



Cisco *live!*

January 29 – February 2, 2018 · Barcelona

Network Function Virtualization (NFV) using IOS-XR

Syed Hassan

Cisco Spark

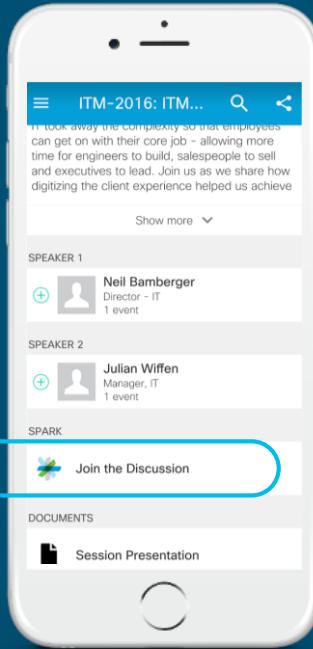


Questions?

Use Cisco Spark to communicate with the speaker after the session

How

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



cs.co/ciscolivebot#BRKSPG-2724

Agenda

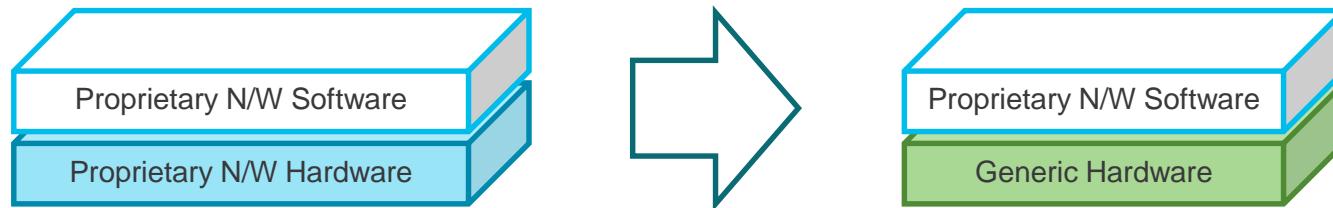
- Role of NFV in Network
- IOS XRv 9000
- Benefits & Use Cases
- Deployment & Troubleshooting
- Service Orchestration for NFV
- Summary



Network Functions Virtualization (NFV) - Defined

.... NFV decouples the network functions such as NAT, IPS, DNS, RR etc. from proprietary hardware appliances, so they can run in software.

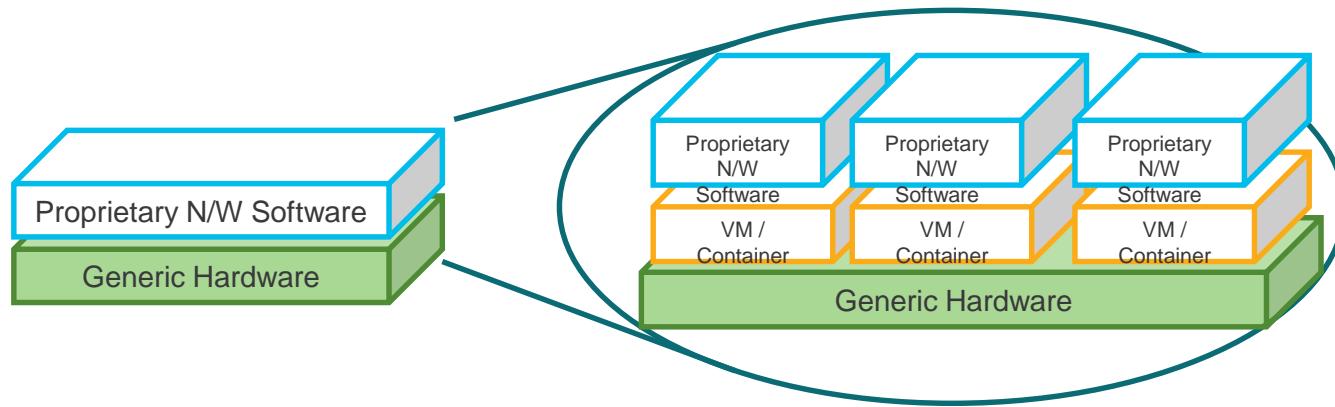
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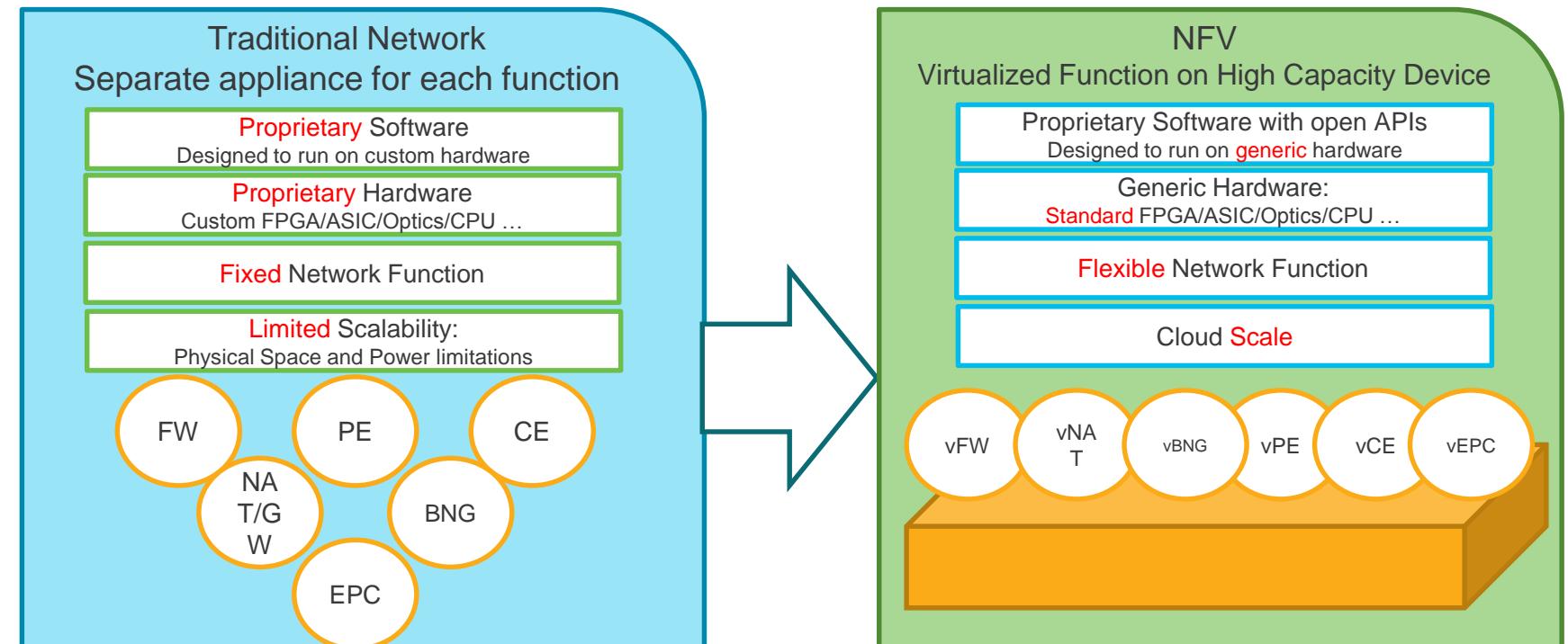
<https://www.sdxcentral.com/nfv/definitions/whats-network-functions-virtualization-nfv/>

Network Functions Virtualization (NFV) - Defined

.....
It utilizes standard IT **virtualization technologies** that run on high-volume service, switch and storage hardware to virtualize network functions..

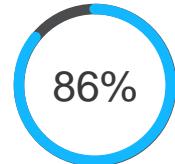


Network Functions Virtualization (NFV) – Market Drivers



Network infrastructure/Service Functions run on Virtualized compute platforms

Network Functions Virtualization (NFV) – Market Ask



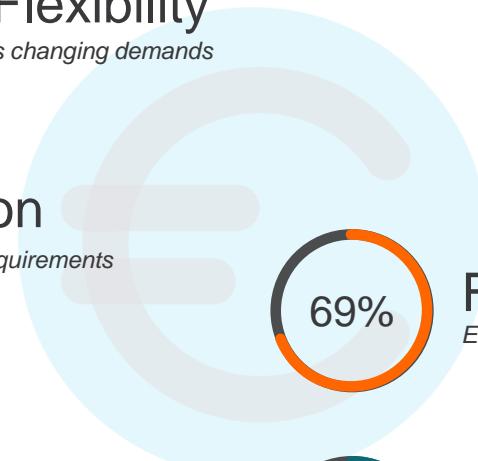
Deliver Agility & Flexibility

Scale up or down services to address changing demands



Opex Optimization

Reduce space, power and cooling requirements



Faster Time to Market

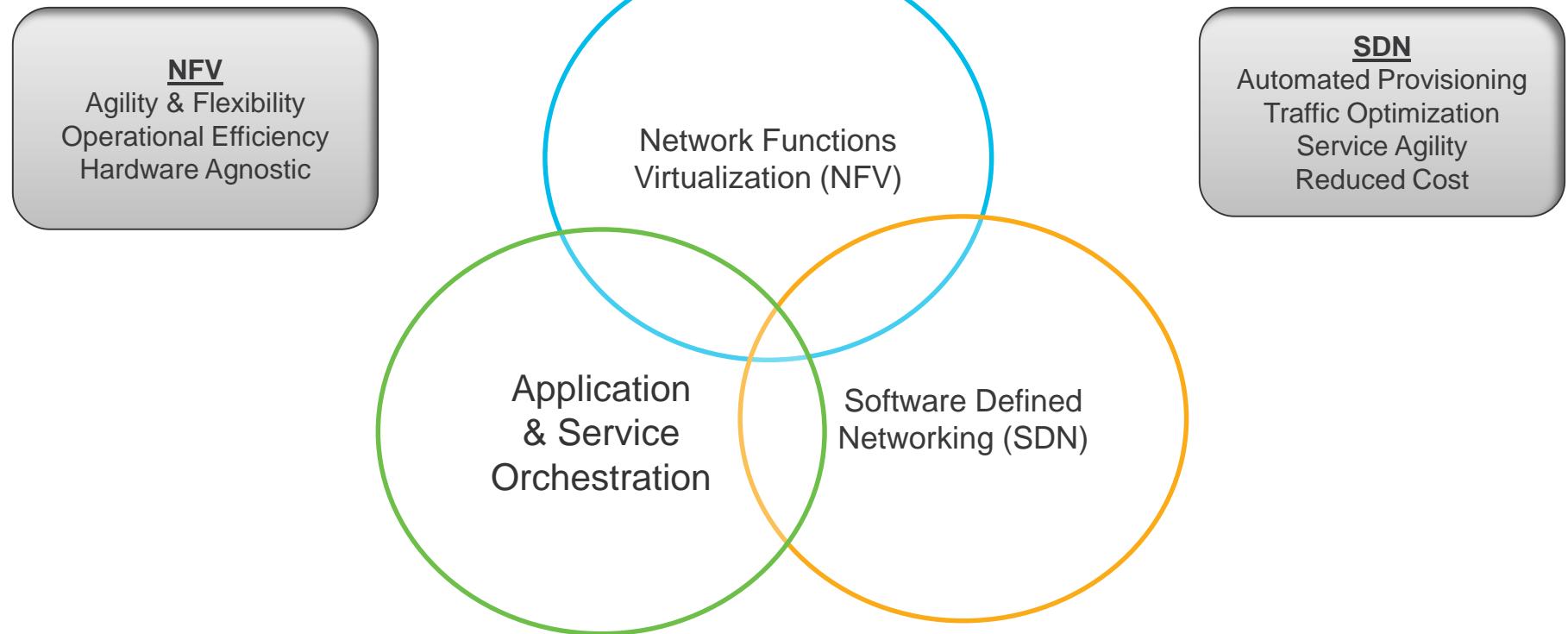
Easy trial & deployment of new services



Reduced Capex

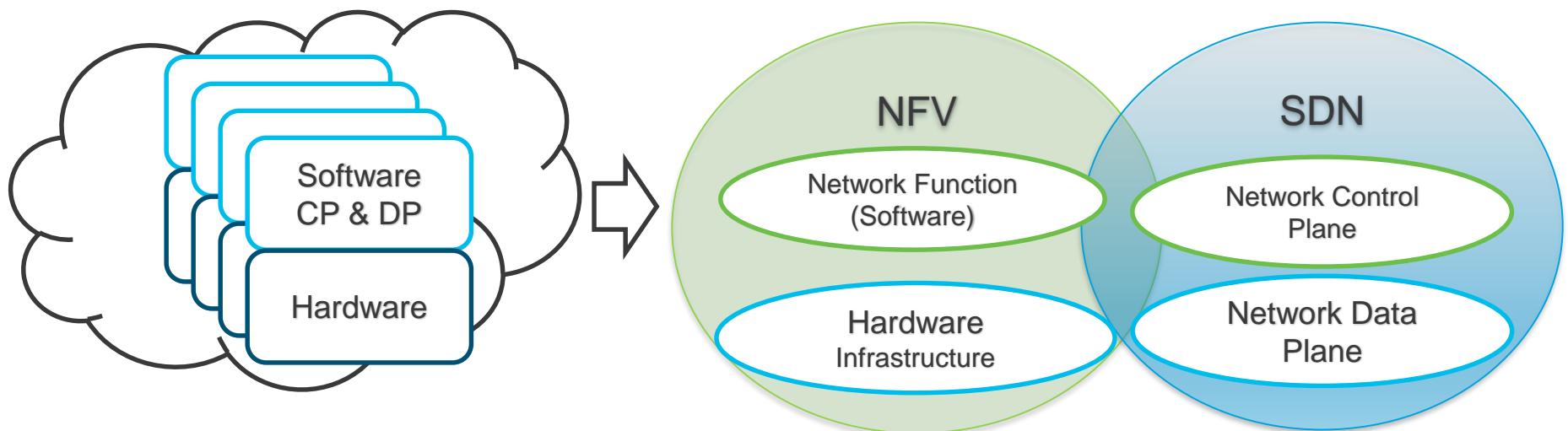
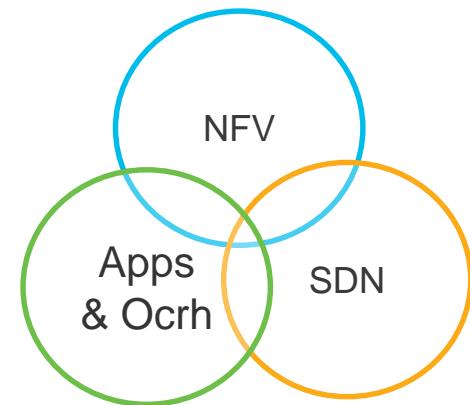
Reduce purpose-built HW ; Rely on Industry standard NFVI

Enablers of SP Network Transformation



Network Functions Virtualization & SDN

- Orthogonal Concepts; Similar Goals
- SDN complementary, but not mandatory



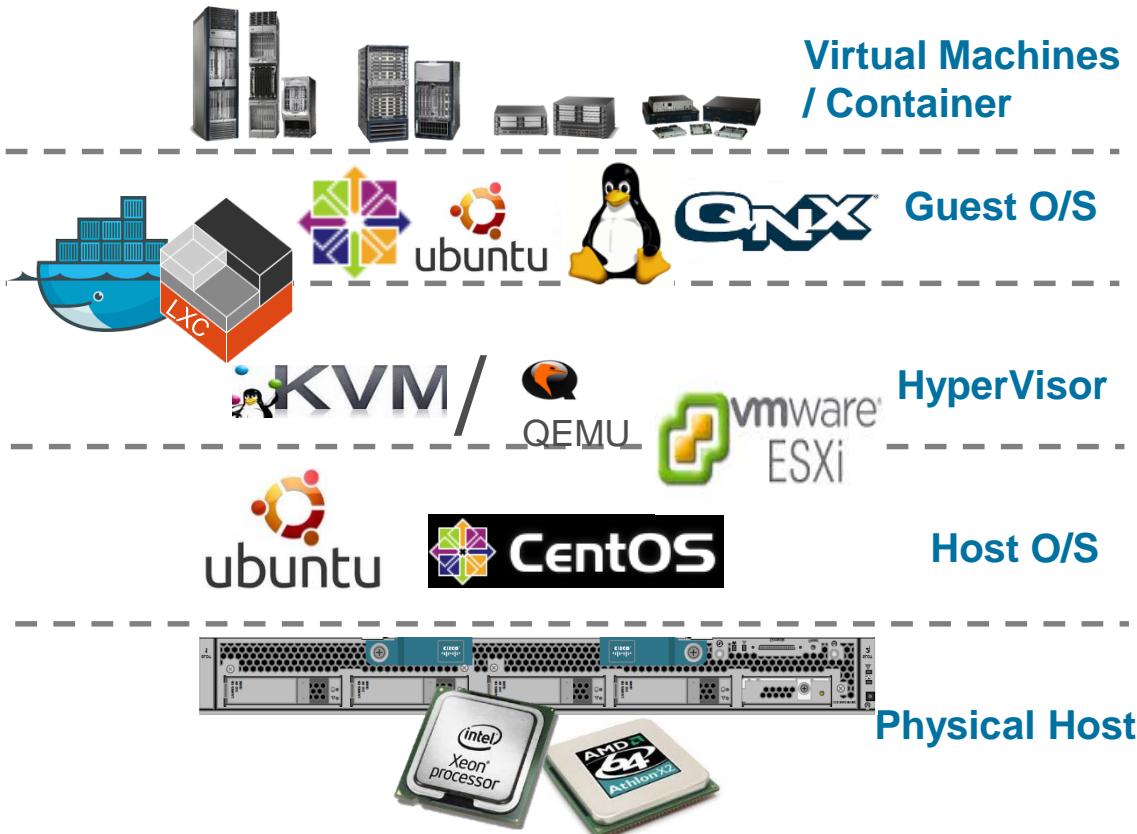
Network Functions Virtualization & SDN

Comparison

	SDN	NFV
Deployment	SDN Controller : Open Daylight (ODL), XR Transport Controller, Wan Automation Engine (WAE) etc.	Virtual network functions : vFW, vRR, vCPE , vPE etc.
Connectivity	OpenFlow, NETCONF/Yang , Path computation element protocol (PCEP)	VM to Host (socket, Taps etc.)
Scope	Involves end to end networking	Involves single network entity
Arch	New network architecture	Virtualization of existing architecture

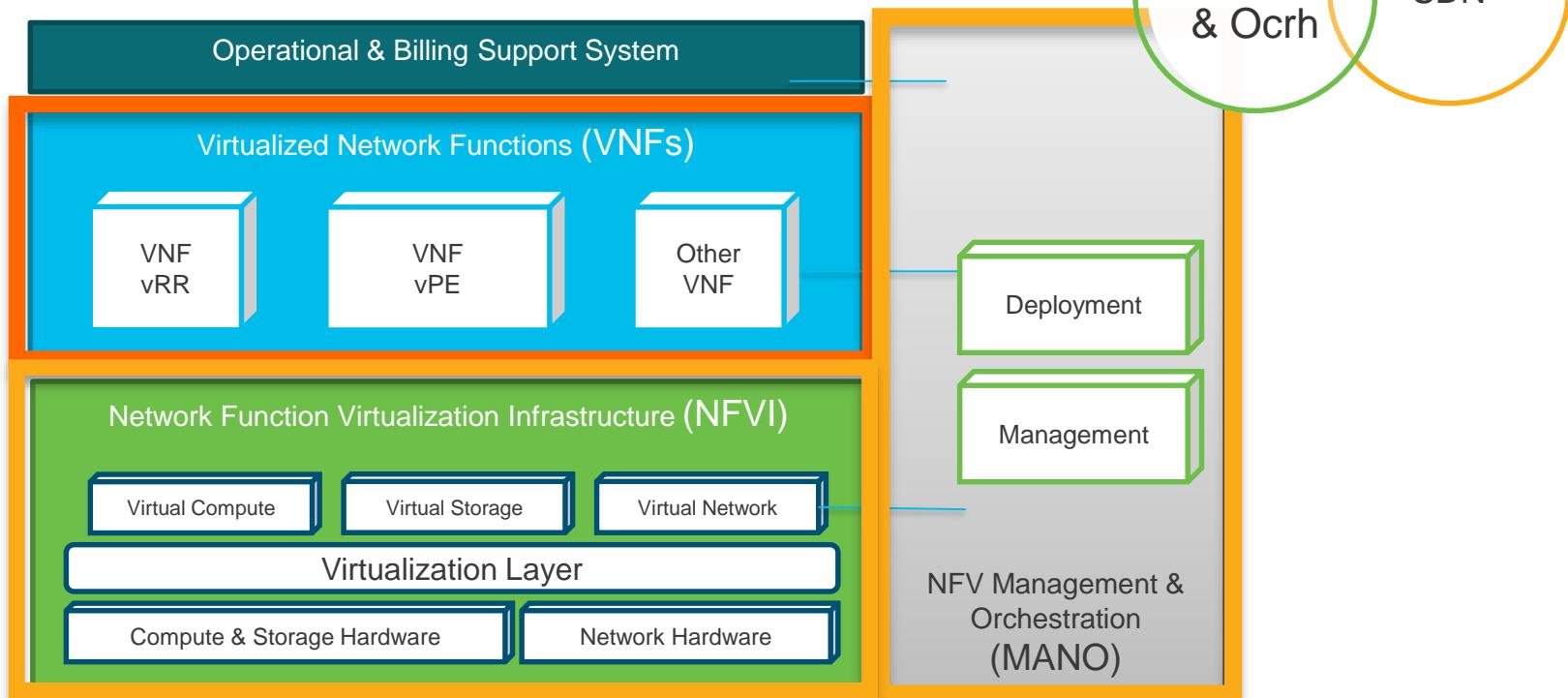
Achieving Network Function Virtualization

- Applications running using virtualized Hardware end CPUs
- Guest O/S running independently in each VM
- HyperVisor - isolated application providing VMs on the Host
- Basic host operating system
- Virtualization capable CPUs



Network Virtualization

ETSI Architecture Framework for NFV

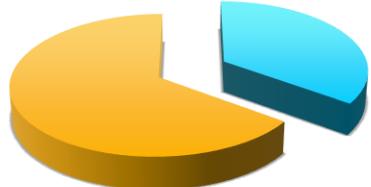


Virtualizing Network Functions

X86 versus Custom Network Processing Unit (NPU)

Network Forwarding (L0-3)	Network Services (L4+)
Mostly predictable traffic	Unpredictable traffic
Stateless functions	Stateful functions
High throughput / BW	Low to Med Throughput
IPv6/v4, MPLS, VPNs, Optical	BGP Route reflector, Firewall, DPI

Better Fit for Custom Hardware



Bandwidth
Compute

Better Fit for NFV



Bandwidth
Compute

NFV across Cisco portfolio

Virtualized Network Operating Systems

IOS-XR



Virtualized as
IOS XRv 9000

NX-OS



Virtualized as
Nexus 1000v

IOS-XE



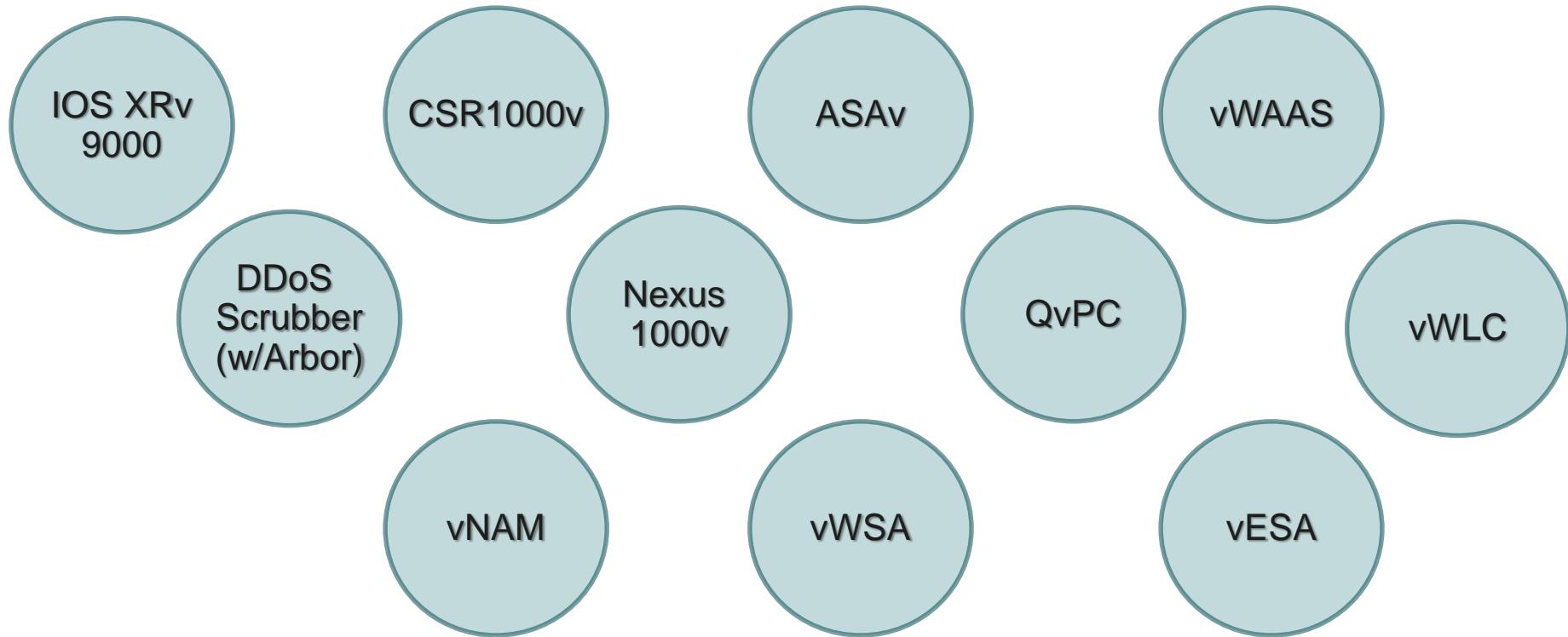
Virtualized as
CSR1000v

ASA

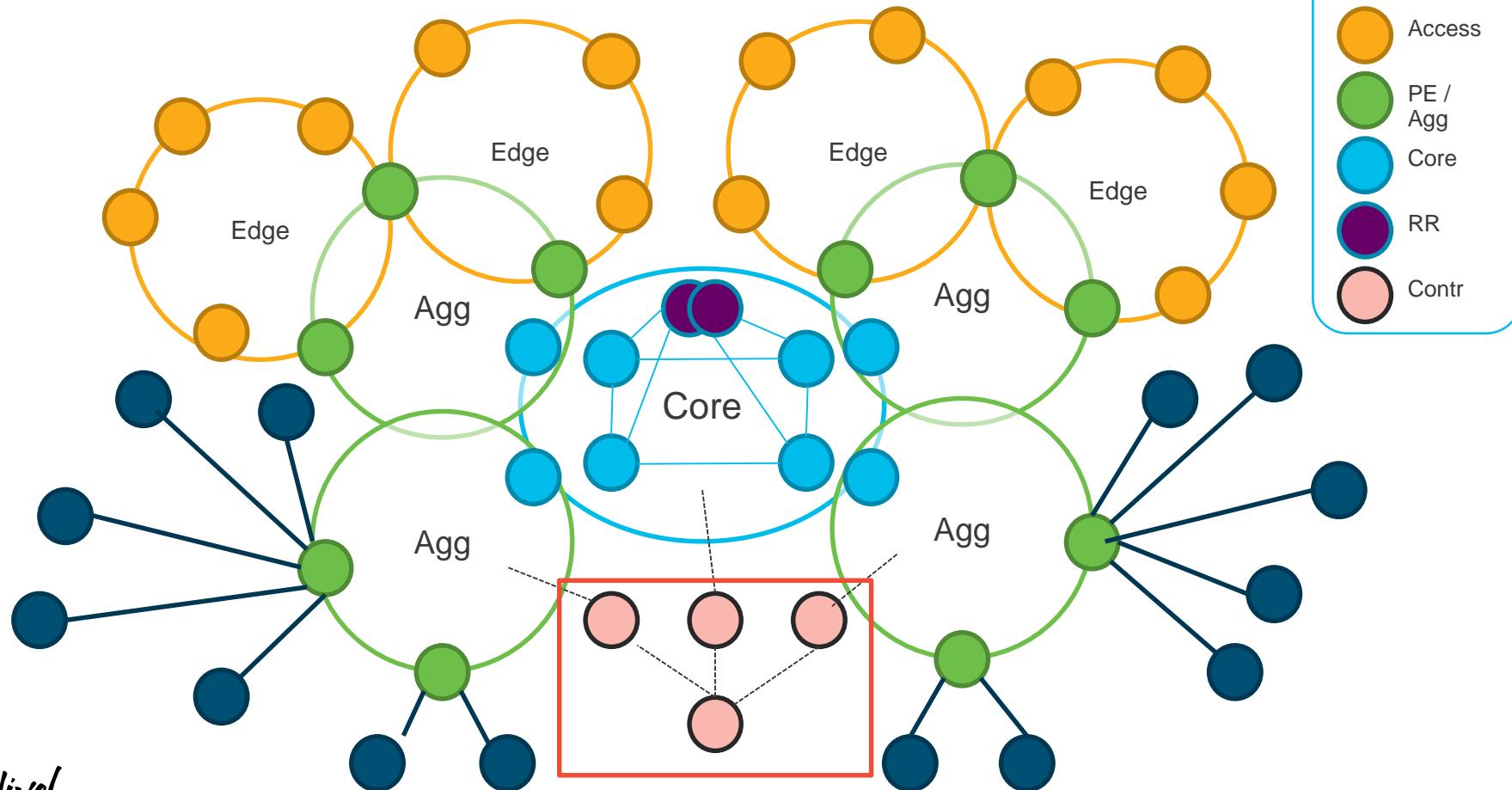


Virtualized as
ASAv

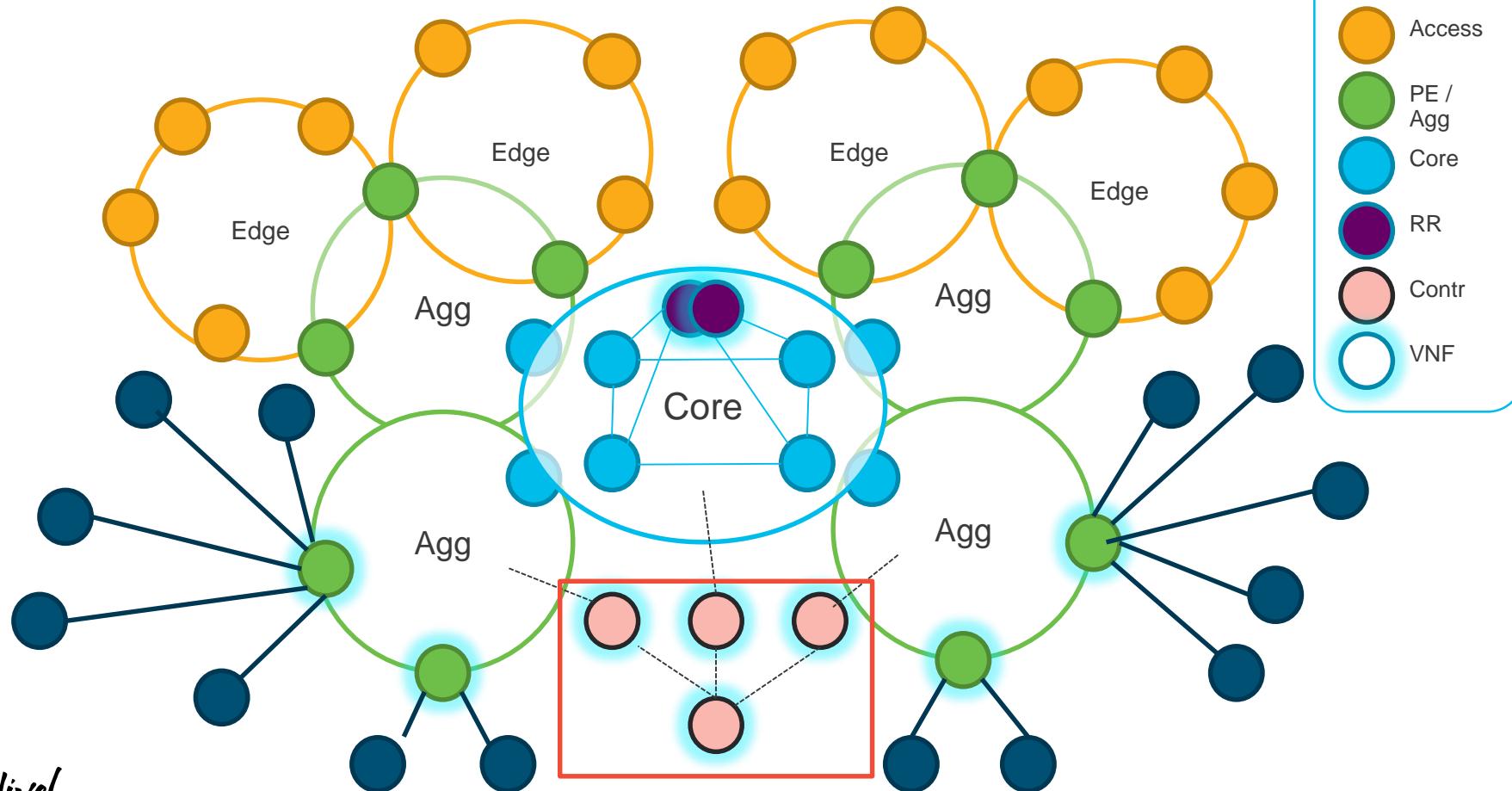
Cisco's VNF Portfolio



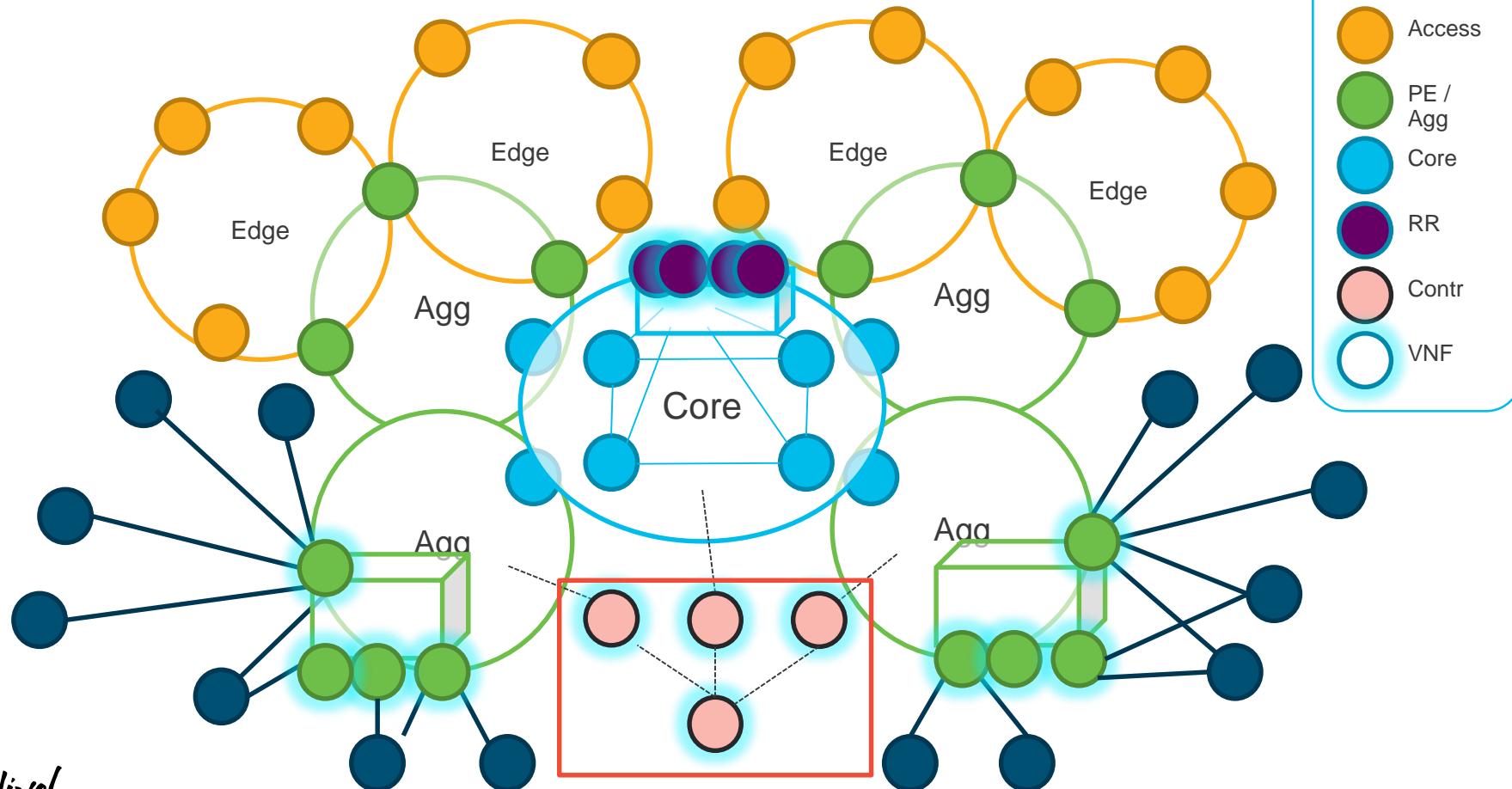
Network Transformation with NFV



Network Transformation with NFV



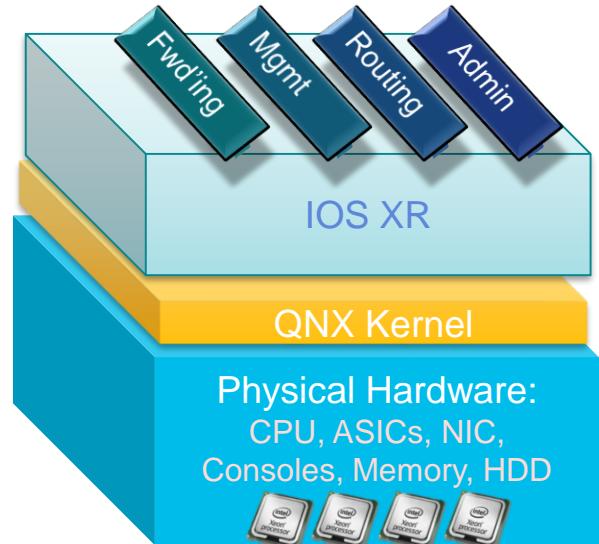
Network Transformation with NFV



IOS XRv 9000

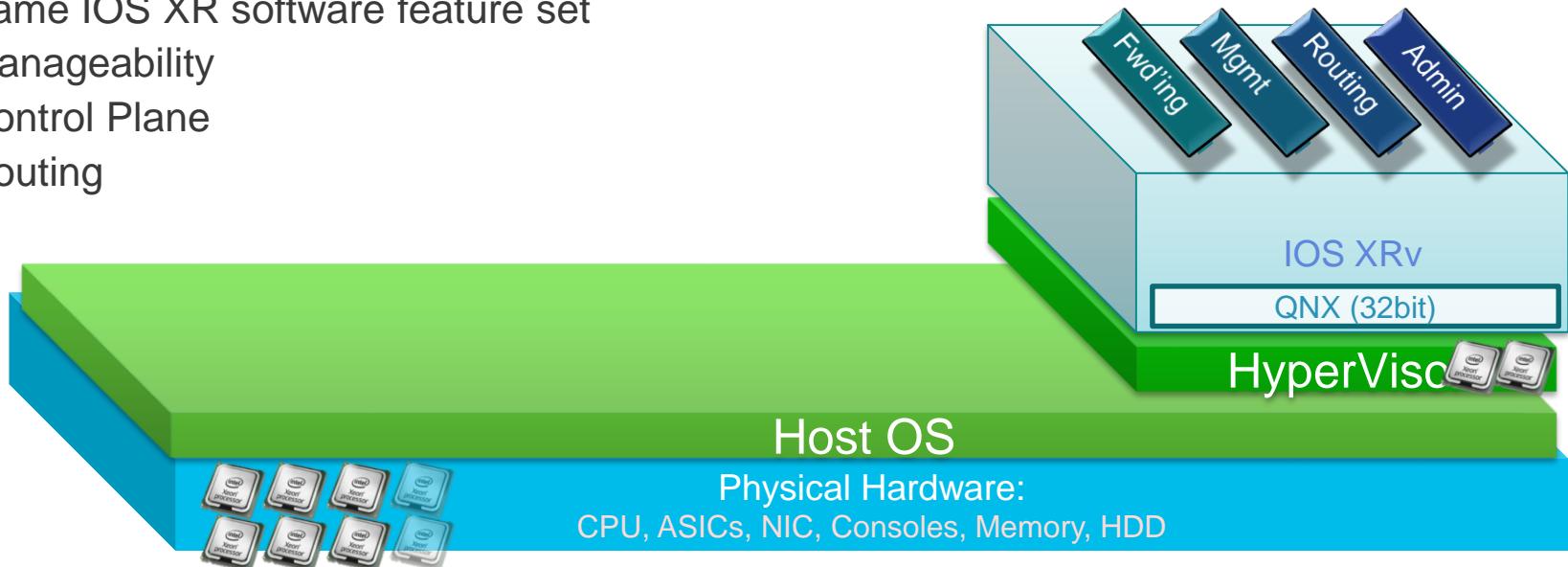
IOS XR

- Time **hardened** for years
 - CRS-1, CRS-3, CRS-X, ASR 9000, NCS 6000
- High-**scale** control plane
- MicroKernel-based
- **Modular** Software
- Process Restartability & **Redundancy**
- Remediation through add-on **patches**

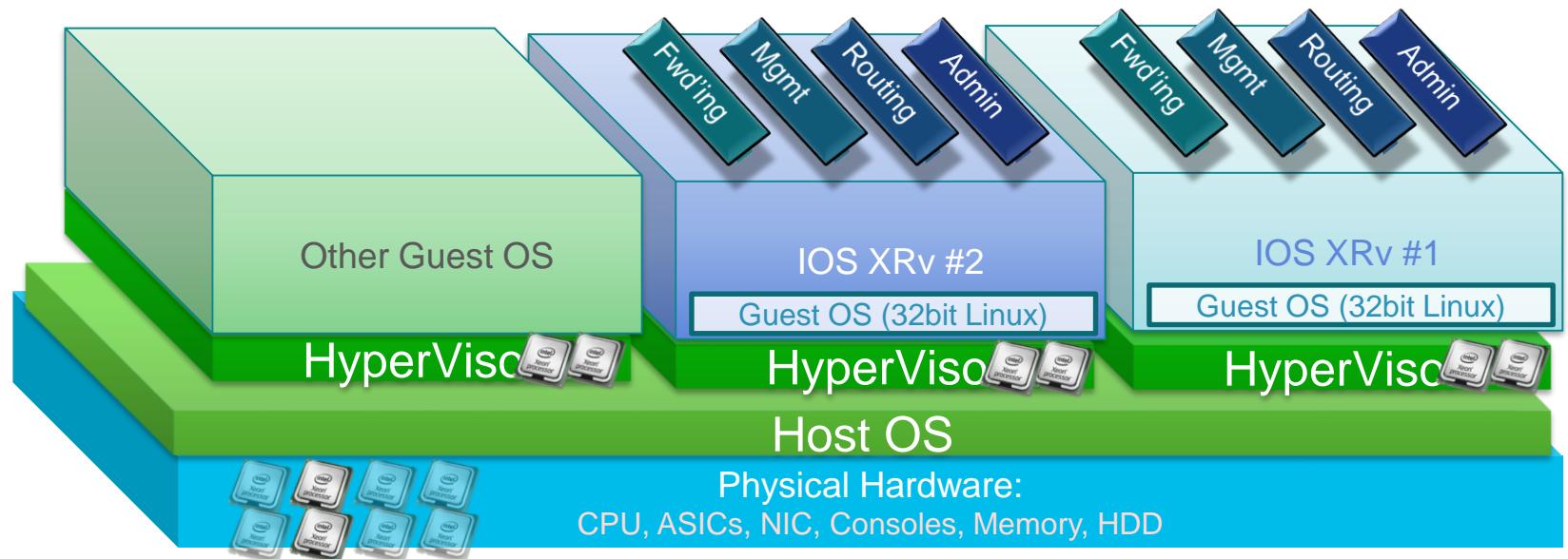


IOS XRv

- IOS XR on x86 **Virtualized** environment
- Full *Platform Independent* IOS XR
 - Same IOS XR software feature set
 - Manageability
 - Control Plane
 - Routing

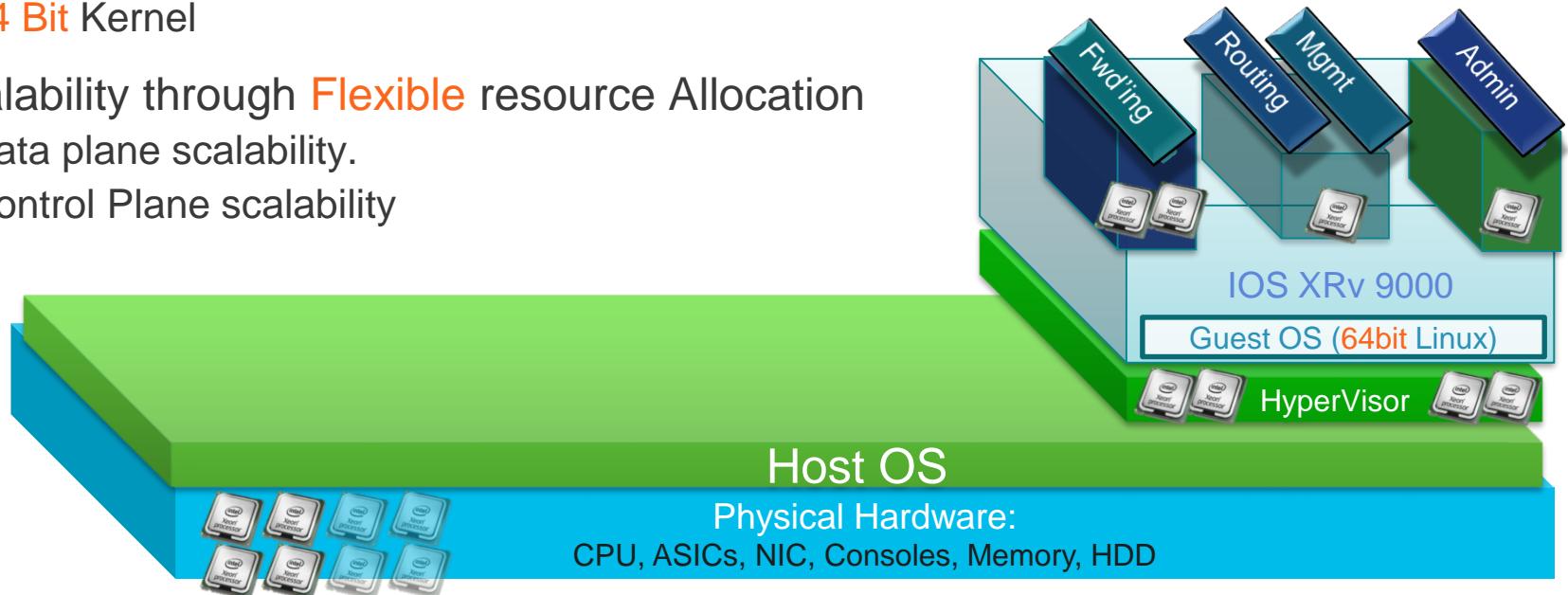


IOS XRv - One Physical hardware -- Multiple Instances

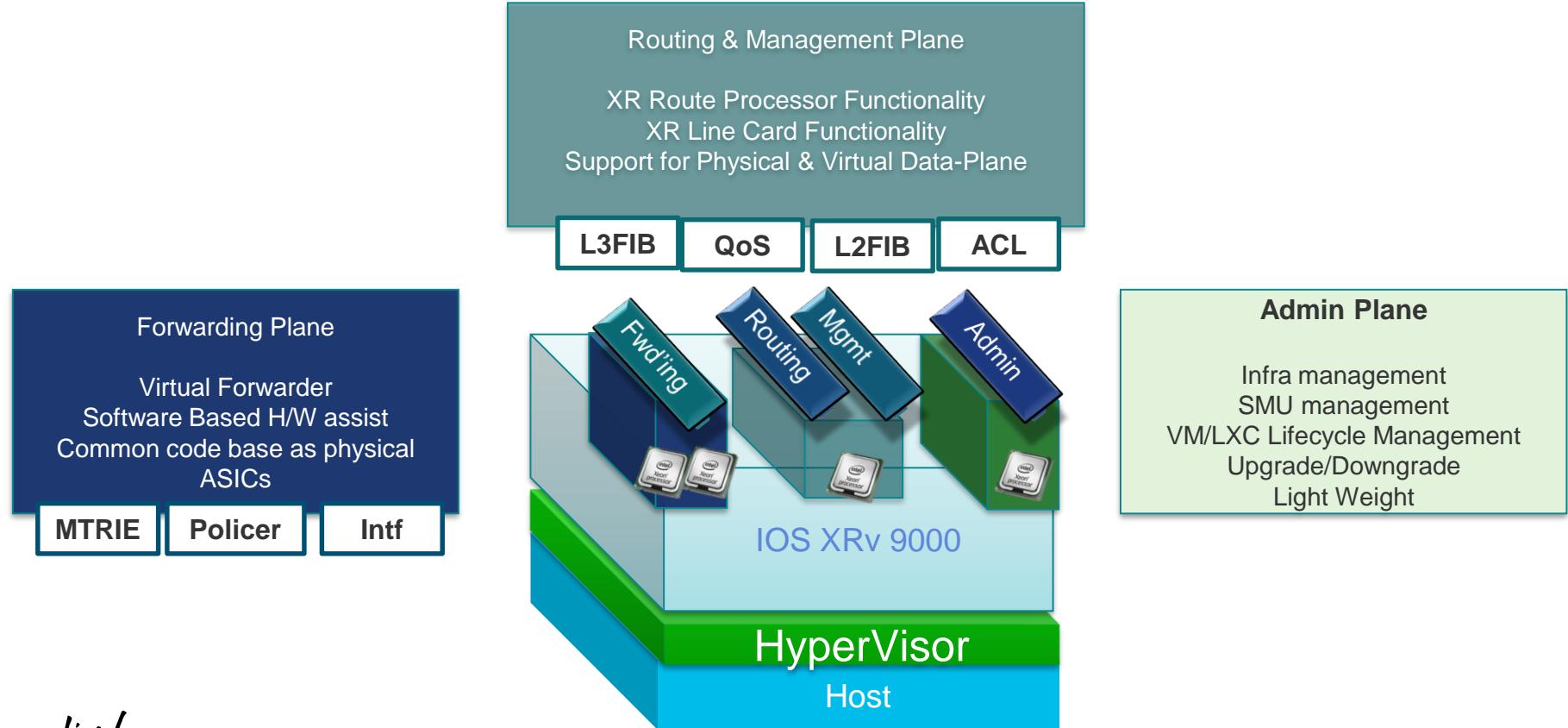


IOS XRv 9000

- Virtualized IOS XR with Control and Data plane Separation
 - Linux **Containers** for Admin, Control and Data Planes
 - **64 Bit Kernel**
- Scalability through **Flexible** resource Allocation
 - Data plane scalability.
 - Control Plane scalability

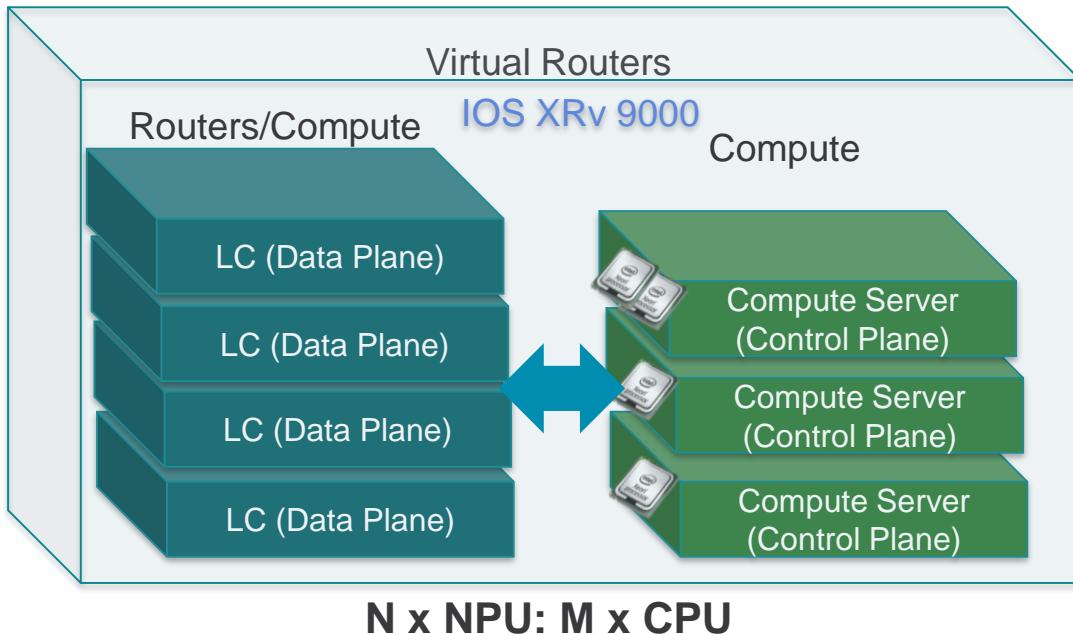
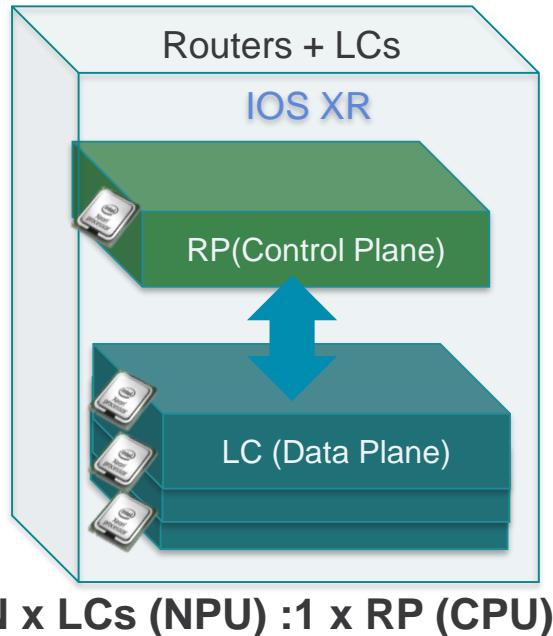


IOS XRv 9000



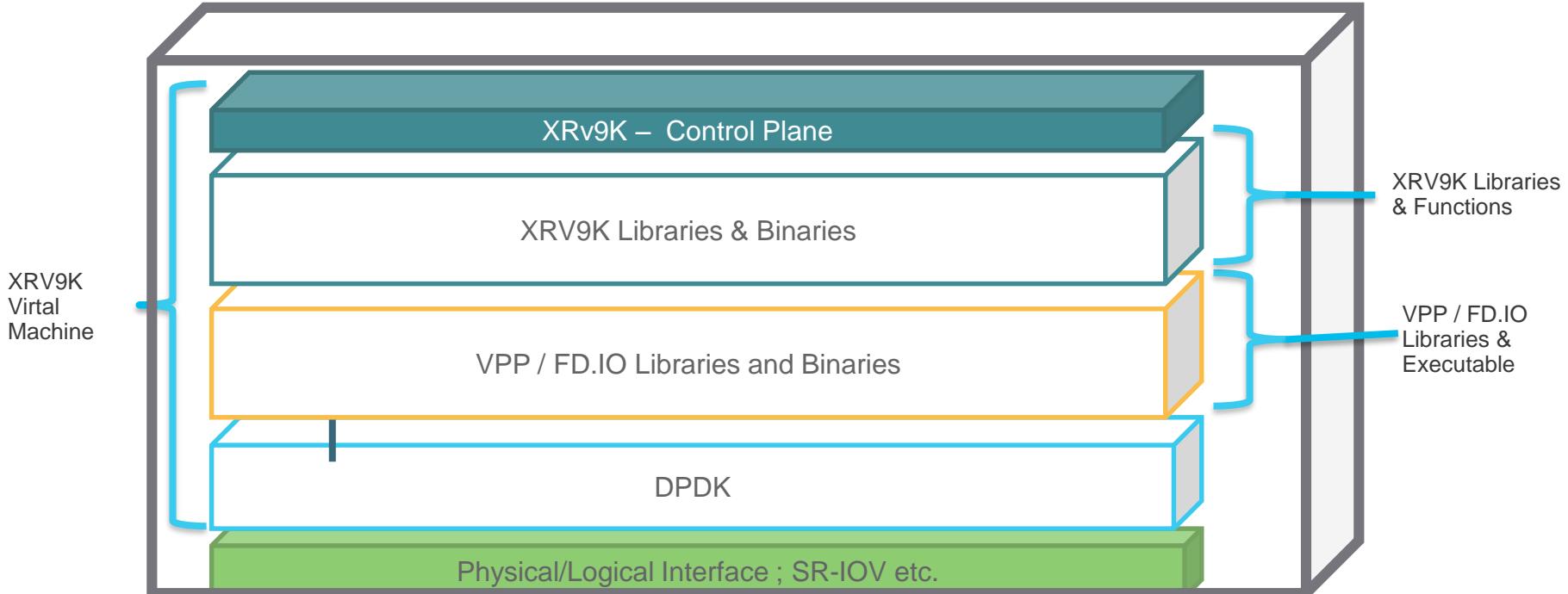
IOS XRv 9000

Right sizing Scale and Throughput through Control and Data Planes



IOS XRV 9000

Architecture

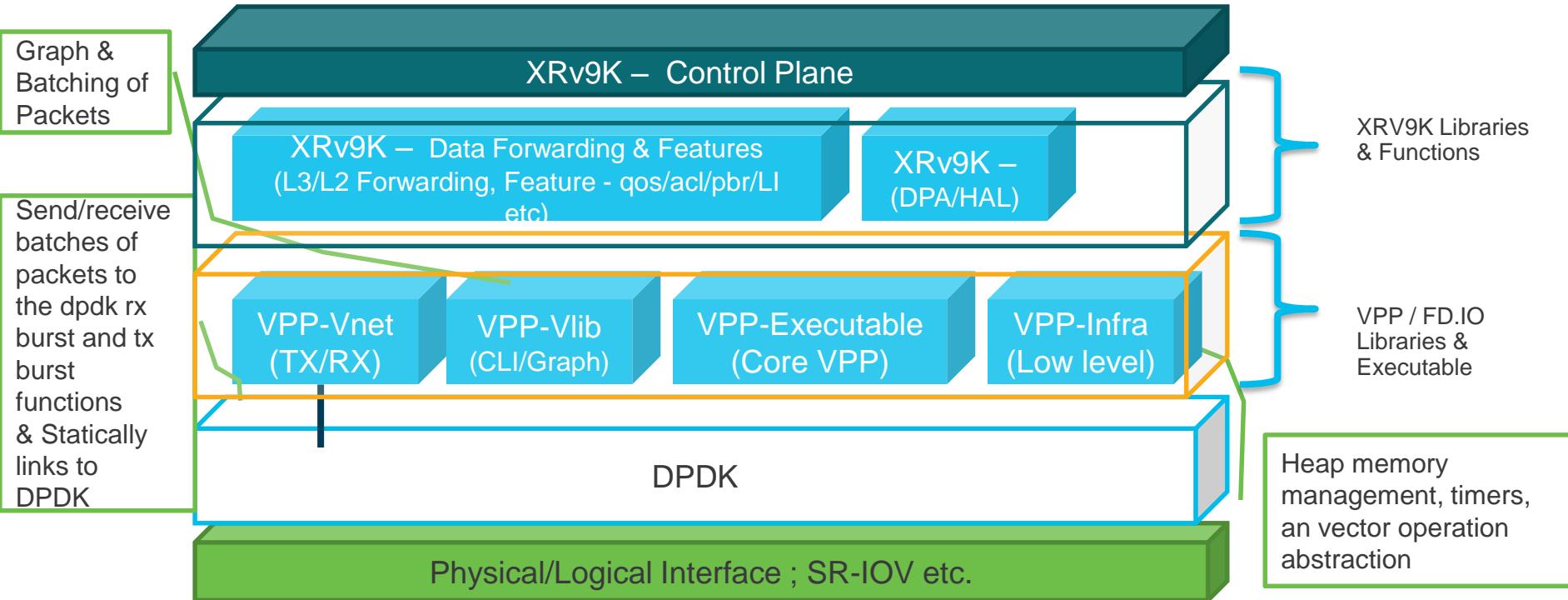


VPP : Vector Packet Processing

DPDK : Data Plane Development Kit

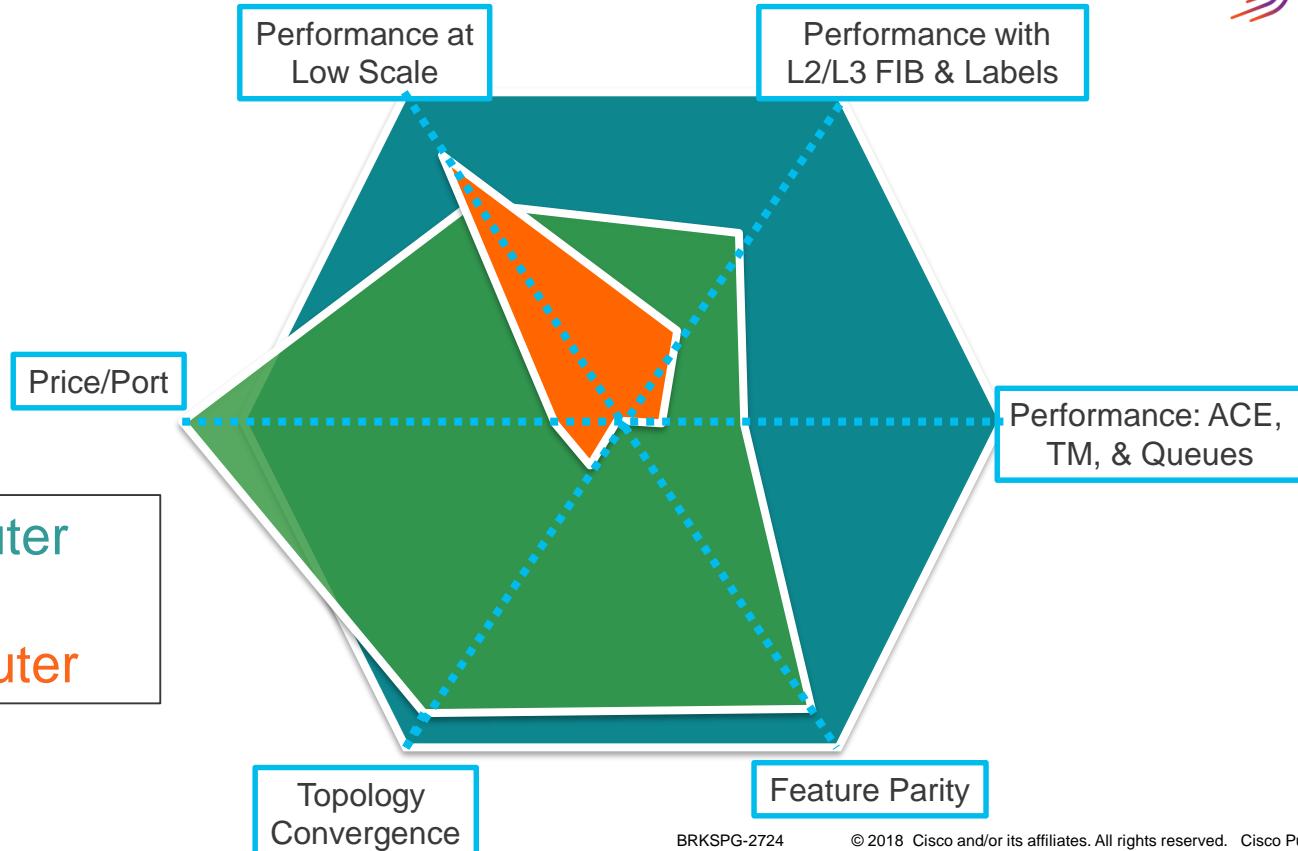
IOS XRV 9000

VPP & DPDK Interaction



Cisco IOS XRv 9000

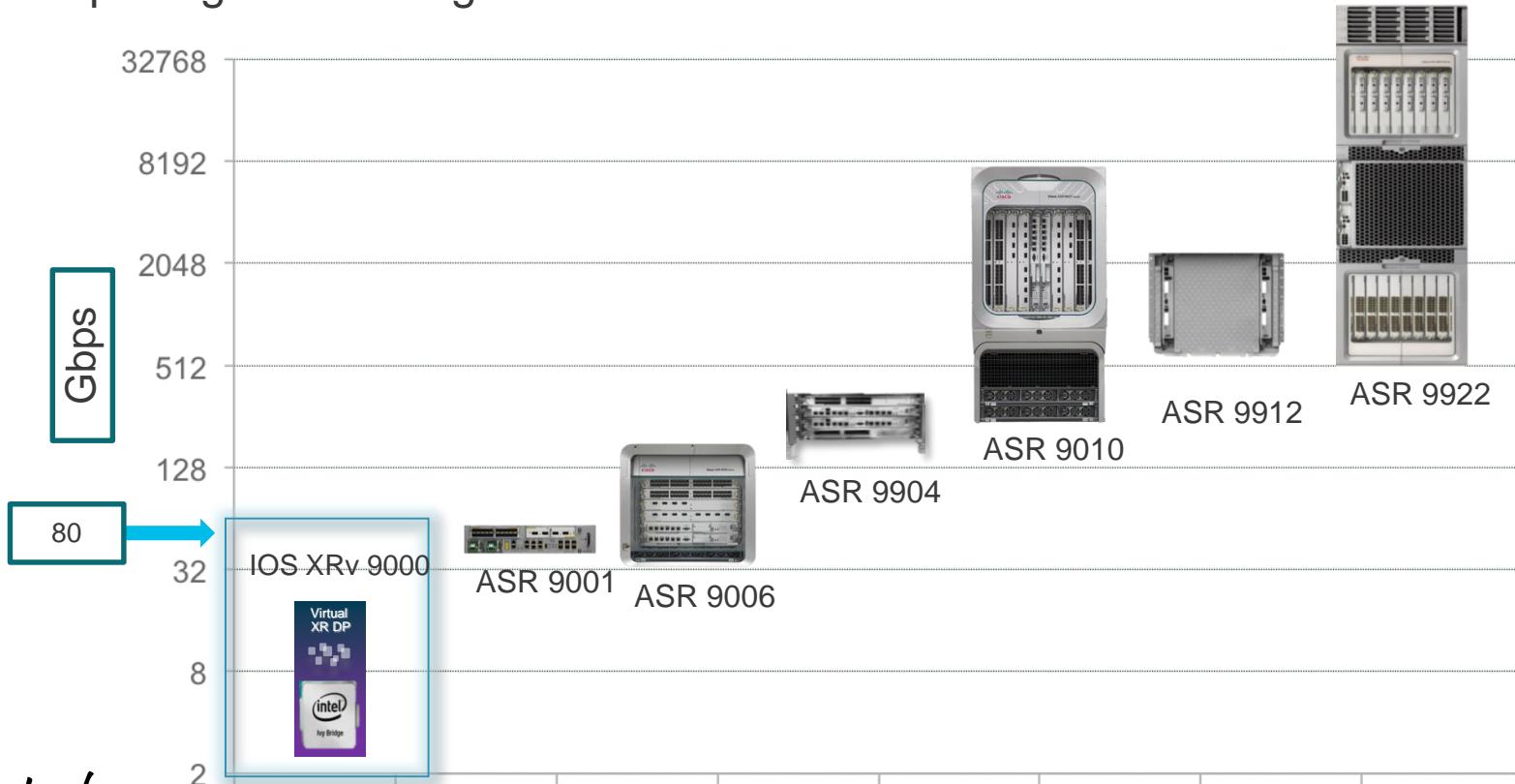
NFV Design Trade Offs



Physical XR Router
IOS XRv 9000
Other Virtual Router

IOS XRV 9000 Positioning

Completing the XR Edge Portfolio



Benefits & Use Cases

IOS XRv 9000

Benefits



Lower Opex

Easy **provisioning**, configuration & deployment for VMs



Elastic

Dynamic **resource allocation** & de-allocation



SDN Ready

Independent control and forwarding



IOS XRv 9000



Green

low **power** consumption → Lower carbon footprint



Flexible Design

CP & DP Separation and independent resource allocation



Lower Capex

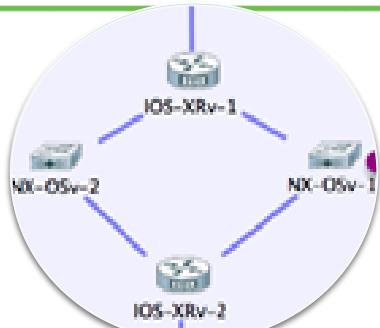
IOS XRv on **standard compute** Consumption Based Growth

IOS XRv 9000

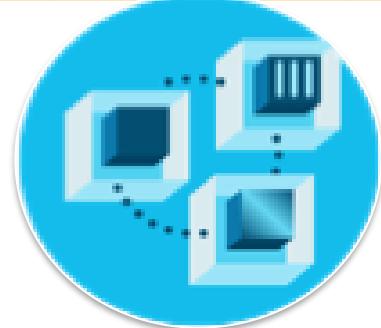
Use Cases



Education and Training



Network
Simulation &
Planning



Network
Functions
Virtualization

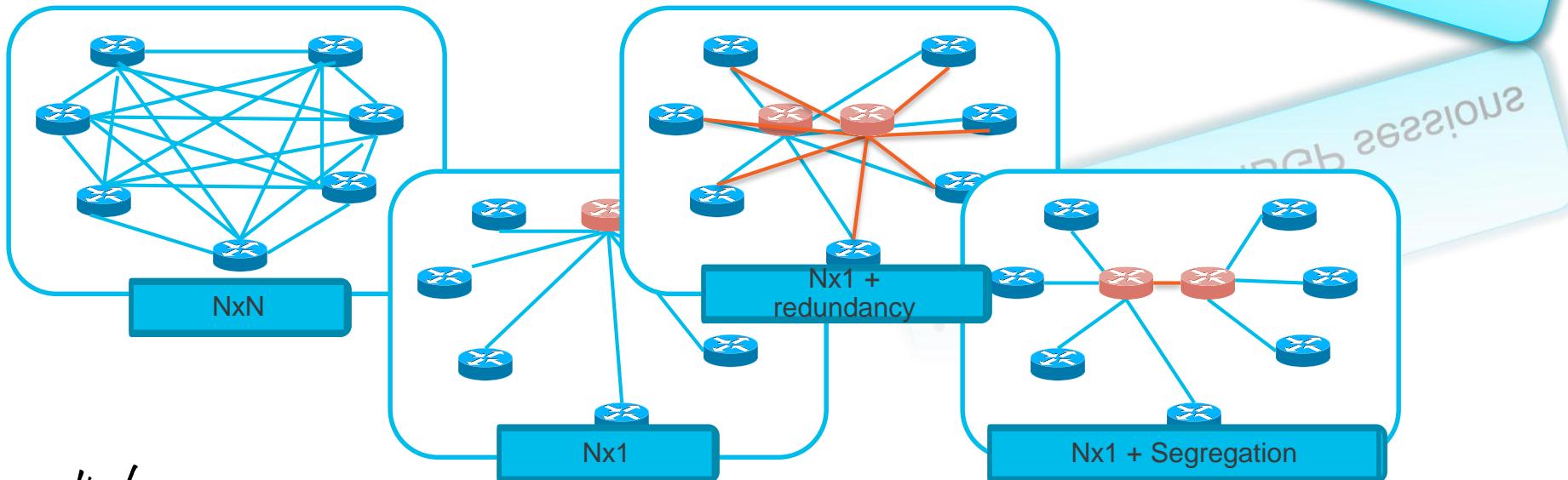
Universities – Enterprise – Public Sector – Service Providers

IOS XRv 9000 VNF Use Cases

IOS XRV 9000 as vRR

- Traditional Role of RR
 - BGP peering
 - Solve N^* N full-mesh BGP interconnect
 - Distribute BGP routes to PEs

- Not in packet path
- Focal point for iBGP sessions



IOS XRV 9000 as vRR

RR role evolution -
centralized provision, services, and applications

Per Service

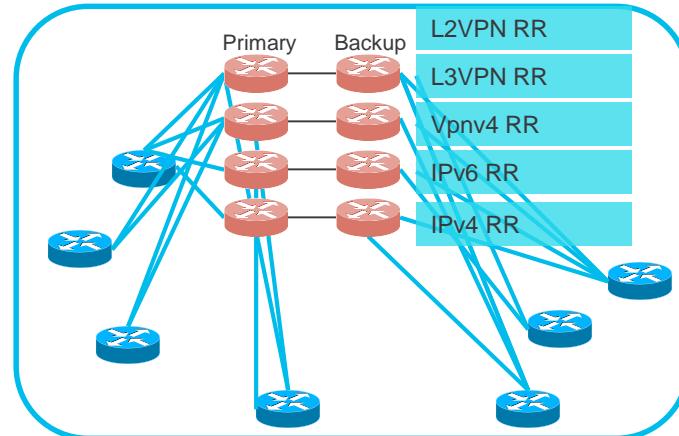
Per Address Family

Redundant

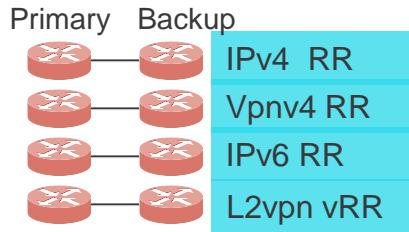
Optimized Placement

Scalable

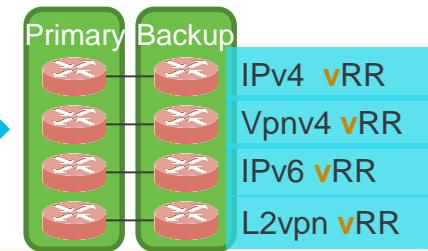
Easy Provisioning



IOS XRV 9000 as vRR



8 Physical Devices



2 Physical Devices
Virtualized RRs per AFI

Without Compromising

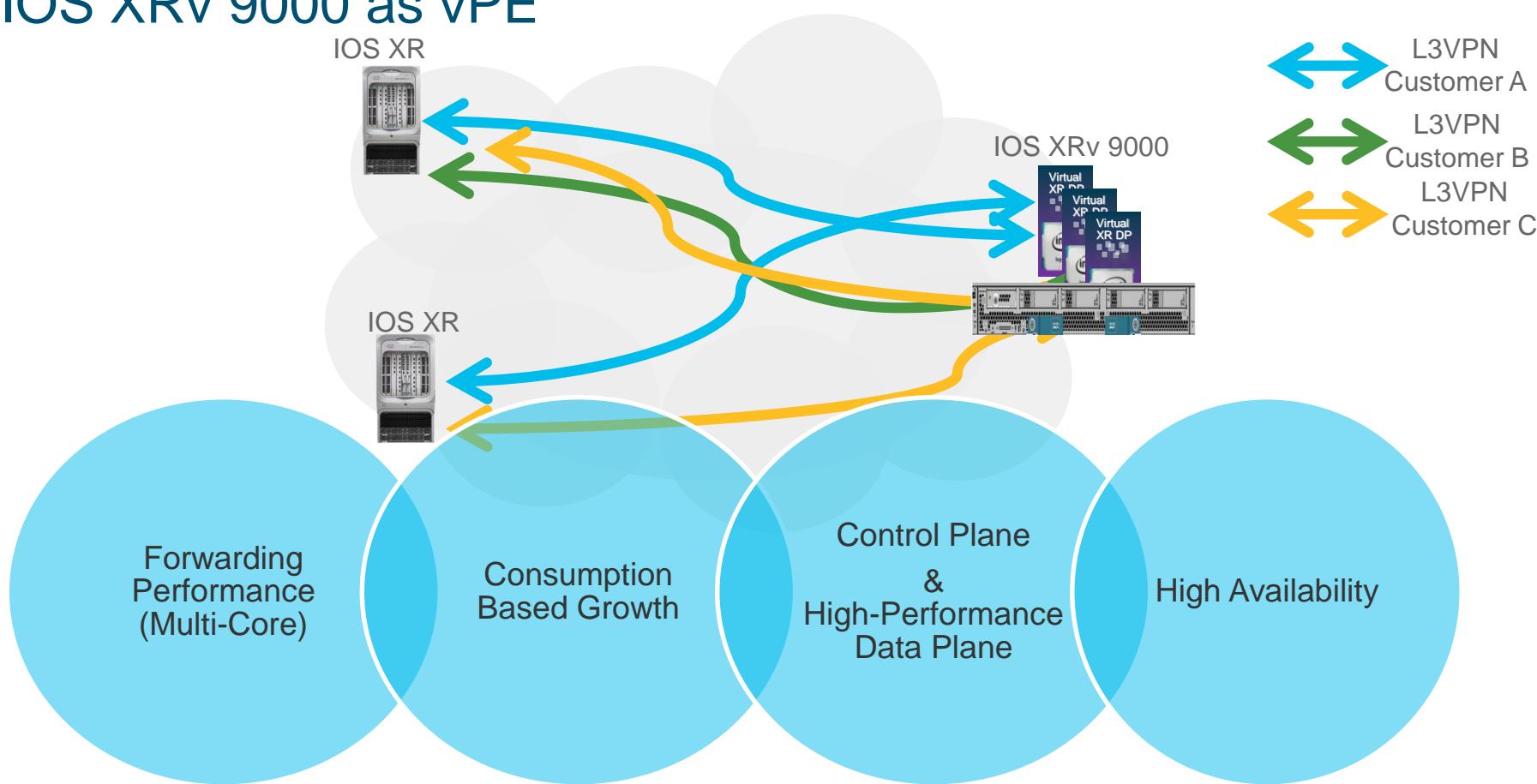
Performance
(Multi-Core)

Independent
Operation

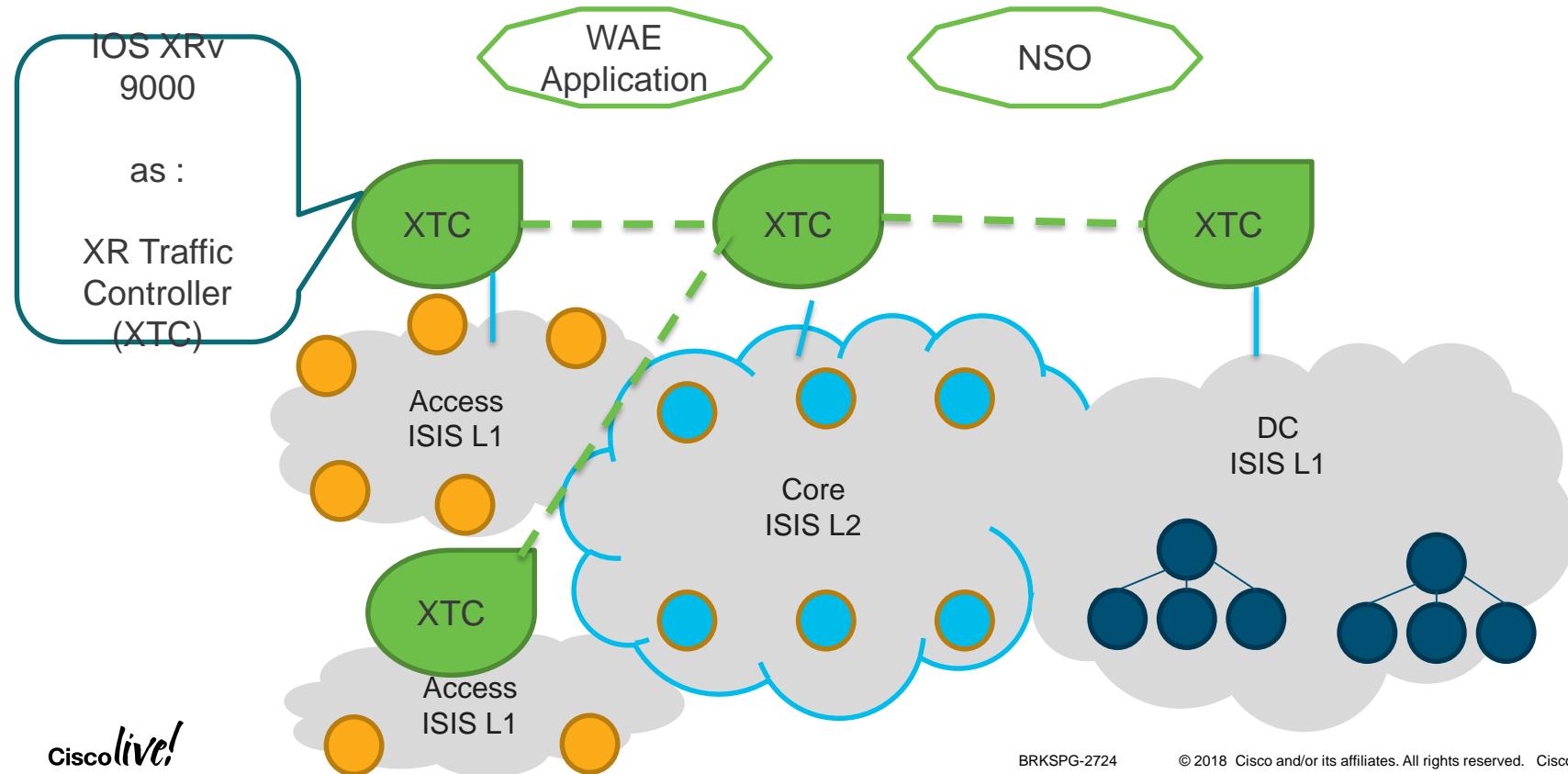
High
Availability

Same BGP
Implementation
(XR)

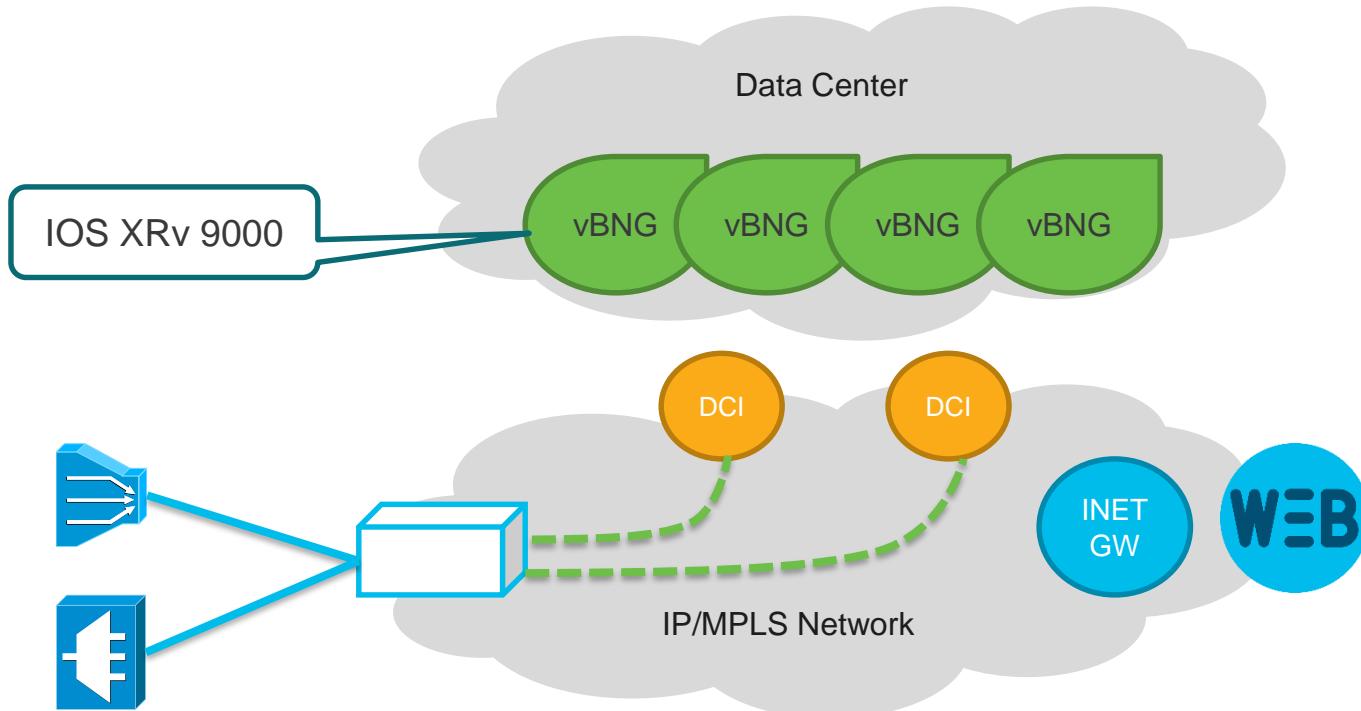
IOS XRv 9000 as vPE



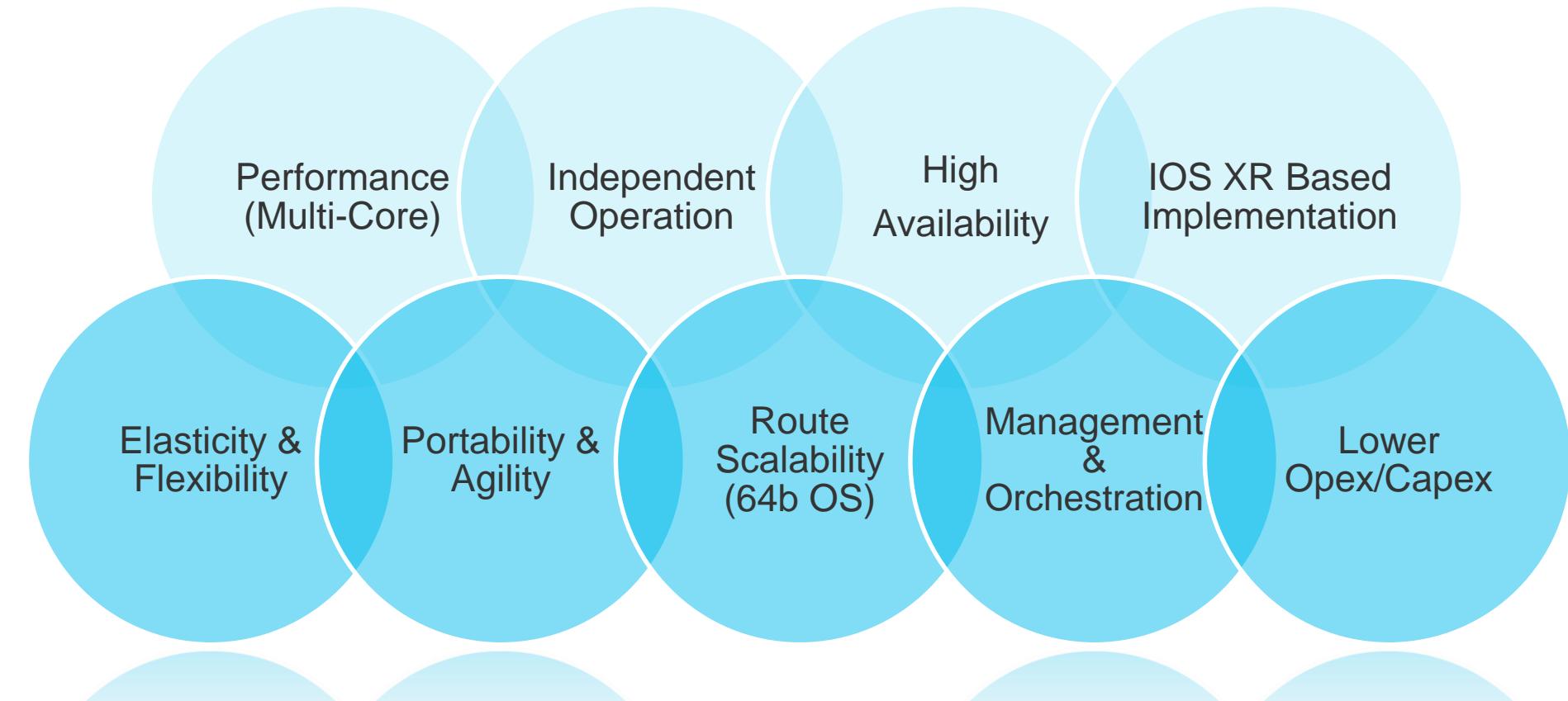
IOS XRV 9000 as SDN Controller



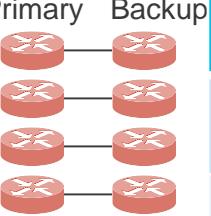
IOS XRV 9000 as a vBNG



Virtualizing Network Functions using IOS XRV 9000



Virtualizing Network Functions using IOS XRV 9000

Physical Router	VRR on UCS Server
	
Max. Power consumption ~425W	Max Power consumption ~410W
Total power for 8 instance ~3.4kW	Total power for 8 instances ~820W
Power/Year = 29,785 KWh	Power/Year = 7,182 KWh
Power Cost/Year = \$5,659 (19c/kWh)	Power Cost/Year= \$1,364 (19c/KWh)

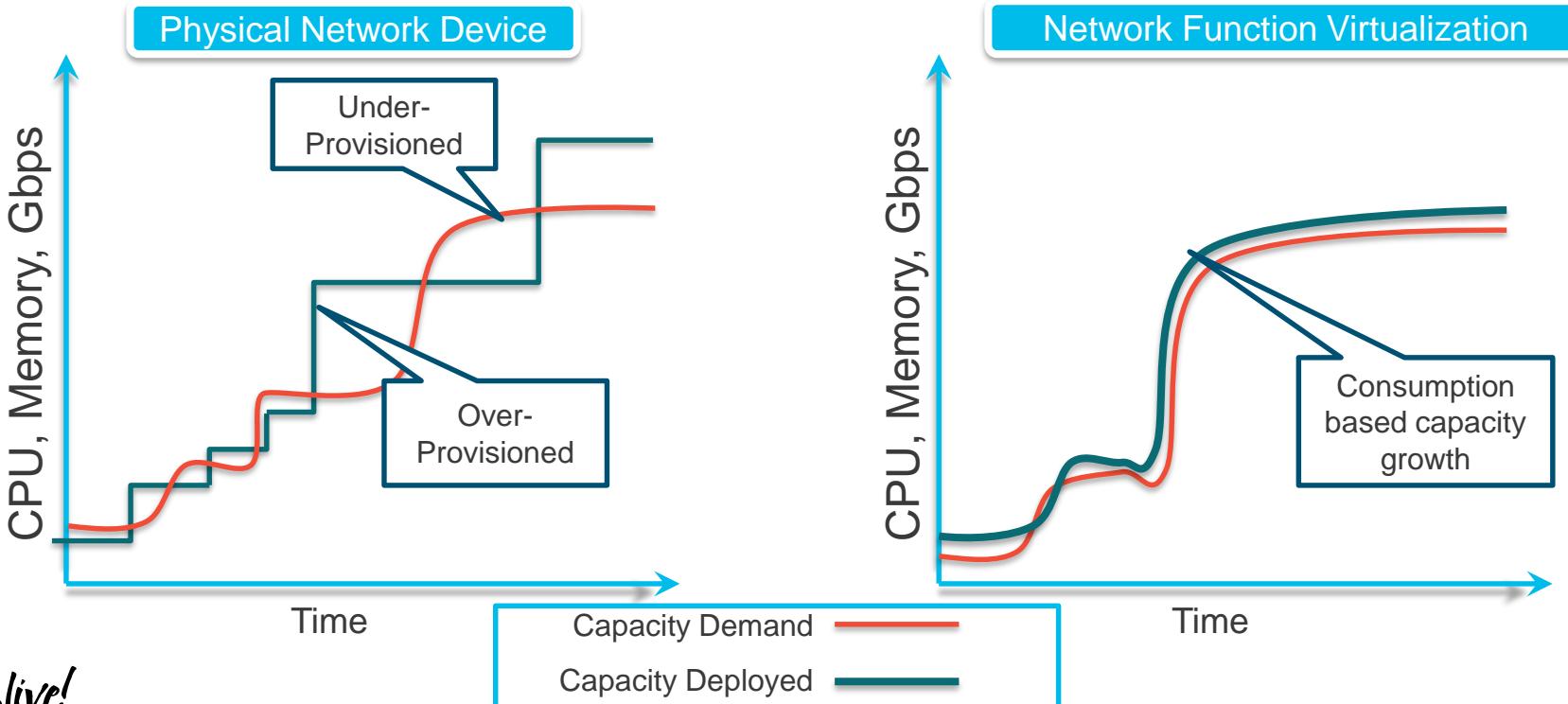


Power Calculations based on
ASR9001 (Max Power)
UCS C240 M3 SFF with Intel E5-2643 v2 3.30 GHz/130W 6C/25MB Cache/DDR3 1866MHz with 96 GB Mem, 4 HDD
with RAID, and 1 Adapters.



Physical Network Device vs NFV

Consumption Based Deployment



IOS XRv 9000 Deployment

IOS XRV 9000 Hardware/Software Requirements

- Hardware
 - Any x86-based server capable of virtualization
 - e.g. Intel® CPUs with VT-x support
- Hypervisor
 - hypervisor agnostic
 - VMWare ESXi 5.5/6.0 , QEMU/KVM (*RHEL & CentOS 7.7.1/7.2/7.3 , Ubuntu 14.04.03/16.04 LTS*)



Parameter	Minimum	Recommended/Max
CPU (Cores)	2 (1 Control Plane, 1 Data Plane)	4 Sockets
Memory (RAM)	12 GB	19GB recommended
Hard Disk	45GB	
NIC Port (E1000, VirtIO, Intel1/10/40G, VMXNet3, SR-IOV)	4 (2 reserved, 1 traffic)	Production 11 (2 reserved, 8 traffic) Simulation : 128

IOS XRV 9000 Features



- MP-BGP/eBGP , BGP 3107, FlowSpec
- OSPF/ISIS etc.
- **BFD** (Bidirectional Forwarding Detection)
- LDP/MPLS, 6PE, 6vPE, RFC 3107 (3 labels), L3VPN
- IPv4 ACL (chained), uRPFv4/v6, LPTS
- Netconf/YANG & SNMP
- Hierarchical QoS policing, WRED
- **EFD** (Early Fast Discard)
- Lawful Intercept
- IOS XR Manageability & Control Plane
 - PIE/SMU Upgrades
 - LPTS/ CoPP
- Gratuitous ARP
- VRRP/HSRP

<http://www.cisco.com/c/en/us/support/routers/ios-xrv-9000-router/tsd-products-support-series-home.html>

IOS XRV 9000 Operational Enhancements



Visibility & Telemetry

- Operational Data, Deep analytical hooks
- Policy-based, flexible, Push Model

Programmability

- Data accessible via published model driven interfaces
- Machine friendly
- Enables automation @ scale

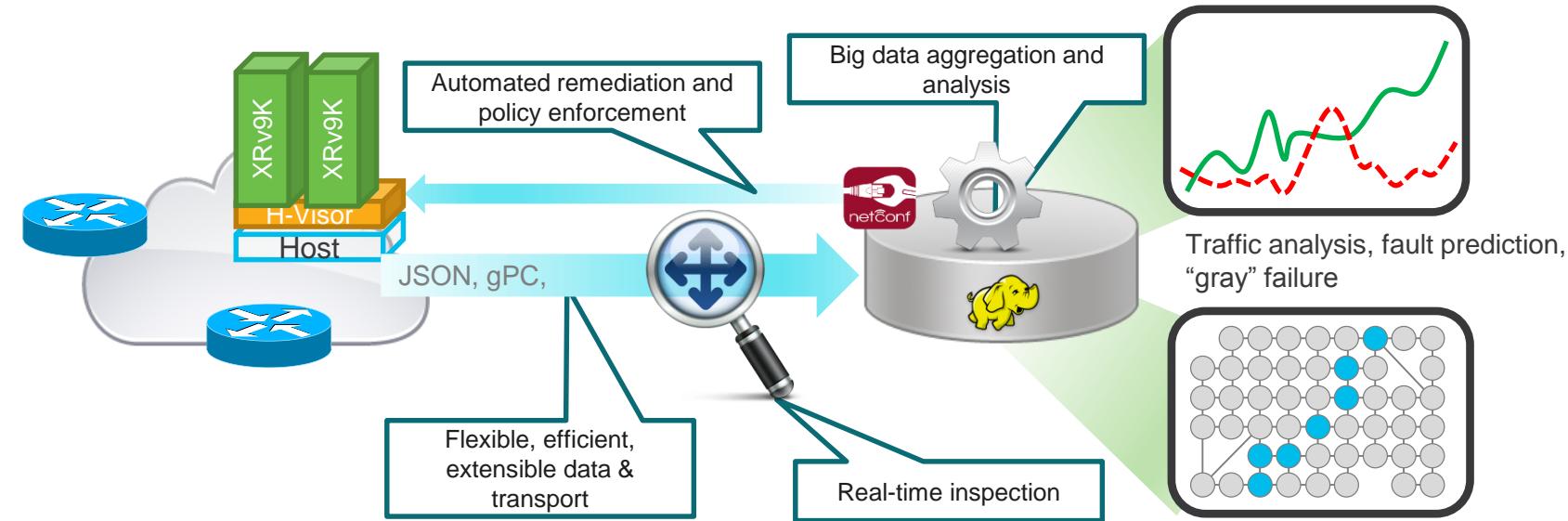
Application Hosting

- Ability to run 3rd party off the shelf applications built with Linux tool chains
- Run custom applications inside an LXC container on the 64-bit Linux host

Flexible Platform and Packaging

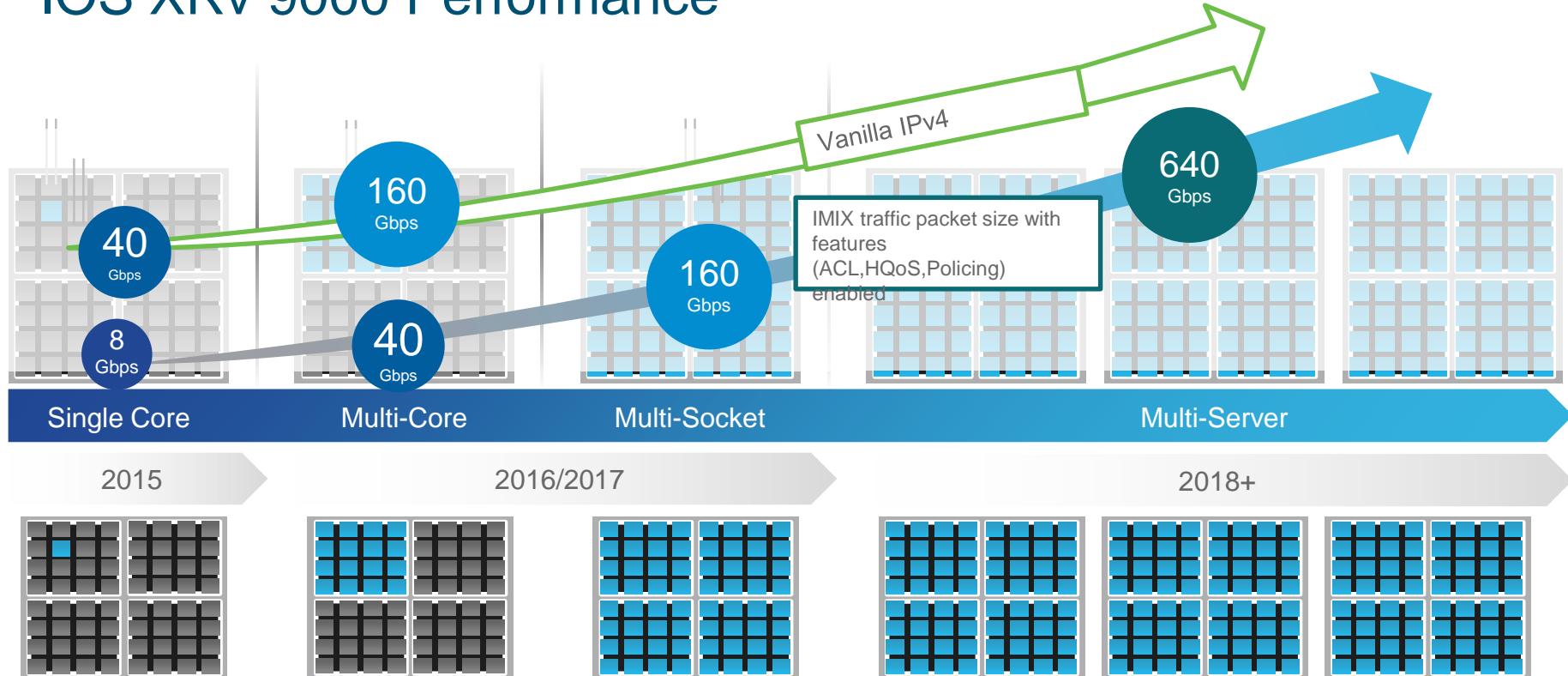
- RPM Packages: EIGRP, MGBL, MPLS, K9SEC, LI, BGP etc.
- Automated package dependency checkers
- Automated Provisioning at Bootup

IOS XRV 9000 Telemetry & Programmability



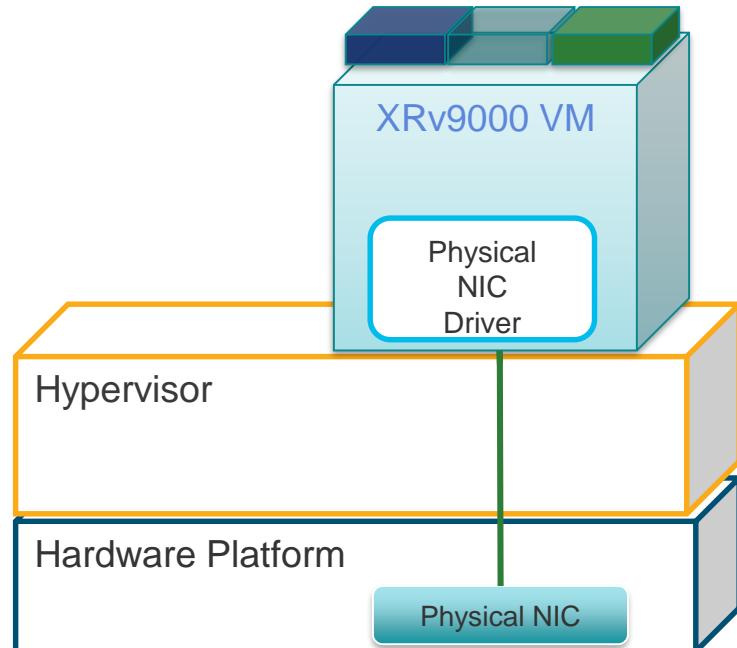
Deeper instrumentation + smarter analytics tools =
Real-time action-ability
Active feedback & Auto-remediation

IOS XRV 9000 Performance

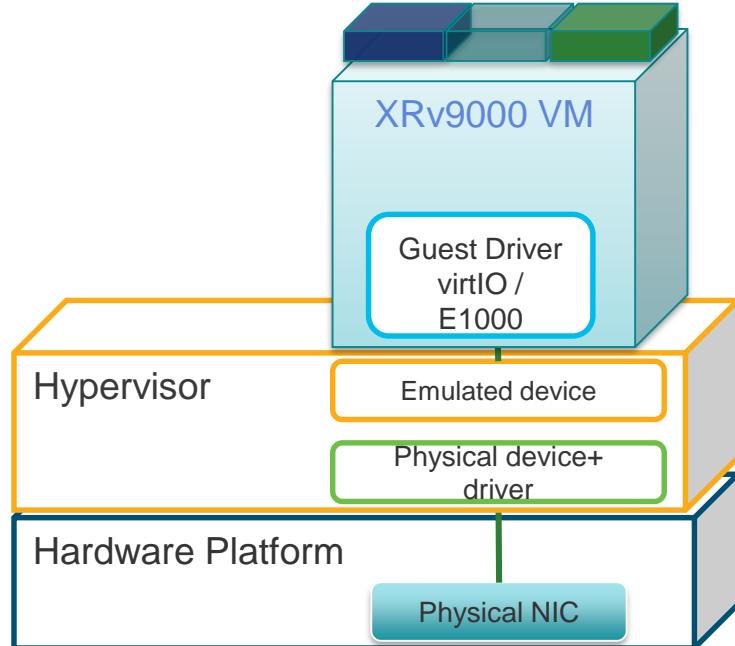


IOS XRV 9000 Deployment

Pass-through vs Device Emulation

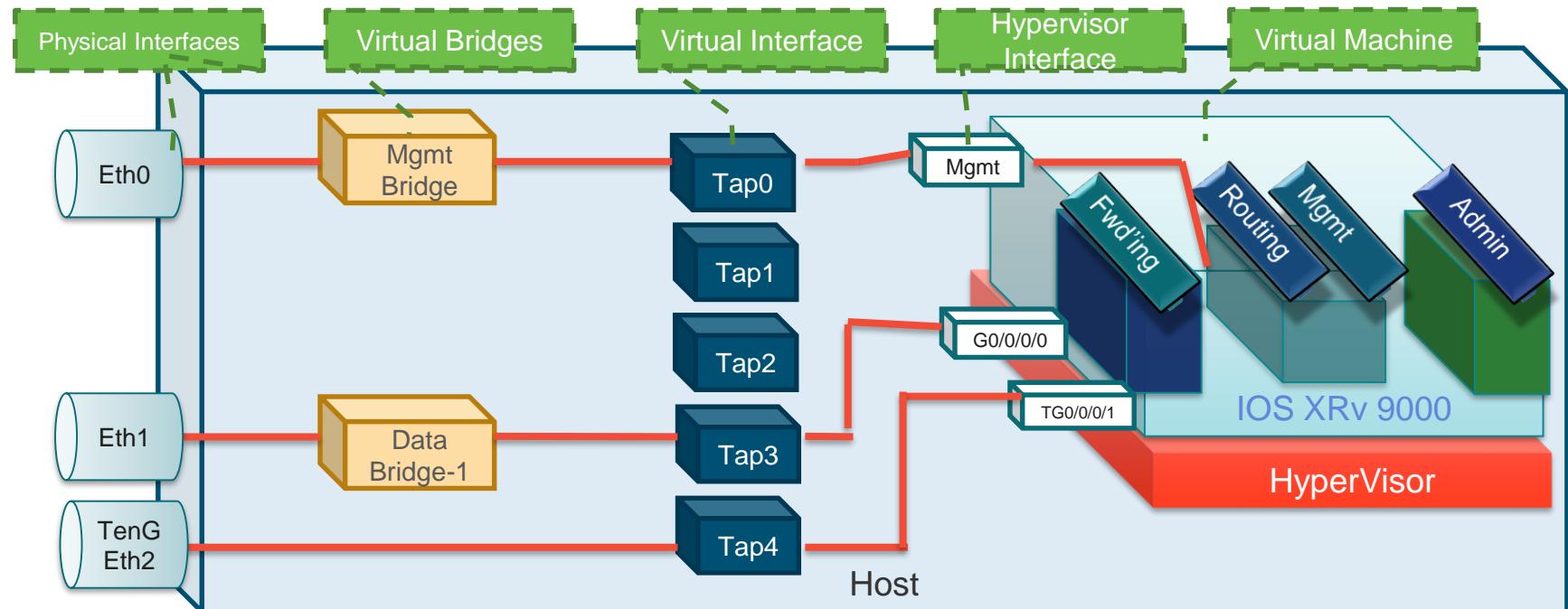


High Performance



Emulated

IOS XRV 9000 Deployment

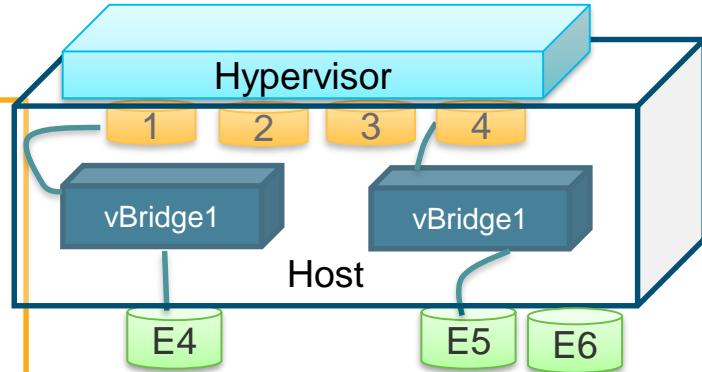


IOS XRV 9000 Deployment

Creating TAP and Bridge

```
cisco@linux:~$ sudo tunctl -t Tap1
Set 'Tap1' persistent and owned by uid 0
cisco@linux:~$ sudo ifconfig Tap1 up
```

```
cisco@linux:~$ sudo tunctl -t Tap2
Set 'Tap2' persistent and owned by uid 0
cisco@linux:~$ sudo ifconfig Tap2 up
<create Tap3/Tap4>
```



```
cisco@linux:~$ sudo brctl addbr vbridge1
cisco@linux:~$ sudo brctl addbr vbridge2
cisco@linux:~$ sudo brctl addif vbridge1 Tap1 eth4
cisco@linux:~$ sudo brctl addif vbridge2 Tap2 eth5
```

```
cisco@linux:~$ sudo brctl show vbridge1
bridge name      bridge id          STP enabled    interfaces
vbridge1        8000.b6c7102ae0f6    no           Tap1
                                         eth4
```

IOS XRv 9000 Bring-up

Launching the IOS XRv 9000 Virtual Machine

```
cisco@linux:~$ sudo /usr/bin/qemu-system-x86_64 \
-m 16384 \
-smp cores=4,sockets=1 \
-name XRv-Test-Launch \
-drive file=./xrv9k.raw,media=disk,index=1 \
-drive file=./xrv9k-fullk9-x.iso-6.0.0,media=cdrom,index=2 \
-serial telnet:0.0.0.0:12345,server,nowait \
-device e1000,netdev=mgmt-intf \
-netdev tap,ifname=Tap1,script=no,downscript=no,id=mgmt-intf \
-device e1000,netdev=data-intf \
-netdev tap,ifname=Tap4,script=no,downscript=no,id=data-intf \
-display none -enable-kvm
-boot once=d
```

16G Memory

4 CPU Cores

XRv9K Instance

XRv9K Disk

XRv Image File

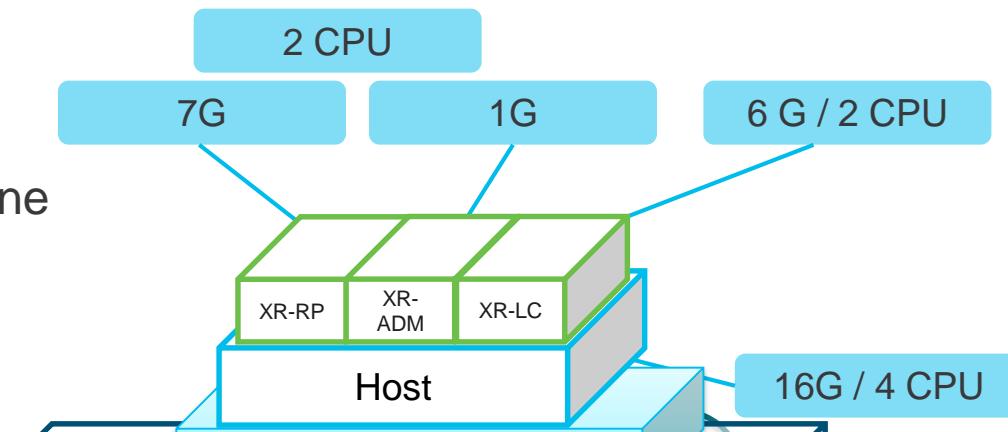
Console port

Ethernet (Mgmt)

Ethernet (GigE)

IOS XRv 9000 Bring-up

Accessing the IOS XRv Virtual Machine



```
cisco@linux:~$ telnet 0.0.0.0 12345
[Linux-initrd @ 0x456bc000, 0x3a93367c bytes]
Starting udev
Populating dev cache
Configuring network interfaces... done.
<snip>
Mon Feb  8 23:48:38 UTC 2016 (<snip>_lxc_iso.sh): Hardware profile: vpe
Mon Feb  8 23:48:38 UTC 2016 (<snip>_lxc_iso.sh): Host has 16Gb RAM / 4 vCPUs
Mon Feb  8 23:48:38 UTC 2016 (<snip>_lxc_iso.sh): Management plane: 1Gb RAM / 0 vCPUs
Mon Feb  8 23:48:38 UTC 2016 (<snip>_lxc_iso.sh): XR control plane: 7Gb RAM / 2 vCPUs
Mon Feb  8 23:48:38 UTC 2016 (<snip>_lxc_iso.sh): XR packet memory: 128Mb RAM
Mon Feb  8 23:48:38 UTC 2016 (<snip>_lxc_iso.sh): Data plane: 6Gb RAM
Mon Feb  8 23:48:38 UTC 2016 (<snip>_lxc_iso.sh): Data plane core assignment: 2-3
Mon Feb  8 23:48:38 UTC 2016 (<snip>_lxc_iso.sh): Control plane core assignment: 0-1
```

IOS XRv 9000 Bring-up

Accessing the IOS XRv Virtual Machine

```
Mon Feb  8 23:49:45 UTC 2016: Install finished on sda
Rebooting XRv9k system after installation ...
[ 99.990922] reboot: Restarting system
<snip>
#####
#                                     #
#       Welcome to the Cisco IOS XRv9k platform      #
#   Please wait for Cisco IOS XR to start.            #
#   Copyright (c) 2014-2015 by Cisco Systems, Inc.    #
#
#####
Cisco IOS XR console      will start on the 1st serial port
Cisco IOS XR aux console will start on the 2nd serial port
Cisco Calvados console     will start on the 3rd serial port
Cisco Calvados aux         will start on the 4th serial port

!!!!!!!!!!!!!! NO root-system username is configured. Need to configure root-system username.
!!!!!!!!!!!!!!
--- Administrative User Dialog ---
Enter root-system username:
```

IOS XRv 9000 Deployment

Show Commands

```
RP/0/RP0/CPU0:ios#show ver
Tue Feb  9 00:10:36.484 UTC
Cisco IOS XR Software, Version 6.0.0
Copyright (c) 2013-2015 by Cisco Systems, Inc.
```

Build Information:

```
Built By      : alnguyen
Built On      : Thu Dec 24 00:54:24 PST 2015
Build Host    : iox-lnx-009
Workspace     : /auto/srcarchive16/production/6.0.0/xrv9k/workspace
Version       : 6.0.0
Location      : /opt/cisco/XR/packages/
```

```
cisco IOS-XRv 9000 () processor
System uptime is 16 minutes
```

```
RP/0/RP0/CPU0:ios#
```

IOS XRV 9000 Deployment

Show Commands

Single RP. No LineCard

```
RP/0/RP0/CPU0:ios#show platform
```

Wed Jun 21 21:00:39.366 UTC

Node	Type	State	Config state
<hr/>			
0/0/CPU0	R-IOSXRV9000-LC-C	IOS XR RUN	NSHUT
0/RP0/CPU0	R-IOSXRV9000-RP-C (Active)	IOS XR RUN	NSHUT

```
RP/0/RP0/CPU0:ios#
```

```
RP/0/RP0/CPU0:ios#show ipv4 int br
```

Tue Feb 9 00:12:04.600 UTC

Interface	IP-Address	Status	Protocol	Vrf-Name
MgmtEth0/RP0/CPU0/0	unassigned	Shutdown	Down	Tap1=MgmtEth0
GigabitEthernet0/0/0/0	unassigned	Shutdown	Down	Tap2=Future
TenGigE0/0/0/1	unassigned	Shutdown	Down	Tap3=Future

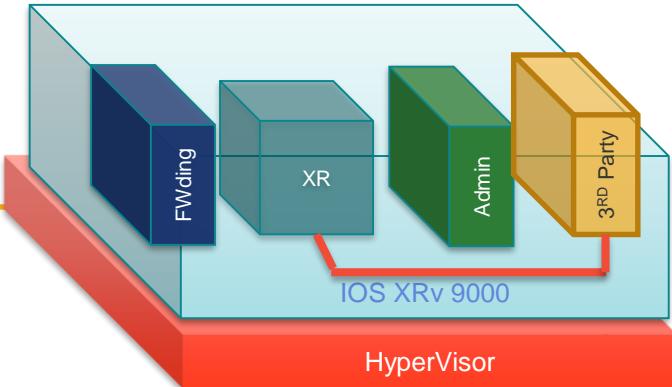
```
RP/0/RP0/CPU0:ios#
```

Tap1=MgmtEth0
Tap2=Future
Tap3=Future
Tap4=Giga0/0/0/0
Tap5=TenGig0/0/0/1

IOS XRV 9000 Deployment

Containers and 3rd Party Network NameSpace

```
[sysadmin-vm:0_RP0:~]$ ssh 10.0.2.16
Last login: Tue Feb  9 01:21:24 2016 from 10.11.12.15
[host:~]$ virsh list
  Id   Name           State
  --
  5299 sysadmin      running
  12065 default-sdr_uvf--2 running
  15153 default-sdr--1 running
  ...
  15154 default-sdr--2 running
```



```
RP/0/RP0/CPU0:ios#show ipv4 int br
Thu Feb 11 15:55:05.581 UTC
Interface          IP-Address      Status
Name
Loopback0          1.2.3.4        Up
Loopback2          110.2.2.2      Up
Loopback3          110.3.3.3      Up
GigabitEthernet0/0/0/0 200.1.1.1    Up
MgmtEth0/RP0/CPU0/0
RP/0/RP0/CPU0:ios#
```

```
[xr-vm_node0_RP0_CPU0:~]$ ip netns exec tpnns ifconfig | more
Gi0_0_0_0  Link encap:Ethernet  HWaddr 00:50:56:b9:44:0c
          inet addr:200.1.1.1  Mask:255.255.255.0
          Link encap:Local Loopback
          inet addr:1.2.3.4  Mask:255.255.255.255
lo:0      Link encap:Local Loopback
          inet addr:110.2.2.2  Mask:255.255.255.255
lo:2      Link encap:Local Loopback
          inet addr:110.3.3.3  Mask:255.255.255.255
lo:3      Link encap:Local Loopback
          inet addr:110.3.3.3  Mask:255.255.255.255
```

IOS XRV 9000 Deployment

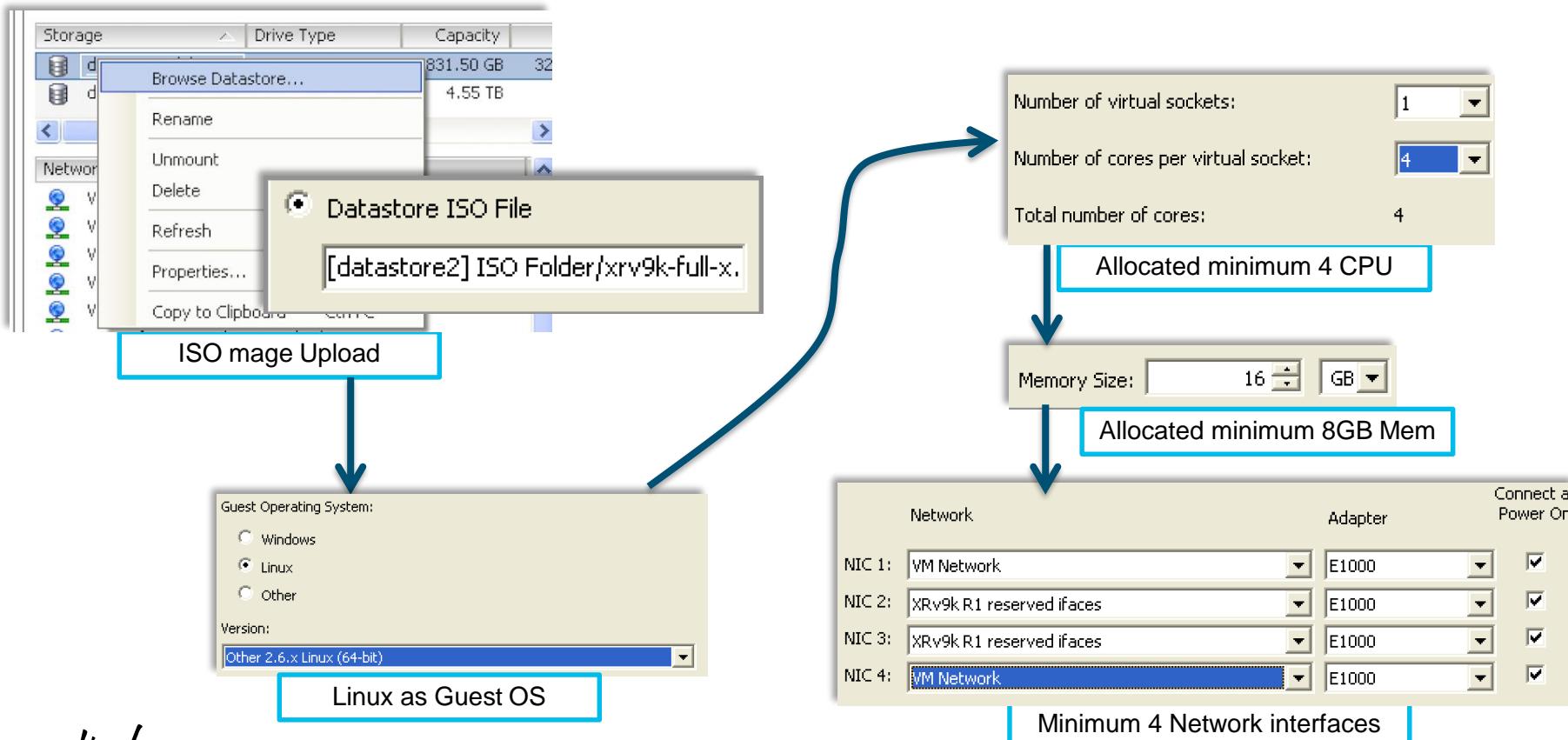
Checking License Status

```
RP/0/# show license platform summary
Sat Dec 26 05:47:08.537 UTC
Current state: PRODUCTION

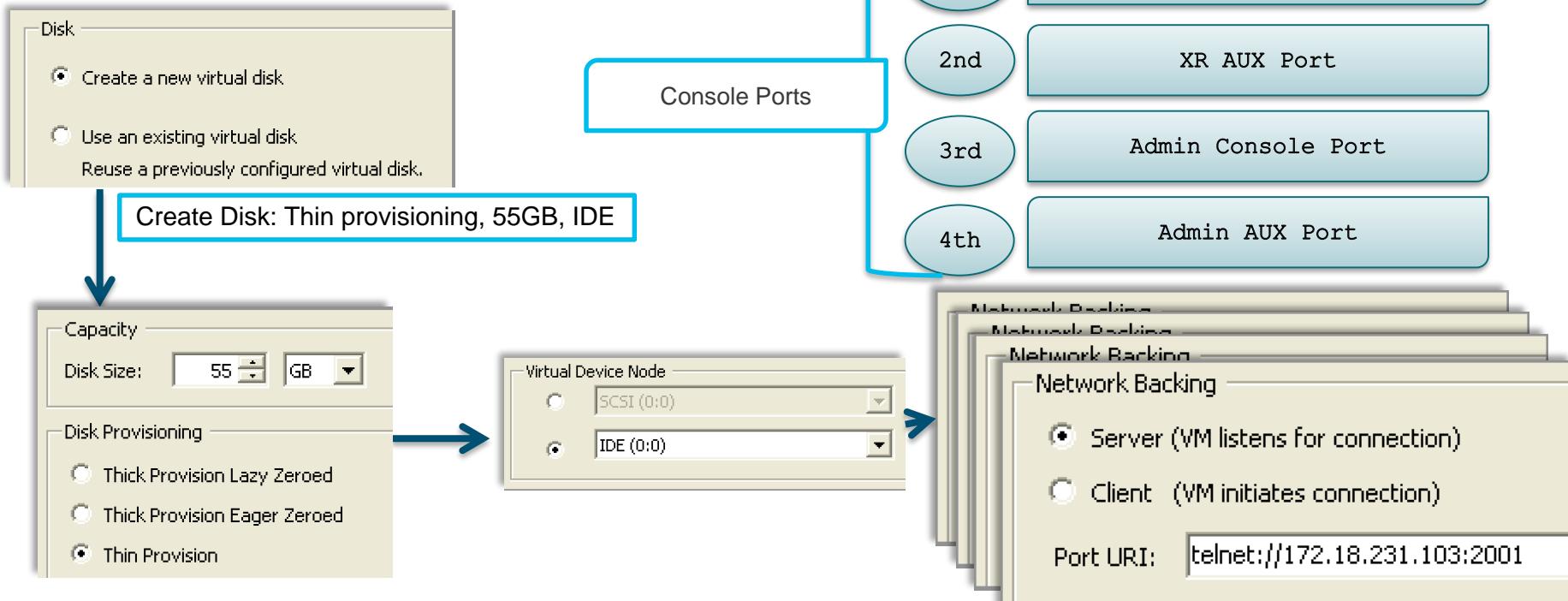
Collection:      LAST: Sat Dec 26 05:47:03 2015
                  NEXT: Sat Dec 26 06:47:03 2015
Reporting:       LAST: Sat Dec 26 05:47:03 2015
                  NEXT: Sun Dec 27 05:47:03 2015

                                         Count
Feature/Area    Entitlement          Last  Next
===== =====
System          Product: Right to Use   1     0
System          Feature: BGP Scale up to 4M 1     0
```

IOS XRV 9000 Deployment using ESXi



IOS XRV 9000 Deployment using ESXi



IOS XRV 9000 - Deployment on ESXi

Accessing the IOS-XRV VM

```
Filesystem type is iso9660, using whole disk  
kernel /boot/bzImage root=/dev/ram console=ttyS0 prod=1 install=/dev/sda platfo
```

```
<SNIP>  
Wed Feb 17 02:13:47 UTC 2016: Copying all ISOs to repository took 68 seconds  
[ 340.853307] reboot: Restarting system  
Press any key to continue.
```

```
<SNIP>
```

```
#####
#  
#          Welcome to the Cisco IOS XRv9k platform  
# Please wait for Cisco IOS XR to start.  
# Copyright (c) 2014-2015 by Cisco Systems, Inc.  
#  
#####  
  
Cisco IOS XR console      will start on the 1st serial port  
Cisco IOS XR aux console will start on the 2nd serial port  
Cisco Calvados console   will start on the 3rd serial port  
  
<snip>  
  
ios con0/RP0/CPU0 is now available  
Press RETURN to get started.  
!!!!!!!!!!!!!! NO root-system username is configured. Need to co  
!!!!!!!!!!!!!!Configuration lock is held by another agent. Plea  
  
--- Administrative User Dialog ---  
Enter root-system username:
```

Telnet to the Serial Port

```
telnet <esxi_host_ip> <port_number>
```

Will go through baking process on first boot up & reload

Only happens once, during the first bootup

Create Username and Password

IOS XRV 9000 Deployment using Openstack

Create Flavor

Create Network

Create Image

Create An Image

Name *

virtual-router

Description

Image Source

Image Location

Image Location

Select format

AKI - Amazon Kernel Image

AMI - Amazon Machine Image

ARI - Amazon Ramdisk Image

Docker

ISO - Optical Disk Image

OVA - Open Virtual Appliance

QCOW2 - QEMU Emulator

Raw

VDI - Virtual Disk Image

VHD - Virtual Hard Disk

VMDK - Virtual Machine Disk

Disk

RAM

Minimum Disk (GB) *

45

Minimum RAM (MB) *

16

Copy Data *

Public

Protected

The screenshot shows the OpenStack Horizon dashboard with the 'Instances' tab selected. In the top right corner, there is a large red box highlighting the 'Launch Instance' button. To the left of the main content area, there is a sidebar with the 'ubuntu' project selected.

Launch Instance

The screenshot shows the 'Launch Instance' configuration dialog. At the top, there is a red box highlighting the 'Select Flavor' dropdown menu. Below it, the 'Flavor Details' table is shown, with a red box highlighting the 'RAM' row. The table also shows other details like VCPUs, Root Disk, and Total Disk.

Name	nfv-router-...
VCPUs	4
Root Disk	55 GB
Ephemeral Disk	0 GB
Total Disk	55 GB
RAM	16,000 MB

Select Flavor



IOS XRv 9000 Deployment using Openstack

Create Image

Assign Network

Launch Instance

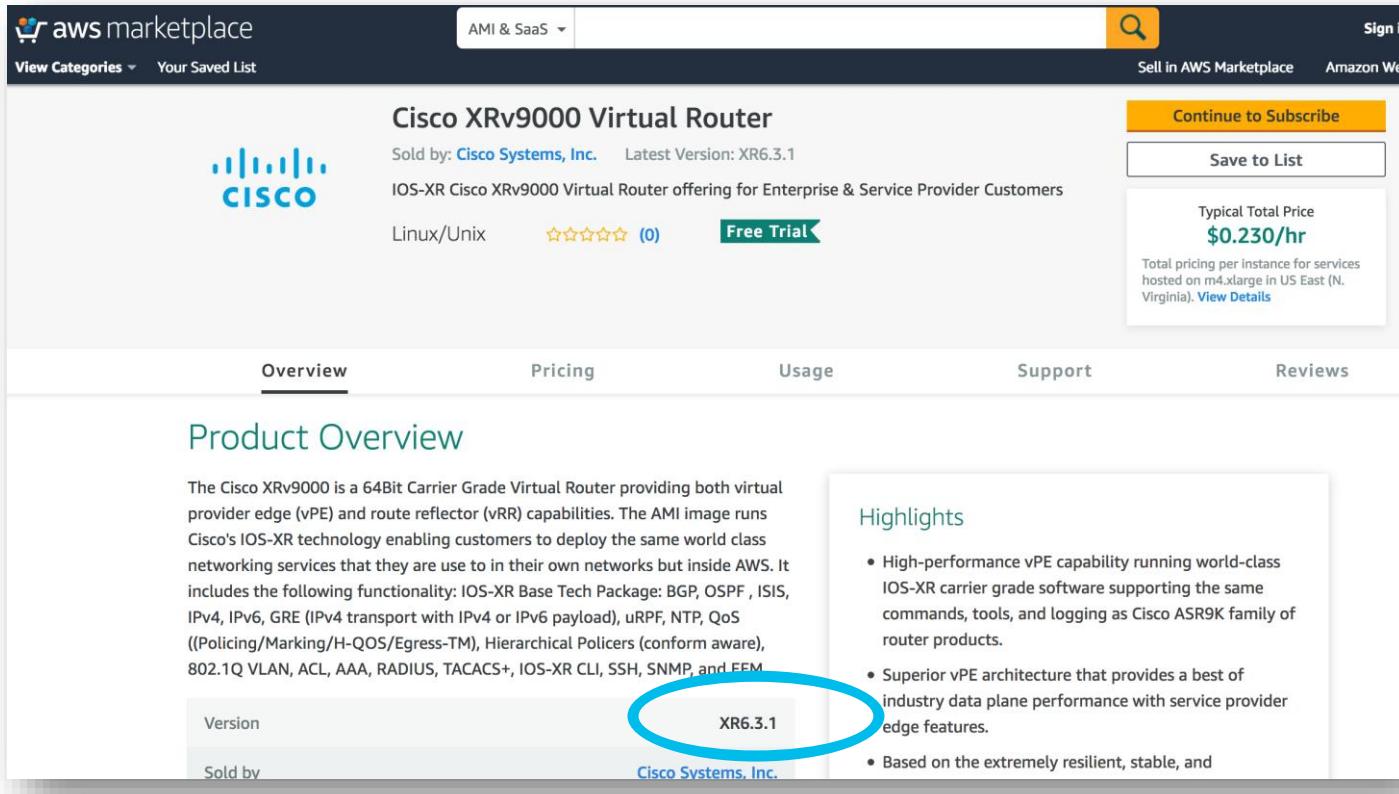
Boot Source

Selected networks

Available networks

Instances

IOS XRV 9000 Deployment on AWS



The screenshot shows the AWS Marketplace listing for the Cisco XRV9000 Virtual Router. The product is sold by Cisco Systems, Inc. and the latest version is XR6.3.1. It is described as an IOS-XR Cisco XRV9000 Virtual Router offering for Enterprise & Service Provider Customers. The listing includes a Free Trial button and typical total price information (\$0.230/hr). The page features tabs for Overview, Pricing, Usage, Support, and Reviews. Below the Overview tab, there is a Product Overview section describing the router's capabilities and functionality. To the right, there is a box titled 'Highlights' containing bullet points about the router's performance and architecture.

Cisco XRV9000 Virtual Router

Sold by: **Cisco Systems, Inc.** Latest Version: XR6.3.1

IOS-XR Cisco XRV9000 Virtual Router offering for Enterprise & Service Provider Customers

Linux/Unix (0) **Free Trial**

Overview **Pricing** **Usage** **Support** **Reviews**

Product Overview

The Cisco XRV9000 is a 64Bit Carrier Grade Virtual Router providing both virtual provider edge (vPE) and route reflector (vRR) capabilities. The AMI image runs Cisco's IOS-XR technology enabling customers to deploy the same world class networking services that they are used to in their own networks but inside AWS. It includes the following functionality: IOS-XR Base Tech Package: BGP, OSPF , ISIS, IPv4, IPv6, GRE (IPv4 transport with IPv4 or IPv6 payload), URPF, NTP, QoS ((Policing/Marking/H-QOS/Egress-TM), Hierarchical Policers (conform aware), 802.1Q VLAN, ACL, AAA, RADIUS, TACACS+, IOS-XR CLI, SSH, SNMP, and EFM.

Version	XR6.3.1
Sold by	Cisco Systems, Inc.

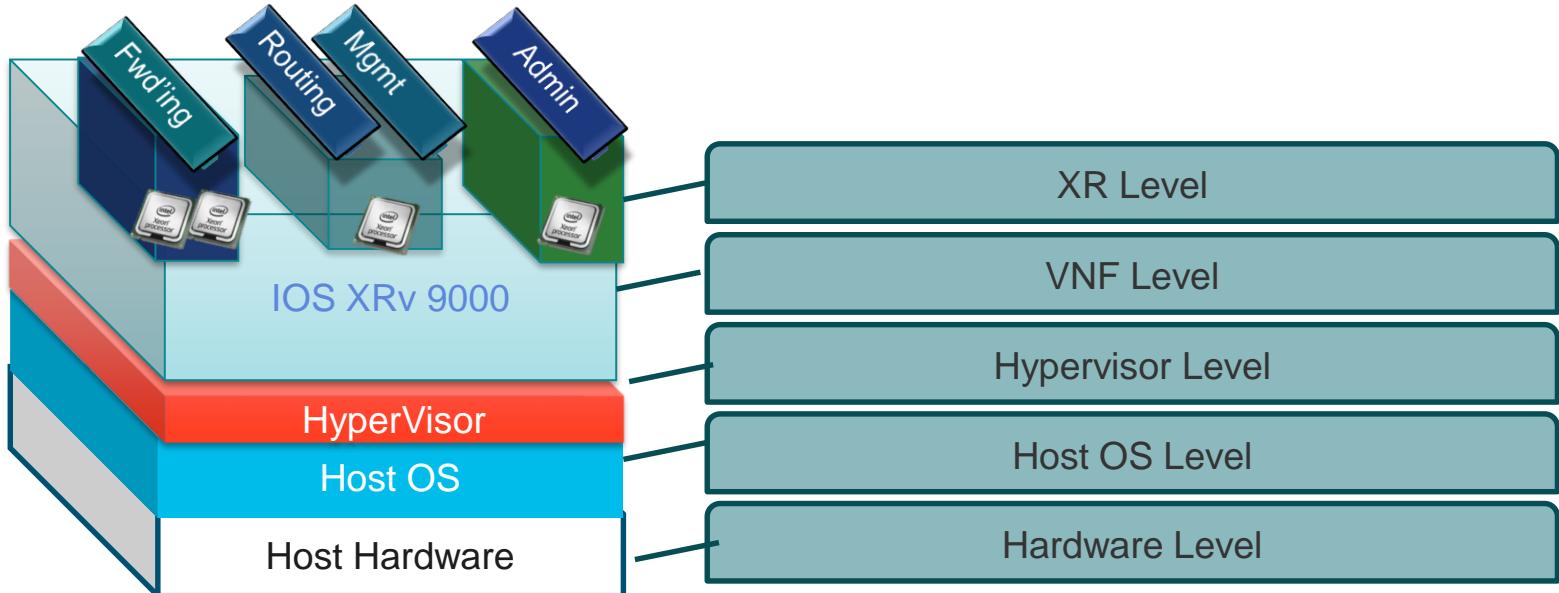
Highlights

- High-performance vPE capability running world-class IOS-XR carrier grade software supporting the same commands, tools, and logging as Cisco ASR9K family of router products.
- Superior vPE architecture that provides a best of industry data plane performance with service provider edge features.
- Based on the extremely resilient, stable, and

IOS XRv Troubleshooting

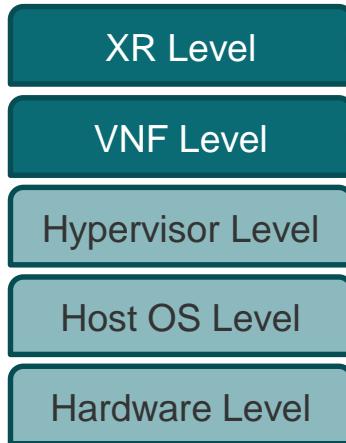
IOS XRv 9000 Troubleshooting

Hierarchy



IOS XRv 9000 Troubleshooting

Hierarchy



Regular XR Troubleshooting Techniques

DPA / DPC Communication and Packet Stats

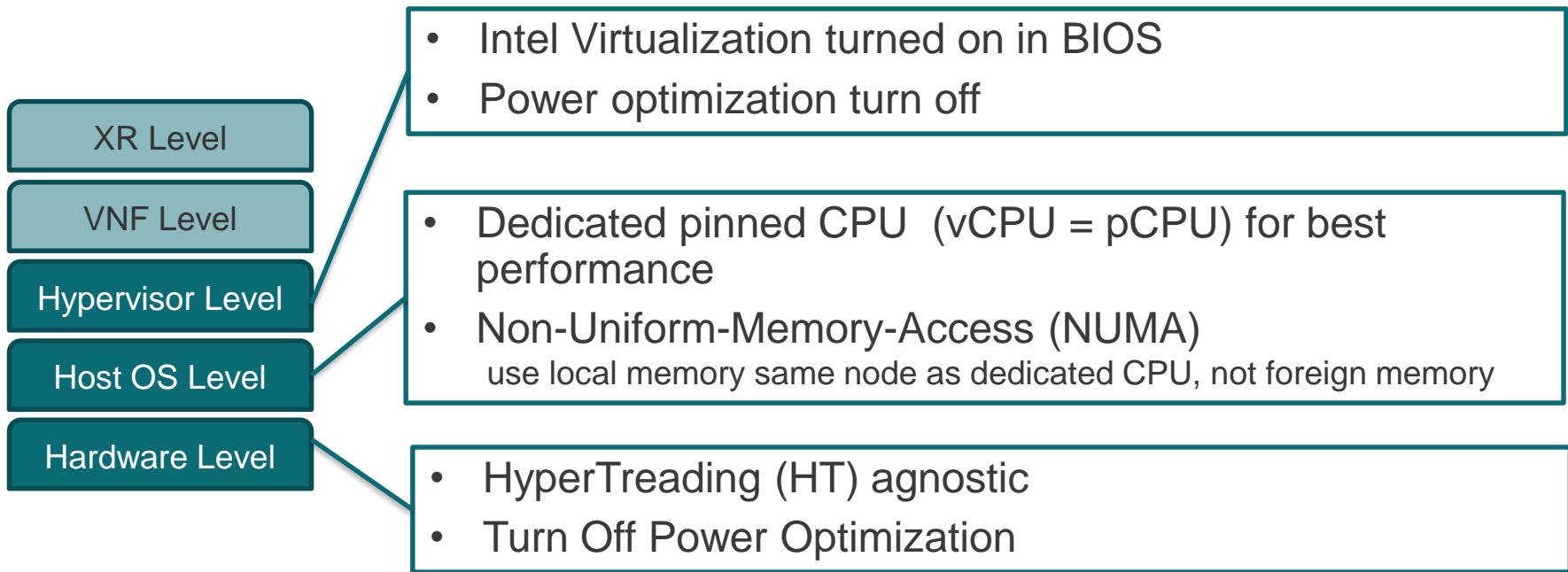
Non-Uniform-Memory-Access (NUMA) Aware

Hyper-threading (HT) Agnostic

RP/0/RP0/CPU0:SS_Node1#show controllers dpa statistics global		
Index	Punt	Count
1575	ARP	10
1677	IFIB	104034
1698	IPv4 BFD	1404379
1722	IPv4 incomplete TX adjacency	4
Index	Inject	Count
268	IPv4 from fabric multicast	103716
270	IPv4 from fabric next-hop	330
275	Inject to fabric	104047
276	Inject to port	1510764
Index	Drop	Count
85	IPv4 disabled in uIDB	3888
113	IPv6 disabled in uIDB	60
236	Preroute PIT lookup missed	1

IOS XRv 9000 Troubleshooting

Hierarchy



IOS XRV 9000 Performance Troubleshooting

```
server!~$ sudo netstat -pln | grep 12346
tcp        0      0 0.0.0.0:12346          0.0.0.0:*
LISTEN
x
```

```
server!~$ numactl --hardware
available: 2 nodes (0-1)
node 0 cpus: 0 1 2 3 4 5 6 7 16 17 18 19 20 21 22 23
node 0 size: 257762 MB
node 0 free: 194589 MB
node 1 cpus: 8 9 10 11 12 13 14 15 24 25 26 27 28 29 30 31
node 1 size: 258045 MB
node 1 free: 247971 MB
```

PID of XRV9000 Process

18135/qemu-system-

CPU / Memory across NUMA nodes

Node 0



Node 1



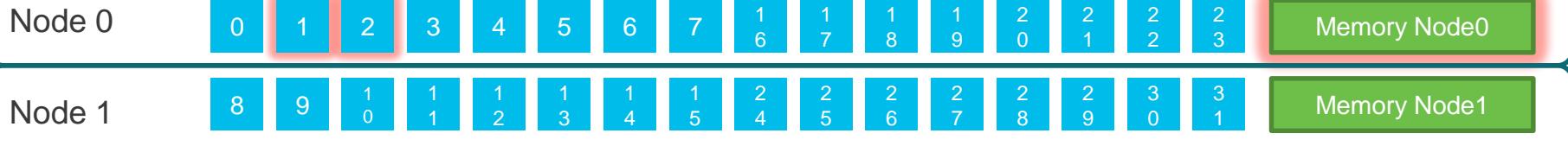
IOS XRv 9000 Performance Troubleshooting

top - 12:58:16 up 64 days, 13:03, 4 users, load average: 2.63, 2.58, 2.24							
Tasks: 443 total, 2 running, 4							
%Cpu0	: 1.7 us,	0.3 sy,	0.7	oppo	a,	0.0 st	
%Cpu1	: 99.7 us ,	0.3 sy ,	0.0	oppo	a,	0.0 st	
%Cpu2	: 1.0 us,	0.0 sy,	0.0	oppo	a,	0.0 st	
%Cpu3	: 1.0 us,	0.0 sy,	0.0 ni, 99.0 id,	0.0 wa,	0.0 ni, 0.0 si,	0.0 st	
%Cpu4	: 1.7 us,	0.3 sy,	0.0 ni, 97.9 id,	0.0 wa,	0.0 hi,	0.0 si,	0.0 st
%Cpu5	: 7.2 us,	3	cisco@uLinux-4:~\$ sudo numastat -p 18135				
%Cpu6	: 1.3 us,	0	Per-node process memory usage (in MBs) for PID 18135 (qemu-system-x86)				
%Cpu7	: 4.4 us,	2	Node 0	Node 1	Total		
%Cpu8	: 100.0 us ,	0	-----	-----	-----		
%Cpu9	: 0.0 us,	0	Huge	0.00	0.00	0.00	
%Cpu10	: 0.7 us,	0	Heap	0.71	1.37	2.08	
%Cpu11	: 1.3 us,	0	Stack	0.07	0.03	0.10	
%Cpu12	: 3.0 us,	1	Private	9735.30	372.94	10108.23	
%Cpu13	: 1.0 us,	0	-----	-----	-----		
			Total	9736.07	374.34	10110.41	

IOS XRV 9000 Performance Troubleshooting

```
server!~$ sudo taskset -pc 1 18135
pid 18135's current affinity list: 0-31
pid 18135's new affinity list: 1

server!~$ sudo taskset -pc 2 18135
pid 18135's current affinity list: 1
pid 18135's new affinity list: 2
```



IOS XRV 9000 Troubleshooting

Hypervisor Common mistakes

- Multiple XRV 9000 using same disk image
 - Each instance needs a separate disk
- Multiple XRV using same console

```
$ qemu-system-x86_64 -serial telnet::2345,server,nowait <...snip...>

inet_listen_opts: bind(ipv4,0.0.0.0,2345): Address already in use
inet_listen_opts: FAILED
chardev: opening backend "socket" failed: Address already in use
qemu: could not open serial device 'telnet:0.0.0.0:2345,server,nowait': Address already
in use
```

IOS XRv 9000 Troubleshooting

Host Commands

Process & CPU Status

```
top - 09:26:59 up 13 days, 58 min, 2 users, load average: 0.49, 0.47, 0.50
Tasks: 325 total, 2 running, 322 sleeping, 0 stopped, 1 zombie
Cpu(s): 1.6%us, 0.4%sy, 0.1%ni, 98.0%id, 0.0%wa, 0.0%hi, 0.0%si, 0.0%st
Mem: 181507016k total, 8715152k used, 172791864k free, 146552k buffers
Swap: 134143996k total, 0k used, 134143996k free, 4476556k cached

      PID USER      PR  NI    VIRT    RES    SHR S %CPU %MEM     TIME+ COMMAND
  5477 cisco      20   0  50460  26m 3808 R  39  0.0  4843:57 Xtightvnc
 31187 libvirt-  20   0 5972m 1.9g 7640 S   9  1.1 377:28.36 qemu-system-x86
 34605 libvirt-  20   0 5972m 1.8g 7628 S   7  1.0 348:28.40 qemu-system-x86
 24982 cisco     30  10 32068 1844 1488 S   4  0.0  0:05.99 fuzzyflakes
```

IOS XRv 9000 Troubleshooting

Host OS Common Issues

- Missing qemu/KVM package
 - apt-get install qemu-kvm;
- Not able to create virtual interface:
 - apt-get install uml-utilities (required for tap interface for bridge to physical)
- Virtualization not enabled:
 - Ensure VT-x flag (or equivalent) is exposed to operating system
 - egrep -c '(vmx|svm)' /proc/cpuinfo
- Ensure that user is added to 'kvm' group
 - sudo addgroup `id -un` kvm

```
server!~$ sudo kvm-ok
INFO: /dev/kvm exists
KVM acceleration can be used
```

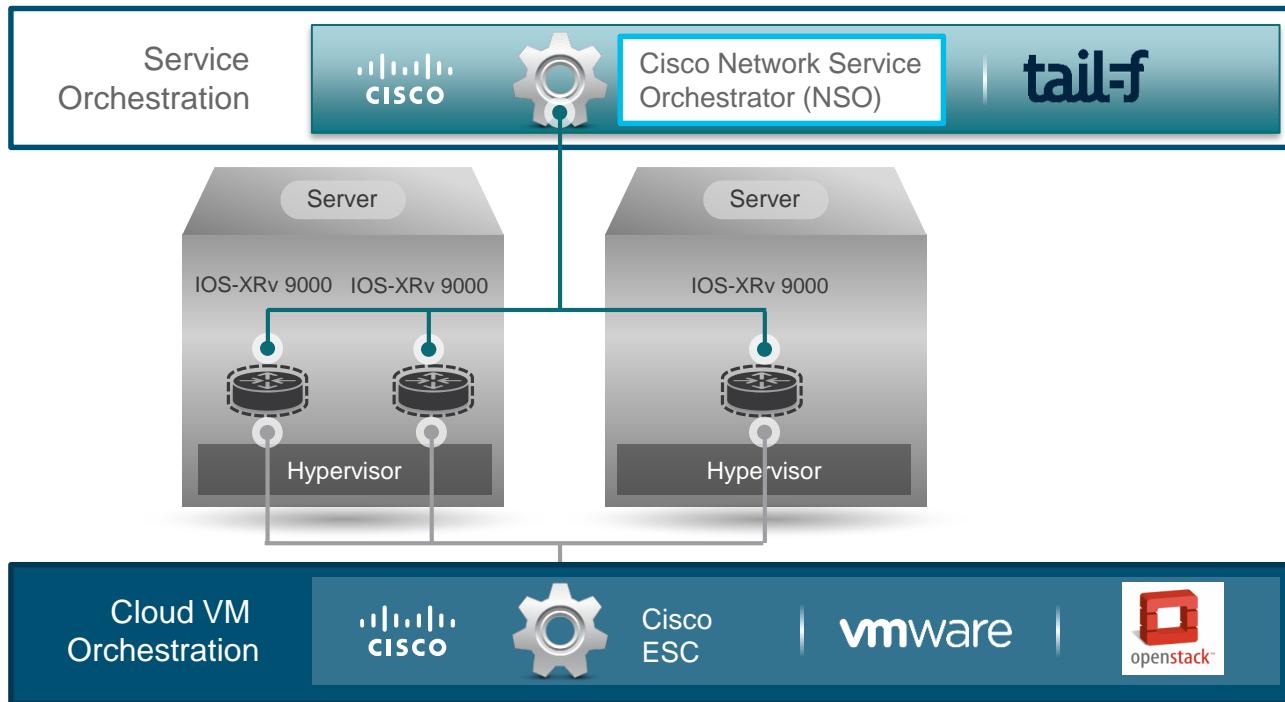
Service Orchestration for NFV

Service Orchestration for IOS XRv 9000

Network Function Virtualization

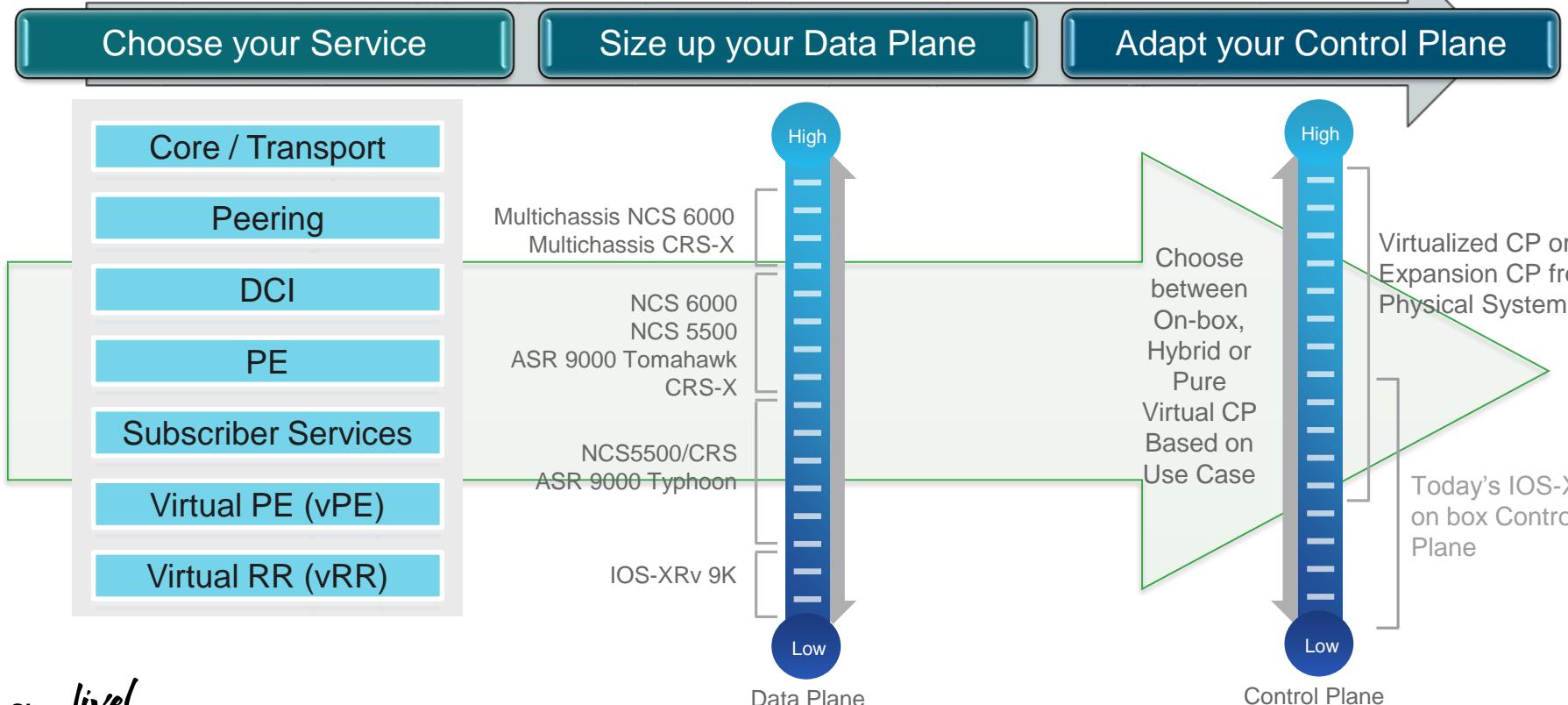
Software Defined Networking

Service Orchestration



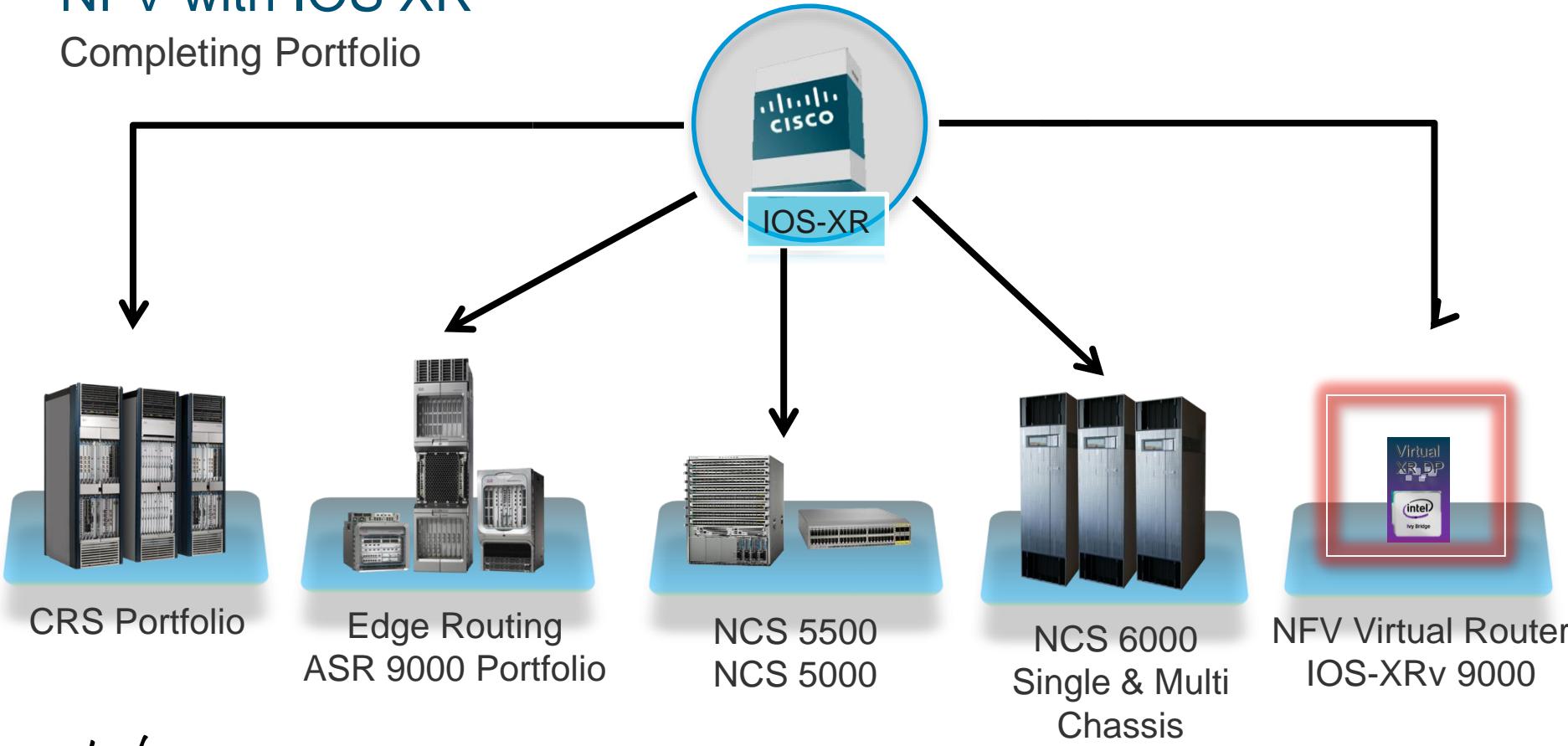
IOS XR 9000 as VNF – Flexible Choices

Right Sizing Your Deployment



NFV with IOS XR

Completing Portfolio



Putting it all together...

SMU-ability

Opex Saving

Low Capex

Carrier Class

Scalable

High Availability

Multi-threaded

Flexible

Elastic



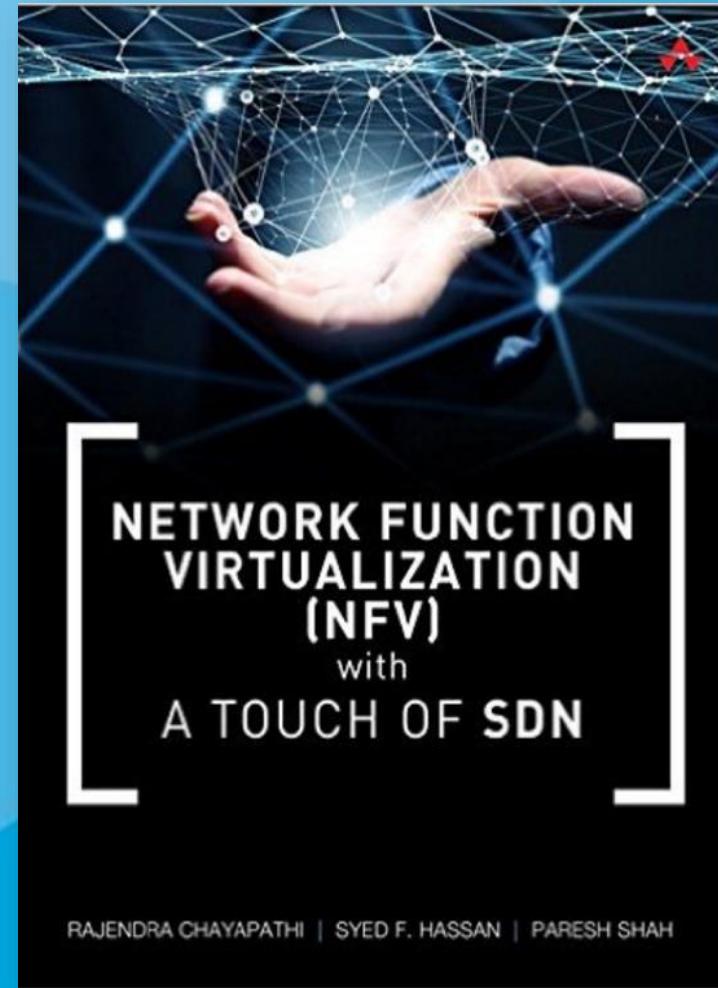
Re-Cap

- Role of NFV in Network
- IOS XRv 9000
- Benefits & Use Cases
- Deployment & Troubleshooting
- Service Orchestration for NFV
- Summary



By the same author...

ISBN: 978-0134463056



Cisco Spark

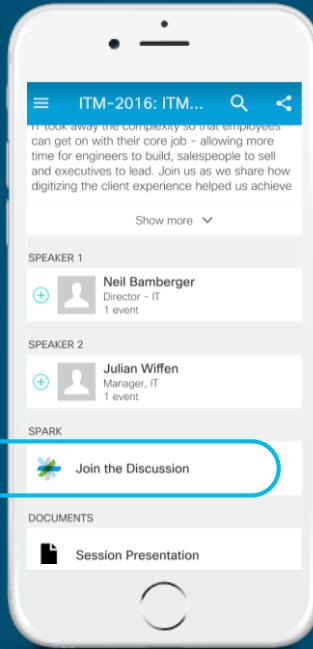


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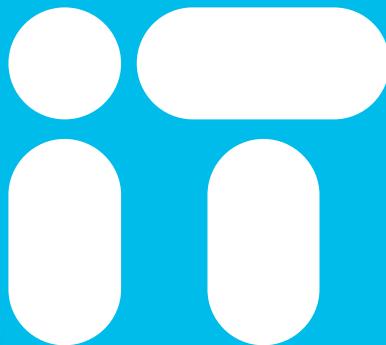
- Demos in the Cisco campus
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Thank you



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