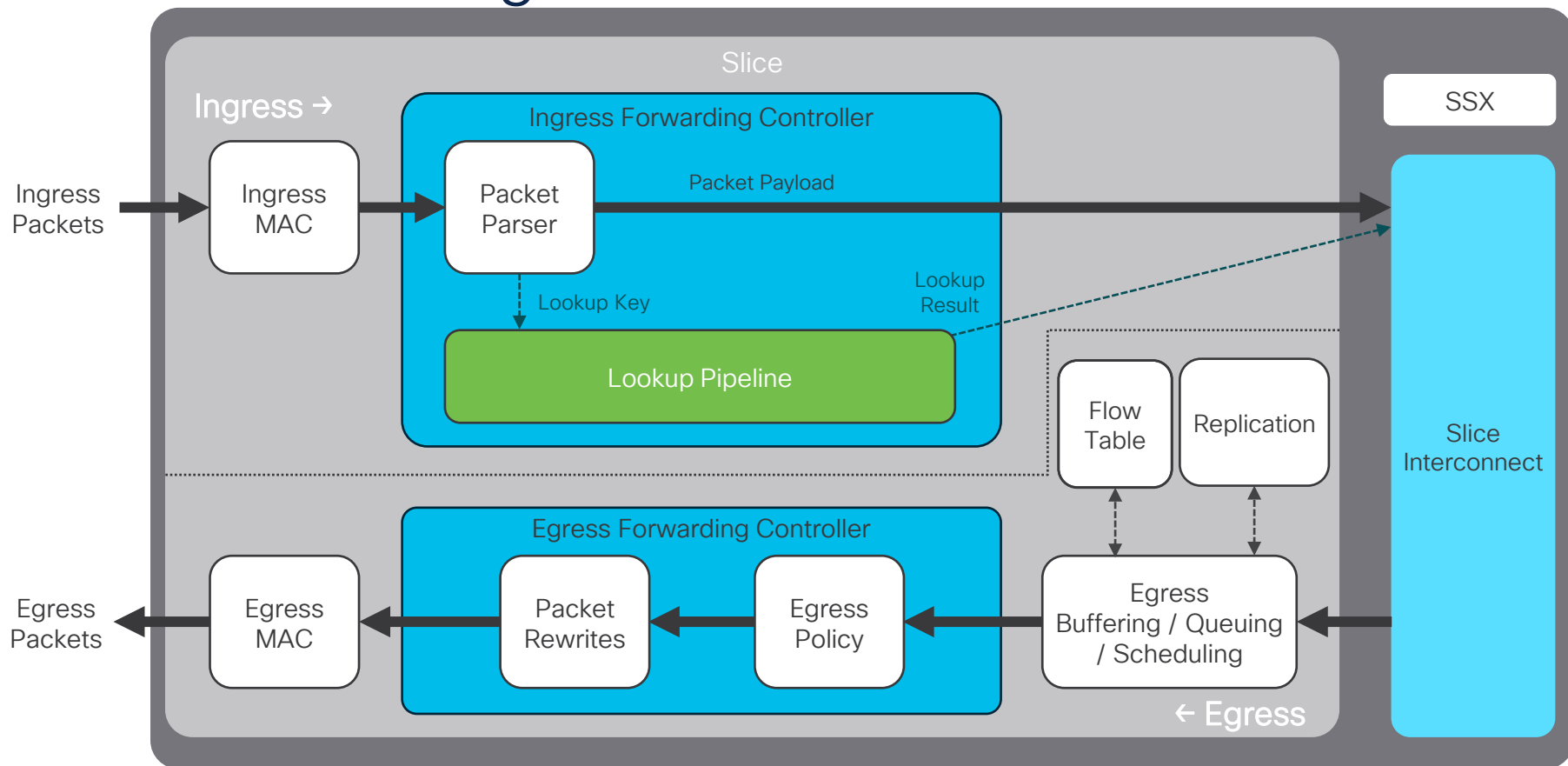
Slice Forwarding Path



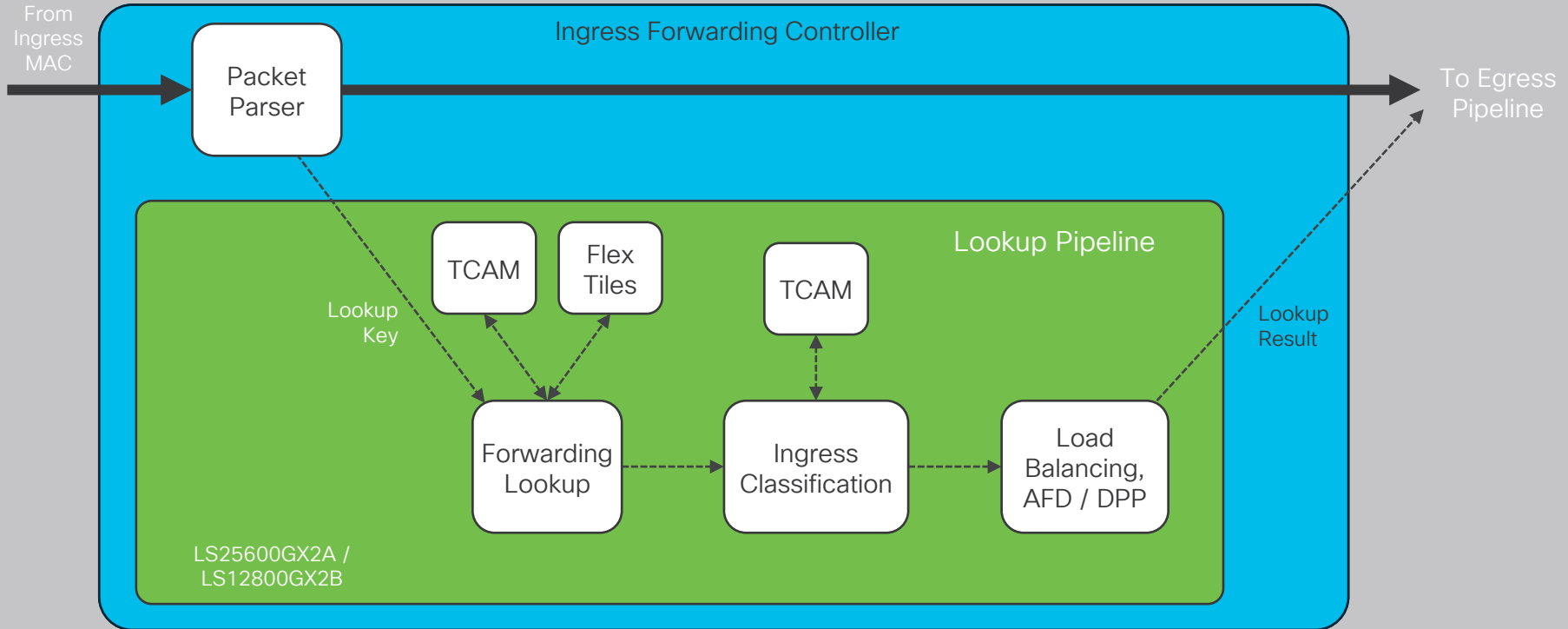
Ingress Lookup Pipeline



Slice Forwarding Path – GX2

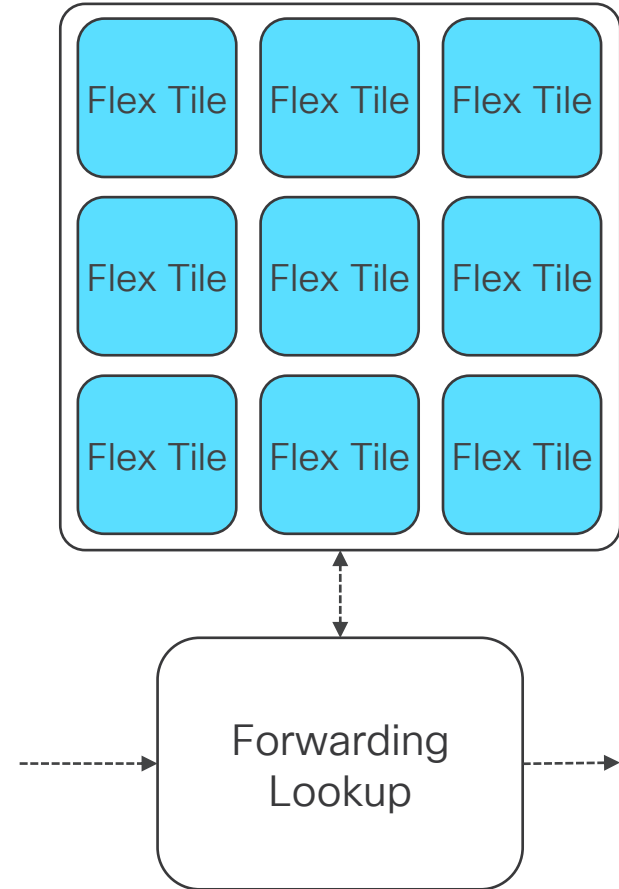


Ingress Lookup Pipeline – GX2



Flexible Forwarding Tiles

- Provide fungible pool of table entries for lookups
- Number of tiles and number of entries in each tile varies between ASICs
- Variety of functions, including:
 - IPv4/IPv6 unicast longest-prefix match (LPM)
 - IPv4/IPv6 unicast host-route table (HRT)
 - IPv4/IPv6 multicast (*,G) and (S,G)
 - MAC address/adjacency tables
 - ECMP tables
 - ACI policy



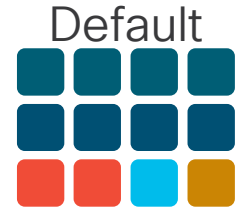
Flex Tile Routing Templates

- Configurable forwarding templates determine flex tile functions
 - “system routing template” syntax
- Templates as of NX-OS 10.3(2):
 - Default
 - L3-heavy
 - Dual-stack host scale*†
 - MPLS heavy*
 - Dual-stack multicast
 - Multicast heavy
 - Internet peering*
 - Multicast extra-heavy
 - LPM heavy
 - Service provider
 - L2-heavy
- Defined at system initialization – reboot required to change profile

* Template does not support IP multicast

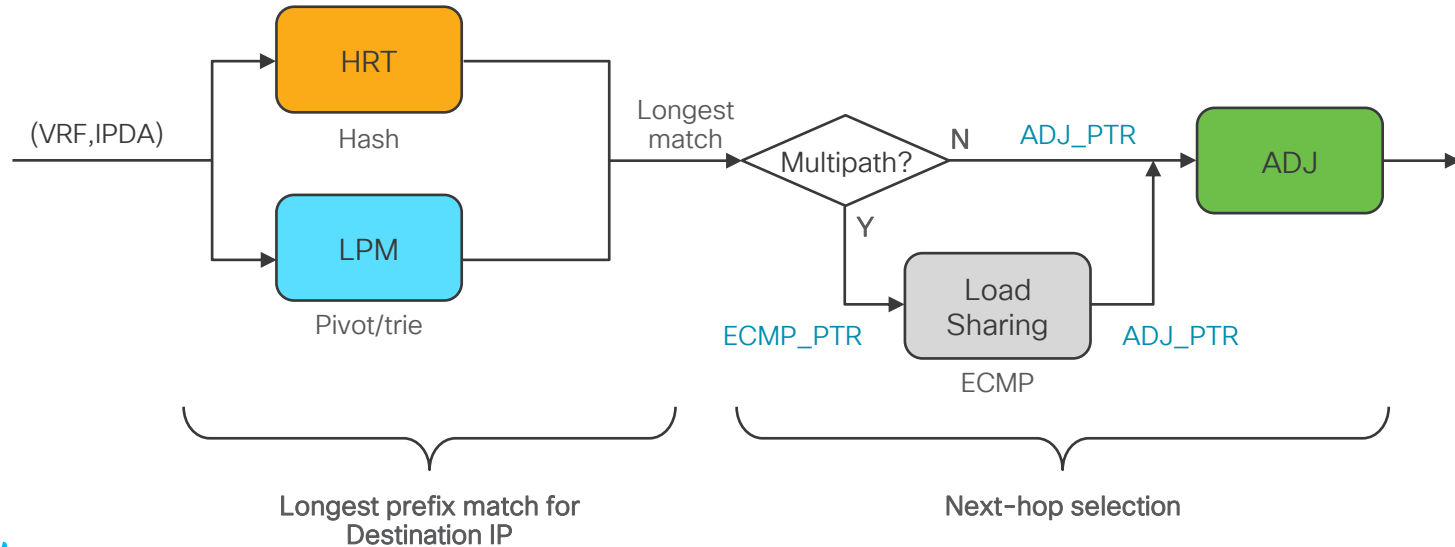
† Template not supported on modular Nexus 9500

** Template not supported on TORs



IP Unicast Forwarding

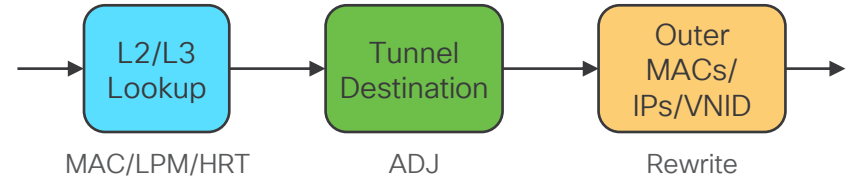
- Hardware lookup in flex tiles based on (VRF, IPDA)
- Longest-match from hash-based exact match (**HRT**) + pivot/trie match (**LPM**)
- Lookup result returns **adjacency** – directly or via **load-sharing** decision (ECMP)



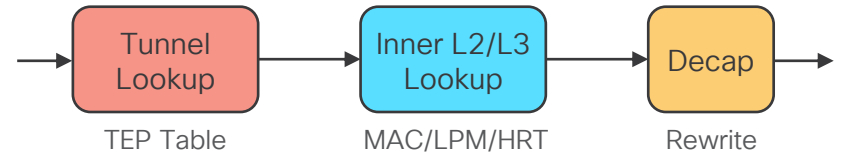
VXLAN Forwarding

- VXLAN and other tunnel encapsulation/decapsulation performed in single pass
- Encapsulation
 - L2/L3 lookup drives tunnel destination
 - Rewrite block drives outer header fields (tunnel MACs/IPs/VNID, etc.)
- Decapsulation
 - Outer lookup determines if tunnel is transit or terminated on local TEP
 - Inner lookup determines final output port and rewrites

Encapsulation



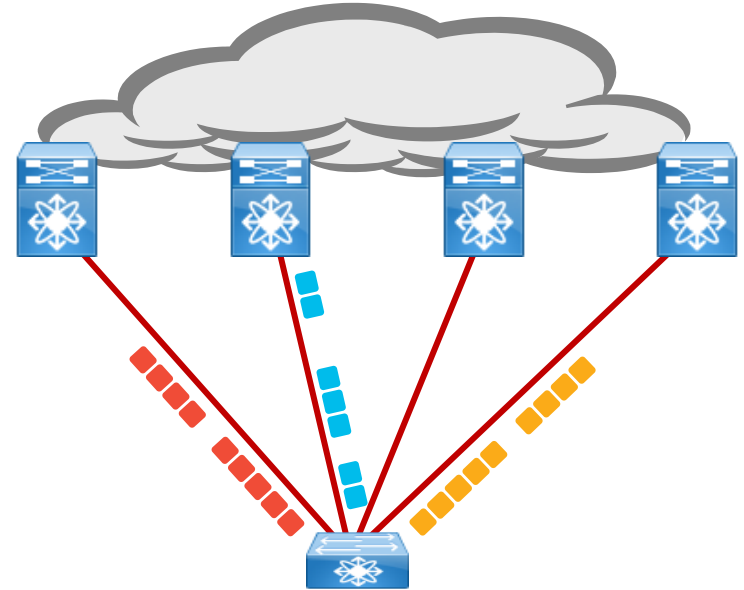
Decapsulation



Load Sharing

Equal-Cost Multipath (ECMP)

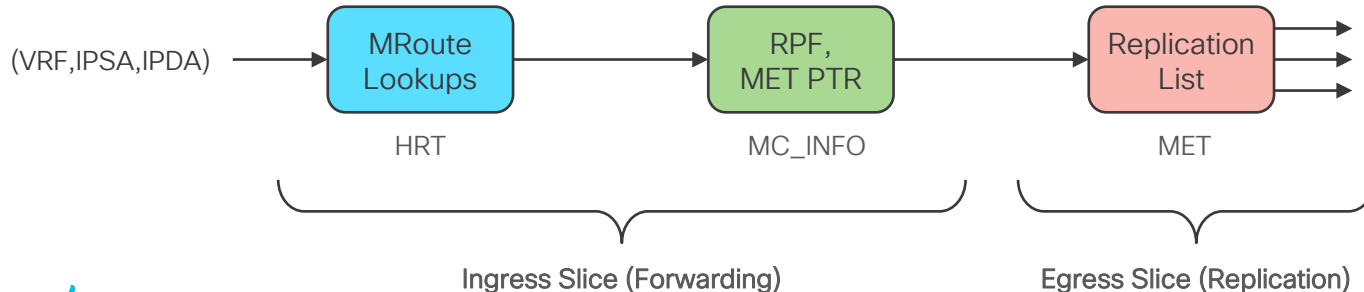
- Static flow-based load-sharing
- Picks ECMP next-hop based on hash of packet fields and universal ID
 - Source / destination IPv4 / IPv6 address (L3)
 - Source / destination TCP / UDP ports (L4)
 - L3 + L4 (default)
 - GRE key field
 - GTP TEID



ECMP

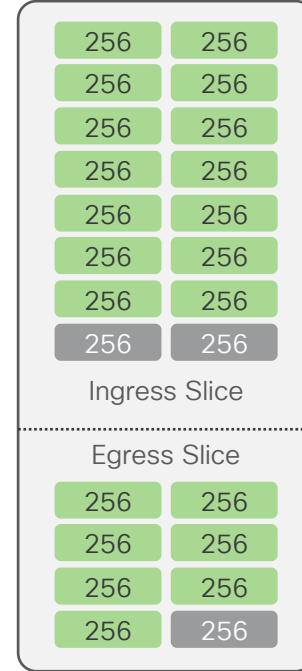
Multicast Forwarding

- Hardware performs multicast lookups in **HRT**
- Additional, secondary table for multicast also provisioned (“MC_INFO”) from flex tiles – **RPF check** and **MET pointer**
- **MET** in egress slice holds local output interface list (OIL)
- Replication is single copy, multiple reads

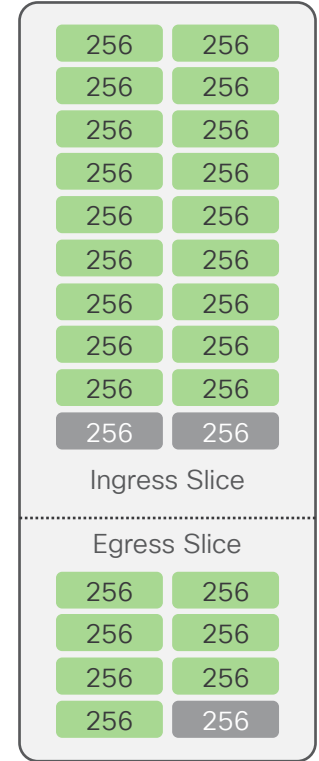


Classification TCAM

- Dedicated TCAM for packet classification
- Capacity varies depending on platform
- Leveraged by variety of features:
 - RACL / VACL / PACL
 - L2/L3 QOS
 - SPAN / SPAN ACL
 - NAT
 - COPP
 - Flow table filter



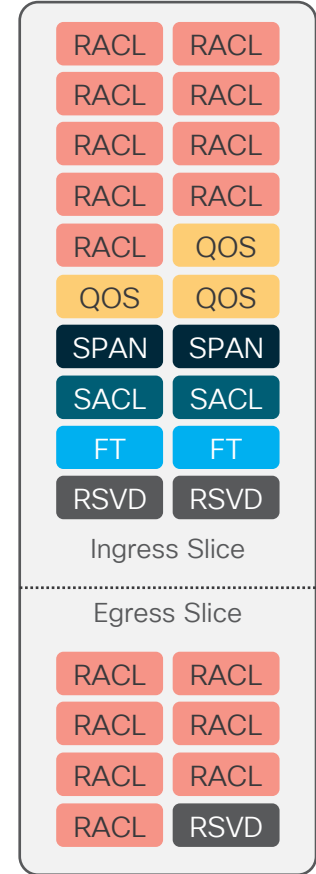
LS1800FX/FX3 /
LS3600FX2 / LS6400GX
5K ingress ACEs /
2K egress ACEs per slice



LS12800GX2B /
LS26500GX2A
6K ingress ACEs /
3K egress ACEs per slice

TCAM Region Resizing

- Default carving allocates 100% of TCAM and enables:
 - Ingress / Egress RACL
 - Ingress QOS
 - SPAN
 - SPAN ACLs
 - Flow table filter
 - Reserved regions
- Based on features required, user can resize TCAM regions to adjust scale
 - To increase size of a region, some other region must be sized smaller
- Region sizes defined at initialization – changing allocation requires system reboot
 - Configure all regions to desired size (“hardware access-list tcam region”), save configuration, and reload



Cloud Scale Hardware Telemetry

Flow Table (FT)

- Captures full data-plane packet flow information, plus metadata

Flow Table Events (FTE)

- Triggers notifications based on thresholds / criteria met by data-plane packet flows

Data-Plane Flow Data

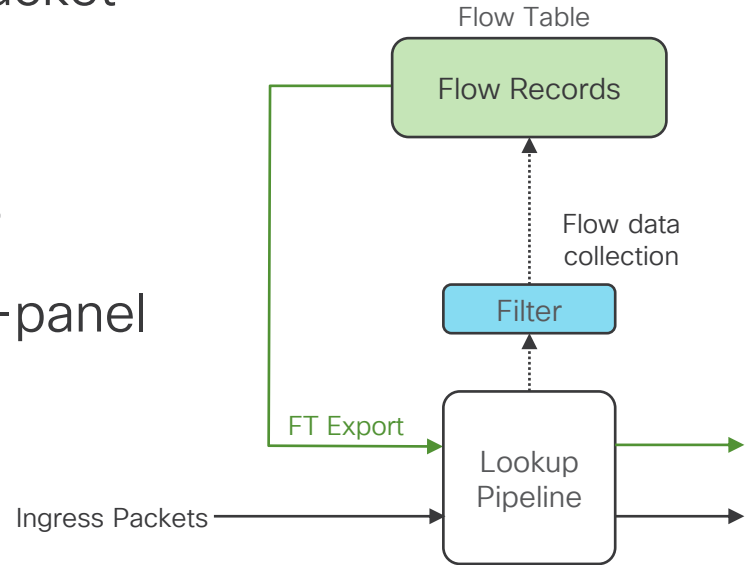
Flow Table

- Collects full flow information plus metadata
 - 5-tuple flow info
 - Interface/queue info
 - Flow start/stop time
 - Packet disposition (drop indicators)
 - Burst measurement
- 32K flow table entries per slice FX/FX2/FX3
- 64K flow table entries per slice on GX/GX2
- Direct hardware export
- Leveraged by Nexus Dashboard Insights, Netflow
- LS1800FX/FX3 / LS3600FX2 / LS6400GX / LS12800GX2B / LS25600GX2A platforms support hardware flow table



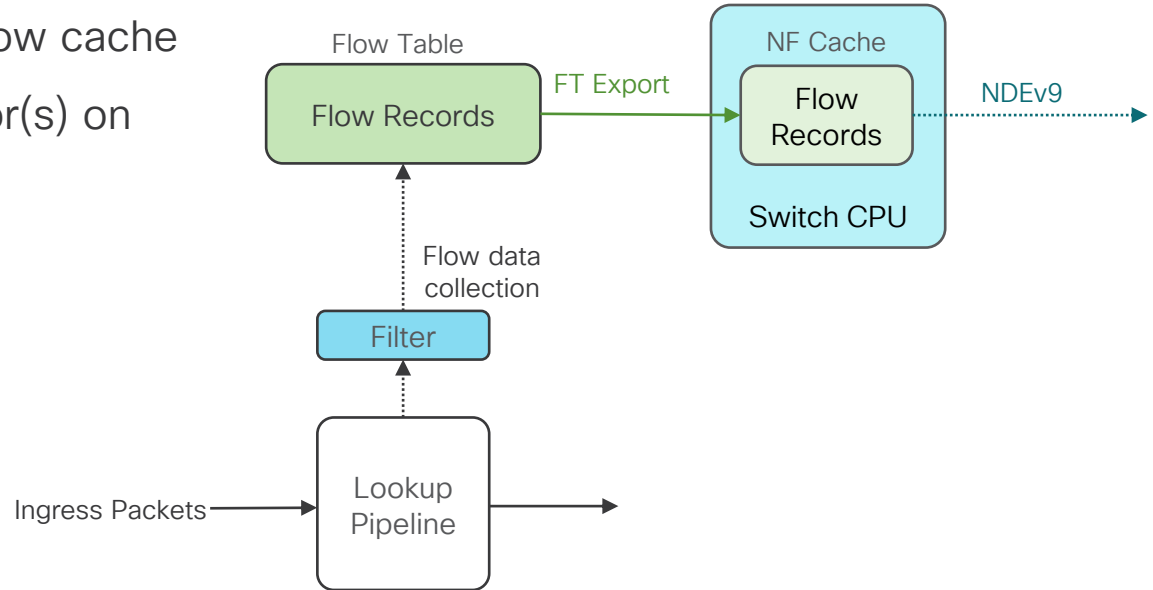
Flow Table Operation – ND Insights

- Determine if collection enabled for packet (filter TCAM)
- If so, install FT record
- Flush records, encapsulate in IP/UDP
- Perform lookup and forward on front-panel port



Flow Table Operation – Netflow

1. Install FT records as usual
2. Flush records to switch CPU
3. CPU builds traditional Netflow cache
4. NDEv9 exported to collector(s) on front-panel port or mgmt0



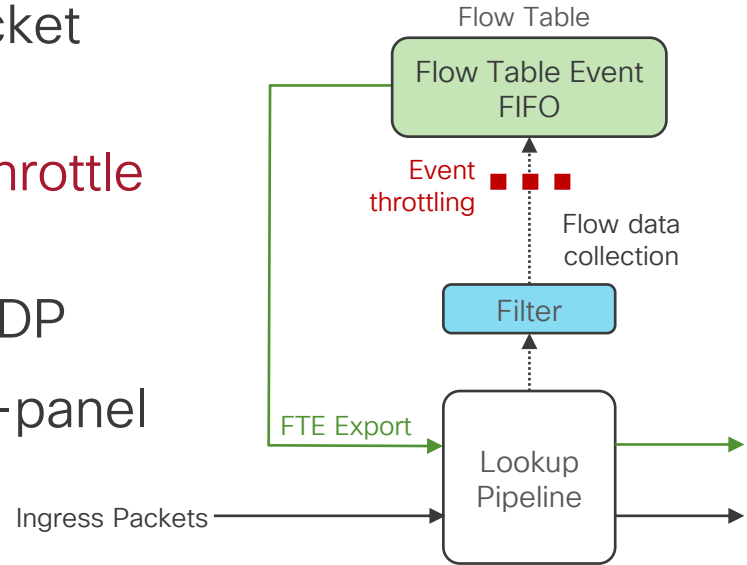
Flow Table Events

- Triggers notifications based on criteria / thresholds met by data-plane packet flows
- Collects full flow information plus metadata
 - 5-tuple flow info with timestamp
 - Interface/queue info
 - Buffer drop indication
 - Forwarding drop, ACL drop, policer drop indication
 - Latency/burst threshold exceeded indication
- Direct hardware export, with flow-level and global throttling
- LS1800FX/FX3 / LS3600FX2 / LS6400GX / LS12800GX2B / LS25600GX2A platforms support hardware flow table events



Flow Table Events Operation

- Determine if event(s) enabled for packet (filter TCAM)
- If so, collect flow data in FTE FIFO; **Throttle excess events**
- Flush and encapsulate record in IP/UDP
- Perform lookup and forward on front-panel port

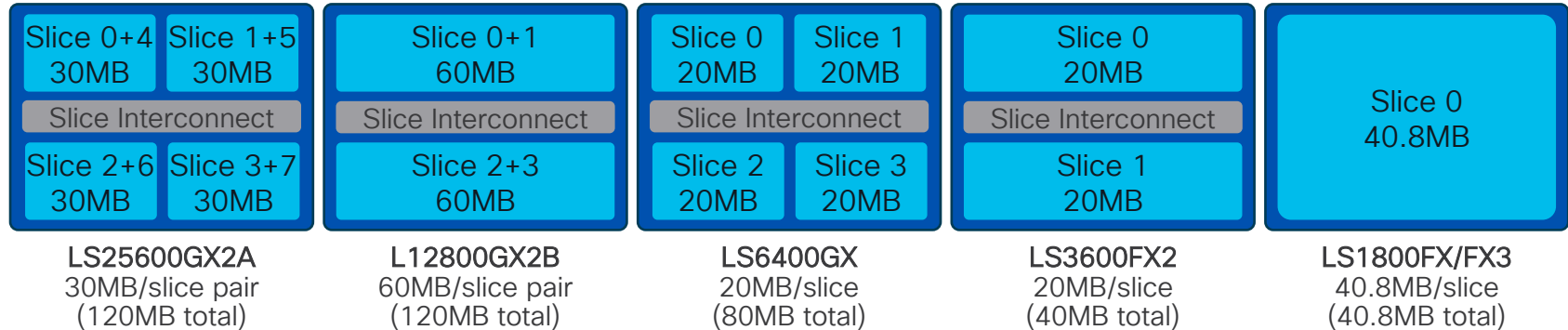


Hardware Telemetry Platform Support

Platform	ASIC	FT	FTE
9300-GX2A	LS25600GX2A	✓	✓
9300-GX2B	LS12800GX2B	✓	✓
9300-GX / X9700-GX	LS6400GX	✓	✓
9300-FX2	LS3600FX2	✓	✓
9300-FX3	LS1800FX3	✓	✓
9300-FX / X9700-FX	LS1800FX	✓	✓

Buffering

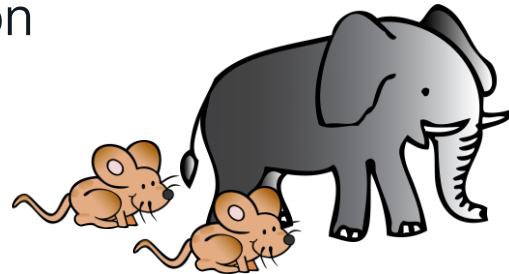
- Cloud Scale platforms implement shared-memory egress buffered architecture
- Each ASIC slice has dedicated buffer – only ports on that slice can use that buffer
- Dynamic Buffer Protection adjusts max thresholds based on class and buffer occupancy
- Intelligent buffer options maximize buffer efficiency



Intelligent Buffering

Innovative Buffer Management for Cloud Scale switches

- **Dynamic Buffer Protection (DBP)** – Controls buffer allocation for congested queues in shared-memory architecture
- **Approximate Fair Drop (AFD)** – Maintains buffer headroom per queue to maximize burst absorption
- **Dynamic Packet Prioritization (DPP)** – Prioritizes short-lived flows to expedite flow setup and completion



Images courtesy of:
<https://www.cler.com/clipart-206333.html>
<https://www.cler.com/clipart-cartoon-mouse.html>

Miercom Report: Speeding Applications in Data Center Networks
<http://miercom.com/cisco-systems-speeding-applications-in-data-center-networks/>

Dynamic Buffer Protection (DBP)

- Prevents any output queue from consuming more than its fair share of buffer in shared-memory architecture
- Defines dynamic max threshold for each queue
 - If queue length exceeds threshold, packet is discarded
 - Otherwise, packet is admitted to queue and scheduled for transmission
- Threshold calculated by multiplying free memory by configurable, per-queue **Alpha** (α) value (weight)
 - Alpha controls how aggressively DBP maintains free buffer pages during congestion events

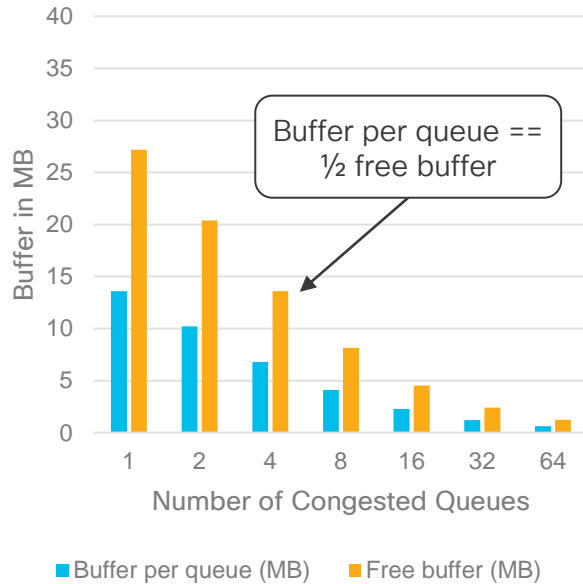
A large, bold, teal-colored Greek letter alpha symbol (α) is positioned on the right side of the slide.

Alpha Parameter Examples

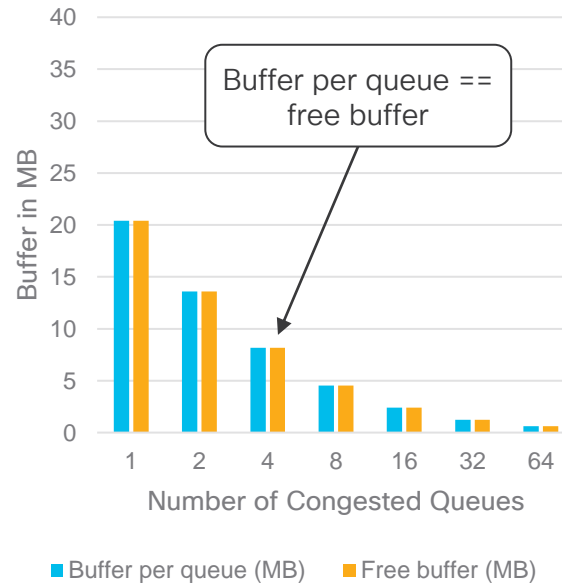
Default Alpha on
Cloud Scale switches



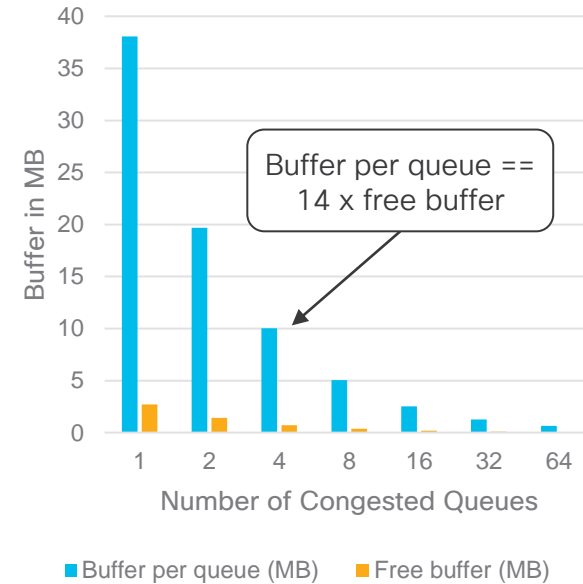
Alpha (α) = 0.5



Alpha (α) = 1

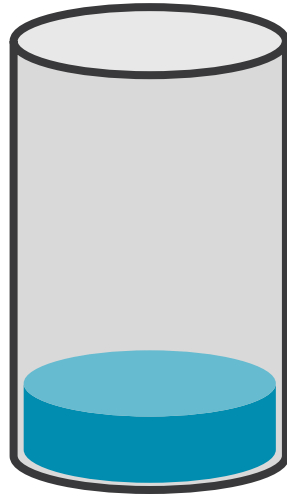


Alpha (α) = 14



Buffering – Ideal versus Reality

Ideal buffer state



Buffer available for burst absorption

Buffer consumed by sustained-bandwidth TCP flows

Sustained-bandwidth TCP flows
back off before all buffer
consumed



Actual buffer state



Buffer available for burst absorption

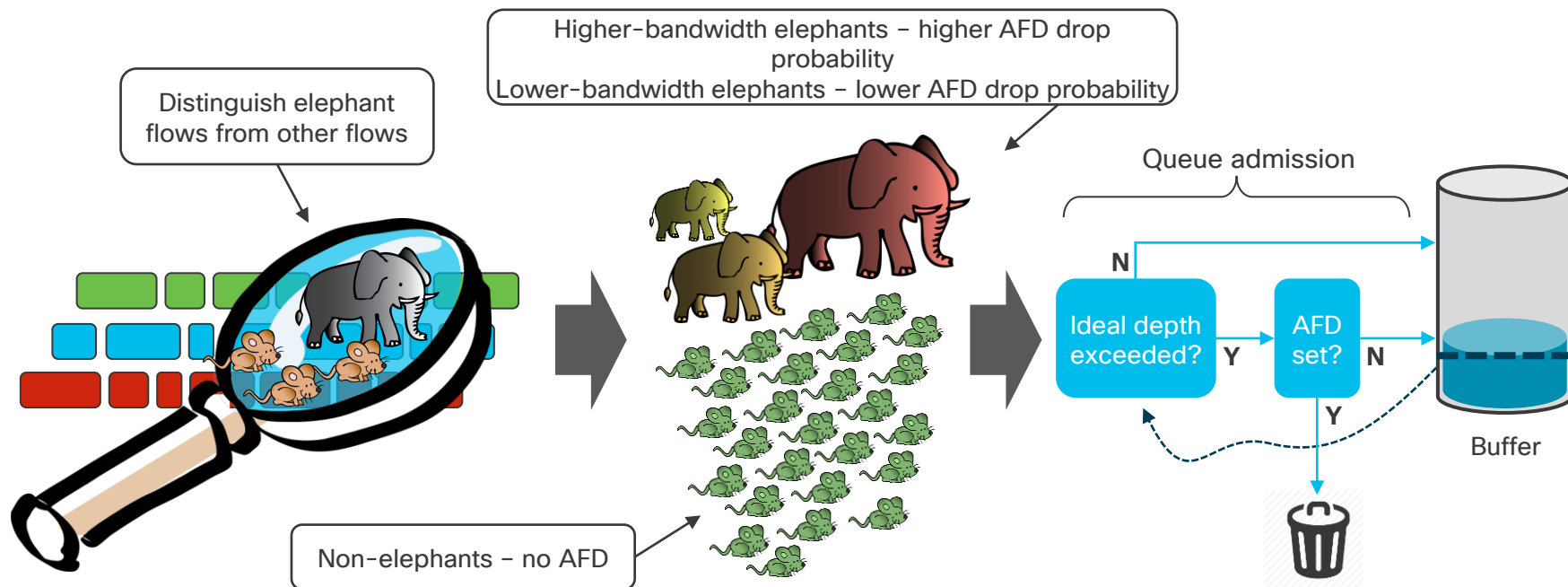
Buffer consumed by sustained-bandwidth TCP flows

Sustained-bandwidth TCP flows
consume all available
buffer before backing off



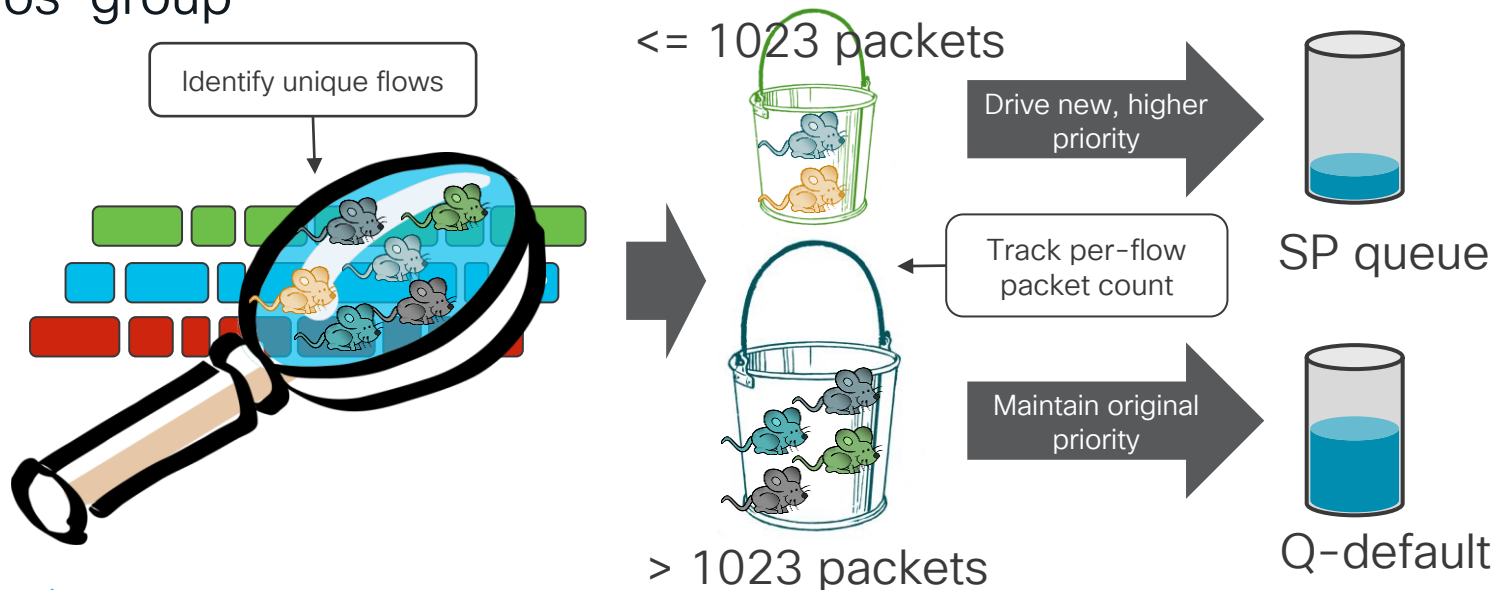
Approximate Fair Drop (AFD)

Maintain throughput while minimizing buffer consumption by elephant flows – **keep buffer state as close to the ideal as possible**

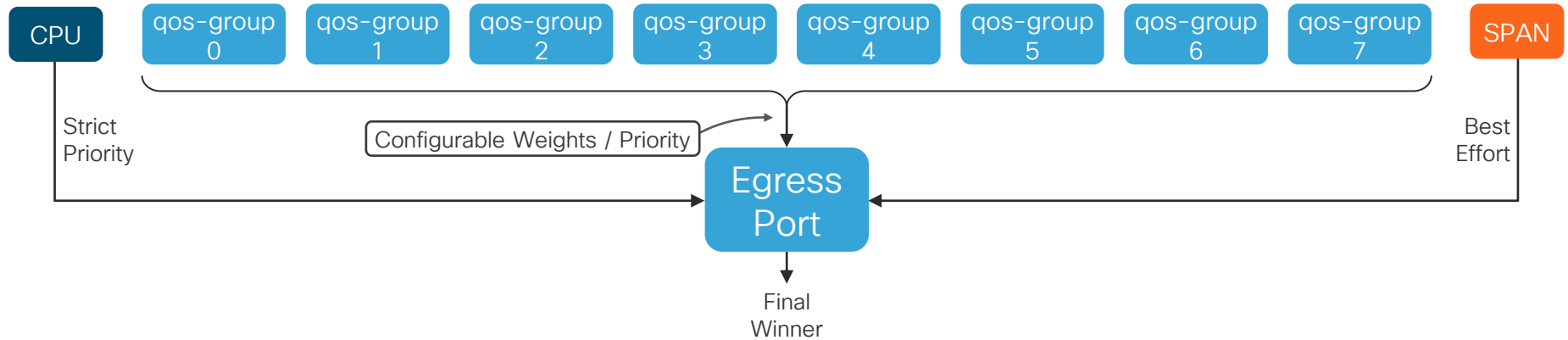


Dynamic Packet Prioritization (DPP)

- Prioritize initial packets of new / short-lived flows
- Up to first 1023 packets of each flow assigned to higher-priority qos-group



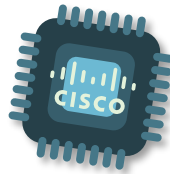
Queuing and Scheduling



- 8 qos-groups per output port – shared by unicast and multicast traffic
- Egress queuing policy defines priority and weights
- Dedicated classes for CPU traffic and SPAN traffic

Agenda

- Data Center and Silicon Strategy
- Cloud Scale ASIC Architecture
- Cloud Scale Switching Platforms
- Packet Walks
- Key Takeaways



Cloud Scale Platforms

Nexus 9300-FX/FX2/FX3, GX/GX2 and 9408

- Premier TOR platforms
- Full Cloud Scale functionality
- ACI leaf / standalone leaf or spine
- FX option with MACSEC using LS1800FX silicon
- FX2 option with key enhancements using LS3600FX2 silicon
- GX option with 400G and SRv6
- GX2 high density 400G

Nexus 9500 with X9700-FX and X9700-GX Modules

- Switching modules for Nexus 9500 modular chassis
- Full Cloud Scale functionality
- ACI spine / standalone aggregation or spine
- FX option with MACSEC using LS1800FX silicon
- GX option with MACSEC

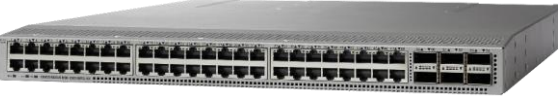
Nexus 9300-EX Cloud Scale TOR Switches

Key Features



**48-port 10/25G SFP28 +
6-port 100G QSFP28**

N9K-C93180YC-EX – LSE-based
ACI: 1.3(1)
NX-OS: 7.0(3)I4(2)



**48-port 1/10GBASE-T +
6-port 100G QSFP28**

N9K-C93108TC-EX – LSE-based
ACI: 2.0(1)
NX-OS: 7.0(3)I4(2)

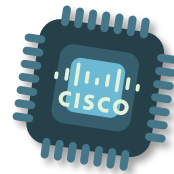
Dual capability – ACI and NX-OS mode

Flexible port configurations –
1/10/25/40/50/100G

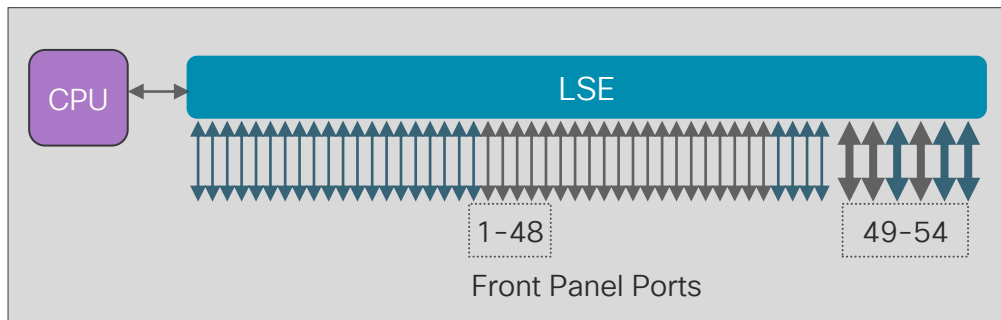
Native 25G server access ports

Flow Table for ND Insights, Netflow

Smart buffer capability (AFD / DPP)



Nexus 9300-EX Switch Architectures



C93180YC-EX (10/25G + 100G) /
C93108TC-EX (10G + 100G)



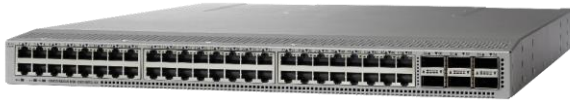
Nexus 9300-FX Cloud Scale TOR Switches

Pervasive MACSEC



**48-port 10/25G SFP28 +
6-port 100G QSFP28**

N9K-C93180YC-FX -
LS1800FX-based
ACI: 2.2(2e)
NX-OS: 7.0(3)I7(1)



**48-port 1/10GBASE-T +
6-port 100G QSFP28**

N9K-C93108TC-FX -
LS1800FX-based
ACI: 2.2(2e)
NX-OS: 7.0(3)I7(1)



**48-port 100M/1GBASE-T +
4-port 10G/25G + 2-port
100G QSFP28**

N9K-C9348GC-FXP -
LS1800FX-based
ACI: 3.0(1)
NX-OS: 7.0(3)I7(1)

Key Features

Dual capability – ACI and NX-OS mode

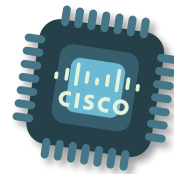
Flexible port configurations –
100M/1/10/25/40/50/100G

Line-rate 256-bit encryption on all ports

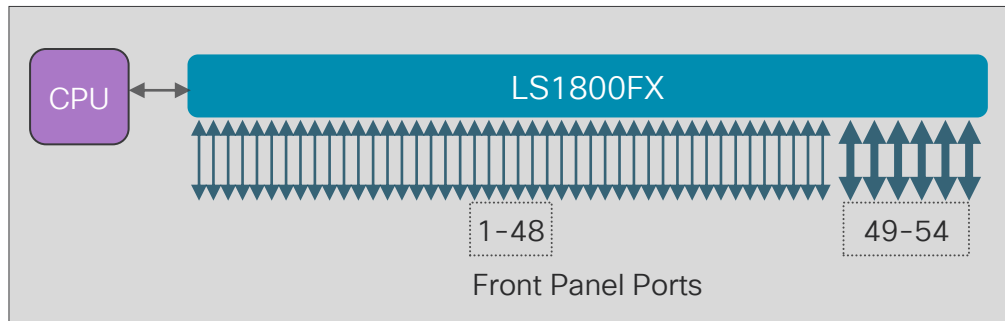
32G FC support on all SFP ports

Flow Table for ND Insights, Netflow

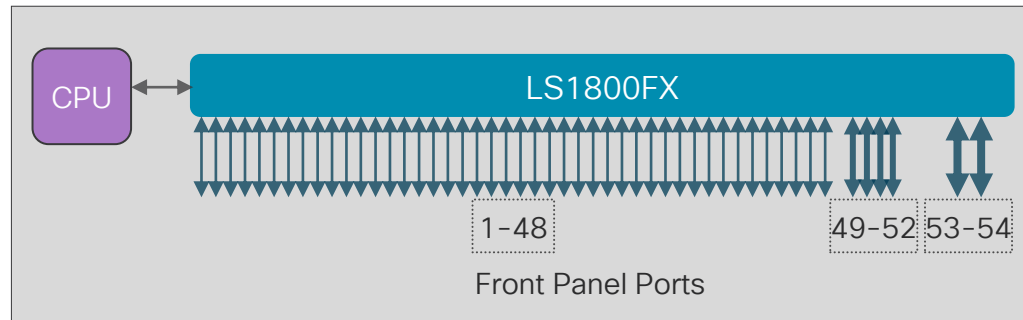
Smart buffer capability (AFD / DPP)



Nexus 9300-FX Switch Architectures



C93180YC-FX (10/25G + 100G) /
C93108TC-FX (10G + 100G)



C9348GC-FXP (100M/1G + 10/25G + 100G)

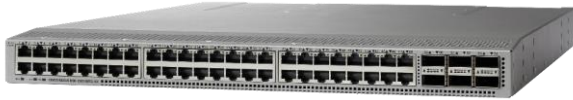
Nexus 9300-FX3 Cloud Scale TOR Switches

Pervasive MACSEC



**48-port 10/25G SFP28 +
6-port 100G QSFP28**

N9K-C93180YC-FX3 -
LS1800FX3-based
ACI: 5.1(3)
NX-OS: 9.3(7)



**48-port 1/10GBASE-T +
6-port 100G QSFP28**

N9K-C93108TC-FX3P -
LS1800FX3-based
ACI: 5.1(3)
NX-OS: 9.3(7)

Key Features

Dual capability – ACI and NX-OS mode

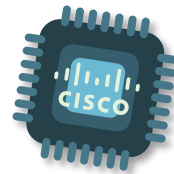
Flexible port configurations –
100M/1/10/25/40/50/100G

Flow Table for ND Insights, Netflow

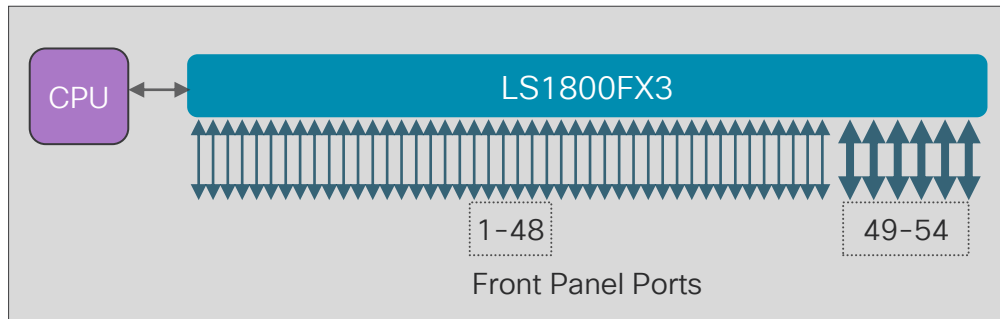
MACSEC on all ports

Smart buffer capability (AFD / DPP)

Teleco PTP and SyncE on N93180YC-FX3



Nexus 9300-FX3 Switch Architectures



C93180YC-FX3 (10/25G + 100G) /
C93108TC-FX3P (10G + 100G)

↕ Slice 0

Nexus 9300-FX2 Cloud Scale TOR Switches



36-port 100G QSFP28

N9K-C9336C-FX2 - LS3600FX2-based

ACI: 3.1(2)

NX-OS: 7.0(3)I7(3)



48-port 10/25G SFP28 + 12-port 100G QSFP28

N9K-C93240YC-FX2 - LS3600FX2-based

ACI: 4.0(1)

NX-OS: 7.0(3)I7(3)



96-port 10/25G SFP28 + 12-port 100G QSFP28

N9K-C93360YC-FX2 - LS3600FX2-based

ACI: 4.1(2)

NX-OS: 9.3(1)



96-port 1/10GBASE-T + 12-port 100G QSFP28

N9K-C93216TC-FX2 - LS3600FX2-based

ACI: 4.1(2)

NX-OS: 9.3(1)

Key Features

Dual capability – ACI and NX-OS mode

Versatile standalone 100G switch (9336C)

High-performance 100G ACI leaf switch (9336C)

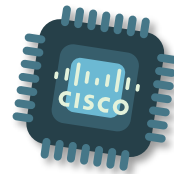
100G/50G/40G/10G with breakout capability

2RU copper/fiber options for high density racks

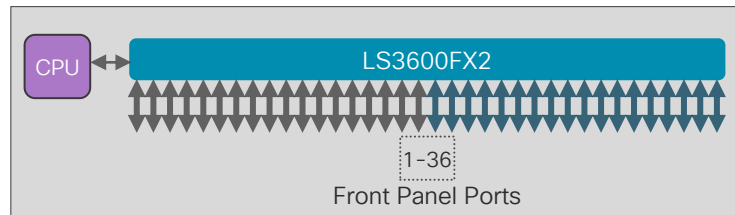
Flow Table for Network Insights, Netflow

MACSEC on all ports

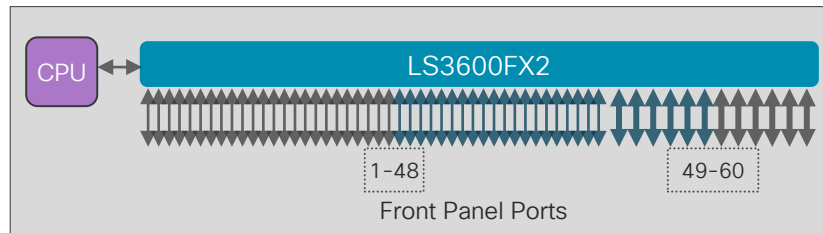
Smart buffer capability (AFD / DPP)



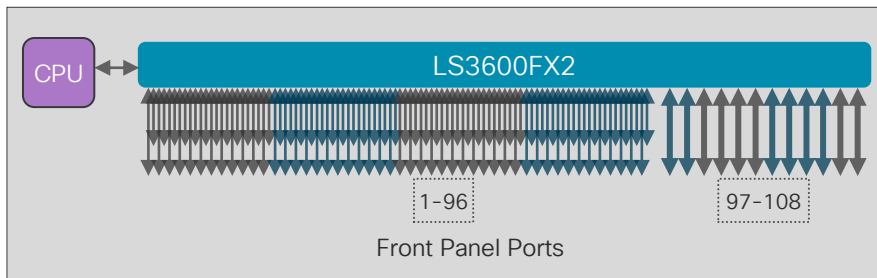
Nexus 9300-FX2 Switch Architecture



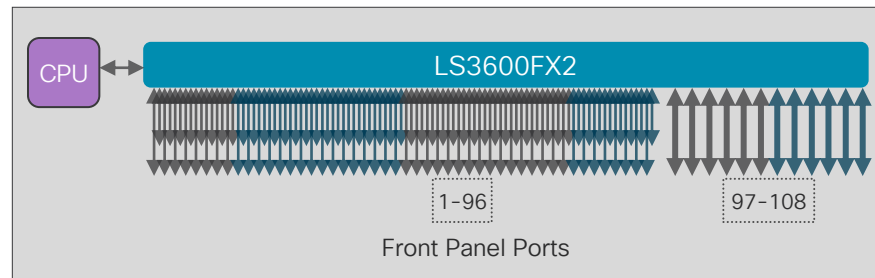
C9336C-FX2 (100G)



C93240YC-FX2 (10/25G + 100G)



N9K-C93360YC-FX2 (10/25G + 100G)



N9K-C93216TC-FX2 (1/10G + 100G)



Nexus 9300-GX Cloud Scale TOR Switches



16-port 400G QSFP-DD

N9K-C9316D-GX - LS6400GX-based

ACI: 4.2(2)

NX-OS: 9.3(3)



28-port 100G QSFP28 +

8-port 400G QSFP-DD

N9K-C93600CD-GX - LS6400GX-based

ACI: 4.2(2)

NX-OS: 9.3(3)



64-port 100G QSFP28

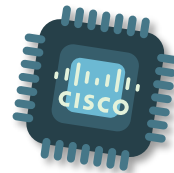
N9K-C9364C-GX - LS6400GX-based

ACI: 4.2(3I)

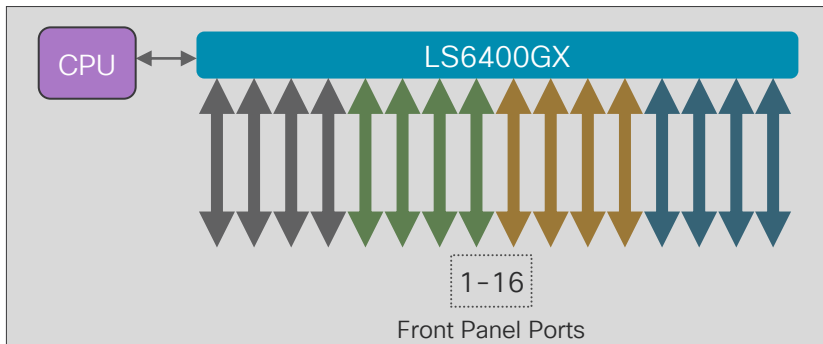
NX-OS: 9.3(3)

Key Features

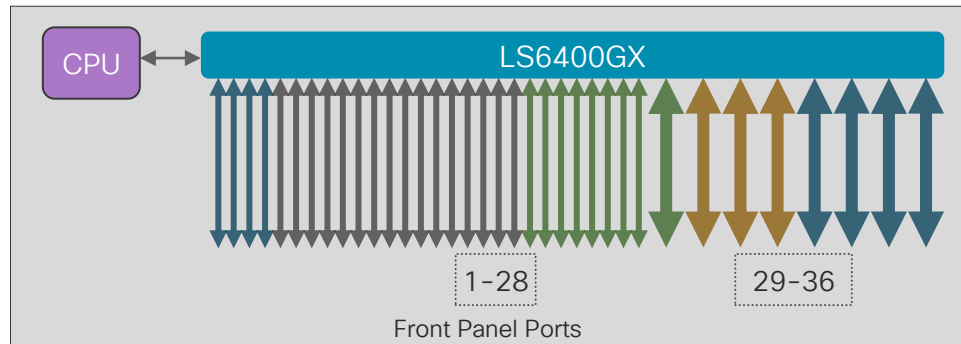
Dual capability – ACI and NX-OS mode
First 400G-capable Cloud Scale platforms
400G ACI/standalone spine (9316D-GX)
100G leaf with 400G uplinks (93600CD)
64-port 100G fixed TOR
400G/100G/50G/40G/10G with breakout capability
Flow Table for Network Insights, Netflow
Smart buffer capability (AFD / DPP)



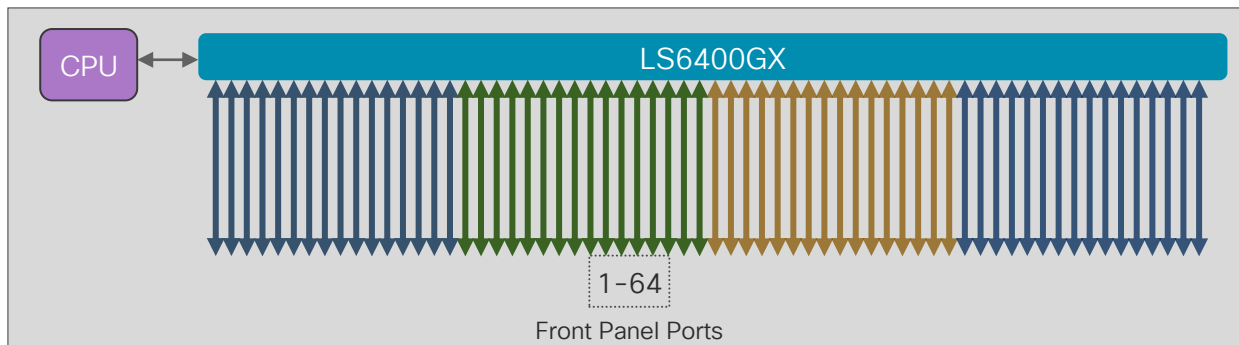
Nexus 9300-GX Switch Architecture



C9316D-GX (400G)



C93600CD-GX (100G + 400G)

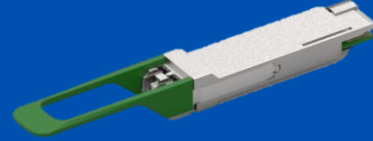


C9364C-GX (100G)



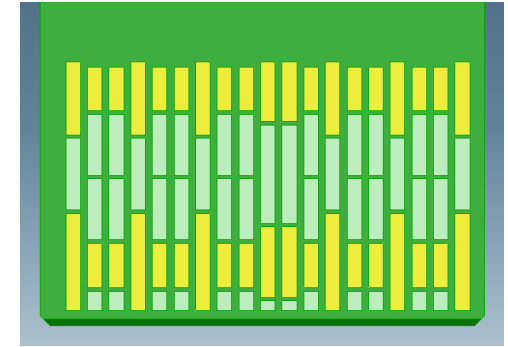
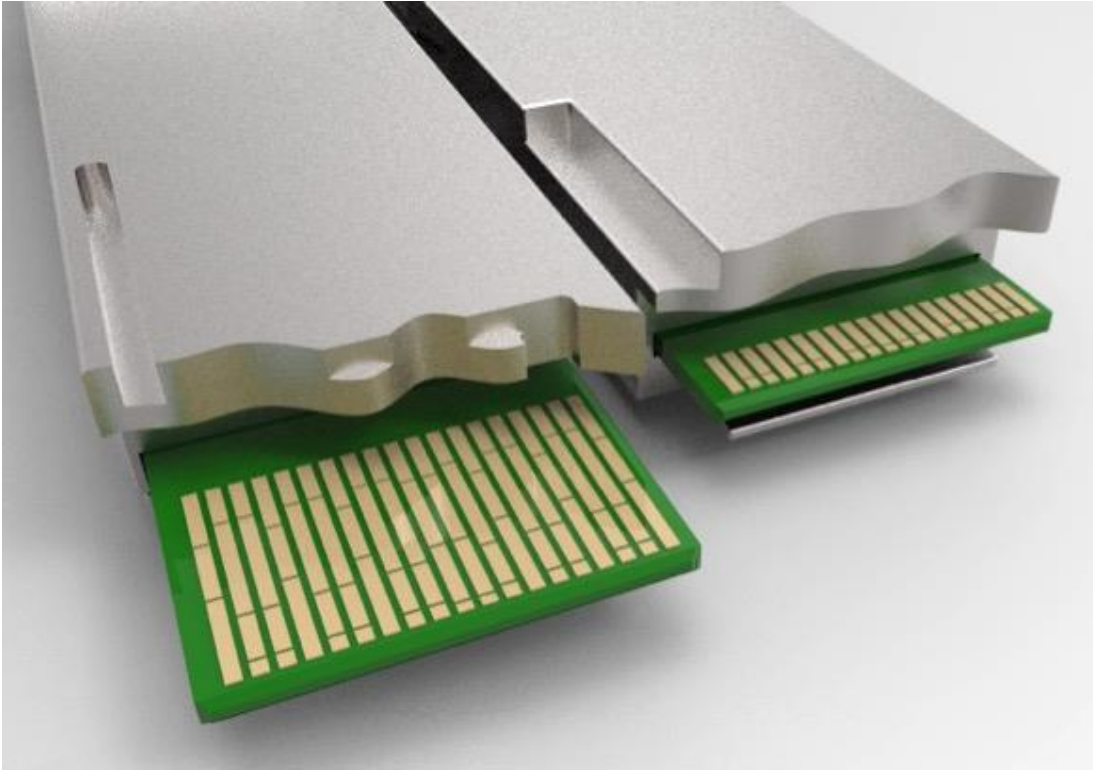
400G Transceivers – QSFP-DD

QSFP-DD



- ✓ Same front-panel dimensions as QSFP28
- ✓ Backward compatible with QSFP+ & QSFP28
- ✓ Can support 25G, 50G & 100G SERDES
- ✓ Supports all media (Fiber & Copper)
- ✓ Supports all reaches (3m – 100km)
- ✓ Meets thermal & signal integrity requirements for 400G

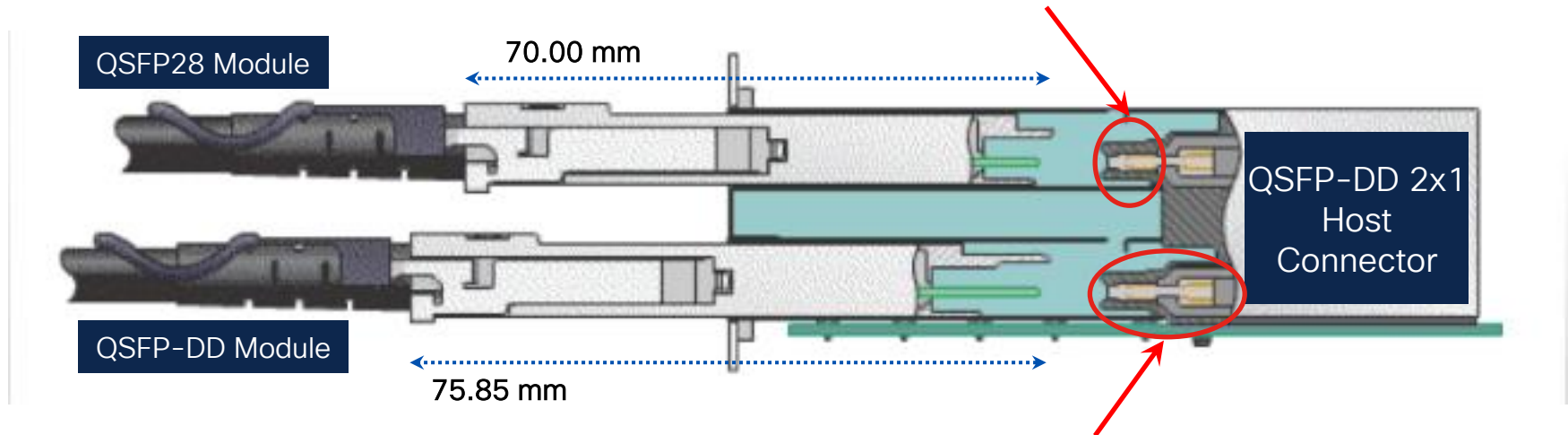
QSFP-DD Module



Additional 4 lanes doubles
the density

QSFP-DD Compatibility With QSFP28

Inserting QSFP28 engages only the first row of contacts



Inserting QSFP-DD goes deeper & engages both rows of contacts

Nexus 9300-GX2B Cloud Scale TOR Switches

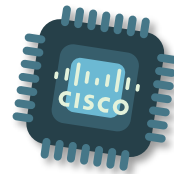


32-port 400G QSFP-DD

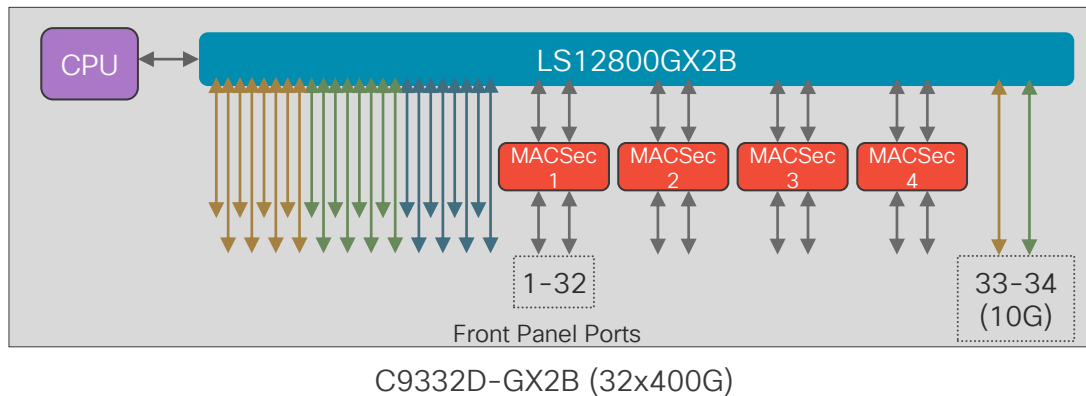
N9K-C9332D-GX2B
LS12800GX2B-based
ACI: 5.2(3)
NX-OS: 10.2(1q)

Key Features

Dual capability – ACI and NX-OS mode
400G-capable Cloud Scale platforms
400G ACI/standalone spine
400G/100G/50G/40G/10G with breakout capability
Flow Table for Network Insights, Netflow
Smart buffer capability (AFD / DPP)



Nexus 9300-GX2B Switch Architecture



Nexus 9300-GX2A Cloud Scale TOR Switches



64-port 400G QSFP-DD

N9K-C9364D-GX2A - LS25600GX2A-based
ACI: 5.2(5)
NX-OS: 10.2(3)



48-port 400G QSFP-DD

N9K-C9348D-GX2A - LS25600GX2A-based
ACI: 5.2(5)
NX-OS: 10.2(3)

Key Features

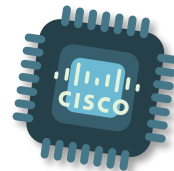
Dual capability – ACI and NX-OS mode
400G-capable Cloud Scale platforms
400G/100G/50G/40G/10G with breakout capability

MACSEC support:

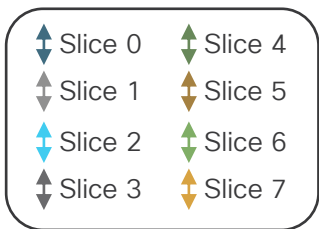
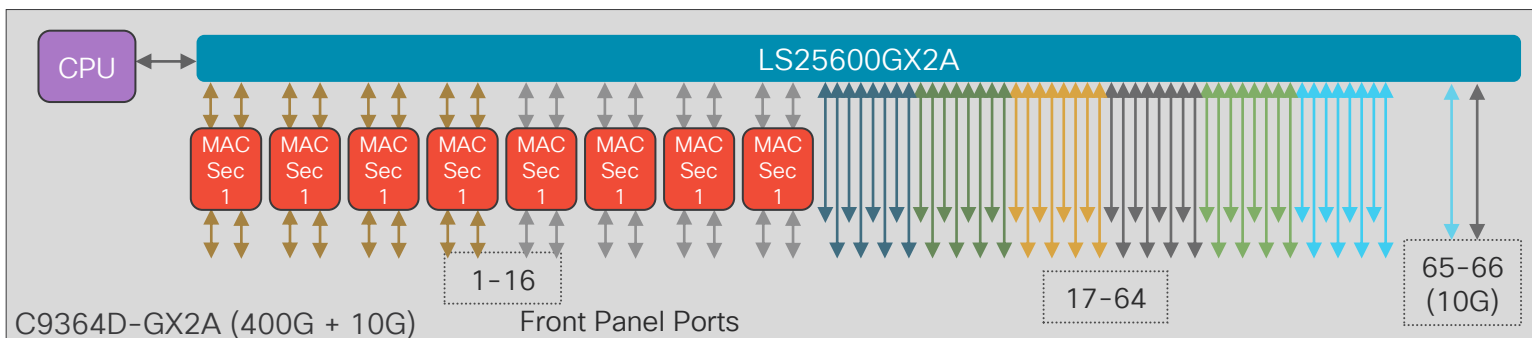
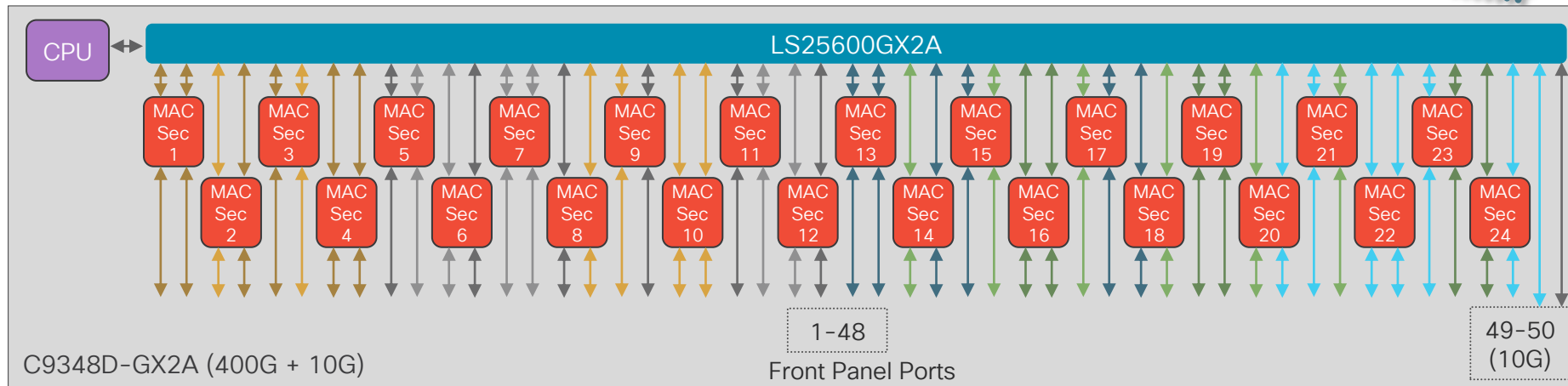
N9364D-GX2A: First 16 ports

N9348D-GX2A: All of the ports

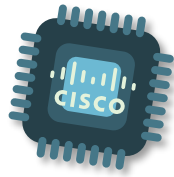
Flow Table for Network Insights, Netflow
Smart buffer capability (AFD / DPP)



Nexus 9300-GX2A Switch Architecture



Nexus 9400 Centralized Modular Switches



Nexus 9408

Chassis and Centralized Forwarding



Line-card Expansion-Module (LEM)

Nexus 9408 Cloud Scale Centralized Modular



64-port 400G QSFP-DD
N9K-C9408 – LS25600GX2A-based
ACI: 6.0(2)
NX-OS: 10.3(2)



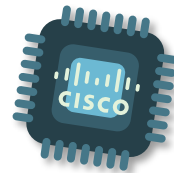
8-port 400G QSFP-DD
X9400-8D LEM

16-port 200G QSFP56
X9400-16W LEM

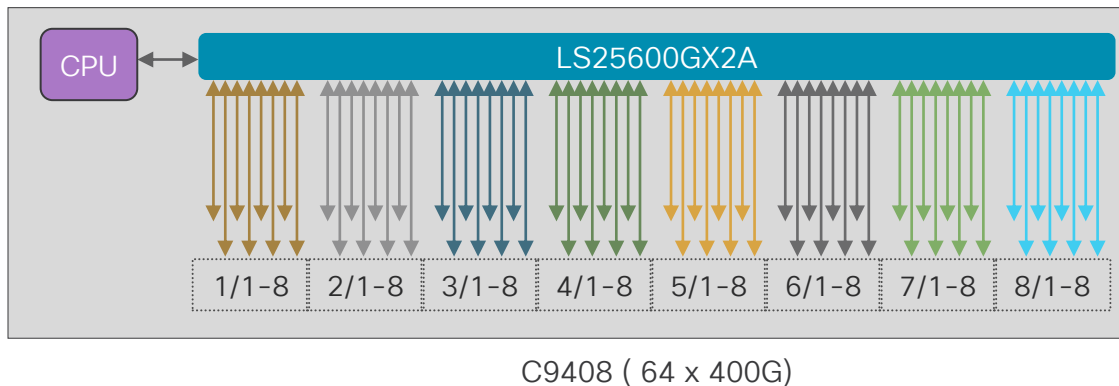
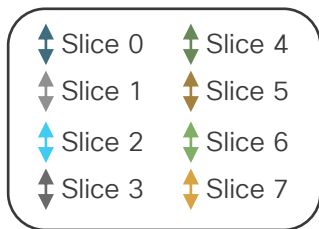
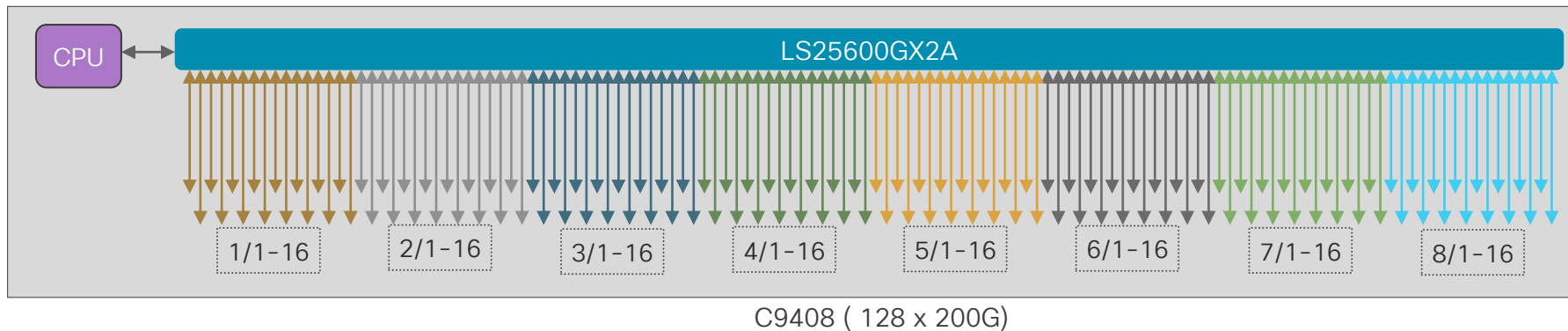


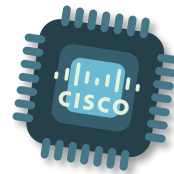
Key Features

- Dual capability – ACI and NX-OS mode
- 400G-capable Cloud Scale platforms
- Based on LS25600GX2A ASIC
- 400G/100G/50G/40G/10G with breakout capability
- MACSec support
- Flow Table for Network Insights, Netflow
- Smart buffer capability (AFD / DPP)

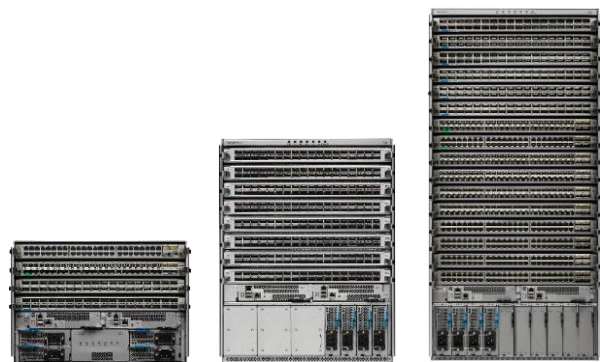


Nexus 9408 Switch Architecture





Nexus 9500 Modular Cloud Scale Switches

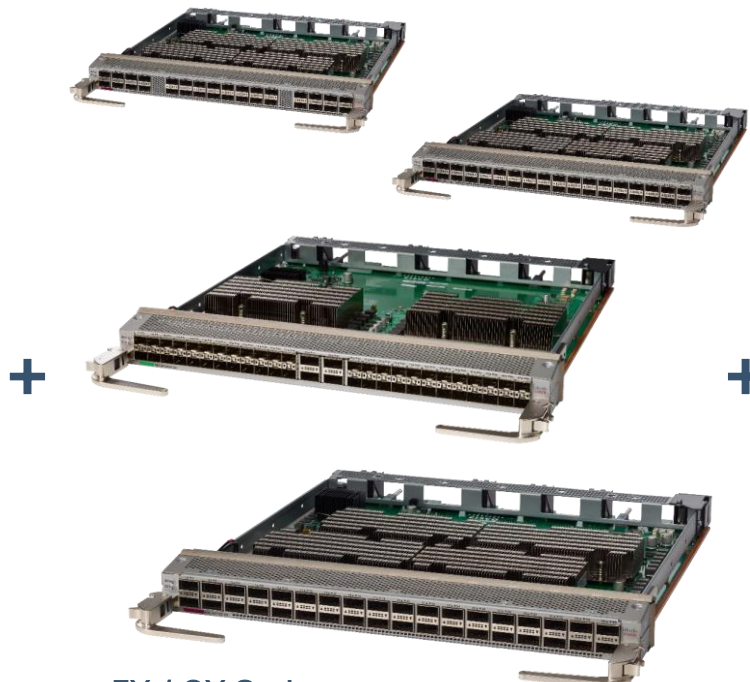


Nexus 9504

Nexus 9508

Nexus 9516

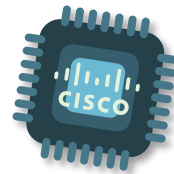
Common Equipment



FX / GX Series
Line Cards



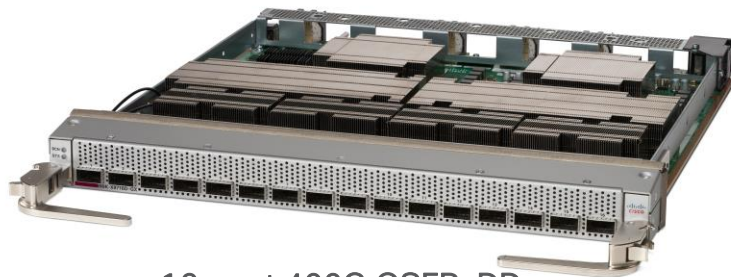
E2 / G-Series
Fabric Modules



X9700-GX 400G Cloud Scale Modules

N9K-X9716D-GX

Key Features



16-port 400G QSFP-DD

X9716D-GX – LS6400GX-based

ACI: 5.1

NX-OS: 10.1(1)

9716D-DX – Dual capability ACI and NX-OS

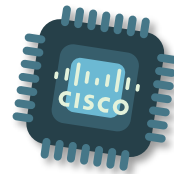
6.4Tbps capacity per module

Flexible port configurations –
10/25/40/50/100/400G with breakout

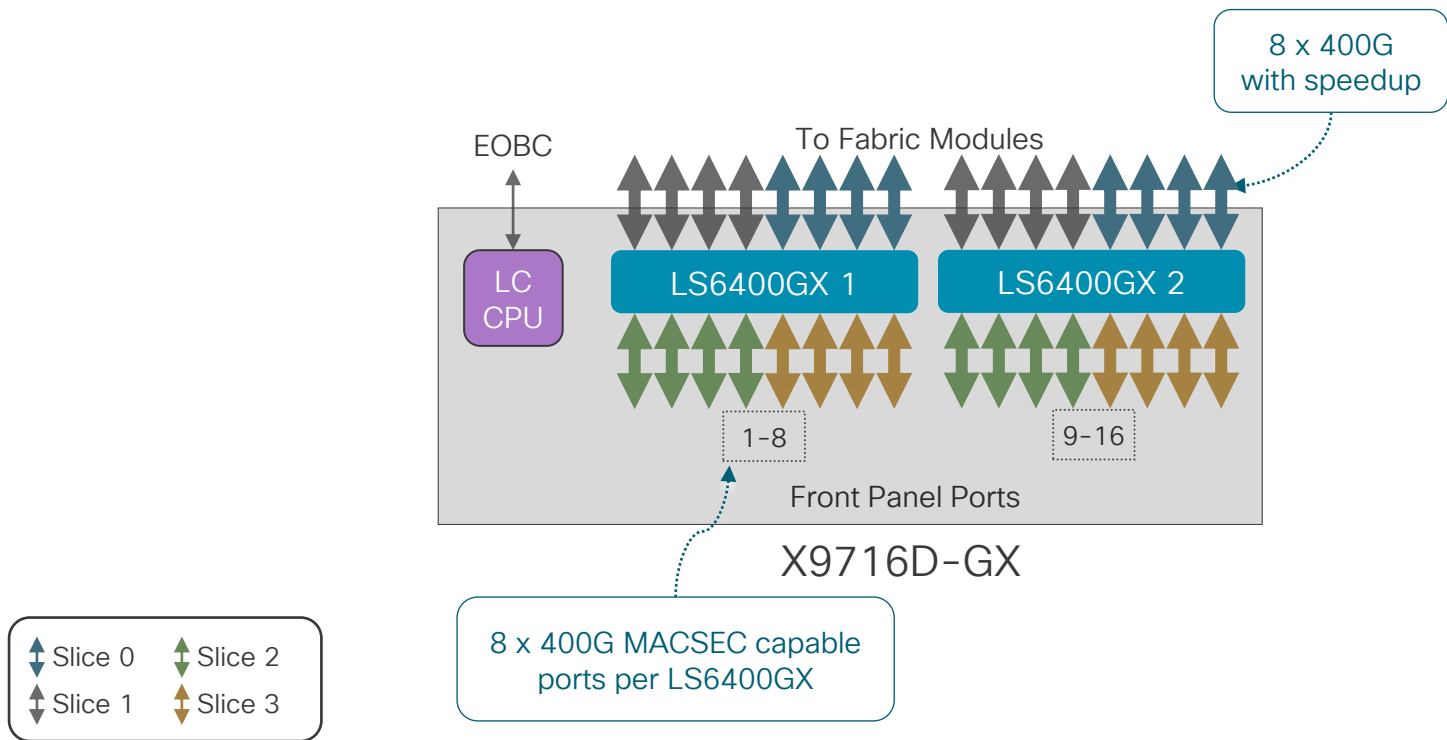
Line-rate MACSEC on all ports

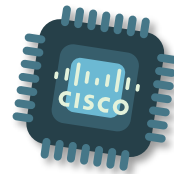
Flow Table for Network Insights, NetFlow

Smart buffer capability (AFD / DPP)



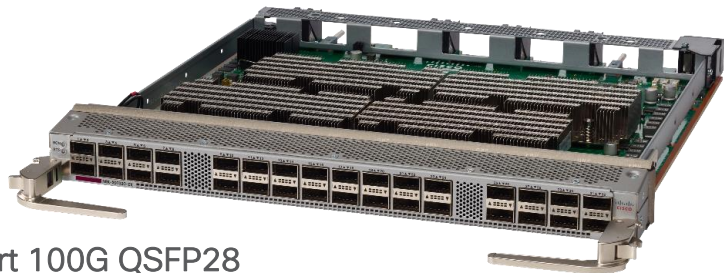
N9K-X9716D-GX Architecture





X9700-EX 100G Cloud Scale Modules

N9K-X9732C-EX / N9K-X9736C-EX



32-port 100G QSFP28

X9732C-EX – LSE-based

ACI: 1.3(1)

NX-OS: 7.0(3)I4(2)



36-port 100G QSFP28

X9736C-EX – LSE-based

ACI: Not supported

NX-OS: 7.0(3)I6(1)

Key Features

9732C-EX – Dual capability ACI and NX-OS

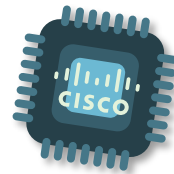
9736C-EX – NX-OS only

3.2Tbps capacity per module

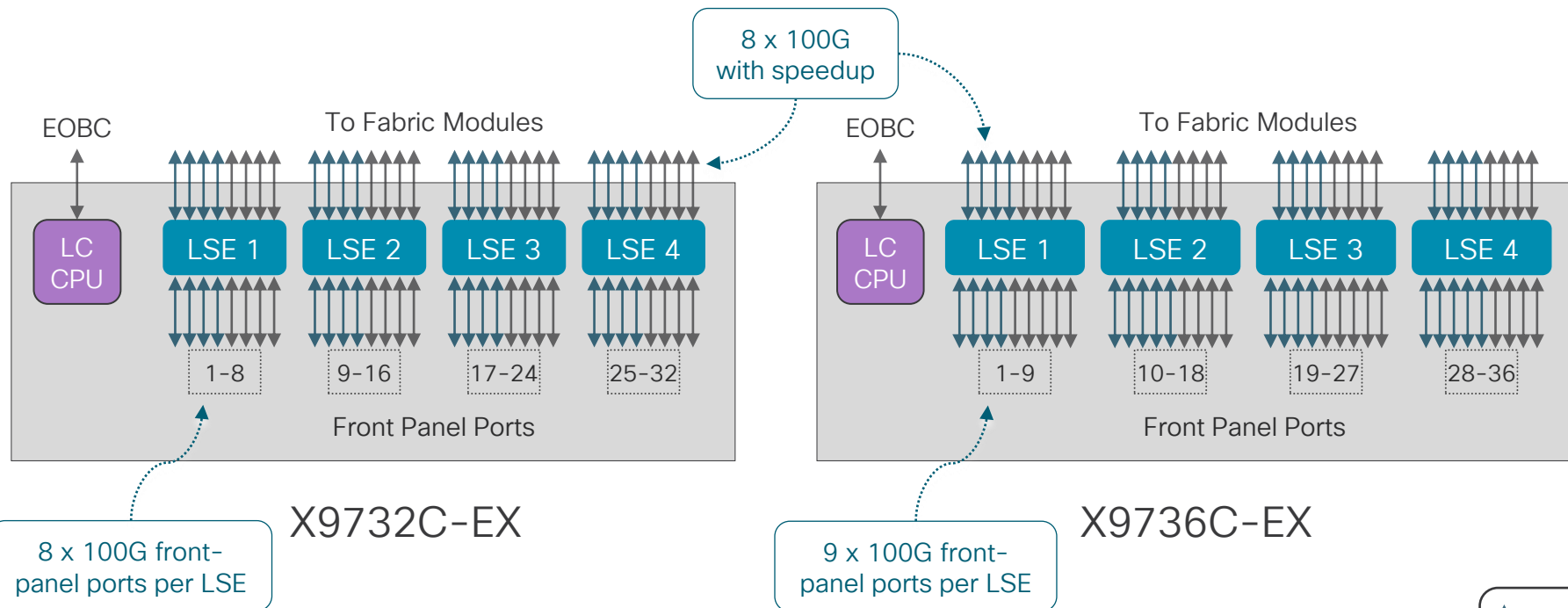
Flexible port configurations –
10/25/40/50/100G with breakout

Flow Table for Network Insights, Netflow

Smart buffer capability (AFD / DPP)

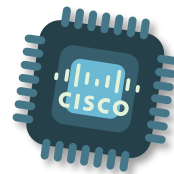


N9K-X9732C-EX / N9K-X9736C-EX Architecture

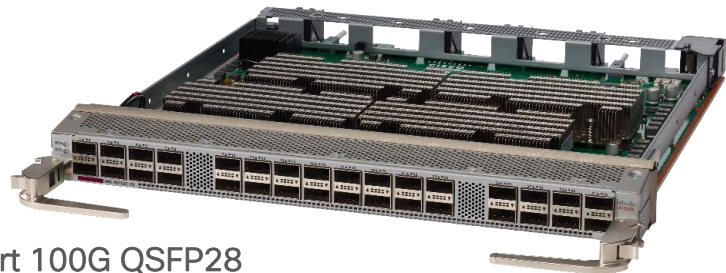


X9700-FX 100G Cloud Scale Modules

N9K-X9732C-FX / N9K-X9736C-FX



Key Features

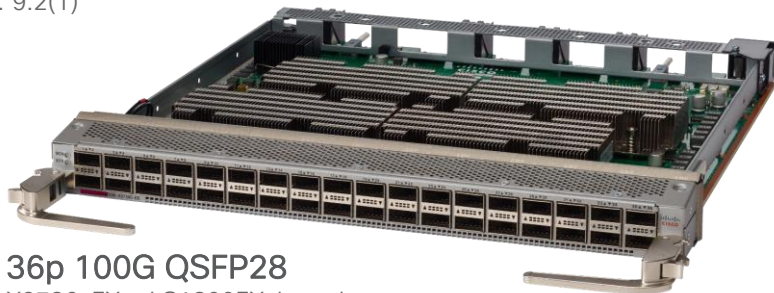


32-port 100G QSFP28

X9732C-FX – LS1800FX-based

ACI: Not supported

NX-OS: 9.2(1)



36p 100G QSFP28

X9736C-FX – LS1800FX-based

ACI: 13.0(1)

NX-OS: NX-OS: 7.0(3)I7(3)

9732C-FX – NX-OS only

9736C-FX – Dual capability ACI and NX-OS

3.2Tbps capacity per module

3.6Tbps capacity with optional 5th fabric module on 9736C-FX

N+1 fabric redundancy option on 9732C-FX

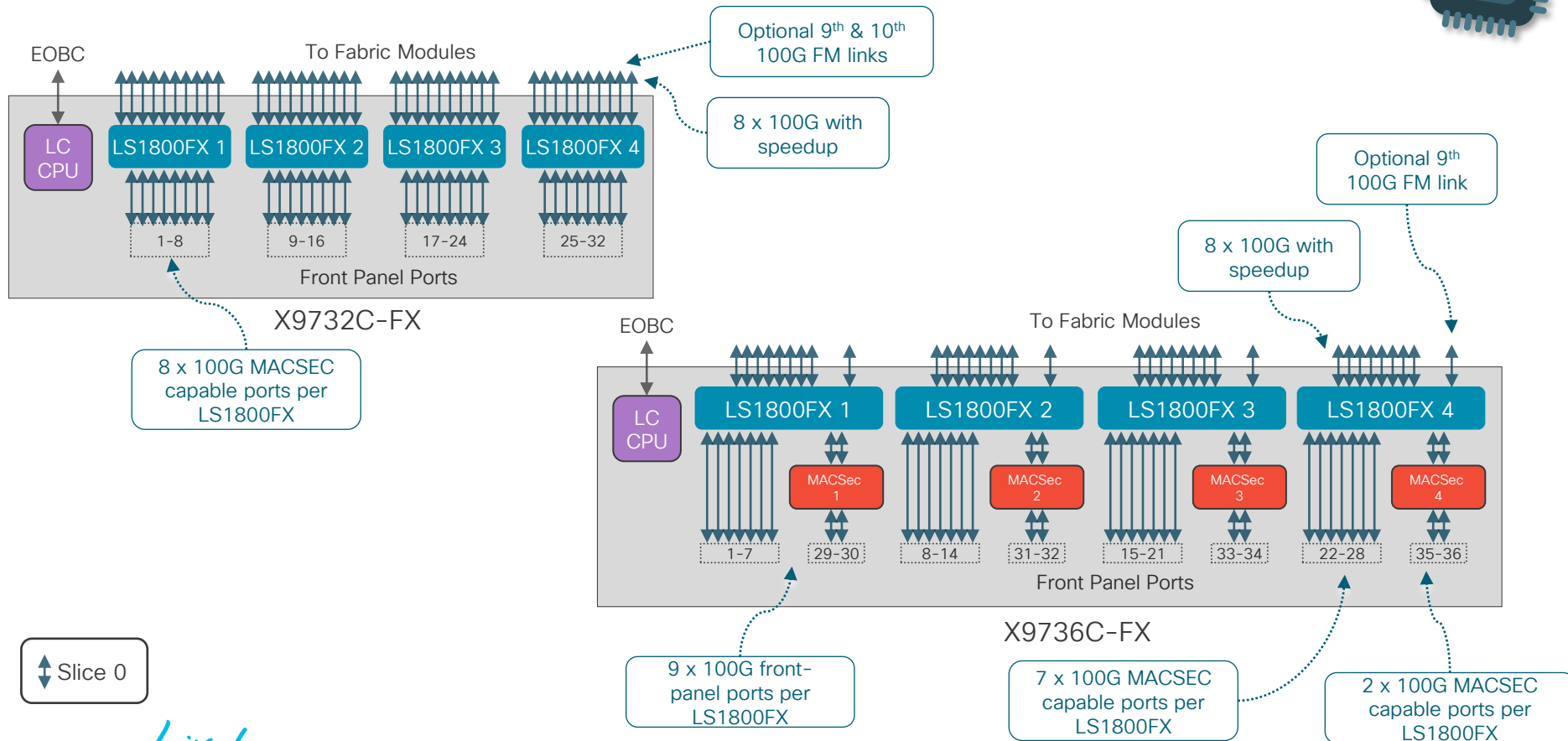
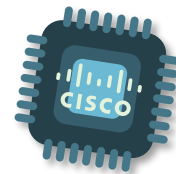
Flexible port configurations – 10/25/40/50/100G with breakout

Line-rate MACSEC on all ports

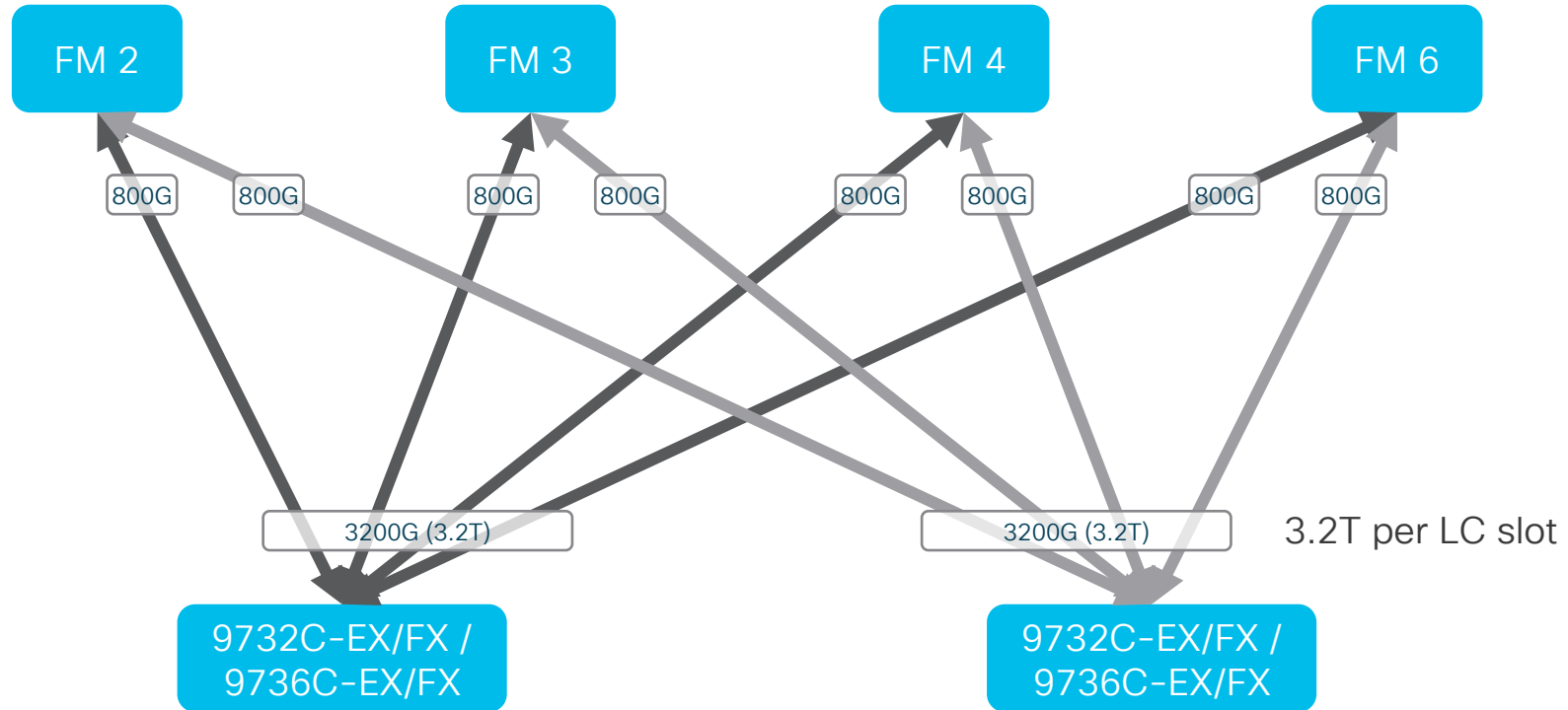
Flow Table for Network Insights, NetFlow

Smart buffer capability (AFD / DPP)

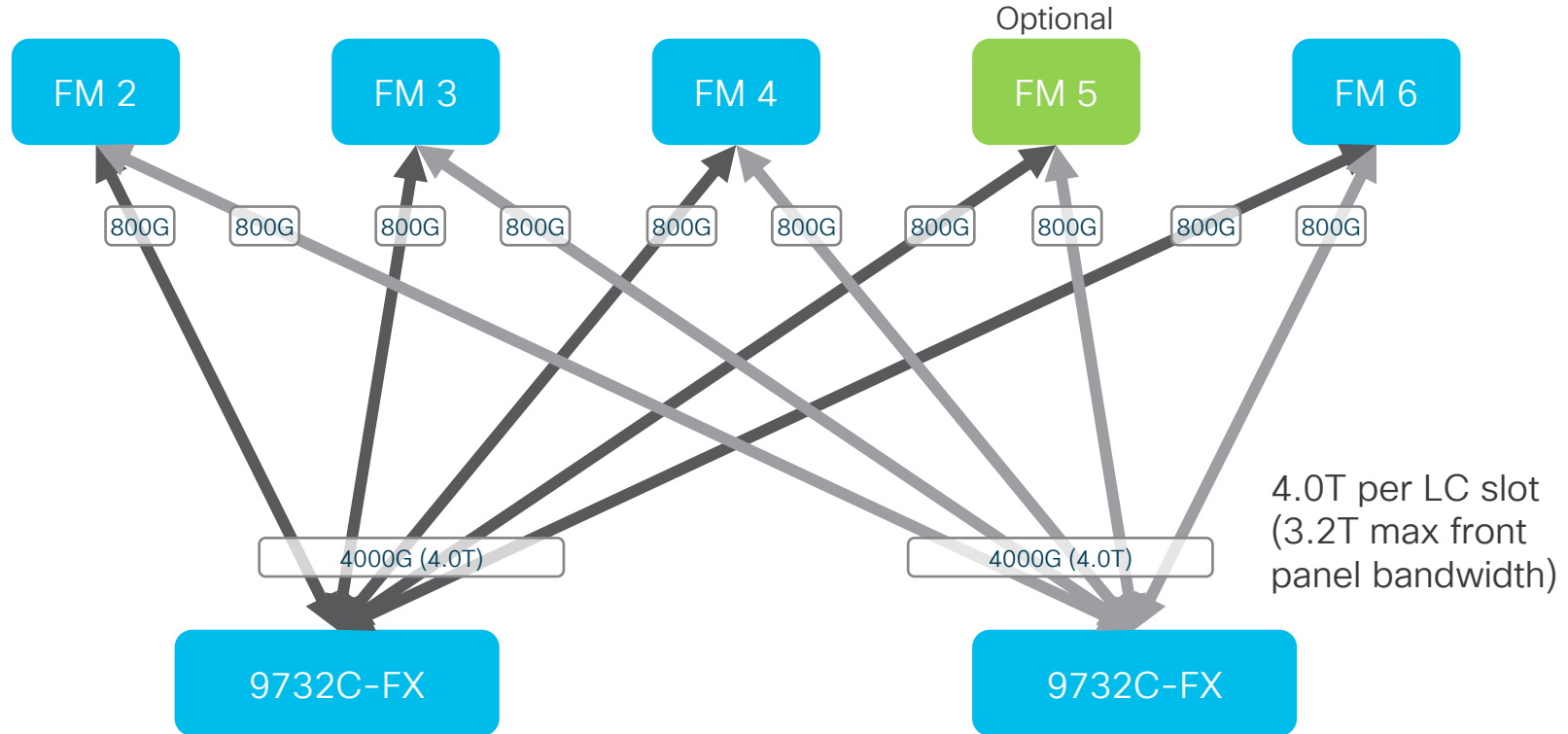
N9K-X9732C-FX / N9K-X9736C-FX Architecture



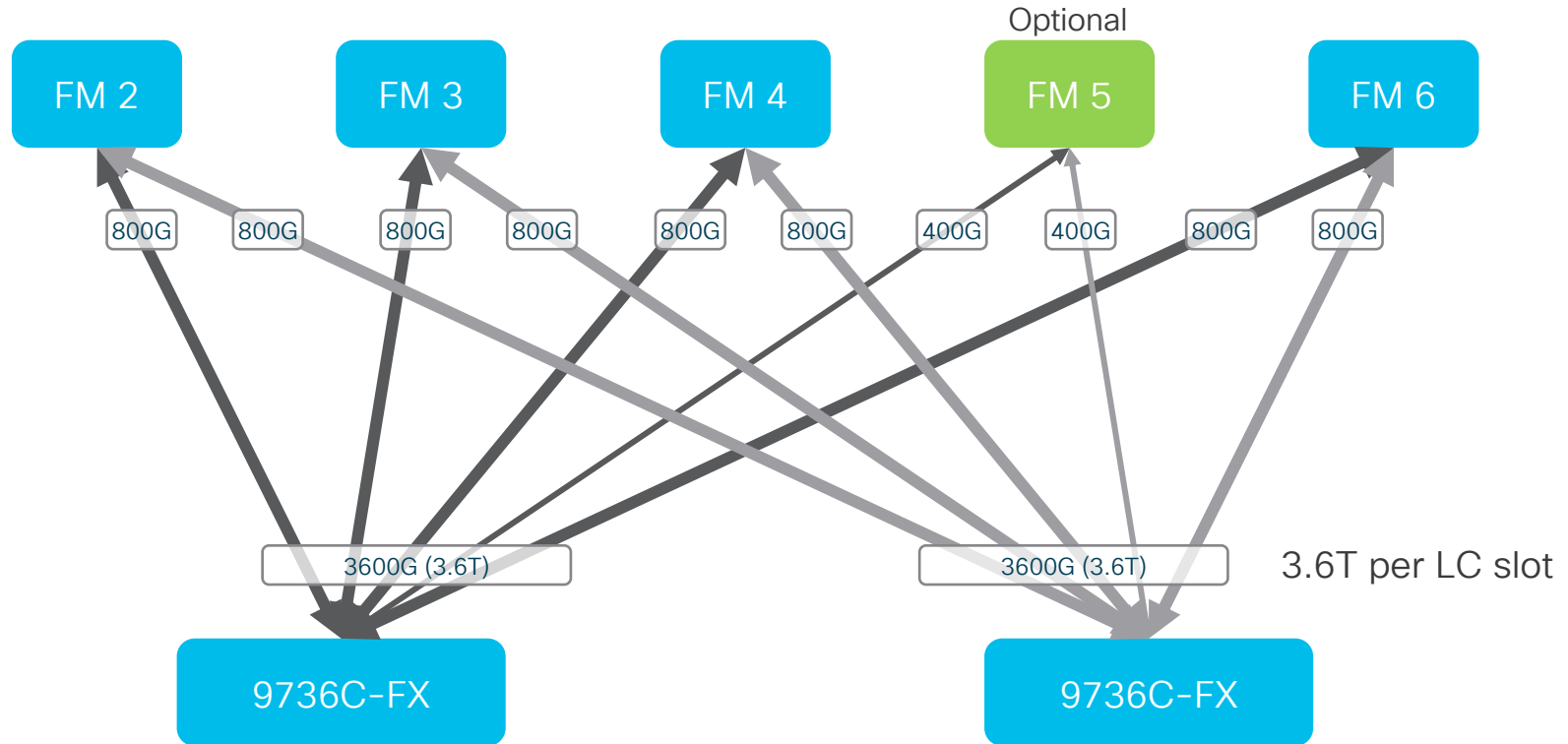
9732C-FX / 9736C-FX Fabric Connectivity



9732C-FX Fabric Connectivity – 5 FMs



9736C-FX Fabric Connectivity – 5 FMs



Using 5 Fabric Modules

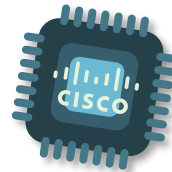
Limitations and Notes

- **All** modules installed in chassis must be either 9732C-FX or 9736C-FX to use 5 FMs
 - If other module type installed, 5th FM powered off automatically
- **9732C-FX:**
 - 5 FMs required for N+1 fabric module redundancy
- **9736C-FX:**
 - 5 FMs required for full bandwidth
 - Bandwidth reduction on FM failure varies depending on which FM failed

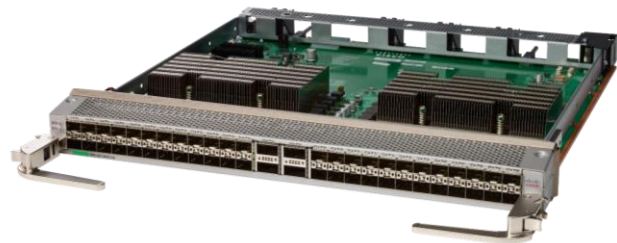
Note: 5 x FMs supported on all chassis types in standalone from 7.0(3)I7(2). 5 x FMs with 9736C-FX supported from in ACI 13.2(2).

X9700-EX/FX EOR/MOR Cloud Scale Modules

N9K-X97160YC-EX / N9K-X9788TC-FX



Key Features



48p 10/25G SFP+ and 4p

100G QSFP28

X97160YC-EX – LSE-based

ACI: Not supported

NX-OS: 7.0(3)I5(2)



48p 1/10GBASE-T and 4p

100G QSFP28

X9788TC-FX – LS1800FX-based

ACI: Not supported

NX-OS: 7.0(3)I7(3)

NX-OS mode only

Flow Table for Network Insights, NetFlow

Smart buffer capability (AFD / DPP)

97160-EX:

1.6Tbps capacity with line-rate performance

Flexible port configurations – 1/10/25G SFP28 ports, 1/10/25/40/50/100G QSFP28 ports

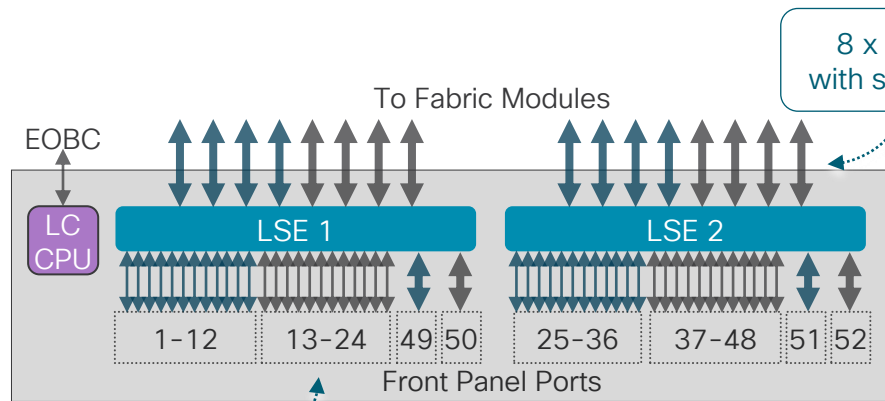
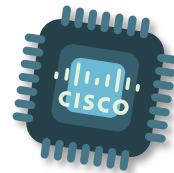
9788-FX:

880Gbps capacity with line-rate performance

Flexible port configurations – 1/10GBASE-T ports, 1/10/25/40/50/100G QSFP28 ports

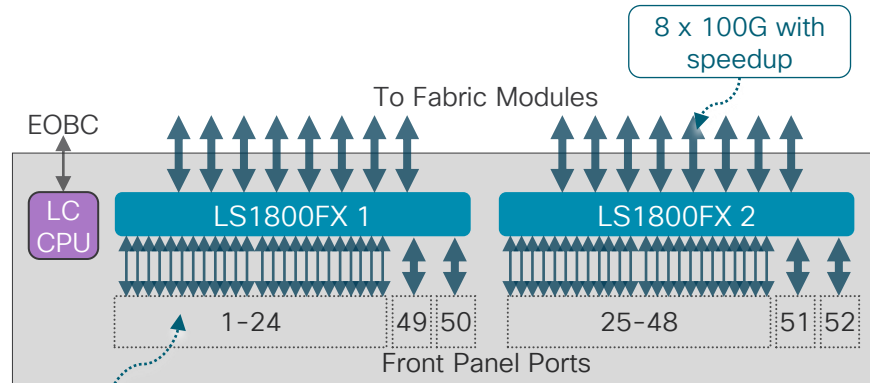
Line-rate MACSEC on all ports

N9K-X97160YC-EX / N9K-X9788TC-FX Architecture



X97160YC-EX

24 x 10/25G and 2 x 100G
front-panel ports per LSE



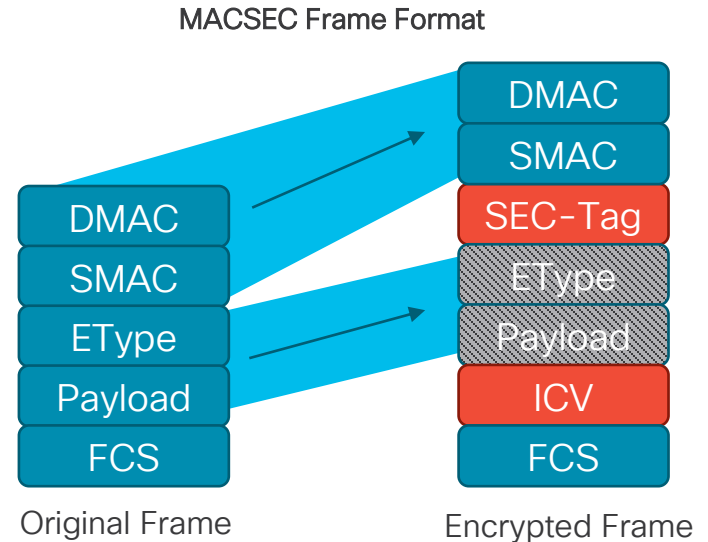
X9788TC-FX

24 x 1/10G and 2 x
100G front-panel
ports per LS1800FX

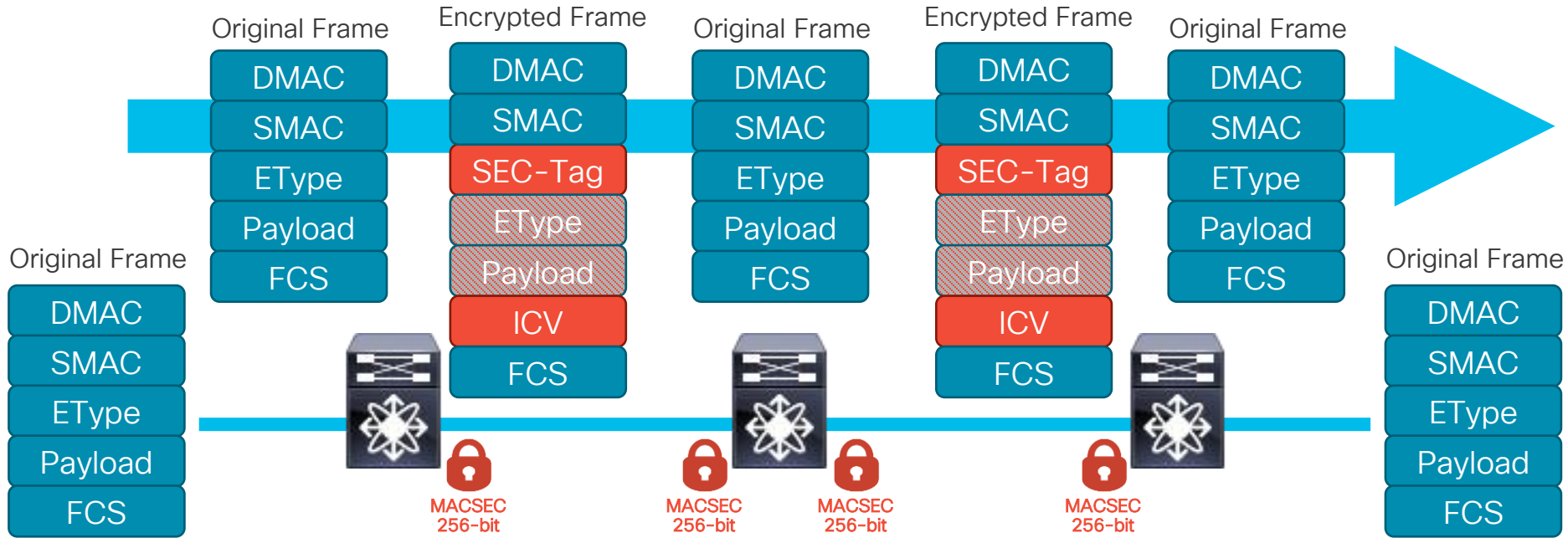


MACSEC Hardware Encryption

- Provides link-level hop-by-hop encryption
- IEEE 802.1AE 128-bit and 256-bit AES encryption with MKA Key Exchange
- Native hardware support available on:
 - All ports on X9736C-FX linecard
 - All ports on Nexus 93180YC-FX / 93108TC-FX switches
 - 16 x 100G ports on Nexus 9364C switch
 - All ports on Nexus 9336C-FX2 / N9K-C93240YC-FX2 switches



MACSEC

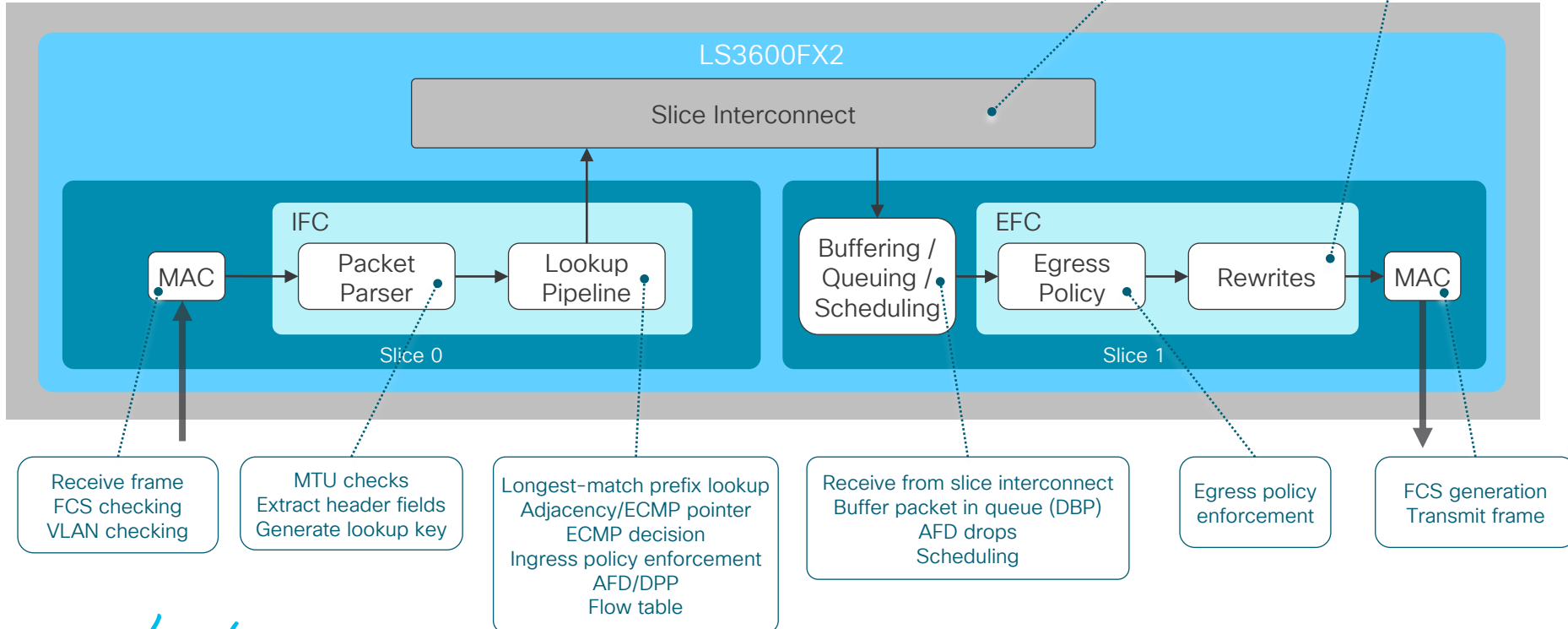


Agenda

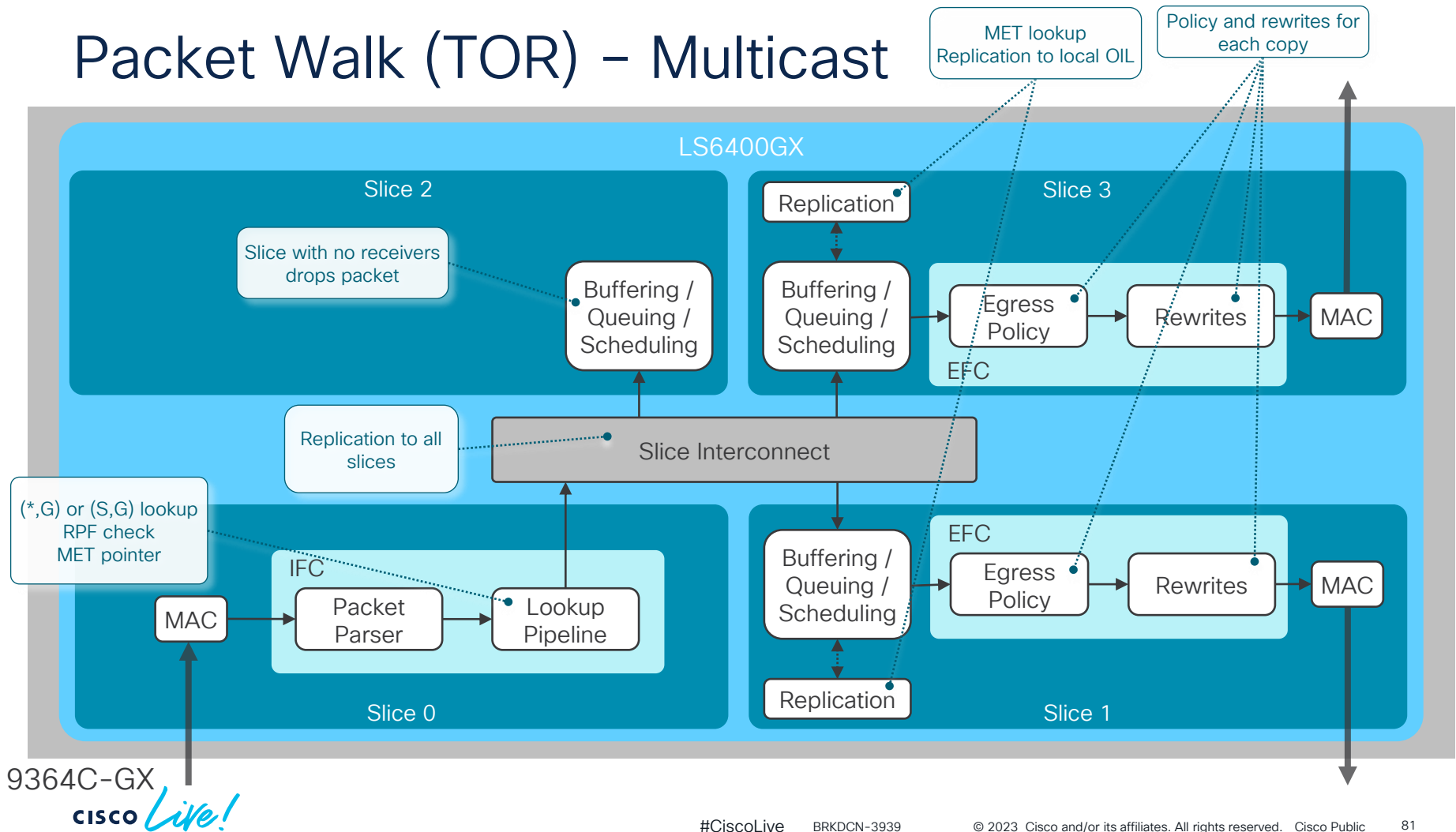
- Data Center and Silicon Strategy
- Cloud Scale ASIC Architecture
- Cloud Scale Switching Platforms
- Packet Walks
- Key Takeaways

Packet Walk (TOR) – IP Unicast

9336C-FX2



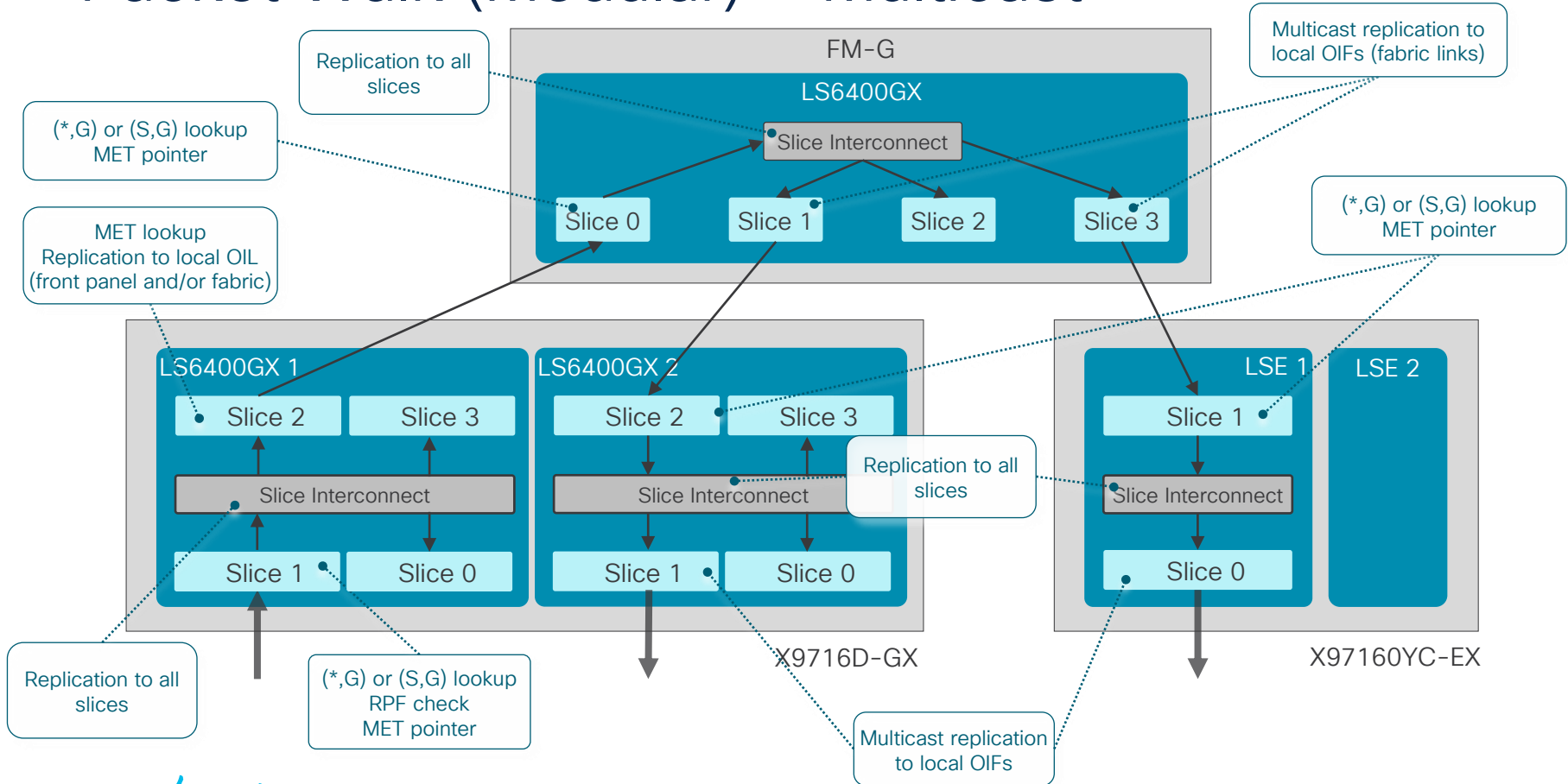
Packet Walk (TOR) – Multicast



9364C-GX

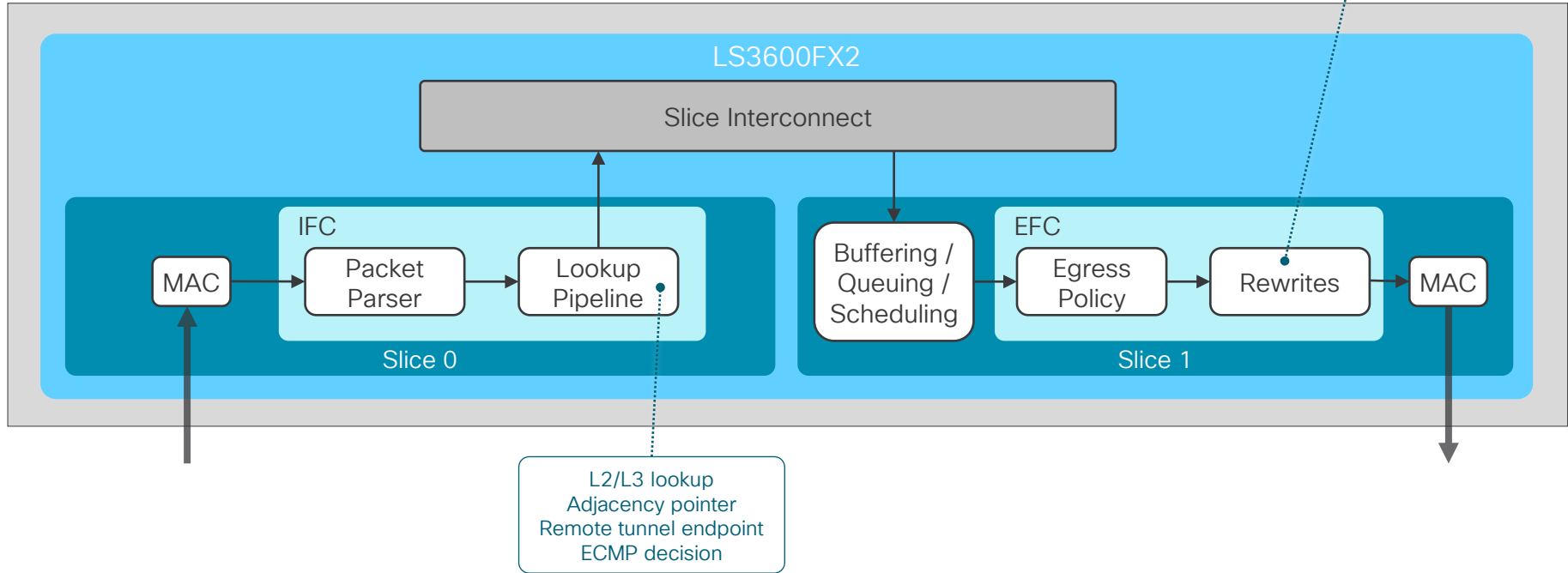
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Packet Walk (Modular) – Multicast



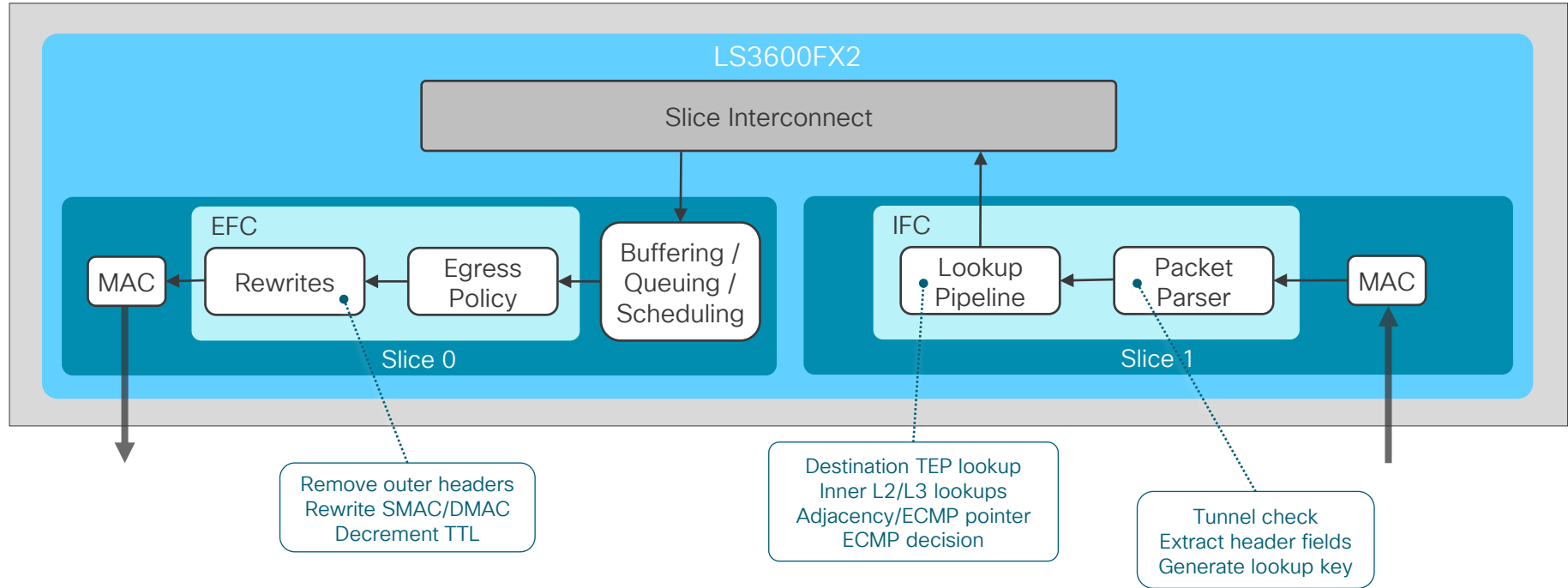
Packet Walk – VXLAN Encapsulation

9336C-FX2



Packet Walk – VXLAN Decapsulation

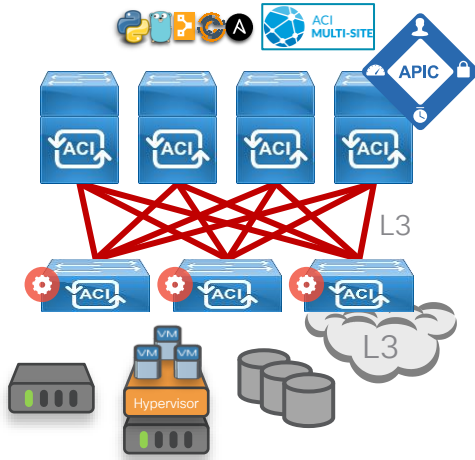
9336C-FX2



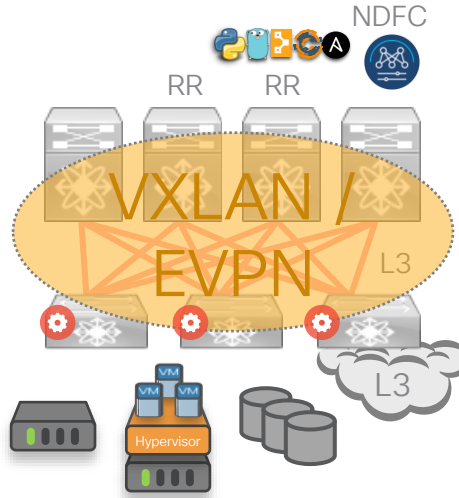
Agenda

- Data Center and Silicon Strategy
- Cloud Scale ASIC Architecture
- Cloud Scale Switching Platforms
- Packet Walks
- Key Takeaways

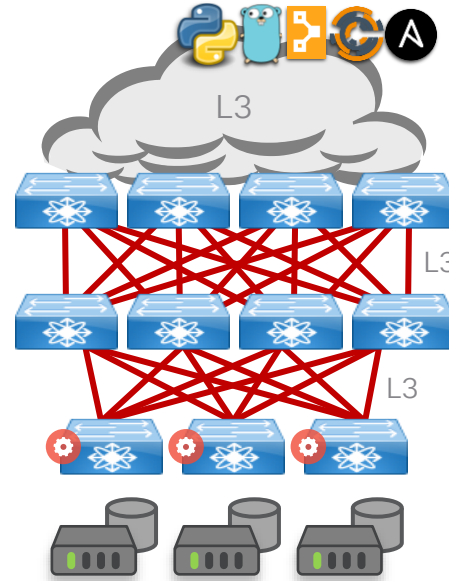
Building Data Center Fabrics with Nexus 9000



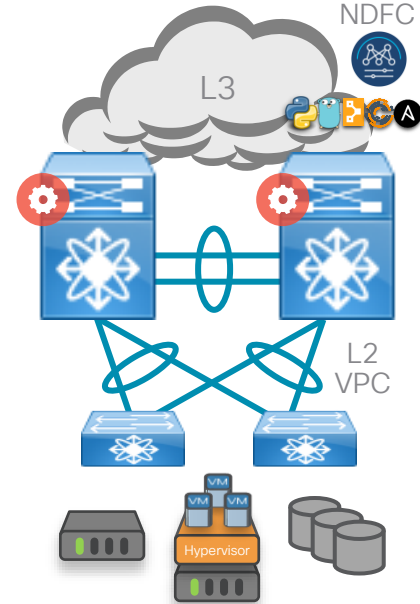
ACI - Turnkey Fabric



Standalone -
Programmable Fabric with
VXLAN+EVPN



Standalone -
Programmable IP Network



Standalone - Traditional
Data Center Network

Key Takeaways

- You should now have a thorough understanding of the Nexus 9000 Cloud Scale switching platform architecture
- Feature-rich, innovative switching platform addresses virtually every deployment scenario
- Nexus 9000 Cloud Scale platform forms foundation of Cisco Data Center strategy



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The bridge to possible

Thank you

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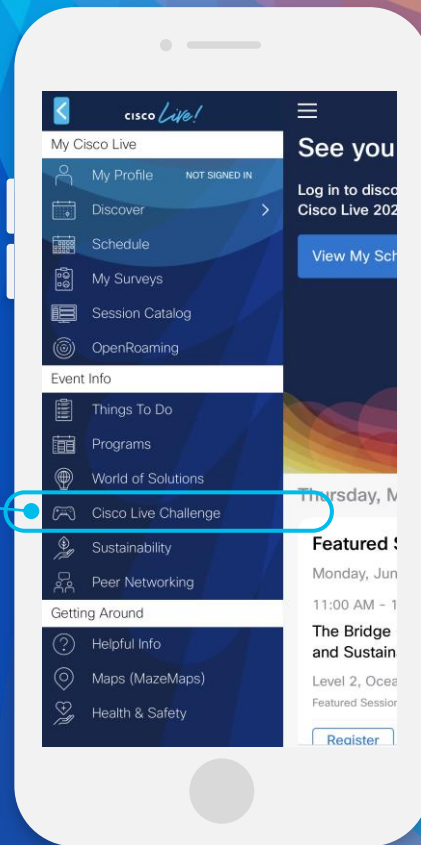
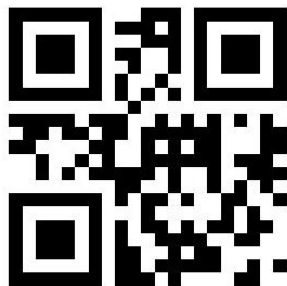
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The background is a vibrant, abstract graphic. It features a central bright white light source from which numerous colorful rays emanate, creating a sunburst or starburst effect. The rays transition through a spectrum of colors: yellow, orange, red, pink, purple, blue, and green. Overlaid on this are large, flowing, wavy shapes in shades of orange, red, and yellow, resembling liquid or smoke. The overall composition is dynamic and energetic.

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Let's go

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