# Network Service Lifecycle management & API (NFV-SOL 005)

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Agenda

- Section 1: Introduction
- Section 2: VNF Package, Physical Network Function Descriptor and Network Service Descriptor interfaces
- Section 3: Network Service Lifecycle Management
- Section 4: Network Service API realization (NFV SOL-005)
- Section 5: APIs Work progress and future plans
- Section 6: Conclusion
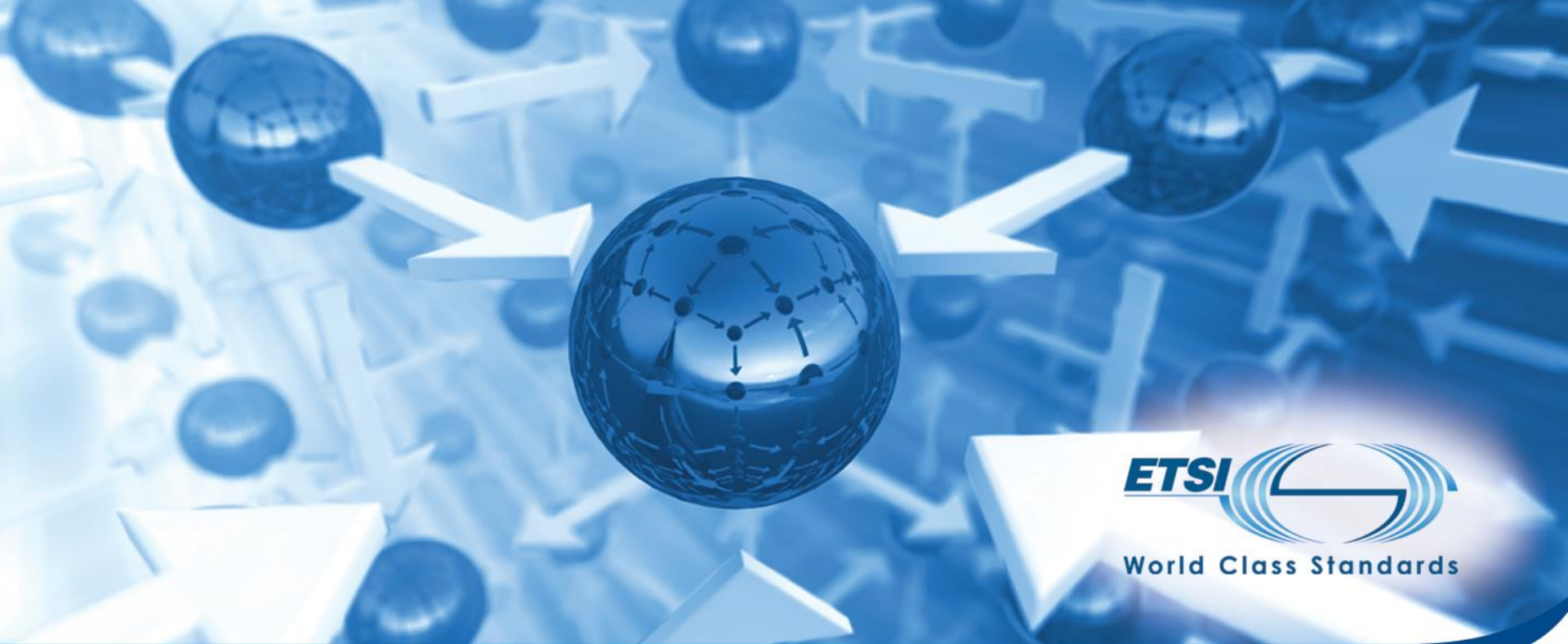
Section 1
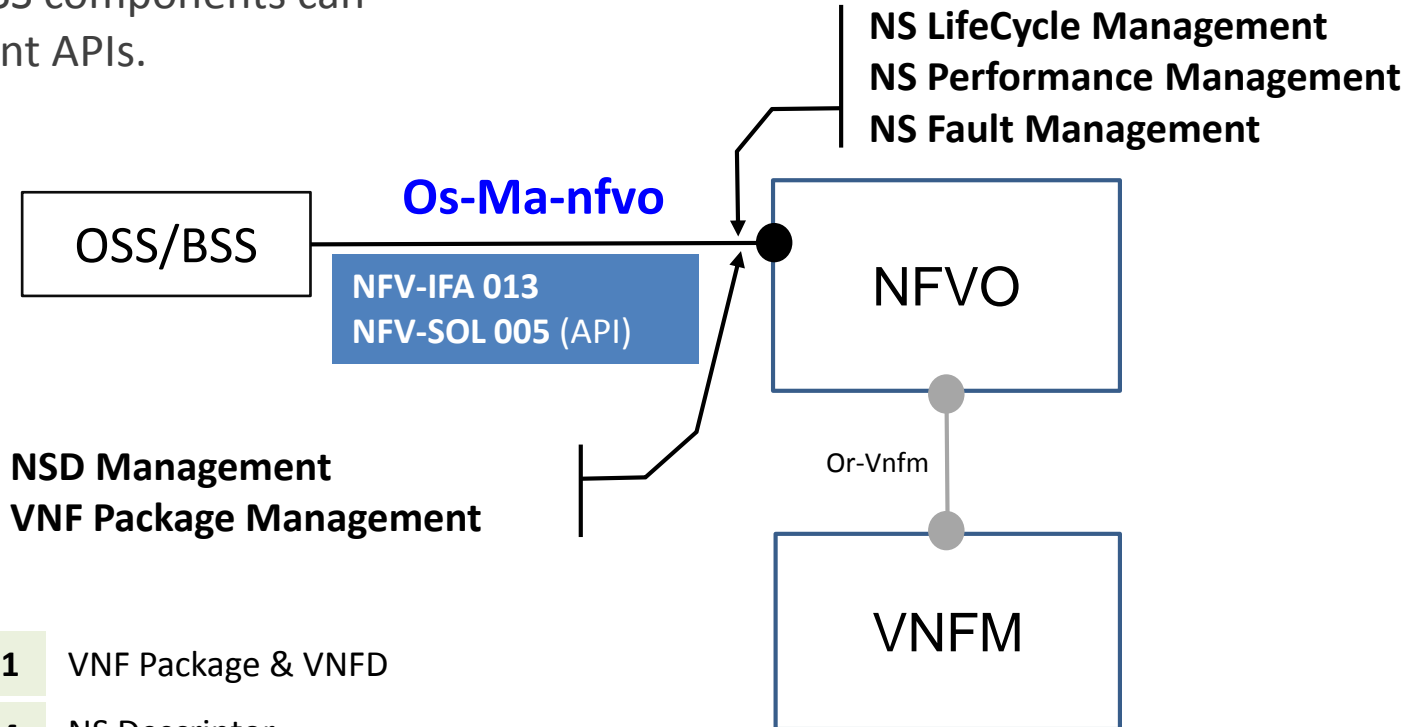
Introduction

Overall objective and key enablers

- **ETSI NFV ISG's objective:** Standardise templates and APIs that facilitate automated deployment, management, modification and removal of Network Services in an NFV environment.

- **Key enablers:**
  - **Define the components** of a Network Service,
  - **Define network composition** of a Network Service,
  - **Control the lifecycle management** of a Network Service,
  - **Monitor** what is happening,
  - **Instigate appropriate actions** in response to events.

Os-Ma-nfvo Reference Point

Different OSS/BSS components can consume different APIs.

Os-Ma-nfvo

NS LifeCycle Management
NS Performance Management
NS Fault Management

OSS/BSS

NFV-IFA 013
NFV-SOL 005 (API)

NFVO

NSD Management
VNF Package Management

Or-Vnfm

VNFM

| ETSI GS NFV-IFA 011 | VNF Package & VNFD |
| ETSI GS NFV-IFA 014 | NS Descriptor |
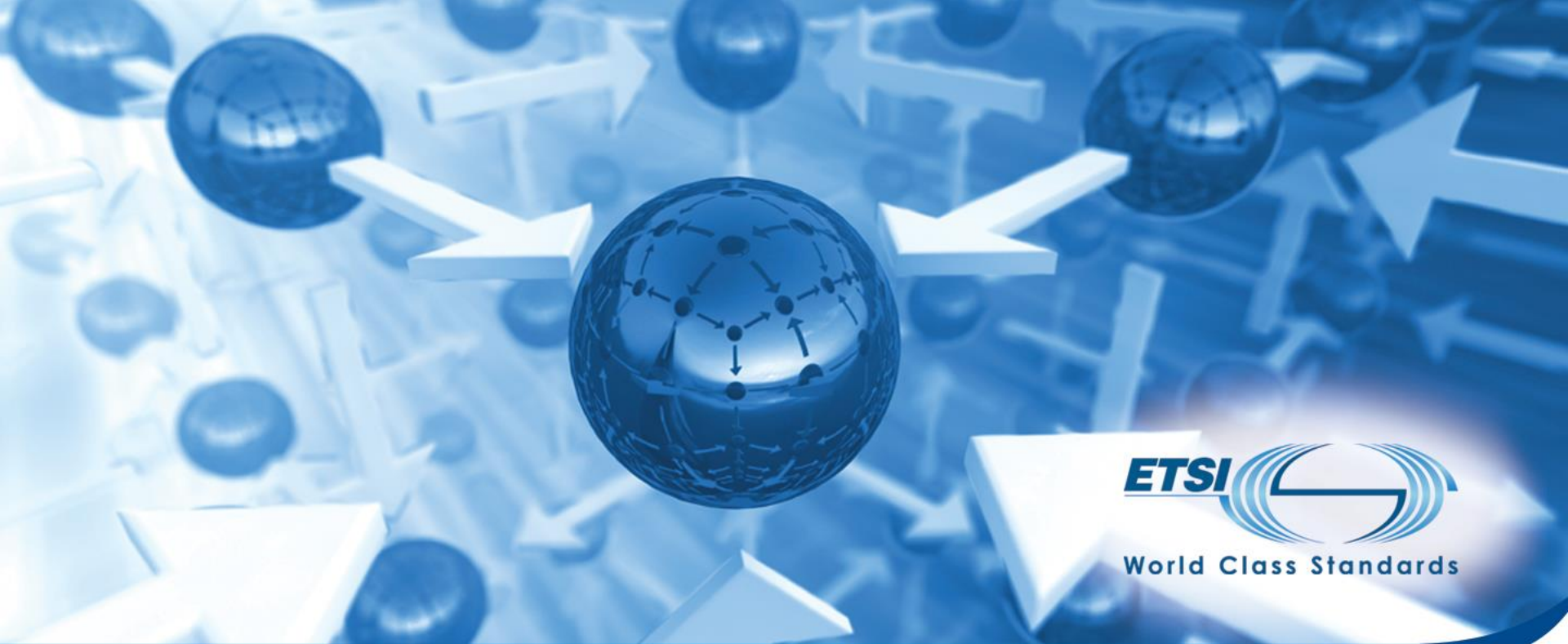
Section 2

VNF Package, PNFD and NSD interfaces

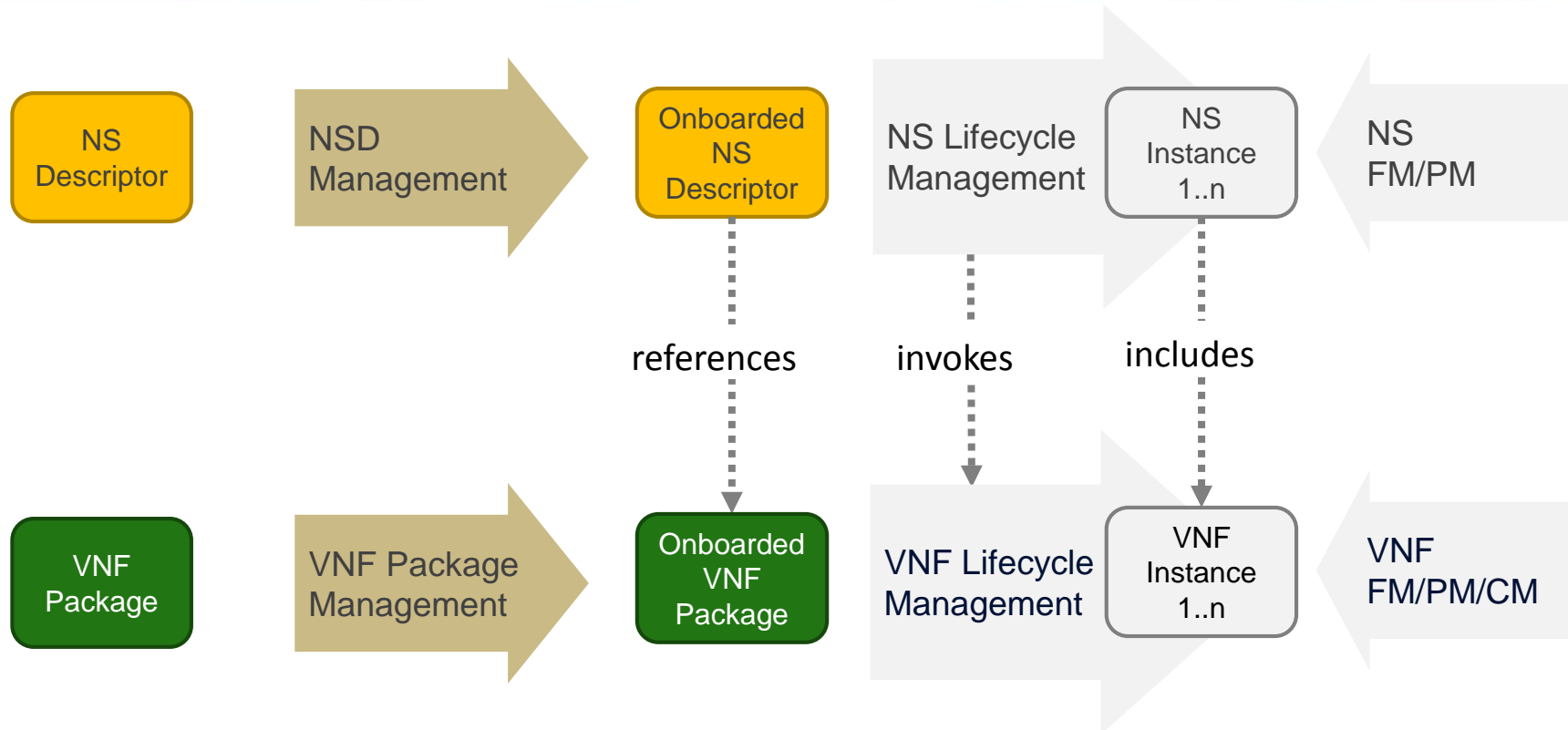# Management and Orchestration (MANO) of Network Services and VNFs

NS Descriptor → NSD Management → Onboarded NS Descriptor → NS Lifecycle Management → NS Instance 1..n ← NS FM/PM

VNF Package → VNF Package Management → Onboarded VNF Package → VNF Lifecycle Management → VNF Instance 1..n ← VNF FM/PM/CM

references

invokes

includes

VNF Package management overview

- Over time new VNFs will be developed and existing VNFs superseded.

- **ETSI GS NFV-IFA 013** specifies:
  - Operations to enable the OSS/BSS to on-board VNF Packages to the NFVO.
  - The VNF Package Management interface to enable the management of VNF Packages on the NFVO.

Mandatory VNF Package Operations for the NFVO
On-board VNF Package
Enable VNF Package
Disable VNF Package
Delete VNF Package
Query On-boarded VNF Package Information
Fetch On-boarded VNF Package
Fetch On-boarded VNF Package Artifacts
Abort VNF Package deletion
Subscribe
Notify

Physical Network Function Descriptor (PNFD)

- The **Physical Network Function Descriptor (PNFD)** is a template to describe connectivity aspects of Physical Network functions.

- PNFD contains:
  - Identification and version information.
  - Connection Point Descriptor (CPD) specifying how to connect PNFs to Virtual Links.

- **ETSI GS NFV-IFA 014** specifies:
  - Physical Network Function Descriptor (PNFD)

- **ETSI GS NFV-IFA 013** specifies:
  - Operations to enable the OSS/BSS to on-board PNFDs to the NFVO.
  - A management interface to manage PNFDs on the NFVO
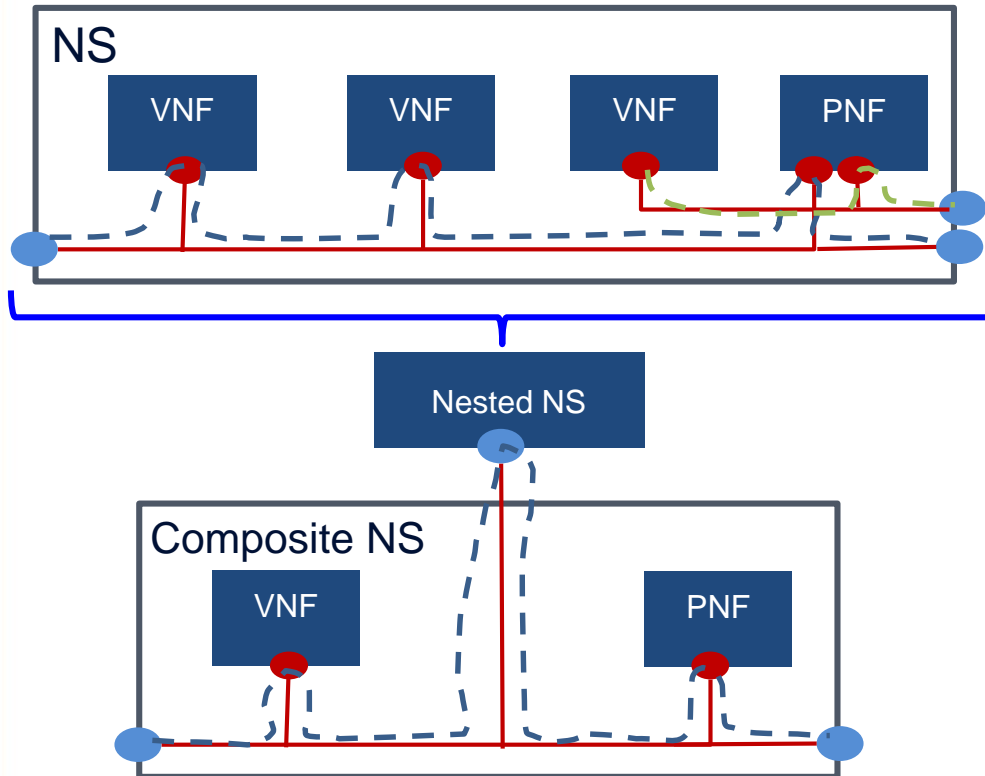
Mandatory PNFD Management Operations for the NFVO
On-board PNFD
Update PNFD
Delete PNFD
Query PNFD

What is a Network Service?
A look inside

- **NS** has constituent **VNFs** and **PNFs**.

- **Composite NS** can have **Nested NS** included as reference.

- **Virtual Link** (VL) provides the connectivity between constituent VNFs and PNFs.

- **VNF Forwarding Graph** (VNFFG) is composed of **Network Forwarding Paths** (NFP), each one as a sequence of connection points and a classification and selection rule.

- A NS has **Service Access Points** (SAP) used to access the NS from the outside.

Network Service Descriptor (NSD)
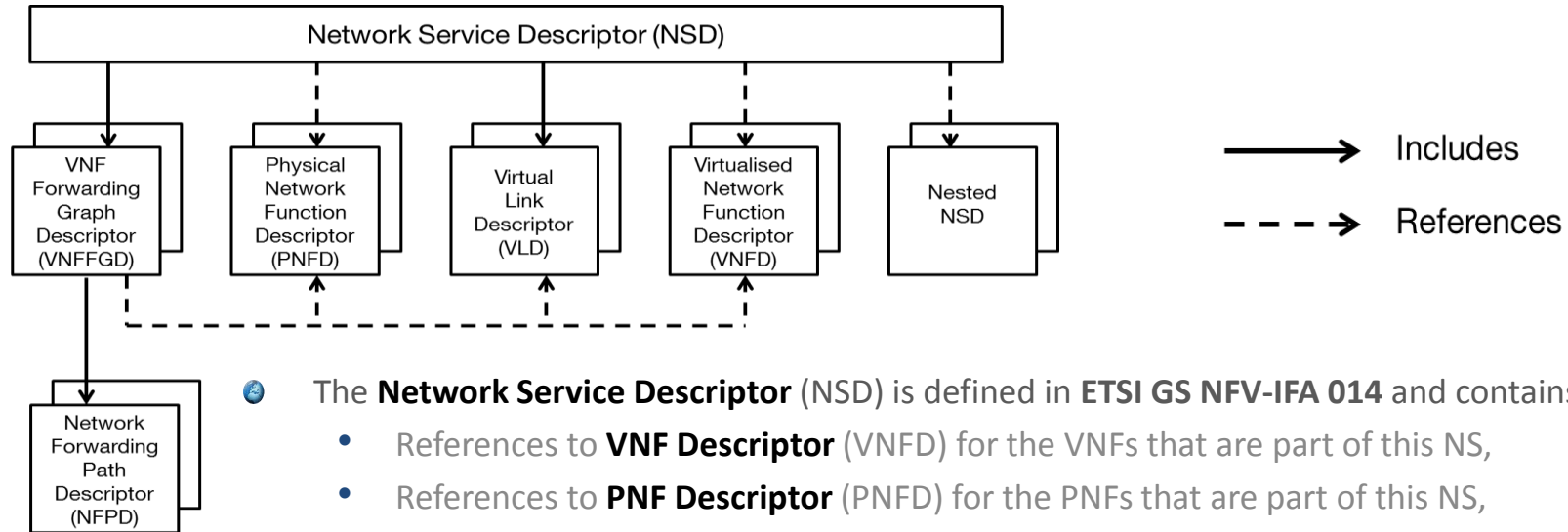
- The **Network Service Descriptor** (NSD) is defined in **ETSI GS NFV-IFA 014** and contains:
  - References to **VNF Descriptor** (VNFD) for the VNFs that are part of this NS,
  - References to **PNF Descriptor** (PNFD) for the PNFs that are part of this NS,
  - References to **NSD for the nested NS** of this NS,
  - **VNF Forwarding Graph Descriptor** (VNFFGD) and **Network Forwarding Path Descriptor** (NFPD) describing the topology of the NS,
  - **Virtual Link Descriptor** (VLD) used by NFVO to deploy Virtual Links.
- The NS Descriptor is stored by the NFVO and can be accessed by OSS/BSS

NS Descriptor (NSD) management overview

- Over time new Network Services will be developed and existing ones superseded.

- **ETSI GS NFV-IFA 013** specifies:
  - Operations to enable the OSS/BSS to on-board NS Descriptors to the NFVO.
  - The NSD management interface to manage NSDs in the NFVO.

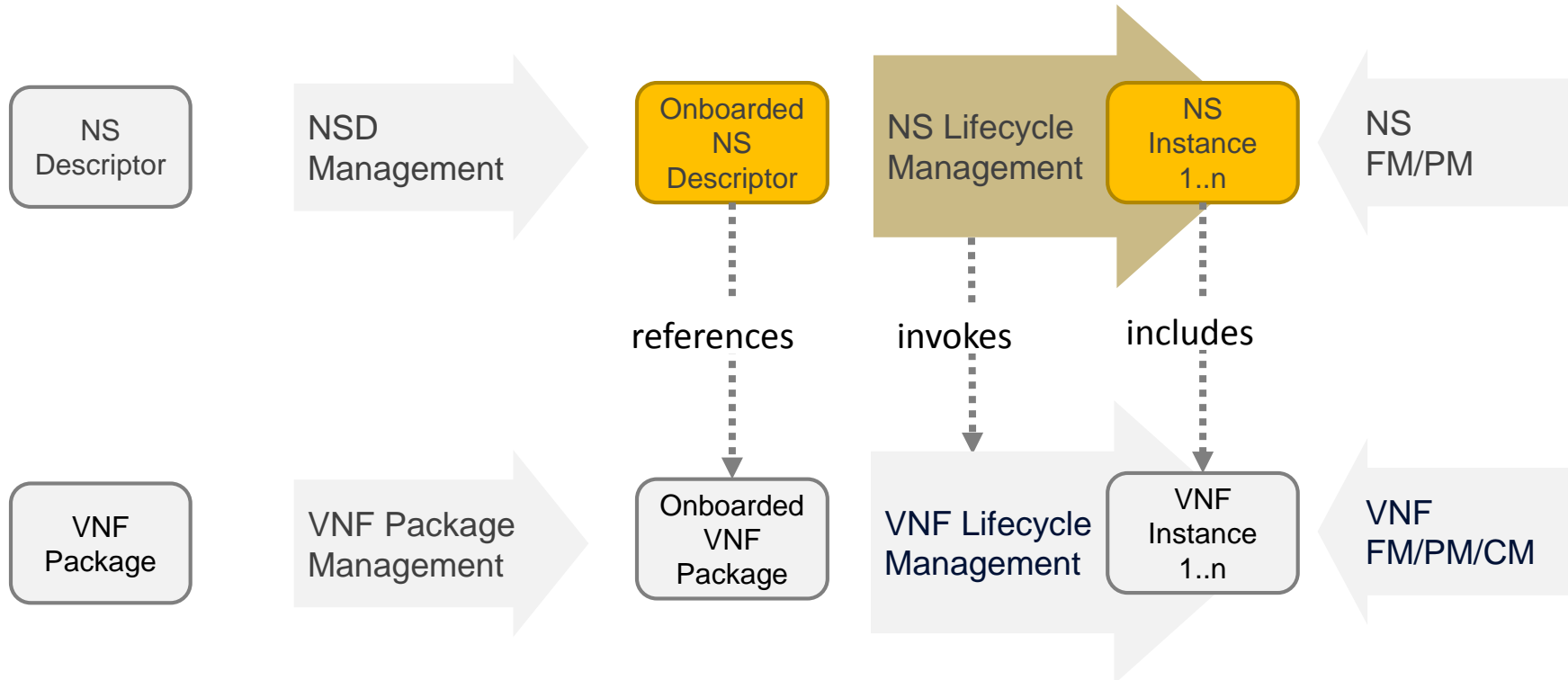| **Mandatory NSD Management operations for the NFVO** |
| --- |
| On-board NSD |
| Enable NSD |
| Disable NSD |
| Update NSD |
| Delete NSD |
| Query NSD |
| Subscribe |
| Notify |

Section 3

Network Service Lifecycle Management

Management and Orchestration (MANO) of Network Services and VNFs

NS Descriptor → NSD Management → Onboarded NS Descriptor → NS Lifecycle Management → NS Instance 1..n ← NS FM/PM

VNF Package → VNF Package Management → Onboarded VNF Package → VNF Lifecycle Management → VNF Instance 1..n ← VNF FM/PM/CM

references — invokes — includes

Managing the NS lifecycle:
NS lifecycle management (LCM) overview

- After the necessary descriptors have been on-boarded to the NFVO, the OSS/BSS may deploy, manage, modify and then remove a NS.

- **ETSI GS NFV-IFA 013** specifies:
  - Operations to enable the OSS/BSS to manage the Lifecycle of Network Services

- Typically, **LCM operations are long-running operations** (minutes, hours):
  - Tracking is essential
  - Each individual NS LCM operation occurrence can be identified and has a status that can be queried.
  - NFVO will notify the start and completion of each operation.

Mandatory NS LCM Operations for the NFVO
Create NS Identifier
Instantiate NS
Scale NS
Update NS
Query NS
Terminate NS
Delete NS Identifier
Heal NS
Get Operation Status
Subscribe
Notify
Terminate Subscription
Query Subscription

Principles related to VNF lifecycle management over Os-Ma-nfvo ref point

- For an OSS/BSS to influence a VNF, that VNF must be associated with at least one Network Service Instance under its control.

- A simplified mapping of NS LCM operations to VNF operations.

NS LCM operation(s)	VNF operation
Instantiate NS or Update NS	VNF instantiation
Scale NS	VNF Scaling
Heal NS	VNF Healing
Terminate NS or Update NS	VNF Termination
Update NS	Other VNF operations (e.g. changing: VNF deployment flavour, VNF operational state, configurable properties…)

Section 4

Network Service APIs realization (NFV SOL-005)

REST (Representational State Transfer) design applied to ETSI NFV

- **HTTP-based** incarnation of REST (HTTP/1.1)
- **JSON** used as the format for resource representations
- Manipulation of resources using **CRUD**(*) operations
  - POST – create resource
  - GET – read resource / query resources
  - PATCH/PUT – update resource
  - DELETE – delete resource
- **Special resources** for
  - notification management (notification endpoint)
  - complex and/or long-running operations
    - task resources providing an RPC-like service
    - operation occurrences
    - task resources for error handling on operation occurrences
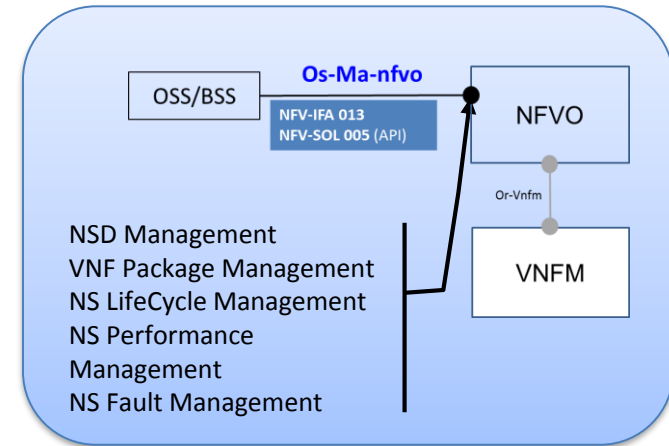
(*) CRUD = Create, Read, Update, Delete

Resource URI structure of the VNF Package Management Interface

{apiRoot}/vnfpkgm/v1

/vnf_packages → **VNF packages** (POST | GET)

/{vnfPkgId} → Individual VNF package (GET | PATCH | DELETE)

/vnfd → VNFD of an individual VNF Package (GET)

/package_content → VNF package content (GET | PUT)

/upload_from_uri → Upload VNF package from URI task

/artifacts

/{artifactPath} → Individual VNF package artifact (GET)

/subscriptions → **Subscriptions** for VNF package notifications (POST | GET)

/{subscriptionId} → Individual subscription (GET | DELETE)

Resource URI structure of the NSD Management Interface

{apiRoot}/nsd/v1

- /ns_descriptors → **NSDs** (POST | GET)
  - /{nsdInfoId} → Individual NSD (GET | PATCH | DELETE)
    - /nsd_content → NSD content (GET | PUT)
- /pnf_descriptors → **PNFDs** (POST | GET)
  - /{pnfdInfoId} → Individual PNFD (GET | PATCH | DELETE)
    - /pnfd_content → PNFD content (GET | PUT)
- /subscriptions → **Subscriptions** for NSD/PNFD notifications (POST | GET)
  - /{subscriptionId} → Individual subscription (GET | DELETE)
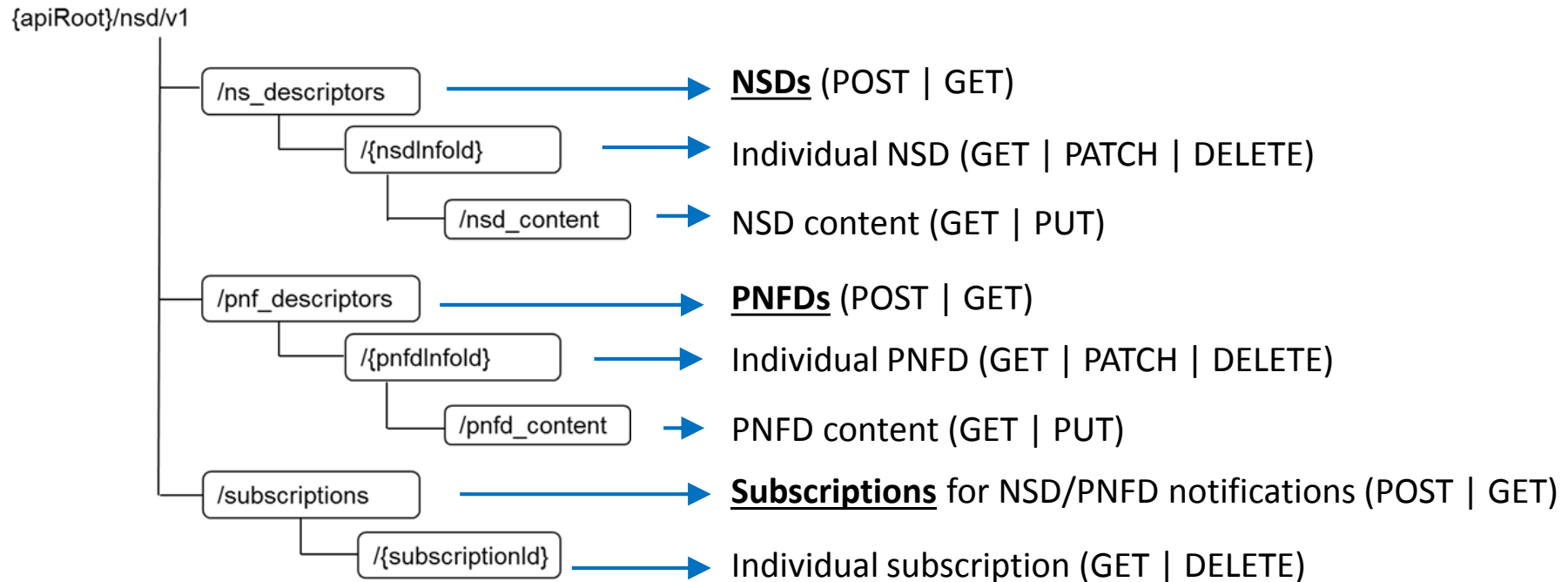
Resource URI structure of the Network Service Lifecycle Management interface

{apiRoot}/nslcm/v1

- /ns_instances → **NS Instances** (POST | GET)
  - /{nsInstanceId} → Individual NS Instance (GET | DELETE)
    - /instantiate
    - /scale
    - /update
    - /terminate
    - /heal

    Task Resources for NS lifecycle management (POST)

- /ns_lcm_op_occs → **NS LCM operation occurrences** (GET)
  - /{nsLcmOpOccId} → Individual VNF LCM operation occurrence (GET)
    - /retry
    - /rollback
    - /continue
    - /fail
    - /cancel

    Task Resources for LCM operation error handling (POST)

- /subscriptions → **Subscriptions** for NS lifecycle notifications (POST | GET)
  - /{subscriptionId} → Individual subscription (GET | DELETE)

NS Lifecycle Management Example:
NS Instantiation
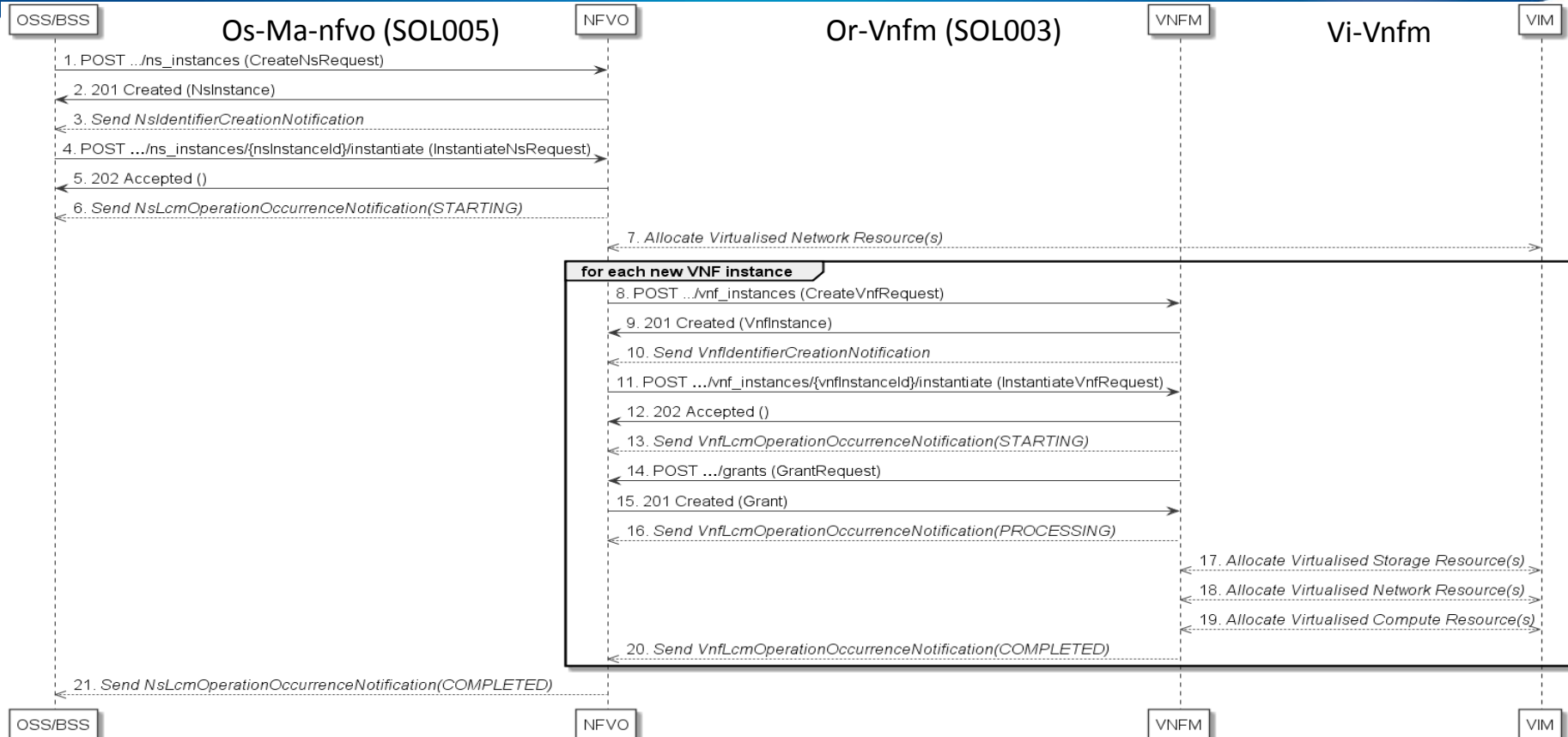
Section 5

APIs Work progress and future plans (SOL WG)

RESTful APIs
in the ETSI NFV MANO Architecture

Os-Ma-nfvo
NFV-SOL 005
→ Manage Network Services and VNF Packages

OSS/BSS

NFVO

Ve-Vnfm
NFV-SOL 002
→ Manage VNF Instances

Or-Vnfm
NFV-SOL 003
→ Manage VNF Instances

EM

VNF

NFVI

VNFM

VIM
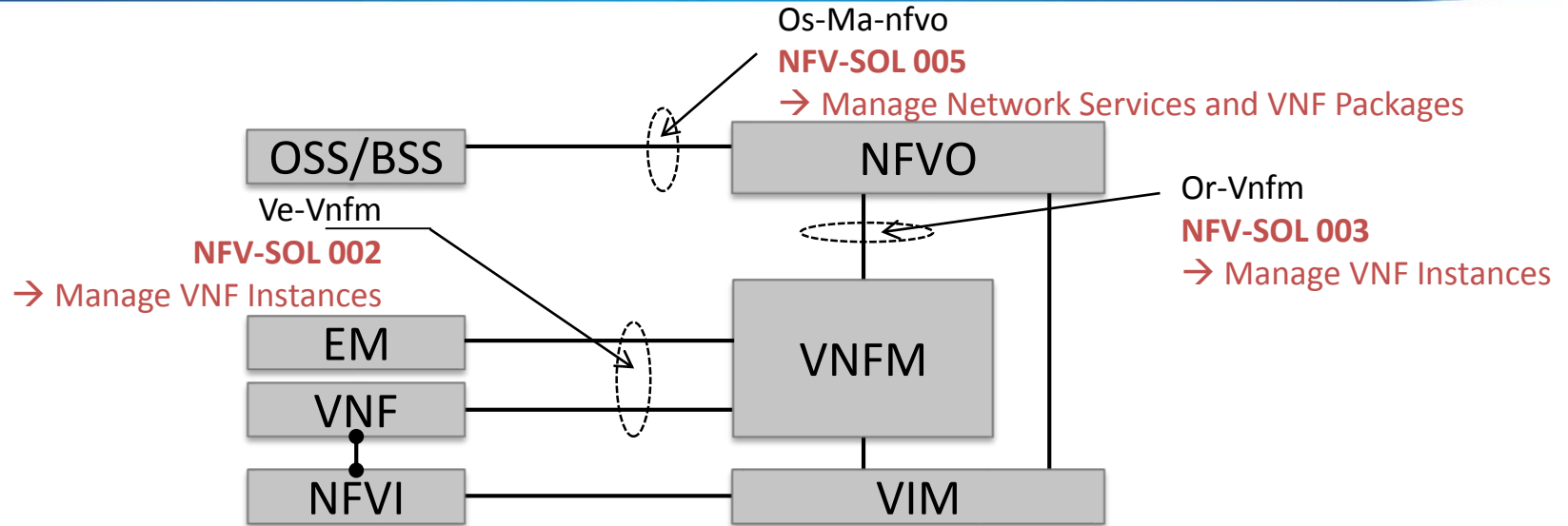
- The ETSI Group Specifications (GS) NFV-SOL 002, NFV-SOL 003 and NFV-SOL 005 define RESTful APIs for the Ve-Vnfm, Or-Vnfm, and Os-Ma-nfvo reference points, respectively.

- They enable multi-vendor integration on these reference points.

NFV-MANO API WORK PROGRESS

OpenAPI descriptions publically available for all APIs specified in GS NFV-SOL 002/003 (version 2.4.1)

- 1st publication of GS NFV-SOL 005 (version 2.4.1).
- Publication of revised versions of GS NFV-SOL 002/003 (Version 2.4.1)

- 1st publication of GS NFV-SOL 002 (version 2.3.1).
- 1st publication of GS NFV-SOL 003 (version 2.3.1).

July 2017

February 2018

March 2018
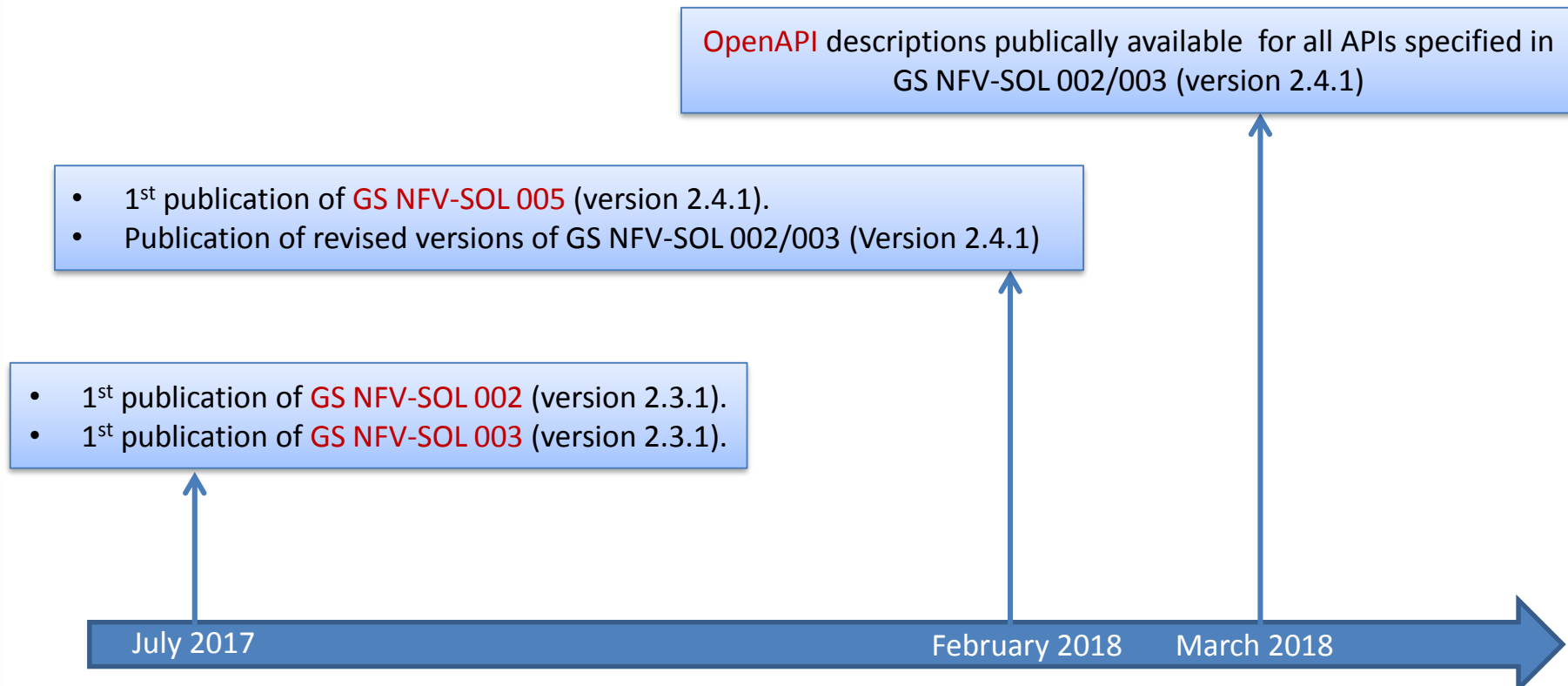
OpenAPI for NFV-MANO

https://nfvwiki.etsi.org/index.php?title=API_specifications#OpenAPIs

- OpenAPI descriptions available for GS NFV-SOL 002 and 003. Under development for GS NFV-SOL 005.

- OpenAPI descriptions available as YAML, JSON and PDF form.

- Direct Links to open YAML files in the Swagger UI or Editor.

- In case of discrepancies the published ETSI Group Specification (GS) takes precedence.

- Bugs can be reported using Bugzilla
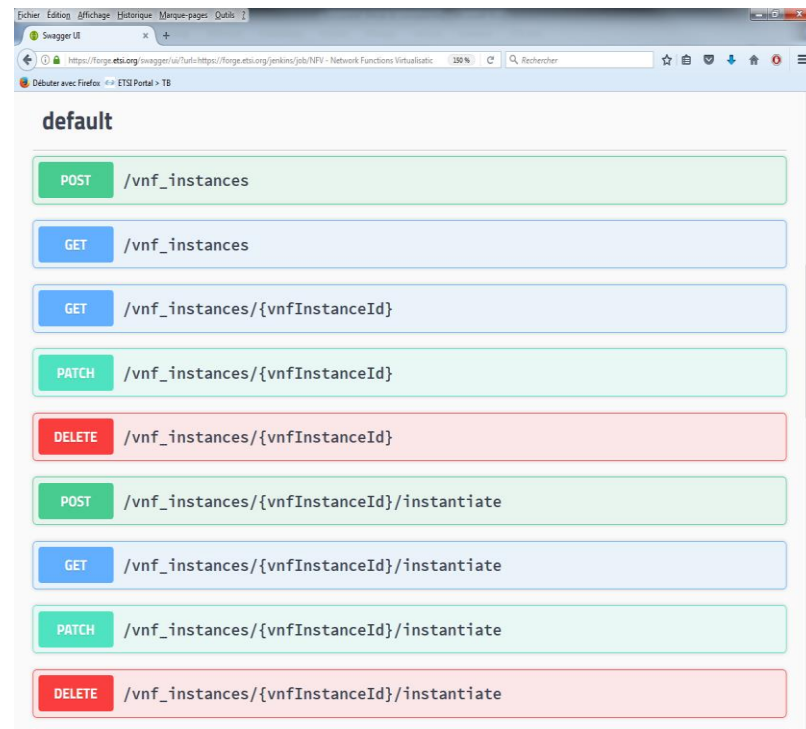
API FUTURE work plan

- 2018H1 maintenance ongoing for NFV-SOL002, 003 and 005
  - Bug fixing
  - Consolidation of the API framework by addressing version management.
- Enhance existing APIs to support NFV Release 3 features.
- Develop OpenAPI descriptions for the NFV-SOL 005 APIs.
- Specifications of new APIs on new reference points identified as part of the Release 3 specification effort (e.g. NFVO-NFVO).
- Work started on conformance testing specifications for MANO APIs. A Specialists Task Force (STF) is about to be set-up to accelerate the work.

Section 6

Conclusion

Conclusion

Covered in this presentation….

- What a NFV Network Service is, and the NSD template used to describe NSs to the NFVO,

- The NFVO interfaces used to on-board NS Descriptors, PNF Descriptors and VNF Package,

- Network Service lifecycle management interface on the NFVO,

- ETSI NFV SOL specifications provide standardized APIs for implementing NFV management and orchestration interfaces,

  - With OpenAPI support definition files for these APIs to ease adoption

More information

- NFV Technology Page (information) **http://www.etsi.org/nfv**
- NFV Portal (working area) **http://portal.etsi.org/nfv**
- NFV Proofs of Concept (information) **http://www.etsi.org/nfv-poc**
- NFV Plugtest (information & registration) **http://www.etsi.org/nfvplugtest**
- Open Area:
  - Published Docs: https://docbox.etsi.org/ISG/NFV/Open/Publications_pdf
  - Working Drafts http://docbox.etsi.org/ISG/NFV/Open/Drafts/
  - Issue tracker http://nfvwiki.etsi.org/index.php?title=NFV_Issue_Tracker

Backup material

NS Performance Management operations

- The NS Performance Management (PM) interface allows measurement results collection and notifications related to a network service.

- Collection and reporting of performance information is controlled by creation of "**PM job**".

- PM notifications indicate:
  - The crossing of a threshold
  - Availability of PM information

- **ETSI GS NFV-IFA 013** specifies:
  - Operations to enable the OSS/BSS to create PM Jobs and subscribe to Performance related notifications for a Network Service

Performance Management Operations: Mandatory for the NFVO
Create PM Job
Delete PM Jobs
Create Threshold
Delete Thresholds
Subscribe
Notify

NS Fault Management

- The NS Fault Management interface instructs the NFVO to provide alarms related to the NSs visible to the OSS/BSS.

- **ETSI GS NFV-IFA 013** specifies:
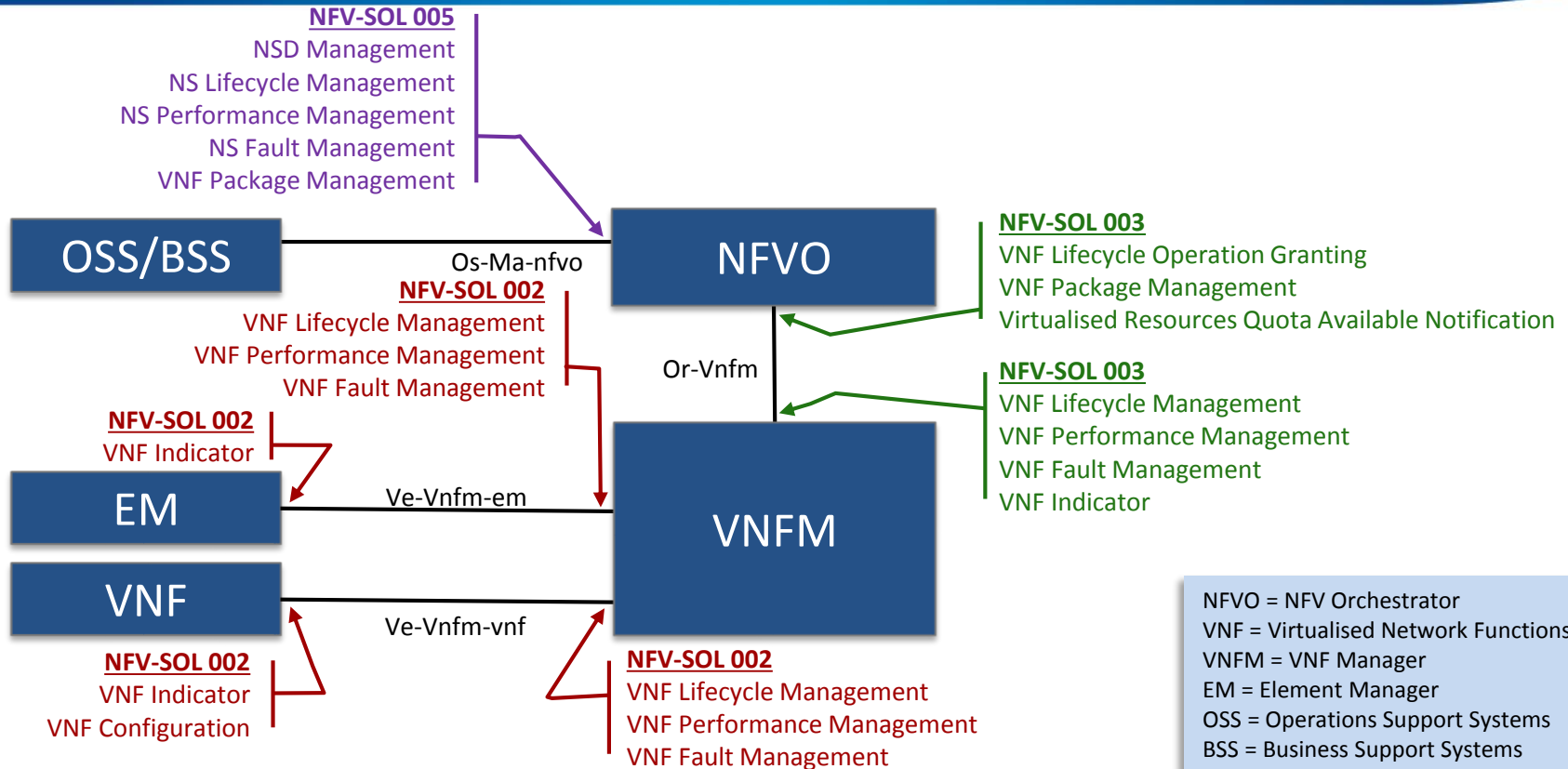 - Operations to enable the OSS/BSS to subscribe to fault alarm notifications for a Network Service

Mandatory Fault Management Operations for NFVO
Subscribe
Notify
Get Alarm List

RESTful APIs
in the ETSI NFV MANO architecture

NFV-SOL 005
NSD Management
NS Lifecycle Management
NS Performance Management
NS Fault Management
VNF Package Management

OSS/BSS

Os-Ma-nfvo

NFVO

NFV-SOL 003
VNF Lifecycle Operation Granting
VNF Package Management
Virtualised Resources Quota Available Notification

NFV-SOL 002
VNF Lifecycle Management
VNF Performance Management
VNF Fault Management

Or-Vnfm

NFV-SOL 003
VNF Lifecycle Management
VNF Performance Management
VNF Fault Management
VNF Indicator

NFV-SOL 002
VNF Indicator

EM

Ve-Vnfm-em

VNFM

VNF

Ve-Vnfm-vnf

NFV-SOL 002
VNF Indicator
VNF Configuration

NFV-SOL 002
VNF Lifecycle Management
VNF Performance Management
VNF Fault Management

NFVO = NFV Orchestrator
VNF = Virtualised Network Functions
VNFM = VNF Manager
EM = Element Manager
OSS = Operations Support Systems
BSS = Business Support Systems

2018H1 NFV-MANO API enhancements

- NFV-SOL002/003
  - Support of API client authentication/authorization based on TLS-supported certificates as an alternative to Oauth
  - Clarifying normative statements regarding the support of the resources and HTTP methods
  - Various small bug fixes and editorial corrections
- NFV-SOL 003
  - Major bug fix to the configuration parameters for external connection points
  - Update of the VNF Package Management interface to allow consistent cross-API design in NFV-SOL 005
- NFV-SOL 002
  - Fixing misalignment between stage 2 and stage 3 w.r.t. treatment of VNFC in PM interface