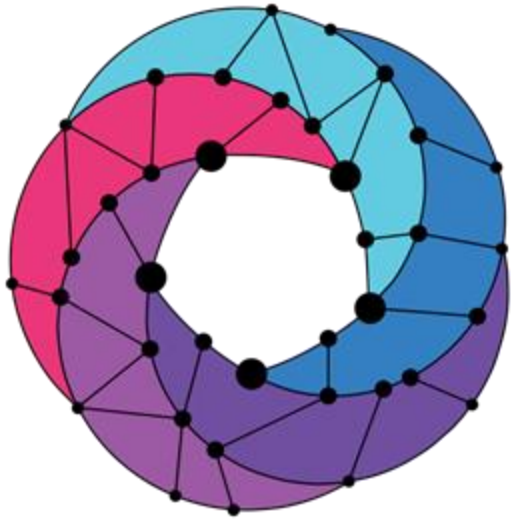


Open Source
MANO

OSM is Awesome

A Practical Introduction to OSM

Gianpietro Lavado - Whitestack

OSM#5 Louisville - April 2018

ETSI

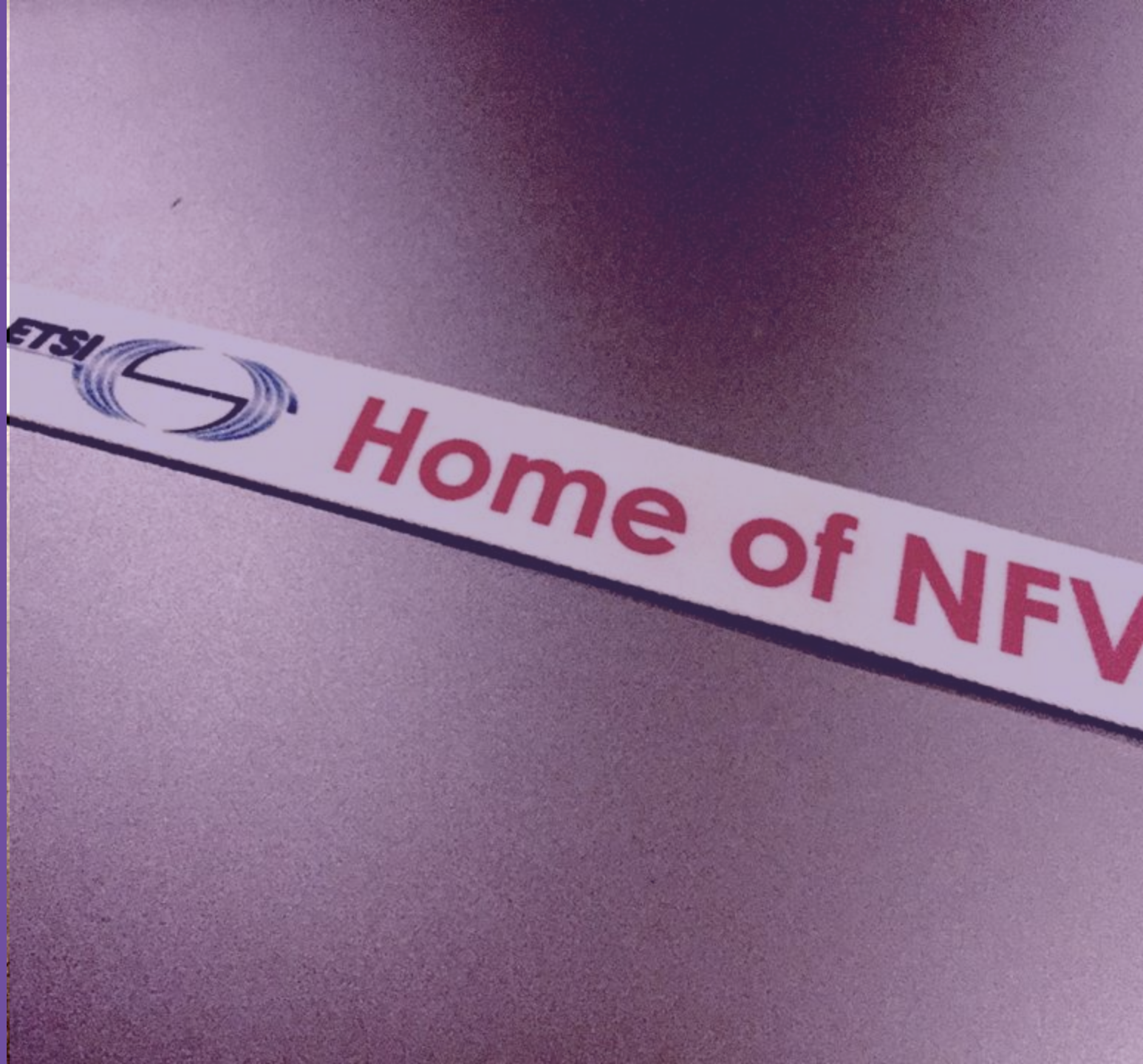
Agenda

- **Introduction: Architecture and OSM R3**
- Hands On! - Installation, configuration and instantiation
- Contributing to the Community

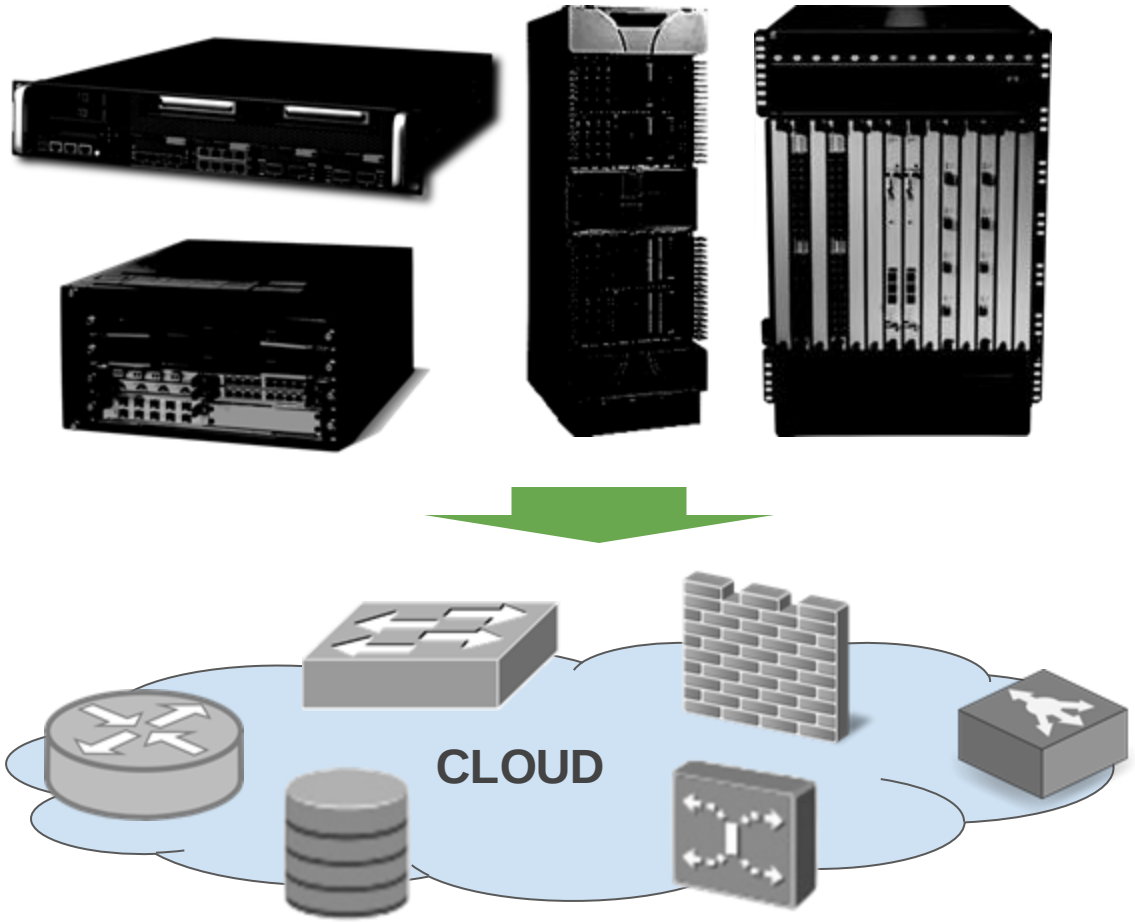
Open Source MANO

ETSI NFV architecture and components

Section: Introduction



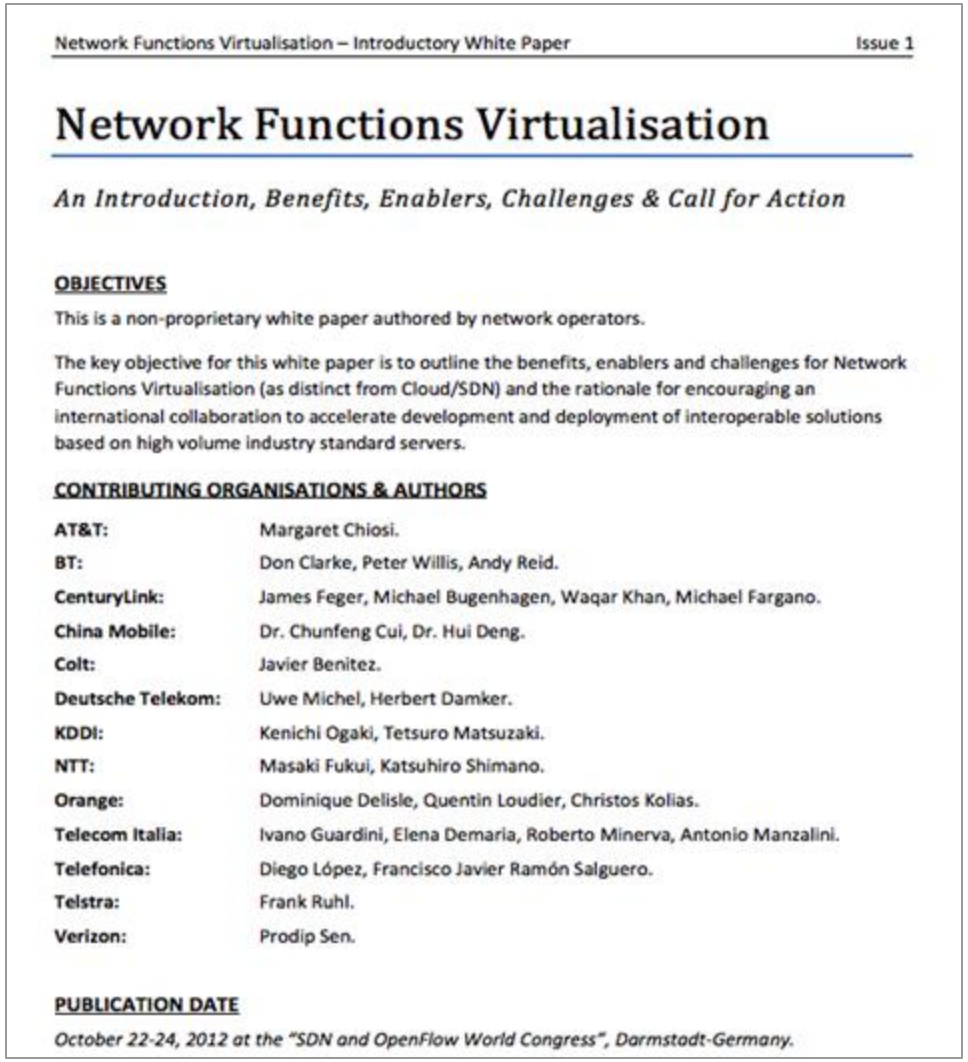
What is NFV trying to address?



- Network Function Virtualization (NFV) proposes to virtualize network functions that typically run in dedicated appliances
- The main goal is to support virtualized functions over COTS servers.
- Virtual Network Functions (VNFs) acquire all the advantages of Cloud Applications!

How was this originated?

- A white paper was written in 2012 by the world's leading telecom network operators.
- This group evolved to the ETSI NFV ISG (Industry Specification Group), formed today by 300+ companies.
- Their main motivation had to do with the increasing TCO of building a network with proprietary hardware appliances.



Network Functions Virtualisation – Introductory White Paper Issue 1

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.

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Verizon:	Prodip Sen.

PUBLICATION DATE

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

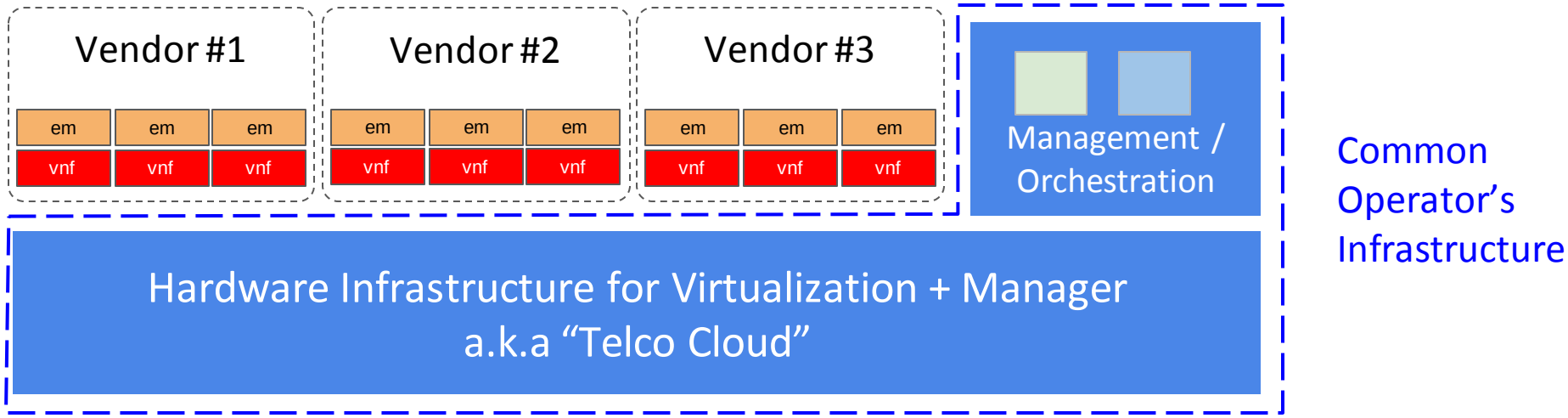
ETSI Publications

- 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
  - NFV Infrastructure Overview
    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/standards-search

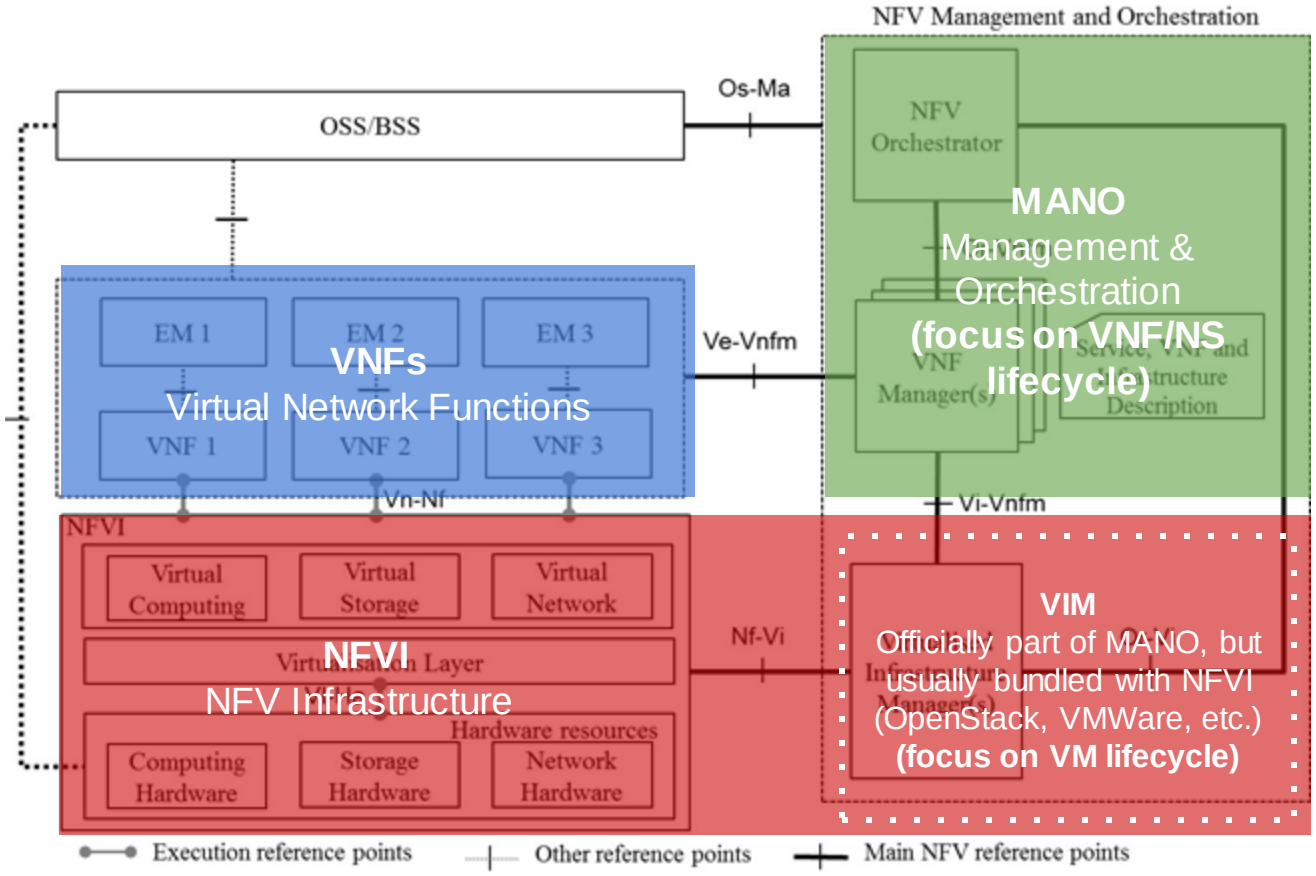
Benefits of a standard NFV architecture

- We are looking for a **unified and generic virtualization infrastructure**, compatible with any vendor's Virtual Networking Function (VNF), **so standardization is a must**.



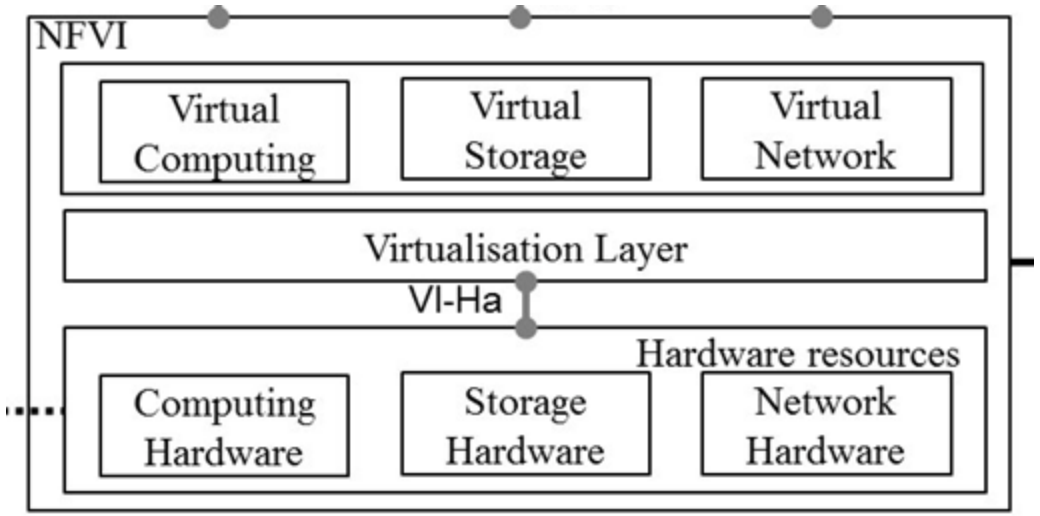
The ETSI NFV Architecture

- The standard architecture can be better understood in three blocks:



NFVI: NFV Infrastructure

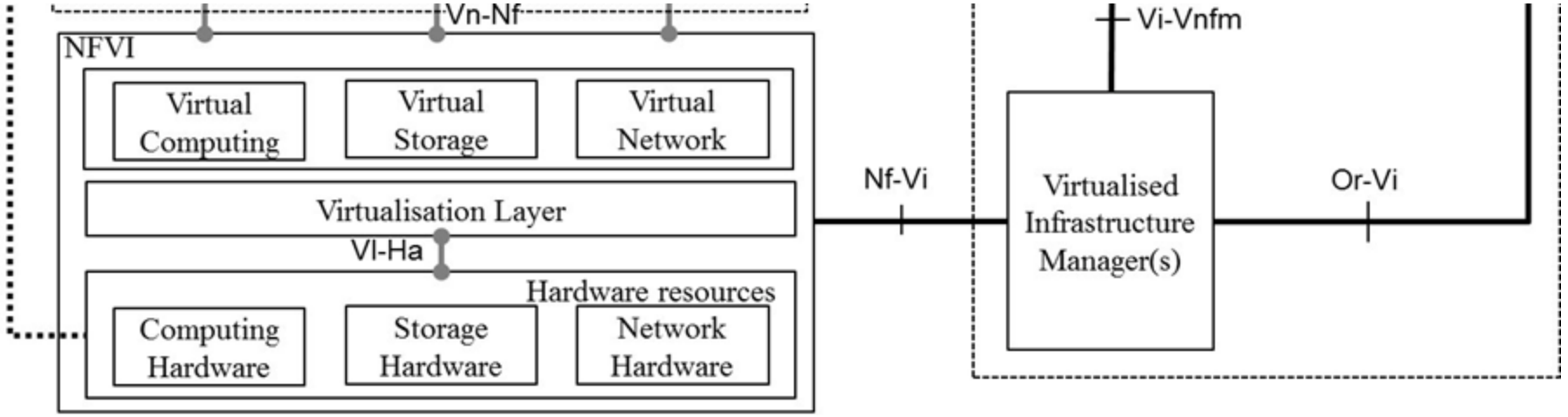
- NFVI goal is to provide a virtualization environment for VNFs, including virtual compute, storage and networking resources.



- But! networking applications may have more strict performance requirements, we will discuss that later.

MANO: Virtualized Infrastructure Manager

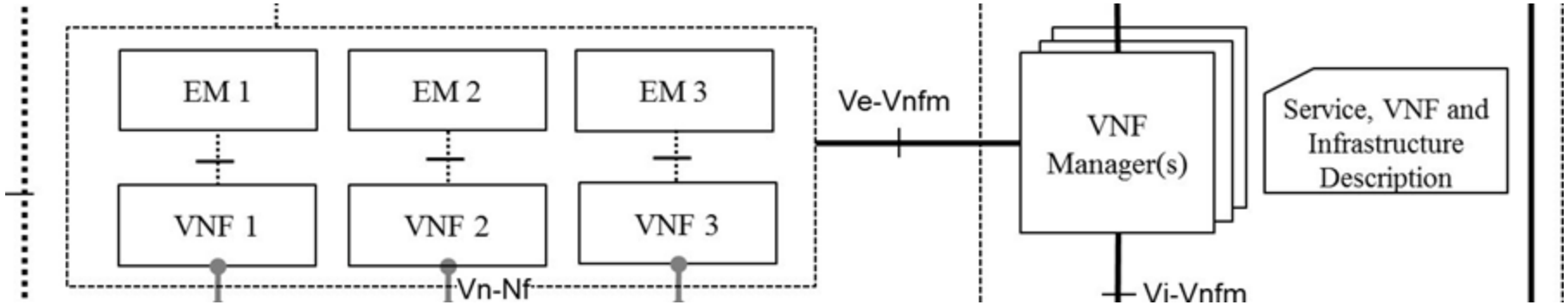
- The Virtualized Infrastructure Manager is part of the 'MANO Stack' and addresses provides lifecycle management for virtualized resources (VMs, volumes, networking paths and connectivity, etc.)



Examples: OpenStack distributions, VMWare products, Public Cloud managers, etc.

MANO: VNF Manager

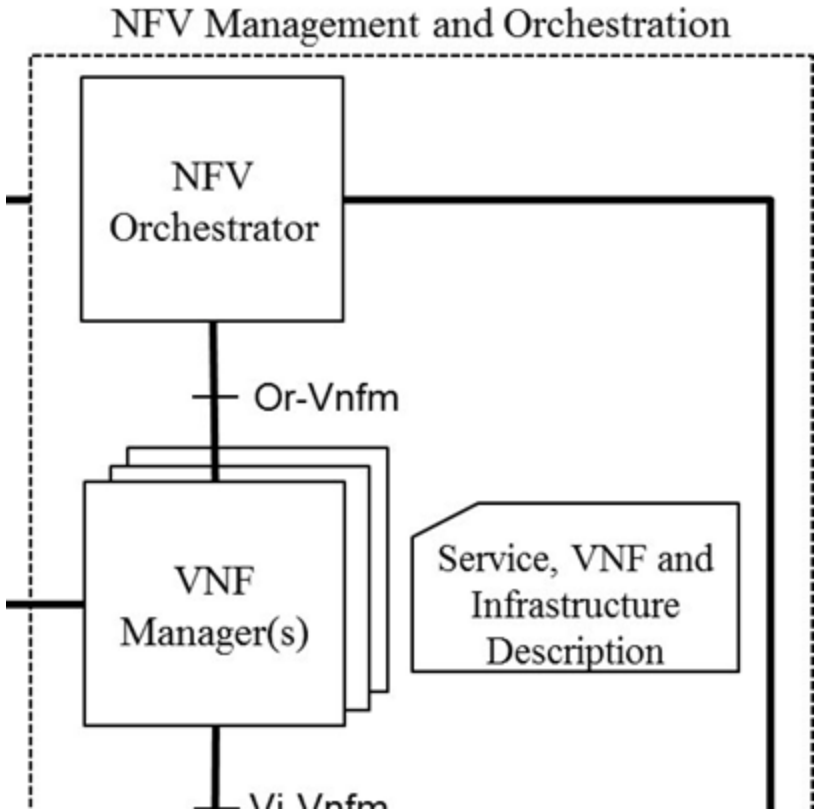
- The VNF Manager, also part of the ‘MANO Stack’, covers lifecycle management for Virtual Network Functions (VNFs), either directly or through their own Element Management System (EMS).



- VNF Managers can be generic (current trend), or vendor-specific ones.

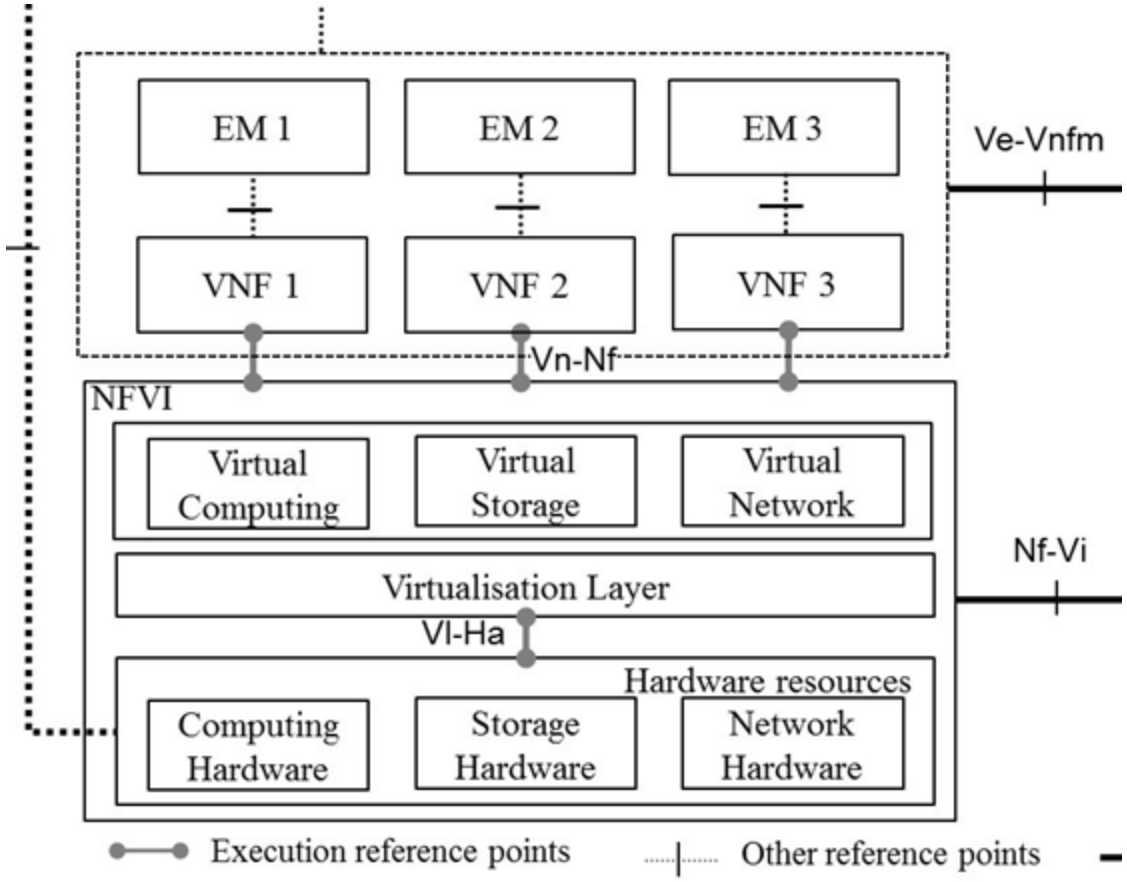
MANO: NFV Orchestrator

- The NFV Orchestrator, the higher entity in the ‘MANO Stack’, covers general resource orchestration and services lifecycle, which comprise multiple VNFs and define their roles (traffic paths, scaling decisions, and other service-related requirements)
- It can interact with a generic VNF Manager, or vendor-specific ones.



Virtual Network Functions

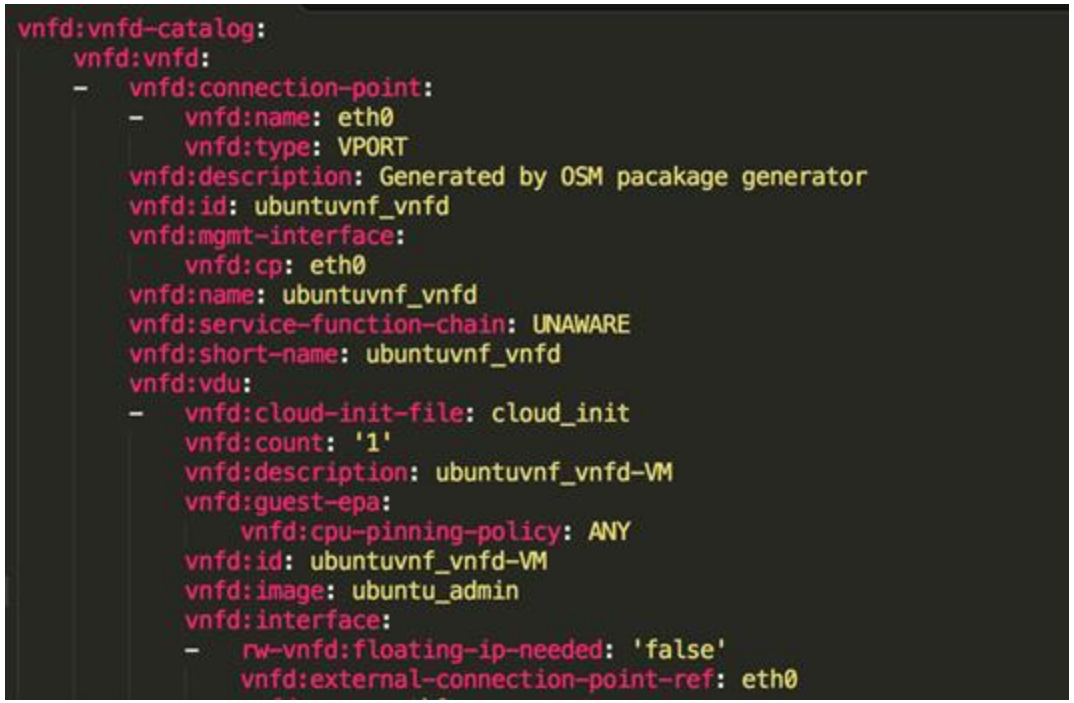
- Finally, the VNFs, which are supported by the underlying NFVI, and managed by their own EM (internal manager) and the VNF Manager (external, ‘context-aware’ manager)
- They should be able to provide any networking function and interact with other VNFs.



VNF Descriptor files

One of the most important aspects of achieving a unified VNF catalogue, is having a standard way of describing VNFs.

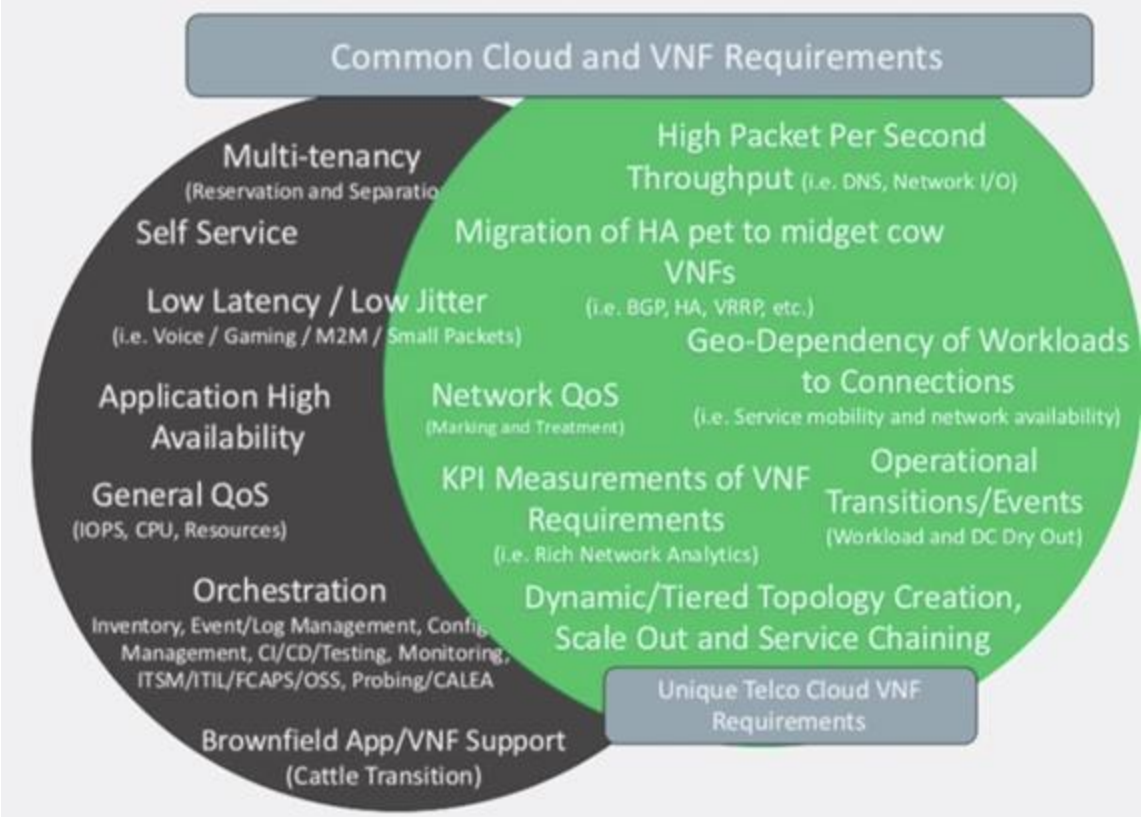
- MANO solutions should give the possibility to describe VNFs through ‘descriptor files’
- The industry’s goal is a unified and standard descriptor file format across different platforms.
- Both NS (comprised of VNFs) and VNFs should be described in a simple way.



VNF Special Requirements

VNFs, especially data-plane ones, usually have additional requirements than common cloud applications, including:

- Minor latency (disk I/O & network)
  → faster disks, QoS, higher BW
- Geographical distribution
  → multi-site cloud
- Horizontal auto-scaling
  → automated operations
- Higher throughput or PPS
  → EPA: Enhanced Platform Awareness



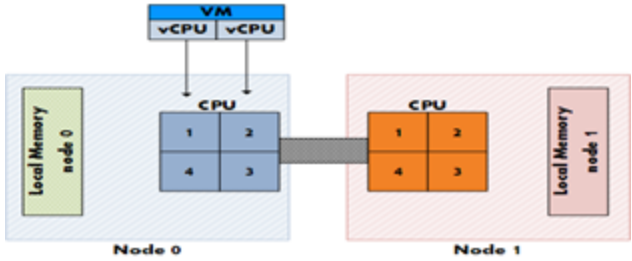
OpenStack Austin 2016: Telco Cloud Requirements: What VNF's Are Asking For

VNF Special Requirements: EPA!

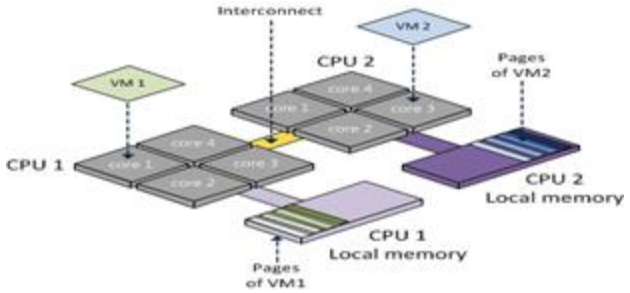
EPA covers the different approaches that can be taken to increase performance while maintaining a generic (COTS) infrastructure

Huge Pages

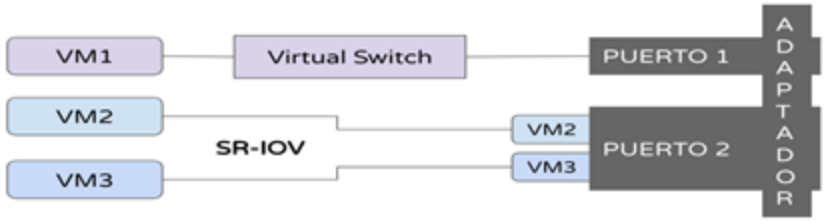
NUMA Topology Awareness



CPU Pinning



Data Plane assignment



The NFV MANO Landscape

- Given that the VIM is already well covered by OpenStack distributions and proprietary solutions, in practice, **the "NFV MANO" part focuses on the VNF Manager and NFV Orchestrator.**
- Among the most popular open source platforms for NFV MANO, we have:

Open Source MANO

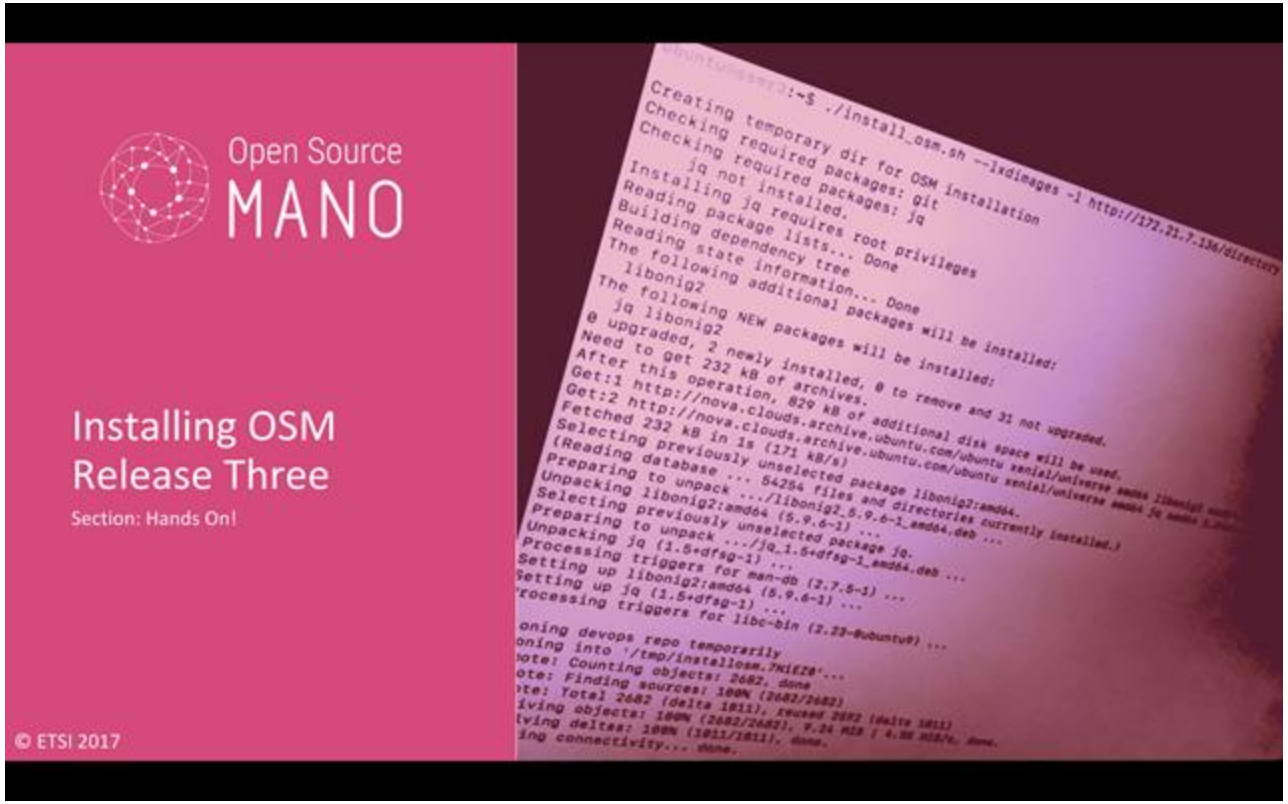
Introduction to OSM Release Three

Section: Introduction

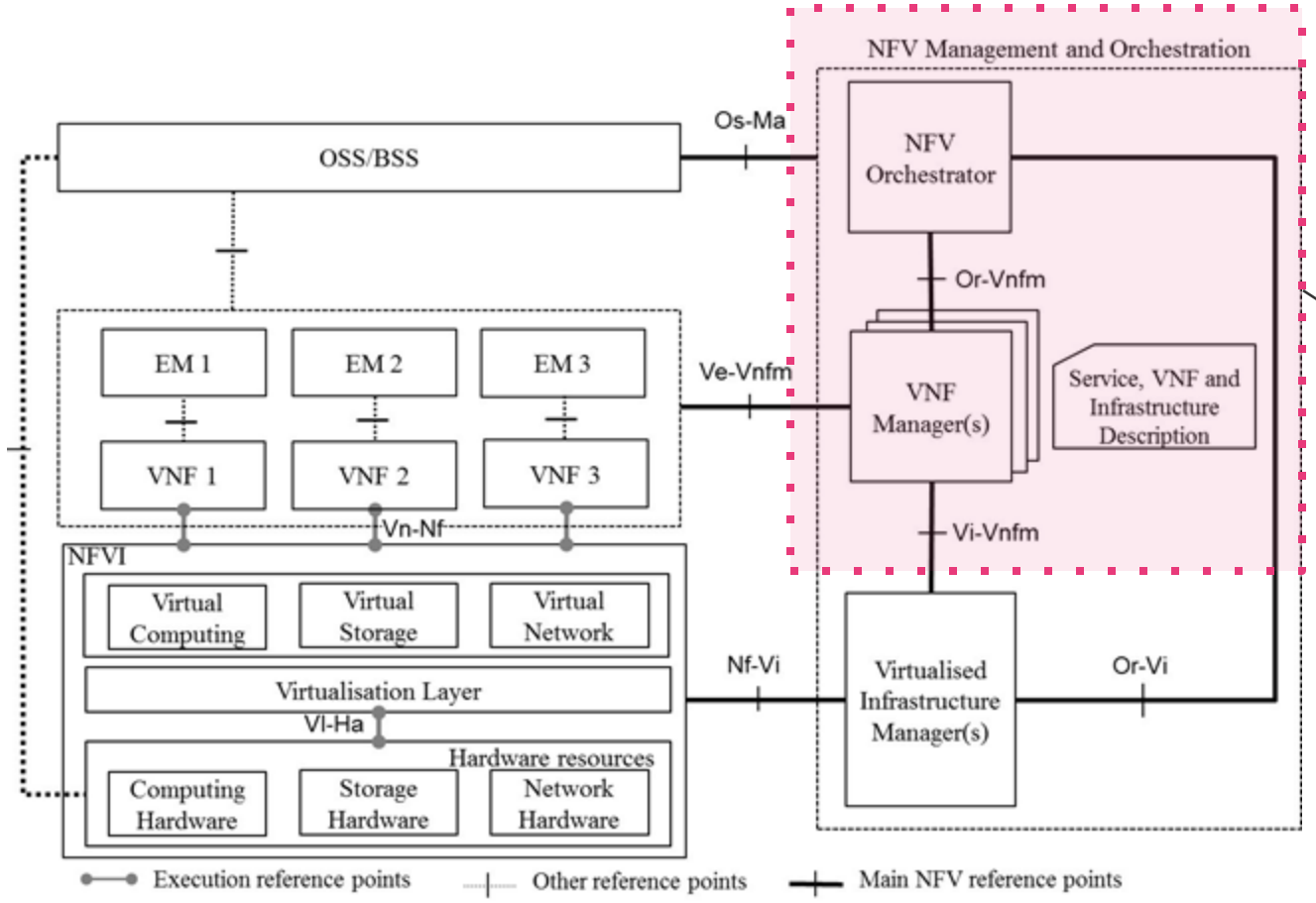
Let’s get started with OSM

Before exploring the highlights of OSM, let’s begin the installation to make the best use of time.

- Go to slide 32 and begin OSM installation.



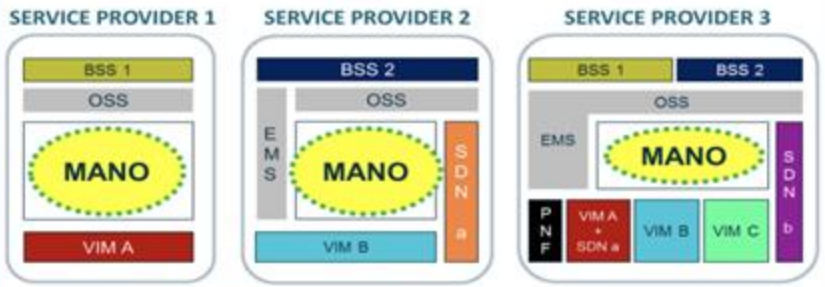
The Open Source MANO Project



We are here!
Open Source MANO is an ETSI-hosted project to develop an Open Source NFV Management and Orchestration (MANO) software stack aligned with ETSI NFV.

OSM Strategy

FOCUS ON **WHAT WE HAVE IN COMMON**



Key is **INTEROPERABILITY**, not full architecture

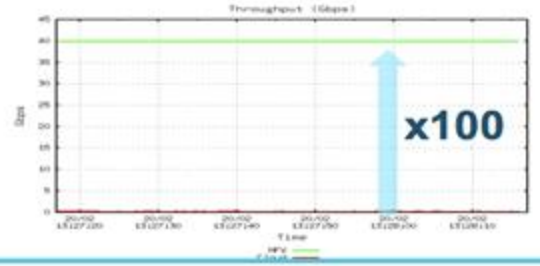
MULTIPLE VIMs & SDNs ARE HERE TO STAY (public clouds too!)

openstack · vmware · WIND · amazon web services · OPEN DAYLIGHT · onos Open Network Operating System

LEVERAGE ON **ETSI NFV** WORK

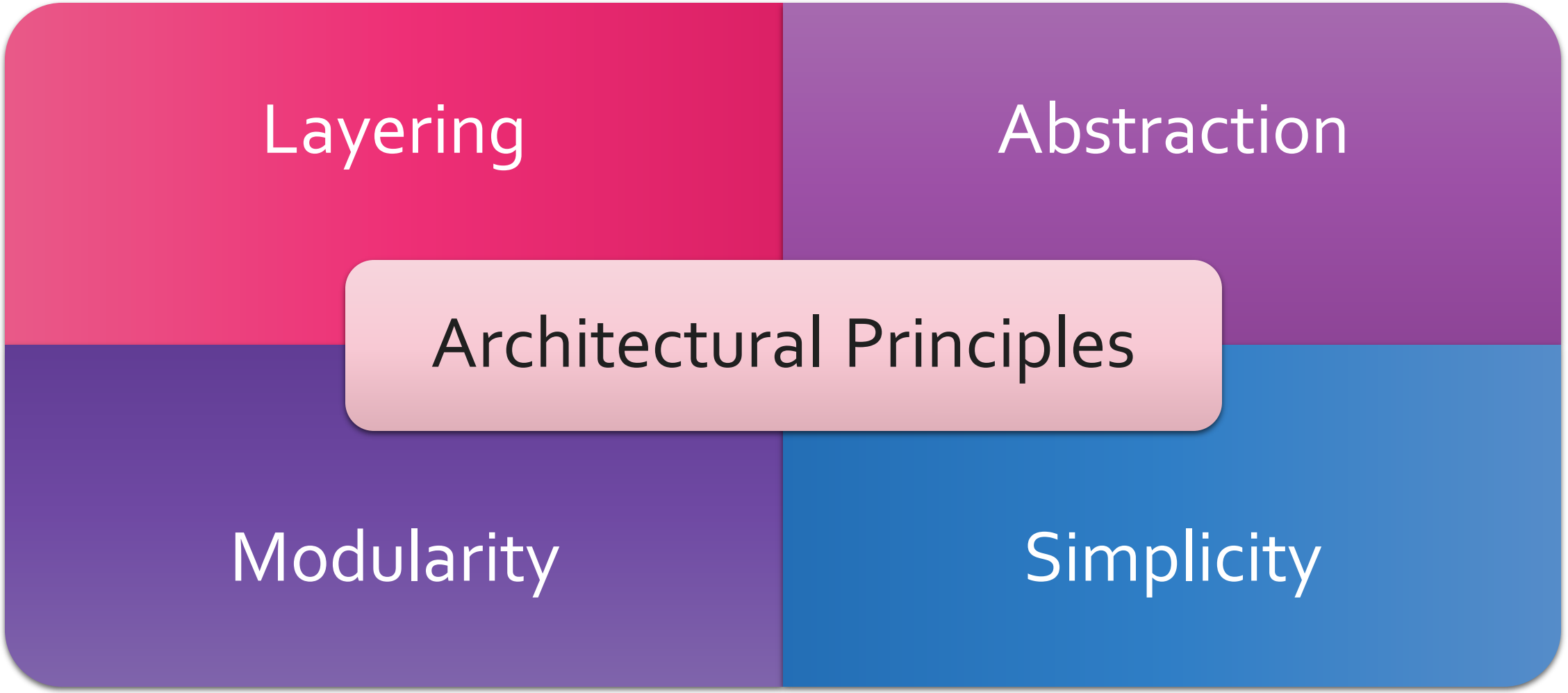
READY FOR **GREENFIELD** AND **BROWNFIELD**

PERFORMANCE MATTERS FOR THE BUSINESS CASE



OPEN SOURCE AS TOOL TO FACILITATE CONVERGENCE

OSM Architectural Principles



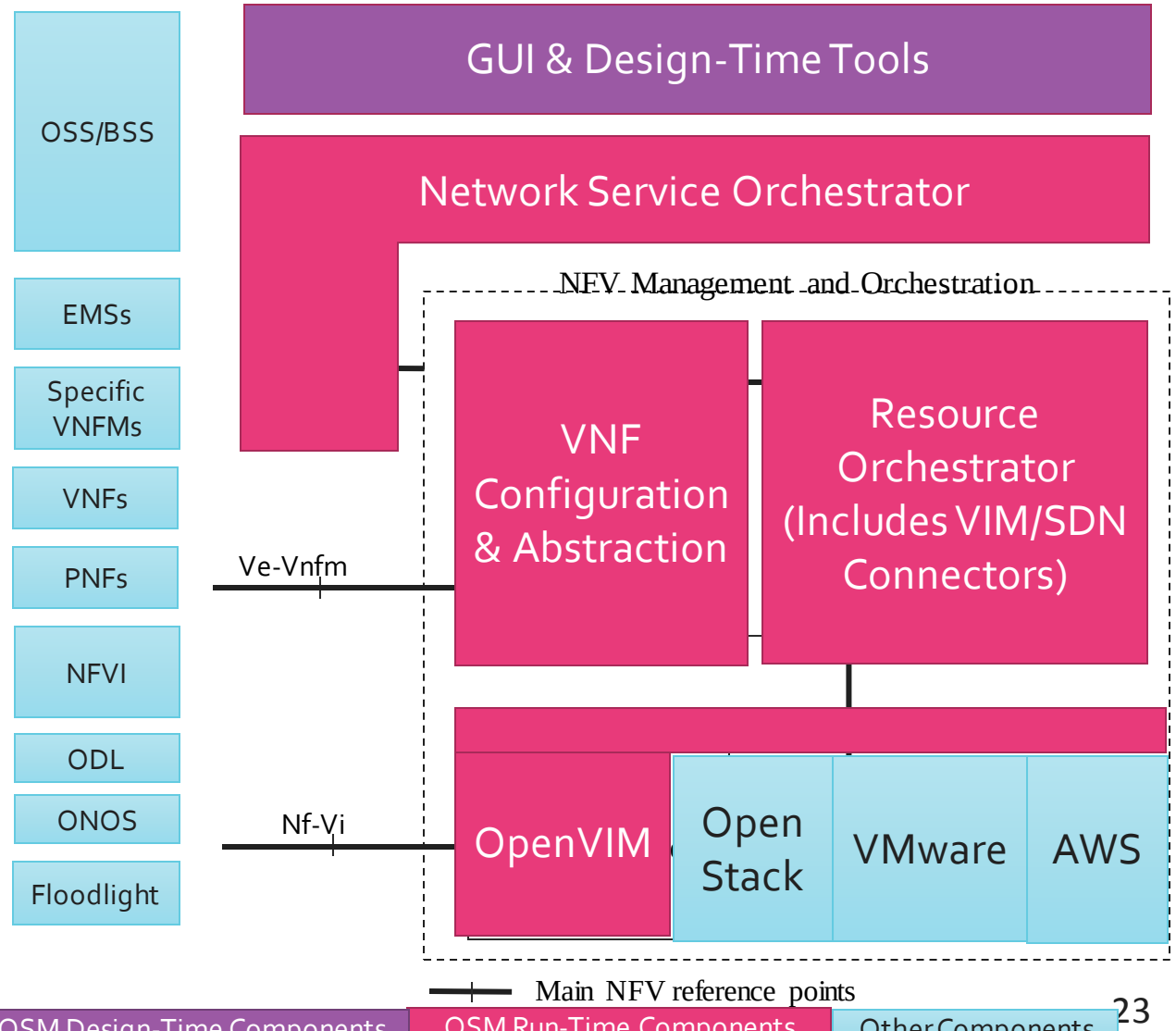
How OSM maps to ETSI NFV MANO?

Run-Time Scope

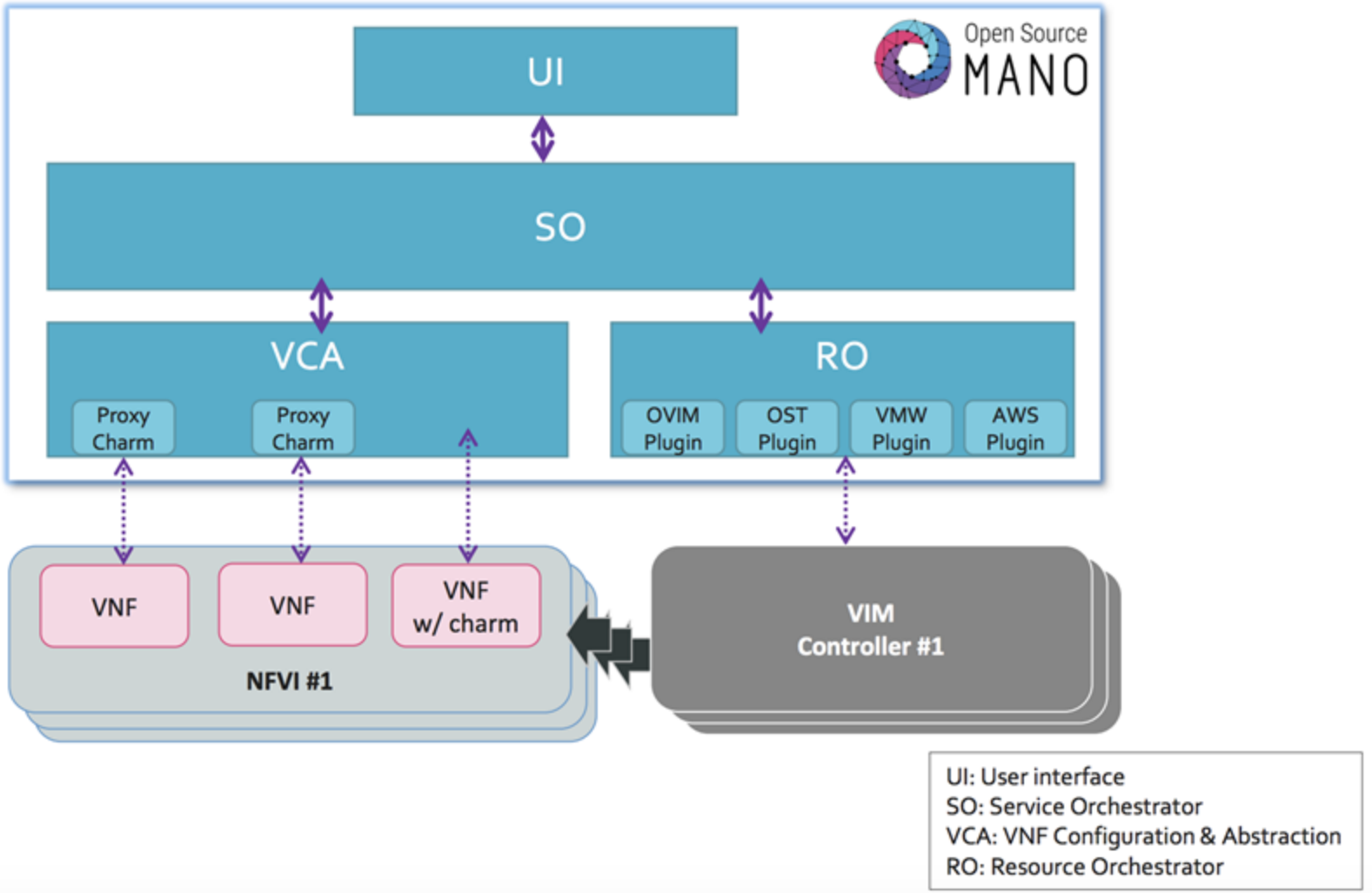
- Automated end-to-end Service Orchestration
- Superset of ETSI NFV MANO
- Plugin model for integrating multiple SDN controllers
- Plugin model for integrating multiple VIMs
- Plugin model for integrating monitoring tools
- Integrated Generic VNFM with support for integrating Specific VNFMs
- Support for Physical Network Function integration
- Greenfield and brownfield deployments

Design-Time Scope

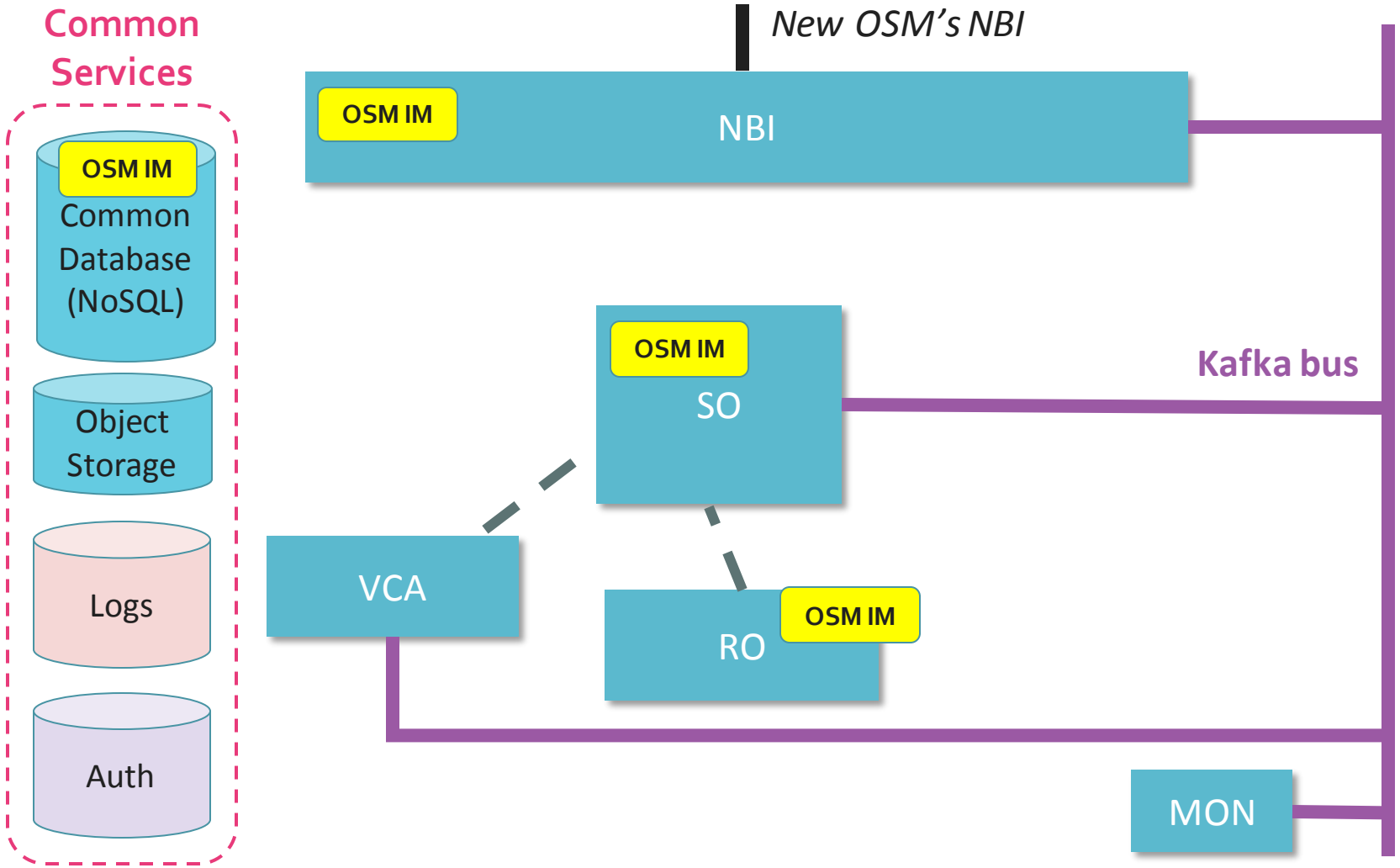
- Network Service Definition (CRUD operations)
- Model-Driven Environment with Data Models aligned with ETSI NFV
- VNF Package Generation
- GUI



This is today's OSM (simplified) Architecture



...which is evolving!

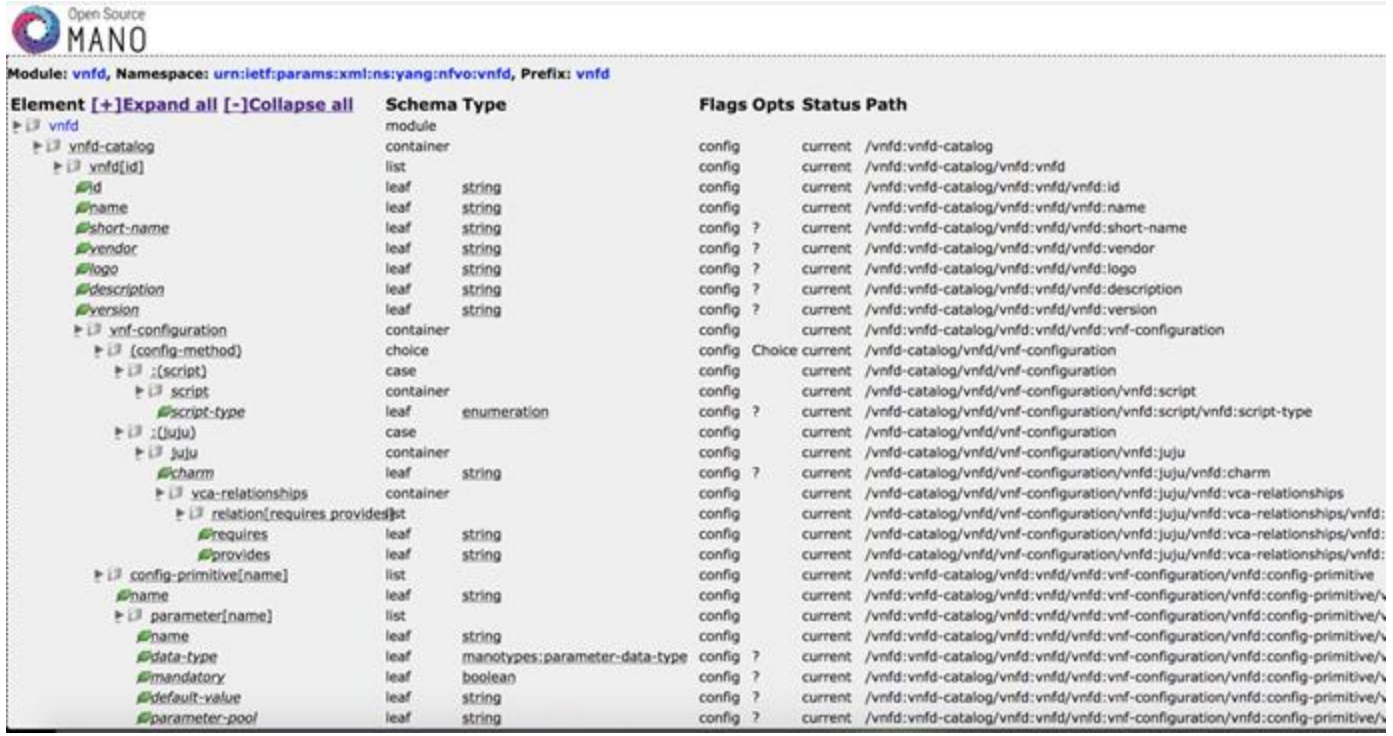


Why is OSM Awesome?

It has a rich and open information model

- Agnostic to VIM, SDN platform, VNF and OSS connectors/specifics.
- It allows for a uniform NFV orchestration, abstracted from the environment
- Aligned with ETSI-NFV Information Model

Visit:
https://osm.etsi.org/wikipub/index.php/OSM_Information_Model


Open Source MANO

Module: vnfd, Namespace: urn:ietf:params:xml:ns:yang:nfvo:vnfd, Prefix: vnfd

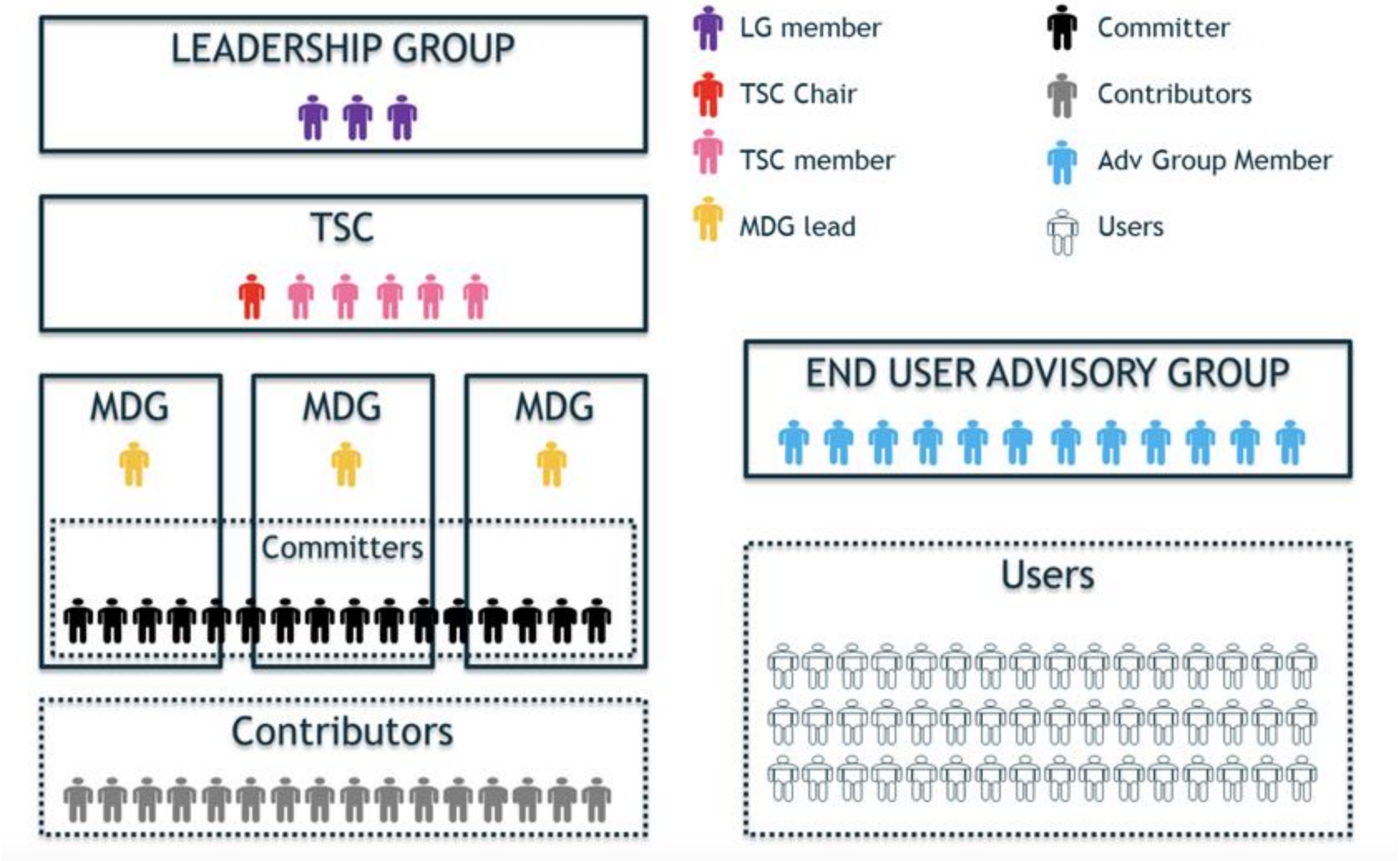
Element [+]Expand all [-]Collapse all	Schema Type		Flags	Opts	Status	Path
vnfd	module					
vnfd-catalog	container		config		current	/vnfd:vnfd-catalog
vnfd[id]	list		config		current	/vnfd:vnfd-catalog/vnfd:vnfd
id	leaf	string	config		current	/vnfd:vnfd-catalog/vnfd:vnfd/vnfd:id
name	leaf	string	config		current	/vnfd:vnfd-catalog/vnfd:vnfd/vnfd:name
short-name	leaf	string	config	?	current	/vnfd:vnfd-catalog/vnfd:vnfd/vnfd:short-name
vendor	leaf	string	config	?	current	/vnfd:vnfd-catalog/vnfd:vnfd/vnfd:vendor
logo	leaf	string	config	?	current	/vnfd:vnfd-catalog/vnfd:vnfd/vnfd:logo
description	leaf	string	config	?	current	/vnfd:vnfd-catalog/vnfd:vnfd/vnfd:description
version	leaf	string	config	?	current	/vnfd:vnfd-catalog/vnfd:vnfd/vnfd:version
vnf-configuration	container		config		current	/vnfd:vnfd-catalog/vnfd:vnfd/vnfd:vnf-configuration
(config-method)	choice		config	Choice	current	/vnfd-catalog/vnfd/vnf-configuration
:(script)	case		config		current	/vnfd-catalog/vnfd/vnf-configuration
script	container		config		current	/vnfd-catalog/vnfd/vnf-configuration/vnfd:script
script-type	leaf	enumeration	config	?	current	/vnfd-catalog/vnfd/vnf-configuration/vnfd:script/vnfd:script-type
:(juju)	case		config		current	/vnfd-catalog/vnfd/vnf-configuration
juju	container		config		current	/vnfd-catalog/vnfd/vnf-configuration/vnfd:juju
charm	leaf	string	config	?	current	/vnfd-catalog/vnfd/vnf-configuration/vnfd:juju/vnfd:charm
vca-relationships	container		config		current	/vnfd-catalog/vnfd/vnf-configuration/vnfd:juju/vnfd:vca-relationships
relation[requires provides]	list		config		current	/vnfd-catalog/vnfd/vnf-configuration/vnfd:juju/vnfd:vca-relationships/vnfd:
requires	leaf	string	config		current	/vnfd-catalog/vnfd/vnf-configuration/vnfd:juju/vnfd:vca-relationships/vnfd:
provides	leaf	string	config		current	/vnfd-catalog/vnfd/vnf-configuration/vnfd:juju/vnfd:vca-relationships/vnfd:
config-primitive[name]	list		config		current	/vnfd:vnfd-catalog/vnfd:vnfd/vnfd:vnf-configuration/vnfd:config-primitive
name	leaf	string	config		current	/vnfd:vnfd-catalog/vnfd:vnfd/vnfd:vnf-configuration/vnfd:config-primitive/v
parameter[name]	list		config		current	/vnfd:vnfd-catalog/vnfd:vnfd/vnfd:vnf-configuration/vnfd:config-primitive/v
name	leaf	string	config		current	/vnfd:vnfd-catalog/vnfd:vnfd/vnfd:vnf-configuration/vnfd:config-primitive/v
data-type	leaf	manotypes:parameter-data-type	config	?	current	/vnfd:vnfd-catalog/vnfd:vnfd/vnfd:vnf-configuration/vnfd:config-primitive/v
mandatory	leaf	boolean	config	?	current	/vnfd:vnfd-catalog/vnfd:vnfd/vnfd:vnf-configuration/vnfd:config-primitive/v
default-value	leaf	string	config	?	current	/vnfd:vnfd-catalog/vnfd:vnfd/vnfd:vnf-configuration/vnfd:config-primitive/v
parameter-pool	leaf	string	config	?	current	/vnfd:vnfd-catalog/vnfd:vnfd/vnfd:vnf-configuration/vnfd:config-primitive/v

Why is OSM Awesome?

It has a large and diverse community!
More than 90 members and growing

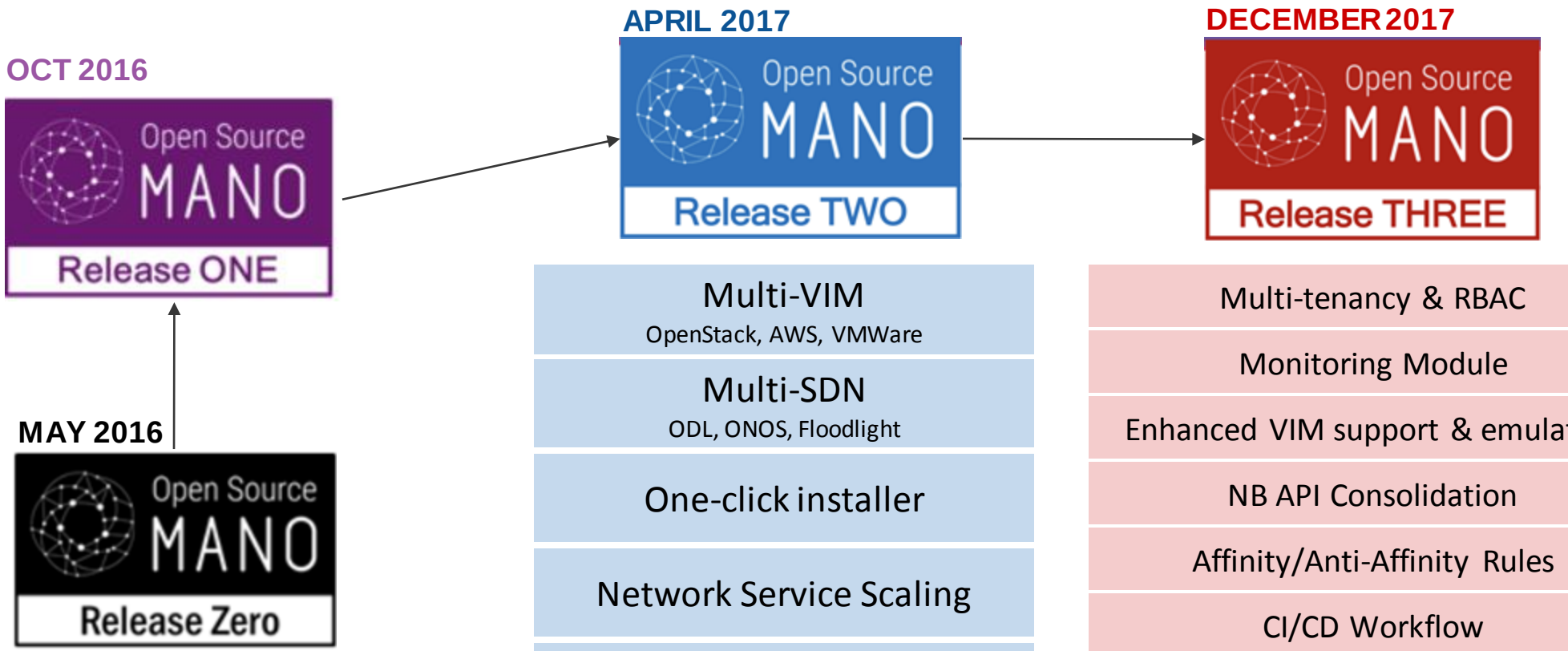
Why is OSM Awesome?

It is well organized for producing production-ready upstream code



Why is OSM Awesome?

It prioritizes features for production readiness



Why is OSM Awesome?

…and will keep expanding its features towards production deployments:

- Alignment of OSM NBI to SOL05 & SOL04
- Tighter integration of Monitoring module
  - Leverage on metrics and alarms to drive further automation (new Policy Manager module)
- Management of VNFs of new generation
  - Docker containers + Kubernetes mgmt
  - Hybrid NFs (Virtual + Physical)
- Support of future 5G deployments
  - Network Slicing likely to require NS Nesting, Management of shared resources
- Improvements in packaging format
- Portable and lightweight deployments

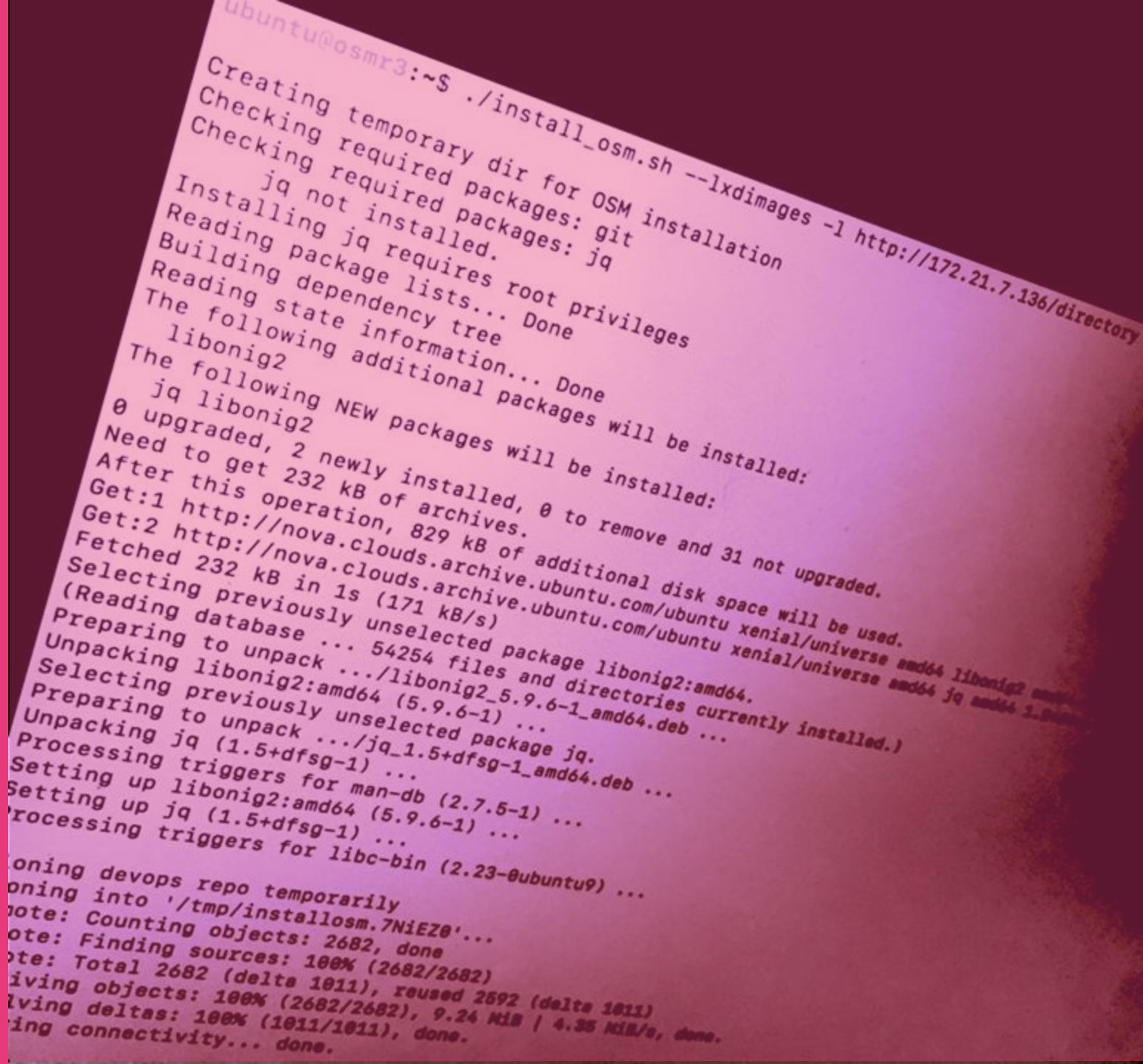
Agenda

- Introduction: Architecture and OSM R3
- **Hands On! - Installation, configuration and instantiation**
- Contributing to the Community

Open Source MANO

Installing OSM Release Three

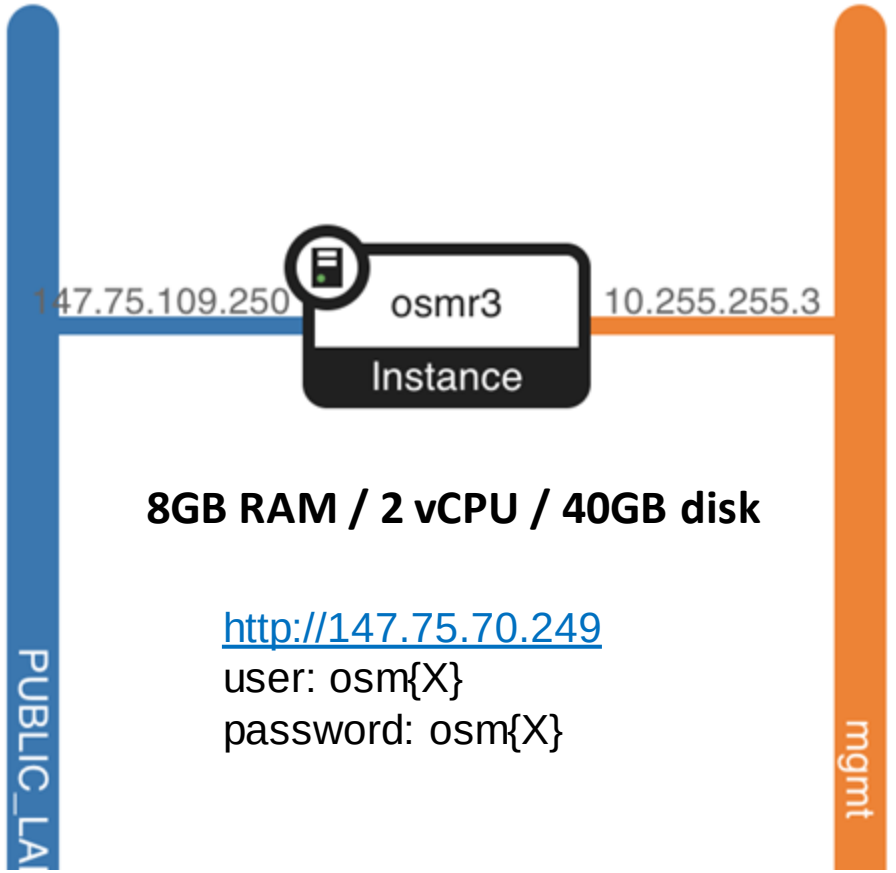
Section: Hands On!



The lab environment

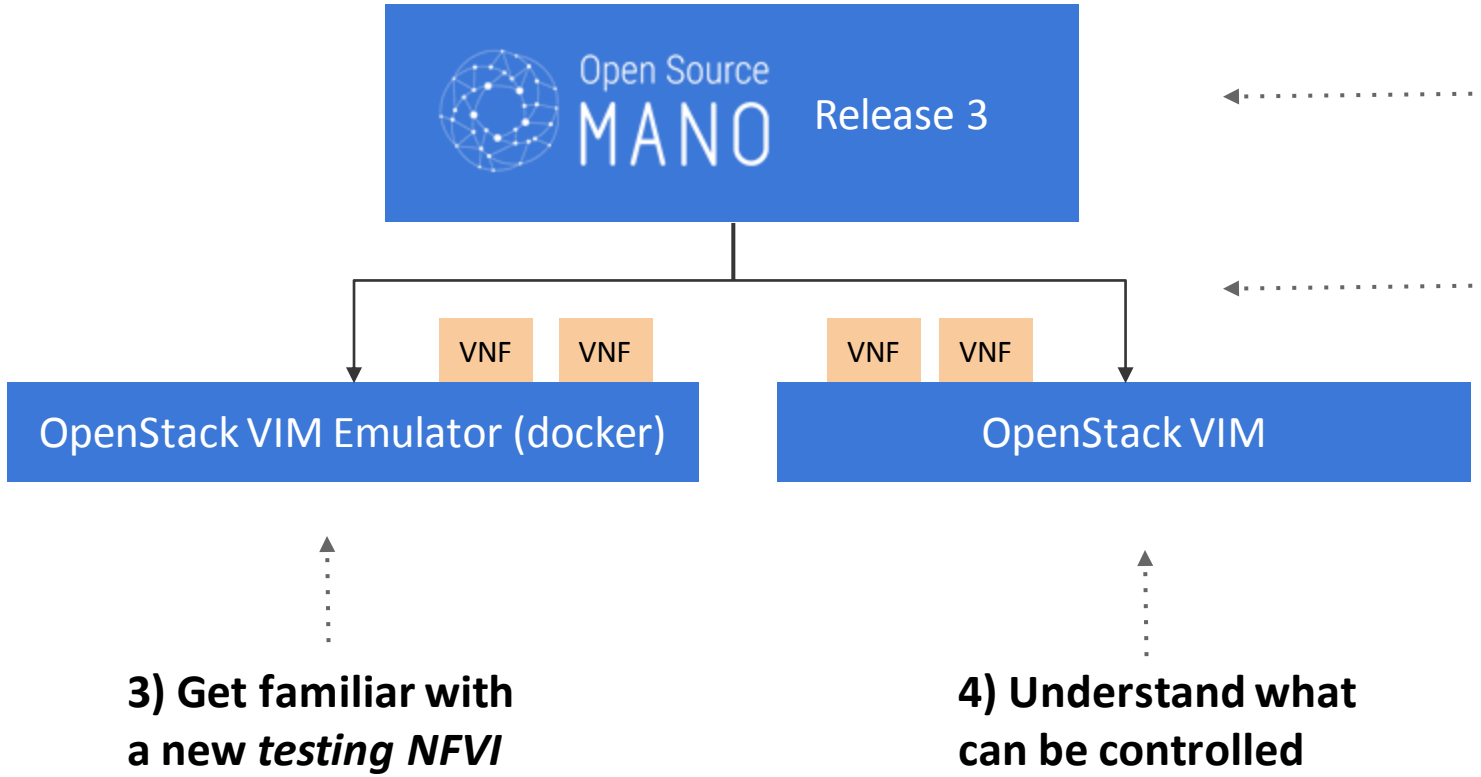
Each POD is an OpenStack tenant containing:

- A VM running Ubuntu, ready to install OSM and the VIM Emulator.
- Connection to 2 networks:
  - “PUBLIC_LAB”: for external management.
  - “mgmt”: to place VNFs and directly interact with them.



Lab folder: https://goo.gl/Vuv7xw

The lab objectives



Installing OSM

There are multiple options for installing OSM, including:

- Installing into LXC containers (current official way)
  - From binaries (>60m)
  - From source code (>60m)
  - From prepared LXC images (~7-12m)
  - Adding a the VIM emulator (+ ~10m, ~1m with images)
- Installing into Docker Containers (experimental, ~3m with images)

Official options → https://osm.etsi.org/wikipub/index.php/OSM_Release_THREE

Hands-on: Let's install OSM!

In this exercise, we will use prepared LXC containers, with a new option for including an OpenStack VIM Emulator * (~10min)

1. Access your POD's virtual machine (ubuntu/ubuntu), which already includes LXC/LXD setup, the installer file, and Docker (for the VIM Emulator)
2. Run the following command to initiate automated installation:

   ./install_osm.sh --lxdimages -l http://147.75.91.107/directory --vimemu

   → The procedure will import LXC images from a local repository (if specified without "-l", it will download them from the official public repository)

   → The --vimemu option is only available with the latest installer file

Hands-on: Let's install OSM!

At the end of the installation script, some environment variables should be set to your session to run the OSM client and VIM Emulator.

```
# You can copy the following lines or directly put the IPs after the equal signs.
# OSM client related variables
    export OSM_HOSTNAME=`lxc list | awk '($2=="SO-ub"){print $6}'`
    export OSM_RO_HOSTNAME=`lxc list | awk '($2=="RO"){print $6}'`
# VIM Emulator related variables
    export VIMEMU_HOSTNAME=172.17.0.2
```

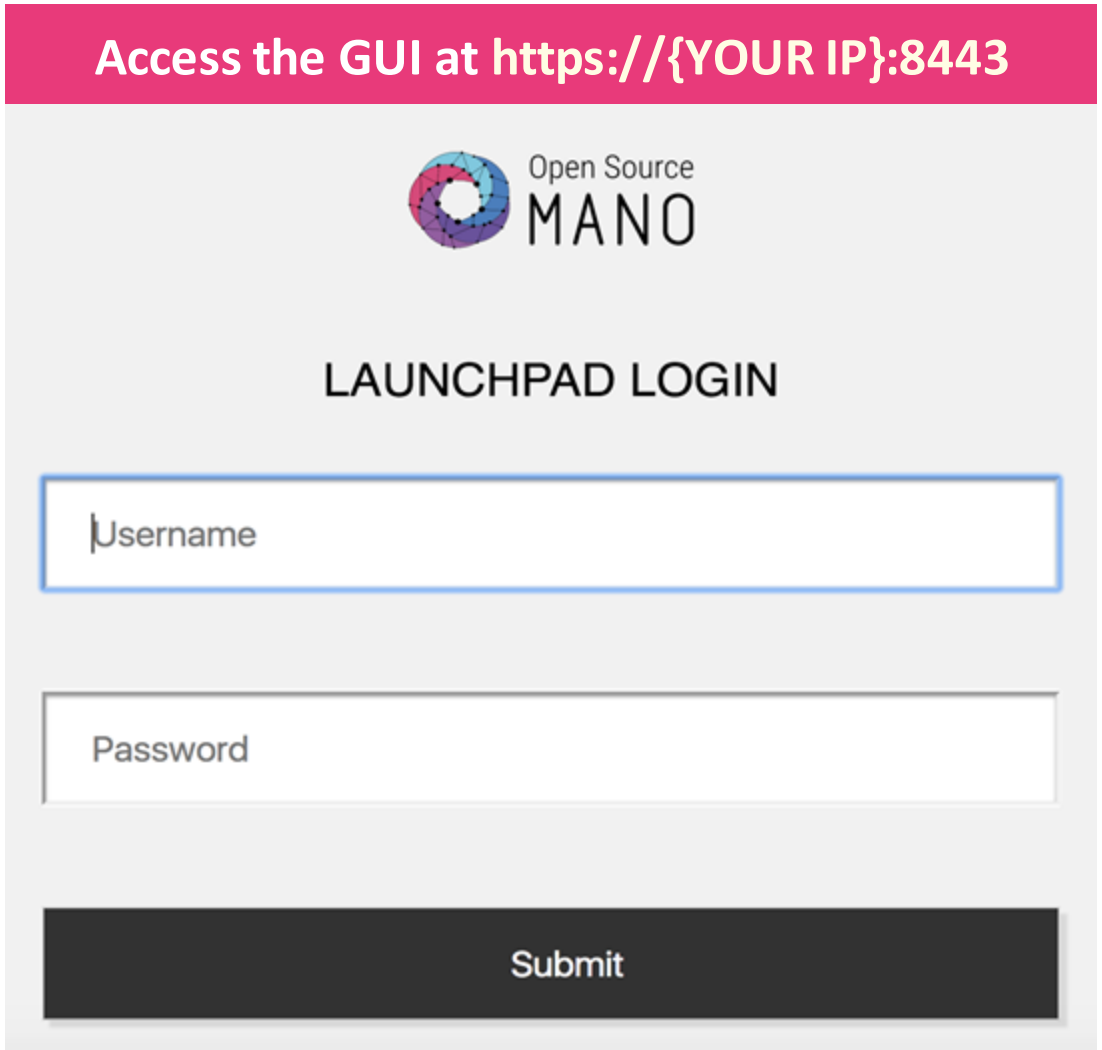
→ They can be set on the fly or persisted at the end of your ~/.bashrc file.

Hands-on: Let's install OSM!

Finally, you should be able to login with **admin** / **admin** credentials to the UI, or run some OSM commands from the host

```
# VIM List and Network Service Descriptors list
# will show empty for now

osm vim-list

osm nsd-list

# VIM Emulator should show a couple of
# "emulated datacenters"

docker exec vim-emu vim-emu datacenter list
```

Access the GUI at https://{YOUR IP}:8443



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Time for a

let’s grab some 

ETSI

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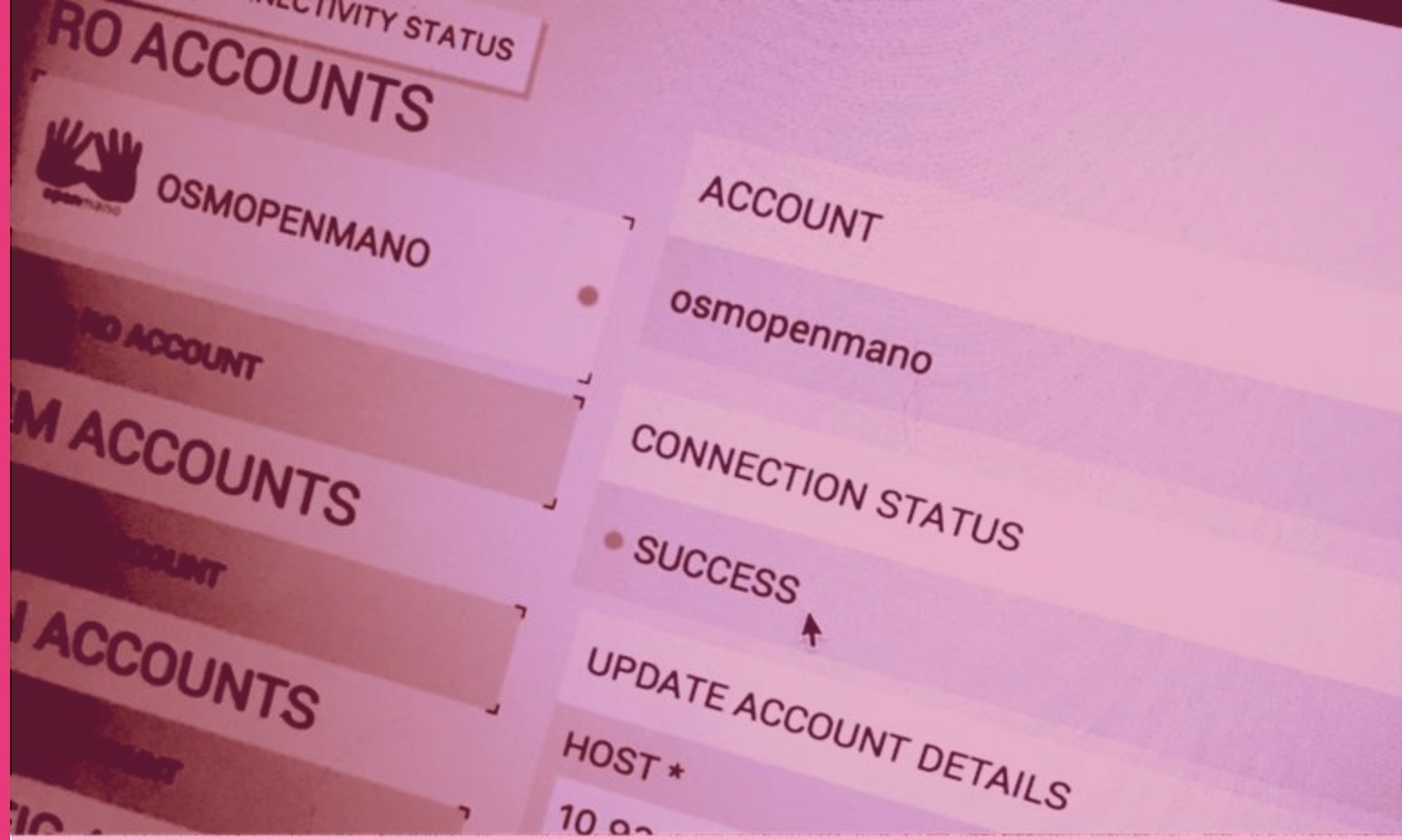
OSM initial configuration

Section: Hands On!



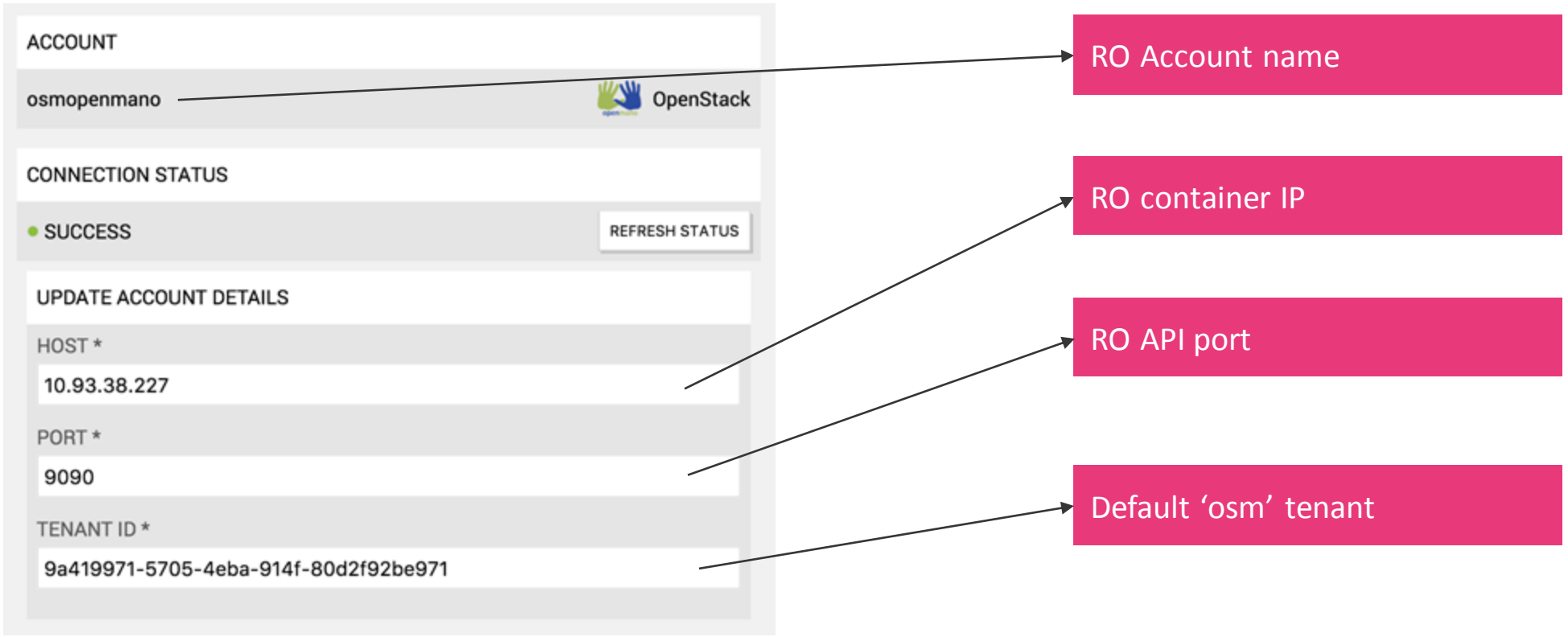
Configuring OSM

There are a few things to get started:

- Ensure that components have been adequately integrated during the installation process
  - SO - RO
  - SO - VCA Config Agent
- Associate a VIM (or VIMs) to OSM
  - OpenStack (real, or VIM Emulator)
  - VMWare VCD
  - Amazon Web Services

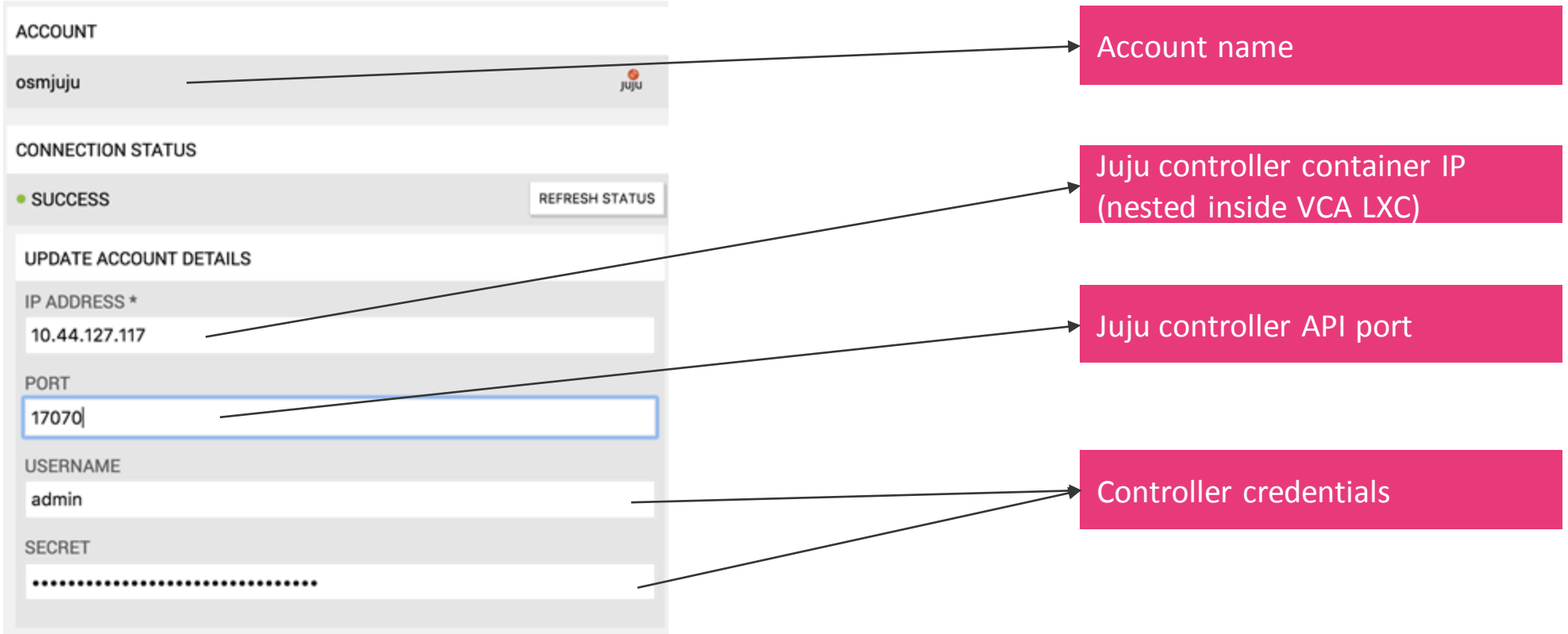
Hands-on: Let's check the accounts!

In this exercise, we will check that relevant components have been integrated during installation. Go to 'Accounts' tab and check RO:



Hands-on: Let's check the accounts!

Now, let's check the config-agent account, which is the main Juju controller that resides inside the VCA container:



Hands-on: Our first VIMs

In this exercise, we will connect our first VIMs to be able to instantiate Network Services. Let's start with the VIM Emulator:

1. Using the OSM client, let's register the OpenStack VIM Emulator*:

   osm vim-create --name emu-vim1 --user username --password password --auth_url http://172.17.0.2:6001/v2.0 --tenant tenantName --account_type openstack

1. Check that it gets listed and its details shown:

   osm vim-list

   osm vim-show emu-vim1

* More references about the VIM Emulator can be found at https://osm.etsi.org/wikipub/index.php/VIM_emulator

Hands-on: Our first VIMs

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Now, let's connect an OpenStack VIM that has been prepared for your POD

1. Using the OSM client, let's register the OpenStack VIM:

   osm vim-create --name openstack-osm{X} --user osm{X} --password osm{X} --auth_url http://147.75.70.249:5000/v3 --tenant osm{X} --account_type openstack

   ...where {X} is your POD number (you can copy the command from the POD list)

1. Check that it gets listed and its details shown:

   osm vim-list

   osm vim-show openstack-osm{X}

Open Source MANO

Onboarding my first NS/VNF

Section: Hands On!

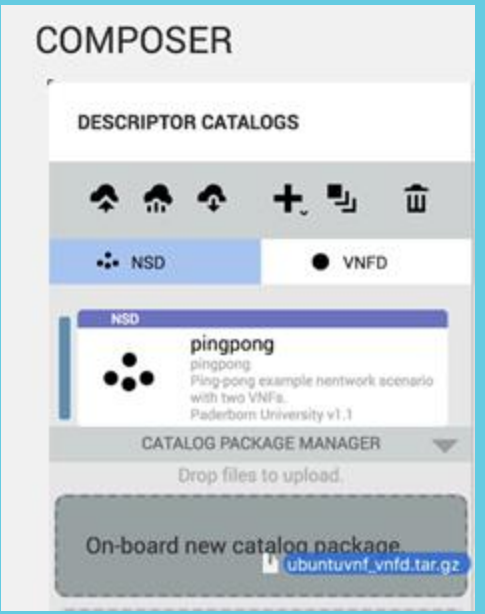
Onboarding NSs / VNFs

- The NS / VNF package containing the descriptors (at least) should be prepared first, options:
  - Downloading examples and editing them.
  - Using the Design-time Tools:
    - Build a base one using the CLI tool, then customize it.
    - Build it using the GUI Composer, from scratch.
- Once we have our packages, we need to onboard them, using the OSM client or the GUI Composer. Note that VNFs should be onboarded first, since NS usually contain references to existing VNFs.

Hands-on: Let's get a NS onboarded!

In this exercise, we will onboard a sample NS/VNF which will be instantiated later over a real OpenStack environment.

1. Download the packages from here to explore them together first.
2. Onboard the packages by dragging and dropping the tar.gz files from your computer to the 'Catalog' area. Ensure you upload the VNF package first, and then the NS package.
3. Check that the package options can be explored and modified using the composer tool (menus at the right). Double check that they appear using the OSM client as well.



Hands-on: Let's get a NS onboarded!

Now, we will confirm that the NS/VNFs were correctly onboarded.

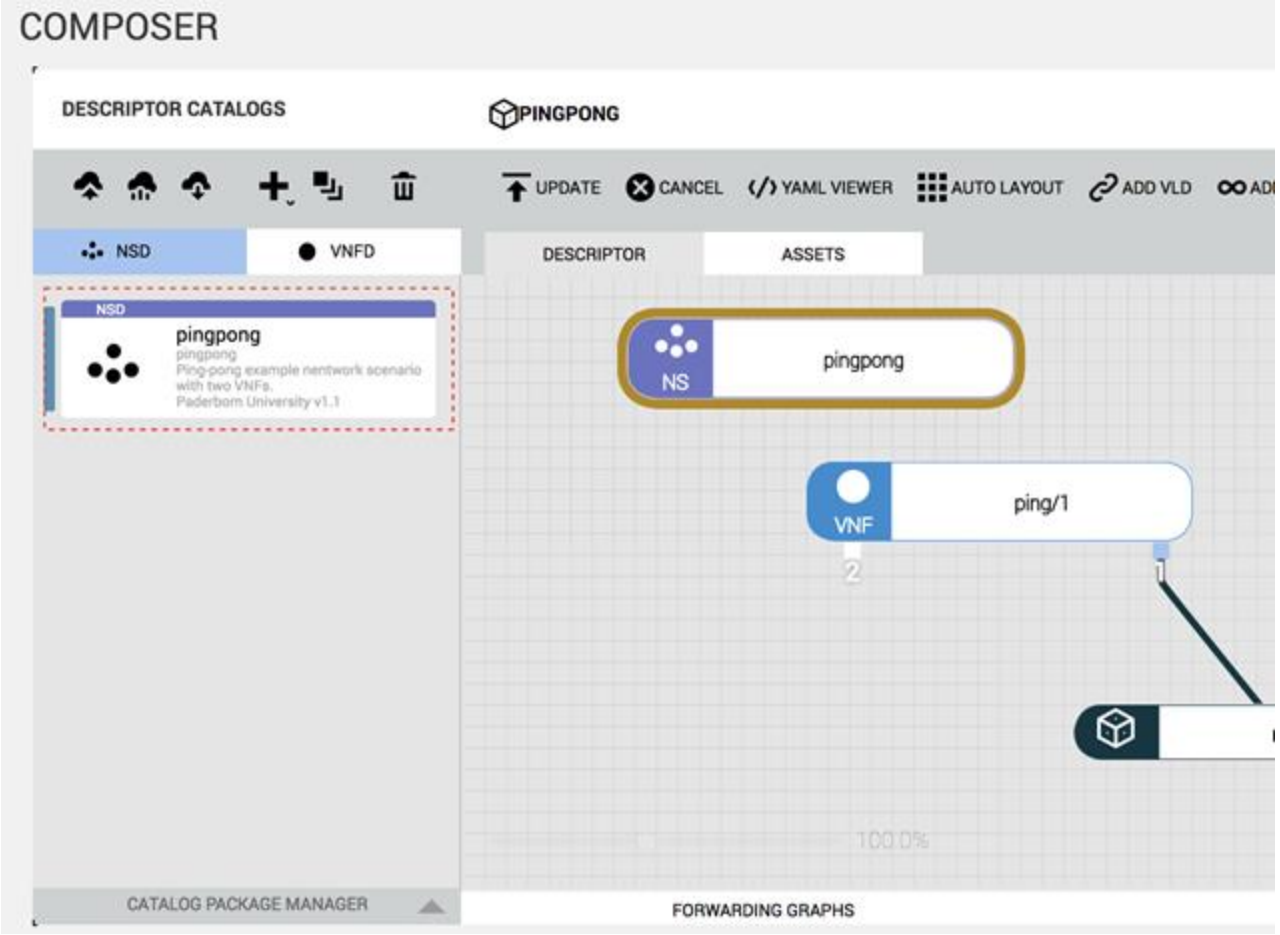
1. In 'Catalog' area, check the upload NSDs and VNFDs, you will be able to edit them as well.
2. From the OSM Client, run:

   # List VNF Descriptors

   osm vnfd-list

   # List NS Descriptors

   osm nsd-list



Hands-on: Let's onboard another NS!

Next, we will onboard sample NS/VNF packages that come with the VIM Emulator. This time we will use the OSM CLI.

1. Download them from here to explore them together first.
2. Onboard the packages, already present your host VM

```
# VNFs
osm upload-package vim-emu/examples/vnfs/ping.tar.gz
osm upload-package vim-emu/examples/vnfs/pong.tar.gz
# NS
osm upload-package vim-emu/examples/services/pingpong_nsd.tar.gz
```

Hands-on: Let's onboard another NS!

Don't forget to ensure they have been uploaded accordingly.

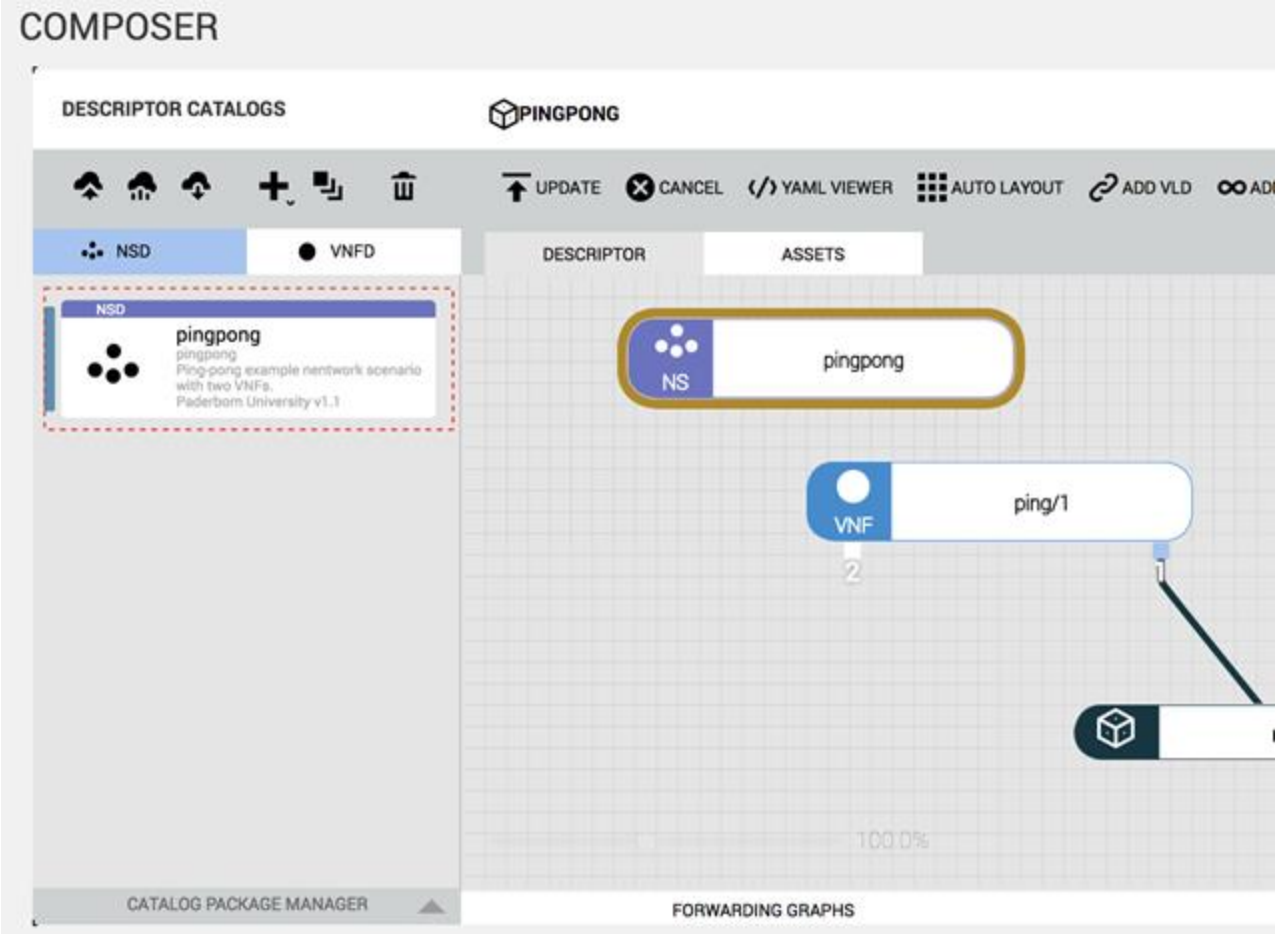
1. In 'Catalog' area, check the upload NSDs and VNFDs, you will be able to edit them as well.
2. From the OSM Client, run:

   # List VNF Descriptors

   osm vnfd-list

   # List NS Descriptors

   osm nsd-list



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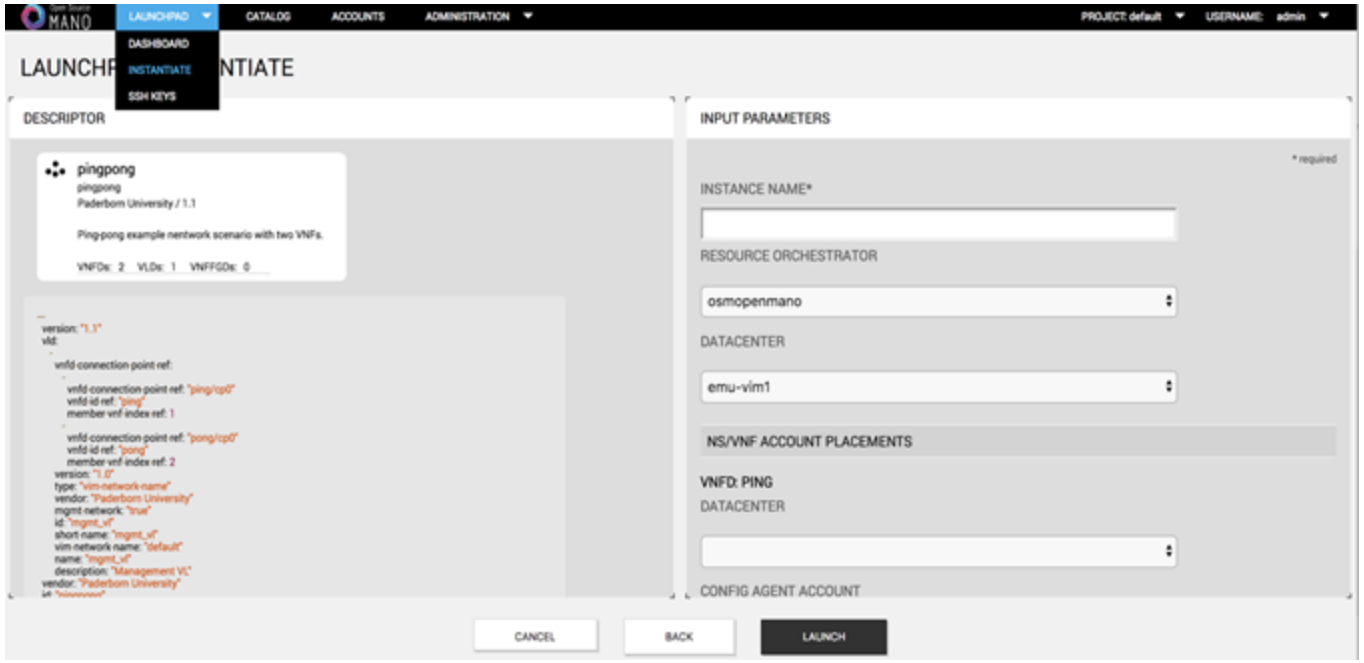
Launching my first VNF instances

Section: Hands On!

Launching Network Services

- Launching VNFs consists on instantiating a Network Service that already contains them.
- It can be done through two methods:
  - Using the GUI, ‘Launchpad’ menu.
  - Using the OSM client.



Hands-on: Let's instantiate our first NS!

In this exercise, we will instantiate the sample Network Service for the VIM Emulator first. We will use the OSM client for this.

1. While viewing the 'Dashboard', and using the OSM client, launch your first Network Service:

   osm ns-create --nsd_name pingpong --ns_name test --vim_account emu-vim1

1. Check the status both in the GUI (Dashboard tab) and using the command line:

   # From OSM Client

   osm vnf-list / osm ns-list

   # From VIM Emulator command line

   docker exec vim-emu vim-emu compute list

Hands-on: Let's instantiate our first NS!

Now that our first NS is active, let's interact with it. We will see that the VIM emulator launches each instance as a Docker container.

1. Being at the host VM shell, get insinde the 'ping VNF' container

   docker exec -it mn.dc1_test.ping.1.ubuntu /bin/bash

1. Once inside the 'ping VNF', check its networking interfaces the other 'pong VNF'

   ifconfig

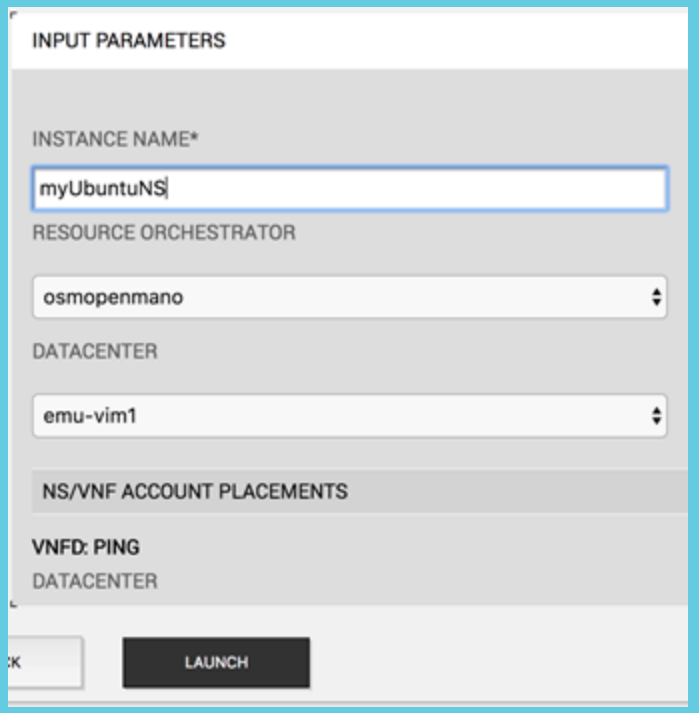
1. Ping the 'pong VNF' to check that the 'default' network has been correctly simulated.

   ping 192.168.100.4

Hands-on: Let's instantiate a new NS!

In this second exercise, we will instantiate a Network Service in a real OpenStack VIM. We will use the GUI for this.

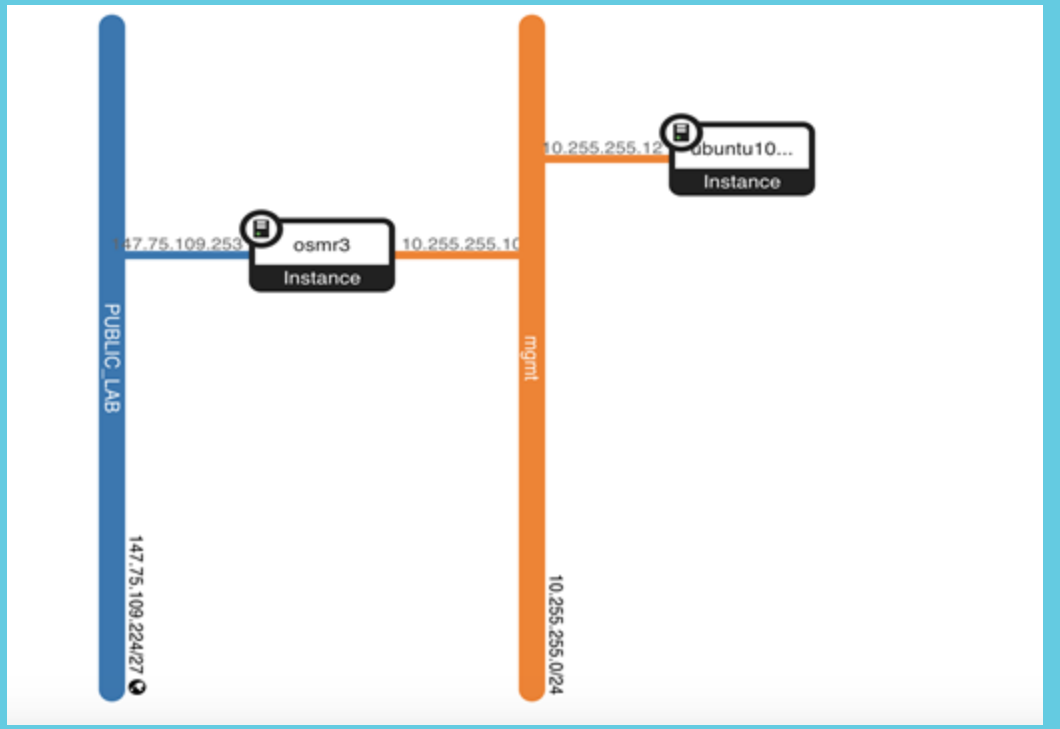
1. Go to the GUI 'Launchpad' menu and select 'Instantiate'
2. Select the 'ubuntu_nsd' and clic 'Next'
3. Put a name to your NS instance.
4. Select the OpenStack datacenter corresponding to your POD (example: "openstack-osm1")
5. Clic 'Launch'!



Hands-on: Let's instantiate a new NS!

Now that our second NS is active, let's confirm that it actually appeared in the OpenStack VIM

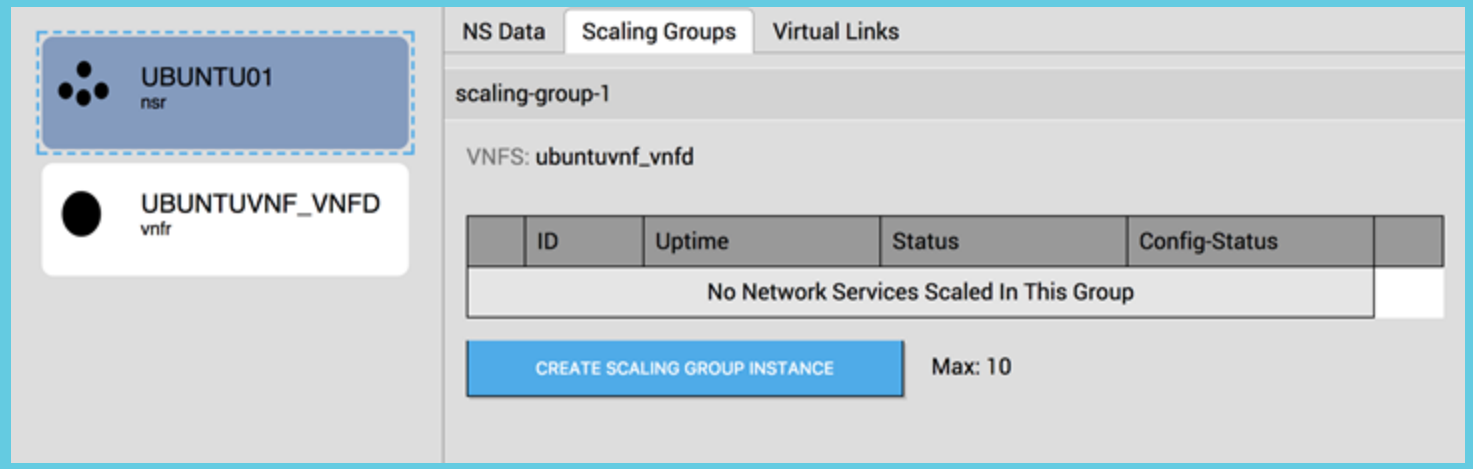
1. Go to the your OpenStack VIM at http://147.75.70.249 (credentials: osm{X} / osm{X})
2. Go to Project → Network → Network Topology to see your instantiated VNF.
3. Access the console directly from the OSM GUI Dashboard by clicking the  icon



Hands-on: Can we scale it?

This VNF's descriptor has been configured to be scaled-out. Let's scale it out manually and then see it appear at the VIM.

1. Clic on the link from the OSM GUI Dashboard, next to the NS name.
2. Clic on the 'Scaling Groups' tab and then over the 'Create Scaling Group Instance' button.

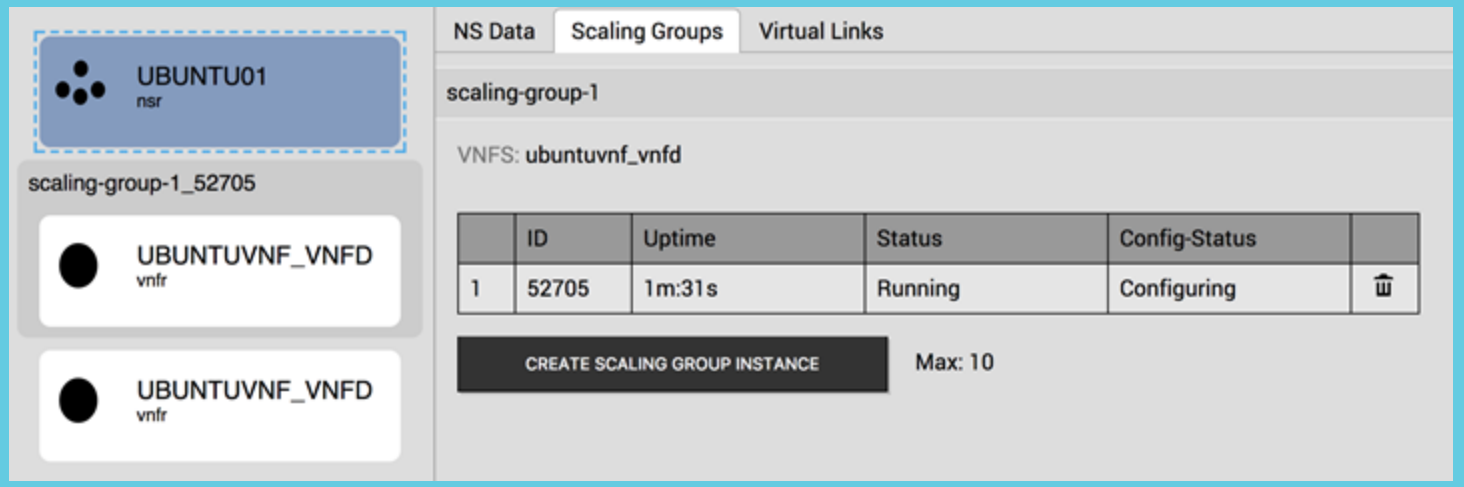


Note! Scaling out/in and most other operations are also supported through the OSM client or directly interacting with the REST API

Hands-on: Can we scale it?

Autoscaling in or out is not officially supported in Release THREE. Let's manually scale the VNF "in" for now.

1. Clic on the 'trash can' icon next to the scaling group instance created in the previous task.
2. You will see the VNF disappearing from both the OSM GUI and VIM platforms.



Note! Scaling out/in and most other operations are also supported through the OSM client or directly interacting with the REST API

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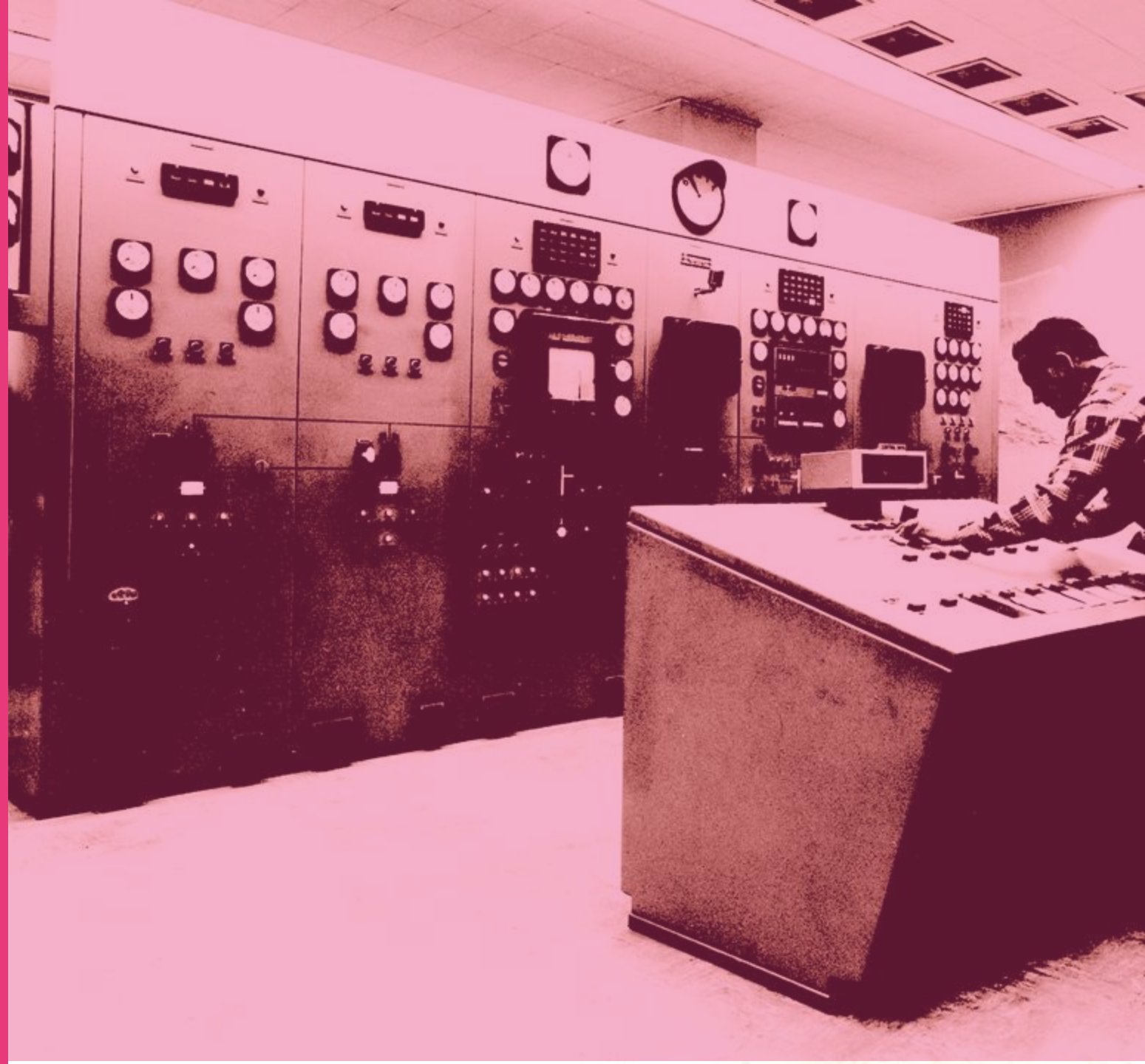
Managing VNF lifecycle

Section: Hands On!



VNF Lifecycle Management

- The main mechanism to manage VNF lifecycle during runtime is using proxy charms, managed by a Juju Controller at the VCA container.
- Proxy charms implement actions for VNF runtime configuration.
- To build a proxy charm:
  - Follow the guide here (‘Discussion’ tab includes further details), it will make use of existing ‘layers’ already in place that are able to send SSH commands to the VNF.
  - There is a recent contribution that adds support for Ansible, available here: https://osm.etsi.org/wikipub/index.php/Example_VNF_Charms

Hands-on: Let's manage this VNF!

The 'ubuntuvnf' descriptor includes a proxy charm. First of all, we'll check the code that implements the main actions for this VNF.

1. Explore the downloaded VNFD package, you will find a 'charms' folder.
2. Open the file located at: ubuntuvnf/reactive/ubuntuvnf.py
3. You will find a function called "say_hello()" which is used for this example.
   Explore the code to see what it's supposed to do.

```
@when('actions.say-hello')
def say_hello():
    err = ''
    #try:
    # Put the code here that you want to execute
    param1 = "Hello " + action_get("name")
    cmd = "sudo wall -n " + param1
    result, err = charms.sshproxy._run(cmd)
    #except:
    #action_fail('command failed:' + err)
    #else:
    #    action_set({'output': result})
    #finally:
    remove_flag('actions.say-hello')
```

Hands-on: Let's manage this VNF!

Now, let's check that the proxy charm was correctly loaded into the VCA container when the VNF was launched.

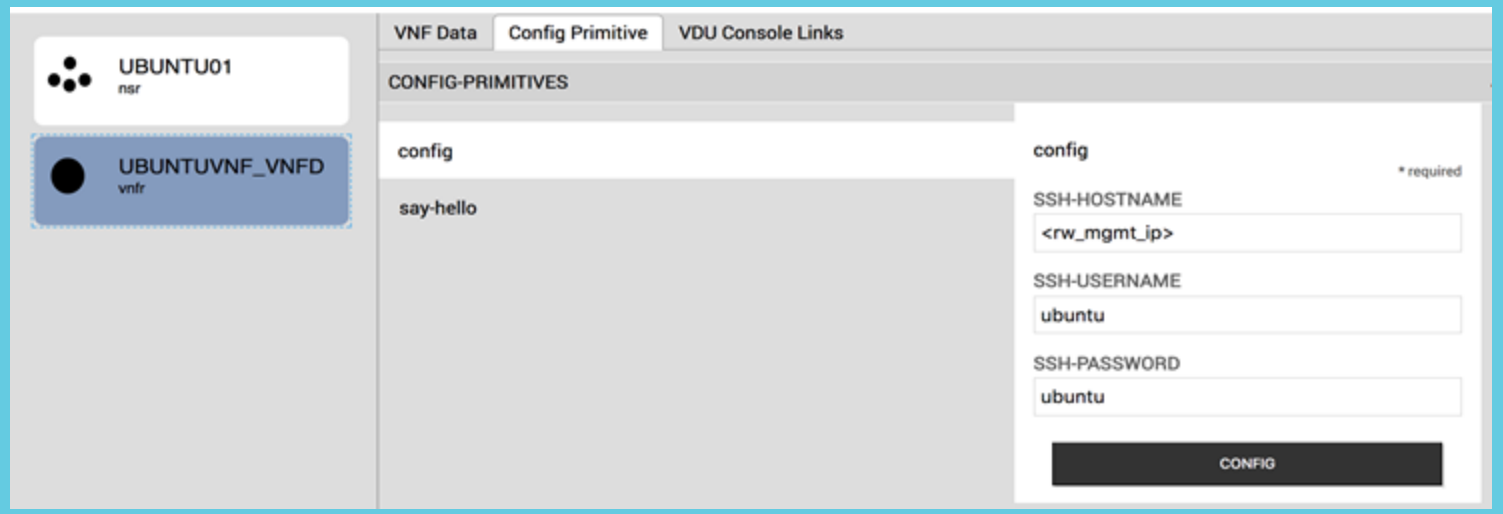
1. From the host's shell, go to the VCA container: lxc exec VCA bash
2. Run the juju command to confirm if the proxy charm is "active": juju status

```
root@VCA:~# juju status
Model    Controller  Cloud/Region         Version  SLA
default  osm         localhost/localhost  2.2.6    unsupported

App                                       Version  Status  Scale  Charm      Store  Rev  OS      Notes
ubuntuab-default-ubuntuab-ubuntuvnf-vnfd-b-b           active      1  ubuntuvnf  local   14  ubuntu

Unit                                         Workload  Agent  Machine  Public address  Ports  Message
ubuntuab-default-ubuntuab-ubuntuvnf-vnfd-b-b/0*  active    idle   14       10.44.127.136          ready with credentials 10.25
5.255.4-ubuntu-ubuntu

Machine  State    DNS            Inst id         Series  AZ  Message
14       started  10.44.127.136  juju-5f9726-14  xenial      Running
```

Hands-on: Let's manage this VNF!

The proxy charm actions reflect into 'config primitives' that can be invoked from the GUI using forms and buttons.

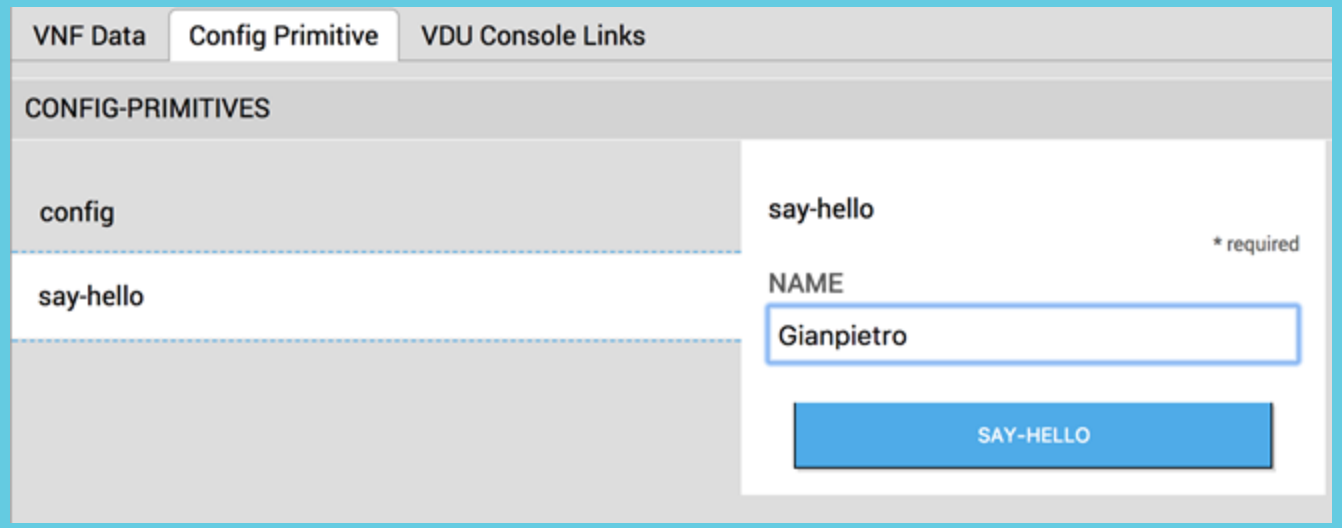
1. Clic on the  link in the OSM GUI Dashboard, next to the NS name.
2. Clic on the VNF instance, 'Config Primitive' tab, and you will see a list of primitives:



Hands-on: Let's manage this VNF!

In this example, the "say hello" simple primitive has been implemented to send a message to the VNF's console.

1. Go to your VNF console by clicking under "VDU Console Link" (ubuntu/ubuntu)
2. Using the 'say-hello' primitive, send a message to the VNF terminal



Agenda

- Introduction: Architecture and OSM R3
- Hands On! - Installation, configuration and instantiation
- **Contributing to the Community**

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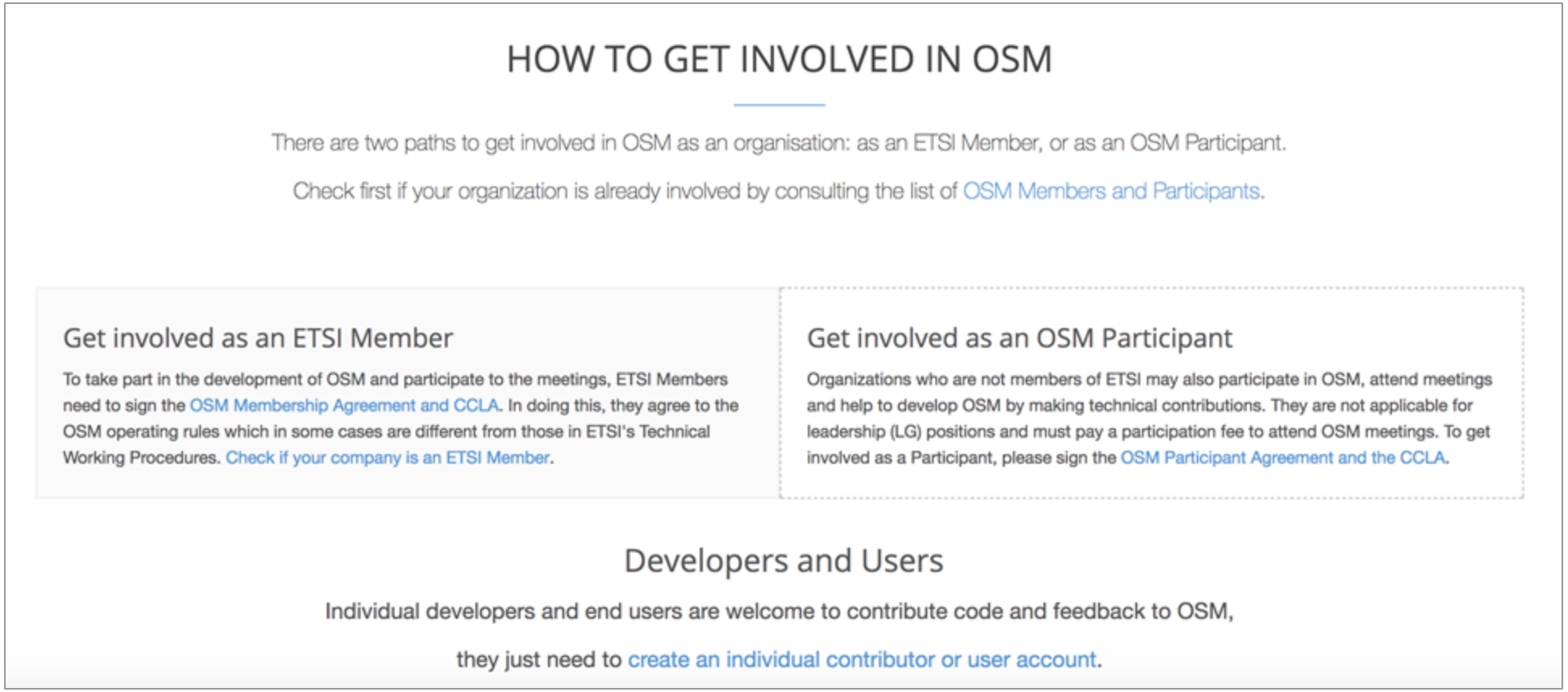
Joining OSM

Section: Contributing to the Community

Joining the OSM Community

- Join here as a company or individual contributor!



HOW TO GET INVOLVED IN OSM

There are two paths to get involved in OSM as an organisation: as an ETSI Member, or as an OSM Participant.

Check first if your organization is already involved by consulting the list of OSM Members and Participants.

Get involved as an ETSI Member

To take part in the development of OSM and participate to the meetings, ETSI Members need to sign the OSM Membership Agreement and CCLA. In doing this, they agree to the OSM operating rules which in some cases are different from those in ETSI's Technical Working Procedures. Check if your company is an ETSI Member.

Get involved as an OSM Participant

Organizations who are not members of ETSI may also participate in OSM, attend meetings and help to develop OSM by making technical contributions. They are not applicable for leadership (LG) positions and must pay a participation fee to attend OSM meetings. To get involved as a Participant, please sign the OSM Participant Agreement and the CCLA.

Developers and Users

Individual developers and end users are welcome to contribute code and feedback to OSM,

they just need to create an individual contributor or user account.

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Activities

Section: Contributing to the Community

OSM Community Activities

- Weekly Conference Calls
  - Technical, leadership, DevOps, and more!

- Face to Face Meetings
  - Plenaries and Mid-Release meetings (every 2-3 months)
  - Next locations: Oslo (Norway), Palo Alto (US)

- OSM Hackfest
  - Second edition had place on March 2018 at Spain, with tons of useful information for new comers and advanced OSM users.

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Ways to contribute

Section: Contributing to the Community

Ways to contribute to OSM

- **Try OSM** and give feedback to the community.
- Join as a developer to **make contributions to the code**.
- Join the community to **contribute to design discussions**.
- **Start building your own distribution** of OSM as an integrator.
- **Host an OSM meeting** to contribute to the community's growth and diversity.

Useful References

- OSM Release Three main wiki page
  https://osm.etsi.org/wikipub/index.php/OSM_Release_THREE
- VIM Emulator, by Manuel Peuster
  https://osm.etsi.org/wikipub/index.php/VIM_emulator
- VIM Emulator video
  https://youtu.be/Iji6FFIKL0w

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Thank you!

Questions about this presentation?

Contact Gianpietro Lavado at glavado@whitestack.com

ETSI