

Introduction to Cisco IOS XRv 9000 BGP Route-Reflector Appliance

cisco Live !

Architecture, Operations, Observability

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Cisco Webex App

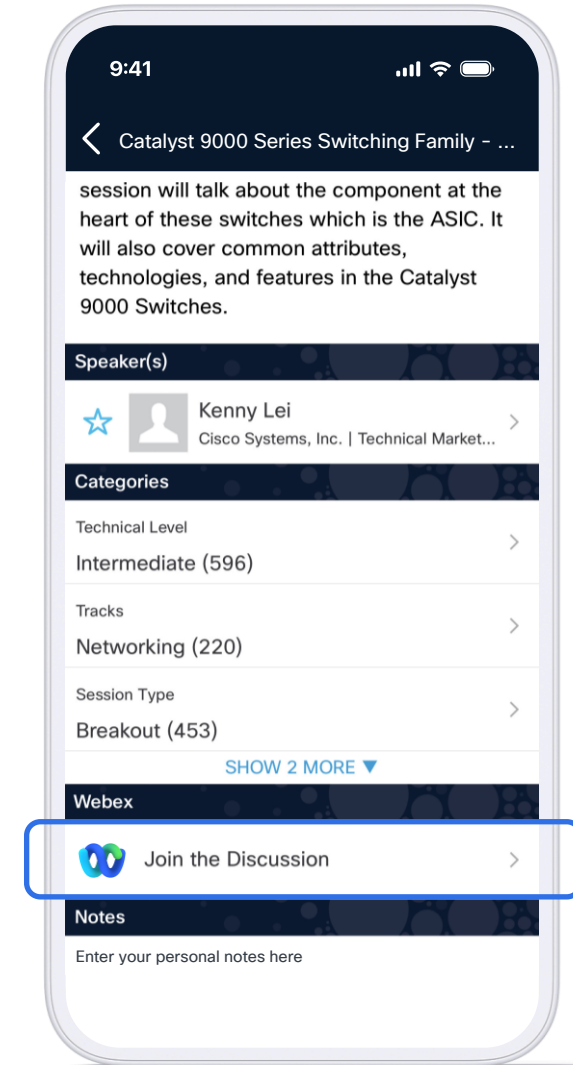
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<https://ciscolive.ciscoevents.com/ciscolivebot/#BRKSPG-2051>

Agenda

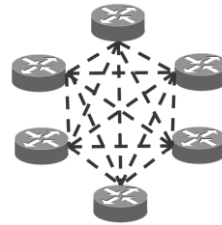
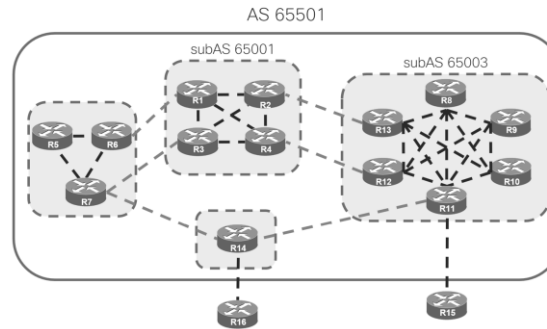
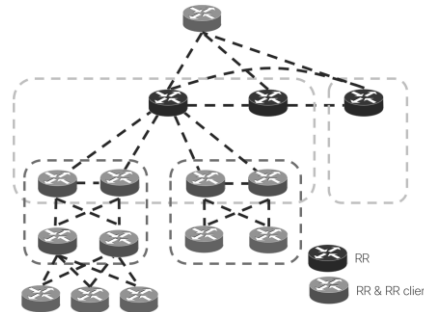
- 01 Intro & Deployment Models
- 02 Hardware Architecture
- 03 Software Architecture
- 04 Appliance Operations
- 05 Performance & Scale
- 06 Best Practices
- 07 BGP Observability
- 08 Conclusion

Introduction & Deployment Models

Why do we Need BGP Route-Reflector?

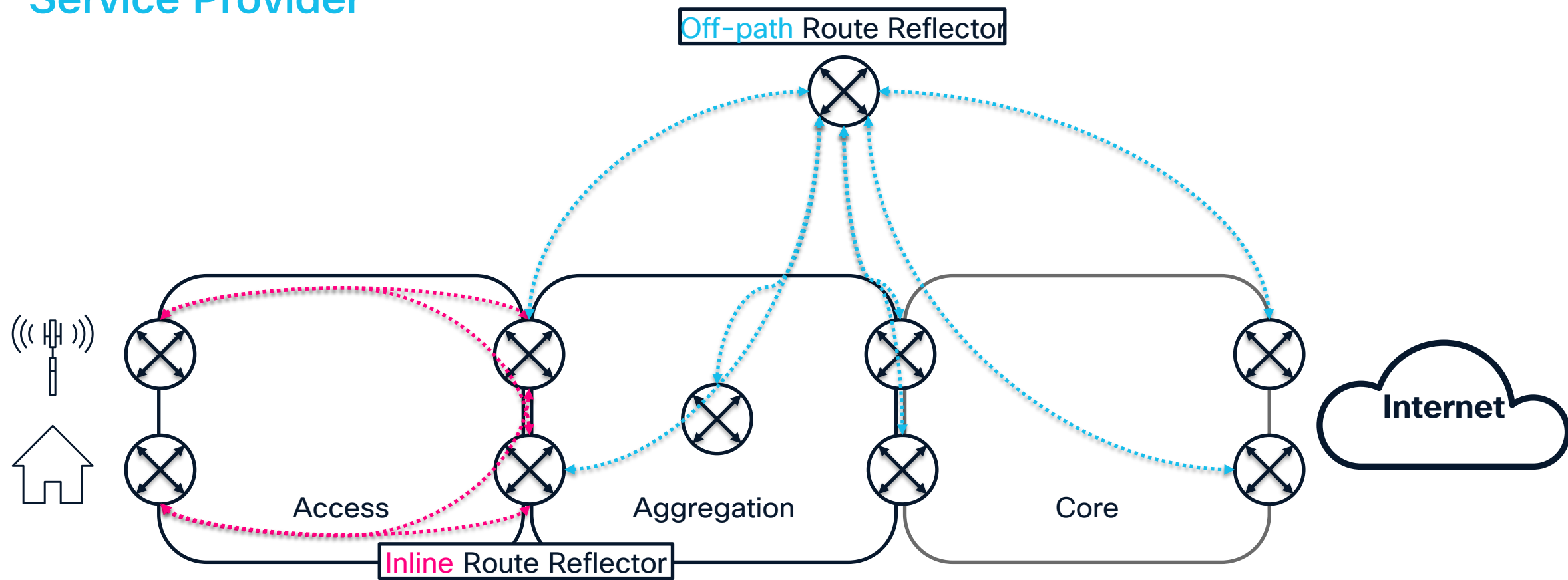
Back to the basics

- 3 main models for iBGP connectivity
 - Full mesh
 - Pros: Good for small scale, optimal routing
 - Cons: Exponential sessions scale
 - BGP confederations
 - Pros: Good scale
 - Cons: Operational complexity, hard to evolve design
 - Route-Reflectors
 - Pros: High scale, hierarchical
 - Cons: Routing sometimes not optimal (use ORR)



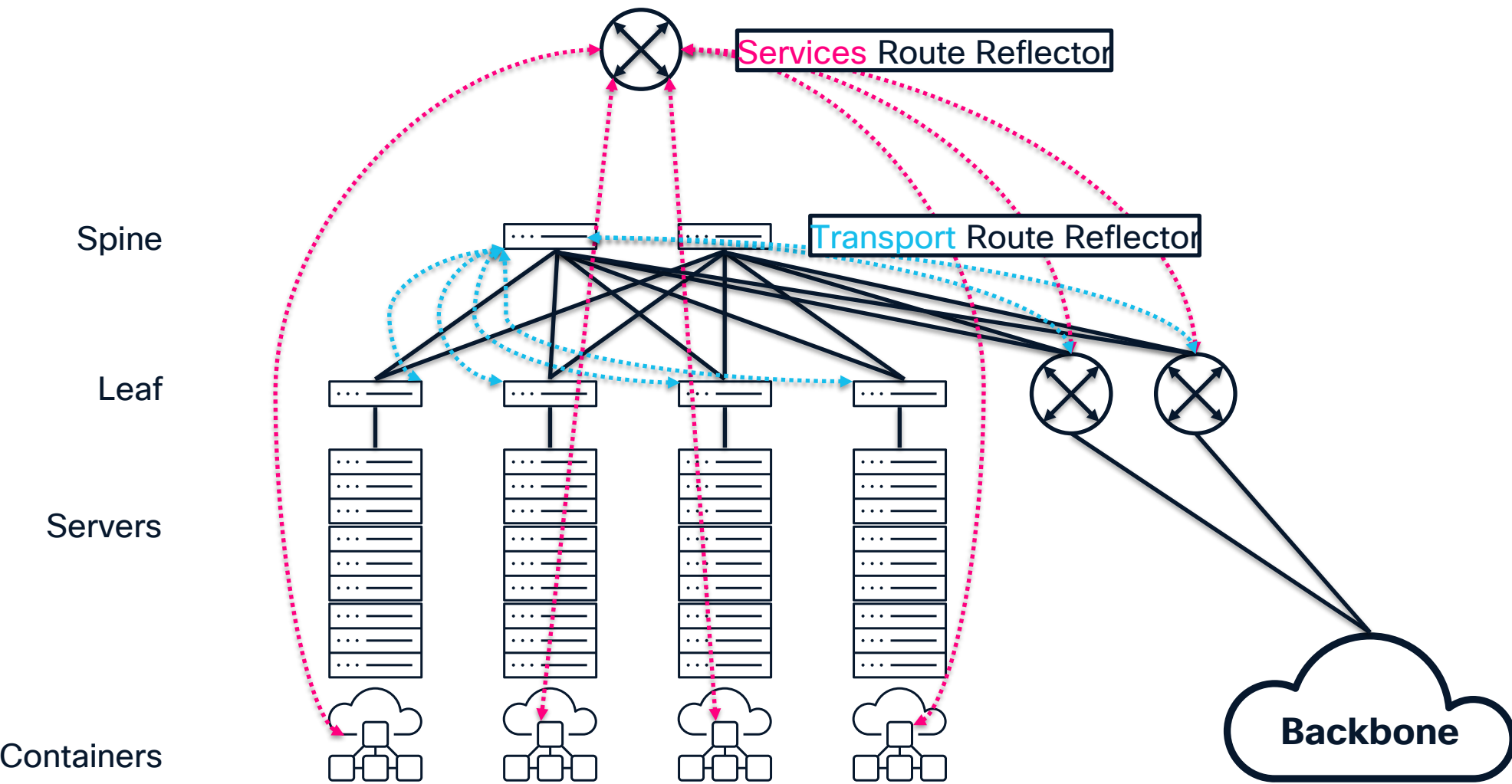
Deployment Model

Service Provider



Deployment Model

Datacenter & Cloud



Single IOS XR BGP Stack...

... Multiple Form Factors Available

	Traditional Router	VNF (Container/VM)	Appliance
Scale	Low/Medium/High	Medium/High	Very high
Operation simplicity	Fully integrated	Support requirements from NFVI vendor and VNF vendor	Fully integrated
Security	Integrated, hardware TPM	Underlying compute & virtualization layers must be secured	Integrated, hardware TPM
Multi apps	Support extra features, capable of forwarding	Can support Multi-VMs and Applications	Can support only single application
Cost	\$\$\$	\$	\$\$
Flexibility	Fixed Scale, Fixed Resource, can be repurposed	Variable resource allocation; flexible	Fixed Scale, Fixed Resource, fully dedicated for RR

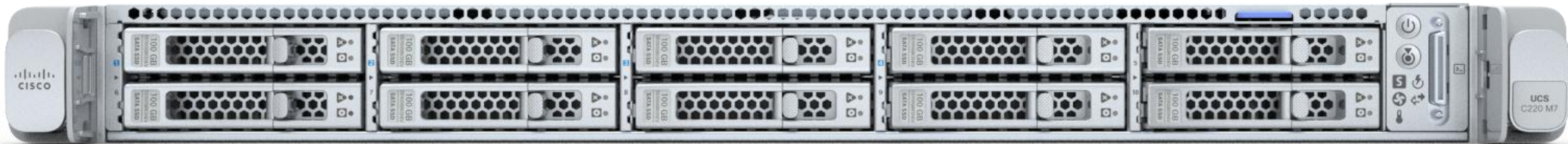
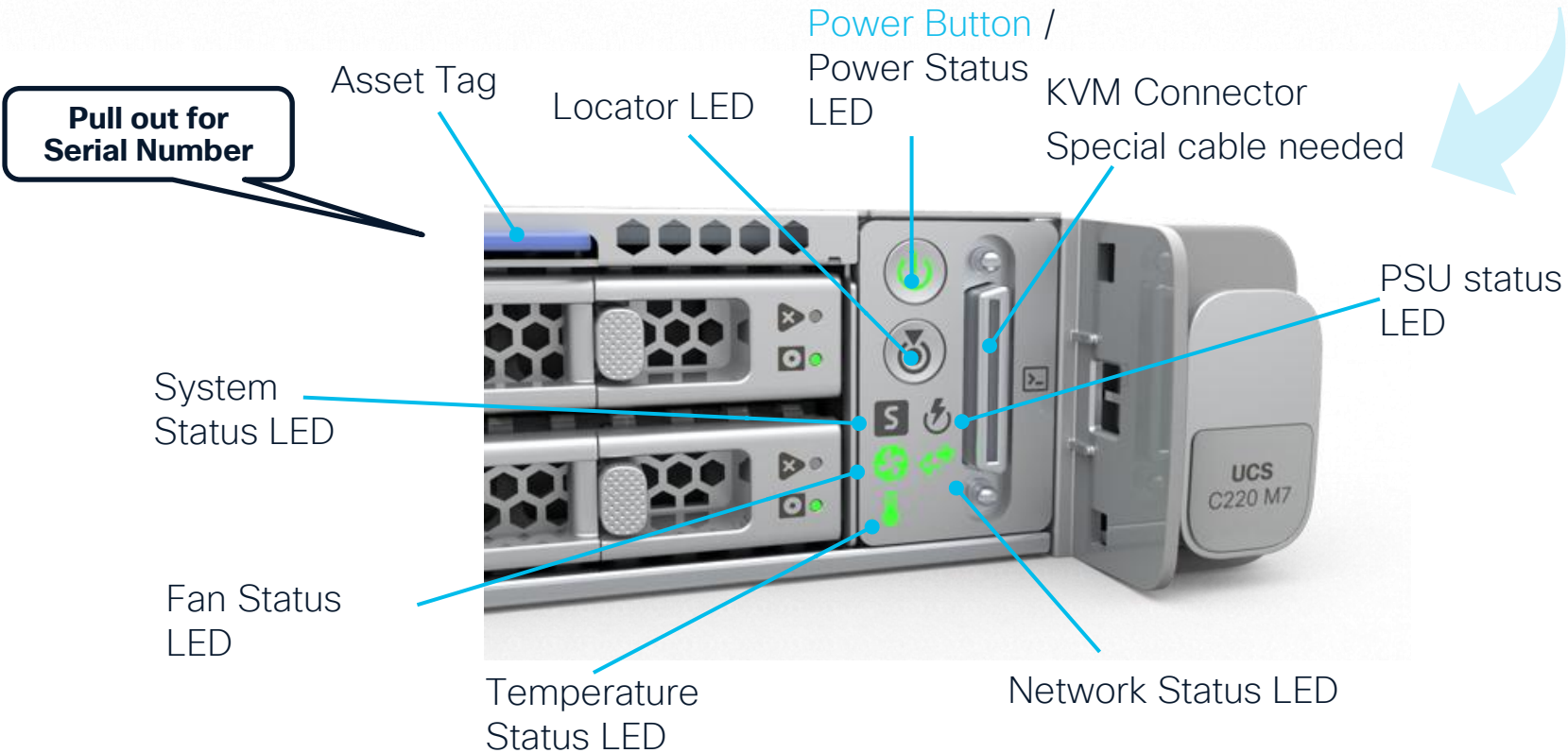
What is IOS XRv 9000 UCS M7 Appliance?

- Fully integrated IOS XRv 9000 router running over Cisco UCS hardware server, out of factory
 - Bare Metal: no need to operate, secure, maintain & optimize NIC drivers/virtualization layer
 - Behaves like a regular IOS XR router...
 - But on steroids for BGP RR function: augmented CPU & RAM for optimal scale & convergence
 - Low footprint & low power: 1RU, < 250W
- Two versions available
 - XRV-M7-APLN-25G: 4x10G/25G ports
 - XRV-M7-APLN-100G: 4x100G



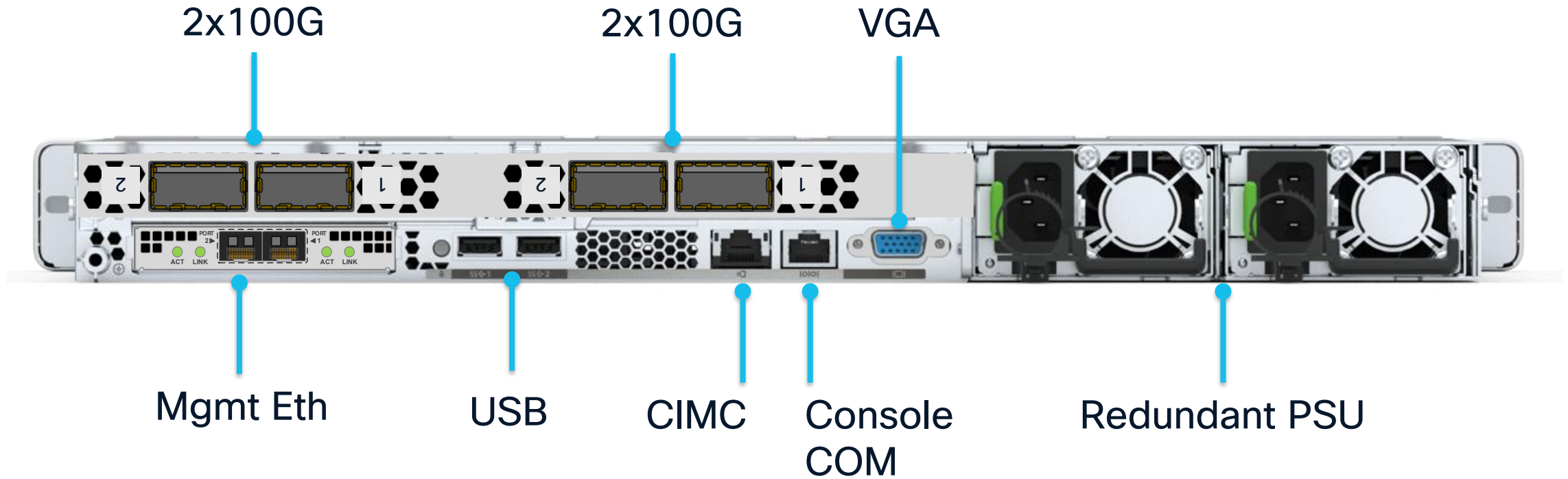
Hardware Architecture

Front View



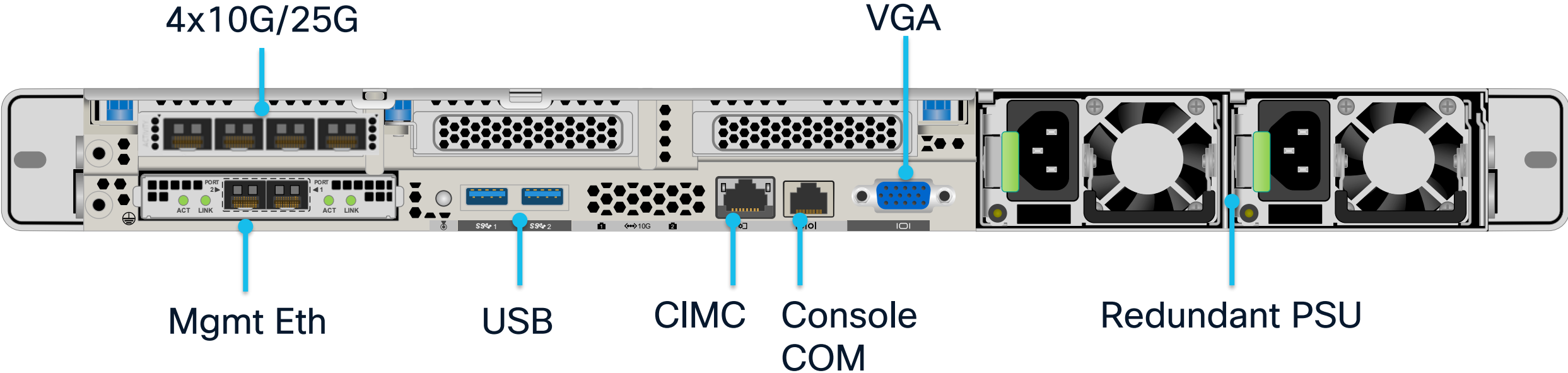
Rear View

XRV-M7-APLN-100G



Rear View

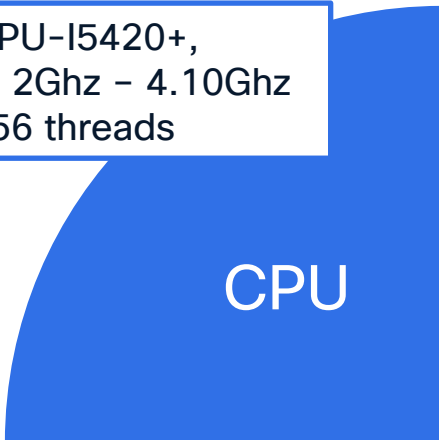
XRV-M7-APLN-25G



Key Hardware Components



1 x UCS-CPU-I5420+,
Frequency: 2Ghz - 4.10Ghz
28 Cores, 56 threads

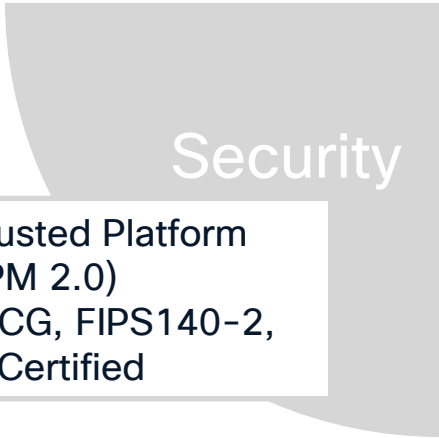


CPU



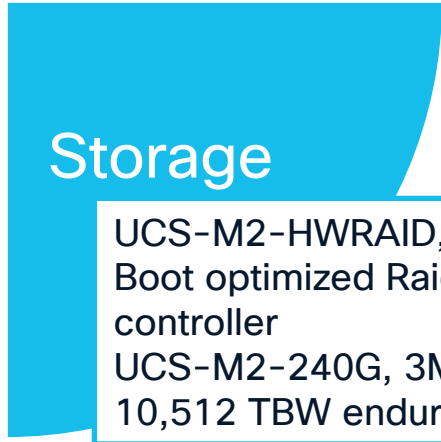
Memory

128GB DDR5
8 x UCS-MRX16G1RE1
Samsung 16GB DDR5-4800



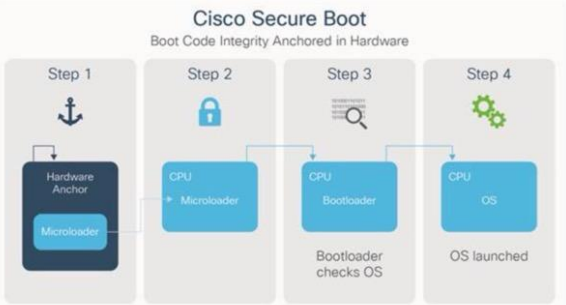
Security

Modular Trusted Platform
Module (TPM 2.0)
TPM 2.0, TCG, FIPS140-2,
CC EAL4+ Certified

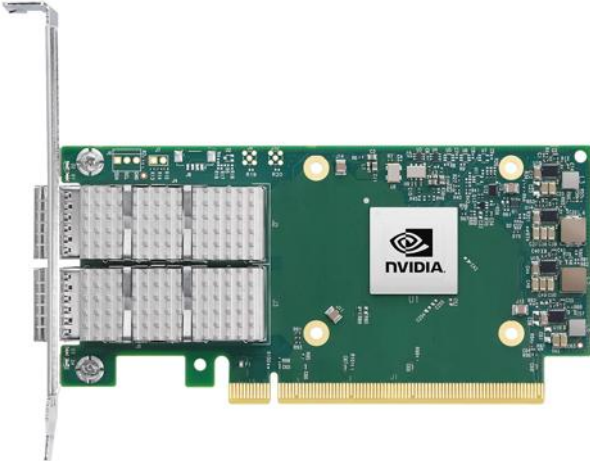


Storage

UCS-M2-HWRAID, Cisco
Boot optimized Raid
controller
UCS-M2-240G, 3M hours,
10,512 TBW endurance



Networking Options

	XRV-M7-APLN-25G	XRV-M7-APLN-100G
NIC Model	Intel E810 XXVDA4	NVIDIA ConnectX-6 Dx
		
Interfaces per NIC	4x25G SFP28	2x100G QSFP56
Number of NIC	1	2
Total number of ports	4x10G/25G	4x100G
Supported Optics	SFP-10G-LR/SR, SFP-10G-AOCxM, SFP-H10GB-CUxM, SFP-10/25G-LR-S, SFP-25G-SR, SFP-25G-AOCxM, SFP-H25GB-CUxM	QSFP-100G-SR4-S/QSFP-100G-LR4-S/QSFP-100G-LR-S/QSFP-100G-FR-S/QSFP-100G-CUxM/QSFP-100G-AOCxM
NIC Performance	100Gbps / 80-90Mpps	200Gbps / 215Mpps

Software Architecture

Software Architecture

- IOS XRv 9000 software runs bare-metal over the appliance hardware
- It uses 3 x LXC (lightweight, faster to boot, no nested virtualization, fault isolation, application hosting)
 - Admin + XR = virtual RP (admin plane, control plane, management plane)
 - UVF = virtual LC (forwarding plane)
- All running over Linux 64-bit kernel

Admin LXC

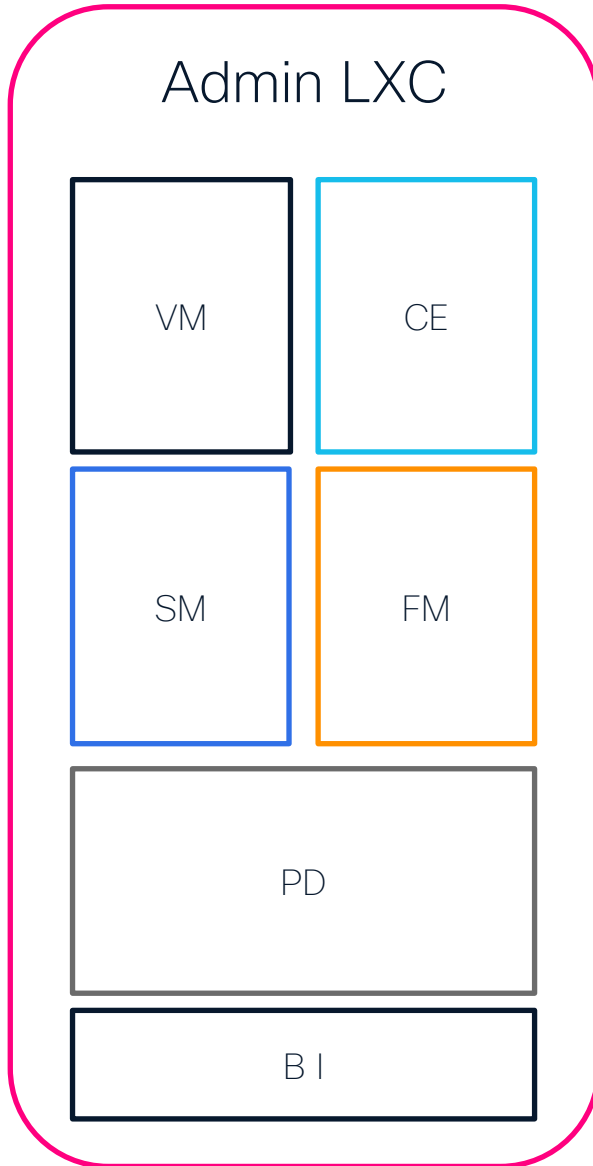
XR LXC

UVF LXC

Linux OpenEmbedded (OE) 6.6 yocto-standard 64-bit kernel

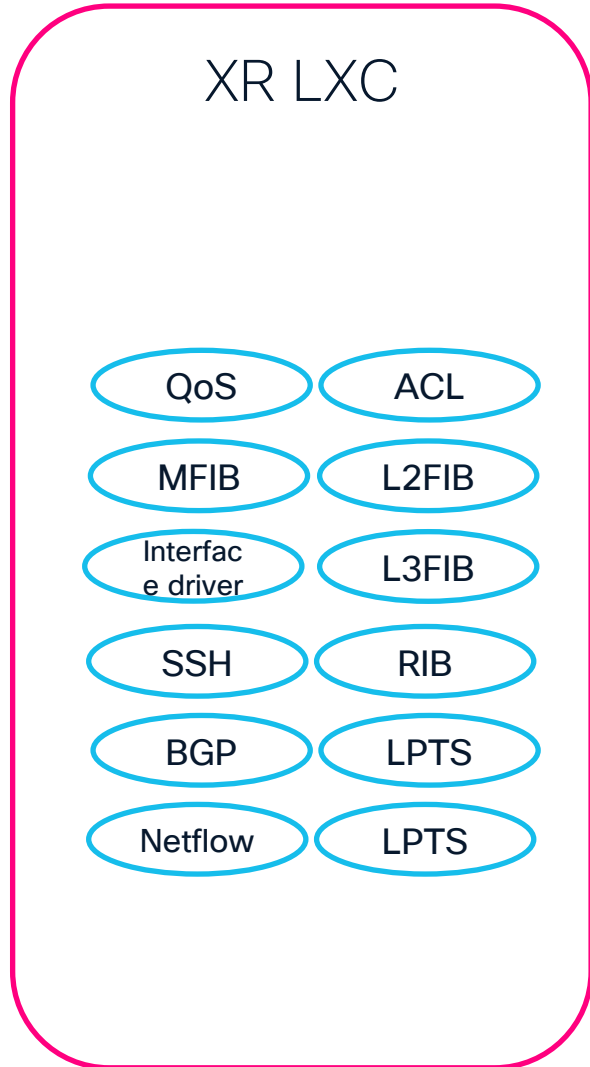
UCS Hardware

Admin LXC



- Also called 'Calvados' or 'sysadmin'
- Lightweight and optimized admin plane
- Infra management
- SMU management
- VM/LXC management
- Lifecycle Management for CP and DP
 - Install
 - Start/Stop
 - Upgrade/Downgrade
 - Liveness (Heartbeat monitoring)
- Environmental monitoring

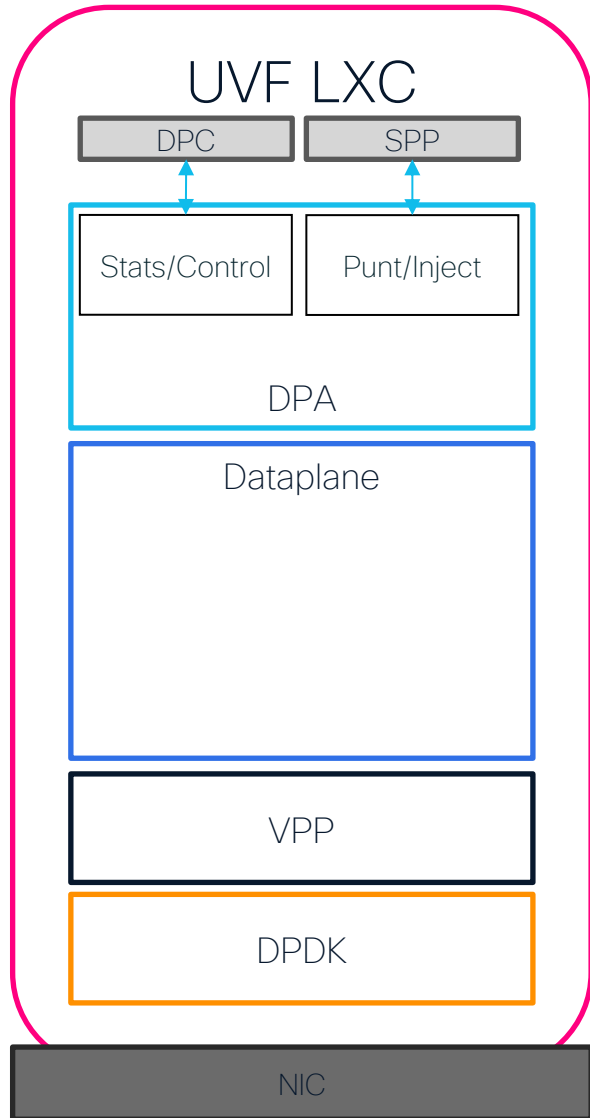
XR LXC



- Control Plane & Management plane
 - Routing Protocols, RIB, interface manager
- Full IOS XR protocol stack
 - ACL, QoS, Multicast, Netflow, etc.

UVF LXC

Universal Virtual Forwarder



- DPA
 - Handles control messages to/from the DPC
 - Handles punt / inject packets to/from the SPP
 - Performs statistics scraping and aggregation and export to the DPC
- UVF ucode - packet processing work
 - XR based L2 classification, mTrie Lookup, Forwarding / Features, TM
- VPP - Data plane OS
 - High performance batch packet delivery and input classification, load balancing, work scheduling - some functions can be shared across all forwarders based on VPP/DPDK
- DPDK
 - High performance poll mode drivers for NFV
 - NIC Support, memory management

Cisco IOS XRv 9000 Profiles

- 2 x IOS XRv 9000 profiles exist

VRR
Focus on Control Plane

VPE
Focus on Forwarding Plane

README-fullk9-R-XRV9000-2432-RR.txt
xrv9k-fullk9-x.virsh-24.3.2.xml
xrv9k-fullk9-x.vrr-24.3.2.iso
xrv9k-fullk9-x.vrr-24.3.2.ova
xrv9k-fullk9-x.vrr-24.3.2.qcow2

README-fullk9-R-XRV9000-2432.txt
xrv9k-bng-1.0.0.0-r2432.x86_64.rpm
xrv9k-bng-suppl-x64-1.0.0.0-r2432.x86_64.rpm
xrv9k-eigrp-1.0.0.0-r2432.x86_64.rpm
xrv9k-fullk9-x-24.3.2.iso
xrv9k-fullk9-x-24.3.2.ova
xrv9k-fullk9-x-24.3.2.qcow2
xrv9k-goldenk9-x-24.3.2-PROD_BUILD_24_3_2.iso
xrv9k-isis-1.0.0.0-r2432.x86_64.rpm
xrv9k-k9sec-1.0.0.0-r2432.x86_64.rpm
xrv9k-li-x-1.0.0.0-r2432.x86_64.rpm
xrv9k-m2m-1.0.0.0-r2432.x86_64.rpm
xrv9k-mcast-1.0.0.0-r2432.x86_64.rpm
xrv9k-mgbl-1.0.0.0-r2432.x86_64.rpm
xrv9k-mini-x-24.3.2.iso
xrv9k-mpls-1.0.0.0-r2432.x86_64.rpm
xrv9k-mpls-te-rsvp-1.0.0.0-r2432.x86_64.rpm
xrv9k-ospf-1.0.0.0-r2432.x86_64.rpm

IOS XRv 9000 Router

Release 24.3.2 MD

[My Notifications](#)

Related Links and Documentation

- No related links or documentation -

File Information	Release Date	Size	
Cisco IOS XRV 9000 software Upgrade/downgrade Document XRV9K-docs-24.3.2.tar Advisories	08-Dec-2024	0.54 MB	Download Cart Bookmark
Cisco IOS XRV 9000 software, VRR profile fullk9-R-XRV9000-2432-RR tar Advisories	08-Dec-2024	4520.38 MB	Download Cart Bookmark
Cisco IOS XRV 9000 software, VRR profile with VGA support fullk9-R-XRV9000-2432-RRVG tar Advisories	08-Dec-2024	4520.90 MB	Download Cart Bookmark
Cisco IOS XRV 9000 software, Non VRR profile with VGA support fullk9-R-XRV9000-2432-VG tar Advisories	08-Dec-2024	4520.34 MB	Download Cart Bookmark
Cisco IOS XRV 9000 software, Non VRR profile fullk9-R-XRV9000-2432 tar Advisories	08-Dec-2024	7118.67 MB	Download Cart Bookmark

The appliance is always VRR

CPU & Memory Resources Allocation

```
sysadmin-vm:0_RP0# show virtual-platform
Sat Nov 1 15:22:57.624 UTC+00:00
Virtual Platform Info
-----
System UUID: 4ba34a9e-69e8-934f-b0f6-4bca81487744
Operation Mode: ( reboot_on_xr_bake reboot_on_xr_bake )
HW Profile: ( vrr )
```

Memory Info:

Name	Total(MB)	Used(MB)
=====		
Whole System	128173.62	13086.71
sysadmin	8192.00	5131.26
default-sdr--1	103424.00	4257.72
default-sdr--2	16384.00	3697.46

CPU Model: Intel(R) Xeon(R) Gold 5420+

CPU Set: 0-27

CPU Allocation:

VM Name	CPU Allocation
=====	
sysadmin	0-21
default-sdr--1	0-21
default-sdr--2/uvfcp	0-21
default-sdr--2/uvfdp	22-27

Most RAM and CPU allocated
for Control Plane operations

Appliance Ordering and Licensing Structure

PID	Description
<div>1</div> <div>XRV-M7-APLN-25G XRV-M7-APLN-100G</div>	XRV 9000 Appliance using UCS C220 M7. Entitles the customer up to 20M BGP paths
<div>2</div> <div>S-XRV-ROUTE-T4</div>	IOS XRv 9000 vRR scale upgrade license from 20M BGP paths & beyond

LICENSING STRUCTURE

1. The base PID XRV-M7-APLN entitles the customer to use vRR Appliance for up to 20M BGP paths
2. S-XRV-ROUTE-T4 is a PID that needs to be purchased if the customer wants to scale to 75M BGP paths & beyond

✓ ***vRR Appliance licensing is disabled; this means all licenses are honour based***

Appliance Operations

CIMC Access

- HTTPS to CIMC IP (trust certificate). Intersight message can be ignored. SSH access also possible
- Default credentials: admin/password (must be changed after first login)

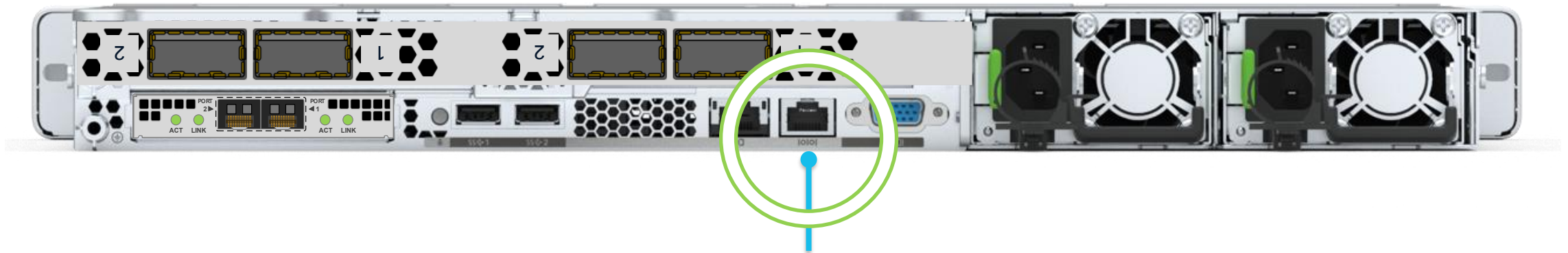
The screenshot displays the Cisco Integrated Management Controller (CIMC) interface. The top navigation bar includes the Cisco logo, the text "Cisco Integrated Management Controller", a "Dashboard" dropdown menu, and user information for "admin@10.209.197.12" with device ID "C220-WZP28359K2C". A notification banner states: "Please note: Intersight Infrastructure Services license is required with this server. [Learn More.](#)".

The main content area is divided into two sections:

- Dashboard:** Contains two summary cards.
 - Server Details:** Lists Product Name (XRV-M7-APLN-100G), Serial Number (WZP28359K2C), UUID (CB52067A-3FDC-4969-9E11-757086E85117), BIOS Version (C220M7.4.3.5a.0_XRV9K), and PID (XRV-M7-APLN-100G).
 - CIMC Information:** Lists IP Address (172.20.166.102), Host Name (C220-WZP28359K2C), MAC Address (EC:F4:0C:8C:EC:F0), Current Time (Wed, Feb 19, 2025, 03:20:58 PM), Firmware Version (4.3(5.240021)), and Timezone (UTC).
- KVM Console:** Shows a terminal window with a sidebar menu (Console, File, View, Macros, Tools, Power, Boot Device, Virtual Media, Chat). The terminal output displays the Cisco logo, copyright information, and a login prompt: "Press F2: BIOS Setup / F8: Boot Menu / F10: Supervisor Press F9: CIMC Setup / F12: Network Boot".

The footer contains the copyright notice: "© 2024 Cisco Systems, Inc."

Console Port



Console/COM

- XR console is mapped to physical UCS console port (like a router)
- Baud rate 115200 / Data Bits 8 / Parity None / Stop Bits 2
- XR output does not reflect because it's tunnelled

```
RP/0/RP0/CPU0:XRv9k-M7-RR-2#show line console location 0/rp0/CPU0
```

```
Tue Feb 18 17:27:02.061 UTC
```

Tty	Speed	Overruns	Acc I/O
con0/RP0/CPU0	9600	0/0	-/-

```
Line "con0_RP0_CPU0", Location "0/RP0/CPU0", Type "Console"
```

```
Length: 24 lines, Width: 80 columns
```

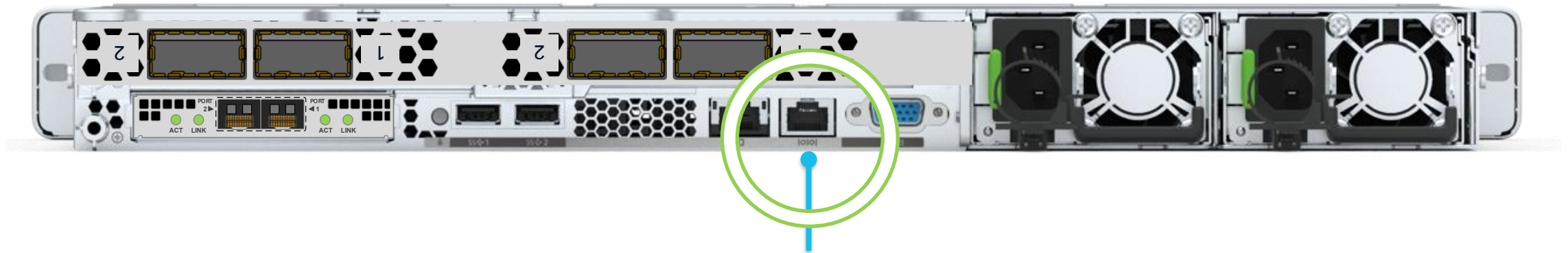
```
Baud rate (TX/RX) is 9600, "No" Parity, 2 stopbits, 8 databits
```

```
Template: console
```

```
Capabilities: Timestamp Disabled
```

```
Allowed transports are none.
```

Console Port



Console/COM

- Single console port to access both CIMC console and XR console
- Possible to switch between both

```
XRv9k-RR-1 con0/RP0/CPU0 is now available
Press RETURN to get started.
User Access Verification
Username:
Username:
^[
User Access Verification
```

```
Username:
[C220-WZP28359K25] Username:admin
Password:
Welcome to CIMC CLI
C220-WZP28359K25#
```

Press Esc+9 or Esc+8 to
switch between consoles

XR Console

CIMC Console

XR Management Port

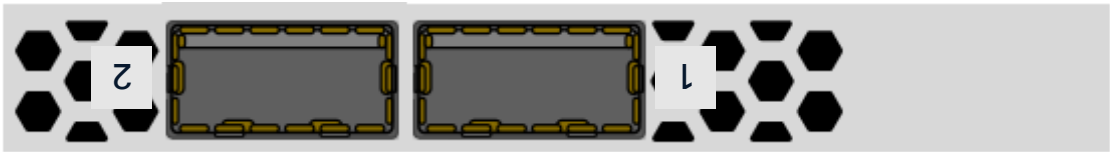


- Single management port
- Left port from modular LAN on Motherboard (mLOM)/OCP 3.0 slot maps to IOS XR Mgmt interface

```
interface MgmtEth0/RP0/CPU0/0
description "type=mgmt"
vrf MGMT
ipv4 address 172.20.166.104 255.255.255.128
```

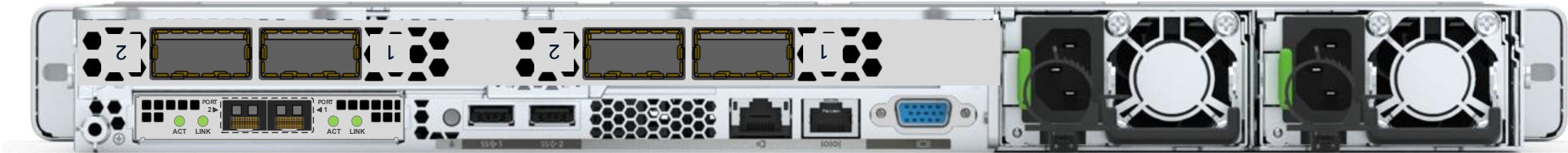
XR to mlx-eth to NIC binding

- XR ports are named in PCI address order
- NIC are installed upside down



XR interface	Mellanox interface	PCIe Riser	NIC Port	CIMC PCIe Inventory
HundredGigE0/0/0/0	mlx-eth0	1	2	Port 1
HundredGigE0/0/0/1	mlx-eth1	1	1	Port 0
HundredGigE0/0/0/2	mlx-eth2	2	2	Port 1
HundredGigE0/0/0/3	mlx-eth3	2	1	Port 0

Hu0/0/0/1Hu0/0/0/0 Hu0/0/0/3Hu0/0/0/2



Appliance Software Upgrade

Just like any other IOS XR 64bit upgrade

- Two main techniques
 - Traditional
 - Pick-up mini ISO and individual packages or SMUs
 - Use *install add + install activate + install commit*
 - Enhanced
 - Build your own or pick-up Cisco provided golden ISO
 - Use *install replace*
- Procedure documented on xrdocs.io

 @XRDOCS

VIRTUAL ROUTING XRDOCS BLOGS TUTORIALS SEARCH Q TAGS



Frederic Cuiller
Architect, Cisco.

Email
Twitter
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Cisco IOS XRv 9000 UCS M7 Appliance software upgrade

11 minutes read

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Introduction

This document aims to describe and document how to upgrade Cisco IOS XR software running on a Cisco IOS XRv 9000 UCS M7 appliance.

There are two main cases to consider:

- Software reimage: this technique is usually used for initial staging or disaster recovery. The procedure is documented in details in [this blog post](#).
- Traditional software upgrade: the appliance is already running a certain IOS XR version which must be upgraded. This second case is documented in this article.

This procedure will strictly focus on the software upgrade aspect, it does not cover:

- Software upgrade pre-checks and post-checks
- BGP RR isolation and draining best practices

Prerequisite

The files required to perform software upgrade can be obtained on cisco.com in the [IOS XRv 9000 Download section](#).

Software Download

[Downloads Home](#) / [Routers](#) / [Virtual Routers](#) / [IOS XRv 9000 Router](#) / [IOS XR Software - 25.2.2](#)

Expand All Collapse All

IOS XRv 9000 Router

Release 25.2.2

My Notifications

Related Links and Documentation

No related links or documentation

CISCO IOS XRv 9000 UCS M7 APPLIANCE SOFTWARE UPGRADE

INTRODUCTION

PREREQUISITE

IOS XR SOFTWARE UPGRADE

APPLIANCE MANAGEMENT

FIRMWARE

CIMC GUI

CIMC CLI

CONCLUSION

Appliance Reimage

- Use [reimage procedure](#) documented on [xrdocs.io](#) for disaster recovery
-



IOS XRv 9000 UCS M7 Appliance

Reimage Procedure

Fred Cuiller
Technical Marketing, Engineering Technical Leader
January 2025

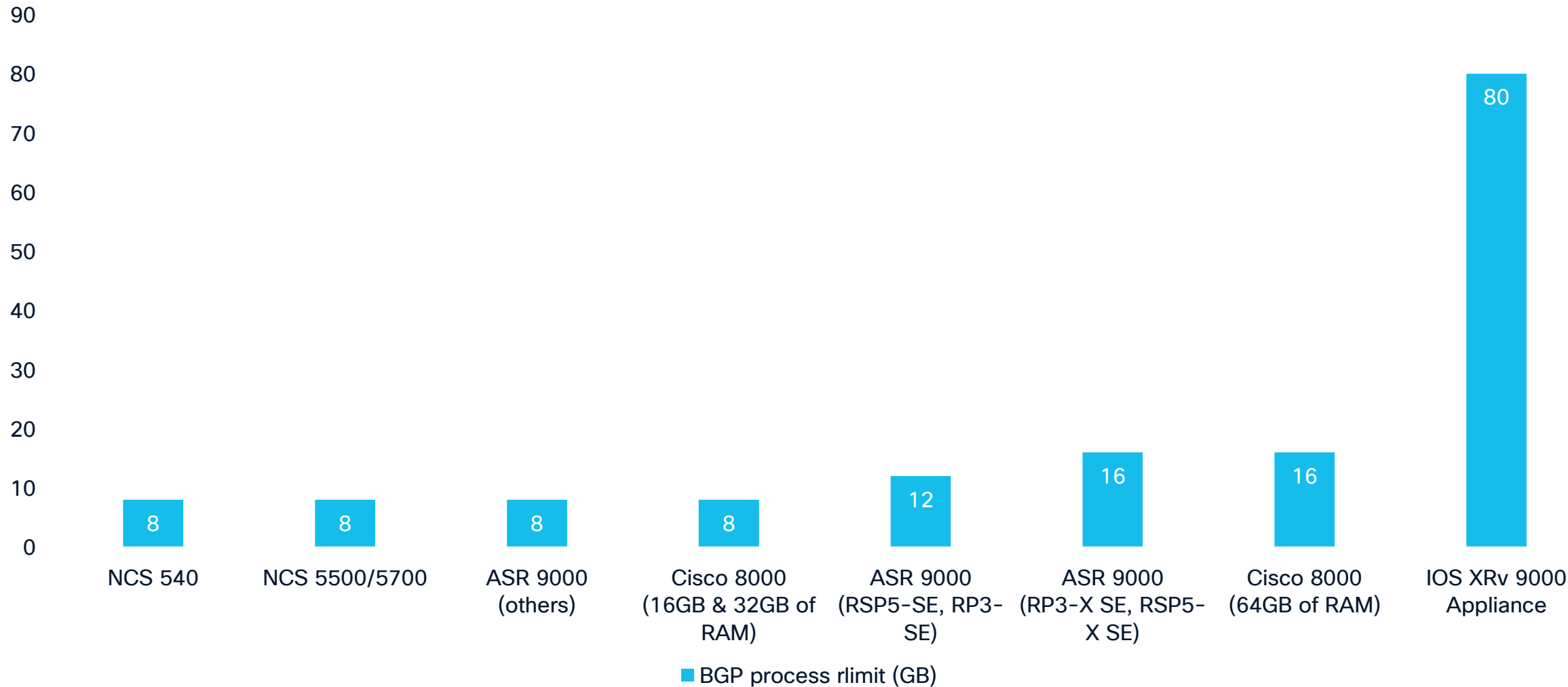
Performance & Scale

Supported 1D Scale

Feature	1D Scale Number
BGP Sessions	2000
BGP Route scale (# of paths)	75M, 120M Roadmap
Max Number of BGP Paths/Prefix	32
OSPF (v2/v3) Adjacencies	512
OSPF (v2/v3) Paths	64
OSPF (v2/v3) Routes	40000
ISIS Adjacencies	240
ISIS Paths	64
ISIS Routes (v4/v6)	20000
BFD Sessions	2000 BFD sessions at 3x1s OR 1200 BFD sessions at 3x100ms

BGP rlimit Comparison

BGP process rlimit (GB)



Performance

- RR Performance Profiles used by Engineering Team

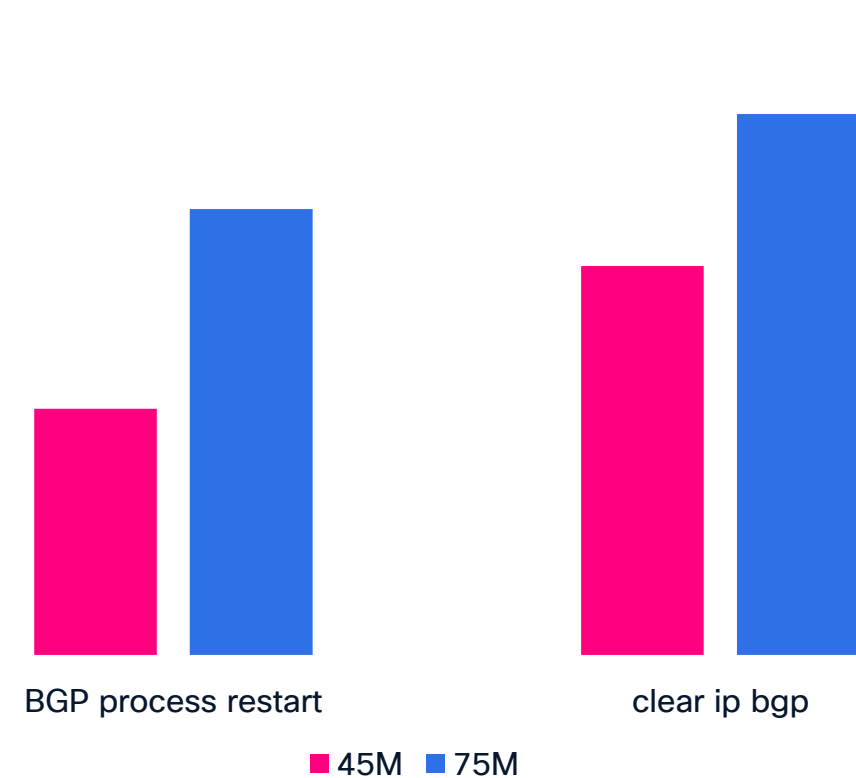
- 45M & 75M BGP paths
- 900 BGP sessions
- IPv4 unicast, IPv6 unicast
- BGP soft-reconfig, BMP, Graceful-Restart

- Make your own benchmark with your own data

- Large number of neighbors, small number of routes
- Large number of routes, small number of neighbors
- Features enabled: BGP soft-reconfig, RPL, add-path, GR, ORR
- LPTS tuning
- Number of update-groups
- Route-Reflection pattern
- Performance of RR clients

400
350
300
250
200
150
100
50
0

Convergence Time (seconds)



Best Practices

LPTS Policers Tuning

- Default values for BGP

```
RP/0/RP0/CPU0:XRv9k-M7-RR-2#sh lpts pifib hardware police location 0/0/CPU0
Wed Jan 29 13:25:28.516 UTC
```

Node 0/0/CPU0:

flow_type	priority	sw_police_id	hw_policer_addr	Cur. Rate	burst	static_avgrate	avgrate_type	AggrAccepts	AggrDrops	TOS Value
BGP-known	high	6	221	2500	2500	2500	Static	3884464	148676	01234567
BGP-cfg-peer	medium	7	222	2000	1000	2000	Static	80968	454	01234567
BGP-default	low	8	223	1500	750	1500	Static	1171201	143	01234567

2500 pps for established sessions
2000 pps for configured sessions
1500 pps for others

- Good idea to increase default policers for known and configured BGP peers (25k – 50k pps)

```
RP/0/RP0/CPU0: XRv9k-M7-RR-2(config)#lpts pifib hardware police
RP/0/RP0/CPU0: XRv9k-M7-RR-2(config-lpts-policer-global)#flow bgp known rate 50000
RP/0/RP0/CPU0: XRv9k-M7-RR-2(config-lpts-policer-global)#flow bgp configured rate 50000
RP/0/RP0/CPU0: XRv9k-M7-RR-2(config-lpts-policer-global)#commit
RP/0/RP0/CPU0: XRv9k-M7-RR-2 #sh lpts pifib hardware police location 0/0/CPU0 | i BGP
Sun Nov  2 22:16:11.431 UTC
```

Node 0/0/CPU0:

flow_type	priority	sw_police_id	hw_policer_addr	Cur. Rate	burst	static_avgrate	avgrate_type	AggrAccepts	AggrDrops	TOS Value
BGP-known	high	6	221	50000	25000	2500	Global	21061	0	01234567
BGP-cfg-peer	medium	7	222	50000	25000	2000	Global	5	0	01234567
BGP-default	low	8	223	1500	750	1500	Static	0	0	01234567

TCP Optimizations

- Path MTU Discovery not enabled by default on IOS XR.
 - Must be enabled globally, or per BGP neighbor

```
RP/0/RP0/CPU0: XRv9k-M7-RR-2(config)#tcp path-mtu-discovery
RP/0/RP0/CPU0: XRv9k-M7-RR-2(config)#commit
```

- TCP MSS: can be a good idea to configure big first segment

```
RP/0/RP0/CPU0:XRv9k-M7-RR-2(config)#tcp mss ?
<68-10000> TCP initial maximum segment size

RP/0/RP0/CPU0:XRv9k-M7-RR-2#show tcp brief | i "100.111.192.1|PCB"
Tue Feb 18 21:29:46.164 UTC

  PCB                VRF-ID      Recv-Q  Send-Q  Local Address           Foreign Address         State
0x00007f42e00ce780 0x60000000      0        0  198.19.208.0:55195      100.111.192.1:179      ESTAB

RP/0/RP0/CPU0:XRv9k-M7-RR-2#show tcp detail pcb 0x00007f42e00ce780 | i "MTU|MSS"
Feature flags: Win Scale, Nagle, Path MTU
Datagrams (in bytes): MSS 9060, peer MSS 9074, min MSS 9060, max MSS 9060
```

- Other: tcp accept-rate (lower only for very high number of clients), tcp num-thread (keep default)

BGP Passive

- Whenever there is a **big number of clients**, **distribute TCP SYN “load” to clients**, instead of RR
- When there is a major network event
 - Many or all BGP sessions on RR could reset
 - Let the remote BGP peers initiate the BGP session, not the RR
 - This will spread the initiation over some time interval and make it less bursty

```
RP/0/RP0/CPU0:XRv9k-M7-RR-2(config-bgp-nbrgrp)# session-open-mode ?
  active-only  Active only
  both         Prevent session-open-mode being inherited from the parent
  passive-only Passive only

router bgp 65537
  neighbor-group RR-CLIENTS
    session-open-mode passive-only
```

Routes Filtering

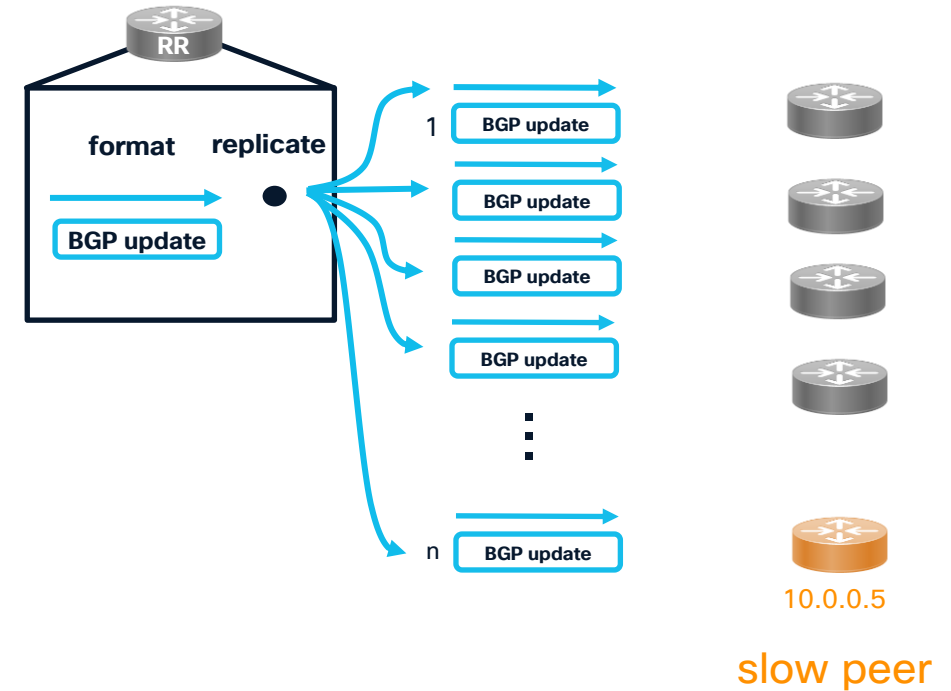
- Selective RIB Download
 - Prevent all/most BGP routes from being installed in RIB (dedicated RR does not route traffic)
 - Implemented via BGP table-policy, leverages IOS XR RPL for fine-grained filtering (can use prefix-set, community-set, etc.)
 - For IPv4 & IPv6 unicast (not needed for VPNv4 & VPNv6 unicast)

```
route-policy TABLE-POLICY
  if destination in BGP-ROUTES then
    drop
  else
    pass
  end-if
end-policy
router bgp 65537
  address-family ipv4 unicast
    table-policy TABLE-POLICY
```

- BGP Route Target Constraint (RTC): RFC 4684
 - Applicable for VPNv4 and VPNv6, capability negotiated between neighbors
 - Send only relevant routes to clients (and not all routes)

BGP Slow Peer

- BGP update generation uses **update groups** to optimize performance.
- A slow peer is a peer that cannot keep up with the rate at which the router is generating update messages over a prolonged period of time.
 - The slow peer slows down the BGP processing of all peers in that update group.
 - A slow peer has a large Output Queue
 - **Slow-peer detection is enabled by default**
 - Slow peers are moved to a separate **refresh sub-group**
- Common reasons for slow BGP peer
 - Client is far (RTT) or lossy transport
 - Legacy router
 - High CPU
 - Temporary network issues



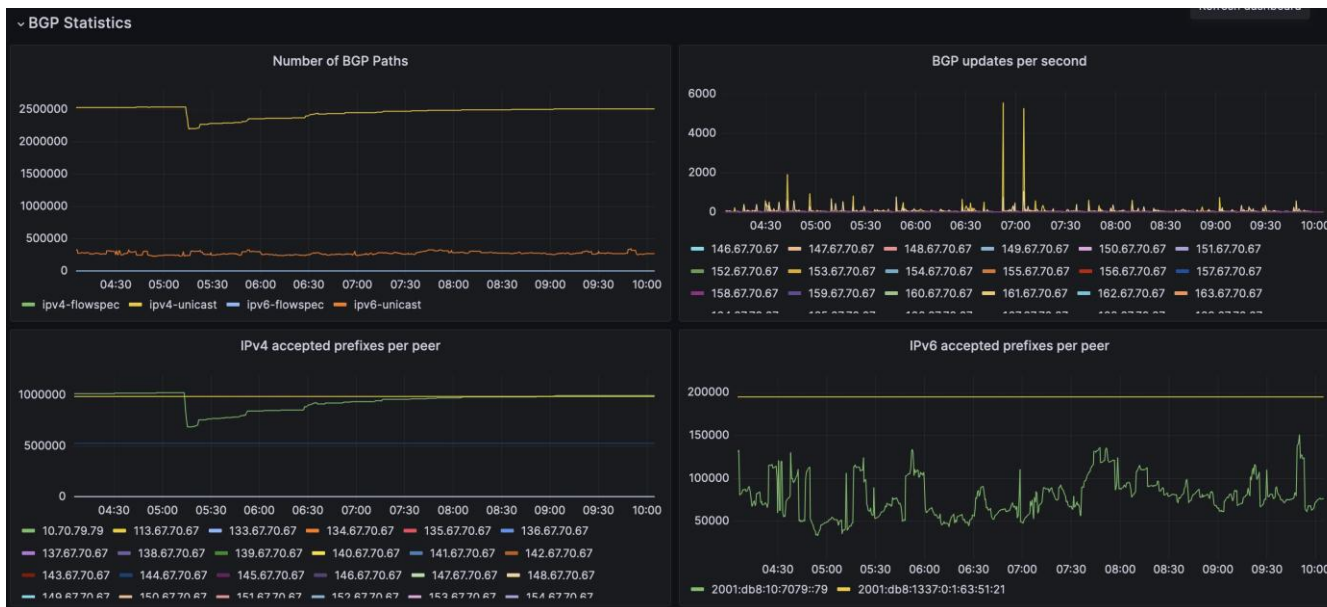
```
bgp[1079]: %ROUTING-BGP-5-AF_SLOW_PEER : BGP neighbor 10.0.0.5 of vrf default afi 0 is detected as slow-peer
bgp[1079]: %ROUTING-BGP-5-AF_SLOW_PEER_RECOVERED : Slow BGP peer 10.0.0.5 of vrf default afi 0 has recovered
```

BGP Observability

BGP Observability Techniques

- Telemetry

- BGP Monitoring Protocol (BMP)



```
{
  "action": "add",
  "router_hash": "1a91a6dddd3fdc453fb26e463bdb055c",
  "router_ip": "82.82.82.0",
  "base_attrs": {
    "base_attr_hash": "9d7140cfa5dec46a951507e7033cb02b",
    "origin": "igp",
    "as_path": [
      65000
    ],
    "as_path_count": 1,
    "is_atomic_agg": false,
    "ext_community_list": [
      "rt=1:132"
    ]
  },
  "peer_hash": "aad545261626f113f726b92132b25698",
  "peer_ip": "82.82.82.1",
  "peer_type": 1,
  "peer_asn": 65000,
  "timestamp": "2025-06-02T15:34:02.000051615Z",
  "prefix": "105.243.121.0",
  "prefix_len": 24,
  "is_ipv4": true,
  "origin_as": 65000,
  "nexthop": "82.82.82.1",
  "is_nexthop_ipv4": true,
  "is_adj_rib_in_post_policy": true,
  "is_adj_rib_out_post_policy": false,
  "is_loc_rib_filtered": false
}
```

Cisco IOS XR BMP Implementation

- Compatible with open-source collectors
- Individual Modes
 - Inbound pre-policy Route **Mirroring** (analyze malformed or malicious updates)
 - Inbound (Adj-RIB-in) **pre-policy** Route Monitoring
 - Inbound **post-policy** Route Monitoring
 - Local-RIB
- Combined Modes
 - Inbound Post-Policy Route-Monitoring and Local-RIB
 - Simultaneous Monitoring of Inbound Pre-Policy and Post-Policy Views (monitor RTBH, troubleshoot RPL)



```
bmp server all
  route-monitoring inbound pre-policy
  !
  route-monitoring inbound post-policy
  !
  !
  bmp server 1
    host 1.63.51.21 port 5000
    update-source MgmtEth0/RP0/CPU0/0
    tcp mss 1200
```

```
router bgp 65535
  neighbor 13.37.40.2
    remote-as 40
    bfd fast-detect
    bfd multiplier 3
    bfd minimum-interval 50
    bmp-activate server 1
    address-family ipv4 unicast
      route-policy RPL-IN in
      route-policy RPL-OUT out
```

- Roadmap: Outbound (Adj-RIB-out) pre-policy & post-policy

Streaming Telemetry for BGP

- Possible to monitor routing protocol KPI in real-time, Dial-in or Dial-out
- BGP has huge YANG models
 - Limit the data
- Interesting Data Points
 - Memory
 - CPU
 - Prefixes total
 - Advertised
 - Received
 - Installed
 - Neighbors
 - Paths
 - Convergence/Table version
 - LPTS

How to retrieve YANG models/paths

- Netconf explorer connects to device and retrieves all available models
- Possible to search, navigate, subscribe directly

Advanced Netconf ExplorerDevice 1.63.51.19 (1043 YANG models)

Start

NETCONF console

YANG Models

View

Download all

NETCONF Capabilities

Telemetry Tools

Select or input sensor group name

Edit

Live data

CLI to YANG

GNMI Interval

GNMI Port

GNMI Path

change

57500

Cisco-IOS-XR-ipv4-bgp-oper:bgp/insta

GNMI Subscribe

Parameters

Name	Value
Name	neighbor-version
Namespace	http://cisco.com/ns/yang/Cisco-IOS-XR-ipv4-bgp-oper
Type	list (operational)
XPath	/ipv4-bgp-oper:bgp/ipv4-bgp-oper:instances/ipv4-bgp-oper:instance/ipv4-bgp-oper:instance-active/
Sensor Path	Cisco-IOS-XR-ipv4-bgp-oper:bgp/instances/instance/instance-active/default-vrf/sessions/session/ne
Filter Path	Cisco-IOS-XR-ipv4-bgp-oper:bgp/instances/instance[instance-name={instance-name}]/instance-acti
Maagic Path	bgp.instances.instance[...].instance_active.default_vrf.sessions.session[...].neighbor_version[...]
Maagic QPa...	ipv4_bgp_oper__bgp.ipv4_bgp_oper__instances.ipv4_bgp_oper__instance[...].ipv4_bgp_oper__instanc

Description

BGP neighbor version for alladdress-families

Search models

Search nodes

Apply

Clear

Show Data

▸ bgp (http://cisco.com/ns/yang/Cisco-IOS-XR-ipv4-bgp-cfg)

▾ bgp (http://cisco.com/ns/yang/Cisco-IOS-XR-ipv4-bgp-oper)

▸ bpm-instances-table

▸ config-instances

▾ instances

▾ instance

▾ instance-active

▸ attribute-filter-groups

▸ attributes

▸ bmp-server

▾ default-vrf

▸ afs

▸ bmp

▸ bmp-local-rib-emulated-peer-briefs

▸ bmp-local-rib-emulated-peers

▸ global-process-info

▸ information

▸ message-logs

▸ neighbor-missing-eor-table

▸ neighbor-ranges

▸ neighbors

▸ next-hop-vrf

▸ postits

▸ process-info

▸ sessions

▸ update-inbound-error-neighbors

▸ update-inbound-error-vrf

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BRKSPG-2051

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Third Party Application (TPA) & Linux Networking

- gRPC is considered as 3rd party application on IOS XR
- Third Party Application (TPA) used in 24.4.2
- Starting IOS XR 25.2.1, TPA is replaced by Linux Networking
 - Increased support for VRF and MPLS traffic
 - Better filtering capabilities

```
RP/0/RP0/CPU0: XRv9k-M7-RR-2 #sh run tpa
Sat Nov  1 14:08:20.305 UTC
linux networking
vrf MGMT
address-family ipv4
default-route software-forwarding
source-hint default-route interface MgmtEth0/RP0/CPU0/0
protection
protocol tcp local-port 57400 default-action deny
  permit remote-address 13.37.35.0/24
  permit remote-address 13.37.36.0/24
!
!
address-family ipv6
protection
protocol tcp local-port 57400 default-action denyx
```

```
RP/0/RP0/CPU0: XRv9k-M7-RR-2 #sh linux networking vrf detail
Sat Nov  1 14:11:22.368 UTC
VRF MGMT (Linux network namespace vrf-MGMT):
  Status: active
  IPv4 default route source hint: 172.20.166.103
                                     (from MgmtEth0/RP0/CPU0/0, configured by
user)
  IPv4 default route MTU: 1500 (from MgmtEth0/RP0/CPU0/0)
  IPv6 default route source hint: none
  IPv6 default route MTU: not set
  IPv4 XR East-West: none
  IPv6 XR East-West: none

VRF default (Linux network namespace vrf-default):
  Status: active
  IPv4 default route source hint: 198.19.208.128
                                     (from Loopback0, automatically selected)
  IPv4 default route MTU: 9100 (from HundredGigE0/0/0/3)
  IPv6 default route source hint: 198:19:208::128
                                     (from Loopback0, automatically selected)
  IPv6 default route MTU: 9100 (from HundredGigE0/0/0/3)
  IPv4 XR East-West: none
  IPv6 XR East-West: none
```

Wrap-Up

Key Takeaways

- 1 Cisco IOS XR has the best BGP stack in the industry
 - Fast, scalable, secured, robust, field proven
 - Available in multiple formats: traditional router, container, VM, bare-metal appliance
- 2 IOS XRv 9000 BGP Route-Reflector appliance based on UCS M7 is unique
 - Provides unmatched scale & performance
 - Native 100G connectivity
- 3 Multiple rich options available on Cisco IOS XR to observe BGP routing protocol
 - Telemetry
 - BMP

References & Acknowledgements

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 - [IOS XR software hardening guide](#)
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- Cisco UCS
 - [Cisco UCS C220 M7 SFF Rack Server spec sheet](#)
 - [Cisco UCS C220 M7 Server Installation and Service Guide](#)
- xrdocs.io
 - [Cisco IOS XRv 9000 UCS M7 Appliance reimage procedure](#)
 - [Cisco IOS XRv 9000 UCS M7 Appliance software upgrade procedure](#)
- Features
 - [Cisco IOS XR BMP video](#)

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