Network Functions Virtualization
Network Functions Virtualization

NfV = Transition of network infrastructure services to run on virtualized compute platforms – typically x86

- NfV Initiative
  - Initiative announced at “SDN and OpenFlow World Congress”, Darmstadt, Oct 2012

- Key Enabler: using cloud technology to support network functions
  - Hypervisor and cloud computing technology
  - Improving x86 h/w performance
  - Network industry standardizing on Ethernet
  - Network automation / orchestration

- Value Proposition
  - Reduction in CAPEX and OPEX
  - Faster service provisioning
  - Service agility

- Not technically SDN but may use SDN technology – APIs, Controllers
Why Network Function Virtualization?

• Similar to compute moving to cloud, networking is virtualizing and moving to cloud: **Enabled by SDN and NFV**

• Capturing this transition is a top priority for nearly all service providers: Lower CAPEX, OPEX, truck rolls, & agility; Portal-based sales to SMB

• Enterprises: Cloud traffic driving the need for hybrid WANs and new internet-based services from service providers

• Drivers: Service velocity, Agility, Cost reduction, PAYG, Efficient Resource usage, Elasticity, On-demand Self Service

• Virtualized functions can reside On-Prem, in the POP, in the Cloud, or a mix.

• Extend Enterprise network infrastructure into the Cloud
Next Generation Business Services
Delivering business outcomes based on an integrated SDN network / cloud platform

Cross Domain Orchestration

- Automation - open platform for integration with open source, VNFs, & applications
- Built for integrated network and cloud services
- End customer visibility and control

Virtual Network Functions & applications

Distributed or Centralized NFV
Cisco Virtual Network Function (VNF’s)

• Vast and comprehensive set of VNF’s.
• Sample list:
  • Networking – CSR1000V, XRv
  • Security – ASAv, WSAv, ESAv, vFirePOWER, vSCE, vISE
  • Services – NetScaler1000v, vNAM, vWaaS, CUCM
  • vSwitch – Nexus1000v, VPP/VTS
  • Controllers – vWLC, vMSE, APIC, APIC-EM, OSC/ODL, WAE
  • Management – NSO (Tail-f), ESC, PNSC, PSC
• Etc…
Service Chaining

- **Service Function**: Networking function that provides connectivity service, security service etc.

- **Service Chain**: Multiple functions linked together to provide a service

- **How are services chained:**
  - Chaining of features within a device – IOS ingress/egress feature (ACL+QoS+NAT)
  - Chaining via VLAN-stitching and routing within a device – ASR9K with VSM module
  - Chaining via Routing across devices – hop-by-hop services
  - Chaining via diversion mechanisms like WCCP, Tunnels, PBR
  - Chaining via encapsulation mechanisms like vPath (Nexus1000v based) and Network Service Header (NSH)
Cisco CSR 1000V – Virtual IOS XE Networking

- **Single-tenant WAN Gateway**
  - Small Footprint, Low Performance

- **IOS XE Cloud Edition**
  - IOS XE features for Cloud and NfV Use Cases

- **Rich Network Services**
  - Routing, VPN, App Visibility & Control, DC Interconnect, and more

- **Infrastructure Agnostic**
  - Server, Switch, Hypervisor

- **Perpetual, Term, Usage-based Licenses**
  - Elastic Capacity (Throughput)

- **Programmability**
  - RESTful APIs for Automated Management

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**Rapid Deployment and Flexibility**

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Grand Prix

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Cloud Ready Router

- Extending Enterprise WAN to Cloud

**Security**
- IPSec VPN, L2TP
- Route-based VPNs (DMVPN, ..)
- Firewall, ACL, AAA

**Integration**
- NAT, LISP, OTV
- HSRP, QoS, AVC
- IOS-XE CLI, Cisco PNSC

**User Experience**
- Routing (BGP, EIGRP, Multicast, ..)
- AppNav, WCCP, QoS, AVC
- IP SLA, NetFlow, SNMP

**Tenant Scalability**
- 802.1Q VLAN, VXLAN
- Routing (BGP, GRE, VRF-Lite)
- MPLS (MPLS VPN, VRF)

**Enterprise Services**
- DMVPN, EasyVPN, FlexVPN
- Firewall, NAT, WCCP, QoS, AVC
- IP SLA, NetFlow, SNMP

**Tenant Manageability**
- 10 Mbps to 10 Gbps
- RESTful APIs
- Term and Usage Licensing
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
Cisco IOS XRv 9000
Right sizing Scale and Throughput through Control and Data Planes

Present Mode of Operation
Routers + LCs
IOS XR
RP(Control Plane)
LC (Data Plane)
NxLCs :1xCPU

Future Mode of Operation
Virtual Routers
Routers/Compute
IOS XRv 9000
Compute
Compute Server (Control Plane)
LC (Data Plane)
N x NPU: MxCPU
Compute Server (Control Plane)
Compute Server (Control Plane)
Cisco ASAv Firewall and Management Features

- 10 vNIC interfaces and VLAN tagging
- Virtualization displaces multiple-context and clustering
- Parity with all other Cisco ASA platform features

- SDN (Cisco APIC) and traditional (Cisco ASDM and CSM) management tools
- Dynamic routing includes OSPF, EIGRP, and BGP
- IPv6 inspection support, NAT66, and NAT46/NAT64
- REST API for programmed configuration and monitoring
- Cisco TrustSec® PEP with SGT-based ACLs
- Zone-based firewall
- Equal-Cost Multipath
- Failover Active/Standby HA model
vMS Architecture Fundamentals
Model Driven Orchestration Approach

- Service Intent is done through Modeling Languages that Abstract out the “How” and “Where”
- The Service is looked at summarily across the implementation domains.
- The Orchestrator has both a Service and Device component. Each independent of the other. Answers the “How”.
- The Orchestrator is able to Instantiate a Service Across the derived Topology (Infrastructure). Answer the “Where”.

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Service Intention

Service Instantiation

Infrastructure

Service Definition

X-Domain Orchestration

Prem

Access

WAN

Compute

CPE

Metro

Router

L2NID

ISR

x86

3rd party CPE

ME36xx

3rd Party

9K

CRS

3rd Party

CSR

ASA

3rd party VNF

Service Chaining

VNF

VNF
Elastic Services Controller (ESC)
Tenant Portal
SP’s OSS/BSS

NETCONF/YANG
REST API
NC/YANG, RC/YANG

PnP Functionality
Zero Touch Provisioning

CPE

Customer Orders Service

Provide Day 1 Configuration

Network Service Orchestrator (NSO)

Elastic Services Controller (ESC)

OpenStack

Establish VPN: IPSec tunnel, IP Overlay (L2TP, VXLAN, GRE, LISP)

CPE Shipped at Customer Site, connected & Powered ON

PnP server

Internet Gateway

VNF Service chain

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Some Use-Cases
Use Case: Cloud CE/PE Router

Challenges

• Mapping tenant traffic from VRFs to VLANs
• Maximum 4,096 VLANs limits scalability

Benefits

• More Tenants per Physical Infrastructure
• End-to-end Managed Connectivity and SLAs

Tenant Scale
Use Case: Secure VPN Gateway

- **Benefit**: Scalable, Dynamic, and Consistent Connectivity with the Cloud

**Challenges**
- Inconsistent Security
- High Network Latency
- Limited Scalability

**Benefits**
- Direct, Secure Access
- Scalable, Reliable VPN
- Operational Simplicity

**Solutions**
- IPSec VPN, DMVPN, EZVPN, FlexVPN
- Routing and Addressing
- Firewall, ACLs, AAA
Multicast Service to Non-Multicast Enabled Public Cloud
Cisco CSR1000v

Gateway

PIM over GRE

Virtual Public Cloud
vRouter
GRE
GRE
GRE

GRE on Linux is ~ 3 CLI commands!
Key Takeways

- Cisco Virtual Managed Services (vMS) is an architecture and orchestration solution for enabling NFV services using virtual appliances, overlay networking, and VNF service chaining.

- NfV provides: elasticity, PAYG, automation, service agility and reduced OPEX can be provided by the vMS platform

- Cisco has a broad portfolio of VNF’s that can utilized in the vMS solution

- The Cisco vMS solution will keep introducing new Function Packs to enable new usecases, service topologies and VNF’s
What is an example of a VNF?
How can you extend IP Multicast into the public cloud?
TOMORROW starts here.