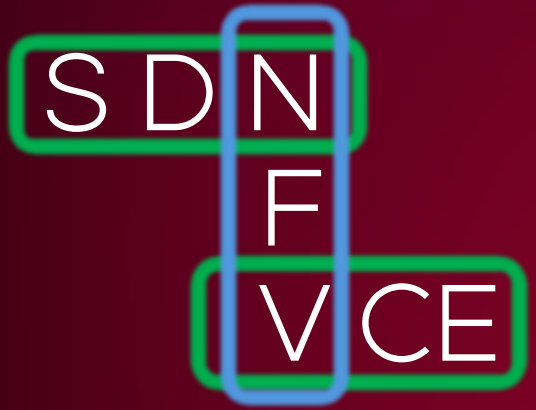

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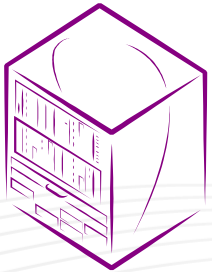
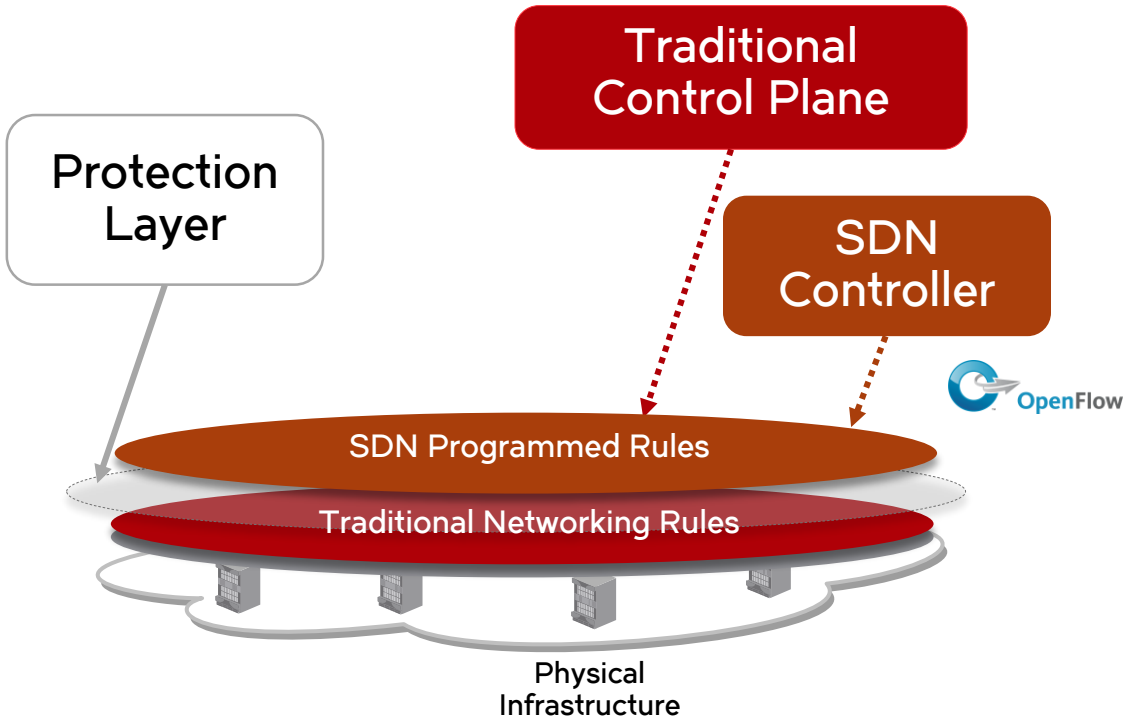
SDN: Example Openflow



SDN in the Data Center: Programmatic Control

50% reduction in SDN deployment cost

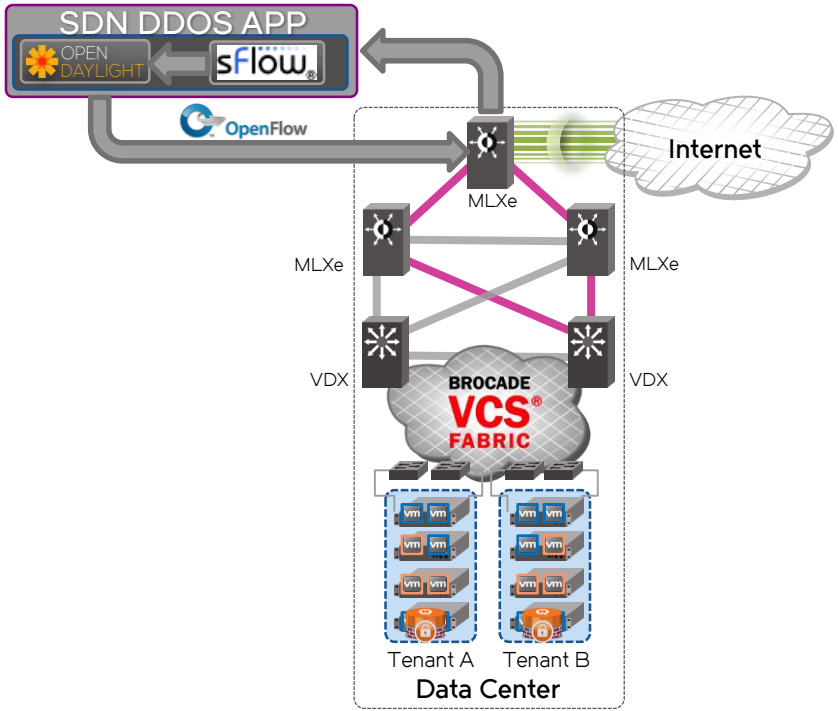
- Concurrent network control by SDN controller and traditional control plane
- Optional "protection" layer between both modes
- Enabled by "**Hybrid port mode**"
- Reuses infrastructure for both SDN and traditional control plane



Example: Volumetric traffic management

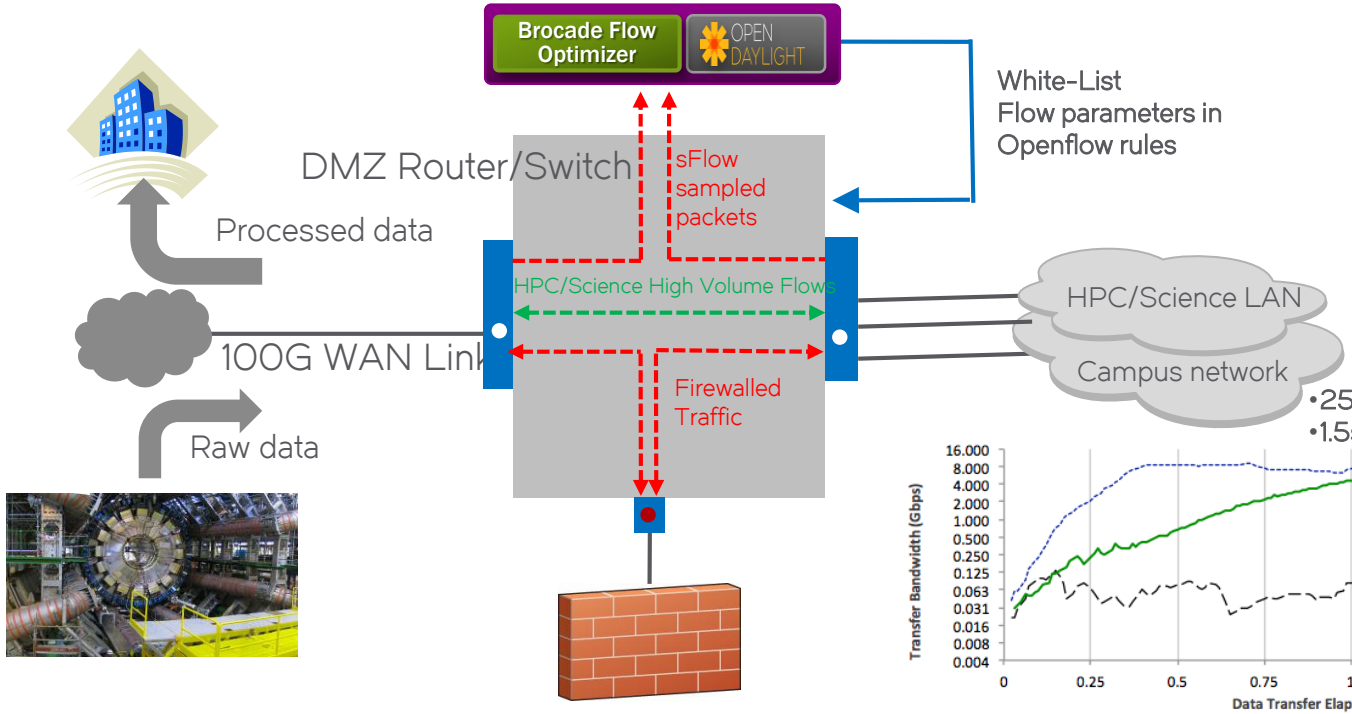
Efficient and scalable

- Real-time detection of large flows via sFlow-RT (Real-Time)
- Collector programs controller to apply appropriate treatment of flow
- Brocade value:
  - Capability integrated into router with OpenFlow hybrid mode
  - High-performance flow management
- Benefits:
  - Mitigation at border relieves rest of DC
  - Programmatic closed-loop control
  - Limits investment in expensive appliances

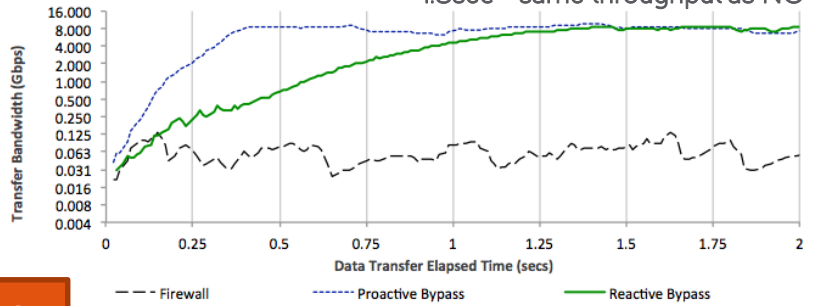


100G Firewall Bypass

White-List Flow Offload



- 250ms - double throughput of firewall path
- 1.5sec - same throughput as NO firewall



Improves 100G performance by 2x for legitimate flows

OpenFlow Feature overview

Version	Port Match	L2+IPv4+L4 Header Match	L2+IPv6+L4 Header Match	MAC Mask and IP Mask (Standards-based)	IPv6 Support (In NI5.8)	Group Table Select, Indirect	Multiple Controller	Extensible Match with TLV	QinQ	per-flow meters	Enqueu	TTL
1.0	Yes	Yes	No	No	No	No	No	No	No	No	No	No
1.3	Yes	Yes	Yes	Yes	Yes*	Yes	Yes	Yes	Yes	Yes	Yes	Yes

- OpenFlow v1.3 is not backward compatible with OpenFlow 1.0
- Greater flexibility with OpenFlow v1.3
- Watch out for the details

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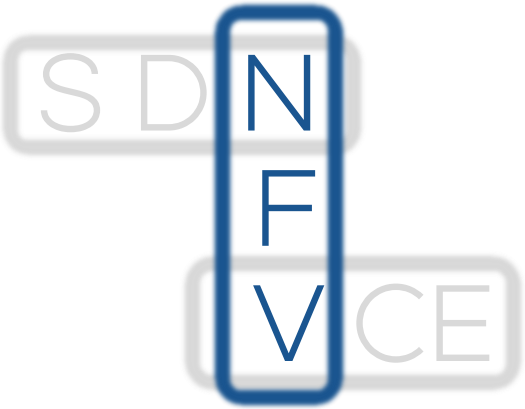
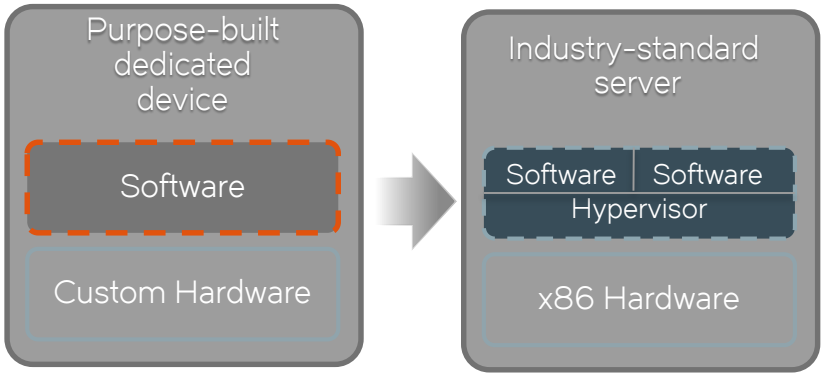
Network Functions Virtualization



What is the Difference between SDN and NFV?

Complimentary, but independent technologies

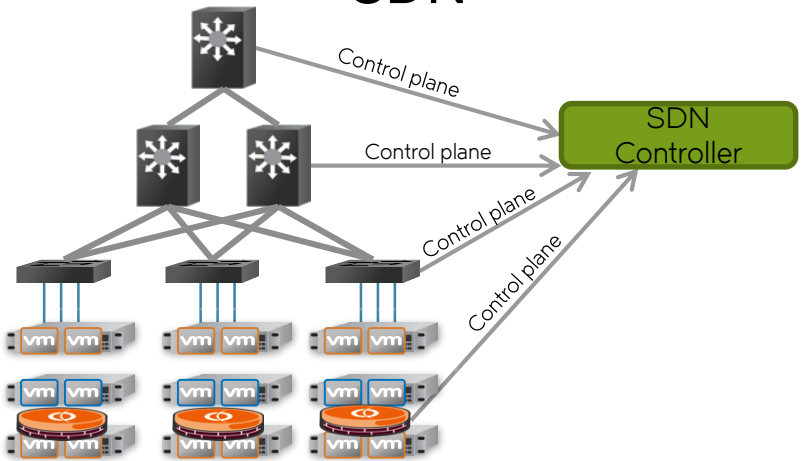
NFV



Consolidate diverse network equipment types (firewall, switching, routing, ADC, BRAS, EPC, etc.) onto industry-standard x86 servers using virtualization.

Benefits: Reduced cost and increased agility

SDN



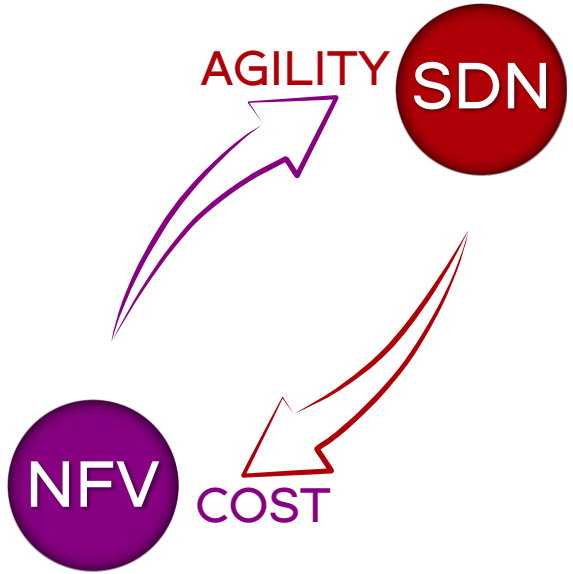
Separate control plane from the data plane in network devices (physical and virtual) with intelligence and programmability centralized in a controller.

Benefits: Increased agility via automation and increased innovation via programmability

Complementary Forces

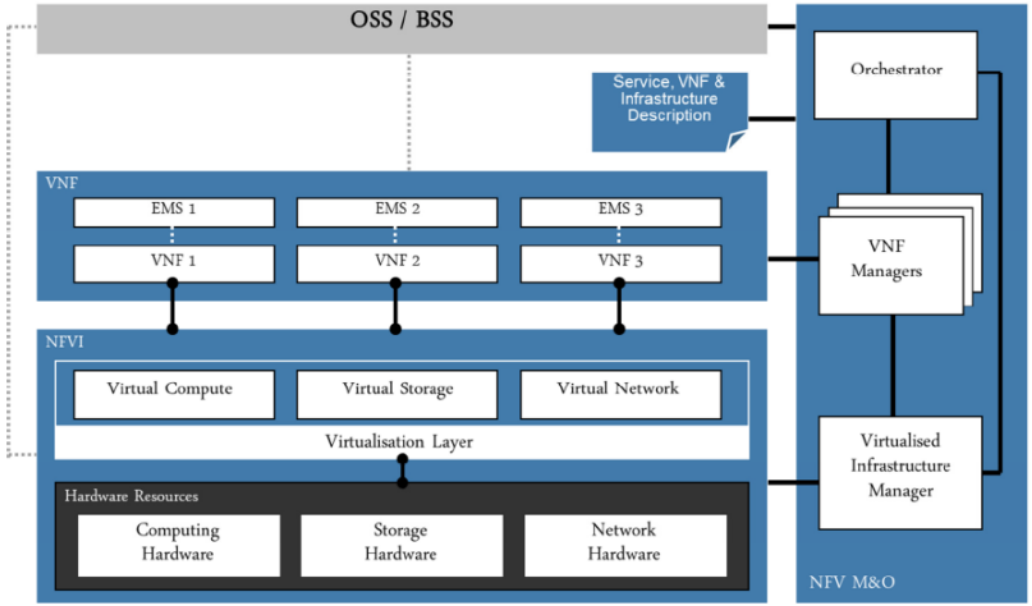
A compound disruption

- SDN: "Manipulator"
  - Global controller
  - Orchestration & automation
- NFV: "Manipulated"
  - Virtual machine-based
  - Elastic & agile



ETSI NFV Reference Architecture

- Three key components
- NFVI (Physical and Virtual resources)
  - Compute
  - Storage
  - Network
- Orchestration and Management
- VNF
- OSS/BSS

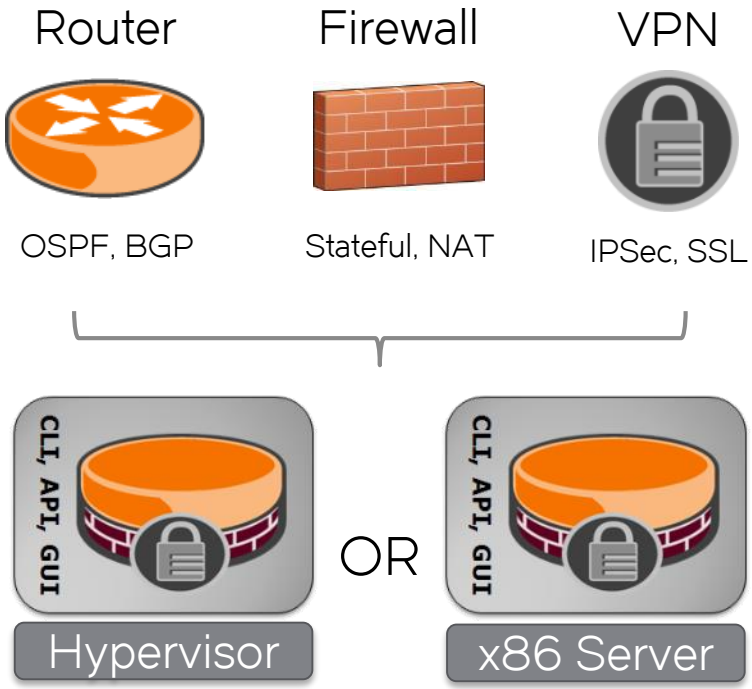


NFV E2E Architectural Framework

Source: ETSI NFV

Brocade Vyatta 5400 vRouter

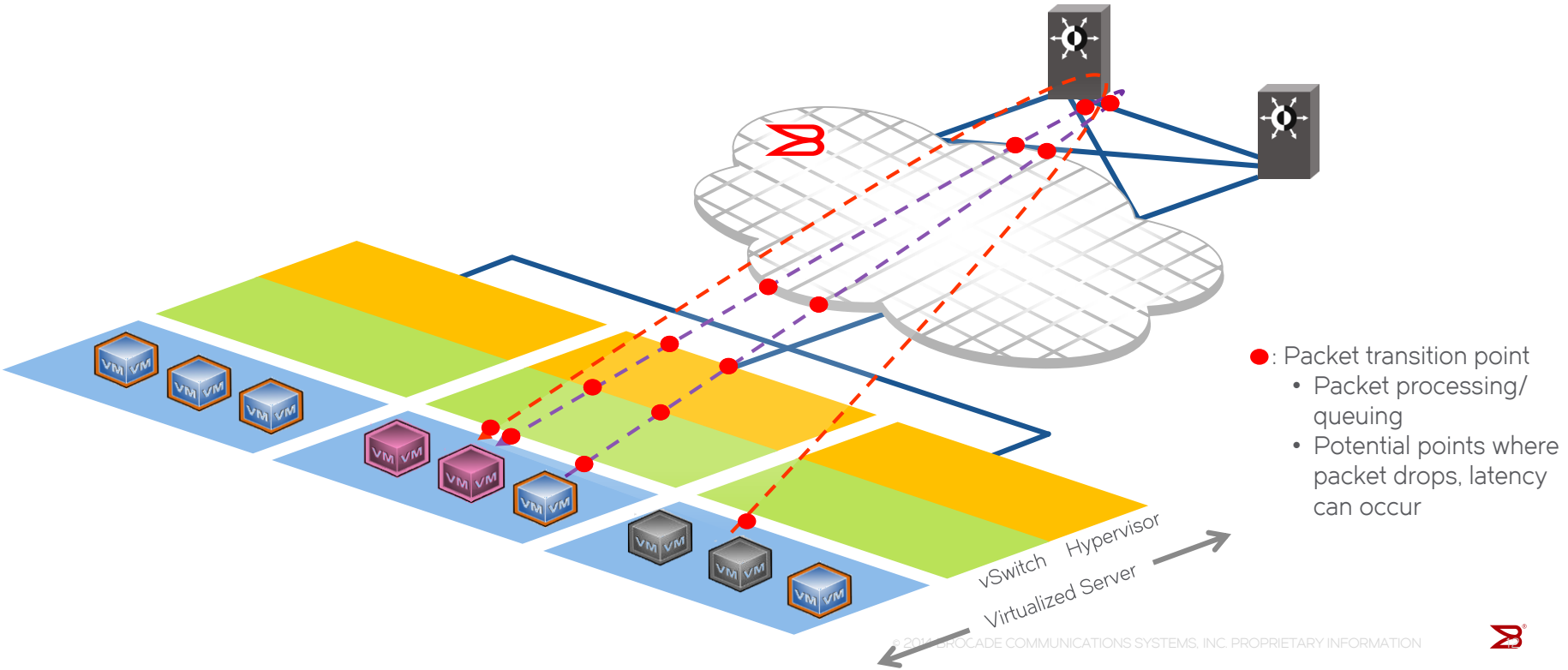
The most widely used virtual router in the world



Feature Highlights	
Routing	IPv4, IPv6, Static, PBR, OSPF, RIP, BGP, Multicast
Security	IPv4, IPv6, Stateful Firewall, NAT
VPN	IPSec, SSL, Route-based, L2-bridging, DMVPN
System Management	CLI, RESTful API, GUI
IP Services	SSH, DHCP, DNS, SNMP
High Availability	VRRP, Stateful Failover, Config Sync
Platforms	VMware, Xen, KVM, Hyper-V, x86

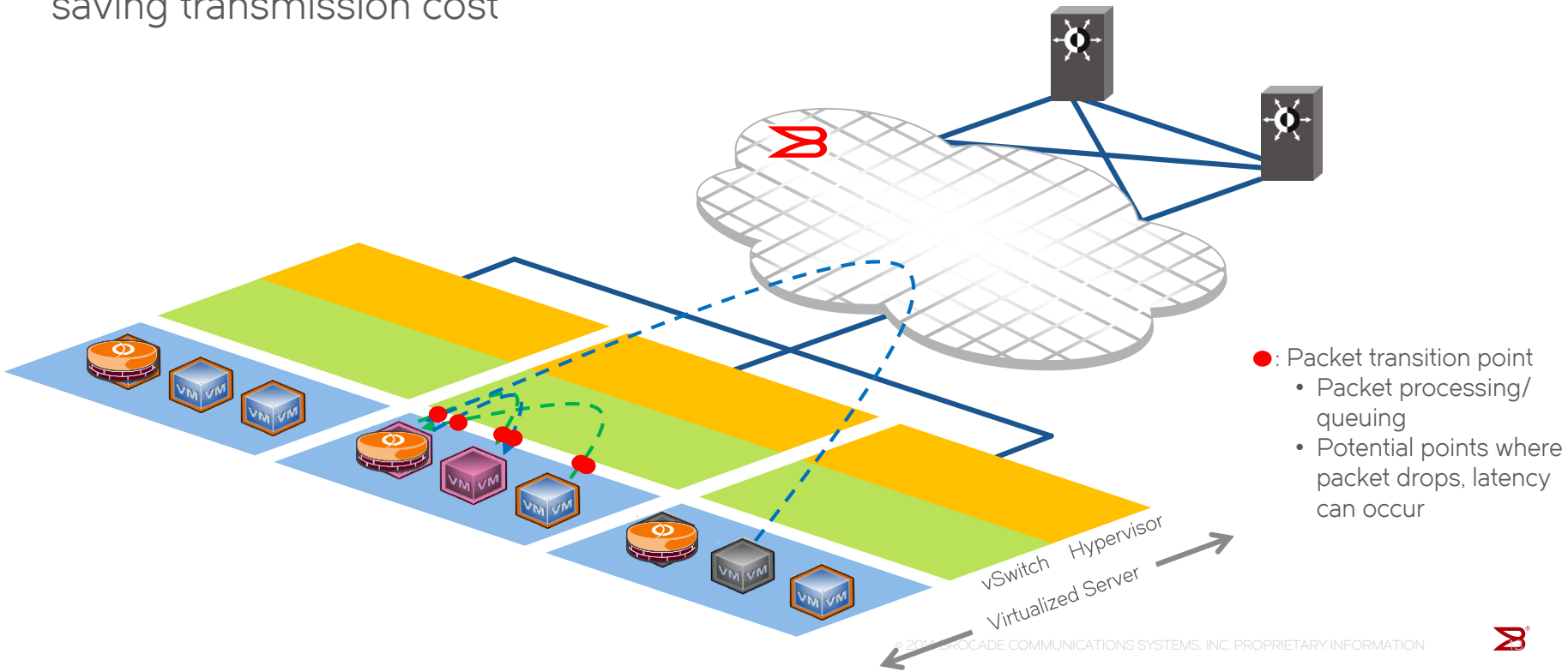
Cloud services #1

Virtual routing / tenant isolation in traditional hierarchical L2/L3-networks



Cloud services #1 – cont'd

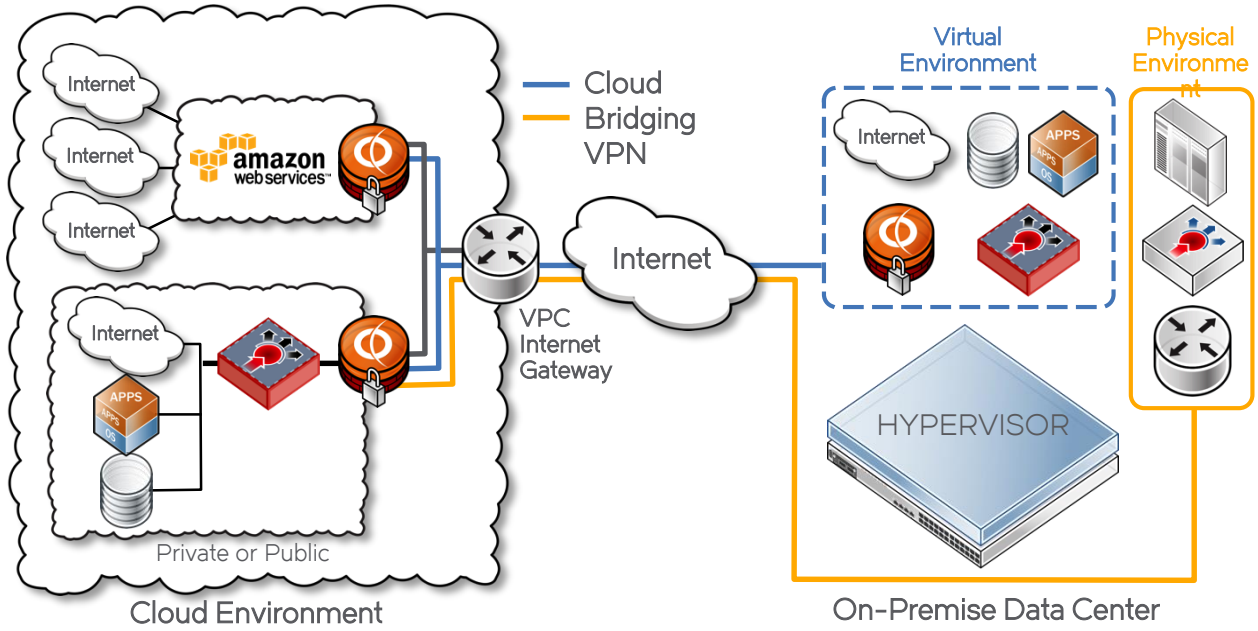
Virtual routing and tenant isolation localized using VNFs saving transmission cost



Cloud services #2

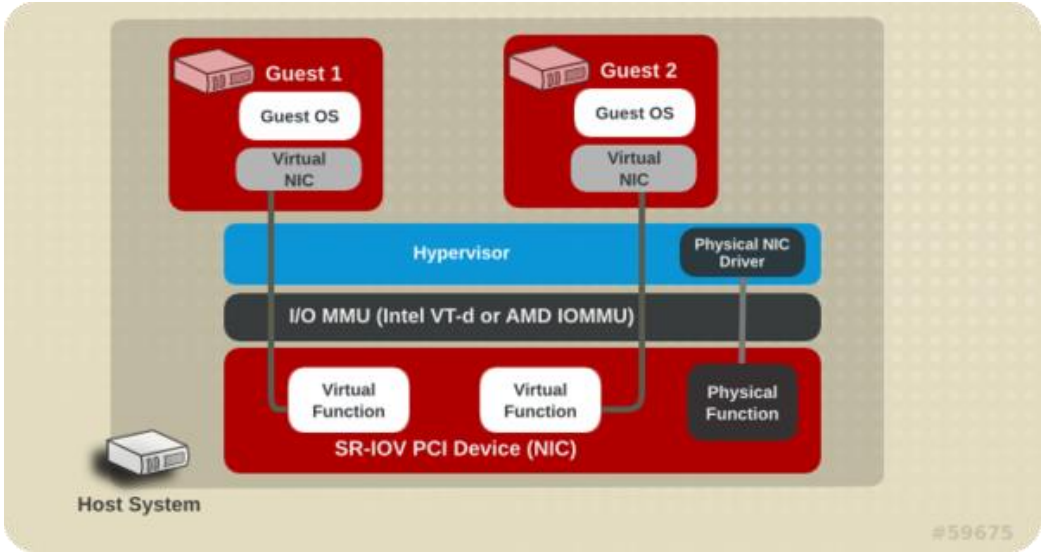
Cloud Bridging

- Simple and secure VPN services between data centers and cloud providers
- Enables Cloud expansion
- Cloud Bursting



Single Root I/O Virtualization (SR-IOV)

- Virtualizes PCIe
  - Appears as multiple physical devices
  - Works with Guest OS or Hypervisor
- Physical Functions (PFs)
  - Full PCIe functions
  - SR-IOV Extended Capability
- Virtual Functions (VFs)
  - Lightweight PCIe functions
  - Uses minimized set of config resources



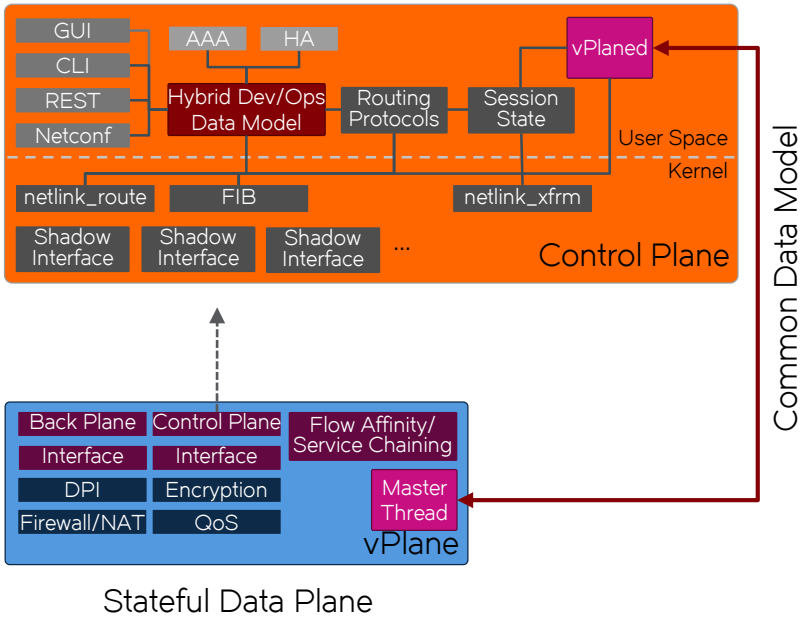
Brocade Vyatta 5600 Virtual Router

THE HIGHEST PERFORMING VIRTUAL ROUTER IN THE WORLD

- New Architecture
  - vPlane architecture
  - Up to 10Gbps per Core on bare metal
  - 10Gbps+ on VM with SRIOV or PCI pass-through
- Target Use Case: NFV
  - vRR, vPE, vCE, vBRAS
  - High Performance BGP Routing
- Target Use Case: CSP
  - vR, vFW, vVPN
- VMware, KVM, Xen, Bare Metal

Feature Highlights	
Routing	IPv4, IPv6, Static, PBR, OSPF, RIP, BGP, Multicast
Security	IPv4, IPv6, Stateful Firewall, NAT
VPN	IPSec, SSL, Route-based, L2-bridging, DMVPN
System Management	CLI, RESTful API, GUI
IP Services	HQoS, SSH, DHCP, DNS, SNMP
High Availability	VRRP, Stateful Failover, Config Sync
Platforms	VMware, KVM, x86

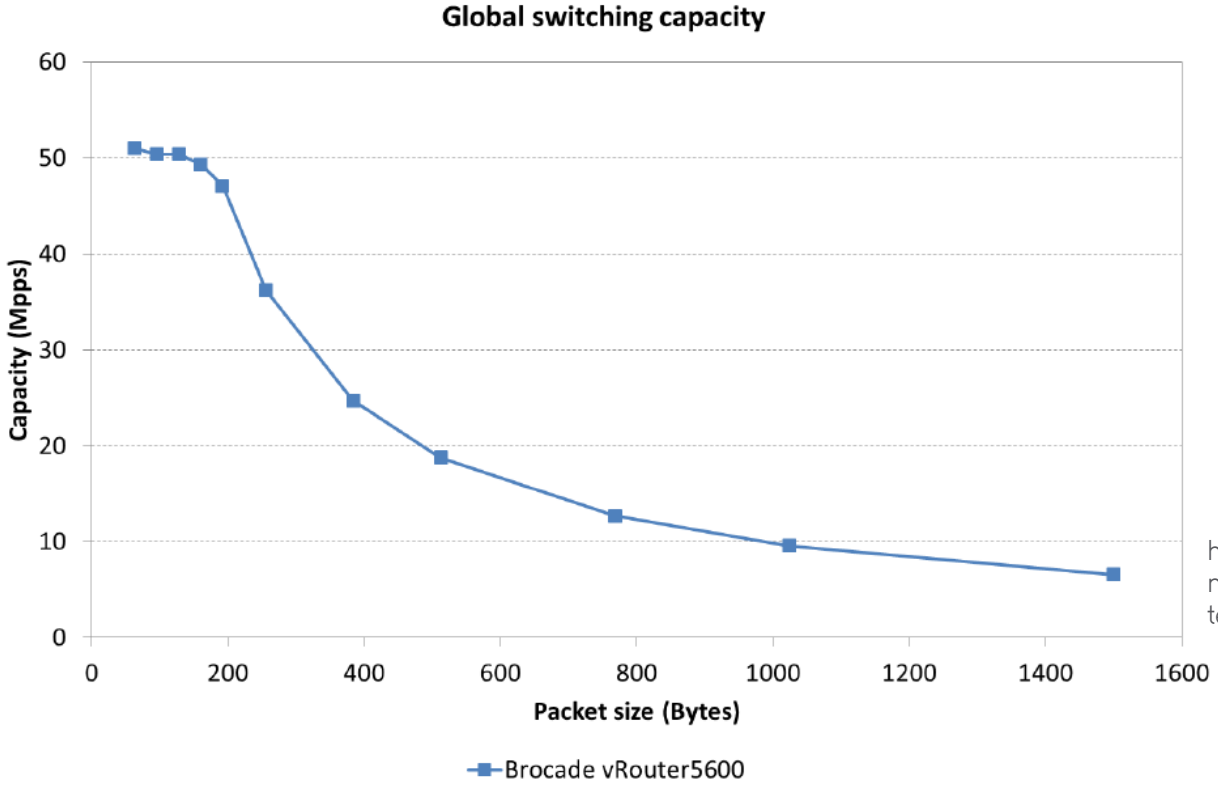
Vyatta 5600 vRouter Architecture



- vRouter control plane and data plane on single VM or host
- Extensible high speed packet pipeline
- Full RFC compliant router in data plane
- Stateful firewall, NAT in data plane
- Scale performance by number of cores
- Hybrid Dev/Ops data model with interface support for REST, YANG/Netconf
- Backplane leverages IPC and shared memory

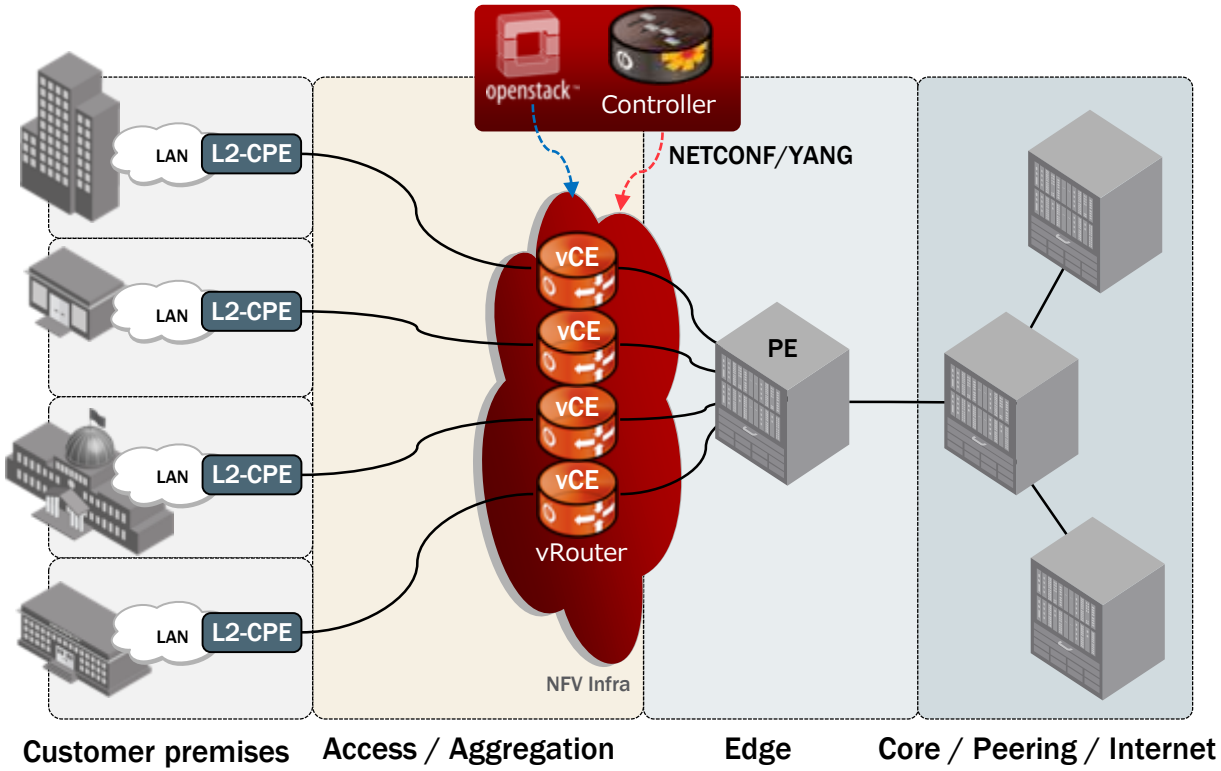
Throughput Results of Vyatta 5600 on KVM

Dual-socket Intel E5-2667v2 server, RFC2544 Test

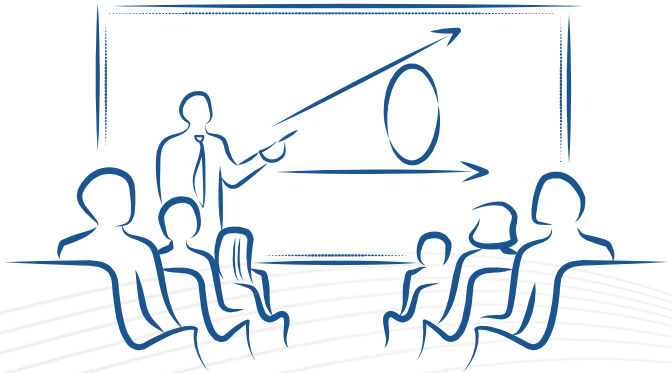


http://www.brocade.com/downloads/documents/success_stories/brocade-telefonica-ss.pdf

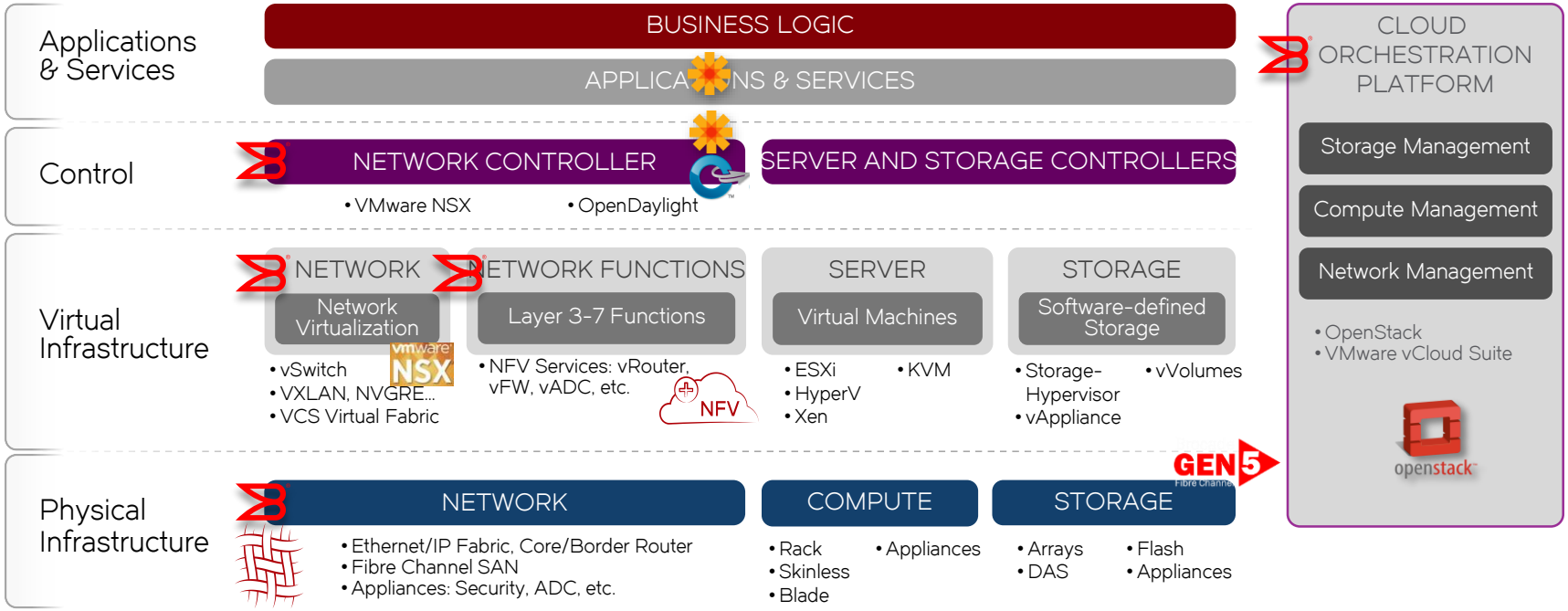
Vyatta vRouter SP NFV Use Cases : vCE



Summary



The OSI stack of Data Centers



Resiliency and Redundancy

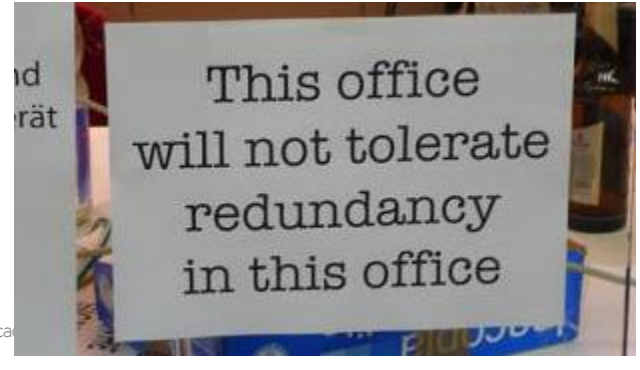
Definition

re · sil · ien · cy (noun) \ri-’zil-yən(t)-sē

- the ability to become strong, healthy, or successful again after something bad happens
- an ability to recover from or adjust easily to misfortune or change
- the ability of something to return to its original shape after it has been pulled, stretched, pressed, bent, etc.

re · dun · dan · cy (noun) \ri-’dən-dən(t)-sē

- a part in a machine, system, etc., that has the same function as another part and that exists so that the entire machine, system, etc., will not fail if the main part fails



Summary

- There are many flavours of SDN – Openflow is just one
- Server hardware matters - also for Software performance
- VNFs have their place, so has networking hardware
- Consider alternative resilience strategies (virtual compute like)
- VNF Production deployments exist, many PoCs are under way

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Thank you!