

# Demonstrating NFV is possible

## 1st Open Multi-Vendor NFV Showcase

enabled by



**Gianpietro Lavado**

[glavado@whitestack.com](mailto:glavado@whitestack.com)

Whitestack



**Jose Miguel Guzmán**

[jmguzman@whitestack.com](mailto:jmguzman@whitestack.com)

Whitestack

# NFV



**OPEN INFRASTRUCTURE  
SUMMIT**

Denver, CO | April 29–May 1, 2019

# Agenda

- **Current models of NFV Adoption**
- **Introducing Multi Vendor NFV Showcase**
- **Describe Tests and Results**
- **Conclusions & Invitation**

Demonstrating NFV is possible  
1st Open Multi-Vendor NFV Showcase

# Quick review about Current models of NFV Adoption



# The foundational paper

A white paper was written in 2012 by the world's leading telecom network operators (US, Europe & Asia).

- Introduction
- Benefits
- Enablers
- Challenges
- Call for Action



[https://portal.etsi.org/nfv/nfv\\_white\\_paper.pdf](https://portal.etsi.org/nfv/nfv_white_paper.pdf)

Issue 1

---

Network Functions Virtualisation – Introductory White Paper

## Network Functions Virtualisation

---

An Introduction, Benefits, Enablers, Challenges & Call for Action

**OBJECTIVES**

This is a non-proprietary white paper authored by network operators.

The key objective for this white paper is to outline the benefits, enablers and challenges for Network Functions Virtualisation (as distinct from Cloud/SDN) and the rationale for encouraging an international collaboration to accelerate development and deployment of interoperable solutions based on high volume industry standard servers.

**CONTRIBUTING ORGANISATIONS & AUTHORS**

<b>AT&amp;T:</b>	Margaret Chiosi.
<b>BT:</b>	Don Clarke, Peter Willis, Andy Reid.
<b>CenturyLink:</b>	James Feger, Michael Bugenhagen, Waqar Khan, Michael Fargano.
<b>China Mobile:</b>	Dr. Chunfeng Cui, Dr. Hui Deng.
<b>Colt:</b>	Javier Benitez.
<b>Deutsche Telekom:</b>	Uwe Michel, Herbert Damker.
<b>KDDI:</b>	Kenichi Ogaki, Tetsuro Matsuzaki.
<b>NTT:</b>	Masaki Fukui, Katsuhiro Shimano.
<b>Orange:</b>	Dominique Delisle, Quentin Loudier, Christos Koliass.
<b>Telecom Italia:</b>	Ivano Guardini, Elena Demaria, Roberto Minerva, Antonio Manzalini.
<b>Telefonica:</b>	Diego López, Francisco Javier Ramón Salguero.
<b>Telstra:</b>	Frank Ruhl.
<b>Verizon:</b>	Prodir Sen.

**PUBLICATION DATE**

October 22-24, 2012 at the “SDN and OpenFlow World Congress”, Darmstadt-Germany.

This white paper is available at the following link: [http://portal.etsi.org/NFV/NFV\\_White\\_Paper.pdf](http://portal.etsi.org/NFV/NFV_White_Paper.pdf)

# ETSI NFV Recommendations

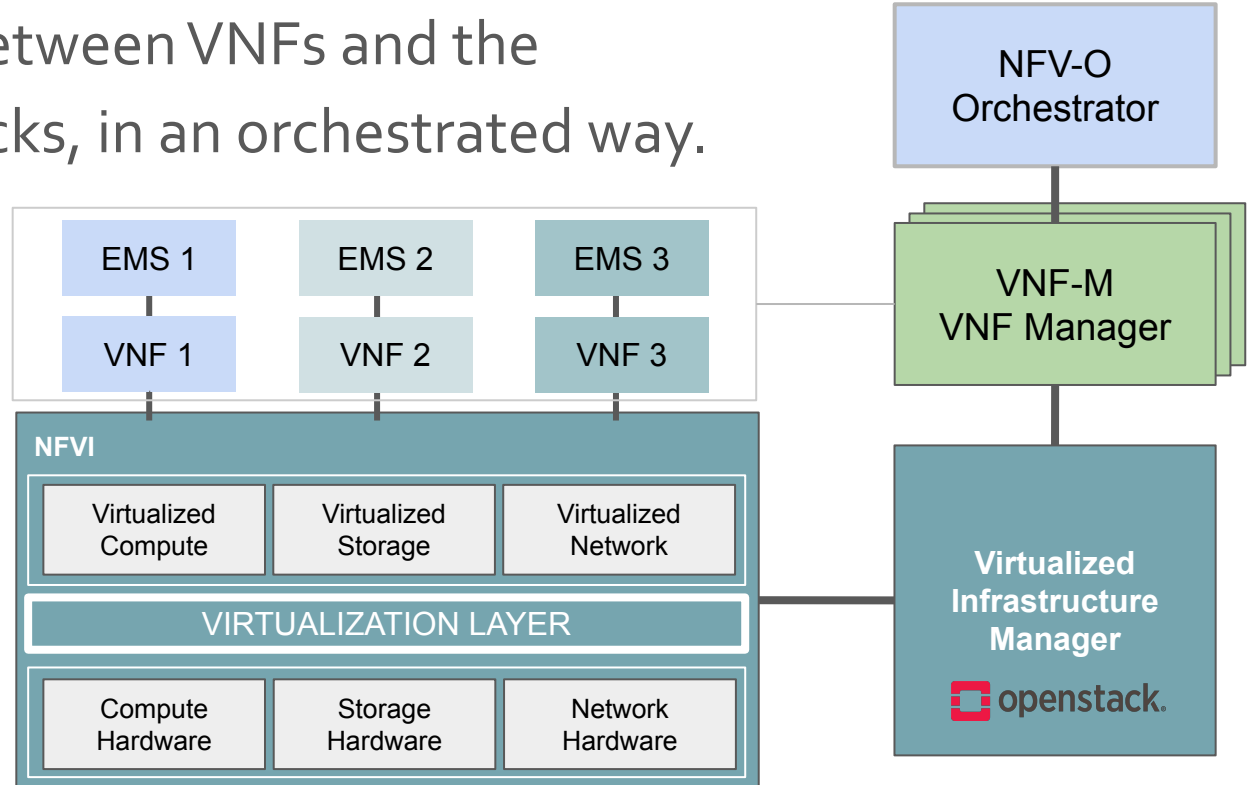
- Based on member's feedback, field experiences and proof of concepts, standard documents have evolved.
- 60+ publications exist today, including the following three main documents:
- NFV Architectural Framework  
[http://www.etsi.org/deliver/etsi\\_gs/NFV/001\\_099/002/01.02.01\\_60/gs\\_NFV002v010201p.pdf](http://www.etsi.org/deliver/etsi_gs/NFV/001_099/002/01.02.01_60/gs_NFV002v010201p.pdf)
- NFV Infrastructure Overview  
[http://www.etsi.org/deliver/etsi\\_gs/NFV-INF/001\\_099/001/01.01.01\\_60/gs\\_NFV-INF001v010101p.pdf](http://www.etsi.org/deliver/etsi_gs/NFV-INF/001_099/001/01.01.01_60/gs_NFV-INF001v010101p.pdf)
- NFV Management and Orchestration  
[http://www.etsi.org/deliver/etsi\\_gs/NFV/001\\_099/002/01.02.01\\_60/gs\\_NFV002v010201p.pdf](http://www.etsi.org/deliver/etsi_gs/NFV/001_099/002/01.02.01_60/gs_NFV002v010201p.pdf)

<http://www.etsi.org/standards-search>



# The NFV framework

ETSI defined an architecture to allow interoperability between VNFs and the infrastructure blocks, in an orchestrated way.

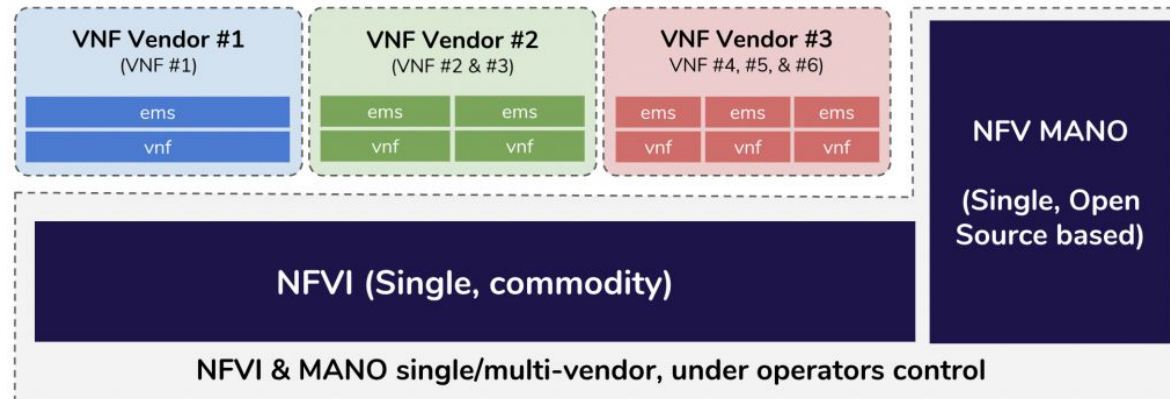


# The expected scenario

## “Horizontal Virtualization”

An architecture where

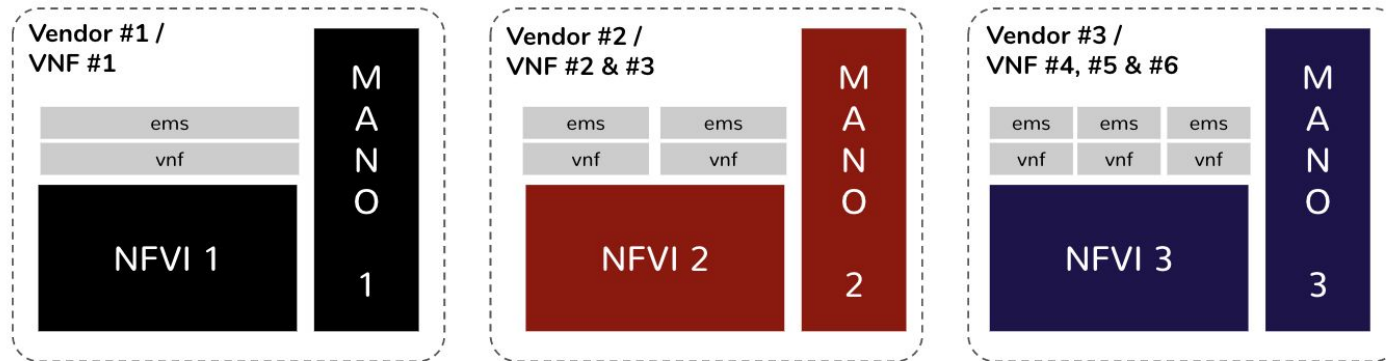
- Operators make the NFVI, VIM and MANO stacks available for multiple vendors
- VNF vendors provide “VNF Packages” that can be deployed on top of a compatible NFV infrastructure.



# What is really happening “Vertical Virtualization”

An suboptimal deployment, where

- Each vendor deploy an complete NFV stack and its VNFs
- There are different NFVIs, VNF-Ms and NFV-Os
- Vendors remain the ultimate responsible for the solution.





# What is delaying Adoption

Some operators are still concerned about:

- Running software on other's vendor hardware is too complex.  
*Who do I blame?*
- Most required software components are not mature enough.
- If we save CAPEX by going NFV, I will end spending more OPEX.
- Virtualization on commodity hardware is not able to handle much traffic
- VNF Onboarding is very difficult (day-0, day-1 and day-2)
- Composing (multi-vendor) Network Services, is not possible (yet)



**Demonstrating NFV is possible**  
1st Open Multi-Vendor NFV Showcase

# The Multi Vendor NFV Showcase



# Objective

Demonstrate that **NFV Orchestrated Network Services**, integrating VNF from multiple vendors, on top of commoditized hardware, are possible (*with not too much effort*)

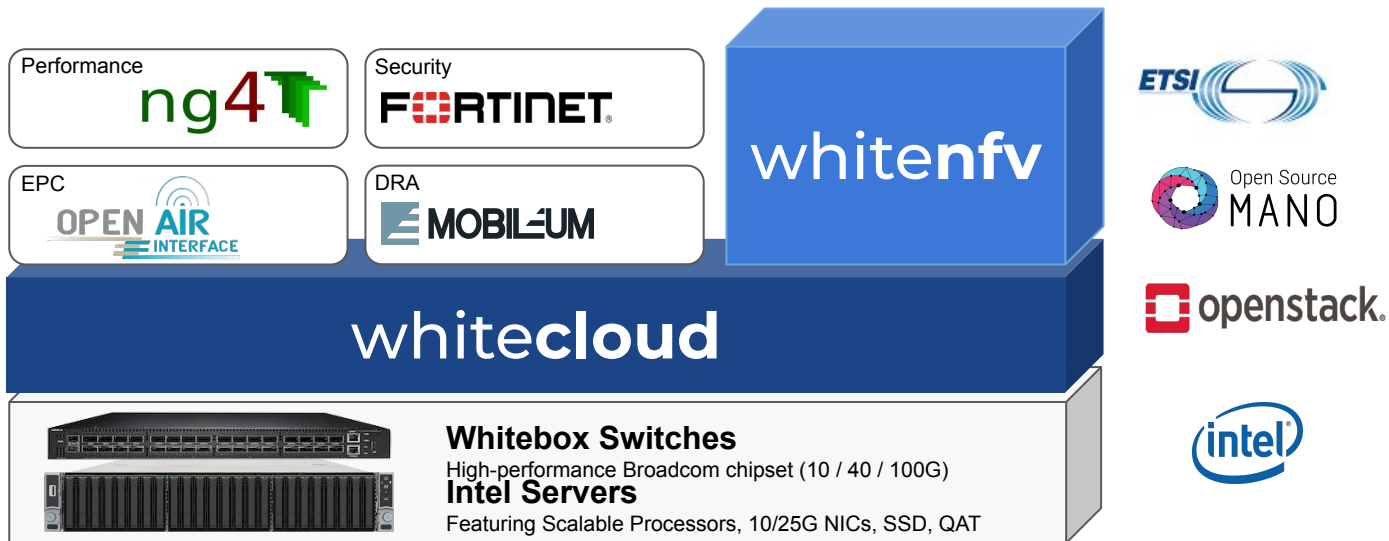


**OpenStack and Open Source MANO:  
Technologies for NFV Deployment**

# Architecture

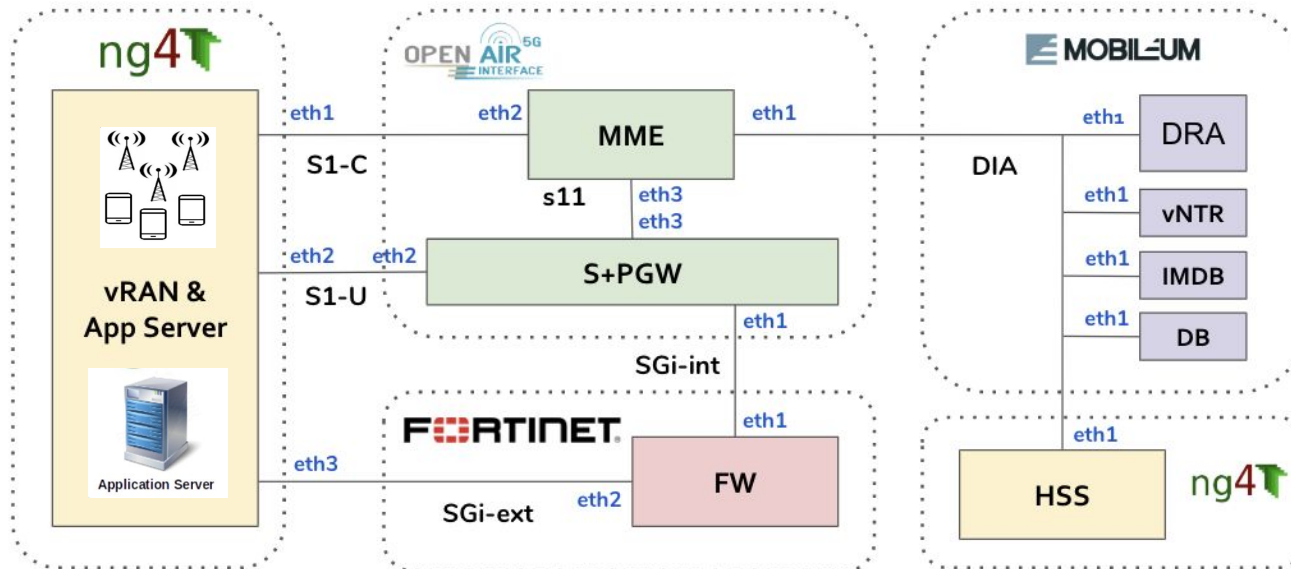
“**Multi-vendor NFV Showcase**” with the support of leading NFV-enablers, putting together a number of leading VNF vendors, on top of commoditized **x86** infrastructure, managed by well-known, production-ready, open-source components like **OpenStack** and **Open Source MANO**.

**Goal: to demonstrate publicly that multi-vendor networks are possible**



# Network Service

- **ng4t VRAN:** Emulates the vRAN
- **OpenAir Interface:** Implement the vEPC (MME, SGW, PGW)
- **Fortinet:** implement security
- **Mobileum:** implement DRA and NTR (Roaming Steering)



# Enablers

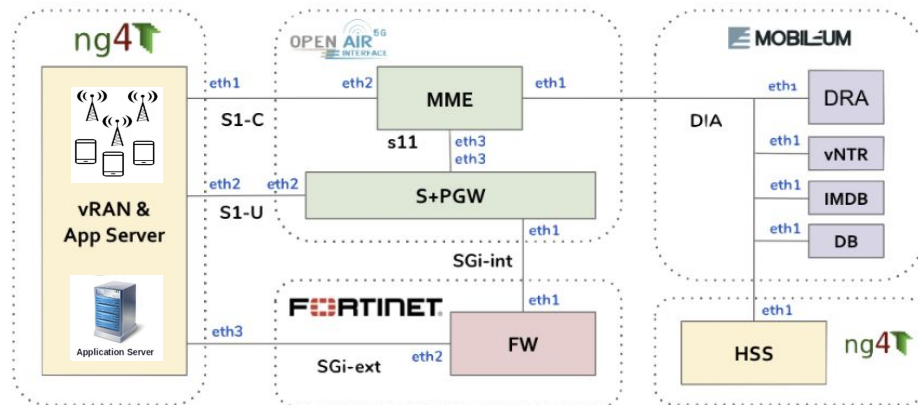
- **ETSI:** Provide the **NFV Plugtests Programme** as a framework for the initiative, including access to its HIVE infrastructure (Hub for Interoperability and Validation at ETSI) for facilitating remote testing
- **OpenStack Foundation:** would provide general endorsement to the initiative, highlighting its support to using open technologies in NFV environments.
- **Intel:** Provides the the main hardware conforming the NFVI.
- **Whitestack:** provides the testbed to be used on this event
  - **NFVI:** Linux / Hypervisors
  - **VIM:** Whitecloud (Openstack distro)
  - **MANO:** WhiteNFV (Open Source Mano distro)



# Tests and results



## ETSI NFV ISG Architectural Framework



**whitestack**  
**whitenfv**  
**MANO**

powered by:  
 Open Source  
**MANO**

**whitestack**  
**whitecloud**  
**VIM**

powered by:  
 **openstack.**

**KVM**

**OvS**  
Open vSwitch

powered by:

**intel**

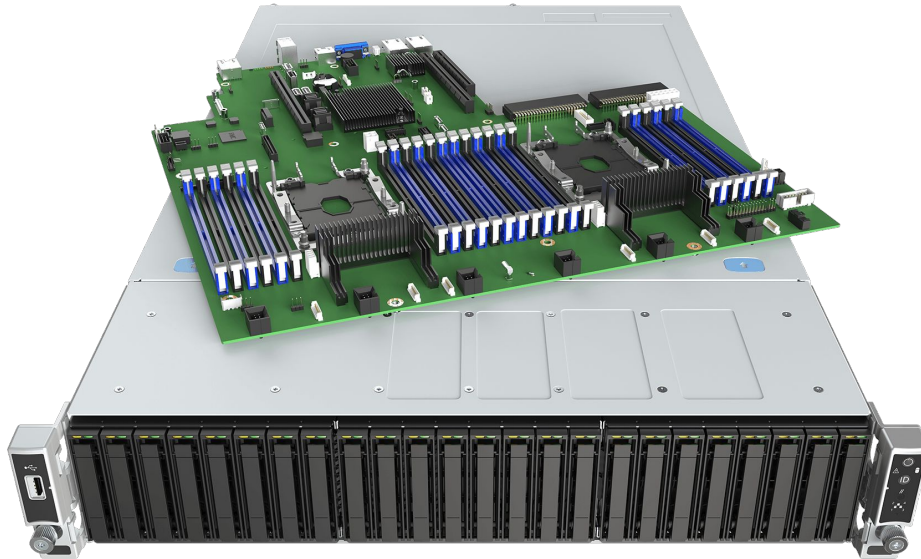
**intel**  
**XEON**  
**GOLD**  
inside

- This setup builds a completely **virtualized LTE Packet Core** with security features at the packet data network, and advanced roaming/analytics functions at the control plane.
- It is built using commodity hardware at NFVI, and open-source based MANO/VIM software.
- Multi-vendor, horizontal NFV is effectively achieved by leveraging ETSI NFV ISG standards.



# Hardware for NFVI

Attribute	Description
CPU	Intel(R) Xeon(R) Gold 6139 CPU @ 2.30GHz
Memory	384GB RDIMM RAM
Disk	2 x 512GB SSD (OS) 4 x 1TB nvme (VNFs)



# Software for NFVI & MANO

Performance

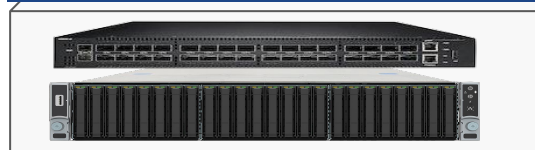
Security

Packet Core

DRA



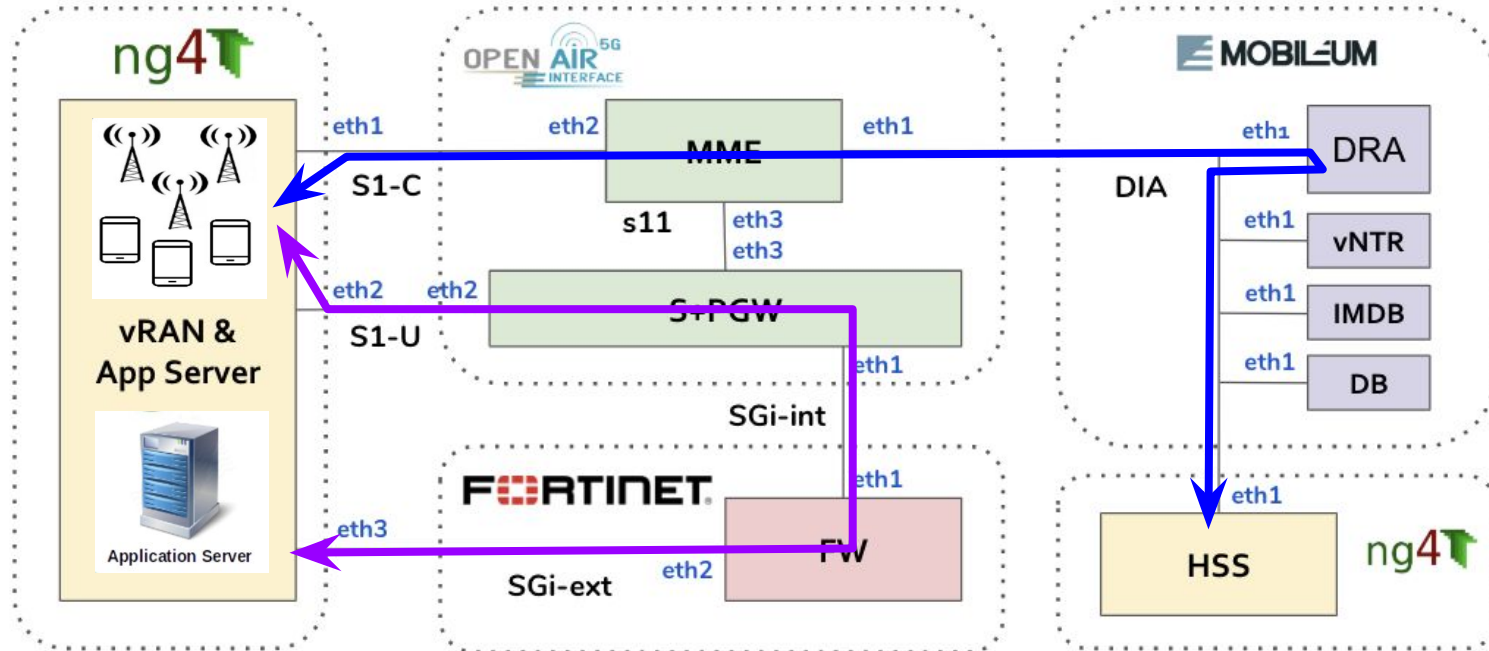
Attribute	Description
Component	Open Source MANO
Release	5.0.5
Distribution	WhiteNFV (by Whitestack)
Version	alcobendas-1rc3



Attribute	Description
Operating System	Ubuntu Server
Release	18.0.4 LTS
Kernel	4.15.0-48
KVM	4.15.0-48
QEMU	2.11

Attribute	Description
Component	Openstack
Release	Rocky
Distribution	WhiteCloud (by Whitestack)
Version	rio-1

# Network Service

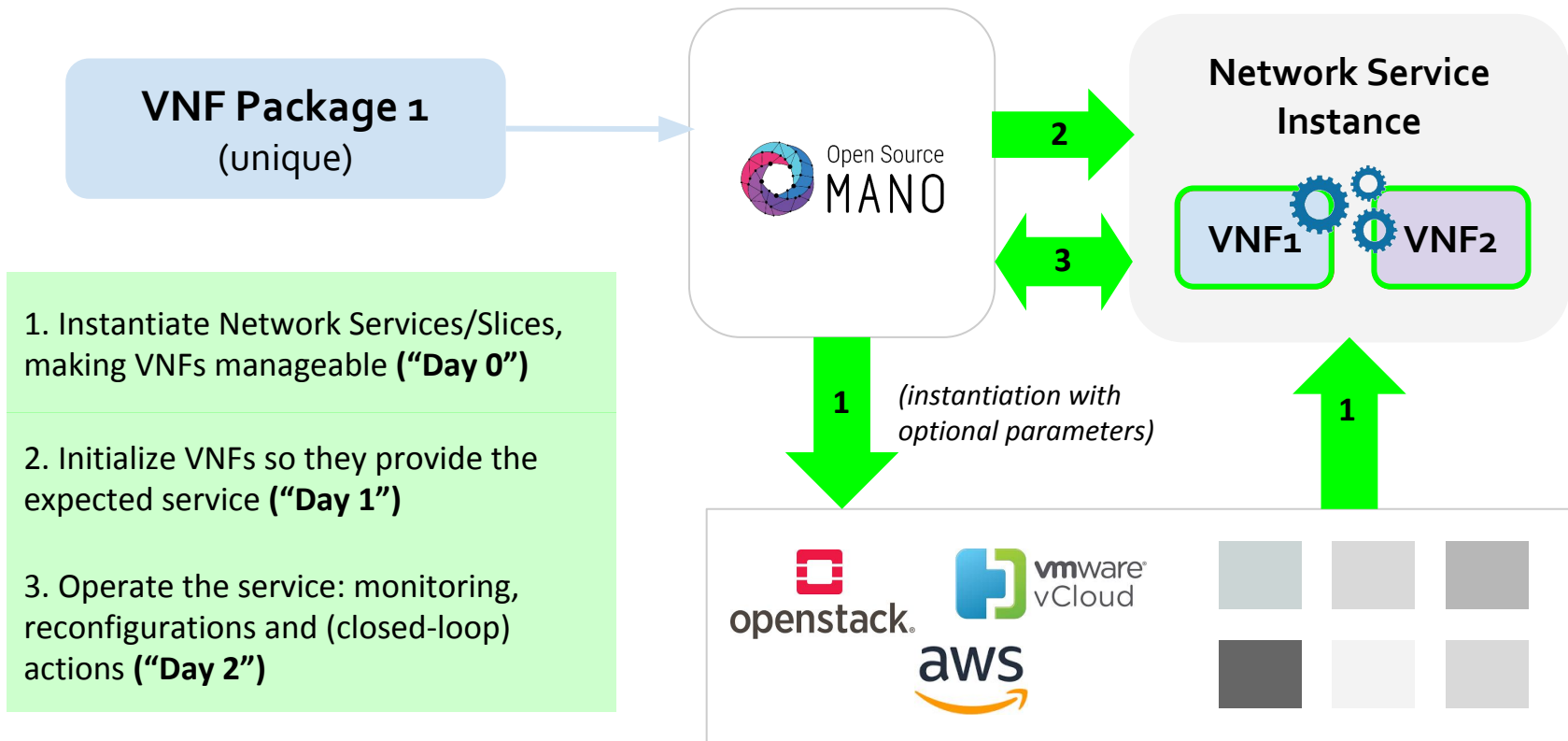


Mobile Data Service Control Plane

Mobile Data Service Data Plane

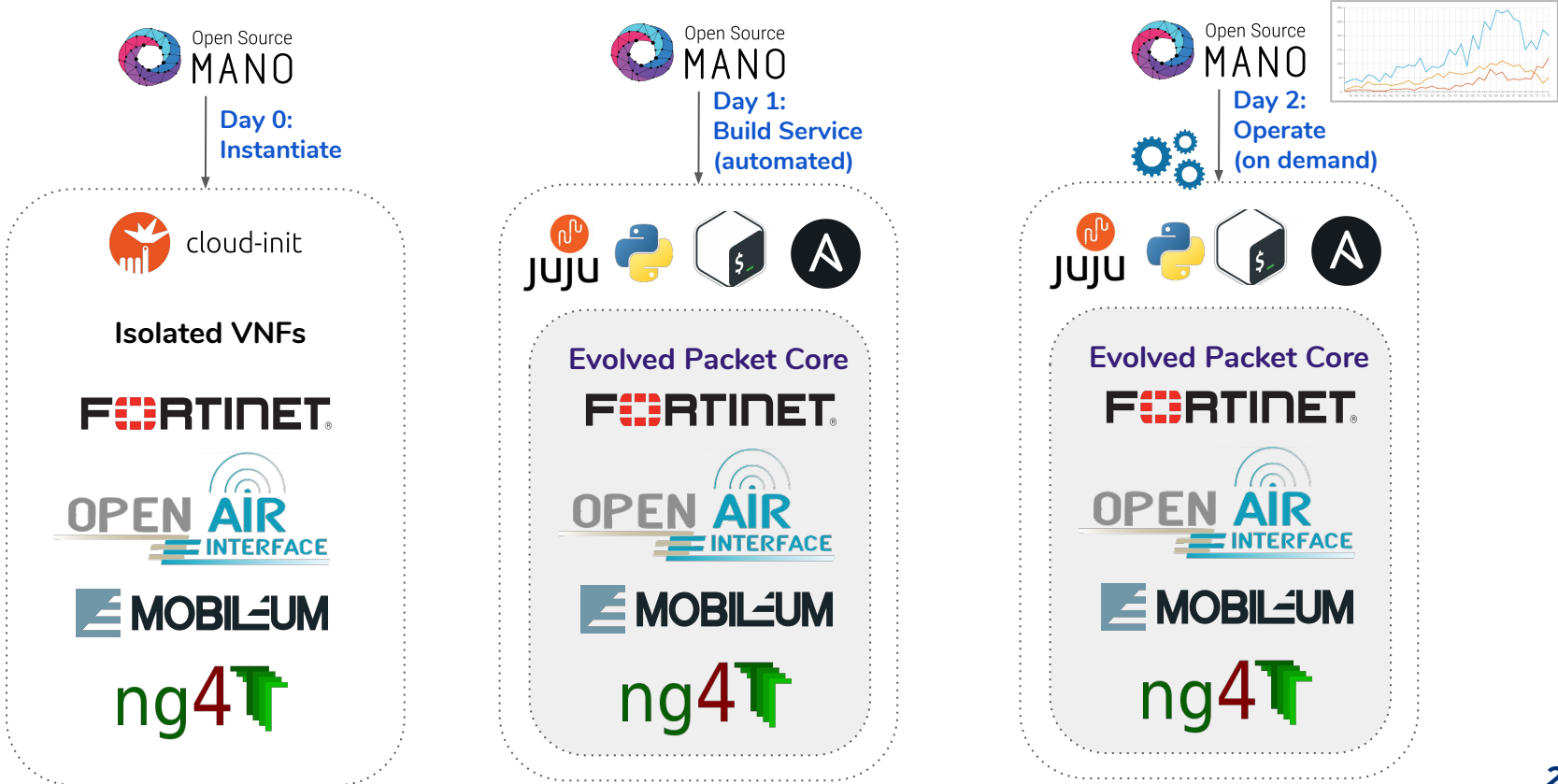
# The VNF Onboarding Challenge

What's the real objective?



# The VNF Onboarding Challenge

How do we achieve it?



# The VNF Onboarding Challenge

## How do we achieve it?

The VNF Onboarding process concludes when we have a package that models the VNF Day-0 to Day-2 requirements

```

1 nsd:nsd-catalog:
2   nsd:
3     - constituent-vnfd:
4       - member-vnf-index: 1
5         vnfd-id-ref: vran-vnfd
6       - member-vnf-index: 2
7         vnfd-id-ref: oai-psgw
8     - member-vnf-index: 3
9       vnfd-id-ref: h
10    - member-vnf-index: 4
11      vnfd-id-ref: m
12    - member-vnf-index: 5
13      vnfd-id-ref: m
14    - member-vnf-index: 6
15      vnfd-id-ref: m
16    - member-vnf-index: 7
17      vnfd-id-ref: m
18    - member-vnf-index: 8
19      vnfd-id-ref: f
20    - member-vnf-index: 9
21      vnfd-id-ref: d
22    id: ng4t-oai-for
23    ip-profiles:
24      - name: s1-c
25        description:
26          ip-profile-p
  
```

```

1 vnfd-catalog:
2   vnfd:
3     - connection-point:
4       - name: eth0
5         type: VPORT
6       - name: eth1
7         port-security-enabled: 'false'
8         type: VPORT
9       - name: eth2
10        port-security-enabled: 'false'
11        type: VPORT
12      - name: eth3
13        port-security-enabled: 'false'
14        type: VPORT
15      description: oai-psgw
16      id: oai-psgw-vnfd
17      mgmt-interface:
18        cp: eth0
19        name: oai-psgw-vnfd
20        service-function-chain: UNAWARE
21        short-name: oai-psgw-vnfd
22        vdu:
23          - cloud-init-file: psgw-cloud-init
24            supplemental-boot-data:
25              boot-data-drive: true
26            count: '1'
  
```

```

1 - hosts: all
2   connection: local
3   vars:
4     username: "admin"
5     password: "password"
6   tasks:
7     - name: Configure interfaces.
8       fortios_system_interface:
9         host: "{{ fgt_mgmt_ip }}"
10        username: "{{ username }}"
11        password: "{{ password }}"
12        https: "False"
13      system_interfaces:
14        @when('actions.add-routes')
15        def add_routes():
16          # Adding LTE routes
17          ue_network = action_get('ue_network')
18          sgiint_fw_ip = action_get('sgiint_fw_ip')
19          app_network = action_get('app_network')
20          cmd = "sudo ip r add default via " + sgiint_fw_ip + " dev ens4 table lte && \
21              sudo ip rule add from " + ue_network + " table lte && \
22              sudo route add -net " + app_network + " gw " + sgiint_fw_ip
23          charms.sshproxy._run(cmd)
24          remove_flag('actions.add-routes')
25
26        @when('actions.start-service')
27        def start_service():
28          err = ''
29          # Start SPGW
30          cmd = "/home/ubuntu/OAI/start_spgw"
31          charms.sshproxy._run(cmd)
32          remove_flag('actions.start-service')
  
```

# The VNF Onboarding Challenge

## What do we get?

1. We are able to instantiate the VNFs successfully.

The screenshot illustrates the VNF onboarding process in the whitestack platform. The main interface shows the NSD Composer with a network topology diagram. A pop-up window for instance **D-5-ntrvdu-1** provides the following details:

- ID:** 48a5a091-4fda-4aac-a599-98d31b07ad2f
- STATUS:** Active
- IP Addresses:**
  - 14.10.20.5
  - 25e1a09f-cef4-4213-b174-2c62e76cb64f
  - 172.21.7.180
  - e7115eae-f235-43cc-a371-75ed72b6c62e
- Actions:** View Instance Details, Open Console, Delete Instance

The secondary window, titled "Network Topology", shows a detailed view of the network with vertical bars representing VNF instances. The instances are labeled as follows:

- D-5-ntr (Red bar)
- D-5-ntr (Purple bar)
- D-5-ntr (Brown bar)
- D-5-ntr (Pink bar)
- vfn-ntrvdu (Grey bar)

The IP addresses for these instances are listed below the bars:

- 14.10.20.0/24
- 192.168.246.0/24
- 192.168.24.0/24
- 192.168.134.0/24
- 10.10.10.0/24

# The VNF Onboarding Challenge

## What do we get?

### 2. We get a fully functional Network Service without manual intervention

The screenshot displays the FortiGate VM64-KVM interface for the FortiGate-NFV-Showcase. The left sidebar shows the navigation menu with 'Interfaces' selected. The main panel shows the configuration for the 'port2' source interface, with a summary of traffic statistics: Bytes: 54.20 kB, Sessions: 1, and Bandwidth: 2.22 kbps.

Overlaid on the interface is a configuration window for 'MOBILEUM' Applications. The 'Connections' tab is active, showing a search for 'Diameter Routing Agent' with instances 'DRA-01'. Below the search, there is a 'New Entry' button and a table of connections:

Name	Type	Self Address	Peer Address	Host Name	Realm	Status
HSS	Initiator	tcp://14.10.20.6:3869	tcp://14.10.20.3:3869	Demo.EDB.HSS	com.roamware.com	Enabled
MME	Responder	tcp://14.10.20.6:3868	NA	Demo.EDB2.MME.ng4T.com	com.roamware.com	Enabled

In the background, a terminal window shows the execution of a test script: 'run 4G\_M2AS\_PING\_FIX Straffduration=10000'. The terminal output includes details about the test case, log files, and the execution of a 4G ping test with a fixed length of 10000. The output also shows a table of test results with columns for time, Attache, Active, Attac, and various status indicators.



# The VNF Onboarding Challenge

## What do we get?

3. We are able to operate the service through simple interfaces through the Orchestrator

The screenshot displays the OSM Sample Dashboard with two line charts and a modal dialog box.

**VDU CPU Metric (VIM)** chart shows CPU usage for various VNF instances from 09:56:40 to 09:57:30. The y-axis ranges from 0 to 25. A significant spike is visible for VNF 1 (green line) around 09:57:00.

**VDU Memory Metric (VIM)** chart shows memory usage for the same VNF instances. The y-axis ranges from 200 to 1.4 K. Memory usage is relatively stable across all instances.

**Perform Action** dialog box details:

- Primitive:** change-ippool
- VNF Member index:** 8
- Primitive parameters:**
  - Name:** poolname, **Value:** pool1 (with a red minus button)
  - Name:** startip, **Value:** 192.168.147.200 (with a red minus button)
  - Name:** endip, **Value:** 192.168.147.203 (with a green plus button)
- Buttons:** Cancel, Execute

# Conclusions & Invitation



# Conclusions



In only 4 weeks:

1. VNFs from different vendors were **described** (VNFD) and **onboarded** in the Open Source MANO catalog.
2. **Day-0, Day-1 and Day-2 operations were automated** for each VNF, by using **Open Source MANO VCA** (VNF Configuration and Abstraction), on top of OpenStack, following ETSI NFV Standards.
3. A multi vendor **virtualized Evolved Packet Core was modeled**, by using the ETSI OSM Information Model, including multiple Virtual Links for implementing the service topology.
4. And we deployed it on OpenStack with OSM.

## LESSONS LEARNT

Most of the challenges are not related to technology  
**but to the use of good practices**

We are not anymore in the discussion if traditional  
software would work virtualized on x86,  
**but how to scale by using the cloud**

**Dynamic Configuration - Scalability Models - Manageability**

*(that are also limitations in the baremetal model)*

# Final Report

The final results, including configurations used for deploying this vEPC, are published, following the guidelines from ETSI Plugtests Programme.



<https://www.whitestack.com/posts/results-multivendor-nfv-showcase/>



Demonstrating NFV is Possible

## Open Multi-Vendor NFV Showcase

Results and conclusions

1st Edition - April 2019

Participating VNFs



Enabled by



Developed within the ETSI NFV Plugtests™ Programme



# Invitation

The Cloud was the result of a **industry effort to reach more efficiencies**, aligning manufacturers, software developers, systems integrators and service providers.

The Telco industry is **struggling to scale**, and needs to move to the Cloud. Virtualizations is not enough!

# Invitation

Vendors need to **get on board**, by

- Adopting new **tools and technologies** (cloud-centric)
- Using more recent **best practices**  
(*dynamic config, horizontal scaling*)
- Creating cloud-native solution,  
**and demonstrate them in action.**

We encourage vendors to follow that path, and participate in our

## **2nd Multi Vendor NFV Showcase**

(Oct/2019)

# Thanks!

Download report from:



Gianpietro Lavado  
[glavado@whitestack.com](mailto:glavado@whitestack.com)  
Whitestack



Jose Miguel Guzmán  
[jmguzman@whitestack.com](mailto:jmguzman@whitestack.com)  
Whitestack