ETSI ISG NFV: Work program and Releases overview

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For: 2019 ONAP Joint Subcommittee Silicon Valley

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Outline

PART 1: ETSI ISG NFV Overview
- ETSI NFV Releases overview
- ETSI NFV ongoing work

PART 2: NFV Release 2
- What does it contain?
- Maintenance, API development, etc.

PART 3: NFV Release 3
- Overview
- Features and specification work
Part 1: ETSI ISG NFV overview
ETSI NFV Releases overview

**Release 1**
- **Focus:** the feasibility of NFV.
- Delivered the baseline studies and specifications.
- **Set the NFV Architecture:**
  - Infrastructure (NFVI),
  - Virtualized network functions (VNF),
  - Integration of the VNFs into Network Services (NS), and
  - NFV Management and Orchestration (NFV-MANO) aspects at different layers.

**Release 2**
- **Focus:** interoperability of NFV solutions.
- Details requirements and specification of interfaces and descriptors.
- Realizes the interoperability of solutions based on the NFV Architecture, detailing
  - VNF Package and VNF and NS Descriptors,
  - Acceleration,
  - Internal and external NFV-MANO interfaces.

**Release 3**
- **Focus:** feature enriching the NFV Architectural Framework, readying NFV for deployment and operation.
- Interfaces, modeling, etc. to support new features such as (not exhaustive list):
  - Policy framework,
  - VNF snapshot,
  - NFV-MANO management,
  - Licensing,
  - Multi-site,
  - Cloud-native, etc.
Release 2: API standardization process

The content of the NFV-SOL APIs is based on the related NFV-IFA specifications.

The NFV-SOL specifications are implementable representations of the design defined in the stage 2 specifications, not alternative solutions.

Stage 2: Requirements and information model
- NFV-IFA 007 (Or-Vnfm)
- NFV-IFA 008 (Ve-Vnfm)
- NFV-IFA 013 (Os-Ma-nfvo)
- NFV-IFA 011 (VNF Package, VNFD)
- NFV-IFA 014 (NSD)

Mapping information model to data model
- Defining protocol machinery for the operations specified in stage 2
- Closing gaps left open in stage 2 (e.g. error handling, technical details)

Stage 3: Protocols and data model
- NFV-SOL 003 (Or-Vnfm)
- NFV-SOL 002 (Ve-Vnfm)
- NFV-SOL 005 (Os-Ma-nfvo)
- NFV-SOL 013 (Common API aspects)
- NFV-SOL 004 (VNF Packaging)
- NFV-SOL 001 (TOSCA VNFD, NSD)
- NFV-SOL 006 (YANG VNFD, NSD)
- NFV-SOL 007 (NSD file structure)

Testing: Benchmarking, interop, conformance
- NFV-TST 007 (testing guidelines)
- NFV-TST 010 (API conformance)

OpenAPI descriptions publically available for all APIs specified in GS NFV-SOL 002/003/005 (v2.4.1)
https://nfvwiki.etsi.org/index.php?title=API_specifications#OpenAPIs

Latest published versions to be published: NFV-SOL001/002/003/004/005/007/013 v2.6.1 (~Apr. 2019)
TST010 – MANO API Conformance Test Suite

For 3 Reference Points:

✓ Os-Ma-Nfvo - ETSI GS NFV-SOL 005
✓ Or-Vnfm - ETSI GS NFV-SOL 003
✓ Ve-Vnfm - ETSI GS NFV-SOL 002

Document + Automatable Test Descriptions

✓ OpenAPIs developed by the SOL WG
✓ Using the open source Robot Framework

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Part 3: NFV Release 3
Release 3: overview

Main focus:

- Enriching the NFV Architectural Framework, readying NFV for expansive deployment, enhanced operation, taking into account the evolution of networking and cloud technologies.
- In commercial deployments, operational aspects are critical!

The intersection among

- Advances in virtualization
- NS, VNF and VR operational framework
- Support for future and next generation networks
- Additional operational features
- Evolution of networking and cloud technologies
- Operational aspects
Release 3: stage 1&2 completed features

Completed until 1H2018 (aka drop #1)

✔ Compute Host Reservation
✔ NFV-MANO Policy Management Framework
✔ VNF Snapshots
✔ Management of NFV-MANO
✔ Network Service (NS) across multiple administrative domains
✔ Enhancement of acceleration related features:
  ✔ Hardware-independent acceleration
  ✔ Network acceleration for VNF
✔ Virtualization technologies:
  ✔ Hypervisor-based virtualisation
  ✔ Hardware environment for NFV

NFV-IFA specification versions:
Drop 1H2018 → v3.1.1
Drop 2H2018 → v3.2.1

Completed in 2H2018 (aka drop #2)

✔ VNF software modification
✔ Support of network slicing
✔ Management and connectivity for multi-site services.

Highlighted in blue: more information on the following slides
Release 3 features:
Compute Host Reservation

**Objective:** Enable reservation of physical hosts in the NFVI by „authorized consumers of NFVI administration“.

**Use cases:**
- Secure NFVI resource availability during maintenance processes.
- Hardware interoperability requirements (see ETSI GS NFV-EVE 007).
- Security regulations (see ETSI GS NFV-SEC 012).
- See also OPNFV’s Promise project: wiki.opnfv.org/display/promise/

**Specification outcomes:**
- Requirements and interface specification in ETSI GS NFV-IFA 010 and ETSI GS NFV-IFA 005 (versions v3.1.1).

**Other information:**
- Aligned with (Resource reservation service): https://docs.openstack.org/blazar/ which supports reservation of virtual compute(s) and physical compute host(s).
Release 3 features: NFV-MANO Policy Management Framework

Objective: Create a policy management framework to further enhance the flexibility in NFV Management and Orchestration.

Use cases:
- Change the behaviour of VNF, NS and VR lifecycle and orchestration based on policies.
- See also use cases documented in the published report ETSI GR NFV-IFA 023.

Specification outcomes:
- NFV-MANO FB (i.e., NFVO, VNFM and VIM) act as Policy Functions (PF) to enforce policies. NFV-MANO FB can also act as Policy Administration Points (PAP).
- A new policy management interface is added for each reference point, which includes operations of policy transfer, deletion, query, activation and deactivation. Specified in v3.1.1 versions of ETSI GS NFV-IFA 010/005/006/007/008/013.

Other information:
- RESTful protocol and data model solution (stage 3) work expected to start soon (work item proposal currently under ISG approval).
Release 3 features: VNF Snapshots

**Objective:** Solution to manage, store and transfer a snapshot of a VNF.

**Use cases:**
- Testing, troubleshooting, as fall-back in LCM procedures, e.g., quick VNF recovery.
- See also use cases documented in the published report ETSI GR NFV-TST 005.

**Specification outcomes:**
- Extending VNF and NS lifecycle management interfaces with new operations to create and revert to snapshots. Specified in ETSI GS NFV-IFA 010/007/008/013.

**Other information:**
- Data model (stage 3) work for the VNF Snapshot Packages just started (work item DGS/NFV-SOL010).
Release 3 features: Management of NFV-MANO

Objective: Create a framework for flexible NFV-MANO management to ease the integration/interworking of NFV-MANO system with network operators support systems.

Use cases:
- NFV-MANO functions need to be configured for interworking, and monitored against fault and performance issues.
- See also use cases documented in the published report ETSI GR NFV-IFA 021.

Specification outcomes:
- Set of requirements, interfaces and information model for the operation, management and maintenance of NFV-MANO (see also ETSI GS NFV-IFA 031).

Other information:
- RESTful protocol and data model solution (stage 3) work just started (work item DGS/NFV-SOL009).
Release 3 features: NS across multiple administrative domains

Objective: Enable different business models where the NFV infrastructure or Network Services are provided by another administrative domain.

Use cases:
- NS provisioning and lifecycle management require coordination between two NFVOs in different administrative domains.
- See also use cases documented in the published report ETSI GR NFV-IFA 028.

Specification outcomes:
- Enable a new reference point Or-Or with the functionality mainly referencing to the existing ETSI GS NFV-IFA 013 operations. Developed in the ETSI GS NFV-IFA 030.

Other information:
- RESTful protocol and data model solution (stage 3) work just started (work item DGS/NFV-SOL011).
Release 3 features:
VNF software modification

**Objective:** Minimize the impact of VNF software modification on service continuity.

**Use cases:**
- Change software version of deployed VNF.
- See also use cases documented in published report **ETSI GS NFV-REL 006**.

**Specification outcomes:**
- Extending functional requirements to support the change of a VNF Package to update the VNF instance as specified in ETSI GS NFV-IFA 010.
- Extending VNF lifecycle management interfaces with new operations to change to a VNF Package containing a modified VNF as specified in ETSI GS NFV-IFA 007/008/010/011/013.

**Other information:**
- The LCM supports the change of a VNF Package to allow for upgrade and downgrade of VNF instances.
Release 3 features: Network Slicing

Objective: Support Network Slicing by defining the necessary requirements and enhancements of interfaces and descriptors.

Use cases:
- NFV network services as constituents for network slices.
- See also use cases documented in the published report ETSI GR NFV-EVE 012.

Specification outcomes:
- New touchpoint in ETSI GR NFV-IFA 024.
- Updated NS descriptor in ETSI GS NFV-IFA 014: The NSD includes in the Deployment Flavour the "priority" attribute, which is assigned by the consumer (OSS/NSMF/NSSMF), based on the priority of the slice that uses the NS instance.
- Requirements and interface specification in ETSI GS NFV-IFA 010 and NFV-IFA 013: Os-Ma-nfvo support for the LCM coordination notifications to enable the consumer to subsequently resolve priority conflicts.

Other information:
- Mgmt. of Network Services already supports most requirements for the use network slice management functions (e.g. multi-tenancy, nested NSs).
- Main new requirement: Priority attribute for Network Service instances to be used to resolve conflicts during resource allocation.
Release 3 Feature: Management & Connectivity of Multi-Site Services

**Objective:** Specify management aspects for enabling inter-connectivity between, and management of network services across, multiple NFVI-PoPs over WAN infrastructure.

**Use cases:**
- A set of requirements, interfaces and information models for the WAN Infrastructure Manager (WIM).
- See also use cases documented in the published report ETSI GR NFV-IFA 022.

**Specification outcomes:**
- 4 management interfaces (Multi-site connectivity service, Capacity, Performance, Fault management) to provision and manage multi-site connectivity services (refer to ETSI GS NFV-IFA 032).
- Updates on ETSI GS NFV-IFA 005/007/010/013/014 specifications to support exposure of connectivity information and multi-site service deployment.

**Other information:**
- Proposal to develop Stage 3 related work is planned as a next step.
Conclusion
Conclusion

**Release 2 documentation is almost fully complete.**

- Only few stage 3 and testing specifications are remaining.
- Maintenance has been performed since 2017, and it continues (focusing particularly on protocols and data model specifications) until Release 3 is completed.

**Release 3 specification work is progressing.**

- Few informative/study work items are remaining.
- Focus is mostly on stage 2 normative specification work. A pipeline of features is being delivered every 6 months.
- Stage 3 work has just started on a set of features completed at stage 2 level in the summer 2018.
- Work will continue through 2019.
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/


✔️ Detailed Release 3 specification progress can be found at:
Release 2: specification summary

Published documents


- 13 Stage 2 GS (12 from IFA, 1 from TST).
- 8 Stage 3 GS (SOL).
- 4 Stage 2 GR (IFAl).
- 1 testing GR (TST).

Active work items

Currently, 5 ongoing unpublished active WI:

- 2 Stage 3 GS drafts (NFV-SOL006/014).
- 2 GS drafts related to security (NFV-SEC021/022).
- 1 GS draft on conformance testing (NFV-TST010).

Refer to regular updates on the Release 2 Description (latest version v1.7.1, Dec. 2018, to be updated in Apr. 2019).

4 rounds of maintenance have been completed (1H2017, 2H2017, 1H2018 and 2H2018), and 1 round is now ongoing for 1H2019:

Versioning: First round: v2.3.1; Second round: v2.4.1; Third round: v2.5.1 (some specs without maintenance remain in v2.4.1); and Fourth round: v2.6.1 (some specs w/o maintenance remain in v2.4.1 or v2.5.1).
Release 2: specification summary

- NFV-IFA 015 (NFV Information Model Report)
  + NFV-IFA 016 (Papyrus Guidelines),
  - NFV-IFA 017 (UML Modeling Guidelines),
  - NFV-IFA 024 (NFV Information Model External Touchpoints)

- NFV-TST 008 (NFVI metrics)

- NFV-IFA 002 (Acceleration)
- NFV-IFA 003 (Acceleration)
- NFV-IFA 008 (Performance metrics)
- NFV-IFA 009 (VNF Pkg)
- NFV-IFA 010 (NFV-MANO Functional Reqs)
- NFV-IFA 011 (VNFD and VNF Pkg)
- NFV-IFA 013 (NFV Information Model Report)
- NFV-IFA 014 (NS templates)
- NFV-IFA 015 (VNF and NS Descriptors)
- NFV-IFA 016 (Papyrus Guidelines),
- NFV-IFA 017 (UML Modeling Guidelines),
- NFV-IFA 024 (NFV Information Model External Touchpoints)

- NFV-SOL 003 (NSD file structure)
- NFV-SOL 004 (VNF Pkg
- NFV-SOL 007 (NS templates)
- NFV-SOL 001 (NFV-SOL 006 (VNF and NS Descriptors)
- NFV-TST 007 (NFV-MANO interop guidelines)
- NFV-TST 010 (API conformance)

- NFV-SOL 011 (API common aspects)
- NFV-SOL 012 (API common aspects)
- NFV-SOL 013 (API common aspects)

- SOL014 (VR mgmt descriptor)
- SOL015 (VR mgmt descriptor)
- SOL016 (VR mgmt descriptor)

- Published! Stage 3

Status as of Apr. 2019
## Release 2: stage 2 published documents (for reference)

### Functional requirements

<table>
<thead>
<tr>
<th>ID</th>
<th>Title</th>
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<tbody>
<tr>
<td>ETSI GS NFV-IFA 010 v2.5.1</td>
<td>MANO; Functional requirements specification</td>
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### Acceleration (with interfaces)

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<tr>
<td>ETSI GS NFV-IFA 002 v2.4.1</td>
<td>Acceleration Technologies: VNF Interfaces Specification</td>
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<tr>
<td>ETSI GS NFV-IFA 003 v2.4.1</td>
<td>Acceleration Technologies; vSwitch Benchmarking and Acceleration Specification</td>
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<tr>
<td>ETSI GS NFV-IFA 004 v2.4.1</td>
<td>Acceleration Technologies; Management aspects Specification</td>
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### NFV-MANO reference points and interfaces

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<tr>
<td>ETSI GS NFV-IFA 005 v2.5.1</td>
<td>MANO; Or-Vi reference point - Interface and Information Model Specification</td>
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<tr>
<td>ETSI GS NFV-IFA 006 v2.5.1</td>
<td>MANO; Vi-Vnfm reference point - Interface and Information Model Specification</td>
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<td>ETSI GS NFV-IFA 007 v2.5.1</td>
<td>MANO; Or-Vnfm reference point - Interface and Information Model Specification</td>
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<td>ETSI GS NFV-IFA 008 v2.5.1</td>
<td>MANO; Ve-Vnfm reference point - Interface and Information Model Specification</td>
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<tr>
<td>ETSI GS NFV-IFA 013 v2.5.1</td>
<td>MANO; Os-Ma-Nfvo reference point - Interface and Information Model Specification</td>
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## Release 2:
stage 2 published documents (for reference)

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<tr>
<td><strong>Descriptors and artefacts</strong></td>
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<tr>
<td>ETSI GS NFV-IFA 011 v2.6.1</td>
<td>MANO; VNF Descriptor and Packaging Specification</td>
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<td>ETSI GS NFV-IFA 014 v2.6.1</td>
<td>MANO; Network Service Templates Specification</td>
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<tr>
<td><strong>Information modeling</strong></td>
<td></td>
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<tr>
<td>ETSI GR NFV-IFA 015 v2.5.1</td>
<td>MANO; Report on NFV Information Model</td>
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<tr>
<td>ETSI GR NFV-IFA 016 v2.5.1</td>
<td>IM; Papyrus Guidelines</td>
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<td>ETSI GR NFV-IFA 017 v2.5.1</td>
<td>IM; UML Modeling Guidelines</td>
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<tr>
<td>ETSI GR NFV-IFA 024 v2.1.1</td>
<td>IM; Report on External Touchpoints related to NFV Information Model</td>
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<td><strong>Metrics, measurements</strong></td>
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<tr>
<td>ETSI GS NFV-TST 008 v2.5.1</td>
<td>Testing; NFVI Compute and Network Metrics Specification</td>
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<tr>
<td>ETSI GS NFV-IFA 027 v2.4.1</td>
<td>MANO; Performance Measurements Specification</td>
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**NOTE:** v2.6.1 versions of specs (see tables) will be published in April. These are currently under pre-processing by ETSI editing team.
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<td><strong>NFV-MANO APIs</strong></td>
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<tr>
<td>ETSI GS NFV-SOL 002 v2.6.1</td>
<td>Protocols and Data Models; RESTful protocols specification for the Ve-Vnfm Reference Point</td>
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<td>ETSI GS NFV-SOL 003 v2.6.1</td>
<td>Protocols and Data Models; RESTful protocols specification for the Or-Vnfm Reference Point</td>
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<td>ETSI GS NFV-SOL 005 v2.6.1</td>
<td>Protocols and Data Models; RESTful protocols specifications for the Os-Ma-nfvo Reference Point</td>
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<tr>
<td>ETSI GS NFV-SOL 013 v2.6.1</td>
<td>Protocols and Data Models; Specification of common aspects of RESTful NFV-MANO APIs</td>
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<tr>
<td><strong>Artefacts</strong></td>
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<tr>
<td>ETSI GS NFV-SOL 004 v2.6.1</td>
<td>Protocols and Data Models; VNF Package specification</td>
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<tr>
<td>ETSI GS NFV-SOL 001 v2.6.1</td>
<td>Protocols and Data Models; NFV descriptors based on TOSCA specification</td>
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<td>ETSI GS NFV-SOL 007 v2.6.1</td>
<td>Protocols and Data Models; Network Service Descriptor File Structure Specification</td>
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other published documents (for reference)

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<td>Testing; Guidelines on Interoperability Testing for MANO</td>
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<tr>
<td>ETSI GR NFV-TST 007 v2.5.1</td>
<td>Testing; Guidelines on Interoperability Testing for MANO</td>
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Status as of Apr. 2019
Release 2: more information and feedback

More information about Release 2 features:

✔️ https://docbox.etsi.org/isg/nfv/open/Other/ReleaseDocumentation/NFV(18)000241r1_NFV_Release_2_Description_v1_7_1.pdf

Ongoing work (drafts) publicly available here:

✔️ https://docbox.etsi.org/ISG/NFV/Open/Drafts/
Release 3: specification summary

Published documents


- 4 Stage 1/2 GS (NFV-EVE001/007/011, NFV-REL006)
- 5 Stage 2 GS (NFV-IFA018, NFV-IFA019, NFV-IFA030, NFV-IFA031, NFV-IFA032).
- 9 Stage 2 GS evolved from Release 2 (NFV-IFA005/006/007/008/010/011/013/014 and NFV-TST008) and 4 GR (NFV-IFA015/016/017/024).
- 3 GS on security (NFV-SEC012, NFV-SEC013, NFV-SEC014).
- 9 GR (NFV-EVE008/010/012, NFV-IFA012/021/022/023/028, NFV-TST005).
- 1 GS on testing/benchmarking (NFV-TST009).

Active work items

Release 3, ongoing unpublished work items (refer to Release 3 Definition): 18 WI.

- 1 Stage 1/2 GS draft (NFV-REL009).
- 2 Stage 2 GS draft (NFV-IFA026/033).
- 3 GR draft (NFV-IFA029/034, NFV-REL010).
- 2 GS drafts on security (NFV-SEC019, NFV-SEC020).
- Evolved Rel. 2 deliverables from stage 2 and 3: 6 GS (NFV-IFA002, and NFV-SOL002/003/004/005/013).
- 4 GS drafts on newly stage 3 (NFV-SOL009/010/011/012).

Release 3, ongoing “continuation and maintenance work”: 11 WI.

- Propagated/evolved Rel. 2 deliverable drafts: 9 Stage 2 GS (NFV-IFA005/006/007/008/010/011/013/014, NFV-TST008).
- Newly added by Release 3: 2 Stage 2 GS (NFV-IFA030/031).

Refer to regular updates of the Release 3 Definition (latest version v0.12.0 Dec. 2018, to be updated in Apr. 2019).
Release 3: feature-based specification

18 candidate features, including Release 3 definition features and small enhancements.

Approach:

✔ 6-month delivery cadence.

✔ Main workload is still on stage 2 level specifications.

✔ But stage 3 work has started.

✔ Release 3 specification progress and plans are publicly available on the NFV Public Wiki.

Refer also to Release 3 Definition Annex B for a summary of work, impacted specifications and features tracking.

First version v0.1.0 of Release 3 Description with the 1H2018 specification outcomes is now available. To be updated in Apr. 2019 with the 2H2018 spec outcomes.
Release 3: work items and features from stage 1&2 perspective

1) Advances in future network virtualization

- Cloud-native VNF (NFV-EVE011)
- PaaS support for cloud-native, and containers (NFV-IFA029)
- Hypervisor (NFV-EVE001)
- NFVI aspects: Hardware environment (NFV-EVE007)
- Acceleration (NFV-IFA018/IFA019, **)

2) Support for future network technologies

- Network LCM, Packaging and Descriptor (NFV-IFA007/008/011)
- Virtualised Resource management (NFV-IFA005/006)
- Information Modeling (NFV-IFA015/016/017)

- Network Slicing to NFV concepts (NFV-EVE012/NFV-REL010, **)
- MEC in NFV (**)

3) Additional operational features

- NFV software update and upgrade (NFV-REL006, **)
- Policy management framework (NFV-IFA023, **)
- VNF snapshotting (NFV-TST005, **)
- Charging, billing and accounting (NFV-EVE008, **)
- NFV licensing (NFV-EVE010, NFV-IFA034, **)

- NFV-MANO management (NFV-IFA021/031, **)
- Security management (NFV-IFA026/033)
- Multi administrative NFV-MANO (NFV-IFA028/030, **)
- Connectivity for multi-site (NFV-IFA022/032, **)
- Service availability (**)
- Host reservation (**)
Release 2: what does it contain?

Release 2 specifications set up the NFV framework with essential capabilities related to NS, VNF and VR management.

More information about Release 2 features: [https://docbox.etsi.org/ISG/NFV/Open/Other/NFV(18)000241_NFV_Release_2_Description_v17.pdf](https://docbox.etsi.org/ISG/NFV/Open/Other/NFV(18)000241_NFV_Release_2_Description_v17.pdf)
ETSI NFV ongoing work

**Release 2 maintenance:**

- Fourth round (2H2018) was completed.
- Fifth round (1H2019) is underway.

**Release 2 ongoing work for new specifications:**

- Some stage 3 specification, e.g., YANG based VNFD and NSD, VR mgmt. templates.
- Specific technical gaps, such as security enhancements for VNF Packaging and APIs.
- Testing specifications, including API conformance testing.

**Release 3 features work:**

- Few remaining informative/study works.
- Most of the stage 2 normative specification. Based on a feature set, whereby features may deliver new specifications or evolve current Release 2 specifications.
- Several features completed at stage 2 level.
Release 2: maintenance work (1/2)

4 rounds completed (1H2017, published as v2.3.1; 2H2017, published as v2.4.1; 1H2018, published as v2.5.1, and 2H2018 published as v2.6.1).

1H2019 maintenance is ongoing (targeting publication of affected specifications as v2.7.1).

- Focus is on stage 3 specifications (NFV-SOL specs), and stage 2 specifications closely related to unfinished Rel. 2 stage 3 specifications (NFV-IFA011/014). Additional stage 2 specifications are considered for maintenance as well.

Main aspects addressed (so far) as part of maintenance:

- Correction of bugs.
- Feedback received from deployments and development: remove ambiguities, enhance certain APIs, etc.
- Alignment in between Stage 2 and 3 specifications.
- Feedback from open source projects, e.g., OpenStack gap analysis and alignment to NFV-IFA005 and NFV-IFA006, OSM information model feedback to NFV-IFA011 and NFV-IFA014, contributions to NFV-IFA011 and NFV-SOL004 by companies participating in ONAP providing feedback, etc.
Capability changes and enhancements developed during maintenance (not an exhaustive list) since first published version of the specs (i.e., v2.1.1 and v2.2.1):

- Adding support for compute flavour management.
- Merging of VNF and NS lifecycle change notifications into VNF and NS LCM interfaces, respectively.
- Merging of VNF configuration and instance information mgmt. into VNF LCM interface.
- Adding support for changing the external VNF connectivity.
- Enhancements and consistency to alarm management within the fault management interfaces.
- Enhancements in the information and data modelling of network connectivity.
Release 3: feature-based specification and next steps

- Following a feature-based specification approach.
- 17+ candidate features (see backup slides).
- “stage 2 level” specification is well underway, and now transitioning into “stage 3 work.

1) Delivery of specifications. Sequencing the completion of features and providing input for Stage 3 to start. 6-month delivery cadence.

2) Stage 2 level specification is expected to be completed in 2019.

3) Stage 3 work undergoing in 2019.

4) Other activities needed after specification outcomes, e.g., testing, plugtests, etc.

Release specification progress and plans are publicly available on the NFV Public Wiki. List of features is available in the Release 3 Definition (periodically updated, latest v0.12.0 Dec. 2018). See also backup slides.