Open networking in a service provider network.

March 2015
What’s the problem?

**DECLINING MARGINS**

The increased demand for video and cloud services creates an “explosion” in the amount of carried traffic.

The revenue per customer (ARPU/ARPA) does not increase linearly with the amount of carried traffic, resulting in declining margins.

**HIGH COST**

Decline of core network equipment cost does not follow Moore’s law.

Network heterogeneity (multi-technology within and between layers) requires multiple highly specialized operations solutions/teams.

Little automation for configuration and provisioning of network resources.

**LOW ROI**

Networks are built for the peak and are overprovisioned most of the time.

**BUSINESS LOCK**

Current mode of operation results in slow service innovation, e.g., lack of network automation and service integration results in long provisioning delays.
My task (March 2015).

Architect a platform that can be used across Verizon for running VNFs

Scalable from 1-100+ racks

- Central office to Datacenter
- COTS HW and SW as much as possible
- OpenStack cloud software

Network focus (large percentage of north-south traffic)

- SDN control of connectivity among all the elements
- Low over-subscription
- QoS (priority queue and reserved BW) support
- Connect to all Verizon networks without cross-contamination
- Support for high bandwidth to VMs (SR-IOV)
ETSI Network Functions Virtualization architectural framework.

- NFV Management and Orchestration
- OSS/BSS
- Service, VNF, Infrastructure Description
- VNF Manager(s)
- Or orchestrator
- Virtualized Infrastructure Manager(s)
- SDN Controller
- Virtual Computing
- Virtual Network
- Virtual Storage
- Compute
- Network
- Storage

Execution Reference Points: Red
NFV Reference Points: Black
Centralized control functions and distributed local compute

Deployable in small sites and in centralized data centers

Value
Reduce latency to a customer
Reduce core network usage

Large scale at the regional DC
- 20-50 racks per regional DC
- Relatively low BW 10Gb per server

Small scale, high bandwidth at the edge DC
- 2-6 racks per edge DC
- Up to 100 Gb per server
Network selection criteria.

Switches that support ONIE loadable OS

OpenStack Neutron/Nova integration
• vSwitch/SR-IOV control

CLOS fabric

VMs directly visible on provider networks
Lab environment.

64x scalable servers (4 sleds in 2U)
- 2x 8 core CPUs, 128GB RAM, 6x drives,
  2x 10/40Gb NIC

4x 1U rack servers (provisioning and monitoring)
4x 48x 10Gb + 6x 40Gb ONIE TII switches
4x 32x 40Gb ONIE capable TII switches
Possible to build several different topologies
External routers
L2 segmentation or L3 with encapsulation?

Scale
• L2 VLAN limit!!!

Fault containment

Multicast support

Multi-path control
• No spanning tree

VxLAN vs. NVGRE

Decided to use L2 fabric with an SDN controller
Candidates

L2 Switch OS
- Open Network Linux with OF-DPA
- Cumulus
- Big Switch Switch Light OS
- Proprietary switch OS with OpenFlow

SDN Controller
OpenDaylight
RYU
Floodlight
Big Switch Big Cloud Fabric
Conclusions as of May 2015

Open Source not quite ready at the time
Best fit for our requirements was a supported proprietary solution
Thank you.