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GROUP REPORT

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Foreword

This Group Report (GR) has been produced by ETSI Industry Specification Group (ISG) Network Functions Virtualisation (NFV).

Modal verbs terminology

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

1   Scope

The present document describes the NFV Release 3 and in particular its version 3.7.1. It lists and defines the features forming this release and their relation to work items. It also documents the versions of the related published specifications and reports. The present document provides an overview of version 3.7.1 and is intended to help the user as an entry point to ETSI NFV documentation.

2   References

2.1   Normative references

Normative references are not applicable in the present document.

2.2   Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1]   ETSI GS NFV 002: "Network Functions Virtualisation (NFV); Architectural Framework".

[i.2]   ETSI GR NFV 003: "Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV".

[i.3]   ETSI GS NFV 006: "Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Architectural Framework Specification".

[i.4]   ETSI Work Programme (EWP).

[i.5]   ETSI Search and Browse Standards.

[i.6]   ETSI GS NFV-PER 001: "Network Functions Virtualisation (NFV); NFV Performance & Portability Best Practises".

[i.7]   ETSI GS NFV-SOL 005: "Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Os-Ma-nfvo Reference Point ".

[i.8]   ETSI GS NFV-IFA 005: "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Or-Vi reference point - Interface and Information Model Specification".

[i.9]   ETSI GS NFV-SOL 015: "Network Functions Virtualisation (NFV); Protocols and Data Models; Specification of Patterns and Conventions for RESTful NFV-MANO APIs".

[i.10]   ETSI GS NFV-SOL 002: "Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Ve-Vnfm Reference Point".

[i.11]   ETSI GS NFV-SOL 003: "Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Or-Vnfm Reference Point".

[i.12]   ETSI GS NFV-SOL 009: "Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models: RESTful protocols specification for the management of NFV-MANO".

[i.13]   ETSI GS NFV-SOL 011: "Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Or-Or Reference Point".

[i.14]   ETSI GS NFV-SOL 012: "Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Policy Management Interface".

NOTE: The release description includes tables, figures and lists of documents to define the versions of the documents comprising the release. In these cases the documents are not listed as references in this clause.

3   Definition of terms, symbols and abbreviations

3.1   Terms

For the purposes of the present document, the terms given in ETSI GR NFV 003 [i.2] 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: 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: 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: ensemble of features of a particular release

release description: description of specification outputs delivered by the release

3.2   Symbols

Void.

3.3   Abbreviations

For the purposes of the present document, the abbreviations given in ETSI GR NFV 003 [i.2] and the following apply:

GR   Group Report
GS   Group Specification
ISG   Industry Specification Group
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, see ETSI GS NFV 006 [i.3]. 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:

- 45 Group Specifications, among which:

  - 20 new specifications.

  - 25 specifications evolved from Release 2.

- 13 Group Reports, among which:

  - 9 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, see ETSI GS NFV 002 [i.1].

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, see ETSI GS NFV 006 [i.3].

- 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).

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

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

4.4   Specification work state

Table 4.4-1 summarizes the status of the specification work at different stages. Annex B describes the meaning of the "state" of the specification work.

Table 4.4-1: Specification work state within the present Release

Stage	Meaning	State	Additional notes
Informative (stage 0)	Informative work within a Release used to study new use cases and technical features.	Closed	None.
Stages 1 and 2	Normative work: Service and business requirements Architecture, interfaces and information models.	Closed	All work within this stage has been completed. V3.7.1 is the latest published version of relevant specifications, if applicable. For more information, refer to clause 6.2.
Stage 3	Normative work on protocols and data models. Informative work on studying potential profiling of existing solutions.	Closed	The majority of the work within this stage has been completed. Remaining parts of one feature have been carried over to Release 4. See details in Table 5.1-1. V3.7.1 is the latest published version of relevant specifications, if applicable. For more information, refer to clause 6.3.
Stage 4	Normative work on testing specifications for protocols and data models.	Open	All work within this stage has been completed. V3.6.1 is the latest published version of relevant specifications, if applicable. For more information, refer to clause 6.4.2.

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 see annex D)	FEAT id (from the Definition document see clause D.6))	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	Completed.
Policy management framework	POLICY	R03.F14	FEAT07	Completed. See note 3.
NFV-MANO admin domains	MANOMD	R03.F18	FEAT08	Completed. See note 1.
Host reservation	HOSTRSV	N/A	FEAT04	Partially completed. See note 7.
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 note 2.
VNF software modification	SWUP (VNF)	R03.F10	FEAT02	Completed.
Network slicing in NFV	NFVSLICE	R03.F21	FEAT05	Completed. See note 4.
NFVI software modification	SWUP (NFVI)	R03.F10	FEAT03	Completed. See note 6.
Service availability level (SAL)	SAL	R03.F22	FEAT16	Completed. See note 1.
Enhancements support for MEC in NFV deployments See note 5.	MECinNFV	N/A	FEAT12	Completed. See note 4.
NOTE 1: The completion of the feature was realized in version V3.3.1 of the corresponding specifications.				
NOTE 2: NFV-MANO APIs and NFV Descriptors are completed. Normative profiling of "protocol and data models" for the interfaces exposed by WIM is in Release 4. See clause 5.2.10.4.				
NOTE 3: The completion of the feature was realized in version V3.4.1 of the corresponding specifications.				
NOTE 4: The completion of the feature was realized in version V3.5.1 of the corresponding specifications.				
NOTE 5: Additional enhancements related to this feature were also carried over to Release 5.				
NOTE 6: The completion of the feature was realized in version V3.6.1 of the corresponding specifications.				
NOTE 7: Host reservation is completed. Capacity management is completed except for the case of using descriptor based resource management. Normative profiling of descriptor based resource capacity management is in Release 4. See clause 5.2.9.4.				

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	Stages 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	Stages 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 acoustic 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	Stages 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 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 Management during the modification process.

5.2.6.2 Architecture scope

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

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

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

- Artefacts: VNFD, VNF snapshot package (new).

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	Stages 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	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 operations to support the VNF snapshot in the VNF LCM interface. Updates to the VNF lifecycle operation granting interface to handle snapshot resource definitions. Functional requirements for the VNF Snapshot Package Management support on the Os-Ma-nfvo reference point. Functional and information model description of the new VNF Snapshot Package Management interface.
ETSI GS NFV-IFA 008	Stage 2	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 and information model description of the 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). Addition of requirements related to VNF snapshot packages.
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 NS 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. TOSCA-based models to support the description of the information for the coordination in VNF LCM operations (also used by other features). 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. RESTful protocols and data model specification for the support on the Ve-Vnfm reference point of the new operations of the VNF LCM Coordination interface. See note.

Document Id.	Stage	Description of the feature specification
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 operations 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. YANG-based models to support the description of information used for the coordination in VNF LCM operations (also used by other features).
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, including its authenticity and integrity when artifacts are stored externally to the VNF Snapshot Package within the NFVI.
ETSI GS NFV-SOL 016	Stage 3	Specification includes NFV-MANO procedure flows, key exchanged information and procedure requirements related to VNF snapshotting features such as creation of VNF snapshots and VNF snapshot packages.

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	Stages 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.

Document Id.	Stage	Description of the feature specification
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 006	Stage 2	NFV-MANO architectural framework updated to include Or-Or reference point between NFVO in multiple administrative domains.
ETSI GS NFV-IFA 010	Stages 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.

Document Id.	Stage	Description of the feature specification
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 [i.6]) 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	Stages 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 Os-Ma-nfvo reference point of the new NFVI Capacity Information interface.
ETSI GS NFV-SOL 014	Stage 3	Adds data models and examples corresponding to Create Compute Resource Reservation operation of Virtualised Compute Resources Reservation Management Interface.

5.2.9.4   Parts carried over to Release 4

Compute host reservation is supported by query operations on capacity using the Virtualised Compute Resources Capacity Management Interface. Query operations on capacity using descriptor based resource management are not described in Release 3 but carried over to Release 4.

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, references points and artefacts:

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

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

-        Artefacts: NSD.

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 006	Stage 2	NFV-MANO architectural framework updated to integrate WIM functional block and Or-Wi reference point between NFVO and WIM.
ETSI GS NFV-IFA 010	Stages 1 and 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. Functional requirements for the WIM to support NFV-MANO management features.
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 031	Stage 2	Updates to interface requirements, interface modelling and information model to enable the management of WIM as a new managed NFV-MANO entity. Specification of applicable performance measurements related to WIM.
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.
ETSI GS NFV-SOL 009	Stage 3	Updates to APIs to enable the management of WIM as a new managed NFV-MANO entity.
ETSI GR NFV-SOL 017	Stage 3 (informative)	Profiling report of network connectivity protocols and data model solutions specified by other organizations and analysis of the extend that the solutions address the functional, interface and descriptor requirements of source stage 2 specifications.

5.2.10.4   Parts carried over to Release 4

ETSI GS NFV-SOL 019 has not progressed fast enough, as it was initially planned. Indeed, its delay impacts the official completion of the Release 3.

The following specification items have been postponed to be realized in Release 4 documentation:

- The normative profiling of the protocols and data models for the interfaces produced by the WIM about management of multi-site connectivity services on the WAN resources.

- NOTE: Other specifications in Release 3 rely on information that is exchanged over the interfaces exposed by WIM. For instance, the NS LCM API specified in ETSI GS NFV-SOL 005 [i.7] provides the capability to refer to MSCS as part of the network resources comprising NS and VNF VLs.

- Updates to the data models exposed by the VIM regarding the information and management of NFVI-PoP gateways enabling the connectivity to/from multi-site connectivity services.

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 Management during the modification process.

5.2.11.2   Architecture scope

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

- Functional blocks: NFVO, VNFM and VNF.

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

- Artefacts: VNFD.

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. TOSCA-based models to support the description of the information for the coordination in VNF LCM operations (also used by other features).
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. RESTful protocols and data model specification for the support on the Ve-Vnfm reference point of the new operations of the VNF LCM Coordination interface.
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).

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.

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

5.2.12.2   Architecture scope

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

- Functional blocks: NFVO.

- Reference points: Os-Ma-nfvo.

- Artefacts: NSD.

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.
ETSI GS NFV-SOL 001	Stage 3	Addition of a property to indicate the priority for the NS instance based on a given NS deployment flavour.
ETSI GS NFV-SOL 005	Stage 3	Addition of procedures, according to specific use cases, for NS Lifecycle Management operations that operate on NS instance resources and are triggered by task resources, with the focus on pre-emption, e.g. when realizing multiple network slices with different priorities and determined that not all resources requests can be fulfilled due to a resource shortage situation. Network slicing is accomplished by using the "priority" attribute in the NsInstance structure, the NS LCM Coordination interface and the newly specified NS LCM capacity shortage notification. RESTful protocols and data model specification for the support on the Os-Ma-nfvo reference point of the new NS LCM Coordination interface API. See note.

Document Id.	Stage	Description of the feature specification
ETSI GS NFV-SOL 006	Stage 3	Addition of a property to indicate the priority for the NS instance based on a given NS deployment flavour.
NOTE:		The NS LCM coordination interface is not explicitly coupled to the specification of the network slicing feature, but such interface is used to perform additional management interactions in some use cases arising when supporting network slicing.

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, references points and artefacts:

-    Functional blocks: VIM, VNFM, NFVO.

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

-    Artefacts: VNFD.

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 to lower the impact on VNF's service availability.
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.

Document Id.	Stage	Description of the feature specification
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 005 [i.8] 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.
ETSI GS NFV-SOL 001	Stage 3	Addition of data types to support the description of information and rules related to NFVI operation and maintenance to lower the impact on VNF's service availability.
ETSI GS NFV-SOL 002	Stage 3	Extension in the VNF fault management notifications to describe about fault types and probable causes related to NFVI maintenance.
ETSI GS NFV-SOL 003	Stage 3	Extension in the VNF fault management notifications to describe about fault types and probable causes related to NFVI maintenance.
ETSI GS NFV-SOL 006	Stage 3	Addition of data types to support the description of information and rules related to NFVI operation and maintenance to lower the impact on VNF's service availability.
ETSI GS NFV-SOL 014	Stage 3	Addition of enumeration values to indicate the type of changes on a virtualised resource, including values related to maintenance and operation of the NFVI.

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, references points and artefacts:

-    Functional blocks: NFVO.

-    Reference points: None.

-    Artefacts: NSD.

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.

5.2.15 Enhancements support for MEC in NFV deployments (MECinNFV)

5.2.15.1 Description

The feature addresses various enhancements to support how MEC can be deployed on an NFV environment, allowing to run MEC applications on the NFVI besides VNFs and re-using NFV-MANO components to perform the common management and orchestration task on the MEC applications.

5.2.15.2 Architecture scope

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

- Functional blocks: VNFM.

- Reference points: Ve-Vnfm.

- Artefacts: None.

5.2.15.3 Specification results

The feature has been specified in the specifications and reports listed in table 5.2.15.3-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.2.15.3-1: Specification results of feature "Enhancement support for MEC in NFV deployments"

Document Id.	Stage	Description of the feature specification
ETSI GS NFV-IFA 008	Stage 2	New interface exposed by the EM/VNF to support the coordination in VNF LCM operations (also used by other features).
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 of the VNF LCM Coordination interface.

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	Stages 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.

Document Id.	Stage	Description of the feature specification
ETSI GS NFV-SEC 014	Stages 1 and 2	Security requirements for the NFV-MANO functional blocks and NFV-MANO reference points.

5.4   Testing

5.4.1   API Conformance Testing

5.4.1.1   Description

This test suite provides methodologies and conformance tests including Test Descriptions for NFV implementations with interfaces specified in NFV specifications: ETSI GS NFV-SOL 002 [i.10] for the *Ve-Vnfm* reference point, ETSI GS NFV-SOL 003 [i.11] for the *Or-Vnfm* reference point and ETSI GS NFV-SOL 005 [i.7] for the *Os-Ma-Nfvo* reference point. Furthermore, the following specifications are also supported for conformance: ETSI GS NFV-SOL 009 [i.12] for the management of NFV-MANO, ETSI GS NFV-SOL 011 [i.13] for the *Or-Or* reference point and ETSI GS NFV-SOL 012 [i.14] for the policy management interface.

5.4.1.2   Architecture scope

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

- Functional blocks: VNFM, NFVO.

- Reference points: Ve-Vnfm Or-Vnfm, Os-Ma-Nfvo, Or-Or, policy management, NFV-MANO management.

- Artefacts: None.

5.4.1.3   Specification results

The feature has been specified in the specifications and reports listed in table 5.4.1.3-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.4.1.3-1: Specification results of feature "Enhancement support for MEC in NFV deployments"

Document Id.	Stage	Description of the feature specification
ETSI GS NFV-TST 010	Stage 4	API Conformance Testing Specification

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 can differ, e.g. a deliverable can be 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.

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	V3.7.1 Old: V3.6.1 V3.5.1 V3.4.1 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	V3.7.1 Old: V3.6.1 V3.5.1 V3.4.1 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)
ETSI GS NFV-IFA 032	V3.7.1 Old: V3.6.1 V3.5.1 V3.4.1 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)

Id.	Version(s)	Title	Related feature(s)
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 006	V3.6.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Architectural Framework Specification	FEAT08: NFV-MANO admin domains (MANOMD) FEAT10: Management of Network Services and connectivity (NFVWAN)
ETSI GS NFV-IFA 005	V3.7.1 Old: V3.6.1 V3.5.1 V3.4.1 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	V3.7.1 Old: V3.6.1 V3.5.1 V3.4.1 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	V3.7.1 Old: V3.6.1 V3.5.1 V3.4.1 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	V3.7.1 Old: V3.6.1 V3.5.1 V3.4.1 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) FEAT12: MEC in NFV (MECinNFV)

Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-IFA 010	V3.7.1 Old: V3.6.1 V3.5.1 V3.4.1 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	V3.7.1 Old: V3.6.1 V3.5.1 V3.4.1 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	V3.7.1 Old: V3.6.1 V3.5.1 V3.4.1 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	V3.7.1 Old: V3.6.1 V3.5.1 V3.4.1 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

Id.	Version(s)	Title	Related feature(s)
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
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-IFA 027	V3.7.1 Old: V3.6.1 V3.5.1 V3.3.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Performance Measurements Specification	N/A (see note 2)
ETSI GS NFV-TST 008	V3.5.1 Old: V3.3.1 V3.2.1 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Testing; NFVI Compute and Network Metrics Specification	N/A
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	V3.7.1 Old: V3.6.1 V3.5.1 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	V3.7.1 Old: V3.5.1 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	V3.7.1 Old: 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	V3.7.1 Old: 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 can include some aspects of maintenance performed into 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	V3.7.1 Old: V3.6.1 V3.5.1 V3.3.1 (see note 2)	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; NFV descriptors based on TOSCA specification	FEAT02: VNF software modification (SWUP VNF) FEAT03: NFVI software modification (SWUP NFVI) FEAT05: Network slicing in NFV (NFVSLICE) FEAT10: Management of Network Services and connectivity (NFVWAN) FEAT15: VNF snapshotting (VNF_PHOTO) FEAT16: Service availability level (SAL)
ETSI GS NFV-SOL 002	V3.7.1 Old: V3.6.1 V3.5.1 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) FEAT03: NFVI software modification (SWUP NFVI) FEAT12: MEC in NFV (MECinNFV) FEAT15: VNF snapshotting (VNF_PHOTO)

Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-SOL 003	V3.7.1 Old: V3.6.1 V3.5.1 V3.3.1 (see note 2)	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Or-Vnfm Reference Point	FEAT02: VNF software modification (SWUP VNF) FEAT03: NFVI software modification (SWUP NFVI) FEAT04: Host reservation (HOSTRSV) FEAT10: Management of Network Services and connectivity (NFVWAN) FEAT15: VNF snapshotting (VNF_PHOTO)
ETSI GS NFV-SOL 004	V3.7.1 Old: V3.6.1 V3.5.1 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	V3.7.1 Old: V3.6.1 V3.5.1 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) FEAT05: Network slicing in NFV (NFVSLICE) FEAT10: Management of Network Services and connectivity (NFVWAN) FEAT15: VNF snapshotting (VNF_PHOTO)
ETSI GS NFV-SOL 006	V3.7.1 Old: V3.6.1 V3.5.1 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) FEAT03: NFVI software modification (SWUP NFVI) FEAT05: Network slicing in NFV (NFVSLICE) FEAT10: Management of Network Services and connectivity (NFVWAN) FEAT15: VNF snapshotting (VNF_PHOTO) FEAT16: Service availability level (SAL)
ETSI GS NFV-SOL 007	V3.7.1 Old: V3.5.1 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	V3.7.1 Old: V3.5.1 V3.4.1 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).
ETSI GS NFV-SOL 014	V3.7.1 Old: V3.6.1 V3.5.1	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; YAML data model specification for descriptor-based virtualised resource management	FEAT03: NFVI software modification (SWUP NFVI) FEAT04: Host reservation
ETSI GS NFV-SOL 016	V3.7.1	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; NFV-MANO procedures specification	FEAT15: VNF snapshotting (VNF_PHOTO)
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 can include some aspects of maintenance performed into the V3.4.1 of ETSI GS NFV-IFA related Group Specifications.			

6.3.3   Stage 3 publication packages

As indicated in Annex A, ETSI ISG NFV publishes deliverables in rounds, also referred as "drops" or "packages". Some documents are also not re-published if no technical changes or maintenance are performed. Clause A.3.3 describes guidelines and rules related to version alignments and inter-stage relationships.

The present clause lists the "Packages" of stage 3 deliverables to guide the readers and consumers of the specifications about consistently specified sets of deliverables. In the package tables, the tag "Not republished" applies when a deliverable is not republished with a new version and a previously published version is considered to be part of the package.

Release 3 stage 3 Package 1:

Table 6.3.3-1 lists the deliverables that are part of Release 3 stage 3 Package 1 delivered during the 2020H2.

Table 6.3.3-1: Deliverables part of Release 3 stage 3 Package 1

Id.	Version	Publication date (year-month)
ETSI GS NFV-SOL 001	V3.3.1	2020-09
ETSI GS NFV-SOL 002	V3.3.1	2020-08
ETSI GS NFV-SOL 003	V3.3.1	2020-08
ETSI GS NFV-SOL 004	V3.3.1	2020-08
ETSI GS NFV-SOL 005	V3.3.1	2020-09
ETSI GS NFV-SOL 006	V3.3.1	2020-08
ETSI GS NFV-SOL 007	V3.3.1	2020-08
ETSI GS NFV-SOL 009	V3.3.1	2019-10
ETSI GS NFV-SOL 010	V3.3.1	2020-12
ETSI GS NFV-SOL 011	V3.3.1	2020-01
ETSI GS NFV-SOL 012	V3.4.1	2020-10
ETSI GS NFV-SOL 013	V3.4.1	2021-01

Package 21H1:

Table 6.3.3-2 lists the deliverables that are part of Release 3 stage 3 Package 2 delivered during the 2021H1.

Table 6.3.3-2: Deliverables part of Release 3 stage 3 Package 2

Id.	Version	Publication date (year-month)
ETSI GS NFV-SOL 001	V3.5.1	2021-07
ETSI GS NFV-SOL 002	V3.5.1	2021-07
ETSI GS NFV-SOL 003	V3.5.1	2021-07
ETSI GS NFV-SOL 004	V3.5.1	2021-05
ETSI GS NFV-SOL 005	V3.5.1	2021-09
ETSI GS NFV-SOL 006	V3.5.1	2021-07
ETSI GS NFV-SOL 007	V3.5.1	2021-06
ETSI GS NFV-SOL 009	V3.5.1	2021-06
ETSI GS NFV-SOL 010	V3.5.1	2021-07
ETSI GS NFV-SOL 011	V3.3.1	2020-01: Not republished
ETSI GS NFV-SOL 012	V3.4.1	2020-10: Not republished
ETSI GS NFV-SOL 013	V3.5.1	2021-07
ETSI GS NFV-SOL 014	V3.5.1	2021-05

Package 21H2:

Table 6.3.3-3 lists the deliverables that are part of Release 3 stage 3 Package 3 delivered during the 2021H2.

Table 6.3.3-3: Deliverables part of Release 3 stage 3 Package 3

Id.	Version	Publication date (year-month)
ETSI GS NFV-SOL 001	V3.6.1	2022-02
ETSI GS NFV-SOL 002	V3.6.1	2022-02
ETSI GS NFV-SOL 003	V3.6.1	2022-01
ETSI GS NFV-SOL 004	V3.6.1	2022-01
ETSI GS NFV-SOL 005	V3.6.1	2022-02
ETSI GS NFV-SOL 006	V3.6.1	2022-02
ETSI GS NFV-SOL 007	V3.5.1	2021-06: Not republished
ETSI GS NFV-SOL 009	V3.6.1	2022-02
ETSI GS NFV-SOL 010	V3.5.1	2021-07: Not republished
ETSI GS NFV-SOL 011	V3.3.1	2020-01: Not republished
ETSI GS NFV-SOL 012	V3.4.1	2020-10: Not republished
ETSI GS NFV-SOL 013	V3.5.1	2021-07: Not republished
ETSI GS NFV-SOL 014	V3.6.1	2022-01

Package 22H2:

Table 6.3.3-4 lists the deliverables that are part of Release 3 stage 3 Package 4 delivered during the 2022H2.

Table 6.3.3-4: Deliverables part of Release 3 stage 3 Package 4

Id.	Version	Publication date (year-month)
ETSI GS NFV-SOL 001	V3.7.1	2022-11
ETSI GS NFV-SOL 002	V3.7.1	2022-11
ETSI GS NFV-SOL 003	V3.7.1	2022-11
ETSI GS NFV-SOL 004	V3.7.1	2022-11
ETSI GS NFV-SOL 005	V3.7.1	2022-11
ETSI GS NFV-SOL 006	V3.7.1	2023-03
ETSI GS NFV-SOL 007	V3.7.1	2022-11
ETSI GS NFV-SOL 009	V3.7.1	2022-11
ETSI GS NFV-SOL 010	V3.7.1	2022-11
ETSI GS NFV-SOL 011	V3.7.1	2022-11
ETSI GS NFV-SOL 012	V3.7.1	2022-11
ETSI GS NFV-SOL 013	V3.7.1	2022-11
ETSI GS NFV-SOL 014	V3.7.1	2022-11
ETSI GS NFV-SOL 016	V3.7.1	2022-11

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 GR NFV-TST 007	V3.1.1	Network Functions Virtualisation (NFV) Release 3; Testing; Guidelines on Interoperability Testing for MANO	R03.F12: Interoperability and conformance testing (CONF&IOP) N/A (general guidelines)
ETSI GS NFV-TST 009	V3.4.1 Old: V3.3.1 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) N/A (Benchmarking)
ETSI GS NFV-TST 010	V3.6.1 Old: V3.5.1 V3.3.1	Network Functions Virtualisation (NFV) Release 3; Testing; API Conformance Testing Specification	R03.F12: Interoperability and conformance testing (CONF&IOP) N/A (specifies API conformance testing common to all API specs).

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)

Id.	Version(s)	Title	Related feature(s)
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 architecture 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)
ETSI GR NFV-SOL 017	V3.3.1	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; Report on protocol and data model solutions for Multi-site Connectivity Services	FEAT10: Management of Network Services and connectivity (NFVWAN)
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 necessary 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

ETSI GR NFV 003 [i.2] 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 GR NFV 003 [i.2]. The latest published version (2022-11) is:

-     ETSI GR NFV 003 V1.7.1 "Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV".

ETSI GS NFV-SOL 015 [i.9] on "NFV; Protocols and Data Models; Specification of Patters and Conventions for RESTful NFV-MANO APIs" defines patterns and conventions for RESTful NFV-MANO API specifications, gives recommendations on API versioning and provides an API specification template. The present 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 Architectural Framework:

- specifications with requirements, information models and architecture (as known as Stages 1 and 2) are depicted in red;

- specifications and work items related to protocols and data models (as known as Stage 3) are depicted in green;

- specifications and work items related to security enhancements are depicted in orange; and

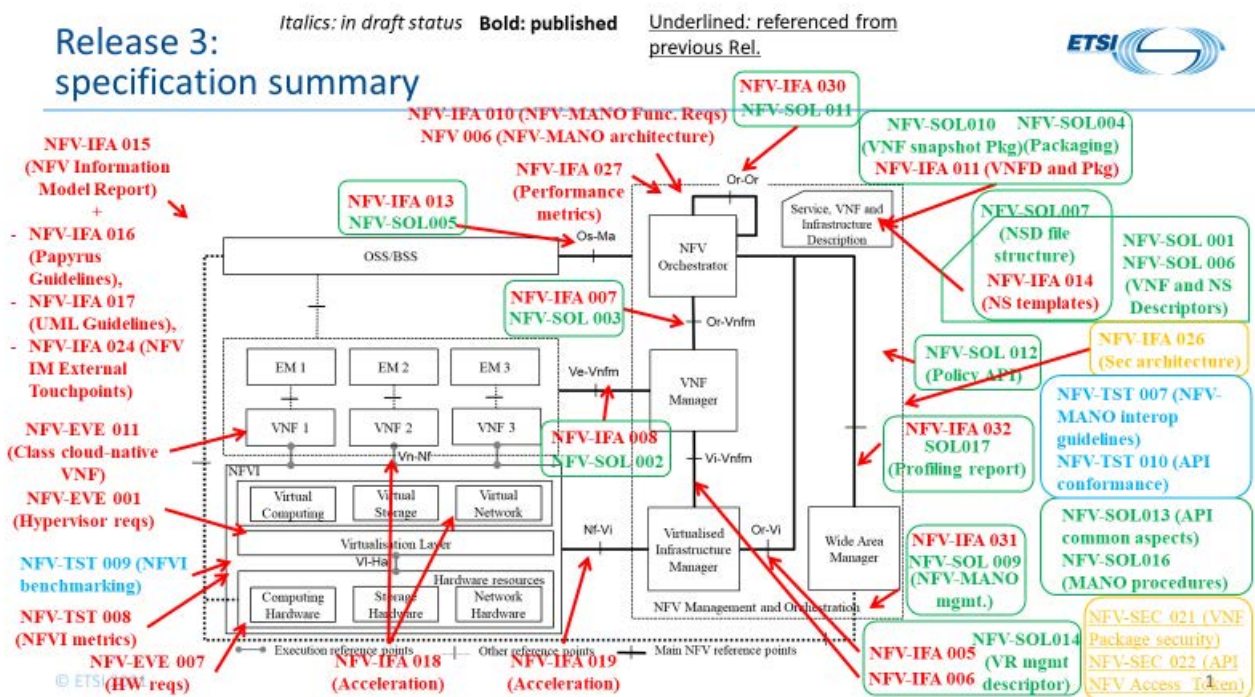- specifications and work items related to testing (as known as Stage 4) are depicted in blue.

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

7 Work Items planned for NFV Release 3 but not published as part of Release 3

Table 7-1 lists work items planned for NFV Release 3 but not published as part of Release 3.

ETSI GR NFV 007 V3.7.1 (2023-11)

Table 7-1: Work Items planned for NFV Release 3 but not published as part of Release 3

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). See note 1.
DGS/NFV-SOL019	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; Profiling specification of solutions for Multi-site Connectivity Services based on Abstraction and Control of TE Networks (ACTN)	Specification	FEAT10: Management of Network Services and connectivity (NFVWAN). See note 2.
NOTE 1: ETSI GS NFV-SEC 020 is moved to Release 5. NOTE 2: With moving part of FEAT10 to Release 4 (see details in clause 5.2.10.4), SOL019 is not published as part of Release 3.			

ETSI

Annex A:
Versioning of published deliverables

A.1   Introduction

The present Annex A provides information about the versioning of the deliverables published by the ETSI ISG NFV. The purpose is to ease the understanding about the version semantics and the alignments/relationships between published deliverables depending on their versions.

A.2   Types of specifications/reports produced by the ETSI ISG NFV

By using the Release process, the ETSI ISG NFV differentiates between four categories of deliverables:

-    **Release-dependent GS (normative) deliverable:** this is a specification that contains normative provisions and specifies features that become part of an NFV Release. By making a deliverable Release-dependent, the ISG foresees that such deliverable will be part of an NFV Release. Features are specified consistently across other NFV Release-dependent GS deliverables. The deliverables that are Release-dependent are included in the NFV Release Description.

-    **Release-independent GS (normative) deliverable:** this is a specification that contains normative provisions, but is not associated to any specific Release. This can be either because the specification was published as pre-Release (i.e. when a Release system was not established yet), or the specification is used or referred across many different Releases. A GS deliverable that is Release-independent can be included in the NFV Release Description when it is referred or directly used by some other Release-dependent deliverable(s).

-    **Release-dependent GR (informative) deliverable:** this is a report that contains informative elements used to document different aspects of a feature or set of features part of an NFV Release. For instance, it fulfils the purposes of documenting use cases and potential solutions to support the feature or set of features. The deliverables that are Release-dependent are included in the NFV Release Description.

-    **Release-independent GR (informative) deliverable:** this is a report that contains informative elements used to report about aspects of NFV that are related to features of several NFV Releases, related to future Releases, or independent of Releases. A GR deliverable that is Release-independent can be included in the NFV Release Description when it is referred or directly used by some other Release-dependent deliverable(s).

A.3   Deliverables naming and version semantics

A.3.1   Deliverables naming and numbering

All ETSI ISG NFV GS/GR deliverables follow the following naming and numbering scheme:

   ETSI GS NFV[-XXX] YYY

   ETSI GR NFV[-XXX] YYY

Where:

-    XXX: optionally identifies the working group of the ISG that has produced the deliverable;

-    YYY: stands for the chronological number from 000 to 999, which is unique within the namespace of the ISG or the working group identified by XXX;

   EXAMPLE: ETSI GS NFV-IFA 001 V1.1.1

A.3.2   Deliverables versioning

All published ISG NFV GS/GR deliverables follow a versioning scheme:

> **ETSI GS NFV[-XXX] YYY vm.a.b**

> **ETSI GR NFV[-XXX] YYY vm.a.b**

The "m.a.b" stands for the version number where:

- "m", or first digit. It identifies a major version and it is used to identify the Release number of Release-dependent deliverables. The value "m = 1" indicates that the deliverable is Release-independent and/or pre-Release (i.e. set of deliverables published when a Release system was not established yet).

- "a", or second digit. It typically stands for new publication with technical changes, which is incremented every time a (set of) technical change is introduced.

- "b", or third digit. It typically stands for an editorial version, which is incremented every time a (set of) purely editorial change is introduced. The digit is reset to "1" every time "a" is incremented.

Table A.3.2-1 summarizes the deliverable versioning "m.a.b" of published deliverables.

Table A.3.2-1: Summary deliverable versioning.

	Type of deliverable	
	Release-dependent	**Release-independent and/or pre-Release**
On first publication	"m" = Release number "a" = 1 "b" = 1 (see note 1)	"m" = 1 "a" = 1 "b" = 1
On subsequent publication after first publication	"m" = Release number "a" = incremented with (expected) technical changes. "b" = 1. (see note 2)	"m" = 1 "a" = incremented with (expected) technical changes. "b" = incremented only with editorial changes.
Specific naming guidelines	The first title uses the tag "Release #", indicating the Release to which the deliverable belongs to.	Not applicable.
NOTE 1: Due the sequencing in the specification work and the inter-stage alignment (e.g. in between stage 2 and stage 3), the second digit "a" of the first publication version can differ from the one indicated in the present table. For instance, if stage 3 specifications already target the first publication providing an alignment with specifications of stage 2 published as V3.3.1, it is recommended that the first publication version of the stage 3 equivalence is also V3.3.1 and not V3.1.1.		
NOTE 2: During drafting of subsequent versions of a published deliverable within a Release, the third digit "b" is used to track new draft versions which can include technical and/or editorials changes.		

A.3.3   Version alignments and relations

Aiming at identifying the technical alignment between specifications stages, principally stage 2 (architecture, interfaces and information model), stage 3 (protocols and data models) and stage 4 (testing), the following rules and guidelines are followed for determining the target publications versions.

Guideline #1:

As part of the Release development and while the Release feature work is still "open" within a particular specification stage, certain features or technical changes are completed first than others. Furthermore, the ETSI ISG NFV typically publishes documents twice per year. Consequently, for Release-dependent deliverables within a Release, the second digit "a" of the published version of a deliverable denotes the "drop" or publication package.

> EXAMPLE 1:   Version V3.1.1 of a published deliverable denotes the publication within "drop #1" (version digit "a = 1"). Version V3.2.1 of a published deliverable denotes the publication within "drop #2"

Guideline #2:

Inter-stages specification alignment is important for keeping traceability of requirements across the different specification stages. During the development of the technical features of a Release, different specification publication "drops" can occur. In addition, a feature that has been completed at a specific drop can also be further maintained for corrections, improvements or clarifications, whose outcomes are reflected in subsequent specification publication drops.

To show the correspondence of requirements across different specification stages, higher (or subsequent) stages (e.g. stage 3 compared to stage 2) target same publication version as lower (or prequel) stages.

EXAMPLE 2:   Table A.3.3-1 illustrates and example.

Table A.3.3-1: Example 2.

Stage 2	Stage 3
Drop #1: publications as V3.1.1 Feature #1 and #2 are completed. Feature #3 is partially completed.	No publication.
Drop #2: publications as V3.2.1 Feature #3 is completed. Feature #4 and #5 are completed. Feature #1 is updated with maintenance	**Package #A: publications as V3.2.1** Feature #1 and #3 is completed. Stage 3 aligns with requirements and maintenance done in stage 2 drop #2 of completed features in this package.
Drop #3: publications as V3.3.1 Feature #6 is completed. No more features are to be specified within the Release. Features #1, #2 and #5 are updated with maintenance.	**Package #B: publications as V3.3.1** Feature #2, #4, #5 are completed. Stage 3 aligns with requirements and maintenance done in stage 2 drop #3 of completed features in this package.
First round of full maintenance: publications as V3.4.1 Feature #1 and #6 are updated with maintenance.	**Package #C: publications as V3.4.1** Feature #6 is completed. Stage 3 aligns with requirements and maintenance done in the first round of full maintenance in stage 2.
Second round of full maintenance: publications as V3.5.1	**First round of full maintenance: publications as V3.5.1** Stage 3 aligns with requirements and maintenance done in the second round of full maintenance in stage 2.

Guideline #3:

Within a specification stage, all associated Release-dependent deliverables are expected to be published with new version as part of specification publication drops. However, in some cases a deliverable might not be re-published if no technical changes or maintenance are performed. In such a case, differences in the latest published version of a specification can occur among the set of Release-dependent deliverables.

Normative and informative cross-references among deliverables published by the ETSI ISG NFV are typically present in deliverables without specifying a concrete version, only the "Release #". In such a case, the following guideline applies:

-      If a deliverable X published with version "m.a.b" contains a reference to a deliverable Y that is published with same version "m.a.b", the applicable referenced version is thus "m.a.b" of deliverable Y.

-      If a deliverable X published with version "m.a.b" contains a reference to a deliverable Y that is not published with same version "m.a.b", the applicable reference version is the latest version published of deliverable Y. For instance, the latest published version of deliverable Y might be "m.a-1.b".

Annex B:
Release specification states

B.1   Overview

The meaning of the specification states of the specification stages is provided in table B.1-1.

Table B.1-1: Meanings of specification work states.

State	Meaning
Not started	Specification work has not started.
Open	Specification work is ongoing and the specifications/reports are being either newly created or updated to incorporate new technical features or modify existing ones.
Frozen	Specification work to incorporate new technical features or modify existing ones is completed. Only maintenance work can be performed.
Closed	Specification work is completed and the specifications are not further maintained. If corrections are necessary, these are handled on a case by case basis.

The release specification state transitions is as follows:

"Not started" → "Open" → "Frozen" → "Closed"

Release specification states are associated to the specification stages, so while a Release can be in one state at an earlier specification stage, it can be in another state at a later specification stage.

EXAMPLE: Stage 2 specification work can be "frozen" while the stage 3 specification work can be still in development, i.e. "open".

Annex C:
Release Description of predecessor Release 2

C.1 to C.3 Void

C.4   Release Description

C.4.1   Introduction

ETSI ISG NFV Release 2 (hereinafter referred also as NFV Release 2 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 does not include any architectural changes and the list of capabilities part of the Release are thus aligned with the ETSI NFV Architectural Framework, see ETSI GS NFV 002 [i.1].

NFV Release 2 is comprised of 27 normative GSs and 5 informative GRs (see clause C.5). All deliverables are available at ETSI's "Search and Browse Standards" tool [i.5].

A high-level description of the main outcomes of the NFV Release 2 are provided in clause C.4.2. Clause C.4.3 describes the capabilities that are covered in the present Release. Clause C.5 lists the published GS comprising the present Release and the active Work Items specifying the data models and interface protocols of capabilities part of the present Release.

C.4.2   High-level description

NFV Release 2 specifies requirements, information models, data models and interface protocols to enable interoperable implementations of the NFV Architectural Framework.

NFV Release 2 specifies 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, see ETSI GS NFV 006 [i.3].

- 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).

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

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

C.4.3   Release capabilities

The capabilities that comprise the NFV Release 2 are listed in Table C.4.3-1.

Table C.4.3-1: Description of Release capabilities

Capability title	Capability Id.	Description	Mapping to Architectural Framework ([i.1] and [i.3])
Management of virtualised resources	R02.CAP01	The capability supports performing the necessary operations on virtualised resources in order to instantiate and maintain VNFs during their lifecycle. The present release supports performing virtualised resource management operations to allocate, query, update, scale, migrate, operate and release virtualised resources. Change notifications related to virtualised resources is also supported. Operations are provided both in direct mode (consumer invokes directly the producer) and indirect mode (consumer invokes through an entity that is not the end producer of the capability and only applicable at the Or-Vnfm ref. point). All these operations are available for the three types of virtualised resources that can be instantiated from the NFVI, i.e. compute, storage and network resources. Specifically to network resources, the present release specifies management functions to create, query, delete, update and change the state of NFP. The present release supports the management of virtualised compute resources through "compute flavours". Operations for the management of virtualised compute flavours, including creation, query and deletion of compute flavours are also specified. The present release supports the following resource commitment methods as part of the virtualised resource management: • With reservation, where resources are committed but not allocated, including operations to create, query, update and release of resource reservations. • Quota-based, which limits number of resources used by consumers.	Functional blocks: VIM, VNFM, NFVO Reference points: Or-Vi, Vi-Vnfm, Or-Vnfm.

Capability title	Capability Id.	Description	Mapping to Architectural Framework ([i.1] and [i.3])
		On-demand, where resources are committed only when they are requested to be allocated.	
Virtualised resources information management	R02.CAP02	The capability comprises operations to retrieve information about consumable virtualised resources. The present release supports operations for the subscription and notification of resources information changes as well as the query of consumable virtualised resources information. Operations are provided both in direct mode (consumer invokes directly the producer) and indirect mode (consumer invokes through an entity that is not the end producer of the capability and only applicable to the Or-Vnfm ref. point). All these operations are available for the three types of virtualised resources that can be instantiated from the NFVI, i.e. compute, storage and network resources.	Functional blocks: VIM, VNFM, NFVO Reference points: Or-Vi, Vi-Vnfm, Or-Vnfm.
Fault and performance management of virtualised resources	R02.CAP03	The capability enables providing fault and performance information to functional blocks responsible for the lifecycle management of VNFs and NSs. The present release specifies means for monitoring virtualised resource faults, the correlation with other underlying NFVI faults and the notification of such fault events by means of subscription, or through explicit retrieval of the alarms. With respect to virtualised resource performance management, the present release specifies: • the management of PM jobs, including creation, querying and deletion of jobs; the management of performance thresholds, including creation, querying and deletion of thresholds; and • the corresponding notifications related to threshold crossing and performance information availability based on subscriptions. Operations are provided both in direct mode (consumer invokes directly the producer) and indirect mode (consumer invokes through an entity that is not the end producer of the capability and only applicable to the Or-Vnfm ref. point). Fault and performance information is available for the three types of virtualised resources that can be instantiated from the NFVI, i.e. compute, storage and network resources.	Functional blocks: VIM, VNFM, NFVO. Reference points: Or-Vi, Vi-Vnfm, Or-Vnfm.

Capability title	Capability Id.	Description	Mapping to Architectural Framework ([i.1] and [i.3])
Lifecycle management of VNFs	R02.CAP04	The capability enables the creation, maintenance and termination of VNFs. This set of functions allow managing the association of the virtualised resources throughout the lifecycle of a VNF instance and the maintenance of such association according to VNFD and runtime information. In the present release, VNF lifecycle management functions specified are the creation/deletion of VNF instance identifier, instantiation, scaling, scaling to VNF level, change of VNF deployment flavour, healing, operation of the VNF, modification and querying of VNF information, change of external VNF connectivity and termination of VNF instances. In addition, in the present release, notifications related to the state of a VNF instance as a result of changes made during lifecycle procedures, updates of VNF information attributes and creation/deletion of VNF instance identifier are also supported. Finally, the present release supports the VNF lifecycle operation granting, which allows the VNFM to request NFVO the permission to perform a lifecycle management action and its associated resource management operations. Such a capability is only supported at the Or-Vnfm reference point.	Functional blocks: VNFM, NFVO, EM, VNF. Reference points: Or-Vnfm, Ve-Vnfm-em, Ve-Vnfm-vnf.
Fault, configuration and performance management of VNFs	R02.CAP05	The present release specifies capabilities related to fault, configuration and performance management of VNFs. Fault management of VNFs enables the provisioning of VNF fault information (e.g. faults detected by the VNFM, faults generated due to changes in state of virtualised resources used by a VNF instance) to a consumer functional block. In the present release, VNF fault management supports the retrieval of on-demand fault information, alarm acknowledgement, as well as fault and alarm list rebuilt notifications by means of subscription. Escalating the perceived severity of a fault by the EM towards the VNFM is also supported. Performance management of VNFs enables the provisioning of VNF performance information. The present release specifies: the management of PM jobs, including creation, querying and deletion of jobs; the management of performance thresholds, including creation, querying and deletion of thresholds; and the corresponding notifications related to threshold crossing and performance information availability based on subscriptions. Configuration of VNFs comprises the configuration of a VNF during its lifecycle as part of lifecycle changes (e.g. instantiation, scaling, etc.) and due to explicit VNF configuration management request. In the present release, the set of configuration	Functional blocks: VNFM, NFVO, EM, VNF. Reference points: Or-Vnfm, Ve-Vnfm-em, Ve-Vnfm-vnf.

Capability title	Capability Id.	Description	Mapping to Architectural Framework ([i.1] and [i.3])
		management functions provided by VNFM are the modification of VNF instance information and VNF configurable properties and notifications due to changes in the corresponding attribute values. The VNF configuration interface produced by the VNF include operations to support setting configuration for a VNF instance. Finally, the present release specifies the interface for providing information on value changes of VNF-related indicators, including notification of value changes and retrieval of indicator values.	
Lifecycle management of Network Services	R02.CAP06	The capability enables the lifecycle management of Network Services (NS) as performed by the NFV Orchestrator and the management of related NS descriptors. With respect to NSD and PNFD management, the present release supports: • the management of NSD, including: on-boarding, enabling, disabling, updating, deleting and querying NSD; • the management of PNFD, including: on-boarding, updating, deleting and querying PNFD; and • notification of NSD on-boarding and NSD changes. With respect to NS lifecycle, the present release supports the set of functions for the creation/deletion of NS instance identifier, instantiation, scaling, healing, update (including changing NS deployment flavour), querying of information and termination of NS instances. As part of NS update, several NS LCM fine-grained sub-operations related to VNF instances part of an NS instance, service access points (SAP) and VNFFG are supported. The present release also supports other functions, such as runtime notifications related to NS instance lifecycle changes.	Functional blocks: OSS, NFVO Reference points: Os-Ma-Nfvo.

Capability title	Capability Id.	Description	Mapping to Architectural Framework ([i.1] and [i.3])
Fault and performance management of Network Services	R02.CAP07	The present release specifies capabilities related to fault and performance management of NS instances. NS fault management comprises the provisioning of fault information on NS instances, including the fault information resulting from the processing of information received from other functional blocks, as well as forwarding of fault information after correlation to the Network Service instance affected. These information facilitate the fault management operation on NSs performed by OSS. The present release specifies the function to support the retrieval of on-demand fault information, as well as fault notifications by means of subscription. NS performance management comprises the provisioning of NS-related performance information. NS metrics can be calculated from measurement results coming from the underlying layers including metrics related to network performance and resource consumption. The present release specifies: • the management of PM jobs, including creation, querying and deletion of jobs; • the management of performance thresholds, including creation, querying and deletion of thresholds; and • the corresponding notifications related to threshold crossing and performance information availability based on subscriptions.	Functional blocks: OSS, NFVO Reference points: Os-Ma-Nfvo
Package and software image management	R02.CAP08	The capability concerns to end-to-end view of the VNF package lifecycle, from design to runtime, including the necessary lifecycle management operations. The present release specifies requirements related to VNF Packaging and VNF package management functions to enable on-boarding, querying, fetching, fetching of VNF Package artifacts, enabling, disabling, deleting and aborting deletion of VNF packages. It also supports the notifications for VNF Package on-boarding and management changes. With respect to VNF software image management, the present release supports the set of functions that enable adding, deleting, updating, querying and copying a software image in the image repository controlled by the VIM(s).	Functional blocks: OSS, NFVO, VNFM, VIM. Reference points: Os-Ma-Nfvo, Or-Vnfm, Or-Vi, Vi-Vnfm.

Capability title	Capability Id.	Description	Mapping to Architectural Framework ([i.1] and [i.3])
VNF Descriptor - VNF information modelling	R02.CAP09	The capability concerns to the specification of VNFD. The present release specifies the attributes and information elements part of the VNFD, including: • VNF metadata; • Virtualisation Deployment Unit (VDU) of a VNF Component (VNFC); • Internal VNF Virtual Links; • Virtual compute, storage and network resources requirements; • VNF external Connection Points (CP); • configurable properties and modifiable attributes; • VNF indicators and monitoring parameters; • VNF deployment flavours; and • VNF lifecycle management scripts.	Functional blocks: NFVO, VNFM. Reference points: Or-Vnfm.
Network Service descriptors - NS information modelling	R02.CAP10	The capability concerns to the specification of NSD. The present release specifies the attributes and information elements part of an NSD and contained in the NSD that reference other descriptors, including: • NS metadata, deployment flavour, monitoring information and lifecycle management scripts, • SAP Descriptor (SAPD), • VL Descriptor (VLD) and deployment flavour, • VNFD, • VNFFG Descriptor (VNFFGD), • Physical Network Function Descriptor (PNFD); and • NFP Descriptor (NFPD).	Functional blocks: OSS, NFVO Reference points: Os-Ma-Nfvo
Virtualised resources capacity management	R02.CAP11	This capability enables the capture of information about resources usage and input to capacity planning, capacity changes and consequently for Network Service planning. The present release supports functions to retrieve information about the total capacity of the resources managed by a VIM instance, the consumable capacity available for new virtualised resources and the utilization of the capacity, both on VIM global level and per resource zone. In the present release, both on-demand retrieval of capacity information and information from notifications through subscription are supported.	Functional blocks: VIM, NFVO Reference points: Or-Vi

Capability title	Capability Id.	Description	Mapping to Architectural Framework ([i.1] and [i.3])
Hardware-independent acceleration	R02.CAP12	This capability comprises the functions to enable the implementation of high-performance VNFs ensuring the decoupling of VNF software from underlying acceleration resources. The present release specifies functional requirements for VIM and NFVI for NFV acceleration from an infrastructure management perspective, including the controlling and management of acceleration resources. The present release also specifies requirements for abstract interfaces enabling a VNF to leverage acceleration services from the infrastructure. It also provides an acceleration architectural model. The present release specifies performance benchmarking metrics for virtual switching achieved through virtual switch acceleration and associated requirements.	Functional blocks: NFVI, VIM, NFVO, VNFM. Reference points: Nf-Vi, Vi-Vnfm, Or-Vi.

C.5 Release Group Specifications

C.5.1 Published deliverables

The present clause lists the deliverables (Group Specifications and Group Reports) that form the NFV Release 2. The NFV Release 2 is comprised of multiple specification and reports, which can be categorized according to different specification stages (Stage 1, Stage 2, etc.) and provisions 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.

Table C.5.1-1 lists the published GSs that comprise the NFV Release 2 and the addressed capabilities and that provide the specification of requirements, architecture, interfaces and information models (Stage 1 and Stage 2).

Table C.5.1-1: List of GSs specifying requirements and information models that comprise the NFV Release 2

GS Id. & version	Old versions	Full title	Addressed capabilities(s)
ETSI GS NFV 006 V2.1.1	n/a	Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; NFV-MANO Architectural Framework Specification	N/A (specification of architectural aspects)
ETSI GS NFV-IFA 002 V2.4.1	V2.3.1 V2.1.1	Network Functions Virtualisation (NFV) Release 2; Acceleration Technologies; VNF Interfaces Specification	R02.CAP12
ETSI GS NFV-IFA 003 V2.4.1	V2.3.1 V2.1.1	Network Functions Virtualisation (NFV) Release 2; Acceleration Technologies; vSwitch Benchmarking and Acceleration Specification	R02.CAP12

GS Id. & version	Old versions	Full title	Addressed capabilities(s)
ETSI GS NFV-IFA 004 V2.4.1	V2.3.1 V2.1.1	Network Functions Virtualisation (NFV) Release 2; Acceleration Technologies; Management aspects Specification	R02.CAP12
ETSI GS NFV-IFA 005 V2.7.1	V2.5.1 V2.4.1 V2.3.1 V2.1.1	Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Or-Vi reference point - Interface and Information Model Specification	R02.CAP01 R02.CAP02 R02.CAP03 R02.CAP08 R02.CAP11
ETSI GS NFV-IFA 006 V2.7.1	V2.5.1 V2.4.1 V2.3.1 V2.1.1	Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Vi-Vnfm reference point - Interface and Information Model Specification	R02.CAP01 R02.CAP02 R02.CAP03 R02.CAP08
ETSI GS NFV-IFA 007 V2.7.1	V2.5.1 V2.4.1 V2.3.1 V2.1.1	Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Or-Vnfm reference point - Interface and Information Model Specification	R02.CAP04 R02.CAP05 R02.CAP08
ETSI GS NFV-IFA 008 V2.7.1	V2.5.1 V2.4.1 V2.3.1 V2.1.1	Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Ve-Vnfm reference point - Interface and Information Model Specification	R02.CAP04 R02.CAP05
ETSI GS NFV-IFA 010 V2.7.1	V2.5.1 V2.4.1 V2.3.1 V2.2.1 V2.1.1	Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Functional requirements specification	R02.CAP01 R02.CAP02 R02.CAP03 R02.CAP04 R02.CAP05 R02.CAP06 R02.CAP07 R02.CAP08 R02.CAP11 R02.CAP12
ETSI GS NFV-IFA 011 V2.7.1	V2.6.1 V2.5.1 V2.4.1 V2.3.1 V2.1.1	Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; VNF Descriptor and Packaging Specification	R02.CAP08 R02.CAP09
ETSI GS NFV-IFA 013 V2.7.1	V2.5.1 V2.4.1 V2.3.1 V2.1.1	Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Os-Ma-Nfvo reference point - Interface and Information Model Specification	R02.CAP06 R02.CAP07 R02.CAP08
ETSI GS NFV-IFA 014 V2.7.1	V2.6.1 V2.5.1 V2.4.1 V2.3.1 V2.1.1	Network Functions Virtualisation (NFV) Release 2; Management and Orchestration Network Service Templates Specification	R02.CAP10
ETSI GS NFV-IFA 027 V2.4.1	N/A	Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Performance Measurements Specification	R02.CAP03 R02.CAP05 R02.CAP07
ETSI GS NFV-TST 008 V2.5.1	V2.4.1 V2.1.1	Network Functions Virtualisation (NFV) Release 2; Testing; NFVI Compute and Network Metrics Specification	R02.CAP03

Table C.5.1-2 lists the published GS that are also part of the NFV Release 2 and specify the data models and interface protocols (Stage 3) corresponding to NFV Release 2 capabilities.

**Table C.5.1-2: List of GSs that specify data models and
interface protocols corresponding to NFV Release 2 capabilities**

GS Id. & version	Old versions	Full Title	Associated Stage 2 GS	Addressed capabilities(s)
ETSI GS NFV-SOL 001 V2.8.1	V2.7.1 V2.6.1 V2.5.1	Network Functions Virtualisation (NFV) Release 2; Protocols and Data Models; NFV Descriptors based on TOSCA	ETSI GS NFV-IFA 011 and ETSI GS NFV-IFA 014	R02.CAP09 R02.CAP10
ETSI GS NFV-SOL 002 V2.8.1	V2.7.1 V2.6.1 V2.5.1 V2.4.1 V2.3.1	Network Functions Virtualisation (NFV) Release 2; Protocols and Data Models; RESTful protocols specification for the Ve-Vnfm Reference Point	ETSI GS NFV-IFA 008	R02.CAP04 R02.CAP05
ETSI GS NFV-SOL 003 V2.8.1	V2.7.1 V2.6.1 V2.5.1 V2.4.1 V2.3.1	Network Functions Virtualisation (NFV) Release 2; Protocols and Data Models; RESTful protocols specification for the Or-Vnfm Reference Point	ETSI GS NFV-IFA 007	R02.CAP04 R02.CAP05 R02.CAP08
ETSI GS NFV-SOL 004 V2.8.1	V2.7.1 V2.6.1 V2.5.1 V2.4.1 V2.3.1	Network Functions Virtualisation (NFV) Release 2; Protocols and Data Models; VNF Package and PNFD Archive specification	ETSI GS NFV-IFA 011	R02.CAP08 R02.CAP09
ETSI GS NFV-SOL 005 V2.8.1	V2.7.1 V2.6.1 V2.5.1 V2.4.1	Network Functions Virtualisation (NFV) Release 2; Protocols and Data Models; RESTful protocols specification for the Os-Ma-nfvo Reference Point	ETSI GS NFV-IFA 013	R02.CAP06 R02.CAP07 R02.CAP08
ETSI GS NFV-SOL 006 V2.8.1	V2.7.1 V2.6.1	Network Functions Virtualisation (NFV) Release 2; Protocols and Data Models; NFV Descriptors based on YANG Specification	ETSI GS NFV-IFA 011 and ETSI GS NFV-IFA 014	R02.CAP09 R02.CAP10
ETSI GS NFV-SOL 007 V2.8.1	V2.7.1 V2.6.1 V2.5.1	Network Functions Virtualisation (NFV) Release 2; Protocols and Data Models; Network Service Descriptor File Structure Specification	ETSI GS NFV-IFA 014	R02.CAP10
ETSI GS NFV-SOL 013 V2.8.1	V2.7.1 V2.6.1	Network Functions Virtualisation (NFV) Release 2; Protocols and Data Models; Specification of common aspects for RESTful NFV-MANO APIs	N/A	N/A (specification of common API aspects)
ETSI GS NFV-SOL 014 V2.8.1	N/A	Network Functions Virtualisation (NFV) Release 2; Protocols and Data Models; YAML data model specification for descriptor-based virtualised resource management	ETSI GS NFV-IFA 005 and ETSI GS NFV-IFA 006	R02.CAP01 R02.CAP02
ETSI GS NFV-SOL 016 V2.8.1	N/A	Network Functions Virtualisation (NFV) Release 2; Protocols and Data Models; NFV-MANO procedures specification	N/A	Many capabilities (specification of NFV-MANO procedures)

Table C.5.1-3 lists the Group Reports (GRs) that are also part of the NFV Release 2. GRs are of informative nature and complement the normative specification(s) with additional information.

NOTE 2: For any discrepancy on a specific aspect or specified feature between a GR and GS, the GS takes precedence.

Table C.5.1-3: List of GRs that comprise the NFV Release 2

GR Id. & version	Old versions	Full title	Description
ETSI GR NFV-IFA 015 V2.5.1	V2.4.1 V2.3.1 V2.1.2	Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Report on NFV Information Model	The NFV-IFA 015 provides an overall information model view taking as input the interface and information elements specified in the descriptor and interface specifications.
ETSI GR NFV-IFA 016 V2.5.1	V2.4.1 V2.1.1	Network Functions Virtualisation (NFV) Release 2; Information Modeling; Papyrus Guidelines	The NFV-IFA 016 provides the guidelines for the development of a protocol-neutral Unified Modeling Language (UML) information model for ETSI NFV based on Papyrus and it used by ETSI NFV when building the NFV information model.
ETSI GR NFV-IFA 017 V2.5.1	V2.4.1 V2.1.1	Network Functions Virtualisation (NFV) Release 2; Information Modeling; UML Modeling Guidelines	The NFV-IFA 017 provides the guidelines for the development of a protocol-neutral Unified Modeling Language (UML) information model for ETSI NFV.
ETSI GR NFV-IFA 024 V2.1.1	N/A	Network Functions Virtualisation (NFV) Release 2; Information Modeling; Report on External Touchpoints related to NFV Information Model	The NFV-IFA 024 defines the touchpoints/relations between the NFV Information Model (see NFV-IFA 015) and the models from other organisations including: ONF, 3GPP and TM Forum.
ETSI GR NFV-TST 007 V2.6.1	V2.5.1 V1.1.1	Network Functions Virtualisation (NFV) Release 2; Testing; Guidelines on Interoperability Testing for MANO	Testing aspects of other specified capabilities.

Table C.5.1-4 lists the GSs that are also part of the NFV Release 2 and specify additional requirements related to security aspects corresponding to NFV Release 2 capabilities.

**Table C.5.1-4: List of GSs specifying requirements related to
security aspects corresponding to NFV Release 2 capabilities**

GS Id. & version	Old versions	Full Title	Addressed capabilities(s)
ETSI GS NFV-SEC 021 V2.6.1	N/A	Network Functions Virtualisation (NFV) Release 2; Security; VNF Package Security Specification	R02.CAP08 R02.CAP09 Security aspects of other specified capabilities.
ETSI GS NFV-SEC 022 V2.8.1	V2.7.1 V2.6.1	Network Functions Virtualisation (NFV) Release 2; Security; Access Token Specification for API Access	Security aspects of other specified capabilities.

Table C.5.1-5 lists the GS that specify testing aspects and conformance corresponding to NFV Release 2 capabilities.

**Table C.5.1-5: List of GSs specifying requirements related to
testing corresponding to NFV Release 2 capabilities**

GS Id. & version	Old versions	Full Title	Addressed capabilities(s)
ETSI GS NFV-TST 010 V2.8.1	V2.7.1 V2.6.1 V2.4.1	Network Functions Virtualisation (NFV) Release 2; Testing; API Conformance Testing Specification	Testing aspects of other specified capabilities.

ETSI GR NFV 003 [i.2] 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 2 documentation are defined and present in the ETSI GR NFV 003 [i.2]. The latest published version is:

- ETSI GR NFV 003 V1.6.1 "Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV".

ETSI GS NFV-SOL 015 [i.9] on "NFV; Protocols and Data Models; Specification of Patters and Conventions for RESTful NFV-MANO APIs" defines patterns 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".

C.5.2 Map of ETSI NFV specifications and the NFV Architectural Framework

NFV Release 2 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 C.5.2-1 illustrates a map of ETSI NFV specifications, reports and ongoing work items to the NFV Architectural Framework:

- specifications with requirements, information models and architecture (as known as Stages 1 and 2) are depicted in red;

- specifications and work items related to protocols and data models (as known as 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 (as known as Stage 4) are depicted in blue.
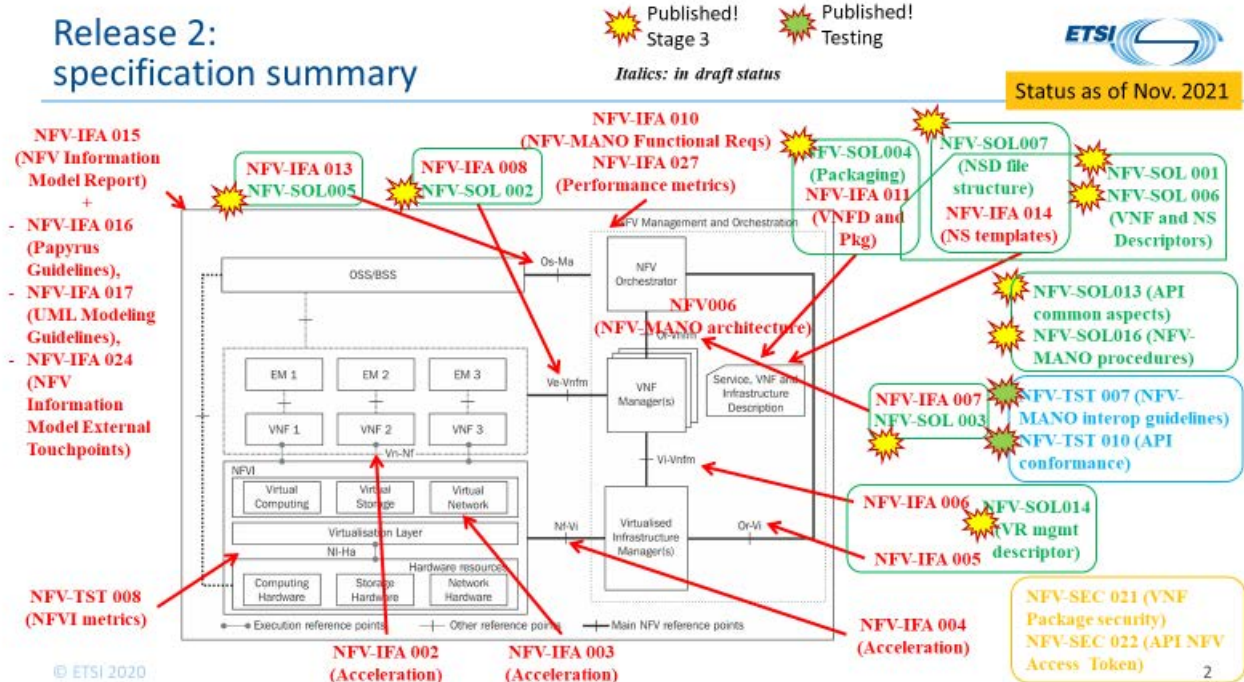
Figure C.5.2-1: Map of ETSI NFV specifications, reports and the NFV Architectural Framework

C.6   Release associated active work items

C.6.1   Introduction

Clause C.6 lists the active work items from which Release 2 specifications or reports will be delivered.

> NOTE: The list of work items does not reflect those specifications that have already been published once and are currently under maintenance, unless the previous published version had been Release independent, i.e. not associated to a specific Release.

C.6.2   Active work items

Table C.6.2-1 lists the Work Items that will specify architecture requirements, information model and interfaces (Stage 2) corresponding to NFV Release 2 capabilities.

> NOTE 1:   The deliverables that will result from the Work Items listed in Table C.6.2-1 will be published at a later time once the specification work has been completed.

Table C.6.2-1: List of Work Items specifying additional information model and interfaces corresponding to NFV Release 2 capabilities

Work Item Id.	Full Title	Addressed capabilities(s)
None	None	None

Table C.6.2-2 lists the active Work Items that will specify the data models and interface protocols (Stage 3) corresponding to NFV Release 2 capabilities.

> NOTE 2:   The deliverables that will result from the Work Items listed in Table C.6.2-2 will be published at a later time once the specification work has been completed.

**Table C.6.2-2: List of Work Items specifying data models and
interface protocols corresponding to NFV Release 2 capabilities**

Work Item Id.	Full Title	Associated Stage 2 GS	Addressed capabilities(s)
None	None	None	None

Table C.6.2-3 lists the Work Items that will specify additional requirements related to security aspects corresponding to NFV Release 2 capabilities.

NOTE 3: The deliverables that will result from the Work Items listed in Table C.6.2-3 will be published at a later time once the specification work has been completed.

**Table C.6.2-3: List of Work Items specifying additional requirement related to
security aspects corresponding to NFV Release 2 capabilities**

Work Item Id.	Full Title	Addressed capabilities(s)
None	None	None

Table C.6.2-4 lists the Work Items that will specify testing aspects and conformance corresponding to NFV Release 2 capabilities.

NOTE 4: The deliverables that will result from the Work Items listed in Table C.6.2-4 will be published at a later time once the specification work has been completed.

**Table C.6.2-4: List of Work Items specifying additional requirement related to
testing corresponding to NFV Release 2 capabilities**

Work Item Id.	Full Title	Addressed capabilities(s)
None	None	None

Annex D:
Definition of the Release 3 at its beginning

D.1 to D.3 Void

D.4 Release Definition

D.4.1 Introduction

ETSI ISG NFV Release 3 (hereinafter referred also as NFV Release 3) will build on top of already published Group Specification deliverables [i.4] and cover additional Features identified by the ISG. The complete set of Features, capabilities and functions supported by NFV Release 3 will be described in the Release Description, once the work in NFV Release 3 is finalized.

NFV Release 3 Definition is composed of 23 Features, including 20 new Features and 3 additional features carried over from functionality identified in the NFV Release 2 Definition.

NOTE: The NFV Release 3 Definition lists all the features that have been developed or are currently under development at a certain point in time. The final set of features, capabilities and functions supported by NFV Release 3 will be described in the Release 3 Description document, to be available at a later time.

The main objectives of NFV Release 3 are described in clause D.4.2. Clause D.4.3 describes the new and extended Features that are defined for NFV Release 3. Clause D.4.4 lists the Work Items of the present Release linking to the Features they derive from. Finally, clause D.4.5 lists the work items that have been completed and the published specifications and reports.

D.4.2 Objectives

NFV Release 3 work is defined in the present document to address the following main objectives:

- To specify core information model for NFV, including further development of related NS and VNF descriptors.

- To specify requirements and interfaces to support charging, billing and accounting in NFV.

- To specify requirements and framework applicable to policy distribution and general policy description in VNF and NS Descriptors.

- To specify requirements and enhancements on (existing) interfaces and information models to enable automated deployment of element management and other OSS functions.

- To specify requirements, procedures and enhancements on (existing) interfaces and information models to support management of NFV-MANO functions.

- To specify functional requirements for WIM and requirements on associated reference points, including enhancements to relevant information models and interfaces.

- To specify information model and interfaces to support network acceleration to be transparent to VNF.

- To specify the requirements and interface information models for the support of hardware-independent acceleration.

- To specify requirements for security sensitive components in the NFV framework.

- To specify requirements and enhancements on (existing) functional blocks, reference points and interfaces for security monitoring management.

- To specify requirements of update/upgrade controlling functions to support the update and upgrade of NFV software components in an NFV context (or environment), e.g. a VNF.

- To specify requirements, procedures and enhancements on interfaces and information models to support VNF snapshots.

- To develop interoperability test descriptions to support NFV Plugtests.

- To specify requirements to enable interoperability of equipment in the telecommunications environment to support NFV deployment.

- To specify requirement to support lawful interception and critical national infrastructures in an NFV environment.

- To specify requirements related to orchestration and lifecycle management of application and service with and end-to-end view on top of NS.

- To specify the requirements for the usage of Hypervisor based virtualisation and stand-alone vSwitch.

- To specify requirements and enhancements to NFV Architectural Framework to support NFV license management.

- To specify requirements and enhancements to NFV Architectural Framework to support NFV-MANO services across multiple administrative domains.

- To specify requirements and enhancements to NFV Architectural Framework to support PaaS features.

- To specify non-functional parameters to classify and characterize VNF cloud-native implementations.

- To specify requirements and enhancements to NFV Architectural Framework to support Network Slicing use cases.

- To specify vendor-agnostic definitions of performance metrics and the associated methods of measurement for benchmarking network supported in the NFVI.

- To specify requirements to enable development of necessary architectural mechanisms in support of service reliability and availability.

- To specify requirements to secure VNF identity management and trust relationships.

D.4.3   Release content

D.4.3.1   NFV Release 3 Features

The Features that comprise the NFV Release 3 Definition are listed in Table D.4.3.1-1.

Table D.4.3.1-1: Description of Release capabilities

Feature Title (and Acronym)	NFV Release 3 Id	Description and Scope	Mapping to Architectural Framework ([i.1] and [i.3])	Traceability
NFV Information Model (IM-NFV)	R03.F01	Consolidation and extension of current information model with a top-down approach independently for the various GS(s). The feature scope encompasses: • Specification of a VNF and NS logical model, with VNFD and NSD being deployment views of them. See note 1.	Descriptors: Service, VNF and Infrastructure Description.	Feature proposal: FTR001 Extension of ETSI GS NFV-IFA 015.

Feature Title (and Acronym)	NFV Release 3 Id	Description and Scope	Mapping to Architectural Framework ([i.1] and [i.3])	Traceability
Charging, billing and accounting for NFV (CHRG)	R03.F02	Framework for charging, billing and accounting for NFV. The feature scope encompasses: • Identification of use cases to determine support of charging and billing. • Specification of requirements from the set of use cases. • Identification of possible solutions to determine what type of usage information needs to be collected and various interaction points in between existing or new functional blocks. Specification of interfaces to support the agreed identified solution(s). This will include the definition of new interfaces or update of existing interfaces.	Functional blocks: TBD. Reference points: TBD.	Feature proposal: FTR002.
Automated deployment of element management and other OSS functions (VEMOSS)	R03.F03	Automated deployment of element management functions and other OSS functions. The feature scope encompasses: • Study and clarification of the concept of element management functions and service-dependent OSS functions. • Report on deployment options and recommendations on preferred options. Specification of requirements and enhancements on (existing) interfaces and information models to enable automated deployment of element management functions and other OSS functions.	Functional blocks: EM, OSS/BSS. Reference points: Os-Ma-nfvo, Ve-Vnfm-em.	Feature proposal: FTR013.
Management of NFV-MANO (NFV_M&Ms)	R03.F04	Enable the management of the NFV Management and Orchestration functional blocks identified by the NFV Architectural Framework, including: update of NFV-MANO functions, configuration of NFV-MANO functions, automate the deployment and decommission of NFV-MANO functions and manage aspects of reliability for NFV-MANO functions. The feature scope encompasses: • Definition of use case(s) to determine the scope of management tasks to support. • Specification of requirements to support the determined use cases. • Definition of end-to-end management and orchestration procedures. Specification of enhancements on existing interfaces or new interfaces and information models to support the required management tasks.	Functional blocks: NFVO, VNFM, VIM. Reference points: none new.	Feature proposal: FTR017.

Feature Title (and Acronym)	NFV Release 3 Id	Description and Scope	Mapping to Architectural Framework ([i.1] and [i.3])	Traceability
Management of Network Services and connectivity (NFVWAN)	R03.F05	NFVWAN encompasses the deployment and management of network services that require connectivity across one or more WANs and the implications for the NFVI to provide required network service endpoints. The feature scope encompasses: • Identification of use cases and scenarios for network services distributed across one or more WAN(s) and the constraints and context to be considered when deploying these network services. Evaluate the implications for NFV of running on WAN legacy, SDN and hybrid infrastructures. • Description of architectural options for the management and operations of services across WAN(s) and identifying the roles and responsibilities of the management functional blocks. Describe how Network Services and their components (e.g. VNFG, virtual links, etc.) map to the underlying PoP and WAN infrastructures, including VNF, PNF and PoP/WAN gateways, overlays, etc. • Specification of requirements for WIM and associated reference points. Specification of enhancements to relevant information models and interfaces.	Functional blocks: NFVO, WIM (network). Reference points: Os-Ma-nfvo, Or-Vi.	Feature proposal: FTR030.
Service Orchestration and Network Service Orchestration (NFVO_ARCH)	R03.F06	Voided	Voided.	Feature proposal: FTR010. Extension of ETSI GS NFV-IFA 009. Feature voided due to stopping the DGR/NFV-IFA020 work item approval at NFV#19.
Network Acceleration for VNF (FASTSWITCH)	R03.F07	Interaction (e.g. API(s)) between the virtualization layer and switching accelerator drivers, to enable network acceleration to be transparent VNF (independent of accelerator vendor and type). The feature scope encompasses: • Definition of the problem statement for the support of API and analysis of placement in the NFVI. • Identification of function types of APIs, e.g. switch, route, VLAN, VXLAN, etc. Specification of the information model and interfaces.	Functional blocks: NFVI, VIM. Reference points: Vn-Nf, Nf-Vi.	Feature proposal: FTR035. Extension of ETSI GS NFV-IFA 003.

Feature Title (and Acronym)	NFV Release 3 Id	Description and Scope	Mapping to Architectural Framework ([i.1] and [i.3])	Traceability
Security management and monitoring for NFV (NFV_SEC)	R03.F08	Security management and monitoring for NFV for establishment of holistic security policies, coherent enforcement of the policies and security monitoring across the lifecycle of the end-to-end network service in both virtualized and legacy networks. The feature scope encompasses: • Definition of use cases for NFV Security Management across planning, enforcement and monitoring targeting at holistic security policies and functions. • Specification of requirements and workflows for NFV Security Management. Specification of enhancements to current NFV Architectural Framework (functional blocks and reference points) based on derived requirements and workflows.	Functional blocks: NFVO, VNFM, VIM and SM (new). Reference points: Or-Vnfm, Vi-Vnfm, Or-Vi and new Sc-Vi, Sc-Vnfm and Sc-Or.	Feature proposal: FTR003. Extension of ETSI GS NFV-SEC 009.

Secure sensitive components in NFV Framework (SEC4SNC)	R03.F09	Secure sensitive components in the NFV framework.
		The feature scope encompasses:
		• Providing guidance on:
		  − Securing hosts on which sensitive components will be hosted.
		  − Securing the broader context in which sensitive components will be hosted.
		  − Physical, logical and operational measures related to securing sensitive components.
		  − Provisioning and de-provisioning sensitive components.
		Specification of requirements for sensitive components.
			Functional blocks: NFVI, VNF.
			
			Reference points: Vn-Nf.
				Feature proposal: FTR003.
				
				NWI NFV(17)000245r4

Updated and upgrade of NFV software (SWUP)	R03.F10	Update and upgrade of NFV software components in an NFV context (or environment), e.g. a VNF. The feature scope encompasses: • Identification of the required set of update/upgrade controlling functions to facilitate software updates/upgrades. Specification of requirements for software update/upgrade controlling functions.	Functional blocks: VNF, NFVO, VNFM, VIM, NFVI. Reference points: N/A.	Feature proposal: FTR019.

Feature Title (and Acronym)	NFV Release 3 Id	Description and Scope	Mapping to Architectural Framework ([i.1] and [i.3])	Traceability
VNF snapshotting (VNF_PHOTO)	R03.F11	Creation and use of VNF snapshots. The feature scope encompasses: • Definition of use case(s) to determine the usage of VNF snapshots and study under what conditions the capture of VNFC snapshots and VNF data can be performed. • Specification of requirements for the support of VNF/VNFC snapshots. • Definition of end-to-end orchestration procedures for VNF snapshot, providing an overall framework supporting the capture of VNF information and VNFC snapshots. Specification of enhancements on interfaces and information models to support VNF snapshots.	Functional blocks: VNF, VNFM, VIM. Reference points: Ve-Vnfm-em/vnf, Or-Vnfm, Vi-Vnfm.	Feature proposal: FTR016.
Interoperability, conformance testing and benchmarking (CONF&IOP)	R03.F12	The feature scope encompasses: • Development of Interoperability Test Descriptions to support NFV Plugtests. • Study and report on Conformance Testing Methodology for NFV. Specification of vendor-agnostic definitions of performance metrics and the associated methods of measurement for benchmarking networks supported in the NFVI.	Functional blocks: NFVO, VNFM, VIM, NFVI, VNF. Reference points: Os-Ma-nfvo, Or-Vnfm, Vi-Vnfm, Or-Vi, Ve-Vnfm, Nf-Vi.	Feature proposal: FTR031. NWI NFV(17)000123r1.
Hardware Environment for NFV (HWENV)	R03.F13	Interoperable hardware ecosystem and telecommunications physical environment to support NFV deployment. The feature scope encompasses: • Identification of situations where de-facto standard data centre equipment is not suitable for deployment in the telecommunications environment to support NFV deployment. • Specification of requirements to enable interoperability of equipment in the telecommunications environment to support NFV deployment. Focus areas in: operating environmental, mechanical, baseline reliability, cabling and maintenance. • Specification of requirements for the support of lawful intercept and/or critical national infrastructures. Analysis of gaps with existing industry reference guidelines and standards.	Functional blocks: VIM, NFVI. Reference points: none.	Feature proposal: FTR026. Extension of GS NFV-EVE 003.
Hardware-independent acceleration (ACCEL)	R02.CAP12	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.	Functional blocks: NFVI, VIM, VNFM, NFVO. Reference points: Nf-Vi, Vi-Vnfm, Or-Vi.	Extension of ETSI GS NFV-IFA 002 and ETSI GS NFV-IFA 004

Feature Title (and Acronym)	NFV Release 3 Id	Description and Scope	Mapping to Architectural Framework ([i.1] and [i.3])	Traceability
Policy management framework (POLICY)	R03.F14	Policy management framework for NFV-MANO, including distribution of policy, policy conflict detection and resolution and federation of policy domains. The feature scope encompasses: • Study use cases related to applying policy framework in NFV-MANO. • Study of the impacts on NFV-MANO for applicable policy components at referred functional blocks and reference points. • Specification of requirements applicable to NFV-MANO functional blocks, interfaces and information models applicable to policy distribution and general policy description in VNF and NS descriptors. See note 2.	Functional blocks: NFVO, VNFM, VIM. Reference points: Os-Ma-nfvo, Or-Vnfm, Vi-Vnfm, Or-Vi.	Feature proposal: FTR007.
Application and Service Management (APPSM)	R03.F15	Application and Service Management enables the orchestration and lifecycle management of services with an end-to-end view on top of the capabilities and interfaces already introduced for the management of NSs. OSS uses the interfaces provided on the reference point Os-Ma-nfvo for the interaction with the NFVO. The feature covers service management related functionalities e.g. service fulfilment and assurance, monitoring, inventory and order management. Furthermore the feature addresses the definition of descriptors and information model required for the management of services.	Functional blocks: OSS, NFVO Reference points: Os-Ma-Nfvo.	Release 2 Definition: R02.CAP13 Addressed in ETSI GR NFV-IFA 012.
Hypervisor-based virtualisation (HYPER)	R03.F16	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 abstracts hardware to enable the portability of software appliances. The present feature covers hypervisor-related functions including allocating the compute resources to the software appliance virtual machines and services through management interfaces which allow for loading and monitoring of VMs, VM, terminating a VM, scaling a VM and live migrating a VM. The release also supports hypervisor networking functionality to enable the intercommunication for hosted VMs by integrating vSwitch.	Functional blocks: NFVI (Virtualisation Layer). Reference points: Vl-Ha, Nf-Vi.	Release 2 Definition: R02.CAP14 Addressed in ETSI GS NFV-EVE 001.

Feature Title (and Acronym)	NFV Release 3 Id	Description and Scope	Mapping to Architectural Framework ([i.1] and [i.3])	Traceability
License management (LIC)	R03.F17	NFV license management framework aspects to ensure Service Providers can deploy VNFs quickly without customizing the licensing mechanisms for each VNF and each VNF Provider. The feature scope encompasses: • Develop use cases related to license management. • Derive requirements from license management use cases. Identify what NFV Architectural Framework support and enhancements are needed to cover license management requirements.	Functional blocks: VNF, NFVO, VNFM, OSS. Reference points: Or-Vnfm, Or-Vi, Os-Ma-nfvo, Ve-Vnfm.	NFVEVE(16)000160r1.
NFV-MANO admin domains (MANOMD)	R03.F18	NFV-MANO services across multiple administrative domains. The feature scope encompasses: • Develop use cases related to offering NFV MANO services across multiple administrative domains, including NFVIaaS and NS over multiple administrative domains. • Examine interactions between functional blocks belonging to different administrative domains. • Derive requirements from use cases. Identify what NFV Architectural Framework support and enhancements are needed to cover support of NFV MANO services across multiple administrative domains.	Functional blocks: VNF, NFVO, VNFM, OSS. Reference points: Or-Vnfm, Or-Vi, Os-Ma-nfvo, Ve-Vnfm.	NWI NFV(16)000363r1.
NFV Architecture PaaS (NFVPAAS)	R03.F19	NFV Architecture support for providing "PaaS"-type capabilities and supporting VNFs which follow "cloud-native" design principles. The feature scope encompasses: • Develop use cases related to supporting on the NFV Architecture flexible choices for the designers of VNFs. Identify and provide recommendations on what NFV Architectural Framework support and enhancements are needed to cover support PaaS-type capabilities.	Functional blocks: VNF, NFVO, VNFM. Reference points: Or-Vnfm, Or-Vi, Vi-Vnfm, Nf-Vi.	NWI NFV(16)000361r10.
Cloud-Native VNF (VNFCLOUD)	R03.F20	Classification and characterization of VNF cloud-native implementations. The feature scope encompasses: Specification of a set of non-functional parameters to classify and characterize VNF cloud-native implementation.	Functional blocks: VNF. Reference points: N/A.	NWI NFV(16)000404r10.

Feature Title (and Acronym)	NFV Release 3 Id	Description and Scope	Mapping to Architectural Framework ([i.1] and [i.3])	Traceability
Network Slicing in NFV (NFVSLICE)	R03.F21	Analysis of Use Cases related to Network Slicing as defined in SDOs and industry for a. The feature scope encompasses: • Documentation of the use cases and mapping to current NFV concepts and support by the ETSI NFV Architectural Framework. • Specification of requirements and enhancements to the NFV Architectural Framework to support Network Slicing use cases. Guiding principles of NFV resiliency assurance for the support of network slicing based on an NFV infrastructure and covering all resiliency related operational facets supporting network slicing.	Functional blocks: TBD. Reference points: TBD.	NWI NFV(17)000057r1. NWI NFV(17)000278r2.
NFV Reliability and Availability (RELAV)	R03.F22	Support for configuration and deployment of VNFs from multiple vendors onto a common platform such that service reliability and availability expectations are satisfactorily met, including reliability and availability of NFVI components and Management and Orchestration components and their support for ensure the reliability and availability of the VNFs. The feature scope encompasses: Specification of requirements to enable development of necessary architectural mechanisms in support of service reliability and availability.	Functional blocks: NFVI, VIM, VNFM, NFVO. Reference points: TBD.	NWI NFV(17)000099r3.
Identity management (IDENTITY)	R03.F23	Secure VNF identity management and trust relationships in NFV. The feature scope encompasses: • Specification of requirements to secure VNF identity management and trust relationships. • Specify how identities are securely lifecycle managed, verified and trusted. Considering horizontal and vertical relationships.	Functions blocks: TBD. Reference points: TBD.	NWI NFV(17)000246r5.
NOTE 1: May changes be introduced in current NFV Information Model, the goal is to keep backward compatibility. NOTE 2: Developing the detail policy content / data model / information for specific operations, such as developing detailed policies for VNF/NS LCM will not be in the scope of the work derived from this Feature.				

D.4.4   NFV Release 3 active Work Items

D.4.4.1 Introduction

The present clause D.4.4 lists the active Work Items associated to the NFV Release 3.

Clause D.4.4.2 lists the Work Items that will produce new specifications and reports (i.e. complete new deliverables). Clause D.4.4.1 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.

D.4.4.2   Work Items producing new specifications or reports

The current Work Items associated to the NFV Release 3 and that will produce new specification or reports are listed in Table D.4.4.2-1.

NOTE: For tracking purposes, Work Items listed in Table D.4.4.2-1 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 D.4.4.2-1: NFV Release 3 Work Items producing new specification or reports

Work Item	Full Title	Type	Related Feature(s)
DGS/NFV-IFA026	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Architecture enhancement for Security Management Specification	Specification	R03.F08: Security management and monitoring for NFV (NFV_SEC) R03.F09: Secure sensitive components in NFV Framework (SEC4SNC)
DGR/NFV-IFA029	Network Functions Virtualisation (NFV) Release 3; Software Architecture; Report on the Enhancements of the NFV Architecture towards "Cloud-native" and "PaaS	Report	R03.F19: NFV Architecture PaaS (NFVPASS)
DGS/NFV-IFA032	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Interface and Information Model Specification for Multi-Site Connectivity Services	Specification	R03.F05: Management of Network Services and connectivity (NFVWAN)
DGS/NFV-IFA033	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Sc-Or, Sc-Vnfm, Sc-Vi reference points - Interface and Information Model Specification	Specification	R03.F08: Security management and monitoring for NFV (NFV_SEC)
DGR/NFV-IFA034	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Report on architectural enhancements for VNF License Management support and use of VNF licenses	Report	R03.F17: License management (LIC)
DGS/NFV-REL009	Network Functions Virtualisation (NFV); Reliability; Specification of Requirements to Support NFV Reliability and Availability	Specification	R03.F22: NFV Reliability and Availability (RELAV)
DGR/NFV-REL010	Network Functions Virtualisation (NFV); Reliability; Report on NFV Resiliency for the Support of Network Slicing	Report	R03.F21: Network Slicing in NFV (NFVSLICE)
DGS/NFV-SEC019	Network Functions Virtualisation (NFV) Release 3; Security; System Architecture Specification for NFV Security Enhancements	Specification	R03.F09: Secure sensitive components in NFV Framework (SEC4SNC)
DGS/NFV-SEC020	Network Functions Virtualisation (NFV) Release 3; Security; Identity Management and Security Specification	Specification	R03.F23: Identity management (IDENTITY)
DGS/NFV-SOL009	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the management of NFV-MANO	Specification	R03.F04: Management of NFV-MANO (NFV_M&Ms)

Work Item	Full Title	Type	Related Feature(s)
DGS/NFV-SOL010	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; VNF Snapshot Package specification	Specification	R03.F11: VNF snapshotting (VNF_PHOTO)
DGS/NFV-SOL011	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Or-Or Reference Point	Specification	R03.F18: NFV-MANO admin domains (MANOMD)
DGS/NFV-SOL012	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Policy Management Interface	Specification	R03.F14: Policy management framework (POLICY)

D.4.4.3   Work Items evolving/propagating NFV Release 2 specifications and reports

A set of deliverables of NFV Release 2 are evolved/propagated into the NFV Release 3. The corresponding Work Items are listed in Table D.4.4.3-1. These Work Items will produce a new version of a previously published specification or report.

Table D.4.4.3-1: NFV Release 3 Work Items of propagated/evolved NFV Release 2 deliverables

Work Item	Full Title	Type	Related Feature(s)
DGS/NFV-IFA002ed321	Network Functions Virtualisation (NFV) Release 3; Acceleration Technologies; VNF Interfaces Specification	Specification	R02.CAP12: Hardware independent acceleration (ACCEL)
DGS/NFV-SOL002ed311	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Ve-Vnfm Reference Point	Specification	See clause D.6 for the relationship of features with tentatively impacted specifications
DGS/NFV-SOL003ed311	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Or-Vnfm Reference Point	Specification	See clause D.6 for the relationship of features with tentatively impacted specifications
DGS/NFV-SOL004ed311	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; VNF Package specification	Specification	N/A (only propagating to this point).
DGS/NFV-SOL005ed311	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Os-Ma-nfvo Reference Point	Specification	See clause D.6 for the relationship of features with tentatively impacted specifications
DGS/NFV-SOL013ed311	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; Specification of common aspects for RESTful NFV MANO APIs	Specification	N/A (specifies common API matters applicable to all API specs).

D.4.5   NFV Release 3 published deliverables

D.4.5.1   Introduction

The present clause D.4.5 lists the published deliverables associated to the NFV Release 3.

Clause D.4.5.2 lists the specifications and reports that have been newly produced (i.e. complete new deliverables). Clause D.4.5.3 lists the specifications and reports that have been published as a result of evolving or propagating a deliverable published in a previous Release.

D.4.5.2   NFV Release 3 newly published specification and reports

The published deliverables associated to the NFV Release 3 and that have produced new specifications or reports are listed in Table D.4.5.2-1.

NOTE: For tracking purposes, published deliverables listed in Table D.4.5.2-1 include both informative Group Reports (GR) and normative Group Specifications (GS). The final list of Release-dependent deliverables will be made available as part of the Release Description document.

Table D.4.5.2-1: NFV Release 3 dependent published deliverables

GS/GR Id.	Full Title	Type	Related Feature(s)
ETSI GS NFV-EVE 001 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Virtualisation Technologies; Hypervisor Domain Requirements specification	Specification (GS)	R03.F16: Hypervisor-based virtualisation (HYPER)
ETSI GS NFV-EVE 007 V3.1.1 Revised in: V3.1.2	Network Functions Virtualisation (NFV) Release 3; NFV Evolution and Ecosystem; Hardware Interoperability Requirements Specification	Specification (GS)	R03.F13: Hardware Environment for NFV (HWENV)
ETSI GR NFV-EVE 008 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Charging; Report on Usage Metering and Charging Use Cases and Architectural Study	Report (GR)	R03.F02: Charging, billing and accounting for NFV (CHRG)
ETSI GR NFV-EVE 010 V3.1.1	Network Functions Virtualisation (NFV) Release 3; License Management; Report on License Management for NFV	Report (GR)	R03.F17: License management (LIC)
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	Specification (GS)	R03.F20: Cloud-Native VNF (VNFCLOUD)
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	Report (GR)	R03.F21: Network Slicing in NFV (NFVSLICE)
ETSI GR NFV-IFA 012 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Report on Os-Ma-Nfvo reference point - application and service management use cases and recommendations	Report (GR)	R03.F15: Application and Service Management (APPSM)
ETSI GS NFV-IFA 018 V3.1.1	Network Functions Virtualisation (NFV); Acceleration Technologies; Network Acceleration Interface Specification; Release 3	Specification (GS)	R03.F07: Network Acceleration for VNF (FASTSWITCH)

GS/GR Id.	Full Title	Type	Related Feature(s)
ETSI GS NFV-IFA 019 V3.1.1	Network Functions Virtualisation (NFV); Acceleration Technologies; Acceleration Resource Management Interface Specification; Release 3	Specification (GS)	R02.CAP12: Hardware independent acceleration (ACCEL)
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	Report (GR)	R03.F03: Automated deployment of element management and other OSS functions (VEMOSS) R03.F04: 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	Report (GR)	R03.F05: 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	Report (GR)	R03.F14: 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	Report (GR)	R03.F18: NFV-MANO admin domains (MANOMD)
ETSI GS NFV-IFA 030 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Multiple Administrative Domain Aspect Interfaces Specification	Specification (GS)	R03.F18: NFV-MANO admin domains (MANOMD)
ETSI GS NFV-IFA 031 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Requirements and interfaces specification for management of NFV-MANO	Specification (GS)	R03.F04: Management of NFV-MANO (NFV_M&Ms)
ETSI GS NFV-REL 006 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Reliability; Maintaining Service Availability and Continuity Upon Software Modification	Specification (GS)	R03.F10: Updated and upgrade of NFV software (SWUP)
ETSI GS NFV-SEC 012 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Security; System architecture specification for execution of sensitive NFV components	Specification (GS)	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	Specification (GS)	R03.F08: Security management and monitoring for NFV (NFV_SEC)
ETSI GS NFV-SEC 014 V3.1.1	Network Functions Virtualisation (NFV) Release 3; NFV Security; Security Specification for MANO Components and Reference points	Specification (GS)	R03.F08: Security management and monitoring for NFV (NFV_SEC)
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	Report (GR)	R03.F11: VNF snapshotting (VNF_PHOTO)

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

D.4.5.3 NFV Release 3 related published deliverables evolved/propagated from a previous Release

The published deliverables associated to the NFV Release 3 and that represent an evolved/propagated specification from a previous Release are listed in Table D.4.5.3-1.

Details about the specified features in the evolved/propagated version are available in the Release 3 Description document.

Table D.4.5.3-1: NFV Release 3 dependent published deliverables evolved/propagated from previous a Release

GS/GR Id.	Full Title	Type
ETSI GS NFV-IFA 005 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Or-Vi reference point - Interface and Information Model Specification	Specification (GS)
ETSI GS NFV-IFA 006 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Vi-Vnfm reference point - Interface and Information Model Specification	Specification (GS)
ETSI GS NFV-IFA 007 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Or-Vnfm reference point - Interface and Information Model Specification	Specification (GS)
ETSI GS NFV-IFA 008 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Ve-Vnfm reference point - Interface and Information Model Specification	Specification (GS)
ETSI GS NFV-IFA 010 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Functional requirements specification	Specification (GS)
ETSI GS NFV-IFA 011 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; VNF Descriptor and Packaging Specification	Specification (GS)
ETSI GS NFV-IFA 013 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Os-Ma-Nfvo reference point - Interface and Information Model Specification	Specification (GS)
ETSI GS NFV-IFA 014 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration Network Service Templates Specification	Specification (GS)
ETSI GR NFV-IFA 015 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Report on NFV Information Model	Report (GR)
ETSI GR NFV-IFA 016 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Information Modeling; Papyrus Guidelines	Report (GR)
ETSI GR NFV-IFA 017 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Information Modeling; UML Modeling Guidelines	Report (GR)
ETSI GS NFV-TST 008 V3.1.1	Network Functions Virtualisation (NFV) Release 3; Testing; NFVI Compute and Network Metrics Specification	Specification (GS)

D.5 Work Program composition

The ETSI ISG NFV Work Program is composed of:

- Reports (Informative).

- Release (Normative): including Group Specifications that handle:

  - Work Items for new features that require normative work and deliver new Group Specification deliverables.

  - Work items for maintenance of previous Release(s) published deliverables.

  - Work items for update (e.g. addition of feature related capabilities) of published Release-associated Group Specification published in previous Release(s).

Work Items can cover diverse stages of specification (e.g. Stage 1, 2, 3), as needed by the ISG.

Figure D.5-1 illustrates the high-level work item composition of the Work Program for 2016 as described above.
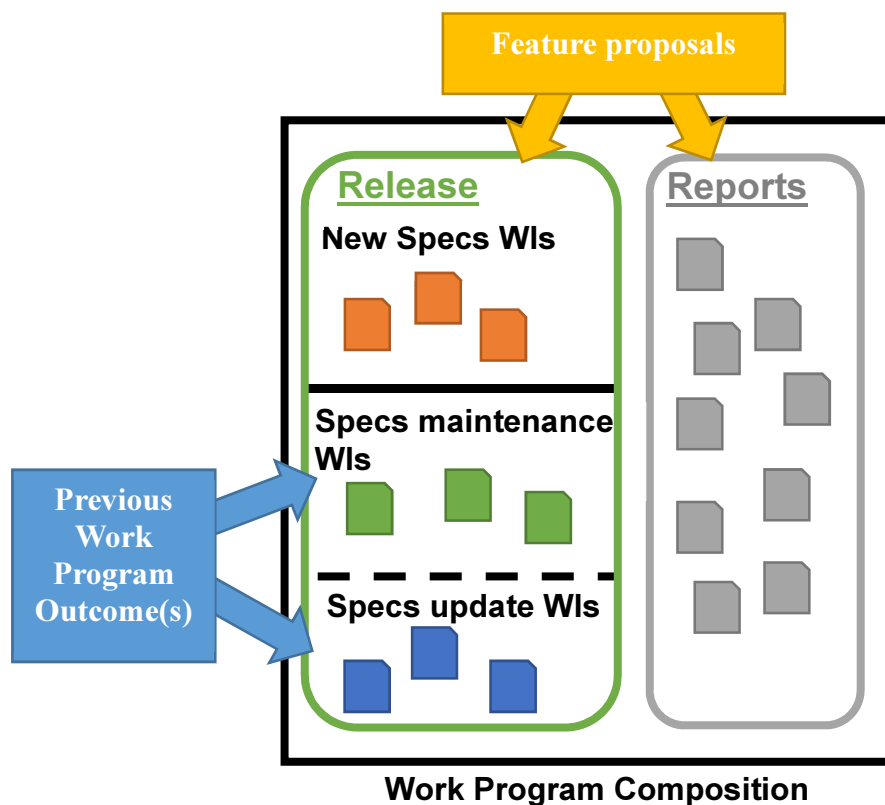

Figure D.5-1: ETSI ISG NFV Work Program high-level work item composition

D.6 NFV Release 3 candidate features for additional normative work

The ETSI ISG NFV assessed at NFV#19 the input of Release 3 features that required additional normative work, considering the two cases as listed below:

- evolving/propagating NFV Release 2 deliverables (refer to NFV Release 2 Description) into NFV Release 3; and

- creating new deliverables.

Table D.6-1 lists the set of candidate features that are considered for the Work Item Descriptions (WID).

NOTE: Table D.6-1 will be updated reflecting the status and specification progress of the features.

Table D.6-1: NFV Release 3 candidate features for additional normative work

Candidate feature # (NFV Release 3 Id)	Title	Related Feature(s) in the present Definition	New normative specifications? (or current ones impacted). See note 1.	Status (candidate/completed) and additional notes. See note 2.
FEAT01	REL to IFA Feature MANOMOD REL006 MANO software modification	R03.F10: Updated and upgrade of NFV software (SWUP)	**New GS: Yes**, could be combined in normative spec for new normative ETSI GS NFV-IFA 021	Candidate
FEAT02	REL to IFA Feature VNFMOD REL006 VNF software modification	R03.F10: Updated and upgrade of NFV software (SWUP)	**New GS: No Impacted GS:** could be addressed in ETSI GS NFV-IFA 010, ETSI GS NFV-IFA 013.	Candidate
FEAT03	REL to IFA Feature NFVIMOD REL006 NFVI software modification	R03.F10: Updated and upgrade of NFV software (SWUP)	**New GS: No Impacted GS:** could be included in ETSI GS NFV-IFA 005, ETSI GS NFV-IFA 006, ETSI GS NFV-IFA 010.	Candidate
FEAT04	Other to IFA Enhancement Host Reservation	N/A	**New GS: No Impacted GS:** could be included in ETSI GS NFV-IFA 005, ETSI GS NFV-IFA 010.	Stage 2 completed.
FEAT05	EVE to IFA REL SEC Feature NFVSLICE EVE012 network slicing	R03.F21: Network Slicing in NFV (NFVSLICE)	**New GS: No Impacted GS:** could be included in ETSI GS NFV-IFA 013, ETSI GS NFV-IFA 014.	Candidate
FEAT06	IFA to IFA Enhancement NS Package	N/A	**New GS: No Impacted GS:** could be included in ETSI GS NFV-IFA 010, ETSI GS NFV-IFA 013, ETSI GS NFV-IFA 014.	Closed. See note 3.

Candidate feature # (NFV Release 3 Id)	Title	Related Feature(s) in the present Definition	New normative specifications? (or current ones impacted). See note 1.	Status (candidate/completed) and additional notes. See note 2.
FEAT07	IFA to IFA Feature MANOPLC IFA023 MANO Policy Mgt	R03.F14: Policy management framework (POLICY)	**New GS: No** **Impacted GS:** could be included in ETSI GS NFV-IFA 005, ETSI GS NFV-IFA 006, ETSI GS NFV-IFA 007, ETSI GS NFV-IFA 008, ETSI GS NFV-IFA 010, ETSI GS NFV-IFA 013. Stage 3: new GS.	Stage 2 completed. Stage 3 ongoing.
FEAT08	IFA to IFA Feature MANOMD IFA028 NS composite nested multi-domain	R03.F18: NFV-MANO admin domains (MANOMD)	**New GS: Yes**, new specification for Multi-domain aspects **Impacted GS:** could be included ETSI GS NFV-IFA 010. **Stage 3:** **New GS:** Yes.	Stage 2 completed. Stage 3 ongoing.
FEAT09	IFA to IFA Feature MANOMD IFA028 NFVIaaS multi-domain	R03.F18: NFV-MANO admin domains (MANOMD)	**New GS: Yes**, new specification for Multi-domain aspects **Impacted GS:** ETSI GS NFV-IFA 005, ETSI GS NFV-IFA 006 ETSI GS NFV-IFA 010.	Candidate.
FEAT10	IFA to IFA Feature NFVWAN IFA022 ManAndConn Multi-Site	R03.F05: Management of Network Services and connectivity (NFVWAN)	**New GS: Yes**, new specification for WIM **Impacted GS:** ETSI GS NFV-IFA 005, ETSI GS NFV-IFA 007, ETSI GS NFV-IFA 010, ETSI GS NFV-IFA 011, ETSI GS NFV-IFA 014	Candidate.
FEAT11	IFA to IFA Feature NFV_M&Ms IFA021 management NFV-MANO	R03.F04: Management of NFV-MANO (NFV_M&Ms)	**New GS: Yes**, new specification for managing MANO **Impacted GS:** ETSI GS NFV-IFA 010. **Stage 3:** **New GS:** Yes.	Stage 2 completed. Stage 3 ongoing.
FEAT12	Ext to IFA SOL Enhancement support for MEC in NFV deployments	N/A	**New GS: Yes**, new spec(s) **Impacted GS:** ETSI GS NFV-IFA 010,	Candidate

Candidate feature # (NFV Release 3 Id)	Title	Related Feature(s) in the present Definition	New normative specifications? (or current ones impacted). See note 1.	Status (candidate/completed) and additional notes. See note 2.
			ETSI GS NFV-IFA 013.	
FEAT13	EVE to IFA Feature LIC EVE010 Licensing Management	R03.F17: License management (LIC)	**New GS: Yes**, new spec **Impacted GS:** ETSI GS NFV-IFA 010.	Candidate
FEAT14	EVE to IFA Feature CHRG EVE008 Charging and Billing	R03.F02: Charging, billing and accounting for NFV (CHRG)	**New GS: Yes**, new spec **Impacted GS:** ETSI GS NFV-IFA 005, ETSI GS NFV-IFA 006, ETSI GS NFV-IFA 007, ETSI GS NFV-IFA 010, ETSI GS NFV-IFA 013.	Candidate
FEAT15	TST to IFA Feature VNF_PHOTO TST005 VNF_Snapshot	R03.F11: VNF snapshotting (VNF_PHOTO)	**New GS: No** **Impacted GS:** ETSI GS NFV-IFA 005, ETSI GS NFV-IFA 006, ETSI GS NFV-IFA 007, ETSI GS NFV-IFA 008, ETSI GS NFV-IFA 010, ETSI GS NFV-IFA 011, ETSI GS NFV-IFA 013. **Stage 3: impacted GS:** ETSI GS NFV-IFA 002, ETSI GS NFV-IFA 003, ETSI GS NFV-IFA 005. **New GS:** yes.	Stage 2 completed in first version. See note 4. Stage 3 ongoing.
FEAT16	NFV(17)000209_ REL_to_IFA_Feat ure_SAL_REL001 _Service_availabil ity_level	N/A	**New GS: No** **Impacted GS:** ETSI GS NFV-IFA 005, ETSI GS NFV-IFA 006, ETSI GS NFV-IFA 007, ETSI GS NFV-IFA 010, ETSI GS NFV-IFA 011, ETSI GS NFV-IFA 013.	Candidate.

Candidate feature # (NFV Release 3 Id)	Title	Related Feature(s) in the present Definition	New normative specifications? (or current ones impacted). See note 1.	Status (candidate/completed) and additional notes. See note 2.
FEAT17	Release 3 Recommended Feature - Cloud Native VNF (EVE011) - NFV Architecture PaaS (ETSI GS NFV-IFA 029)	R03.F20: Cloud-Native VNF (VNFCLOUD) R03.F19: NFV Architecture PaaS (NFVPAAS)	**New GS: Yes Impacted GS:** ETSI GS NFV-IFA 007, ETSI GS NFV-IFA 008, ETSI GS NFV-IFA 010, ETSI GS NFV-IFA 011, ETSI GS NFV-IFA 013.	Candidate.
FEAT18	Security management, monitoring and securing sensitive functions	R03.F08: Security management and monitoring for NFV (NFV_SEC) R03.F09: Secure sensitive components in NFV Framework (SEC4SNC)	**New GS: Yes Impacted GS:** none identified so far.	Candidate.
NOTE 1: Only references to stage 2 impacted specifications is provided. Stage 3 impacts/enhancements will be determined at a later stage.				
NOTE 2: Features that have been completed may require maintenance. The maintenance will not be tracked in this table.				
NOTE 3: The specification work was determined to be part of the NFV Release 2 as a continuation of stage 3 work from ETSI GS NFV-IFA 014. The current work item is DGS/NFV-SOL007 and the output deliverable will be ETSI GS NFV-SOL 007.				
NOTE 4: Additional work is needed for stage 2 to cover aspects of VNF snapshot description for ETSI GS NFV-IFA 011 and gaps in the interface definitions to handle VNF snapshot. This work is envisioned to be handled as "maintenance".				

Annex E:
Change history

Change history		
Version	**Date**	**Changes**
0.0.1	September 2018	Initial draft.
0.0.2	October 2018	Addition of security features and other features completed in 1H2018 by NFV-IFA (aka drop #1).
0.0.3	November 2018	Implemented feedback received from feature primes and small edits.
0.1.0	November 2018	First version uploaded to the ETSI NFV Portal.
0.2.0	Aprl 2019	Updates from Release 3 drop 2H2018 (aka drop #2).
0.3.0	September 2019	Updates from Release 3 drop 1H2019 (aka drop #3).
0.4.0	December 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	January 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. - Tables 5.2.8.3-1, 6.3.1-1, 7.2-1: changes to reflect the completion and publication of SOL011.
0.6.0	July 2020	Updates after 1H2020 Release 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). - Tables 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 present 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	November 2020	Updates after 1H2020 additional Release 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 specifications and references to the scope of applicability on top of the NFV architectural framework.
0.7.1	February 2021	Several corrections: - Clause 4.2: correct the number of published Group Reports. - Clause 5.2.6: update the description of VNF snapshotting feature according to the maintenance that was done in several NFV-IFA specifications in 1H2020. - Clause 5: in all relevant features, a new list item has been added to the architecture scope sub-clause to indicate artefacts (such as VNFD, NSD, etc.) that have also been updated due to the feature. - Clause 6.7: update the figure with the latest status as of end of Jan. 2021.

Change history		
Version	**Date**	**Changes**
0.8.0	September 2021	Updates after NFV#34-e and completion of several 2021H1 work items: - Clause 4.4: new clause to provide information about the specification work state. - Clause 5.1: updated the table to reflect status of FEAT15, FEAT02, FEAT05 and acknowledgment of related enhancements of MECinNFV (FEAT12). - Clauses 5.2.6, 5.2.11, 5.2.10, 5.2.12: update list of items completed in specification results. Performed corrections in Table 5.2.6-1 regarding VNF snapshotting. - Clause 5.2.15: new clause to detail about completed aspects relevant to MECinNFV feature. - Tables 6.2.1-1, 6.2.2-1, 6.3.1-1, 6.3.2-1: update set of features completed and latest version of listed specifications in the tables. - Table 6.2.2-1: added the missing ETSI GS NFV-IFA 027. - Clause 6.3.3: new clause to describe about the stage 3 publication packages. - Table 6.5-1 and Table 7.2-1: list the SOL017 as completed and published. - Clause 6.7: update the figure with status as of Jun. 2021. - Annex A: new annex providing information and guidelines about the versioning of published deliverables. - Annex B: new annex providing information and meaning about the release specification states. - Clause 4.2: corrected and updated the number of GS and GR. - Clause 6.3.2: added missing publication of ETSI GS NFV-SOL 014 V3.5.1. Needed to also update the corresponding clause 6.3.3. - Table 7.3-1: added the NFV006ed361 and SOL016ed351.
0.8.1	December 2021	Updates before NFV#36-e: - Clause 2: voided the NFV-MAN 001 and added the NFV 006 instead. - Clause 6.3.3: corrected wrong Table reference. - Clause 6.2.2: updated (to be) published versions of TST008 (new V3.5.1). - Figure 6.7-1: updated the figure according to latest status. - Clause 7.2: added newly approved NWI of SOL019. - Clause 7.3: added missing NWI of TST007 in Release 3, which had been approved in May.
0.9.0	February 2022	Updates before NFV#37-e: - Clause 4.4: update the status and notes of stage 3 to indicate completion of drop #3 published as V3.6.1. - Clause 5.1: marked FEAT03 as completed from stage 3 perspective. - Clause 5.2.13.3: update the list of specifications related to the FEAT03 "NFVI software modification". Added the stage 3 publications. - Clauses 6.2 and 6.3: updated the tables with new published version. - Clause 6.3.3: added new stage 3 SOL Package 21H2 description and table. - Clause 6.7: updated the figure with status as of Feb. 2022.
0.10.0	May 2022	Updates before NFV#38: - Table 4.4-1: update the additional notes of the stage 4 entry. - Table 5.2.8.3-1: added NFV006 to the list of specification results related to NFV-MANO admin domains. - Table 5.2.10.3-1: added NFV006 to the list of specification results related to Management and connectivity of multi-site services. - Clause 6.2.2: updated the list of published specs: added the NFV006. - Clause 6.4.2: updated the list of published testing specs/reports: added the TST007. Updated the versions of TST010. - Figure 6.7-1: updated the figure to reflect the status as of May 2022. - Clause 7.3: deleted the entries of work items that have been completed, i.e. NFV006 and TST007.
0.10.1	November 2022	Updates before NFV#40 - Clause 4.4: update status of the specification work. - Updated versions of several specifications, mostly about completion of ed371. - Clause 6.3.3: added new stage 3 package 22H2 with V3.7.1 published versions. - Table 5.2.6.3-1: added reference to SOL016, which documents procedures related to VNF snapshotting. - Figure 6.7-1: updated with status as of Nov. 2022. - Table 5.2.10.3-1: bug fixing to indicate the impacts of Multi-site connectivity in NFV-MANO management specifications.
0.10.2	November 2022	Cover decision to carry over parts of FEAT10 to Release 4.
0.10.3	November 2022	Add explanation for moving FEAT10 to Release 4. Prepare to add description for TST010.

Change history		
Version	**Date**	**Changes**
3.6.2	December 2022	Many editorial changes to transform the document to a GR. Copied Release 2 description to Annex C. Copied Release 3 definition document to Annex D. Corrected all references. Removed void notes. Added a note in clause 5.2.10.4 about dependencies when moving parts of FEAT10. Added many editors notes.
3.6.3	February 2023	NFVTSC(23)000005 NFV007ed371 Update FEAT04. NFVTSC(23)000006 NFV007ed371 Clean-up Editors notes.
3.6.4	September 2023	NFVTSC(23)000015 NFV007ed371 Update for SOL006. NFVTSC(23)000095 NFV007ed371 Update for Testing.

History

Document history		
V3.7.1	November 2023	Publication