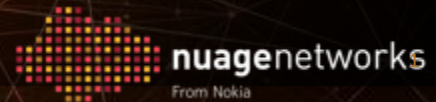


SDN in the context of NFV automation

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Cloud Solution Designer

Software Defined Networks - ISCTE
Lisbon | April 5, 2018



Network Functions Virtualization

Telco

Supporting the Virtualization
of Telco Infrastructure

NFV is being used in the Telco space as Network applications like Mobile Packet Core (i.e. for 5G), CDN, IMS, etc. are being virtualized to the DC or even to the Edge of the network due to delay requirements

**Enterprise Network
Value Added Services**
Instant Service

There are a number of Virtualized Network Value Added Services (i.e. vFW) that are being offered centrally from the Public or Private Cloud or even stretched to the branch Office, at the distance of a click

WAN Services
Instant Deployment and
Flexible Service

SD-WAN can simultaneously be a Virtualized Network Function or enable the support of VNFs at the branch office in a very flexible and automated way

What is the relation between NFV and SDN?

- NFV was primarily designed to allow Telcos to move from their traditional physical Network Functions (PNFs) to its virtual variants, which would allow for greater deployment flexibility and speed to respond to the increasingly demanding and sophisticated Network Applications.
- Software Defined Networking (SDN) is the Network Engine that is often used with NFV to abstract and automate all the necessary Networking between the VNFs and between these and the end users.

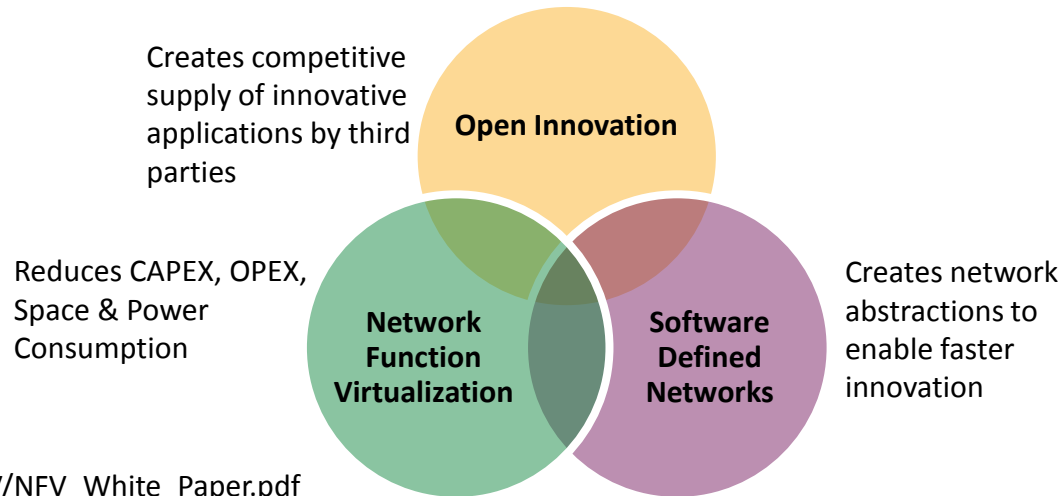
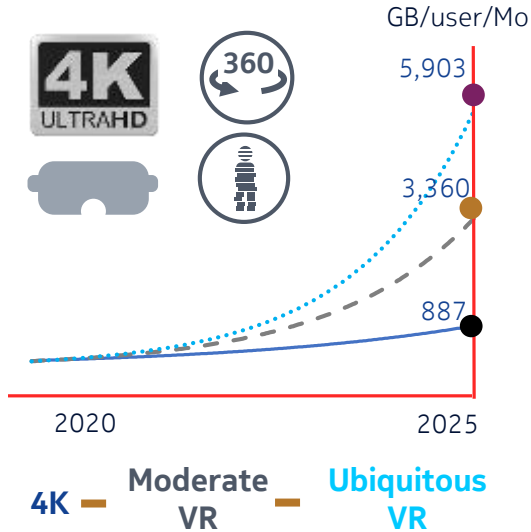


Diagram source:

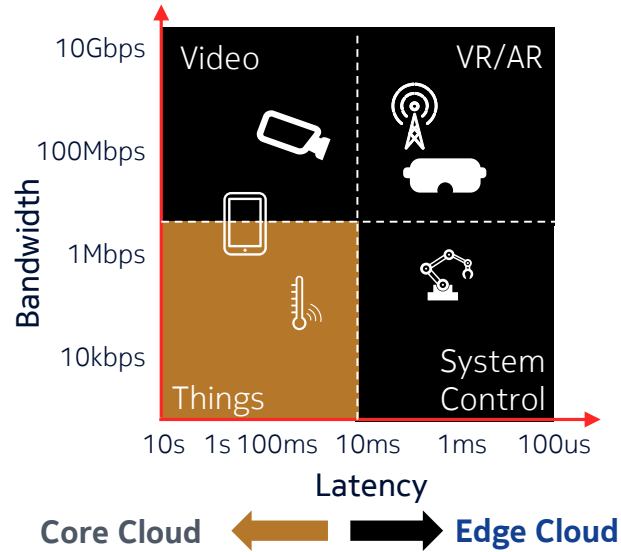
https://portal.etsi.org/NFV/NFV_White_Paper.pdf

New applications redefine network requirements

Seemingly infinite capacity



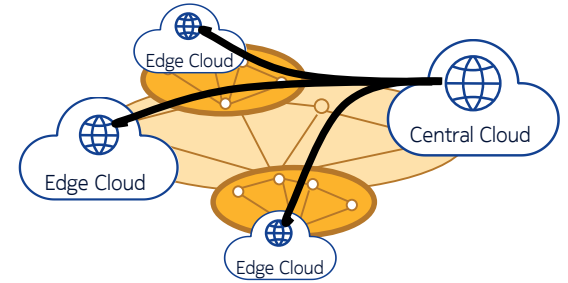
Imperceptible latency



Global-local alliance

Local delivery with global reach

- New global-local value chains
- Disruptive business models
- Local service performance, efficiency and customization



~100x more capacity in < 10 years and ms latency for networks & 'human' services leveraging global-local business

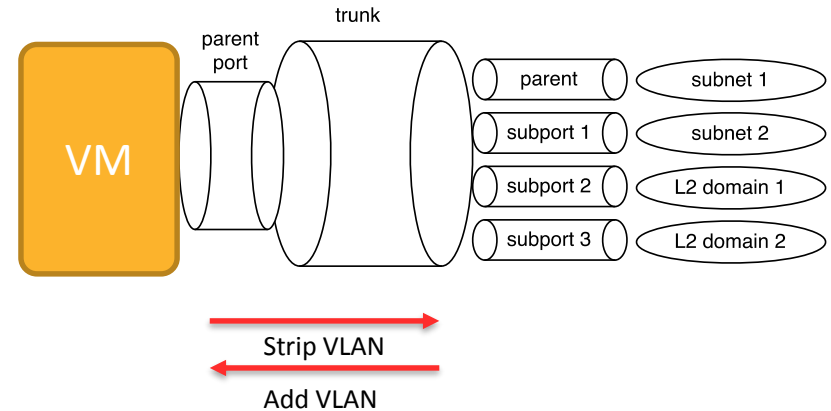
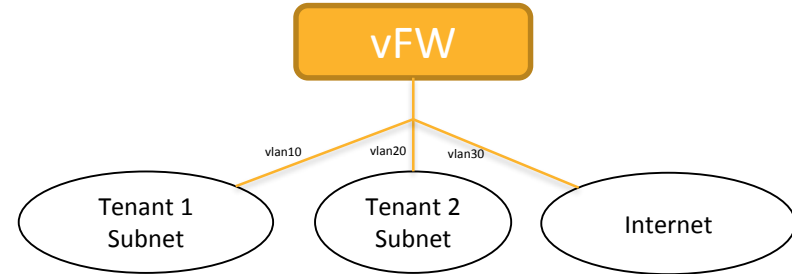
Key Points of Consideration for VNFs

Virtualization of Physical Functions Creates New NW Requirements

- Traffic is tagged with VLANs
- User Plane has high throughput requirements
- VNFs interact with routing protocols

Support of VLAN Trunks to VNF

- Goal
 - Support VNFs with VNIC that use VLAN IDs as discriminator to identify connection to multiple networks
- Solution
 - Model VM VNIC attached to a **trunk** port
 - **Parent port** associated with VLAN 0
 - **Sub-ports** are mapped to VLAN ids
 - VLAN tag stripped by VRS/VSG before forwarding into L2 domain or L3 domain subnet



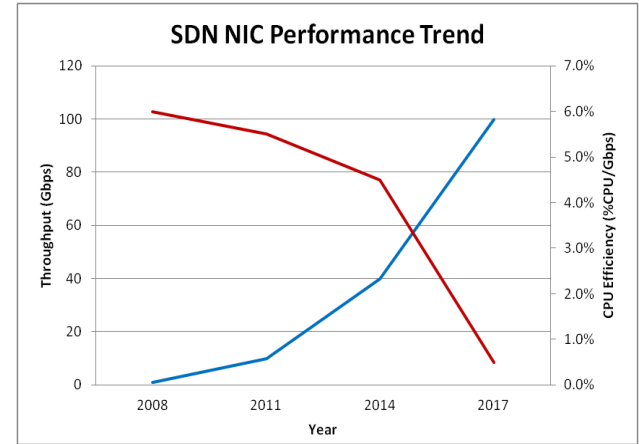
Managing high throughput requirements for VNFs

Technology Changes allow NFs to become VNFs

- CPU more powerful/affordable
- 10 -> 25 -> 40 -> 100GbE NIC
- Throughput techniques
 - Regular Virtio
 - DPDK
 - SRIOV
 - Stateless VXLAN Offloads
 - OVS Offloads

“What should we do?”

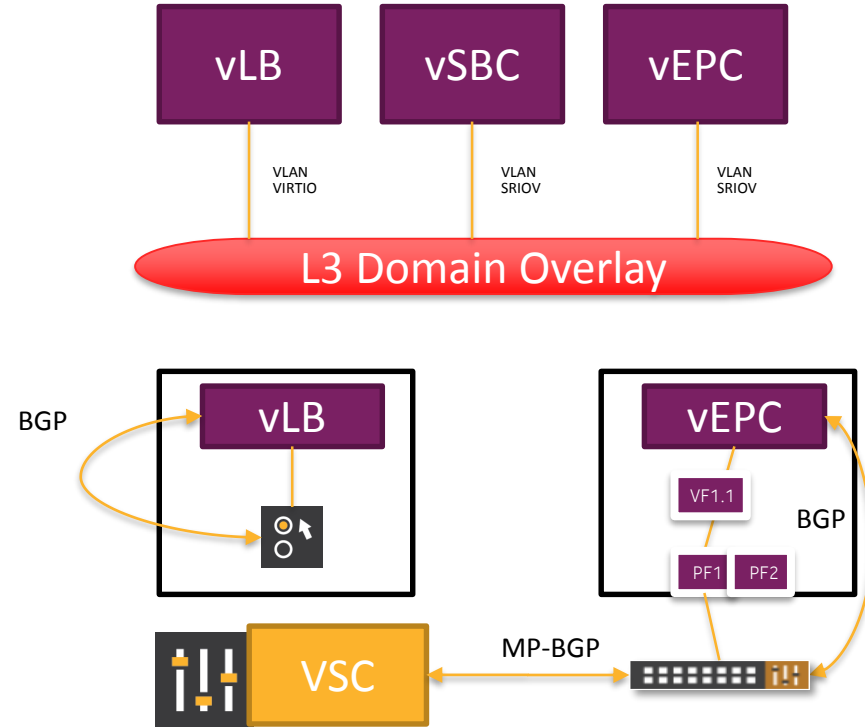
Depends on server type, NIC, price of hw +
Required pps, average packet size, number of flows



Each offloading technique requires specialized support from SDN layer

Supporting VNFs with routing protocols

- Goal
 - VNFs like to advertise loopbacks
 - VNFs need to learn eg UE-Pools, SIP Agent Subnets
- Solution
 - Support Dynamic routing protocol interaction between VNF and Nuage Overlay Network



Key Trends

- **Software Defined Datacenter**
 - Hosting and Public Cloud
 - NFV
 - Cloud Native architectures
- **SD-WAN**
 - Disruption in Branch VPN
 - Boundary-less
 - Self-service & Full Automation
- **Software Defined Security**
 - Network Visibility
 - Actionable Big data analytics
 - Not just perimeter

The Nuage Networks solution for SD-DC; SD-WAN & SD-Security

- Open Orchestration API**
- Integration with Nokia orchestrators
 - Open orchestration ecosystem



- Integration with existing networks**
- Direct integration with SR OS
 - Open protocols for multi-vendor



Nuage Networks Virtualized Services Platform (VSP)



Virtualized Services Directory (VSD)

- Network Policy Engine – abstracts complexity
- Service templates and analytics



Virtualized Services Controller (VSC)

- SDN Controller, programs the network
- Rich routing feature set



Virtualized Services Assurance Platform (VSAP)

- Operational tools
- Monitoring and correlation



Route Monitor

- Utilize standard routing protocols
- Discover topologies
- Peer with networks



Correlation Engine

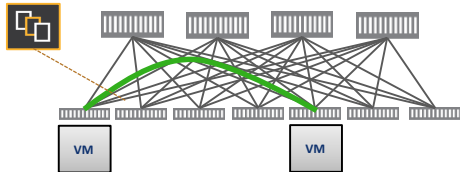
- Aggregate physical and virtual topologies
- Correlate services
- Analyze faults

Virtualized Cloud Services for the software defined DC



Virtual Routing & Switching (VRS)

- Distributed switch / router – L2-4 rules
- Multi-hypervisor and bare metal assets
- HW Switches for DC Fabric and HW-VTEP

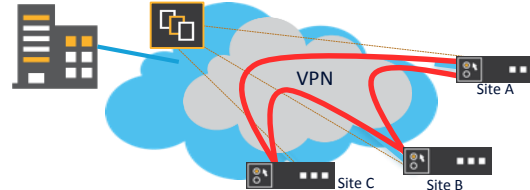


Virtualized Network Services for the software defined WAN



Network Services Gateway (NSG)

- Network service platform for branches
- L2-L4 Switching and routing with advanced network functions

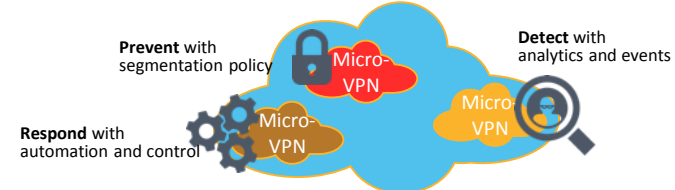


Virtualized Security Services for SD-DC and SD-WAN



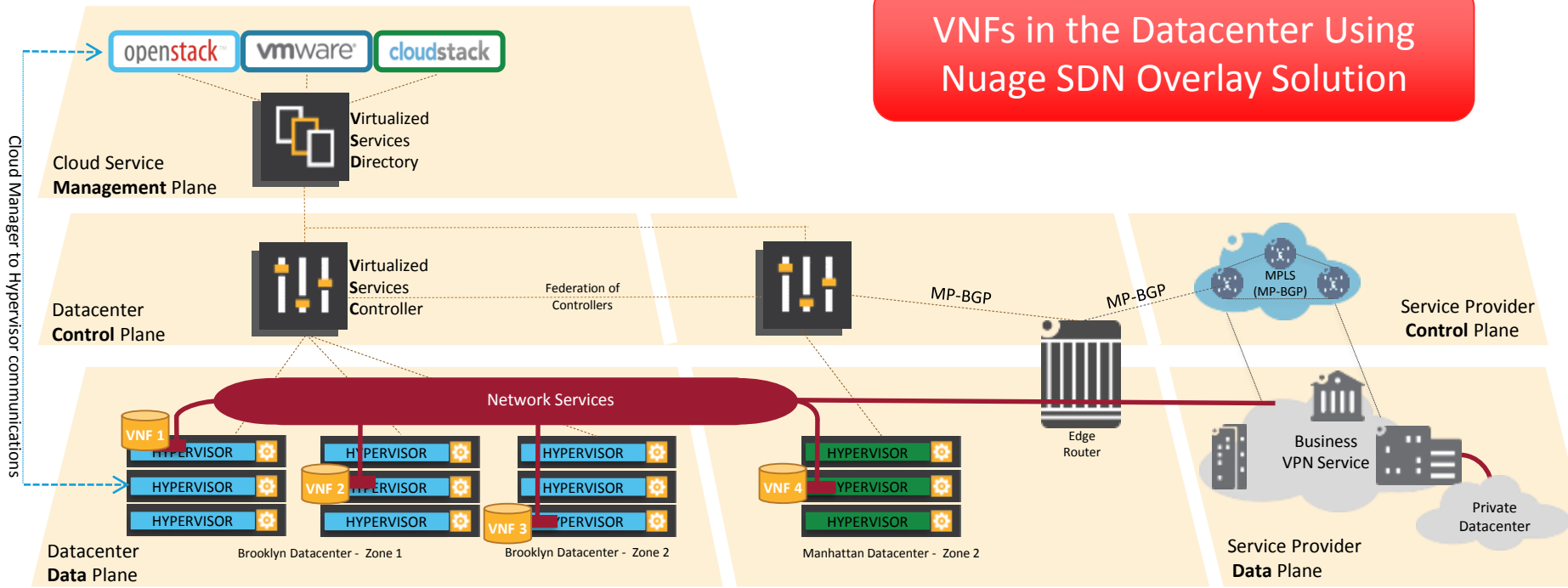
Software Defined Security

- Prevent/Detect/Respond to security threats
- Visualize, report, take action based on real time data
- Enforce micro-segmentation

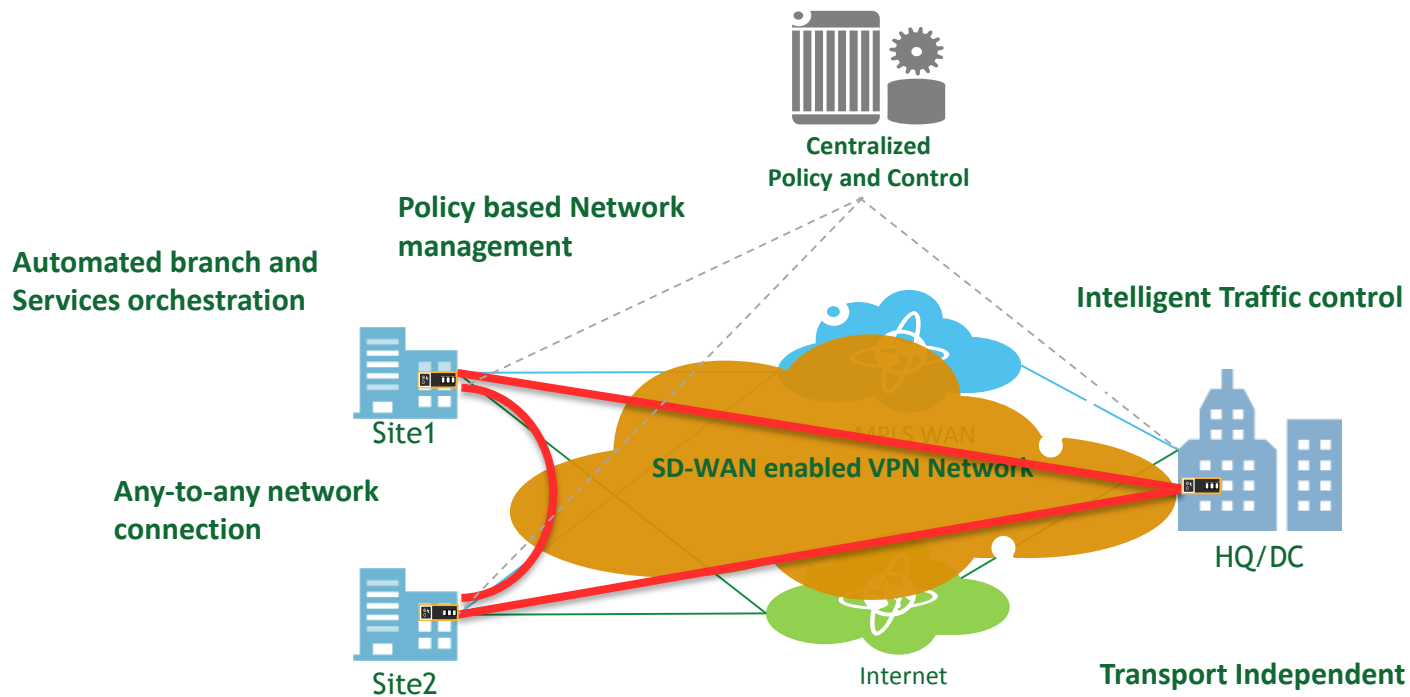


Cloud Service Network Instantiation with Nuage Networks Federated Inter Datacenter Services (multiple CMS)

VNFs in the Datacenter Using Nuage SDN Overlay Solution

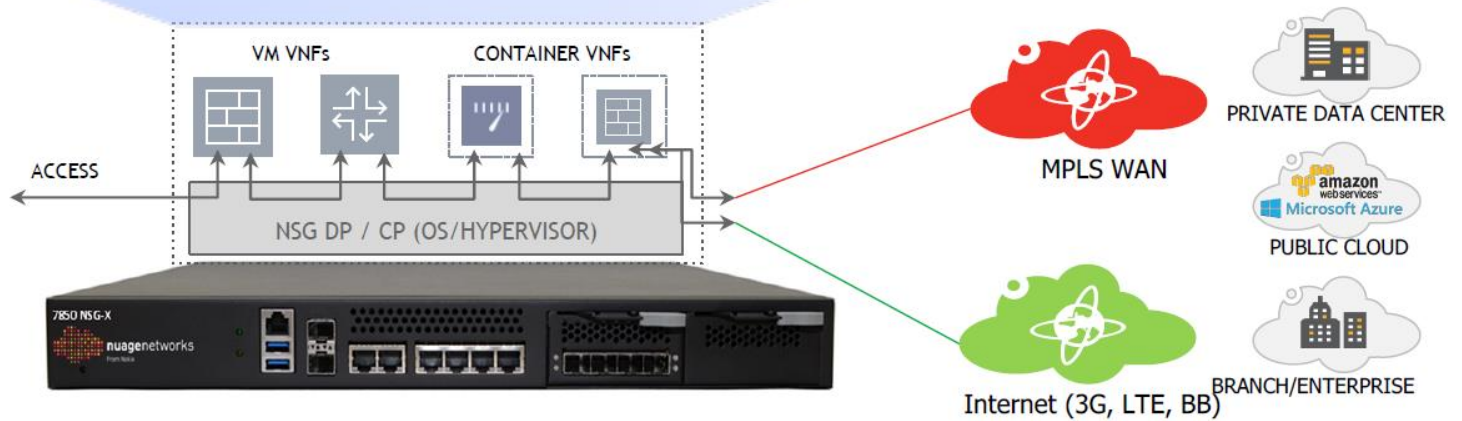


SD-WAN – Overview

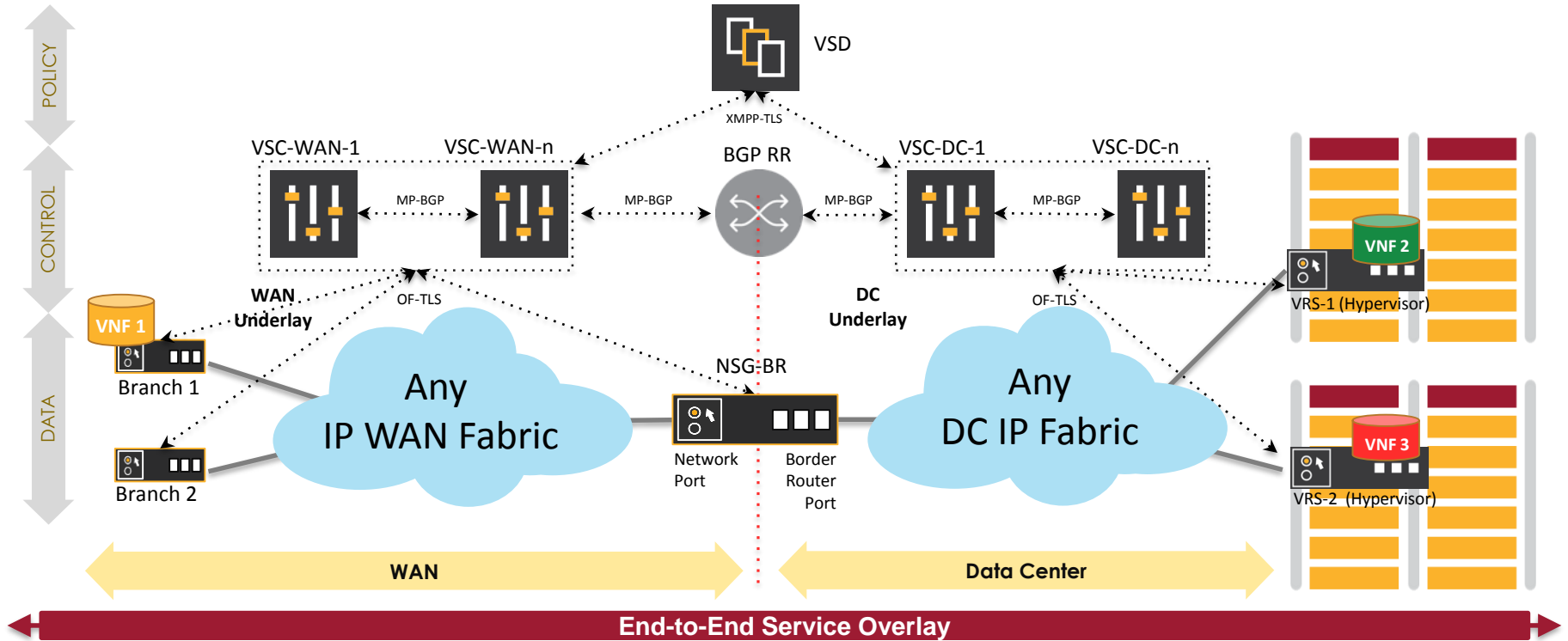


Branch in a Box

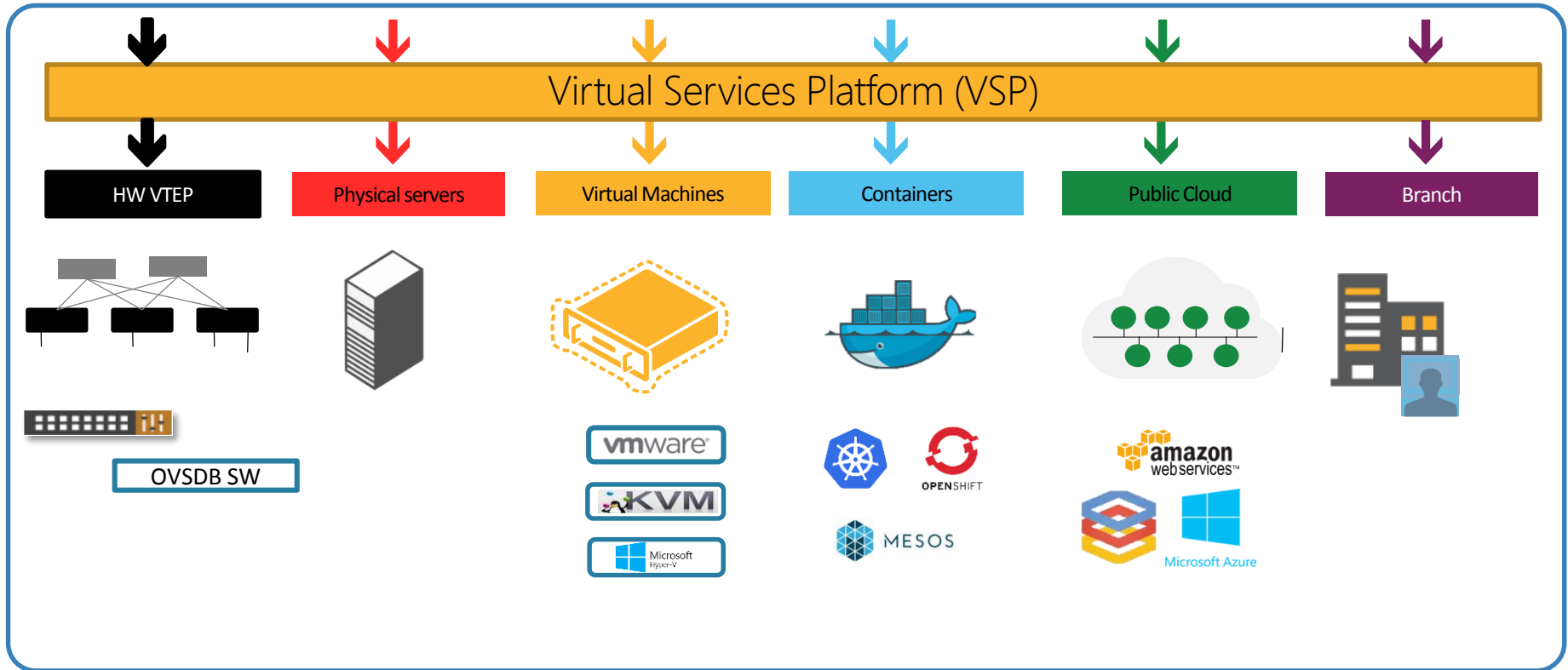
CPE hosted VNF



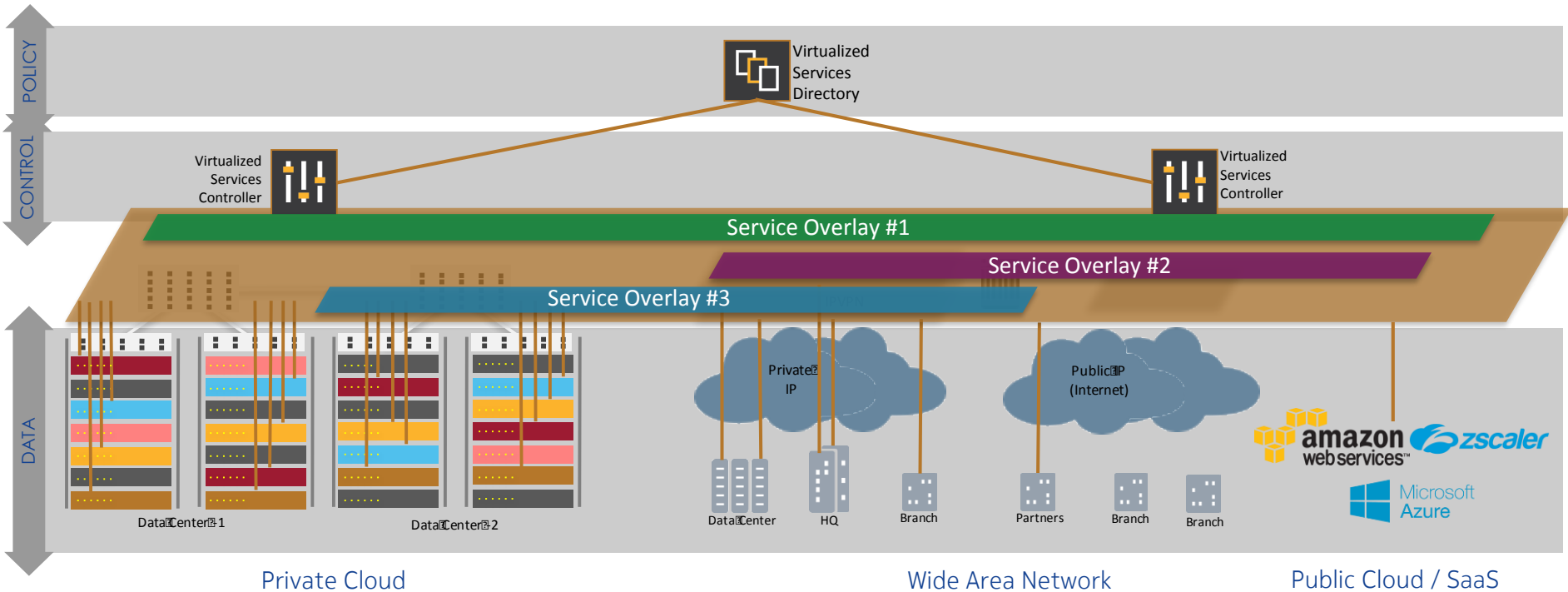
Boundary-less SD-DC + SD-WAN Architecture



Policy-Driven Virtualized Networking for all Environments



Nuage End-2-End automation



Market Momentum

185+ successful trials / pilots , 100+ wins and deployments

SD-DC



SD-WAN



* Pilot

Thank you



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5/14/2018

NSG Hardware Details



Cloud

S/M Branch Sites

M/L Branch Sites / DC

NSG-V

NSG-C

NSG-E

NSG-E200/E300

NSG-X200

NSG-X

- NSG-V KVM Image
- NSG-V ESXi Image
- NSG-V Amazon Machine Image (AMI)

- Atom E series (2C)
- 3x RJ45 GbE
- 2GB memory
- 16GB storage
- TPM v1.2
- 1x AC PSU
- 2x USB
- 1x RJ45 console

- Atom C series (2C)
- 6x RJ45 GbE
- 4GB memory
- 4GB storage
- TPM v1.2
- 1x AC PSU
- 2x USB
- 1x RJ45 console

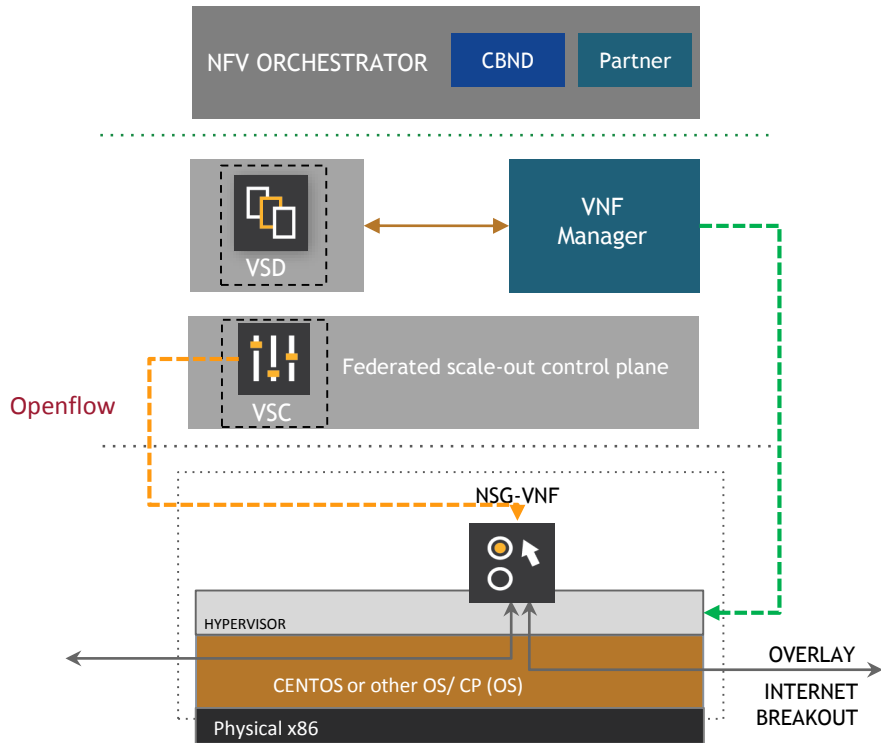
- Atom C series (4C/8C)
- 6x RJ45 GbE
- 2x SFP GbE
- 4/8GB memory
- 16GB storage
- TPM v1.2
- 1x AC PSU
- 1x USB
- 1x RJ45 console

- Xeon D series (4C)
- 4x RJ45 GbE
- 2x SFP+ 10GbE
- 16GB memory
- 32GB + 128 GB storage
- TPM v1.2
- 1x AC (upgradable to 2xAC) PSU
- 2x USB3.0
- 1X RJ45 console

- Xeon D series (8C)
- 2x SFP+ 10GbE
- 4x RJ45 GbE
- 4x SFP GbE
- 32GB memory
- 32GB + 256 GB storage
- TPM v 1.2
- 2x AC PSU
- 2x USB3.0
- 1x RJ45 serial console

NFV Capable

Nuage NSG-V as VNF running on top of a universal CPE (uCPE)

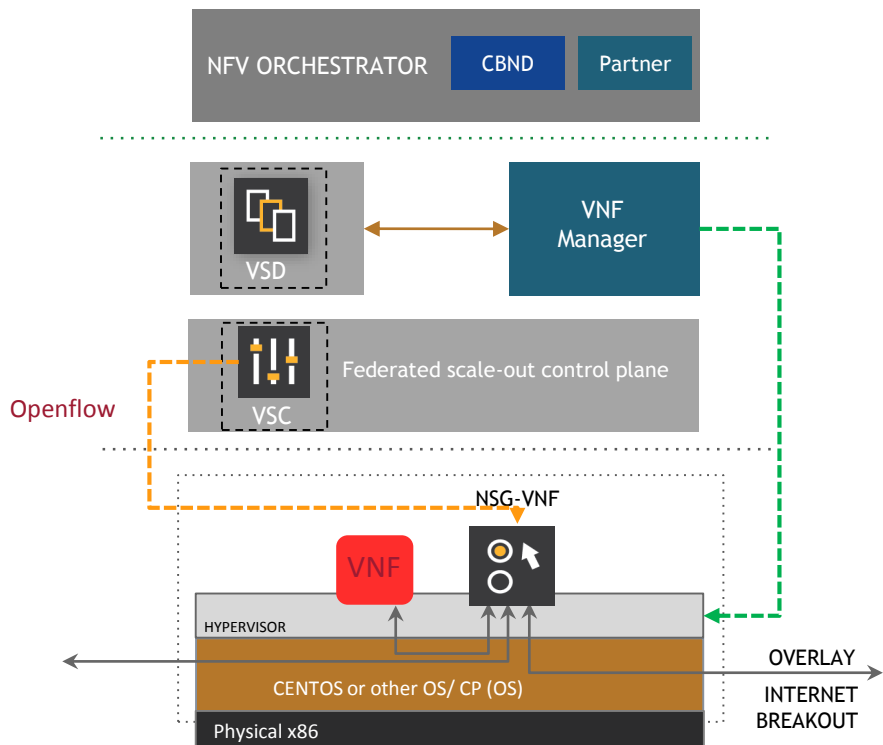


- REST API based integration w/ NFV Orchestrator

- VNF Manager launches the NSG-V VNF on the x86
- Simple pre-provisioned virtual bridges connect the virtual ports of the NSG-V to the LAN and to the uplink(s)
- NSG can be deployed with a disk volume mounted to automatically be bootstrapped to the controller
- All the Interconnections between sites and /or Internet local breakout is handled by the NSG-V and configured through the VSD APIs;

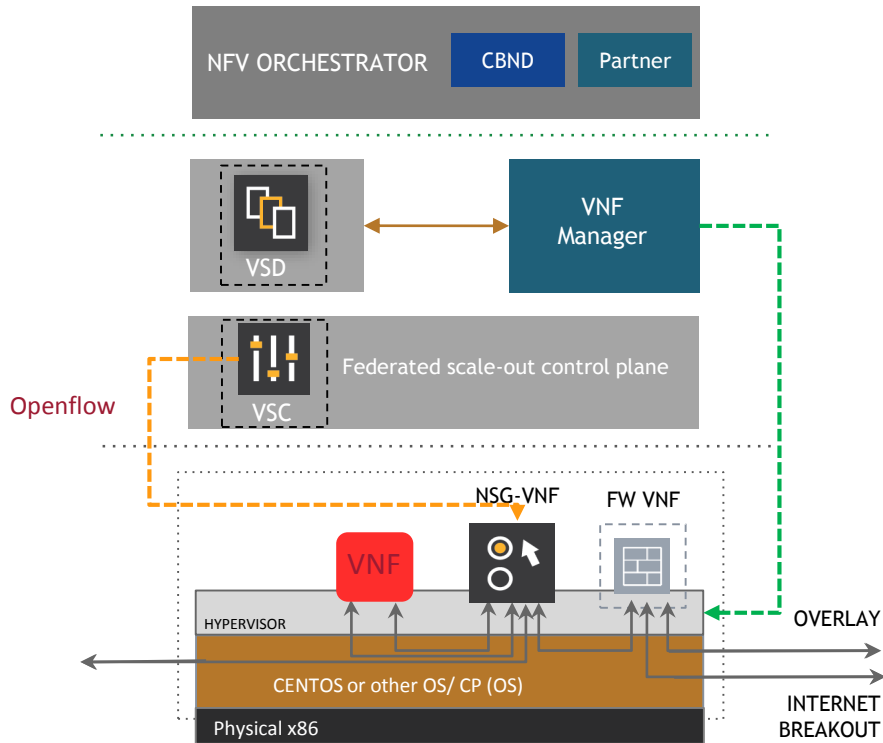
- VNF Manager will be responsible for Resource Monitoring & VNF Health Checks

Nuage NSG-V as a VNF alongside another VNF – no Service Chaining



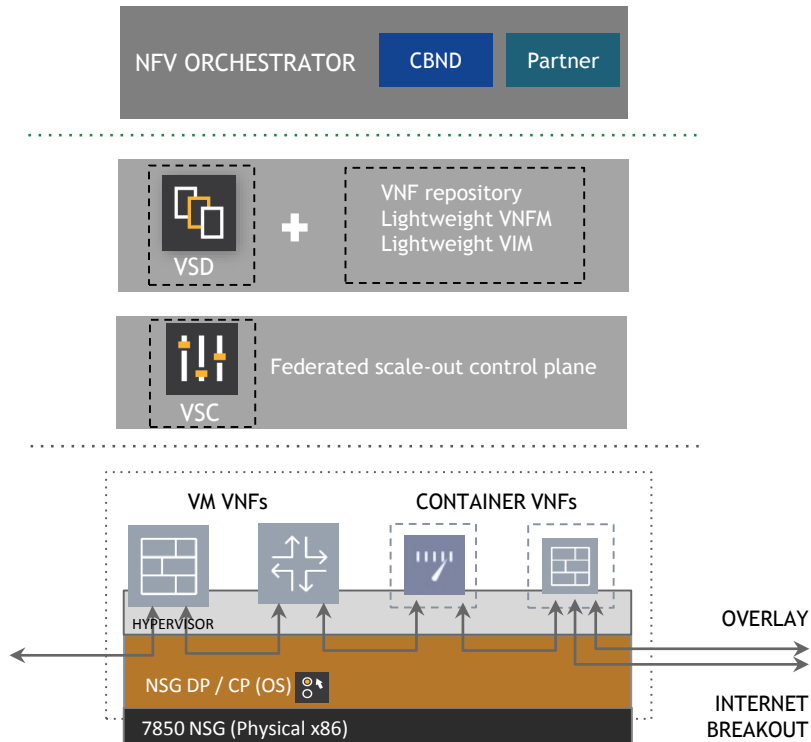
- VNF Manager launches other VNFs on the x86 alongside with the NSG-V (depending on the compute platform processing Capability and available memory)
- Example can be a POS virtualized function for a small store. The VNF will connect directly to an NSG-V virtual port as if it was in the LAN, through a virtual bridge (can even be the same as the physical LAN virtual bridge)
- Interconnection between sites will be handled by the NSG-V;

Multiple VNFs with Service Chaining for advanced topologies



- More complex topologies would also be possible with multiple VNFs running in parallel with the NSG-V.
- Service chaining between the VNFs can be orchestrated by the NSG-V (Each VNF connects with one or two ports to the NSG-V)
- I.e. A dedicated tier 1 FW VNF (like Palo Alto or Fortinet) can be used to allow for secured local breakout to the Internet;
- Interconnection between sites will be handled by the NSG-V;

Solution Architecture for Hosted VNFs with Nuage VNFM

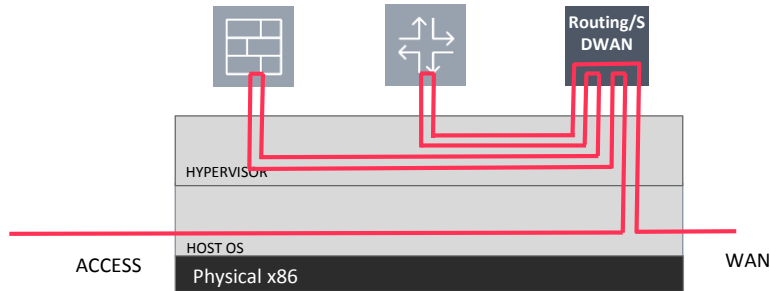


- REST API based integration w/ NFV Orchestrator

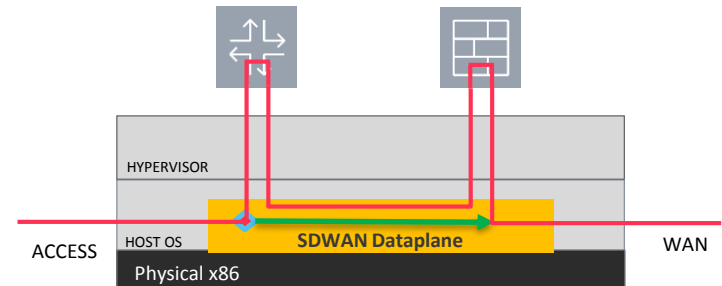
- VNF Onboarding, Repository Management
- Lightweight VNF lifecycle management
 - Light weight VIM (Scheduler)
 - VM instantiation/deletion/default config
- Service Chaining & Insertion Framework
 - L2/Transparent VNF insertion in packet flow
 - New policy rules for symmetry
 - Failover options (Open / Close)

- KVM hypervisor / Libvirt Management of VNF
- Resource Monitoring & VNF Health Checks

Traditionnal CPE vs Nuage Approach



- Complex packet processing - Overhead of multiple hops of traffic through hypervisor and routing VM
- L3 based policies for Service Chaining
- Multiple bootstrapping procedures for the hostOS and routing/SDWAN VNF
- VNF provisioning and platform provisioning independent and need integration



- Integrated networking capabilities simplifies packet processing
- L4 and L7 based policies for Service Chaining
- Onboarding VNF onto the host CPE based on the same control plane that manages the SDWAN
- Fully integrated automated management and provisioning

Security & Analytics

Sample Dashboards

Elastic Server Address

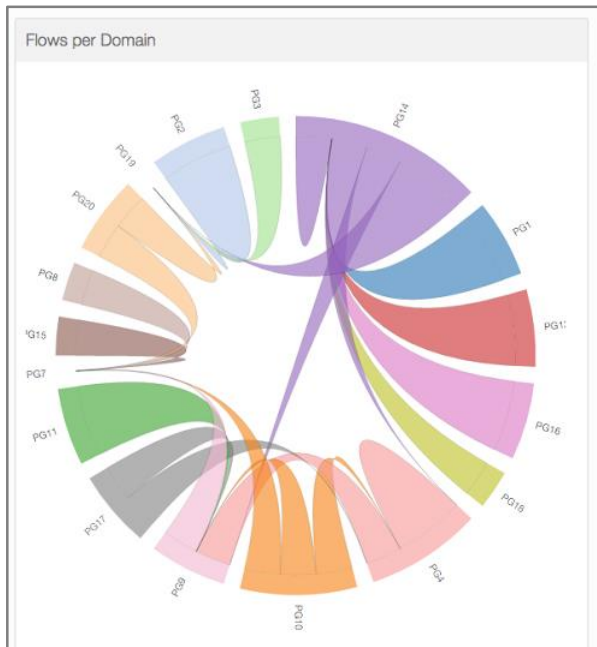
oc-vss-stats.caso:93C

Elastic Server UI URL

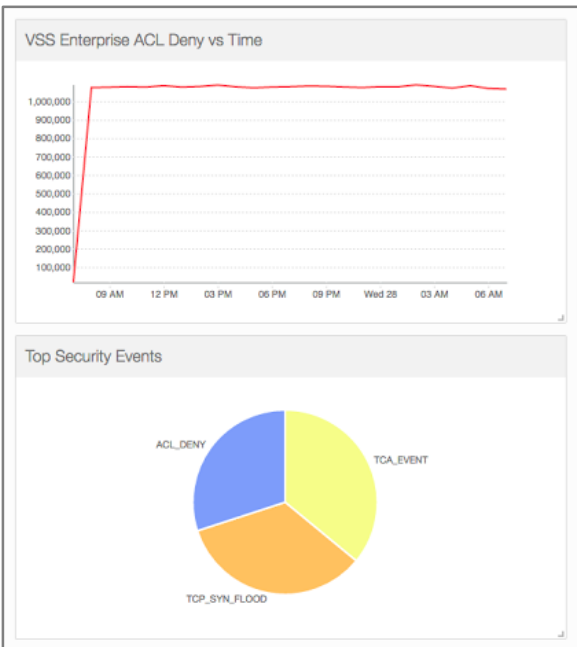
https://135.227.181.6:

Enable VSS Flow and Event Collection

Contextual Flow Visualization



Security Event Dashboards



ACL and Traffic Analytics



Nuage SD-WAN – Key Differentiators

PRODUCT

- **Boundary-less:** Unified Policy and Automation from DC to Branch to Cloud
- **Open & Customizable:** Protocols and x86 Platform; API Centric
- **Standard Service Architecture:** Consistency across L2 and L3; Hybrid Deployments
- **Advanced Networking:** Carrier Grade SROS enabled Features, Resilience & Scale
- **Branch in a Box:** Most flexible framework for Value Added Services
 - Embedded, Hosted (VMs & Containers), Chained (including cloud hosted)
- **Deep Analytics & Security:** Best in class analytics for security & application insight
 - Micro-segmentation from Branch to the DC with Contextual Visibility & policy automation

Strong Partner Eco-system: Technology Orchestration, Security, System Integrators

Global Supply Chain Fulfillment, Service & Support Worldwide