v0.7.0 (2020-11)

NFV Release 3 Description

Contents

Foreword

An initial set of capabilities of the Network Functions Virtualisation Release 3 had been identified and described in the NFV Release 3 Definition [1]. The present NFV Release 3 Description is issued once some of the capabilities identified within the Release 3 Definition document have been specified up to the level of requirements, architecture, interfaces and/or information model(s).

NFV Release 3 dependent deliverables are a subset of the whole ETSI ISG NFV's work programme. In addition to the release dependent specifications, the ETSI ISG NFV has published in the same timeframe several other reports and guidelines. All NFV deliverables are available at ETSI's "Search and Browse Standards" tool [2].

NOTE: In case of discrepancies between the contents of the present document and the ETSI NFV Group Specifications/Reports, the latter source of information takes precedence.

1 Scope

The present document describes the NFV Release 3. It documents the contents of the Release 3, listing the specified features and the Group Specifications (GS) and Group Reports (GR) that comprise the Release.

The purpose of the Release Description is to also describe the normative work that ETSI ISG NFV has developed as part of Release 3 with the objective to specify a stable and internally aligned set of features.

2 References

For the purposes of the present document, the following references apply:

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

[1] ETSI ISG NFV, "NFV Release 3 Definition", Contribution NFV(18)000240 (and revisions).

[2] ETSI, "Search and Browse Standards". [Online]. Available at http://www.etsi.org/standards-search. Access date: September 2018.

[3] ETSI, "ETSI Directives," Feb. 2018. [Online]. Available at https://portal.etsi.org/directives/38_directives_feb_2018.pdf

[4] ETSI GS NFV 003, "Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV".

[5] ETSI GS NFV 002, "Network Functions Virtualisation (NFV); Architectural Framework".

[6] ETSI GS NFV-MAN 001, "Network Functions Virtualisation (NFV); Management and Orchestration,".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions in [4], and the following apply:

Capability: ability of an item to perform an action under given internal conditions in order to meet some demand

Feature: functionality which represents added value to the system for a defined set of users

NOTE: A user could be a network operator, service provider, VNF provider, or some other defined actor.

Function: the abstract concept of a particular piece of functionality in a device, entity or service

Functionality: sum of actions or any aspect an item can do

    NOTE: Functionality can be associated to diverse items, including devices, entities, services and/or features.

Release: a set of deliverables that specify a well-defined, stable and internally consistent set of functions

    NOTE: A Release differs from the previous Release by having added and/or improved functionality introduced as a result of standardization work.

Release Definition: the ensemble of Features of a particular Release

Release Description: the description of specification outputs delivered by the Release

3.2 Abbreviations

For the purposes of the present document, the abbreviations in [4], and the following abbreviations apply:

ISG	Industry Specification Group
GR	Group Report
GS	Group Specification
WI	Work Item

4 Release overview

4.1 Introduction

ETSI ISG NFV Release 3 (hereinafter referred also as Release 3 or the present Release) builds on top and leverages the results of ETS ISG NFV documents published by the end of 2014. The NFV Release 2 did not include any architectural changes and the list of capabilities part of the Release were thus aligned with the ETSI NFV Architectural Framework [6]. The Release 3 introduces new features on top of the Release 2 specified capabilities.

A high-level description of the main outcomes of the Release 3 are provided in clause 5. Clause 4.2 provides a statistical summary of the Release 3 in terms of number of specifications and reports. Clause 4.3 describes the capabilities that have been specified in past Releases, namely the Release 2. Clause 6 lists the published GS comprising the present Release.

4.2 Overview

At the time the present Description document version is delivered, the Release 3 is comprised of:

- 35 Group Specifications, among which:

  + 18 new specifications.

  + 17 specifications evolved from Release 2.

- 12 Group Reports, among which:

  + 8 new reports.

  + 4 reports evolved from Release 2.

4.3 Summary of past Releases

The Release 3 is built upon the capabilities and features specified as part of the NFV Release 2. The Release 2 specified requirements, information models, data models and interface protocols to enable interoperable implementations of the NFV Architectural Framework [5].

The NFV Release 2 specified in the following categories:

- Functional requirements applicable to the Virtualised Infrastructure Manager (VIM), VNF Manager (VNFM) and Network Functions Virtualisation Orchestrator (NFVO) functional blocks of NFV-MANO identified by the NFV Architectural Framework.

- Requirements applicable to the reference points Or-Vi, Vi-Vnfm, Or-Vnfm, Os-Ma-nfvo, Ve-Vnfm-vnf and Ve-Vnfm-em identified by the NFV Architectural Framework and NFV-MANO Architectural Framework [7].

- Requirements, specification of interfaces and protocols defined at the reference points Or-Vi, Vi-Vnfm, Or-Vnfm, Os-Ma-nfvo and Ve-Vnfm identified by the NFV Architectural Framework and NFV-MANO Architectural Framework, including:

  * Virtualised resources information management,

  * Virtualised resources management and change notification,

  * Virtualised resources reservation management and change notification,

  * Virtualised resources quota management and change notification,

  * Virtualised resources fault, performance and capacity management,

  * VNF Packaging and software image management,

  * Network Forwarding Path (NFP) management,

  * VNF lifecycle management and change notification,

  * Granting of VNF lifecycle operation(s),

  * VNF fault, performance and configuration management,

  * VNF indicator(s),

  * Network Service (NS) lifecycle management and change notification, and

  * NS fault and performance management.

- Requirements, information model specification and data models of Network Service Descriptor (NSD),

- Requirements for VNF Packaging, and requirements, information model specification and data models of VNF Descriptor (VNFD), and

- Requirements for hardware-independent acceleration and virtual switch acceleration.

- Requirements related to the security aspects concerning the specified capabilities.

5 Release 3 features

5.1 Overview

The new features introduced as part of the Release 3 are listed in Table 5.1-1.

Table 5.1-1 lists only the Release 3 features whose specification has been completed with normative provisions at least from an architecture, functional and information model perspective (stage 2). The table also lists the status of the specification of normative provisions concerning protocols and data models (stage 3).

Table 5.1-1: Release 3 features

Feature name	Acronym	Id (from the Definition document [1])	FEAT id (from Annex B of the Definition [1])	Stage 3 status
Hardware-independent acceleration	ACCEL	R02.CAP12	N/A	N/A
Network Acceleration for VNF	FASTSWITCH	R03.F07	N/A	N/A
Hypervisor-based virtualisation	HYPER	R03.F16	N/A	N/A
Hardware environment for NFV	HWENV	R03.F13	N/A	N/A
Management of NFV-MANO	NFV_M&Ms	R03.F04	FEAT11	Completed. See note 1.
VNF Snapshotting	VNF_PHOTO	R03.F11	FEAT15	Partially completed. See note 2.
Policy management framework	POLICY	R03.F14	FEAT07	Completed. See note 4.
NFV-MANO admin domains	MANOMD	R03.F18	FEAT08	Completed. See note 1.
Host reservation	HOSTRSV	N/A	FEAT04	Completed. See note 1.
Secure sensitive components in NFV Framework	SEC4SNC	R03.F09	N/A	N/A
Security management and monitoring for NFV	SECMM	R03.F08	FEAT18	N/A
Management and connectivity of multi-site services	NFVWAN (MCMSS)	R03.F05	FEAT10	Partially completed. See note3.
VNF software modification	SWUP (VNF)	R03.F10	FEAT02	Partially completed. See note 2.
Network slicing in NFV	NFVSLICE	R03.F21	FEAT05	Ongoing
NFVI software modification	SWUP (NFVI)	R03.F10	FEAT03	Ongoing
Service availability level (SAL)	SAL	R03.F22	FEAT16	Completed. See note 1.
NOTE 1: The completion of the feature was realized in version v3.3.1 of the corresponding specifications. NOTE 2: The "new interface exposed by EM/VNF to support the coordination in VNF LCM operations" is not specified in the first published version (v3.3.1) of the specification. NOTE 3: NFV-MANO APIs and NFV Descriptors are completed. Profiling of "protocol and data models" for the interfaces exposed by WIM is ongoing. NOTE 4: The completion of the feature was realized in version v3.4.1 of the corresponding specifications.				

5.2   Functional features

5.2.1   Hardware-independent acceleration (ACCEL)

5.2.1.1   Description

The feature provides NFV related management and orchestration operations to flexibly allocate VNFs to available NFVI and acceleration components by exposing acceleration capabilities instead of specific acceleration resource characteristics.

Four interfaces support the exchanges between the NFVI and VIM regarding acceleration resource management:

-    Acceleration Resource Discovery,

-    Acceleration Resource Lifecycle Management,

-    Acceleration Resource Fault Management, and

-    Acceleration Image Management.

5.2.1.2   Architecture scope

The feature concerns the following main functional blocks and references points:

- Functional blocks: NFVI and VIM.

- Reference points: Nf-Vi.

5.2.1.3 Specification results

The feature has been specified in the specifications and reports listed in table 5.2.1.3-1. Refer to clause 6 for the latest version available of the referred document.

Table 5.2.1.3-1: Specification results of feature "Hardware-independent acceleration"

Document Id.	Stage	Description of the feature specification
ETSI GS NFV-IFA 019	Stage 2	Functional requirements to support acceleration related interfaces on the Nf-Vi reference point. Functional requirements for the acceleration related interfaces: Acceleration Resource Discovery, Acceleration Resource Lifecycle Management, Acceleration Resource Fault Management, and Acceleration Image Management. Functional and information model description of four new interfaces listed above.

5.2.2 Network acceleration for VNF (FASTSWITCH)

5.2.2.1 Description

The feature encompasses the interaction (e.g., interfaces) between the virtualization layer and switching accelerator drivers to enable network acceleration transparent to the VNF, and to be independent of any accelerator vendor and type. The feature specification is built on the use of the Dynamic Optimization of Packet Flow Routing (DOPFR) mechanism which offers the capability to accelerate the data plane processing of a VNF on a dedicated switch.

Three interfaces exposed by the switches support the exchanges between the VNF and the dedicated switch:

- Forwarding Table Configuration,

- Performance Monitoring, and

- Unmatched Packets Forward Notification.

5.2.2.2 Architecture scope

The feature concerns the following main functional blocks and references points:

- Functional blocks: NFVI and VNF.

- Reference points: Vn-Nf.

5.2.2.3 Specification results

The feature has been specified in the specifications and reports listed in table 5.2.2.3-1. Refer to clause 6 for the latest version available of the referred document.

Table 5.2.2.3-1: Specification results of feature "network acceleration for VNF"

Document Id.	Stage	Description of the feature specification
ETSI GS NFV-IFA 018	Stage 2	Functional and information model description of the Forwarding Table Configuration, Performance Monitoring and Unmatched Packets Forward Notification interfaces exposed by the dedicated switch towards the VNF at the Vn-Nf reference point.

5.2.3 Hypervisor-based virtualisation (HYPER)

5.2.3.1 Description

A hypervisor mediates the resources of the compute domain to the virtual machines of the software appliances and offers one of the virtualization environment solutions for the instantiation of VNFs. The hypervisor itself is a software environment which partitions the underlying physical resources and creates VMs, and isolates the VMs from each other.

The present feature covers hypervisor-related functions needed to support NFV use cases. Focus areas of specification concern to:

- Real-time guest support,

- Networking, in particular regarding virtual switch resiliency,

- NFV acceleration support,

- Security,

- Energy efficiency, and

- Performance management.

5.2.3.2 Architecture scope

The feature concerns the following main functional blocks and references points:

- Functional blocks: NFVI.

- Reference points: Nf-Vi.

5.2.3.3 Specification results

The feature has been specified in the specifications and reports listed in table 5.2.3.3-1. Refer to clause 6 for the latest version available of the referred document.

Table 5.2.3.3-1: Specification results of feature "Hypervisor-based virtualisation"

Document Id.	Stage	Description of the feature specification
ETSI GS NFV-EVE 001	Stage 1 and 2	Service and functional requirements in the areas of: real-time guest support, virtual switch resiliency, NFV acceleration, security, energy efficiency and performance management.

5.2.4 Hardware environment for NFV (HWENV)

5.2.4.1 Description

The feature deals with providing a reference framework for interoperable hardware ecosystem and telecommunications physical environment to support NFV deployments. The reference framework enables compatibility between hardware equipment provided by different hardware vendors and suppliers.

The feature scope encompasses the definition of requirements in the areas of: operations, environmental, mechanical, cabling, maintenance and security.

5.2.4.2 Architecture scope

The feature concerns the following main functional blocks and references points:

- Functional blocks: NFVI.

- Reference points: none.

5.2.4.3 Specification results

The feature has been specified in the specifications and reports listed in table 5.2.4.3-1. Refer to clause 6 for the latest version available of the referred document.

Table 5.2.4.3-1: Specification results of feature "Hardware environment for NFV"

Document Id.	Stage	Description of the feature specification
ETSI GS NFV-EVE 007	Stage 1 and 2	Service and functional requirements in the areas of: racks/frames, processors and storage, power, interconnections, cooling, hardware platform management, hardware security, radiated emissions and electromagnetic compliance, climatic and accoustic considerations, timing and synchronization issues, and reliability.

5.2.5 Management of NFV-MANO (NFV_M&Ms)

5.2.5.1 Description

The feature enables the management of the NFV-MANO framework, thus providing the capabilities to configure and monitor NFV-MANO functional entities. The framework for the management of NFV-MANO is based on the definition and exposure of a set of management interfaces by the NFV-MANO functional entities. The set of interfaces can be consumed in two ways: a) by an external entity beyond NFV-MANO, and/or, b) by an NFV-MANO functional entity.

As part of the feature, the present release specifies interface requirements, the interfaces and the necessary information elements enabling the fault, configuration and information, performance, state and log management of NFV-MANO functional entities.

5.2.5.2 Architecture scope

The feature concerns the following main functional blocks and references points:

- Functional blocks: NFVO, VNFM, VIM.

- Reference points: certain interfaces/operations may be exposed over Os-Ma-nfvo, Or-Vnfm, Or-Vi, and Vi-Vnfm.

5.2.5.3 Specification results

The feature has been specified in the specifications and reports listed in table 5.2.5.3-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.2.5.3-1: Specification results of feature "Management of NFV-MANO"

Document Id.	Stage	Description of the feature specification
ETSI GR NFV-IFA 021	Stage 0	Feasibility study of the feature. Use cases related to the management of NFV-MANO functional entities.
ETSI GS NFV-IFA 010	Stage 1 and 2	Service and functional requirements for NFV-MANO functional blocks to support the NFV-MANO management capabilities.
ETSI GS NFV-IFA 031	Stage 2	Functional requirements of NFV-MANO management interfaces. Functional and information model description of NFV-MANO management interfaces: configuration and information management, performance management, fault management, log management. Specification of metrics and performance measurements. Requirements related to security.
ETSI GR NFV-IFA 015	Stage 2	Information model (with UML representations) of NFV-MANO management derived from information elements specified in ETSI GS NFV-IFA 031.
ETSI GS NFV-SOL 009	Stage 3	RESTful protocols and data model specification of NFV-MANO management interfaces: configuration and information management, performance management, fault management, and log management.

5.2.6 VNF snapshotting (VNF_PHOTO)

5.2.6.1 Description

The feature concerns the creation and use of VNF snapshots. A VNF snapshot is a replication of a VNF instance at a specific point in time. A VNF snapshot package collects the files representing a VNF snapshot, and the package can be distributed to fulfil various network operator use cases, such as root cause analysis, testing, etc.

The feature implementation enables operations on and management of VNF snapshots and their corresponding packages. Snapshots can be triggered for the whole VNF instance, or on individual VNF Components (VNFC) of a VNF instance. As part of the creation and reversion of VNF snapshots, attaching and detaching of virtualised storage resources that are part of the VNF is performed.

In addition, the feature also enables the mechanism to package the VNF/VNFC snapshots for distribution and operation purposes. A new interface provides the operations allowing a consumer of the interface to create, build, upload, extract, query information, fetch and delete the VNF/VNFC snapshot packages.

The feature also encompasses enhancements and a new interface to support the coordination in between the VNFM and the VNF instance and/or Element Manager during the modification process.

5.2.6.2 Architecture scope

The feature concerns the following main functional blocks and references points:

- Functional blocks: NFVO, VNFM, VIM, VNF.

- Reference points: Os-Ma-nfvo, Or-Vnfm, Or-Vi, Vi-Vnfm, Ve-Vnfm-em, and Ve-Vnfm-vnf.

5.2.6.3 Specification results

The feature has been specified in the specifications and reports listed in table 5.2.6.3-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.2.6.3-1: Specification results of feature "VNF snapshotting"

Document Id.	Stage	Description of the feature specification
ETSI GR NFV-TST 005	Stage 0	Feasibility study of the feature. Use cases related to the use and management of VNF snapshots and VNF snapshot package.
ETSI GS NFV-IFA 010	Stage 1 and 2	Functional requirements for NFV-MANO functional blocks to support the handling of VNF snapshots and VNF snapshot package.
ETSI GS NFV-IFA 005	Stage 2	Requirements to extend the Virtualised Resource Management interface to attach and detach virtualised storage resources. Extensions to interfaces operations create and revert snapshot of virtualised resources.
ETSI GS NFV-IFA 006	Stage 2	Requirements to extend the Virtualised Resource Management interface to attach and detach virtualised storage resources. Extensions to interfaces operations create and revert snapshot of virtualised resources.
ETSI GS NFV-IFA 007	Stage 2	Functional requirements for the VNF Snapshot Package Management support on the Or-Vnfm reference point. Extensions to the VNF Lifecycle Management interface to support creating VNF snapshots, reverting to VNF snapshots, querying information about available snapshots, deleting the information associated to the snapshots. Functional and information model description of the new VNF Snapshot Package Management interface, and of new operations to support the VNF snapshot in the VNF LCM interface.

ETSI GS NFV-IFA 008	Stage 2	Functional requirements for the VNFC Snapshot Package Management support on the Ve-Vnfm reference point. Extensions to the VNF Lifecycle Management interface to support creating VNF/VNFC snapshots, reverting to VNF/VNFC snapshots, querying information about available snapshots, and deleting the information associated to the snapshots. New interface exposed by the EM/VNF to support the coordination in VNF LCM operations (also used by other features). Functional requirements for the new VNFC Snapshot Package Management interface. Functional and information model description of the new VNF Snapshot Package Management interface, and of new operations to support the VNFC snapshot in the VNF LCM interface.
ETSI GS NFV-IFA 011	Stage 2	Addition of attributes and new information elements to support the parameterization needed for the create and revert snapshot operations. Addition of events related to snapshots for the LCM scripts. Addition of attributes and new information elements to support the description of information used for the coordination in VNF LCM operations (also used by other features).
ETSI GS NFV-IFA 013	Stage 2	Functional requirements for the VNF Snapshot Package Management support on the Os-Ma-nfvo reference point. Extensions to the NS Lifecycle Management interface to support creating VNF snapshots, reverting to VNF snapshots, querying information about available snapshots, deleting the information associated to the snapshots as part of the update of an NS. Functional and information model description of the new VNF Snapshot Package Management interface, and of new operations to support the VNF snapshot in the VNF LCM interface.
ETSI GR NFV-IFA 015	Stage 2	Information model (with UML representations) of VNF Snapshot and VNF Snapshot Packaging derived from information elements specified in the rest of documents listed in the present table.
ETSI GS NFV-SOL 001	Stage 3	TOSCA-based models to support the description of the related VNF snapshot VNF LCM operation capabilities. See note.
ETSI GS NFV-SOL 002	Stage 3	RESTful protocols and data model specification for the support on the Ve-Vnfm reference point of the new operations to support the VNF snapshot in the VNF LCM interface. See note.
ETSI GS NFV-SOL 003	Stage 3	RESTful protocols and data model specification for the support on the Or-Vnfm reference point of the new VNF Snapshot Package Management interface. New resources and operations to support the VNF snapshot in the VNF LCM interface. Extensions in the LCM Granting interface.
ETSI GS NFV-SOL 005	Stage 3	RESTful protocols and data model specification for the support on the Os-Ma-nfvo reference point of the new VNF Snapshot Package Management interface. New resources and operations to support the VNF snapshot opeations in the NS LCM interface.
ETSI GS NFV-SOL 006	Stage 3	YANG-based models to support the description of related VNF snapshot VNF LCM operation capabilities.
ETSI GS NFV-SOL 010	Stage 3	Specification of the structure and format of a VNF Snapshot Package file and of the artifacts it contains.
NOTE:		The "new interface exposed by EM/VNF to support the coordination in VNF LCM operations" and/or its support in NFV Descriptors is not specified in the first published version (v3.3.1) of this specification.

5.2.7 Policy management framework (POLICY)

5.2.7.1 Description

The feature introduces a policy management framework for NFV-MANO, including distribution of policy, policy conflict detection and resolution, and federation of policy domains. The feature addresses the interface operation definition when policy management is introduced into NFV-MANO.

As part of the feature, a new interface applicable to multiple reference points (see clause 5.2.7.2) is introduced. The interface allows to invoke policy management operations towards the corresponding NFV-MANO functional block.

The interface defines the follow operations: transfer, delete, query, activate and deactivate policy. The interface also exposes the subscription and notification mechanism for issuing notifications concerning policy handling.

5.2.7.2 Architecture scope

The feature concerns the following main functional blocks and references points:

- Functional blocks: NFVO, VNFM, VIM.

- Reference points: Os-Ma-nfvo, Or-Vnfm, Or-Vi, Vi-Vnfm, and Ve-Vnfm.

5.2.7.3 Specification results

The feature has been specified in the specifications and reports listed in table 5.2.7.3-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.2.7.3-1: Specification results of feature "Policy management framework"

Document Id.	Stage	Description of the feature specification
ETSI GR NFV-IFA 023	Stage 0	Feasibility study of the feature. Use cases related to the introduction of policy usage and management into NFV-MANO.
ETSI GS NFV-IFA 010	Stage 1 and 2	Functional requirements for NFV-MANO functional blocks (NFVO, VNFM and VIM) to support the capability to manage NFV-MANO policies. Definition of scope and category of policies applicable to the different reference points (informative).
ETSI GS NFV-IFA 005	Stage 2	Functional requirements of the Policy Management interface on the Or-Vi reference point. Functional and information model description of the Policy Management interface.
ETSI GS NFV-IFA 006	Stage 2	Functional requirements of the Policy Management interface on the Vi-Vnfm reference point. Functional and information model description of the Policy Management interface.
ETSI GS NFV-IFA 007	Stage 2	Functional requirements of the Policy Management interface on the Or-Vnfm reference point. Functional and information model description of the Policy Management interface.
ETSI GS NFV-IFA 008	Stage 2	Functional requirements of the Policy Management interface on the Ve-Vnfm reference point. Functional and information model description of the Policy Management interface.
ETSI GS NFV-IFA 013	Stage 2	Functional requirements of the Policy Management interface on the Os-Ma-nfvo reference point. Functional and information model description of the Policy Management interface.
ETSI GR NFV-IFA 015	Stage 2	Information model (with UML representations) of Policy Management derived from information elements specified in in the rest of documents listed in the present table.
ETSI GS NFV-SOL 012	Stage 3	RESTful protocols and data model specification for the support of the Policy Management interface.

5.2.8 NFV-MANO admin domains (MANOMD)

5.2.8.1 Description

The feature concerns with the support of NFV-MANO services across multiple administrative domains. The feature develops the necessary enhancements to the NFV Architectural Framework to enable the interactions between NFVOs in different administrative domains for:

- The management of composite Network Service (NS) and its constituent nested NSs in different administrative domains.

5.2.8.2 Architecture scope

The feature concerns the following main functional blocks and references points:

- Functional blocks: NFVO.

- Reference points: Or-Or (new across administrative domains).

5.2.8.3 Specification results

The feature has been specified in the specifications and reports listed in table 5.2.8.3-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.2.8.3-1: Specification results of feature "NFV-MANO admin domains"

Document Id.	Stage	Description of the feature specification
ETSI GS NFV-IFA 010	Stage 1 and 2	Service and functional requirements for the NFVO to support the management of network services in a multiple administrative domain environment.
ETSI GS NFV-IFA 030	Stage 2	Functional requirements for the Or-Or reference point. Functional requirements for the following interfaces concerning the support of NS in multiple administrative domains: NS lifecycle management, NS lifecycle operation granting, NS instance usage notification, NS performance management, and NS fault management. Functional and information model description of the interfaces listed above. Requirements related to security when handling NS in multiple administrative domains.
ETSI GR NFV-IFA 015	Stage 2	Information model (with UML representations) of NS across multiple administrative domains management derived from information elements specified in in the rest of documents listed in the present table.
ETSI GS NFV-SOL 011	Stage 3	RESTful protocols and data model specification of network services in a multiple administrative domain: new APIs for NS lifecycle operation granting interface, and NS instance usage notification interfaces; references/reuse of NFV-SOL 005 APIs for NSD management, NS lifecycle management, NS performance management, and NS fault management.

5.2.9 Host reservation (HOSTRSV)

5.2.9.1 Description

The feature adds the capability to the NFV-MANO architectural framework to support the reservation of compute hosts (see clause 3.1 in ETSI GS NFV-PER 001) in the NFVI. The feature allows the network operator to guarantee that the allocation of some of the virtualised resources takes place on certain hosts isolated from others, e.g., under certain security enclaves, or to guarantee the availability of resources at the host level.

5.2.9.2 Architecture scope

The feature concerns the following main functional blocks and references points:

- Functional blocks: NFVO, VNFM, VIM.

- Reference points: Or-Vi, Vi-Vnfm, Os-Ma-nfvo.

5.2.9.3 Specification results

The feature has been specified in the specifications and reports listed in table 5.2.9.3-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.2.9.3-1: Specification results of feature "Host reservation"

Document Id.	Stage	Description of the feature specification

ETSI GS NFV-IFA 010	Stage 1 and 2	Functional requirements for the NFVO and VIM related to NFVI capacity management including compute hosts. Functional requirements for the NFVO and VIM to support capabilities about compute host reservation management (creation, query, etc.).
ETSI GS NFV-IFA 005	Stage 2	Interface requirements for compute host reservation management. Functional and information model description of the Compute Host Reservation Management interface, Compute Host Reservation Change Notification interface, and Compute Host Capacity Management interface.
ETSI GS NFV-IFA 007	Stage 2	Updates to the VNF Lifecycle Operation Granting interface adding support for reserved compute hosts.
ETSI GS NFV-IFA 013	Stage 2	Interface requirements for NFVI Capacity Information. Functional and information model description of the NFVI Capacity Information interface.
ETSI GR NFV-IFA 015	Stage 2	Information model (with UML representations) of Host Reservation management derived from information elements specified in in the rest of documents listed in the present table.
ETSI GS NFV-SOL 003	Stage 3	Modifications to the LCM Granting interface to generalize the reservation types and include reserved compute hosts.
ETSI GS NFV-SOL 005	Stage 3	RESTful protocols and data model specification for the support on the Or-Vnfm reference point of the new NFVI Capacity Information interface.

5.2.10 Management and connectivity of multi-site services (NFVWAN/MCMSS)

5.2.10.1 Description

The feature addresses the network connectivity aspects to support seamlessly the deployment and connectivity requirements for the service components NFV, e.g. NS, VNF, VNFC, PNF, possibly across wide area networks (WAN), and/or access networks (collectively referred as WANs hereafter), both legacy and SDN-enabled and their hybrid.

The feature enhances the NFV Architectural Framework to support the integration of WAN infrastructure management deployed as:

- Part of the NFV-MANO framework,

- External to the NFV-MANO framework (e.g., under control of other OSS/BSS systems).

The management of connectivity across different NFVI-PoPs (also referred as sites) is performed by the WAN Infrastructure Manager (WIM), which produces the following interfaces related to the connectivity services:

- Multi-site connectivity service management,

- Capacity management,

- Fault management, and

- Performance management.

The WIM may rely on network controllers that handle the fulfilment of the connectivity at a lower level, potentially making use of different network technologies and protocols. The WIM offers to the consumers an abstraction of such network connectivity to ease the provisioning and monitoring of it.

Two types of managed objects are exposed by the WIM concerning network connectivity: multi-site connectivity service (MSCS), and multi-site network connection (MSNC).

5.2.10.2 Architecture scope

The feature concerns the following main functional blocks and references points:

- Functional blocks: WIM (new), and NFVO, VNFM, and VIM.

- Reference points: Os-Ma-nfvo, Or-Vi, Or-Vnfm.

5.2.10.3 Specification results

The feature has been specified in the specifications and reports listed in table 5.2.10.3-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.2.10.3-1: Specification results of feature "Management and connectivity of multi-site services"

Document Id.	Stage	Description of the feature specification
ETSI GS NFV-IFA 010	Stage 2	Functional requirements to support the management and connectivity for multi-site services, and the integration of WAN infrastructure management deployed as part or external to the NFV-MANO framework. Functional requirements for the NFVO, VNFM and VIM to support the management of connectivity for multi-site services. New functional requirements for the WIM to support management of connectivity for multi-site services.
ETSI GS NFV-IFA 013	Stage 2	Updates to handle information related to externally-managed multi-site virtual links. Updates to the NS lifecycle management interface to provide WAN connectivity information managed externally from or internally by the NFV-MANO.
ETSI GS NFV-IFA 007	Stage 2	Updates to handle information related to externally-managed multi-site virtual links.
ETSI GS NFV-IFA 005	Stage 2	Updates to expose and handle information related to connectivity service endpoints of the NFVI-PoP for external WAN connectivity.
ETSI GS NFV-IFA 014	Stage 2	Updates to the affinity/anti-affinity scopes to consider WAN connectivity aspects.
ETSI GS NFV-IFA 032	Stage 2	Functional requirements for the WIM to produce multi-site connectivity related interfaces. Interface requirements for the multi-site connectivity related interfaces: MSCS, capacity, fault, and performance management. Functional and information model description of the above mentioned interfaces. Specification of performance metrics and measurements. Specification of capacity metrics and measurements. Requirements related to security.
ETSI GS NFV-SOL 001	Stage 3	TOSCA-based models to support affinity/anti-affinity scopes considering WAN connectivity aspects.
ETSI GS NFV-SOL 003	Stage 3	Updates to handle information related to externally-managed multi-site virtual links in the VNF LCM interface and the VNF Lifecycle Operation Granting interface.
ETSI GS NFV-SOL 005	Stage 3	Updates to handle information related to externally-managed multi-site virtual links. Updates to the NS lifecycle management interface to provide WAN connectivity information managed externally from or internally by the NFV-MANO.
ETSI GS NFV-SOL 006	Stage 3	YANG-based models to support affinity/anti-affinity scopes considering WAN connectivity aspects.

5.2.11 VNF software modification (SWUP VNF)

5.2.11.1 Description

The feature addresses the initiation and coordination of changing the current VNF Package of a VNF instance. The feature covers the software modification process related to VNF instances, with the goal to minimize the impact of software modification on service availability.

The VNFM supports the change of the current VNF Package by handling the software images and required resource related aspects. Accordingly, a new interface operation of "change the current VNF Package" of a VNF instance is exposed by the VNFM. The modifications that are supported by means of the new interface operation are:

- Changes of the VNF virtualised resources, without changing the VNF software version,

- Changes of both VNF software version and VNF virtualised resources, and

- Changes related to the VNFD.

The support of changing the current VNF Package of a VNF instance is indicated by the VNFD by the addition of corresponding description and information used for performing the change. This information encompasses processes and rules for performing the resource related tasks while assisting the "change current VNF Package" to change the VNF instance to a different VNF Package. Changes of current VNF Package can be performed for different source VNFDs.

The feature also encompasses enhancements and a new interface to support the coordination in between the VNFM and the VNF instance and/or Element Manager during the modification process.

5.2.11.2 Architecture scope

The feature concerns the following main functional blocks and references points:

- Functional blocks: NFVO, VNFM, and VNF.

- Reference points: Os-Ma-nfvo, Or-Vnfm, Ve-Vnfm-em, and Ve-Vnfm-vnf.

5.2.11.3 Specification results

The feature has been specified in the specifications and reports listed in table 5.2.11.3-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.2.11.3-1: Specification results of feature "VNF software modification"

Document Id.	Stage	Description of the feature specification
ETSI GS NFV-REL 006	Stage 1	Analysis, use cases and high-level requirements for maintaining service availability during NFV software modifications in the NFVI, NFV-MANO and VNF.
ETSI GS NFV-IFA 010	Stage 2	Functional requirements for the NFVO, VNFM to support the capability of changing the current VNF Package of a VNF instance.
ETSI GS NFV-IFA 013	Stage 2	Interface requirement on the NS LCM interface to support changing the current VNF package of a VNF instance as part of the update of an NS. Updates to the NS update operation to support the change of current VNF Package of a VNF instance.
ETSI GS NFV-IFA 007	Stage 2	Interface requirement on the VNF LCM interface to support changing the current VNF package. Addition of a new interface operation in the VNF LCM interface to change current VNF package. Updates to the VNF lifecycle operation granting interface to handle changes of current VNF package.
ETSI GS NFV-IFA 008	Stage 2	Interface requirement on the VNF LCM interface to support changing the current VNF package. Addition of a new interface operation in the VNF LCM interface to change current VNF package. Updates to the VNF lifecycle operation granting interface to handle changes of current VNF package. New interface exposed by the EM/VNF to support the coordination in VNF LCM operations (also used by other features).
ETSI GS NFV-IFA 011	Stage 2	Addition of attributes and new information elements to support the description of the information for changing the current VNF Package applicable to a VNF. Addition of attributes and new information elements to support the description of information used for the coordination in VNF LCM operations (also used by other features).
ETSI GS NFV-SOL 001	Stage 3	TOSCA-based models to support the description of the information for changing the current VNF Package applicable to a VNF. See note.
ETSI GS NFV-SOL 002	Stage 3	Addition of a new interface operation in the VNF LCM interface to change current VNF package. Addition of attributes to signal VNF changes due to the change current VNF package operation. See note.

ETSI GS NFV-SOL 003	Stage 3	Addition of a new interface operation in the VNF LCM interface to change current VNF package. Addition of attributes to signal VNF changes due to the change current VNF package operation. Updates to the Lifecycle Granting interface to signal the new VNF LCM interface change current VNF package operation.
ETSI GS NFV-SOL 005	Stage 3	Update of the NS update operation in the NS LCM interface to change current VNF package. Addition of attributes to signal VNF changes due to the change current VNF package operation.
ETSI GS NFV-SOL 006	Stage 3	YANG-based models to support the description of the information for changing the current VNF Package applicable to a VNF. YANG-based models to support the description of information used for the coordination in VNF LCM operations (also used by other features).
NOTE:	The "new interface exposed by EM/VNF to support the coordination in VNF LCM operations" and/or its support in NFV Descriptors is not specified in the first published version (v3.3.1) of this specification.	

5.2.12   Network slicing in NFV (NFVSLICE)

5.2.12.1   Description

The feature addresses the definition of necessary requirements and enhancements of interfaces to support network slicing. External management systems will use NFV-MANO and its capabilities to manage Network Services and their resources used for the network slices. Network slice management functions will consume NS LCM when it manages the constituents that are forming the network slices. NFV-MANO is then enhanced to manage resources (service resources and infrastructure resources) taking in account priorities based on operator policies and SLAs.

The key aspects for NFV-MANO and the managed objects (e.g., Network Services) to support network slicing are:

- Priorities handling based on operator policies and SLAs,

- Priorities information to be considered while performing NS, VNF and virtualised resource management.

- Isolation of NSs and infrastructure resources assigned to different tenants, and

- NS deployment spanning over multiple sites and multiple administrative domains.

5.2.12.2   Architecture scope

The feature concerns the following main functional blocks and references points:

- Functional blocks: NFVO.

- Reference points: Os-Ma-nfvo.

5.2.12.3   Specification results

The feature has been specified in the specifications and reports listed in table 5.2.12.3-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.2.12.3-1: Specification results of feature "Network slicing in NFV"

Document Id.	Stage	Description of the feature specification
ETSI GS NFV-IFA 010	Stage 2	Functional requirements for the NFVO to consider priority information when handling NS, VNF and virtualised resource management. Functional requirements for the NFVO to consider resource isolation among multiple tenants.
ETSI GS NFV-IFA 013	Stage 2	Addition of a new notification in the NS LCM interface to notify about capacity shortage. Requirements extending the NS LCM operation occurrence notification to provide information about resource shortage and pre-emption.
ETSI GS NFV-IFA 014	Stage 2	Addition of an attribute to indicate the priority for the NS instance based on a given NS deployment flavour.
ETSI GR NFV-IFA 024	Stage 2	Addition of a touchpoint between the NFV and 3GPP network slicing information models.

5.2.13 NFVI software modification (SWUP NFVI)

5.2.13.1 Description

The feature addresses the support and coordination of the NFVI software modification process with the VNFs hosted on the NFVI in order to minimize impact on service availability.

The VIM supports the modification process by notifying any upcoming changes that impact the virtualised resources. In addition, the VIM processes related NFVI operation and maintenance constraints (in the form of policies) and takes them into account during the modification process. The constraints and policies are provided by other functional blocks consuming services from the VIM, such as the NFVO and VNFM. The NFVO supports the handling of policies and constraints when the VNF-related resource management in indirect mode is applicable.

The VNFM supports the modification process by determining, based on VNFD information or information at runtime, the resources to overcome the impact on currently allocated virtualised resources. The VNFM also support the provisioning and update of NFVI operation and maintenance constraints to the VIM.

5.2.13.2 Architecture scope

The feature concerns the following main functional blocks and references points:

- Functional blocks: VIM, VNFM, NFVO.

- Reference points: Or-Vi, Vi-Vnfm, Or-Vnfm, Ve-Vnfm.

5.2.13.3 Specification results

The feature has been specified in the specifications and reports listed in table 5.2.13.3-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.2.13.3-1: Specification results of feature "NFVI software modification"

Document Id.	Stage	Description of the feature specification
ETSI GS NFV-REL 006	Stage 1	Analysis, use cases and high-level requirements for maintaining service availability during NFV software modifications in the NFVI, NFV-MANO and VNF.
ETSI GS NFV-IFA 010	Stage 2	Functional requirements for the VIM, VNFM and NFVO to consider the use of NFVI operation and maintenance constraints to support and coordinate the NFVI software modification process. Functional specification of the NFVI operation and maintenance constraints. Informative procedures related to NFVI operation and maintenance.
ETSI GS NFV-IFA 011	Stage 2	Addition of attributes and new information elements to support the description of information and rules related to NFVI operation and maintenance.
ETSI GS NFV-IFA 005	Stage 2	Updates to the virtualised resource change notifications to enable advance notifications and to be able to notify about affinity/anti-affinity groups of virtualised resources to which the notification applies, and addition of NFVI maintenance related attributes. Specification of the process in between the VNFM and VIM for handling the NFVI operation and maintenance constraints in the form of policies.
ETSI GS NFV-IFA 006	Stage 2	Updates to the virtualised resource change notifications to be able to notify about affinity/anti-affinity groups of virtualised resources to which the notification applies, and addition of NFVI maintenance related attributes. References to the specification in ETSI GS NFV-IFA 006 about the process in between the VNFM and VIM for handling the NFVI operation and maintenance constraints in the form of policies.
ETSI GS NFV-IFA 008	Stage 2	Extension in the VNF fault management notifications to cover changes due to NFVI operation and maintenance. Specification of the process in between the EM and VNFM for handling the NFVI operation and maintenance constraints in the form of policies.

5.2.14 Service availability level (SAL)

5.2.14.1 Description

The feature addresses the functions needed to assist in the selection of appropriate virtualised resources to be allocated to or reserved for constituents of a Network Service to meet the availability expectation of the service provider towards the NS the constituents belong to. Use of SAL is optional for service providers.

The NFVO responsibility is extended to support the capability to consider the provided SAL information at the allocation or reservation of virtualised resources and consider such information to mitigate conflicts in resource allocation in case of conflicting resource requests.

5.2.14.2 Architecture scope

The feature concerns the following main functional blocks and references points:

- Functional blocks: NFVO.

- Reference points: None.

5.2.14.3 Specification results

The feature has been specified in the specifications and reports listed in table 5.2.14.3-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.2.14.3-1: Specification results of feature "Service availability level"

Document Id.	Stage	Description of the feature specification
ETSI GS NFV-IFA 010	Stage 2	Specification of requirements for the NFVO to consider SAL information in the selection, allocation and mitigation of conflicts during virtualised resource management.
ETSI GS NFV-IFA 014	Stage 2	Addition of attributes in NS deployment flavour information of the NSD to specify the SAL of NS and VNF.
ETSI GS NFV-SOL 001	Stage 3	TOSCA-based models to support in the NSD the description of SAL of NS and VNF.
ETSI GS NFV-SOL 006	Stage 3	YANG-based models to support in the NSD the description of SAL of NS and VNF.

5.3 Security features

5.3.1 Secure sensitive components in NFV Framework (SEC4SNC)

5.3.1.1 Description

The feature concerns to ensuring the isolation of sensitive workloads from non-sensitive workloads sharing an infrastructure platform. Workloads refer to the components of the NFV architecture that are virtualised in the context of a particular deployment and running on host systems. A host system is referred as the collection of hardware, software and firmware making up the system, which in NFVI terms refer to the virtualisation layer (e.g., hypervisor) and host (e.g., physical compute).

To ensure the isolation of sensitive workloads, requirements for different aspects are considered, such as:

- Platform, including: core hardware and core software.

- Lifecycle, including: Trusted Computing Base, workload provisioning, runtime checks, entropy and random numbers, cryptographic primitives, installed software and configuration on host system, de-provisioning of workloads, and failure handling.

From a system hardening perspective, specific technologies ensure an appropriate security posture for the host system. The techniques and technologies concern cover the following aspects: secure logging, OS-level access and confinement control, physical control and alarms, authentication control, access control, communications security, boot, attestation, hardware-mediated execution enclaves, Hardware-Based Root of Trust, self-encrypting storage, direct access to memory, hardware security modules, software integrity protection and verification.

5.3.1.2 Architecture scope

The feature concerns the following main functional blocks and references points:

- Functional blocks: NFVI, VNF.

- Reference points: Vn-Nf.

5.3.1.3 Specification results

The feature has been specified in the specifications and reports listed in table 5.3.1.3-1. Refer to clause 6 for the latest version available of the referred document.

Table 5.3.1.3-1: Specification results of feature "Secure sensitive components in NFV framework"

Document Id.	Stage	Description of the feature specification
ETSI GS NFV-SEC 012	Stage 1	Requirements for the host systems that execute the workloads.
NOTE: Technologies analysed in the ETSI GS NFV-SEC 012 are introduced and defined in ETSI GR NFV-SEC 009.		

5.3.2 Security management and monitoring for NFV (SECMM)

5.3.2.1 Description

The feature concerns to NFV security lifecycle management for the establishment of consistent security policies and uniform enforcement of the policies on virtualised networks. As part of the feature outcomes, enhancements to the architecture are introduced whereby different functional blocks responsible for security monitoring and management interface with other NFV blocks such as NFVI, VNF and NFV-MANO functional blocks.

In addition, the feature considers the needed security requirements for the NFV-MANO functional blocks and the reference points in between and to/from the NFV-MANO functional blocks to reduce the security risks in terms of authenticity, integrity, confidentiality and privacy.

5.3.2.2 Architecture scope

The feature concerns the following main functional blocks and references points:

- Functional blocks: Security Manager (SM) (new), NFVO, VNFM, VIM.

- Reference points:

  + New reference points Sc-Vi, Sc-Vnfm, and Sc-Or for security monitoring and management.

  + Or-Vnfm, Vi-Vnfm, Or-Vi on security requirements.

5.3.2.3 Specification results

The feature has been specified in the specifications and reports listed in table 5.3.2.3-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.3.2.3-1: Specification results of feature "Security management and monitoring for NFV"

Document Id.	Stage	Description of the feature specification
ETSI GS NFV-IFA 026	Stage 2	Specification of architecture enhancements and requirements to interface the security control to NFV-MANO. Functional specification of requirement of Security Manager and new Sc-Vi, Sc-Vnfm and Sc-Or reference points.
ETSI GS NFV-SEC 013	Stage 1 and 2	Functional and security requirements for automated, dynamic security policy management and security function lifecycle management, and security monitoring of NFV systems. Architecture enhancements for NFV security monitoring and management.
ETSI GS NFV-SEC 014	Stage 1 and 2	Security requirements for the NFV-MANO functional blocks and NFV-MANO reference points.

6　NFV Release 3 published deliverables

6.1　Introduction

The present clause 6 lists the published deliverables (Group Specifications and Group Reports) associated to the Release 3. The NFV Release 3 is comprised of multiple specification and reports, which can be categorized according to different specification stages (stage 1, stage 2, etc.) and compliance (normative or informative).

NOTE 1:　The versions among the different deliverables may differ, e.g., a deliverable may have been updated and published with a newer version due to maintenance, whereas some other deliverable not. The latest available published version of each deliverable is indicated in the following tables.

NOTE 2:　The present clause 6 only lists GS and GR that contain the specification of features listed in clause 5. GRs associated to features that have not reached a status of at least specifying normative provisions of architecture, functional and information model (stage 2) are not listed. A complete list of published specifications and reports associated to Release 3 is available in the Release 3 Definition document.

6.2　Stage 1 and stage 2 Group Specifications

6.2.1　Newly published Group Specifications

The newly published specifications associated to the Release 3 are listed in Table 6.2.1-1.

Table 6.2.1-1: Newly published stage 1 and stage 2 Group Specifications

Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-EVE 001	V3.1.1	Network Functions Virtualisation (NFV) Release 3; Virtualisation Technologies; Hypervisor Domain Requirements specification	R03.F16: Hypervisor-based virtualisation (HYPER)
ETSI GS NFV-EVE 007	V3.1.2 Old: V3.1.1	Network Functions Virtualisation (NFV) Release 3; NFV Evolution and Ecosystem; Hardware Interoperability Requirements Specification	R03.F13: Hardware Environment for NFV (HWENV)
ETSI GS NFV-EVE 011	V3.1.1	Network Functions Virtualisation (NFV) Release 3; Virtualised Network Function: Specification of the Classification of Cloud Native VNF implementations	N/A (see note)
ETSI GS NFV-IFA 018	V3.1.1	Network Functions Virtualisation (NFV); Acceleration Technologies; Network Acceleration Interface Specification; Release 3	R03.F07: Network Acceleration for VNF (FASTSWITCH)
ETSI GS NFV-IFA 019	V3.1.1	Network Functions Virtualisation (NFV); Acceleration Technologies; Acceleration Resource Management Interface Specification; Release 3	R02.CAP12: Hardware independent acceleration (ACCEL)
ETSI GS NFV-IFA 030	V3.4.1 Old: V3.3.1 V3.2.1 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Multiple Administrative Domain Aspect Interfaces Specification	FEAT08: NFV-MANO admin domains (MANOMD)
ETSI GS NFV-IFA 031	V3.4.1 Old: V3.3.1 V3.2.1 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Requirements and interfaces specification for management of NFV-MANO	FEAT11: Management of NFV-MANO (NFV_M&Ms)

Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-IFA 032	V3.4.1 Old: V3.3.1 V3.2.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Interface and Information Model Specification for Multi-Site Connectivity Services	FEAT10: Management of Network Services and connectivity (NFVWAN)
ETSI GS NFV-REL 006	V3.1.1	Network Functions Virtualisation (NFV) Release 3; Reliability; Maintaining Service Availability and Continuity Upon Software Modification	FEAT02: VNF software modification (SWUP VNF) FEAT03: NFVI software modification (SWUP NFVI)
NOTE:	The specification has been published as part of the Release 3 work programme. However, the required specification work of the associated feature has not been fully completed as part of the Release 3, and it has been carried over to Release 4.		

6.2.2 Evolved/propagated published deliverables from a previous Release

The published deliverables associated to the Release 3 that have been evolved/propagated from a previous Release are listed in table 6.2.2-1.

Table 6.2.2-1: Published stage 1 and stage 2 deliverables evolved/propagated from a previous Release

Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-IFA 005	V3.4.1 Old: V3.3.1 V3.2.1 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Or-Vi reference point - Interface and Information Model Specification	FEAT15: VNF snapshotting (VNF_PHOTO) FEAT07: Policy management framework (POLICY) FEAT04: Host reservation (HOSTRSV) FEAT10: Management of Network Services and connectivity (NFVWAN) FEAT03: NFVI software modification (SWUP NFVI)
ETSI GS NFV-IFA 006	V3.4.1 Old: V3.3.1 V3.2.1 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Vi-Vnfm reference point - Interface and Information Model Specification	FEAT15: VNF snapshotting (VNF_PHOTO) FEAT07: Policy management framework (POLICY) FEAT03: NFVI software modification (SWUP NFVI)
ETSI GS NFV-IFA 007	V3.4.1 Old: V3.3.1 V3.2.1 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Or-Vnfm reference point - Interface and Information Model Specification	FEAT15: VNF snapshotting (VNF_PHOTO) FEAT07: Policy management framework (POLICY) FEAT04: Host reservation (HOSTRSV) FEAT10: Management of Network Services and connectivity (NFVWAN) FEAT02: VNF software modification (SWUP VNF)
ETSI GS NFV-IFA 008	V3.4.1 Old: V3.3.1 V3.2.1 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Ve-Vnfm reference point - Interface and Information Model Specification	FEAT15: VNF snapshotting (VNF_PHOTO) FEAT07: Policy management framework (POLICY) FEAT02: VNF software modification (SWUP VNF) FEAT03: NFVI software modification (SWUP NFVI)

Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-IFA 010	V3.4.1 Old: V3.3.1 V3.2.1 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Functional requirements specification	FEAT11: Management of NFV-MANO (NFV_M&Ms) FEAT15: VNF snapshotting (VNF_PHOTO) FEAT08: NFV-MANO admin domains (MANOMD) FEAT07: Policy management framework (POLICY) FEAT04: Host reservation (HOSTRSV) FEAT10: Management of Network Services and connectivity (NFVWAN) FEAT02: VNF software modification (SWUP VNF) FEAT05: Network slicing in NFV (NFVSLICE) FEAT03: NFVI software modification (SWUP NFVI) FEAT16: Service availability level (SAL)
ETSI GS NFV-IFA 011	V3.4.1 Old: V3.3.1 V3.2.1 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; VNF Descriptor and Packaging Specification	FEAT15: VNF snapshotting (VNF_PHOTO) FEAT02: VNF software modification (SWUP VNF) FEAT03: NFVI software modification (SWUP NFVI)
ETSI GS NFV-IFA 013	V3.4.1 Old: V3.3.1 V3.2.1 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Os-Ma-Nfvo reference point - Interface and Information Model Specification	FEAT15: VNF snapshotting (VNF_PHOTO) FEAT07: Policy management framework (POLICY) FEAT04: Host reservation (HOSTRSV) FEAT10: Management of Network Services and connectivity (NFVWAN) FEAT02: VNF software modification (SWUP VNF) FEAT05: Network slicing in NFV (NFVSLICE)
ETSI GS NFV-IFA 014	V3.4.1 Old: V3.3.1 V3.2.1 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration Network Service Templates Specification	FEAT10: Management of Network Services and connectivity (NFVWAN) FEAT05: Network slicing in NFV (NFVSLICE) FEAT16: Service availability level (SAL)
ETSI GR NFV-IFA 015	V3.4.1 Old: V3.3.1 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Report on NFV Information Model	FEAT11: Management of NFV-MANO (NFV_M&Ms) FEAT15: VNF snapshotting (VNF_PHOTO) FEAT08: NFV-MANO admin domains (MANOMD) FEAT07: Policy management framework (POLICY) FEAT04: Host reservation (HOSTRSV)
ETSI GR NFV-IFA 016	V3.4.1 Old: V3.1.1	Network Functions Virtualisation (NFV) Release 3; Information Modeling; Papyrus Guidelines	See note 1.
ETSI GR NFV-IFA 017	V3.4.1 Old: V3.1.1	Network Functions Virtualisation (NFV) Release 3; Information Modeling; UML Modeling Guidelines	See note 1.

Id.	Version(s)	Title	Related feature(s)
ETSI GR NFV-IFA 024	V3.2.1	Network Functions Virtualisation (NFV) Release 3; Information Modeling; Report on External Touchpoints related to NFV Information Model	FEAT05: Network slicing in NFV (NFVSLICE)
ETSI GS NFV-TST 008	V3.3.1 Old: V3.2.1 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Testing; NFVI Compute and Network Metrics Specification	N/A (see note 2).
NOTE 1: The specification document from the previous Release has been updated into the present Release 3 by updating the guidelines used to build the Information Models present in ETSI GR NFV-IFA 015.			
NOTE 2: The specification has been updated into the present Release 3, but without outcomes of specific Release 3 features (e.g., maintenance performed in Release 2 specification versions).			

6.3 Stage 3 Group Specifications

6.3.1 Newly published Group Specifications

The newly published specifications associated to the Release 3 are listed in Table 6.3.1-1.

Table 6.3.1-1: Newly published stage 3 Group Specifications

Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-SOL 009	V3.3.1	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the management of NFV-MANO	FEAT11: Management of NFV-MANO (NFV_M&Ms)
ETSI GS NFV-SOL 010	V3.3.1	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; VNF Snapshot Package specification	FEAT15: VNF snapshotting (VNF_PHOTO)
ETSI GS NFV-SOL 011	V3.3.1	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Or-Or Reference Point	FEAT08: NFV-MANO admin domains (MANOMD)
ETSI GS NFV-SOL 012	V3.4.1	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Policy Management Interface	FEAT07: Policy management framework (POLICY)
NOTE: Versions v3.3.1 of the Group Specifications might include some aspects of maintenance performed into the v3.4.1 of ETSI GS NFV-IFA related Group Specifications.			

6.3.2 Evolved/propagated published deliverables from a previous Release

The published deliverables associated to the Release 3 that have been evolved/propagated from a previous Release are listed in table 6.3.2-1.

Table 6.3.2-1: Published stage 3 deliverables evolved/propagated from a previous Release

Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-SOL 001	V3.3.1 (see note 2)	Network Fucntions Virtualisation (NFV) Release 3; Protocols and Data Models; NFV descriptors based on TOSCA specification	FEAT02: VNF software modification (SWUP VNF) FEAT10: Management of Network Services and connectivity (NFVWAN) FEAT15: VNF snapshotting (VNF_PHOTO) FEAT16: Service availability level (SAL)
ETSI GS NFV-SOL 002	V3.3.1 (see note 2)	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Ve-Vnfm Reference Point	FEAT02: VNF software modification (SWUP VNF) FEAT15: VNF snapshotting (VNF_PHOTO)

Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-SOL 003	V3.3.1 (see note 2)	Network Functions Virtualisation (NFV) Release 3; Protocls and Data Models; RESTful protocols specification for the Or-Vnfm Reference Point	FEAT02: VNF software modification (SWUP VNF) FEAT04: Host reservation (HOSTRSV) FEAT10: Management of Network Services and connectivity (NFVWAN) FEAT15: VNF snapshotting (VNF_PHOTO)
ETSI GS NFV-SOL 004	V3.3.1	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; VNF Package and PNFD Archive specification	See note 1.
ETSI GS NFV-SOL 005	V3.3.1 (see note 2)	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Os-Ma-nfvo Reference Point	FEAT02: VNF software modification (SWUP VNF) FEAT04: Host reservation (HOSTRSV) FEAT10: Management of Network Services and connectivity (NFVWAN) FEAT15: VNF snapshotting (VNF_PHOTO)
ETSI GS NFV-SOL 006	V3.3.1 (see note 2)	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; NFV descriptors based on YANG Specification	FEAT02: VNF software modification (SWUP VNF) FEAT10: Management of Network Services and connectivity (NFVWAN) FEAT15: VNF snapshotting (VNF_PHOTO) FEAT16: Service availability level (SAL)
ETSI GS NFV-SOL 007	V3.3.1	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; Network Service Descriptor File Structure Specification	See note 1.
ETSI GS NFV-SOL 013	V3.3.1	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; Specification of common aspects for RESTful NFV MANO APIs	N/A (specifies common API matters applicable to all API specs).
NOTE 1: The specification has been updated into the present Release 3, but without outcomes of specific Release 3 features (only including e.g., maintenance performed in Release 2 specification versions). NOTE 2: Versions v3.3.1 of the listed Group Specifications might include some aspects of maintenance performed into the v3.4.1 of ETSI GS NFV-IFA related Group Specifications.			

6.4 Other Group Specifications

6.4.1 Security specifications

The newly published deliverables of Release 3 specifying security aspects are listed in table 6.4.1-1.

Table 6.4.1-1: Published deliverables related to security

Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-IFA 026	V3.4.1 Old: V3.2.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Architecture enhancement for Security Management Specification	R03.F08: Security management and monitoring for NFV (SECMM)
ETSI GS NFV-SEC 012	V3.1.1	Network Functions Virtualisation (NFV) Release 3; Security; System architecture specification for execution of sensitive NFV components	R03.F09: Secure sensitive components in NFV Framework (SEC4SNC)
ETSI GS NFV-SEC 013	V3.1.1	Network Functions Virtualisation (NFV) Release 3; Security; Security Management and Monitoring Specification	R03.F08: Security management and monitoring for NFV (SECMM)
ETSI GS NFV-SEC 014	V3.1.1	Network Functions Virtualisation (NFV) Release 3; NFV Security; Security Specification for MANO Components and Reference Points	R03.F08: Security management and monitoring for NFV (SECMM)

6.4.2 Testing specifications

The newly published deliverables of Release 3 specifying testing aspects are listed in table 6.4.2-1.

Table 6.4.2-1: Published deliverables related to testing

Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-TST 009	V3.3.1 Old: V3.2.1 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Testing; Specification of Networking Benchmarks and Measurement Methods for NFVI	R03.F12: Interoperability and conformance testing (CONF&IOP)

6.5 Newly published Group Reports

The newly published reports associated to the Release 3 are listed in Table 6.5-1.

Table 6.5-1: Newly published Group Reports

Id.	Version(s)	Title	Related feature(s)
ETSI GR NFV-EVE 012	V3.1.1	Network Functions Virtualisation (NFV) Release 3; Evolution and Ecosystem; Report on Network Slicing Support with ETSI NFV Architecture Framework	FEAT05: Network slicing in NFV (NFVSLICE)
ETSI GR NFV-IFA 021	V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Report on management of NFV-MANO and automated deployment of EM and other OSS functions	FEAT11: Management of NFV-MANO (NFV_M&Ms)
ETSI GR NFV-IFA 022	V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Report on Management and Connectivity for Multi-Site Services	FEAT10: Management of Network Services and connectivity (NFVWAN)
ETSI GR NFV-IFA 023	V3.1.1	Network Functions Virtualisation (NFV); Management and Orchestration; Report on Policy Management in MANO; Release 3	FEAT07: Policy management framework (POLICY)
ETSI GR NFV-IFA 028	V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Report on architecture options to support multiple administrative domains	FEAT08: NFV-MANO admin domains (MANOMD)
ETSI GR NFV-IFA 029	V3.3.1	Network Functions Virtualisation (NFV) Release 3; Architecture; Report on the Enhancements of the NFV architecdture towards "Cloud-native" and "PaaS"	N/A (see note)
ETSI GR NFV-REL 010	V3.1.1	Network Functions Virtualisation (NFV) Release 3; Reliability; Report on NFV Resiliency for the Support of Network Slicing	FEAT05: Network slicing in NFV (NFVSLICE)

Id.	Version(s)	Title	Related feature(s)
ETSI GR NFV-TST 005	V3.1.1	Network Functions Virtualisation (NFV); Continuous Development and Integration; Report on use cases and recommendations for VNF Snapshot	FEAT15: VNF snapshotting (VNF_PHOTO)
NOTE:	The specification has been published as part of the Release 3 work programme. However, the required specification work of the associated feature has not been fully completed as part of the Release 3, and it has been carried over to Release 4.		

6.6   Other documentation

The ETSI GS NFV 003 on "NFV; Terminology for main concepts in NFV" includes terminology used across several NFV Releases. As a result, a number of terms and acronyms used in Release 3 documentation are defined and present in the ETSI GS NFV 003. The latest published version is:

-    ETSI GR NFV 003 v1.5.1 "Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV".

The ETSI GS NFV-SOL 015 on "NFV; Protocols and Data Models; Specification of Patters and Conventions for RESTful NFV-MANO APIs" defines pattersn and conventions for RESTful NFV-MANO API specifications, gives recommendations on API versioning and provides an API specification template. This document is followed by the ETSI NFV when creating RESTful NFV-MANO API specifications. The latest published version is:

-    ETSI GS NFV-SOL 015 v1.2.1: " NFV; Protocols and Data Models; Specification of Patters and Conventions for RESTful NFV-MANO APIs".

6.7   Map of ETSI NFV specifications and the NFV Architectural Framework

NFV Release 3 documentation is, to a great extend, structured according to the NFV Architectural Framework, with some specifications mapping one to one to the reference points and functional blocks identified in the framework. Figure 6.7-1 illustrates a map of ETSI NFV specifications, reports, and ongoing work items to the NFV Architetural Framework.

-    Specifications with requirements, information models and architecture (aka Stage 1 and 2) are depicted in red,

-    Specifications and work items related to protocols and data models (aka Stage 3) are depicted in green,

-    Specifications and work items related to security enhancements are depicted in orange, and

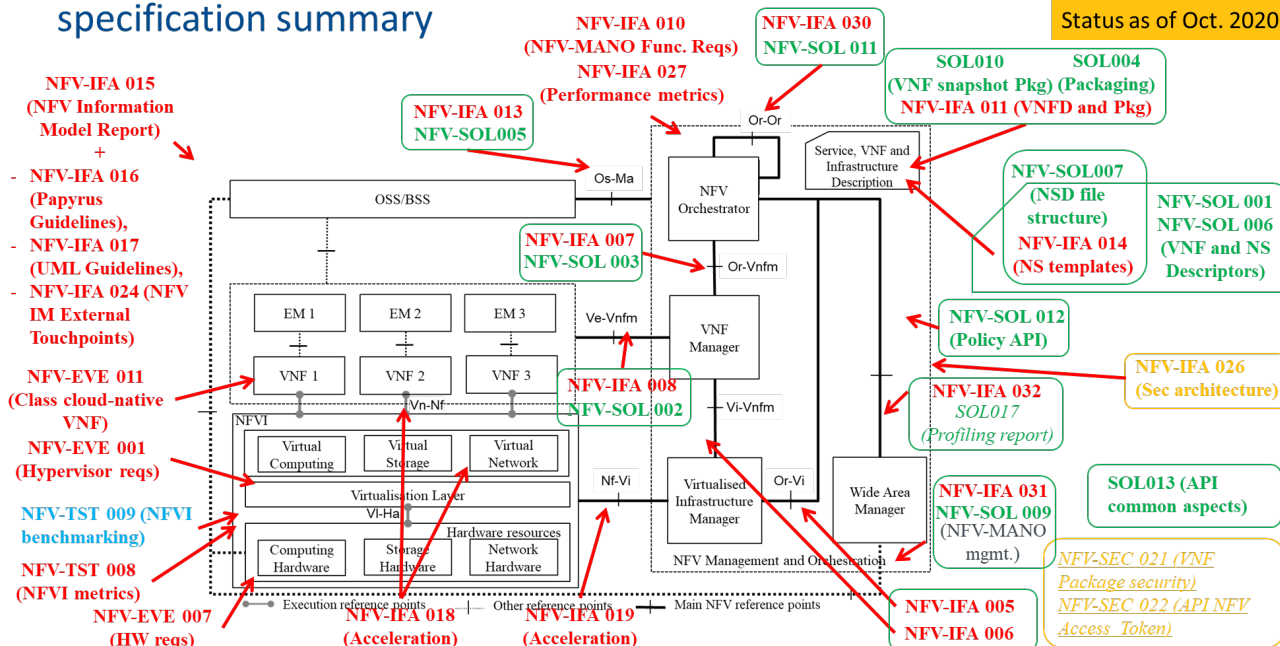-   Specifications and work items related to testing (aka Stage 4) are depicted in blue.

Figure 6.7-1: Map of ETSI NFV specifications, reports, and the NFV Architectural Framework.

7 NFV Release 3 active Work Items of unpublished deliverables

7.1 Introduction

The present clause 7 lists the active Work Items associated to the NFV Rel-3.

Clause 7.2 lists the Work Items that will produce new specifications and reports (i.e., complete new deliverables).
Clause 7.3 lists the Work Items that will produce a new version of a specification or report that has been published in a previous Release and which is evolved/propagated in order to document the needed Release 3 features.

7.2 Work Items producing new specifications or reports

The current Work Items associated to the NFV Rel-3 and that will produce new specification or reports are listed in Table 7.2-1.

NOTE: For tracking purposes, Work Items listed in Table 7.2-1 include both informative and normative work. The final list of Release-dependent deliverables will be listed within the Release Description upon publication of the deliverables..

Table 7.2-1: NFV Release 3 Work Items producing new specification or reports.

Work Item	Full Title	Type	Related Feature(s)
DGS/NFV-SEC020	Network Functions Virtualisation (NFV) Release 3; Security; Identity Management and Security Specification	Specification	R03.F23: Identity management (IDENTITY)
DGR/NFV-SOL017	Nework Functions Virtualisation (NFV) Release 3; Protocols and Data Models; Report on protocol and data model solutions for Multi-Site Connectivity Services	Report	FEAT10: Management of Network Services and connectivity (NFVWAN)

7.3 Work Items evolving/propagating NFV Rel-2 specifications and reports

A set of deliverables of NFV Rel-2 are evolved/propagated into the NFV Rel-3. The corresponding Work Items are listed in Table 7.3-1. These Work Items will produce a new version of a previously published specification or report.

Table 7.3-1: NFV Release 3 Work Items of propagated/evolved NFV Rel-2 deliverables.

Work Item	Full Title	Type	Related Feature(s)
DGS/NFV-TST010ed331	Network Functions Virtualisation (NFV) Release 3; Testing; API Conformance Testing Specification	Specification	N/A (specifies API conformance testing common to all API specs).

History

| Document history ||||
Version	Date	Changes
0.0.1	Sep. 2018	Initial draft.
0.0.2	Oct. 2018	Addition of security features and other features completed in 1H2018 by NFV-IFA (aka drop #1).
0.0.3	Nov. 2018	Implemented feedback received from feature primes and small edits.
0.1.0	Nov. 2018	First version uploaded to the ETSI NFV Portal.
0.2.0	Apr. 2019	Updates from Release 3 drop 2H2018 (aka drop #2).
0.3.0	Sep. 2019	Updates from Release 3 drop 1H2019 (aka drop #3).
0.4.0	Dec. 2019	Updates considering the completion of some stage 3 specification and documentation associated to features that are carried over to Release 4.
0.5.0	Jan. 2020	Updates after NFV#28: - Table 7.2-1: deletion of SEC019 due to approval to stop the WI at NFV#28. - Table 7.3-1: addition of TST010. - Table 5.2.8.3-1, 6.3.1-1, 7.2-1: changes to reflect the completion and publication of SOL011.
0.6.0	Jul. 2020	Updates after 1H2020 Rel. 3 stage 2 maintenance and first stage 3 drop: - Clause 4.2: update the number of documents. - Clause 5.2: update tables to add references to the stage 3 specifications in which certain features have been specified in the first stage 3 drop (v3.3.1). - Table 6.2.1-1, 6.2.2-1, 6.4.1-1: update most recent published versions to applicable documents. - Clause 6.3.2: fill in content of published documents evolved from Release 2. - Table 7.2-1: delete the IFA033 entry, since the document will be published as Release 4. - Table 7.3-1: remove entries of work items for which a first publication has been delivered. - Global: changes to refer to the FEATXX numbers, instead of the identifiers from the original Release 3 Definition, as the FEATXX numbers are more commonly used and also referred to in the SOL documents. - Added indications about the status of the stage 3 work, where applicable.
0.7.0	Nov. 2020	Updates after 1H2020 additional Rel. 3 stage 3: - Table 5.1-1: update the status of the FEAT07 on Policy management. - Table 5.2.6.3-1: add the SOL010. - Table 5.2.7.3-1: add the SOL012. - Table 6.3.1-1: add newly published SOL010 and SOL012. - Table 6.3.2-1: add a note to indicate special relationship between SOLed331 and IFAed341. - Table 6.4.2-1: update version of TST009. - Clause 6.6: new clause to provide information/references to other relevant documentation such a terminology and API guidelines. - Clause 6.7: new clause providing a mapping of the specfications and references to the scope of applicability on top of the NFV architectural framework.