ETSI GR NFV 007 V5.2.1 (2025-08)

GROUP REPORT

Network Functions Virtualisation (NFV); Release Description; Release 5

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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).

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1 Scope

The present document describes the NFV Release 5 and in particular its version 5.2.1. 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 5.2.1 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 1: 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 may be useful in implementing an ETSI deliverable or add to the reader's understanding, but are not required for conformance to the present document.

NOTE 2: The release description includes tables, figure 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.

[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 GR NFV 007 (V4.5.1): "Network Functions Virtualisation (NFV) Release 4; Release Description; Release 4 Edition 4.5.1".

[i.4] ETSI GR NFV-TST 006: "Network Functions Virtualisation (NFV); Testing; Report on CICD and DevOps".

[i.5] ETSI GR NFV-SEC 005: "Network Functions Virtualisation (NFV); Trust; Report on Certificate Management".

[i.6] ETSI GS NFV 006: "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Architectural Framework Specification".

[i.7] ETSI NFV wiki: "Feature tracking".

[i.8] ETSI GR NFV-IFA 038 (V4.1.1): "Network Functions Virtualisation (NFV) Release 4; Architectural Framework; Report on network connectivity for container-based VNF".

[i.9] ETSI GS NFV-IFA 053: "Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Requirements and interface specification for Physical Infrastructure Management".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms and definitions 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

None.

3.3 Abbreviations

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

GR	Group Report
GS	Group Specification
ISG	Industry Specification Group

4 Release overview

4.1 Introduction

ETSI ISG NFV Release 5 (hereinafter referred also as Release 5 or the present release) builds on top and leverages the results of ETSI ISG NFV documents published as part of the Release 4. The Release 5 introduces new features on top of the specified capabilities and features in previous releases and continues features not completed in Release 4.

Clause 4.2 provides a statistical summary of the Release 5 in terms of number of specifications and reports published to date. Clause 4.3 summarizes the capabilities and features that have been specified in past Releases and clause 4.4 summarizes the specification work state at each of the specification stages. A high-level description of the main outcomes of the Release 5 are provided in clause 5. Clause 6 lists the published GR and GS comprising Release 5. A high-level definition for each of the features which are considered during the development of current Release 5 work is provided in Annex C.

4.2 Overview

At the time the present Description document version is delivered, the Release 5 is comprised of the following number of published deliverables:

- 30 Group Specifications, among which:
  - 1 new stage 2 specification.
  - 21 stage 2 specifications evolved from earlier Releases.
  - 1 new stage 3 specification.
  - 11 stage 3 specifications evolved from earlier Releases.
  - 4 new security specifications.
  - 3 security specifications evolved from earlier Releases.
- 13 Group Reports, among which:
  - 12 new reports.
  - 1 report evolved from earlier Releases.

4.3 Summary of past Releases

Each NFV release is building upon the capabilities and features specified as part of the previous release. All NFV releases enable interoperable implementations of the NFV Architectural Framework (see ETSI GS NFV 002 [i.1]).

The Release 3 added the following major architectural changes:

- Addition of the Or-Or reference point in between two NFVO.
- Exposure by the NFV-MANO functional blocks of new interfaces for policy management.
- Exposure by the NFV-MANO functional blocks of new interfaces for the management of NFV-MANO functional blocks.
- Definition of the Wide Area Infrastructure Management (WIM) and exposure of interfaces for multi-site network connectivity management.

The Release 4 added the following major capabilities and architectural changes:

- Support of cloud-native VNFs by introducing new functions CISM, CIR and CCM.
- Introducing service interfaces for CISM, CIR and CCM and related artifacts.
- Introducing new functions to support automation and autonomous networks: MDAF and intent management with related service interfaces.
- Enhancements for the support of 5G, including support of PaaS framework, introducing new functions of PSM and PSR.
- Introducing VNF generic management functions.
- Definition of policy management and fault management models.
- Enhancements for flexible VNF deployments.
- Introducing security management and monitoring.
- Introducing certificate management.

The NFV-MANO architecture is further described in ETSI GS NFV 006 [i.6].

ETSI GR NFV 007 (V4.5.1) [i.3] provides details about the capabilities that had been specified in the Release 4.

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
Stage 1/2	Normative work: Service and business requirements Architecture, interfaces and information models.	Open	None
Stage 3	Normative work on protocols and data models. Informative work on studying potential profiling of existing solutions.	Open	None
Stage 4	Normative work on testing specifications for protocols and data models.	Open	None

5 Release 5 features

5.1 Overview

The features introduced as part of the Release 5 are listed in Table 5.1-1.

Table 5.1-1: Release 5 features

FEAT Id	Feature title	History	Studies, etc.	Stage 2 status	Stage 3 status
FEAT19a	Enhanced container networking	Started in Release 4	IFA043	Completed in edition 5.1.1	Open, Updates in edition 5.2.1
FEAT19b	NFV-Connect - connectivity integration and operationalization	Started in Release 4	IFA035	Open, Updates in edition 5.2.1	Open, Updates in edition 5.2.1
FEAT20	Auto	Started in Release 4	IFA041	Open, Updates in edition 5.2.1	Open, Updates in edition 5.2.1
FEAT21	5G	Started in Release 4	IFA037	Open, Updates in edition 5.2.1	Open, Updates in edition 5.2.1
FEAT24	VNF generic management functions	Started in Release 4	EVE019	Open, Updates in edition 5.2.1	Not started
FEAT26	Policy Management Models	Started in Release 4	IFA042	Completed in Release 4	Not started
FEAT27	NFV for vRAN	New	IFA046	Open, Updates in edition 5.2.1	Not started
FEAT29	Green NFV	New	EVE021	Open, Updates in edition 5.2.1	Open, Updates in edition 5.2.1
FEAT30	VNF configuration	New	EVE022	Open, Updates in edition 5.2.1	Open, Updates in edition 5.2.1
FEAT31	Flexible VNF deployment	New, see note	IFA044	Completed in edition 5.1.1	Completed in edition 5.1.1
FEAT33	Physical Infrastructure Management	New	-	Open, Updates in edition 5.2.1	Not started
FEAT35	VNF management gaps with Open Source	New	IFA051	Open, Updates in edition 5.2.1	Open, Updates in edition 5.2.1
NOTE: The feature was planned newly in Release 5, some parts were already published in Release 4.					

Currently there are no enhancement features (specific technical enhancements) in Release 5.

Table 5.1-2 lists the Release 5 security features.

Table 5.1-2: Release 5 security features

FEAT Id	Title	History	Studies, etc.	Stage 2 status	Stage 3 status
ENH01.01	Certificate management	Started in Release 4	SEC005	Open, Updates in edition 5.2.1	Open, Updates in edition 5.2.1

Several features are delivered in multiple packages (also known as drops or editions). The following clauses describe the features and content provided in various drops. The present document describes up to edition 5.2.1; planning for later drops is also provided.

5.2 Functional features

5.2.1 FEAT19a: Network connectivity integration and operationalization for NFV - container networking (NFV-Connect-container)

5.2.1.1 Description

The feature enhances the NFV architectural framework to provide support for multiple networks connectivity for OS container-based VNF.

More precisely, the feature enhances the NFV descriptors and NFV-MANO functional blocks/functions and exposed interfaces to enable the management of secondary container cluster networks, and connectivity of OS container-based VNF to such networks.

The feature is a continuation and evolution of FEAT19 on "Network connectivity integration and operationalization for NFV".

NOTE: This work has been started as ETSI GR NFV-IFA 038 [i.8].

5.2.1.2 Architecture scope

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

- Functional blocks and functions: NFVO, VNFM, CISM, CCM.
- Reference points and interfaces: Os-Ma-nfvo, Or-Vnfm, CISM service interfaces, CCM service interfaces.
- Artefacts: VNFD.

5.2.1.3 Documentation results in Release 4

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 documents.

Table 5.2.1.3-1: Documentation results Release 4 of feature "Network connectivity integration and operationalization for NFV - container networking"

Document Id.	Stage	Description of the feature result
ETSI GR NFV-IFA 038	Info	Report on network connectivity for container based VNF.
ETSI GS NFV-IFA 010	Stages 1 and 2	Functional requirements for the NFVO to support requesting the creation of secondary container cluster network management and providing information about such networks in VNF LCM procedures to the VNFM. Functional requirements for the VNFM to support processing resource requirements related to network resources for secondary container cluster networks. Functional requirements for the VNFM to support requesting attachment of groups of one or more OS containers of container-based VNF to secondary container cluster networks. Functional requirements for the CISM to support the capabilities to management the attachment to secondary container cluster networks.
ETSI GS NFV-IFA 007	Stage 2	Additional attributes in VNF Lifecycle Management interface to signal information about network attachment definition resources used to signal the attachment to secondary container cluster networks, and exposure of relevant runtime information.
ETSI GS NFV-IFA 008	Stage 2	Additional attributes in VNF Lifecycle Management interface to signal information about network attachment definition resources used to signal the attachment to secondary container cluster networks, and exposure of relevant runtime information.
ETSI GS NFV-IFA 040	Stage 2	Add secondary networks.
ETSI GS NFV-SOL 002	Stage 3	Additional data type attributes in VNF Lifecycle Management API to signal information about network attachment definition resources used to signal the attachment to secondary container cluster networks, and exposure of relevant runtime information.
ETSI GS NFV-SOL 003	Stage 3	Additional data type attributes in VNF Lifecycle Management API to signal information about network attachment definition resources used to signal the attachment to secondary container cluster networks, and exposure of relevant runtime information.
ETSI GS NFV-SOL 018	Stage 3	Add secondary networks.

5.2.1.4 Parts carried over to Release 5

The feature was not completed in Release 4. The following parts of the feature are carried over to Release 5:

- Analyse complex telecom specific use cases and solution for container networking, and profile open source container solutions.
- Enhance multiple network support and add more automation into container network management.
- Specify enhancements to support network policies for container networking.

5.2.1.5 Documentation results in Release 5

The feature has been specified in the specifications and reports listed in Table 5.2.1.5-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.2.1.5-1: Documentation results Release 5 of feature "Network connectivity integration and operationalization for NFV - container networking"

Document Id.	Stage	Description of the feature result
ETSI GR NFV-IFA 043	Info V5.1.1	Report on enhanced container networking.

5.2.2 FEAT19b: NFV-Connect - connectivity integration and operationalization (NFV-Connect-container)

5.2.2.1 Description

The feature covers the following areas:

- A "flatter" networking to remove complex L1 and L2 network layering dependencies for the network functions.
- Exposure of high-performance overlay network capabilities to network functions.
- Support of dynamic routing capabilities in the network.
- Enable more dynamic network provisioning and reconfiguration "end-to-end", within and across sites.
- Minimize manual intervention for network provisioning, while increasing automation.

5.2.2.2 Architecture scope

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

- Functional blocks and functions: VIM, WIM, PIM (not yet a function).
- Reference points and interfaces: Or-Wi, Or-Vi, Vi-Vnfm.
- Artefacts: VNFD.

5.2.2.3 Documentation results in Release 5

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 documents.

Table 5.2.2.3-1: Documentation results of feature "Network connectivity integration and operationalization for NFV - container networking"

Document Id.	Stage	Description of the feature result
ETSI GR NFV-IFA 035	Info V5.1.1	Report on network connectivity integration and operationalization for NFV.
ETSI GS NFV-IFA 010	Stage 2 V5.2.1	Add functional requirements for the NFV architectural framework to support the capabilities regarding network connectivity and integration according to recommendations derived in ETSI GR NFV-IFA 035 (V5.1.1).
ETSI GS NFV-IFA 006	Stage 2 V5.2.1	Add enhancements in the relevant interfaces and information elements based on the gaps identified in ETSI GR NFV-IFA 035 (V5.1.1).
ETSI GS NFV-IFA 005	Stage 2 V5.2.1	Add enhancements in the relevant interfaces and information elements based on the gaps identified in ETSI GR NFV-IFA 035 (V5.1.1).
ETSI GS NFV-IFA 011	Stage 2 V5.2.1	Enhance NFV descriptors to carry information related to networking management based on the gaps identified in ETSI GR NFV-IFA 035 (V5.1.1).
ETSI GS NFV-SOL 014	Stage 3 V5.2.1	Clarify allocation of resource zone identifiers.

5.2.3 FEAT20: NFV-MANO automation and autonomous networks (Auto)

5.2.3.1 Description

The scope of the feature covers the following areas:

- NFV-MANO support for managing autonomous networks.
- Enabling higher level of automation for NFV-MANO.
- Intent-based principles for external exposure network services management.

5.2.3.2 Architecture scope

The feature concerns the following main functional blocks (or functions) and service interfaces:

- Functional blocks and functions: NFVO, MDAF (new), Intent Management (new).
- Service interfaces: MDAF service interfaces, Intent Management service interfaces.

5.2.3.3 Documentation results in Release 4

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 documents.

Table 5.2.3.3-1: Documentation results Release 4 of feature "NFV-MANO automation and autonomous networks"

Document Id.	Stage	Description of the feature result
ETSI GS NFV-IFA 010	Stages 1 and 2	Add functional requirements for the MDAF and the Intent Management. Add functional requirements for the NFVO, related to MDAF and Intent Management.
ETSI GS NFV-IFA 047	Stage 2	Specify the service requirements for the Management Data Analytics (MDA) Function (MDAF), corresponding service interfaces produced by the MDAF, and related information elements.
ETSI GS NFV-IFA 050	Stage 2	Specify the intent management service interface, including interface requirements, service requirements, operations and their associated information model. Specify the information model of intents which is specific to NFV-MANO domain.
ETSI GS NFV-SOL 009	Stage 3	Add MDAF into NFV-MANO mgmt interfaces.

5.2.3.4 Parts carried over to Release 5

The feature was not completed in Release 4. Stage 2 was completed; main part of stage 3 is provided in Release 5.

5.2.3.5 Documentation results in Release 5

The feature has been specified in the specifications and reports listed in Table 5.2.3.5-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.2.3.5-1: Documentation results Release 5 of feature "NFV-MANO automation and autonomous networks"

Document Id.	Stage	Description of the feature result
ETSI GS NFV-SOL 021	Stage 3 V5.3.1 work ongoing	A RESTful protocol and data model specification fulfilling the requirements specified in the ETSI GS NFV-IFA 050 for the intent management service interface integrated with NFV-MANO framework.

5.2.4 FEAT21: NFV enhancements for 5G (5GNFV)

5.2.4.1 Description

The feature enhances the NFV architectural framework to further support 5G network deployments.

The feature comprises several types of enhancements including:

- Enhancements to the NSD processing and flexible handling of NS constituents (e.g. version dependencies) to support the deployment and continuous update of 5G services delivered by constituent VNFs.
- PaaS Services management.
- Various enhancements on interfaces and descriptors related to networking aspects.

5.2.4.2 Architecture scope

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

- Functional blocks and functions: NFVO, VNFM, and VNF generic OAM/PaaS framework, new in Release 5: PSM and PSR.
- Reference points and interfaces: Os-Ma-nfvo, Or-Vnfm, and NB-M, NB-F, SB-V, SB-F of the VNF generic OAM/PaaS framework.
- Artefacts: NSD, VNFD, new in Release 5: PSD.

5.2.4.3 Documentation results in Release 4

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 documents.

Table 5.2.4.3-1: Documentation results Release 4 of feature "NFV enhancements for 5G"

Document Id.	Stage	Description of the feature result
ETSI GR NFV-IFA 037	Info	Informative and study analysis of NFV enhancements for 5G.
ETSI GS NFV 006	Stage 2	Specification of the PaaS Services management framework: addition of the Pass Services Management (PSM) and PaaS Services Repository (PSR) functions to the NFV-MANO architectural framework.
ETSI GS NFV-IFA 010	Stages 1 and 2	Functional requirements for the NFVO to process and maintain information about version dependencies in NSD constituents. Functional requirements for the PaaS Service Management, the PaaS Services Repository and related Functional requirements for the NFVO and VNFM.
ETSI GS NFV-IFA 007	Stage 2	Extensions to the granting interface to support PaaS Service assignments. Enhancement of the related interface and information model specification, including runtime information. Extensions for the modelling to support domain naming.
ETSI GS NFV-IFA 008	Stage 2	Extensions to the runtime information of PaaS Services used by the VNF. Extensions for the modelling to support domain naming.
ETSI GS NFV-IFA 011	Stage 2	Extensions to the VNFD for the modelling of the PaaS Service requests. Extensions for the modelling to support domain naming.
ETSI GS NFV-IFA 013	Stage 2	Extensions to the NS Lifecycle Management interface to support the provisioning and handling of versions dependencies between NSD constituents. Enhancement of the related interface and information model specification, including runtime information. Extensions to the runtime information elements to model PaaS Services used by the NS and VNF instances. Extensions to the modelling to support domain naming, information about external L2 networks, and further qualifying location constraints.

Document Id.	Stage	Description of the feature result
ETSI GS NFV-IFA 014	Stage 2	Extensions to the NSD information modelling to support the indication of version dependencies between NSD constituents and information to determine the constraints of onboarding of packaging associated to the constituents. Extensions to the NSD information modelling to support PaaS Services. Extensions to the NSD information modelling to support additional VL capabilities.
ETSI GS NFV-SOL 001	Stage 3	Extensions with new properties in datatypes and node types of the NSD data model to support the indication of version dependencies between NSD constituents and information to determine the constraints of onboarding of packaging associated to the constituents. VNFD PaaS Service modelling refinements. NSD modelling to use PaaS Services.
ETSI GS NFV-SOL 002	Stage 3	New attributes on NS Lifecycle Management API
ETSI GS NFV-SOL 003	Stage 3	New attributes on NS Lifecycle Management API and granting, modified semantics and permitted attribute values.
ETSI GS NFV-SOL 005	Stage 3	Extensions to the NS Lifecycle Management API to support the provisioning and handling of versions dependencies between NSD constituents. Enhancement of the related interface and information model specification, including runtime information. New attributes on NS Lifecycle Management API.
ETSI GS NFV-SOL 016	Stage 3	Addition of PaaS.

5.2.4.4 Parts carried over to Release 5

The feature was not completed in Release 4. The following parts of the feature are carried over to Release 5:

- PaaS Services management service interface requirement and interface specification.
- PaaS Services descriptors.
- Some enhancements on interfaces and descriptors related to networking aspects, e.g. connection points lifecycle management, and aspects related to resources sharing.

5.2.4.5 Documentation results in Release 5

The feature has been specified in the specifications and reports listed in Table 5.2.4.5-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.2.4.5-1: Documentation results Release 5 of feature "NFV enhancements for 5G"

Document Id.	Stage	Description of the feature result
ETSI GS NFV-IFA 007	Stage 2 V5.2.1	Extension to support the granting of shared virtualised resources. Add support for adding/removing VNF external CPs that are not sub-ports of a trunk.
ETSI GS NFV-IFA 008	Stage 2 V5.2.1	Add support for adding/removing VNF external CPs that are not sub-ports of a trunk.
ETSI GS NFV-IFA 010	Stage 2 V5.2.1	Add support for the VNFM to support adding/removing VNF external CPs that are not sub-ports of a trunk.
ETSI GS NFV-IFA 011	Stage 2 V5.2.1	Enhancements to VNFD to relate scaling aspects with VNF services.
ETSI GS NFV-IFA 013	Stage 2 V5.2.1	Add support for adding/removing VNF external CPs that are not sub-ports of a trunk.
ETSI GS NFV-IFA 049	Stages 1 and 2 V5.2.1	PaaS Services framework and specification of the relationship of VNF generic OAM functions with PaaS Services.

Document Id.	Stage	Description of the feature result
		Specification of interface requirements, service interfaces and relevant information modelling for the management of PaaS Services by the PaaS Services Management (PSM) and PaaS Services Repository (PSR) functions. Specification of PaaS Services Descriptors (PSD).
ETSI GS NFV-SOL 001	Stage 3 V5.2.1	Enhancements to NSD modelling for PaaS services and additional VL capabilities.
ETSI GS NFV-SOL 024	Stage 3 V5.3.1 work ongoing	Specification of VNF generic OAM functions using Custom Resource Definition (CRD) approach.

5.2.5 FEAT24: VNF generic management functions (VNF-OAM)

5.2.5.1 Description

The feature analyses and defines the type of OAM functions for VNFs that can be generalized and be provided as a "generic function" supporting the provisioning, connectivity, configuration, testing and monitoring of VNFs on a virtualised platform.

The feature also enhances the NFV architectural framework to further support VNF Generic OAM functions. Interactions with other NFV-MANO entities like MDAF are also delineated.

The feature also determines possible solutions to realize such generic OAM functions, e.g. by leveraging PaaS capabilities, the interfaces exposed by the VNF generic OAM functions and the relevant information elements.

Release 5 extends the functionality and the feature analyses further the types of OAM functions for VNFs defined in Release 4 and Release 5 (stage 0/1) supporting the provisioning, connectivity, configuration and monitoring of VNFs on a virtualised platform. The feature also formalizes the way generic OAM functions can be realized by leveraging PaaS capabilities.

The necessary functional requirements, interface requirements, like also the necessary interfaces and necessary information models are specified for functions defined in Release 5 stage 0/1, while interfaces and IE defined functions will be extended, if necessary. The result will also report possible NFV-MANO architectural enhancements.

5.2.5.2 Architecture scope

The feature concerns interactions between VNF generic OAM functions and other Paas Services with the main functional blocks and references points:

- Functional blocks and functions: NFV-MANO, OSS/BSS and NFVI.
- Artefacts: PSD, VNFD and NSD (via PaaS Services enhancements of FEAT21).

5.2.5.3 Documentation results in Release 4

The feature has been specified in the specifications and reports listed in Table 5.2.5.3-1.

Table 5.2.5.3-1: Documentation results Release 4 of feature "VNF Generic OAM functions"

Document Id.	Stage	Description of the feature result
ETSI GR NFV-EVE 019	Info and stage 1 V4.1.1	Report on VNF generic OAM functions.
ETSI GS NFV-IFA 049	Stage 2 V4.4.1	Definition of interfaces and information elements, description of the VNF generic OAM functions architectural model.

5.2.5.4 Parts carried over to Release 5

The feature was not completed in Release 4. The following parts of the feature are carried over to Release 5:

- Relationship between VNF generic OAM functions and MDAF.
- Notifications management for VNF generic OAM functions.

Additional technical aspects investigated in Release 5 are about Policy management for VNF generic OAM functions and other PaaS services, closed loop control for NFV, VNF testing management and interaction with Intent management function.

The stage 3 specification is to be developed as part of the Release 5.

5.2.5.5 Documentation results in Release 5

The feature has been specified in the specifications and reports listed in Table 5.2.5.5-1.

Table 5.2.5.5-1: Documentation results Release 5 of feature "VNF Generic OAM functions"

Document Id.	Stage	Description of the feature result
ETSI GR NFV-EVE 019	Info and stage 1 V5.1.1	Report on VNF generic OAM functions.
ETSI GS NFV-IFA 049	Stage 2 V5.2.1	Specifies functional requirements and interfaces of new VNF generic OAM functions like "Testing manager", "Policy agent", "Notifications manager", and enhancements to support service mesh connectivity.
ETSI GS NFV-SOL 024	Stage 3 V5.3.1 work ongoing	New specification of protocol and data model solutions for VNF Generic OAM functions and PaaS Services.

5.2.6 FEAT26: Policy management models (Policy-model)

5.2.6.1 Description

The feature defines the models necessary for policy management, while the architectural enhancements for the introduction of the policy framework and the specification of a policy engine, with its procedures, interfaces and handling of the input events, goals and output/actions is not in scope of this feature.

The scope of the feature covers the following areas:

- Analyse existing policy information and data models and identify solutions that potentially could be applied to NFV-MANO.
- Clarify the main alternative for policy management (between NFV-MANO and OSS/BSS).
- Determine the objectives and management alternatives for policy management applicable to NFV-MANO.
- Identify policy expression information model applicable to NFV-MANO.
- Identify policy expression data model applicable to NFV-MANO.

5.2.6.2 Architecture scope

The feature does not introduce architectural changes. The main functional block affected by the feature is the NFVO.

5.2.6.3 Documentation results in Release 4

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: Documentation results Release 4 of feature "Policy management models"

Document Id.	Stage	Description of the feature result
ETSI GS NFV-IFA 048	Stage 2	Specifies the structure and content of the NFV-MANO policy information model
ETSI GS NFV-IFA 005	Stage 2	Specifies enhancements according to the policy information model
ETSI GS NFV-IFA 006	Stage 2	Specifies enhancements according to the policy information model
ETSI GS NFV-IFA 007	Stage 2	Specifies enhancements according to the policy information model
ETSI GS NFV-IFA 008	Stage 2	Specifies enhancements according to the policy information model
ETSI GS NFV-IFA 013	Stage 2	Specifies enhancements according to the policy information model
ETSI GS NFV-SOL 012	Stage 3	Specifies the structure and content of the NFV-MANO policy information model

5.2.6.4 Parts carried over to Release 5

The feature was not completed in Release 4. Stage 2 was completed; main part of stage 3 is provided in Release 5. Specification of additional alarms can take place in future releases too.

5.2.6.5 Documentation results in Release 5

The feature has been specified in the specifications and reports listed in Table 5.2.6.5-1.

Table 5.2.6.5-1: Documentation results Release 5 of feature "Policy management models"

Document Id.	Stage	Description of the feature result
ETSI GS NFV-SOL 022	Stage 3 V5.3.1 work ongoing	Addition of policy data model.
ETSI GS NFV-SOL 024	Stage 3 V5.3.1 work ongoing	New specification of protocol and data model solutions for VNF Generic OAM functions and PaaS Services.

5.2.7 FEAT27: NFV for vRAN

5.2.7.1 Description

The scope of this feature covers the following areas:

- Study the advances concerning the virtualisation of the RAN and profile the NFV framework to determine how it can support virtualised RAN (vRAN) use cases.
- Identify key technical challenges relevant to architectural, operational and management aspects, in case the NFV architectural framework is leveraged to support virtualisation of the RAN.
- Provide recommendations for enhancements to the NFV architectural framework and its functionality, aiming to provide further support for vRAN use cases.
- Based on the recommendations, enhance when needed the overall NFV-MANO framework, existing NFV-MANO interfaces and descriptors.

5.2.7.2 Architecture scope

The feature investigates profiling of NFV-MANO to the architecture defined by the O-RAN Alliance. It also considers physical infrastructure management aspects for NFV-MANO.

5.2.7.3 Documentation results in Release 5

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: Documentation results of feature "NFV for vRAN"

Document Id.	Stage	Description of the feature result
ETSI GR NFV-IFA 046	Stage 1 V5.2.1	Report on NFV support for virtualisation of RAN.

5.2.8 FEAT29: Green NFV

5.2.8.1 Description

The scope of the feature covers the following areas:

- Analyse aspects of NFV (VNF design, NFV-MANO and VNF operation, deployment configuration of NFV-MANO, NFVI, etc.) that have impact on energy consumption and those that can enable smart energy NFV and power saving features.
- Identify design guidelines needed for optimizing energy consumption.
- Specify enhancements to specifications on interfaces and information model, augment exposed KPIs and metrics to enable resources orchestration and VNF/NS LCM to operate following power saving policies.

5.2.8.2 Architecture scope

No new architectural elements are specified, but extensions and enhancements are developed concerning the following main functional blocks, functions and references points:

- Functional blocks and functions: CCM, VIM, CISM, PIM, VNFM, NFVO.
- Reference points and interfaces: Vi-Vnfm, Or-Vi, Or-Vnfm, and interfaces produced by CCM, CISM and PIM.
- Artefacts: none in V5.2.1.

5.2.8.3 Documentation results in Release 5

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: Documentation results of feature "Green NFV"

Document Id.	Stage	Description of the feature result
ETSI GR NFV-EVE 021	Info V5.1.1	Report on energy efficiency aspects for NFV.
ETSI GS NFV-IFA 010	Stages 1 and 2 V5.2.1	Functional requirements for the PIM, VIM and CISM to support providing power consumption and energy metrics associated to its managed objects. Functional requirements for the VIM to support scheduling and instantiation of virtualised resources considering power state requirements, and managing the power states of managed virtualised compute resources. Functional requirements for the CISM to support scheduling and instantiation of containerized workloads considering power state requirements. Functional requirements for the CCM to support managing the power states of CIS cluster nodes. Functional requirements for the VNFM to support providing power consumption and energy metrics associated to VNFs, and requirements for the NFVO to support providing power consumption and energy metrics associated to its managed objects.

Document Id.	Stage	Description of the feature result
ETSI GS NFV-IFA 005	Stage 2 V5.2.1	Enhancements on the relevant virtualised resource management interfaces produced by the VIM to support providing power state requirements for the virtualised resources to be allocated and managing the power states of managed virtualised compute resources. Requirements and enhancements for the virtualised resource reservation interface(s) produced by the VIM to support providing information about which virtualised resources are expected to be terminated, and providing references to existing allocated virtualised resources during which virtualised resource reservation creation.
ETSI GS NFV-IFA 006	Stage 2 V5.2.1	Enhancements on the relevant virtualised resource management interfaces produced by the VIM to support providing power state requirements for the virtualised resources to be allocated.
ETSI GS NFV-IFA 036	Stage 2 V5.2.1	Requirements for the CCM to support additional tagging scopes for CIS cluster nodes related to CPU power profiles, and enhance relevant models and interfaces produced by the CCM and CISM. Enhancements on relevant CIS cluster management interfaces produced by the CCM to support managing the power states of CIS cluster nodes.
ETSI GS NFV-IFA 040	Stage 2 V5.2.1	Enhancements on relevant interfaces produced by the CISM to support scheduling and instantiation of containerized workloads considering power state requirements.
ETSI GS NFV-IFA 027	Stage 2 V5.2.1	Definition of energy consumption metrics associated to virtualised compute resources and containerized workloads, and update of VNF/VNFC related metrics considering containerized workloads. New measurements about energy consumption associated to VNF and NS instances.
ETSI GS NFV-IFA 031	Stage 2 V5.2.1	Requirements and enhancements to the NFV-MANO configuration and information management interface produced by an NFV-MANO functional entity to support suspending a managed entity, such as the NFV-MANO functional entity application and NFV-MANO service interfaces, and suspending the consumption of NFV-MANO service interfaces produced by a peer NFV-MANO functional entity.
ETSI GS NFV-IFA 053	Stage 2 V5.2.1	Requirements for the PIM to support managing the power states of physical resources in the NFVI, and enhance relevant management interfaces produced by the PIM. Support for discovery, collection and use of information about power consumption characteristics, information about power state aware zoning and pooling of physical resource in the NFVI. Inventory of physical resources in NFVI.

5.2.9 FEAT30: VNF configuration

5.2.9.1 Description

The scope of this feature covers the following areas:

- Provide guidelines on the use of the configuration options available in the NFV framework and the types of configuration data applicable to each of these options.
- Specify related enhancements to the set of ETSI NFV specifications needed to improve interoperability between VNFs and independently-developed VNF configuration management functions and further facilitate automation of VNF configuration.

5.2.9.2 Architecture scope

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

- Functional blocks and functions: NFVO, VNFM, VNF generic OAM/PaaS framework, new in Release 5: Configuration Server PaaS Service.
- Reference points and interfaces: NB-M, NB-F, SB-V, SB-F of the VNF generic OAM/PaaS framework.
- Artefacts: VNFD.

5.2.9.3 Documentation results in Release 5

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: Documentation results of feature "VNF configuration"

Document Id.	Stage	Description of the feature result
ETSI GR NFV-EVE 022	Info V5.1.1	Report on VNF configuration.
ETSI GS NFV-IFA 007	Stage 2 V5.2.1	Enhancing the VNF runtime information with configuration management metadata.
ETSI GS NFV-IFA 008	Stage 2 V5.2.1	Enhancing the VNF runtime information with configuration management metadata.
ETSI GS NFV-IFA 010	Stages 1 and 2 V5.2.1	Support in the NFV architectural framework for the distribution and storage of configuration data by means of a "Configuration Server".
ETSI GS NFV-IFA 011	Stage 2 V5.2.1	Specification of VNF configurable properties to identify and configure CPs to be connected to management systems. Support in LCM scripts to invoke agent-less configuration solutions. Added descriptor metadata to indicate supported configuration protocols. Generalized the use of LCM scripts for VM-based deployment pertaining to the mapping of input parameters for configuration, and extending their support to also link to LCM procedures involved in VNF configuration.
ETSI GS NFV-IFA 013	Stage 2 V5.2.1	Enhancements to NS LCM: notifications and information exposing relevant attributes to be used in VNF configuration procedures. Enhancing the VNF runtime information with configuration management metadata.
ETSI GS NFV-IFA 049	Stages 1 and 2 V5.2.1	Specification of the "Configuration Server" as new PaaS Service: functional requirements, interface requirements, interface and information modelling. Enhancements in the VNF generic OAM framework to support interactions and use of "Configuration Server".
ETSI GS NFV-SOL 001	Stage 3 V5.2.1	Enhancements on VNFD for configuration.
ETSI GS NFV-SOL 005	Stage 3 V5.2.1	New attribute VnfInstance.vnfmId.

5.2.10 FEAT31: Flexible VNF deployment

5.2.10.1 Description

The feature has two parts: deployable modules and dynamic capacity.

The feature was planned for Release 5, but the deployable modules part was added late to Release 4.

The dynamic capacity part of the FEAT 31 Flexible VNF deployment introduces support for parameterizing the VDU attributes related to capacity in the interfaces.

Dynamic capacity allows the VNF vendor to define which VDU attributes related to capacity can be configured in run time as well as providing a range of valid values, and the service provider to decide at deployment time the values for those attributes, as well as modifying the values during the life time of the VNF instance, i.e. to perform a vertical scaling operation.

5.2.10.2 Architecture scope

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

- Functional blocks and functions: NFVO, VNFM.
- Reference points and interfaces: Os-Ma-nfvo, Or-Vnfm, Ve-Vnfm.
- Artefacts: NSD, VNFD.

NOTE: All changes related to Os-Ma-nfvo reference point were completed in Release 4.

5.2.10.3 Documentation Results in Release 4

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: Documentation results Release 4 of feature "Flexible VNF deployment"

Document Id.	Stage	Description of the feature result
ETSI GR NFV-IFA 044	Info V5.1.1	Network Functions Virtualisation (NFV) Release 5. Management and Orchestration. Report on Flexible VNF Deployment.
ETSI GS NFV-IFA 010	Stage 1 and 2	Functional requirements for the modification of selected deployable modules added to the NFVO and VNFM during VNF lifecycle management.
ETSI GS NFV-IFA 007	Stage 2	Extensions of the instantiate VNF, change VNF deployment flavour and change current VNF package operations and grant request to support deployable modules. Definition of a new VNF LCM operation to select deployable modules.
ETSI GS NFV-IFA 008	Stage 2	Extensions of the instantiate VNF, change VNF deployment flavour and change current VNF package operations to support deployable modules. Definition of a new VNF LCM operation to select deployable modules.
ETSI GS NFV-IFA 011	Stage 2	Extensions of the VNF deployment flavour and VDU profile to support deployable modules.
ETSI GS NFV-IFA 013	Stage 2	Extensions of modelling and LCM operations to support deployable modules.
ETSI GS NFV-IFA 014	Stage 2	Extensions of the NS profile, VNF profile and NSD to support deployable modules.
ETSI GS NFV-SOL 001	Stage 3	Introduction of deployable modules in the VNFD, VNF and NS profiles. Deployable modules relation to scaling aspects, SAP and MCIOPs. Supported operations for change of deployable modules. Example of a VNF with deployable modules.
ETSI GS NFV-SOL 002	Stage 3	Modified attribute semantics, new attributes resources and data types on LCM interface.
ETSI GS NFV-SOL 003	Stage 3	Modified attribute semantics, new attributes resources and data types on LCM interface and granting.
ETSI GS NFV-SOL 005	Stage 3	Modified attribute semantics and new attributes on LCM interface.

5.2.10.4 Parts carried over to Release 5

The deployable modules part of the feature was completed in Release 4. The dynamic capacity part, independent of the deployable modules part, is kept in Release 5, as originally planned.

5.2.10.5 Documentation results in Release 5

The feature has been specified in the specifications and reports listed in Table 5.2.10.5-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.2.10.5-1: Documentation results Release 5 of feature "Flexible VNF deployment"

Document Id.	Stage	Description of the feature result
ETSI GR NFV-IFA 044	Info V5.1.1	Network Functions Virtualisation (NFV) Release 5. Management and Orchestration. Report on Flexible VNF Deployment.
ETSI GS NFV-IFA 010	Stage 1 and 2 V5.2.1	Functional requirements for the support of vertical scaling added to the VNFM during VNF lifecycle management.
ETSI GS NFV-IFA 007	Stage 2 V5.2.1	Extensions of the instantiate VNF, change VNF DF, change current VNF package, scale VNF operations and grant request to support indication of values for capacity related VDU attributes.
ETSI GS NFV-IFA 008	Stage 2 V5.2.1	Extensions of the instantiate VNF, change VNF DF, change current VNF package and scale VNF operations to support indication of values for capacity related VDU attributes.
ETSI GS NFV-IFA 011	Stage 2 V5.2.1	Extensions of the VDU descriptors to support the marking of attributes related to capacity that can be configured in run time and the specification of valid values.
ETSI GS NFV-IFA 014	Stage 2 V5.2.1	Extensions of the VNF profile to support further control for the service provider on which attributes can be modified.
ETSI GS NFV-SOL 001	Stage 3 V5.2.1	Extensions of the VDU descriptors to support the marking of attributes related to capacity that can be configured in run time and the specification of valid values.
ETSI GS NFV-SOL 002	Stage 3 V5.2.1	New attributes and data types on LCM interface.
ETSI GS NFV-SOL 003	Stage 3 V5.2.1	New attributes and data types on LCM interface.

5.2.11 FEAT33: Physical Infrastructure Management

5.2.11.1 Description

The scope of FEAT33 covers the following areas:

- Profile existing solutions related to hardware management specify requirements for physical infrastructure management in the NFV-MANO framework.
- Specify interface specifications for managing physical infrastructure with respect to life cycle and FM/PM of physical compute, storage and networking resources.
- Specify the information model for describing attributes and statuses of NFVI physical resources to support relevant interface specifications.
- Architectural analysis of physical infrastructure management within the NFV-MANO framework.
- Analysis of existing solutions for management of physical resources.
- Potentially profile existing solutions related to physical infrastructure management.

5.2.11.2 Architecture scope

Architectural analysis and framework for physical infrastructure management is provided in ETSI GS NFV-IFA 053 [i.9].

The PIM function, its responsibilities, services and service interfaces are also integrated in the NFV-MANO architectural framework in ETSI GS NFV 006 [i.6].

5.2.11.3 Documentation results in Release 5

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: Documentation results of feature "Physical Infrastructure Management"

Document Id.	Stage	Description of the feature result
ETSI GS NFV-IFA 005	Stage 2 V5.2.1	Clarifcation of resource zones within NFVI and their management.
ETSI GS NFV-IFA 010	Stage 2 V5.2.1	Functional requirements related to physical infrastructure management in NFV-MANO. Functional requirements for the PIM function to manage NFVI physical resources. Functional requirements for the VIM, the CCM and the NFVO to interact with the PIM for management of physical resources. Clarifcation of resource zones within NFVI and their management.
ETSI GS NFV-IFA 052	Stage 2 V5.2.1	Addition of PIM produced service interface requirements and description, to support CIS cluster resource management in the bare-metal CIS cluster case.
ETSI GS NFV-IFA 053	Stage 1 and 2 V5.2.1	Requirements and information modelling for Physical Infrastructure Management. Analysis of relevant solutions, and mapping of their features and capabilities against PIM services and their requirements.
ETSI GR NFV 003	Terminology V1.9.1	Updates to NFV003 existing definitions to separate the NFVI resources into physical and virtualised domains, and accommodate the newly added concepts of physical resources, physical infrastructure management in IFA053.
ETSI GS NFV 006	Architecture V5.2.1	NFV-MANO architectural framework including the PIM function and service interfaces.

5.2.12 FEAT35: VNF management gaps with Open Source

5.2.12.1 Description

The feature has two parts: support simplified VNFD design based on gap analysis with ONAP ASD project and enhancements VNF LCM/FM/PM based on gap analysis with Openstack Tracker.

5.2.12.2 Architecture scope

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

- Functional blocks and functions: VNFM, CISM.
- Reference points and interfaces: Os-Ma-nfvo, Or-Vnfm, CISM service interfaces, Ve-Vnfm.
- Artefacts: VNFD.

5.2.12.3 Documentation Results in Release 5

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: Documentation results of feature "VNF management gaps with Open Source"

Document Id.	Stage	Description of the feature result
ETSI GR NFV-IFA 051	Info V5.1.1	Network Functions Virtualisation (NFV) Release 5. Architectural framework. Report on VNF management gap analysis with open source projects.
ETSI GS NFV-IFA 010	Stage 2 V5.2.1	Add functional requirements for the NFV architectural framework to support the capabilities regarding simplified VNFD design according to recommendations derived in ETSI GR NFV-IFA 051 (V5.1.1).
ETSI GS NFV-IFA 011	Stage 2 V5.2.1	Enhance NFV descriptors to support simplified VNFD design based on the gaps identified in ETSI GR NFV-IFA 051 (V5.1.1).
ETSI GS NFV-IFA 007	Stage 2 V5.2.1	Add enhancements in the relevant interfaces and information elements based on the gaps identified in ETSI GR NFV-IFA 051 (V5.1.1).
ETSI GS NFV-IFA 008	Stage 2 V5.2.1	Add enhancements in the relevant interfaces and information elements based on the gaps identified in ETSI GR NFV-IFA 051 (V5.1.1).
ETSI GS NFV-IFA 013	Stage 2 V5.2.1	Add enhancements in the relevant interfaces and information elements based on the gaps identified in ETSI GR NFV-IFA 051 (V5.1.1).
ETSI GS NFV-SOL 001	Stage 3 V5.2.1	Add clarification on osContainer and Mciop usage. Add clarification on monitoring type. Add example_of_VNFD_with_simple_design. Add new property to VnfPackageChange policy.
ETSI GS NFV-SOL 002	Stage 3 V5.2.1	Add enhancements in the relevant interfaces and information elements.
ETSI GS NFV-SOL 003	Stage 3 V5.2.1	Add enhancements in the relevant interfaces and information elements.
ETSI GS NFV-SOL 005	Stage 3 V5.2.1	Added new resource data type and new attributes.
ETSI GS NFV-SOL 009	Stage 3 V5.2.1	Add external access for PM and FM.
ETSI GS NFV-SOL 016	Stage 3 V5.2.1	Add osContainerDesc.

5.3 Enhancement features

There are currently no enhancement features for Release 5.

5.4 Security features

5.4.1 ENH01.01: Certificate Management

5.4.1.1 Description

The security enhancement provides a capability to support certificate management by introducing Certificate Management Function (CMF) within the NFV MANO architecture and is enhancing the NFV-MANO reference points and functional blocks. CMF enhances "Operator Certificate Enrolment Server" as defined in ETSI GR NFV-SEC 005 [i.5].

5.4.1.2 Architecture scope

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

- Functional blocks: Certificate Management Function (CMF), NFVO, VNFM, VIM, CISM.
- Reference points: all:
  - Security reference point Cm-Vnfm for certificate management.

5.4.1.3 Documentation results in Release 4

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: Documentation results Release 4 of enhancement feature "Certificate Management"

Document Id.	Stage	Description of the feature result
ETSI GS NFV-IFA 006	Stage 2	Add modelling for certificate data.
ETSI GS NFV-IFA 007	Stage 2	Add requirements, parameters and attributes for certificates.
ETSI GS NFV-IFA 008	Stage 2	Add requirements, parameters and attributes for certificates.
ETSI GS NFV-IFA 010	Stage 2	Add general requirements for certificate management.
ETSI GS NFV-IFA 011	Stage 2	Add modelling for certificate data.
ETSI GS NFV-IFA 013	Stage 2	Add requirements and modelling for certificate management.
ETSI GS NFV-IFA 026	Stage 2	Add use case and requirements for certificate management. Specify the Certificate Management Architecture, functions and reference points.
ETSI GS NFV-IFA 031	Stage 2	Add management for the Certificate Management Function.
ETSI GS NFV-IFA 033	Stage 2	Specify the Certificate Management Function, its requirements, reference points, interfaces and information model.
ETSI GS NFV-IFA 040	Stage 2	Add note on certificate data in MCIO configurations.
ETSI GS NFV-SOL 001	Stage 3	Add CertificateDesc. Update mapping table and add CertSubjectData.
ETSI GS NFV-SOL 002	Stage 3	Modified description semantics, new attributes on VNF LCM interface.
ETSI GS NFV-SOL 003	Stage 3	Modified description semantics, new attributes on VNF LCM interface.
ETSI GS NFV-SOL 005	Stage 3	New attributes on VNF and NS Lifecycle Management APIs and NVF config API, modified attribute and description semantics on NS Lifecycle Management APIs.
ETSI GS NFV-SOL 009	Stage 3	Add certificate mgmgt mode.
ETSI GS NFV-SOL 014	Stage 3	Add certificateData.
ETSI GS NFV-SOL 016	Stage 3	Add of certificate management.

5.4.1.4 Parts carried over to Release 5

The feature was not completed in Release 4. The following parts of the feature are carried over to Release 5:

- Use case of renewal and revoke for certificate management of direct mode/delegation mode.
- MANO certificates further specified.

5.4.1.5 Documentation results in Release 5

The feature has been specified in the specifications and reports listed in Table 5.4.1.5-1. Refer to clause 6 for the latest version available of the referred documents.

Table 5.4.1.5-1: Documentation results Release 5 of enhancement feature "Certificate Management"

Document Id.	Stage	Description of the feature result
ETSI GR NFV-IFA 026	Stage 2 V5.2.1	Add clarifications and additional information on the functions and services involved in certificate management. Introduce multiple PKI domains including use cases and security considerations.
ETSI GS NFV-IFA 033	Stage 2 V5.2.1	Addition of certificate management interface and certificate notification interface.
ETSI GS NFV-SOL 018	Stage 3 V5.2.1	Add mapping for certificate data.
ETSI GS NFV-SOL 023	Stage 3 V5.3.1 work ongoing	Addition of certificate management interface and certificate notification interface.

5.5 Testing

5.5.1 API Conformance Testing

5.5.1.1 Description

At this time, no Release 5 specific tests are provided.

6 NFV Release 5 published deliverables

6.1 Introduction

The present clause 6 lists the published deliverables (Group Specifications and Group Reports) associated to the Release 5. The NFV Release 5 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: 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.

6.2 Group Reports of Release 5

6.2.1 New Group Reports

The new reports associated to the Release 5 are listed in Table 6.2.1-1.

Table 6.2.1-1: New Group Reports Release 5

Document Id.	Version(s)	Title	Related feature(s)
ETSI GR NFV-EVE 018	V5.1.1	Network Functions Virtualisation (NFV) Release 5; Evolution and Ecosystem; Report on Multi-tenancy in NFV	No normative provisions in Release 5
ETSI GR NFV-EVE 020	V5.1.1	Network Functions Virtualisation (NFV) Release 5; Evolution and Ecosystem; Report on NFV support for Network Function Connectivity eXtensions	No normative provisions in Release 5

Document Id.	Version(s)	Title	Related feature(s)
ETSI GR NFV-EVE 021	V5.1.1	Network Functions Virtualisation (NFV) Release 5; Evolution and Ecosystem; Report on energy efficiency aspects for NFV	FEAT29
ETSI GR NFV-EVE 022	V5.1.1	Network Functions Virtualisation (NFV) Release 5; Architectural Framework; Report on VNF configuration	FEAT30
ETSI GR NFV-IFA 035	V5.1.1	Network Functions Virtualisation (NFV) Release 5; Architectural Framework; Report on network connectivity integration and operationalization for NFV	FEAT19b
ETSI GR NFV-IFA 039	V5.1.1	Network Functions Virtualisation (NFV) Release 5; Architectural Framework; Report on Service Based Architecture (SBA) design	No normative provisions in Release 5
ETSI GR NFV-IFA 043	V5.1.1	Network Functions Virtualisation (NFV) Release 5; Architectural Framework; Report on enhanced container networking	FEAT19a
ETSI GR NFV-IFA 044	V5.1.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Report on Flexible VNF Deployment	FEAT31
ETSI GR NFV-IFA 046	V5.1.1	Network Functions Virtualisation (NFV) Release 5; Architectural Framework; Report on NFV support for virtualisation of RAN	FEAT27
ETSI GR NFV-IFA 051	V5.1.1	Network Functions Virtualisation (NFV) Release 5; Architectural framework; Report on VNF management gap analysis with open source projects	FEAT35
ETSI GR NFV-REL 013	V5.1.1	Network Functions Virtualisation (NFV) Release 5; Reliability; Report on cognitive use of operations data for reliability	No normative provisions in Release 5
ETSI GR NFV-REL 014	V5.1.1	Network Functions Virtualisation (NFV) Release 5; Reliability; Report on evaluating reliability for cloud-native VNFs	No normative provisions in Release 5

6.2.2 Evolved/propagated Group Reports

The group reports associated to the Release 5 that have been evolved/propagated from a previous Release are listed in Table 6.2.2-1.

Table 6.2.2-1: Updated/propagated Group Reports

Document Id.	Version(s)	Title	Related feature(s)
ETSI GR NFV-EVE 019	V5.1.1 Old: V4.1.1	Network Functions Virtualisation (NFV) Release 5; Architectural Framework; Report on VNF generic OAM functions	FEAT24

6.3 Stage 1 and stage 2 Group Specifications of Release 5

6.3.1 New Group Specifications

The published new specifications associated to the Release 5 are listed in Table 6.3.1-1.

Table 6.3.1-1: Newly published stage 1 and stage 2 Group Specifications

Document Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-IFA 053	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Requirements and interface specification for Physical Infrastructure Management	FEAT27, FEAT29, FEAT33

6.3.2 Evolved/propagated published deliverables from a previous Release

The published deliverables associated to the Release 5 that have been evolved/propagated from a previous Release are listed in Table 6.3.2-1.

Table 6.3.2-1: Published stage 1 and stage 2 deliverables evolved/propagated from a previous Release

Document Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV 006	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Architectural Framework Specification	FEAT33
ETSI GS NFV-IFA 005	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Or-Vi reference point - Interface and Information Model Specification	FEAT19b, FEAT27, FEAT29, FEAT33
ETSI GS NFV-IFA 006	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Vi-Vnfm reference point - Interface and Information Model Specification	FEAT19b, FEAT27, FEAT29, ENH01.01
ETSI GS NFV-IFA 007	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Or-Vnfm reference point - Interface and Information Model Specification	FEAT21, FEAT29, FEAT30
ETSI GS NFV-IFA 008	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Ve-Vnfm reference point - Interface and Information Model Specification	FEAT21, FEAT29, FEAT30, ENH01.01
ETSI GS NFV-IFA 010	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Functional requirements specification	FEAT21, FEAT24, FEAT27, FEAT29, FEAT30, FEAT33
ETSI GS NFV-IFA 011	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; VNF Descriptor and Packaging Specification	FEAT21, FEAT19b, FEAT27, FEAT29, FEAT30
ETSI GS NFV-IFA 013	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Os-Ma-Nfvo reference point - Interface and Information Model Specification	FEAT21, FEAT29, FEAT30
ETSI GS NFV-IFA 014	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration Network Service Templates Specification	FEAT27
ETSI GS NFV-IFA 026	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Architecture enhancement for Security Management Specification	ENH01.01
ETSI GS NFV-IFA 027	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Performance Measurements Specification	FEAT29
ETSI GS NFV-IFA 030	V5.1.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Multiple Administrative Domain Aspect Interfaces Specification	See note 1
ETSI GS NFV-IFA 031	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Requirements and interfaces specification for management of NFV-MANO	FEAT29
ETSI GS NFV-IFA 032	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Interface and Information Model Specification for Multi-Site Connectivity Services	FEAT19b
ETSI GS NFV-IFA 036	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Requirements for service interfaces and object model for container cluster management and orchestration specification	FEAT27, FEAT29

Document Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-IFA 040	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Requirements for service interfaces and object model for OS container management and orchestration specification	FEAT27, FEAT29
ETSI GS NFV-IFA 045	V5.2.1	Network Functions Virtualisation (NFV) Release 5 Management and Orchestration; Fault and alarms modelling specification	See note 1
ETSI GS NFV-IFA 047	V5.1.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Management data analytics Service Interface and Information Model Specification	FEAT24
ETSI GS NFV-IFA 048	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Policy Information Model Specification	FEAT24, FEAT27
ETSI GS NFV-IFA 049	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Architectural Framework; VNF generic OAM f and PaaS services specification	FEAT21, FEAT24, FEAT20, FEAT30
ETSI GS NFV-IFA 050	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Intent Management Service Interface and Information Model Specification	FEAT27, FEAT29
ETSI GS NFV-IFA 052	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Interface and Information Model Specification for supporting CIS cluster resource management	

6.3.3 Stage 2 publication packages

As indicated in Annex A of the present document, 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 2 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 5 stage 2 Package 1:

Table 6.3.3-1 lists the deliverables that are part of Release 5 stage 2 Package 1.

Table 6.3.3-1: Deliverables part of Release 5 stage 2 Package 1

Document Id.	Version	Publication date (year-month)
ETSI GS NFV-IFA 005	V5.1.1	2024-06
ETSI GS NFV-IFA 006	V5.1.1	2024-06
ETSI GS NFV-IFA 007	V5.1.1	2024-06
ETSI GS NFV-IFA 008	V5.1.1	2024-06
ETSI GS NFV-IFA 010	V5.1.1	2024-06
ETSI GS NFV-IFA 011	V5.1.1	2024-06
ETSI GS NFV-IFA 013	V5.1.1	2024-06
ETSI GS NFV-IFA 014	V5.1.1	2024-06

Document Id.	Version	Publication date (year-month)
ETSI GS NFV-IFA 026	V5.1.1	2024-08
ETSI GS NFV-IFA 027	V5.1.1	2024-06
ETSI GS NFV-IFA 030	V5.1.1	2024-06
ETSI GS NFV-IFA 031	V5.1.1	2024-06
ETSI GS NFV-IFA 032	V5.1.1	2024-06
ETSI GS NFV-IFA 036	V5.1.1	2024-06
ETSI GS NFV-IFA 040	V5.1.1	2024-06
ETSI GS NFV-IFA 047	V5.1.1	2024-06
ETSI GS NFV-IFA 049	V5.1.1	2024-06
ETSI GS NFV-IFA 053	V5.1.1	2024-08

Release 5 stage 2 Package 2:

Table 6.3.3-2 lists the deliverables that are part of Release 5 stage 2 Package 2.

Table 6.3.3-2: Deliverables part of Release 5 stage 2 Package 2

Document Id.	Version	Publication date (year-month)
ETSI GS NFV 006	V5.2.1	2024-12
ETSI GS NFV-IFA 005	V5.2.1	2024-12
ETSI GS NFV-IFA 006	V5.2.1	2024-11
ETSI GS NFV-IFA 007	V5.2.1	2024-12
ETSI GS NFV-IFA 008	V5.2.1	2024-12
ETSI GS NFV-IFA 010	V5.2.1	2024-11
ETSI GS NFV-IFA 011	V5.2.1	2024-11
ETSI GS NFV-IFA 013	V5.2.1	2024-12
ETSI GS NFV-IFA 014	V5.2.1	2024-11
ETSI GS NFV-IFA 026	V5.2.1	2024-12
ETSI GS NFV-IFA 027	V5.2.1	2024-09
ETSI GS NFV-IFA 030	V5.1.1	Not republished
ETSI GS NFV-IFA 031	V5.2.1	2024-11
ETSI GS NFV-IFA 032	V5.2.1	2024-11
ETSI GS NFV-IFA 036	V5.2.1	2024-12
ETSI GS NFV-IFA 040	V5.2.1	2024-12
ETSI GS NFV-IFA 045	V5.2.1	2024-11
ETSI GS NFV-IFA 047	V5.1.1	Not republished
ETSI GS NFV-IFA 048	V5.2.1	2024-12
ETSI GS NFV-IFA 049	V5.2.1	2024-12
ETSI GS NFV-IFA 050	V5.2.1	2024-11
ETSI GS NFV-IFA 052	V5.2.1	2024-11
ETSI GS NFV-IFA 053	V5.2.1	2024-11

6.4 Stage 3 Group Specifications

6.4.1 New Group Specifications

The published new specifications associated to the Release 5 are listed in Table 6.4.1-1.

Table 6.4.1-1: Newly published stage 3 Group Specifications

Document Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-SOL 025	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Protocols and Data Models; Specification of protocol and data model solutions for Telco Cloud data analytics service	FEAT20

6.4.2 Evolved/propagated published deliverables from a previous Release

The published deliverables associated to the Release 5 that have been evolved/propagated from a previous Release are listed in Table 6.4.2-1.

Table 6.4.2-1: Published stage 3 deliverables evolved/propagated from a previous Release

Document Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-SOL 001	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Protocols and Data Models; NFV descriptors based on TOSCA specification	FEAT21, FEAT30, FEAT31, FEAT35
ETSI GS NFV-SOL 002	V5.2.1	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Ve-Vnfm Reference Point	FEAT31, FEAT35
ETSI GS NFV-SOL 003	V5.2.1	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Or-Vnfm Reference Point	FEAT31, FEAT35
ETSI GS NFV-SOL 004	V5.1.1	Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; VNF Package and PNFD Archive specification	See note.
ETSI GS NFV-SOL 005	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Protocols and Data Models; RESTful protocols specification for the Os-Ma-nfvo Reference Point	FEAT30, FEAT35
ETSI GS NFV-SOL 009	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Protocols and Data Models; RESTful protocols specification for the management of NFV-MANO	FEAT35
ETSI GS NFV-SOL 013	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Protocols and Data Models; Specification of common aspects for RESTful NFV MANO APIs	See note.
ETSI GS NFV-SOL 014	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Protocols and Data Models; YAML data model specification for descriptor-based virtualised resource management	See note.
ETSI GS NFV-SOL 016	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Protocols and Data Models; NFV-MANO procedures specification	FEAT35
ETSI GS NFV-SOL 018	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Protocols and Data Models; Profiling specification of protocol and data model solutions for OS Container management and orchestration	ENH01.01
ETSI GS NFV-SOL 020	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Protocols and Data Models Specification of protocols and data models for Container Infrastructure Service Cluster Management	See note.
NOTE: The specification has been updated into the present Release 5, but without outcomes of specific Release 5 features (only including e.g. maintenance performed in previous specification versions).			

6.4.3 Stage 3 publication packages

As indicated in Annex A of the present document, 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 5 stage 3 Package 1:

Table 6.4.3-1 lists the deliverables that are part of Release 5 stage 3 Package 1.

Table 6.4.3-1: Deliverables part of Release 5 stage 3 Package 1

Document Id.	Version	Publication date (year-month)
ETSI GS NFV-SOL 001	V5.1.1	2024-07
ETSI GS NFV-SOL 002	V5.1.1	2024-07
ETSI GS NFV-SOL 003	V5.1.1	2024-07
ETSI GS NFV-SOL 004	V5.1.1	2024-07
ETSI GS NFV-SOL 005	V5.1.1	2024-07
ETSI GS NFV-SOL 009	V5.1.1	2024-07
ETSI GS NFV-SOL 013	V5.1.1	2024-07
ETSI GS NFV-SOL 014	V5.1.1	2024-07
ETSI GS NFV-SOL 016	V5.1.1	2024-08
ETSI GS NFV-SOL 018	V5.1.1	2024-07
ETSI GS NFV-SOL 020	V5.1.1	2024-07

Release 5 stage 3 Package 2:

Table 6.4.3-2 lists the deliverables that are part of Release 5 stage 3 Package 2.

Table 6.4.3-2: Deliverables part of Release 5 stage 3 Package 2

Document Id.	Version	Publication date (year-month)
ETSI GS NFV-SOL 001	V5.2.1	2024-12
ETSI GS NFV-SOL 002	V5.2.1	2024-12
ETSI GS NFV-SOL 003	V5.2.1	2025-01
ETSI GS NFV-SOL 004	V5.1.1	Not republished
ETSI GS NFV-SOL 005	V5.2.1	2024-12
ETSI GS NFV-SOL 009	V5.2.1	2024-12
ETSI GS NFV-SOL 013	V5.2.1	2024-12
ETSI GS NFV-SOL 014	V5.2.1	2024-12
ETSI GS NFV-SOL 016	V5.2.1	2025-05
ETSI GS NFV-SOL 018	V5.2.1	2025-05
ETSI GS NFV-SOL 020	V5.2.1	2025-03
ETSI GS NFV-SOL 025	V5.2.1	2025-03

6.5 Security Specifications

6.5.1 Newly published Security Specifications

The published new security specifications associated to the Release 5 are listed in Table 6.5.1-1.

Table 6.5.1-1: Newly published security specifications

Document Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-SEC 029	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Security; Security Assurance Specification (SCAS) for VIM	
ETSI GS NFV-SEC 030	V5.2.1	Network Function Virtualisation (NFV) Release 5; Security; Security Assurance Specification (SCAS) for VNFM	
ETSI GS NFV-SEC 031	V5.2.1	Network Function Virtualisation (NFV) Release 5; Security; Security Assurance Specification (SCAS) for NFVO	

6.5.2 Evolved/propagated published Security Specifications

The deliverables associated to the Release 5 that have been evolved/propagated from a previous Release are listed in Table 6.5.2-1.

Table 6.5.2-1: Published security specifications evolved/propagated from a previous Release

Document Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-IFA 026	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Security Architecture enhancements for NFV Specification	ENH01.01
ETSI GS NFV-IFA 033	V5.2.1	Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Reference points related to Security Manager and Certificate Management Function - Interface and Information Model Specification	ENH01.01
ETSI GS NFV-SEC 028	V5.1.1	Network Functions Virtualisation (NFV) Release 5; Security; Security Assurance Specification (SCAS) for Generic NFV-MANO	See note.
NOTE: The specification has been updated into the present Release 5, but without outcomes of specific Release 5 features (e.g. maintenance).			

6.5.3 Release independent Security Documents

The release independent deliverables relevant for Release 5 are listed in Table 6.5.3-1.

Table 6.5.3-1: Release independent Security Documents

Document Id.	Version(s)	Title
ETSI GS NFV-SEC 001	V1.1.1	Network Functions Virtualisation (NFV); NFV Security; Problem Statement
ETSI GS NFV-SEC 002	V1.1.1	Network Functions Virtualisation (NFV); NFV Security; Cataloguing security features in management software
ETSI GR NFV-SEC 003	V1.3.1	Network Functions Virtualisation (NFV); NFV Security; Security and Trust Guidance
ETSI GS NFV-SEC 004	V1.1.1	Network Functions Virtualisation (NFV); NFV Security; Privacy and Regulation; Report on Lawful Interception Implications
ETSI GS NFV-SEC 006	V1.1.1	Network Functions Virtualisation (NFV); Security Guide; Report on Security Aspects and Regulatory Concerns
ETSI GR NFV-SEC 007	V1.2.1	Network Functions Virtualisation (NFV); Trust; Report on Attestation Technologies and Practices for Secure Deployments
ETSI GR NFV-SEC 009	V1.3.1	Network Functions Virtualisation (NFV); NFV Security; Report on use cases and technical approaches for multi-layer host administration

Document Id.	Version(s)	Title
ETSI GR NFV-SEC 016	V1.2.1	Network Functions Virtualisation (NFV); Security; Location, locstamp and timestamp; Report on location, timestamping of VNFs
ETSI GS NFV-SEC 020	work ongoing	Network Functions Virtualisation (NFV); Security; Identity Management and Security Specification
ETSI GS NFV-SEC 024	work ongoing	Network Functions Virtualisation (NFV) Security; Security Management Specification
ETSI GS NFV-SEC 025	work ongoing	Network Functions Virtualisation (NFV) ; Security; Secure End-to-End VNF and NS management specification
ETSI GS NFV-SEC 026	work ongoing	Network Functions Virtualisation (NFV); Security; Isolation and trust domain specification

Table 6.5.3-2 lists security specifications from earlier releases that are considered valid in Release 5 without change:

Table 6.5.3-2: Other security specifications valid in Release 5

Document Id.	Version(s)	Title
ETSI GS NFV-SEC 012	V3.1.1	Network Functions Virtualisation (NFV) Release 3; Security; System architecture specification for execution of sensitive NFV components
ETSI GS NFV-SEC 013	V3.1.1	Network Functions Virtualisation (NFV) Release 3; Security ; Security Management and Monitoring specification
ETSI GS NFV-SEC 014	V3.1.1	Network Functions Virtualisation (NFV) Release 3; NFV Security; Security Specification for MANO Components and Reference points

6.6 Testing specifications

The newly published deliverables of Release 5 specifying testing aspects are listed in Table 6.6-1.

Table 6.6-1: Published deliverables related to testing

Document Id.	Version(s)	Title	Related feature(s)
ETSI GS NFV-TST 010	work ongoing	Network Functions Virtualisation (NFV) Release 5; Testing; API Conformance Testing Specification	

6.7 Other documentation

The release independent documents valid in Release 5 are listed in Table 6.7-1.

Table 6.7-1: Release independent documents

Document Id.	Version(s)	Title	Description
ETSI GR NFV 003	V1.9.1	Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV	It includes terminology used across several NFV Releases. As a result, a number of terms and acronyms introduced in Release 4 are added in the newest version.

Document Id.	Version(s)	Title	Description
ETSI GS NFV-SOL 015	V1.2.1	Network Functions Virtualisation (NFV); Protocols and Data Models; Specification of Patters and Conventions for RESTful NFV-MANO APIs	It 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.
ETSI GR NFV-TST 006	V1.2.1	Network Functions Virtualisation (NFV); Testing; Report on CICD and DevOps	It provides guidance and recommendations on how to leverage DevOps and CI/CD techniques.

Table 6.7-2 lists specifications from earlier releases that are considered valid in Release 5 without change:

Table 6.7-2: Other specifications valid in Release 5

Document Id.	Version(s)	Title
ETSI GS NFV-REL 006	V3.1.1	Network Functions Virtualisation (NFV) Release 3; Reliability; Maintaining Service Availability and Continuity Upon Software Modification
ETSI GS NFV-IFA 018	V3.1.1	Network Functions Virtualisation (NFV); Acceleration Technologies; Network Acceleration Interface Specification; Release 3
ETSI GS NFV-IFA 019	V3.1.1	Network Functions Virtualisation (NFV); Acceleration Technologies; Acceleration Resource Management Interface Specification; Release 3

6.8 Map of ETSI NFV specifications and the NFV Architectural Framework

NFV Release 4 documentation is, to a great extent, 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 6.8-1 is based on Figure 5.2-3 in ETSI GS NFV 006 [i.6] and illustrates a mapping of ETSI NFV specifications to the reference points and service interfaces shown in the NFV Architectural Framework diagram:

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

The following specifications are not shown in the diagram:

- ETSI GS NFV 006 (NFV-MANO architecture)
- ETSI GS NFV-IFA 010 (NFV-MANO functional requirements)
- ETSI GR NFV-IFA 024 (GR, external touchpoints)
- ETSI GS NFV-IFA 026 (Security Architecture enhancements)
- ETSI GS NFV-IFA 027 (Performance metrics)
- ETSI GS NFV-IFA 033 (Security Manager and Certificate Management Function)
- ETSI GS NFV-IFA 045 (Fault and alarm models)
- ETSI GS NFV-IFA 047 (Management data analytics Service)
- ETSI GS NFV-IFA 048 (Policy Information Model)

- ETSI GS NFV-IFA 049 (VNF generic OAM functions specification)
- ETSI GS NFV-IFA 050 (Intent Management Service)
- ETSI GS NFV-IFA 053 (Physical Infrastructure Management)
- ETSI GS NFV-IFA 055 (Non-functional reliability requirements)
- ETSI GS NFV-SOL 012 (Policy Management)
- ETSI GS NFV-SOL 013 (API common aspects)
- ETSI GS NFV-SOL 015 (Patters and Conventions for APIs)
- ETSI GS NFV-SOL 016 (NFV-MANO procedures)
- ETSI GS NFV-SOL 021 (Intent Management Service)
- ETSI GS NFV-SOL 022 (Policy descriptor)
- ETSI GS NFV-SOL 023 (CMF-MANO reference point)
- ETSI GS NFV-SOL 024 (Generic OAM functions and PaaS Services)
- ETSI GS NFV-SOL 025 (Telco cloud data analytics service)
- ETSI GS NFV-SEC 022 (Access Token Specification)
- ETSI GS NFV-SEC 028 (Security Assurance Specification)
- ETSI GS NFV-TST 010 (API Conformance Testing)
- Other Release 3 specifications and release independent specifications valid in Release 5 are listed in Table 6.7-2

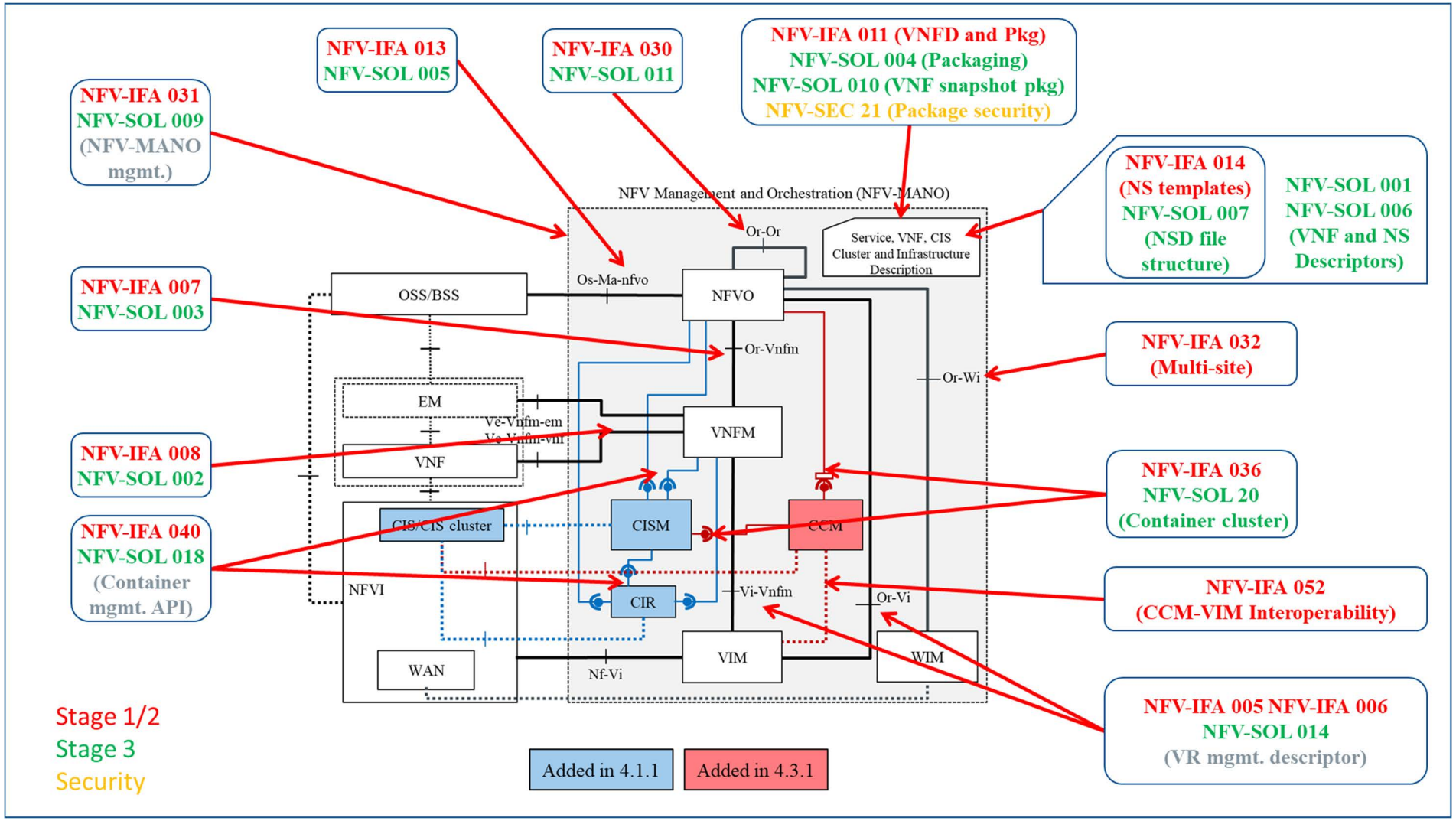

Figure 6.8-1: Map of ETSI NFV specifications and the NFV Architectural Framework

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 3.1.1 of a published deliverable denotes the publication within "drop #1" (version digit "a = 1"). Version 3.2.1 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. Feature #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 5 planning and definition

C.1 Introduction

The following clauses describe the planning and definition of the Release 5.

Feature details are not repeated but described here only for features not included in Release 5.

Feature progress can be monitored via the feature wiki [i.7] which is updated more frequently than the present document.

C.2 Schedule

Table C.2-1 shows the publication schedule for Release 5.

Table C.2-1: Schedule for Release 5

Stage	Edition 5.1.1	Edition 5.2.1	Edition 5.3.1	Edition 5.4.1
Studies	2024-05	-	-	-
Stage 1	2024-06	2024-12	2025-07	2025-12
Stage 2	2024-06	2024-12	2025-07	2025-12
Stage 3	2024-07	2025-01	2025-08	2026-01
Testing	2025-02	2025-08	2026-03	2026-08

C.3 Feature overview

During release definition of Release 5 there were 11 features started from Release 4 and 7 new feature proposals.

Table C.3-1 shows the features considered during planning of Release 5.

Table C.3-1: Features considered for Release 5

FEAT Id.	History	Title	Studies, etc.	Remark
FEAT19a	Extended Release 4	Enhanced container networking	IFA043	
FEAT19b	Carry over Release 4	NFV-Connect - connectivity integration and operationalization	IFA035 (published)	
FEAT20	Main parts in Release 4	Auto	IFA041, IFA047, IFA050	
FEAT21	Main parts in Release 4	5G	IFA037	
FEAT22	Carry over Release 4	M-Tenant	EVE018	The normative work is postponed and is to be considered within Release 6 scope in the context of possible evolution of NFV-MANO architecture.
FEAT23	Carry over Release 4	MANO-SBA	IFA039	The normative work is postponed and is to be considered within Release 6 scope in the context of possible evolution of NFV-MANO architecture.
FEAT24	Extended Release 4	VNF generic management functions	EVE019, IFA049	
FEAT25	Not started in Release 4	VNF-CI	TST006	No normative work in Release 5.
FEAT26	Extended Release 4	Policy Management Models	IFA042, IFA048 (published)	
FEAT27	New	NFV for vRAN	IFA046 (published)	
FEAT28	New	Fault Management Models	IFA045	The feature was planned for Release 5, but then added late to Release 4. No normative work in Release 5.
FEAT29	New	Green NFV	EVE021 (final draft)	
FEAT30	New	VNF configuration	EVE022 (published)	
FEAT31	New	Flexible VNF deployment (Release 5 extensions)	IFA044 (published)	
FEAT32	New	Reliability for cloud-native VNF	REL014 (final draft)	No normative work in Release 5.
FEAT33	New	Physical Infrastructure Management	No study, IFA053 started	
FEAT35	New	Follow-up from IFA051	IFA051 (final draft)	
ENH02.06	Extended Release 4	Support for parameter mapping artifacts for MCIOP input		The feature was completed in Release 4.
ENH01.01	Extended Release 4	Security Enhancements	IFA026, IFA033 (published)	

Release 4 features not included in Table C.3-1 are closed. Further work related to them can be done like maintenance work or a small enhancement is added.

No normative work expected as follow-up of the following studies:

- REL013, Report on cognitive use of operations data for reliability.
- EVE020, Report on NFV support for Network Function Connectivity eXtensions.

No further feature proposals expected for Release 5.

C.4 Feature details

C.4.1 FEAT22: Multi-tenancy enhancements for NFV-MANO (M-Tenant)

C.4.1.1 Description

The scope of the feature covers the following areas:

- Multi-tenancy technology to share IT resources securely among multiple tenants that use the cloud.
- Virtualisation-based features as a means to isolate tenants.
- Association/disassociation of tenancy and NFV-MANO objects.
- Definition of isolation expectations of tenants.
- Management of tenants.

C.4.1.2 Architecture scope

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

- Functional blocks and functions: all.
- Reference points and interfaces: all.

C.4.1.3 Documentation results in Release 5

The feature has been specified in the specifications and reports listed in Table C.4.1.3-1. Refer to clause 6 for the latest version available of the referred documents.

Table C.4.1.3-1: Documentation results of feature "Multi-tenancy enhancements for NFV-MANO"

Document Id.	Stage	Description of the feature result
ETSI GR NFV-EVE 018	V5.1.1	Report on Multi-tenancy in NFV

C.4.2 FEAT23: SBA for NFV-MANO (MANO-SBA)

C.4.2.1 Description

The scope of the feature covers the following areas:

- Service exposure to 3rd party access for selected NFV-MANO services.
- Assess steps in the SBA transformation (different steps have different levels of complexity), such as NFV-MANO service independence, modularization, data separation/split, exposure, dynamic registration and discovery of services.
- Optimal routing of service requests to NFV-MANO service instances, including load balancing and failover management.
- Enabling new interface consumers (e.g. policy engines, license managers, AI-based systems, etc.).

C.4.2.2 Architecture scope

The scope of the feature covers possible evolution of NFV-MANO architecture depending on the applied transformation target, as described in ETSI GR NFV-IFA 039.

C.4.2.3 Documentation results

The feature has been specified in the specifications and reports listed in Table C.4.2.3-1. The normative work is postponed and is to be considered within Release 6 scope in the context of possible evolution of NFV-MANO architecture.

Table C.4.2.3-1: Documentation results of feature "SBA for NFV-MANO"

Document Id.	Stage	Description of the feature result
ETSI GR NFV-IFA 039	Info V5.1.1	Report on Service Based Architecture (SBA) design

C.4.3 FEAT25: Continuous VNF integration (VNF-CI)

The feature was studied in ETSI GR NFV-TST 006 [i.4].

The scope of the feature covers the following areas:

- Optimization of the VNF Package structure and VNF.
- Test execution of test functions and feedback to VNF provider/developer.
- VNF/VNFC software component update/upgrade supporting continuous development and integration paradigms.

The "technical areas" covered by this feature are: A.2), D.1), and D.2).

This feature analyses and defines how to implement a "Joint Pipeline" to provide DevOps process between VNF providers and VNF operators. The feature also determines possible extensions of NFV MANO to realize such DevOps process.

C.4.4 FEAT28: Fault management models (FM-models)

C.4.4.1 Description

The feature was planned for Release 5, but parts of it were added late to Release 4.

The scope of the feature covers the following areas:

- Extend the information and data model of Alarms to address unspecified model elements and define applicable values to ensure proper processing of failure information and interoperability in between producers and consumers of the alarms.
- Enrich the fault management interfaces to exchange fault related closed loops information/results between different layers.
- Enable automated fault detection and performance degradation analysis with standardized metrics.

C.4.4.2 Architecture scope

C.4.4.3 Documentation Results

The feature has been specified in the specifications and reports listed in Table C.4.4.3-1. Refer to clause 6 for the latest version available of the referred documents.

Table C.4.4.3-1: Documentation results of feature "Fault management models"

Document Id.	Stage	Description of the feature result
ETSI GS NFV-IFA 045	Stage 1 and 2	Specify an information model for alarms associated to the objects that are managed by NFV-MANO. Provide related use cases, illustrating also the correlation of fault information and the use of the information in fault management processes.

C.4.5 FEAT32: Reliability for cloud-native VNF

C.4.5.1 Description

This feature provides study and guidelines on evaluating measurable reliability aspects of cloud-native VNFs during VNF management processes. Corresponding functional and non-functional requirements are derived for guiding reliability management during the operations and maintenance of cloud-native VNFs.

C.4.5.2 Architecture scope

This feature is foreseen to bring no new architectural elements in the NFV-MANO framework.

C.4.5.3 Documentation results

The feature has been specified in the specifications and reports listed in Table C.4.5.3-1. Refer to clause 6 for the latest version available of the referred documents.

Table C.4.5.3-1: Documentation results of feature "Reliability for cloud-native VNF"

Document Id.	Stage	Description of the feature result
ETSI GR NFV-REL 014	Info: V5.1.1	Report on evaluating reliability for cloud-native VNFs.

There are no normative provisions in Release 5.

Annex D:
Change history

Date	Version	Information about changes
January 2024	V5.0.1	First version of Release 5 All feature content updated. Rebased on NFV007ed451 version 444.
April 2024	V5.0.2	Update to Edition 5.1.1, stage 2 changes NFVTSC(24)000029r1 NFV007ed511 FEAT24 update NFVTSC(24)000030r1 NFV007ed511 FEAT21 update NFVTSC(24)000031r1 NFV007ed511 FEAT29 update NFVTSC(24)000032r1 NFV007ed511 FEAT30 update NFVTSC(24)000033 NFV007ed511 FEAT19b update NFVTSC(24)000034 NFV007ed511 FEAT33 PIM description update NFVTSC(24)000035 NFV007ed511 FEAT31 update NFVTSC(24)000036 NFV007ed511 Updates on general clauses NFVTSC(24)000037 NFV007ed511 FEAT35 update
May 2024	V5.0.3	NFVTSC(24)000041 NFV007ed511 Clause 4.3 past releases and editorials
August 2024	V5.0.4	NFVTSC(24)000062r1 NFV007ed511 Update for recent publications NFVTSC(24)000063 NFV007ed511 Remove testing parts
September 2024	V5.0.5	NFVTSC(24)000071 NFV007ed511 Final updates NFVTSC(24)000074 NFV007ed511 Remove FEAT22 from Release 5
May 2025	V5.1.2	NFVTSC(25)000008r3 Draft of NFV007 for ed521

History

Document history		
V5.1.1	November 2024	Publication
V5.2.1	August 2025	Publication