Understanding NFV and the MANO Stack

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About me

PhD (CS) from USC, undergrad (EE) from EME. Avid technologist, researcher and academic. Built a top-quality research lab at FAST-NU and then migrated to industry.

Director Engineering at PLUMgrid, and NFV/SDN company until recently. Founded and head the Openstack Pakistan user-group.
Talk outline
Goals/outline

Why NFV?
   Its motivation and challenges

ETSI NFV Stack and the MANO
   Overview of MANO components
   MANO implementations and current status

State of the MANO stack

OPNFV
THE NFV buzz....

To NFV or not to NFV...
3GPP Communication ecosystem
Telecom Networks and their clouds

Access network → Core DC → Internet

RAN → Access network

Service chains:
- Video acc
- xyz
- Classifer
- VoIP
Network Function Virtualization (NFV)

Replace hardware network appliances with software

Deployable over commodity machines

Cost savings and no vendor lock-in

Agility in service provisioning

Each service/network function is in software
<table>
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<tr>
<th>Legacy Limitation</th>
<th>Benefits of NFV</th>
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<tr>
<td>Physical install appliance/site</td>
<td>Flexibility / Extensibility</td>
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<tr>
<td>Inefficient asset utilization</td>
<td>High asset utilization</td>
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<td>Development is time consuming, upgrade difficult</td>
<td>Continuously deployed /upgraded</td>
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<td>Limits modularity, vendor choice</td>
<td>Achieve Modularity</td>
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<td>Opens the competitive ' landscape</td>
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<td>Innovative Ecosystem</td>
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Lots of promise

Business value; **real!**

Lots of Challenges

NFV = managing a “Carrier-grade” Cloud

Everything that was known, is now unknown

Technical Challenges for NFV

Carrier grade software (99.999% reliable)

**How:** use micro-services, load balancing, and cloud-native VNFs

Containers, Hyper-convergence, and SDN for flexibility

Security and visibility in managing virtual infra

**How:** new tools and techniques to monitor virtual infra; group-based policies

failure prediction, virtual Tap, Isolation guarantees

Packet processing at line rates, latency and jitter

**How:** high speed packet processing on commodity machines

SR-IOV, fd.io/VPP, DPDK, IOVisor
THE ETSI NFV Stack

aka a potpourri of difficult-to-remember-acronyms
Network Functions Virtualization (NFV):

*principle of separating network functions from the hardware they run, i.e. Software Defined Functionality!*

**Virtual NF (VNF)**

*implementation of an NF as software on an NFV infrastructure*

**Network Service (NS)**

*composition of Network Functions for an in-network service (e2e)*
NFV High Level Framework

MANO is to NFV as Control Plane is to SDN.
NFV Arch details (Focusing on MANO)

A graphical depiction of the NFV architecture, with the MANO components on the right side in blue.
Virtual Infrastructure Manager (VIM)

Manages *life cycle* of virtual resources in an NFVI domain.

Keeps inventory of virtual machines (VMs) associated with physical resources.

APIs to expose physical and virtual resources to other management systems.

For IT people, it’s just a CMS
VNFM manages life cycle of VNFs.

VNF resources managed by VMs

Generic vs application specific

It scales up/down VNFs

FCAPS of VNF

fault, configuration, accounting, performance, security management
NFV Orchestrator (NFVO): Why Needed?

Stringing VNFs together to form a service chain

Managing multi-site resources to best meet operator/telco goals

Integration with SDN components important
Addressing the State of MANO
The many ways in which NFV is being implemented!

NFVI and VIM are the lowest layer, generally separable
- Openstack/VMWare (a lifeline for Openstack viz the Docker craze!)

VNFM can be generic, OR provided by VNF/app developers
- A VNFM typically is for a single VIM/Cloud (some confusion)

NFVO is the most “in-the-air” at this point
- likely a different space for startups, innovation (Rift, Aria)
  - Standardizing modeling language (TOSCA, YAML, NETCONF/YANG)
- selection of SDN and VIM(s) can be made here (multi-site/multi-cloud)
- unclear if applications over NFV go through OSS-NFVO or a different northbound API will exist?

Multi hypervisor, Multi-VIM, Multi-VNFM
Lots of “Open” implementations that are trying to standardize around the APIs to talk between managers open-source vs standards

As of Dec 2016, most of the “implementations” of MANO layers have varying levels of compliance and interpretation

e.g. AT&T’s ECOMP, Rift.ware, Cloudify/Aria
Other takes on NFV orchestration
OPNFV: Open source, meet NFV
What is OPNFV?

In Colorado the focus has started to move towards MANO.
Conclusion

NFV is real, so are its challenges

NFV standardization is happening via code

Telcos need to quickly understand the landscape
Thank you!

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