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An operator's perspective on NFV standardization progress

Bruno CHATRAS, Orange, ETSI NFV ISG Vice-Chairman

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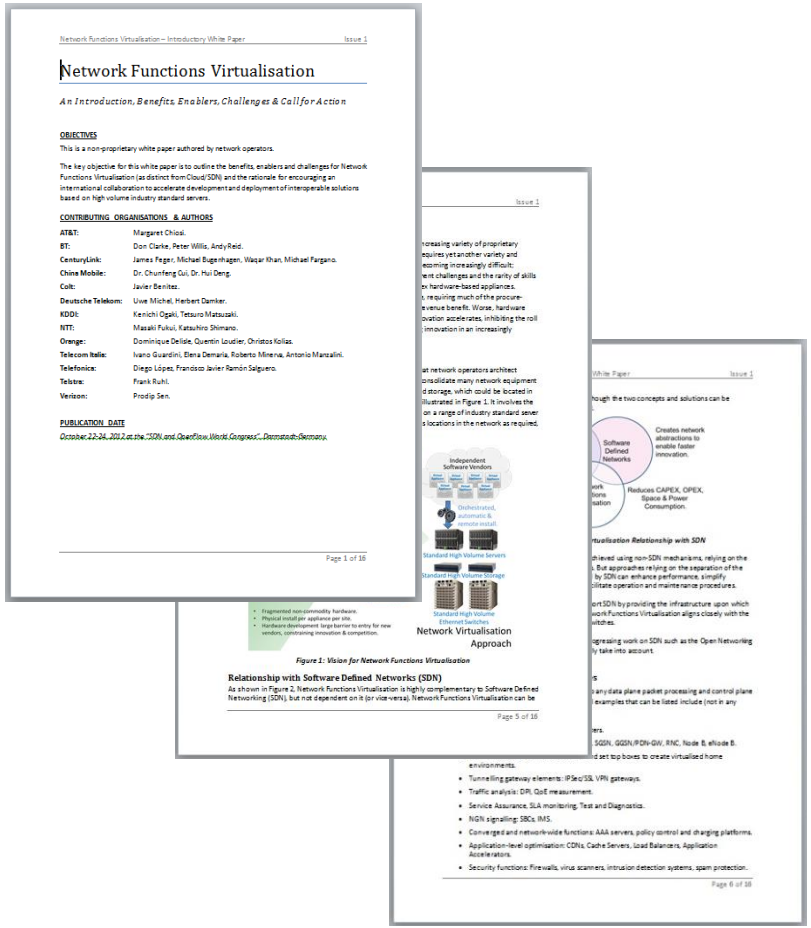
NFV is now a 4-year old concept!

The seminal white paper on Network Functions Virtualisation (NFV) signed by 13 network operators was published at the ONS conference in Darmstadt in October 2012.

The first meeting of the ETSI Industry Specification Group (ISG) on NFV was held in January 2013.

- Today, the ISG membership has grown over 290 companies.



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

AT&T:	Margaret Chiosi.
BT:	Don Clarke, Peter Willis, Andy Reid.
CenturyLink:	James Feger, Michael Bugenhagen, Waqar Khan, Michael Fargano.
China Mobile:	Dr. Chunfeng Cui, Dr. Hui Deng.
Colt:	Javier Benitez.
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.

Page 1 of 16

Network Virtualisation Approach

Figure 1: Vision for Network Functions Virtualisation

Relationship with Software Defined Networks (SDN)

As shown in Figure 2, Network Functions Virtualisation is highly complementary to Software Defined Networking (SDN), but not dependent on it (or vice-versa). Network Functions Virtualisation can be

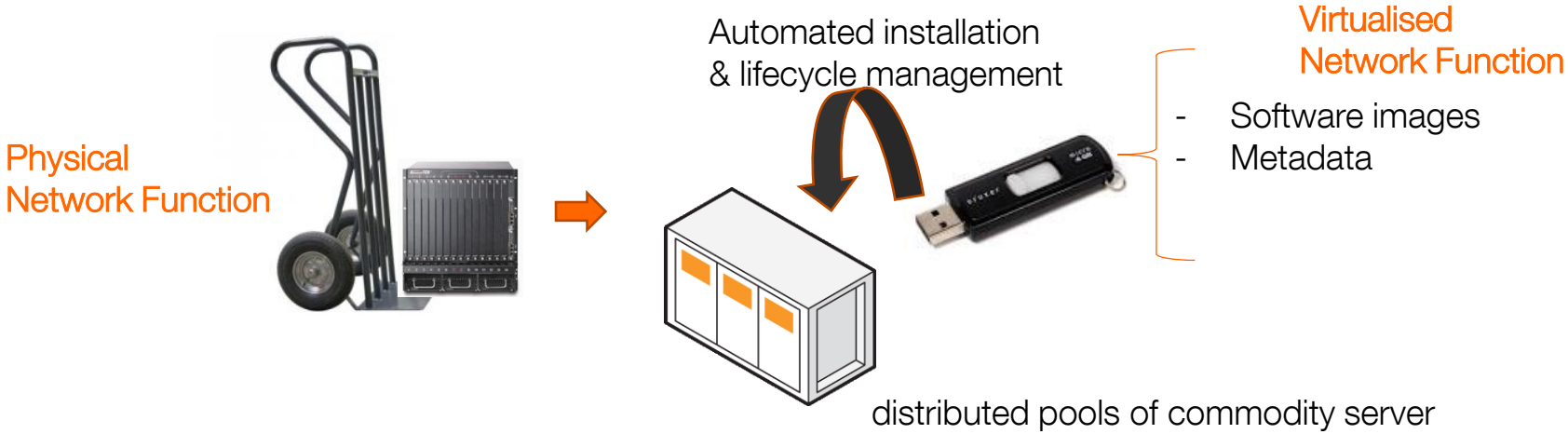
Page 3 of 16

Page 6 of 16

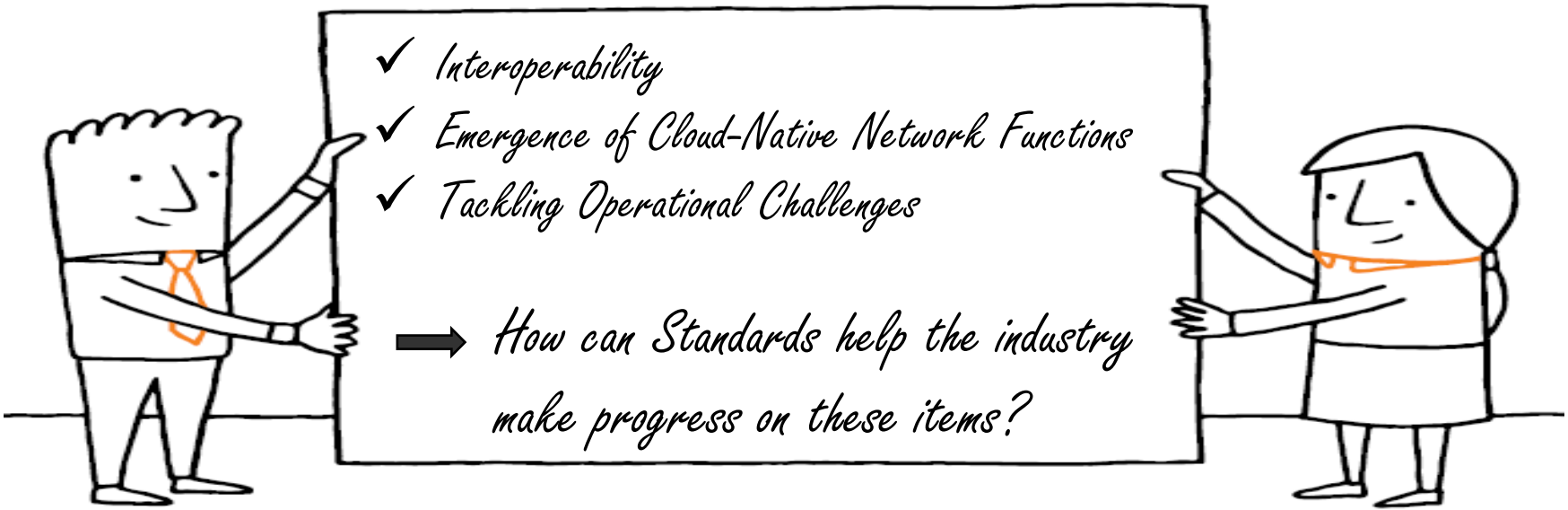
Network Functions Virtualisation in a Nutshell

Relocating network functions from dedicated appliances to pools of generic industry servers, leveraging:

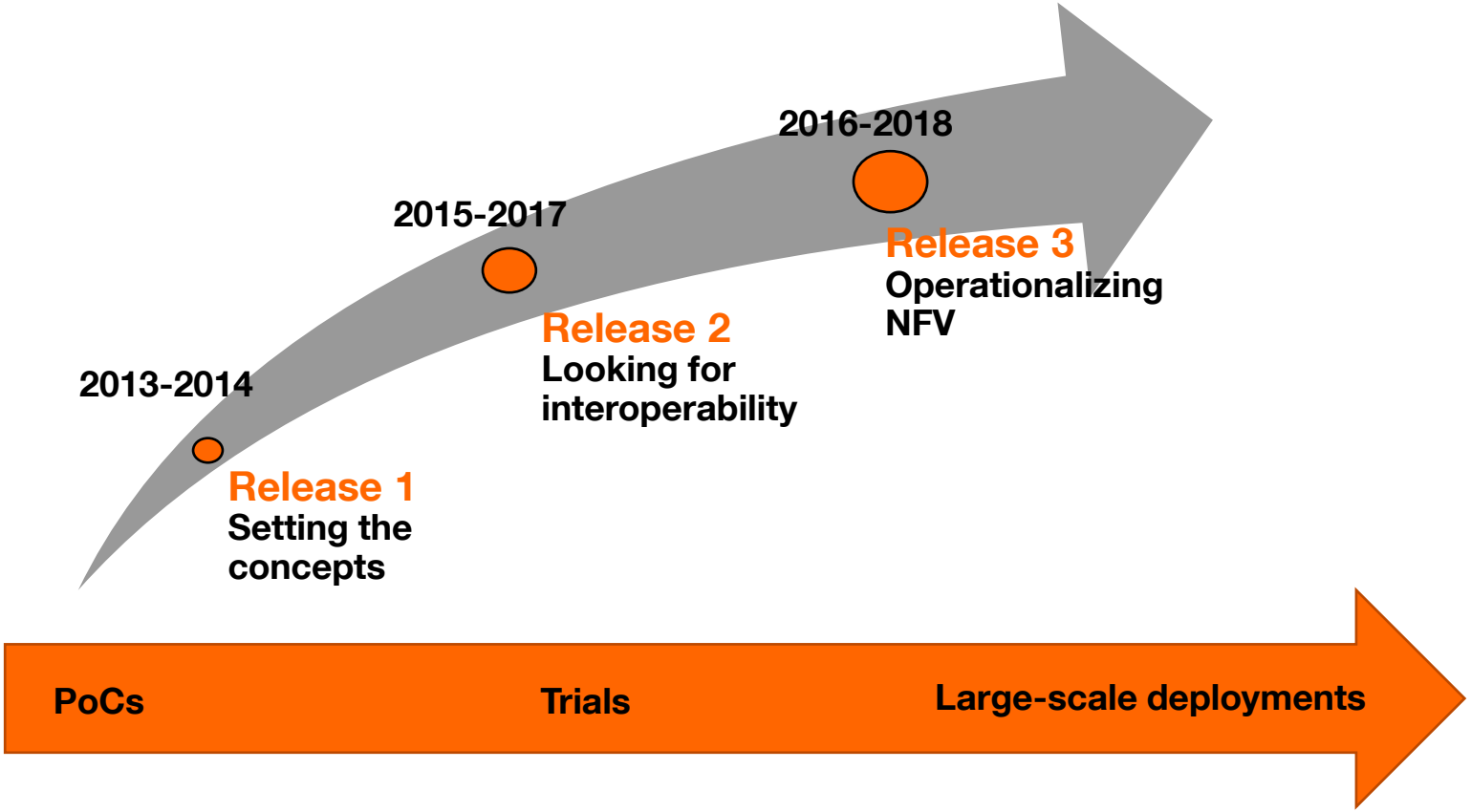
- **Cloud Computing Technology**
- **Virtualisation Technologies**
- **Advances in general purpose processors performance**



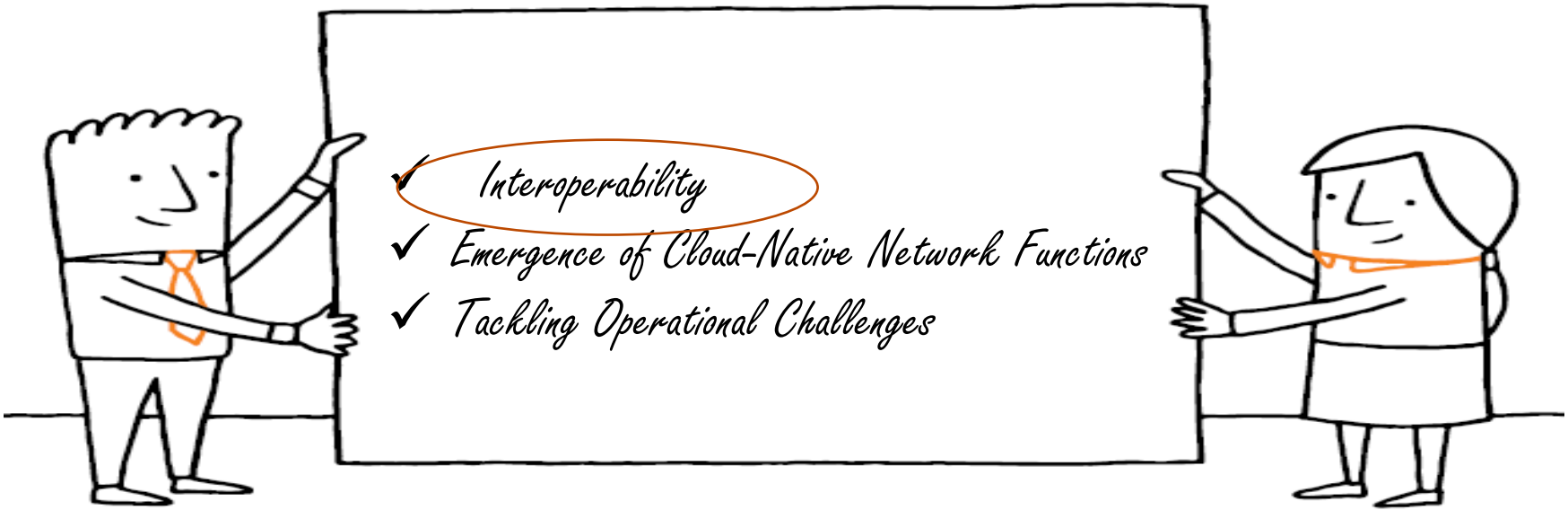
Transforming NFV promises into reality is conditional on industry progress on …



ETSI NFV Specification Releases



How can Standards help?

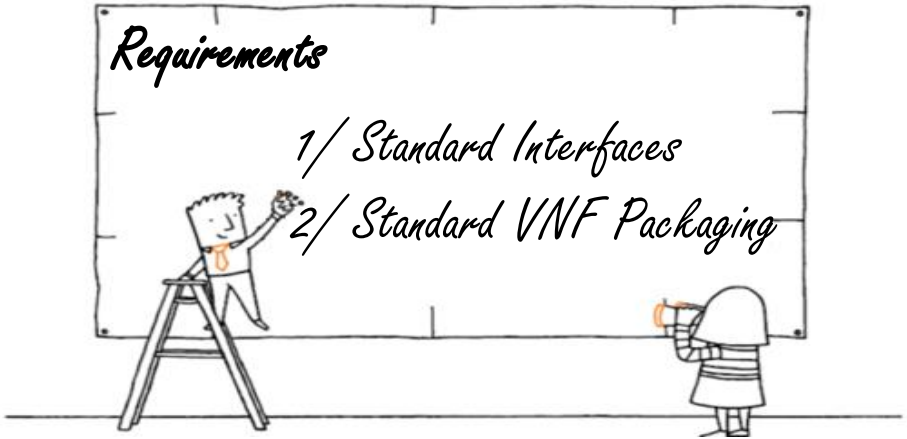


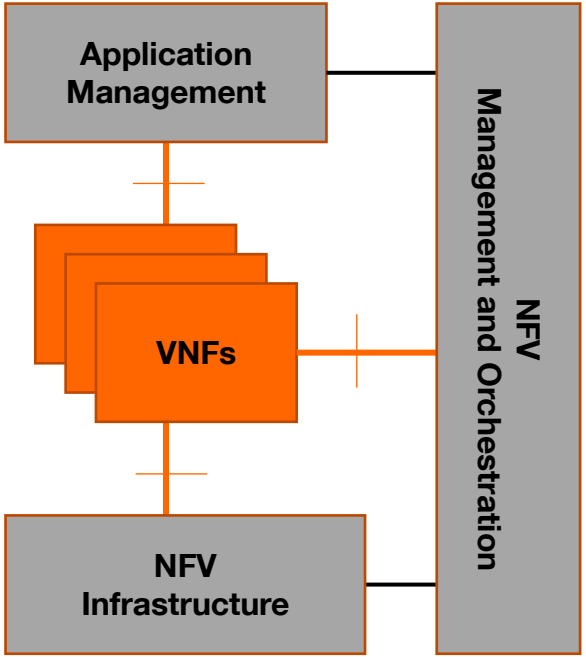
Primary interoperability goal

Virtualised Network Functions (VNFs) must be

Independent from the underlying infrastructure thereby permitting independent hardware and software upgrades, and portability.

Interoperable with independently developed management systems.



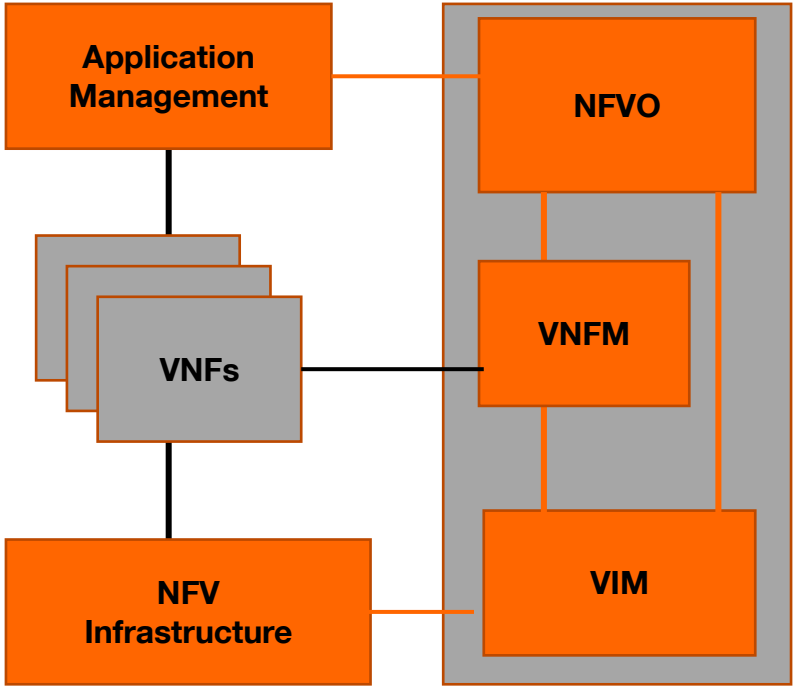


VNF = Virtualised Network Function

Another interoperability goal

NFV Management and Orchestration functions must be interoperable with independently developed NFV infrastructures and application management systems.

It must be possible to create an NFV Management and Orchestration system from independently developed components.



NFVO: NFV Orchestrator
VNFM: VNF Manager
VIM: Virtualised Infrastructure Manager

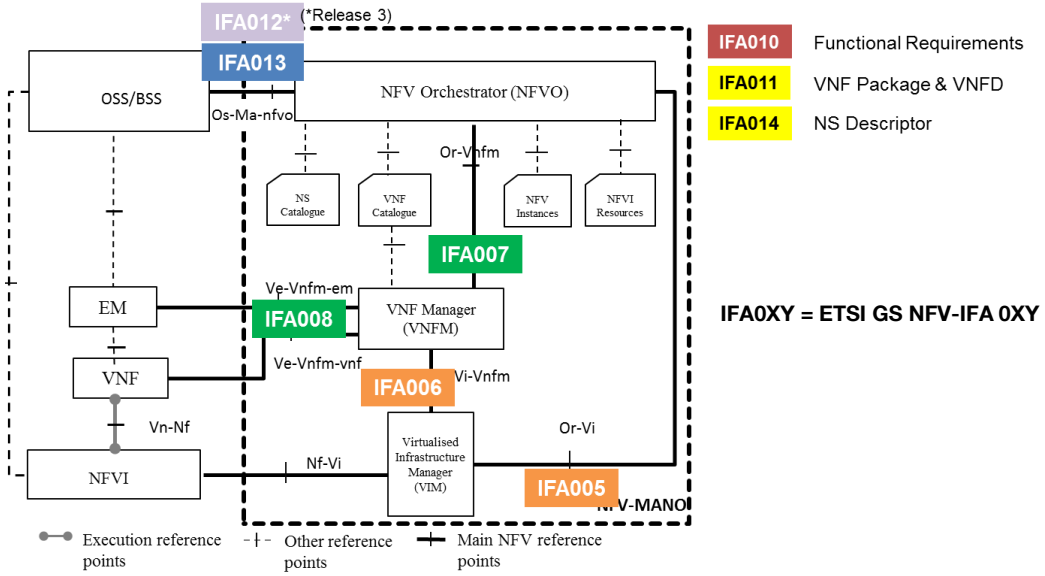
NFV Management and Orchestration standardization

The 2nd Release of ETSI NFV specifications so far includes:

A set of protocol-independent specifications of the interfaces exposed on the reference points of the NFV Management & Orchestration framework (NFV-MANO).

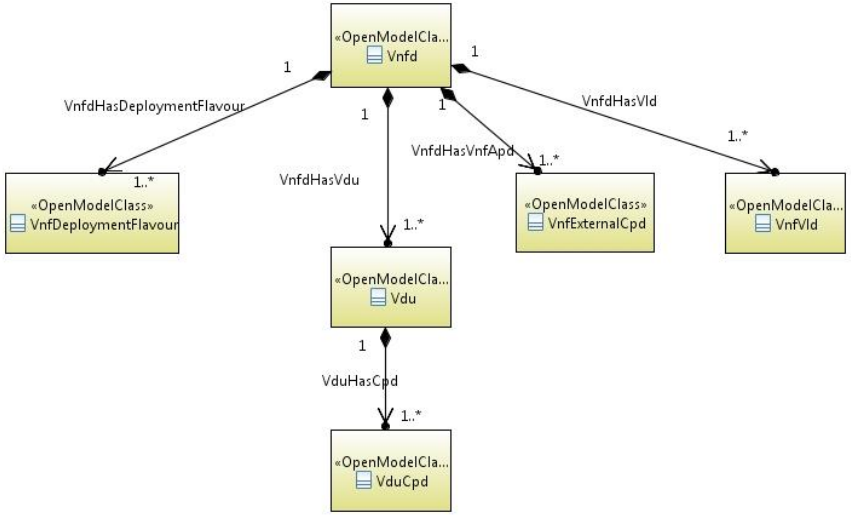
Language-independent specifications of NFV descriptors (a.k.a. deployment templates).

Also known as
“Stage 2” specifications



Dual-form “Stage 2” specifications

Tabular form & UML descriptions



Attribute	Qualifier	Cardinality	Content	Description
vnfdId	M	1	Identifier	Identifier of this VNFD information element. This attribute shall be globally unique. The format will be defined in the data model specification phase. See note 1.
vnfProvider	M	1	String	Provider of the VNF and of the VNFD.
vnfProductName	M	1	String	Name to identify the VNF Product. Invariant for the VNF Product lifetime.
vnfSoftwareVersion	M	1	Version	Software version of the VNF. This is changed when there is any change to the software that is included in the VNF Package.
vnfdVersion	M	1	Version	Identifies the version of the VNFD.
vnfProductInfoName	M	0..1	String	Human readable name for the VNF Product. Can change during the VNF Product lifetime.
vnfProductInfoDescription	M	0..1	String	Human readable description of the VNF Product. Can change during the VNF Product lifetime.
vnfmInfo	M	1..N	String	Identifies VNFM(s) compatible with the VNF described in this version of the VNFD.
localizationLanguage	M	0..N	Not specified	Information about localization languages of the VNF (includes e.g. strings in the VNFD). See note 4.
defaultLocalizationLanguage	M	0..1	Not specified	Default localization language that is instantiated if no information about selected localization language is available. Shall be present if “localizationLanguage” is present and shall be absent otherwise.
vdu	M	1..N	Vdu	Virtualisation Deployment Unit. See clause 7.1.6.
virtualComputeDesc	M	0..N	VirtualComputeDesc	Defines descriptors of virtual compute resources to be used by the VNF. See clause 7.1.9.2.2.

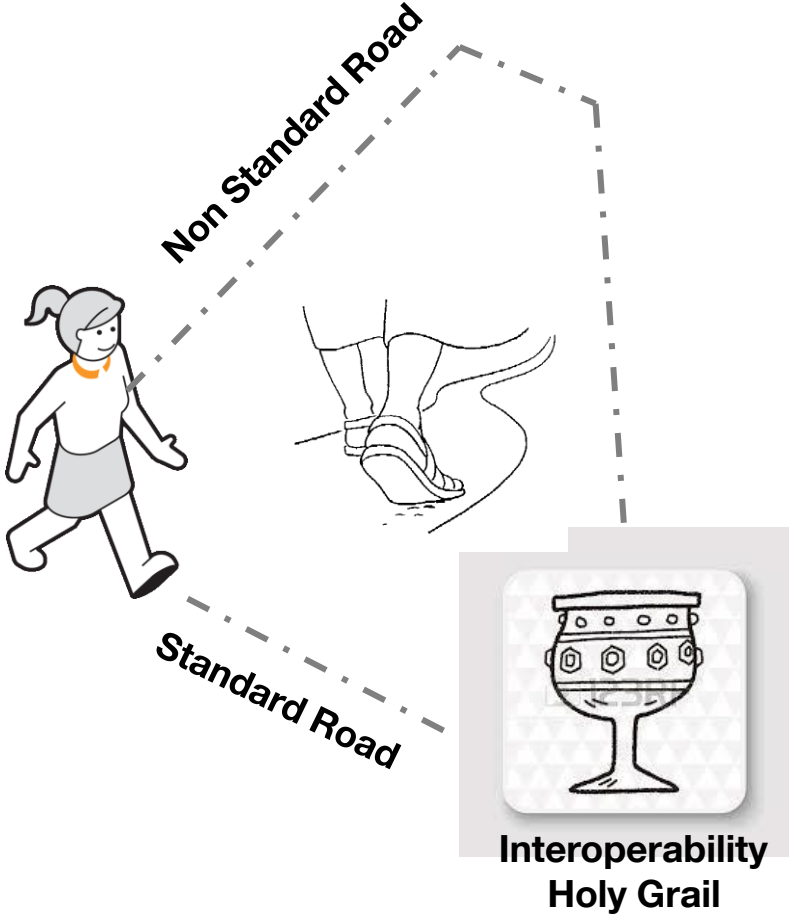
The road to interoperability

Approval of the ETSI GS NFV-IFA specifications was a major step towards enabling interoperability between

Management & Orchestration functions

VNFs and Management & Orchestration functions and VNFs

But … further steps are required



The role of standards on the road to interoperability

“Stage 2” specifications are not sufficient to enable a truly open ecosystem.

Multiple incompatible solutions can be derived while being functionally compatible, e.g.

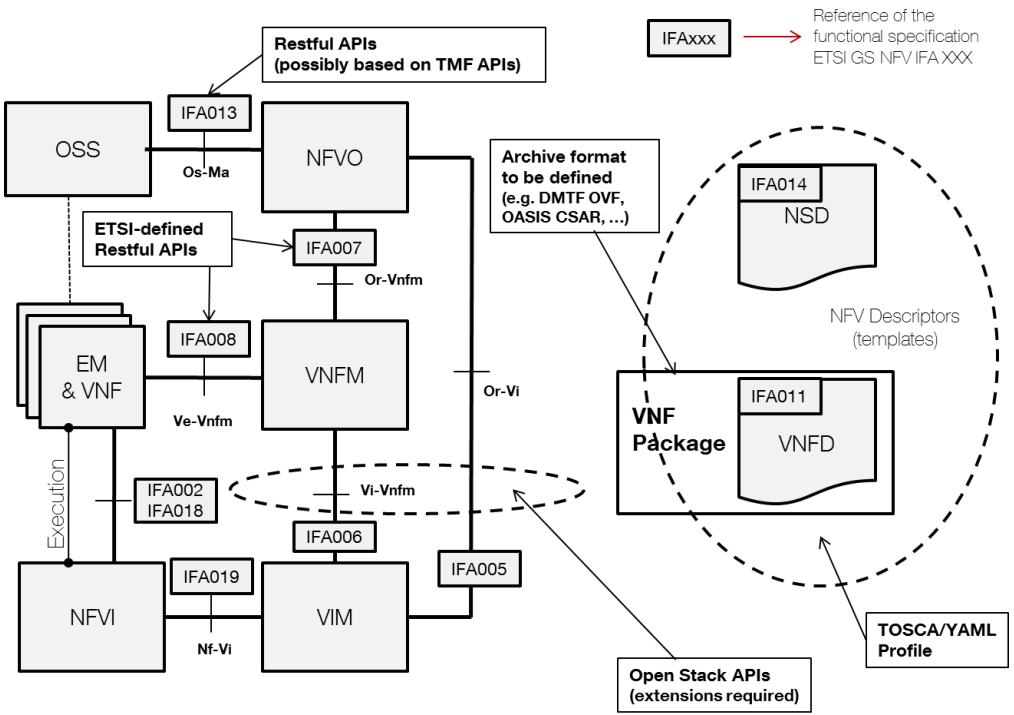
Interfaces: REST vs. Non-REST solutions, REST variants (e.g. TMF vs OMA-style)

Descriptors: TOSCA vs. YANG representation of the VNF Descriptor, and multiple variants are possible in each case…

Open Source communities cannot solve the problem alone… unless there is only one community!

According to a survey carried out by the ETSI NFV Network Operators Council (NOC) over the summer of 2016, the 2nd reason why ETSI NFV should engage in “Stage 3 work is that Open Source is not considered sufficient to guarantee interoperability .

Activities of the ETSI NFV Solutions (SOL) Working Group



Ongoing work

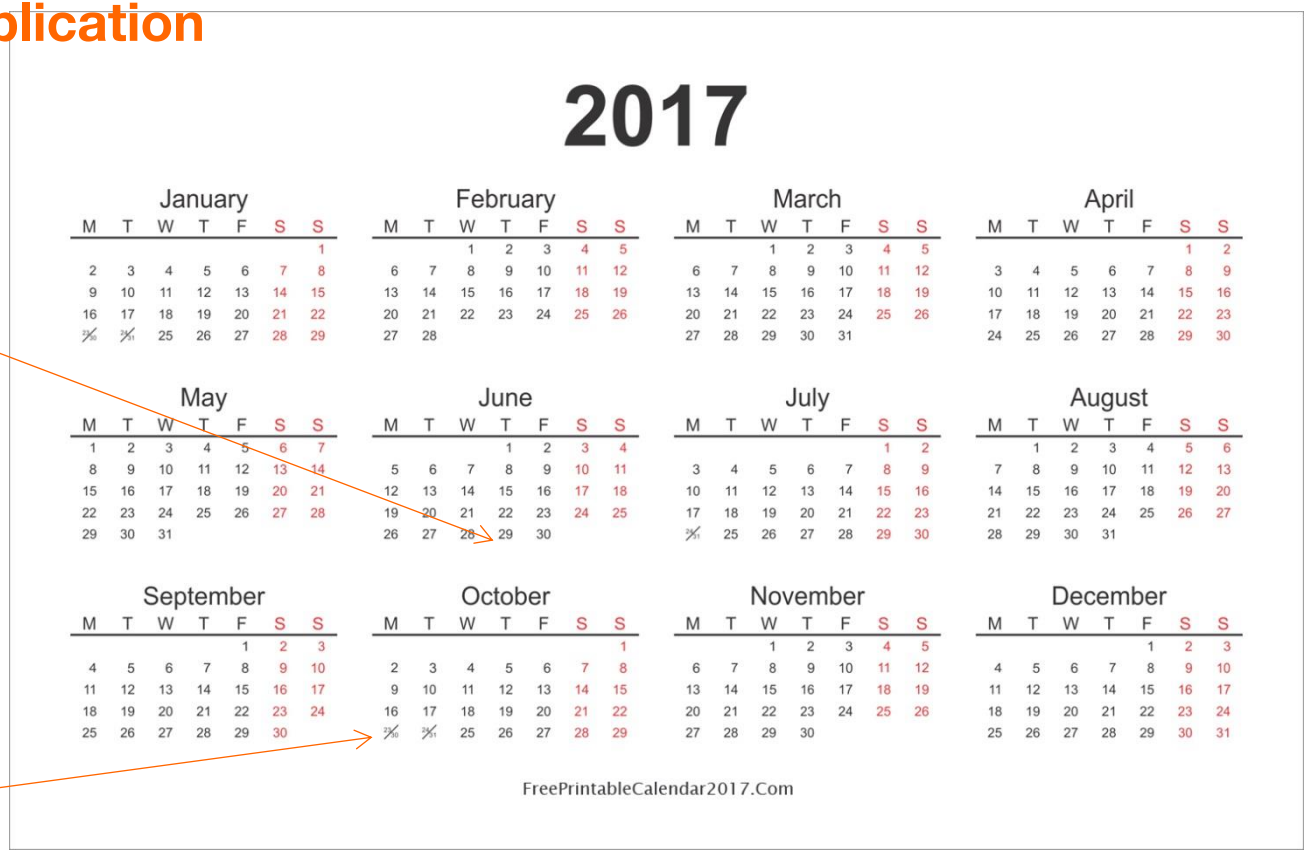
- Specification of a set of REST APIs applicable to the VNFM – NFVO reference point): SOL003
- Specification of a set of REST APIs applicable to the VNFM – VNF/EM reference points: SOL002
- Specification of a TOSCA profile for the VNFD and NSD: SOL001

Next to come

- Specification of a set of REST APIs applicable to the OSS-NFVO reference point.
- Specification of a VNF Packaging Format.

Milestones for publication

REST Protocols/APIs



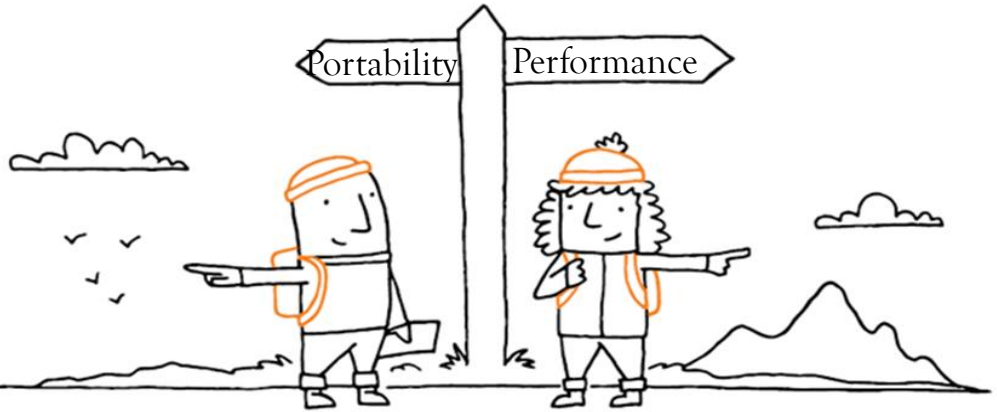
TOSCA-based NFV descriptors

A VNFD-only version might be available before

Interoperability between VNFs and NFV infrastructure: The portability challenge

Many VNFs need to be “accelerated” to deliver high performance will running on COTS servers.

Hardware acceleration is a widespread solution, which today creates dependencies between the VNF and the underlying hardware



Example

The VNF is a Diameter Routing Agent

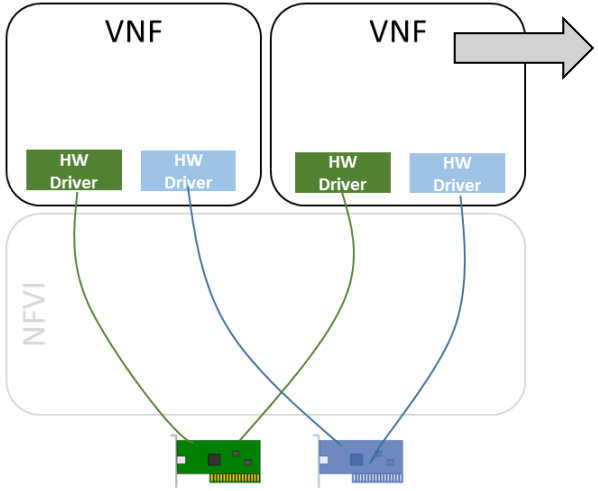
IPSec processing is off-loaded to an enhanced Network Interface Card (NIC)

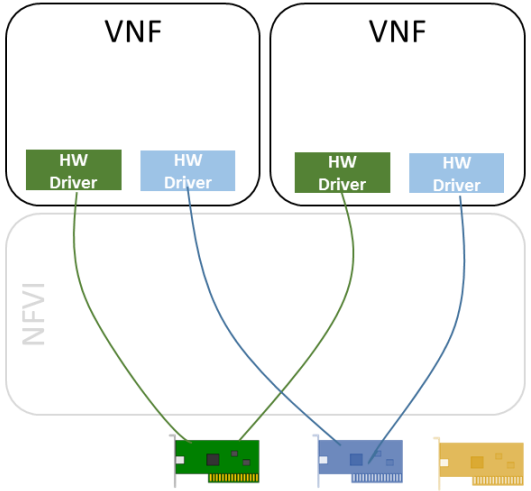
The VNF software communicates with the NIC using a proprietary API, specific to the card model.

The Pass-through model

Dependencies have to be specified in the VNF Descriptor, by the VNF provider.

Restricted ability to move the VNF from one server to another.





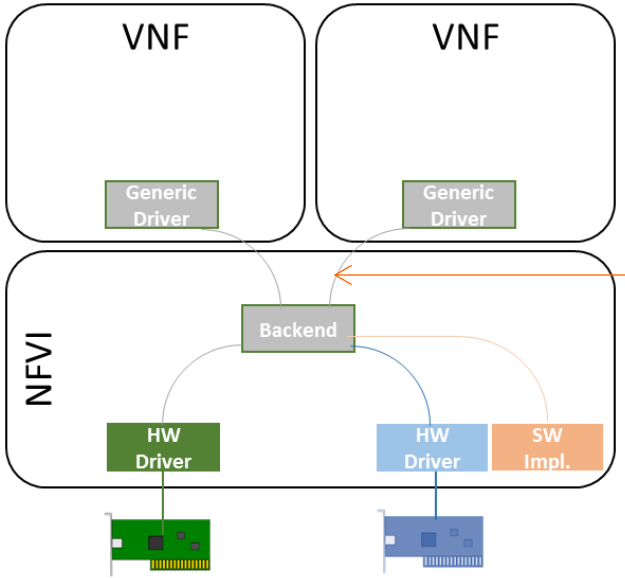
All drivers for all possible hardware must be present in the VNF

New yellow hardware cannot be used until VNF Vendors update their VNF package and the new VNF on-boarded

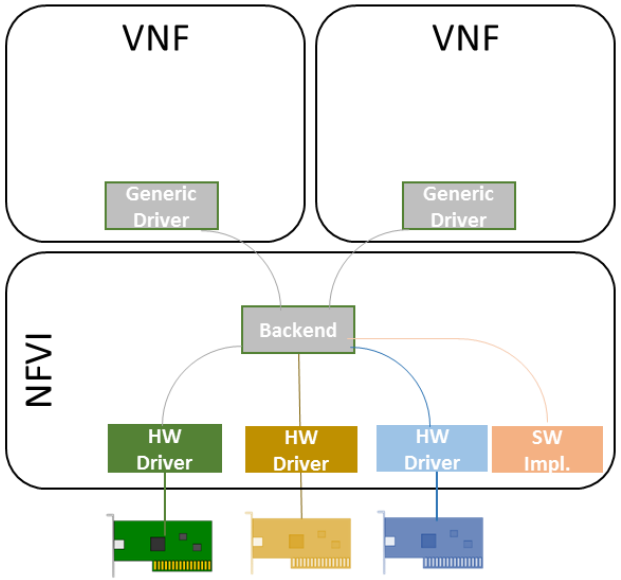
Towards a solution

Under standardization in ETSI GS NFV-IFA 002

Open source implementations in OPNFV DPACC

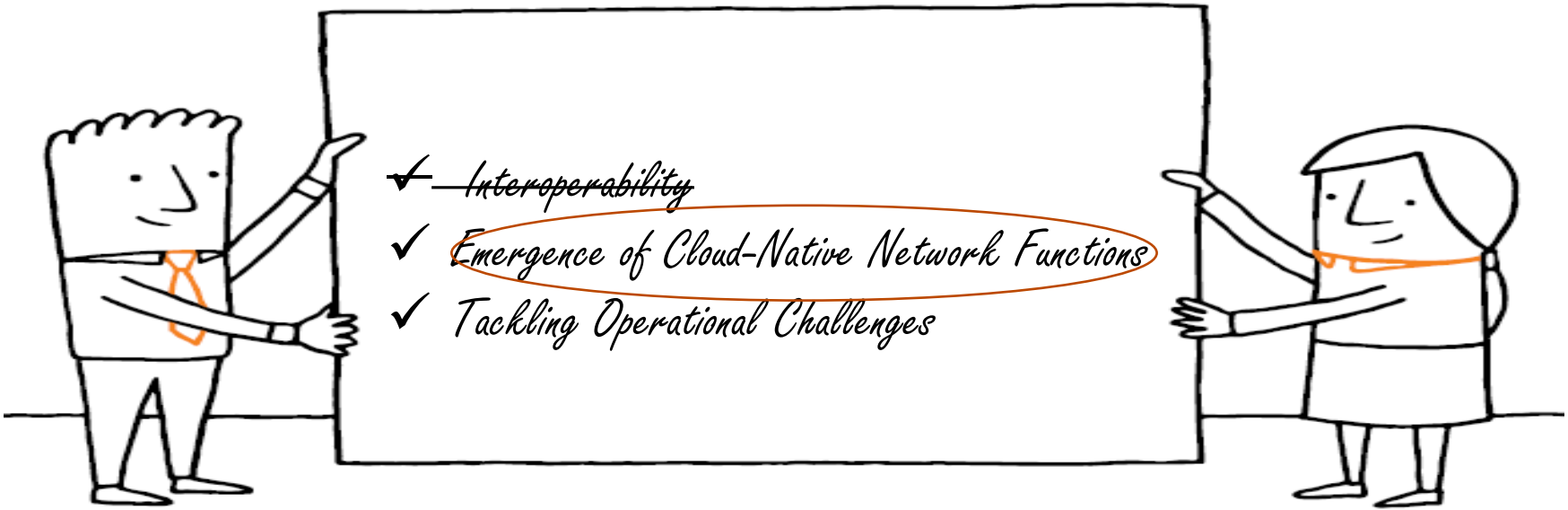


Operator ensures its NFVI is loaded with relevant hardware drivers



Operator update its NFVI to benefit from new yellow hardware

How can Standards help?



Cloud-native / Cloud-ready VNFs

Today, these are "marketing" terms referring to a VNF whose software has been (re-)designed to get the most from the Cloud-based nature of the NFV technology, as opposed to just porting existing network applications to COTS servers.

Sometimes also advocates a Microservice design style, entering aspects not directly related to virtualisation, e.g. Focus on a single capability (i.e. "do a single thing well" motto)

A set of guidelines developed and agreed by the NFV community would be welcomed.

Cloud-native / Cloud-ready VNFs

Example guidelines

Design small VNFs or VNF Components to enable fast instantiation and increase resource utilization

Include a “load balancing” VNF Component to facilitate scaling and resilience

Minimize the number of stateful VNFCs within a VNF, to facilitate resilience.

Minimize coupling between VNF Components to facilitate partial upgrades

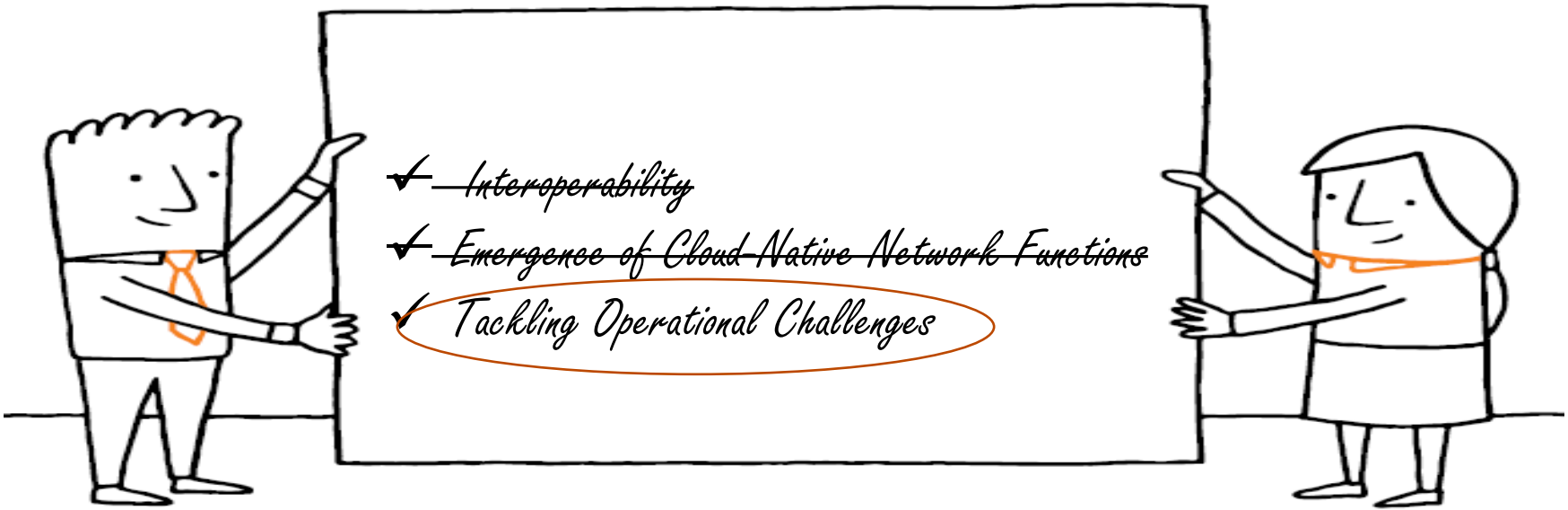
Design for failure (internal redundancy, synchronization middleware between stateful VNF Components, etc.)

Challenges

No one-size-fits-all solution

Should not hinder vendor differentiation

How can Standards help?



Operationalizing NFV

Addressing considerations related to licensing, accounting and charging

Consistent operational integration with connectivity services

Managing Management & Orchestration systems

Consolidating security mechanisms

Addressing E2E automation

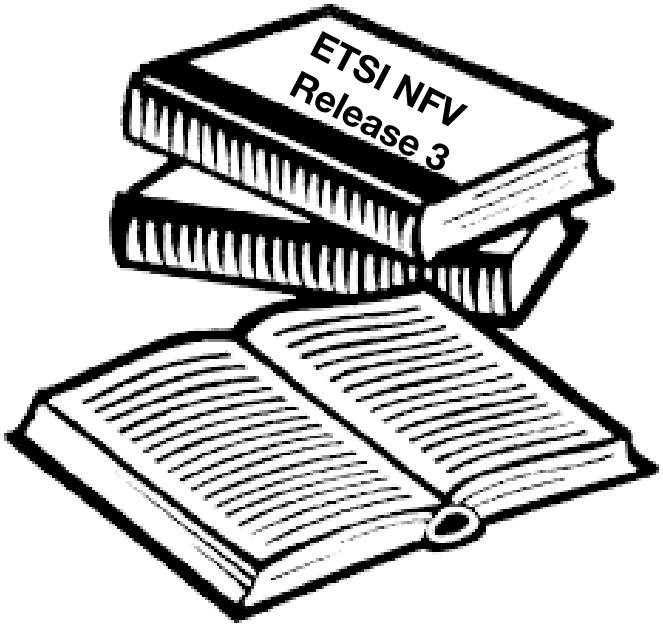
Supporting multi-domain (incl. multi domain orchestration) and multi-tenancy scenarios

Maintaining service availability and continuity when updating/upgrading software

Addressing troubleshooting solutions

Specifying hardware requirements

Integrating policy management in NFV Management & Orchestration

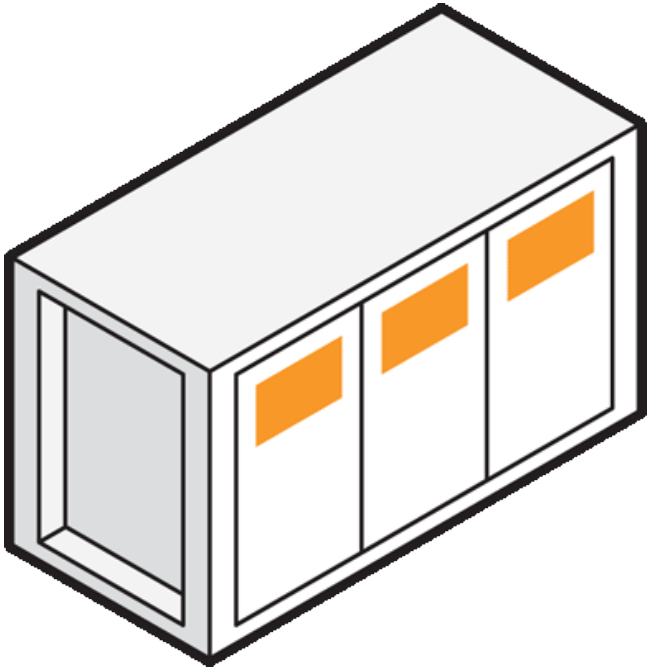


Hardware requirements

Specification of requirements to enable interoperability of equipment in the telecommunications environment to support NFV deployment. The focus includes the following areas:

- Operations
- Environmental
- Mechanical
- Cabling
- Maintenance.

Specification of requirements for the support of lawful intercept and/or critical national infrastructures.



ETSI GS NFV-EVE 007: Specification on NFVI Node Physical Architecture - Multi-Vendor Interoperability Requirements.
To be approved: 2017Q1

Software Upgrade

Service providers are looking for Software Update/Upgrade solutions such that service availability and continuity is maintained.

Software update in conventional networks typically implies reduced redundancy during upgrade process and/or upgrade can only take place during off-peak periods No failover possibility while switching over.

NFV provides an opportunity for a better approach.

Guidance and Best Practices available in GS NFV-REL 002 & GS NFV-REL 003 (published)

A new work item has been launched to specify requirements on software update.

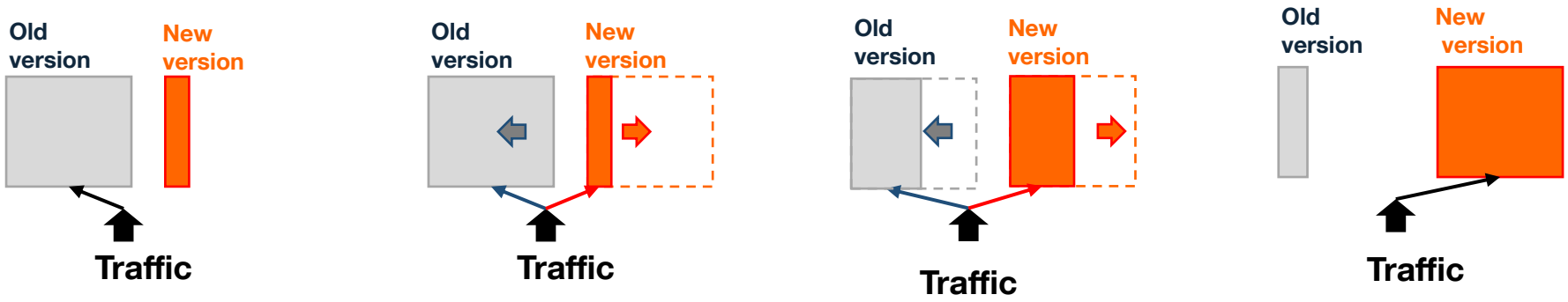
The scope covers all types of software related to NFV: VNFs, MANO and NFVI.

ETSI GR NFV-REL 006:
Specification for maintaining service availability and continuity when updating/upgrading software
To be published: June 2017

VNF Software Upgrade principle

Software upgrade should be done in a gradual and revertible way

e.g. upgrade a fraction of the whole capacity, a certain service type or a certain user group, with the constraint of preserving the service availability and service continuity.



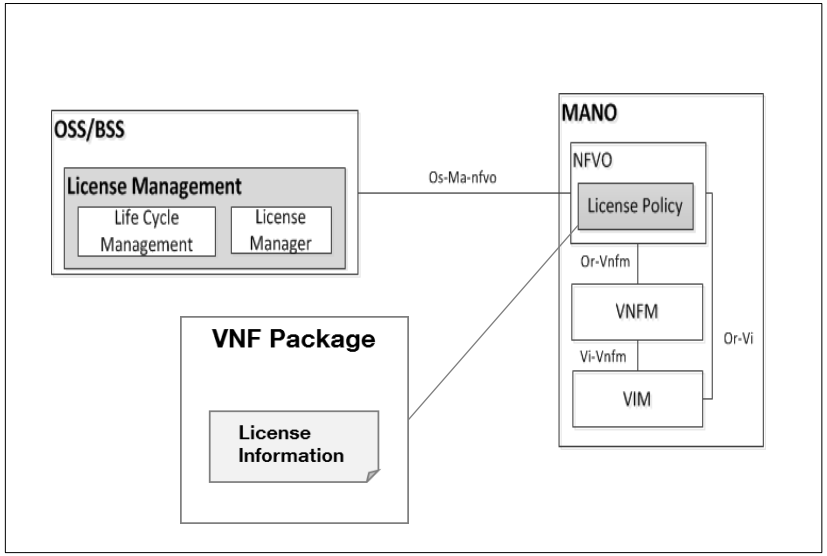
Typically requires an SDN controller to direct an increasing% of the traffic to the new version.

License Management

Today: Vendor specific licenses management and lack of process automation for service provisioning and licence renewal/updates.

Flexible deployment requires flexible license management (e.g. in case of auto-scaling).

A new study has been launched in ETSI to identify the features needed to support license management for NFV and their impact on Management and Orchestration functions.



ETSI GR NFV-EVE 010:
Report on License Management for NFV
To be approved: June 2017

Management & Orchestration functions
need to be managed and reliable as well…

Management

Automated deployment of new instances, including automatic discovery of new peers

Configuration of Management & Orchestration functions according to operator's policies

Fault Management and Performance Management of Management & Orchestration functions

In-service software update

Reliability

Automated failover/recovery

Redundancy models to avoid single points of failure and/or distribute the load

Stand-alone mode of operation for the VIM and VNFM in case of NFVO failure

ETSI GR NFV-IFA 021:
Report on Management of MANO functions…
To be approved: January 2017

Addressing E2E automation: The missing link

For a VNF to become fully operational, the embedded network application needs to be configured and managed.

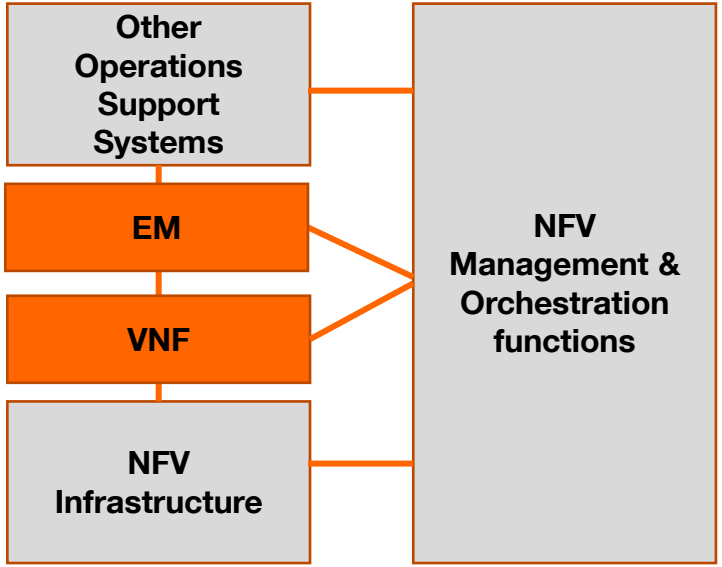
When a new VNF is being deployed,

an Element Manager (EM) needs to be deployed as well in an automated way.

or

the VNF needs to be manageable through generic EM functionality embedded in the OSS

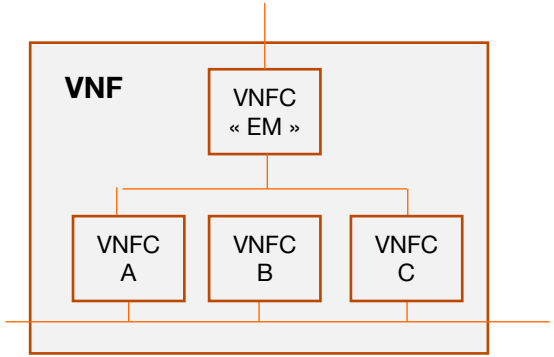
Quite a challenge!

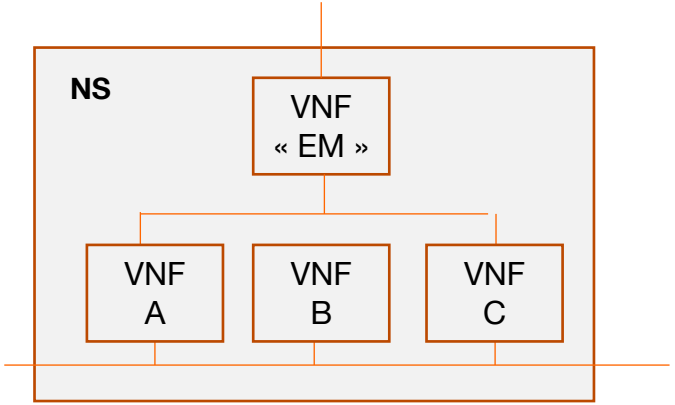


ETSI GR NFV-IFA 021:
Report **on management of NFV-MANO and automated deployment of EM and other OSS functions** To be approved: January 2017

Typical solutions for automated EM deployment

Deploy EMs as special components of these VNFs or as additional VNFs.

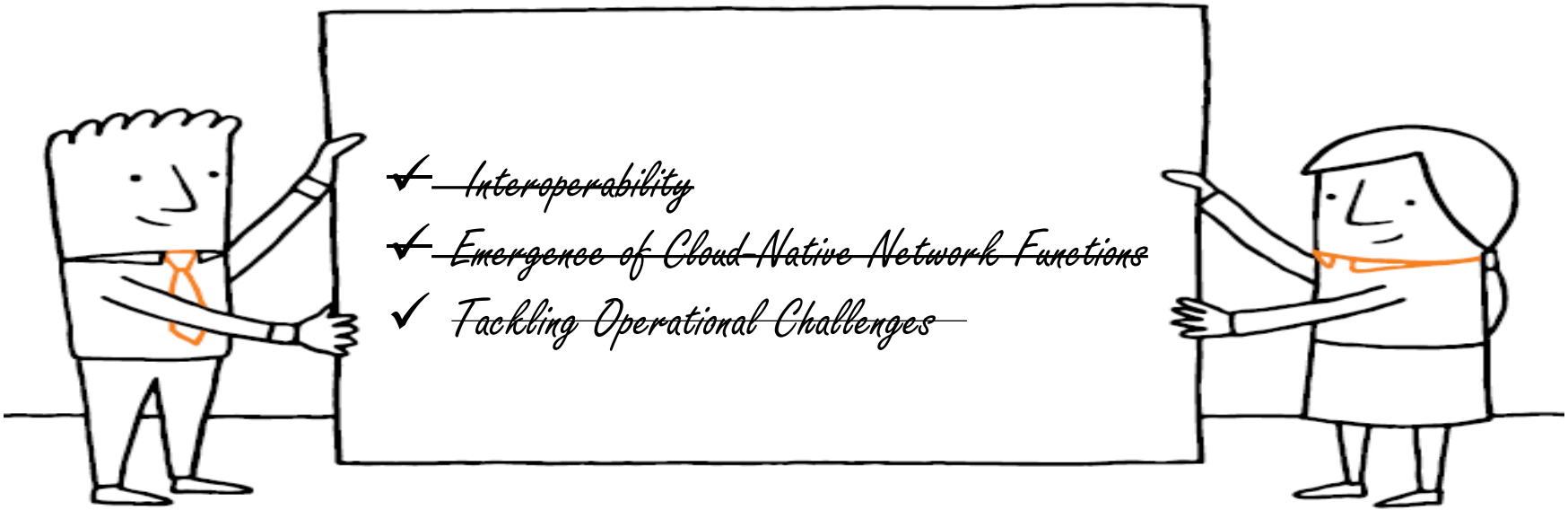




Full deployment automation also requires that standard interfaces to the OSS be available.

Interface configuration templates can be embedded in the VNF Package to allow for some degree of per-VNF customization.

How can Standards help?



By way of conclusion: What about the relation to 5G?

Network Slicing

NFV network services can be regarded as means to implement network slices (e.g. one network slice supported by one or more concatenated or nested network services, possibly deployed in different administrative domains).

Mobility

The ability to move virtualisation containers – and thus VNFs - across locations opens the door to new thinking around mobility management, e.g. services can follow their users to optimize performance and latency.

Cloud Native

Cloud-readyness and the Microservices design style should be a source of inspiration for the design of both the 5G functional architecture and the software architecture of 5G network functions…

Further details

ETSI NFV Technology Web page

www.etsi.org/nfv

and (Drafts specifications)

https://docbox.etsi.org/ISG/NFV/Open

Thank you

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