OSM 5th Hackfest – Introduction to NFV and OSM

José Miguel Guzmán (Whitestack)

Agenda

- Background for moving to a NFV world

- Quick review of NFV

- Introduction to the latest OSM Release

- Contributing to the Community

Open Source MANO

Background for moving to a NFV world

Credit: Bruer Da

How was this originated?

Open Source MANO

A white paper was written in 2012 by the world's leading telecom network operators.

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

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.

CONTRIBUTING ORGANISATIONS & AUTHORS

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

PUBLICATION DATE

October 22-24, 2012 at the "SDN and OpenFlow World Congress", Darmstadt-Germany.
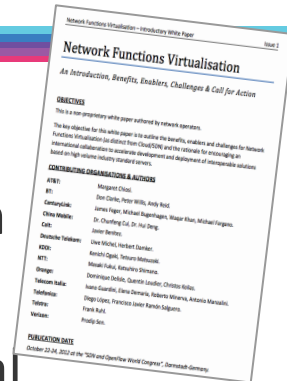
How was this originated?

The issues

- Network Operators' networks are populated with a **large and increasing variety of proprietary** hardware appliances.

- To launch a new network service often requires **finding the space and power to accommodate these boxes,** what is becoming increasingly difficult;

- **Increasing costs** of energy, capital investment challenges and the **rarity of skills necessary** to design, integrate and operate increasingly complex hardware-based appliances.

- Moreover, hardware-based appliances rapidly reach end of life, **requiring much of the procure-design-integrate-deploy cycle to be repeated with little or no revenue** benefit.
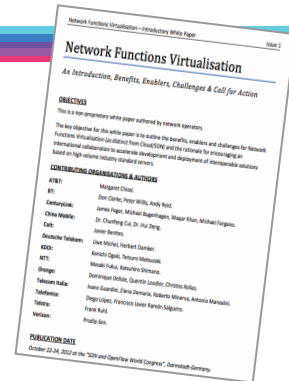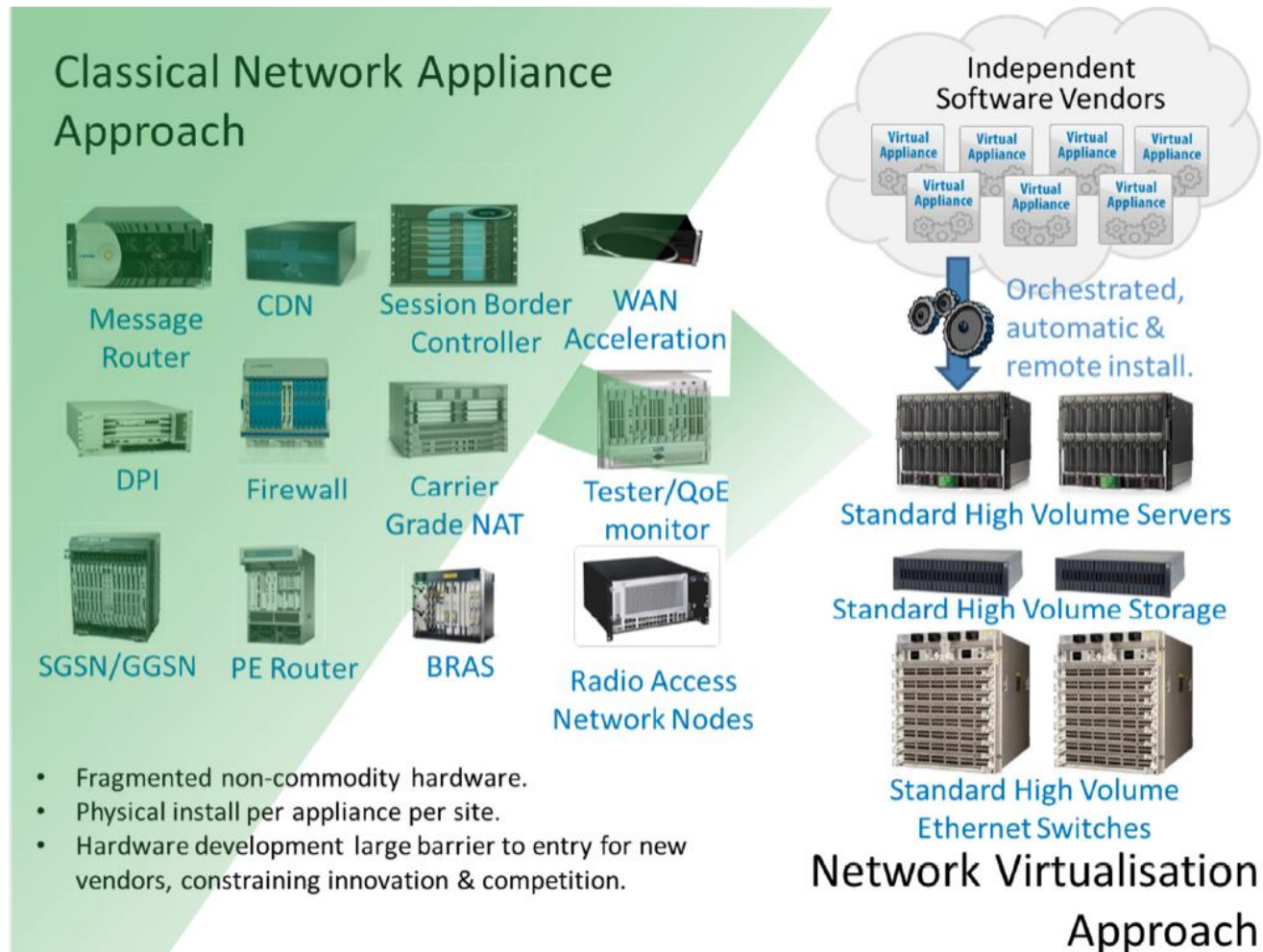
How was this originated?

The Benefits

- **Reduced equipment costs** and reduced power consumption through consolidating equipment (scale of the IT industry)

- Increased speed of **Time to Market** by minimising the typical network operator cycle of innovation.

- Availability of network appliance multi-version and multi-tenancy, which allows use of a **single platform for different applications, users and tenants**.

- **Targeted service introduction** based on geography or customer sets is possible. **Services can be rapidly scaled up/down** as required.

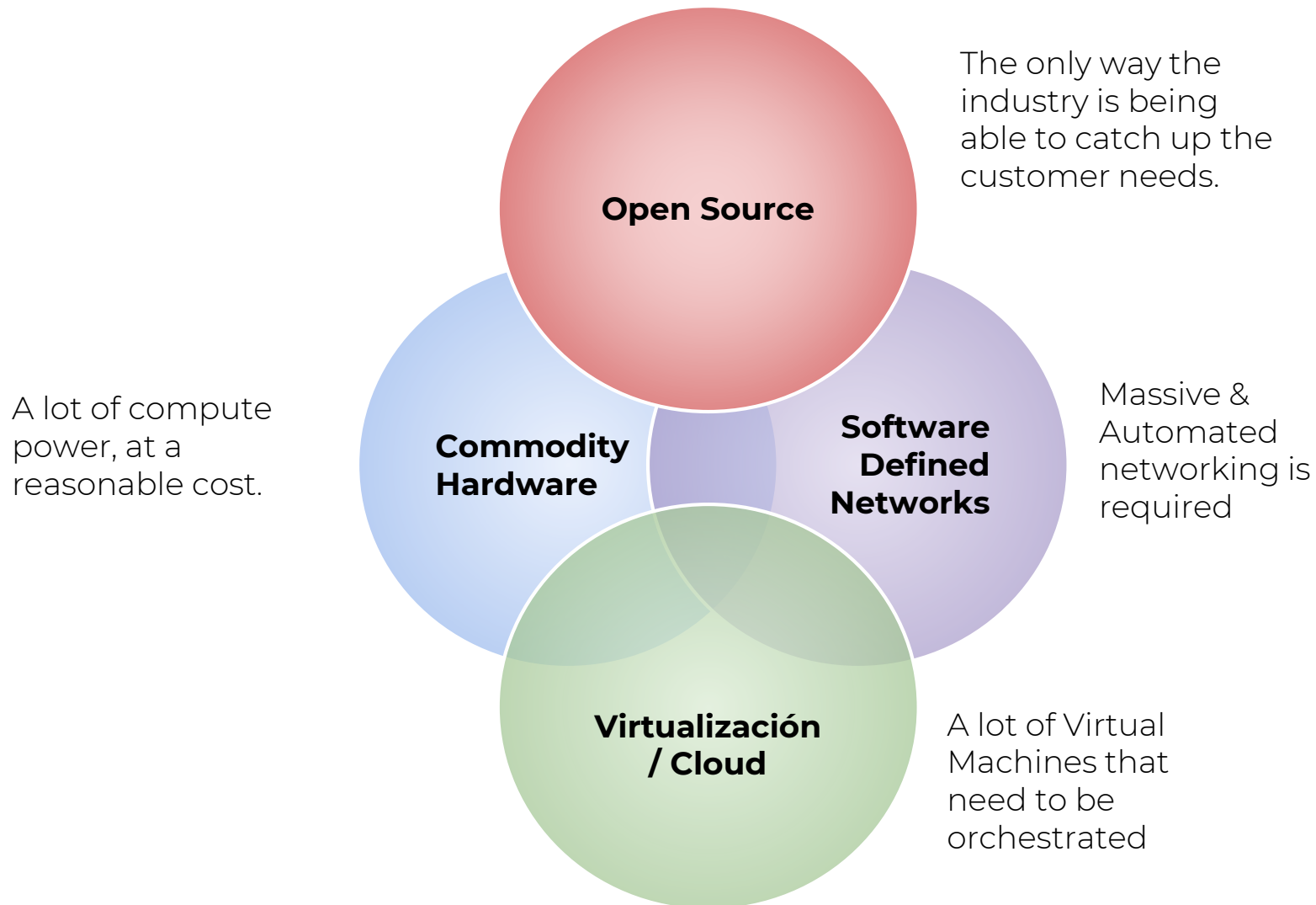- Enables a wide **variety of eco-systems and encourages openness**.

What is NFV trying to address?

Bringing "cloud efficiencies" to the Telecom Industry

Classical Network Appliance Approach

- Message Router
- CDN
- Session Border Controller
- WAN Acceleration
- DPI
- Firewall
- Carrier Grade NAT
- Tester/QoE monitor
- SGSN/GGSN
- PE Router
- BRAS
- Radio Access Network Nodes

- Fragmented non-commodity hardware.
- Physical install per appliance per site.
- Hardware development large barrier to entry for new vendors, constraining innovation & competition.

Independent Software Vendors

Virtual Appliance

Orchestrated, automatic & remote install.

Standard High Volume Servers

Standard High Volume Storage

Standard High Volume Ethernet Switches

Network Virtualisation Approach

Conjunction of 4 mature technologies

Open Source

The only way the industry is being able to catch up the customer needs.

A lot of compute power, at a reasonable cost.

Commodity Hardware

Software Defined Networks

Massive & Automated networking is required

Virtualización / Cloud

A lot of Virtual Machines that need to be orchestrated

1) Commodity Hardware

- The Telecom industry has transitioned from proprietary (tailor-made) hardware platforms, to commodity (COTS) x86 hardware

Proprietary HW → Standardized HW → Commodity HW (COTS)

Arquitectura Hardware Advanced TCA

Arquitectura Hardware Commodity "off-the-shelf" con procesador x86

1) Commodity Hardware

- In recent years, the performance of Microprocessors has more than duplicated, specially in the servers segment

Processor Performance Trends

1) Commodity Hardware

Open Source MANO
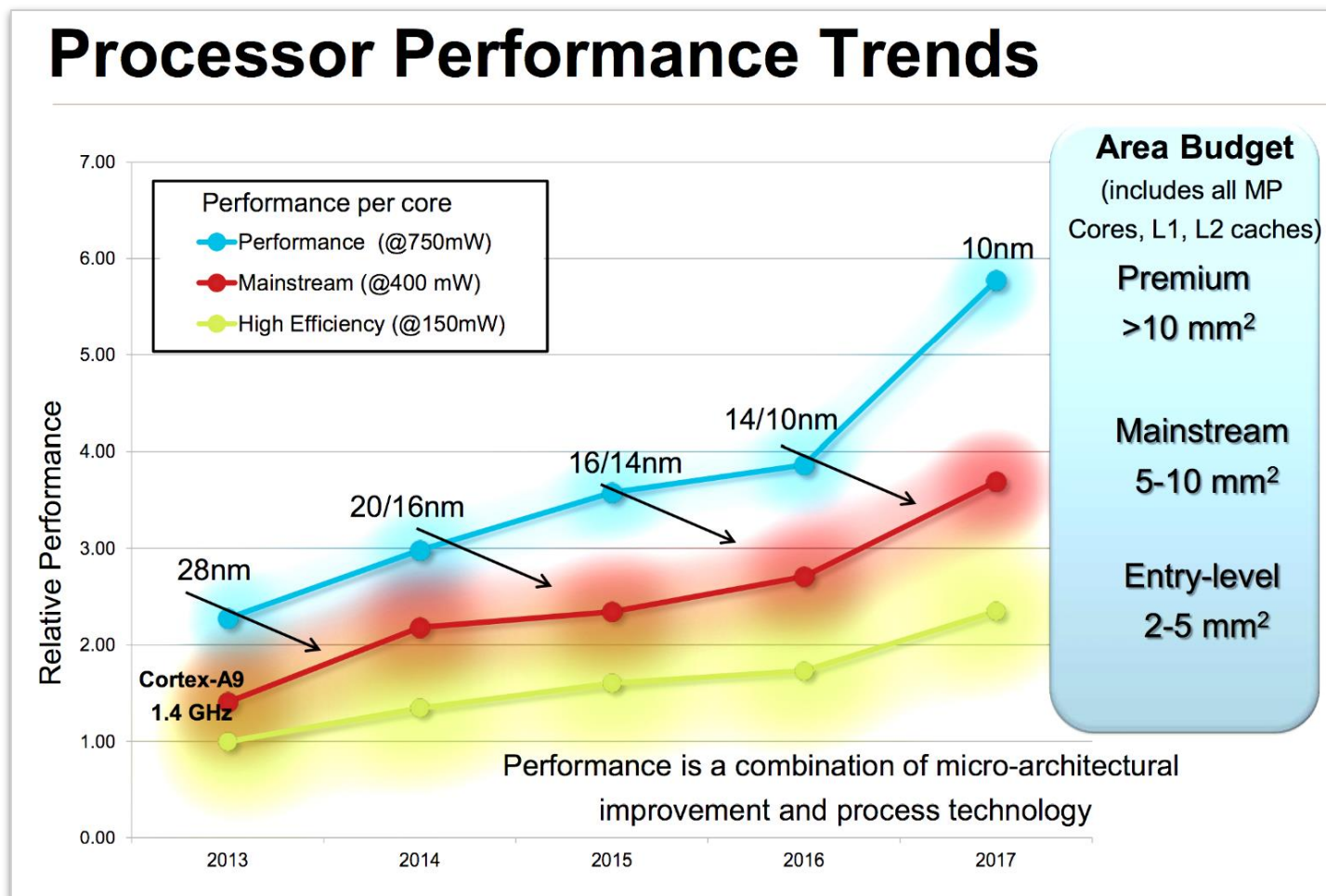
- New form factors, might achieve the highest compute & storage density levels

2 RU

8x = 224 physical

Core Intel XEON PLATINUM inside

96x = 6 TB of RAM

24x = 96 TB of SSD

4x = 16 x 10G Ports

1) Commodity Hardware

- A super computer.. in a rack

5K Physical Cores
60 TB of RAM
3840 TB of Solid State Storage
320 x 10G Ports

/Rack

@ ~ 20K Watts
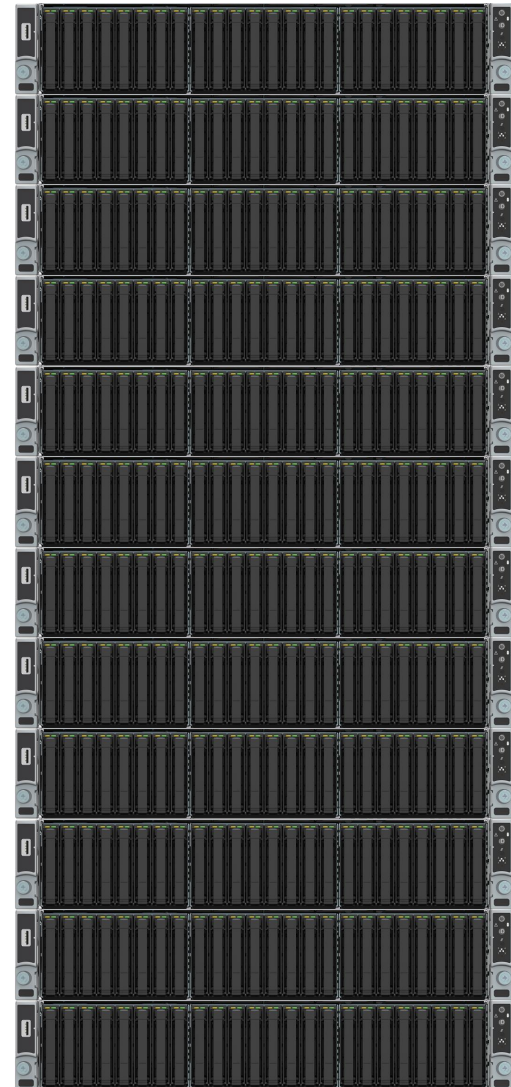
1) Commodity Hardware

- Non-Volatile RAM, improves the performance of traditional SSD storage

Mixed 4kB Random Read/Write
Average of All Read/Write Distributions in MB/s - Higher is Better

	MB/s
Intel Optane SSD 900P 280GB	1,275.2
Samsung PM981 1TB	433.6
Samsung 960 PRO 1TB	387.0
SanDisk Extreme Pro 1TB	342.7
Western Digital WD Black 1TB (3D NAND)	342.1
OCZ RD400 1TB	291.5
Samsung 960 EVO 1TB	273.6
Intel SSD 760p 512GB	262.3
ADATA XPG SX8000 512GB	251.6
Patriot Hellfire 480GB	246.4
Toshiba XG5 1TB	220.1
Samsung 860 EVO 2TB M.2	199.6
Crucial MX500 1TB	151.2
Western Digital WD Black 512GB (2D NAND)	134.9
SanDisk Ultra 3D 1TB	127.2
Western Digital WD Black 7200RPM 1TB	0.8

0   200   400   600   800   1000 1200 1400

3

1) Commodity Hardware

• New SSD form-factors, improve the SSD density

2) HW Assisted Virtualization

- Intel/AMD have developed a number of hardware features, to accelerate virtualization

Intel® Virtualization Technology

Intel VT refers to all the hardware assists for virtualization that Intel offers across its platform (CPU, Chipset, I/O)

Intel® VT-x
Intel VT refers to all the hardware assists for virtualization in Intel® 64 and IA32 processors

Intel® VT-i
Intel VT refers to all the hardware assists for virtualization in Itanium processors

Intel® VT for Directed I/O (Intel® VT-d)
Intel VT refers to all the hardware assists for virtualization in Intel chipset

Intel® VT for Connectivity (Intel® VT-c)
Intel VT refers to all the hardware assists for virtualization in Intel networking and I/O devices

Processor

Chipset

Network

2) HW Assisted Virtualization

- Two leading solutions for virtualization

Commercial

Open Source

Fuente: 2017 Openstack Survey

High Capacity switching chipsets
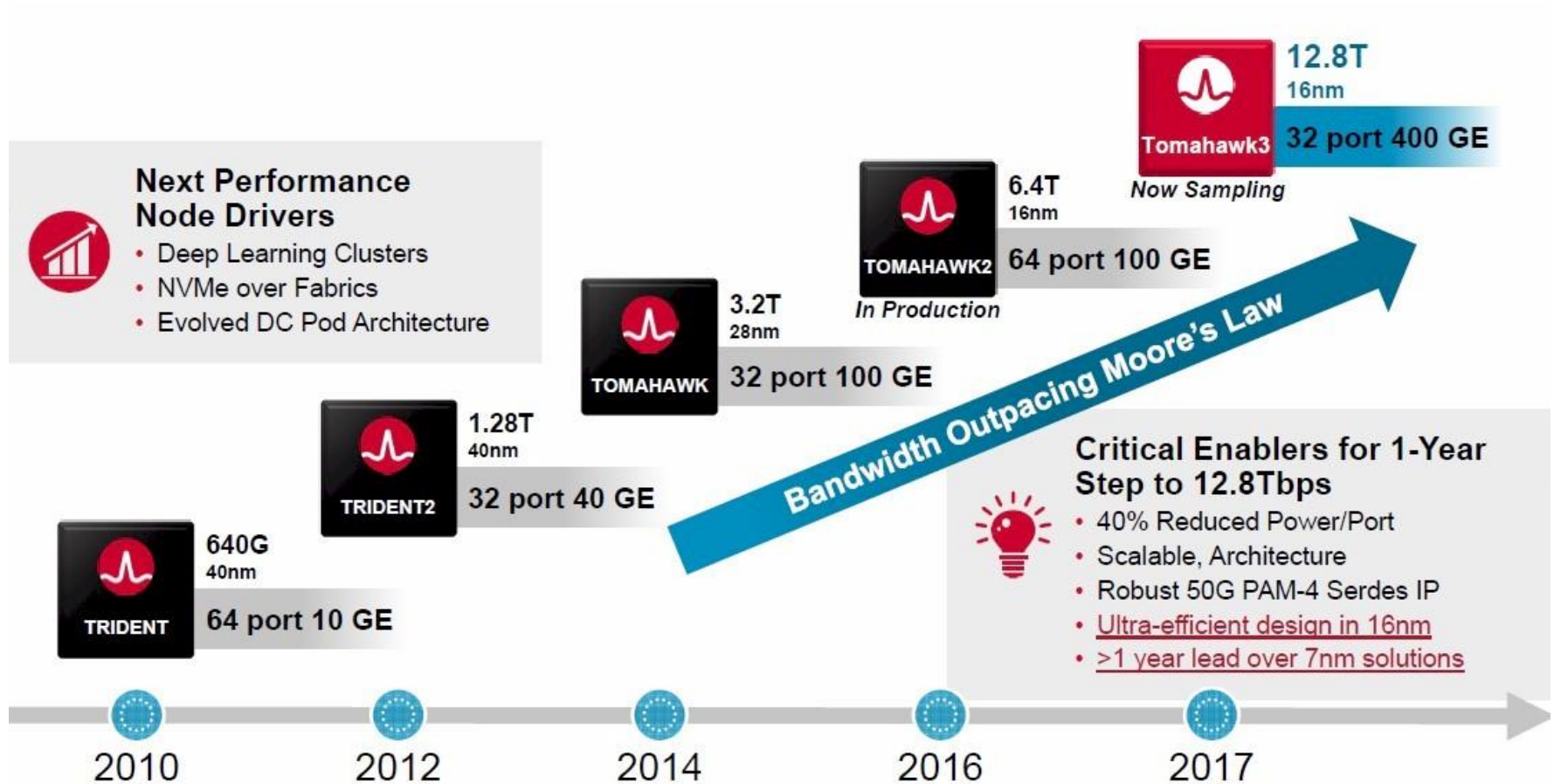
3) SDN / Open Networking

Most vendors adopting "Merchant Silicon"

3) SDN / Open Networking

SDN is not a requirement, but increases the potential of NFV
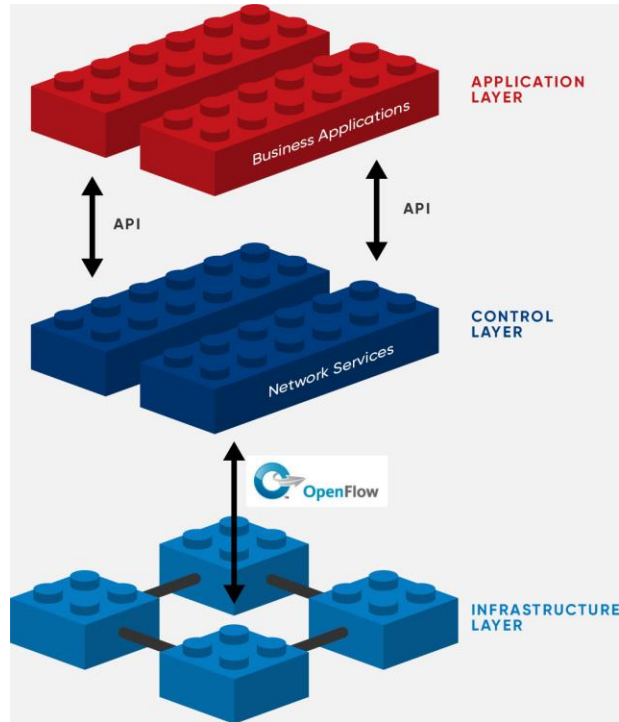
Easily portable to general purpose **CPUs**, therefore _highly virtualizable_

Achievable by using **ASICs** or **CPUs** (dataplane acceleration)

- NFV and SDN aligns closely with the objectives to use commodity servers and switches.
- Control plane can be easily ported to NFV
  But, dataplane too (lots of improvements here)

4) Open Source initiatives

Current landscape provides several open source initiatives, that cover most of the industry challenges:
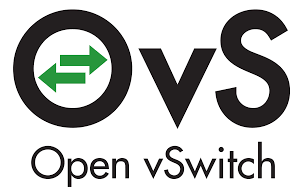
Quick review of NFV

© ETSI

What is NFV trying to address?
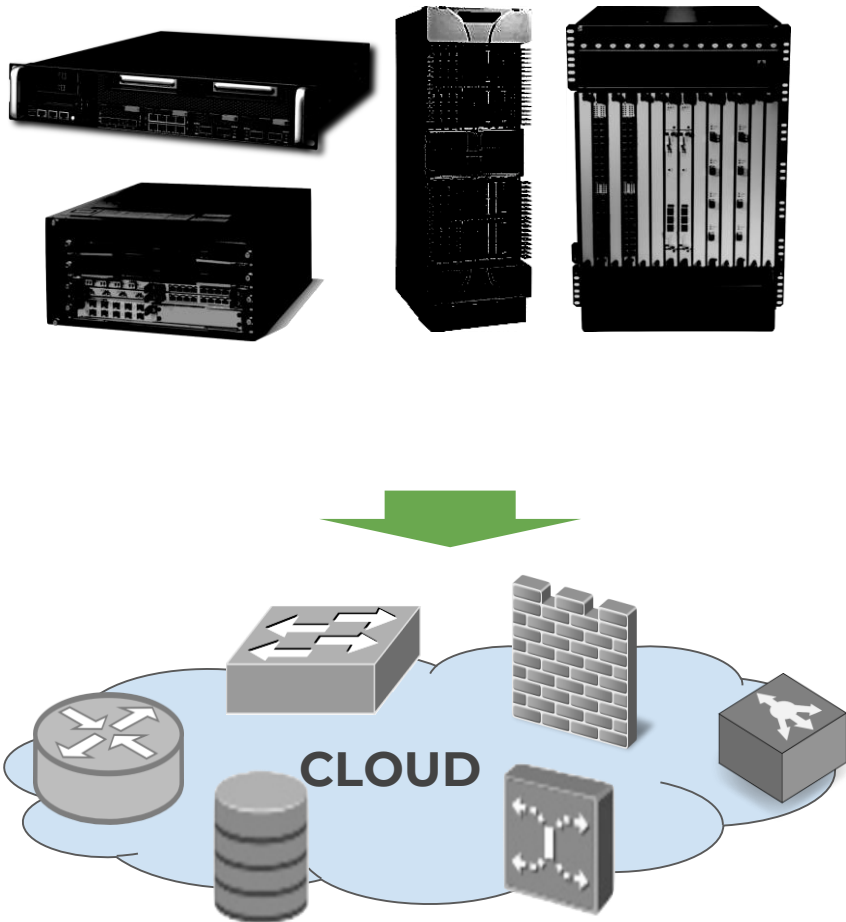
- Network Function Virtualization (NFV) proposes to virtualize network functions that typically run in dedicated appliances

- The main goal is to support virtualized functions over COTS servers.

- Virtual Network Functions (VNFs) acquire all the advantages of Cloud Applications!

The original idea…. triggered an industry movement

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

- This group evolved to the ETSI NFV ISG (Industry Specification Group), formed today by 300+ companies.

- Their main motivation had to do with reducing TCO of building a network by using open solutions.

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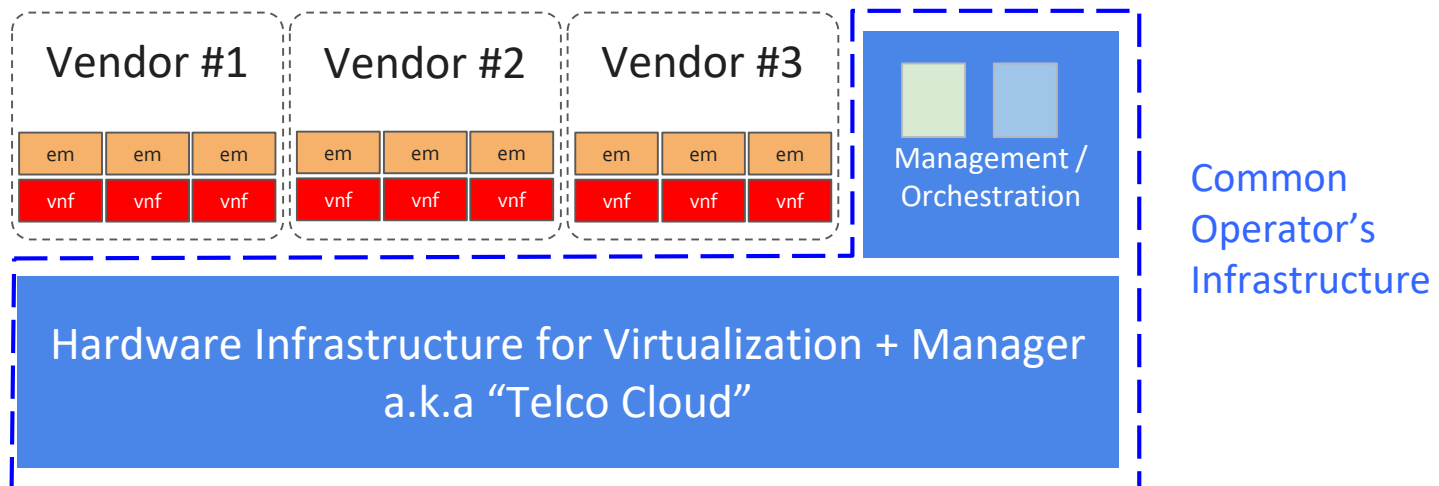
ETSI Publications

- 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**.

Vendor #1	Vendor #2	Vendor #3
em em em	em em em	em em em
vnf vnf vnf	vnf vnf vnf	vnf vnf vnf

Management / Orchestration

Common Operator's Infrastructure

Hardware Infrastructure for Virtualization + Manager a.k.a "Telco Cloud"

The ETSI NFV Architecture

The standard architecture can be better understood in three blocks:
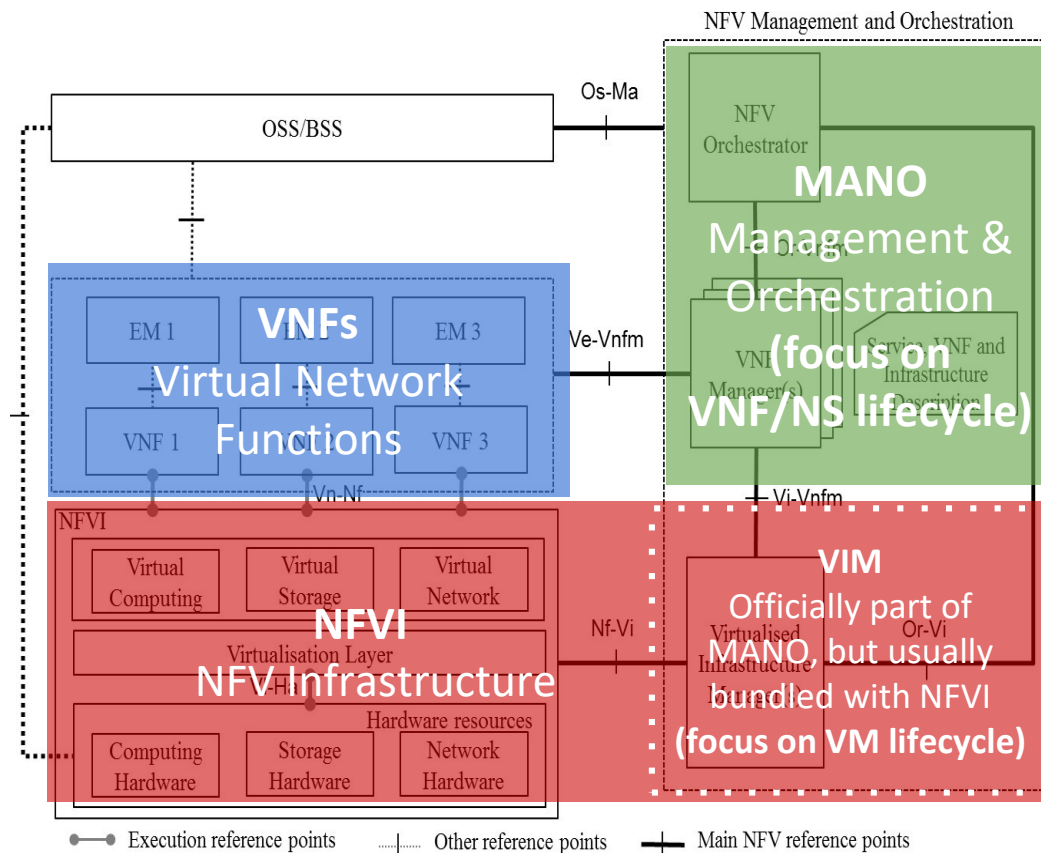
NFVI:
NFV Infrastructure

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

NFVI

| Virtual Computing | Virtual Storage | Virtual Network |

Virtualisation Layer

VI-Ha

Hardware resources

| Computing Hardware | Storage Hardware | Network Hardware |
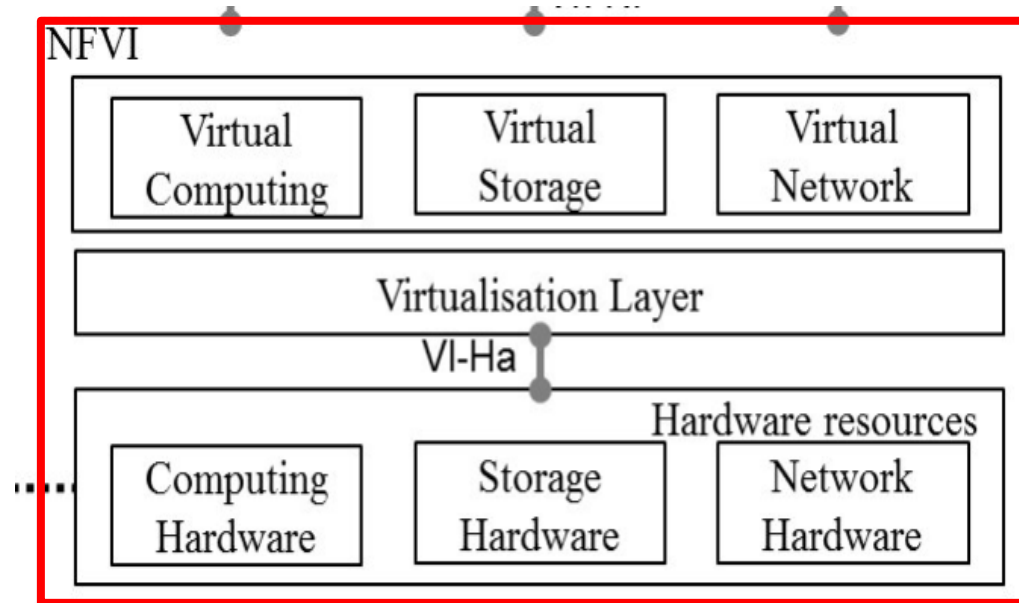
- But!
  Networking applications may have more strict performance requirements, we will discuss that later.

VNF Special Requirements

Common Cloud and VNF Requirements

Multi-tenancy
(Reservation and Separation)

Self Service

Low Latency / Low Jitter
(i.e. Voice / Gaming / M2M / Small Packets)

Application High Availability

General QoS
(IOPS, CPU, Resources)

Orchestration
Inventory, Event/Log Management, Config Management, CI/CD/Testing, Monitoring, ITSM/ITIL/FCAPS/OSS, Probing/CALEA

Brownfield App/VNF Support
(Cattle Transition)

High Packet Per Second Throughput (i.e. DNS, Network I/O)

Migration of HA pet to midget cow VNFs
(i.e. BGP, HA, VRRP, etc.)

Geo-Dependency of Workloads to Connections
(i.e. Service mobility and network availability)

Network QoS
(Marking and Treatment)

KPI Measurements of VNF Requirements
(i.e. Rich Network Analytics)

Operational Transitions/Events
(Workload and DC Dry Out)

Dynamic/Tiered Topology Creation, Scale Out and Service Chaining

Unique Telco Cloud VNF Requirements

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

VNF Special Requirements

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

- **Minor latency** (disk I/O & network)
  → Faster hardware (More cores, SSD disks, faster buses)
  → Dataplane acceleration

- **Higher throughput or PPS**
  → Dataplane acceleration
  → EPA: Enhanced Platform Awareness

- **Geographical distribution**
  → multi-site cloud

- **Horizontal auto-scaling**
  → automated operations (orchestration)

VNF Special Requirements

EPA covers the different approaches that can be taken at the NFVI layer to increase performance while maintaining a generic (COTS) infrastructure. VIM and MANO should be able to request them.

Huge Pages

NUMA Topology Awareness
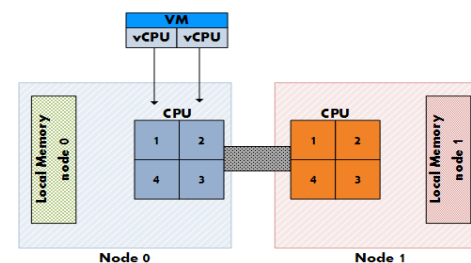
CPU Pinning
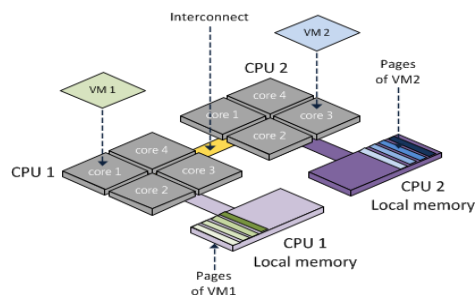
Data Plane assignment
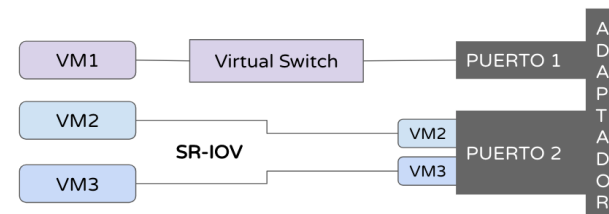
VIM:
Virtualized Infrastructure Manager

- 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.)

VNF-M:
VNF Manager

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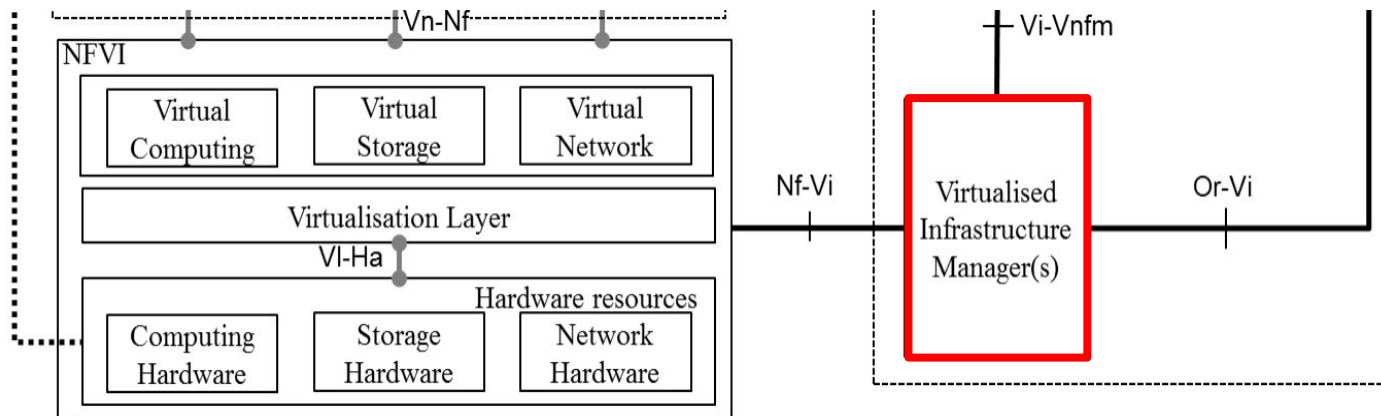
- The VNF Manager, also part of the 'MANO Stack', covers **lifecycle management for Virtual Network Functions** (VNFs), either directly or through their own Element Management System (EMS).

- VNF Manager can be generic (common ones), or vendor-specific ones.

CANONICAL

Juju
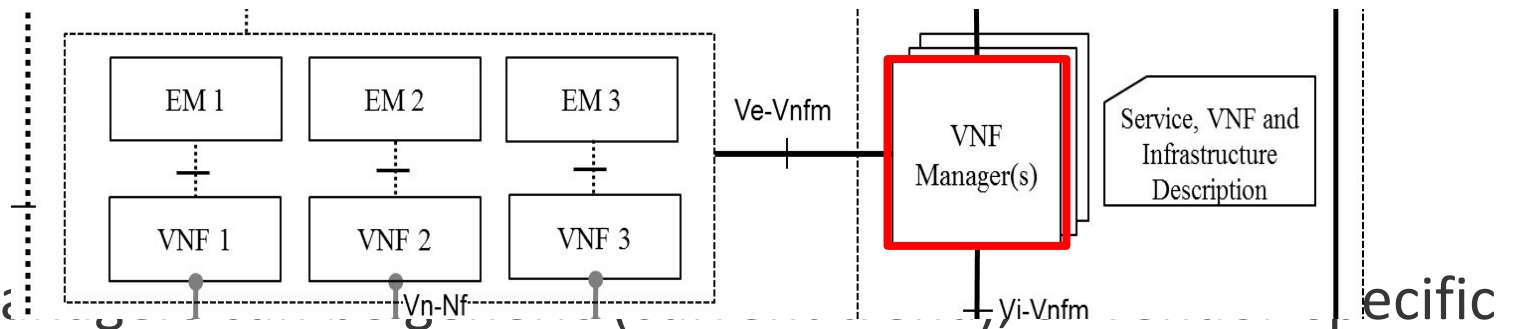
MANO: NFV Orchestrator (NFV-O)

- 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.

VF-C *(Virtual Functions Controller)*

LCM & RO
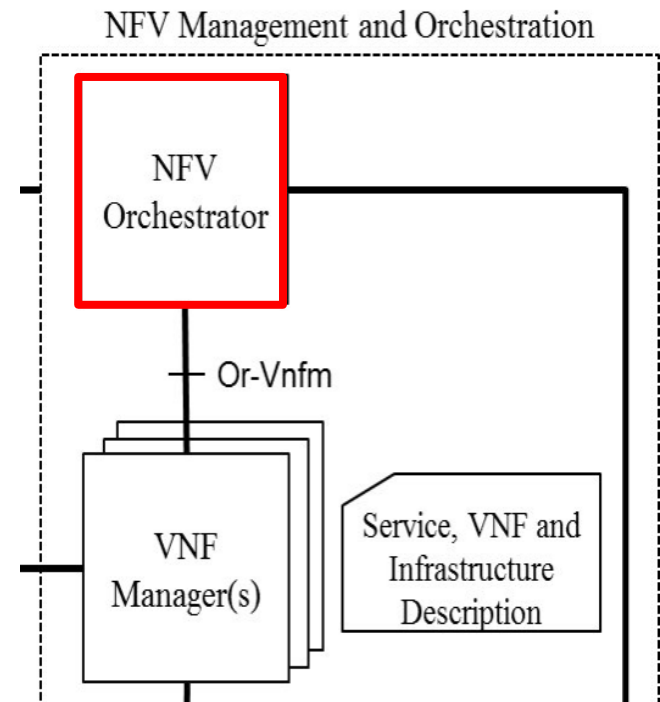
Virtual Network Functions (VNF)

- 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.
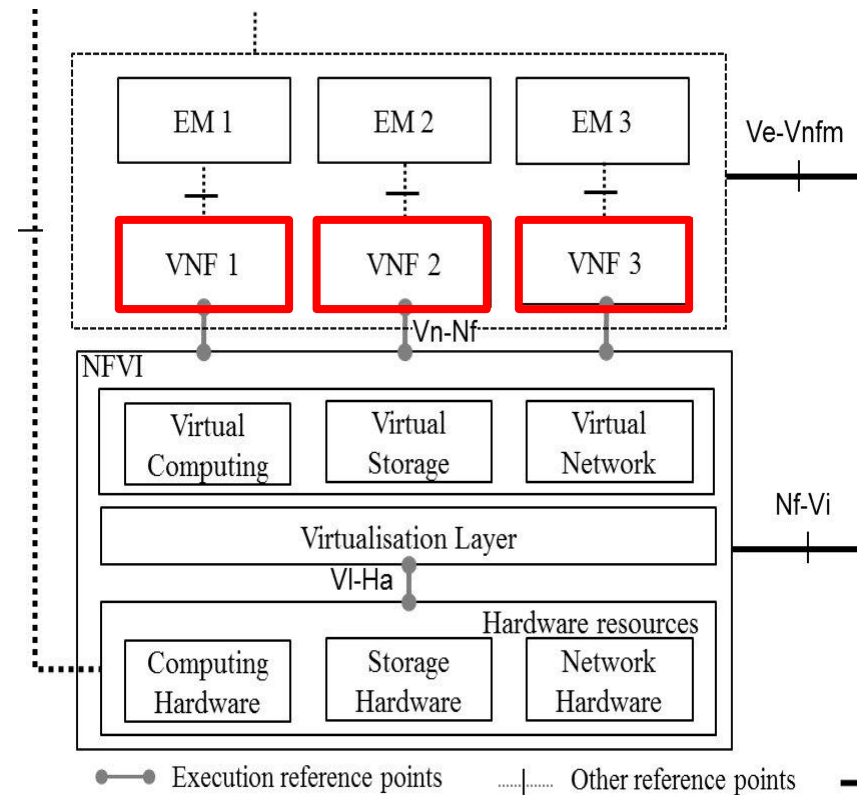
VNF Descriptor files (VNFD)

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.

```
vnfd:vnfd-catalog:
    vnfd:vnfd:
    -   vnfd:connection-point:
        -   vnfd:name: eth0
            vnfd:type: VPORT
        vnfd:description: Generated by OSM pacakage generator
        vnfd:id: ubuntuvnf_vnfd
        vnfd:mgmt-interface:
            vnfd:cp: eth0
        vnfd:name: ubuntuvnf_vnfd
        vnfd:service-function-chain: UNAWARE
        vnfd:short-name: ubuntuvnf_vnfd
        vnfd:vdu:
        -   vnfd:cloud-init-file: cloud_init
            vnfd:count: '1'
            vnfd:description: ubuntuvnf_vnfd-VM
            vnfd:guest-epa:
                vnfd:cpu-pinning-policy: ANY
            vnfd:id: ubuntuvnf_vnfd-VM
            vnfd:image: ubuntu_admin
            vnfd:interface:
            -   rw-vnfd:floating-ip-needed: 'false'
                vnfd:external-connection-point-ref: eth0
```

Open Source
MANO

Introduction
to OSM
Release Five

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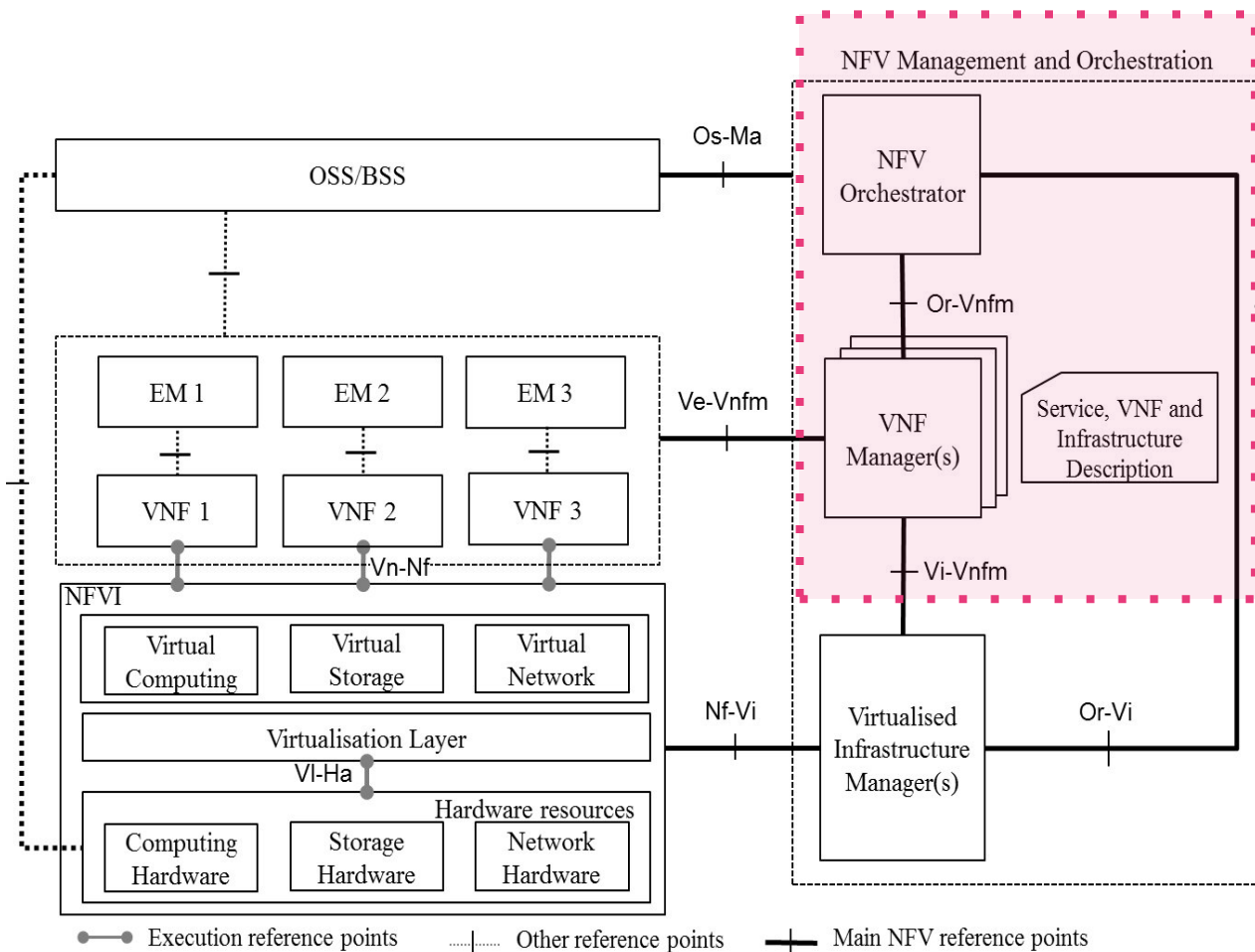
We are here!
Open Source MANO is an ETSI-hosted project to develop an Open Source NFV Management and Orchestration (MANO) software stack aligned with ETSI NFV.

OSM Architectural Principles

Layering

Abstraction

Architectural Principles

Modularity

Simplicity
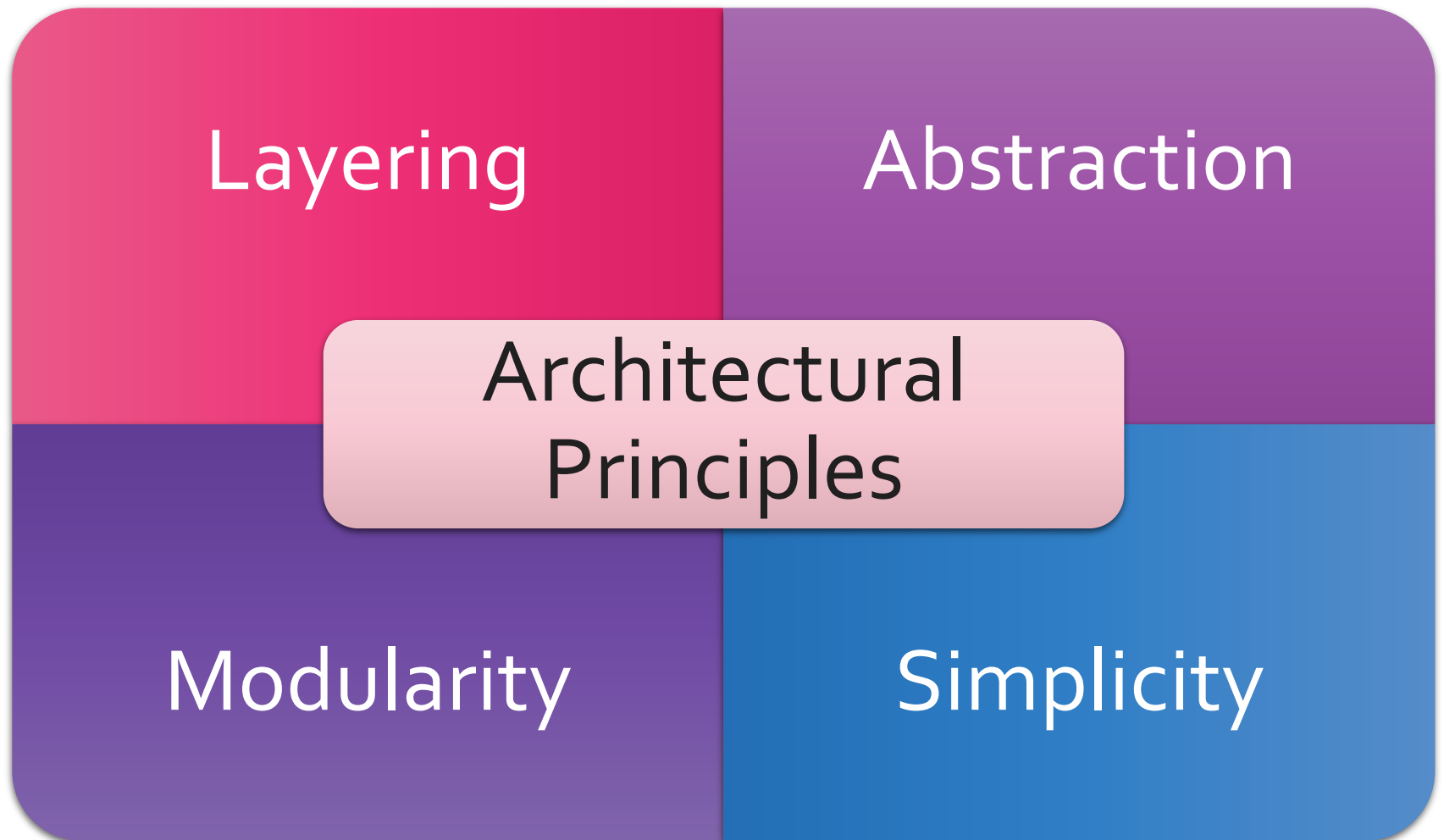
Layered Model

A multilayered model, where each layer provides a "service object", composed by service objects provided by lower layers.
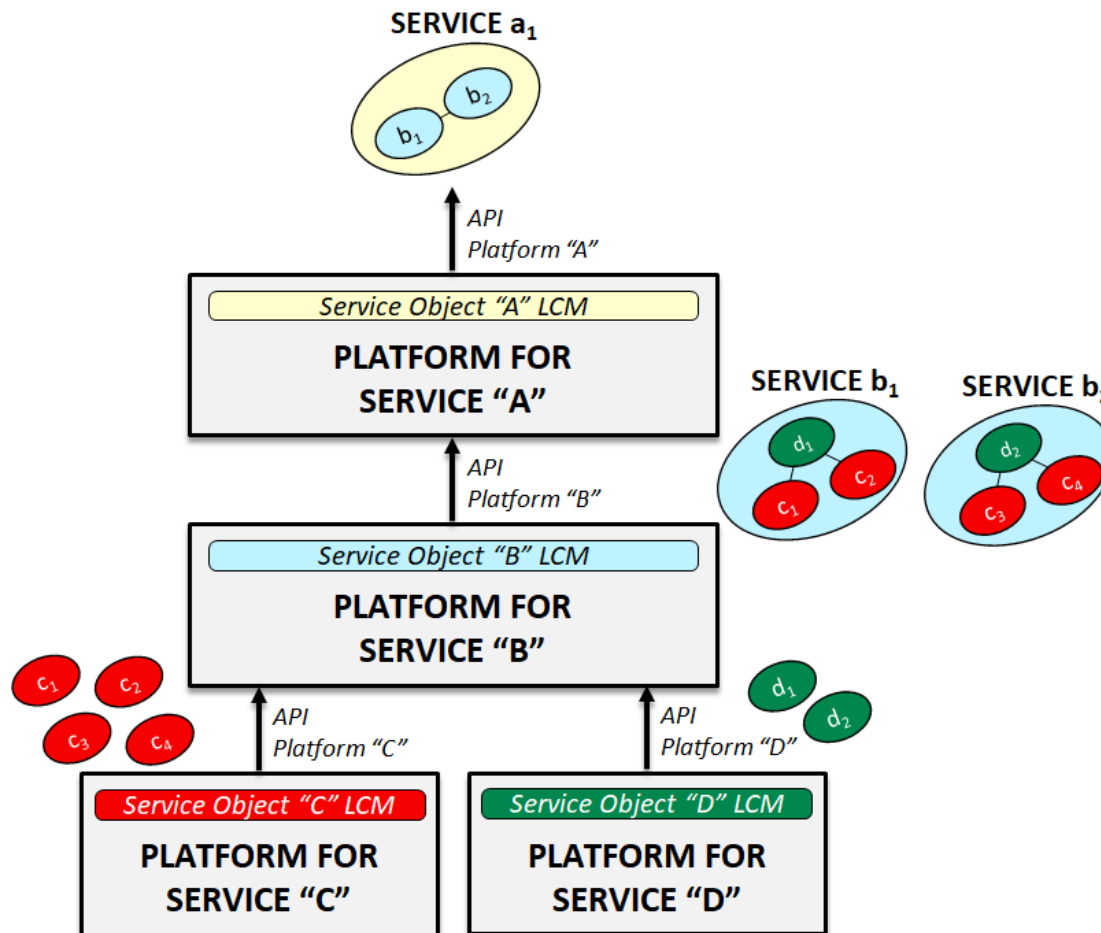
OSM's approach aims to minimize integration efforts

1. **A well-known Information Model (IM)**, aligned with ETSI NFV, that is capable of modelling and automating the full lifecycle of Network Functions:

   - VNFD (VNF Descriptor),
     VNFR (VNF Record),
   - NSD (Network Service Descriptor),
     NSR (Network Service Record),
   - NST (Network Slice Template),
     NSI (Network Slice Instance)
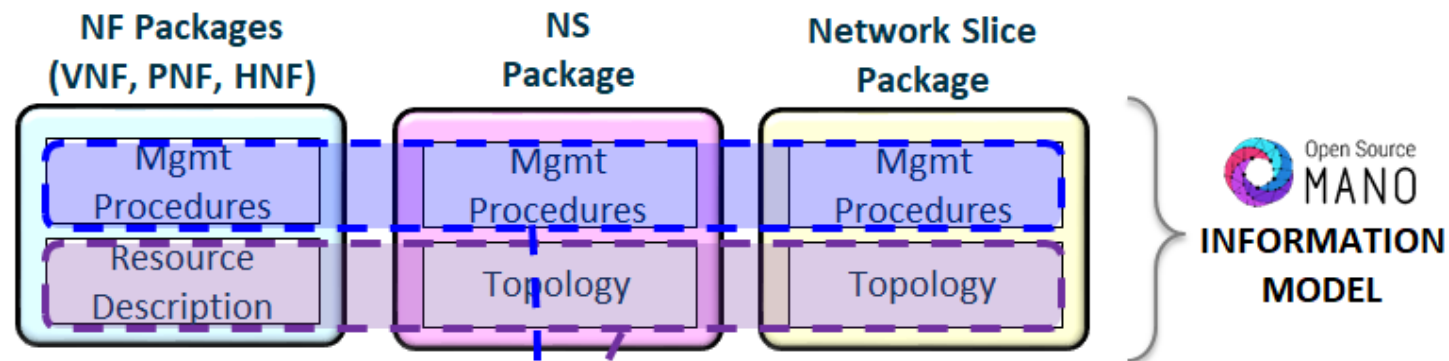
OSM's approach aims to minimize integration efforts

2. A **unified northbound interface** (NBI), based on NFV SOL005
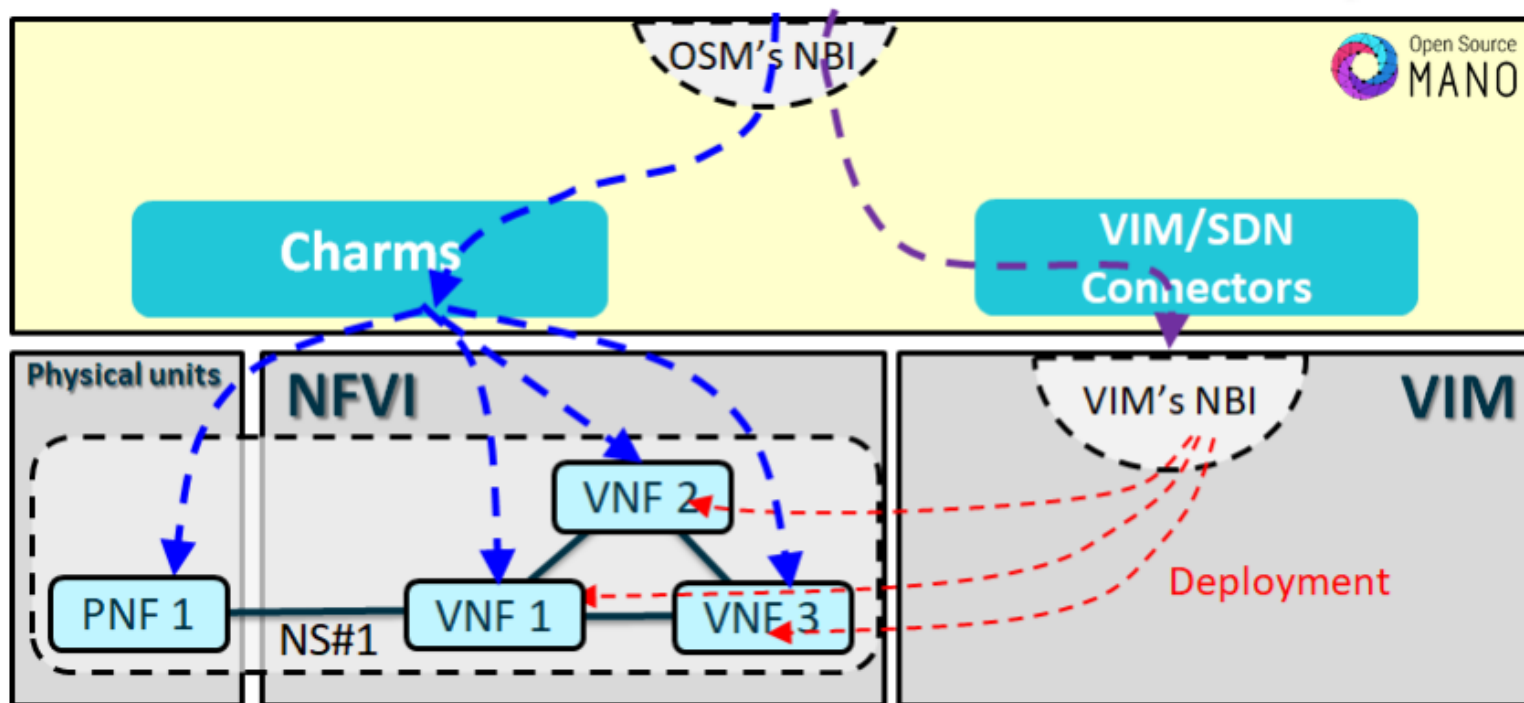
OSM's approach aims to minimize integration efforts

3. The extended concept of "**Network Service**" in OSM, so that an NS can span across the different domains identified and therefore control the full lifecycle of an NS interacting with VNFs, PNFs and HNFs.
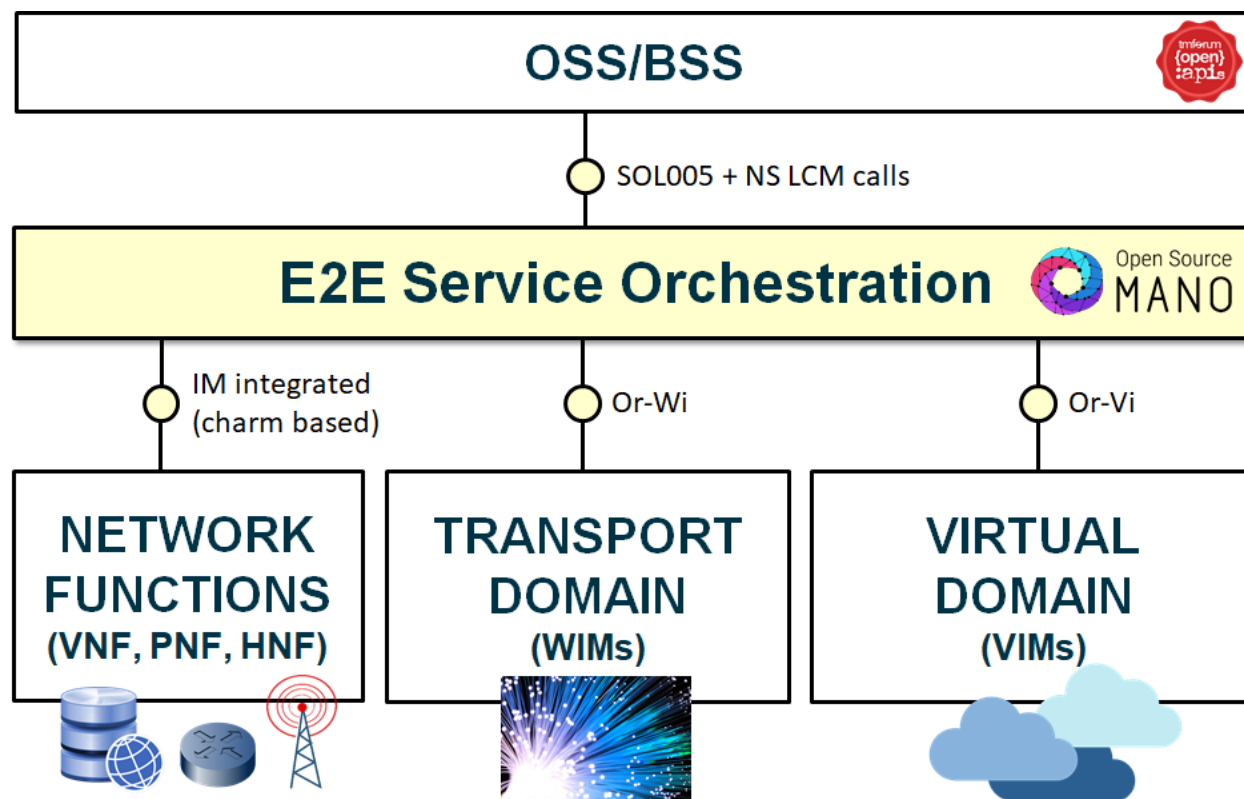
OSM's approach aims to minimize integration efforts

4. In addition, OSM can also manage the lifecycle of **Network Slices**, assuming if required the role of Slice Manager, or integrating with an external Slice Manager
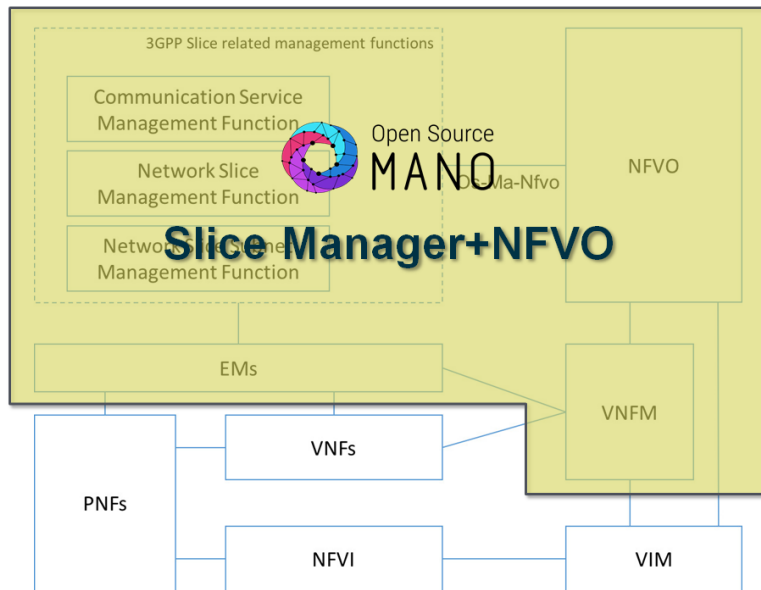
Full E2E Management
(Integrated Modelling)
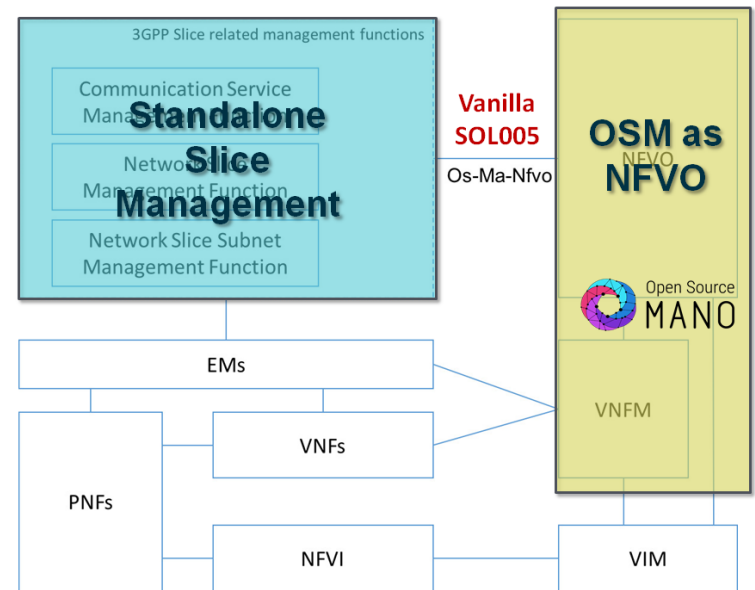
Standalone Management
(Vanilla NFV/3GPP)

Service Platform view
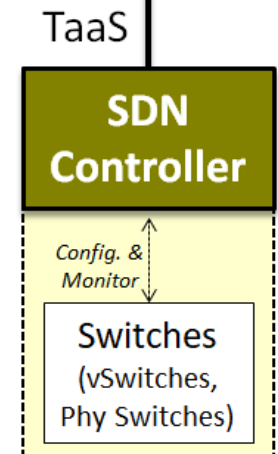
OSM as a Network Service Orchestrator (NSO)
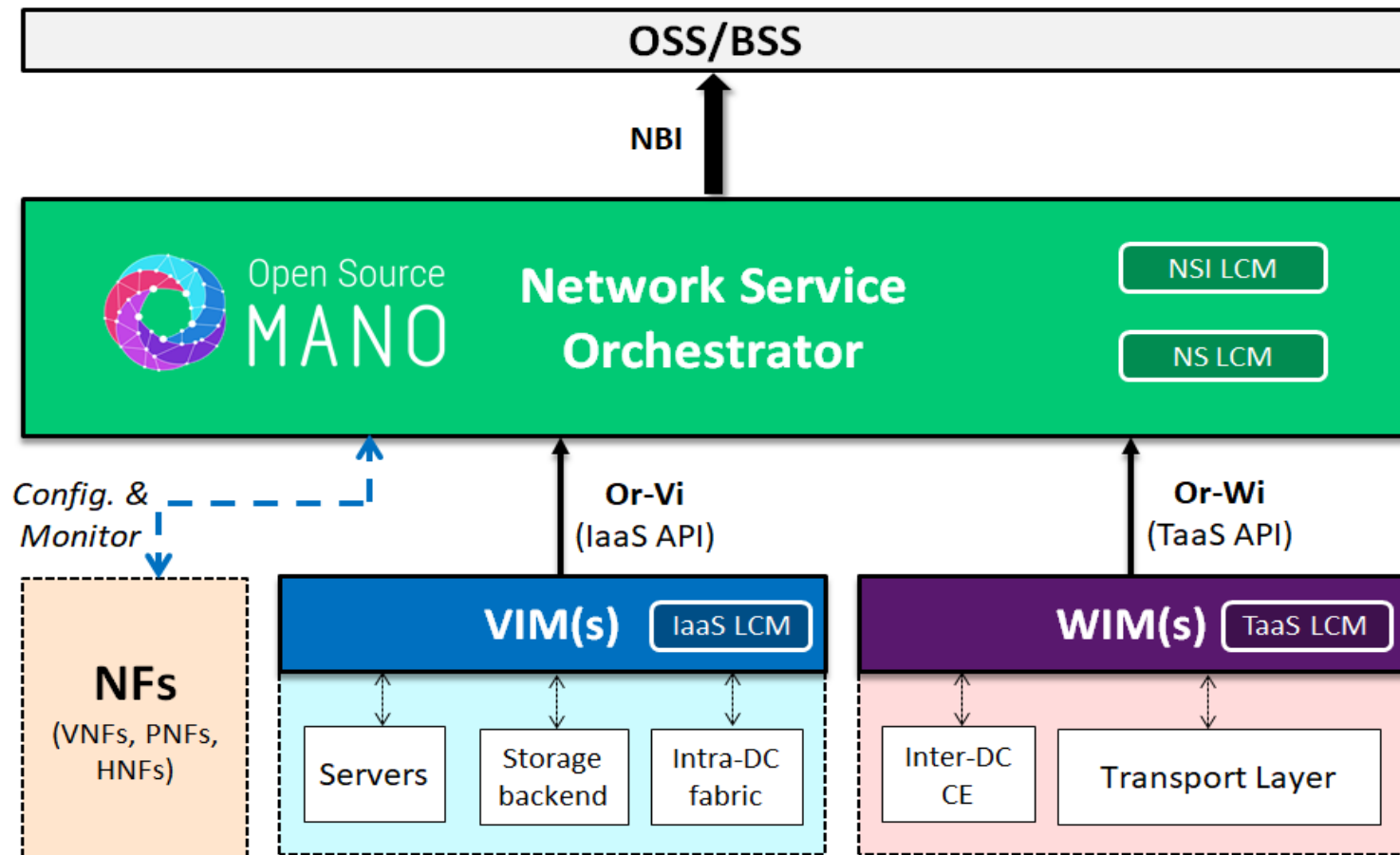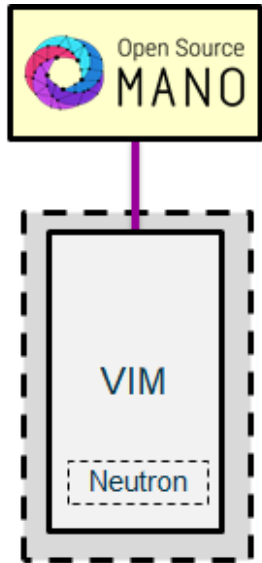
Service Platform view

VIM manages the virtual network to support VNF's connectivity
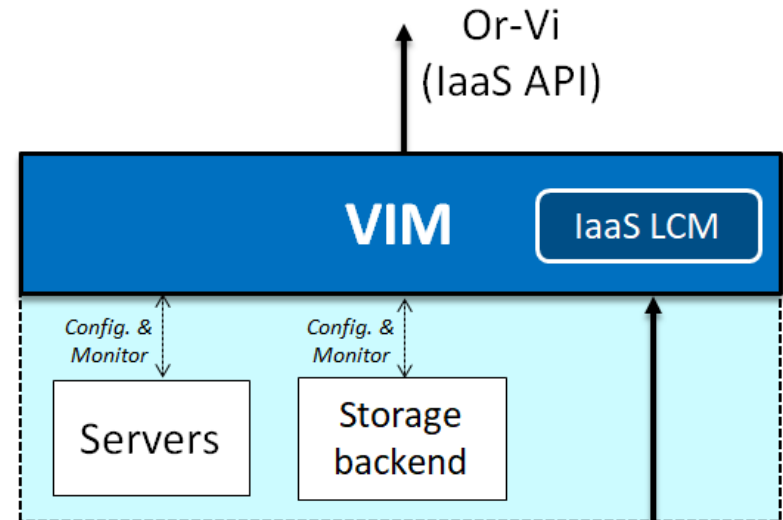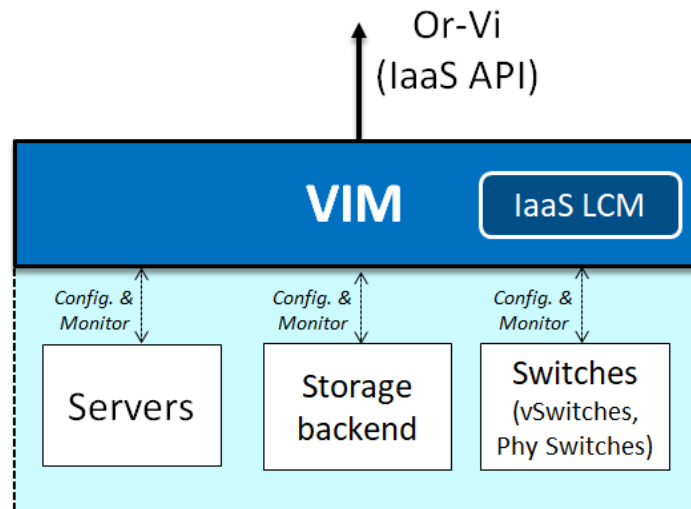
In advanced cases, the VIM might (transparently) control al external SDN Controller, to fulfill the connectivity requirements
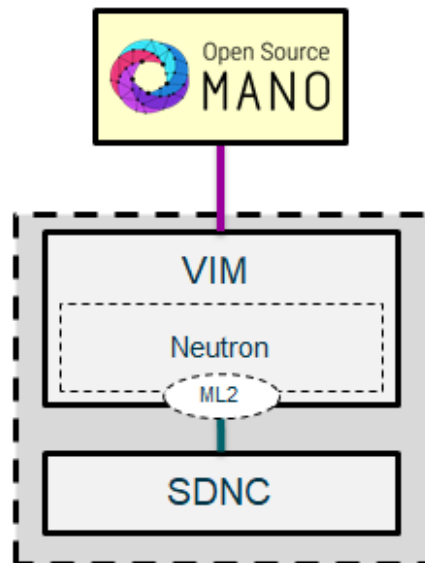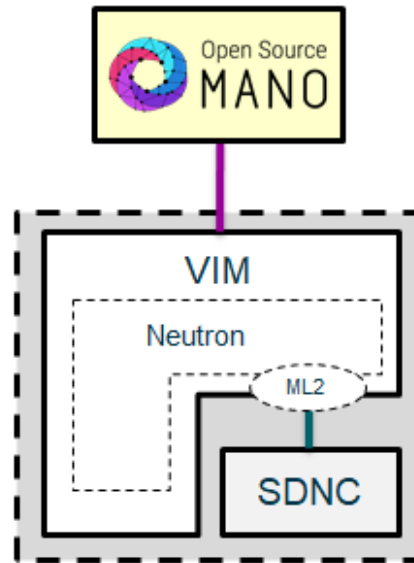
Integration with SDN Controller

CASE #1: Vanilla
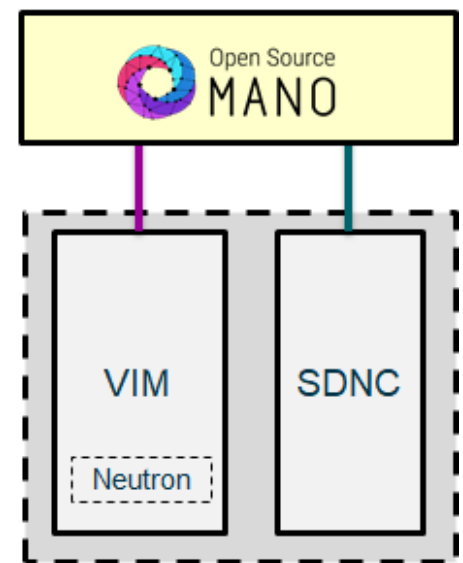- Overlay: Native
- No underlay

CASE #2: VIM + all SDN
- Overlay: SDNC
- Underlay: if available, via SDNC

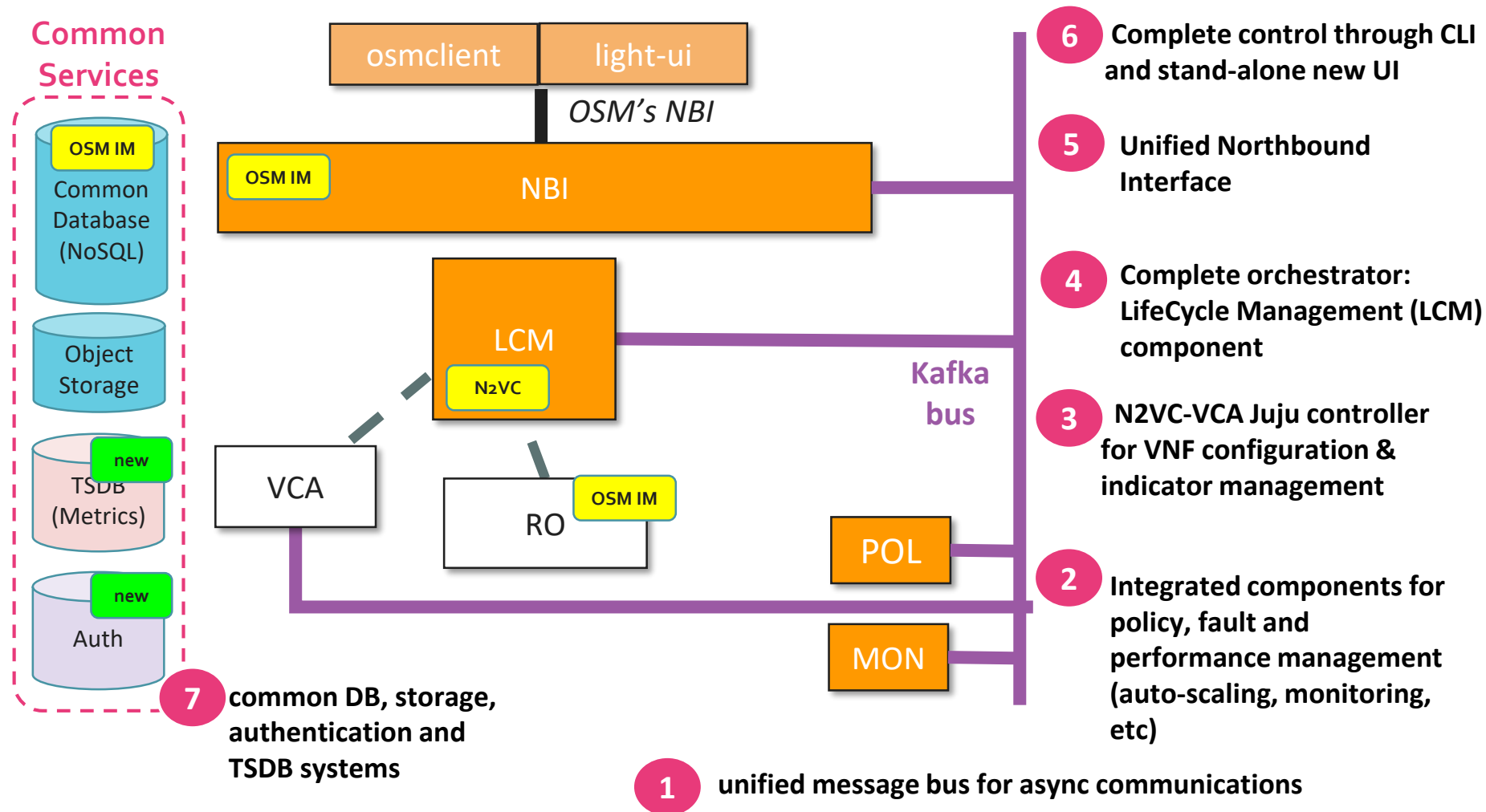**CASE #3: VIM with partial SDN**
- Overlay: Native
- Underlay: SDNC

CASE #4: SDN Assist
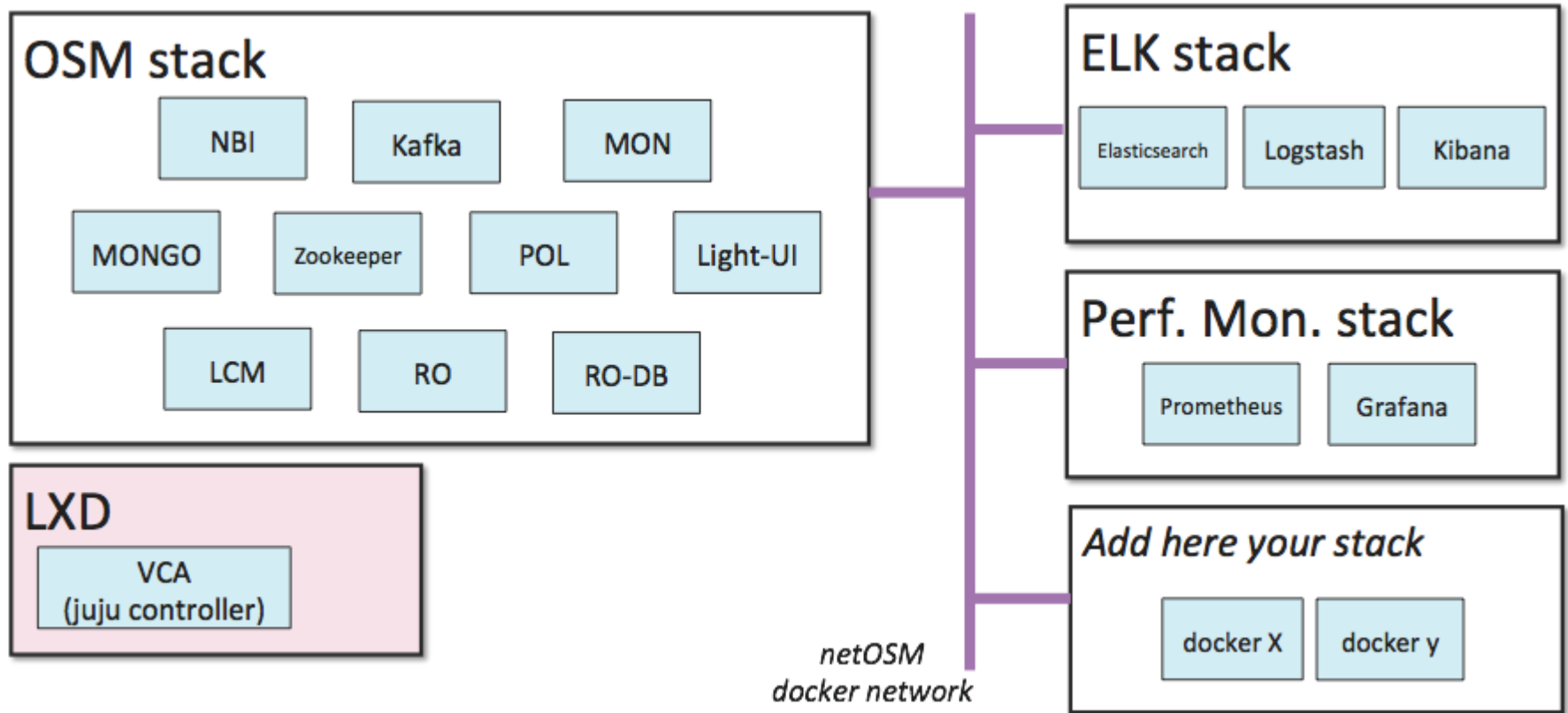- Overlay: VIM native
- Underlay: SDNC, via OSM

SDN Assist
Allows OSM to control SDN connectivity, even when not possible by the VIM (eg: PCI Passthrough, SR-IOV)

Release FOUR+ architectural view

Release FOUR+ architecture

Microservice architecture to enable extensibility

Why is OSM Awesome?

It has a large and diverse community! More than 110 members!
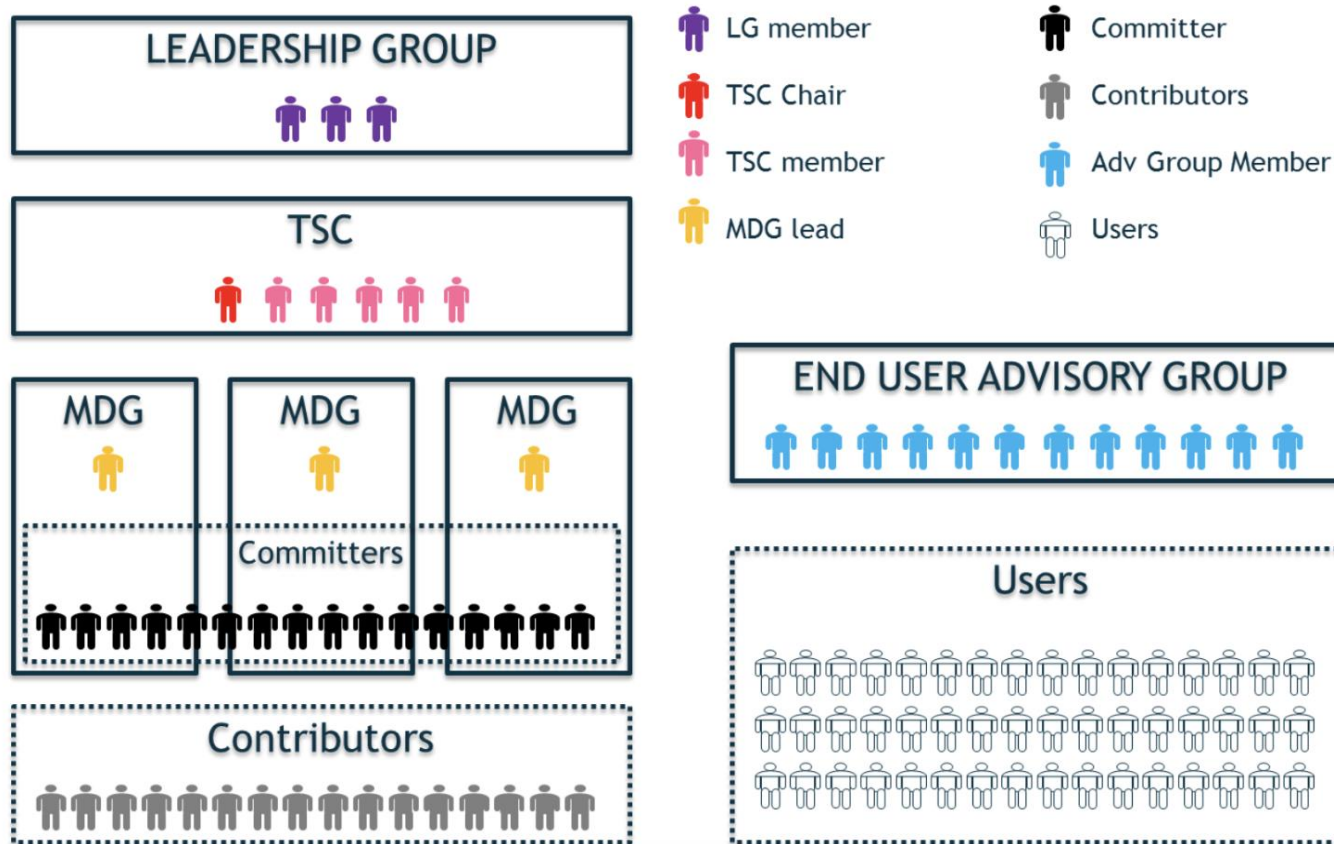
- 12 Global Service Providers
- Leading IT/Cloud players
- VNF providers

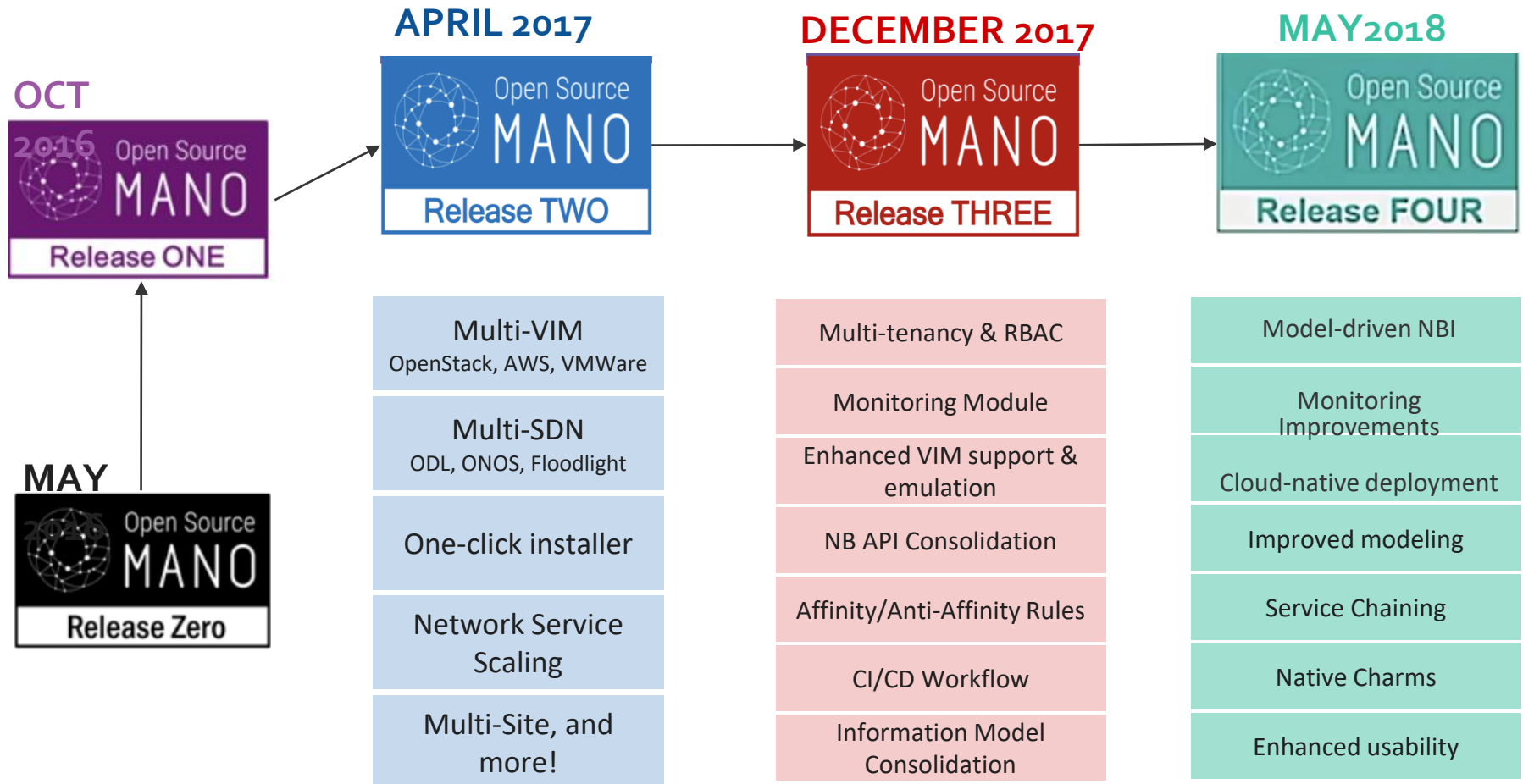(*) Names & brands may be claimed as the property of others

Why is OSM Awesome?

It is well organized for producing production-ready upstream code

Why is OSM Awesome?

It prioritizes features for production readiness...

OCT 2016	APRIL 2017	DECEMBER 2017	MAY 2018
Release ONE	Release TWO	Release THREE	Release FOUR

MAY 2016 — Release Zero

Release TWO	Release THREE	Release FOUR
Multi-VIM OpenStack, AWS, VMWare	Multi-tenancy & RBAC	Model-driven NBI
Multi-SDN ODL, ONOS, Floodlight	Monitoring Module	Monitoring Improvements
One-click installer	Enhanced VIM support & emulation	Cloud-native deployment
Network Service Scaling	NB API Consolidation	Improved modeling
Multi-Site, and more!	Affinity/Anti-Affinity Rules	Service Chaining
	CI/CD Workflow	Native Charms
	Information Model Consolidation	Enhanced usability

Why is OSM Awesome?

...and launched Release FIVE in December 2018, with key features for 5G and production environments!

Release FIVE

The most ambitious release so far!

- Support for hybrid Network Services! VNFs and PNFs

- Network Slicing for 5G

- Multi-site Inter-DC extensions

- Monitoring & Policy improvements (VNF + VIM metrics, autoscaling)

- Improved modelling of VNF networking (SFC, multi-VDU relations)

- Better user experience (GUI package composer, faster installation, events/logs GUI)

Open Source
MANO

Contributing to the Community

Joining the OSM Community
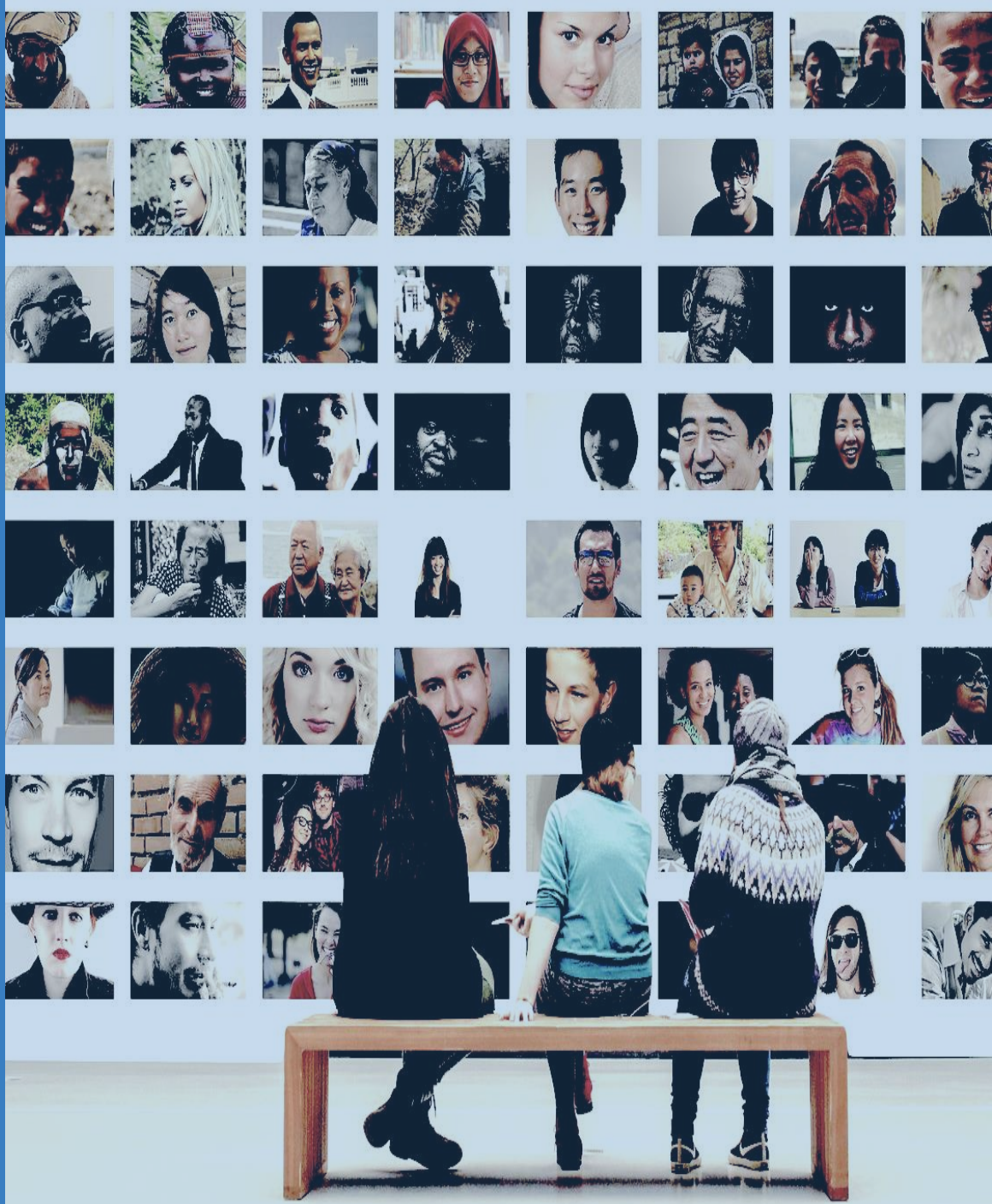
- Join here as a company or individual contributor! https://osm.etsi.org/about/how-to-join

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.

OSM Community Activities

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

- **Face to Face Meetings**
  - Plenaries and Mid-Release meetings (every 3 months)
  - Next location: Santa Clara, US (May 2019)

- **OSM Hackfest**
  - Sixth edition taking place on May 2019 at Santa Clara, expecting to keep **co-locating** with OSM Face-to-Face meetings.

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.
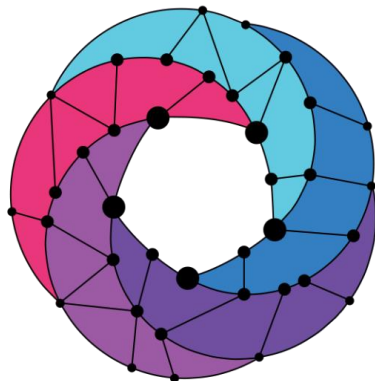
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