Cisco live!

January 28 - February 1, 2019 - Barcelona

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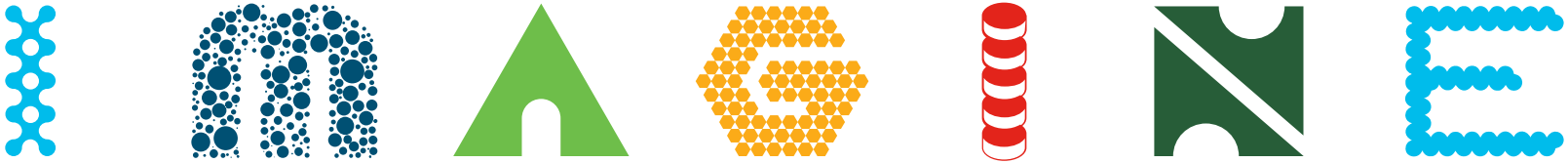
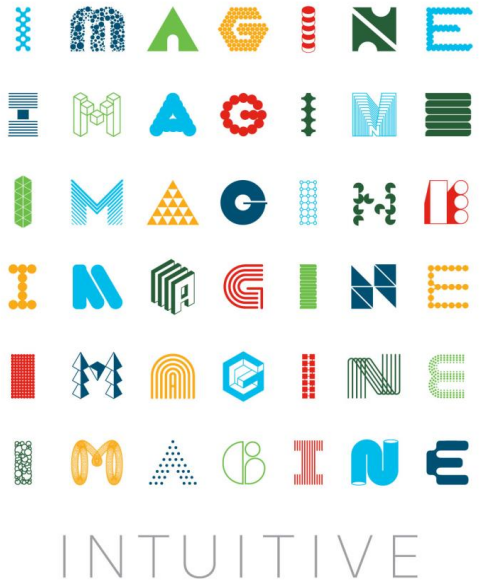


INTUITIVE

BRKARC-2001

ASR 1000 Architecture Overview and Use Cases

Jason Yang, Technical Marketing Engineer – CCIE#10467



Agenda

- Introducing the ASR 1000
- ASR 1000 System Architecture
- ASR 1000 Software Architecture
- Applications & Solutions
- Conclusion

Cisco ASR 1000 Series Routers: Overview

2.5 Gbps to 200Gbps – Designed today to scale up in the future

COMPACT, POWERFUL ROUTER

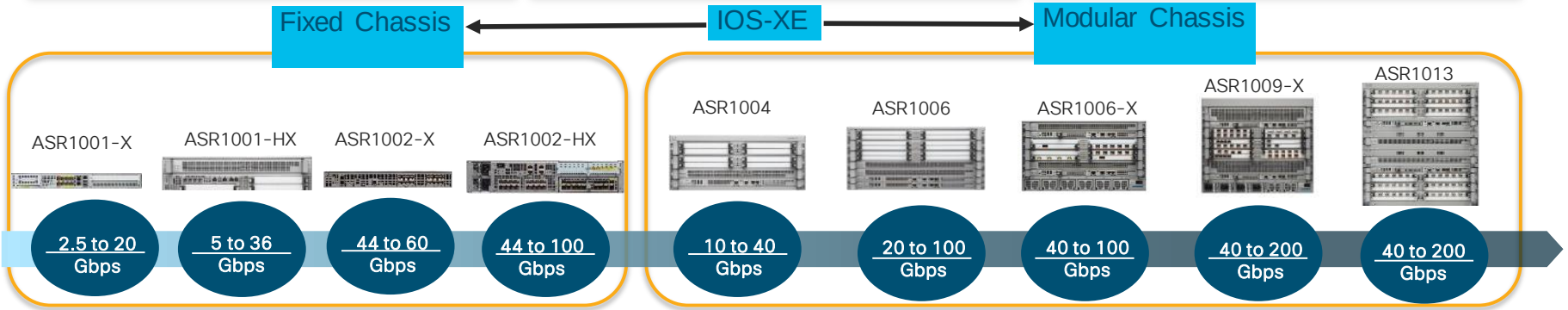
- Line-rate performance 2.5G to 200G
- Investment protection with modular engines, IOS CLI and SPAs for I/O
- Hardware assists for ACL, QoS, etc.
- Hardware-based QoS engine with up to 464k queues
- New Ethernet CC, 100GE & 40GE EPA

BUSINESS-CRITICAL RESILIENCY

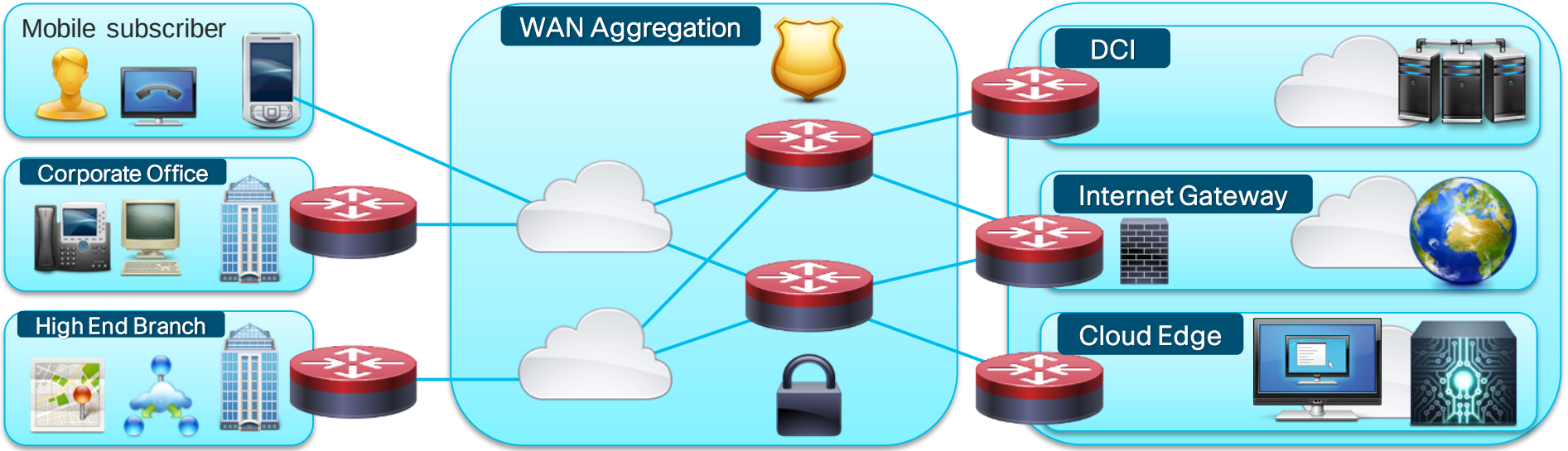
- Fully separated control and forwarding planes
- Hardware and software redundancy
- In-service software upgrades
- Inter and Intra-chassis redundancy
- DCI to support clustering across geographically dispersed DC

INSTANT ON SERVICE DELIVERY

- Scalable on-chip service enablement through software licensing
- Industry leading VPN/Crypto solutions
- Optimal user/app experience with AVC, Path Control, and AppNav
- Software consumption model with CiscoONE



ASR 1000 Enterprise Applications

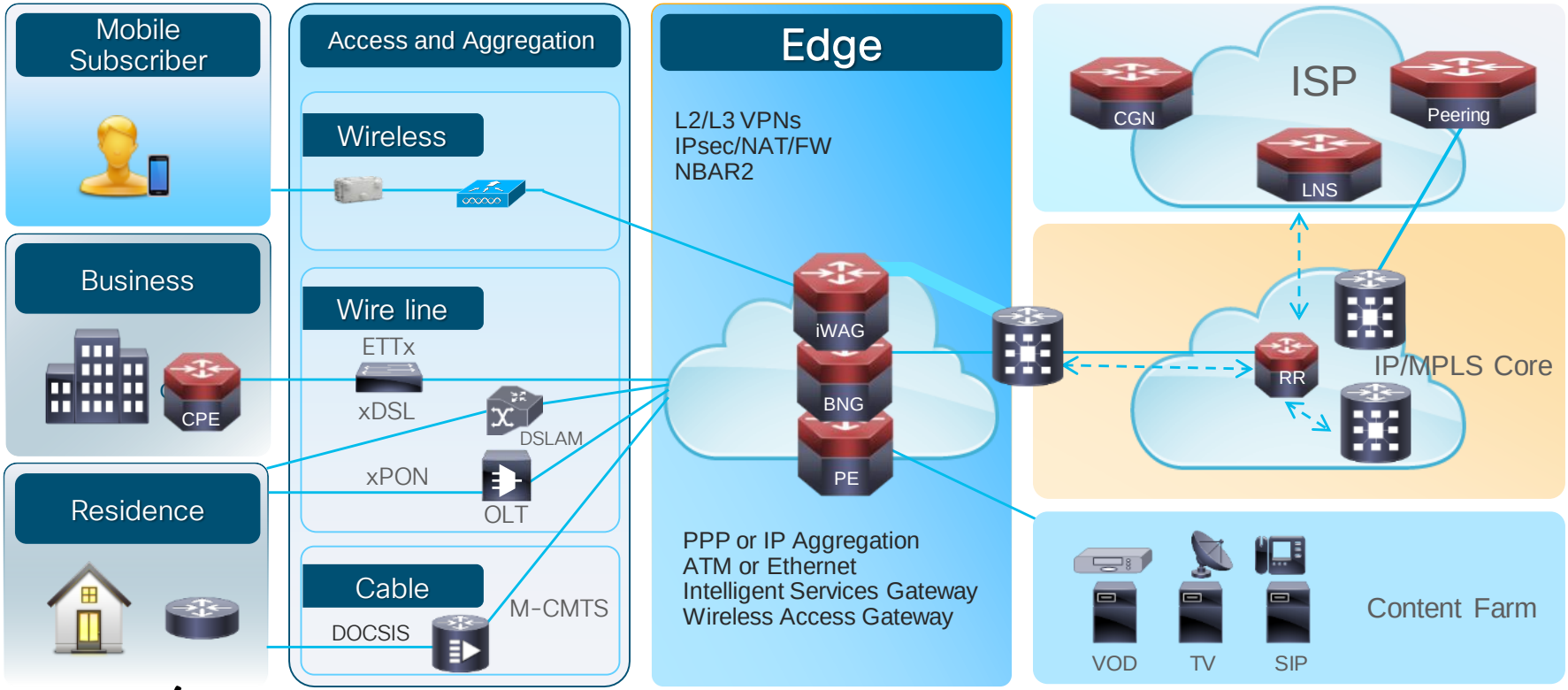


High Speed CPE
SDA Border

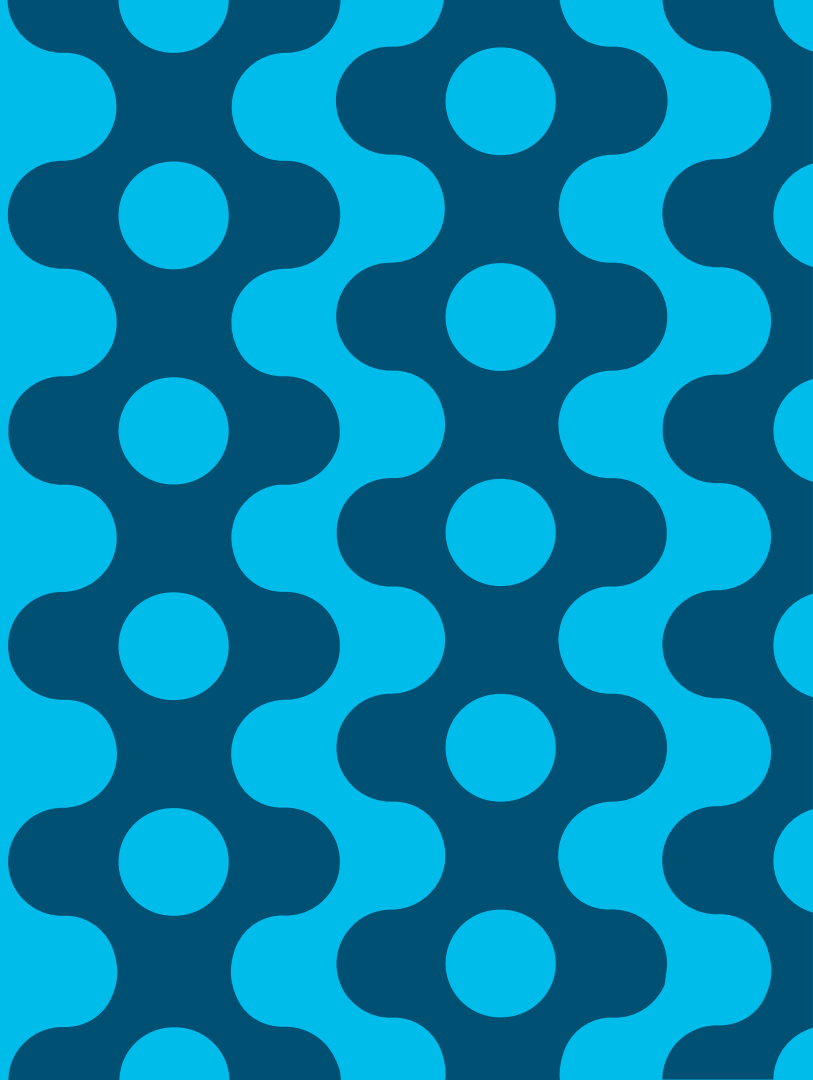
WAN Aggregation
IPSec VPN
L2 and L3 VPN
SD-WAN

Data Center Interconnect
Internet gateway
Cloud Services Edge

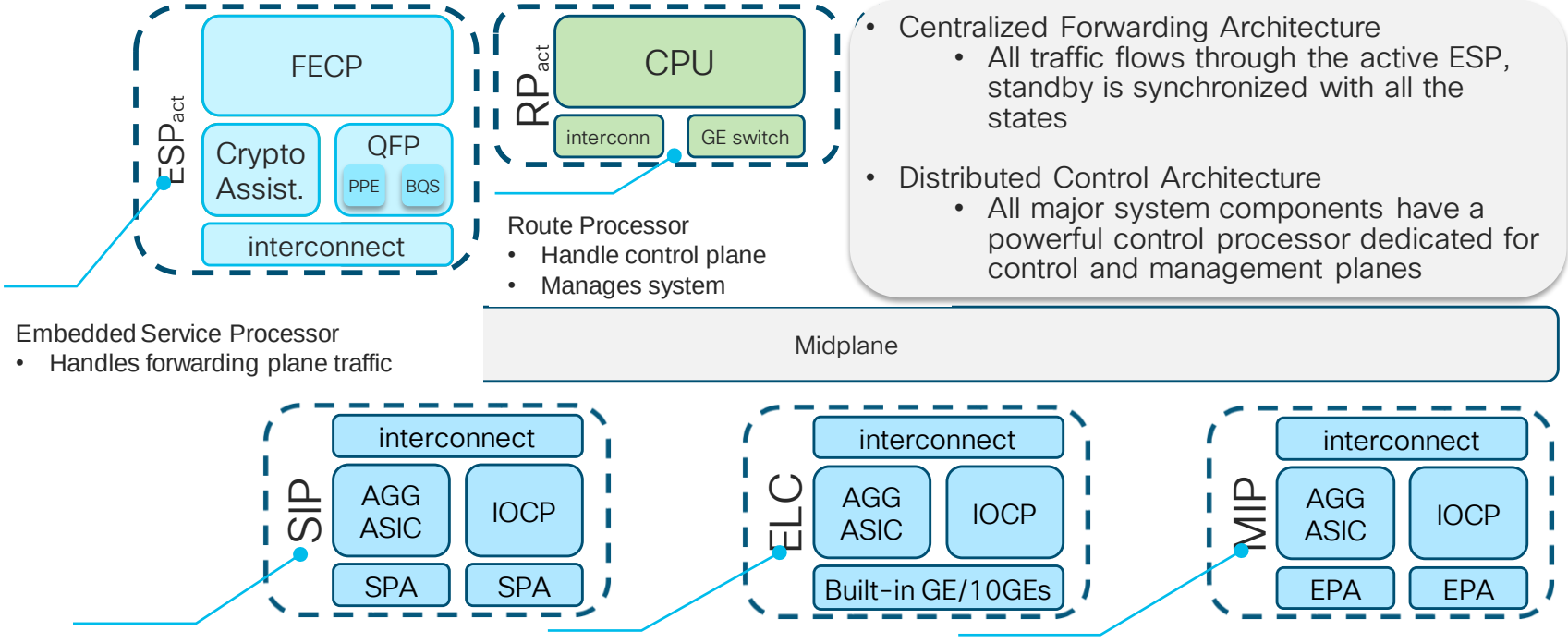
ASR 1000 Service Provider Applications



ASR 1000 System Architecture

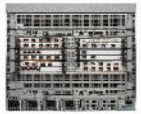
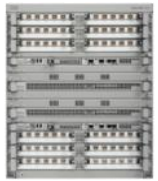


ASR 1000 Building Blocks



- Centralized Forwarding Architecture
  - All traffic flows through the active ESP, standby is synchronized with all the states
- Distributed Control Architecture
  - All major system components have a powerful control processor dedicated for control and management planes

ASR 1000 Modular Chassis Overview

	ASR 1004	ASR 1006	ASR1006-X	ASR 1009-X	ASR 1013
					
RP Slots	1	2	2	2	2
ESP Slots	1	2	2	2 (super)	2 (super)
SIP/MIP Slots	2 (SIP only)	3 (SIP only)	2	3	6
Built-In Ethernet	N/A	N/A	N/A	N/A	N/A
Redundancy	Software	Hardware	Hardware	Hardware	Hardware
Height	7” (4RU)	10.5” (6RU)	10.5” (6RU)	15.7” (9RU)	22.7” (13RU)
Bandwidth	10 – 40 Gbps	10 -100 Gbps	40 - 100 Gbps	40 - 200 Gbps	40 - 200 Gbps
Max Output Pwr	765W	1275W	1100 power modules N+1, Max 6	1100 power modules N+1, Max 6	3200W
Airflow	Front to back	Front to back	Front to back	Front to back	Front to back

ASR 1009-X

System Management

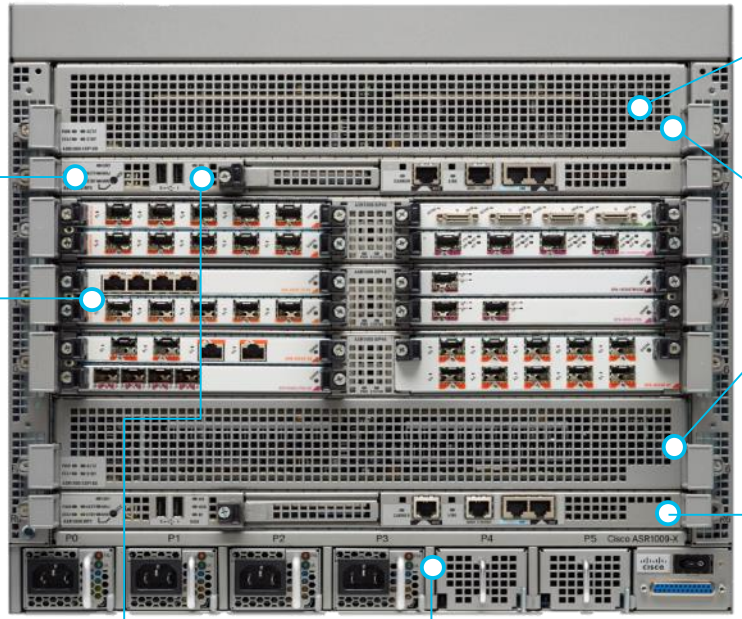
- RJ45 Console
- Auxiliary Port
- 2x USB Ports

I/O Connectivity

- 12x SPA slots (SIP-40)
- 3x ELC slots
- 6x EPA (MIP-100)

Modular Fan Tray

- Field Replaceable
- 30% improvement in airflow per slots vs integrated Fan module



Forwarding Plane (ESP)

- Up to 200Gbps per system
- Supports ESP40, ESP100, ESP200 and future ESPs

Hardware Redundancy

- Dual ESP and RP slots for data plane and control plane redundancy
- ISSU

Control Plane

- Support RP2 and RP3
- 8 - 64 GB Memory
- FIPS-140-2 certification

BITS clocking

- Stratum 3 built-in

Power Supply

- Modular power supply with N+1 redundancy
- High efficiency, Load sharing, Hot-swappable
- AC (1100W) or DC (950W)

FYI

ASR 1000 Modular Chassis Compatibility Matrix

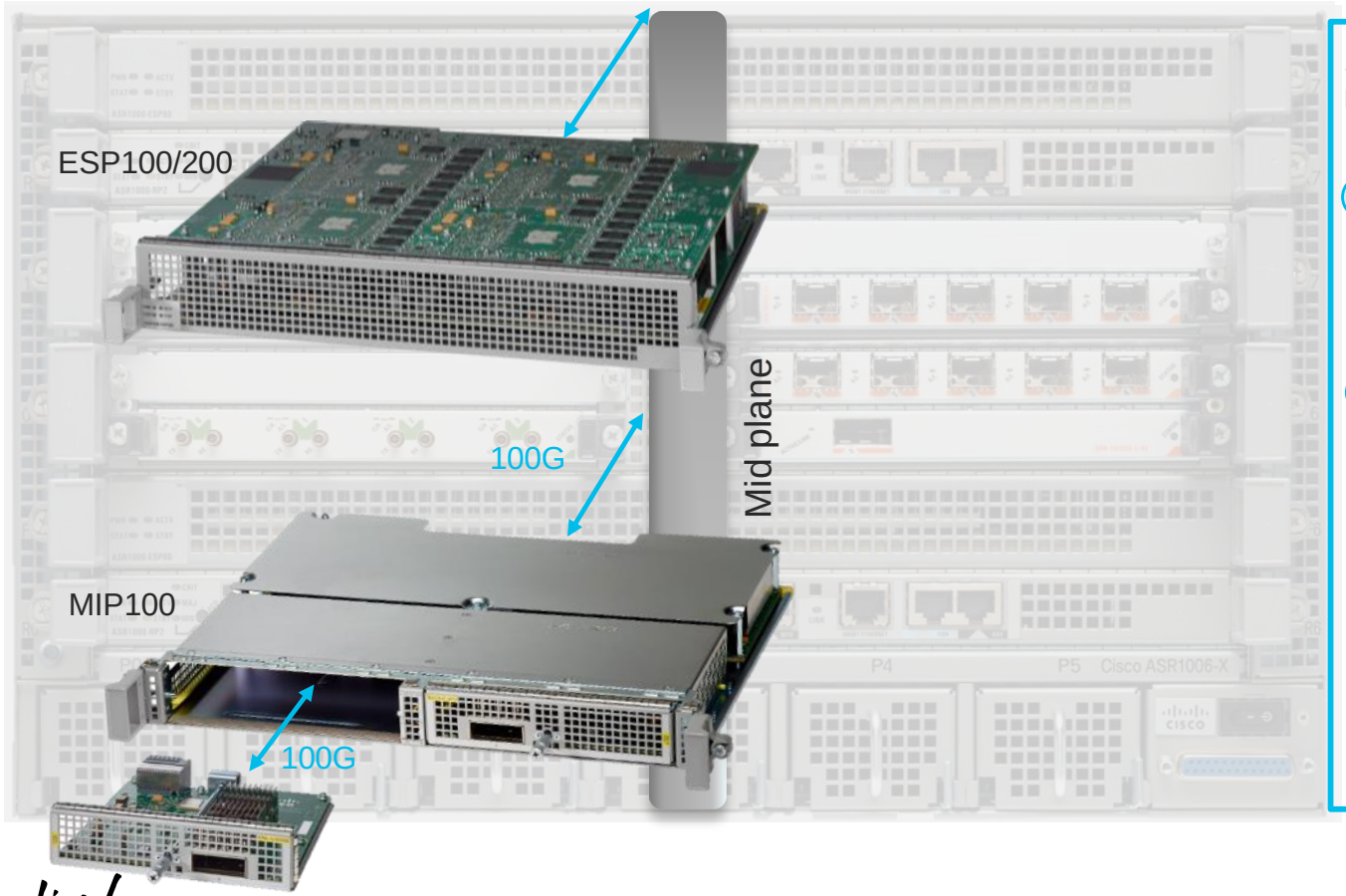
Chassis	RP2	RP3	SIP40	ELC	MIP100	ESP20	ESP40	ESP100	ESP200
ASR1004	Yes	No	Yes	Yes	No	Yes	Yes	No	No
ASR1006	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No
ASR1013	Yes	Yes	Yes	Yes	Yes[2][3]	No	Yes	Yes	Yes
ASR1006-X	Yes[1]	Yes	Yes	Yes	Yes[3]	No	Yes	Yes	No
ASR1009-X	Yes[1]	Yes	Yes	Yes	Yes[3]	No	Yes	Yes	Yes

[1]RP2 with new CPLD

[2]100G support in Slots 2&3; others at 40G

[3]ASR1000-MIP100 is not supported with ESP40

ASR1000-MIP100 (Modular Interface Processor)



1006-X/1009-X with ESP100/ESP200

10x10G

- Line rate
- No oversubscription

1x100G

- Line rate
- No oversubscription

1x100G
1x100G

- 2 to 1 oversubscription

Ethernet Port Adapter (EPA)

EPA		Modular Chassis with MIP-100	ASR1002-HX	Optics Modules
EPA-QSFP-1X100GE		XE 16.9.1 (MACSec)	XE 16.9.1 (MACSec)	MMF, SMF, SR, LR, ER, -S Class transceivers
EPA-1x40GE EPA-2x40GE		XE 16.6.2 XE 16.8.1 (MACSec)	XE 16.6.2 XE 16.8.1 (MACSec)	MMF, SMF, SR, LR, ER, -S Class transceivers
EPA-1x100GE		XE 3.16.1 XE 16.2.1	XE 16.4.1	 CPAK-100G-SR10  CPAK-100G-LR4
EPA-CPAK-2x40GE		XE 3.16.2 XE 16.3.1	XE 16.4.1	 CPAK-100G-SR10 CAB-MPO24-2XMPO12 QSFP-40G-SR4
EPA-10x10GE		XE 3.16.4 XE 16.2.1 XE 16.3.1 (MACSec)	XE 16.3.1 XE 16.3.2 (MACSec)	SFP-10G-SR, SFP-10G-SR-X, SFP-10G-LR, SFP-10G-LRM, SFP-10G-LR-X, SFP-10G-ER
EPA-18x1GE		XE 16.2.1 XE 16.3.2 (MACSec)	XE 16.2.1 XE 16.3.1 (MACSec)	GLC-GE-100FX, GLC-SX-MMD, GLC-LH-SMD, SFP-GE-T, GLC-BX-U, GLC-BX-D, GLC-TE, GLC-SX-MM, GLC-LH-SM, GLC-EX-SMD, GLC-ZX-SMD, CWDM-SFP, DWDM-SFP

Modular Route Processors: RP2 & RP3

	RP2	RP3
		
CPU	2.66GHz Intel Xeon Dual-core	2.2GHz Intel Broadwell Quad-core
Default memory	8GB (4x2GB) – DDR2	8GB (2x4GB) – DDR4
Memory upgrade options	16GB (4x4GB)	16GB (2x8GB), 32GB (4x8GB); 64GB (4x16GB)
Built-In eUSB Bootflash	2GB	8GB
Storage	80GB HDD external USB	100GB SSD default, 200GB and 400GB upgrade options external USB
IOS XE OS	64 bits	64 bits
Chassis Support	ASR 1004 ASR 1006 ASR 1013 ASR 1006-X ASR 1009-X	ASR 1006-X ASR 1009-X ASR 1013

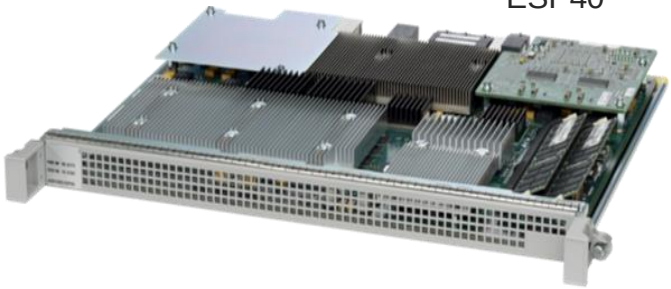
30%+ Faster!

60%+ Scale!

ASR1000 Embedded Services Processor (ESP)

- Centralized, programmable, multiprocessor forwarding engine providing full-packet processing
- Packet Buffering and Queuing/Scheduling (BQS)
  - For output traffic to carrier cards/SPAs/EPAs
  - For special features such as traffic shaping, reassembly, replication, punt to RP, cryptography, etc.
  - 5 levels of HQoS scheduling, up to 464K Queues, Priority Propagation
- Dedicated crypto co-processor
- Interconnect providing data path links (ESI) to/from other cards over midplane
  - Transports traffic into and out of the Cisco Quantum Flow Processor (QFP)
  - Input scheduler for allocating QFP BW among ESIs
- FECP CPU manages QFP, crypto device, midplane links, etc.

ESP40



ESP100

ESP Bandwidth

- Overall throughput is determined by the type of ESP and SIPs used in modular platforms.
- Modular platforms are rate limited by speed of bus from QFP complex to backplane ASIC
- Bandwidth is expressed in terms of aggregated throughput, use ESP100 as example:

- 50G Unicast in each direction
- Total Output bandwidth 50+50=100

- 10G Multicast with 8X replication in one direction
- 20G unicast in the other direction
- Total Output bandwidth 80+20=100G

- 50Gbps Unicast in one direction and 70Gbps Unicast in the other direction
- Total output bandwidth (50+70=120) exceeds 100Gbps; only 100Gbps will be forwarded.

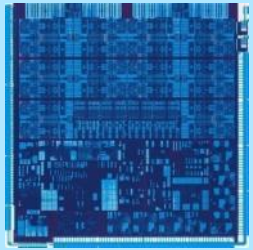
- 10Gbps Multicast with 10X replication in one direction
- 10Gbps Unicast in the other direction
- Total bandwidth (100+20=110) exceeds 100Gbps; only 100 Gbps will be forwarded

Cisco Quantum Flow Processor (QFP)

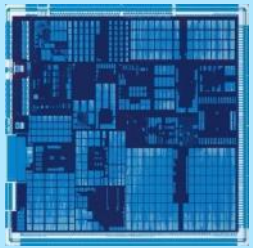
ASR1000 series innovation

- Five year design and continued evolution – now on 3rd generation
- Architected to scale to > 100Gbps
- Multiprocessor with 64 multi-threaded cores; 4 threads per core
- 256 processes per chip available to handle traffic
- High-priority traffic is prioritized
- Packet replication capabilities for Multicast
- Many H/W assists for accelerated processing
- 3rd generation QFP is capable for 70Gbps, 32Mpps processing
- Mesh-able: 1, 2 or 4 chips to build higher capacity ESPs
- Latency: tens of microseconds with features enabled

QFP Chip Set



Cisco QFP
Packet Processor



Cisco QFP Traffic Manager
(Buffering, Queueing, Scheduling)

ASR 1000 Fixed Chassis Overview

	ASR 1001-X 	ASR 1002-X 	ASR 1001-HX 	ASR 1002-HX 
SPA Slots	1	3	N/A	N/A
EPA Slots	N/A	N/A	N/A	1
NIM Slots	1	N/A	N/A	1
Built-In GE	6	6	8	8
Built-In TenGE	2	N/A	4 + 4 (configurable 10GE/GE)	8
CPU	2.0GHz quad-core	2.13GHz quad-core	2.5GHz quad-core	2.5GHz quad-core
Memory	8GB; upgradable to 16GB	4GB; upgradable to 8GB/16GB	8GB; upgradable to 16GB	16GB; upgradable to 32GB
Storage	eUSB(8GB) SSD (200GB, 400GB)	eUSB(8GB) Optional HDD (160GB)	eUSB(32GB)	eUSB(32GB) SSD (200GB, 400GB)
IOS Redundancy	Software	Software	Software	Software
Height	1.75” (1RU)	3.5” (2RU)	1.75” (1RU)	3.5” (2RU)
Throughput	2.5 to 20Gbps	5 to 36Gbps	60Gbps	100Gbps
Maximum Output Power	250W	470W	360W	500W
Airflow	Front to back	Front to back	Front to back	Front to back

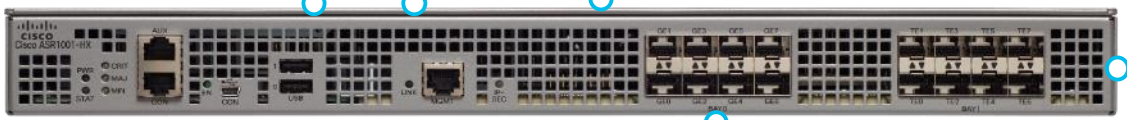
ASR 1001-HX

Control plane
- CPU: Quad Core @ 2.5 GHz
- Memory: 8GB DDR3 default memory, upgradeable to 16GB
- Secure Boot + Image Signing

Pay as you grow
- License on built-in ports
- 4x TenGE+ 4xGE enabled by default
- The remaining ports can be enabled in pairs

Multi-Core Network Processor
- 60Gbps forwarding capacity
- 62 Cores
- 4 HW Threads / Core
- 248 simultaneous threads

Miscellaneous
- RJ45 & mini-USB console
- eUSB: 32GB

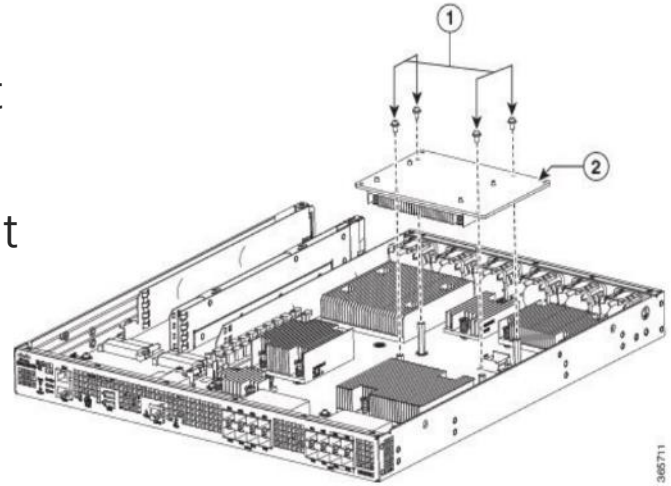


Built in I/O
- 8x Gigabit Ethernet interfaces
- 8x TenGigabit Ethernet interfaces (4 configurable 10G/1G ports)
- Multipoint MACSEC for linerate encryption (1G & 10G)

Crypto module
- Field upgradeable
- 16 Gbps crypto throughput
- Suite B support

ASR 1001-HX Crypto Module

- ASR 1001-HX can be ordered with or without the crypto module
- Crypto module can be installed in the field unit when it need the function
- Crypto bandwidth licensed from factory (default 8Gbps, upgradeable to 16Gbps on demand)
- 16Gbps crypto license unlocks crypto performance cap of 29Gbps (1400bytes)



1	Screws	2	Crypto module

ASR 1002-HX

Pay as you grow
- License on built-in ports
- 4x TenGE+ 4xGE enabled by default
- The remaining ports can be enabled in pairs

Multi-Core Network Processor
- 100 Gbps forwarding capacity
- 124 Cores
- 4 HW Threads / Core
- 496 simultaneous threads

Miscellaneous
- RJ45 & mini-USB console
- eUSB: 32GB

Network Interface Module
- 1 double wide or 1 single wide NIM

Control plane
- CPU: Quad Core @ 2.5 GHz
- Memory: 16GB DDR3 default memory, upgradeable to 32GB
- Secure Boot + Image Signing

Power Supply & Fans
- Modular PS, FRUable
- Fan Tray

Built in I/O
- 8x Gigabit Ethernet interfaces
- 8x TenGigabit Ethernet interfaces
- Multipoint MACSEC for linerate encryption (1G & 10G)

Ethernet Port Adapter
- 1x EPA slot

Crypto module
- Field upgradeable
- 25 Gbps crypto throughput
- Suite B support

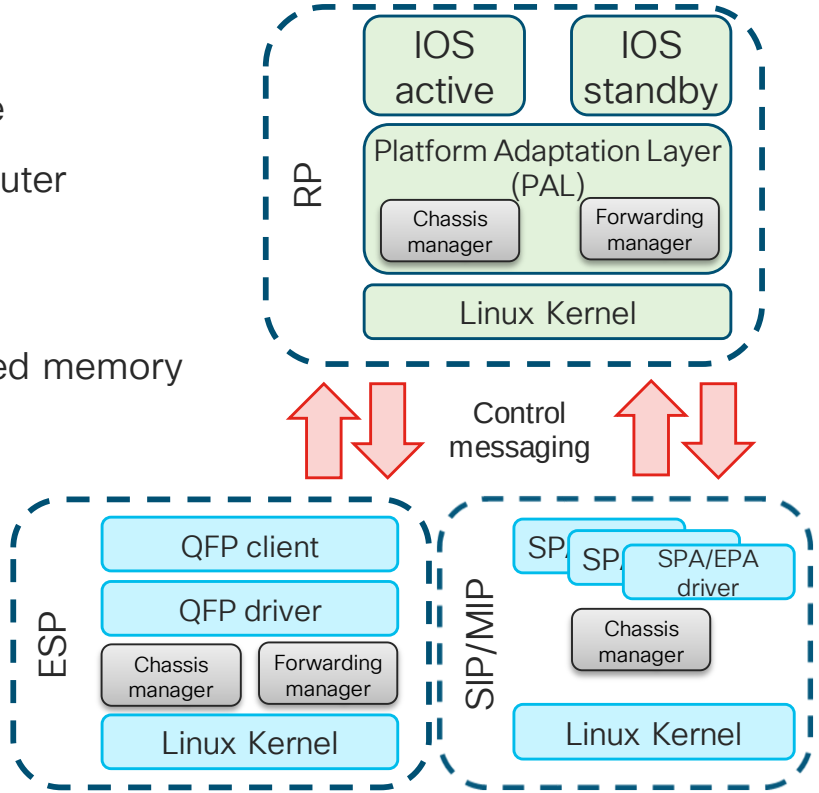
ASR 1002-HX Crypto Module

- ASR 1002-HX can be ordered with or without the crypto hardware
- Crypto module can be installed in the field unit when it need the function
- Crypto bandwidth licensed from factory (default 8Gbps, upgradeable to 16Gbps and 25Gbps on demand)
- 25Gbps crypto license unlocks crypto performance cap of 39Gbps (1400bytes)
- ASR 1002-HX must be powered down to install/remove crypto module

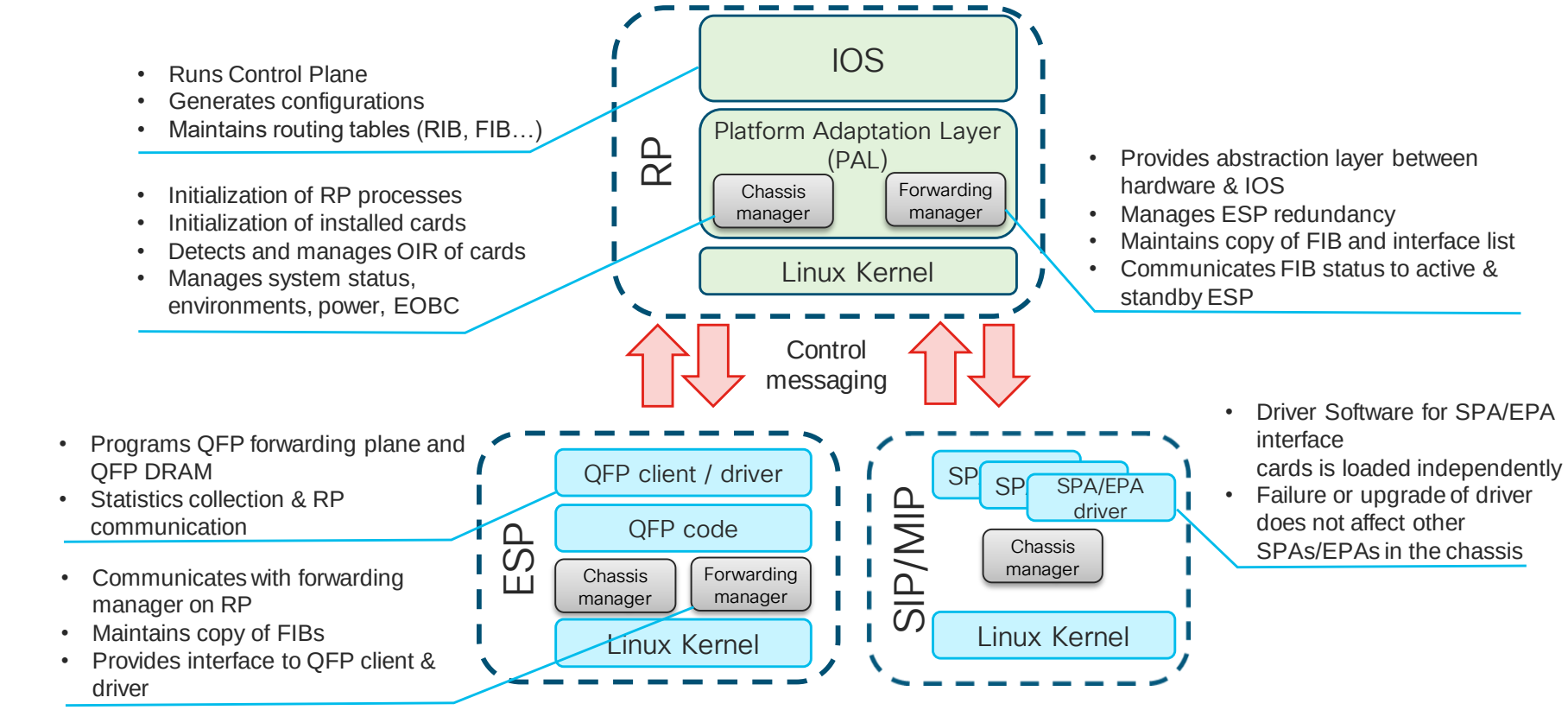
Software Architecture

IOS XE Software architecture

- IOS XE = IOS + IOS XE Middleware + Platform Software
- Operational Consistency—same look and feel as IOS Router
- IOS runs as its own Linux process for control plane (Routing, SNMP, CLI etc.) 64-bit operation
- Linux kernel with multiple processes running in protected memory
  - Fault containment
  - Re-startability
  - ISSU of individual SW packages
- ASR 1000 HA Innovations
  - Zero packet loss with RP Failover
  - <50ms ESP Failover
  - Software redundancy

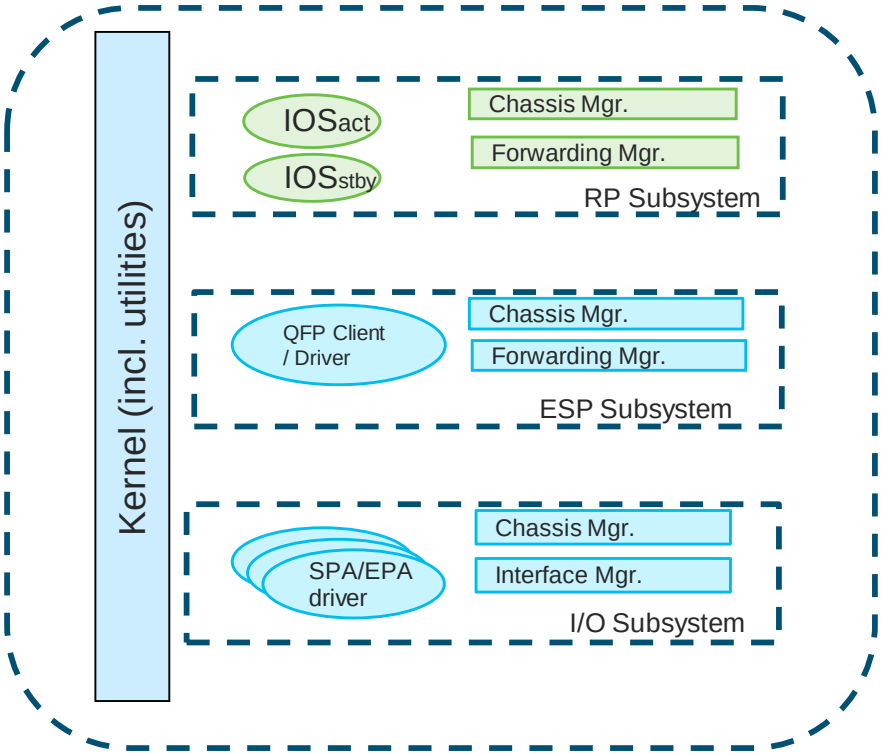


Software Architecture – Modular Platform

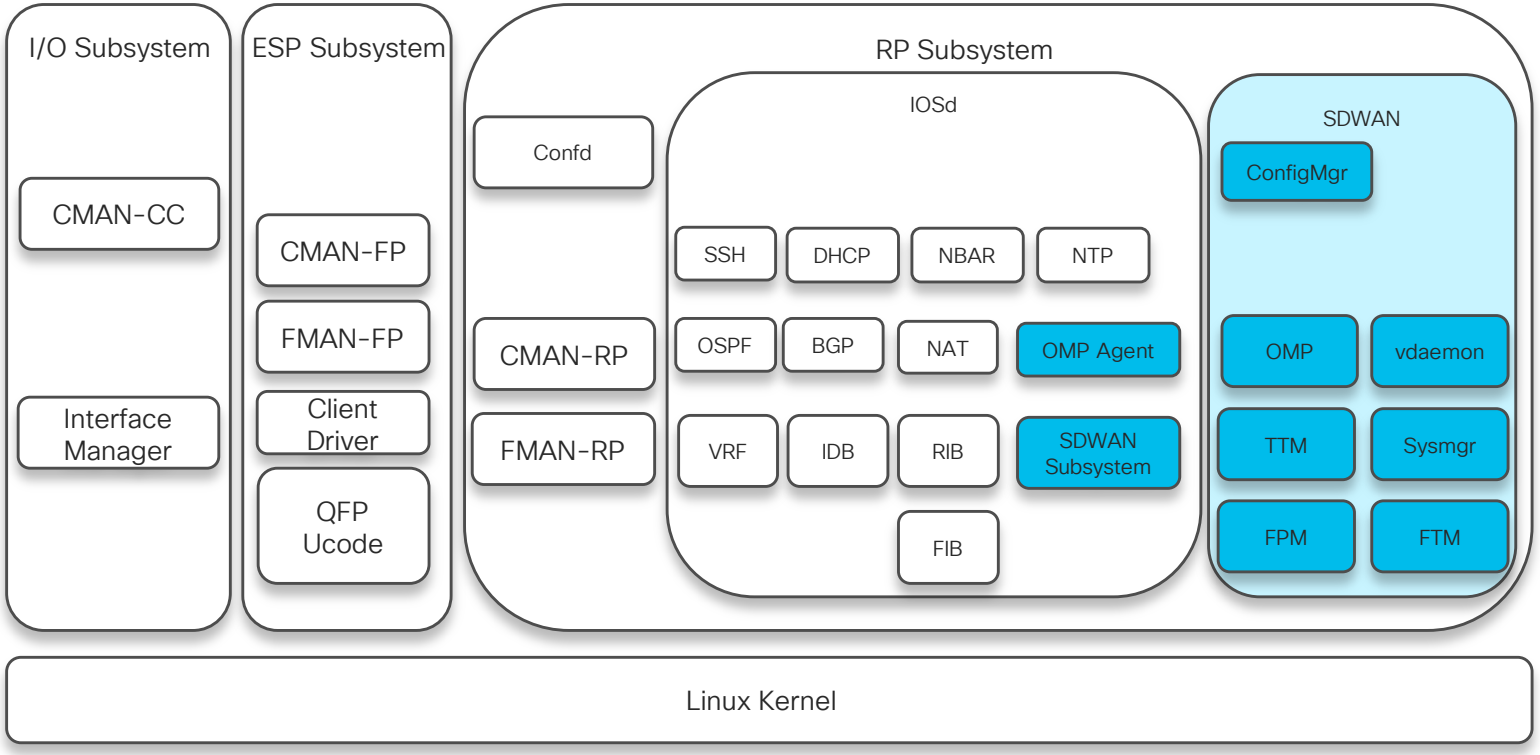


Software Architecture – Fixed Platform

- Single Control CPU
  - Quad-core
  - 64 bit OS
  - 8GB, 16GB, 32GB memory support
- Standard IOS XE Processes
  - Running over a single Linux kernel
- High Availability
  - IOS redundancy
  - Fault Containment
  - Process Restartability
- Operational Consistency
  - Same look and feel as standard IOS
- Ethernet Out of Band Channel
  - Method by which processes in different subsystems communicate

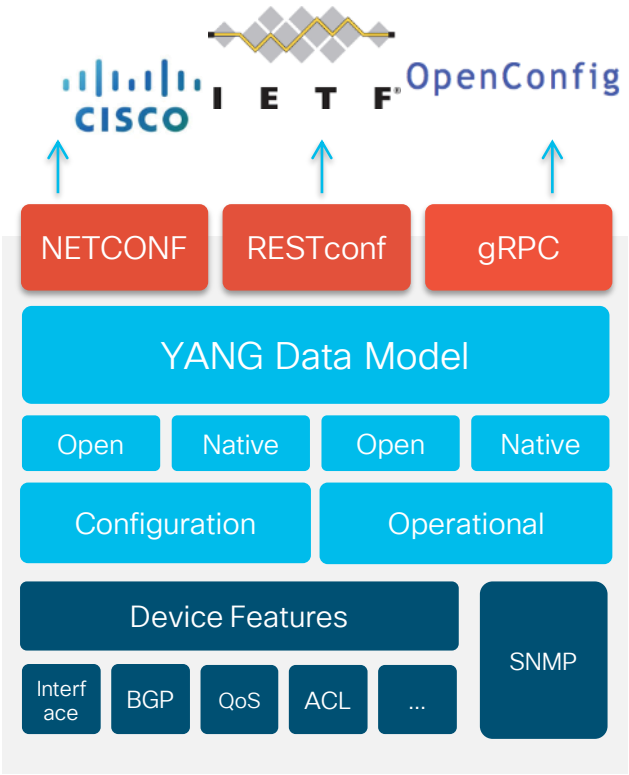


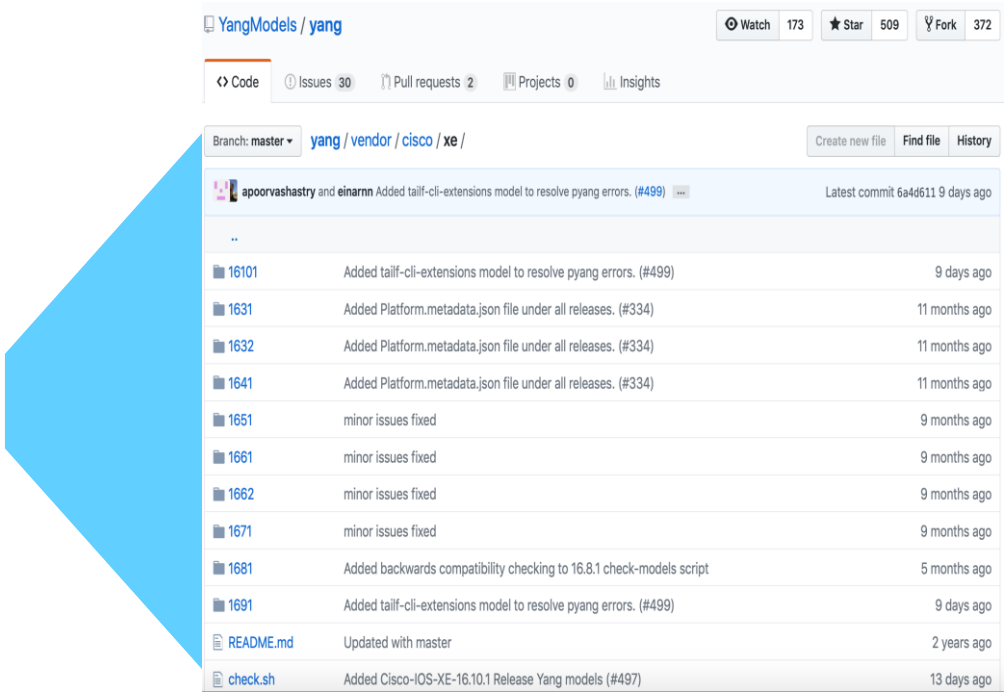
XE SD-WAN Software Architecture



IOS XE Software Innovation

Programmable Interface “Stack”



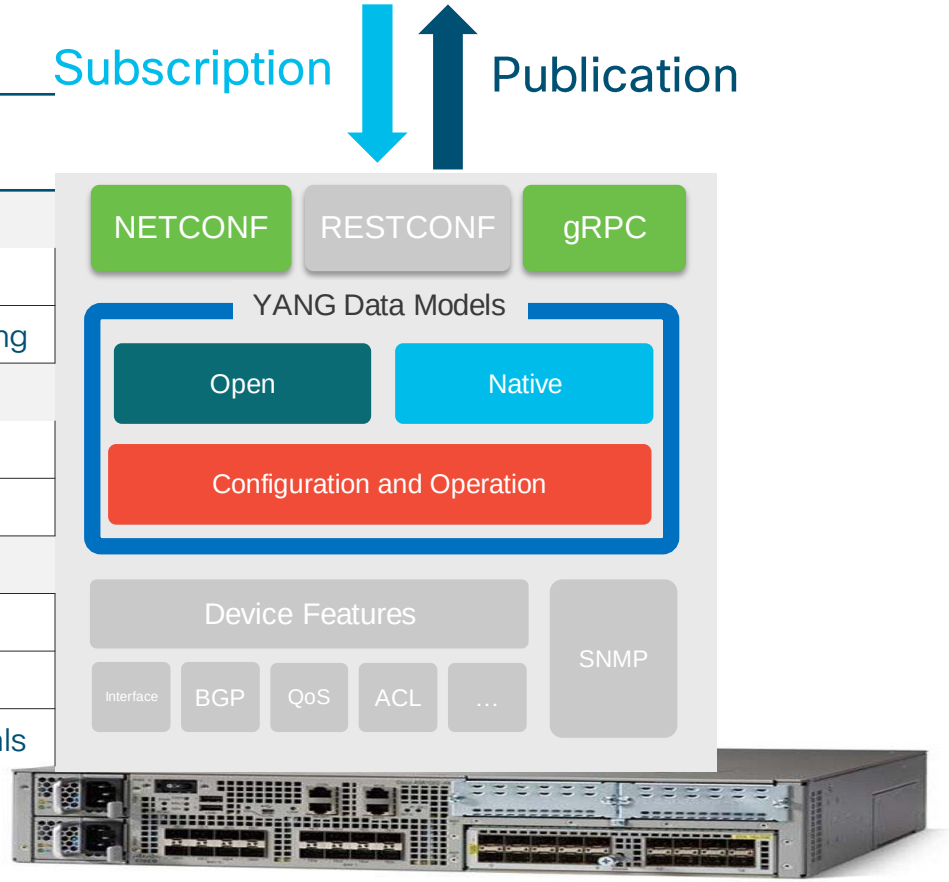


https://github.com/YangModels/yang/tree/master/vendor/cisco/xe

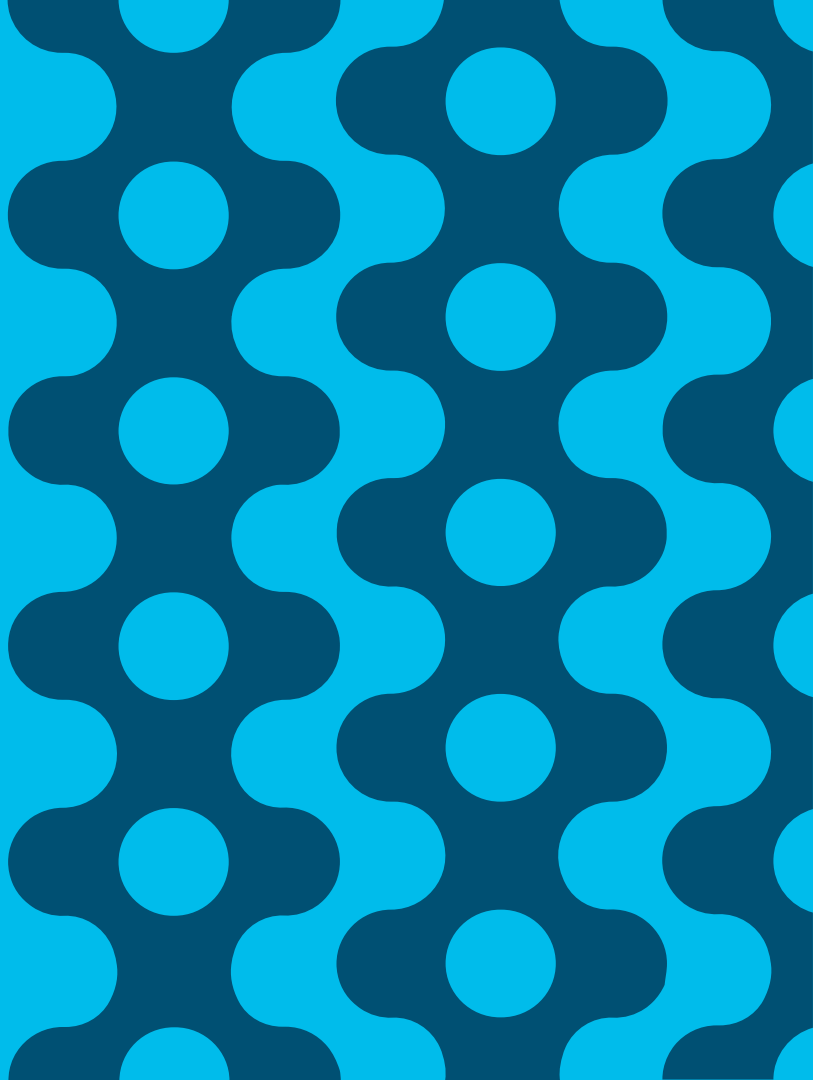
IOS XE Software Innovation

Telemetry

	NETCONF Dial-In 16.6.1	gRPC Dial-Out 16.10.1
Subscriptions		
Type	Dynamic	Configured
Method	ietf-yangpush.yang	ietf-yangpush.yang
Publication Transport Protocol		
NETCONF	✓	
gRPC		✓
Notifications		
Periodic	✓	
On-Change	✓ (model dependent)	
License	Network Essentials or Cisco DNA Essentials	

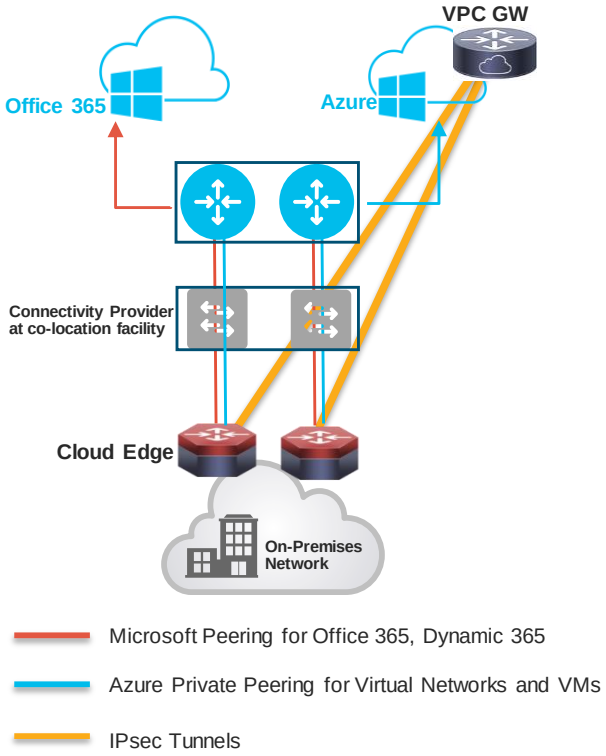


Applications & Solutions



JOIINT VALIDATED DESIGN

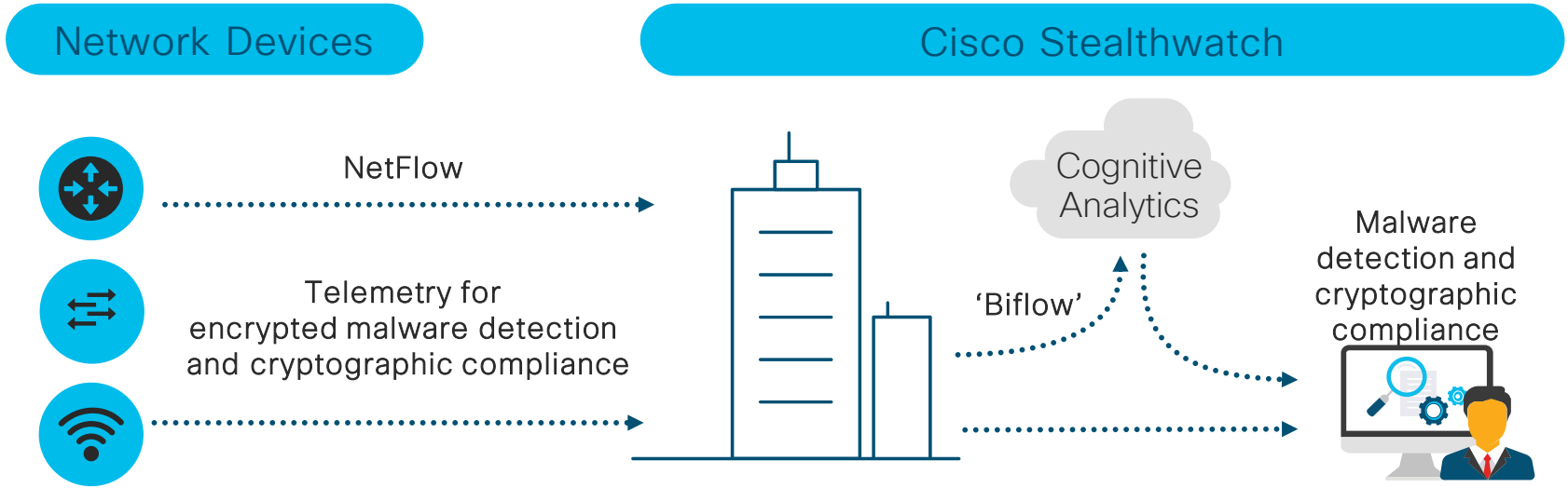
Cloud Edge to Microsoft Azure via ExpressRoute



- ExpressRoute: Private, dedicated, high-throughput network connection between on-premises and Microsoft Azure.
- Cisco and Microsoft have partnered to help you efficiently transition to the cloud with Microsoft Azure ExpressRoute and Cisco Solution Support.
- Create a joint-validated design guide featuring
  - The steps required to extend an on premise network into the ExpressRoute using ASR 1000.
  - Best practices for high availability, optimized routing, NAT and network security.
  - Validation of solution compatibility, connectivity, and correct operation for the on premise deployment from Cisco.

Encrypted Traffic Analytics (ETA)

Find malicious activity hidden in encrypted traffic

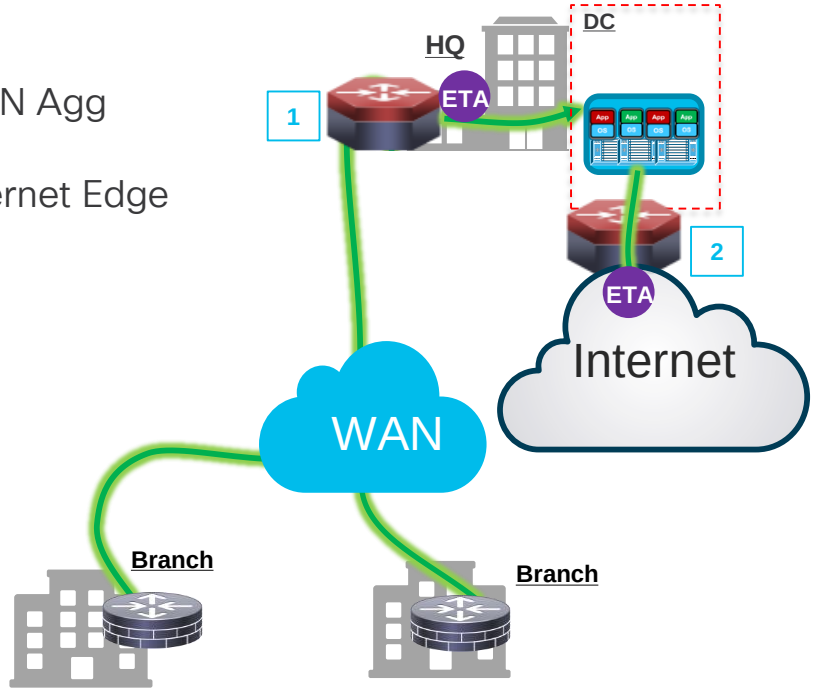


Leveraged network	Faster investigation	Higher precision	Stronger protection
Enhanced NetFlow from Cisco's routers (ASR, ISR, CSR) and switches	Enhanced analytics and machine learning	Global-to-local knowledge correlation	Continuous Enterprise-wide compliance

ASR 1000 ETA Deployment Models

1 WAN Agg

2 Internet Edge



Miercom Report

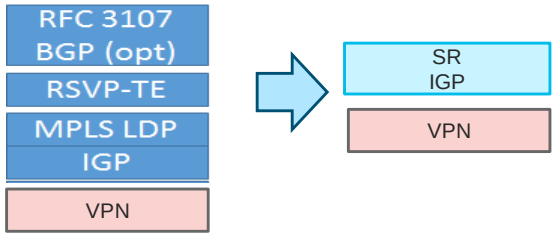
- "Cisco ETA showed as much as 36 percent higher rates of detection than the non-ETA system, finding 100 percent of threats within three hours."
- "An enterprise no longer has to wait months to discover encrypted breaches. Cisco ETA can deliver detection and remediation in just a few hours. "
- "With ETA enabled, malicious flows are detected with speed and increased accuracy over time."

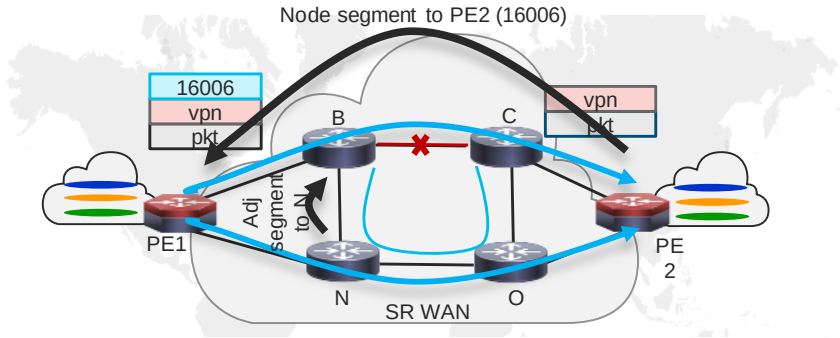
https://www.cisco.com/c/dam/en/us/td/docs/solutions/CVD/Campus/CVD-Encrypted-Traffic-Analytics-Deployment-Guide-2018AUG.pdf

Segment Routing

Simplifying the Transport

- Source Routing: the source chooses a path and encodes it in the packet header as an ordered list of segment
- Segment: an identifier for any type of instructions forwarding or service
- IGP only: no LDP, no RSVT-TE
- ECMP
- Interworking with LDP: ease of migration
- Topology independent Loop Free Alternate
- Support all existing VPN services
- Engineered for SDN





CISCO VALIDATED PROFILE

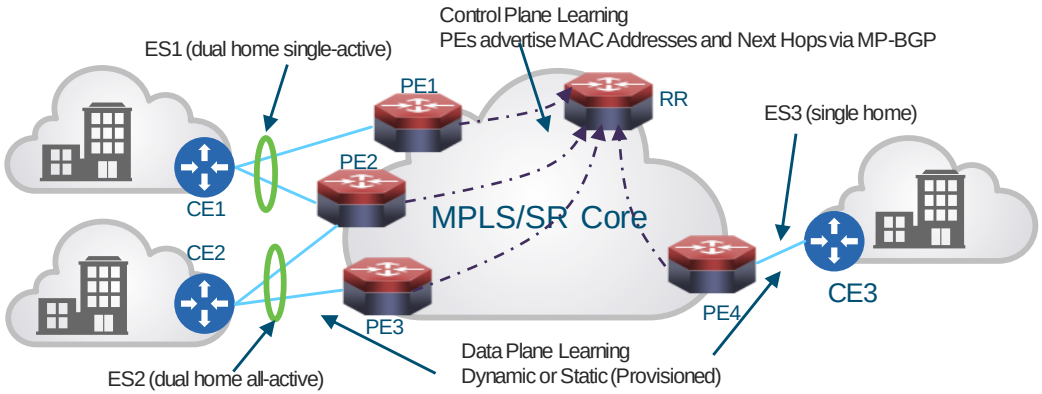
Segment Routing - Making WAN Simple

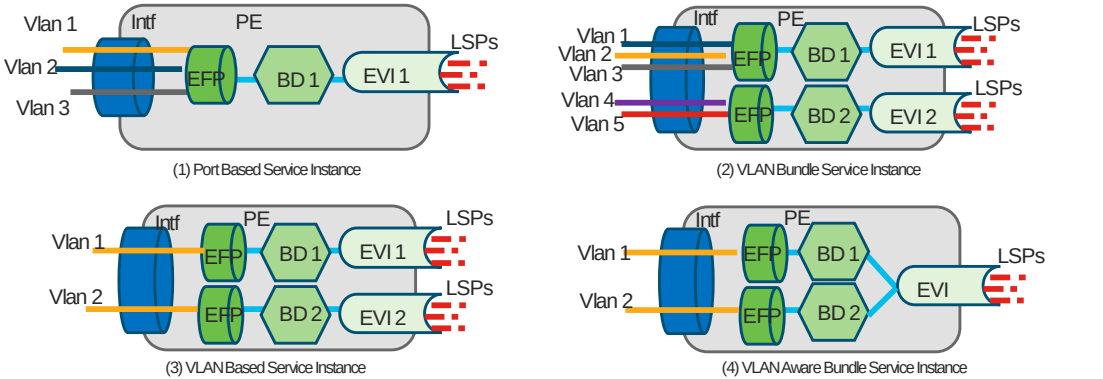
- Use Case 1: Basic Segment Routing in WAN core with MPLS services
- Use case 2: Single-level/area manual SRTE in WAN core with MPLS services
- Use case 3: Multi-area SRTE in WAN core with MPLS services
- Use case 4: On-demand next-hop (ODN) for L3 VPN & L2 VPN
- Use case 5: PCE instantiation of SRTE tunnels in WAN core with MPLS services

https://www.cisco.com/c/en/us/solutions/design-zone/cisco-validated-profiles.html#branch

Ethernet VPN – NG L2VPN Solution

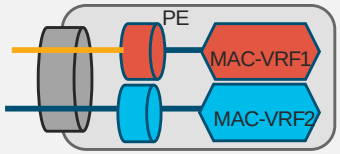
- Scale - Control Plane Address Learning in Core
- Simple – Auto Discovery and Easy Provisioning
- Resiliency - Active-Standby Multi-homing, All-Active Multi-homing
- Rich Services - vlan-based, vlan bundle, vlan-aware bundle
- ASR1k Scale:
  - EVIs – 4k
  - BD – 4k
  - MACs per BD: 64k
  - MACs per box: 256k





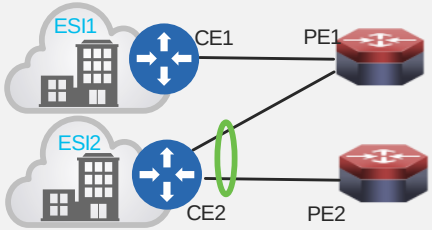
EVPN Components

EVPN Instance (EVI) & MAC-VRF



- EVI identifies a VPN in the network
- MAC-VRF: A VRF table for MAC addresses on a PE
- Encompass one or more bridge-domains, depending on service interface type:
  - Port Based Service Interface
  - VLAN Based Service Interface
  - Vlan Bundle Service Interface
  - Vlan-Aware Bundle Service Interface

Ethernet Segment



- ES: Represents a site (device or network) is connected to one or more PEs via a set of Ethernet links, then that set of links is referred to as an Ethernet Segment
- Could be
  - Single-Homed Device (SHD)
  - Multi-homed Device (MHD)
  - Single-homed Network (SHN)
  - Multi-Homed Network (MHN)

BGP NLRI & Communities

Route Types
[1] Ethernet AD Route
[2] MAC Advertisement Route
[3] Inclusive Multicast Route
[4] Ethernet Segment Route
[5] IP Prefix Route

Extended Communities
ESI Label
ES-Import RT
MAC Mobility
Default Gateway

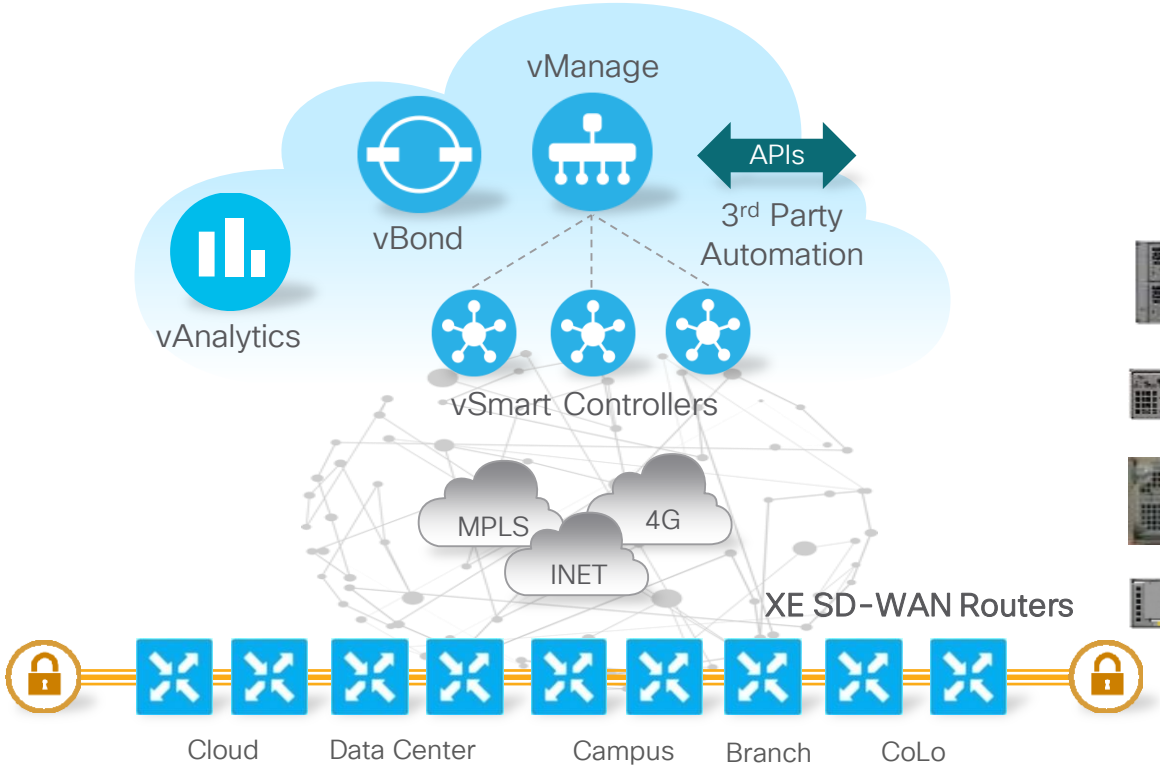
- AFI 25 (L2VPN), SAFI 70 (EVPN)
- Purposes:

MAC address reachability
MAC mass withdraw
Split-Horizon label adv
Aliasing
Multicast endpoint discovery
Redundancy group discovery
Designated forwarder election

- Carry information:

MAC address moves
C-MAC flush notification
Redundancy mode
MAC / IP bindings of GW
Split-Horizon label encoding

XE SD-WAN on ASR 1000




ASR1002-HX

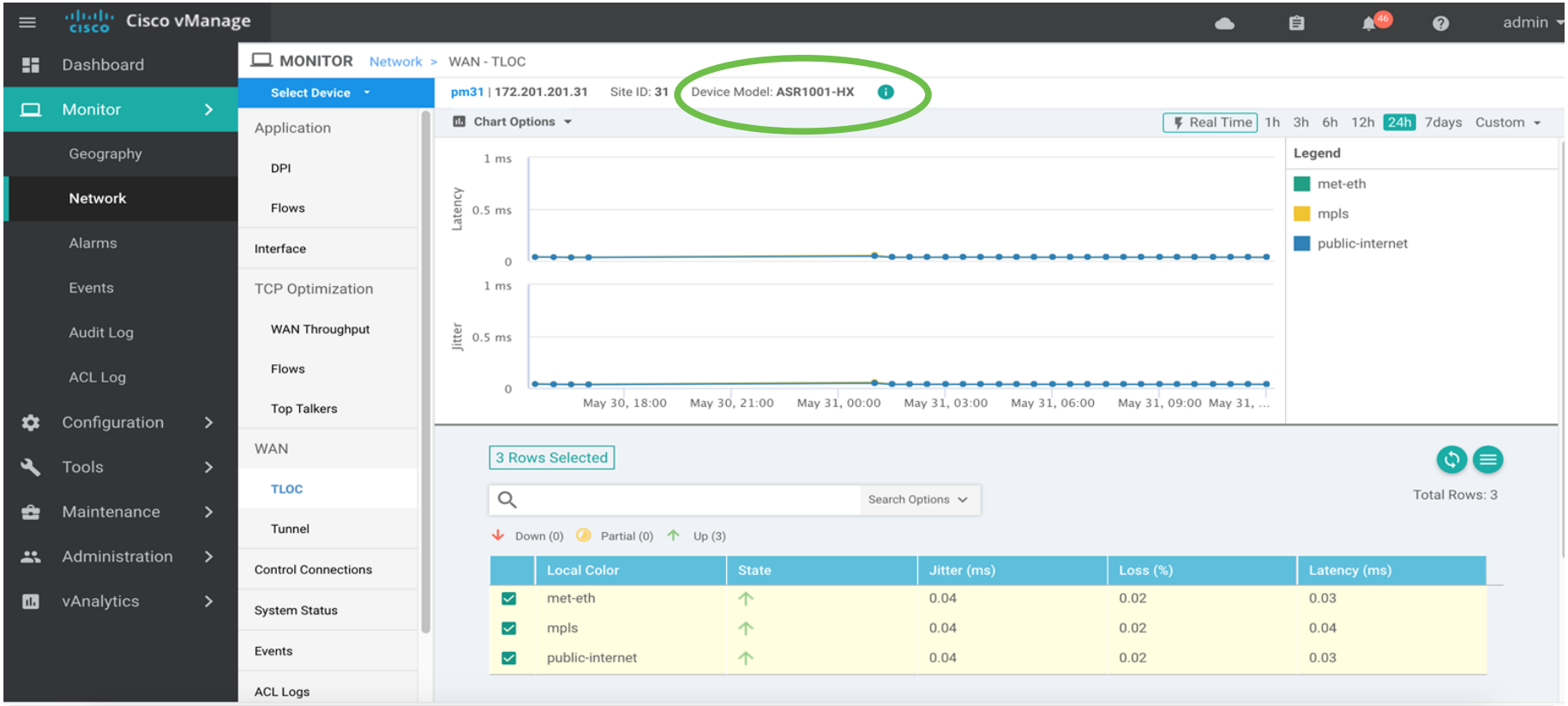

ASR1001-HX


ASR1002-X


ASR1001-X

ASR 1000 managed by vManage

FYI



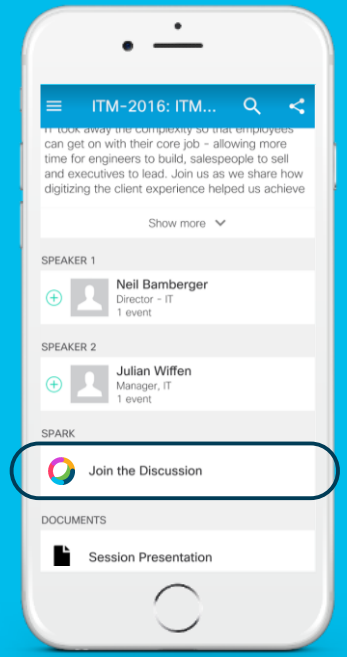
Conclusion

Agenda

- Introducing the ASR 1000
- ASR 1000 System Architecture
- ASR 1000 Software Architecture
- Applications & Solutions
- Conclusion

Summary and Key Takeaways

- ASR 1000 is the Swiss Army Knife to solve your tough network problems
- Reduce complexity in your network edge.
- ASR 1000 is well positioned for both Enterprise and Service Provider Architectures.
- ASR 1000 is fully embedded in the Cisco Digital Network Architecture



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Cisco Webex Teams

Questions?

Use Cisco Webex Teams (formerly Cisco Spark) to chat with the speaker after the session

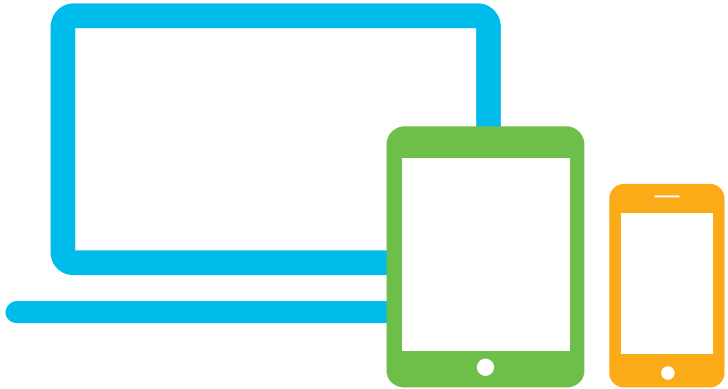
How

1. Find this session in the Cisco Events Mobile App
2. Click “Join the Discussion”
3. Install Webex Teams or go directly to the team space
4. Enter messages/questions in the team space

Complete your online session survey

- Please complete your Online Session Survey after each session
- Complete 4 Session Surveys & the Overall Conference Survey (available from Thursday) to receive your Cisco Live T-shirt
- All surveys can be completed via the Cisco Events Mobile App or the Communication Stations

Don't forget: Cisco Live sessions will be available for viewing on demand after the event at ciscolive.cisco.com



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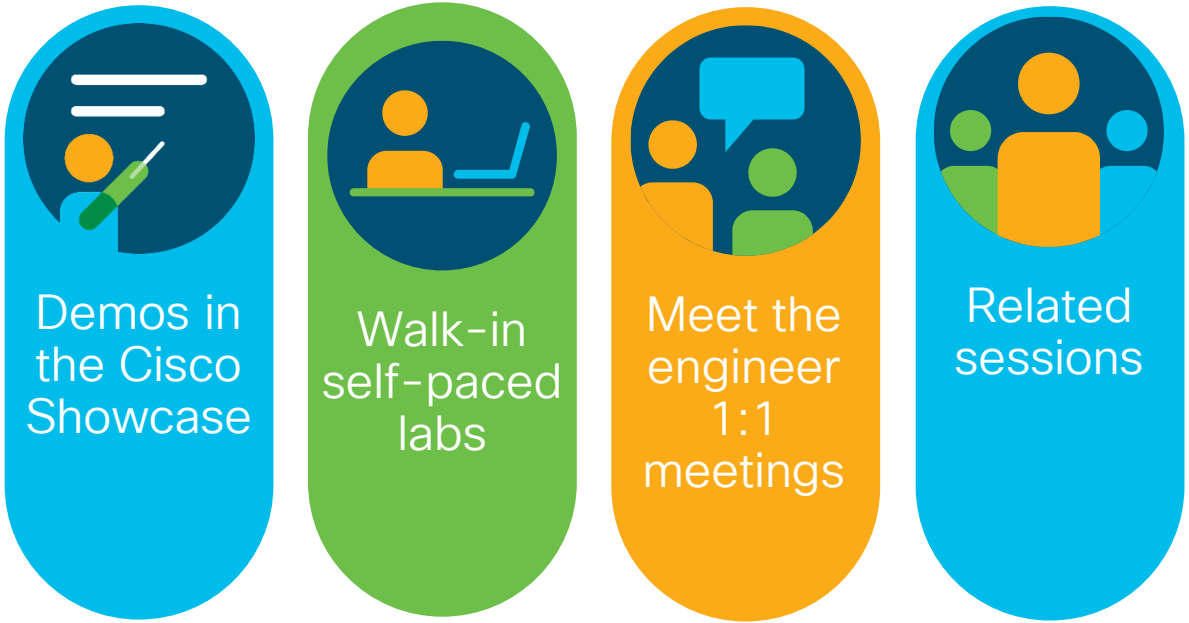
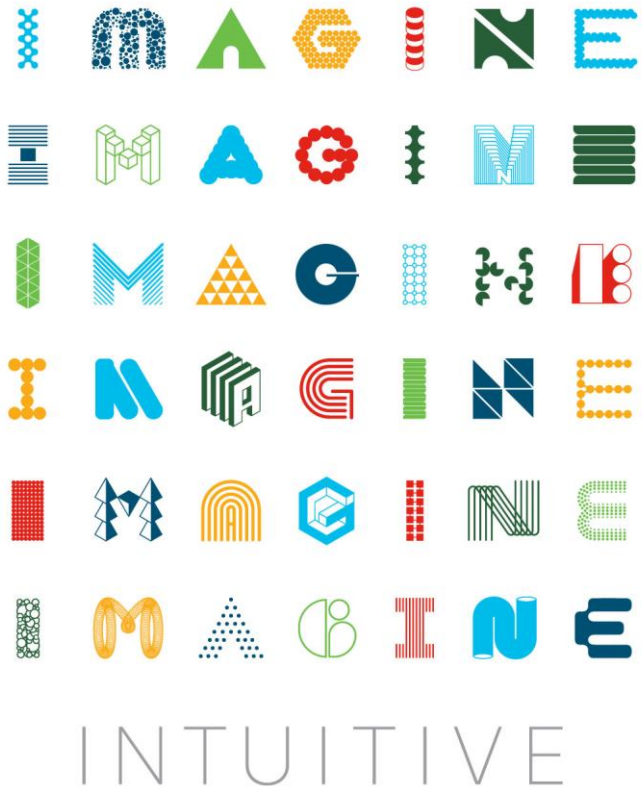


Related Sessions

- LTRARC-3500 - IOS XE (Routers) troubleshooting
- BRKSDN-2666 - IOS XE Architecture for Programmability
- BRKCRS-2811 - Cisco SD-Access - Connecting the Fabric to External Networks
- BRKCRS-1560 - Detect threats in encrypted traffic without decryption, using network based security analytics
- BRKMPL-2118 - Evolving Network Application Use-Cases Using Segment Routing In the Enterprise
- BRKCRS-2110 - Delivering Cisco Next Generation SD-WAN with Viptela

Thank you



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