



Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Os-Ma-nfvo reference point - Interface and Information Model Specification

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ReferenceRGS/NFV-IFA013ed511

Keywordsinterface, management, MANO, NFV,
orchestration, virtualisation

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Foreword

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

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**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 defines the interfaces supported over the Os-Ma-nfvo reference point of the NFV-MANO architectural framework ETSI GS NFV 006 [i.10] as well as the information elements exchanged over those interfaces.

2 References

2.1 Normative 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.

Referenced documents which are not found to be publicly available in the expected location might be found at <https://docbox.etsi.org/Reference>.

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

The following referenced documents are necessary for the application of the present document.

- [1] [ETSI GS NFV-IFA 010](#): "Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Functional requirements specification".
- [2] [ETSI GS NFV-IFA 011](#): "Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; VNF Descriptor and Packaging Specification".
- [3] [ETSI GS NFV-IFA 014](#): "Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Network Service Templates Specification".
- [4] [Recommendation ITU-T X.733](#): "Information technology - Open Systems Interconnection - Systems Management: Alarm reporting function".
- [5] [ETSI GS NFV-IFA 027](#): "Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Performance Measurements Specification".
- [6] [ETSI GS NFV-IFA 048](#): "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Policy Information Model Specification".
- [7] [ETSI GS NFV-IFA 045](#): "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Faults and alarms modelling specification".

2.2 Informative references

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

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

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

- [i.1] ETSI GR NFV 003: "Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV".
- [i.2] Void.

- [i.3] ISO/IEC 9646-7: "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 7: Implementation Conformance Statements".
- [i.4] ETSI GS NFV-IFA 005: "Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Or-Vi reference point - Interface and Information Model Specification".
- [i.5] ETSI GS NFV-IFA 007: "Network Functions Virtualisation (NFV) Release 5; Management and Orchestration; Or-Vnfm reference point - Interface and Information Model Specification".
- [i.6] ETSI GS NFV-IFA 009: "Network Functions Virtualisation (NFV); Management and Orchestration; Report on Architectural Options".
- [i.7] Void.
- [i.8] IEEE 802.1Q™-2018: "IEEE Standard for Local and metropolitan area networks - Bridges and Bridged Networks".
- [i.9] ETSI GR NFV-IFA 023: "Network Functions Virtualisation (NFV); Management and Orchestration; Report on Policy Management in Mano; Release 3".
- [i.10] ETSI GS NFV 006: "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Architectural Framework Specification".
- [i.11] ETSI GS NFV-IFA 026: "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Architecture enhancement for Security Management Specification".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI GR NFV 003 [i.1] and the following apply:

Compute MCIO: MCIO which declarative descriptor specifies compute infrastructure resource requests

deployable module: set of optional VDUs, specified in the VNFD for a particular VNF deployment flavour, which are used to create VNFC instances only if selected by the consumer in a VNF lifecycle management operation

NOTE: This definition is from ETSI GS NFV-IFA 010 [1].

Network MCIO: MCIO which declarative descriptor specifies network infrastructure resource requests

policy group: construct including a set of NFV-MANO policies intended to be operated holistically

Storage MCIO: MCIO which declarative descriptor specifies storage infrastructure resource requests

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI GR NFV 003 [i.1] and the following apply:

NOTE: An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in ETSI GR NFV 003 [i.1].

CMF Certificate Management Function

4 Overview of interfaces and information elements associated to the Os-Ma-nfvo reference point

4.1 Introduction

This clause provides an overview of interfaces and information models associated to the Os-Ma-nfvo reference point.

The Os-Ma-nfvo reference point is used for exchanges between the OSS/BSS and the NFV Orchestrator (NFVO), and supports the following interfaces:

- Network Service Descriptor (NSD) Management (produced by the NFVO, consumed by the OSS/BSS).
- Network Service (NS) Lifecycle Management (produced by the NFVO, consumed by the OSS/BSS).
- NS Performance Management (produced by the NFVO, consumed by the OSS/BSS).
- NS Fault Management (produced by the NFVO, consumed by the OSS/BSS).
- VNF Package Management (produced by the NFVO, consumed by the OSS/BSS).
- Policy Management (produced by the NFVO, consumed by the OSS/BSS).
- VNF Snapshot Package Management (produced by the NFVO, consumed by the OSS/BSS).
- LCM Coordination (produced by OSS/BSS, consumed by NFVO).

The information elements exchanged via the interfaces above are also part of the present document.

4.2 Relation to other NFV group specifications

The present document is referencing information from the following ISG NFV Group Specifications:

- Management and Orchestration - Report on Architectural Options ETSI GS NFV-IFA 009 [i.6]:
 - ETSI GS NFV-IFA 009 [i.6] provides architectural options that can influence the way some of the Os-Ma-nfvo interfaces are used or might even suggest the need for extension.
- Management and Orchestration - Functional requirements specification ETSI GS NFV-IFA 010 [1]:
 - Interfaces associated with the Os-Ma-nfvo reference point are based on the functional requirements specified in ETSI GS NFV-IFA 010 [1] for the NFVO FB.
- Management and Orchestration - Or-Vnfm reference point - Interface and Information Model Specification ETSI GS NFV-IFA 007 [i.5].

4.3 Conventions

The following notations, defined in ISO/IEC 9646-7 [i.3], are used for the qualifier column of interface information elements:

- M mandatory - the capability is required to be supported.
- O optional - the capability may be supported or not.
- CM conditional mandatory - the capability is required to be supported and is conditional on the support of some condition. This condition shall be specified in the Description column.
- CO conditional optional - the capability may be supported or not and is conditional on the support of some condition. This condition shall be specified in the Description column.

The following notation is used for parameters that represent identifiers, and for attributes that represent identifiers in information elements and notifications:

- If parameters are referring to an identifier of an actual object, their type is "Identifier".
- If an object (information element or notification) contains an attribute that identifies the object, the type of that attribute is "Identifier" and the description states that the attribute is the identifier of that particular notification or information element.

EXAMPLE 1: Identifier "resourceId" of the "NetworkSubnet information element" has type "Identifier" and description "Identifier of this NetworkSubnet information element".

- If an object (information element or notification) contains an attribute that references another object or objects defined in an ETSI NFV GS, the type of the attribute is "Identifier", followed by the list of objects it references.

EXAMPLE 2: "Identifier (Reference to Vnfc)" or "Identifier (Reference to Vnfc, Virtual Link (VL) or VirtualStorage)".

- If the type of a parameter or attribute has been marked as "Not specified" in the "Content" column, this means that its specification is part of the protocol design/data model design.

5 Reference point and interface requirements

5.1 Introduction

This clause defines requirements applicable to interfaces in the specific context of the Os-Ma-nfvo reference point.

5.2 Os-Ma-nfvo reference point requirements

Table 5.2-1 specifies requirements applicable to the Os-Ma-nfvo reference point.

Table 5.2-1: Os-Ma-nfvo reference point requirements

Numbering	Functional requirement description
Os-Ma-nfvo.001	The Os-Ma-nfvo reference point shall support the NSD Management interface produced by the NFVO.
Os-Ma-nfvo.002	The Os-Ma-nfvo reference point shall support the NS Lifecycle Management interface produced by the NFVO.
Os-Ma-nfvo.003	Void.
Os-Ma-nfvo.004	The Os-Ma-nfvo reference point shall support the NS Performance Management interface produced by the NFVO.
Os-Ma-nfvo.005	The Os-Ma-nfvo reference point shall support the NS Fault Management interface produced by the NFVO.
Os-Ma-nfvo.006	The Os-Ma-nfvo reference point shall support the VNF Package Management interface produced by the NFVO.
Os-Ma-nfvo.007	Any interaction on the Os-Ma-nfvo reference point concerning a VNF shall be associated with at least one NS instance.
Os-Ma-nfvo.008	The Os-Ma-nfvo reference point shall support the NFVI Capacity Information interface produced by the NFVO.
Os-Ma-nfvo.009	The Os-Ma-nfvo reference point shall support the Policy Management interface produced by the NFVO.
Os-Ma-nfvo.010	The Os-Ma-nfvo reference point shall support the VNF Snapshot Package Management interface produced by the NFVO.
Os-Ma-nfvo.011	The Os-Ma-nfvo reference point may support the LCM Coordination interface produced by OSS/BSS (see note).
NOTE: The dependency on the LCM Coordination interface is declared in the NSD.	

5.3 Interface requirements

5.3.1 NSD Management interface requirements

Table 5.3.1-1 specifies requirements applicable to the NSD management interface produced by the NFVO on the Os-Ma-nfvo reference point.

Table 5.3.1-1: NSD management interface requirements

Numbering	Functional requirement description
Os-Ma-nfvo.Nsd.001	The NSD Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support on-boarding NSD.
Os-Ma-nfvo.Nsd.002	The NSD Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support disabling an NSD.
Os-Ma-nfvo.Nsd.003	The NSD Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support enabling an NSD.
Os-Ma-nfvo.Nsd.004	The NSD Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support updating an NSD. See note.
Os-Ma-nfvo.Nsd.005	The NSD Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support querying NSDs.
Os-Ma-nfvo.Nsd.006	The NSD Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support deleting an NSD.
Os-Ma-nfvo.Nsd.007	The NSD Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support providing notifications about the on-boarding of NSDs.
Os-Ma-nfvo.Nsd.008	The NSD Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support providing notifications as a result of changes on NSD states.
Os-Ma-nfvo.Nsd.009	The NSD Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support on-boarding Physical Network Function Descriptor (PNFD).
Os-Ma-nfvo.Nsd.010	The NSD Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support updating a PNFD.
Os-Ma-nfvo.Nsd.011	The NSD Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support deleting a PNFD.
Os-Ma-nfvo.Nsd.012	The NSD Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support querying PNFs.
Os-Ma-nfvo.Nsd.013	The NSD Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support subscribing to notifications related to NSD management changes.
Os-Ma-nfvo.Nsd.014	The NSD Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support fetching an NSD, or selected artifacts contained in an NSD archive.
Os-Ma-nfvo.Nsd.015	The NSD Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support fetching a PNFD, or selected artifacts contained in an NSD archive.
Os-Ma-nfvo.Nsd.016	The NSD Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support providing notifications about the on-boarding of PNFs.
Os-Ma-nfvo.Nsd.017	The NSD Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support providing notifications about the deletion of PNFs.
NOTE:	Updating an NSD can include changing the operational state of the NSD and updating the user defined data.

5.3.2 NS Lifecycle Management interface requirements

Table 5.3.2-1 specifies requirements applicable to the network service lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point.

Table 5.3.2-1: Network service lifecycle management interface requirements

Numbering	Functional requirement description
Os-Ma-nfvo.NsLcm.001	The NS Lifecycle Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support instantiating an NS.
Os-Ma-nfvo.NsLcm.002	The NS Lifecycle Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support terminating an NS.
Os-Ma-nfvo.NsLcm.003	The NS Lifecycle Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support querying NSs.
Os-Ma-nfvo.NsLcm.004	The NS Lifecycle Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support scaling an NS.

Numbering	Functional requirement description
Os-Ma-nfvo.NsLcm.005	The NS Lifecycle Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support updating an NS.
Os-Ma-nfvo.NsLcm.006	The NS Lifecycle Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support creating a classification and selection rule for the existing Network Forwarding Path (NFP) instance.
Os-Ma-nfvo.NsLcm.007	The NS Lifecycle Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support updating the classification and selection rule for the existing NFP instance.
Os-Ma-nfvo.NsLcm.008	The NS Lifecycle Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support instantiating an NS which includes existing VNF instance(s). See notes 1 and 3.
Os-Ma-nfvo.NsLcm.009	The NS Lifecycle Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support updating an NS which includes existing VNF instance(s). See notes 2 and 3.
Os-Ma-nfvo.NsLcm.010	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support healing an NS.
Os-Ma-nfvo.NsLcm.011	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support sharing a VNF instance or a nested NS instance between multiple NS instances. See note 3.
Os-Ma-nfvo.NsLcm.012	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support instantiating a VNF instance explicitly as part of the update of an NS.
Os-Ma-nfvo.NsLcm.013	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support adding/removing an existing VNF instance to/from an NS instance as part of the update of an NS. See note 4.
Os-Ma-nfvo.NsLcm.014	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support scaling a VNF instance explicitly as part of the scaling of an NS.
Os-Ma-nfvo.NsLcm.015	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support querying information about a VNF instance as part of the query of an NS.
Os-Ma-nfvo.NsLcm.016	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support healing a VNF instance explicitly as part of the healing of an NS.
Os-Ma-nfvo.NsLcm.017	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support changing the state of a VNF instance explicitly as part of the update of an NS. See note 5.
Os-Ma-nfvo.NsLcm.018	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support changing the Deployment Flavour (DF) of a VNF instance explicitly as part of the update of an NS.
Os-Ma-nfvo.NsLcm.019	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support modifying information and/or the configuration parameters of a VNF instance explicitly as part of the update of an NS.
Os-Ma-nfvo.NsLcm.036	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support changing the external connectivity of a VNF instance explicitly as part of the update of an NS.
Os-Ma-nfvo.NsLcm.021	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support providing additional affinity or anti-affinity rules when instantiating an NS.
Os-Ma-nfvo.NsLcm.035	The NS Lifecycle Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support creating an NS instance identifier and the associated instance of an NS information element.
Os-Ma-nfvo.NsLcm.022	The NS Lifecycle Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support deleting an NS instance identifier and the associated instance of an NS information element.
Os-Ma-nfvo.NsLcm.023	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support adding/removing an existing nested NS instance to/from an NS instance explicitly as part of the update of an NS.
Os-Ma-nfvo.NsLcm.024	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support adding new Service Access Point (SAP) to an NS and removing existing SAP from an NS explicitly as part of the update of an NS.
Os-Ma-nfvo.NsLcm.025	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support associating a new NSD version to an existing NS instance explicitly as part of the update of an NS.
Os-Ma-nfvo.NsLcm.026	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support moving existing VNF instance(s) from one NS instance (source) to another NS instance (destination) explicitly as part of the update of an NS.
Os-Ma-nfvo.NsLcm.027	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support adding a new VNFFG to an NS instance, remove existing VNF Forwarding Graph (VNFFG) and updating a VNFFG from an NS instance explicitly as part of the update of an NS.

Numbering	Functional requirement description
Os-Ma-nfvo.NsLcm.028	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support querying the status of an NS lifecycle management operation.
Os-Ma-nfvo.NsLcm.029	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support providing to the OSS/BSS notifications about changes of an NS instance that are related to NS lifecycle management operations.
Os-Ma-nfvo.NsLcm.030	Notifications provided on the NS lifecycle interface produced by the NFVO on the Os-Ma-nfvo reference point shall contain information about the type of the NS lifecycle change, the addition/deletion/modification of VNFs and/or Physical Network Functions (PNFs), about change in the connectivity between elements of the NS. See note 7.
Os-Ma-nfvo.NsLcm.031	Notifications provided on the NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall contain information about the VLs and VNFFGs that are added/modified/deleted as part of the NS lifecycle operation. See note 6.
Os-Ma-nfvo.NsLcm.032	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support notifying the result (successful or failed) of NS instantiation with indicating the NS instance Id.
Or-Ma-nfvo.NsLcm.033	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support providing to the OSS/BSS notifications about creation and deletion of an NS instance identifier and the associated instance of an NS information element, further referred to as NS identifier creation/deletion notifications.
Or-Ma-nfvo.NsLcm.034	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support subscribing to NS lifecycle change notifications and to NS identifier creation/deletion notifications.
Or-Ma-nfvo.NsLcm.037	The NS Lifecycle Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support the capability to invoke NS error handling operation(s) after the NS life cycle operation occurrence fails. See note 8 and note 9.
Or-Ma-nfvo.NsLcm.038	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support creating VNF Snapshots explicitly as part of the update of an NS.
Or-Ma-nfvo.NsLcm.039	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support reverting to VNF Snapshots explicitly as part of the update of an NS.
Or-Ma-nfvo.NsLcm.040	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support deleting available VNF Snapshot information explicitly as part of the update of an NS.
Or-Ma-nfvo.NsLcm.041	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support querying information about available VNF Snapshots as part of the query of an NS.
Os-Ma-nfvo.NsLcm.043	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support changing the current VNF package of a VNF instance explicitly as part of the update of an NS.
Or-Ma-nfvo.NsLcm.042	Notifications provided on the NS lifecycle interface produced by the NFVO on the Os-Ma-nfvo reference point shall include appropriate error information. See note 10.
Os-Ma-nfvo.NsLcm.044	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support modifying information and/or the configuration parameters of WAN connectivity as part of the update of an NS.
Os-Ma-nfvo.NsLcm.045	The NS lifecycle Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support providing descriptor identifiers of NSD constituents to override the identifiers indicated in the NSD when these constituents are instantiated or added to the NS. See notes 11 and 12.
Os-Ma-nfvo.NsLcm.046	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support creating Data Flow Mirroring Job(s) as part of the update of an NS.
Os-Ma-nfvo.NsLcm.047	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support deleting existing Data Flow Mirroring Job(s) as part of the update of an NS.
Os-Ma-nfvo.NsLcm.048	The NS lifecycle management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support updating existing Data Flow Mirroring Job(s) as part of the update of an NS.
Os-Ma-nfvo.NsLcm.049	The NS lifecycle Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support providing information related to version dependencies between NSD constituents to override the version dependencies indicated in the NSD when these constituents are instantiated, updated or added to the NS. See notes 11 and 12.
Os-Ma-nfvo.NsLcm.050	The NS lifecycle Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support providing certificate configuration data and modifying information and/or the configuration parameters of certificate management as part of the creating an NS instance identifier.

Numbering	Functional requirement description
NOTE 1:	The existing VNF instance(s) may need to be modified as part of NS instantiation.
NOTE 2:	The existing VNF instance(s) may need to be modified as part of NS update.
NOTE 3:	A VNF instance or a nested NS instance can be shared between NS instances managed by the same NFVO.
NOTE 4:	If the VNF instance being removed is no longer part of any NS instance, it will be terminated.
NOTE 5:	Changing the state of a VNF instance refers to starting or stopping a VNF instance. These operations are complementary to instantiating or terminating a VNF.
NOTE 6:	This provides information about VLs and VNFFGs points used by the NS and whose creation was triggered by the NFVO.
NOTE 7:	The modification of VNFs includes VNF scaling, change of VNF flavours, VNF healing, change of VNF operational state, modification of VNF information, and/or VNF configuration parameters and the change of VNF external connectivity.
NOTE 8:	The details of the error handling operation(s) are part of the protocol design.
NOTE 9:	It depends on the NS capabilities whether and how the operation(s) are supported by a particular NS.
NOTE 10:	In case of resource shortage and parallel LCM operations, appropriate error information includes information about pre-emption by higher priority operations.
NOTE 11:	This requirement does not imply a modification of the NSD.
NOTE 12:	When it affects new instances of VNFs, nested NSs or PNFs, the descriptor and version dependency referred in the interface will be used for the instantiation. When it affects existing instances of VNFs and nested NSs to be included in the NS, these instances shall have been based on the descriptors and version dependencies indicated in the interface.

5.3.3 Void

5.3.4 NS Performance Management interface requirements

Table 5.3.4-1 specifies requirements applicable to the network service performance management interface produced by the NFVO on the Os-Ma-nfvo reference point.

Table 5.3.4-1: Network service performance management interface requirements

Numbering	Requirements description
Os-Ma-nfvo.NsPm.001	The NS Performance Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall enable the OSS/BSS to control the collection and reporting of performance information for NSs.
Os-Ma-nfvo.NsPm.002	The NS Performance Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support the capability to notify the availability of performance information and to manage subscriptions to such notifications. See note 1.
Os-Ma-nfvo.NsPm.003	The NS Performance Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall expose the type of performance information that the NFVO can collect from the NSs.
Os-Ma-nfvo.NsPm.004	The NS Performance Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall enable the OSS/BSS to create a PM job specifying the type of resource(s) and performance information that the OSS/BSS requires.
Os-Ma-nfvo.NsPm.005	The NS Performance Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall enable the OSS/BSS to create a PM job specifying the granularity for collection and reporting of performance information on NSs.
Os-Ma-nfvo.NsPm.006	The NS Performance Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall enable the OSS/BSS to delete one or more explicitly identified PM job(s).
Os-Ma-nfvo.NsPm.007	The NS Performance Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support periodic collection of performance information (bounded or unbounded).
Os-Ma-nfvo.NsPm.008	The NS Performance Management interface produced by the NFVO on the Os-Ma-nfvo reference shall support the grouping of measurements. See note 2.
Os-Ma-nfvo.NsPm.009	The NS Performance Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall enable the OSS/BSS to manage the thresholds on the performance information collected by the NFVO for NSs. See note 3.
Os-Ma-nfvo.NsPm.010	The NS Performance Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support the capability to notify about a threshold defined for a specified metric of NSs being crossed and to manage subscriptions to such notifications.
Os-Ma-nfvo.NsPm.011	The NS Performance Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall enable the OSS/BSS to receive notifications related to threshold crossing.

Numbering	Requirements description
Os-Ma-nfvo.NsPm.012	The NS Performance Management interface produced by the NFVO on the Os-Ma-nfvo reference point should support querying the list of active PM jobs and defined threshold conditions by the consumer entity that created them.
Os-Ma-nfvo.NsPm.013	The NS Performance Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support the deletion of threshold conditions on the performance information collected by the NFVO for NSs.
NOTE 1:	Performance information on a given NS results from either collected performance information of the virtualised resources impacting the connectivity of this NS instance or VNF performance information issued by the VNFM for the VNFs that is part of this NS instance. The latter performance information also results from collected performance information of the virtualised resources.
NOTE 2:	The group does not imply any modification/aggregation of performance measurements data and may be viewed as an alias for a pre-defined list of measurements. The group can be created by VNF, by NS, by virtual machine, etc.
NOTE 3:	Management of thresholds includes creation, deletion and query of the thresholds on the performance information collected.

5.3.5 NS Fault Management interface requirements

Table 5.3.5-1 specifies requirements applicable to the network service fault management interface produced by the NFVO on the Os-Ma-nfvo reference point.

Table 5.3.5-1: Network service fault management interface requirements

Numbering	Requirements description
Os-Ma-nfvo.NsFm.001	The NS Fault Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support collecting NSs fault information. See note.
Os-Ma-nfvo.NsFm.002	The NS Fault Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support providing alarm notifications related to faults on NSs to the OSS/BSS.
Os-Ma-nfvo.NsFm.003	The NS Fault Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support providing a notification when there is a change in the alarm information on NS.
Os-Ma-nfvo.NsFm.004	The NS Fault Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support the sending of notification to the OSS/BSS when an alarm on an NS has been created.
Os-Ma-nfvo.NsFm.005	The NS Fault Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support the sending of notification to the OSS/BSS when an alarm on an NS has been cleared.
Os-Ma-nfvo.NsFm.006	The NS Fault Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall allow unambiguous identification of the alarm on an NS sent to the OSS/BSS.
Os-Ma-nfvo.NsFm.007	The NS Fault Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall allow unambiguous identification of the NS causing the alarm.
Os-Ma-nfvo.NsFm.008	The NS Fault Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall allow unambiguous identification of the alarm cause.
Os-Ma-nfvo.NsFm.009	The NS Fault Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support alarm acknowledgement.
Os-Ma-nfvo.NsFm.010	The NS Fault Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support the sending of notification to the OSS/BSS when the alarm list has been rebuilt.
NOTE:	Fault information on a given NS instance can include the information related to the alarm (e.g. alarm created, alarm cleared, etc.), alarm cause(s) and identification of this NS instance and fault information concerning the virtualised resources supporting the constituent VNFs for this NS instance and the virtualised resources supporting the connectivity of this NS instance.

5.3.6 VNF Package Management interface requirements

Table 5.3.6-1 specifies requirements applicable to the VNF Package management interface produced by the NFVO on the Os-Ma-nfvo reference point.

Table 5.3.6-1: VNF Package management interface requirements

Numbering	Functional requirement description
Os-Ma-nfvo.VnfPkgm.001	The VNF Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support on-boarding a VNF Package.
Os-Ma-nfvo.VnfPkgm.002	The VNF Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support disabling a VNF Package.
Os-Ma-nfvo.VnfPkgm.003	The VNF Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support enabling a VNF Package.
Os-Ma-nfvo.VnfPkgm.004	The VNF Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support querying VNF Package information. See note 1.
Os-Ma-nfvo.VnfPkgm.005	The VNF Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support deleting a VNF Package.
Os-Ma-nfvo.VnfPkgm.006	The VNF Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support providing notifications about the on-boarding of VNF Packages.
Os-Ma-nfvo.VnfPkgm.007	The VNF Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support providing notifications as a result of changes on VNF Package states.
Os-Ma-nfvo.VnfPkgm.008	The VNF Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support fetching a VNF Package, or selected artifacts contained in a package.
Os-Ma-nfvo.VnfPkgm.009	Void.
Os-Ma-nfvo.VnfPkgm.010	The VNF Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support updating VNF Package information. See note 2.
NOTE 1: VNF Package information can include information such as release date, vendor info, manifest, VNFD, SW image meta-data, files contained in the VNF Package, etc.	
NOTE 2: Updating VNF package information can include changing the operational state of the VNF package and updating the user defined data.	

5.3.7 NFVI Capacity Information interface

Table 5.3.7-1 specifies requirements applicable to the NFVI Capacity Information interface produced by the NFVO on the Os-Ma-nfvo reference point.

Table 5.3.7-1: NFVI Capacity Information interface requirements

Numbering	Functional requirement description
Os-Ma-nfvo.NfviCi.001	The NFVI Capacity Information interface produced by the NFVO on the Os-Ma-nfvo reference point shall support querying NFVI capacity information.
Os-Ma-nfvo.NfviCi.002	The NFVI Capacity Information interface produced by the NFVO on the Os-Ma-nfvo reference point shall support providing notifications about capacity shortage and capacity threshold crossing in the NFVI. See note 1.
Os-Ma-nfvo.NfviCi.003	The NFVI Capacity Information interface produced by the NFVO on the Os-Ma-nfvo reference point shall enable the OSS/BSS to manage the thresholds on the NFVI capacity information collected by the NFVO. See note 2.
Os-Ma-nfvo.NfviCi.004	The NFVI Capacity Information interface produced by the NFVO on the Os-Ma-nfvo reference point shall support querying capacity information related with CIS clusters.
NOTE 1: Capacity shortage definitions are declared via NFVI capacity thresholds.	
NOTE 2: Management of thresholds includes creation, deletion and query of the thresholds on the NFVI capacity information collected.	

5.3.8 Policy Management interface requirements

Table 5.3.8-1 specifies requirements applicable to the policy management interface produced by the NFVO on the Os-Ma-nfvo reference point.

Table 5.3.8-1: Policy management interface requirements

Numbering	Requirements description
Os-Ma-nfvo.Plcm.001	The Policy Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support transferring NFV-MANO policies. See notes 1, 2 and 3.
Os-Ma-nfvo.Plcm.002	The Policy Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support deleting NFV-MANO policies. See note 1.
Os-Ma-nfvo.Plcm.003	The Policy Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support querying NFV-MANO policies. See note 1.
Os-Ma-nfvo.Plcm.004	The Policy Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support activating NFV-MANO policies. See note 1.
Os-Ma-nfvo.Plcm.005	The Policy Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support deactivating NFV-MANO policies. See note 1.
Os-Ma-nfvo.Plcm.006	The Policy Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support providing to the OSS/BSS notifications about changes of a policy that are related to operations of transferring policy, deleting policy, activating policy, deactivating policy, associating policy and disassociating policy.
Os-Ma-nfvo.Plcm.007	The Policy Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support providing to the OSS/BSS notifications about any detected policy conflicts.
Os-Ma-nfvo.Plcm.008	The Policy Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support subscribing to policy management related notifications.
Os-Ma-nfvo.Plcm.009	The Policy Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support associating NFV-MANO policies to NS instances.
Os-Ma-nfvo.Plcm.010	The Policy Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support disassociating NFV-MANO policies from NS instances.
Os-Ma-nfvo.Plcm.011	The Policy Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support creating policy groups.
Os-Ma-nfvo.Plcm.012	The Policy Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support deleting policy groups.
Os-Ma-nfvo.Plcm.013	The Policy Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support updating policy groups.
NOTE 1: For this reference point, NFV-MANO policies include policies applied in NS lifecycle management (instantiation, scaling, update, healing and termination).	
NOTE 2: The case of transferring NFV-MANO policy applies when: <ul style="list-style-type: none"> - a new policy is imported from the OSS, which results in the creation of a new policy locally; or - the changes for an existing policy are imported from the OSS, which results in the update of a policy locally. 	
NOTE 3: The OSS/BSS could also transfer, via the NFVO, NFV-MANO policies (related to VNF lifecycle management) to the VNFM, or transfer NFV-MANO policies (related to virtualised resource management) to the VIM.	

5.3.9 VNF Snapshot Package Management interface requirements

Table 5.3.9-1 specifies requirements applicable to the VNF Snapshot Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point.

Table 5.3.9-1: VNF Snapshot Package Management interface requirements

Numbering	Requirement
Os-Ma-nfvo.VnfSnapPkgm.001	The VNF Snapshot Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support creating VNF Snapshot Package information elements.
Os-Ma-nfvo.VnfSnapPkgm.002	The VNF Snapshot Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support building VNF Snapshot Packages.
Os-Ma-nfvo.VnfSnapPkgm.003	The VNF Snapshot Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support uploading VNF Snapshot Packages.
Os-Ma-nfvo.VnfSnapPkgm.004	The VNF Snapshot Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support extracting VNF Snapshot Packages.
Os-Ma-nfvo.VnfSnapPkgm.005	The VNF Snapshot Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support querying information about available VNF Snapshot Packages (see note).
Os-Ma-nfvo.VnfSnapPkgm.006	The VNF Snapshot Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support fetching a VNF Snapshot Package, or selected artifacts contained in a VNF Snapshot Package.
Os-Ma-nfvo.VnfSnapPkgm.007	The VNF Snapshot Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support deleting VNF Snapshot Packages.
Os-Ma-nfvo.VnfSnapPkgm.008	The VNF Snapshot Package Management interface produced by the NFVO on the Os-Ma-nfvo reference point shall support updating a VNF Snapshot Package.
NOTE:	VNF Snapshot Package information can include information such as creation date, configuration data of included snapshots, and files contained in the VNF Snapshot Package.

5.3.10 LCM Coordination interface requirements

Table 5.3.10-1 specifies requirements applicable to the LCM Coordination interface produced by the OSS/BSS on the Os-Ma-nfvo reference point.

Table 5.3.10-1: LCM Coordination interface requirements

Numbering	Requirement
Os-Ma-nfvo.LcmCoord.001	The LCM Coordination interface produced by the OSS/BSS on the Os-Ma-nfvo reference point shall support receiving requests to coordinate LCM operations affecting an NS instance and its VNF instances.

6 OSS exposed interfaces

6.1 LCM Coordination interface

6.1.1 Description

This interface enables a NFVO to request OSS/BSS to coordinate LCM operations.

The following operations shall be supported:

- CoordinateLcmOperation.

6.1.2 CoordinateLcmOperation operation

6.1.2.1 Description

This operation enables an NFVO to request the coordination of an LCM operation with management operations executed in the OSS/BSS on an NS instance by invoking a coordination action towards the OSS/BSS. The coordination can be needed at various stages of the LCM operation. The corresponding execution of the LCM operation within the NFVO will be paused until the response is received or no response is received until the expiration of a timer.

The response includes an indication whether to continue or abort the LCM operation execution and may include additional information.

The CoordinateLcmOperation operation allows the following use cases:

- 1) Following the execution of a coordination action, the execution of the LCM operation occurrence is continued immediately.
- 2) Following the execution of a coordination action, the execution of the LCM operation occurrence is aborted immediately.
- 3) Following the execution of a coordination action, the execution of the LCM operation occurrence is continued after a delay.
- 4) Following the execution of a coordination action, the same coordination action is retried after a delay.

Table 6.1.2.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

NOTE: The cancellation of a pending coordination is part of the protocol design.

Table 6.1.2.1-1: CoordinateLcmOperation operation

Information Flow	Requirement	Direction
CoordinateLcmOperationRequest	Mandatory	NFVO → OSS/BSS
CoordinateLcmOperationResponse	Mandatory	OSS/BSS → NFVO

6.1.2.2 Input parameters

The input parameters sent when invoking the operation are provided in table 6.1.2.2-1.

Table 6.1.2.2-1: CoordinateLcmOperation operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
nsInstancelId	M	1	Identifier	Uniquely identifies the NS instance.
lifecycleOperationOccurrenceId	M	1	Identifier	The identifier of LCM operation occurrence concerning the coordination.
lcmOperationType	M	1	Not specified	Indicates the type of LCM operation concerning the coordination.
coordinationActionName	M	1	Identifier	Indicates the LCM coordination action.
inputParam	M	0..N	KeyValuePair	Additional parameters passed as input to the coordination action.
NOTE 1: Void.				
NOTE 2: Void.				

6.1.2.3 Output parameters

The output parameters sent when responding to the operation is provided in table 6.1.2.3-1.

Table 6.1.2.3-1: CoordinateLcmOperation operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
coordinationResult	M	1	Enum	Indicates how the LCM operation execution to be continued. VALUES: <ul style="list-style-type: none"> • ABORT • CONTINUE • CONTINUE_AFTER_DELAY • RETRY_AFTER_DELAY • etc. See note.

Parameter	Qualifier	Cardinality	Content	Description
operationResumeDelay	M	0..1	TimeDuration	The time interval to wait until the new coordination request is to be sent ("RETRY AFTER DELAY" coordinationResult) or the LCM operation execution can be resumed ("CONTINUE AFTER DELAY" coordinationResult). Shall be present in case the coordinationResult indicates a delay and shall be absent otherwise. See note.
outputParam	M	0..N	KeyValuePair	Additional information on the result of the coordination with the OSS/BSS, e.g. on the reason for the indicated coordinationResult.
NOTE: Either the NFVO or the OSS/BSS can execute the waiting cycle in the use cases that include a delay. In case the OSS/BSS executes the waiting cycle, the "operationAction" values "CONTINUE_AFTER_DELAY" and "RETRY_AFTER_DELAY" and the "operationResumeDelay" attribute are not applicable.				

6.1.2.4 Operation results

As a result of this operation, the OSS/BSS shall indicate to the NFVO in the CoordinateLcmOperationResponse message whether the requested coordination with the OSS/BSS was successful or not.

Upon reception of a CoordinateLcmOperationResponse message, the NFVO has gathered information from the OSS/BSS to continue, delay (if applicable) or abort an LCM operation based on the success of the coordination with the OSS/BSS.

7 NFVO exposed interfaces

7.1 Introduction

This clause defines the interfaces exposed by the NFVO towards the OSS/BSS over the Os-Ma-nfvo reference point.

NOTE: The fact that information elements and attributes are presented in tabular form does not preclude protocol designs in which these information elements and attributes are encoded in different parts of request and response messages. For example, in a RESTful interface, parts of them may be encoded in the URL, in the message header, in the message body or any combination thereof.

7.2 NSD Management interface

7.2.1 Description

This interface allows the management of NSDs and associated PNFDs. Virtual Link Descriptors (VLDs) and VNF Forwarding Graph Descriptors (VNFFGDs) are considered as part of the NSD and handled along with it.

The following operations are defined for this interface:

- Create NSD Info.
- Upload NSD.
- Fetch NSD.
- Update NSD Info.
- Delete NSD.
- Query NSD Info.
- Fetch NSD Archive Artifacts.

- Create PNFD Info.
- Upload PNFD.
- Fetch PNFD.
- Update PNFD Info.
- Delete PNFD.
- Query PNFD Info.
- Fetch PNFD Archive Artifacts.
- Subscribe, for subscribing to notifications related to NSD and PNFD management changes.
- Notify, for delivering notifications related to NSD and PNFD management changes.
- Terminate Subscription operation: for terminating a particular subscription related to NSD and PNFD management changes.
- Query Subscription Info operation: for querying subscription information related to NSD and PNFD management changes.

In the present document, the on-boarding of an NSD or PNFD includes:

- 1) Creating an NSD information object or PNFD information object.
- 2) Uploading the NSD or PNFD.
- 3) Processing the NSD or PNFD, including validation, inside the NFVO.

An NSD or PNFD is referred as "on-boarded" only after these three procedures are successfully accomplished.

7.2.2 Upload NSD operation

7.2.2.1 Description

This operation will upload an NSD to the NFVO. An NSD information object shall be created a priori via the Create NSD Info operation. Only one NSD is allowed per NSD information object.

Associated descriptors (VLD and VNFFGD), that are part of the NSD, are uploaded at the same time.

Whether all descriptors referenced from the NSD: VNFD, PNFD and NSD for nested NSs shall be on-boarded before this operation depends on the value of "strict NSD constituent onboarding" present in the NSD.

The user may use this operation to upload a new NSD version, which can be associated to an NS instance with the Update NS operation (see clause 7.3.5). Different NSD versions have the same "nsdInvariantId" attribute, but different "nsdId" attributes and different NSD information objects. The design of different NSD versions and their business logic is out of scope of the present document.

Table 7.2.2.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.2.2.1-1: Upload NSD operation

Message	Requirement	Direction
UploadNsdRequest	Mandatory	OSS/BSS → NFVO
UploadNsdResponse	Mandatory	NFVO → OSS/BSS

7.2.2.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.2.2-1.

Table 7.2.2.2-1: Upload NSD operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
nsdInfold	M	1	Identifier	Identifier of the NSD information object associated with the NSD to be uploaded.
nsd	M	1	Nsd	NSD to be uploaded.

7.2.2.3 Output parameters

No output parameter.

7.2.2.4 Operation results

The result of the operation indicates whether the uploading and processing, including validation, of the NSD has been successful or not with a standard success/error result.

After a successful result, the NSD and those referenced descriptors that are already on-boarded are known to and validated by the NFVO. The associated NSD information object is updated with the information populated from the validated NSD. The NSD is on-boarded and is in "ENABLED, NOT_IN_USE" state, allowing its use for NS lifecycle management. See the NSD state model in clause D.2. If there are on-boarded NSDs that refer to this NSD as a nested NSD, their respective NsdInfo records are updated to refer to the on-boarded nested NSD.

7.2.3 Void

7.2.4 Void

7.2.5 Update NSD Info operation

7.2.5.1 Description

This operation will update the user defined data and/or the operational state of an existing NSD information object. The usage state shall not change as a result of the operation.

Table 7.2.5.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.2.5.1-1: Update NSD Info operation

Message	Requirement	Direction
UpdateNsdInfoRequest	Mandatory	OSS/BSS → NFVO
UpdateNsdInfoResponse	Mandatory	NFVO → OSS/BSS

7.2.5.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.5.2-1.

Table 7.2.5.2-1: Update NSD Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
nsdInfold	M	1	Identifier	Identifier of the NSD information object to be updated.
userDefinedData	O	0..N	KeyValuePair	User defined data to be updated. For existing keys, the value is replaced. See note.
operationalState	M	0..1	Enum	Operational state of the on-boarded NSD. VALUES: <ul style="list-style-type: none"> • ENABLED • DISABLED See note.
NOTE: At least one of the two parameters shall be present. If NSD is not on-boarded, the operation is used only to update existing or add additional user defined data using the userDefinedData parameter.				

7.2.5.3 Output parameters

No output parameter.

7.2.5.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

7.2.6 Delete NSD operation

7.2.6.1 Description

This operation will delete one or more NSD(s). The associated NSD information objects will be deleted as well.

It is possible to delete only a single version of an NSD or all versions.

An NSD can only be deleted when there is no NS instance using it, there is no NSD referring to it which have a value of "strict NSD constituent onboarding" set to true and the operational state is DISABLED.

Table 7.2.6.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.2.6.1-1: Delete NSD operation

Message	Requirement	Direction
DeleteNsdRequest	Mandatory	OSS/BSS → NFVO
DeleteNsdResponse	Mandatory	NFVO → OSS/BSS

7.2.6.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.6.2-1.

Table 7.2.6.2-1: Delete NSD operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
nsdInfold	M	1..N	Identifier	Identifier of the NSD information objects to be deleted. See note.
NOTE: It is part of the protocol design whether this operation is modelled as a "bulk" operation that allows to delete multiple NSDs in one request, or as a series of requests that delete one NSD at a time.				

7.2.6.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.2.6.3-1.

Table 7.2.6.3-1: Delete NSD operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
deletedNsdInfold	M	1..N	Identifier	Identifier of the deleted NSD information objects.

7.2.6.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

7.2.7 Query NSD Info operation

7.2.7.1 Description

This operation will enable the OSS/BSS to query the NFVO concerning details of one or more NSD information objects.

Table 7.2.7.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.2.7.1-1: Query NSD Info operation

Message	Requirement	Direction
QueryNsdInfoRequest	Mandatory	OSS/BSS → NFVO
QueryNsdInfoResponse	Mandatory	NFVO → OSS/BSS

7.2.7.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.7.2-1.

Table 7.2.7.2-1: Query NSD Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Filter defining the NSD information objects on which the query applies, based on attributes of the NSD information objects. It can also be used to specify one or more NSD information objects to be queried by providing their identifiers.
attributeSelector	M	0..N	String	Provides a list of attribute names of the NSD information objects. If present, only these attributes are returned for the NSD information objects matching the filter. If absent, the complete NSD information objects are returned.

7.2.7.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.2.7.3-1.

Table 7.2.7.3-1: Query NSD Info operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
queryResult	M	0..N	NsdInfo	Details of the NSD information objects matching the input filter.

7.2.7.4 Operation results

After success operation, the NFVO has queried the internal NSD information objects. The result of the operation indicates if it has been successful or not with a standard success/error result. For a particular query, the NSD information objects that the consumer has access to and that match the filter are returned.

7.2.8 Upload PNFD operation

7.2.8.1 Description

This operation will upload a PNFD to the NFVO, making it available to be used by NSDs. A PNFD information object shall be created a priori via the Create PNFD Info operation. Only one PNFD is allowed per PNFD information object.

The user may use this operation to upload a new PNFD version. Different PNFD versions have the same "pnfdInvariantId" attribute, but different "pnfdId" attributes and different PNFD information objects. The design of different PNFD versions and their business logic is out of scope of the present document.

Table 7.2.8.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.2.8.1-1: Upload PNFD operation

Message	Requirement	Direction
UploadPnfdRequest	Mandatory	OSS/BSS → NFVO
UploadPnfdResponse	Mandatory	NFVO → OSS/BSS

7.2.8.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.8.2-1.

Table 7.2.8.2-1: Upload PNFD operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
pnfdInfold	M	1	Identifier	Identifier of the PNFD information object associated with the PNFD to be uploaded.
pnfdArchive	M	1	Binary	Archive file containing the PNFD to be uploaded.

7.2.8.3 Output parameters

No output parameter.

7.2.8.4 Operation results

The result of the operation indicates whether the uploading and processing, including validation, of the PNFD has been successful or not with a standard success/error result.

Once on-boarded, the PNFD is known to and validated by the NFVO. The associated PNFD information object is updated with the information populated from the validated PNFD. If there are on-boarded NSDs that refer to this PNFD, their respective NsdInfo records are updated to refer to the on-boarded PNFD.

7.2.9 Update PNFD Info operation

7.2.9.1 Description

This operation will update the user defined data of an existing PNFD information object.

Table 7.2.9.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.2.9.1-1: Update PNFD Info operation

Message	Requirement	Direction
UpdatePnfdInfoRequest	Mandatory	OSS/BSS → NFVO
UpdatePnfdInfoResponse	Mandatory	NFVO → OSS/BSS

7.2.9.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.9.2-1.

Table 7.2.9.2-1: Update PNFD Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
pnfdInfold	M	1	Identifier	Identifier of the PNFD information object to be updated.
userDefinedData	O	0..N	KeyValuePair	User defined data to be updated. For existing Keys, the value is replaced.

7.2.9.3 Output parameters

No output parameter.

7.2.9.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

7.2.10 Delete PNFDF operation

7.2.10.1 Description

This operation will delete one or more PNFDFs. The associated PNFDF information objects will be deleted as well.

A PNFDF can only be deleted when there is no NS (in the active or NOT_INSTANTIATED state) using it and there is no NSD referring to it which have a value of "strict NSD constituent onboarding" set to true.

Table 7.2.10.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.2.10.1-1: Delete PNFDF operation

Message	Requirement	Direction
DeletePnfdRequest	Mandatory	OSS/BSS → NFVO
DeletePnfdResponse	Mandatory	NFVO → OSS/BSS

7.2.10.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.10.2-1.

Table 7.2.10.2-1: Delete PNFDF operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
pnfdfInfd	M	1..N	Identifier	Identifier of the PNFDF information object(s) to be deleted.
applyOnAllVersions	O	0..1	Boolean	Indicates if the delete operation is to be applied on all versions of these PNFDF instances. By default, if not present, it applies only on the current version.
NOTE: It is part of the protocol design whether this operation is modelled as a "bulk" operation that allows to delete multiple PNFDF in one request, or as a series of requests that delete one PNFDF at a time.				

7.2.10.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.2.10.3-1.

Table 7.2.10.3-1: Delete PNFDF operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
deletedPnfdInfd	M	1..N	Identifier	Identifier of the deleted PNFDF information objects.

7.2.10.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

7.2.11 Query PNFD Info operation

7.2.11.1 Description

This operation will enable the OSS/BSS to query the NFVO concerning details of one or more PNFD information objects.

Table 7.2.11.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.2.11.1-1: Query PNFD Info operation

Message	Requirement	Direction
QueryPnfdInfoRequest	Mandatory	OSS/BSS → NFVO
QueryPnfdInfoResponse	Mandatory	NFVO → OSS/BSS

7.2.11.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.11.2-1.

Table 7.2.11.2-1: Query PNFD Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Filter defining the PNFD information objects on which the query applies, based on attributes of the PNFD information objects. It can also be used to specify one or more PNFD information objects to be queried by providing their identifiers.
attributeSelector	M	0..N	String	Provides a list of attribute names of the PNFD information object. If present, only these attributes are returned for the PNFD information objects matching the filter. If absent, the complete PNFD information objects are returned.

7.2.11.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.2.11.3-1.

Table 7.2.11.3-1: Query PNFD Info operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
queryResult	M	0..N	PnfdInfo	Details of the PNFD information objects matching the input filter.

7.2.11.4 Operation results

After success operation, the NFVO has queried the internal PNFD information objects. The result of the operation indicates if it has been successful or not with a standard success/error result. For a particular query, the PNFD information objects that the consumer has access to and that are matching the filter are returned.

7.2.12 Subscribe operation

7.2.12.1 Description

This operation enables the OSS/BSS to subscribe with a filter for the notifications related to changes of NSD and PNFD sent by the NFVO.

NOTE: Specification of the filtering mechanism is part of the protocol design.

Table 7.2.12.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.2.12.1-1: Subscribe operation

Message	Requirement	Direction
SubscribeRequest	Mandatory	OSS/BSS → NFVO
SubscribeResponse	Mandatory	NFVO → OSS/BSS

7.2.12.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.12.2-1.

Table 7.2.12.2-1: Subscribe operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Input filter for selecting the NSD(s)/PNFD(s) and the related change notifications to subscribe to. This filter can contain information about specific types of changes to subscribe to, or attributes of the NsdInfo/PnfdInfo.

7.2.12.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.2.12.3-1.

Table 7.2.12.3-1: Subscribe operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
subscriptionId	M	1	Identifier	Identifier of the subscription realized.

7.2.12.4 Operation results

After successful subscription, the consumer (OSS/BSS) is registered to receive notifications about changes of NSD/PNFD.

The result of the operation shall indicate if the subscription has been successful or not with a standard success/error result. For a particular subscription, only notifications matching the filter will be delivered to the consumer.

7.2.13 Notify operation

7.2.13.1 Description

This operation distributes notifications to subscribers related to NSD/PNFD Management changes. It is a one-way operation issued by the NFVO that cannot be invoked as an operation by the consumer (OSS/BSS).

In order to receive notifications, the OSS/BSS shall have a subscription.

Table 7.2.13.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.2.13.1-1: Notify operation

Message	Requirement	Direction
Notify	Mandatory	NFVO → OSS/BSS

The following notification is sent by this operation:

- NsdOnBoardingNotification. See clause 8.2.6.
- NsdChangeNotification. See clause 8.2.7.
- NsdDeletionNotification. See clause 8.2.8.

- PnfdOnBoardingNotification. See clause 8.2.9.
- PnfdDeletionNotification. See clause 8.2.10.

7.2.14 Terminate Subscription operation

7.2.14.1 Description

This operation enables the OSS/BSS to terminate a particular subscription.

Table 7.2.14.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.2.14.1-1: Terminate Subscription operation

Message	Requirement	Direction
TerminateSubscriptionRequest	Mandatory	OSS/BSS → NFVO
TerminateSubscriptionResponse	Mandatory	NFVO → OSS/BSS

7.2.14.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.14.2-1.

Table 7.2.14.2-1: Terminate Subscription operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
subscriptionId	M	1	Identifier	Identifier of the subscription to be terminated.

7.2.14.3 Output parameters

No output parameter.

7.2.14.4 Operation results

After successful termination of a subscription, the identified subscription does not exist anymore, and the OSS/BSS will not receive notifications related that subscription any longer. The result of the operation shall indicate if the subscription termination has been successful or not with a standard success/error result.

7.2.15 Query Subscription Info operation

7.2.15.1 Description

This operation enables the OSS/BSS to query information about subscriptions.

Table 7.2.15.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.2.15.1-1: Query Subscription operation

Message	Requirement	Direction
QuerySubscriptionInfoRequest	Mandatory	OSS/BSS → NFVO
QuerySubscriptionInfoResponse	Mandatory	NFVO → OSS/BSS

7.2.15.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.15.2-1.

Table 7.2.15.2-1: Query Subscription Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Filtering criteria to select one or a set of subscriptions. Details are part of the protocol design.

7.2.15.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.2.15.3-1.

Table 7.2.15.3-1: Query Subscription Info operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
queryResult	M	0..N	Not specified	Information about the subscription(s) matching the query.

7.2.15.4 Operation results

After successful operation, the NFVO has queried the internal subscription objects. The result of the operation indicates if it has been successful or not with a standard success/error result. For a particular query, information about the subscriptions to notifications related to NSD/PNFD management that the OSS/BSS has access to and that are matching the filter shall be returned.

7.2.16 Create NSD Info operation

7.2.16.1 Description

This operation will create an NSD information object in the NFVO for the NSD to be uploaded.

Table 7.2.16.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.2.16.1-1: Create NSD Info operation

Message	Requirement	Direction
CreateNsdInfoRequest	Mandatory	OSS/BSS → NFVO
CreateNsdInfoResponse	Mandatory	NFVO → OSS/BSS

7.2.16.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.16.2-1.

Table 7.2.16.2-1: Create NSD Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
userDefinedData	O	0..N	KeyValuePair	User defined data for the NSD to be uploaded.

7.2.16.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.2.16.3-1.

Table 7.2.16.3-1: Create NSD Info operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
nsdInfoId	M	1	Identifier	Identifier of the created NSD information object.

7.2.16.4 Operation results

The result of the operation indicates whether the creation of NSD information object has been successful or not with a standard success/error result.

The nsdInfoId is only returned when the operation has been successful.

7.2.17 Fetch NSD operation

7.2.17.1 Description

This operation will fetch an NSD from the NFVO.

Associated descriptors (VLD and VNFFGD), that are part of the NSD, are fetched at the same time.

Table 7.2.17.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.2.17.1-1: Fetch NSD operation

Message	Requirement	Direction
FetchNsdRequest	Mandatory	OSS/BSS → NFVO
FetchNsdResponse	Mandatory	NFVO → OSS/BSS

7.2.17.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.17.2-1.

Table 7.2.17.2-1: Fetch NSD operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
nsdInfoId	M	1	Identifier	Identifier of the NSD information object associated with the NSD to be fetched.

7.2.17.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.2.17.3-1.

Table 7.2.17.3-1: Fetch NSD operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
nsd	M	1	Nsd	The fetched NSD.

7.2.17.4 Operation results

The result of the operation indicates whether the fetching of the NSD has been successful or not in the NFVO with a standard success/error result.

7.2.18 Create PNFD Info operation

7.2.18.1 Description

This operation will create a PNFD information object in the NFVO for the PNFD to be uploaded.

Table 7.2.18.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.2.18.1-1: Create PNFD Info operation

Message	Requirement	Direction
CreatePnfdInfoRequest	Mandatory	OSS/BSS → NFVO
CreatePnfdInfoResponse	Mandatory	NFVO → OSS/BSS

7.2.18.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.18.2-1.

Table 7.2.18.2-1: Create PNFD Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
userDefinedData	O	0..N	KeyValuePair	User defined data for the PNFD to be uploaded.

7.2.18.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.2.18.3-1.

Table 7.2.18.3-1: Create PNFD Info operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
pndfInfoId	M	1	Identifier	Identifier of the created PNFD information object.

7.2.18.4 Operation results

The result of the operation indicates whether the creation of PNFD information object has been successful or not with a standard success/error result.

The pndfInfoId is only returned when the operation has been successful.

7.2.19 Fetch PNFD operation

7.2.19.1 Description

This operation will fetch a PNFD from the NFVO.

Table 7.2.19.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.2.19.1-1: Fetch PNFD operation

Message	Requirement	Direction
FetchPnfdRequest	Mandatory	OSS/BSS → NFVO
FetchPnfdResponse	Mandatory	NFVO → OSS/BSS

7.2.19.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.19.2-1.

Table 7.2.19.2-1: Fetch PNFD operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
pnfdInfold	M	1	Identifier	Identifier of the PNFD information object associated with the PNFD to be fetched.

7.2.19.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.2.19.3-1.

Table 7.2.19.3-1: Fetch PNFD operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
pnfdArchive	M	1	Binary	The archive file containing the PNFD.

7.2.19.4 Operation results

The result of the operation indicates whether the fetching of the PNFD has been successful or not in the NFVO with a standard success/error result.

7.2.20 Fetch NSD Archive Artifacts operation

7.2.20.1 Description

This operation enables the OSS/BSS to fetch selected artifacts contained in an NSD archive. Artifacts are addressed using selector information that can be obtained using the Query NSD Info operation.

Table 7.2.20.1-1 lists the information flow exchanged between the OSS and the NFVO.

Table 7.2.20.1-1: Fetch NSD Archive Artifacts operation

Message	Requirement	Direction
FetchNsdArchiveArtifactsRequest	Mandatory	OSS → NFVO
FetchNsdArchiveArtifactsResponse	Mandatory	NFVO → OSS

7.2.20.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.20.2-1.

Table 7.2.20.2-1: Fetch NSD Archive Artifacts operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
nsdInfold	M	1	Identifier	Identifier of NSD information object associated with the NSD archive artifacts to be fetched.
artifactSelector	M	1..N	Not specified	Selector to address an individual NSD archive artifact, or list of selectors to address multiple of those. See note.
NOTE: It is up to the protocol design stage to determine whether this operation will be modelled as a "bulk" operation that allows to obtain multiple artifacts in one go, or as a series of operations that obtain one artifact at a time.				

7.2.20.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.2.20.3-1.

Table 7.2.20.3-1: Fetch NSD Archive Artifacts operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
nsdArchiveArtifact	M	1..N	Not specified	An NSD archive artifact (e.g. file) or multiple thereof. See note.
NOTE: It is up to the protocol design stage to determine whether this operation will be modelled as a "bulk" operation that allows to obtain multiple artifacts in one go, or as a series of operations that obtain one artifact at a time.				

7.2.20.4 Operation results

After successful operation, the NFVO has provided to the OSS a copy/copies of the requested artifact(s) contained in the NSD archive.

7.2.21 Fetch PNFD Archive Artifacts operation

7.2.21.1 Description

This operation enables the OSS/BSS to fetch selected artifacts contained in a PNFD archive. Artifacts are addressed using selector information that can be obtained using the Query PNFD Info operation.

Table 7.2.21.1-1 lists the information flow exchanged between the OSS and the NFVO.

Table 7.2.21.1-1: Fetch PNFD Archive Artifacts operation

Message	Requirement	Direction
FetchPnfdArchiveArtifactsRequest	Mandatory	OSS → NFVO
FetchPnfdArchiveArtifactsResponse	Mandatory	NFVO → OSS

7.2.21.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.21.2-1.

Table 7.2.21.2-1: Fetch PNFD Archive Artifacts operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
pnfdInfold	M	1	Identifier	Identifier of PNFD information object associated with the PNFD archive artifacts to be fetched.
artifactSelector	M	1..N	Not specified	Selector to address an individual PNFD archive artifact, or list of selectors to address multiple of those. See note.
NOTE: It is up to the protocol design stage to determine whether this operation will be modelled as a "bulk" operation that allows to obtain multiple artifacts in one go, or as a series of operations that obtain one artifact at a time.				

7.2.21.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.2.21.3-1.

Table 7.2.21.3-1: Fetch PNFD Archive Artifacts operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
pnfdArchiveArtifact	M	1..N	Not specified	A PNFD archive artifact (e.g. file) or multiple thereof. See note.
NOTE: It is up to the protocol design stage to determine whether this operation will be modelled as a "bulk" operation that allows to obtain multiple artifacts in one go, or as a series of operations that obtain one artifact at a time.				

7.2.21.4 Operation results

After successful operation, the NFVO has provided to the OSS a copy/copies of the requested artifact(s) contained in the PNFD archive.

7.3 NS Lifecycle Management interface

7.3.1 Description

This interface allows the OSS/BSS to invoke NS lifecycle management operations towards the NFVO.

The following operations are defined for this interface:

- Create NS Identifier.
- Instantiate NS.
- Scale NS.
- Update NS.
- Query NS.
- Terminate NS.
- Delete NS Identifier.
- Heal NS.
- Get Operation Status.

An identifier (i.e. lifecycleOperationOccurrenceId) is generated for each NS lifecycle operation occurrence, except for Query NS, Create NS Identifier, Delete NS Identifier and Get operation status.

Furthermore, this interface allows the OSS/BSS to manage subscriptions to notifications sent by the NFVO which inform about changes of an NS instance that are related to NS lifecycle management operation occurrences, related to updates of NS information attributes as well as related to the creation/deletion of an NS instance identifier. It further allows the NFVO to provide such notifications to the subscriber.

The use of direct-mode of certificate management specified in clause 5.2.3.2 of ETSI GS NFV-IFA 026 [i.11] does not require any certificate specific attributes in the interfaces described in the present document.

7.3.2 Create NS Identifier operation

7.3.2.1 Description

This operation creates an NS instance identifier, and an associated instance of an NsInfo information element, identified by that identifier, in the NOT_INSTANTIATED state without instantiating the NS or doing any additional lifecycle operation(s). It allows the immediate return of an NS instance identifier that can be used in subsequent lifecycle operations, such as the Instantiate NS operation. The NS state model is provided in clause D.3.

Table 7.3.2.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.3.2.1-1: Create NS Identifier operation

Message	Requirement	Direction
CreateNsIdentifierRequest	Mandatory	OSS/BSS → NFVO
CreateNsIdentifierResponse	Mandatory	NFVO → OSS/BSS

7.3.2.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.3.2.2-1.

Table 7.3.2.2-1: Create NS Identifier operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
nsId	M	1	Identifier (Reference to Nsd)	Reference to the NSD used to create this NS instance.
nsName	M	1	String	Human readable name of the NS instance.
nsDescription	M	1	String	Human readable description of the NS instance.
certificateConfigurationData	M	0..1	CertificateConfigurationData	Configuration for certificate management such as certificate profile, information of CMF and security policy in this NS. It shall be present when using delegation mode, otherwise it shall be absent.

7.3.2.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.3.2.3-1.

Table 7.3.2.3-1: Create NS Identifier operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
nsInstanceId	M	1	Identifier	Identifier of the instance of an NS that has been created.

7.3.2.4 Operation results

In case of success, an NS instance identifier and the associated instance of an NsInfo information element has been created in the NOT_INSTANTIATED state and can be used in subsequent lifecycle operations. In case of failure, appropriate error information is returned.

7.3.3 Instantiate NS operation

7.3.3.1 Description

This operation will instantiate an NS, will run a feasibility check of the NS instantiation, or will run a feasibility check followed by the actual NS instantiation. This operation can only be used with an NS instance in the NOT_INSTANTIATED state.

NOTE 1: When only feasibility check is requested without instantiating the NS instance, OSS/BSS needs to first create a (temporary) NS instance Id using the Create NS Identifier operation (see clause 7.3.2) that is used as input parameter to the Instantiate NS operation for the feasibility check.

NOTE 2: After the termination of the NS instance or after completion of feasibility check when "feasibility check only" was requested, the OSS/BSS is responsible to delete the NS instance Id. Refer to Delete NS Identifier operation (see clause 7.3.8).

The operation allows for references to existing VNF instances and NS instances that are to be used in the new NS (i.e. the NS being instantiated) and additional parameterization for new VNFs and NSs. The hierarchy of nested NS and VNFs below the NS being instantiated shall be acyclic (i.e. no loops).

An NSD instance, which can be reused among different NS instantiations, shall have been indicated using the Create NS Identifier operation (see clause 7.3.2) previous to executing the Instantiate NS operation.

If the NS LCM operation is a scheduled operation, it shall be possible to modify the schedule time, whereas it shall not be possible to change any other operational parameters. Specification of handling the change of the schedule time is part of the protocol design.

Before the NFVO initiates the operation it shall verify (if not already done previously when onboarding the NSD) that all descriptors referenced in the selected NS deployment flavour, or a respective overriding descriptor indicated in the operation, are already on-boarded.

Table 7.3.3.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.3.3.1-1: Instantiate NS operation

Message	Requirement	Direction
InstantiateNsRequest	Mandatory	OSS/BSS → NFVO
InstantiateNsResponse	Mandatory	NFVO → OSS/BSS

7.3.3.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.3.3.2-1.

Table 7.3.3.2-1: Instantiate NS operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
nsInstancelId	M	1	Identifier	Identifier of the instance of the NS.
flavourId	M	1	Identifier (Reference to NsDf)	Flavour of the NSD used to instantiate this NS. See note 1.
sapData	M	0..N	SapData	Create data concerning the SAPs of this NS.
addPnfData	M	0..N	AddPnfData	Information on the PNF(s) that are part of this NS.
vnfInstanceData	M	0..N	VnfInstanceData	Specify an existing VNF instance to be used in the NS. If needed, the VNF Profile to be used for this VNF instance is also provided. See note 2.
nestedNsInstanceData	M	0..N	NestedNsInstanceData	Specify an existing NS instance to be used as a nested NS within the NS. If needed, the NS Profile to be used for this nested NS instance is also provided. See notes 3 and 4.
locationConstraints	M	0..N	VnfLocationConstraint	Defines the location constraints for the VNF to be instantiated as part of the NS instantiation. An example can be a constraint for the VNF to be in a specific geographic location.
nestedNsLocationConstraints	M	0..N	NestedNsLocationConstraint	Defines the location constraints for the nested NS to be instantiated as part of the NS instantiation. An example can be a constraint for the nested NS to be in a specific geographic location.
additionalParamForNs	M	0..N	KeyValuePair	Allows the OSS/BSS to provide additional parameter(s) at the composite NS level (as opposed to the VNF level, which is covered in additionalParamForVnf, and as opposed to the nested NS level, which is covered in additionalParamForNestedNs).

Parameter	Qualifier	Cardinality	Content	Description
additionalParamForNestedNs	M	0..N	ParamsForNestedNs	Allows the OSS/BSS to provide additional parameter(s) per nested NS instance (as opposed to the composite NS level, which is covered in additionalParamForNs, and as opposed to the VNF level, which is covered in additionalParamForVnf). This is for nested NS instances that are to be created by the NFVO as part of the NS instantiation and not for existing nested NS instances that are referenced for reuse.
additionalParamForVnf	M	0..N	ParamsForVnf	Allows the OSS/BSS to provide additional parameter(s) per VNF instance (as opposed to the composite NS level, which is covered in additionalParamForNs, and as opposed to the nested NS level, which is covered in additionalParamForNestedNs). This is for VNFs that are to be created by the NFVO as part of the NS instantiation and not for existing VNF that are referenced for reuse.
startTime	M	0..1	DateTime	Indicates the earliest time to instantiate the NS. Cardinality "0" indicates the NS instantiation takes place immediately. See note 6.
nsInstantiationLevelId	M	0..1	Identifier	Identifies one of the NS instantiation levels declared in the DF applicable to this NS instance. See note 11.
targetNsScaleLevelInfo	M	0..N	NsScaleInfo	This attribute is applicable for NS target scale level instantiation. This attribute defines the target NS scale level to which the NS instance is to be instantiated for each NS scaling aspect of the DF applicable to this NS instance. See notes 11 and 12.
wanConnectionData	M	0..N	WanConnectionData	Information for connecting VNs to the WAN when VNs are deployed across a WAN. See note 5.
additionalAffinityOrAntiAffinityRule	M	0..N	AffinityOrAntiAffinityRule	Specifies additional affinity or anti-affinity constraint for the VNF instances to be instantiated as part of the NS instantiation. Shall not conflict with rules already specified in the NSD.

Parameter	Qualifier	Cardinality	Content	Description
feasibilityCheckReserve	M	0..1	Enum	Specifies the feasibility check and reserve option for the NS instantiation operation. VALUES: <ul style="list-style-type: none"> NO_FEASIBILITY_CHECK FEASIBILITY_CHECK_ONLY FEASIBILITY_CHECK_WITH_OPERATION FEASIBILITY_CHECK_WITH_RESERVATION_AND_OPERATION Default option is NO_FEASIBILITY_CHECK. If not present, default value applies. See notes 6, 7, 8, 9 and 10.
dataFlowMirroringData	M	0..N	DataFlowMirroringData	Information for the data flow mirroring to be associated to this NS.
<p>NOTE 1: The NsdF information element is defined in ETSI GS NFV-IFA 014 [3], clause 6.3.2.</p> <p>NOTE 2: The DF of the VNF instance shall match the VNF DF present in the associated VNF Profile. The VNFD of the VNF instance shall match the one in the associated VNF Profile if no overridingVnfdId is provided in the interface as part of vnflInstanceData, or the overridingVnfdId provided in the interface if it is provided.</p> <p>NOTE 3: The NS DF of each nested NS shall be one of the allowed flavours in the associated NSD (as referenced in the nestedNsd attribute of the NSD of the NS to be instantiated).</p> <p>NOTE 4: The NSD of each referenced NSs (i.e. each nestedInstanceId) shall match the one of the nested NSD in the composite NSD if no overridingNsdId is provided in the interface as part of NestedNsInstanceData, or the overridingNsdId provided in the interface if it is provided.</p> <p>NOTE 5: When the NS is deployed over several sites, the VNs of this NS will include VNs in each site connected over the WAN. In this case, the wanConnectionData provides the needed information required to connect each VN to the WAN.</p> <p>NOTE 6: When feasibilityCheckReserve is set to FEASIBILITY_CHECK_ONLY, the startTime parameter shall be ignored.</p> <p>NOTE 7: When feasibilityCheckReserve is set to NO_FEASIBILITY_CHECK, feasibility check is not performed. Resources might be reserved as triggered by means outside the present operation request (e.g. configuration or policies), e.g. if it is a schedule NS instantiation operation. See clause A.2.3 in ETSI GS NFV-IFA 010 [1].</p> <p>NOTE 8: When feasibilityCheckReserve is set to FEASIBILITY_CHECK_ONLY, only feasibility check is performed for the operation, no resources are reserved.</p> <p>NOTE 9: When feasibilityCheckReserve is set to FEASIBILITY_CHECK_WITH_OPERATION, feasibility check is performed and based on the feasibility check result, the actual NS instantiation operation is performed at the time indicated by the startTime parameter, if provided. Resources might be reserved as triggered by means outside the present operation request (e.g. configuration or policies), e.g. if it is a schedule NS instantiation operation. See clause A.2.3 in ETSI GS NFV-IFA 010 [1].</p> <p>NOTE 10: When feasibilityCheckReserve is set to FEASIBILITY_CHECK_WITH_RESERVATION_AND_OPERATION, feasibility check is performed and based on the feasibility check result, resources are reserved as part of the feasibility check, and the actual NS instantiation operation is performed using the resources reserved during the feasibility check, and at the time indicated by the startTime parameter, if provided.</p> <p>NOTE 11: The target size for NS instantiation may be specified in either nsInstantiationLevelId or targetNsScaleLevelInfo, but not both. If none of the two parameters (nsInstantiationLevelId or targetNsScaleLevelInfo) are present, the default NS instantiation level as declared in the NSD shall be used.</p> <p>NOTE 12: If targetNsScaleLevelInfo is specified, information provided in targetNsScaleLevelInfo shall be used to calculate the number of instances of the VNFs/nested NSs referred in the NSD. For VNFs or nested NSs that are not scalable based on targetNsScaleLevelInfo, the default NS instantiation level as declared in the NSD shall be used to calculate the number of instances those VNFs/nested NSs.</p>				

7.3.3.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.3.3.3-1.

Table 7.3.3.3-1: Instantiate NS operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
lifecycleOperationOccurrenceId	M	1	Identifier	The identifier of the NS lifecycle operation occurrence.

7.3.3.4 Operation results

The NFVO shall return a lifecycleOperationOccurrenceId that identifies the LCM operation. The LCM operation shall trigger the sending of the "start" NS LCM Operation Occurrence Notification (see clause 8.3.2.2) before additional notifications as part of this operation are triggered, or operations towards the VNFM or VIM are invoked.

If only feasibility check is required (feasibilityCheckReserve parameter value is "FEASIBILITY_CHECK_ONLY"), instantiation of the NS is not performed. In case of success, the feasibility check has been performed and the NFVO shall send the "result" NS LCM Operation Occurrence Notification (see clause 8.3.2.2). In case of failure, appropriate error information is provided in the "result" NS LCM Operation Occurrence Notification (see clause 8.3.2.2). The error information shall include the cause of the error and appropriate details: e.g. if the failure is caused by lack of sufficient resources, the error information in the NS LCM Operation Occurrence Notification shall include quantitative and qualitative details of all missing resources at each target location.

If the actual NS instantiation operation is requested to be performed after the feasibility check (feasibilityCheckReserve parameter value is "FEASIBILITY_CHECK_WITH_OPERATION" or "FEASIBILITY_CHECK_WITH_RESERVATION_AND_OPERATION"), after successful feasibility check, the NFVO shall send the feasibility check result as a "result" NS LCM Operation Occurrence Notification (see clause 8.3.2.2) and proceeds with the instantiation of NS. In case of failure of the feasibility check, appropriate error information is provided in the "result" NS LCM Operation Occurrence Notification (see clause 8.3.2.2) and the NFVO will not proceed with the NS instantiation.

In case of successful completion of the NS instantiation operation, the NS has been instantiated. In case of failure during NS instantiation, appropriate error information is provided in the "result" NS LCM Operation Occurrence Notification (see clause 8.3.2.2).

On the successful as well as the unsuccessful completion of the operation, the NFVO shall send the "result" NS LCM Operation Occurrence Notification.

If the NS instance was already in the INSTANTIATED state, this operation fails.

7.3.4 Scale NS operation

7.3.4.1 Description

This operation will scale an NS instance. Scaling an NS instance can be performed by explicitly adding/removing existing VNF instances to/from the NS instance, by leveraging on the abstraction mechanism provided by the NS scaling aspects and NS levels information elements declared in the NSD or by scaling individual VNF instances that are part of the NS itself. When adding VNFs and nested NSs - already existing or not - to the NS to be scaled, the NFVO shall follow the indications provided by the dependencies attribute, as specified in the corresponding NSD.

NOTE: In case the NS is a composite NS, it is also possible to scale directly its nested NS, as they are also NS and thus indirectly effectively scale the composite NS.

If the NS LCM operation is a scheduled operation, it shall be possible to modify the schedule time, whereas it shall not be possible to change any other operational parameters. Specification of handling the change of the schedule time is part of the protocol design.

Table 7.3.4.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.3.4.1-1: Scale NS operation

Message	Requirement	Direction
ScaleNsRequest	Mandatory	OSS/BSS → NFVO
ScaleNsResponse	Mandatory	NFVO → OSS/BSS

7.3.4.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.3.4.2-1.

Table 7.3.4.2-1: Scale NS operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
nsInstanceid	M	1	Identifier	Identifier of the instance of the NS.
scaleType	M	1	Enum	Indicates the type of scaling to be performed. VALUES: <ul style="list-style-type: none"> • SCALE_NS • SCALE_VNF
scaleNsData	M	0..1	ScaleNsData	Provides the necessary information to scale the referenced NS instance. It shall be present when scaleType = SCALE_NS. See note.
scaleVnfData	M	0..N	ScaleVnfData	Provides the information to scale a given VNF instance that is part of the referenced NS instance. Shall be present when scaleType = SCALE_VNF. See note.
scaleTime	M	0..1	DateTime	Indicates when the NS will be scaled. Cardinality "0" indicates the NS scaling takes place immediately.
NOTE: Either scaleNsData or scaleVnfData, but not both, shall be present.				

7.3.4.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.3.4.3-1.

Table 7.3.4.3-1: Scale NS operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
lifecycleOperationOccurrenceid	M	1	Identifier	The identifier of the NS lifecycle operation occurrence.

7.3.4.4 Operation results

In case of success, the NS instance has been scaled according to the request. In case of failure, appropriate error information is provided in the "result" NS LCM Operation Occurrence Notification (see clause 8.3.2.2).

The NFVO shall return a lifecycleOperationOccurrenceId that identifies the LCM operation. The LCM operation shall trigger the sending of the "start" NS LCM Operation Occurrence Notification (see clause 8.3.2.2) before additional notifications as part of this operation are triggered, or operations towards the VNFM or VIM are invoked.

In case of scaling in an NS, if some VNF instances are removed from this NS instance, these VNF instances are terminated unless they are still part of another NS instance.

On the successful as well as the unsuccessful completion of the operation, the NFVO shall send the "result" NS LCM Operation Occurrence Notification.

7.3.5 Update NS operation

7.3.5.1 Introduction

This operation updates an NS instance. This operation is also used to embed VNF LCM operations in support of fine grained NS LCM approach. See the informative message flows in annex C. Actions that can be performed with an update include:

- Adding existing VNF instances to the NS instance.
- Removing VNF instances from the NS instance.
- Instantiating new VNF instances and adding them to the NS instance.
- Changing the DF of VNF instances belonging to the NS instance.
- Changing the operational state of a VNF instance belonging to the NS instance.
- Modifying information data and/or the configurable properties of a VNF instance belonging to the NS instance.
- Changing the external connectivity of a VNF instance belonging to the NS instance.
- Adding SAPs to the NS instance.
- Removing SAPs from the NS instance.
- Adding existing NS instances to the NS instance.
- Removing nested NS instances from the NS instance.
- Associating a new NSD version to the NS instance.
- Moving VNF instances from one NS instance to another NS instance.
- Adding VNFFGs to the NS instance.
- Removing VNFFGs from the NS instance.
- Updating VNFFGs of the NS instance.
- Changing the DF of the NS instance.
- Adding PNFs to the NS instance.
- Modifying PNFs in the NS instance.
- Removing PNFs from the NS instance.
- Creating VNF Snapshots of VNF instances belonging to the NS instance.
- Reverting to VNF Snapshots of VNF instances belonging to the NS instance.
- Deleting available VNF Snapshot information for VNF instances belonging to the NS instance.
- Associating a PNF with a new or updated PnfProfile.
- Associating a VNF instance with a new or updated VnfProfile.
- Changing current VNF package of a VNF instance belonging to the NS instance.
- Creating a new NsVirtualLink instance.
- Deleting an existing NsVirtualLink instance.

- Modifying WAN connectivity information.
- Creating Data Flow Mirroring Job(s).
- Deleting existing Data Flow Mirroring Job(s).
- Updating existing Data Flow Mirroring Job(s).
- Selecting deployable modules of a VNF instance.

Only one type of update shall be allowed per operation.

If the NS LCM operation is a scheduled operation, it shall be possible to modify the schedule time, whereas it shall not be possible to change any other operational parameters. Specification of handling the change of the schedule time is part of the protocol design.

If the Update NS operation involves adding a VNF instance, a nested NS instance or a PNF to the NS instance, changing an NS or VNF deployment flavour, or changing the associated NSD descriptor or a current VNF package, the NFVO shall, before it initiates the operation, verify (if not already done previously when onboarding the NSD) that all descriptors referenced in the selected NS deployment flavour, or a respective overriding descriptor indicated in the operation, are already on-boarded.

Table 7.3.5.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO. It is possible, however, to request several updates of a given type in one Update NS operation (as indicated in the cardinalities in table 7.3.5.2-1).

Table 7.3.5.1-1: Update NS operation

Message	Requirement	Direction
UpdateNsRequest	Mandatory	OSS/BSS → NFVO
UpdateNsResponse	Mandatory	NFVO → OSS/BSS

7.3.5.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.3.5.2-1.

Table 7.3.5.2-1: Update NS operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
nsInstancelid	M	1	Identifier	Identifier of the NS instance being updated.
updateType	M	1	Not specified	Specifies the type of update. This parameter determines also which one of the following parameters is present in the operation. Possible values are: <ul style="list-style-type: none"> • AddVnf (adding existing VNF instance(s)); • RemoveVnf (removing VNF instance(s)); • InstantiateVnf (instantiating new VNF(s)); • ChangeVnfDf (Changing VNF DF); • OperateVnf (changing VNF state); • ModifyVnfInformation (modifying VNF information and/or the configurable properties of VNF instance(s)); • ChangeExtVnfConnectivity (changing the external connectivity of VNF instance(s)); • AddSap (adding SAP(s)); • RemoveSap (removing SAP(s)); • AddNestedNs (adding existing NS instance(s) as nested NS(s)); • RemoveNestedNs (removing existing nested NS instance(s));

Parameter	Qualifier	Cardinality	Content	Description
				<ul style="list-style-type: none"> • AssocNewNsdVersion (associating a new NSD version to the NS instance); • MoveVnf (moving VNF instance(s) from one origin NS instance to another target NS instance); • AddVnffg (adding VNFFG(s)); • RemoveVnffg (removing VNFFG(s)); • UpdateVnffg (updating VNFFG(s)); • ChangeNsDf (changing NS DF); • AddPnf (adding PNF); • ModifyPnf(modify PNF); • RemovePnf (removing PNF); • CreateSnapshot (creating VNF Snapshot). See note 3; • RevertToSnapshot (reverting to VNF Snapshot). See notes 3 and 4; • DeleteSnapshotInfo (deleting available VNF Snapshot information). See note 3; • AssocPnfWithPnfProfile (associating a PNF with a new or updated PnfProfile); • AssocVnfWithVnfProfile (associating a VNF instance with a new or updated VnfProfile); • ChangeVnfPkg (Changing current VNF package). See note 14; • CreateNsVirtualLink (Creating a VL instance); • DeleteNsVirtualLink (Deleting a VL instance); • ModifyWanConnectionInfo (modifying WAN connection info); • CreateDataFlowMirroring (Creating Data Flow Mirroring Job(s)); • DeleteDataFlowMirroring (Deleting existing Data Flow Mirroring Job(s)); • UpdateDataFlowMirroring (Updating existing Data Flow Mirroring Job(s)); • SelectVnfDeployableModules (Selecting the deployable modules of a VNF instance).
addVnfInstance	M	0..N	VnfInstanceData	Specify an existing VNF instance to be added to the NS instance. This parameter shall be present only if updateType=AddVnf.
removeVnfInstanceld	M	0..N	Identifier	Specify an existing VNF instance to be removed from the NS instance. The parameter contains the identifier(s) of the VNF instances to be removed. This parameter shall be present only if updateType=RemoveVnf. See note 1.
instantiateVnfData	M	0..N	InstantiateVnfData	Specify the new VNF to be instantiated. This parameter can be used e.g. for the bottom-up NS creation. This parameter shall be present only if updateType=InstantiateVnf.

Parameter	Qualifier	Cardinality	Content	Description
terminateVnfData	M	0..N	TerminateVnfData	Provides the information needed to terminate VNF instance(s). This parameter shall be present only if updateType= RemoveVnf and if the VNF instance(s) is(are) to be terminated as part of Update NS operation. See notes 1 and 13.
changeVnfFlavourData	M	0..N	ChangeVnfFlavourData	Specify the new DF of the VNF instance to be changed to. This parameter shall be present only if updateType=ChangeVnfDf.
operateVnfData	M	0..N	OperateVnfData	Specify the state of the VNF instance to be changed. This parameter shall be present only if updateType=OperateVnf.
modifyVnfInfoData	M	0..N	ModifyVnfInfoData	Specify the VNF Information parameters and/or the configurable properties of VNF instance to be modified. This parameter shall be present only if updateType=ModifyVnfInformation.
changeExtVnfConnectivityData	M	0..N	ChangeExtVnfConnectivityData	Specify the new external connectivity data of the VNF instance to be changed. This parameter shall be present only if updateType= ChangeExtVnfConnectivity.
addSap	M	0..N	SapData	Specify a new SAP to be added to the NS instance. This parameter shall be present only if updateType=AddSap.
removeSapId	M	0..N	Identifier	Specify an existing SAP to be removed from the NS instance. The parameter shall be present only if updateType=RemoveSap.
addNestedNsData	M	0..N	NestedNsInstanceData	Specify an existing nested NS instance to be added to (nested within) the NS instance. This parameter shall be present only if updateType=AddNestedNs.
removeNestedNsId	M	0..N	Identifier	Specify an existing nested NS instance to be removed from the NS instance. The parameter shall be present only if updateType=RemoveVnfNestedNs.
assocNewNsdVersionData	M	0..1	AssocNewNsdVersionData	Specify the new NSD to be used for the NS instance. This parameter shall be present only if updateType=AssocNewNsdVersion.
moveVnfInstanceData	M	0..N	MoveVnfInstanceData	Specify existing VNF instance to be moved from one NS instance to another NS instance. This parameter shall be present only if updateType=MoveVnf.
addVnffg	M	0..N	AddVnffgData	Specify the new VNFFG to be created to the NS Instance. This parameter shall be present only if updateType=AddVnffg.
removeVnffgId	M	0..N	Identifier	Identifier of an existing VNFFG to be removed from the NS Instance. This parameter shall be present only if updateType=RemoveVnffg.
updateVnffg	M	0..N	UpdateVnffgData	Specify the new VNFFG Information data to be updated for a VNFFG of the NS Instance. This parameter shall be present only if updateType=UpdateVnffg.
changeNsFlavourData	M	0..1	ChangeNsFlavourData	Specifies the new DF to be applied to the NS instance. It shall be present only if updateType=ChangeNsDf.
updateTime	M	0..1	DateTime	Indicates when the NS will be updated. Cardinality "0" indicates the NS update takes place immediately. See note 8.
addPnfData	M	0..N	AddPnfData	Information of the PNF(s) that are being added into the NS instance. This parameter shall be present only if updateType=AddPnf.

Parameter	Qualifier	Cardinality	Content	Description
modifyPnfData	M	0..N	ModifyPnfData	Information on the PNF(s) that are being modified in this NS instance. This parameter shall be present only if updateType=ModifyPnf. See note 2.
removePnfId	M	0..N	Identifier	Identifier of the PNF(s) that are part of this NS instance and that should be deleted from it. This parameter shall be present only if updateType=RemovePnf.
createSnapshotData	M	0..1	CreateSnapshotData	Specify the VNF instance to be snapshotted. This parameter shall be present only if updateType=CreateSnapshot.
revertToSnapshotData	M	0..1	RevertToSnapshotData	Specify the VNF instance to be reverted and the VNF Snapshot to be reverted to. This parameter shall be present only if updateType=RevertToSnapshot.
deleteSnapshotData	M	0..1	DeleteSnapshotData	Specify the VNF Snapshot info to be deleted and the related VNF instance. This parameter shall be present only if updateType=DeleteSnapshotInfo.
associatePnfWithPnfProfile	M	0..N	PnfProfileData	Specify the data needed for associating PNF with the new or updated PnfProfile. This parameter shall be present only if updateType=AssocPnfWithPnfProfile. See note 5.
associateVnfWithVnfProfile	M	0..N	VnfProfileData	Specify the data needed for associating VNF instance with the new or updated VnfProfile. This parameter shall be present only if updateType=AssocVnfWithVnfProfile. See note 6.
changeVnfPkgData	M	0..N	ChangeVnfPackageData	Specify the information for changing the current VNF package of the VNF instance. This parameter shall be present only if updateType=ChangeVnfPkg.
nsVirtualLinkProfile	M	0..N	Identifier (Reference to VirtualLinkProfile)	Reference the virtual link profile to be used to create a new NsVirtualLink instance. This parameter shall be present only if updateType=CreateNsVirtualLink. See note 7.
deleteNsVirtualLinkId	M	0..N	Identifier	Identify an existing NsVirtualLink instance to be deleted. The parameter shall be present only if updateType=DeleteNsVirtualLink.
modifyWanConnectionInfoData	M	0..N	ModifyWanConnectionInfoData	Specifies the data to modify about WAN related connectivity information. The parameter shall be present only if updateType=ModifyWanConnectionInfo.
feasibilityCheckReserve	M	0..1	Enum	Specifies the feasibility check and reserve option for the Update NS instantiation operation. VALUES: <ul style="list-style-type: none"> • NO_FEASIBILITY_CHECK • FEASIBILITY_CHECK_ONLY • FEASIBILITY_CHECK_WITH_OPERATION • FEASIBILITY_CHECK_WITH_RESERVATION_AND_OPERATION Default option is NO_FEASIBILITY_CHECK. If not present, default value applies. See notes 8, 9, 10, 11 and 12.

Parameter	Qualifier	Cardinality	Content	Description
createDataFlowMirroringJob	M	0..N	CreateDataFlowMirroringJob	Information of the Data Flow Mirroring Job(s) that are associated with the NS instance. This parameter shall be present only if updateType=CreateDataFlowMirroring.
deleteDataFlowMirroringJobId	M	0..N	Identifier	Identifier of the Data Flow Mirroring Job(s) that are associated with the NS instance and that should be deleted from it. This parameter shall be present only if updateType=DeleteDataFlowMirroring.
updateDataFlowMirroringJob	M	0..N	UpdateDataFlowMirroringJob	Information on the Data Flow Mirroring Job(s) associated to the NS instance that are being modified. This parameter shall be present only if updateType=UpdateDataFlowMirroring.
selectVnfDeployableModuleData	M	0..N	SelectVnfDeployableModuleData	Specify the data needed for selecting deployable modules of a VNF instance. This parameter shall be present only if updateType= SelectVnfDeployableModules.
<p>NOTE 1: If a VNF instance is removed from an NS and this NS was the last one for which this VNF instance was a part, the VNF instance is terminated by the NFVO.</p> <p>NOTE 2: New CP addresses should be contained in the element, if PNF CPs need to be changed.</p> <p>NOTE 3: It depends on the VNF capabilities, and is declared in the VNFD (refer to the "supportedOperations" attribute in the VnfDf information element; see clause 7.1.8.2 in ETSI GS NFV-IFA 011 [2]), whether the operation is supported for a particular VNF.</p> <p>NOTE 4: The operation might be service-disruptive.</p> <p>NOTE 5: A new version of NSD with the new or updated PnfProfile needs to be uploaded, and associated with the NS prior to invoking the NS update operation.</p> <p>NOTE 6: A new version of NSD with the new or updated VnfProfile needs to be uploaded, and associated with the NS prior to invoking the NS update operation.</p> <p>NOTE 7: All NsVirtualLink instances of a particular NS DF based on a specific NsVirtualLinkDesc have the same characteristics as they use the same VirtualLinkProfile.</p> <p>NOTE 8: When feasibilityCheckReserve is set to FEASIBILITY_CHECK_ONLY, the updateTime parameter shall be ignored.</p> <p>NOTE 9: When feasibilityCheckReserve is set to NO_FEASIBILITY_CHECK, feasibility check is not performed. Resources might be reserved as triggered by means outside of the present operation request (e.g. configuration or policies), e.g. if it is a schedule Update NS operation. See clause A.2.3 in ETSI GS NFV-IFA 010 [1].</p> <p>NOTE 10: When feasibilityCheckReserve is set to FEASIBILITY_CHECK_ONLY, only feasibility check is performed for the operation, no resources are reserved.</p> <p>NOTE 11: When feasibilityCheckReserve is set to FEASIBILITY_CHECK_WITH_OPERATION, feasibility check is performed and based on the feasibility check result, the actual Update NS operation is performed at the time indicated by the updateTime parameter, if provided. Resources might be reserved as triggered by means outside of the present operation request (e.g. configuration or policies), e.g. if it is a schedule Update NS operation. See clause A.2.3 in ETSI GS NFV-IFA 010 [1].</p> <p>NOTE 12: When feasibilityCheckReserve is set to FEASIBILITY_CHECK_WITH_RESERVATION_AND_OPERATION, feasibility check is performed and based on the feasibility check result, resources are reserved as part of the feasibility check, and the actual Update NS operation is performed using the resources reserved during the feasibility check, and at the time indicated by the updateTime parameter, if provided.</p> <p>NOTE 13: For each of the referred vnfInstancelId in the terminateVnfData, there shall be a corresponding value in the removeVnfInstancelId.</p> <p>NOTE 14: A change of VNFD version of a constituent VNF where the source and target VNFD versions have the same vnfExtInvariantId can also be performed without a change in the NSD by a sequence of two Update NS operations, the first one of type RemoveVnf, the second one of type AddVnf or of type InstantiateVnf; or with the Scale NS operation, removing the existing VNF instance and adding a VNF instance with the target VNFD.</p>				

7.3.5.3 Output parameters

The output parameter returned by the operation shall follow the indications provided in table 7.3.5.3-1.

Table 7.3.5.3-1: Update NS operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
vnfInstanceld	M	0..N	Identifier	Identifier of the instance of the instantiated VNF. This information shall be returned as the result of the operation if successful.
pnfld	M	0..N	Identifier	Identifier of the PNF assigned by OSS. It shall be present only if updateType = AddPnf. This information shall be returned as the result of the operation if successful.
vnffgld	M	0..N	Identifier	Identifier of the instance of the created VNFFG. It shall be present only if updateType = AddVnffg. This information shall be returned as the result of the operation if successful.
sapld	M	0..N	Identifier	Identifier of the instance of the created SAP. It shall be present only if updateType = addSap. This information shall be returned as the result of the operation if successful.
vnfSnapshotInfold	M	0..1	Identifier	Identifier of information held by the VNFM about the specific VNF Snapshot. It shall be present only if updateType = CreateSnapshot. This information shall be returned as the result of the operation if successful.
lifecycleOperationOccurrenceId	M	1	Identifier	The identifier of the NS lifecycle operation occurrence. This information shall be returned immediately before any notification, message or operation is done.
mirroringJobld	M	0..N	Identifier	Identifier of the created Data Flow Mirroring Job. It shall be present only if updateType = CreateDataFlowMirroring. This information shall be returned as the result of the operation if successful.

7.3.5.4 Operation results

The NFVO shall return a lifecycleOperationOccurrenceId that identifies the LCM operation. The LCM operation shall trigger the sending of the "start" NS LCM Operation Occurrence Notification (see clause 8.3.2.2) before additional notifications as part of this operation are triggered, or operations towards the VNFM or VIM are invoked.

If only feasibility check is required (feasibilityCheckReserve parameter value is "FEASIBILITY_CHECK_ONLY"), update of the NS is not performed. In case of success, the feasibility check has been performed and the NFVO shall send the "result" NS LCM Operation Occurrence Notification (see clause 8.3.2.2). In case of failure, appropriate error information is provided in the "result" NS LCM Operation Occurrence Notification (see clause 8.3.2.2).

If the actual Update NS operation is requested to be performed after the feasibility check (feasibilityCheckReserve parameter value is "FEASIBILITY_CHECK_WITH_OPERATION" or "FEASIBILITY_CHECK_WITH_RESERVATION_AND_OPERATION"), after successful feasibility check, the NFVO shall send the feasibility check result as a "result" NS LCM Operation Occurrence Notification (see clause 8.3.2.2) and proceeds with the update operation. In case of failure of the feasibility check, appropriate error information is provided in the "result" NS LCM Operation Occurrence Notification (see clause 8.3.2.2). The error information shall include the cause of the error and appropriate details: e.g. if the failure is caused by lack of sufficient resources, the error information in the NS LCM Operation Occurrence Notification shall include quantitative and qualitative details of all missing resources at each target location. The NFVO will not proceed with the Update NS operation.

In case of successful completion of the Update NS operation, the NS has been updated according to the request. In case of failure during Update NS, appropriate error information is provided in the "result" NS LCM Operation Occurrence Notification (see clause 8.3.2.2).

On successful as well as unsuccessful completion of the operation, the NFVO shall send the "result" NS LCM Operation Occurrence Notification.

7.3.6 Query NS operation

7.3.6.1 Description

This operation will enable the OSS/BSS to query from the NFVO information on one or more NS(s). The operation also supports querying information about VNF instance(s) that is (are) part of an NS. The operation also supports querying information about available Snapshots of VNF instance(s) that is (are) part of an NS.

Table 7.3.6.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.3.6.1-1: Query NS operation

Message	Requirement	Direction
QueryNsRequest	Mandatory	OSS/BSS → NFVO
QueryNsResponse	Mandatory	NFVO → OSS/BSS

7.3.6.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.3.6.2-1.

Table 7.3.6.2-1: Query NS operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Filter defining the NSs on which the query applies, based on attributes of the Network Service. It can also be used to specify one or more NS(s) to be queried by providing their identifiers. It can also be used to specify one or more VNF instances(s) that are part of an NS by providing their identifiers. It can also be used to specify one or more Snapshots of VNF instances(s) that are part of an NS by providing their identifiers.
attributeSelector	M	0..N	String	Provides a list of attribute names of NS. If present, only these attributes are returned for the instances of NS matching the filter. If absent, the complete instances of NS(s) are returned. In the case of query information about VNF instance(s) that are part of an NS, it provides a list of attribute names. And only the attributes are returned for the VNF instance(s) matching the filter. And if absent, the complete information is returned for the VNF instance(s) matching the filter. In the case of query information about Snapshots of VNF instance(s) that are part of an NS, it provides a list of attribute names. And only the attributes are returned for the Snapshots matching the filter. And if absent, the complete information is returned for the Snapshots matching the filter.

7.3.6.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.3.6.3-1.

Table 7.3.6.3-1: Query NS operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
queryNsResult	M	0..N	NsInfo	Information on the NS and VNF instances part of the NS and Snapshots matching the input filter. If attributeSelector is present, only the attributes listed in attributeSelector are returned for the selected NSs and VNF instances and Snapshots. See note.

NOTE: The lower cardinality is 0 since there may be no matches to the provided filter.

7.3.6.4 Operation results

After success operation, the NFVO has queried the internal NS information objects including retrieved requested VNF instance and Snapshot information. The result of the operation indicates whether it has been successful or not with a standard success/error result. For a particular query, information about the NSs including VNF instance(s) part of the NS and information about Snapshots that the consumer has access to and that are matching the filter shall be returned.

7.3.7 Terminate NS operation

7.3.7.1 Description

This operation will terminate an NS. This can also be used to terminate an NS instance that is scheduled to be instantiated (i.e. a startTime parameter had been provided in the Instantiate NS operation).

Terminating an NS instance does not delete the NS instance identifier, and the associated instance of the NsInfo information element, but rather transitions the NS into the NOT_INSTANTIATED state.

If the NS LCM operation is a scheduled operation, it shall be possible to modify the schedule time, whereas it shall not be possible to change any other operational parameters. Specification of handling the change of the schedule time is part of the protocol design.

Table 7.3.7.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.3.7.1-1: Terminate NS operation

Message	Requirement	Direction
TerminateNsRequest	Mandatory	OSS/BSS → NFVO
TerminateNsResponse	Mandatory	NFVO → OSS/BSS

7.3.7.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.3.7.2-1.

Table 7.3.7.2-1: Terminate NS operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
nsInstanceId	M	1	Identifier	Identifier of the NS instance to terminate.
terminateTime	M	0..1	DateTime	Indicates the end time of the NS, i.e. the NS will be terminated automatically at this time. Cardinality "0" indicates the NS termination takes place immediately.
terminateNsData	M	0..1	TerminateNsData	Provides additional parameter(s) to the termination process at the NS level. See note 1.
terminateVnfData	M	0..N	TerminateVnfData	Provides the information needed to terminate VNF instance(s). See notes 1 and 2.

NOTE 1: Information needed for terminating specific VNF instances shall only be specified in the "terminateVnfData", and not in the "terminateNsData".

NOTE 2: VNF instance(s) part of this NS instance is(are) terminated as part of Terminate NS operation only if the instance(s) is(are) not used by any other NS instance.

7.3.7.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.3.7.3-1.

Table 7.3.7.3-1: Terminate NS output parameters

Parameter	Qualifier	Cardinality	Content	Description
lifecycleOperationOccurrenceId	M	1	Identifier	The identifier of the NS lifecycle operation occurrence.

7.3.7.4 Operation results

In case of success, the NS has been terminated (i.e. put into NOT_INSTANTIATED state), and resources used by the NS or reserved for the NS have been released. As part of the NS termination, the following actions take place:

- All the VNF instances part of the terminated NS are terminated, unless they are still part of any other NS instance(s).
- All VLs, VNF FGs and information on PNF Connection Points (CPs) created at NS instantiation are deleted.
- Nested NS instances are just released and not terminated.

NOTE: It is possible to avoid termination of the constituent VNFs by first moving the VNFs to another NS (by requesting "Update NS/Move Vnf" before the Terminate NS request).

In case of failure, appropriate error information is provided in the "result" NS LCM Operation Occurrence Notification (see clause 8.3.2.2).

The NFVO shall return a lifecycleOperationOccurrenceId that identifies the LCM operation. The LCM operation shall trigger the sending of the "start" NS LCM Operation Occurrence Notification (see clause 8.3.2.2) before additional notifications as part of this operation are triggered, or operations towards the VNFM or VIM are invoked.

On successful as well as unsuccessful completion of the operation, the NFVO shall send the "result" NS LCM Operation Occurrence Notification.

If the NS instance was already in the NOT_INSTANTIATED state, this operation fails.

7.3.8 Delete NS Identifier operation

7.3.8.1 Description

This operation deletes an NS instance identifier and the associated NsInfo information element which is in the NOT_INSTANTIATED state.

Table 7.3.8.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.3.8.1-1: Delete NS Identifier operation

Message	Requirement	Direction
DeleteNsRequest	Mandatory	OSS/BSS → NFVO
DeleteNsResponse	Mandatory	NFVO → OSS/BSS

7.3.8.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.3.8.2-1.

Table 7.3.8.2-1: Delete NS Identifier operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
nsInstanceId	M	1	Identifier	NS instance identifier to be deleted.

7.3.8.3 Output parameters

No output parameter.

7.3.8.4 Operation results

In case of success, the NS instance identifier and the associated instance of the NsInfo information element has been deleted and can no longer be used. If the NS instance was not in the NOT_INSTANTIATED state (i.e. terminated or not instantiated), the operation is rejected.

In case of failure, appropriate error information is returned.

7.3.9 Heal NS operation

7.3.9.1 Description

This operation supports the healing of an NS instance, either by healing the complete NS instance or by healing one of more of the VNF instances that are part of this NS.

NOTE: In case the NS is a composite NS, it is also possible to execute individual heal requests on one or more of the NSs that are nested within this NS.

Table 7.3.9.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.3.9.1-1: Heal NS operation

Message	Requirement	Direction
HealNsRequest	Mandatory	OSS/BSS → NFVO
HealNsResponse	Mandatory	NFVO → OSS/BSS

7.3.9.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.3.9.2-1.

Table 7.3.9.2-1: Heal NS operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
nsInstanceId	M	1	Identifier	The parameter identifies the NS instance which shall be healed.
healNsData	M	0..1	HealNsData	Provides the information needed to heal an NS. See note.
healVnfData	M	0..N	HealVnfData	Provides the information needed to heal a VNF. See note.

NOTE: Either the parameter healNsData or the parameter healVnfData, but not both shall be provided.

7.3.9.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.3.9.3-1.

Table 7.3.9.3-1: Heal NS output parameters

Parameter	Qualifier	Cardinality	Content	Description
lifecycleOperationOccurrenceId	M	1	Identifier	The identifier of the NS lifecycle operation occurrence. This information shall be returned immediately before any notification, message or operation is done.

7.3.9.4 Operation results

In case of success, the NS has been healed, that means complete or partial healing as requested. In case of failure, appropriate error information is provided in the "result" NS LCM Operation Occurrence Notification (see clause 8.3.2.2).

NOTE: Testing procedures could be used e.g. to find the root cause of a failure situation. In addition testing procedures could also be applied during or after the healing process to check whether the healing actions were successful, etc.

The NFVO shall return a lifecycleOperationOccurrenceId that identifies the LCM operation. The LCM operation shall trigger the sending of the "start" NS LCM Operation Occurrence Notification (see clause 8.3.2.2) before additional notifications as part of this operation are triggered, or operations towards the VNFM or VIM are invoked.

On the successful as well as the unsuccessful completion of the operation, the NFVO shall send the "result" NS LCM Operation Occurrence Notification.

7.3.10 Get Operation Status operation

7.3.10.1 Description

This operation provides the status of an NS lifecycle management operation.

Table 7.3.10.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.3.10.1-1: Get Operation Status operation

Message	Requirement	Direction
GetOperationStatusRequest	Mandatory	OSS/BSS → NFVO
GetOperationStatusResponse	Mandatory	NFVO → OSS/BSS

7.3.10.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.3.10.2-1.

Table 7.3.10.2-1: Get Operation Status operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
lifecycleOperationOccurrenceId	M	1	Identifier	Identifier of the NS lifecycle operation occurrence.

7.3.10.3 Output Parameters

The output parameters returned by the operation shall follow the indications provided in table 7.3.10.3-1.

Table 7.3.10.3-1: Get Operation Status operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
operationStatus	M	1	Not specified	Indicates the operation status (which includes, for example: Processing, Successfully done, Failed, but can also include operation-specific states).

7.3.10.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

7.3.11 Subscribe operation

7.3.11.1 Description

This operation enables the OSS/BSS to subscribe with a filter for the notifications sent by the NFVO which are related to NS lifecycle changes, as well as to the creation/deletion of NS instance identifiers and the associated NsInfo information element instances.

NOTE: Specification of the filtering mechanism is part of the protocol design.

Table 7.3.11.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.3.11.1-1: Subscribe operation

Message	Requirement	Direction
SubscribeRequest	Mandatory	OSS/BSS → NFVO
SubscribeResponse	Mandatory	NFVO → OSS/BSS

7.3.11.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.3.11.2-1.

Table 7.3.11.2-1: Subscribe operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Input filter for selecting the notifications. It can be on the NS instances of interest or other attributes of the notification.

7.3.11.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.3.11.3-1.

Table 7.3.11.3-1: Subscribe operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
subscriptionId	M	1	Identifier	Identifier of the subscription realized.

7.3.11.4 Operation results

After successful subscription, the consumer (OSS/BSS) is registered to receive notifications about events related to NS lifecycle operation occurrences, as well as the creation/deletion of NS instance identifiers and the associated NsInfo information element instances.

The result of the operation shall indicate if the subscription has been successful or not with a standard success/error result. For a particular subscription, only notifications matching the filter will be delivered to the consumer.

7.3.12 Notify operation

7.3.12.1 Description

This operation notifies a subscriber about events related to notifications about lifecycle operation occurrences on NS instance, lifecycle operation occurrences impacting NS components, as well as the creation/deletion of NS instance identifiers and the associated NsInfo information element instances.

This operation distributes notifications to subscribers. It is a one-way operation issued by the producer (NFVO) that cannot be invoked as an operation by the consumer (OSS/BSS). In order to receive notifications, the consumer (OSS/BSS) has to perform an explicit Subscribe operation beforehand.

Table 7.3.12.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.3.12.1-1: Notify operation

Message	Requirement	Direction
Notify	Mandatory	NFVO → OSS/BSS

The following notifications can be notified/sent by this operation:

- NsLcmOperationOccurrenceNotification. See clause 8.3.2.2.
- NsChangeNotification. See clause 8.3.2.11.
- NsIdentifierCreationNotification. See clause 8.3.2.9.
- NsIdentifierDeletionNotification. See clause 8.3.2.10.
- NsLcmCapacityShortageNotification. See clause 8.3.5.

7.3.13 Terminate Subscription operation

7.3.13.1 Description

This operation enables the OSS/BSS to terminate a particular subscription.

Table 7.3.13.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.3.13.1-1: Terminate Subscription operation

Message	Requirement	Direction
TerminateSubscriptionRequest	Mandatory	OSS/BSS → NFVO
TerminateSubscriptionResponse	Mandatory	NFVO → OSS/BSS

7.3.13.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.3.13.2-1.

Table 7.3.13.2-1: Terminate Subscription operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
subscriptionId	M	1	Identifier	Identifier of the subscription to be terminated.

7.3.13.3 Output parameters

No output parameter.

7.3.13.4 Operation results

After successful termination of a subscription, the identified subscription does not exist anymore, and the OSS/BSS will not receive notifications related that subscription any longer. The result of the operation shall indicate if the subscription termination has been successful or not with a standard success/error result.

7.3.14 Query Subscription Info operation

7.3.14.1 Description

This operation enables the OSS/BSS to query information about subscriptions.

Table 7.3.14.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.3.14.1-1: Query Subscription Info operation

Message	Requirement	Direction
QuerySubscriptionInfoRequest	Mandatory	OSS/BSS → NFVO
QuerySubscriptionInfoResponse	Mandatory	NFVO → OSS/BSS

7.3.14.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.3.14.2-1.

Table 7.3.14.2-1: Query Subscription Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Filtering criteria to select one or a set of subscriptions. Details are part of the protocol design.

7.3.14.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.3.14.3-1.

Table 7.3.14.3-1: Query Subscription Info operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
queryResult	M	0..N	Not specified	Information about the subscription(s) matching the query.

7.3.14.4 Operation results

After successful operation, the OSS/BSS has queried the internal subscription objects. The result of the operation indicates if it has been successful or not with a standard success/error result. For a particular query, information about the subscriptions to notifications related to NS lifecycle management that the OSS/BSS has access to and that are matching the filter shall be returned.

7.4 Void

7.5 NS Performance Management interface

7.5.1 Description

This interface allows providing of performance information (measurement results collection and notifications) related to network services.

Collection and reporting of performance information is controlled by a PM job that groups details of performance collection and reporting information.

Performance information on a given NS related measured object instance (see note) results from either collected performance information of the virtualised resources impacting the connectivity of this NS related measured object instance or VNF performance information, resulting from virtualised resource performance information, issued by the VNFM related to the VNFs that are part of this NS instance.

NOTE: The NS related measured object instance is the instance of one of the measured object type(s) for which the performance measurements applicable to Os-Ma-nfvo reference point are defined in clause 7.3 of ETSI GS NFV-IFA 027 [5].

When new performance information is available, the consumer is notified using the notification PerformanceInformationAvailableNotification (see clause 8.4.8). The details of the performance measurements are provided using the PerformanceReport information element (see clause 8.4.5). Delivery mechanism for the performance reports is not specified in the present document.

The following operations are defined for this interface which will be consumed by the OSS/BSS:

- Create PM Job operation.
- Delete PM Jobs operation.
- Subscribe operation.
- Notify operation.
- Query PM Job operation.
- Create Threshold operation.
- Delete Thresholds operation.
- Query Threshold operation.
- Terminate Subscription operation.
- Query Subscription Info operation.

7.5.2 Create PM Job operation

7.5.2.1 Description

This operation will create a PM job, enabling an OSS/BSS to specify one or more NS related measured object(s), that the NFVO is managing, for which it wants to receive performance information. This will allow the requesting OSS/BSS to specify its performance information requirements with the NFVO.

The OSS/BSS needs to be subscribed to receive PerformanceInformationAvailable notifications in order to know when new collected performance information is available.

Table 7.5.2.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.5.2.1-1: Create PM Job operation

Message	Requirement	Direction
CreatePmJobRequest	Mandatory	OSS/BSS → NFVO
CreatePmJobResponse	Mandatory	NFVO → OSS/BSS

7.5.2.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.5.2.2-1.

Table 7.5.2.2-1: Create PM Job operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
objectSelector	M	1	ObjectSelection	Defines the NS related measured object(s) for which performance information is to be collected.
performanceMetric	M	0..N	String	This defines the type of performance metric(s) for the specified measured object(s). At least one of the two attributes (performance metric or metricGroup) shall be present.

Parameter	Qualifier	Cardinality	Content	Description
performanceMetricGroup	M	0..N	String	Group of performance metrics. A metric group is a pre-defined list of metrics, known to the producer that it can decompose to individual metrics. At least one of the two attributes (performance metric or metricGroup) shall be present.
collectionPeriod	M	1	Not specified	Specifies the periodicity at which the NFVO will collect performance information. See note.
reportingPeriod	M	1	Not specified	Specifies the periodicity at which the NFVO will report to the OSS/BSS about performance information. See note.
reportingBoundary	O	0..1	Not specified	Identifies a boundary after which the reporting will stop. The boundary shall allow a single reporting as well as periodic reporting up to the boundary.
NOTE:	At the end of each reportingPeriod, the NFVO informs OSS/BSS about availability of the performance data collected for each completed collection period during this reportingPeriod. While the exact definition of the types for collectionPeriod and reportingPeriod is part of the protocol design, it is recommended that the reportingPeriod be equal to or a multiple of the collectionPeriod. In the latter case, the performance data for the collection periods within one reporting period would be reported together.			

7.5.2.3 Output parameters

The parameters returned by the operation shall follow the indications provided in table 7.5.2.3-1.

Table 7.5.2.3-1: Create PM Job operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
pmJobId	M	1	Identifier	Identifier of the created PM job.

7.5.2.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

The pmJobId is only returned when the operation has been successful.

7.5.3 Delete PM Jobs operation

7.5.3.1 Description

This operation will delete one or more PM job(s).

Table 7.5.3.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.5.3.1-1: Delete PM Jobs operation

Message	Requirement	Direction
DeletePmJobsRequest	Mandatory	OSS/BSS → NFVO
DeletePmJobsResponse	Mandatory	NFVO → OSS/BSS

7.5.3.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.5.3.2-1.

Table 7.5.3.2-1: Delete PM Jobs operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
pmJobId	M	1..N	Identifier	Identifiers of the PM jobs to be deleted.

7.5.3.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.5.3.3-1.

Table 7.5.3.3-1: Delete PM Jobs operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
deletedPmJobId	M	1..N	Identifier	Identifiers of the PM Jobs that have been deleted successfully.

7.5.3.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

7.5.4 Subscribe operation

7.5.4.1 Description

This operation enables the OSS/BSSs to subscribe with a filter for the notifications related to performance information with the NFVO.

NOTE 1: Specification of the filtering mechanism is part of the protocol design.

NOTE 2: It is part of the protocol design whether subscribing is represented as a separate "Subscribe" operation or whether subscription-related information is managed as part of managing PM jobs and Thresholds.

Table 7.5.4.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.5.4.1-1: Subscribe operation

Message	Requirement	Direction
SubscribeRequest	Mandatory	OSS/BSS → NFVO
SubscribeResponse	Mandatory	NFVO → OSS/BSS

7.5.4.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.5.4.2-1.

Table 7.5.4.2-1: Subscribe operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Input filter for selecting notifications. The filter can be on network service, type of notification or attribute of the notification.

7.5.4.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.5.4.3-1.

Table 7.5.4.3-1: Subscribe operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
subscriptionId	M	1	Identifier	Identifier of the subscription realized.

7.5.4.4 Operation results

As a result of this operation, the NFVO shall indicate to the OSS/BSS in the subscribeResponse message whether the subscription was successful or not.

For a particular subscription, only notifications matching the filter will be delivered to the consumer.

7.5.5 Notify operation

7.5.5.1 Description

This operation distributes notifications to subscribers. It is a one-way operation issued by the NFVO that cannot be invoked as an operation by the consumer (OSS/BSS).

In order to receive notifications, the OSS/BSS shall have a subscription.

Table 7.5.5.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.5.5.1-1: Notify operation

Message	Requirement	Direction
Notify	Mandatory	NFVO → OSS/BSS

The following notifications can be notified/sent by this operation:

- PerformanceInformationAvailableNotification. See clause 8.4.8.
- ThresholdCrossedNotification. See clause 8.4.9.

7.5.6 Query PM Job operation

7.5.6.1 Description

This operation will enable the OSS/BSS to solicit from the NFVO the details of one or more PM job(s).

This operation does not return performance reports.

Table 7.5.6.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.5.6.1-1: Query PM Job operation

Message	Requirement	Direction
QueryPmJobRequest	Mandatory	OSS/BSS → NFVO
QueryPmJobResponse	Mandatory	NFVO → OSS/BSS

7.5.6.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.5.6.2-1.

Table 7.5.6.2-1: Query PM Job operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Filter defining the PM Jobs on which the query applies. It can be a single identifier, multiple identifiers or a wildcard.

7.5.6.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.5.6.3-1.

Table 7.5.6.3-1: Query PM Job operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
pmJobDetails	M	1..N	PmJob	Details of PM jobs matching the input filter.

7.5.6.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

7.5.7 Create Threshold operation

7.5.7.1 Description

This operation will allow the OSS/BSS to create a threshold and specify threshold levels on specified performance metric (for NS related measured object (s)) for which notifications will be generated when crossed.

Creating a threshold does not trigger collection of metrics. In order for the threshold to be active, there needs to be a PM job collecting the needed metric for the selected entities.

Table 7.5.7.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.5.7.1-1: Create Threshold operation

Message	Requirement	Direction
CreateThresholdRequest	Mandatory	OSS/BSS → NFVO
CreateThresholdResponse	Mandatory	NFVO → OSS/BSS

7.5.7.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.5.7.2-1.

Table 7.5.7.2-1: Create Threshold operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
objectSelector	M	1	ObjectSelection	Defines the NS related measured object instances for which the threshold will be defined.
performanceMetric	M	1	String	Defines the performance metric on which the threshold will be defined.
thresholdType	M	1	Enum	Defines the type of threshold. The list of possible values is part of the protocol design and might include: single/multi valued threshold, static/dynamic threshold, template based threshold, etc. VALUES: <ul style="list-style-type: none"> SIMPLE: Single-valued static threshold etc.
thresholdDetails	M	1	Not specified.	Details of the threshold: value to be crossed, direction in which it is crossed, details on the notification to be generated, etc.

7.5.7.3 Output parameters

The parameters returned by the operation shall follow the indications provided in table 7.5.7.3-1.

Table 7.5.7.3-1: Create Threshold operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
thresholdId	M	1	Identifier	Identifier of created threshold.

7.5.7.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

The thresholdId is only returned when the operation has been successful.

7.5.8 Delete Thresholds operation

7.5.8.1 Description

This operation will allow the OSS/BSS to delete one or more existing threshold(s).

Table 7.5.8.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.5.8.1-1: Delete Thresholds operation

Message	Requirement	Direction
DeleteThresholdsRequest	Mandatory	OSS/BSS → NFVO
DeleteThresholdsResponse	Mandatory	NFVO → OSS/BSS

7.5.8.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.5.8.2-1.

Table 7.5.8.2-1: Delete Thresholds operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
thresholdId	M	1..N	Identifier	Identifiers of the thresholds to be deleted.

7.5.8.3 Output parameters

The parameters returned by the operation shall follow the indications provided in table 7.5.8.3-1.

Table 7.5.8.3-1: Delete Thresholds operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
deletedThresholdId	M	1..N	Identifier	Identifiers of the thresholds that have been deleted successfully.

7.5.8.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

7.5.9 Query Threshold operation

7.5.9.1 Description

This operation will allow the OSS/BSS to query the details of an existing threshold.

Table 7.5.9.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.5.9.1-1: QueryThreshold operation

Message	Requirement	Direction
QueryThresholdRequest	Mandatory	OSS/BSS → NFVO
QueryThresholdResponse	Mandatory	NFVO → OSS/BSS

7.5.9.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.5.9.2-1.

Table 7.5.9.2-1: QueryThreshold operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Filter defining the thresholds on which the query applies. It can be a single identifier, multiple identifiers or a wildcard.

7.5.9.3 Output parameters

The parameters returned by the operation shall follow the indications provided in table 7.5.9.3-1.

Table 7.5.9.3-1: QueryThreshold operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
thresholdDetails	M	1..N	Threshold	List of threshold details matching the input filter.

7.5.9.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

7.5.10 Terminate Subscription operation

7.5.10.1 Description

This operation enables the OSS/BSS to terminate a particular subscription.

NOTE: It is part of the protocol design whether terminating a subscription is represented as a separate "Terminate Subscription" operation or whether subscription-related information is managed as part of managing PM jobs and Thresholds.

Table 7.5.10.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.5.10.1-1: Terminate Subscription operation

Message	Requirement	Direction
TerminateSubscriptionRequest	Mandatory	OSS/BSS → NFVO
TerminateSubscriptionResponse	Mandatory	NFVO → OSS/BSS

7.5.10.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.5.10.2-1.

Table 7.5.10.2-1: Terminate Subscription operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
subscriptionId	M	1	Identifier	Identifier of the subscription to be terminated.

7.5.10.3 Output parameters

None.

7.5.10.4 Operation results

After successful termination of a subscription, the identified subscription does not exist anymore, and the OSS/BSS will not receive notifications related that subscription any longer. The result of the operation shall indicate if the subscription termination has been successful or not with a standard success/error result.

7.5.11 Query Subscription Info operation

7.5.11.1 Description

This operation enables the OSS/BSS to query information about subscriptions.

NOTE: It is part of the protocol design whether querying information about subscriptions is represented as a separate "Query Subscription Info" operation or whether subscription-related information is managed as part of managing PM jobs and Thresholds.

Table 7.5.11.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.5.11.1-1: Query Subscription operation

Message	Requirement	Direction
QuerySubscriptionInfoRequest	Mandatory	OSS/BSS → NFVO
QuerySubscriptionInfoResponse	Mandatory	NFVO → OSS/BSS

7.5.11.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.5.11.2-1.

Table 7.5.11.2-1: Query Subscription Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Filtering criteria to select one or a set of subscriptions. Details are part of the protocol design.

7.5.11.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.5.11.3-1.

Table 7.5.11.3-1: Query Subscription Info operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
queryResult	M	0..N	Not specified	Information about the subscription(s) matching the query.

7.5.11.4 Operation results

After successful operation, the NFVO has queried the internal subscription objects. The result of the operation indicates if it has been successful or not with a standard success/error result. For a particular query, information about the subscriptions to notifications related to NS performance management that the OSS/BSS has access to and that are matching the filter shall be returned.

7.6 NS Fault Management interface

7.6.1 Description

This interface shall allow the NFVO to provide alarms related to the NSs visible to the consumer.

An alarm on a given NS results from either a collected virtualised resource fault impacting the connectivity of the NS instance or a VNF alarm, resulting from a virtualised resource alarm, issued by the VNFM for a VNF that is part of this NS instance.

The fault management interface shall support the following operations:

- Subscribe operation: Subscription of OSS/BSSs with the NFVO for the notifications related to the alarms.
- Notify operation: Notifications of alarms or alarm state change from NFVO to OSS/BSS.
- Get alarm list operation: Accessing active alarms from the NFVO.
- Terminate Subscription operation: Terminating a particular subscription in the NFVO.
- Query Subscription Info operation: Querying subscription information from the NFVO.
- Acknowledge Alarms operation: Acknowledging alarms by the OSS/BSS.

7.6.2 Subscribe operation

7.6.2.1 Description

This operation enables the OSS/BSS to subscribe with a filter for the notifications related to NS alarms sent by the NFVO.

NOTE: Specification of the filtering mechanism is part of the protocol design.

Table 7.6.2.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.6.2.1-1: Subscribe operation

Message	Requirement	Direction
SubscribeRequest	Mandatory	OSS/BSS → NFVO
SubscribeResponse	Mandatory	NFVO → OSS/BSS

7.6.2.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.6.2.2-1.

Table 7.6.2.2-1: Subscribe operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Input filter for selecting NSs and related alarms. This can contain the NS information, severity and cause of the alarm.

7.6.2.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.6.2.3-1.

Table 7.6.2.3-1: Subscribe operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
subscriptionId	M	1	Identifier	Id of the subscription realized.

7.6.2.4 Operation results

As a result of this operation, the NFVO shall indicate to the OSS/BSS in the subscribeResponse message whether the subscription was successful or not.

For a particular subscription, only notifications matching the filter will be delivered to the consumer.

7.6.3 Notify operation

7.6.3.1 Description

This operation distributes notifications to subscribers. It is a one-way operation issued by the NFVO and cannot be invoked as an operation by the consumer (OSS/BSS).

In order to receive notifications, the OSS/BSS shall have a subscription.

Table 7.6.3.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.6.3.1-1: Notify operation

Message	Requirement	Direction
Notify	Mandatory	NFVO → OSS/BSS

The following notifications can be notified/sent by this operation:

- AlarmNotification. See clause 8.5.2.
- AlarmClearedNotification. See clause 8.5.3.
- AlarmListRebuiltNotification. See clause 8.5.5.

7.6.4 Get Alarm List operation

7.6.4.1 Description

This operation enables the OSS/BSSs to query the active alarms from the NFVO.

Table 7.6.4.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.6.4.1-1: Get Alarm List operation

Message	Requirement	Direction
GetAlarmListRequest	Mandatory	OSS/BSS → NFVO
GetAlarmListResponse	Mandatory	NFVO → OSS/BSS

7.6.4.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.6.4.2-1.

Table 7.6.4.2-1: Get Alarm List operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Input filter for selecting alarms. This can contain the list of the NS identifiers, severity and cause.

7.6.4.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.6.4.3-1.

Table 7.6.4.3-1: Get Alarm List operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
alarm	M	0..N	Alarm	Information about an alarm including AlarmId, affected NS Id, and FaultDetails. The cardinality can be "0" to indicate that no Alarm could be retrieved based on the input filter information (e.g. no matching alarm).

7.6.4.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

For a particular request, only alarms matching the filter will be delivered to the OSS/BSS.

7.6.5 Terminate Subscription operation

7.6.5.1 Description

This operation enables the OSS/BSS to terminate a particular subscription.

Table 7.6.5.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.6.5.1-1: Terminate Subscription operation

Message	Requirement	Direction
TerminateSubscriptionRequest	Mandatory	OSS/BSS → NFVO
TerminateSubscriptionResponse	Mandatory	NFVO → OSS/BSS

7.6.5.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.6.5.2-1.

Table 7.6.5.2-1: Terminate Subscription operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
subscriptionId	M	1	Identifier	Identifier of the subscription to be terminated.

7.6.5.3 Output parameters

No output parameter.

7.6.5.4 Operation results

After successful termination of a subscription, the identified subscription does not exist anymore, and the OSS/BSS will not receive notifications related that subscription any longer. The result of the operation shall indicate if the subscription termination has been successful or not with a standard success/error result.

7.6.6 Query Subscription Info operation

7.6.6.1 Description

This operation enables the OSS/BSS to query information about subscriptions.

Table 7.6.6.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.6.6.1-1: Query Subscription operation

Message	Requirement	Direction
QuerySubscriptionInfoRequest	Mandatory	OSS/BSS → NFVO
QuerySubscriptionInfoResponse	Mandatory	NFVO → OSS/BSS

7.6.6.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.6.6.2-1.

Table 7.6.6.2-1: Query Subscription Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Filtering criteria to select one or a set of subscriptions. Details are part of the protocol design.

7.6.6.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.6.6.3-1.

Table 7.6.6.3-1: Query Subscription Info operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
queryResult	M	0..N	Not specified	Information about the subscription(s) matching the query.

7.6.6.4 Operation results

After successful operation, the NFVO has queried the internal subscription objects. The result of the operation indicates if it has been successful or not with a standard success/error result. For a particular query, information about the subscriptions to notifications related to NS fault management that the OSS/BSS has access to and that are matching the filter shall be returned.

7.6.7 Acknowledge Alarms operation

7.6.7.1 Description

This operation enables the OSS/BSS to acknowledge alarms at NFVO.

Table 7.6.7.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.6.7.1-1: Acknowledge alarms operation

Message	Requirement	Direction
AcknowledgeAlarmsRequest	Mandatory	OSS/BSS → NFVO
AcknowledgeAlarmsResponse	Mandatory	NFVO → OSS/BSS

7.6.7.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.6.7.2-1.

Table 7.6.7.2-1: Acknowledge alarms operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
alarmId	M	1..N	Identifier (Reference to Alarm)	Identifier of an individual alarm to be acknowledged, or multiple identifiers of the alarms to be acknowledged. See note.
NOTE: It is part of the protocol design whether this operation is modelled as a "bulk" operation that allows to acknowledge multiple alarms in one request, or as a series of requests that acknowledge one alarm at a time.				

7.6.7.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.6.7.3-1.

Table 7.6.7.3-1: Acknowledge alarms operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
acknowledgedAlarmId	M	1..N	Identifier (Reference to Alarm)	Identifier of an individual alarm that is acknowledged, or multiple identifiers of the alarms that are acknowledged. See note.
NOTE: It is part of the protocol design whether this operation is modelled as a "bulk" operation that allows to acknowledge multiple alarms in one request, or as a series of requests that acknowledge one alarm at a time.				

7.6.7.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

7.7 VNF Package management interface

7.7.1 Description

This interface allows for the management of VNF Packages.

The following operations are defined for this interface:

- Create VNF Package Info.
- Upload VNF Package.
- Update VNF Package Info.
- Delete VNF Package.
- Query VNF Package Info.
- Fetch VNF Package.
- Fetch VNF Package Artifacts.
- Subscribe to new notifications.
- Notify of on-boarding of new VNF Package or of changes of VNF Packages.
- Terminate Subscription.
- Query Subscription Info.

In the present document, the on-boarding of a VNF Package includes:

- 1) Creating a VNF Package information object.
- 2) Uploading the VNF Package.
- 3) Processing, including validation, the VNF Package inside the NFVO.

The VNF Package is referred as "on-boarded" only after these three procedures are successfully accomplished.

7.7.2 Upload VNF Package operation

7.7.2.1 Description

This operation will upload a VNF Package to the NFVO. A VNF Package information object shall be created a priori via the Create VNF Package Info operation. Only one VNF Package is allowed per VNF Package information object.

Table 7.7.2.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.7.2.1-1: Upload VNF Package operation

Message	Requirement	Direction
UploadVnfPackageRequest	Mandatory	OSS/BSS → NFVO
UploadVnfPackageResponse	Mandatory	NFVO → OSS/BSS

7.7.2.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.7.2.2-1.

Table 7.7.2.2-1: Upload VNF Package operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
vnfPkgInfoId	M	1	Identifier	Identifier of the VNF Package information object associated with the VNF Package to be uploaded.
vnfPackage	M	0..1	Binary	VNF Package to be uploaded. This attribute shall be supported when the VNF package is uploaded as a local file. See notes 2 and 3.
vnfPackagePath	M	0..1	URL	Address information based on which the VNF Package can be obtained. See note 1. This attribute shall be supported when the VNF package is uploaded from a remote server. See notes 2 and 3.
NOTE 1: This Structure can be the address information related to an FTP server when the VNF Package is stored, or be a URL where the NFVO can download the VNF Package.				
NOTE 2: Either the parameter vnfPackage or the parameter vnfPackagePath, but not both shall be provided.				
NOTE 3: For the onboarding procedure, the VNF Package contents may be split into more than one file, e.g. software image files separate from the VNF Package file containing the VNFD and other artifacts. The mechanism to support the upload of the one or more files comprising the VNF Package is part of the protocol design.				

7.7.2.3 Output parameters

No output parameter.

7.7.2.4 Operation results

The result of the operation indicates if the uploading and processing, including validation, of the VNF Package has been successful or not with a standard success/error result.

After a successful result, the VNF Package is known to and validated by the NFVO. The associated VNF Package information object is updated with the information populated from the validated VNF Package. The VNF Package is on-boarded and in "ENABLED,NOT_IN_USE" state, allowing its use for VNF lifecycle management. See the VNF Package state model in clause D.1. If there are on-boarded NSDs that refer to the VNFD included in this VNF Package, their respective NsdInfo records are updated to refer to the on-boarded VNF Package.

7.7.3 Void

7.7.4 Void

7.7.5 Delete VNF Package operation

7.7.5.1 Description

This operation will delete a VNF Package. The associated VNF Package information objects will be deleted as well.

A VNF Package may only be deleted once:

- there are no VNFs using it;
- there are no NSs using it;
- there are no NSDs referencing to it which have a value of "strict NSD constituent onboarding" set to true; and
- the operational state is DISABLED.

NOTE: An NS instance can be using a VNF Package even if no VNF instance is using it if the VNF is part of the selected NS deployment flavour but the current NS scale level determines zero instances for the VNF.

Table 7.7.5.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.7.5.1-1: Delete VNF Package operation

Message	Requirement	Direction
DeleteVnfPackageRequest	Mandatory	OSS/BSS → NFVO
DeleteVnfPackageResponse	Mandatory	NFVO → OSS/BSS

7.7.5.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.7.5.2-1.

Table 7.7.5.2-1: Delete VNF Package operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
VnfPkgInfolId	M	1	Identifier	Identifier of the VNF Package information object and associated VNF Package, which is to be deleted. This identifier was allocated by the NFVO.

7.7.5.3 Output parameters

No output parameter.

7.7.5.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

7.7.6 Query VNF Package Info operation

7.7.6.1 Description

This operation will enable the OSS/BSS to query from the NFVO for details of one or more VNF Package information objects.

Table 7.7.6.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.7.6.1-1: Query VNF Package Info operation

Message	Requirement	Direction
QueryVnfPkgInfoRequest	Mandatory	OSS/BSS → NFVO
QueryVnfPkgInfoResponse	Mandatory	NFVO → OSS/BSS

7.7.6.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.7.6.2-1.

Table 7.7.6.2-1: Query VNF Package Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Filter defining the VNF Packages on which the query applies, based on attributes of VnfPkgInfo. It can also be used to specify one or more VNF Package information objects to be queried by providing their vnfldd or vnfPkgInfold. See note.
attributeSelector	M	0..N	String	It provides a list of attribute names of VnfPkgInfo. If present, only these attributes are returned for VnfPkgInfo matching the filter. If absent, the complete VnfPkgInfo are returned.
NOTE: The vnfldd, which is managed by the VNF provider, identifies the VNF Package and the VNFD in a globally unique way. See ETSI GS NFV-IFA 011 [2], clause 7.1.2.2. The vnfPkgInfold identifies the information related to the onboarding of a VNF package into the NFVO, which implies that it also identifies an onboarded VNF package.				

7.7.6.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.7.6.3-1.

Table 7.7.6.3-1: Query VNF Package Info operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
queryResult	M	0..N	VnfPkgInfo	Details of the VNF Package information objects matching the input filter. If attributeSelector is present, only the attributes listed in attributeSelector are returned for the selected entities.

7.7.6.4 Operation results

After success operation, the NFVO has queried the internal VNF Package information objects. The result of the operation indicates if it has been successful or not with a standard success/error result. For a particular query, the VNF Package information objects that the consumer has access to and that are matching the filter shall be returned.

7.7.7 Subscribe operation

7.7.7.1 Description

This operation enables the OSS/BSS to subscribe with a filter for the notifications related to on-boarding of VNF Packages and changes of VNF Packages sent by the NFVO.

NOTE: Specification of the filtering mechanism is part of the protocol design.

Table 7.7.7.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.7.7.1-1: Subscribe operation

Message	Requirement	Direction
SubscribeRequest	Mandatory	OSS/BSS → NFVO
SubscribeResponse	Mandatory	NFVO → OSS/BSS

7.7.7.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.7.7.2-1.

Table 7.7.7.2-1: Subscribe operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
inputFilter	M	1	Filter	Input filter for selecting the VNF Package(s) and the related change notifications to subscribe to. This filter can contain information about specific types of changes to subscribe to, or attributes of the VNF Package.

7.7.7.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.7.7.3-1.

Table 7.7.7.3-1: Subscribe operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
subscriptionId	M	1	Identifier	Identifier of the subscription realized.

7.7.7.4 Operation results

After successful subscription, the OSS/BSS is registered to receive notifications related to changes of VNF Packages sent by the NFVO. The result of the operation shall indicate if the subscription has been successful or not with a standard success/error result. For a particular subscription, only notifications matching the filter will be delivered to the OSS/BSS.

7.7.8 Notify operation

7.7.8.1 Description

This operation distributes notifications to subscribers. It is a one-way operation issued by the NFVO that cannot be invoked as an operation by the consumer (OSS/BSS).

In order to receive notifications, the OSS/BSS shall have a subscription.

Table 7.7.8.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.7.8.1-1: Notify operation

Message	Requirement	Direction
Notify	Mandatory	NFVO → OSS/BSS

The following notification is sent by this operation:

- VnfPackageOnBoardingNotification. See clause 8.6.8.
- VnfPackageChangeNotification. See clause 8.6.9.

7.7.9 Void

7.7.10 Fetch VNF Package operation

7.7.10.1 Description

This operation enables the OSS to fetch a whole VNF Package from the NFVO. The package is addressed using an identifier of the VNF Package information object associated with the VNF Package to be fetched. This identifier is contained within the VnfPackageOnBoardingNotification or is returned as a result of the Create VNF Package Info or Query VNF Package Info operations.

Table 7.7.10.1-1 lists the information flow exchanged between the NFVO and the OSS.

Table 7.7.10.1-1: Fetch VNF Package operation

Message	Requirement	Direction
FetchVnfPackageRequest	Mandatory	OSS → NFVO
FetchVnfPackageResponse	Mandatory	NFVO → OSS

7.7.10.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.7.10.2-1.

Table 7.7.10.2-1: Fetch VNF Package operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
VnfPkgInfold	M	1	Identifier	Identifier of the VNF Package information object associated with the VNF Package to be fetched. This identifier was allocated by the NFVO.

7.7.10.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.7.10.3-1.

Table 7.7.10.3-1: Fetch VNF Package operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
vnfPackage	M	1	Binary	The VNF Package.

7.7.10.4 Operation results

The result of the operation indicates whether the fetching of the VNF Package has been successful or not in the NFVO with a standard success/error result. After successful operation, the NFVO has provided to the OSS a copy of the requested VNF package.

7.7.11 Fetch VNF Package Artifacts operation

7.7.11.1 Description

This operation enables the OSS/BSS to fetch selected artifacts contained in a VNF package. Artifacts are addressed using selector information that can be obtained using the Query VNF Package Info operation.

Table 7.7.11.1-1 lists the information flow exchanged between the OSS and the NFVO.

Table 7.7.11.1-1: Fetch VNF Package Artifacts operation

Message	Requirement	Direction
FetchPackageArtifactsRequest	Mandatory	OSS → NFVO
FetchVnfPackageArtifactsResponse	Mandatory	NFVO → OSS

7.7.11.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.7.11.2-1.

Table 7.7.11.2-1: Fetch VNF Package Artifacts operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
VnfPkgInfold	M	1	Identifier	Identifier of VNF Package information object associated with the VNF Package artifacts to be fetched. This identifier was allocated by the NFVO.
artifactSelector	M	1..N		Selector to address an individual VNF package artifact, or list of selectors to address multiple of those. See note.
NOTE:	It is part of the protocol design whether this operation is modelled as a "bulk" operation that allows to obtain multiple artifacts in one go, or as a series of operations that obtain one artifact at a time.			

7.7.11.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.7.11.3-1.

Table 7.7.11.3-1: Fetch VNF Package Artifacts operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
vnfPackageArtifact	M	1..N	Not specified	A VNF package artifact (e.g. file) or multiple thereof. See note.
NOTE:	It is part of the protocol design whether this operation is modelled as a "bulk" operation that allows to obtain multiple artifacts in one go, or as a series of operations that obtain one artifact at a time.			

7.7.11.4 Operation results

After successful operation, the NFVO has provided to the OSS a copy/copies of the requested artifact(s) contained in the VNF package.

7.7.12 Void

7.7.13 Terminate Subscription operation

7.7.13.1 Description

This operation enables the OSS/BSS to terminate a particular subscription.

Table 7.7.13.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.7.13.1-1: Terminate Subscription operation

Message	Requirement	Direction
TerminateSubscriptionRequest	Mandatory	OSS/BSS → NFVO
TerminateSubscriptionResponse	Mandatory	NFVO → OSS/BSS

7.7.13.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.7.13.2-1.

Table 7.7.13.2-1: Terminate Subscription operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
subscriptionId	M	1	Identifier	Identifier of the subscription to be terminated.

7.7.13.3 Output parameters

No output parameter.

7.7.13.4 Operation results

After successful termination of a subscription, the identified subscription does not exist anymore, and the OSS/BSS will not receive notifications related that subscription any longer. The result of the operation shall indicate if the subscription termination has been successful or not with a standard success/error result.

7.7.14 Query Subscription Info operation

7.7.14.1 Description

This operation enables the OSS/BSS to query information about subscriptions.

Table 7.7.14.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.7.14.1-1: Query Subscription operation

Message	Requirement	Direction
QuerySubscriptionInfoRequest	Mandatory	OSS/BSS → NFVO
QuerySubscriptionInfoResponse	Mandatory	NFVO → OSS/BSS

7.7.14.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.7.14.2-1.

Table 7.7.14.2-1: Query Subscription Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Filtering criteria to select one or a set of subscriptions. Details are part of the protocol design.

7.7.14.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.7.14.3-1.

Table 7.7.14.3-1: Query Subscription Info operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
queryResult	M	0..N	Not specified	Information about the subscription(s) matching the query.

7.7.14.4 Operation results

After successful operation, the NFVO has queried the internal subscription objects. The result of the operation indicates if it has been successful or not with a standard success/error result. For a particular query, information about the subscriptions to notifications related to VNF Package management that the OSS/BSS has access to and that are matching the filter shall be returned.

7.7.15 Create VNF Package Info operation

7.7.15.1 Description

This operation enables the OSS/BSS to create a VNF Package information object in the NFVO for the VNF Package to be uploaded.

Table 7.7.15.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.7.15.1-1: Create VNF Package Info operation

Message	Requirement	Direction
CreateVnfPackageInfoRequest	Mandatory	OSS/BSS → NFVO
CreateVnfPackageInfoResponse	Mandatory	NFVO → OSS/BSS

7.7.15.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.7.15.2-1.

Table 7.7.15.2-1: Create VNF Package Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
userDefinedData	O	0..N	KeyValuePair	User defined data for the VNF package to be uploaded.

7.7.15.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.7.15.3-1.

Table 7.7.15.3-1: Create VNF Package Info operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
vnfPkgInfoId	M	1	Identifier	Identifier of the created VNF Package information object.

7.7.15.4 Operation results

The result of the operation indicates whether the creation of VNF Package information object has been successful or not with a standard success/error result.

The vnfPkgInfoId is only returned when the operation has been successful.

7.7.16 Update VNF Package Info operation

7.7.16.1 Description

This operation enables the OSS/BSS to update the user defined data and/or the operational state of an existing VNF Package information object. The usage state shall not change as a result of the operation.

Table 7.7.16.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.7.16.1-1: Update VNF Package Info operation

Message	Requirement	Direction
UpdateVnfPackageInfoRequest	Mandatory	OSS/BSS → NFVO
UpdateVnfPackageInfoResponse	Mandatory	NFVO → OSS/BSS

7.7.16.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.7.16.2-1.

Table 7.7.16.2-1: Update VNF Package Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
vnfPkgInfolId	M	1	Identifier	Identifier of the VNF Package information object to be updated.
operationalState	M	0..1	Enum	Operational state of the on-boarded VNF Package. VALUES: <ul style="list-style-type: none"> • ENABLED • DISABLED See note.
userDefinedData	O	0..N	KeyValuePair	User defined data to be updated. For existing keys, the value is replaced. See note.
NOTE: At least one of the two parameters (operationalState and userDefinedData) shall be present. If VNF Package is not on-boarded, the operation is used only to update existing or add additional user defined data using the userDefinedData parameter.				

7.7.16.3 Output parameters

No output parameter.

7.7.16.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

7.8 NFVI Capacity Information interface

7.8.1 Description

This interface allows providing of NFVI capacity information (including capacity shortage notifications) to the OSS/BSS.

The following operations are defined for this interface which will be consumed by the OSS/BSS:

- Query NFVI capacity operation.
- Subscribe operation.
- Terminate Subscription operation.

- Query Subscription Info operation.
- Notify operation.
- Create capacity threshold operation.
- Query capacity threshold operation.
- Delete capacity threshold operation.

The interface also provides the capabilities to create, query and delete capacity thresholds, which are used to set thresholds on specified NFVI capacity metrics. On the definition of a capacity threshold, a value for a given NFVI capacity metric is provided. When a threshold defined for a specific metric is crossed in up or down direction, an NFVI capacity information notification shall be raised to the consumer.

7.8.2 Query NFVI capacity operation

7.8.2.1 Description

This operation will enable the OSS/BSS to solicit from the VIM or CCM via the NFVO information about the available, reserved, allocated/used and total NFVI capacity and CIS Cluster capacity.

NOTE: Specification of the filtering mechanism is part of the protocol design.

Table 7.8.2.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.8.2.1-1: Query NFVI capacity operation

Message	Requirement	Direction
QueryNfviCapacityRequest	Mandatory	OSS/BSS → NFVO
QueryNfviCapacityResponse	Mandatory	NFVO → OSS/BSS

7.8.2.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.8.2.2-1.

Table 7.8.2.2-1: Query NFVI capacity operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Input filter for selecting information to query. For instance, based on the resource zone, VIM or CIS clusters, time interval for which capacity is queried, and which capacity information (i.e. available, total, reserved and/or allocated/used capacity) is queried.

7.8.2.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.8.2.3-1.

Table 7.8.2.3-1: Query NFVI capacity operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
capacityResponse	M	0..1	Not specified	The capacity matching the query. Cardinality is 0 if no data is matching the input filter.

7.8.2.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

7.8.3 Subscribe operation

7.8.3.1 Description

This operation enables the OSS/BSSs to subscribe with a filter for the notifications related to NFVI capacity shortage with the NFVO.

NOTE 1: Specification of the filtering mechanism and how to update the input parameters is part of the protocol design.

NOTE 2: It is part of the protocol design whether subscribing is represented as a separate "Subscribe" operation or whether subscription-related information is managed as part of managing Capacity Thresholds.

Table 7.8.3.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.8.3.1-1: Subscribe operation

Message	Requirement	Direction
SubscribeRequest	Mandatory	OSS/BSS → NFVO
SubscribeResponse	Mandatory	NFVO → OSS/BSS

7.8.3.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.8.3.2-1.

Table 7.8.3.2-1: Subscribe operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Input filter for selecting notifications. The filter shall support: <ul style="list-style-type: none"> Resource type(s): specifies the type(s) of resources (virtual compute, virtual network, virtual storage, and/or compute hosts) for which notifications shall be triggered. Resource zone(s): specifies the resource zone(s) for which notifications shall be triggered. If no resource zone is provided, notifications for the whole VIM or NFVI shall be provided. CIS cluster(s): specifies the CIS cluster(s) for which notifications shall be triggered. VIM(s): specifies the VIM(s) for which notifications shall be triggered. CCM(s): specifies the CCM for which notifications shall be triggered. See note.
NOTE: If the input filter does not contain CIS cluster or CCM or VIM, notifications for the whole NFVI shall be provided				

7.8.3.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.8.3.3-1.

Table 7.8.3.3-1: Subscribe operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
subscriptionId	M	1	Identifier	Identifier of the subscription realized.

7.8.3.4 Operation results

As a result of this operation, the NFVO shall indicate to the OSS/BSS in the SubscribeResponse message whether the subscription was successful or not.

For a particular subscription, only notifications matching the filter will be delivered to the consumer.

7.8.4 Terminate Subscription operation

7.8.4.1 Description

This operation enables the OSS/BSS to terminate a particular subscription.

NOTE: It is part of the protocol design whether terminating a subscribing is represented as a separate "Terminate Subscription" operation or whether subscription-related information is managed as part of managing Capacity Thresholds. Table 7.8.4.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.8.4.1-1: Terminate Subscription operation

Message	Requirement	Direction
TerminateSubscriptionRequest	Mandatory	OSS/BSS → NFVO
TerminateSubscriptionResponse	Mandatory	NFVO → OSS/BSS

7.8.4.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.8.4.2-1.

Table 7.8.4.2-1: Terminate Subscription operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
subscriptionId	M	1	Identifier	Identifier of the subscription to be terminated.

7.8.4.3 Output parameters

No output parameter.

7.8.4.4 Operation results

After successful termination of a subscription, the identified subscription does not exist anymore, and the OSS/BSS will not receive notifications related that subscription any longer. The result of the operation shall indicate if the subscription termination has been successful or not with a standard success/error result.

7.8.5 Query Subscription Info operation

7.8.5.1 Description

This operation enables the OSS/BSS to query information about subscriptions.

NOTE: It is part of the protocol design whether querying information about subscriptions is represented as a separate "Query Subscription Info" operation or whether subscription-related information is managed as part of managing Capacity Thresholds.

Table 7.8.5.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.8.5.1-1: Query Subscription operation

Message	Requirement	Direction
QuerySubscriptionInfoRequest	Mandatory	OSS/BSS → NFVO
QuerySubscriptionInfoResponse	Mandatory	NFVO → OSS/BSS

7.8.5.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.8.5.2-1.

Table 7.8.5.2-1: Query Subscription Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Filtering criteria to select one or a set of subscriptions. Details are part of the protocol design.

7.8.5.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.8.5.3-1.

Table 7.8.5.3-1: Query Subscription Info operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
queryResult	M	0..N	Not specified	Information about the subscription(s) matching the query.

7.8.5.4 Operation results

After successful operation, the NFVO has queried the internal subscription objects. The result of the operation indicates if it has been successful or not with a standard success/error result. For a particular query, information about the subscriptions to notifications related to NSD/PNFD management that the OSS/BSS has access to and that are matching the filter shall be returned.

7.8.6 Notify operation

7.8.6.1 Description

This operation distributes notifications to subscribers. It is a one-way operation issued by the NFVO that cannot be invoked as an operation by the consumer (OSS/BSS).

In order to receive notifications, the OSS/BSS shall have a subscription.

Table 7.8.6.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.8.6.1-1: Notify operation

Message	Requirement	Direction
Notify	Mandatory	NFVO → OSS/BSS

The following notifications can be notified/sent by this operation:

- CapacityThresholdCrossedNotification. See clause 8.7.2.

7.8.7 Create Capacity Threshold operation

7.8.7.1 Description

This operation enables the OSS/BSS to create on the NFVO a threshold and specify threshold levels on a specified NFVI capacity metric. Notifications will be generated when crossed in up or down direction.

The OSS/BSS needs to be subscribed to receive CapacityThresholdCrossedNotification notifications.

Table 7.8.7.1-1 lists the information flow exchange between the OSS/BSS and the NFVO.

Table 7.8.7.1-1: Create Capacity Threshold operation

Message	Requirement	Direction
CreateCapacityThresholdRequest	Mandatory	OSS/BSS → NFVO
CreateCapacityThresholdResponse	Mandatory	NFVO → OSS/BSS

7.8.7.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.8.7.2-1.

Table 7.8.7.2-1: Create Capacity Threshold operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
thresholdType	M	1	Enum	Defines the type of threshold. The list of possible values is part of the protocol design and might include: single/multi valued threshold, static/dynamic threshold, template based threshold, etc. VALUES: <ul style="list-style-type: none"> • SIMPLE: Single-valued static threshold • etc.
thresholdDetails	M	1	Not specified.	Details of the threshold: value to be crossed, direction in which it is crossed, details on the notification to be generated, etc.

7.8.7.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.8.7.3-1.

Table 7.8.7.3-1: Create Capacity Threshold operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
thresholdId	M	1	Identifier	Identifier of the created threshold.

7.8.7.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

The thresholdId is only returned when the operation has been successful.

7.8.8 Delete Capacity Thresholds operation

7.8.8.1 Description

This operation enables the OSS/BSS to delete one or more existing NFVI capacity threshold(s) on the NFVO.

NOTE: It is part of the protocol design whether this operation is modelled as a "bulk" operation that allows to delete multiple thresholds in one request, or as a series of requests that delete one threshold at a time.

Table 7.8.8.1-1 lists the information flow exchange between the OSS/BSS and the NFVO.

Table 7.8.8.1-1: Delete Capacity Thresholds operation

Message	Requirement	Direction
DeleteCapacityThresholdsRequest	Mandatory	OSS/BSS → NFVO
DeleteCapacityThresholdsResponse	Mandatory	NFVO → OSS/BSS

7.8.8.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.8.8.2-1.

Table 7.8.8.2-1: Delete Capacity Thresholds operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
thresholdId	M	1..N	Identifier	Identifiers of the thresholds to be deleted.

7.8.8.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.8.8.3-1.

Table 7.8.8.3-1: Delete Capacity Thresholds operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
deletedThresholdId	M	1..N	Identifier	Identifiers of the thresholds that have been deleted successfully.

7.8.8.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

7.8.9 Query Capacity Threshold operation

7.8.9.1 Description

This operation enables the OSS/BSS to query the details of one or more existing NFVI capacity thresholds on the NFVO.

Table 7.8.9.1-1 lists the information flow exchange between the OSS/BSS and the NFVO.

Table 7.8.9.1-1: Query Capacity Threshold operation

Message	Requirement	Direction
QueryCapacityThresholdRequest	Mandatory	OSS/BSS → NFVO
QueryCapacityThresholdResponse	Mandatory	NFVO → OSS/BSS

7.8.9.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.8.9.2-1.

Table 7.8.9.2-1: Query Capacity Threshold operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Filter defining the thresholds on which the query applies. It can be a single identifier, multiple identifiers or a wildcard.

7.8.9.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.8.9.3-1.

Table 7.8.9.3-1: Query Capacity Threshold operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
thresholdDetails	M	0..N	NfviCapacity Threshold	Details of thresholds matching the input filter.

7.8.9.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

7.9 Policy Management interface

7.9.1 Description

This interface allows the OSS/BSS to invoke policy management operations towards the NFVO.

The following policy management operations are defined for this interface:

- Transfer Policy.
- Delete Policy.
- Query Policy.
- Activate Policy.
- Deactivate Policy.
- Associate Policy.
- Disassociate Policy.
- Create Policy Group.
- Delete Policy Group.
- Update Policy Group.

This interface allows the OSS/BSS to manage subscriptions to notifications sent by the NFVO which inform about changes of a policy and about any detected policy conflicts. It allows the NFVO to provide such notifications to the subscriber (i.e. OSS/BSS).

7.9.2 Transfer Policy operation

7.9.2.1 Description

This operation enables the OSS/BSS to transfer a NFV-MANO policy to the NFVO. Table 7.9.2.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.9.2.1-1: Transfer Policy operation

Message	Requirement	Direction
TransferPolicyRequest	Mandatory	OSS/BSS → NFVO
TransferPolicyResponse	Mandatory	NFVO → OSS/BSS

7.9.2.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.9.2.2-1.

Table 7.9.2.2-1: Transfer Policy operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
designer	M	1	String	Human readable name of designer of the policy.
name	M	1	String	Human readable name of the policy.
version	M	1	Version	Version of the policy. Its value shall be the same as the one within the policy being transferred, i.e. the "policyVersion" attribute in the "Policy" information element as specified in ETSI GS NFV-IFA 048 [6].
pflid	M	0..1	Identifier	Identifier of the Policy Function (PF) which enforces the policy. The PF is either a VNFM or a VIM. Cardinality of zero indicates that the PF is the NFVO itself. See note 3.
policy	M	1	Policy	Specifies the policy. See notes 1 and 2. "Policy" is specified in clause 5.2 of ETSI GS NFV-IFA 048 [6].
NOTE 1: An identifier for uniquely identifying the policy is included in the policy.				
NOTE 2: The OSS/BSS may use this operation to update an existing policy with a new version. Different policy versions share the same internal identifier of the policy but having different PolicyInfo instances. The design of different policy versions and their business logic is out of the scope of the present document.				
NOTE 3: The NFVO uses the pflid attribute to identify the policy function enforcing the policy. More information concerning the policy function can be found in ETSI GR NFV-IFA 023 [i.9].				

7.9.2.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.9.2.3-1.

Table 7.9.2.3-1: Transfer Policy operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
policyInfoId	M	1	Identifier	Identifier of the policy information created by the NFVO.

7.9.2.4 Operation results

In case of success, the NFV-MANO policy is transferred to the NFVO and corresponding policy information is created by the NFVO. In case of failure, appropriate error information is returned.

7.9.3 Delete Policy operation

7.9.3.1 Description

This operation enables the OSS/BSS to delete one or multiple NFV-MANO policy(ies) from the NFVO. Table 7.9.3.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.9.3.1-1: Delete Policy operation

Message	Requirement	Direction
DeletePolicyRequest	Mandatory	OSS/BSS → NFVO
DeletePolicyResponse	Mandatory	NFVO → OSS/BSS

7.9.3.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.9.3.2-1.

Table 7.9.3.2-1: Delete Policy operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
policyInfoId	M	1..N	Identifier (Reference to PolicyInfo)	Identifier(s) of policy information.
NOTE: It is part of the protocol design whether this operation is modelled as a "bulk" operation that allows to delete multiple policies in one request, or as a series of requests that delete one policy at a time.				

7.9.3.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.9.3.3-1.

Table 7.9.3.3-1: Delete Policy operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
deletedPolicyInfoId	M	0..N	Identifier (Reference to PolicyInfo)	Identifier(s) of the deleted NFV-MANO policy information.

7.9.3.4 Operation results

In case of success, the NFV-MANO policy(ies) is (are) deleted from the NFVO, and a success indicator is returned to the OSS/BSS. In case of failure, e.g. if the policy to be deleted is still in a policy group, appropriate error information is returned.

7.9.4 Query Policy operation

7.9.4.1 Description

This operation enables the OSS/BSS to query the information from the NFVO on one or multiple NFV-MANO policy(ies). Table 7.9.4.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.9.4.1-1: Query Policy operation

Message	Requirement	Direction
QueryPolicyRequest	Mandatory	OSS/BSS → NFVO
QueryPolicyResponse	Mandatory	NFVO → OSS/BSS

7.9.4.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.9.4.2-1.

Table 7.9.4.2-1: Query Policy operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Filter defining the NFV-MANO policy information on which the query applies, based on attributes of NFV-MANO policy information. It can also be used to specify one or more NFV-MANO policy(ies) information to be queried by providing their identifiers or identifier(s) of policy group(s).
attributeSelector	M	0..N	String	Provides a list of attribute names of NFV-MANO policy information. If present, only these attributes are returned for the policy information matching the filter. If absent, the complete policy information is returned.

7.9.4.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.9.4.3-1.

Table 7.9.4.3-1: Query Policy operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
queryNsPolicyInfoResult	M	0..N	PolicyInfo	NFV-MANO policy information matching the input filter. If attributeSelector is present, only the attributes listed in attributeSelector are returned for the selected policy information. See note.

NOTE: The lower cardinality is 0 since there may be no matches to the provided filter.

7.9.4.4 Operation results

After success operation, the NFVO has queried the internal NFV-MANO policy information. The result of the operation indicates whether it has been successful or not with a standard success/error result. For a particular query, policy information that is matching the filter shall be returned.

7.9.5 Activate Policy operation

7.9.5.1 Description

This operation enables the OSS/BSS to activate one or multiple NFV-MANO policy(ies) in the NFVO. Table 7.9.5.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.9.5.1-1: Activate Policy operation

Message	Requirement	Direction
ActivatePolicyRequest	Mandatory	OSS/BSS → NFVO
ActivatePolicyResponse	Mandatory	NFVO → OSS/BSS

7.9.5.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.9.5.2-1.

Table 7.9.5.2-1: Activate Policy operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
policyInfoId	M	0..N	Identifier (Reference to PolicyInfo)	Identifier(s) of policy information. See note 1 and 2.
policyGroupId	M	0..1	Identifier	Identifier of policy group. See note 2.

NOTE 1: It is part of the protocol design whether this operation is modelled as a "bulk" operation that allows to activate multiple policies in one request, or as a series of requests that activate one policy at a time.

NOTE 2: Either policyId or policyGroupId, but not both, shall be provided.

7.9.5.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.9.5.3-1.

Table 7.9.5.3-1: Activate Policy operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
activatedPolicyInfoId	M	0..N	Identifier (Reference to PolicyInfo)	Identifier(s) of the activated NFV-MANO policy(ies).

7.9.5.4 Operation results

In case of success, the NFV-MANO policy(ies), either individually specified or specified by a containment policy group in the operation request, are activated in the NFVO, and a success indicator is returned to the OSS/BSS. In case of failure, e.g. if the polices are specified by a containment policy group in the operation request and not all policies in the policy group are activated, appropriate error information is returned.

7.9.6 Deactivate Policy operation

7.9.6.1 Description

This operation enables the OSS/BSS to deactivate one or multiple NFV-MANO policy(ies) in the NFVO. Table 7.9.6.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.9.6.1-1: Deactivate Policy operation

Message	Requirement	Direction
DeactivatePolicyRequest	Mandatory	OSS/BSS → NFVO
DeactivatePolicyResponse	Mandatory	NFVO → OSS/BSS

7.9.6.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.9.6.2-1.

Table 7.9.6.2-1: Deactivate Policy operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
policyInfoId	M	0..N	Identifier (Reference to PolicyInfo)	Identifier(s) of policy information. See note 1 and 2.
policyGroupId	M	0..1	Identifier	Identifier of policy group. See note 2.
NOTE 1: It is up to the protocol design stage to determine whether this operation will be modelled as a "bulk" operation that allows to deactivate multiple policies in one request, or as a series of requests that deactivate one policy at a time.				
NOTE 2: Either policyId or policyGroupId, but not both, shall be provided.				

7.9.6.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.9.6.3-1.

Table 7.9.6.3-1: Deactivate Policy operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
deactivatedPolicyInfoId	M	0..N	Identifier (Reference to PolicyInfo)	Identifier(s) of the deactivated NFV-MANO policy(ies).

7.9.6.4 Operation results

In case of success, the NFV-MANO policy(ies), either individually specified or specified by a containment policy group in the operation request, are deactivated in the NFVO, and a success indicator is returned to the OSS/BSS. In case of failure, e.g. if the polices are specified by a containment policy group in the operation request and not all policies in the policy group are deactivated, appropriate error information is returned.

7.9.7 Subscribe operation

7.9.7.1 Description

This operation enables the OSS/BSS to subscribe with a filter for the notifications sent by the NFVO which are related to changes of a policy and any detected policy conflicts. Changes of a policy are related to operations of transferring policy, deleting policy, activating policy, deactivating policy, associate policy and disassociate policy.

Table 7.9.7.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.9.7.1-1: Subscribe operation

Message	Requirement	Direction
SubscribeRequest	Mandatory	OSS/BSS → NFVO
SubscribeResponse	Mandatory	NFVO → OSS/BSS

7.9.7.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.9.7.2-1.

Table 7.9.7.2-1: Subscribe operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Input filter for selecting the notifications. This filter can contain information about specific types of notifications to subscribe to, or attributes of the PolicyInfo identified by a policy information identifier or belonging to a policy group. Details are part of the protocol design.

7.9.7.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.9.7.3-1.

Table 7.9.7.3-1: Subscribe operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
subscriptionId	M	1	Identifier	Identifier of the subscription realized.

7.9.7.4 Operation results

After successful subscription, the consumer (OSS/BSS) is registered to receive notifications about events related to changes of a policy and any detected policy conflicts.

The result of the operation shall indicate if the subscription has been successful or not with a standard success/error result. For a particular subscription, only notifications matching the filter will be delivered to the consumer.

7.9.8 Notify operation

7.9.8.1 Description

This operation notifies a subscriber about events related to notifications about changes of a policy and any detected policy conflicts.

This operation distributes notifications to subscribers. It is a one-way operation issued by the producer (NFVO) that cannot be invoked as an operation by the consumer (OSS/BSS). In order to receive notifications, the consumer (OSS/BSS) has to perform an explicit Subscribe operation beforehand.

Table 7.9.8.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.9.8.1-1: Notify operation

Message	Requirement	Direction
Notify	Mandatory	NFVO → OSS/BSS

The following notifications can be notified/sent by this operation:

- PolicyChangeNotification. See clause 8.8.3.
- PolicyConflictNotification. See clause 8.8.4.

7.9.9 Terminate Subscription operation

7.9.9.1 Description

This operation enables the OSS/BSS to terminate a particular subscription.

Table 7.9.9.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.9.9.1-1: Terminate Subscription operation

Message	Requirement	Direction
TerminateSubscriptionRequest	Mandatory	OSS/BSS → NFVO
TerminateSubscriptionResponse	Mandatory	NFVO → OSS/BSS

7.9.9.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.9.9.2-1.

Table 7.9.9.2-1: Terminate Subscription operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
subscriptionId	M	1	Identifier	Identifier of the subscription to be terminated.

7.9.9.3 Output parameters

No output parameter.

7.9.9.4 Operation results

After successful termination of a subscription, the identified subscription does not exist anymore, and the OSS/BSS will not receive notifications related that subscription any longer. The result of the operation shall indicate if the subscription termination has been successful or not with a standard success/error result.

7.9.10 Query Subscription Info operation

7.9.10.1 Description

This operation enables the OSS/BSS to query information about subscriptions.

Table 7.9.10.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.9.10.1-1: Query Subscription Info operation

Message	Requirement	Direction
QuerySubscriptionInfoRequest	Mandatory	OSS/BSS → NFVO
QuerySubscriptionInfoResponse	Mandatory	NFVO → OSS/BSS

7.9.10.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.9.10.2-1.

Table 7.9.10.2-1: Query Subscription Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Filtering criteria to select one or a set of subscriptions. Details are part of the protocol design.

7.9.10.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.9.10.3-1.

Table 7.9.10.3-1: Query Subscription Info operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
queryResult	M	0..N	Not specified	Information about the subscription(s) matching the query.

7.9.10.4 Operation results

After successful operation, the NFVO has queried the internal subscription objects. The result of the operation indicates if it has been successful or not with a standard success/error result. For a particular query, information about the subscriptions to notifications related to changes of a policy and any detected policy conflicts that the OSS/BSS has access to and that are matching the filter shall be returned.

7.9.11 Associate Policy operation

7.9.11.1 Description

This operation enables the OSS/BSS to associate an NFV-MANO policy to one or multiple NS instances in the NFVO.

Table 7.9.11.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.9.11.1-1: Associate Policy operation

Message	Requirement	Direction
AssociatePolicyRequest	Mandatory	OSS/BSS → NFVO
AssociatePolicyResponse	Mandatory	NFVO → OSS/BSS

7.9.11.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.9.11.2-1.

Table 7.9.11.2-1: Associate Policy operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
policyInfold	M	1	Identifier (Reference to PolicyInfo)	Identifier of policy information.
nsInstanceld	M	1..N	Identifier	Identifier(s) of the NS instance(s) to associate policy to. See note.
NOTE: It is part of the protocol design whether this operation is modelled as a "bulk" operation that allows to associate a policy to multiple NS instances in one request, or as a series of requests that associate the policy to one NS instance at a time.				

7.9.11.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.9.11.3-1.

Table 7.9.11.3-1: Associate Policy operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
nsInstanceld	M	0..N	Identifier	Identifier(s) of the NS instance(s) to which the policy has been associated.

7.9.11.4 Operation results

After successful operation, the NFVO has associated the MANO policy to the NS instance(s), and a success indicator is returned to the OSS/BSS. In case of failure, appropriate error information is returned. The associations performed via the present interface operation take precedence and override any of the associations defined by "targetObjectId", if present, within the policy itself as defined by the "Policy" information element specified in ETSI GS NFV-IFA 048 [6].

7.9.12 Disassociate Policy operation

7.9.12.1 Description

This operation enables the OSS/BSS to disassociate a MANO policy from one or multiple NS instances in the NFVO.

Table 7.9.12.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.9.12.1-1: Disassociate Policy operation

Message	Requirement	Direction
DisassociatePolicyRequest	Mandatory	OSS/BSS → NFVO
DisassociatePolicyResponse	Mandatory	NFVO → OSS/BSS

7.9.12.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.9.12.2-1.

Table 7.9.12.2-1: Query Subscription Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
policyInfold	M	1	Identifier (Reference to PolicyInfo)	Identifier of policy information.
nsInstanceld	M	1..N	Identifier	Identifier(s) of the NS instance(s) to disassociate policy from. See note.
NOTE: It is part of the protocol design whether this operation is modelled as a "bulk" operation that allows to disassociate a policy from multiple NS instances in one request, or as a series of requests that disassociate the policy from one NS instance at a time.				

7.9.12.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.9.12.3-1.

Table 7.9.12.3-1: Query Subscription Info operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
nsInstanceld	M	0..N	Identifier	Identifier(s) of the NS instance(s) from which the policy has been disassociated.

7.9.12.4 Operation results

After successful operation, the NFVO has disassociated the MANO policy from the NS instance(s), and a success indicator is returned to the OSS/BSS. In case of failure, appropriate error information is returned. The disassociations performed via the present interface operation take precedence and override any of the associations defined by "targetObjectId", if present, within the policy itself as defined by the "Policy" information element specified in ETSI GS NFV-IFA 048 [6].

7.9.13 Create Policy Group operation

7.9.13.1 Description

This operation enables the OSS/BSS to create a policy group to the NFVO. Table 7.9.13.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.9.13.1-1: Create Policy Group operation

Message	Requirement	Direction
CreatePolicyGroupRequest	Mandatory	OSS/BSS → NFVO
CreatePolicyGroupResponse	Mandatory	NFVO → OSS/BSS

7.9.13.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.9.13.2-1.

Table 7.9.13.2-1: Create Policy Group operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
policyInfold	M	0..N	Identifier	The identifier of the policy information of a policy to be part of the policy group to be created.
subPolicyGroupId	M	0..N	Identifier	The identifier of policy group to be part of the policy group to be created in a hierarchical structure.

7.9.13.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.9.13.3-1.

Table 7.9.13.3-1: Create Policy Group operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
policyGroupId	M	1	Identifier	Identifier of the created policy group.

7.9.13.4 Operation results

In case of success, the policy group is created by the NFVO. In case of failure, appropriate error information is returned.

7.9.14 Delete Policy Group operation

7.9.14.1 Description

This operation enables the OSS/BSS to delete one or multiple policy groups from the NFVO. Table 7.9.14.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.9.14.1-1: Delete Policy Group operation

Message	Requirement	Direction
DeletePolicyGroupRequest	Mandatory	OSS/BSS → NFVO
DeletePolicyGroupResponse	Mandatory	NFVO → OSS/BSS

7.9.14.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.9.14.2-1.

Table 7.9.14.2-1: Delete Policy Group operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
policyGroupId	M	1..N	Identifier	Identifier(s) of policy group.
NOTE: It is part of the protocol design whether this operation is modelled as a "bulk" operation that allows to delete multiple policy groups in one request, or as a series of requests that delete one policy group at a time.				

7.9.14.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.9.14.3-1.

Table 7.9.14.3-1: Delete Policy Group operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
deletedPolicyGroupId	M	0..N	Identifier	Identifier(s) of the deleted policy group.

7.9.14.4 Operation results

In case of success, the policy group(s) is (are) deleted from the NFVO, and a success indicator is returned to the OSS/BSS. In case of failure, appropriate error information is returned.

7.9.15 Update Policy Group operation

7.9.15.1 Description

This operation enables the OSS/BSS to update a policy group to the NFVO. Table 7.9.15.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.9.15.1-1: Update Policy Group operation

Message	Requirement	Direction
UpdatePolicyGroupRequest	Mandatory	OSS/BSS → NFVO
UpdatePolicyGroupResponse	Mandatory	NFVO → OSS/BSS

7.9.15.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.9.15.2-1.

Table 7.9.15.2-1: Update Policy Group operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
policyGroupld	M	1	Identifier	Identifier of the policy group.
addPolicyInfold	M	0..N	Identifier	The identifier of the policy information of a policy to be added in the policy group.
removePolicyInfold	M	0..N	Identifier	The identifier of the policy information of a policy to be removed from the policy group.
addSubPolicyGroupld	M	0..N	Identifier	The identifier of the policy group to be added in the policy group in a hierarchical structure.
removeSubPolicyGroupld	M	0..N	Identifier	The identifier of the policy group to be removed from the policy group in a hierarchical structure.

7.9.15.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.9.15.3-1.

Table 7.9.15.3-1: Update Policy Group operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
policyInfold	M	0..N	Identifier	Identifier(s) of policy information to indicate the full set of policy(ies) in the policy group, after the successful update policy group operation.
subPolicyGroupld	M	0..N	Identifier	Identifier(s) of policy group to indicate the full set of policy group(s) in the policy group in a hierarchical structure, after the successful update policy group operation.

7.9.15.4 Operation results

In case of success, the policy group is updated by the NFVO. In case of failure, appropriate error information is returned.

7.10 VNF Snapshot Package Management interface

7.10.1 Description

This interface allows the OSS/BSS to access the VNF Snapshot Package information and to fetch, create, upload, extract, delete VNF Snapshot packages. The create VNF Snapshot Package operation is designed as a 2-step operation, whereby first a VNF Snapshot Package information object is created based on the VNF Snapshot metadata. Then, second, either a new VNF Snapshot Package is built or an existing VNF Snapshot Package is uploaded.

7.10.2 Create VNF Snapshot Package Info operation

7.10.2.1 Description

This operation enables the OSS/BSS to request to the NFVO the creation of a VNF Snapshot Package identifier and associated instance of a VNF Snapshot Package information element, identified by that identifier.

Table 7.10.2.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.10.2.1-1: Create VNF Snapshot Package Info operation

Message	Requirement	Direction
CreateVnfSnapshotPackageInfoRequest	Mandatory	OSS/BSS → NFVO
CreateVnfSnapshotPackageInfoResponse	Mandatory	NFVO → OSS/BSS

7.10.2.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.10.2.2-1.

Table 7.10.2.2-1: Create VNF Snapshot Package Info operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
name	M	1	String	Human-readable name of the VNF Snapshot Package.
userDefinedData	O	0..N	KeyValuePair	User defined data for the VNF Package to be created.

7.10.2.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.10.2.3-1.

Table 7.10.2.3-1: Create VNF Snapshot Package Info operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
vnfSnapshotPkgInfoId	M	1	Identifier (Reference to VnfSnapshotPkgInfo)	References the information held by the NFVO about the created VNF Snapshot Package.

7.10.2.4 Operation results

The result of the operation indicates if the creation of the VNF Snapshot Package information object has been successful or not with a standard success/error result.

After successful operation, the NFVO has created a VNF Snapshot Package information object and the state of this VnfSnapshotPkgInfo is "CREATED". Once created, the VNF Snapshot Package is known to the NFVO. It is enabled to be queried for its associated information and is enabled for building/uploading the VNF Snapshot package.

7.10.3 Build VNF Snapshot Package operation

7.10.3.1 Description

This operation enables the OSS/BSS to request to the NFVO to populate the VNF Snapshot Package information object with the information from the VnfSnapshotInfo, the VnfcSnapshotImageInfo object(s), and SnapshotPkgArtifactInformation object(s). The VNF Snapshot to be packaged is addressed using an identifier of information known to the NFVO about a specific VNF Snapshot.

Table 7.10.3.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.10.3.1-1: Build VNF Snapshot Package operation

Message	Requirement	Direction
BuildVnfSnapshotPackageRequest	Mandatory	OSS/BSS → NFVO
BuildVnfSnapshotPackageResponse	Mandatory	NFVO → OSS/BSS

7.10.3.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.10.3.2-1.

Table 7.10.3.2-1: Build VNF Snapshot Package operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
vnfSnapshotPkgInfoId	M	1	Identifier (Reference to VnfSnapshotPkgInfo)	References the information held by the NFVO about the specific VNF Snapshot Package to which the VNF Snapshot image(s) are to be added.
vnfSnapshotInfoId	M	1	Identifier (Reference to VnfSnapshotInfo)	References the information about a specific VNF Snapshot to be added to the VNF Snapshot Package. This identifier was allocated by the VNFM and is assumed to be known to the NFVO.

7.10.3.3 Output parameters

No output parameter.

7.10.3.4 Operation results

The result of the operation indicates if the build of the VNF Snapshot Package has been successful or not with a standard success/error result.

After successful operation, the NFVO has populated the VNF Snapshot Package Info object with the information from the VnfSnapshotInfo, the VnfSnapshotImageInfo object(s), and SnapshotPkgArtifactInformation object(s). It is enabled to be queried for its associated information, its content is enabled to be fetched, and it is enabled to be extracted.

The state of the VnfSnapshotPkgInfo is changed to "BUILDING" during the build operation, is changed to "PROCESSING" once the build is completed, and is changed to "AVAILABLE" once the validation is completed. Also, a globally unique vnfSnapshotPkgId is created that remains the same for the lifetime of the package.

7.10.4 Upload VNF Snapshot Package operation

7.10.4.1 Description

This operation enables the OSS/BSS to request to the NFVO to upload an external VNF Snapshot Package from an external location into the NFVO. A new VNF Snapshot Package information element shall be created a priori via the Create VNF Snapshot Package Info operation. Only one VNF Snapshot Package is allowed per VNF Snapshot Package information object.

NOTE: The NFVO may utilize remote storage capabilities to store the package.

Table 7.10.4.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.10.4.1-1: Upload VNF Snapshot Package operation

Message	Requirement	Direction
UploadVnfSnapshotPackageRequest	Mandatory	OSS/BSS → NFVO
UploadVnfSnapshotPackageResponse	Mandatory	NFVO → OSS/BSS

7.10.4.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.10.4.2-1.

Table 7.10.4.2-1: Upload VNF Snapshot Package operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
vnfSnapshotPkgInfo	M	1	Identifier (Reference to VnfSnapshotPkgInfo)	References the information held by the NFVO about the specific VNF Snapshot Package info which the external VNF Snapshot Package shall be uploaded to.
vnfSnapshotPkg	M	0..1	Binary	VNF Snapshot Package to be uploaded. This attribute shall be supported when the VNF Snapshot Package is uploaded as a local file. See note 2.
vnfSnapshotPkgPath	M	0..1	Not specified	Address information based on which the VNF Snapshot Package can be obtained. See note 1. This attribute shall be supported when the VNF Snapshot Package is uploaded from a remote server. See note 2.

NOTE 1: This structure can be the address information related to an FTP server where the VNF Snapshot Package is located, or be a URL where the NFVO can download the VNF Snapshot Package.
NOTE 2: Either the parameter vnfSnapshotPkg or the parameter vnfSnapshotPkgPath, but not both shall be provided.
NOTE 3: The vnfId shall match the vnfId in the VNF Snapshot Package (if this parameter exists inside the VNF Snapshot Package).

7.10.4.3 Output parameters

No output parameter.

7.10.4.4 Operation results

The result of the operation indicates if the upload of the VNF Snapshot Package has been successful or not with a standard success/error result.

After successful operation, the VNF Snapshot Package is known to and validated by the NFVO. The associated VNF Snapshot Package information object was updated with the information populated from the validated VNF Snapshot Package, e.g. the globally unique vnfSnapshotPkgId was obtained from the VNF Snapshot Package. It is enabled to be queried for its associated information, its content is enabled to be fetched, and it is enabled to be extracted.

The state of the VnfSnapshotPkgInfo is changed to "UPLOADING" during the upload operation, is changed to "PROCESSING" once the upload is completed, and is changed to "AVAILABLE" once the validation is completed.

7.10.5 Extract VNF Snapshot Package operation

7.10.5.1 Description

This operation enables the OSS/BSS to request to the NFVO the extraction of a VNF Snapshot Package, i.e. it requests the NFVO to extract the VNF Snapshot Package and store the included VNFC Snapshot information object(s) and VNF Snapshot information. The VNF Snapshot Package to be extracted is addressed using an identifier of information held by the NFVO about a specific VNF Snapshot Package.

Table 7.10.5.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.10.5.1-1: Extract VNF Snapshot Package operation

Message	Requirement	Direction
ExtractVnfSnapshotPackageRequest	Mandatory	OSS/BSS → NFVO
ExtractVnfSnapshotPackageResponse	Mandatory	NFVO → OSS/BSS

7.10.5.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.10.5.2-1.

Table 7.10.5.2-1: Extract VNF Snapshot Package operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
vnfSnapshotPkgInfoId	M	1	Identifier (Reference to VnfSnapshotPkgInfo)	References the information held by the NFVO about a specific VNF Snapshot Package to be extracted.
vnfSnapshotInfoId	M	0..1	Identifier (Reference to VnfSnapshotInfo)	Identifier held by the NFVO about an "Individual VNF snapshot" managed by the VNFM to which the content of the VNF snapshot package will be extracted to. See note.
vnfInstanceId	M	0..1	Identifier (Reference to VnfInfo)	Identifier of the VNF instance to which the content and extraction of the VNF snapshot package is to be associated. See note.
NOTE: Either the parameter vnfSnapshotInfoId or vnfInstanceId, but not both, shall be provided.				

7.10.5.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.10.5.3-1.

Table 7.10.5.3-1: Extract VNF Snapshot Package operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
vnfSnapshotInfoId	M	1	Identifier (Reference to VnfSnapshotInfo)	References the information held by the NFVO about the extracted VNF Snapshot.

7.10.5.4 Operation results

The result of the operation indicates if the extraction of the VNF Snapshot Package has been successful or not with a standard success/error result.

After successful operation, the NFVO has extracted a VNF Snapshot from the specified VNF Snapshot Package and has created information associated with this VNF Snapshot. Once extracted, the VNF Snapshot is known to the NFVO. It is enabled to be queried for its associated information, and it is enabled to be reverted to.

The state of the VnfSnapshotPkgInfo is changed to "EXTRACTING" during the extract operation and is changed to "AVAILABLE" once the extraction is completed.

7.10.6 Fetch VNF Snapshot Package operation

7.10.6.1 Description

This operation enables the OSS/BSS to fetch a whole VNF Snapshot Package from the NFVO. The package is addressed using an identifier of information held by the NFVO about the specific VNF Snapshot Package.

Table 7.10.6.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.10.6.1-1: Fetch VNF Snapshot Package operation

Message	Requirement	Direction
FetchVnfSnapshotPackageRequest	Mandatory	OSS/BSS → NFVO
FetchVnfSnapshotPackageResponse	Mandatory	NFVO → OSS/BSS

7.10.6.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.10.6.2-1.

Table 7.10.6.2-1: Fetch VNF Snapshot Package operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
vnfSnapshotPkgInfo	M	1	Identifier (Reference to VnfSnapshotPkgInfo)	References the information held by the NFVO about the VNF Snapshot Package to be fetched.

7.10.6.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.10.6.3-1.

Table 7.10.6.3-1: Fetch VNF Snapshot Package operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
vnfSnapshotPackage	M	1	Binary	The VNF Snapshot Package.

7.10.6.4 Operation results

After successful operation, the NFVO has provided to the OSS/BSS a copy of the requested VNF Snapshot Package.

7.10.7 Fetch VNF Snapshot Package Artifacts operation

7.10.7.1 Description

This operation enables the OSS/BSS to fetch selected artifacts contained in an VNF Snapshot Package. Artifacts are addressed using selector information that can be obtained using the QueryVnfSnapshotPkgInfo operation.

Table 7.10.7.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.10.7.1-1: Fetch VNF Snapshot Package Artifacts operation

Message	Requirement	Direction
FetchVnfSnapshotPackageArtifactsRequest	Mandatory	OSS/BSS → NFVO
FetchVnfSnapshotPackageArtifactsResponse	Mandatory	NFVO → OSS/BSS

7.10.7.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.10.7.2-1.

Table 7.10.7.2-1: Fetch VNF Snapshot Package Artifacts operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
vnfSnapshotPkgInfo	M	1	Identifier (Reference to VnfSnapshotPkgInfo)	References the information held by the NFVO about the VNF Snapshot Package.
artifactSelector	M	1..N	Not specified	Selector to address an individual VNF Snapshot Package artifact, or list of selectors to address multiple of those. See note.
NOTE:	It is part of the protocol design whether this operation is modelled as a "bulk" operation that allows to obtain multiple artifacts in one go, or as a series of operations that obtain one artifact at a time.			

7.10.7.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.10.7.3-1.

Table 7.10.7.3-1: Fetch VNF Snapshot Package Artifacts operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
vnfSnapshotPackageArtifact	M	1..N	Not specified	A VNF Snapshot Package artifact (e.g. file), or multiple thereof. See note.
NOTE: It is part of the protocol design whether this operation is modelled as a "bulk" operation that allows to obtain multiple artifacts in one go, or as a series of operations that obtain one artifact at a time.				

7.10.7.4 Operation results

After successful operation, the NFVO has provided to the OSS/BSS a copy/copies of the requested artifact(s) contained in the VNF Snapshot Package.

7.10.8 Query VNF Snapshot Package Information operation

7.10.8.1 Description

When a VNF Snapshot Package information element and the VNF Snapshot Package is built by or uploaded to the NFVO, the NFVO creates and stores information associated with this VNF Snapshot Package. It maintains this information during the VNF Snapshot Package's operational lifecycle. This operation will enable the OSS/BSS to query the NFVO for information it has stored about one or more VNF Snapshot Packages. Table 7.10.8.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

The operation allows querying specific components of the information stored in the NFVO about a VNF Snapshot Package, for instance, retrieving the vnfSnapshotInfoId.

NOTE: The vnfSnapshotInfoId is an attribute of the VnfSnapshotPkgInfo.

Table 7.10.8.1-1: Query VNF Snapshot Package Information operation

Message	Requirement	Direction
QueryVnfSnapshotPkgInfoRequest	Mandatory	OSS/BSS → NFVO
QueryVnfSnapshotPkgInfoResponse	Mandatory	NFVO → OSS/BSS

7.10.8.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.10.8.2-1.

Table 7.10.8.2-1: Query VNF Snapshot Package Information operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Filter defining the VNF Snapshot Packages on which the query applies, based on attributes of the VnfSnapshotPkgInfo. It can also be used to specify one or more VNF Snapshot Packages to be queried by providing their vnfSnapshotInfoId or vnfSnapshotPkgInfoId. See note.
attributeSelector	M	0..N	String	It provides a list of attribute names of VnfSnapshotPkgInfo. If present, only these attributes are returned for the VnfSnapshotPkgInfo matching the filter. If absent, the complete VnfSnapshotPkgInfo is returned.
NOTE: The vnfSnapshotInfoId, assigned by the VNFM at VNF Snapshot creation or at VNF Snapshot Package extraction, identifies the information related to a VNF Snapshot. It is assumed that this information is known to the NFVO. The vnfSnapshotPkgInfoId identifies the information related to the creation or storage of a VNF Snapshot Package in the NFVO, which implies that it also identifies an available VNF Snapshot Package.				

7.10.8.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.10.8.3-1.

Table 7.10.8.3-1: Query available VNF Snapshot Package Information operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
queryResult	M	0..N	VnfSnapshotPkgInfo	Details of the VNF Snapshot Packages available to the NFVO matching the input filter. If attributeSelector is present, only the attributes listed in attributeSelector are returned for the selected entities. Cardinality is 0 if no data is matching the input filter.

7.10.8.4 Operation results

After successful operation, the NFVO has queried its internal VNF Snapshot Package information objects. The result of the operation indicates if it has been successful or not with a standard success/error result. For a particular query, information about the VNF Snapshot Package that the consumer has access to and that are matching the filter shall be returned.

7.10.9 Delete VNF Snapshot Package operation

7.10.9.1 Description

This operation enables the OSS/BSS to request to the NFVO the deletion of a VNF Snapshot Package. The VNF Snapshot Package to be deleted is addressed using an identifier of information held by the NFVO about a specific VNF Snapshot Package.

Table 7.10.9.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.10.9.1-1: Delete VNF Snapshot Package operation

Message	Requirement	Direction
DeleteVnfSnapshotPackageRequest	Mandatory	OSS/BSS → NFVO
DeleteVnfSnapshotPackageResponse	Mandatory	NFVO → OSS/BSS

7.10.9.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.10.9.2-1.

Table 7.10.9.2-1: Delete VNF Snapshot Package operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
vnfSnapshotPkgInfoId	M	1	Identifier (Reference to VnfSnapshotPkgInfo)	References the information held by the NFVO about a specific VNF Snapshot Package to be deleted.

7.10.9.3 Output parameters

No output parameter.

7.10.9.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

After successful operation, the NFVO has deleted the referenced artifacts and the held information associated to the specified VNF Snapshot Package.

7.10.10 Update VNF Snapshot Package operation

7.10.10.1 Description

This operation enables the OSS/BSS to request to the NFVO the update of selected attributes of a VNF Snapshot Package. The VNF Snapshot Package to be updated is addressed using an identifier of information held by the NFVO about a specific VNF Snapshot Package.

Table 7.10.10.1-1 lists the information flow exchanged between the OSS/BSS and the NFVO.

Table 7.10.10.1-1: Update VNF Snapshot Package operation

Message	Requirement	Direction
UpdateVnfSnapshotPackageRequest	Mandatory	OSS/BSS → NFVO
UpdateVnfSnapshotPackageResponse	Mandatory	NFVO → OSS/BSS

7.10.10.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.10.10.2-1.

Table 7.10.10.2-1: Update VNF Snapshot Package operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
vnfSnapshotPkgInfo	M	1	Identifier (Reference to VnfSnapshotPkgInfo)	References the information held by the NFVO about a specific VNF Snapshot Package to be updated.
name	M	0..1	String	If present, specified the new value of the human-readable name of the VNF Snapshot Package. See note.
userDefinedData	O	0..N	KeyValuePair	If present, specifies the user defined data for the VNF Snapshot Package to be updated. For existing keys, the value is replaced. See note.
NOTE: At least one of the two parameters name and userDefinedData shall be present. If the VNF snapshot package is not uploaded or built, the operation is used only to update existing or add additional user defined data using the userDefinedData attribute.				

7.10.10.3 Output parameters

No output parameter.

7.10.10.4 Operation results

The result of the operation indicates if it has been successful or not with a standard success/error result.

After successful operation, the NFVO has updated the specified VNF Snapshot Package.

8 Information elements exchanged

8.1 Introduction

This clause defines, or references, definitions of information elements used in the interfaces defined in the present document.

The specification of the following information elements is part of the protocol design:

- String.
- Integer.
- Identifier.
- Filter.
- DateTime.
- Value.
- Rule.
- KeyValuePair.
- Version.
- Binary.

8.2 Information elements related to NSD Management

8.2.1 Introduction

The clauses below define information elements related to NSD management.

8.2.2 NsdInfo information element

8.2.2.1 Description

This information element provides the details of an NsdInfo information element.

8.2.2.2 Attributes

The attributes of the NsdInfo information element shall follow the indications provided in table 8.2.2.2-1.

Table 8.2.2.2-1: Attributes of the NsdInfo information element

Attribute	Qualifier	Cardinality	Content	Description
nsdInfolId	M	1	Identifier	Identifier of the NSD information object.
nsdId	M	0..1	Identifier	Identifier of the on-boarded NSD. See notes 1 and 3.
nsdInvariantId	M	0..1	Identifier	Identifies an NSD in a version independent manner. This attribute is invariant across versions of NSD with no constraint on the changes across versions. See notes 3 and 4.
nsdExtInvariantId	M	0..1	Identifier	Identifies an NSD in a version independent manner. This attribute is invariant across versions of the NSD that fulfil certain conditions related to the external connectivity and management of the NS. See notes 3 and 4.
name	M	0..1	String	Name of the on-boarded NSD. See notes 1 and 3.
version	M	0..1	Version	Version of the on-boarded NSD. See notes 1 and 3.

Attribute	Qualifier	Cardinality	Content	Description
designer	M	0..1	String	Designer of the on-boarded NSD. See notes 1 and 3.
nsd	M	0..1	Identifier (Reference to Nsd)	Reference to the on-boarded NSD details, e.g. URL to the on-boarded NSD. See note 1.
vnfPkgInfold	M	0..N	Identifier (Reference to VnfPkgInfo)	Identifies the VnfPkgInfo objects for the VNFD referenced by the on-boarded NSD. See note 5.
pnfdInfold	M	0..N	Identifier (Reference to PnfdInfo)	Identifies the PNFD information object for the PNFD referenced by the on-boarded NSD. See note 6.
nestedNsdInfold	M	0..N	Identifier (Reference to NsdInfo)	Identifies the NSD information object for the nested NSD referenced by the on-boarded NSD. See note 7.
artifacts	M	0..N	NsdArchiveArtifactInformation	Information about artifacts contained in the NSD archive. See note 2.
onboardingState	M	1	Enum	On-boarding state of the NSD. VALUES: <ul style="list-style-type: none"> • CREATED • UPLOADING • PROCESSING • ONBOARDED
operationalState	M	1	Enum	Operational state of the NSD. VALUES: <ul style="list-style-type: none"> • ENABLED • DISABLED
usageState	M	1	Enum	Usage state of the NSD. VALUES: <ul style="list-style-type: none"> • IN_USE • NOT_IN_USE
userDefinedData	O	0..N	KeyValuePair	User defined data for the NSD.
<p>NOTE 1: These attributes shall be present after the NSD is on-boarded.</p> <p>NOTE 2: The attribute may be present after the NSD archive is on-boarded and shall be absent otherwise.</p> <p>NOTE 3: This attribute is copied from the NSD.</p> <p>NOTE 4: These attributes may be present after the NSD is on-boarded.</p> <p>NOTE 5: This attribute shall be present after the NSD is on-boarded for those VNF packages that are already on-boarded.</p> <p>NOTE 6: This attribute shall be present after the NSD is on-boarded for those PNFDs that are already on-boarded.</p> <p>NOTE 7: This attribute shall be present after the NSD is on-boarded for those nested NSDs that are already on-boarded.</p>				

8.2.3 Pnfd information element

8.2.3.1 Description

This information element provides the details of the PNFD.

8.2.3.2 Attributes

The structure of the Pnfd information element shall comply with the provisions for the Pnfd information element as defined in ETSI GS NFV-IFA 014 [3], clause 6.6.

8.2.4 PnfdInfo information element

8.2.4.1 Description

This information element provides the details of a PNFD.

8.2.4.2 Attributes

The PnfdInfo information element shall follow the indications provided in table 8.2.4.2-1.

Table 8.2.4.2-1: Attributes of the PnfdInfo information element

Attribute	Qualifier	Cardinality	Content	Description
pnfdInfold	M	1	Identifier	Identifier of the on-boarded instance of the PNFD.
pnfdId	M	0..1	Identifier	Identifier of the on-boarded PNFD. See notes 1 and 3.
name	M	0..1	String	Name of the on-boarded PNFD. See notes 1 and 3.
version	M	0..1	Version	Version of the on-boarded PNFD. See notes 1 and 3.
provider	M	0..1	String	Provider of the on-boarded PNFD. See notes 1 and 3.
pnfdInvariantId	M	0..1	Identifier	Identifies a PNFD in a version independent manner. This attribute is invariant across versions of PNFD. See notes 1 and 3.
pnfdExtInvariantId	M	0..1	Identifier	Identifies a PNFD in a version independent manner. This attribute is invariant across versions of the PNFD that expose the same external connectivity, i.e. same number of pnfdExtCpds and same identifiers. See notes 3 and 4.
pnfd	M	0..1	Identifier (Reference to Pnfd)	Reference to the on-boarded PNFD, e.g. URL to the on-boarded PNFD. See note 1.
artifacts	M	0..N	PnfdArchiveArtifactInformation	Information about artifacts contained in the PNFD archive. See note 2.
onboardingState	M	1	Enum	On-boarding state of the PNFD. VALUES: <ul style="list-style-type: none"> • CREATED • UPLOADING • PROCESSING • ONBOARDED
usageState	M	1	Enum	Usage state of the PNFD. VALUES: <ul style="list-style-type: none"> • IN_USE • NOT_IN_USE
userDefinedData	O	0..N	KeyValuePair	User defined data for the PNFD.
NOTE 1: These attributes shall be present after the PNFD is on-boarded.				
NOTE 2: The attribute may be present after the PNFD archive is on-boarded and shall be absent otherwise.				
NOTE 3: This attribute is copied from the PNFD.				
NOTE 4: This attribute may be present after the PNFD is on-boarded.				

8.2.5 Nsd information element

8.2.5.1 Description

This information element provides the details of the NSD.

8.2.5.2 Attributes

The structure of the Nsd information element shall comply with the provisions for the Nsd information element as defined in ETSI GS NFV-IFA 014 [3], clause 6.2.

8.2.6 NsdOnBoardingNotification

8.2.6.1 Description

This notification indicates that a new NSD is on-boarded, after all the on-boarding steps (e.g. uploading and processing) are done. A change in on-boarding state before the NSD is on-boarded is not reported.

Support of this notification is mandatory.

8.2.6.2 Trigger Conditions

The notification is produced when:

- New NSD is on-boarded.

8.2.6.3 Attributes

The attributes of the NsdOnBoardingNotification shall follow the indications provided in table 8.2.6.3-1.

Table 8.2.6.3-1: Attributes of the NsdOnBoardingNotification

Attribute	Qualifier	Cardinality	Content	Description
nsdInfoId	M	1	Identifier (Reference to NsdInfo)	Identifier of the NSD information object.
nsdId	M	1	Identifier (Reference to Nsd)	Identifies the on-boarded NSD.

8.2.7 NsdChangeNotification

8.2.7.1 Description

This notification indicates a change of state in an on-boarded NSD. Only a change in operational state will be reported. A change in usage state is not reported.

Support of this notification is mandatory.

8.2.7.2 Trigger Conditions

The notification is produced when:

- Change of the operational state of an on-boarded NSD.

8.2.7.3 Attributes

The attributes of the NsdChangeNotification shall follow the indications provided in table 8.2.7.3-1.

Table 8.2.7.3-1: Attributes of the NsdChangeNotification

Attribute	Qualifier	Cardinality	Content	Description
nsdInfoId	M	1	Identifier (Reference to NsdInfo)	Identifier of the NSD information object.
nsdId	M	1	Identifier (Reference to Nsd)	Identifies the on-boarded NSD.
operationalState	M	0..1	Enum	New operational state of the on-boarded NSD. VALUES: <ul style="list-style-type: none"> • ENABLED • DISABLED

8.2.8 NsdDeletionNotification

8.2.8.1 Description

This notification indicates an on-boarded NSD is deleted. Support of this notification is mandatory.

8.2.8.2 Trigger Conditions

The notification is produced when:

- An on-boarded NSD is deleted.

8.2.8.3 Attributes

The attributes of the NsdOnBoardingNotification shall follow the indications provided in table 8.2.8.3-1.

Table 8.2.8.3-1: Attributes of the NsdDeletionNotification

Attribute	Qualifier	Cardinality	Content	Description
nsdInfoId	M	1	Identifier (Reference to NsdInfo)	Identifier of the deleted NSD information object.
nsdId	M	1	Identifier (Reference to Nsd)	Identifies the deleted NSD.

8.2.9 PnfdOnBoardingNotification

8.2.9.1 Description

This notification indicates that a new PNFD is on-boarded, after all the on-boarding steps (e.g. uploading and processing) are done. A change in on-boarding state before the PNFD is on-boarded is not reported.

Support of this notification is mandatory.

8.2.9.2 Trigger Conditions

The notification is produced when:

- New PNFD is on-boarded.

8.2.9.3 Attributes

The attributes of the PnfdOnBoardingNotification shall follow the indications provided in table 8.2.9.3-1.

Table 8.2.9.3-1: Attributes of the PnfdOnBoardingNotification

Attribute	Qualifier	Cardinality	Content	Description
pnfdInfoId	M	1	Identifier (Reference to PnfdInfo)	Identifier of the PNFD information object.
pnfdId	M	1	Identifier (Reference to Pnfd)	Identifies the on-boarded PNFD.

8.2.10 PnfdDeletionNotification

8.2.10.1 Description

This notification indicates an on-boarded PNFD is deleted. Support of this notification is mandatory.

8.2.10.2 Trigger Conditions

The notification is produced when:

- An on-boarded PNFD is deleted.

8.2.10.3 Attributes

The attributes of the PnfdDeletionNotification shall follow the indications provided in table 8.2.10.3-1.

Table 8.2.10.3-1: Attributes of the PnfdDeletionNotification

Attribute	Qualifier	Cardinality	Content	Description
pfnfdInfold	M	1	Identifier (Reference to PnfdInfo)	Identifier of the deleted PNFD information object.
pfnfdId	M	1	Identifier (Reference to Pnfd)	Identifies the deleted PNFD.

8.2.11 NsdArchiveArtifactInformation information element

8.2.11.1 Description

This information element provides identification information for an artifact which is contained in the NSD archive.

8.2.11.2 Attributes

The NsdArchiveArtifactInformation information element shall follow the indications provided in table 8.2.11.2-1.

Table 8.2.11.2-1: Attributes of the NsdArchiveArtifactInformation information element

Attribute	Qualifier	Cardinality	Content	Description
selector	M	1	Not specified	Information (such as a path) that identifies this artifact in the NSD archive.
metadata	M	1	Not specified	The metadata of the artifact that are available in the NSD archive, such as Content type, size, creation date, etc.

8.2.12 PnfdArchiveArtifactInformation information element

8.2.12.1 Description

This information element provides identification information for an artifact which is contained in the PNFD archive.

8.2.12.2 Attributes

The PnfdArchiveArtifactInformation information element shall follow the indications provided in table 8.2.12.2-1.

Table 8.2.12.2-1: Attributes of the PnfdArchiveArtifactInformation information element

Attribute	Qualifier	Cardinality	Content	Description
selector	M	1	Not specified	Information (such as a path) that identifies this artifact in the PNFD archive.
metadata	M	1	Not specified	The metadata of the artifact that are available in the PNFD archive, such as Content type, size, creation date, etc.

8.3 Information elements and notifications related to NS Lifecycle Management

8.3.1 Introduction

The clauses below define information elements and notifications related to network service lifecycle management.

8.3.2 Information elements and notifications related to NS Lifecycle Changes

8.3.2.1 Introduction

The clauses below define information elements and notifications related to NS lifecycle changes.

8.3.2.2 NsLcmOperationOccurrenceNotification

8.3.2.2.1 Description

This notification informs the receiver of changes in the NS lifecycle caused by NS lifecycle management operation occurrences, which may be manually triggered by the OSS/BSS or automatically triggered by the NFVO. The automatic trigger inside the NFVO includes auto-scaling, auto-healing and impact on the nested NS instances triggered by the NS lifecycle operation on its composite NS. The support of the notification is mandatory.

8.3.2.2.2 Trigger conditions

This notification is produced when there is a change in the NS lifecycle caused by NS lifecycle management operation occurrences, including:

- Instantiation of the NS (start and result, including feasibility check).
- Scaling of the NS (start and result, including the auto-scaling).
- Update of the NS (start and result, including feasibility check).
- Termination of the NS (start and result).
- Healing of the NS (start and result, including the auto-healing).
- Impact on the nested NS instances triggered by the NS lifecycle operation on its composite NS.

If this is a notification about the start of an LCM operation occurrence, the notification shall be sent before any action is taken, however, after acknowledging the LCM operation request to the consumer.

If this is a notification about the result of an LCM operation, the notification shall be sent after all other actions of the LCM operation have been executed.

If this is a notification about the result of an unsuccessful LCM operation occurrence and the cause is a resource shortage, the notification shall include appropriate information about the resource shortage.

If this is a notification where a pre-emption occurred due to e.g. a higher priority LCM operation during resource shortage, the notification shall include appropriate information about the pre-emption.

If this is a notification about the result of successful feasibility check of an NS LCM operation, the notification shall include "feasibilityCheckResult".

If this is a notification about the result of failure(s) observed during the feasibility check of an NS LCM operation, the notification shall include appropriate information about the failures experienced in performing the NS LCM operation as part of the feasibility check. It shall include the cause of the error and appropriate details: e.g. if the failure is caused by lack of sufficient resources, the error information shall include quantitative and qualitative details of all missing resources at each target location. It is up to the protocol design stage to determine on how the failure information is sent in the notification.

8.3.2.2.3 Attributes

The attributes of the NsLcmOperationOccurrenceNotification notification shall follow the indications provided in table 8.3.2.2.3-1.

Table 8.3.2.2.3-1: Attributes of the NsLcmOperationOccurrenceNotification

Attribute	Qualifier	Cardinality	Content	Description
nsInstancelid	M	1	Identifier	Identifier of the NS instance affected.
lifecycleOperationOccurrenceId	M	1	Identifier	Identifier of the NS lifecycle operation occurrence associated to the notification.
operation	M	1	Not specified	The lifecycle operation.
notificationStatus	M	1	Enum	Indicates whether this notification reports about the start of a lifecycle operation occurrence or the result of a lifecycle operation occurrence. VALUES: <ul style="list-style-type: none"> START: Informs about the start of the NS LCM operation occurrence. RESULT: Informs about the final or intermediate result of the NS LCM operation occurrence.
operationStatus	M	1	Not specified	Indicates the operation status. See note 1.
isAutomaticInvocation	M	1	Boolean	Set to true if the NS lifecycle operation occurrence has been automatically triggered by the NFVO. The automatic trigger inside the NFVO includes auto-scaling, auto-healing and impact on the nested NS instances triggered by the NS lifecycle operation on its composite NS. Set to false otherwise.
affectedVnf	M	0..N	AffectedVnf	Information about the VNF instances that were affected during the lifecycle operation, if this notification represents the result of a lifecycle operation. See note 2.
affectedPnf	M	0..N	AffectedPnf	Information about the PNF instances that were affected during the lifecycle operation, if this notification represents the result of a lifecycle operation. See note 2.
affectedVl	M	0..N	AffectedVirtualLink	Information about the VL instances that were affected during the lifecycle operation, if this notification represents the result of a lifecycle operation. See note 2.
affectedVnffg	M	0..N	AffectedVnffg	Information about the VNFFG instances that were affected during the lifecycle operation, if this notification represents the result of a lifecycle operation. See note 2.

Attribute	Qualifier	Cardinality	Content	Description
affectedNs	M	0..N	AffectedNs	Information about the nested NS instances that were affected during the lifecycle operation, if this notification represents the result of a lifecycle operation. See note 2.
affectedSap	M	0..N	AffectedSap	Information about the SAP instances that were affected during the lifecycle operation, if this notification represents the result of a lifecycle operation. See note 2.
feasibilityCheckResult	M	0..1	Enum	Information about the feasibility check result. The parameter shall be provided if the notification is sent to indicate the result of feasibility check. VALUES: <ul style="list-style-type: none"> FEASIBILITY_CHECK_D ONE FEASIBILITY_CHECK_D ONE_WITH_RESERVATI ON etc.
siteCapacityInfo	M	0..N	SiteCapacityInfo	Provides additional information about the site capacity computed by the NFVO necessary for the fulfilment of the NS LCM operation. The parameter shall be provided only if feasibilityCheckResult is included in the notification.
NOTE 1: If this notification represents the result of a lifecycle operation that was not successful, the notification shall contain appropriate error information.				
NOTE 2: If the notification represents the successful result of a lifecycle operation, at least an affectedVnf, or affectedPnf, or affectedVI, or affectedVnffg or affectedNs, or affectedSap shall be present.				

8.3.2.3 AffectedVnf information element

8.3.2.3.1 Description

This information element provides information about affected VNF instances.

8.3.2.3.2 Attributes

The AffectedVnf information element shall follow the indications provided in table 8.3.2.3.2-1.

Table 8.3.2.3.2-1: Attributes of the AffectedVnf information element

Attribute	Qualifier	Cardinality	Content	Description
vnfInstancelid	M	1	Identifier	Identifier of the VNF instance.
vnfdId	M	1	Identifier (Reference to Vnfd)	Identifier of the VNFD of the VNF instance.
vnfProfileId	M	1	Identifier (Reference to VnfProfile)	Identifier of the VNF profile of the NSD.
vnfName	M	1	String	Name of the VNF instance.

Attribute	Qualifier	Cardinality	Content	Description
changeType	M	1	Enum	Signals the type of lifecycle change. VALUES: <ul style="list-style-type: none"> • ADD • REMOVE • INSTANTIATE • TERMINATE • SCALE • CHANGE_FLAVOUR • HEAL • OPERATE • MODIFY_INFORMATION • CHANGE_EXT_VNF_CONNECTIVITY • REVERT_TO_VNF_SNAPSHOT • CHANGE_CURRENT_VNF_PKG • ASSOCIATE_WITH_VNF_PROFILE • etc.
changeResult	M	1	Enum	Signal the result of lifecycle change. VALUES: <ul style="list-style-type: none"> • COMPLETED • FAILED • etc.
changedInfo	M	0..1	Not specified	Information about the changed VNF instance information, including VNF configurable properties and certificate content, if applicable.

8.3.2.4 AffectedPnf information element

8.3.2.4.1 Description

This information element provides information about affected PNFs from an NS.

8.3.2.4.2 Attributes

The AffectedPnf information element shall follow the indications provided in table 8.3.2.4.2-1.

Table 8.3.2.4.2-1: Attributes of the AffectedPnf information element

Attribute	Qualifier	Cardinality	Content	Description
pnfId	M	1	Identifier	Identifier of the PNF. Assigned by OSS.
pnfName	M	1	String	Human readable name of the PNF.
pnfId	M	1	Identifier (Reference to Pnf)	Identifier of the PNF.
pnfProfileId	M	1	Identifier (Reference to PnfProfile)	Identifier of the PNF profile of the NSD.
cpInstanceId	M	1..N	Identifier (Reference to PnfExtCpInfo)	Identifier of the affected PNF external CP instance.
changeType	M	1	Enum	Signals the type of lifecycle change. VALUES: <ul style="list-style-type: none"> • ADD • MODIFY • REMOVE
changeResult	M	1	Enum	Signal the result of lifecycle change. VALUES: <ul style="list-style-type: none"> • COMPLETED • FAILED • etc.

8.3.2.5 AffectedVirtualLink information element

8.3.2.5.1 Description

This information element provides information about affected VLs of an NS.

8.3.2.5.2 Attributes

The AffectedVirtualLink information element shall follow the indications provided in table 8.3.2.5.2-1.

Table 8.3.2.5.2-1: Attributes of the AffectedVirtualLink information element

Attribute	Qualifier	Cardinality	Content	Description
nsVirtualLinkId	M	1	Identifier	Identifier of the VL instance.
nsVirtualLinkDescId	M	1	Identifier (Reference to NsVirtualLinkDesc)	Identifier of the VLD in the NSD for this VL.
virtualLinkProfileId	M	1	Identifier (Reference to VirtualLinkProfile)	Identifier of the VL profile of the NSD.
changeType	M	1	Enum	Signals the type of lifecycle change. VALUES: <ul style="list-style-type: none"> • ADD • DELETE • MODIFY • ADD_LINK_PORT • REMOVE_LINK_PORT
linkPortId	M	0..N	Identifier (Reference to NsLinkPortInfo)	Identifiers of the link ports of the affected VL related to the change. Shall be set when changeType is equal to "ADD_LINK_PORT" or "REMOVE_LINK_PORT", and the related link ports are present (case "add") or have been present (case "remove") in the NS VL represented by the "virtualLinkInfo" attribute in the "NsInfo".
changeResult	M	1	Enum	Signal the result of lifecycle change. VALUES: <ul style="list-style-type: none"> • COMPLETED • FAILED • etc.

8.3.2.6 AffectedVnffg information element

8.3.2.6.1 Description

This information element provides information about affected VNFFG instances.

8.3.2.6.2 Attributes

The AffectedVnffg information element shall follow the indications provided in table 8.3.2.6.2-1.

Table 8.3.2.6.2-1: Attributes of the AffectedVnffg information element

Attribute	Qualifier	Cardinality	Content	Description
vnffgId	M	1	Identifier	Identifier of the VNFFG instance.
vnffgdId	M	1	Identifier (Reference to Vnffgd)	Identifier of the VNFFGD of the VNFFG instance.
changeType	M	1	Enum	Signals the type of lifecycle change. VALUES: <ul style="list-style-type: none"> • ADD • REMOVE • MODIFY See note.
changeResult	M	1	Enum	Signal the result of lifecycle change. VALUES: <ul style="list-style-type: none"> • COMPLETED • FAILED • etc.

NOTE: CP or NFP information might be modified for the VNFFG.

8.3.2.7 AffectedNs information element

8.3.2.7.1 Description

This information element provides information about affected nested NSs.

8.3.2.7.2 Attributes

The AffectedNs information element shall follow the indications provided in table 8.3.2.7.2-1.

Table 8.3.2.7.2-1: Attributes of the AffectedNs information element

Attribute	Qualifier	Cardinality	Content	Description
nsInstanceld	M	1	Identifier	Identifier of the nested NS instance.
nsdId	M	1	Identifier (Reference to Nsd)	Identifier of the NSD of the nested NS instance.
changeType	M	1	Enum	Signals the type of lifecycle change. VALUES: <ul style="list-style-type: none"> • ADD • REMOVE • INSTANTIATE • TERMINATE • SCALE • HEAL • UPDATE
changeResult	M	1	Enum	Signal the result of lifecycle change. VALUES: <ul style="list-style-type: none"> • COMPLETED • FAILED • etc.

8.3.2.8 AffectedSap information element

8.3.2.8.1 Description

This information element provides information about affected SAP of an NS.

8.3.2.8.2 Attributes

The AffectedVirtualLink information element shall follow the indications provided in table 8.3.2.8.2-1.

Table 8.3.2.8.2-1: Attributes of the AffectedSap information element

Attribute	Qualifier	Cardinality	Content	Description
sapInstanceld	M	1	Identifier	Identifier of this SapInfo information element, identifying the SAP instance.
sapdId	M	1	Identifier (Reference to Sapd)	Reference to the SAPD for this SAP.
sapName	M	1	String	Human readable name for the SAP.
changeType	M	1	Enum	Signals the type of lifecycle change. VALUES: <ul style="list-style-type: none"> • ADD • REMOVE • MODIFY
changeResult	M	1	Enum	Signal the result of lifecycle change. VALUES: <ul style="list-style-type: none"> • COMPLETED • FAILED • etc.

8.3.2.9 NsIdentifierCreationNotification

8.3.2.9.1 Description

This notification informs the receiver of the creation of a new NS instance identifier and of the associated instance of an NsInfo information element, identified by that identifier. The support of the notification is mandatory.

8.3.2.9.2 Trigger conditions

- Creation of an NS instance identifier and of the associated instance of an NsInfo information element.

8.3.2.9.3 Attributes

The NsIdentifierCreationNotification shall follow the indications provided in table 8.3.2.9.3-1.

Table 8.3.2.9.3-1: Attributes of the NsIdentifierCreationNotification

Attribute	Qualifier	Cardinality	Content	Description
nsInstanceld	M	1	Identifier	The newly created NS instance identifier.

8.3.2.10 NsIdentifierDeletionNotification

8.3.2.10.1 Description

This notification informs the receiver of the deletion of an NS instance identifier and of the associated instance of an NsInfo information element identified by that identifier. The support of the notification is mandatory.

8.3.2.10.2 Trigger conditions

Deletion of an NS instance identifier and of the associated instance of an information element.

8.3.2.10.3 Attributes

The NsIdentifierDeletionNotification shall follow the indications provided in table 8.3.2.10.3-1.

Table 8.3.2.10.3-1: Attributes of the NsIdentifierDeletionNotification

Attribute	Qualifier	Cardinality	Content	Description
nsInstanceld	M	1	Identifier	The NS instance identifier to be deleted.

8.3.2.11 NsChangeNotification

8.3.2.11.1 Description

This notification informs the receiver of changes on an NS instance caused by an LCM operation occurrence, which directly or indirectly impacts its NS component and is triggered without any context of this NS instance. In other words, this notification is triggered by an LCM operation occurrence on one of the components of the NS instance where aforementioned LCM operation occurrence is not associated to an NS LCM operation occurrence on the NS instance itself. Examples for such operations are a VNF LCM operation on a constituent VNF instance e.g. requested by an EM or automatically triggered by a VNFM, or an NS LCM operation on a constituent NS instance executed by either the same NFVO or another NFVO than the one managing the current NS instance. This notification is different from the NsLcmOperationOccurrenceNotification (see clause 8.3.2.2), which is triggered by the LCM operation occurrence on the current NS instance itself. The support of the notification is mandatory.

8.3.2.11.2 Trigger conditions

The trigger conditions include:

- LCM operation occurrence which directly or indirectly impacts the NS component (start and result).

If this is a notification about the start of an LCM operation occurrence impacting the NS component, the notification shall be provided as soon as the impact on the NS component is identified.

If this is a notification about the result of an LCM operation occurrence impacting the NS component, the notification shall be provided after the impact on the NS component has been executed.

8.3.2.11.3 Attributes

The attributes of the NsChangeNotification notification shall follow the indications provided in table 8.3.2.11.3-1.

Table 8.3.2.11.3-1: Attributes of the NsChangeNotification

Attribute	Qualifier	Cardinality	Content	Description
nsInstancelId	M	1	Identifier	Identifier of the NS instance affected.
nsComponentType	M	1	Enum	Indicates the affected NS component type. VALUES: <ul style="list-style-type: none"> • VNF • PNF • NS: Indicates a nested NS
nsComponentId	M	1	Identifier	Identifier of the affected NS component instance.
lcmOpOccIdImpactingNsComponent	M	1	Identifier	Identifier of the lifecycle management operation occurrence impacting the NS component and associated to this notification.
lcmOpOccNameImpactingNsComponent	M	1	String	Name of the lifecycle management operation occurrence impacting the NS component and associated to this notification.

Attribute	Qualifier	Cardinality	Content	Description
lcmOpOccStatusImpactingNsComponent	M	1	Not specified	Status of the lifecycle management operation occurrence impacting the NS component and associated to this notification. Indicates whether this notification reports about the start of a lifecycle operation occurrence or the final result of a lifecycle operation occurrence, e.g. start, completed, failed, etc.

8.3.2.12 SiteCapacityInfo information element

8.3.2.12.1 Description

This information element provides information about site capacity computed by the NFVO necessary for the fulfilment of the NS LCM operation.

8.3.2.12.2 Attributes

The SiteCapacityInfo information element shall follow the indications provided in table 8.3.2.12.2-1.

Table 8.3.2.12.2-1: Attributes of the SiteCapacityInfo information element

Attribute	Qualifier	Cardinality	Content	Description
targetSiteLocation	M	1	LocationConstraints	Location of the target site.
vimCapacityInfo	M	0..N	Not specified	Provides the NFVI capacity computed by the NFVO necessary for fulfilling the lifecycle operation (e.g. instantiation) of VM-based VNF instances. NFVO determines the placement based on VM-based VNF characteristics, affinity/anti-affinity requirements and matching NFVI-PoP and resources zones. See note.
clusterCapacityInfo	M	0..N	Not specified	Provides the CIS cluster capacity computed by the NFVO necessary for fulfilling the lifecycle operation (e.g. instantiation) of container-based VNF instances. NFVO determines the placement based on the container-based VNF characteristics needs, affinity/anti-affinity needs and matching CIS clusters. See note.
missingCapacityInfo	M	0..N	Not specified	In case there is not enough capacity for fulfilling the lifecycle operation, it provides information about the missing capacity identified (e.g. in a specific CIS Cluster). See note.
NOTE: If the targeted site does not contain suitable and enough capacity resources, the attribute "missingCapacityInfo" shall also be provided.				

8.3.3 Information elements related to NsInfo

8.3.3.1 Introduction

The clauses below define information elements related to NsInfo.

8.3.3.2 NsInfo information element

8.3.3.2.1 Description

This information element provides run-time information about an NS instance.

8.3.3.2.2 Attributes

The attributes of the NsInfo information element shall follow the indications provided in table 8.3.3.2.2-1.

Table 8.3.3.2.2-1: Attributes of the NsInfo information element

Attribute	Qualifier	Cardinality	Content	Description
nsInstanceld	M	1	Identifier	Identifier of this NsInfo information element, identifying the NS instance.
nsName	M	1	String	Human readable name of the NS instance.
description	M	1	String	Human readable description of the NS instance.
nsdId	M	1	Identifier (Reference to Nsd)	Reference to the NSD associated with this NS. This is the NSD used to instantiate this NS or an NSD explicitly associated after instantiation.
versionDependency	M	0..N	VersionDependency	Describes version dependencies currently valid for the nested NS instance. Identifies versions of descriptors of other constituents in the NSD upon which the nested NS depends. The dependencies may be described for the NSD referenced in this NsInfo with nsdId and for NSDs with the same NsdExtInvariantId. There shall not be more than one versionDependency present with the same dependentConstituentId. It may be present for the NsInfo of a nested NS. It shall not be present otherwise.
nsdInfoId	M	1	Identifier (Reference to NsdInfo)	Reference to the NSD information object associated with the NS. This identifier was allocated by the NFVO.
flavourId	M	0..1	Identifier (Reference to NsdF)	Reference to the flavour of the NSD used to instantiate this NS. See notes 1 and 2.
vnfInfo	M	0..N	VnfInfo	Information on constituent VNFs of this NS.
pnfInfo	M	0..N	PnfInfo	Information on the PNF(s) that are part of this NS.

Attribute	Qualifier	Cardinality	Content	Description
virtualLinkInfo	M	0..N	NsVirtualLinkInfo	Information on the VLs of this NS.
vnffgInfo	M	0..N	VnffgInfo	Information on the VNFFGs of this NS.
sapInfo	M	0..N	SapInfo	Information on the SAPs of this NS.
nestedNsInfo	M	0..N	Identifier (Reference to NsInfo)	Reference to information on nested NSs of this NS.
vnfSnapshotInfo	M	0..N	VnfSnapshotInfo	Information on Snapshots of VNFs that are part of this NS. See note 4.
nsState	M	1	Enum	The state of the NS. VALUES: <ul style="list-style-type: none"> NOT_INSTANTIATED: the NS instance is not instantiated or terminated INSTANTIATED: the NS instance is instantiated
monitoringParameter	M	0..N	Not specified	Performance metrics tracked by NFVO (e.g. for auto-scaling purposes). See note 3.
nsScaleStatus	M	0..N	NsScaleInfo	Represents for each NS scaling aspect declared in the applicable DF, how "big" the NS instance has been scaled with respect to that aspect.
additionalAffinityOrAntiAffinityRule	M	0..N	AffinityOrAntiAffinityRule	Information on the additional affinity or anti-affinity rule from NS instantiation operation. Shall not conflict with rules already specified in the NSD. See clause 8.3.4.26.
wanConnectionInfo	M	0..N	WanConnectionInfo	Information about WAN related connectivity enabling multi-site VLs.
dataFlowMirroringJobInfo	M	0..N	MirroringJobInfo	Information related to Data Flow Mirroring job(s) associated to the NS instance.
nsPaaSServiceInfo	M	0..N	PaaSServiceInfo	Information on the PaaS Services assigned and used by an NS constituent other than VNF instances. See note 5.
<p>NOTE 1: The NsDf information element is defined in ETSI GS NFV-IFA 014 [3], clause 6.3.2.</p> <p>NOTE 2: Cardinality of zero is only valid for a non-instantiated NS.</p> <p>NOTE 3: The monitoring parameters to be tracked by NFVO are identified by NSD designer in the NSD.</p> <p>NOTE 4: The NFVO shall keep information about the VNF snapshots even if they are not associated to an NS instance, as it shall still be possible to query, delete, and package VNF snapshots after the termination of the NS instance.</p> <p>NOTE 5: Information about PaaS Services assigned to VNF instances shall only be included in the corresponding VnfInfo (see clause 8.3.3.3).</p>				

8.3.3.3 VnfInfo information element

8.3.3.3.1 Description

The VnfInfo information element provides run-time information about a VNF instance.

8.3.3.3.2 Attributes

The VnfInfo information element shall follow the indications provided in table 8.3.3.3.2-1.

Table 8.3.3.3.2-1: Attributes of the VnflInfo information element

Attribute	Qualifier	Cardinality	Content	Description
vnflInstanceid	M	1	Identifier	Identifier of the VNF instance that is represented by this VnflInfo information element.
vnflInstanceName	M	0..1	String	VNF instance name. See note 1.
vnflInstanceDescription	M	0..1	String	Human-readable description of the VNF instance. See note 1.
vnfdId	M	1	Identifier (Reference to Vnfd)	Identifier of the VNFD on which the VNF instance is based. See notes 1, 2 and 4.
vnfProvider	M	1	String	Provider of the VNF and the VNFD. See note 3.
vnfProductName	M	1	String	Name to identify the VNF Product. See note 3.
vnfSoftwareVersion	M	1	Version	Software version of the VNF. See note 3.
vnfdVersion	M	1	Version	Identifies the version of the VNFD. See note 3.
versionDependency	M	0..N	VersionDependency	<p>Describes version dependencies currently valid for the VNF instance. Identifies versions of descriptors of other constituents in the NSD upon which the VNF depends. The dependencies may be described for the VNFD referenced in this VnflInfo with vnfdId and for VNFDs with the same VnfdExtInvariantId.</p> <p>There shall not be more than one versionDependency present with the same dependentConstituentId.</p>
vnfConfigurableProperty	M	0..N	KeyValuePair	<p>Additional VNF-specific attributes that provide the current values of the configurable properties of the VNF instance.</p> <p>These attributes represent values that are stored persistently in the VnflInfo information element and that correspond to configuration parameters of the VNF instance. Modifying the values of these attributes directly affects the configuration of the VNF instance if it exists.</p> <p>Configurable properties referred in this attribute are declared in the VNFD (see clause 7.1.12 in ETSI GS NFV-IFA 011 [2]). See notes 1 and 5.</p>
certificateInfo	M	0..1	CertificateInfo	<p>Information about certificate and certificate management in this VNF. Shall be present when using delegation mode, otherwise shall be absent.</p> <p>Content of this attribute shall not be either added (if previously not set) or removed (if previously set) by using the Update NS operation with updateType ModifyVnflInformation. See notes 1 and 5.</p>

Attribute	Qualifier	Cardinality	Content	Description
instantiationState	M	1	Enum	The instantiation state of the VNF. VALUES: <ul style="list-style-type: none"> NOT_INSTANTIATED: VNF instance is terminated or not instantiated, and the identifier of the VNF instance exists INSTANTIATED: VNF is instantiated
instantiatedVnfInfo	M	0..1	InstantiatedVnfInfo	Information specific to an instantiated VNF instance. Shall be present if the VNF is in INSTANTIATED instantiation state.
metadata	M	0..N	KeyValuePair	Additional VNF-specific attributes that provide metadata describing the VNF instance. Metadata that are writeable are declared in the VNFD (see clause 7.1.14.2 in ETSI GS NFV-IFA 011 [2]). See note 1. These attributes represent values that are stored persistently in the VnfInfo information element for consumption by functional blocks that invoke the VNF lifecycle management interface. They are not consumed by the VNFM or the lifecycle management scripts. Modifying the values of these attributes has no effect on the VNF instance, it only affects the information represented in VnfInfo.
extension	M	0..N	KeyValuePair	Additional VNF-specific attributes that affect the lifecycle management of this VNF instance. These attributes represent values that are stored persistently in the VnfInfo information element for consumption by the VNFM, or the lifecycle management scripts during the execution of VNF lifecycle management operations. Modifying the values of these attributes has no direct effect on the VNF instance; however, the modified attribute values can be considered during subsequent VNF lifecycle management operations, which means that the modified values can indirectly affect the configuration of the VNF instance. Extensions that are writeable are declared in the VNFD (see clause 7.1.14.2 in ETSI GS NFV-IFA 011 [2]). See note 1.
vnfId	M	0..1	Identifier	Identifier of the VNFM that manages the VNF instance.

Attribute	Qualifier	Cardinality	Content	Description
NOTE 1:				This attribute in the VnfInfo shall be writable through the modifyVnfInfoData attribute of the Update NS operation (refer to clause 7.3.5.2).
NOTE 2:				This identifier, which is managed by the VNF provider, identifies the VNF Package and the VNFD in a globally unique way.
NOTE 3:				See ETSI GS NFV-IFA 011 [2], clause 7.1.2.2. This information is copied from the VNFD of the on-boarded VNF Package which was used to instantiate the VNF instance.
NOTE 4:				Modifying the value of this attribute can be performed when no conflicts exist between the previous and the newly referred VNF Package, e.g. when the new VNFD is not changed with respect to the previous VNFD apart from referencing to other VNF software image(s). In order to avoid misalignment of the VnfInfo with the current VNF's on-boarded VNF Package, the values copied from the VNFD of the on-boarded VNF Package (see note 3) need to be kept in sync.
NOTE 5:				These attributes are sometimes also referred to as configuration parameters applicable to a VNF. Some of these are set prior to instantiation and cannot be modified if the VNF is instantiated, some are set prior to instantiation (are part of initial configuration) and can be modified later, and others can be set only after instantiation. The applicability of certain configuration may depend on the VNF and the required operation of the VNF at a certain point in time.

8.3.3.4 InstantiatedVnfInfo information element

8.3.3.4.1 Description

This information element provides run-time information specific to an instantiated VNF instance.

Annex A of ETSI GS NFV-IFA 007 [i.5] provides examples illustrating the relationship among the different run-time information elements (CP, VL and link ports) used to represent the connectivity of a VNF.

8.3.3.4.2 Attributes

The InstantiatedVnfInfo information element shall follow the indications provided in table 8.3.3.4.2-1.

Table 8.3.3.4.2-1: Attributes of the InstantiatedVnfInfo information element

Attribute	Qualifier	Cardinality	Content	Description
flavourId	M	1	Identifier (Reference to VnfDf)	Identifier of the VNF DF applied to this VNF instance. See note 1.
vnfState	M	1	Enum	The state of the VNF instance. VALUES: <ul style="list-style-type: none"> STARTED STOPPED
scaleStatus	M	0..N	VnfScaleInfo	Scale status of the VNF, one entry per aspect. Shall be present if the VNF supports scaling. Represents for every scaling aspect how "big" the VNF has been scaled with respect to that aspect. For an aspect that has not been deployed because it consists of VDUs that belong to a deployable module that has not been selected (or to multiple deployable modules, none of which have been selected), it indicates the scale level that has been requested in the instantiation or in a scaling operation, or, if none has been requested in any of them, the scale level applicable to the aspect based on the default instantiation level. See notes 2 and 5.
maxScaleLevel	M	0..N	VnfScaleInfo	Maximum allowed scale levels of the VNF, one entry per aspect, as defined in the VNFD. This attribute shall be present if the VNF supports scaling. Represents for every scaling aspect how "big" the VNF can be scaled with respect to that aspect. See note 2.

Attribute	Qualifier	Cardinality	Content	Description
selectedDeployableModule	M	0..N	Identifier (Reference to DeployableModule)	References a currently selected deployable module, as defined in the VNFD, that has already completed the instantiation of its VNFCs.
extCplInfo	M	1..N	VnfExtCplInfo	External CPs exposed by the VNF instance.
vipCplInfo	M	1..N	VipCplInfo	VIP CPs that are part of the VNF instance. Shall be present when that particular VIP CP of the VNFC instance is associated to an external CP of the VNF instance. May be present otherwise.
virtualCplInfo	M	0..N	VirtualCplInfo	Virtual CPs that are part of the VNF instance. Shall be present when a particular Virtual CP is associated to an external CP of the VNF instance. May be present otherwise.
extVirtualLinkInfo	M	0..N	ExtVirtualLinkInfo	External VLs the VNF instance is connected to.
extManagedVirtualLinkInfo	M	0..N	ExtManagedVirtualLinkInfo	Externally-managed internal VLs of the VNF instance. See note 4.
monitoringParameter	M	0..N	Not specified	Performance metrics tracked by VNFM (e.g. for auto-scaling purposes). See note 3.
localizationLanguage	M	0..1	Not specified	Information about localization language of the VNF (includes e.g. strings in the VNFD). The localization languages supported by a VNF can be declared in the VNFD, and localization language selection can take place at instantiation time.
vimId	M	0..N	Identifier	Identifier of a VIM that manages resources for the VNF instance.
vnfcResourceInfo	M	0..N	VnfcResourceInfo	Information on the virtualised compute and storage resource(s) used by the VNFCs of the VNF instance.
vnfVirtualLinkResourceInfo	M	0..N	VnfVirtualLinkResourceInfo	Information on the virtualised network resource(s) used by the VLs of the VNF instance.
virtualStorageResourceInfo	M	0..N	VirtualStorageResourceInfo	Information on the virtualised storage resource(s) used as storage for the VNF instance.
mciInfo	M	0..N	MciInfo	Information on the MCIO(s) representing VNFC instance(s) realized by one or a set of OS containers and created from the same VDU for the VNF instance.
vnfPaasServiceInfo	M	0..N	PaasServiceInfo	Information on the PaaS Services assigned and used by the VNF instance.
NOTE 1: The VnfDf information element is defined in ETSI GS NFV-IFA 011 [2], clause 7.1.8.2.				
NOTE 2: For every scaling aspect, the information provided by the "scaleStatus" and "maxScaleLevel" attributes allows an external entity to derive how many scaling steps are possible for scaling in or scaling out a VNF instance. Per aspect, the number of steps possible to scale in corresponds to the "scaleLevel" attribute for that aspect in the "scaleStatus" information element, and the possible number of steps to scale out corresponds to the difference between "maxScaleLevel" for that aspect, and the "scaleLevel" attribute for that aspect in the "scaleStatus" information element.				
NOTE 3: The monitoring parameters to be tracked by VNFM are identified by VNF provider in the VNFD. The VNFM collects the values of identified performance metrics using one or more locally initiated PM Jobs.				
NOTE 4: It is possible to have several ExtManagedVirtualLinkInfo for the same VNF internal VL in case of a multi-site VNF spanning several VIMs. The set of ExtManagedVirtualLinkInfo corresponding to the same VNF internal VL shall indicate so by referencing to the same VnfVirtualLinkDesc and externally-managed multi-site VL instance (refer to clause 8.3.3.19).				
NOTE 5: For a scaling aspect whose related VNFCs have not been instantiated due to the selection of deployable modules, the "scaleStatus" indicates the scale level that would be applicable to the aspect if a VNF LCM operation changes the selected deployable modules and the related VNFCs are instantiated, unless the VNF LCM operation explicitly indicates the scale level for the aspect.				

8.3.3.5 VnfcResourceInfo information element

8.3.3.5.1 Description

This information element provides information on virtualised compute and storage resources used by a VNFC in a VNF.

8.3.3.5.2 Attributes

The VnfcResourceInfo information element shall follow the indications provided in table 8.3.3.5.2-1.

Table 8.3.3.5.2-1: Attributes of the VnfcResourceInfo information element

Attribute	Qualifier	Cardinality	Content	Description
vnfcInstancelId	M	1	Identifier	Identifier of this VNFC instance.
vduId	M	1	Identifier (Reference to Vdu)	Reference to the applicable Vdu information element in the VNFD.
vnfdId	M	0..1	Identifier (Reference to Vnfd)	Identifier of the VNFD. Shall be present in case the value differs from the vnfdId attribute of the VNF instance (e.g. during a "Change current VNF package" operation or due to its final failure).
computeResource	M	1	ResourceHandle	Reference to the VirtualCompute resource or reference to a Compute MCIO.
storageResourceId	M	0..N	Identifier (Reference to VirtualStorageResourceInfo)	Reference(s) to the VirtualStorage resource(s) or reference(s) to Storage MCIO(s).
reservationId	M	0..1	Identifier	The reservation identifier applicable to the resource. It shall be present when an applicable reservation exists.
vnfcCpInfo	M	0..N	VnfcCpInfo	CP(s) of the VNFC instance. Shall be present when that particular CP of the VNFC instance is associated to an external CP of the VNF instance. May be present otherwise.
metadata	M	0..N	KeyValuePair	Metadata about this resource.
trunkPortsInfo	M	0..N	TrunkPortsInfo	Collections of CPs of the VNFC instance in trunk(s). Shall be present when the VNFC has CPs working in trunk mode, as parent port of a trunk, and other CPs working as subports of the same trunk, and the referred CP instances are also present in the vnfcCpInfo attribute.
certificateContentId	M	0..1	Identifier (Reference to CertificateContent)	The identifier of certificate that this VNFC instance uses. Shall be present when using in delegation-mode. Otherwise shall not be present.

8.3.3.6 VnfVirtualLinkResourceInfo information element

8.3.3.6.1 Description

This information element provides information on virtualised network resources used by an internal VL instance in a VNF.

8.3.3.6.2 Attributes

The VnfVirtualLinkResourceInfo information element shall follow the indications provided in table 8.3.3.6.2-1.

Table 8.3.3.6.2-1: Attributes of the VnfVirtualLinkResourceInfo information element

Attribute	Qualifier	Cardinality	Content	Description
virtualLinkInstanceld	M	1	Identifier	Identifier of this VL instance.
vnfVirtualLinkDescld	M	1	Identifier (Reference to VnfVirtualLinkDesc)	Identifier of the VNF VLD in the VNFD.
vnfdld	M	0..1	Identifier (Reference to Vnfd)	Identifier of the VNFD. Shall be present in case the value differs from the vnfdld attribute of the VNF instance (e.g. during a "Change current VNF package" operation or due to its final failure).
networkResource	M	1	ResourceHandle	Reference to the VirtualNetwork resource or reference to a Network MCIO.
reservationId	M	0..1	Identifier	The reservation identifier applicable to the resource. It shall be present when an applicable reservation exists.
vnfLinkPort	M	0..N	VnfLinkPortInfo	Links ports of this VL. Shall be present when the linkPort is used for external connectivity by the VNF (refer to VnfLinkPortInfo in clause 8.3.3.20). May be present otherwise.
metadata	M	0..N	KeyValuePair	Metadata about this resource.

8.3.3.7 VirtualStorageResourceInfo information element

8.3.3.7.1 Description

This information element provides information on virtualised storage resources used by a storage instance in a VNF.

8.3.3.7.2 Attributes

The VirtualStorageResourceInfo information element shall follow the indications provided in table 8.3.3.7.2-1.

Table 8.3.3.7.2-1: Attributes of the VirtualStorageResourceInfo information element

Attribute	Qualifier	Cardinality	Content	Description
virtualStorageInstanceld	M	1	Identifier	Identifier of this virtual storage resource instance.
virtualStorageDescld	M	1	Identifier (Reference to VirtualStorageDesc)	Identifier of the VirtualStorageDesc in the VNFD.
vnfdld	M	0..1	Identifier (Reference to Vnfd)	Identifier of the VNFD. Shall be present in case the value differs from the vnfdld attribute of the VNF instance (e.g. during a "Change current VNF package" operation or due to its final failure).
storageResource	M	1	ResourceHandle	Reference to the VirtualStorage resource(s) or reference to a Storage MCIO.
reservationId	M	0..1	Identifier	The reservation identifier applicable to the resource. It shall be present when an applicable reservation exists.
metadata	M	0..N	KeyValuePair	Metadata about this resource.

8.3.3.8 ResourceHandle information element

8.3.3.8.1 Description

This information element provides information that allows addressing a resource that is used by a VNF instance or by an NS instance.

8.3.3.8.2 Attributes

The ResourceHandle information element shall follow the indications provided in table 8.3.3.8.2-1.

Table 8.3.3.8.2-1: Attributes of the ResourceHandle information element

Attribute	Qualifier	Cardinality	Content	Description
vimId	CM	0..1	Identifier	Identifier of the VIM or WIM or CISM under whose control this resource is placed. CONDITION: This attribute shall be supported when VNF-related Resource Management in direct mode is applicable. It shall also be supported for resources that are part of an NS instance such as virtual link resources.
resourceProviderId	CM	0..1	Identifier	Identifies the entity responsible for the management of the virtualised resource. CONDITION: This attribute shall be supported when VNF-related Resource Management in indirect mode is applicable.
resourceId	M	1	Identifier	Identifier of the resource in the scope of the VIM, the WIM, the CISM or the resource provider.
vimLevelResourceType	M	0..1	Not specified	Type of the resource in the scope of the VIM, the WIM, the CISM or the resource provider. See note 1.
vimLevelAdditionalResourceInfo	M	0..1	Not specified	Additional resource information which is specific to this resource and its type, and which is available from the VIM, the WIM, the CISM or the resource provider. See note 2.
containerNamespace	M	0..1	String	The value of the namespace in which the MCIO corresponding to the resource is deployed. This attribute shall be present if the resource is managed by a CISM and it shall be absent otherwise.
NOTE 1: The value set of the "vimLevelResourceType" attribute is within the scope of the VIM, the WIM or the resource provider and can be used as information that complements the ResourceHandle.				
NOTE 2: Which structure and content of the resource information to be expected depends on the type of resource and its provider. The information shall be limited to properties directly owned by the resource referenced in this ResourceHandle.				

8.3.3.9 PnfInfo information element

8.3.3.9.1 Description

This information element provides information about a PNF that is part of an NS instance.

8.3.3.9.2 Attributes

The attributes of the PnfInfo information element shall follow the indications provided in table 8.3.3.9.2-1.

Table 8.3.3.9.2-1: Attributes of the PnfInfo information element

Attribute	Qualifier	Cardinality	Content	Description
pnfId	M	1	Identifier	Identifier of the PNF. Assigned by OSS and provided to NFVO.
pnfName	M	1	String	Human readable name of the PNF.
pnfdId	M	1	Identifier (Reference to Pnfd)	Identifier of the PNFD.
versionDependency	M	0..N	VersionDependency	Describes version dependencies currently valid for the PNF. Identifies versions of descriptors of other constituents in the NSD upon which the PNF depends. The dependencies may be described for the PNFD referenced in this PnfInfo with pnfdId and for PNFDs with the same PnfExtInvariantId. There shall not be more than one versionDependency present with the same dependentConstituentId.
pnfdInfoId	M	1	Identifier (Reference to PnfdInfo)	Identifier of (reference to) the PNFD information related to this PNF.
pnfProfileId	M	1	Identifier (Reference to PnfProfile)	Identifier of (reference to) the PNF Profile to be used for this PNF.
cpInfo	M	1..N	PnfExtCpInfo	Information on the external CP of the PNF.

8.3.3.10 NsVirtualLinkInfo information element

8.3.3.10.1 Description

This information element provides run-time information about an NS VL instance.

As an NS can include NFs deployed in NFVI-PoPs under the control of several different VIMs, therefore deploying an NS VL can involve several VIMs, each allocating different virtualised network resources, as well as WIMs handling the connectivity in between the NFVI-PoPs in the form of multi-site connectivity services.

When this NsVirtualLinkInfo is provided as an ExtVirtualLinkInfo as input of a VNF LCM operation, the id of the ExtVirtualLinkInfo shall be the one of the corresponding NsVirtualLinkInfo.

8.3.3.10.2 Attributes

The attributes of the NsVirtualLinkInfo information element shall follow the indications provided in table 8.3.3.10.2-1.

Table 8.3.3.10.2-1: Attributes of the NsVirtualLinkInfo information element

Attribute	Qualifier	Cardinality	Content	Description
nsVirtualLinkInstanceId	M	1	Identifier	Identifier of this NsVirtualLinkInfo information element, identifying the NS VL instance.
nsVirtualLinkDescId	M	1	Identifier (Reference to NsVirtualLinkDesc)	Identifier of the VLD in the NSD for this VL.
virtualLinkProfileId	M	1	Identifier (Reference to VirtualLinkProfile)	Identifier of the VL profile in the NSD for this VL.
resourceHandle	M	1..N	ResourceHandle	Identifier(s) of the virtualised network resource(s) and/or multi-site connectivity service(s) realizing this VL.
linkPort	M	0..N	NsLinkPortInfo	Link ports of this VL. Cardinality of zero indicates that no port has yet been created for this VL.

8.3.3.11 NsLinkPortInfo information element

8.3.3.11.1 Description

This information element provides information about a port of an NS VL.

When the NsVirtualLinkInfo, from which the present NsLinkPortInfo is part of, is provided as an ExtVirtualLinkInfo as input of a VNF LCM operation, the id of the ExtLinkPortInfo shall be identical to the one of the corresponding NsLinkPortInfo.

8.3.3.11.2 Attributes

The attributes of the NsLinkPortInfo information element shall follow the indications provided in table 8.3.3.11.2-1.

Table 8.3.3.11.2-1: Attributes of the NsLinkPortInfo information element

Attribute	Qualifier	Cardinality	Content	Description
nsLinkPortId	M	1	Identifier	Identifier of this link port.
resourceHandle	M	1	ResourceHandle	Identifier(s) of the virtualised network resource(s) realizing this link port.
cpId	M	0..1	Identifier (Reference to VnfExtCpInfo or PnfExtCpInfo or SapInfo)	CP connected to this link port.

8.3.3.12 SapInfo information element

8.3.3.12.1 Description

This information element provides information about an SAP of an NS instance.

8.3.3.12.2 Attributes

The attributes of the SapInfo information element shall follow the indications provided in table 8.3.3.12.2-1.

Table 8.3.3.12.2-1: Attributes of the SapInfo information element

Attribute	Qualifier	Cardinality	Content	Description
sapInstancelId	M	1	Identifier	Identifier of this SapInfo information element, identifying the SAP instance.
sapId	M	1	Identifier (Reference to Sapd)	Reference to the SAPD for this SAP.
sapName	M	1	String	Human readable name for the SAP.
description	M	1	String	Human readable description for the SAP.
cpProtocolInfo	M	1..N	CpProtocolInfo	Protocol information for this SAP. There shall be one cpProtocolInfo for each layer protocol supported.

8.3.3.13 VnffgInfo information element

8.3.3.13.1 Description

This information element contains information about a VNFFG instance.

8.3.3.13.2 Attributes

The attributes of the VnffgInfo information element shall follow the indications provided in table 8.3.3.13.2-1.

Table 8.3.3.13.2-1: Attributes of the VnffgInfo information element

Attribute	Qualifier	Cardinality	Content	Description
vnffgld	M	1	Identifier	Identifier of the Vnffg information element.
vnffgdld	M	1	Identifier (Reference to Vnffgd)	Identifier of the VNFFGD used to instantiate this VNFFG.
vnfld	M	1..N	Identifier (Reference to VnflInfo)	Identifier(s) of the constituent VNF instance(s) of the VNFFG.
pnfld	M	0..N	Identifier (Reference to PnflInfo)	Identifier(s) of the constituent PNF instance(s) of the VNFFG.
virtualLinkld	M	1..N	Identifier (Reference to NsVirtualLinkInfo)	Identifier(s) of the constituent VL instance(s) of the VNFFG.
cpld	M	1..N	Identifier (Reference to VnfExtCpInfo or PnfExtCpInfo or SapInfo)	Identifiers of the CP instances attached to the constituent VNFs and PNFs or the sap instances of the VNFFG (see note).
nfpInfo	M	1..N	NfpInfo	Information on the NFPs of this VNFFG.

NOTE: It indicates an exhaustive list of all the CP instances and SAP instances of the VNFFG.

8.3.3.14 PnfExtCpInfo information element

8.3.3.14.1 Description

This information element provides information about the external CP of the PNF.

8.3.3.14.2 Attributes

The attributes of the PnfExtCpInfo information element shall follow the indications provided in table 8.3.3.14.2-1.

Table 8.3.3.14.2-1: Attributes of the PnfExtCpInfo information element

Attribute	Qualifier	Cardinality	Content	Description
cpInstancelld	M	1	Identifier	Identifier of this external CP instance and of this PnfExtCpInfo information element.
cpdld	M	1	Identifier (Reference to Cpd)	Identifier of (reference to) the Connection Point Descriptor (CPD) for this CP.
cpProtocolInfo	M	1..N	CpProtocolInfo	Protocol information for this CP. There shall be one cpProtocolInfo for each layer protocol supported.

8.3.3.15 NfpInfo information element

8.3.3.15.1 Description

The NfpInfo information element defines the information related to the NFP.

8.3.3.15.2 Attributes

The attributes of the NfpInfo information element shall follow the indications provided in table 8.3.3.15.2-1.

Table 8.3.3.15.2-1: Attributes of the NfpInfo information element

Attribute	Qualifier	Cardinality	Content	Description
nfpId	M	1	Identifier	Identifier of this Nfp information element.
nfpDId	M	0..1	Identifier (Reference to Nfpd)	Identifier of the NFPD used to instantiate this NFP.
nfpName	M	0..1	String	Human readable name for the NFP.
description	M	0..1	String	Human readable description for the NFP.
cpGroup	M	1..N	CpGroupInfo	Group(s) of CPs and/or SAPs which the NFP passes through. See note.
totalCp	O	0..1	Integer	Total number of CPs in this NFP.
nfpRule	M	1	NfpRule	NFP classification and selection rule.
nfpState	M	1	Enum	An indication of whether the NFP instance is enabled or disabled. VALUES: <ul style="list-style-type: none"> • ENABLED • DISABLED
NOTE: When multiple identifiers are included, the position of the identifier in the information element value specifies the position of the group in the path.				

8.3.3.16 NsScaleInfo information element

8.3.3.16.1 Description

This information element provides information about an NS scaling aspect.

8.3.3.16.2 Attributes

The attributes of the NsScaleInfo information element shall follow the indications provided in table 8.3.3.16.2-1.

Table 8.3.3.16.2-1: Attributes of the NsScaleInfo information element

Attribute	Qualifier	Cardinality	Content	Description
nsScalingAspectId	M	1	Identifier (Reference to NsScalingAspect)	Identifier of the NS scaling aspect.
nsScaleLevelId	M	1	Identifier (Reference to NsLevel)	Identifier of the NS scale level.

8.3.3.17 VnfExtCpInfo information element

8.3.3.17.1 Description

This information element provides information related to an external CP.

8.3.3.17.2 Attributes

The VnfExtCpInfo information element shall follow the indications provided in table 8.3.3.17.2-1.

Table 8.3.3.17.2-1: Attributes of the VnfExtCplInfo information element

Attribute	Qualifier	Cardinality	Content	Description
cpInstanceId	M	1	Identifier	Identifier of this external CP instance and of this VnfExtCplInfo information element.
cpId	M	1	Identifier (Reference to VnfExtCpd)	Identifier of the external CPD, vnfExtCpd in the VNFD.
vnfdId	M	0..1	Identifier (Reference to Vnfd)	Identifier of the VNFD. Shall be present in case the value differs from the vnfdId attribute of the VNF instance (e.g. during a "Change current VNF package" operation or due to its final failure).
cpProtocolInfo	M	0..N	CpProtocolInfo	Protocol information for this CP. There shall be one cpProtocolInfo for each layer protocol supported.
associatedVnfcCpld	M	0..1	Identifier (Reference to VnfcCplInfo)	Identifier of the VnfcCp that is exposed as this VnfExtCp instance, either directly or via a floating IP address. Shall be present if the cpId of this VnfExtCp has an intCpd attribute. See note 1.
associatedVipCpld	M	0..1	Identifier (Reference to VipCplInfo)	Identifier of the VIP CP that is exposed as this VnfExtCp instance, either directly or via a floating IP address. Shall be present if the cpId of this VnfExtCp has a vipCpd attribute. See note 1.
associatedVirtualCpld	M	0..1	Identifier (Reference to VirtualCplInfo)	Identifier of the VirtualCp that is exposed as this VnfExtCp instance. Shall be present if the cpId of this VnfExtCp has a virtualCpd attribute. See note 1.
associatedVnfVirtualLinkId	M	0..1	Identifier (Reference to VnfVirtualLinkResourceInfo)	Identifier of the Vnf VL that this VnfExtCP maps to. Shall be present if the cpId of this VnfExtCp has an intVirtualLinkDesc attribute. See note 1.
extLinkPortId	M	0..1	Identifier (Reference to ExtLinkPortInfo)	Identifier of the "ExtLinkPortInfo" information element in the "ExtVirtualLinkInfo" information element. Shall be present if the CP is associated to a link port. See note 2.
netAttDefResourceId	M	0..N	Identifier (Reference to NetAttDefResourceInfo)	Identifier of the network attachment definition resource(s) that provides the specification of the interface to attach the connection point to a secondary container cluster network. See notes 3 and 4. It shall be present if the external CP is associated to a VNFC realized by one or a set of OS containers and is connected to a secondary container cluster network. It shall not be present otherwise.

Attribute	Qualifier	Cardinality	Content	Description
metadata	M	0..N	KeyValuePair	Metadata about this external CP.
certificateContentId	M	0..1	Identifier (Reference to CertificateContent)	The identifier of certificate that this VNF CP instance uses. Shall be present when using in delegation-mode. Otherwise shall not be present.
NOTE 1: The attributes associatedVnfcCpld, associatedVipCpld, associatedVirtualCpld and associatedVnfVirtualLinkId are mutually exclusive. Exactly one shall be present.				
NOTE 2: An external CP is not associated to a link port in the cases indicated for the "extLinkPorts" attribute in clause 8.12.2.2 of ETSI GS NFV-IFA 007 [i.5].				
NOTE 3: Cardinality greater than 1 is only applicable for specific cases where more than one network attachment definition resource is needed to fulfil the connectivity requirements of the extCP, e.g. to build a link redundant mated pair in SR-IOV cases.				
NOTE 4: When more than one netAttDefResourceId is indicated, all shall belong to the same namespace.				

8.3.3.18 ExtVirtualLinkInfo information element

8.3.3.18.1 Description

This information element provides a reference to an external VL.

8.3.3.18.2 Attributes

The ExtVirtualLinkInfo information element shall follow the indications provided in table 8.3.3.18.2-1.

Table 8.3.3.18.2-1: Attributes of the ExtVirtualLinkInfo information element

Attribute	Qualifier	Cardinality	Content	Description
extVirtualLinkId	M	1	Identifier	Identifier of this external VL. The identifier is assigned by the NFV-MANO entity that manages this VL instance.
resourceHandle	M	1	ResourceHandle	Reference to the resource realizing this VL.
extLinkPort	M	0..N	ExtLinkPortInfo	Link ports of this VL.
extNetAttDefResource	M	0..N	NetAttDefResource Info	Network attachment definition resources that provide the specification of the interface to attach connection points to this VL.

8.3.3.19 ExtManagedVirtualLinkInfo information element

8.3.3.19.1 Description

This information element provides a reference to an externally-managed internal VL.

8.3.3.19.2 Attributes

The ExtManagedVirtualLinkInfo information element shall follow the indications provided in table 8.3.3.19.2-1.

Table 8.3.3.19.2-1: Attributes of the ExtManagedVirtualLinkInfo information element

Attribute	Qualifier	Cardinality	Content	Description
extManagedVirtualLinkId	M	1	Identifier	Identifier of this externally-managed internal VL. The identifier is assigned by the NFV-MANO entity that manages this VL instance.
vnfVirtualLinkDescId	M	1	Identifier (Reference to VnfVirtualLinkDesc)	Identifier of the VNF Virtual Link Descriptor (VLD) in the VNFD.

Attribute	Qualifier	Cardinality	Content	Description
vnfdId	M	0..1	Identifier (Reference to Vnfd)	Identifier of the VNFD. Shall be present in case the value differs from the vnfdId attribute of the VNF instance (e.g. during a "Change current VNF package" operation or due to its final failure).
networkResource	M	1	ResourceHandle	Reference to the VirtualNetwork resource or multi-site connectivity service providing this VL.
vnfLinkPort	M	0..N	VnfLinkPortInfo	Link ports of this VL.
vnfNetAttDefResource	M	0..N	NetAttDefResourceInfo	Network attachment definition resources that provide the specification of the interface to attach connection points to this VL.
extManagedMultisiteVirtualLinkId	M	0..1	Identifier	Identifier of the externally-managed multi-site VL instance. The identifier is assigned by the NFV-MANO entity that manages the externally managed multi-site VL instance. It shall be present when the externally-managed internal VL is part of a multi-site VL, e.g. in support of multi-site VNF spanning several VIMs. All externally-managed internal VL instances corresponding to an internal VL created based on the same virtualLinkId shall refer to the same extManagedMultisiteVirtualLinkId.

8.3.3.20 VnfLinkPortInfo information element

8.3.3.20.1 Description

This information element provides information about a port of a VNF's internal VL. See also VnfVirtualLinkResourceInfo in clause 8.3.3.6.

8.3.3.20.2 Attributes

The attributes of the VnfLinkPortInfo information element shall follow the indications provided in table 8.3.3.20.2-1.

Table 8.3.3.20.2-1: Attributes of the VnfLinkPortInfo information element

Attribute	Qualifier	Cardinality	Content	Description
vnfLinkPortId	M	1	Identifier	Identifier of this link port as provided by the entity that has created the link port.
resourceHandle	M	1	ResourceHandle	Reference to the virtualised resource realizing this link port.
associatedExtCpld	M	0..1	Identifier (Reference to VnfExtCplInfo)	External CP of the VNF associated to this link port. When an external CP is associated to an internal VL, this attribute reflects this association. Shall be present when the link port is used for external connectivity by the VNF. See notes 1, 2, 3 and 4.
vnfcCplInstanceld	M	0..1	Identifier (Reference to VnfcCplInfo)	VNFC CP of the VNF connected to this link port. May be present. See notes 1, 3 and 4.
vipCplInstanceld	M	0..1	Identifier (Reference to VipCplInfo)	VIP CP instance of the VNF connected to this link port. May be present. See notes 1, 3, 4 and 5.
<p>NOTE 1: There shall be at most one link port associated with any external connection point instance or internal connection point (i.e. VNFC CP) instance or VIP CP instance.</p> <p>NOTE 2: A VnfLinkPort does not terminate on an external CP, as external CPs are connected to external VLs.</p> <p>NOTE 3: Either associatedExtCpld or any combination of vnfcCplInstanceld and vipCplInstanceld (i.e. one or both of them) shall be present for a VnfLinkPortInfo. In case both vnfcCplInstanceld and vipCplInstanceld are present, the two different CP instances share the linkport.</p> <p>NOTE 4: The attributes "associatedExtCpld" and "vnfcCplInstanceld" model two separate associations in the information model. It is part of the protocol design to define the representation of these associations.</p> <p>NOTE 5: Clause A.4 of ETSI GS NFV-IFA 007 [i.5] provides examples for configurations where both vipCplInstanceld and vnfcCplInstanceld are present (UC#5 and UC#5-b), only vnfcCplInstanceld is present (UC#2), or only vipCplInstanceld is present (UC6 and UC#6-b).</p>				

8.3.3.21 VnfScaleInfo information element

8.3.3.21.1 Description

This information element provides information about the scale level of a VNF instance with respect to one scaling aspect.

8.3.3.21.2 Attributes

The VnfScaleInfo information element shall follow the indications provided in table 8.3.3.21.2-1.

Table 8.3.3.21.2-1: Attributes of the VnfScaleInfo information element

Attribute	Qualifier	Cardinality	Content	Description
aspectId	M	1	Identifier (Reference to ScalingAspect)	Reference to the scaling aspect.
vnfdId	M	0..1	Identifier (Reference to Vnfd)	Identifier of the VNFD. Shall be present in case the value differs from the vnfdId attribute of the VNF instance (e.g. during a "Change current VNF package" operation or due to its final failure).
scaleLevel	M	1	Integer	The scale level for that aspect. Minimum value 0, maximum value maxScaleLevel as declared in the VNFD (see ETSI GS NFV-IFA 011 [2], clause 7.1.10.2.2).

8.3.3.22 ExtLinkPortInfo information element

8.3.3.22.1 Description

This information element provides information about a port of an external VL, i.e. a port providing connectivity for the VNF to an NS VL.

8.3.3.22.2 Attributes

The attributes of the ExtLinkPortInfo information element shall follow the indications provided in table 8.3.3.22.2-1.

Table 8.3.3.22.2-1: Attributes of the ExtLinkPortInfo information element

Attribute	Qualifier	Cardinality	Content	Description
extLinkPortId	M	1	Identifier	Identifier of this link port as provided by the entity that has created the link port.
resourceHandle	M	1	ResourceHandle	Reference to the virtualised resource realizing this link port.
cplInstanceCid	M	0..1	Identifier (Reference to VnfExtCplInfo)	External CP of the VNF connected to this link port. See note 1.
secondaryCplInstanceCid	M	0..1	Identifier (Reference to VnfExtCplInfo)	Additional external CP of the VNF connected to this link port. If present, this attribute shall refer to a "secondary" ExtCplInfo item in the VNF instance that exposes a virtual IP CP instance which shares this linkport with the external CP instance referenced by the "cplInstanceCid" attribute. See notes 1 and 2.
NOTE 1: There shall be at most one link port associated with any external connection point instance.				
NOTE 2: The use cases UC#4 and UC#5 in clause A.4 of ETSI GS NFV-IFA 007 [i.5] provide examples for such a configuration.				

8.3.3.23 VnfcCpInfo information element

8.3.3.23.1 Description

This information element provides information related to a CP of a VNFC.

8.3.3.23.2 Attributes

The VnfcCpInfo information element shall follow the indications provided in table 8.3.3.23.2-1.

Table 8.3.3.23.2-1: Attributes of the VnfcCplInfo information element

Attribute	Qualifier	Cardinality	Content	Description
cpInstancelId	M	1	Identifier	Identifier of this VnfcCplInfo information element.
cpdId	M	1	Identifier (Reference to VduCpd)	Identifier of the VDU CPD, cpdId, in the VNFD.
vnfExtCpld	M	0..1	Identifier (Reference to VnfExtCplInfo)	When the VNFC CP is exposed as external CP of the VNF, the identifier of this external VNF CP.
cpProtocolInfo	M	0..N	CpProtocolInfo	Protocol information for this CP. There shall be one cpProtocolInfo for each layer protocol supported.
vnfLinkPortId	M	0..1	Identifier (Reference to VnfLinkPortInfo)	Identifier of the "VnfLinkPortInfo" information element in the "VnfVirtualLinkResourceInfo" information element. Shall be present if the CP is associated to a link port.
netAttDefResourceId	M	0..N	Identifier (Reference to NetAttDefResourceInfo)	Identifier of the network attachment definition resource(s) that provides the specification of the interface to attach the connection point to a secondary container cluster network. See notes 1 and 2. It shall be present if the internal CP is associated to a VNFC realized by one or a set of OS containers and is connected to a secondary container cluster network. It shall not be present otherwise.
metadata	M	0..N	KeyValuePair	Metadata about this VNFC CP.
certificateContentId	M	0..1	Identifier (Reference to CertificateContent)	The identifier of certificate that this VNFC CP instance uses. Shall be present when using in delegation-mode. Otherwise shall not be present.
NOTE 1: Cardinality greater than 1 is only applicable for specific cases where more than one network attachment definition resource is needed to fulfil the connectivity requirements of the internal CP, e.g. to build a link redundant mated pair in SR-IOV cases.				
NOTE 2: When more than one netAttDefResourceId is indicated, all shall belong to the same namespace.				

8.3.3.24 CpProtocolInfo information element

8.3.3.24.1 Description

This information element describes and associates the protocol layer that a CP uses together with other protocol-related information, like addresses.

8.3.3.24.2 Attributes

The CpProtocolInfo information element shall follow the indications provided in table 8.3.3.24.2-1.

Table 8.3.3.24.2-1: Attributes of the CpProtocolInfo information element

Attribute	Qualifier	Cardinality	Content	Description
layerProtocol	M	1	Enum	Identifies which protocol the CP uses for connectivity purposes. See note 1. VALUES: <ul style="list-style-type: none"> • IP_OVER_ETHERNET • IP_FOR_VIRTUAL_CP • etc.
address	M	1..N	Not specified	For a SAP or a PnfExtCp, address of this CP. For a VnfExtCp or a VnfcCp, list of network addresses that have been configured (statically or dynamically) on the link port that connects the CP to a VL. See notes 2 and 3.
domainNames	M	0..N	Not specified	Domain names that have been configured (statically or dynamically) and been associated to the CP.

NOTE 1: The layerProtocol values shall be compatible with the ones defined in the CPD.
NOTE 2: The address information shall be compatible with the layerProtocol attribute.
NOTE 3: For a SAP or a PnfExtCp, only a single address shall be provided. For a SAP, in some cases, the NFVO provides the address.

8.3.3.25 CpGroupInfo information element

8.3.3.25.1 Description

This information element describes a group of CPs and/or SAPs pairs associated to the same position in an NFP.

8.3.3.25.2 Attributes

The attributes of the CpGroupInfo information element shall follow the indications provided in table 8.3.3.25.2-1.

Table 8.3.3.25.2-1: Attributes of the CpGroupInfo information element

Attribute	Qualifier	Cardinality	Content	Description
cpPairInfo	M	1..N	CpPairInfo	One or more pair(s) of ingress and egress CPs or SAPs which the NFP passes by. See note.
forwardingBehaviour	M	0..1	Enum	Identifies a rule to apply to forward traffic to the ingress CPs or SAPs of the group. VALUES: <ul style="list-style-type: none"> • ALL: Traffic flows shall be forwarded simultaneously to all CPs or SAPs of the group. • LB: Traffic flows shall be forwarded to one CP or SAP of the group selected based on a load-balancing algorithm. • Etc.
forwardingBehaviourInputParameters	M	0..1	Not specified	Provides input parameters to configure the forwarding behaviour (e.g. identifies a load balancing algorithm and criteria).

NOTE: All CP or SAP pairs in a group shall be instantiated from connection point descriptors or service access point descriptors referenced in the corresponding NfpPositionDesc (see ETSI GS NFV-IFA 014 [3]).

8.3.3.26 CpPairInfo information element

8.3.3.26.1 Description

This information element describes a pair of ingress and egress CPs or SAPs which the NFP passes by.

8.3.3.26.2 Attributes

The attributes of the CpPairInfo information element shall follow the indications provided in table 8.3.3.26.2-1.

Table 8.3.3.26.2-1: Attributes of the CpPairInfo information element

Attribute	Qualifier	Cardinality	Content	Description
cpInfo	M	1..2	Identifier (Reference to VnfExtCpInfo or PnfExtCpInfo or SapInfo)	Identifier(s) of the CPs and/or SAPs which form the pair. See note.
NOTE: The presence of a single cpInfo occurrence indicates that the CP or SAP is used both as an ingress and egress port at a particular NFP position.				

8.3.3.27 VnfSnapshotInfo information element

8.3.3.27.1 Description

This information element provides the details of a VNF Snapshot of a VNF instance which is part of an NS.

8.3.3.27.2 Attributes

The VnfSnapshotInfo information element shall follow the indications provided in table 8.3.3.27.2-1.

Table 8.3.3.27.2-1: Attributes of the VnfSnapshotInfo information element

Attribute	Qualifier	Cardinality	Content	Description
vnfSnapshotInfoId	M	1	Identifier	Identifier of information held by the VNFM about a specific VNF Snapshot. This identifier was allocated by the VNFM.
triggeredAt	M	1	DateTime	Timestamp indicating when the VNF Snapshot creation has been started.
createdAt	M	0..1	DateTime	Timestamp indicating when the VNF Snapshot creation has been completed. Cardinality is 0 when the VNF Snapshot creation has not yet completed and shall be 1 afterwards. See note 1.
vnfInstanceId	M	1	Identifier	Identifier of the snapshotted VNF instance.
vnfdId	M	1	Identifier (Reference to Vnfd)	References the VNFD in use at the time the snapshot of the VNF instance has been created. See notes 2 and 3.
vnfInfo	M	1	VnfInfo	VnfInfo of the snapshotted VNF instance.
vnfcSnapshotInfo	M	1..N	VnfcSnapshotInfo	Information about VNFC Snapshots constituting this VNF Snapshot.
userDefinedData	O	0..N	KeyValuePair	User defined data for the VNF Snapshot.
NOTE 1: On the Os-Ma-nfvo reference point, the cardinality 0 is not used.				
NOTE 2: This identifier, which is managed by the VNF provider, identifies the VNF Package and the VNFD in a globally unique way.				
NOTE 3: This information is copied from the VNFD of the on-boarded VNF Package which was used to instantiate the VNF instance.				

8.3.3.28 VnfcSnapshotInfo information element

8.3.3.28.1 Description

This information element provides the details of a VNFC Snapshot of a VNFC instance which is part of VNF instance of an NS.

8.3.3.28.2 Attributes

The VnfcSnapshotInfo information element shall follow the indications provided in table 8.3.3.28.2-1.

Table 8.3.3.28.2-1: Attributes of the VnfcSnapshotInfo information element

Attribute	Qualifier	Cardinality	Content	Description
vnfcSnapshotInfoId	M	1	Identifier	Identifier of information held by the VNFM about a specific VNFC Snapshot. This identifier was allocated by the VNFM.
triggeredAt	M	1	DateTime	Timestamp indicating when the VNF Snapshot creation has been started.
createdAt	M	0..1	DateTime	Timestamp indicating when the VNFC Snapshot creation has been completed. Cardinality is 0 when the VNF Snapshot creation has not yet completed and shall be 1 afterwards. See note 2.
vnfcInstanceId	M	1	Identifier	Identifier of the snapshotted VNFC instance.
vnfcInfoId	M	1	Identifier (Reference to VnfcResourceInfo)	Reference to the information about the snapshotted VNFC instance.
computeSnapshotResource	M	0..1	ResourceHandle	Reference to a compute snapshot resource. See note 1.
storageSnapshotResource	M	0..N	StorageSnapshotResource	Mapping of the storage resources associated to the VNFC with the storage snapshot resources.
userDefinedData	O	0..N	KeyValuePair	User defined data for the VNFC Snapshot.
NOTE 1: The identifier of the compute snapshot resource is assigned during creation of a VNFC Snapshot being returned from the VIM as output data in the response message of the individual resource operations. This attribute shall only be present for a VNFC snapshot that has been newly created by the VNFM as a result of the "Create Snapshot operation".				
NOTE 2: On the Os-Ma-nfvo reference point, the cardinality 0 is not used.				

8.3.3.29 WanConnectionInfo information element

8.3.3.29.1 Description

This information element provides information about the connectivity to the WAN of network resources realizing a VL, e.g. when the VL is deployed on several sites across a WAN.

8.3.3.29.2 Attributes

The WanConnectionInfo information element shall follow the indications provided in table 8.3.3.29.2-1.

Table 8.3.3.29.2-1: Attributes of the WanConnectionInfo information element

Attribute	Qualifier	Cardinality	Content	Description
wanConnectionInfoId	M	1	Identifier	Identifier of this WAN connection information.
virtualLinkInstanceId	M	0..1	Identifier (Reference to NsVirtualLinkInfo or VnfVirtualLinkResourceInfo or ExtManagedVirtualLinkInfo)	References the VL instance to which the connection information is associated. Shall be present if the corresponding VL instance has been created.
protocolData	M	0..1	Not specified	Protocol specific information for connecting to the WAN.

8.3.3.30 StorageSnapshotResource information element

8.3.3.30.1 Description

This information element provides a mapping of the storage resources associated to the VNFC with the storage snapshot resources.

8.3.3.30.2 Attributes

The StorageSnapshotResource information element shall follow the indications provided in table 8.3.3.30.2-1.

Table 8.3.3.30.2-1: Attributes of the StorageSnapshotResource information element

Attribute	Qualifier	Cardinality	Content	Description
storageResourceId	M	1	Identifier (Reference to VirtualStorageResourceInfo)	Reference to a virtual storage resource.
storageSnapshotResource	M	0..1	ResourceHandle	Reference to a storage snapshot resource. See note.

NOTE: The identifier of the storage snapshot resource is assigned during creation of a VNFC Snapshot being returned from the VIM as output data in the response message of the individual resource operations. This attribute shall only be present for a VNFC snapshot with associated storage resources and that has been newly created by the VNFM as a result of the "Create Snapshot operation".

8.3.3.31 TrunkPortsInfo information element

8.3.3.31.1 Description

The information element provides runtime information of a collection of CPs of the VNFC instance which has one CP working in trunk mode, as parent port of a trunk, and other CPs working as subports of the same trunk.

8.3.3.31.2 Attributes

The attributes of the TrunkPortsInfo information element shall follow the indications provided in table 8.3.3.31.2-1.

Table 8.3.3.31.2-1: Attributes of the TrunkPortsInfo information element

Attribute	Qualifier	Cardinality	Content	Description
parentPort	M	1	Identifier (Reference to VnfcCplInfo)	Reference to the CP instance which is used as parent port in the trunk.
subportList	M	0..N	Identifier (Reference to VnfcCplInfo)	Reference to the CP instance(s) working as subport(s) in the trunk.

8.3.3.32 VipCpInfo information element

8.3.3.32.1 Description

This information element provides information related to VIP CP.

8.3.3.32.2 Attributes

The VipCpInfo information element shall follow the indications provided in table 8.3.3.32.2-1.

Table 8.3.3.32.2-1: Attributes of the VipCpInfo information element

Attribute	Qualifier	Cardinality	Content	Description
cpInstanceId	M	1	Identifier	Identifier of this VIP CP instance and of this VipCpInfo information element.
cpId	M	1	Identifier (Reference to VipCpd)	Identifier of the VIP Connection Point Descriptor, VipCpd, in the VNFD.
vnfdId	M	0..1	Identifier (Reference to Vnfd)	Reference to the VNFD. Shall be present in case the value differs from the vnfdId attribute of the VNF instance (e.g. during a "Change current VNF package" operation or due to its final failure).
vnfExtCpId	M	0..1	Identifier (Reference to VnfExtCpInfo)	When the VIP CP is exposed as external CP of the VNF, the identifier of this external VNF CP instance.
cpProtocolInfo	M	0..N	CpProtocolInfo	Protocol information for this CP. There shall be one cpProtocolInfo for layer 3. There may be one cpProtocolInfo for layer 2.
associatedVnfcCpId	M	0..N	Identifier (Reference to VnfcCpInfo)	Identifiers of the VnfcCps that share the virtual IP address allocated to the VIP CP instance. See note.
vnfLinkPortId	M	0..1	Identifier (Reference to VnfLinkPortInfo)	Identifier of the "VnfLinkPortInfo" information element in the "VnfVirtualLinkResourceInfo" information element. Shall be present if the CP is associated to a link port in an internal VL.
metadata	M	0..N	KeyValuePair	Metadata about this VIP CP.
NOTE: It is possible that there is no associated VnfcCp because the VIP CP is available but not associated yet.				

8.3.3.33 McioInfo information element

8.3.3.33.1 Description

This information element provides information about an MCIO representing the set of VNFC instances realized by one or a set of OS containers which have been created based on the same VDU.

Within the CISM, an MCIO controller monitors the actual state of an MCIO representing the set of VNFC instances realized by one or a set of OS containers and compare it to the desired state. For an MCIO related to a VDU that has the attribute isNumOfInstancesClusterBased set to FALSE the desired state is specified in the respective declarative descriptor. For an MCIO related to a VDU that has the attribute isNumOfInstancesClusterBased set to TRUE, the desired state is determined by the number of CIS-nodes in the cluster that fulfil the VDU requirements. It triggers actions toward the CIS to align the actual to the desired state. Monitoring the actual state includes monitoring the number of MCIO instances available at any specific point in time. In addition, an MCIO controller maintains properties and runtime information on the MCIO instances which have been created based on the same VDU. The McioInfo information element provides the runtime information on the MCIOs obtained from the respective MCIO controllers.

NOTE: There are different types of MCIOs. The set of VNFC instances based on the same VDU is represented by one MCIO. Each individual VNFC instance is represented by another type of MCIO.

Runtime information of the set of OS containers realizing an individual VNFC instances is not part of the McioInfo information element; such runtime information is provided in the ResourceHandle information element referenced from the VnfcResourceInfo. The McioInfo does not provide runtime information of a constituent VNFC instance created based on a specific VDU.

8.3.3.33.2 Attributes

The McioInfo information element shall follow the indications provided in table 8.3.3.33.2-1.

Table 8.3.3.33.2-1: Attributes of the McioInfo information element

Attribute	Qualifier	Cardinality	Content	Description
mciold	M	1	Identifier	Identifier of this MCIO, created by the CISM.
mcioName	M	1	String	Human readable name of this MCIO.
mcioNamespace	M	1	String	Namespace of this MCIO
vduld	M	1	Identifier (Reference to Vdu)	Reference to the applicable Vdu information element in the VNFD.
cismld	M	1	Identifier	Identifier of the CISM managing this MCIO.
mCIOType	M	1	Not specified	The type of MCIO. See note 1.
desiredInstances	M	1	Integer	Number of desired MCIO instances.
availableInstances	M	1	Integer	Number of available MCIO instances.
additionalInfo	M	0..1	Not Specified	Additional information which is specific to the MCIO, its type, and which is available from the CISM. See note 2.
certificateContentId	M	0..1	Identifier (Reference to CertificateContent)	The identifier of certificate that this MCIO instance uses. Shall be present when using in delegation-mode. Otherwise shall not be present.
<p>NOTE 1: The type of MCIO as specified in the declarative descriptor of the MCIO, and that can be read from the CISM. EXAMPLE: In case of MCIOs managed by Kubernetes®, the type of MCIO corresponds to the "kind" property of the declarative descriptor.</p> <p>NOTE 2: If the attribute additionalInfo is present, it may contain runtime information on the actual and desired state of the MCIO(s).</p>				

8.3.3.34 VirtualCpInfo information element

8.3.3.34.1 Description

This information element provides information related to a Virtual CP of a VNF.

8.3.3.34.2 Attributes

The VirtualCpInfo information element shall follow the indications provided in table 8.3.3.34.2-1.

Table 8.3.3.34.2-1: Attributes of the VirtualCplInfo information element

Attribute	Qualifier	Cardinality	Content	Description
cpInstancelId	M	1	Identifier	Identifier of this VirtualCplInfo information element.
cpdId	M	1	Identifier (Reference to VirtualCpd)	Identifier of the VirtualCpd, cpdId, in the VNFD.
resourceHandle	M	1	ResourceHandle	Reference to the virtualised resource realizing this Virtual CP.
vnfExtCpld	M	0..1	Identifier (Reference to VnfExtCplInfo)	When the Virtual CP is exposed as external CP of the VNF, the identifier of this external VNF CP.
cpProtocolInfo	M	0..N	CpProtocolInfo	Protocol information for this CP. There shall be one cpProtocolInfo for each layer protocol supported.
vduld	M	1..N	Identifier (Reference to Vdu)	Reference to the VDU(s) which implement the service accessible via the Virtual CP. See note.
additionalServiceInfo	M	0..N	AdditionalServiceInfo	Additional service identification information of the Virtual CP.
metadata	M	0..N	KeyValuePair	Metadata about this Virtual CP.
NOTE: A consumer of the VNF LCM interface can learn the actual VNFC instances implementing the service accessible via the Virtual CP by querying the "vnfcResourceInfo" from the "InstantiatedVnfInfo" and filtering by corresponding "vduld" values.				

8.3.3.35 AdditionalServiceInfo information element

8.3.3.35.1 Description

This information element describes the additional service information of the Virtual CP used to expose properties of the Virtual CP to NFV-MANO.

See also description in clause 7.1.18.3 of ETSI GS NFV-IFA 011 [2].

8.3.3.35.2 Attributes

The attributes of the AdditionalServiceInfo information element shall follow the indications provided in table 8.3.3.35.2-1.

Table 8.3.3.35.2-1: Attributes of the AdditionalServiceInfo information element

Attribute	Qualifier	Cardinality	Content	Description
portInfo	M	1..N	ServicePortInfo	Service port numbers exposed by the Virtual CP.
serviceInfo	M	0..1	Not specified	Service matching information exposed by the Virtual CP. See note.
NOTE: This attribute shall only be present if additional information is needed to identify the service termination within the VNF, such as for example a url path information in an HTTP request required to allow a single Virtual CP IP address to be used for several HTTP based services that use the same port number.				

8.3.3.36 ServicePortInfo information element

8.3.3.36.1 Description

This information element describes the service identifying port properties exposed by the Virtual CP.

8.3.3.36.2 Attributes

The attributes of the ServicePortInfo information element shall follow the indications provided in table 8.3.3.36.2-1.

Table 8.3.3.36.2-1: Attributes of the ServicePortInfo information element

Attribute	Qualifier	Cardinality	Content	Description
name	M	1	String	The name of the port exposed by the Virtual CP.
protocol	M	1	Enum	The L4 protocol for this port exposed by the Virtual CP. VALUES: <ul style="list-style-type: none"> • TCP • UDP • SCTP
port	M	1	Integer	The L4 port number exposed by the Virtual CP.
portConfigurable	M	1	Boolean	Specifies whether the port attribute value is allowed to be configurable.

8.3.3.37 NetAttDefResourceInfo information element

8.3.3.37.1 Description

This information element contains information related to a network attachment definition resource that provides the specification of the interface used to connect one or multiple connection points to a secondary container cluster network.

8.3.3.37.2 Attributes

The NetAttDefResourceInfo information element shall follow the indications provided in table 8.3.3.37.2-1.

Table 8.3.3.37.2-1: Attributes of the NetAttDefResourceInfo information element

Attribute	Qualifier	Cardinality	Content	Description
netAttDefResourceInfoId	M	1	Identifier	Identifier of this network attachment definition resource as provided by the entity that has created it.
netAttDefResource	M	1	ResourceHandle	Resource handle of the resource in the scope of the CISM.
associatedExtCpld	M	0..N	Identifier (Reference to VnfExtCplInfo)	External CP of the VNF associated to this network attachment definition resource. Shall be present when the network attachment definition resource is used for external connectivity by the VNF.
associatedVnfCpld	M	0..N	Identifier (Reference to VnfcCplInfo)	VNFC CP of the VNF associated to this network attachment definition resource. May be present when the network attachment definition resource is used for internal connectivity by the VNF.

8.3.3.38 PaasServiceInfo information element

8.3.3.38.1 Description

This information element provides information about a PaaS Service that is used by a VNF instance or some other NS constituent. Examples of PaaS Services and their applicability to NS constituents are provided in clause 6.8.2.1 of ETSI GS NFV-IFA 014 [3].

The PaasServiceInfo is comprised of various sets of information. Some information comes from the descriptors (e.g. VNFD or NSD), other information comes from the PaaS Service assets provided by the NFVO to the VNFM, and other information is provided as runtime information about the usage of the PaaS Service.

8.3.3.38.2 Attributes

The PaasServiceInfo information element shall follow the indications provided in table 8.3.3.38.2-1.

Table 8.3.3.38.2-1: Attributes of the PaasServiceInfo information element

Attribute	Qualifier	Cardinality	Content	Description
paasServiceId	M	1	Identifier	Identifier of the assigned PaaS Service as managed by the PSM.
paasServiceType	M	1	String	The type of PaaS Service. The value of this attribute is expected to be matched against values of the registered PaaS Services in the PSR.
paasServiceVersion	M	0..1	Version	Version of the PaaS Service. It shall be present if the PaaS Service is versioned.
paasServiceRequestId	M	1	Identifier (Reference to PaasServiceRequest)	Identifier of the PaaS Service request in the descriptor (e.g. VNFD or NSD) that maps to the assigned PaaS Service.
paasServiceHandle	M	1	Not specified	A handle enabling the access and use of the PaaS Service by the NS constituent. This can include for instance certain interface endpoint URI together with necessary credentials to access it. The type and format of the handle depends on the form that the PaaS Service is formed.
additionalInfo	M	0..1	Not specified	Additional information which is specific to the PaaS Service, its type, and which is available from the PaaS Service instance.

8.3.3.39 CertificateInfo information element

8.3.3.39.1 Description

This information element provides information related to certificate and certificate management.

8.3.3.39.2 Attributes

The CertificateInfo information element shall follow the indications provided in table 8.3.3.39.2-1.

Table 8.3.3.39.2-1: Attributes of the CertificateInfo information element

Attribute	Qualifier	Cardinality	Content	Description
id	M	1	Identifier	The identifier of this certificate information.
certificateConfigurationInfo	M	0..1	CertificateConfigurationInfo	Configuration for certificate management such as certificate profile, information of CMF and security policy.
certificateContents	M	0..N	CertificateContent	Information for contents of issued certificates. The information contained in this attribute may be updated over time during the VNF LCM, e.g. certificate(s) renewal.

8.3.3.40 CertificateConfigurationInfo information element

8.3.3.40.1 Description

This information element provides information related to certificate management.

8.3.3.40.2 Attributes

The CertificateConfigurationInfo information element shall follow the indications provided in table 8.3.3.40.2-1.

Table 8.3.3.40.2-1: Attributes of the CertificateConfigurationInfo information element

Attribute	Qualifier	Cardinality	Content	Description
certificateBaseProfile	M	0..N	CertificateBaseProfile	Information for certificate profile.
securityPolicy	M	1..N	SecurityPolicy	Information for security policy to be satisfied for certificate.
delegationSupportedCertificateManagements	M	0..1	Not specified	Describes supported certificate management information.
cmfInfo	M	0..1	CmfInfo	Information of CMF.

8.3.3.41 CmflInfo information element

8.3.3.41.1 Description

This information element provides information related to CMF for certificate management.

8.3.3.41.2 Attributes

The CmflInfo information element shall follow the indications provided in table 8.3.3.41.2-1.

Table 8.3.3.41.2-1: Attributes of the CmflInfo information element

Attribute	Qualifier	Cardinality	Content	Description
id	M	1	Identifier	The identifier of this CMF information.
endPoint	M	1	Not specified	End point of CMF instance.
supportedProtocol	M	1..N	Not specified	Supported protocol by CMF instance.
certificateChain	M	0..N	Not specified	Certificate chain that this CMF provides.

8.3.3.42 CertificateContent information element

8.3.3.42.1 Description

This information element provides information related to certificate content.

8.3.3.42.2 Attributes

The CertificateContent information element shall follow the indications provided in table 8.3.3.42.2-1.

Table 8.3.3.42.2-1: Attributes of the CertificateContent information element

Attribute	Qualifier	Cardinality	Content	Description
Id	M	1	Identifier	The identifier of this certificate.
certificateDescId	M	1	Identifier (Reference to CertificateDesc)	The identifier of certificate description in VNFD to be used to issue this certificate. See note.
certificateType	M	1	ENUM	The type of this certificate. Values: VNFCI_CERT VNFOAM_CERT
delegationSupportedCertificateManagements	M	0..1	Not specified	Describes supported certificate management information.
version	M	0..1	Not specified	The version of this certificate.
serialNumber	M	0..1	Not specified	The serial number of this certificate.
signatureAlgorithm	M	0..1	Not specified	The algorithm of this certificate's signature.
Issuer	M	0..1	Not specified	The issuer of this certificate.
NotBefore	M	0..1	Not specified	The start date of valid period for this certificate.
NotAfter	M	0..1	Not specified	The end date of valid period for this certificate.
Subject	M	0..1	CertSubjectData	The subject of this certificate.
publicKeyAlgorithm	M	0..1	Not specified	The algorithm of this certificate's public key.
publicKey	M	0..1	Not specified	The public key of this certificate.
certificateExtensions	O	0..N	Not specified	The extension of this certificate.

NOTE: The CertificateDesc information element is defined in ETSI GS NFV-IFA 011 [2], clause 7.1.19.2.

8.3.4 Information elements related to NS Lifecycle Management operations

8.3.4.1 Introduction

The clauses below define information elements related to network service lifecycle management operations.

8.3.4.2 SapData information element

8.3.4.2.1 Description

The SapData information element defines information related to a SAP of an NS.

8.3.4.2.2 Attributes

The attributes of the SapData information element shall follow the indications provided in table 8.3.4.2.2-1.

Table 8.3.4.2.2-1: Attributes of the SapData information element

Attribute	Qualifier	Cardinality	Content	Description
sapId	M	1	Identifier (Reference to Sapd)	Reference to the SAPD for this SAP.
sapName	M	1	String	Human readable name for the SAP.
description	M	1	String	Human readable description for the SAP.
address	M	0..N	Not specified	Address for this SAP, including the information on applicable layer protocol(s). In some cases, the NFVO provides the address (refer to attribute sapAddressAssignment of Sapd information element in ETSI GS NFV-IFA 014 [3], clause 6.2.3.2). See note 1.
externalL2network	M	0..N	String	Identification of external (to the NS) network segments where the SAP is expected to be connected. The values provided by this attribute have no effect on the configuration of the SAP re-exposed from a respective VNF external CP which is done via the "address" attribute in the SapData, and it only provides information to NFV-MANO regarding the external connectivity for the SAP. The identification can be in the form of network segmentation identifiers. If trunking is enabled on the SAP, and the present "SapData" regards to the trunk SAP, and the "segmentationId" in the SAPs that represent the trunk sub-ports indicates the actual network segment value on the NFVI networking infrastructure, the values in the "externalL2network" attribute shall be either the whole list or a subset of the ones referenced by the "segmentationId" information in the respective trunk sub-port SAPs. If trunking is not enabled on the SAP, at most only one value may be provided by this attribute. See note 2.
NOTE 1: The address information shall be compatible with the layerProtocol values defined in the CPD.				
NOTE 2: The trunking configuration to which the present modelling applies considers the case where at design time a trunk port topology is defined between SAPD: one SAPD is used to represent a trunk SAP, and additional SAPDs are used to represent sub-port SAPs of the trunk SAP.				

8.3.4.3 VnfInstanceData information element

8.3.4.3.1 Description

The VnfInstanceData specifies existing VNF instances to be used in the NS instance and if needed, the VNF Profile to use for this VNF instance.

8.3.4.3.2 Attributes

The attributes of the VnfInstanceData information element shall follow the indications provided in table 8.3.4.3.2-1.

Table 8.3.4.3.2-1: Attributes of the VnfInstanceData information element

Attribute	Qualifier	Cardinality	Content	Description
vnfInstanceid	M	1	Identifier	Identifier of the existing VNF instance to be used in the NS.
vnfProfileid	M	0..1	Identifier (Reference to VnfProfile)	Identifier of (Reference to) a vnfProfile defined in the NSD which the existing VNF instance shall be matched with. If not present, the NFVO will select the VnfProfile matching the information in the VNF instance. See note 1.
overridingVnfldid	M	0..1	Identifier (Reference to a Vnfd)	It replaces the vnfldid indicated in the vnfProfileid. The VNFD referenced by this attribute shall have the same vnfExtInvariantId as the one indicated in the VnfProfile. If the VnfProfile does not contain a vnfExtInvariantId this attribute shall be ignored. If the VNFD of the existing VNF instance referenced by vnfInstanceid does not match the VNFD indicated by this attribute the VNF instance shall not be added to the NS instance. See notes 1, 2 and 4.
overridingVersionDependency	M	0..N	OverridingVersionDependency	If present, information in each overridingVersionDependency replaces the versionDependency in the VnfProfile, NsProfile or PnfProfile indicated in the OverridingVersionDependency. Only the versionDependency in the VnfProfile, NsProfile or PnfProfile with the same dependentConstituentId as in the overridingVersionDependency is replaced. See note 3. If no versionDependency with the dependentConstituentId indicated in the overridingVersionDependency exist in the VnfProfile, NsProfile or PnfProfile, the new versionDependency is added to the runtime information that the NFVO keeps about the profile. See note 4.
NOTE 1: If the overridingVnfldid attribute is present the vnfProfileid attribute shall also be present.				
NOTE 2: This attribute allows to use an existing VNF instance based on a different VNFD to the one specified in the NSD with vnfProfileid, provided both have the same vnfExtInvariantId.				
NOTE 3: A VnfProfile, NsProfile or PnfProfile may contain multiple VersionDependencies as it may describe the version dependencies of the descriptor referenced in the profile or of other descriptors with the same external invariant identifier.				
NOTE 4: The overridingVersionDependency attribute may only be present if the overridingVnfldid attribute is present.				

8.3.4.4 VnfLocationConstraint information element

8.3.4.4.1 Description

The VnfLocationConstraint information element defines the location constraints for the VNF to be instantiated.

8.3.4.4.2 Attributes

The attributes of the VnfLocationConstraint information element shall follow the indications provided in table 8.3.4.4.2-1.

Table 8.3.4.4.2-1: Attributes of the VnfLocationConstraint information element

Attribute	Qualifier	Cardinality	Content	Description
vnfProfileId	M	1	Identifier (Reference to VnfProfile)	Identifier (reference to) of a VnfProfile in the NSD used to manage the lifecycle of the VNF instance.
locationConstraints	M	1	Not specified	Defines the location constraints for the VNF instance to be created. See note.
vnfConstituentLocationConstraints	M	0..N	VnfConstituentLocationConstraint	Defines the location constraints for the constituents of a VNF instance to be created. See note.
NOTE: If "vnfConstituentLocationConstraints" are provided, the location constraint of the VNF constituent referenced by the attribute shall have precedence over the location constraints of the VNF indicated by the "locationConstraints" attribute.				

8.3.4.5 ParamsForVnf information element

8.3.4.5.1 Description

The ParamsForVnf specifies additional parameters for an NS instance on a per VNF instance basis.

8.3.4.5.2 Attributes

The attributes of the ParamsForVnf information element shall follow the indications provided in table 8.3.4.5.2-1.

Table 8.3.4.5.2-1: Attributes of the ParamsForVnf information element

Attribute	Qualifier	Cardinality	Content	Description
vnfProfileId	M	1	Identifier (Reference to VnfProfile)	Identifier of (reference to) a vnfProfile to which the additional parameters apply.
additionalParam	M	0..N	KeyValuePair	Additional parameters that are to be applied per VNF instance.
overridingVnfdId	M	0..1	Identifier (Reference to a Vnfd)	If present it replaces the vnfdId indicated in the referenced VnfProfile at the VNF instantiation. The VNFD referenced by this attribute shall have the same vnfdExtInvariantId as the one indicated in the VnfProfile. If the VnfProfile does not contain a vnfdExtInvariantId this attribute shall be ignored. See notes 1 and 3.

Attribute	Qualifier	Cardinality	Content	Description
overridingVersionDependency	M	0..N	OverridingVersionDependency	<p>If present, information in each overridingVersionDependency replaces the versionDependency in the VnfProfile, NsProfile or PnfProfile indicated in the OverridingVersionDependency.</p> <p>Only the versionDependency in the VnfProfile, NsProfile or PnfProfile with the same dependentConstituentId as in the overridingVersionDependency is replaced. See note 2.</p> <p>If no versionDependency with the dependentConstituentId indicated in the overridingVersionDependency exist in the VnfProfile, NsProfile or PnfProfile, the new versionDependency is added to the runtime information that the NFVO keeps about the profile.</p> <p>See note 3.</p>
targetScaleLevelInfo	M	0..N	VnfScaleInfo	<p>This attribute is applicable if VNF supports target scale level instantiation.</p> <p>For each scaling aspect of the current deployment flavour, the attribute specifies the scale level of VNF constituents (e.g. VDU level) to be instantiated. See notes 4 and 6.</p>
selectedDeployableModule	M	0..N	Identifier (Reference to DeployableModule)	<p>References a selected deployable module, as defined in the VNFD. Only VNFCs based on VDUs that belong to deployable modules listed in this attribute are requested to be instantiated or preserved if they were already instantiated. See note 5.</p>
<p>NOTE 1: This attribute allows at VNF instantiation the use of a VNFD different from the one specified in the NSD with vnfProfileId provided the two VNFDs refer to the same vnfExtInvariantId.</p> <p>NOTE 2: A VnfProfile, NsProfile or PnfProfile may contain multiple VersionDependencies as it may describe the version dependencies of the descriptor referenced in the profile or of other descriptors with the same external invariant identifier.</p> <p>NOTE 3: The overridingVersionDependency attribute may only be present if the overridingVnfId attribute is present.</p> <p>NOTE 4: If targetScaleLevelInfo is specified, information provided in targetScaleLevelInfo shall be used for instantiating scalable constituents of the VNF (e.g. VDUs/VLs). For scaling aspects not specified in targetScaleLevelInfo or for the VNF constituents (e.g. VDUs/VLs) that are not scalable, the default instantiation level as declared in the VNFD shall be used for instantiation.</p> <p>NOTE 5: When the ParamsForVnf information element is used in as part of AssocNewNsdVersionData it can be applied to already existing VNF instances.</p> <p>NOTE 6: If the referenced targetScaleLevelInfo attribute contain information related to VNFCs that are not going to be instantiated due to the selection of deployable modules, when passed to the VNFM, the information is stored in the VNFM for later use and included in the instantiatedVnfInfo, as described in clause 7.2.3.2 of ETSI GS NFV-IFA 007 [i.5].</p>				

8.3.4.6 ScaleNsData information element

8.3.4.6.1 Description

The ScaleNsData information element describes the information needed to scale an NS instance either by explicitly adding/removing existing VNF instances or by leveraging on the abstraction mechanism provided by the NS scaling aspects and NS levels information elements declared in the NSD.

8.3.4.6.2 Attributes

The attributes of the ScaleNsData information element shall follow the indications provided in table 8.3.4.6.2-1.

Table 8.3.4.6.2-1: Attributes of the ScaleNsData information element

Attribute	Qualifier	Cardinality	Content	Description
vnfInstanceToBeAdded	M	0..N	VnfInstanceData	Specifies an existing VNF instance to be added to the NS instance as part of the scaling operation. If needed, the VNF Profile to be used for this VNF instance is also provided. See notes 1, 2 and 3.
vnfInstanceToBeRemoved	M	0..N	Identifier	Specifies a VNF instance to be removed from the NS instance as part of the scaling operation. See notes 1 and 4.
scaleNsByStepsData	M	0..1	ScaleNsByStepsData	Specifies the information needed to scale an NS instance by one or more scaling steps. See note 1.
scaleNsToLevelData	M	0..1	ScaleNsToLevelData	Specifies the information needed to scale an NS instance to a target size. See note 1.
additionalParamForNs	M	0..N	KeyValuePair	Allows the OSS/BSS to provide additional parameter(s) at the NS level necessary for the NS scaling (as opposed to the VNF level, which is covered in additionalParamForVnf).
additionalParamForVnf	M	0..N	ParamsForVnf	Allows the OSS/BSS to provide additional parameter(s) per VNF instance (as opposed to the NS level, which is covered in additionalParamforNs). This is for VNFs that are to be created by the NFVO as part of the NS scaling and not for existing VNF that are covered by the scaleVnfData.
locationConstraints	M	0..N	VnfLocationConstraint	Defines the location constraints for the VNF to be instantiated as part of the NS scaling. An example can be a constraint for the VNF to be in a specific geographic location.
nestedNsLocationConstraints	M	0..N	NestedNsLocationConstraint	Defines the location constraints for the nested NS to be instantiated as part of the NS instantiation. An example can be a constraint for the nested NS to be in a specific geographic location.

Attribute	Qualifier	Cardinality	Content	Description
NOTE 1:				No more than two attributes between <code>vnfInstanceToBeAdded</code> , <code>vnfInstanceToBeRemoved</code> , <code>scaleNsByStepsData</code> and <code>scaleNsToLevelData</code> shall be present. In case of two, the attributes shall be <code>vnfInstanceToBeAdded</code> and <code>vnfInstanceToBeRemoved</code> .
NOTE 2:				The DF of the VNF instance shall match the VNF DF present in the associated VNF Profile of the new NS flavour.
NOTE 3:				This functionality is the same as the one provided by the Update NS operation when the <code>AddVnf</code> update type is selected (see clause 7.3.5).
NOTE 4:				This functionality is the same as the one provided by the Update NS operation when the <code>RemoveVnf</code> update type is selected (see clause 7.3.5).

8.3.4.7 ScaleNsByStepsData information element

8.3.4.7.1 Description

The `ScaleNsByStepsData` information element describes the information needed to scale an NS instance by one or more scaling steps, with respect to a particular NS scaling aspect. Performing a scaling step means increasing/decreasing the capacity of an NS instance in a discrete manner, i.e. moving from one NS scale level to another. The NS scaling aspects and their corresponding NS scale levels applicable to the NS instance are declared in the NSD.

8.3.4.7.2 Attributes

The attributes of the `ScaleNsByStepsData` information element shall follow the indications provided in table 8.3.4.7.2-1.

Table 8.3.4.7.2-1: Attributes of the `ScaleNsByStepsData` information element

Attribute	Qualifier	Cardinality	Content	Description
<code>scalingDirection</code>	M	1	Enum	Specifies the scaling direction. VALUES: <ul style="list-style-type: none"> • <code>SCALE_IN</code> • <code>SCALE_OUT</code>
<code>aspectId</code>	M	1	Identifier (Reference to <code>NsScalingAspect</code>)	Provides the aspect of the NS that is requested to be scaled, as declared in the NSD.
<code>numberOfSteps</code>	M	0..1	Integer	Specifies the number of scaling steps to be performed. Defaults to 1.

8.3.4.8 ScaleNsToLevelData information element

8.3.4.8.1 Description

The `ScaleNsToLevelData` information element describes the information needed to scale an NS instance to a target size. The target size is either expressed as an NS instantiation level or as a list of NS scale levels, one per NS scaling aspect, of the current DF. The NS instantiation levels, the NS scaling aspects and their corresponding NS scale levels applicable to the NS instance are declared in the NSD.

8.3.4.8.2 Attributes

The attributes of the `ScaleNsToLevelData` information element shall follow the indications provided in table 8.3.4.8.2-1.

Table 8.3.4.8.2-1: Attributes of the ScaleNsToLevelData information element

Attribute	Qualifier	Cardinality	Content	Description
nsInstantiationLevel	M	0..1	Identifier (Reference to NsLevel)	Identifier of the target NS instantiation level of the current DF to which the NS instance is requested to be scaled. See note.
nsScaleInfo	M	0..N	NsScaleInfo	For each NS scaling aspect of the current DF, defines the target NS scale level to which the NS instance is to be scaled. See note.

NOTE: Either nsInstantiationLevel or nsScaleInfo, but not both, shall be present.

8.3.4.9 ScaleVnfData information element

8.3.4.9.1 Description

This information element describes the information needed, either to scale a VNF instance to a given level, or to scale a VNF instance by steps.

8.3.4.9.2 Attributes

The attributes of the ScaleVnfData information element shall follow the indications provided in table 8.3.4.9.2-1.

Table 8.3.4.9.2-1: Attributes of the ScaleVnfData information element

Attribute	Qualifier	Cardinality	Content	Description
vnfInstanceId	M	1	Identifier	Identifier of the VNF instance being scaled.
type	M	1	Not specified	Defines the type of the scale VNF operation requested (scale out, scale in, scale to instantiation level, scale to scale level(s)). The set of types actually supported depends on the capabilities of the VNF being managed. See note 1.
scaleToLevelData	M	0..1	ScaleToLevelData	Provides the information needed when scaling to a given level. See note 2.
scaleByStepData	M	0..1	ScaleByStepData	Provides the information needed when scaling by steps. See note 2.

NOTE 1: ETSI GS NFV-IFA 010 [1] specifies that the lifecycle management operations that expand or contract a VNF instance include scale in, scale out, scale up and scale down. Vertical scaling (scale up, scale down) is not supported in the present document.

NOTE 2: Either scaleToLevelData or scaleByStepData but not both shall be present. The scaleByStepData is used for scale out/in type of scaling, and the scaleToLevelData is used for scale to instantiation/scale level type of scaling.

8.3.4.10 ScaleToLevelData information element

8.3.4.10.1 Description

The ScaleToLevelData information element describes the information needed to scale a VNF instance to a target size. The target size is either expressed as an instantiation level of that DF as defined in the VNFD, or given as a list of scale levels, one per scaling aspect of that DF. Instantiation levels and scaling aspects are declared in the VNFD. The NFVO shall then invoke the ScaleVnfToLevel operation towards the appropriate VNF. The specific parameters passed by the NFVO to the VNF are specified in clause 7.2.5.2 of ETSI GS NFV-IFA 007 [i.5].

8.3.4.10.2 Attributes

The attributes of the ScaleToLevelData information element shall follow the indications provided in table 8.3.4.10.2-1.

Table 8.3.4.10.2-1: Attributes of the ScaleToLevelData information element

Attribute	Qualifier	Cardinality	Content	Description
instantiationLevelId	M	0..1	Identifier (Reference to InstantiationLevel)	Identifier of (reference to) the target instantiation level of the current DF to which the VNF instance is requested to be scaled. See notes 1 and 2.
scaleInfo	M	0..N	VnfScaleInfo	For each scaling aspect of the current DF, defines the target scale level to which the VNF instance is to be scaled. The VNF provider defines in the VNFD whether or not a particular VNF supports scaling according to this parameter. Such a property in the VNFD applies for all instances of a particular VNF. See notes 1 and 2.
additionalParam	M	0..N	KeyValuePair	Additional parameters passed by the OSS/BSS as input to the scaling process, specific to the VNF instance being scaled, as declared in the VNFD (see clause 7.1.5.5 in ETSI GS NFV-IFA 011 [2]).
NOTE 1: Either instantiationLevelId or scaleInfo but not both shall be present.				
NOTE 2: If the referenced instantiationLevel or the scaleInfo attribute contain information related to VNFCs that are not going to be instantiated due to the selection of deployable modules, when passed to the VNFM, the information is stored in the VNFM for later use and included in the instantiatedVnfInfo, as described in clause 7.2.5.2 of ETSI GS NFV-IFA 007 [i.5].				

8.3.4.11 ScaleByStepData information element

8.3.4.11.1 Description

The ScaleByStepData information element describes the information needed to scale a VNF instance by steps. The NFVO shall then invoke the ScaleVNF operation towards the appropriate VNFM. The specific parameters passed by the NFVO to the VNFM are specified in clause 7.2.4.2 of ETSI GS NFV-IFA 007 [i.5].

8.3.4.11.2 Attributes

The attributes of the ScaleByStepData information element shall follow the indications provided in table 8.3.4.11.2-1.

Table 8.3.4.11.2-1: Attributes of the ScaleByStepData information element

Attribute	Qualifier	Cardinality	Content	Description
aspectId	M	1	Identifier (Reference to ScalingAspect)	Identifier of (reference to) the aspect of the VNF that is requested to be scaled, as declared in the VNFD.
numberOfSteps	M	0..1	Integer	Number of scaling steps. It shall be a positive number. Defaults to 1. The VNF provider defines in the VNFD whether or not a particular VNF supports performing more than one step at a time. Such a property in the VNFD applies for all instances of a particular VNF. See note.
additionalParam	M	0..N	KeyValuePair	Additional parameters passed by the OSS/BSS as input to the scaling process, specific to the VNF instance being scaled, as declared in the VNFD (see clause 7.1.5.4 in ETSI GS NFV-IFA 011 [2]).
NOTE: A scaling step is the smallest unit by which a VNF instance can be scaled w.r.t a particular scaling aspect.				

8.3.4.12 InstantiateVnfData information element

8.3.4.12.1 Description

The InstantiateVnfData information element specifies the parameters that are needed for VNF instantiation when the OSS/BSS explicitly requests VNF instantiation for a given NS. When the NFVO invokes the Instantiate VNF operation a set of these parameters are then passed by the NFVO to the VNFM. The specific parameters passed by the NFVO to the VNFM are specified in clause 7.2.3.2 of ETSI GS NFV-IFA 007 [i.5].

8.3.4.12.2 Attributes

The attributes of the InstantiateVnfData information element shall follow the indications provided in table 8.3.4.12.2-1.

Table 8.3.4.12.2-1: Attributes of the InstantiateVnfData information element

Attribute	Qualifier	Cardinality	Content	Description
vnfdId	M	0..1	Identifier (Reference to Vnfd)	Information sufficient to identify the VNFD which defines the VNF to be instantiated. See notes 4 and 5.
flavourId	M	0..1	Identifier (Reference to VnfDf)	Identifier of the VNF DF to be instantiated. See notes 1, 4 and 5.
instantiationLevelId	M	0..1	Identifier (Reference to InstantiationLevel)	Identifier of the instantiation level of the DF to be instantiated. See notes 5 and 6.
targetScaleLevelInfo	M	0..N	VnfScaleInfo	This attribute is applicable if VNF supports target scale level instantiation. For each scaling aspect of the current deployment flavour, the attribute specifies the scale level of VNF constituents (e.g. VDU level) to be instantiated. See notes 6 and 7.
vnfProfileId	M	0..1	Identifier (Reference to VnfProfile)	Identifier of (Reference to) a vnfProfile defined in the NSD which is used for instantiating the VNF. See notes 5 and 8.
vnfInstanceName	M	0..1	String	Human-readable name of the VNF instance to be created.
vnfInstanceDescription	M	0..1	String	Human-readable description of the VNF instance to be created.
extVirtualLink	M	0..N	ExtVirtualLinkData	Information about external VLS to connect the VNF to.
extManagedVirtualLink	M	0..N	ExtManagedVirtualLinkData	Information about internal VLS that are managed by other entities than the VNFM. See notes 2 and 3.
localizationLanguage	M	0..1	Not specified	Localization language of the VNF to be instantiated. The localization languages supported by a VNF can be declared in the VNFD. If this parameter is not provided and the "defaultLocalizationLanguage" attribute is declared in the VNFD, the "defaultLocalizationLanguage" shall be used to determine the localization language VNF to be instantiated.
additionalParam	M	0..N	KeyValuePair	Additional parameters passed by the OSS/BSS as input to the instantiation process, specific to the VNF being instantiated, as declared in the VNFD (see clause 7.1.5.3 in ETSI GS NFV-IFA 011 [2]).

Attribute	Qualifier	Cardinality	Content	Description
locationConstraint	M	0..1	VnfLocationConstraint	Defines the location constraints for the VNF to be instantiated as part of the NS Update. An example can be a constraint for the VNF to be in a specific geographic location.
metadata	M	0..N	KeyValuePair	This parameter provides values for the "metadata" input parameter of the Create VNF Identifier operation for the VNF to be instantiated as part of the NS update.
extension	M	0..N	KeyValuePair	This parameter provides values for the "extension" input parameter of the Instantiate VNF operation.
overridingVnfld	M	0..1	Identifier (Reference to Vnfd)	If present the vnfProfileId shall also be present. It replaces the vnfld indicated in the vnfProfileId. The VNFD referenced by this attribute shall have the same vnfExtInvariantId as the one indicated in the VnfProfile. If the VnfProfile does not contain a vnfExtInvariantId this attribute shall be ignored. See notes 8, 9 and 11.
overridingVersionDependency	M	0..N	OverridingVersionDependency	If present, information in each overridingVersionDependency replaces the versionDependency in the VnfProfile, NsProfile or PnfProfile indicated in the OverridingVersionDependency. Only the versionDependency in the VnfProfile, NsProfile or PnfProfile with the same dependentConstituentId as in the overridingVersionDependency is replaced. See note 10. If no versionDependency with the dependentConstituentId indicated in the overridingVersionDependency exist in the VnfProfile, NsProfile or PnfProfile, the new version Dependency is added to the runtime information that the NFVO keeps about the profile. See note 11.
selectedDeployableModule	M	0..N	Identifier (Reference to DeployableModule)	References a selected deployable module, as defined in the VNFD. Only VNFCs based on VDUs that belong to deployable modules listed in this attribute are requested to be instantiated.

Attribute	Qualifier	Cardinality	Content	Description
NOTE 1:				The VnfDf information element is defined in ETSI GS NFV-IFA 011 [2], clause 7.1.8.2.
NOTE 2:				The indication of externally-managed internal VLs is needed in case networks have been pre-configured for use with certain VNFs, for instance to ensure that these networks have certain properties such as security or acceleration features, or to address particular network topologies. The present document assumes that externally-managed internal VLs are managed by the NFVO and created towards the VIM as supported by the virtualised network resource management interface specified in ETSI GS NFV-IFA 005 [i.4].
NOTE 3:				It is possible to have several ExtManagedVirtualLinkData for the same VNF internal VL in case of a multi-site VNF spanning several VIMs. The set of ExtManagedVirtualLinkData corresponding to the same VNF internal VL shall indicate so by referencing to the same VnfVirtualLinkDesc and externally-managed multi-site VL instance (refer to clause 8.3.4.28).
NOTE 4:				If vnfDfd and flavourId (and InstantiationLevelId, if provided) are present, there should be only one vnfProfile that matches the vnfDfd and flavourId (and InstantiationLevelId, if present) in the NS deployment flavour specified in the NSD associated to the NS instance to which the present operation is triggered. In the case there is more than one matching vnfProfile, the NFVO may select a matching vnfProfile based on other information, such as external VL.
NOTE 5:				Either the attribute triple "vnfDfd, flavourId and instantiationLevelId (if provided)" or the attribute "vnfProfileId" shall be present, but not both.
NOTE 6:				The target size for VNF instantiation may be specified in either instantiationLevelId or targetScaleLevelInfo, but not both. If none of the two attributes (instantiationLevelId or targetScaleLevelInfo) are present, the default instantiation level as declared in the VNFD shall be used.
NOTE 7:				If targetScaleLevelInfo is specified, information provided in targetScaleLevelInfo shall be used for instantiating scalable constituents of the VNF (e.g. VDUs/VLs). For scaling aspects not specified in targetScaleLevelInfo or for the VNF constituents (e.g. VDUs/VLs) that are not scalable, the default instantiation level as declared in the VNFD shall be used for instantiation.
NOTE 8:				If the overridingVnfDfd attribute is present the vnfProfileId attribute shall also be present.
NOTE 9:				This attribute allows at VNF instantiation the use of a VNFD different from the one specified in the NSD with vnfProfileId provided the two VNFs have the same vnfDfdExtInvariantId.
NOTE 10:				A VnfProfile, NsProfile or PnfProfile may contain multiple VersionDependencies as it may describe the version dependencies of the descriptor referenced in the profile or of other descriptors with the same external invariant identifier.
NOTE 11:				The overridingVersionDependency attribute may only be present if the overridingVnfDfd attribute is present.

8.3.4.13 ExtVirtualLinkData information element

8.3.4.13.1 Description

This information element provides the information of an external VL to be used as a parameter passed to NS lifecycle management interface.

8.3.4.13.2 Attributes

The ExtVirtualLinkData information element shall follow the indications provided in table 8.3.4.13.2-1.

Table 8.3.4.13.2-1: Attributes of the ExtVirtualLinkData information element

Attribute	Qualifier	Cardinality	Content	Description
extVirtualLinkId	M	1	Identifier	Identifier of this external VL instance. The identifier is assigned by the NFV-MANO entity that manages this VL instance.
vimId	CM	0..1	Identifier	Identifier of the VIM that manages this resource. CONDITION: This attribute shall be supported and present if VNF-related resource management in direct mode is applicable.
resourceProviderId	CM	0..1	Identifier	Identifies the entity responsible for the management of the resource. CONDITION: This attribute shall be supported and present when VNF-related Resource Management in indirect mode is applicable.
resourceId	M	1	Identifier	Identifier of the resource in the scope of the VIM or the resource provider.
extCp	M	1..N	VnfExtCpData	External CPs of the VNF to be connected to this external VL.
extLinkPorts	M	0..N	ExtLinkPortData	Externally provided link ports to be used to connect external connection points to this external VL.
extNetAttDefResourceData	M	0..N	NetAttDefResourceData	Externally provided network attachment definition resource(s) that provide the specification of the interface to attach external CPs to this external VL. See note. It is only applicable if the external VL is realized by a secondary container cluster network. It shall not be present otherwise.
NOTE: An example of the network attachment definition resource when the container infrastructure service is a Kubernetes® instance is a network attachment definition (NAD).				

8.3.4.14 VnfExtCpData information element

8.3.4.14.1 Description

This information element provides input information related to one or more external CP instances created based on the same CPD.

8.3.4.14.2 Attributes

The VnfExtCpData information element shall follow the indications provided in table 8.3.4.14.2-1.

Table 8.3.4.14.2-1: Attributes of the VnfExtCpData information element

Attribute	Qualifier	Cardinality	Content	Description
cpdId	M	1	Identifier	Identifier of the CPD in the VNFD.
cpConfig	M	1..N	VnfExtCpConfig	List of instance data that need to be configured on the CP instances created from the respective CPD.

8.3.4.15 ChangeVnfFlavourData information element

8.3.4.15.1 Description

The ChangeVnfFlavourData specifies existing VNF instance for which the DF needs to be changed. This specifies the new DF, the instantiationLevel of the new DF that may be used and the additional parameters as input for the flavour change.

The change of VNF DF depends on VNF capabilities and its support by the VNF is declared in the VNFD.

8.3.4.15.2 Attributes

The attributes of the ChangeVnfFlavourData information element shall follow the indications provided in table 8.3.4.15.2-1.

Table 8.3.4.15.2-1: Attributes of the ChangeVnfFlavourData information element

Attribute	Qualifier	Cardinality	Content	Description
vnfInstanceId	M	1	Identifier	Identifier of the VNF instance to be modified.
newFlavourId	M	1	Identifier (Reference to VnfDf)	Identifier of the new VNF DF to apply to this VNF instance. See note 3.
instantiationLevelId	M	0..1	Identifier (Reference to InstantiationLevel)	Identifier of the instantiation level of the DF to be used. See note 4.
targetScaleLevelInfo	M	0..N	VnfScaleInfo	This attribute is applicable if VNF supports target scale level instantiation. For each scaling aspect of the current deployment flavour, the attribute specifies the scale level of VNF constituents (e.g. VDU level) to be instantiated. See notes 4 and 5.
extVirtualLink	M	0..N	ExtVirtualLinkData	Information about external VLS to connect the VNF to.
extManagedVirtualLink	M	0..N	ExtManagedVirtualLinkData	Information about internal VLS that are managed by other entities than the VNFM. See notes 1 and 2.
additionalParam	M	0..N	KeyValuePair	Additional parameters passed by the OSS/BSS as input to the flavour change process, specific to the VNF being modified, as declared in the VNFD (see clause 7.1.5.9 in ETSI GS NFV-IFA 011 [2]).
extension	M	0..N	KeyValuePair	This parameter provides values for the "extension" parameter of the ChangeVnfFlavour operation.
vnfConfigurableProperty	M	0..N	KeyValuePair	This parameter provides values for the "vnfConfigurableProperty" parameter of the ChangeVnfFlavour operation.
selectedDeployableModule	M	0..N	Identifier (Reference to DeployableModule)	References a selected deployable module, as defined in the VNFD. Only VNFCs based on VDUs that belong to deployable modules listed in this attribute are requested to be instantiated or preserved if they were already instantiated.
certificateConfigurationData	M	0..1	CertificateConfigurationData	Configuration for certificate management such as certificate profile and security policy in this VNF. Can be present when setting a new certificate to the VNF instance in delegation mode. Otherwise shall not be present.

Attribute	Qualifier	Cardinality	Content	Description
NOTE 1:				The indication of externally-managed internal VLs is needed in case networks have been pre-configured for use with certain VNFs, for instance to ensure that these networks have certain properties such as security or acceleration features, or to address particular network topologies. The present document assumes that externally-managed internal VLs are managed by the NFVO and created towards the VIM as supported by the virtualised network resource management interface specified in ETSI GS NFV-IFA 005 [i.4].
NOTE 2:				It is possible to have several ExtManagedVirtualLinkData for the same VNF internal VL in case of a multi-site VNF spanning several VIMs. The set of ExtManagedVirtualLinkData corresponding to the same VNF internal VL shall indicate so by referencing to the same VnfVirtualLinkDesc and externally-managed multi-site VL instance (refer to clause 8.3.4.28).
NOTE 3:				The VnfDf information element is defined in ETSI GS NFV-IFA 011 [2], clause 7.1.8.2.
NOTE 4:				The target size for VNF instantiation may be specified in either instantiationLevelId or targetScaleLevelInfo, but not both. If none of the two attributes (instantiationLevelId or targetScaleLevelInfo) are present, the default instantiation level as declared in the VNFD shall be used.
NOTE 5:				If targetScaleLevelInfo is specified, information provided in targetScaleLevelInfo shall be used for instantiating scalable constituents of the VNF (e.g. VDUs/VLs). For scaling aspects not specified in targetScaleLevelInfo or for the VNF constituents (e.g. VDUs/VLs) that are not scalable, the default instantiation level as declared in the VNFD shall be used for instantiation.

8.3.4.16 OperateVnfData information element

8.3.4.16.1 Description

The OperateVnfData information element specifies the VNF instance for which the operational state needs to be changed and the requested new state.

8.3.4.16.2 Attributes

The attributes of the OperateVnfData information element shall follow the indications provided in table 8.3.4.16.2-1.

Table 8.3.4.16.2-1: Attributes of the OperateVnfData information element

Attribute	Qualifier	Cardinality	Content	Description
vnfInstanceid	M	1	Identifier	Identifier of the VNF instance.
changeStateTo	M	1	Enum	The desired state to change the VNF to. VALUES: <ul style="list-style-type: none"> STARTED STOPPED
stopType	M	0..1	Enum	It signals whether forceful or graceful stop is requested. <ul style="list-style-type: none"> VALUES: FORCEFUL: The VNF is stopped immediately. See note 2. GRACEFUL: The VNFM first arranges to take the VNF out of service (by means out of scope of the present specification, e.g. involving interaction with EM, if required). Once this is successful, or after a timeout, the VNFM stops the VNF. Only applicable when changing state to stop.

Attribute	Qualifier	Cardinality	Content	Description
gracefulStopTimeout	M	0..1	TimeDuration	The time interval to wait for the VNF to be taken out of service during graceful stop, before stopping the VNF. If not given, it is expected that the VNFM waits for the successful taking out of service of the VNF, no matter how long it takes, before stopping the VNF. See note 1. Minimum timeout or timeout range are specified by the VNF vendor (e.g. defined in the VNFD or communicated by other means). The parameter is not relevant in case of forceful stop.
additionalParam	M	0..N	KeyValuePair	Additional parameters passed by the OSS/BSS as input to the Operate VNF operation, specific to the VNF being operated, as declared in the VNFD (see clause 7.1.5.8 in ETSI GS NFV-IFA 011 [2]).
NOTE 1: This implies that no VNF stop will be attempted if taking the VNF out of service fails or hangs. NOTE 2: If a VNF is stopped immediately and if the VNF is still in service, this may adversely impact network service. Therefore, operator policies apply to determine if forceful stop is allowed in the particular situation.				

8.3.4.17 ModifyVnfInfoData information element

8.3.4.17.1 Description

The ModifyVnfInfoData information element specifies for a VNF instance the information that is requested to be modified. The information to be modified shall comply with the associated NSD.

EXAMPLE: When the vnfIdattribute value of VnfInfo needs to be updated, the value would need to match the identifier's value of a VnfPkgInfo whose vnfId is present in the associated VNF type and profile of the NSD.

8.3.4.17.2 Attributes

The attributes of the ModifyVnfInfoData information element shall follow the indications provided in table 8.3.4.17.2-1.

Table 8.3.4.17.2-1: Attributes of the ModifyVnfInfoData information element

Attribute	Qualifier	Cardinality	Content	Description
vnfInstancelId	M	1	Identifier	Identifier of the VNF instance for which the writable attributes of VnfInfo are requested to be modified.
newValues	M	1..N	KeyValuePair	Contains the set of attributes to update. The key in the KeyValuePair indicates the name of an attribute that is writable through the interface whose value is to be updated. The value in the KeyValuePair indicates the new attribute value.

8.3.4.18 Void

8.3.4.19 AssocNewNsdVersionData information element

8.3.4.19.1 Description

The AssocNewNsdVersionData information element specifies a new NSD version that is associated to the NS instance. After issuing the Update NS operation with updateType=AssocNewNsdVersion, the NFVO shall use the referred NSD as a basis for the given NS instance.

Different versions of the same NSD have same nsdInvariantId, but different nsdId attributes, therefore if the nsdInvariantId of the NSD version that is to be associated to this NS instance is different from the one used before, the NFVO shall reject the request. Only new versions of the same NSD can be associated to an existing NS instance.

8.3.4.19.2 Attributes

The attributes of the AssocNewNsdVersionData information element shall follow the indications provided in table 8.3.4.19.2-1.

Table 8.3.4.19.2-1: Attributes of the AssocNewNsdVersionData information element

Attribute	Qualifier	Cardinality	Content	Description
newNsdId	M	1	Identifier (Reference to Nsd)	Identifier of the new NSD version that is to be associated to the NS instance.
sync	M	0..1	Boolean	<p>Specify whether the NS instance should be automatically synchronized to the new NSD by the NFVO (in case of true value) or the NFVO should not do any action (in case of a false value) and wait for further guidance from OSS/BSS (i.e. waiting for OSS/BSS to issue NS lifecycle management operation to explicitly add/remove VNFs and modify information of VNF instances according to the new NSD).</p> <p>The synchronization to the new NSD means:</p> <ul style="list-style-type: none"> • instantiating/adding those VNFs whose VNFD is referenced by the new NSD version but not referenced by the old one; • terminating/removing those VNFs whose VNFD is referenced by the old NSD version but not referenced by the new NSD version; • adding those VFs whose VLD is referenced by the new NSD version but not referenced by the old NSD version; • removing those VFs whose VLD is referenced by the old NSD version but not referenced by the new NSD version; • adding those nested NSs whose NSD is referenced by the new NSD version but not reference by the old NSD version; • removing those nested NSs whose NSD is referenced by the old NSD version, but not referenced by the new NSD version; • adding those SAPs whose SAPD is referenced by the new NSD version but not referenced by the old NSD version; • removing those SAPs whose SAPD is referenced by the old NSD version but not referenced by the new NSD version; • modifying information of VNF instances to the new applicable VNFD provided in the new NSD version (see note 1). • etc. <p>See notes 2 and 3.</p>

Attribute	Qualifier	Cardinality	Content	Description
additionalParamForNs	M	0..N	KeyValuePair	Provides additional parameter(s) at the composite NS instance level necessary to associate the new NSD version (as opposed to the VNF level, which is covered in additionalParamForVnf, and as opposed to the nested NS level, which is covered in additionalParamForNestedNs). See note 3.
additionalParamForVnf	M	0..N	ParamsForVnf	Provides additional parameter(s) per VNF instance necessary to associate the new NSD version (as opposed to the composite NS level, which is covered in additionalParamforNs, and as opposed to the nested NS level, which is covered in additionalParamForNestedNs). See note 3.
additionalParamForNestedNs	M	0..N	ParamsForNestedNs	Provides additional parameter(s) per nested NS instance (as opposed to the composite NS level, which is covered in additionalParamForNs, as opposed to the VNF level, which is covered in additionalParamForVnf). See note 3.
additionalParamForSap	M	0..N	SapData	Provides additional parameter(s) for SAP(s). See note 3.
<p>NOTE 1: The replacement of VNF instances, nested NS instances or PNF instances by instances whose descriptor is referenced by the new NSD is applicable even if the instance with a descriptor not referenced from the new NSD has the same VnfdExtInvariantId, NsdExtInvariantId or PnfdExtInvariantId as the new one, i.e. the synchronization procedure is based on descriptor identities of NSD constituents, and does not consider VnfdExtInvariantId, NsdExtInvariantId or PnfdExtInvariantId values.</p> <p>NOTE 2: A cardinality of 0 for the attribute sync indicates that synchronization shall not be done by the NFVO.</p> <p>NOTE 3: The attributes "additionalParamForNs", "additionalParamForVnf", "additionalParamForNestedNs" and "additionalParamForSap" may be specified when the attribute sync is set to true, and additional parameters at NS instance, VNF instance, nested NS instance and SAP level are to be specified, respectively.</p>				

8.3.4.20 MoveVnfInstanceData information element

8.3.4.20.1 Description

The MoveVnfInstanceData specifies existing VNF instances that needs to be moved from one NS instance (source) to another NS instance (destination). The NS instance defined in the Update NS operation (refer to nsInstanceId in table 7.3.5.2-1) indicates the source NS instance and the destination NS instance is specified in the present information element (refer to targetNsInstanceId in table 8.3.4.20.2-1).

8.3.4.20.2 Attributes

The attributes of the MoveVnfInstanceData information element shall follow the indications provided in table 8.3.4.20.2-1.

Table 8.3.4.20.2-1: Attributes of the MoveVnfInstanceData information element

Attribute	Qualifier	Cardinality	Content	Description
targetNsInstanceId	M	1	Identifier	Specify the target NS instance where the VNF instances are moved to.
vnfInstanceId	M	1..N	Identifier	Specify the VNF instance that is moved.

8.3.4.21 AddVnffgData information element

8.3.4.21.1 Description

This information element specifies the parameters that are needed for the creation of a new VNFFG instance.

8.3.4.21.2 Attributes

The attributes of the AddVnffgData information element shall follow the indications provided in table 8.3.4.21.2-1.

Table 8.3.4.21.2-1: Attributes of the AddVnffgData information element

Attribute	Qualifier	Cardinality	Content	Description
vnffgld	M	1	Identifier (Reference to Vnffgd)	Identifier of the VNFFGD which defines the VNFFG to be added.
vnffgName	M	1	String	Human readable name for the VNFFG.
description	M	1	String	Human readable description for the VNFFG.

8.3.4.22 UpdateVnffgData information element

8.3.4.22.1 Description

This information element specifies the parameters needed for the update of an existing VNFFG instance.

8.3.4.22.2 Attributes

The attributes of the UpdateVnffgData information element shall follow the indications provided in table 8.3.4.22.2-1.

Table 8.3.4.22.2-1: Attributes of the UpdateVnffgData information element

Attribute	Qualifier	Cardinality	Content	Description
vnffgld	M	1	Identifier (Reference to VnffgInfo)	Identifier of an existing VNFFG information element to be updated for the NS Instance.
nfp	M	0..N	NfpData	Indicate the desired new NFP(s) for a given VNFFG after the operations of addition/removal of NS components (e.g. VNFs, VLs, etc.) have been completed, or indicate the updated or newly created NFP classification and selection rule which applied to an existing NFP.
nfpId	M	0..N	Identifier (Reference to NfpInfo)	Identifier(s) of the NFP to be deleted from a given VNFFG.

8.3.4.23 NfpData information element

8.3.4.23.1 Description

This information element contains information needed to create or modify an NFP instance.

8.3.4.23.2 Attributes

The attributes of the NfpData information element shall follow the indications provided in table 8.3.4.23.2-1.

Table 8.3.4.23.2-1: Attributes of the NfpData information element

Attribute	Qualifier	Cardinality	Content	Description
nfpId	M	0..1	Identifier (Reference to NfpInfo)	Identifier of the NFP to be modified. See note 1.
nfpName	M	0..1	String	Human readable name for the NFP. See note 2.
description	M	0..1	String	Human readable description for the NFP. See note 2.
cpGroup	M	0..N	CpGroupInfo	Group(s) of CPs and/or SAPs which the NFP passes by. Cardinality can be 0 if only updated or newly created NFP classification and selection rule which applied to an existing NFP is provided. See notes 3 and 4.

Attribute	Qualifier	Cardinality	Content	Description
nfpRule	M	0..1	NfpRule	NFP classification and selection rule. See note 3.
NOTE 1: It shall be present for modified NFPs and shall be absent for the new NFP.				
NOTE 2: It shall be present for the new NFP, and it may be present otherwise.				
NOTE 3: At least a CP or an nfpRule shall be present.				
NOTE 4: When multiple identifiers are included, the position of the identifier in the information element value specifies the position of the group in the path.				

8.3.4.24 HealNsData information element

8.3.4.24.1 Description

This information element describes the information needed to heal an NS.

8.3.4.24.2 Attributes

The attributes of the HealNsData information element shall follow the indications provided in table 8.3.4.24.2-1.

Table 8.3.4.24.2-1: Attributes of the HealNsData information element

Attribute	Qualifier	Cardinality	Content	Description
degreeHealing	M	1	Enum	Indicates the degree of healing. VALUES: <ul style="list-style-type: none"> HEAL_RESTORE: Complete the healing of the NS restoring the state of the NS before the failure occurred HEAL_QOS: Complete the healing of the NS based on the newest QoS values HEAL_RESET: Complete the healing of the NS resetting to the state original instantiation state of the NS PARTIAL_HEALING
actionsHealing	M	0..N	String	Used to specify dedicated healing actions in a particular order (e.g. as a script). The actionsHealing can be used to provide a specific script whose content and actions might only be possible to be derived during runtime. See note.
healScript	M	0..1	Identifier (Reference to LifeCycleManagementScript)	Reference to a script from the NSD that shall be used to execute dedicated healing actions in a particular order. The healScript, since it refers to a script in the NSD, can be used to execute healing actions which are defined during NS design time. See note.
additionalParameterForNs	M	0..N	KeyValuePair	Allows the OSS/BSS to provide additional parameter(s) to the healing process at the NS level.
NOTE: Either the actionsHealing or healScript attribute shall be present, not both attributes.				

8.3.4.25 HealVnfData information element

8.3.4.25.1 Description

The information element describes the information needed to heal a VNF that is part of an NS. The NFVO shall then invoke the HealVNF operation towards the appropriate VNFM. The specific parameters passed by the NFVO to the VNFM are specified in clause 7.2.10.2 of ETSI GS NFV-IFA 007 [i.5].

8.3.4.25.2 Attributes

The attributes of the HealVnfData information element shall follow the indications provided in table 8.3.4.25.2-1.

Table 8.3.4.25.2-1: Attributes of the HealVnfData information element

Attribute	Qualifier	Cardinality	Content	Description
vnfInstanceId	M	1	Identifier	Identifies the VNF instance, part of the NS, requiring a healing action.
cause	M	0..1	String	Indicates the reason why a healing procedure is required.
additionalParam	M	0..N	KeyValuePair	Additional parameters passed by the OSS/BSS as input to the healing process, specific to the VNF being healed, as declared in the VNFD (see clause 7.1.5.6 in ETSI GS NFV-IFA 011 [2]). EXAMPLE: Input parameters to VNF-specific healing procedures.
healingResource	M	0..N	ENUM	Indicate kinds of the virtual resource to be healed. Values: <ul style="list-style-type: none"> • VL • LINKPORT • STORAGE • VIRTUALCP • COMPUTE • OSCONTAINER Default value is COMPUTE when the VNF is realized by a virtual resource and OSCONTAINER when the VNF is realized by a set of OS containers.

8.3.4.26 AffinityOrAntiAffinityRule information element

8.3.4.26.1 Description

The AffinityOrAntiAffinityRule describes the additional affinity or anti-affinity rule applicable between the VNF instances to be instantiated in the NS instantiation operation request or between the VNF instances to be instantiated in the NS instantiation operation request and the existing VNF instances.

8.3.4.26.2 Attributes

The attributes of the AffinityOrAntiAffinityRule information element shall follow the indications provided in table 8.3.4.26.2-1.

Table 8.3.4.26.2-1: Attributes of the AffinityOrAntiAffinityRule information element

Attribute	Qualifier	Cardinality	Content	Description
descriptorId	M	1..N	Identifier (Reference to VNFD or VnfProfile)	Reference to a VNFD or vnfProfile defined in the NSD. At least one VnfProfile which is used to instantiate VNF for the NS to be instantiated as the subject of the affinity or anti-affinity rule shall be present. When the VNFD or the VnfProfile which is not used to instantiate VNF, it presents all VNF instances of this type as the subjects of the affinity or anti-affinity rule. The VNF instance which the VnfProfile or the VNFD presents is not necessary as a part of the NS to be instantiated.
vnfInstanceId	M	0..N	Identifier (Reference to VNF instance)	Reference to the existing VNF instance as the subject of the affinity or anti-affinity rule. The existing VNF instance is not necessary as a part of the NS to be instantiated.

Attribute	Qualifier	Cardinality	Content	Description
affinityOrAntiAffinity	M	1	Boolean	Specifies whether the rule is an affinity rule (TRUE) or an anti-affinity rule (FALSE).
scope	M	1	Enum	Specifies whether the scope of the rule. VALUES: <ul style="list-style-type: none"> NFVI_NODE NFVI_POP etc.

8.3.4.27 ChangeNsFlavourData information element

8.3.4.27.1 Description

The ChangeNsFlavourData specifies a new DF to be applied to the NS instance.

8.3.4.27.2 Attributes

The attributes of the ChangeNsFlavourData information element shall follow the indications provided in table 8.3.4.27.2-1.

Table 8.3.4.27.2-1: ChangeNsFlavourData operation information element

Attribute	Qualifier	Cardinality	Content	Description
newFlavourId	M	1	Identifier	Identifier of the new NS DF to be applied to this NS instance.
nsInstantiationLevelId	M	0..1	Identifier	Identifier of the NS instantiation level of the DF to be used. If not present, the default NS instantiation level as declared in the NSD shall be used.
deployableModulesInConstituentVnf	M	0..N	DeployableModulesInConstituentVnf	Indicates the selected deployable modules of a VNF instance which is a constituent of the NS instance. If this attribute is not present, the deployable modules that were selected in the VNF instance prior to the NS LCM operation remain valid.

8.3.4.28 ExtManagedVirtualLinkData information element

8.3.4.28.1 Description

This information element provides the information of an externally-managed internal VL to be used as a parameter passed to multiple interfaces.

8.3.4.28.2 Attributes

The ExtManagedVirtualLinkData information element shall follow the indications provided in table 8.3.4.28.2-1.

Table 8.3.4.28.2-1: Attributes of the ExtManagedVirtualLinkData information element

Attribute	Qualifier	Cardinality	Content	Description
extManagedVirtualLinkId	M	1	Identifier	Identifier of this externally-managed internal VL instance. The identifier is assigned by the NFV-MANO entity that manages this VL instance.
vnfVirtualLinkDescId	M	1	Identifier (Reference to VnfVirtualLinkDesc)	Identifier of the VLD in the VNFD for this VL.

Attribute	Qualifier	Cardinality	Content	Description
vimId	CM	0..1	Identifier	Identifier of the VIM that manages this resource. CONDITION: This attribute shall be supported and present if VNF-related resource management in direct mode is applicable.
resourceProviderId	CM	0..1	Identifier	Identifies the entity responsible for the management of the resource. CONDITION: This attribute shall be supported and present when VNF-related Resource Management in indirect mode is applicable.
resourceId	M	1	Identifier	Identifier of the resource in the scope of the VIM or the resource provider.
vnfLinkPort	M	0..N	VnfLinkPortData	Externally provided link ports to be used to connect VNFC connection points to this externally-managed VL on this network resource. If this attribute is not present, the NFVO or the VNFM shall create the link ports on the externally-managed VL.
netAttDefResourceData	M	0..N	NetAttDefResourceData	Externally provided network attachment definition resource(s) that provide the specification of the interface to attach VNFC connection points to this externally-managed VL. If this attribute is not present, the NFVO shall create the network attachment definition resource(s) for the externally-managed VL See notes 1 and 2.
intCp	M	0..N	IntVnfCpData	Internal CPs of the VNF to be connected to this externally-managed VL. See note 1. This attribute may only be present if the "netAttDefResourceData" is also present.
extManagedMultisiteVirtualLinkId	M	0..1	Identifier	Identifier of the externally-managed multi-site VL instance. The identifier is assigned by the NFV-MANO entity that manages the externally managed multi-site VL instance. It shall be present when the present externally-managed internal VL (indicated by extManagedVirtualLinkId) is part of a multi-site VL, e.g. in support of multi-site VNF spanning several VIMs. All externally-managed internal VL instances corresponding to an internal VL created based on the same virtualLinkId shall refer to the same extManagedMultisiteVirtualLinkId.
NOTE 1: It is only applicable if the externally-managed VL is realized by a secondary container cluster network. It shall not be present otherwise.				
NOTE 2: An example of the network attachment definition resource when the container infrastructure service is a Kubernetes® instance is a Network Attachment Definition (NAD).				

8.3.4.29 ChangeExtVnfConnectivityData information element

8.3.4.29.1 Description

The ChangeExtVnfConnectivityData information element specifies the external connectivity to change for the VNF. The types of changes that this operation supports are:

- Disconnect external CPs that are connected to a particular external VL and connect them to a different external VL.
- Disconnect external CPs that are connected to a particular external VL.
- Disconnect and delete external CPs that are connected to a particular external VL and that represent sub-ports of a trunk port, i.e. CP instances that are created from external CPDs that have trunk mode configured according to clause 7.1.6.3 in ETSI GS NFV-IFA 011 [2]. If the parent port is exposed as an extCp, the VNFM shall ensure that the parent port is not deleted. If the parent port is exposed as an extCp and there are other subports connected, the VNFM shall ensure that the parent port is not disconnected.
- Change the connectivity parameters of the existing external CPs, including changing addresses.

NOTE: Depending on the capabilities of the underlying VIM resources, certain changes (e.g. modifying the IP address assignment) might not be supported without deleting the resource and creating another one with the modified configuration.

- Connect CPs to a particular external VL.
- Create new CPs that represent sub-ports of a trunk port, i.e. CP instances that are created from external CPDs that have trunk mode configured according to clause 7.1.6.3 in ETSI GS NFV-IFA 011 [2], and connect them to a particular external VL. Creation of the parent port with this operation is not supported.

8.3.4.29.2 Attributes

The attributes of the ChangeExtVnfConnectivityData information element shall follow the indications provided in table 8.3.4.29.2-1.

Table 8.3.4.29.2-1: Attributes of the ChangeExtVnfConnectivityData information element

Attribute	Qualifier	Cardinality	Content	Description
vnfInstanceId	M	1	Identifier	Identifier of the VNF instance.
extVirtualLink	M	1..N	ExtVirtualLinkData	Information about external VLs to change (e.g. connect the VNF to).
additionalParam	M	0..N	KeyValuePair	Additional parameters passed by the OSS as input to the external connectivity change process, specific to the VNF being changed, as declared in the VNFD (see clause 7.1.5.10 in ETSI GS NFV-IFA 011 [2]).
certificateConfigurationData	M	0..1	CertificateConfigurationData	Configuration for certificate management such as certificate profile and security policy in this VNF. Can be present when setting a new certificate to the VNF instance in delegation mode. Otherwise shall not be present.

8.3.4.30 NfpRule Information element

8.3.4.30.1 Description

The NfpRule information element is an expression of the conditions that shall be met for the NFP to be applicable to the packet. The condition acts as a flow classifier and it is met only if all the values expressed in the condition are matched by those in the packet.

8.3.4.30.2 Attributes

The attributes of the NfpRule information element shall follow the indications provided in table 8.3.4.30.2-1.

Table 8.3.4.30.2-1: Attributes of the NfpRule information element

Attribute	Qualifier	Cardinality	Content	Description
etherType	M	0..1	Enum	Indicates the protocol carried over the Ethernet layer. VALUES: <ul style="list-style-type: none"> • IPV4 • IPV6 See note.
etherDestinationAddress	M	0..1	MacAddress	Indicates a destination Mac address See note.
etherSourceAddress	M	0..1	MacAddress	Indicates a source Mac address See note.
vlanTag	M	0..N	String	Indicates a VLAN identifier in an IEEE 802.1Q-2018 [i.8] tag. Multiple tags can be included for QinQ stacking. See note.
protocol	M	0..1	String	Indicates the L4 protocol, e.g. "TCP", "UDP", etc. See note.
dscp	M	0..1	String	Differentiated Services Code Point (DSCP) value. See note.
sourcePortRange	M	0..1	PortRange	Indicates a range of source ports. See note.
destinationPortRange	M	0..1	PortRange	Indicates a range of destination ports. See note.
sourceIPAddressPrefix	M	0..1	IpAddress	Indicates the source IP address or prefix. See note.
destinationIPAddressPrefix	M	0..1	IpAddress	Indicates the destination IP address or prefix. See note.
extendedCriteria	M	0..N	Not specified	Indicates values of specific bits in a frame. See note.
NOTE: The presence of at least one attribute is required. If multiple attributes are present, a logical "AND" operation shall be applied to those attributes when matching packets against the rule.				

8.3.4.31 PortRange Information element

8.3.4.31.1 Description

The PortRange information element provides the lower and upper bounds of a range of Internet ports.

8.3.4.31.2 Attributes

The attributes of the PortRange information element shall follow the indications provided in table 8.3.4.31.2-1.

Table 8.3.4.31.2-1: Attributes of the PortRange information element

Attribute	Qualifier	Cardinality	Content	Description
lowerPort	M	1	Integer	Identifies the lower bound of the port range.
upperPort	M	1	Integer	Identifies the upper bound of the port range.

8.3.4.32 AddPnfData information element

8.3.4.32.1 Description

This information element provides input information about PNF which needs to be added into an NS instance.

8.3.4.32.2 Attributes

The AddPnfData information element shall follow the indications provided in table 8.3.4.32.2-1.

Table 8.3.4.32.2-1: Attributes of the AddPnfData information element

Attribute	Qualifier	Cardinality	Content	Description
pnfId	M	1	Identifier	Identifier of the PNF. Assigned by OSS and provided to NFVO.
pnfName	M	1	String	Human readable name of the PNF.
pnfDId	M	1	Identifier (Reference to Pnfd)	Identifier of (reference to) the PNFD related to this PNF. If different to the one indicated in the referenced PnfProfile it replaces it when adding the PNF to an NS. The PNFD referenced by this attribute shall have the same pnfExtInvariantId as the one indicated in the PnfProfile. If the PnfProfile does not contain a pnfExtInvariantId this attribute shall be ignored (see note 1).
pnfProfileId	M	1	Identifier (Reference to PnfProfile)	Identifier of (reference to) the PNF Profile to be used for this PNF.
cpData	M	0..N	PnfExtCpData	Information on the external CP of the PNF.
overridingVersionDependency	M	0..N	OverridingVersionDependency	If present, information in each overridingVersionDependency replaces the versionDependency in the VnfProfile, NsProfile or PnfProfile indicated in the OverridingVersionDependency. Only the versionDependency in the VnfProfile, NsProfile or PnfProfile with the same dependentConstituentId as in the overridingVersionDependency is replaced. See note 2. If no versionDependency with the dependentConstituentId indicated in the overridingVersionDependency exist in the VnfProfile, NsProfile or PnfProfile, the new versionDependency is added to the runtime information that the NFVO keeps about the profile.
NOTE 1: This attribute allows the use of a PNFD different from the one specified in the NSD when adding the PNF to the NS, provided they have the same pnfExtInvariantId.				
NOTE 2: A VnfProfile, NsProfile or PnfProfile may contain multiple VersionDependencies as it may describe the version dependencies of the descriptor referenced in the profile or of other descriptors with the same external invariant identifier.				

8.3.4.33 ModifyPnfData information element

8.3.4.33.1 Description

This information element provides input information about PNFs which need to be modified in an NS instance.

8.3.4.33.2 Attributes

The ModifyPnfData information element shall follow the indications provided in table 8.3.4.33.2-1.

Table 8.3.4.33.2-1: Attributes of the ModifyPnfData information element

Attribute	Qualifier	Cardinality	Content	Description
pnfld	M	1	Identifier	Identifier of the PNF. Assigned by OSS and provided to NFVO.
pnfName	M	0..1	String	Human readable name of the PNF. See note.
cpData	M	0..N	PnfExtCpData	Information on the external CP of the PNF. See note.

NOTE: At least one of the attributes shall be provided.

8.3.4.34 PnfExtCpData information element

8.3.4.34.1 Description

This information element provides input information about the external CP of the PNF.

8.3.4.34.2 Attributes

The attributes of the PnfExtCpData information element shall follow the indications provided in table 8.3.4.34.2-1.

Table 8.3.4.34.2-1: Attributes of the PnfExtCpData information element

Attribute	Qualifier	Cardinality	Content	Description
cpInstanceId	M	0..1	Identifier	Identifier of this external CP instance. Shall be present for existing CP.
cpId	M	0..1	Identifier (Reference to Cpd)	Identifier of (reference to) the Connection Point Descriptor (CPD) for this CP. Shall be present for new CP.
address	M	1..N	Not specified	Address for this CP, including the information on applicable layer protocol(s). See note.

NOTE: The address information shall be compatible with the layerProtocol values defined in the CPD. In case of an IP address, a port number may be included.

8.3.4.35 ExtLinkPortData information element

8.3.4.35.1 Description

This information element represents an externally provided link port to be used to connect an external connection point to an external VL.

8.3.4.35.2 Attributes

The ExtLinkPortData information element shall follow the indications provided in table 8.3.4.35.2-1.

Table 8.3.4.35.2-1: Attributes of the ExtLinkPortData information element

Attribute	Qualifier	Cardinality	Content	Description
extLinkPortId	M	1	Identifier	Identifier of this link port as provided by the entity that has created the link port.
resourceHandle	M	1	ResourceHandle	Resource handle of the virtualised resource that realizes the external link port.

8.3.4.36 VnfExtCpConfig information element

8.3.4.36.1 Description

This information element represents an externally provided link port, or a network attachment definition resource of secondary container cluster network, or network address information per instance of a VNF external connection point.

In the case of VM-based deployment of the VNFC exposing the external CP:

- In case a link port is provided, the NFVO shall use that link port when connecting the VNF external CP to the external VL.
- In case no link port is provided, the NFVO or VNFM shall create a link port on the external VL, and use that link port to connect the VNF external CP to the external VL.

In the case of container-based deployment of the VNFC exposing the external CP, the NFVO and VNFM shall use the network attachment definition resource of secondary container cluster network when connecting the CP to the external VL.

8.3.4.36.2 Attributes

The VnfExtCpConfig information element shall follow the indications provided in table 8.3.4.36.2-1.

Table 8.3.4.36.2-1: Attributes of the VnfExtCpConfig information element

Attribute	Qualifier	Cardinality	Content	Description
cpInstanceid	M	0..1	Identifier	Identifier of the external CP instance to which this set of configuration parameters is requested to be applied. Shall be present if this instance has already been created.
linkPortId	M	0..1	Identifier (Reference to ExtLinkPortData)	Identifier of a pre-configured link port to which the external CP will be associated. See notes 1 and 4.
cpProtocolData	M	0..N	Not specified	Parameters for configuring fixed and dynamic network addresses for the CP, including the information on applicable layer protocol(s). For dynamic addresses, it should be possible to define per parameter set the number of network addresses to be assigned dynamically. Other parameters could be e.g. valid address ranges or subnets, domain name information, etc. See notes 1 and 2.
netAttDefResourceid	M	0..N	Identifier (Reference to NetAttDefResourceData)	Identifiers of network attachment definition resources that provide the specification of the interface to attach the external CP to a secondary container cluster network. It is only applicable if the external CP is connected or to be connected to a secondary container cluster network. It shall not be present if the external CP is related to a virtual network not categorized as secondary container cluster network. See notes 2, 3 and 4.

Attribute	Qualifier	Cardinality	Content	Description
NOTE 1: The following conditions apply to the attributes "linkPortId" and "cpProtocolData" for an external CP instance connected or to be connected to a virtual network not categorized as secondary container cluster network: 1) The "linkPortId" and "cpProtocolData" attributes shall both be absent for the deletion of an existing external CP instance addressed by cpInstanceld. 2) At least one of these attributes shall be present for a to-be-created external CP instance or an existing external CP instance.				
NOTE 2: The following conditions apply to the attributes "netAttDefResourceId" and "cpProtocolData" for an external CP instance connected or to be connected to a secondary container cluster network: 1) The "netAttDefResourceId" and "cpProtocolData" attributes shall both be absent for the deletion of an existing external CP instance addressed by cpInstanceld. 2) At least one of these attributes shall be present for a to-be-created external CP instance or an existing external CP instance.				
NOTE 3: Cardinality greater than 1 is only applicable for specific cases where more than one network attachment definition resource is needed to fulfil the connectivity requirements of the external CP, e.g. to build a link redundant mated pair in SR-IOV cases. When more than one netAttDefResourceId is indicated, all shall belong to the same namespace as defined by the corresponding "containerNamespace" attribute in the "resourceHandle" attribute in the "NetAttDefResourceData".				
NOTE 4: Either linkPortId or netAttDefResourceId may be included, but not both.				

8.3.4.37 NestedNsInstanceData information element

8.3.4.37.1 Description

The NestedNsInstanceData specifies an existing nested NS instance to be used in the NS instance and if needed, the NsProfile to use for this nested NS instance.

8.3.4.37.2 Attributes

The attributes of the NestedNsInstanceData information element shall follow the indications provided in table 8.3.4.37.2-1.

Table 8.3.4.37.2-1: Attributes of the NestedNsInstanceData information element

Attribute	Qualifier	Cardinality	Content	Description
nestedNsInstanceld	M	1	Identifier (Reference to NsInfo)	Identifier of the existing nested NS instance to be used in the NS.
nsProfileId	M	0..1	Identifier (Reference to NsProfile)	Identifier of an NsProfile defined in the NSD which the existing nested NS instance shall be matched with. If not present, the NFVO will select the NsProfile matching the information in the nested NS instance. See note 1.
overridingNsId	M	0..1	Identifier (Reference to an Nsd)	It replaces the nsId indicated in the nsProfileId. The NSD referenced by this attribute shall have the same nsdExtInvariantId as the one indicated in the NsProfile. If the NsProfile does not contain an nsdExtInvariantId this attribute shall be ignored. If the NSD of the existing NS instance referenced by nestedNsInstanceld does not match the NSD indicated by this attribute the NS instance shall not be added as nested NS to the composite NS instance. See notes 1, 2 and 4.

Attribute	Qualifier	Cardinality	Content	Description
overridingVersionDependency	M	0..N	OverridingVersionDependency	<p>If present, information in each overridingVersionDependency replaces the versionDependency in the VnfProfile, NsProfile or PnfProfile indicated in the OverridingVersionDependency.</p> <p>Only the versionDependency in the VnfProfile, NsProfile or PnfProfile with the same dependentConstituentId as in the overridingVersionDependency is replaced. See note 3.</p> <p>If no versionDependency with the dependentConstituentId indicated in the overridingVersionDependency exist in the VnfProfile, NsProfile or PnfProfile, the new versionDependency is added to the runtime information that the NFVO keeps about the profile.</p> <p>See note 4.</p>
<p>NOTE 1: If the overridingNsId attribute is present the nsProfileId attribute shall also be present.</p> <p>NOTE 2: This attribute allows to use as nested NS an existing NS instance based on a different NSD to the one specified in the composite NSD with nsProfileId, provided they have the same nsdExtInvariantId.</p> <p>NOTE 3: A VnfProfile, NsProfile or PnfProfile may contain multiple VersionDependencies as it may describe the version dependencies of the descriptor referenced in the profile or of other descriptors with the same external invariant identifier.</p> <p>NOTE 4: The overridingVersionDependency attribute may only be present if the overridingNsId attribute is present.</p>				

8.3.4.38 ParamsForNestedNs information element

8.3.4.38.1 Description

The ParamsForNestedNs specifies additional parameters on a per nested NS instance basis.

8.3.4.38.2 Attributes

The attributes of the ParamsForNestedNs information element shall follow the indications provided in table 8.3.4.38.2-1.

Table 8.3.4.38.2-1: Attributes of the ParamsForNestedNs information element

Attribute	Qualifier	Cardinality	Content	Description
nsProfileId	M	1	Identifier (Reference to NsProfile)	Identifier of an NsProfile to which the additional parameters apply.
additionalParam	M	0..N	KeyValuePair	Additional parameters that are to be applied per nested NS instance.
overridingNsdId	M	0..1	Identifier (Reference to an NSD)	If present it replaces the nsdId indicated in the referenced NsProfile at the instantiation of the nested NS. The NSD referenced by this attribute shall have the same nsdExtInvariantId as the one indicated in the NsProfile. If the NsProfile does not contain an nsdExtInvariantId this attribute shall be ignored. See notes 1 and 3.
overridingVersionDependency	M	0..N	OverridingVersionDependency	If present, information in each overridingVersionDependency replaces the versionDependency in the VnfProfile, NsProfile or PnfProfile indicated in the OverridingVersionDependency. Only the versionDependency in the VnfProfile, NsProfile or PnfProfile with the same dependentConstituentId as in the overridingVersionDependency is replaced. See note 2. If no versionDependency with the dependentConstituentId indicated in the overridingVersionDependency exist in the VnfProfile, NsProfile or PnfProfile, the new versionDependency is added to the runtime information that the NFVO keeps about the profile. See note 3.
deployableModuleInConstituentVnf	M	0..N	DeployableModulesInConstituentVnf	Indicates the selected deployable modules of a VNF instance which is a constituent of the NS instance.
NOTE 1: This attribute allows for a nested NS at instantiation of the composite NS the use of an NSD different from the one specified in the NSD of the composite NS with nsProfileId, provided they have the same nsdExtInvariantId.				
NOTE 2: A VnfProfile, NsProfile or PnfProfile may contain multiple VersionDependencies as it may describe the version dependencies of the descriptor referenced in the profile or of other descriptors with the same external invariant identifier.				
NOTE 3: The overridingVersionDependency attribute may only be present if the overridingNsdid attribute is present.				

8.3.4.39 RevertToSnapshotData information element

8.3.4.39.1 Description

The RevertToSnapshotData specifies an existing VNF instance of the NS instance to be reverted and the identifier of an existing VNF Snapshot to be reverted to.

8.3.4.39.2 Attributes

The attributes of the RevertToSnapshotData information element shall follow the indications provided in table 8.3.4.39.2-1.

Table 8.3.4.39.2-1: Attributes of the RevertToSnapshotData information element

Attribute	Qualifier	Cardinality	Content	Description
vnfInstanceId	M	1	Identifier	Identifier of the VNF instance to be reverted.
vnfSnapshotInfoId	M	1	Identifier	Identifier of information held by the VNFM about the VNF Snapshot to be reverted to. This identifier was allocated by the VNFM.
additionalParam	M	0..N	KeyValuePair	Additional parameters passed by the OSS as input for the revert to VNF snapshot process, specific for the VNF being "reverted", as declared in the VNFD (see clause 7.1.5.12 in ETSI GS NFV-IFA 011 [2]).

8.3.4.39a CreateSnapshotData information element

8.3.4.39a.1 Description

The CreateSnapshotData specifies an existing VNF instance of the NS instance to be snapshotted.

8.3.4.39a.2 Attributes

The attributes of the CreateSnapshotData information element shall follow the indications provided in table 8.3.4.39a.2-1.

Table 8.3.4.39a.2-1: Attributes of the CreateSnapshotData information element

Attribute	Qualifier	Cardinality	Content	Description
vnfInstanceId	M	1	Identifier	Identifier of the VNF instance to perform the snapshot from.
additionalParam	M	0..N	KeyValuePair	Additional parameters passed by the OSS as input for the VNF snapshot creation process, specific for the VNF being "snapshotted", as declared in the VNFD (see clause 7.1.5.11 in ETSI GS NFV-IFA 011 [2]).
userDefinedData	O	0..N	KeyValuePair	User defined data for the VNF snapshot.

8.3.4.40 DeleteSnapshotData information element

8.3.4.40.1 Description

The DeleteSnapshotData specifies the identifier of information of an available VNF Snapshot to be deleted and the identifier of the related VNF instance of the NS instance.

8.3.4.40.2 Attributes

The attributes of the DeleteSnapshotData information element shall follow the indications provided in table 8.3.4.40.2-1.

Table 8.3.4.40.2-1: Attributes of the DeleteSnapshotData information element

Attribute	Qualifier	Cardinality	Content	Description
vnfSnapshotInfoId	M	1	Identifier	Identifier of information held by the VNFM about the VNF Snapshot to be deleted. This identifier was allocated by the VNFM.
vnfInstanceId	M	1	Identifier	Identifier of the VNF instance to identify the VNFM holding the VNF Snapshot information to be deleted.

8.3.4.41 PnfProfileData information element

8.3.4.41.1 Description

The PnfProfileData information element specifies the information needed to associate a PNF with the PnfProfile. The types of association may include:

- Associate the PNF with a new PnfProfile that has been added to the NSD. If the PNF is currently associated with an existing PnfProfile, it should dissociate with such PnfProfile prior to association with the new PnfProfile.
- Associate the PNF with the PnfProfile that has been updated.

In the present document version, the type of changes permitted in the PnfProfile which allow the re-association of the PNF to the new PnfProfile are:

- To support the changes of connectivity of the PNF, i.e. changes in the pnfVirtualLinkConnectivity (refer to ETSI GS NFV-IFA 014 [3], clause 6.3.6).

The association may result in adding or changing connectivity for the PNF instance.

8.3.4.41.2 Attributes

The attributes of the PnfProfileData information element shall follow the indications provided in table 8.3.4.41.2-1.

Table 8.3.4.41.2-1: Attributes of the PnfProfileData information element

Attribute	Qualifier	Cardinality	Content	Description
pnfld	M	1	Identifier	Identifier of the PNF.
pnfProfileId	M	1	Identifier (Reference to PnfProfile)	Identifier of (Reference to) a PnfProfile. The PnfProfile can be an update of the existing PNF profile or a new PNF profile, which the PNF shall be associated with. See note.

NOTE: The PnfProfile may contain the new or changed NsVirtualLinkConnectivity for the PNF.

8.3.4.42 VnfProfileData information element

8.3.4.42.1 Description

The VnfProfileData information element specifies the information needed to associate a VNF instance with the VnfProfile. The types of association may include:

- Associate the VNF instance with a new VnfProfile that has been added to the NSD. If the VNF instance is currently associated with an existing VnfProfile, it should dissociate with such VnfProfile prior to association with the new VnfProfile.
- Associate the VNF instance with the VnfProfile that has been updated.

In the present document version, the type of changes permitted in the VnfProfile which allow the re-association of the VNF to the new VnfProfile are:

- To support the changes of connectivity of the VNF, i.e. changes in the nsVirtualLinkConnectivity (refer to ETSI GS NFV-IFA 014 [3], clause 6.3.3).

8.3.4.42.2 Attributes

The attributes of the VnfProfileData information element shall follow the indications provided in table 8.3.4.42.2-1.

Table 8.3.4.42.2-1: Attributes of the VnfProfileData information element

Attribute	Qualifier	Cardinality	Content	Description
vnfInstancelid	M	1	Identifier	Identifier of the VNF instance.
vnfProfileid	M	1	Identifier (Reference to VnfProfile)	Identifier of (Reference to) a VnfProfile. The VnfProfile can be an update of the existing VNF profile or a new VNF profile, which the VNF instance shall be associated with. See note.

NOTE: The VnfProfile may contain the new or changed NsVirtualLinkConnectivity for the VNF.

8.3.4.43 WanConnectionData information element

8.3.4.43.1 Description

This information element provides the needed information required to connect to the WAN the comprising network resources realizing a VL, e.g. when the VL is deployed on several sites across a WAN.

8.3.4.43.2 Attributes

The WanConnectionData information element shall follow the indications provided in table 8.3.4.43.2-1.

Table 8.3.4.43.2-1: Attributes of the WanConnectionData information element

Attribute	Qualifier	Cardinality	Content	Description
virtualLinkDescId	M	1	Identifier (Reference to NsVirtualLinkDesc or VnfVirtualLinkDesc)	Identifier of the VLD in the NSD or the VNFD for this VL, for which the connection data is provided.
protocolData	M	0..1	Not specified	Protocol specific information for connecting to the WAN the virtualised networks in the NFVI-PoP managed by the VIM.

8.3.4.44 VnfLinkPortData information element

8.3.4.44.1 Description

This information element represents an externally provided link port to be used to connect a VNFC connection point to an externally-managed VL.

8.3.4.44.2 Attributes

The VnfLinkPortData information element shall follow the indications provided in table 8.3.4.44.2-1.

Table 8.3.4.44.2-1: Attributes of the VnfLinkPortData information element

Attribute	Qualifier	Cardinality	Content	Description
vnfLinkPortId	M	1	Identifier	Identifier of this link port as provided by the entity that has created the link port.
resourceHandle	M	1	ResourceHandle	Resource handle of the virtualised resource that realizes the link port.

8.3.4.45 ChangeVnfPackageData information element

8.3.4.45.1 Description

The ChangeVnfPackageData information element specifies the information needed to change the current VNF package for a VNF instance.

8.3.4.45.2 Attributes

The attributes of the ChangeVnfPackageData information element shall follow the indications provided in table 8.3.4.45.2-1.

Table 8.3.4.45.2-1: Attributes of the ChangeVnfPackageData information element

Attribute	Qualifier	Cardinality	Content	Description
vnfInstanceId	M	1	Identifier	Identifier of the VNF instance for which the current VNF package is requested to be changed.
vnfdId	M	1	Identifier (Reference to Vnfd)	Identifier of the VNFD which defines the destination VNF Package for the change.
extVirtualLink	M	0..N	ExtVirtualLinkData	Information about external VLs to connect the VNF to.
extManagedVirtualLink	M	0..N	ExtManagedVirtualLinkData	Information about internal VLs that are managed by other entities than the VNFM. See notes 1 and 2.
additionalParam	M	0..N	KeyValuePair	Additional parameters passed by the OSS/BSS as input to the modification process, specific to the VNF, whose VNF Package is requested to be changed, as declared in the VNFD (see clause 7.1.5.13 in ETSI GS NFV-IFA 011 [2]).
extension	M	0..N	KeyValuePair	This parameter provides values for the "extension" input parameter of the Change Current VNF Package operation.
vnfConfigurableProperties	M	0..N	KeyValuePair	This parameter provides values for the "vnfConfigurableProperties" input parameter of the Change Current VNF Package operation.
certificateConfigurationData	M	0..1	CertificateConfigurationData	Configuration for certificate management such as certificate profile and security policy in this VNF. Can be present when setting a new certificate to the VNF instance in delegation mode. Otherwise shall not be present.

Attribute	Qualifier	Cardinality	Content	Description
overridingVersionDependency	M	0..N	OverridingVersionDependency	<p>If present, information in each overridingVersionDependency replaces the versionDependency in the VnfProfile, NsProfile or PnfProfile indicated in the OverridingVersionDependency.</p> <p>Only the versionDependency in the VnfProfile, NsProfile or PnfProfile with the same dependentConstituentId as in the overridingVersionDependency is replaced. See note 3.</p> <p>If no versionDependency with the dependentConstituentId indicated in the overridingVersionDependency exist in the VnfProfile, NsProfile or PnfProfile, the new versionDependency is added to the runtime information that the NFVO keeps about the profile.</p>
selectedDeployableModule	M	0..N	Identifier (Reference to DeployableModule)	<p>References a selected deployable module, as defined in the VNFD.</p> <p>If this attribute is present only VNFCs based on VDUs that belong to deployable modules listed in this attribute are requested to be instantiated or preserved if they were already instantiated.</p> <p>If this attribute is not present the deployable modules that were selected before the operation, and that still are defined in the VNFD in the destination package, or the corresponding ones according to the component mappings, remain valid. See note 4.</p>
upgradeType	M	0..1	Enum	<p>Indicate upgrade type when change the current VNF Package on which a VNF instance is based. Values:</p> <ul style="list-style-type: none"> • ROLLING_UPGRADE • BLUE_GREEN • etc
<p>NOTE 1: The indication of externally-managed internal VLs is needed in case networks have been pre-configured for use with certain VNFs, for instance to ensure that these networks have certain properties such as security or acceleration features, or to address particular network topologies. The present document assumes that externally-managed internal VLs are managed by the NFVO and created towards the VIM as supported by the virtualised network resource management interface specified in ETSI GS NFV-IFA 005 [i.4].</p> <p>NOTE 2: It is possible to have several ExtManagedVirtualLinkData for the same VNF internal VL in case of a multi-site VNF spanning several VIMs. The set of ExtManagedVirtualLinkData corresponding to the same VNF internal VL shall indicate so by referencing to the same VnfVirtualLinkDesc and externally-managed multi-site VL instance (refer to clause 8.3.4.28).</p> <p>NOTE 3: A VnfProfile, NsProfile or PnfProfile may contain multiple VersionDependencies as it may describe the version dependencies of the descriptor referenced in the profile or of other descriptors with the same external invariant identifier.</p> <p>NOTE 4: Component mappings are defined in the VNFD in the source or destination package for the relevant change path. See clause 7.1.15.2 in ETSI GS NFV-IFA 011 [2].</p>				

8.3.4.46 ModifyWanConnectionInfoData information element

8.3.4.46.1 Description

This information element provides information requested to be modified about WAN related connectivity information.

8.3.4.46.2 Attributes

The ModifyWanConnectionInfoData information element shall follow the indications provided in table 8.3.4.46.2-1.

Table 8.3.4.46.2-1: Attributes of the ModifyWanConnectionInfoData information element

Attribute	Qualifier	Cardinality	Content	Description
wanConnectionInfoId	M	1	Identifier (Reference to WanConnectionInfo)	References the WAN connection information to be modified.
newProtocolData	M	0..1	Not specified	New protocol specific information to be modified in the referred WAN connection information.

8.3.4.47 NestedNsLocationConstraint information element

8.3.4.47.1 Description

The NestedNsLocationConstraint information element defines the location constraints for the nested NS to be instantiated.

8.3.4.47.2 Attributes

The attributes of the NestedNsLocationConstraint information element shall follow the indications provided in table 8.3.4.47.2-1.

Table 8.3.4.47.2-1: Attributes of the NestedNsLocationConstraint information element

Attribute	Qualifier	Cardinality	Content	Description
nsProfileId	M	1	Identifier (Reference to NsProfile)	Identifier (reference to) of an NsProfile in the NSD used to manage the lifecycle of the nested NS instance.
locationConstraints	M	1	Not specified	Defines the location constraints for the nested NS instance to be created.

8.3.4.48 TerminateNsData information element

8.3.4.48.1 Description

This information element describes the information needed to terminate NS instance.

8.3.4.48.2 Attributes

The attributes of the TerminateNsData information element shall follow the indications provided in table 8.3.4.48.2-1.

Table 8.3.4.48.2-1: Attributes of the TerminateNsData information element

Attribute	Qualifier	Cardinality	Content	Description
additionalParamForNs	M	0..N	KeyValuePair	Additional parameter(s) passed by the OSS/BSS to the termination process at the NS level.

8.3.4.49 TerminateVnfData information element

8.3.4.49.1 Description

The information element describes the information needed to terminate a VNF instance that is part of an NS. The specific parameters passed by the NFVO to the VNFM are specified in clause 7.2.7.2 of ETSI GS NFV-IFA 007 [i.5].

8.3.4.49.2 Attributes

The attributes of the TerminateVnfData information element shall follow the indications provided in table 8.3.4.49.2-1.

Table 8.3.4.49.2-1: Attributes of the TerminateVnfData information element

Attribute	Qualifier	Cardinality	Content	Description
vnfInstanceId	M	1	Identifier	Identifies the VNF instance, part of the NS, to be terminated.
terminationType	M	0..1	Enum	Indicates the type of termination that is requested. VALUES: <ul style="list-style-type: none"> • FORCEFUL • GRACEFUL
gracefulTerminationTimeout	M	0..1	TimeDuration	The time interval to wait for the VNF to be taken out of service during graceful termination, before shutting down the VNF and releasing the resources.
additionalParam	M	0..N	KeyValuePair	Additional parameters passed by the OSS/BSS as input to the termination process, specific to the VNF being terminated. EXAMPLE: Input parameters to VNF-specific termination procedures.

8.3.4.50 OverridingVersionDependency information element

8.3.4.50.1 Description

The OverridingVersionDependency information element defines information to override or add a version dependency in the runtime information that the NFVO keeps about a profile of a NSD constituent.

8.3.4.50.2 Attributes

The attributes of the OverridingVersionDependency information element shall follow the indications provided in table 8.3.4.50.2-1.

Table 8.3.4.50.2-1: Attributes of the OverridingVersionDependency information element

Attribute	Qualifier	Cardinality	Content	Description
profileId	M	1	Identifier (Reference to a vnfProfileId, nsProfileId or pnfProfileId)	Reference to a profileId where the versionDependency overrides an existing versionDependency or is added to the existing version dependencies. See note.
versionDependency	M	1	VersionDependency	Describes version dependencies for a specific NSD constituent.
NOTE:	If the referenced profile contains a versionDependency with a dependentConstituent equal to the one indicated in the versionDependency attribute of this information element, the versionDependency in this information element overrides the one in the profile, otherwise it is added to the version dependencies in the profile.			

8.3.4.51 VersionDependency information element

8.3.4.51.1 Description

The VersionDependency information element describes all dependencies that an NSD constituent has on the versions of other NSD constituents.

8.3.4.51.2 Attributes

The attributes of the VersionDependency information element shall follow the indications provided in table 8.3.4.51.2-1.

Table 8.3.4.51.2-1: Attributes of the VersionDependency information element

Attribute	Qualifier	Cardinality	Content	Description
dependentConstituentId	M	1	Identifier (Reference to VNFD, NSD or PNFD)	Identifier of the NSD constituent which has version dependencies on other NSD constituents.
versionDependencyStatement	M	0..N	VersionDependencyStatement	Identifies one or multiple versions of an NSD constituents upon which the dependent constituent identified by dependentConstituentId has a dependency. Cardinality 0 is used to remove an existing version dependency in a profile.

8.3.4.52 VersionDependencyStatement information element

8.3.4.52.1 Description

The VersionDependencyStatement specifies one or more VNF, NS or PNF descriptor identifiers which describe one single dependency. When more than one descriptor is indicated, they correspond to different versions of the same VNF, NS or PNF and they represent alternatives to fulfil the dependency.

8.3.4.52.2 Attributes

The attributes of the VersionDependencyStatement information element shall follow the indications provided in table 8.3.4.52.2-1.

Table 8.3.4.52.2-1: Attributes of the VersionDependencyStatement information element

Attribute	Qualifier	Cardinality	Content	Description
descriptorId	M	1..N	Identifier (Reference to VNFD or NSD or PNFD)	Identifies a VNFD, NSD or PNFD upon which the entity using this information element depends. When more than one descriptor is indicated, they shall correspond to versions of the same VNF, NS or PNF and they represent alternatives, i.e. the presence of one of them fulfils the dependency.

8.3.4.53 NetAttDefResourceData information element

8.3.4.53.1 Description

This information element represents a network attachment definition resource that provides the specification of the interface to be used to connect one or multiple connection points to a secondary container cluster network realizing a VL.

8.3.4.53.2 Attributes

The NetAttDefResourceData information element shall follow the indications provided in table 8.3.4.53.2-1.

Table 8.3.4.53.2-1: Attributes of the NetAttDefResourceData information element

Attribute	Qualifier	Cardinality	Content	Description
netAttDefResourceId	M	1	Identifier	Identifier of this network attachment definition resource as provided by the entity that has created it.
resourceHandle	M	1	ResourceHandle	Resource handle of the resource identifying the network attachment definition resource that provides the specification of the interface to attach the connection points to a secondary container cluster network.

8.3.4.54 IntVnfCpData information element

8.3.4.54.1 Description

This information element provides input information related to one or more VNF internal CP instances created based on the same CPD.

8.3.4.54.2 Attributes

The IntVnfCpData information element shall follow the indications provided in table 8.3.4.54.2-1.

Table 8.3.4.54.2-1: Attributes of the IntVnfCpData information element

Attribute	Qualifier	Cardinality	Content	Description
cpdId	M	1	Identifier	Identifier of the CPD in the VNFD.
netAttDefResourceId	M	1..N	Identifier (Reference to NetAttDefResourceData)	Identifiers of network attachment definition resources that provide the specification of the interface to attach the VNF internal CP created from the CPD identified by cpdId to a secondary container cluster network. See note.
NOTE: Cardinality greater than 1 is only applicable for specific cases where more than one network attachment definition resource is needed to fulfil the connectivity requirements of the VNF internal CP, e.g. to build a link redundant mated pair in SR-IOV cases. When more than one netAttDefResourceId is indicated, all shall belong to the same namespace as defined by the corresponding "containerNamespace" attribute in the "resourceHandle" attribute in the "NetAttDefResourceData".				

8.3.4.55 DeployableModulesInConstituentVnf information element

8.3.4.55.1 Description

The DeployableModulesInConstituentVnf information element indicates the selected deployable modules of a VNF instance.

8.3.4.55.2 Attributes

The attributes of the DeployableModulesInConstituentVnf information element shall follow the indications provided in table 8.3.4.55.2-1.

Table 8.3.4.55.2-1: Attributes of the DeployableModulesInConstituentVnf information element

Attribute	Qualifier	Cardinality	Content	Description
profileId	M	1	Identifier (Reference to a vnfProfile)	Indicates a profileId of a VNF instance where the selection of the deployable modules applies.
selectedDeployableModule	M	1..N	Identifier (Reference to DeployableModule)	References a selected deployable module, as defined in the VNFD, for the VNF instances created from the VNF profile indicated in profileId attribute.

8.3.4.56 SelectVnfDeployableModuleData information element

8.3.4.56.1 Description

The SelectVnfDeployableModuleData information element indicates the selected deployable modules of an existing VNF instance. It is used to select deployable modules of a VNF instance that were previously not selected or to unselect deployable modules of a VNF instance that were previously selected. The target size expressed as a list of scale levels only refers to VNFCs that are instantiated as a result of this operation. The NFVO shall then invoke the SelectVnfDeployableModules operation towards the appropriate VNFM. The specific parameters passed by the NFVO to the VNFM are specified in clause 7.2.25.2 of ETSI GS NFV-IFA 007 [i.5].

8.3.4.56.2 Attributes

The attributes of the SelectVnfDeployableModuleData information element shall follow the indications provided in table 8.3.4.56.2-1.

Table 8.3.4.56.2-1: Attributes of the SelectVnfDeployableModuleData information element

Attribute	Qualifier	Cardinality	Content	Description
vnfInstanceId	M	1	Identifier	Identifier of the VNF instance.
selectedDeployableModule	M	0..N	Identifier (Reference to DeployableModule)	References a selected deployable module, as defined in the VNFD, for the VNF instance. VNFCs based on VDUs that belong to deployable modules listed in this attribute will be instantiated if not already instantiated. VNFCs based on VDUs that belong to deployable modules not listed in this attribute and that were already instantiated will be terminated.
targetScaleLevelInfo	M	0..N	VnfScaleInfo	<p>For each scaling aspect, it defines the target scale level to which the VNF is to be scaled.</p> <p>If this attribute is not present or if there are VDUs that belong to selected deployable modules that take no part in any of the scaling aspects indicated in this attribute, the VNFCs based on those VDUs shall be instantiated according to the currently valid VNF scale level or instantiation level.</p> <p>This attribute should only contain scale level information of scaling aspects associated to VDUs that will be used to instantiate VNFCs as a result of this operation. If it contains other scale level information it shall be ignored.</p> <p>The VNF Provider defines in the VNFD whether or not a particular VNF supports scaling according to this parameter. Such a property in the VNFD applies for all instances of a particular VNF.</p>
additionalParam	M	0..N	KeyValuePair	Additional parameters passed by the OSS/BSS as input to the Select VNF deployable modules operation, specific to the VNF being affected by the operation, as declared in the VNFD (see clause 7.1.5.14 in ETSI GS NFV-IFA 011 [2]).

8.3.4.57 VnfConstituentLocationConstraint information element

8.3.4.57.1 Description

The VnfConstituentLocationConstraint information element defines the location constraints for the constituent of a VNF to be instantiated, by referencing a constituent of a VNF (in the form of a vduProfile) and providing specific location constraints for its instantiation.

8.3.4.57.2 Attributes

The attributes of the VnfConstituentLocationConstraint information element shall follow the indications provided in table 8.3.4.57.2-1.

Table 8.3.4.57.2-1: Attributes of the VnfConstituentLocationConstraint information element

Attribute	Qualifier	Cardinality	Content	Description
vduProfileId	M	1	Identifier (Reference to VduProfile)	Identifier (reference to) of a VduProfile in the VNFD used to manage the lifecycle of the VNF instance.
locationConstraints	M	1	Not specified	Defines the location constraints for the VNF constituent to be created.

8.3.4.58 CertificateConfigurationData information element

8.3.4.58.1 Description

This information element provides input information related to certificate management.

8.3.4.58.2 Attributes

The CertificateConfigurationData information element shall follow the indications provided in table 8.3.4.58.2-1.

Table 8.3.4.58.2-1: Attributes of the CertificateConfigurationData information element

Attribute	Qualifier	Cardinality	Content	Description
overridingCertificateProfile	M	0..N	CertificateBaseProfile	Overriding certificate profile. This overrides the certificateBaseProfile provided in the VNFD, and the CA and CMF can additionally override aspects of this certificateBaseProfile at later point in the VNF lifecycle if necessary to meet operator security policy.
securityPolicy	M	1..N	SecurityPolicy	Security policy to be satisfied for certificate.
cmfData	M	0..1	CmfData	Information for CMF.

8.3.4.59 SecurityPolicy information element

8.3.4.59.1 Description

This information element provides input information related to security policy for certificate management.

8.3.4.59.2 Attributes

The SecurityPolicy information element shall follow the indications provided in table 8.3.4.59.2-1.

Table 8.3.4.59.2-1: Attributes of the SecurityPolicy information element

Attribute	Qualifier	Cardinality	Content	Description
id	M	1	Identifier	The identifier of this security policy.
maxValidityPeriod	M	0..1	Number	Allowed max validity period for certificates.
allowedAlgorithm	M	0..1	String	Allowed signature algorithm.
minimumKeyLength	M	0..1	Number	Minimum key length for certificates.

8.3.4.60 CertificateBaseProfile information element

8.3.4.60.1 Description

This information element provides input information to override certificate base profile for certificate management.

8.3.4.60.2 Attributes

The CertificateBaseProfile information element shall follow the indications provided in table 8.3.4.60.2-1.

Table 8.3.4.60.2-1: Attributes of the CertificateBaseProfile information element

Attribute	Qualifier	Cardinality	Content	Description
Id	M	1	Identifier	The identifier of this certificate profile.
issuer	M	0..1	String	Issuer of certificates. See note.
issuerUniqueIdentifier	M	0..1	Identifier	Identifier of this issuer of certificates. See note.
Subject	M	0..1	CertSubjectData	Subject of certificates. See note.
subjectUniqueIdentifier	M	0..1	Identifier	Identifier of this subject of certificates. See note.
basicConstraints	M	0..1	String	Basic constraints of certificates. See note.
issuerAltName	M	0..N	String	Alternative issuer of certificates in this NS. See note.
subjectAltName	M	0..N	String	Alternative subject of certificates. Shall be present when this certificate is used for encrypted communication using IP address and subjectAltName attribute of CertificateBaseProfile in CertificateDesc of VNFD is empty (see ETSI GS NFV-IFA 011 [2], clause 7.1.19.2). See note.
nameConstraints	M	0..N	Not specified	Name constraints of certificates. See note.

NOTE: At least one overriding attributes shall be present, otherwise shall be absent.

8.3.4.61 CmfdData information element

8.3.4.61.1 Description

This information element provides input information related to CMF for certificate management.

8.3.4.61.2 Attributes

The CmfdData information element shall follow the indications provided in table 8.3.4.61.2-1.

Table 8.3.4.61.2-1: Attributes of the CmfdData information element

Attribute	Qualifier	Cardinality	Content	Description
endPoint	M	1	Not specified	End point of CMF instance.
supportedProtocol	M	1..N	Not specified	Supported protocol by CMF instance.

8.3.4.62 CertSubjectData information element

8.3.4.62.1 Description

This information element provides input information related to subject of certificate.

8.3.4.62.2 Attributes

The CertSubjectData information element shall follow the indications provided in table 8.3.4.62.2-1.

Table 8.3.4.62.2-1: Attributes of the CertSubjectData information element

Attribute	Qualifier	Cardinality	Content	Description
commonName	M	0..1	Not specified	Information of certification target subject FQDN. Can be set empty when this certificate is used for encrypted communication using IP address. See note.
Organization	M	0..1	Not specified	Information of certification target subject Organization. See note.
country	M	0..1	Not specified	Information of certification target subject Country. See note.
state	M	0..1	Not specified	Information of certification target subject State. See note.
locality	M	0..1	Not specified	Information of certification target subject Locality. See note.
emailAddress	O	0..1	Not specified	Information of certification contact email address. See note.

NOTE: At least one overriding attributes shall be present, otherwise shall be absent.

8.3.5 NsLcmCapacityShortageNotification

8.3.5.1 Description

This notification informs the consumer of NS LCM operations about shortage conditions. It will be sent if an LCM operation could not be executed or completed because of a shortage condition. It is expected that the shortage condition is temporary and the consumer is again notified when the condition has ended. The support of the notification is mandatory.

8.3.5.2 Trigger conditions

This notification is produced when there is a shortage condition that caused an LCM operation to be not successfully completed: The shortage conditions include:

- Necessary resources could not be allocated during an LCM operation because of resource shortage.
- An NS instance with higher priority pre-empted an LCM operation because of resource shortage.
- An NS instance with higher priority pre-empted a running NS instance. Resources were de-allocated from the lower priority NS instance to allow the LCM operation on a higher priority NS instance.
- Due to a capacity or performance shortage within the MANO system an LCM operation could not be executed.
- The resource, capacity or MANO performance shortage situation has ended and it can be expected that an LCM operation that had failed could succeed now.

If this is a notification about pre-emption, it shall be sent to both consumers, that is the tenants of the lower priority NS instance and the higher priority NS instance. See ETSI GS NFV-IFA 010 [1], clause D.2 for use cases.

8.3.5.3 Attributes

The attributes of the NsLcmCapacityShortageNotification notification shall follow the indications provided in table 8.3.5.3-1.

Table 8.3.5.3-1: Attributes of the NsLcmCapacityShortageNotification

Attribute	Qualifier	Cardinality	Content	Description
lifecycleOperationOccurrenceId	M	1	Identifier	Identifier of the NS lifecycle operation occurrence this notification is related to.
nsInstanceld	M	1	Identifier	Identifier of the NS instance affected by that lifecycle operation.

Attribute	Qualifier	Cardinality	Content	Description
status	M	1	Not specified	Indicates the situation of capacity shortage, including: <ul style="list-style-type: none"> The lifecycle operation identified by the first parameter could not be executed because the necessary resources were not available. The lifecycle operation identified by the first parameter pre-empted another lifecycle operation of an NS instance with lower priority. The lifecycle operation identified by the first parameter was pre-empted by another lifecycle operation of an NS instance with higher priority. The lifecycle operation identified by the first parameter pre-empted one or more running NS instances with lower priority. The lifecycle operation identified by the first parameter was triggered by a lifecycle operation on a higher priority NS instance pre-empting a lower priority instance. The shortage situation has ended and the lifecycle operation identified by the first parameter could be tried again.
shortageType	M	1	Not specified	Indicates whether this notification reports about a resource shortage or MANO capacity or performance shortage.
affectedNs	M	0..N	AffectedNs	Information about the NS instances that were affected by the shortage.
capacityInformation	O	1..N	Not specified	Information about the required, available, reserved, allocated/used, and total capacity as applicable for the notification.

8.4 Information elements and notifications related to NS Performance Management

8.4.1 Introduction

The clauses below define information elements and notifications related to network service performance management.

8.4.2 ObjectSelection information element

8.4.2.1 Description

This information element allows specifying network service related measured object instances on which performance information will be provided.

The ObjectSelection is a pattern to select object instances. The pattern is used in multiple interfaces.

In the present interface, the ObjectSelection pattern is used to select NS related measured object instances.

The pattern proposes 2 exclusive options:

- 1) Provide a list of object types and a filter to specify object properties.
- 2) Provide a list of object instances.

In the present interface, the object type will be NS related measured object types (see note).

NOTE: The NS related measured object types are the measured object type(s) for which the performance measurements applicable to Os-Ma-nfvo reference point are defined in clause 7.3 of ETSI GS NFV-IFA 027 [5].

8.4.2.2 Attributes

The attributes of the ObjectSelection information element shall follow the indications provided in table 8.4.2.2-1.

Table 8.4.2.2-1: Attributes of the ObjectSelection information element

Attribute	Qualifier	Cardinality	Content	Description
objectType	M	0..N	String	Defines the measured object type. The object types for this information element will be the NS related measured object types. One of the two (objectType+ objectFilter or objectInstanceld) shall be present.
objectFilter	M	0..1	Filter	The filter will apply on the object types to specify on which object instances the performance information is requested to be collected. One of the two (objectType+ objectFilter or objectInstanceld) shall be present.
objectInstanceld	M	0..N	Identifier	Identifies the object instances for which performance information is requested to be collected. The object instances for this information element will be instances corresponding to the NS related measured object types. One of the two (objectType+ objectFilter or objectInstanceld) shall be present.

8.4.3 PmJob information element

8.4.3.1 Description

This information element provides the details of the PM Job.

The object instances for this information element will be the instances corresponding to the NS related measured object types.

8.4.3.2 Attributes

The attributes of the PmJob information element shall follow the indications provided in table 8.4.3.2-1.

Table 8.4.3.2-1: Attributes of the PmJob information element

Attribute	Qualifier	Cardinality	Content	Description
pmJobId	M	1	Identifier	Identifier of this PmJob information element.
objectSelector	M	1	ObjectSelection	Defines the object instances for which performance information is requested to be collected. The object instances for this information element will be the instances corresponding to the NS related measured object types.
performanceMetric	M	0..N	String	This defines the type of performance metric(s) for the object instances. Valid values are specified as "Measurement Name" values of the performance measurements applicable to Os-Ma-nfvo reference point, as defined in clause 7.3 of ETSI GS NFV-IFA 027 [5]. At least one of the two (performance metric or metricGroup) shall be present.
performanceMetricGroup	M	0..N	String	Group of performance metrics. A metric group is a pre-defined list of metrics, known to the producer that it can decompose to individual metrics. Valid values are specified as "Measurement Group" values of the performance measurements applicable to Os-Ma-nfvo reference point, as defined in clause 7.3 of ETSI GS NFV-IFA 027 [5]. At least one of the two (performance metric or metricGroup) shall be present.
collectionPeriod	M	1	Not specified	Specifies the periodicity at which the producer will collect performance information. See note.
reportingPeriod	M	1	Not specified	Specifies the periodicity at which the producer will report to the consumer about performance information. See note.
reportingBoundary	O	0..1	Not specified	Identifies a boundary after which the reporting will stop. The boundary shall allow a single reporting as well as periodic reporting up to the boundary.
pmJobConnection	M	0..N	MonitoringConnection	An access information and interface information of PM job to monitor the PM of VNF instance by the VNFM. This can include for instance certain interface endpoint URI together with necessary credentials to access it.
NOTE: At the end of each reportingPeriod, the producer will inform the consumer about availability of the performance data collected for each completed collection period during this reportingPeriod. While the exact definition of the types for collectionPeriod and reporting period is part of the protocol design, it is recommended that the reportingPeriod be equal or a multiple of the collectionPeriod. In the latter case, the performance data for the collection periods within one reporting period would be reported together.				

8.4.4 Threshold information element

8.4.4.1 Description

This information element provides the details of a threshold.

The object instances for this information element will be the instances corresponding to the NS related measured object types.

8.4.4.2 Attributes

The attributes of the Threshold information element shall follow the indications provided in table 8.4.4.2-1.

Table 8.4.4.2-1: Attributes of the Threshold information element

Attribute	Qualifier	Cardinality	Content	Description
thresholdId	M	1	Identifier	Identifier of this Threshold information element.
objectSelector	M	1	ObjectSelection	Defines the object instances associated with the threshold. The object instances for this information element will be the instances corresponding to the NS related measured object types.
performanceMetric	M	1	String	Defines the performance metric associated with the threshold. Valid values are specified as "Measurement Name" values of the performance measurements applicable to Os-Ma-nfvo reference point, as defined in clause 7.3 of ETSI GS NFV-IFA 027 [5].
thresholdType	M	1	Enum	Type of threshold. The list of possible values is part of the protocol design and might include: single/multi valued threshold, static/dynamic threshold, template based threshold, etc. VALUES: <ul style="list-style-type: none"> • SIMPLE: Single-valued static threshold • etc.
thresholdDetails	M	1	Not specified	Details of the threshold: value to be crossed, details on the notification to be generated.

8.4.5 PerformanceReport information element

8.4.5.1 Description

This information element defines the format of a performance report provided by the producer to the consumer on a specified object instance or a set of them.

The object instances for this information element will be the instances corresponding to the NS related measured object types.

8.4.5.2 Attributes

The attributes of the PerformanceReport information element shall follow the indications provided in table 8.4.5.2-1.

Table 8.4.5.2-1: Attributes of the PerformanceReport information element

Attribute	Qualifier	Cardinality	Content	Description
performanceReport	M	1..N	PerformanceReportEntry	List of performance information entries.

8.4.6 PerformanceReportEntry information element

8.4.6.1 Description

This information element defines a single performance report entry.

The object instances for this information element will be the instances corresponding to the NS related measured object types.

8.4.6.2 Attributes

The attributes of the PerformanceReportEntry information element shall follow the indications provided in table 8.4.6.2-1.

Table 8.4.6.2-1: Attributes of the PerformanceReportEntry information element

Attribute	Qualifier	Cardinality	Content	Description
objectType	M	1	String	Defines the object type. The object types for this information element will be the NS related measured object types.
objectInstanceId	M	1	Identifier	The object instance for which the performance metric is reported. The object instances for this information element will be the instances corresponding to the NS related measured object types.
performanceMetric	M	1	String	Name of the metric collected. This attribute's value contains the related "Measurement Name" value of the performance measurements applicable to Os-Ma-nfvo reference point, as defined in clause 7.3 of ETSI GS NFV-IFA 027 [5].
performanceValue	M	1..N	PerformanceValueEntry	List of performance values with associated timestamp and measurement context (see ETSI GS NFV-IFA 027 [5]).

8.4.7 PerformanceValueEntry information element

8.4.7.1 Description

This information element defines a single performance value with its associated time stamp and measurement context (see ETSI GS NFV-IFA 027 [5]).

8.4.7.2 Attributes

The attributes of the PerformanceValueEntry information element shall follow the indications provided in table 8.4.7.2-1.

Table 8.4.7.2-1: Attributes of the PerformanceValueEntry information element

Attribute	Qualifier	Cardinality	Content	Description
timeStamp	M	1	DateTime	Timestamp indicating when the data was collected.
performanceValue	M	1	Value	Value of the metric collected. The type of this attribute corresponds to the related "Measurement Unit" of the performance measurements applicable to Os-Ma-nfvo reference point, as defined in clause 7.3 of ETSI GS NFV-IFA 027 [5].
measurementContext	M	0..1	Not specified	Measurement context of the metric collected. The specific measurement context for each kind of performance metrics is defined in ETSI GS NFV-IFA 027 [5].

8.4.8 PerformanceInformationAvailableNotification

8.4.8.1 Description

This notification informs the receiver that performance information is available. Delivery mechanism for the performance reports is not specified in the present document.

The object instances for this information element will be the instances corresponding to the NS related measured object types.

8.4.8.2 Trigger Conditions

The notification is produced when:

- New performance information is available.

8.4.8.3 Attributes

The attributes of the PerformanceInformationAvailableNotification shall follow the indications provided in table 8.4.8.3-1.

Table 8.4.8.3-1: Attributes of the PerformanceInformationAvailableNotification

Attribute	Qualifier	Cardinality	Content	Description
objectInstanceId	M	1..N	Identifier	Object instances for which performance information is available. The object instances for this information element will be the instances corresponding to the NS related measured object types.

8.4.9 ThresholdCrossedNotification

8.4.9.1 Description

This notification informs the receiver that a threshold value has been crossed.

The object instances for this information element will be the instances corresponding to the NS related measured object types.

8.4.9.2 Trigger Conditions

The notification is produced when:

- A Threshold has been crossed. Depending on threshold type, there might be a single or multiple crossing values.

8.4.9.3 Attributes

The attributes of the ThresholdCrossedNotification shall follow the indications provided in table 8.4.9.3-1.

Table 8.4.9.3-1: Attributes of the ThresholdCrossedNotification

Attribute	Qualifier	Cardinality	Content	Description
thresholdId	M	1	Identifier (Reference to Threshold)	Threshold which has been crossed.
crossingDirection	M	1	Enum	An indication of whether the threshold was crossed in upward or downward direction. VALUES: <ul style="list-style-type: none"> • UP • DOWN
objectInstanceId	M	1	Identifier	Object instance for which the threshold has been crossed. The object instances for this information element will be the instances corresponding to the NS related measured object types.
performanceMetric	M	1	String	Performance metric associated with the threshold This attribute's value contains the related "Measurement Name" value of the performance measurements applicable to Os-Ma-nfvo reference point, as defined in clause 7.3 of ETSI GS NFV-IFA 027 [5].
performanceValue	M	1	Value	Value of the metric that resulted in threshold crossing.
measurementContext	M	0..1	Not specified	Measurement context of the metric collected. The specific measurement context for each kind of performance metrics is defined in ETSI GS NFV-IFA 027 [5].

8.4.10 MonitoringConnection

8.4.10.1 Description

This information element provides detail of monitoring connection data. The object instances for this information element provide the way to access to monitoring tool.

8.4.10.2 Attributes

The MonitoringConnection shall follow the indications provided in table 8.4.10.2-1.

Table 8.4.10.2-1: Attributes of the MonitoringConnection

Attribute	Qualifier	Cardinality	Content	Description
monitoringConnectionId	M	1	Identifier	Identifier of the monitoring connection.
monitoringType	M	1	Enum	Type of monitoring way. VALUES: <ul style="list-style-type: none"> VIM_CISM EXTERNAL PAAS
vimId	M	0..1	Identifier (Reference to vimId)	Information about VIM or CISM connection(s) for monitoring resources for the VNF instance. Can be set when MonitoringType is equal to "VIM_CISM".
paasServiceId	M	0..1	Identifier (Reference to paasServiceId)	Information about PaasAsset to be used. Can be set when MonitoringType is equal to "PAAS".
interfaceInfo	M	0..1	Not specified	Information about the interface(s) to the external monitoring tool, if available, including interface endpoint e.g. URL API version, and protocol type. Can be set when MonitoringType is equal to "EXTERNAL".
accessInfo	M	0..1	Not specified	Authentication credentials for accessing the external monitoring tool. Examples can include those to support different authentication schemes, e.g. OAuth, Token, Username/password, etc. Can be set when MonitoringType is equal to "EXTERNAL".
extra	M	0..1	String	Type specific additional information, if applicable.

8.5 Information elements and notifications NS Fault management

8.5.1 Introduction

The clauses below define information elements and notifications related to network service fault management.

8.5.2 AlarmNotification

8.5.2.1 Description

This notification informs the receiver of alarms related to the network services managed by the NFVO. The notification is mandatory.

8.5.2.2 Trigger conditions

The notification is produced when:

- An alarm has been created.
- An alarm has been updated, e.g. if the severity of the alarm has changed.

8.5.2.3 Attributes

The attributes of the AlarmNotification shall follow the indications provided in table 8.5.2.3-1.

Table 8.5.2.3-1: Attributes of the AlarmNotification

Attribute	Qualifier	Cardinality	Content	Description
alarm	M	1	Alarm	Information about an alarm including AlarmId, affected network service ID, and FaultDetails.

8.5.3 AlarmClearedNotification

8.5.3.1 Description

This notification informs the receiver of the clearing of an alarm related to the network services managed by the NFVO. The alarm's perceived severity shall be set to "cleared" since the corresponding fault has been solved. The notification is mandatory.

8.5.3.2 Trigger conditions

The notification is produced when:

- An alarm has been cleared.

8.5.3.3 Attributes

The attributes of the AlarmClearedNotification shall follow the indications provided in table 8.5.3.3-1.

Table 8.5.3.3-1: Attributes of the AlarmClearedNotification

Attribute	Qualifier	Cardinality	Content	Description
alarmId	M	1	Identifier (Reference to Alarm)	Alarm identifier.
alarmClearedTime	M	1	DateTime	Timestamp indicating when the alarm was cleared.

8.5.4 Alarm information element

8.5.4.1 Description

The Alarm information element encapsulates information about an alarm.

8.5.4.2 Attributes

The attributes of the Alarm information element shall follow the indications provided in table 8.5.4.2-1.

Table 8.5.4.2-1: Attributes of the Alarm information element

Attribute	Qualifier	Cardinality	Content	Description
alarmId	M	1	Identifier	Identifier of this Alarm information element.
managedObjectId	M	1	Identifier	Identifier of the affected managed object. The Managed Objects for the present document will be network services. An NS instance can have fault monitored sub-object types and identification information is carried as defined in the respective Alarm definition as defined in clause 7.4 of ETSI GS NFV-IFA 045 [7], e.g. using the "faultDetails" attribute.
rootCauseFaultyComponent	M	1	FaultyComponent Info	The NS components (e.g. nested NS, NS virtual link and VNF) that are causing the NS fault.

Attribute	Qualifier	Cardinality	Content	Description
rootCauseFaultyResource	M	0..1	FaultyResourceInfo	The virtualised resources that are causing the faulty component. It shall be present when the faulty component is "NS Virtual Link" or "VNF" (see clause 8.5.6).
alarmRaisedTime	M	1	DateTime	Timestamp indicating when the alarm was raised by the network service.
alarmChangedTime	M	0..1	DateTime	Timestamp indicating when the alarm was last changed.
alarmClearedTime	M	0..1	DateTime	Timestamp indicating when the alarm was cleared.
ackState	M	1	Enum	State of the alarm. VALUES: <ul style="list-style-type: none"> ACKNOWLEDGED UNACKNOWLEDGED
perceivedSeverity	M	1	Enum	Perceived severity of the managed object failure. VALUES: <ul style="list-style-type: none"> CRITICAL MAJOR MINOR WARNING INDETERMINATE CLEARED Valid values applicable to specific Alarms are specified as "Perceived severity" values of the Alarm applicable to Os-Ma-nfvo reference point, as defined in clause 7.4 of ETSI GS NFV-IFA 045 [7].
eventTime	M	1	DateTime	Timestamp indicating when the fault was observed.
eventType	M	1	Enum	Type of the event. The allowed values for the eventType attribute use the event type defined in Recommendation ITU-T X.733 [4]. VALUES: <ul style="list-style-type: none"> COMMUNICATIONS_ALARM PROCESSING_ERROR_ALARM ENVIRONMENTAL_ALARM QOS_ALARM EQUIPMENT_ALARM Valid values applicable to specific Alarms are specified as "Event type" values of the Alarm applicable to Os-Ma-nfvo reference point, as defined in clause 7.4 of ETSI GS NFV-IFA 045 [7].
faultType	M	0..1	String	Additional information related to the type of the fault. Valid values applicable to specific Alarms are specified as "Alarm definition identifier" values of the Alarm applicable to Os-Ma-nfvo reference point, as defined in clause 7.4 of ETSI GS NFV-IFA 045 [7].
probableCause	M	1	String	Information about the probable cause of the fault. Valid values applicable to specific Alarms are specified as "Probable cause" values of the Alarm applicable to Os-Ma-nfvo reference point, as defined in clause 7.4 of ETSI GS NFV-IFA 045 [7].
isRootCause	M	1	Boolean	Parameter indicating if this fault is the root for other correlated alarms. If TRUE, then the alarms listed in the parameter correlatedAlarmId are caused by this fault.
correlatedAlarmId	M	0..N	Identifier (Reference to Alarm)	List of identifiers of other alarms correlated to this fault.

Attribute	Qualifier	Cardinality	Content	Description
faultDetails	M	0..N	Not specified	Provides additional information about the fault. Valid values applicable to specific Alarms are specified as "Fault details" values of the Alarm applicable to Os-Ma-nfvo reference point, as defined in clause 7.4 of ETSI GS NFV-IFA 045 [7].

8.5.5 AlarmListRebuiltNotification

8.5.5.1 Description

This notification informs the receiver that the active alarm list has been rebuilt by the NFVO. Upon receipt of this notification, the receiver needs to use the "Get Alarm List" operation to synchronize its view on current active alarms with that of the NFVO.

The notification is mandatory.

8.5.5.2 Trigger conditions

- Active alarm list has been rebuilt by the NFVO, e.g. if the NFVO detects its storage holding the alarm list is corrupted.

8.5.5.3 Attributes

The AlarmListRebuiltNotification does not contain any attributes.

8.5.6 FaultyComponentInfo information element

8.5.6.1 Description

The FaultyComponentInfo information element encapsulates information about faulty component that has a negative impact on an NS.

8.5.6.2 Attributes

The FaultyComponentInfo information element shall follow the indications provided in table 8.5.6.2-1.

Table 8.5.6.2-1: Attributes of the FaultyComponentInfo information element

Attribute	Qualifier	Cardinality	Content	Description
faultyNestedNsInstanceid	M	0..1	Identifier (Reference to NsInfo)	Identifier of the faulty nested NS instance. See note.
faultyNsVirtualLinkInstanceid	M	0..1	Identifier (Reference to NsVirtualLinkInfo)	Identifier of the faulty NS virtual link instance. See note.
faultyVnfInstanceid	M	0..1	Identifier (Reference to VnfInfo)	Identifier of the faulty VNF instance. See note.

NOTE: At least one of the parameters shall be present.

8.5.7 FaultyResourceInfo information element

8.5.7.1 Description

The FaultyResourceInfo information element encapsulates information about faulty resource that has a negative impact on a VNF or an NS virtual link, which is the constituent component of the impacted NS.

8.5.7.2 Attributes

The FaultyResourceInfo information element shall follow the indications provided in table 8.5.7.2-1.

Table 8.5.7.2-1: Attributes of the FaultyResourceInfo information element

Attribute	Qualifier	Cardinality	Content	Description
faultyResource	M	1	ResourceHandle	Information that identifies the faulty resource instance and its managing entity. See clause 8.3.3.8.
faultyResourceType	M	1	Enum	Type of the faulty resource. VALUES: <ul style="list-style-type: none"> • COMPUTE • STORAGE • NETWORK

8.6 Information elements and notifications related to VNF Package

8.6.1 Introduction

The clauses below define information elements and notifications related to VNF Package management.

8.6.2 VnfPkgInfo information element

8.6.2.1 Description

This information element provides the details of a VNF Package.

8.6.2.2 Attributes

The attributes of the VnfPkgInfo information element shall follow the indications provided in table 8.6.2.2-1.

Table 8.6.2.2-1: Attributes of the VnfPkgInfo information element

Attribute	Qualifier	Cardinality	Content	Description
vnfPkgInfoId	M	1	Identifier	Identifier of the VNF Package information object. This identifier was allocated by the NFVO.
vnfdId	M	0..1	Identifier	Identifier of the on-boarded the VNF Package. See notes 1, 2 and 3.
vnfdExtInvariantId	M	0..1	Identifier	Identifies a VNFD in a version independent manner. This attribute is invariant across versions of the VNFD that fulfil certain conditions related to the external connectivity and management of the VNF. See notes 2 and 5.
vnfProvider	M	0..1	String	Provider of the on-boarded VNF package. See notes 2 and 3.
vnfProductName	M	0..1	String	Product name of the on-boarded VNF package. See notes 2 and 3.
vnfSoftwareVersion	M	0..1	Version	Software version of the on-boarded VNF package. See notes 2 and 3.

Attribute	Qualifier	Cardinality	Content	Description
vnfdVersion	M	0..1	Version	VNFD version of the on-boarded VNF package. See notes 2 and 3.
checksum	M	0..1	Not specified	Checksum of the on-boarded VNF Package. See note 3.
vnfd	M	0..1	Identifier (Reference to Vnfd)	Reference to the VNFD contained in the on-boarded VNF Package, e.g. URL to the on-boarded VNFD. See note 3.
softwareImage	M	0..N	VnfPackageSoftwareImageInfo	Information about VNF Package artifacts that are software images. See note 3.
additionalArtifact	M	0..N	VnfPackageArtifactInformation	Information about VNF Package artifacts contained in the VNF Package that are not software images. See note 4.
onboardingState	M	1	Enum	On-boarding state of the VNF Package. VALUES: <ul style="list-style-type: none"> • CREATED • UPLOADING • PROCESSING • ONBOARDED
operationalState	M	1	Enum	Operational state of the VNF Package. VALUES: <ul style="list-style-type: none"> • ENABLED • DISABLED
usageState	M	1	Enum	Usage state of the VNF Package. VALUES: <ul style="list-style-type: none"> • IN_USE • NOT_IN_USE
userDefinedData	O	0..N	KeyValuePair	User defined data for the VNF Package.

NOTE 1: This identifier, which is managed by the VNF provider, identifies the VNF Package and the VNFD in a globally unique way. See ETSI GS NFV-IFA 011 [2], clause 7.1.2.2.

NOTE 2: This information is copied from the VNFD of the on-boarded VNF Package.

NOTE 3: These attributes shall be present after the VNF Package is on-boarded.

NOTE 4: It may be present after the VNF Package is on-boarded and shall be absent otherwise.

NOTE 5: This attribute may be present after the VNF Package is on-boarded.

8.6.3 Vnfd information element

8.6.3.1 Description

This information element provides the details of the VNFD.

8.6.3.2 Attributes

The structure of the Vnfd information element shall comply with the provisions for the Vnfd information element as defined in ETSI GS NFV-IFA 011 [2], clause 7.1.2.

8.6.4 VnfPackageSoftwareImageInfo information element

8.6.4.1 Description

This information element represents an artifact contained in a VNF Package which represents a Software Image.

8.6.4.2 Attributes

The VnfPackageSoftwareImageInfo information element shall follow the indications provided in table 8.6.4.2-1.

Table 8.6.4.2-1: Attributes of the VnfPackageSoftwareImageInfo information element

Attribute	Qualifier	Cardinality	Content	Description
id	M	1	Identifier	The identifier of this software image.
name	M	1	Not specified	The name of this software image.
provider	M	1	Not specified	The provider of this software image.
version	M	1	Not specified	The version of this software image.
checksum	M	1	Not specified	The checksum of the software image file.
containerFormat	M	1	Not specified	The container format indicates whether the software image is in a file format that also contains metadata about the actual software.
diskFormat	M	1	Not specified	The disk format of a software image is the format of the underlying disk image.
createdAt	M	1	Not specified	The created time of this software image.
minDisk	M	1	Not specified	The minimal Disk for this software image.
minRam	M	1	Not specified	The minimal RAM for this software image.
size	M	1	Not specified	The size of this software image.
userMetadata	M	0..N	KeyValuePair	User-defined metadata.
accessInformation	M	1	Not specified	Information (such as a URL, a path in the VNF Package, or an identifier) that allows to access a copy of this software image artifact.

8.6.5 Void

8.6.6 VnfPackageArtifactInformation information element

8.6.6.1 Description

This information element provides identification information for an artifact (other than a Software Image) which is contained in the VNF Package.

8.6.6.2 Attributes

The VnfPackageArtifactInformation information element shall follow the indications provided in table 8.6.6.2-1.

Table 8.6.6.2-1: Attributes of the VnfPackageArtifactInformation information element

Attribute	Qualifier	Cardinality	Content	Description
selector	M	1	Not specified	Information (such as a URL, a path in the VNF Package, or an identifier) that allows to access a copy of this artifact.
metadata	M	1	Not specified	The metadata of the artifact that are available in the VNF Package, such as Content type, size, creation date, etc.

8.6.7 Void

8.6.8 VnfPackageOnBoardingNotification

8.6.8.1 Description

This notification indicates a VNF Package is on-boarded, after all the on-boarding steps (e.g. uploading and processing) are done. A change in on-boarding state before the VNF Package is on-boarded is not reported.

Support of this notification is mandatory.

8.6.8.2 Trigger Conditions

- New VNF Package on-boarded.

8.6.8.3 Attributes

The attributes of the VnfPackageOnBoardingNotification shall follow the indications provided in table 8.6.8.3-1.

Table 8.6.8.3-1: Attributes of the VnfPackageOnBoardingNotification

Attribute	Qualifier	Cardinality	Content	Description
onboardedVnfPkgInfold	M	1	Identifier	Identifier of the NFVO VNF Package information object.
vnfdId	M	1	Identifier	Identifier of the on-boarded VNF Package. See note.
NOTE: This identifier, which is managed by the VNF provider, identifies the VNF Package and the VNFD in a globally unique way. See ETSI GS NFV-IFA 011 [2], clause 7.1.2.2. This information is copied from the VNFD of the on-boarded VNF Package.				

8.6.9 VnfPackageChangeNotification

8.6.9.1 Description

This notification indicates a change of status in an on-boarded VNF Package. Only changes in operational state and the deletion of the VNF Package will be reported, change in usage state is not reported.

Support of this notification is mandatory.

8.6.9.2 Trigger Conditions

- Change of the operational state of an on-boarded VNF Package.
- Deletion of an on-boarded VNF Package.

8.6.9.3 Attributes

The attributes of the VnfPackageChangeNotification shall follow the indications provided in table 8.6.9.3-1.

Table 8.6.9.3-1: Attributes of the VnfPackageChangeNotification

Attribute	Qualifier	Cardinality	Content	Description
onboardedVnfPkgInfold	M	1	Identifier	Identifier of the VNF Package information object.
vnfdId	M	1	Identifier	Identifier of the on-boarded VNF Package. See note.
changeType	M	1	Enum	It categorizes the type of change. Possible values can be change of operational state of an on-boarded VNF Package and deletion of a VNF Package. VALUES: <ul style="list-style-type: none"> OP_STATE_CHANGE: change of operational state of an on-boarded VNF Package PKG_DELETE: deletion of a VNF Package
operationalState	M	0..1	Enum	New operational state of the VNF Package. VALUES: <ul style="list-style-type: none"> ENABLED DISABLED
NOTE: This identifier, which is managed by the VNF provider, identifies the VNF Package and the VNFD in a globally unique way. See ETSI GS NFV-IFA 011 [2], clause 7.1.2.2. This information is copied from the VNFD of the on-boarded VNF Package.				

8.7 Information elements and notifications related to NFVI Capacity Information

8.7.1 Description

The clause below defines a notification related to NFVI Capacity Information.

8.7.2 CapacityThresholdCrossedNotification

8.7.2.1 Description

This notification informs the receiver that the available NFVI capacity has crossed a threshold value in either up or down direction.

8.7.2.2 Trigger Conditions

The notification is produced when:

- The NFVI capacity has crossed a threshold.

8.7.2.3 Attributes

The attributes of the CapacityThresholdCrossedNotification shall follow the indications provided in table 8.7.2.3-1.

Table 8.7.2.3-1: Attributes of the CapacityThresholdCrossedNotification

Attribute	Qualifier	Cardinality	Content	Description
subscriptionId	M	1	Identifier	Identifies the subscription associated with this notification.
resourceZoneId	M	0..1	Identifier	Identifies the resource zone in which the available NFVI capacity has crossed the threshold. Cardinality is 0 if the subscription does not specify a particular resource zone and the overall available NFVI capacity has crossed the threshold.
vimId	M	0..1	Identifier	Identifies the VIM in which the available NFVI capacity has crossed below the threshold. Cardinality is 0 if the subscription does not specify a particular VIM and the overall available NFVI capacity has crossed the threshold.
direction	M	1	Enum {UP; DOWN}	Specifies the direction the threshold has been crossed. VALUES: <ul style="list-style-type: none"> • UP • DOWN
capacityInformation	M	1	Not specified	Information about the available, reserved, allocated/used, and total capacity of the NFVI. If the subscription does specify a resource zone and/or vimId, the information is provided for the resource zone/vimId where the NFVI capacity has crossed the threshold.

8.7.3 NfviCapacityThreshold information element

8.7.3.1 Description

This information element provides the details of a NFVI capacity threshold.

8.7.3.2 Attributes

The attributes of the NfviCapacityThreshold information element shall follow the indications provided in table 8.7.3.2-1.

Table 8.7.3.2-1: Attributes of the NfviCapacityThreshold information element

Attribute	Qualifier	Cardinality	Content	Description
thresholdId	M	1	Identifier	Identifier of this NfviCapacityThreshold information element.
objectInstanceId	M	1	Identifier	Identifier of the measured object instance managed by a VIM or CCM instance for which the threshold is defined.
thresholdType	M	1	Enum	Type of threshold. The list of possible values is part of the protocol design and might include: single/multi valued threshold, static/dynamic threshold, template based threshold, etc. VALUES: <ul style="list-style-type: none"> • SIMPLE: Single-valued static threshold • etc.
thresholdDetails	M	1	Not specified	Details of the threshold: value to be crossed, details on the notification to be generated.

8.8 Information elements and notifications related to Policy Management

8.8.1 Introduction

The clauses below define information elements and notifications related to policy management.

8.8.2 Information elements related to Policy Management Operations

8.8.2.1 Introduction

The clauses below define information elements related to policy management operations.

8.8.2.2 PolicyInfo information element

8.8.2.2.1 Description

This information element provides policy related information. It contains the policy itself and additional information related to the policy.

8.8.2.2.2 Attributes

The PolicyInfo information element shall follow the indications provided in table 8.8.2.2.2-1.

Table 8.8.2.2.2-1: Attributes of the PolicyInfo information element

Attribute	Qualifier	Cardinality	Content	Description
policyInfoId	M	1	Identifier	Identifier of policy information.
designer	M	1	String	Human readable name of designer of the policy.
name	M	1	String	Human readable name of the policy.
version	M	1	Version	Version of the policy. Its value shall be the same as the version present in the actual policy content as defined by the "policyVersion" attribute in the "Policy" information element specified in clause 5.2 of ETSI GS NFV-IFA 048 [6].
policy	M	1	Policy	Specifies the policy. "Policy" is specified in clause 5.2 of ETSI GS NFV-IFA 048 [6].
activationStatus	M	1	Enum	Status of the policy. VALUES: <ul style="list-style-type: none"> • ACTIVATED • DEACTIVATED

8.8.3 PolicyChangeNotification

8.8.3.1 Description

This notification indicates a change of a NFV-MANO policy related to operations of transferring policy, deleting policy, activating policy and deactivating policy.

Support of this notification is mandatory.

8.8.3.2 Trigger Conditions

The notification is produced when:

- A policy has been changed as a result of an operation of TransferPolicy, DeletePolicy, ActivatePolicy, DeactivatePolicy, AssociatePolicy or DisassociatePolicy.

8.8.3.3 Attributes

The attributes of the PolicyChangeNotification shall follow the indications provided in table 8.8.3.3-1.

Table 8.8.3.3-1: Attributes of the PolicyChangeNotification

Attribute	Qualifier	Cardinality	Content	Description
policyInfoId	M	1	Identifier (Reference to PolicyInfo)	Identifier of policy information.
operation	M	1	Enum	Policy management operation that causes the change of the policy. VALUES: <ul style="list-style-type: none"> • TRANSFER_POLICY • DELETE_POLICY • ACTIVATE_POLICY • DEACTIVATE_POLICY • ASSOCIATE_POLICY • DISASSOCIATE_POLICY • etc.

8.8.4 PolicyConflictNotification

8.8.4.1 Description

This notification indicates a policy conflict is detected by the NFVO. A policy conflict can include any conflicted monitored events, conditions or actions among two or more policies enforced by the NFVO.

Support of this notification is mandatory.

8.8.4.2 Trigger Conditions

The notification is produced when:

- A policy conflict is detected by the NFVO.

8.8.4.3 Attributes

The attributes of the PolicyConflictNotification shall follow the indications provided in table 8.8.4.3-1.

Table 8.8.4.3-1: Attributes of the PolicyConflictNotification

Attribute	Qualifier	Cardinality	Content	Description
policyInfoId	M	2..N	Identifier (Reference to PolicyInfo)	Identifiers of conflicted policy information.
conflictDescription	M	1	Not specified	Description of the detected policy conflicts, e.g. conflicted events, conditions or actions among the policies.

8.9 Information elements related to VNF Snapshot Package Management

8.9.1 Introduction

This clause defines information elements related to VNF Snapshot Package Management.

8.9.2 VnfSnapshotPkgInfo information element

8.9.2.1 Description

This information element provides the details of a VNF Snapshot Package, which the NFVO creates and stores as part of the ongoing operational VNF Snapshot Package management process.

8.9.2.2 Attributes

The VnfSnapshotPkgInfo information element shall follow the indications provided in table 8.9.2.2-1.

Table 8.9.2.2-1: Attributes of the VnfSnapshotPkgInfo information element

Attribute	Qualifier	Cardinality	Content	Description
vnfSnapshotPkgInfoId	M	1	Identifier	Identifier of information held by the NFVO about a specific VNF Snapshot Package.
vnfSnapshotPkgId	M	0..1	Identifier	Identifier that identifies the VNF Snapshot Package. See notes 1 and 2.
name	M	1	String	Human-readable name of the VNF Snapshot Package.
checksum	M	0..1	Not specified	Checksum of the stored VNF Snapshot Package. See note 2.
createdAt	M	0..1	DateTime	Timestamp indicating when the VNF Snapshot Package creation has been completed. See note 2.
vnfSnapshotInfoId	M	0..1	Identifier (Reference to VnfSnapshotInfo)	Reference to the information held by the NFVO about a specific VNF Snapshot. This identifier was allocated by the VNFM. See note 2.
isFullSnapshot	M	1	Boolean	Value is 1 (true) in case of a "full" VNF Snapshot Package, i.e. containing all snapshotted VNFC instances; otherwise the value is 0 (false).
vnfd	M	0..1	Vnfd	VNFD of the snapshotted VNF instance that is contained in the stored VNF Snapshot Package. See note 2.
vnfInfo	M	0..1	VnfInfo	VnfInfo of the snapshotted VNF instance that is contained in the stored VNF Snapshot Package. See note 2.
vnfcSnapshotInfoId	M	0..N	Identifier (Reference to VnfcSnapshotInfo)	Identifier of information held by the VNFM about specific VNFC Snapshot(s). These identifiers were allocated by the VNFM. See note 2.
vnfcSnapshotImage	M	0..N	VnfcSnapshotImageInfo	Information about VNFC Snapshot artifact(s) that are VNFC Snapshot Images. See note 2.
additionalArtifact	M	0..N	SnapshotPkgArtifactInformation	Information about VNF Snapshot artifact(s) that are not VNFC Snapshot images.
state	M	1	Enum	State of the VNF Snapshot Package. VALUES: <ul style="list-style-type: none"> • CREATED • BUILDING • UPLOADING • AVAILABLE • EXTRACTING • PROCESSING • ERROR
userDefinedData	O	0..N	KeyValuePair	User defined data for the VNF Snapshot Package.

Attribute	Qualifier	Cardinality	Content	Description
accessInformation	M	0..1	Not specified	Information (such as a URL, or an identifier) that allows to access a copy of this VNF Snapshot Package. See note 2.
NOTE 1: This identifier identifies the VNF Snapshot Package in a globally unique way. It is created during the Build VNF Snapshot Package operation. Multiple instances of the same VNF Snapshot Package share the same vnfSnapshotPkgId.				
NOTE 2: Cardinality is 0 when the VnfSnapshotPkgInfo was created but the VNF Snapshot Package was not yet built or uploaded.				

8.9.3 SnapshotPkgArtifactInformation information element

8.9.3.1 Description

This information element represents an artifact other than a VNFC Snapshot Image which is contained in the VNF Snapshot Package.

8.9.3.2 Attributes

The SnapshotPkgArtifactInformation information element shall follow the indications provided in table 8.9.3.2-1.

Table 8.9.3.2-1: Attributes of the SnapshotPkgArtifactInformation information element

Attribute	Qualifier	Cardinality	Content	Description
selector	M	1	Not specified	Information (such as a path) that identifies/addresses this artifact in the VNF Snapshot Package.
metadata	M	1	Not specified	The metadata of the artifact that are available in the VNF Snapshot Package, such as content type, size, creation date, etc.

8.9.4 VnfcSnapshotImageInfo information element

8.9.4.1 Description

This information element represents VNFC Snapshot Image Information.

8.9.4.2 Attributes

The VnfcSnapshotImageInfo information element shall follow the indications provided in table 8.9.4.2-1.

Table 8.9.4.2-1: Attributes of the VnfcSnapshotImageInfo information element

Attribute	Qualifier	Cardinality	Content	Description
vnfcSnapshotImageId	M	1	Identifier	The identifier of this VNFC Snapshot image.
name	M	1	Not specified	The name of this VNFC Snapshot image.
checksum	M	1	Not specified	The checksum of the VNFC Snapshot image file.
vnfcInstanceCid	M	1	Identifier	Identifier of the snapshotted VNFC instance that this VNFC Snapshot image belongs to.
containerFormat	M	1	Not specified	The container format indicates whether the VNFC Snapshot image is in a file format that also contains metadata about the actual snapshot.
diskFormat	M	1	Not specified	The disk format of a VNFC Snapshot image is the format of the underlying disk image.
createdAt	M	1	DateTime	The time when this VNFC Snapshot image creation has been completed.
minDisk	M	1	Not specified	The minimal Disk for this VNFC Snapshot image.
minRam	M	1	Not specified	The minimal RAM for this VNFC Snapshot image.
size	M	1	Not specified	The size of this VNFC Snapshot image.
userMetadata	M	0..N	KeyValuePair	User-defined metadata.
accessInformation	M	1	Not specified	Information such as a path (if the image is included in the VNF Snapshot Package), or an URL or identifier (if the image is not included in the VNF Snapshot Package) that allows to access a copy of this VNFC Snapshot Image.

8.10 Information elements related to Data Flow Mirroring

8.10.1 Introduction

This clause specifies information elements related to data flow mirroring.

8.10.2 CreateDataFlowMirroringJob information element

8.10.2.1 Description

This information element represents details of creating Data Flow Mirroring Job.

8.10.2.2 Attributes

The CreateDataFlowMirroringJob information element shall follow the indications provided in table 8.10.2.2-1.

Table 8.10.2.2-1: Attributes of the CreateDataFlowMirroringJob information element

Attribute	Qualifier	Cardinality	Content	Description
mirroringJobName	M	1	String	Name of Data Flow Mirroring Job.
description	M	1	String	Information description of Data Flow Mirroring Job.
collectorDetails	M	0..1	Not specified	Information about where the mirrored flow is to be delivered. If absent, the information shall be determined by NFVO. See note 1.
vnfInstanceCid	M	0..N	Identifier	Identifier of the VNF instance from where the data flows are requested to be mirrored.
cpInstanceCid	M	0..N	Identifier	Identifier of the CP instance from where the data flows are requested to be mirrored.
dataFlowDetails	M	0..N	Not specified	Information about the data flows that are requested to be mirrored. See note 2.
NOTE 1: Information could include ports where to mirror the data flow.				
NOTE 2: Information could include characteristics of the data flows on the CP instance, such as source IP addresses, destination IP addresses or direction, etc.				

8.10.3 UpdateDataFlowMirroringJob information element

8.10.3.1 Description

This information element represents details for updating a Data Flow Mirroring Job.

8.10.3.2 Attributes

The UpdateDataFlowMirroringJob information element shall follow the indications provided in table 8.10.3.2-1.

Table 8.10.3.2-1: Attributes of the UpdateDataFlowMirroringJob information element

Attribute	Qualifier	Cardinality	Content	Description
mirroringJobId	M	1	Identifier	Identifier of the Data Flow Mirroring Job to update.
mirroringJobName	M	0..1	String	Name of Data Flow Mirroring Job. See note.
description	M	0..1	String	Information description of Data Flow Mirroring Job. See note.
collectorDetails	M	0..1	Not specified	New information about the destination where the mirrored flow is to be delivered. See note.
NOTE: Updating Data Flow Mirroring Job can involve one or more following cases: 1) updating the name of data flow mirroring job, related to "mirroringJobName"; 2) updating information description of data flow mirroring job, related to "description"; 3) updating the definition about where the mirrored data flow is requested to be delivered, related to "collectorDetails".				

8.10.4 MirroringJobInfo information element

8.10.4.1 Description

This information element represents the runtime information that the NFVO holds about a Data Flow Mirroring Job.

8.10.4.2 Attributes

The MirroringJobInfo information element shall follow the indications provided in table 8.10.4.2-1.

Table 8.10.4.2-1: Attributes of the MirroringJobInfo information element

Attribute	Qualifier	Cardinality	Content	Description
mirroringJobId	M	1	Identifier	Unique identifier of the Data Flow Mirroring Job. The identifier is assigned by the NFVO. See note 1.
mirroringJobName	M	1	String	Name of Data Flow Mirroring Job.
description	M	1	String	Information description of Data Flow Mirroring Job.
collectorDetails	M	0..1	Not specified	Information about where the mirrored flow is delivered. See note 2.
vnfInstanceId	M	0..N	Identifier	Identifier of the VNF instance from where the data flows are requested to be mirrored.
cpInstanceId	M	0..N	Identifier	Identifier of the CP instance from where the data flows are mirrored.
dataFlowDetails	M	0..N	Not specified	Information about the data flows that are mirrored. See note 3.
NOTE 1: It is responsibility of the NFVO to map the mirroringJobIds exposed towards the consumer on the Os-Ma-nfv ref. point with the corresponding identifiers of the mirroring Jobs that are created towards the VIM. NOTE 2: Information could include ports where to mirror the data flow. NOTE 3: Information could include characteristics of the data flows on the CP instance, such as source IP addresses, destination IP addresses or direction, etc.				

8.10.5 DataFlowMirroringData information element

8.10.5.1 Description

This information element represents details of DataFlowMirroringData.

8.10.5.2 Attributes

The DataFlowMirroringData information element shall follow the indications provided in table 8.10.5.2-1.

Table 8.10.5.2-1: Attributes of the DataFlowMirroringData information element

Attribute	Qualifier	Cardinality	Content	Description
mirroringJobName	M	1	String	Name of Data Flow Mirroring Job.
description	M	1	String	Information description of Data Flow Mirroring Job.
collectorDetails	M	1	Not specified	Information about where the mirrored flow is to be delivered.
dataFlowData	M	1..N	DataFlowData	Information about the data flows to be mirrored.

8.10.6 DataFlowData information element

8.10.6.1 Description

This information element represents details of DataFlowData.

8.10.6.2 Attributes

The DataFlowData information element shall follow the indications provided in table 8.10.6.2-1.

Table 8.10.6.2-1: Attributes of the DataFlowData information element

Attribute	Qualifier	Cardinality	Content	Description
dataFlowInfold	M	0..1	Identifier	Identifier of the Data flow information in NSD. It may be provided if a corresponding data flow has been declared in the NSD. See note.
dataFlowDetails	M	1	Not specified	Detailed information about the data flows that are requested to be mirrored.
NOTE: A value need not be provided at runtime if the interface consumer does not intend to refer to a data flow defined in the NSD.				

Annex A (informative): Principles related to VNF lifecycle management and NS lifecycle management

The following bullets list the main principles related to VNF lifecycle management and NS lifecycle management:

- 1) **Principle #1:** The VNFM offers a layer of decoupling for VNFs:
 - VNF lifecycle management is handled by the VNFM corresponding to a given VNF.
 - The VNF can be modified without a call through the VNF lifecycle management interface, for instance in reaction to some alarms/metrics resulting in a scaling. So the FBs using the service of the VNF lifecycle management interface, like NFVO, should expect that some changes are possible for a given VNF. These changes are communicated through notifications.
 - This does not prevent NFVO from being able to send VNF lifecycle management operations to the VNFM.
- 2) **Principle #2:** The NFVO offers a layer of decoupling for NSs:
 - NS lifecycle management is handled by the NFVO corresponding to a given NS.
 - The NS can be modified without a request from the OSS/BSS through the NS lifecycle management interface, either because of a VNF change or because the NFVO has reacted to some event and decided to change something in the NS or in a VNF that is part of an NS. So the OSS/BSS should expect that some changes in the NS (and the VNFs that are part of it) are possible. These changes are communicated through notifications.
 - This does not prevent OSS/BSS from being able to send directly NS lifecycle management operations to the NFVO.
- 3) **Principle #3:**
 - With respect to the Os-Ma-nfvo reference point, any interaction concerning a VNF is associated with at least one NS instance.

Annex B (informative): Use cases for VNF reuse and referencing in NSs

B.1 Re-use of VNFs from a terminated NS

In this use case, the consumer (OSS/BSS FB) requests that the provider (NFVO) terminate a given NS instance, and the NFVO retains some of the VNF instances for use in future NS instances (in NS instantiate and/or NS update).

NOTE: The OSS/BSS FB can instruct the NFVO to retain VNF instances by adding the VNF instances in another NS (e.g. a VNF Pool NS).

Some additional points to consider with regard to the reuse of VNF instances:

- At the time the NS instance is terminated, the consumer may not know what specific NS instances are to use the retained VNF instances but only that the VNF instances should be retained. The VNF instances to be retained need to be part of another NS instance (e.g. a VNF Pool NS) before terminating the NS instance to which those VNFs belong.
- The retained VNF instances are of various types, could be a relative large number (consider an NS type such a virtual CDN) and may be reused in multiple NS instances (which may not even be of the same type as the original NS).
- A retained VNF instance may need to be updated before being used in a new NS instance.
- Some reasons for VNF instance retention:
 - The particular type of VNF may take some "cost" (e.g. time) to instantiate and it is easier to retain the VNF instances for future use.
 - There is a known demand for a given type of VNF and it is easier to just retain the VNF instance rather than to terminate and wait for when it needs to be re-used (which might be immediately).
 - As part of some sort of NS instance migration, it may be necessary (or easier) to retain some of the VNF instances from the NS instance that is to be migrated.
 - The VNF instance is part of a leased network segment (allocated to a specific consumer) and whether to retain the VNF instance or not is basically a decision of the consumer.

B.2 Creation of VNF instances in anticipation of future NS demand

Based on (for example, customer demand forecasts) VNF instances are created in advance for use in NS instances at some later point in time. This might be done because instances of the given type of VNF may take some time to instantiate and the OSS/BSS FB wants to ensure quick instantiation of the NS instances that use these VNF instances.

In a variation of this use case, the OSS/BSS FB may create VNF instances in advance for use in pre-ordered NS instances (for some future date by a customer). In this case, the OSS/BSS FB could first request instantiation of the required resources (e.g. VNF instances) in a context of a holding NS (e.g. a VNF Pool NS), and then request the NS instance later when it is needed, with the knowledge that the required VNF instances (for example) are there and ready to be used immediately.

B.3 Bottom-up NS instantiation

It may be that VNF instances are created in advance for a given NS instance, with the knowledge that some of the VNF instances will take longer to create than others and that an immediate NS instantiate request will fail unless all the required VNF instances are instantiated beforehand.

B.4 Shared VNF instances

Some VNF instances can be shared by several NS instances. In some cases, the OSS/BSS FB will indicate to the NFVO that a VNF instance (already being used by at least one NS instance) is to be used in another NS instance.

A shared VNF instance may need to be updated before it is reused in another NS instance.

Annex C (informative): Message flows for supporting use cases with fine grained NS lifecycle management

C.1 Introduction

This annex describes how the use cases presented in annex B can be supported by fine-grain control over VNF instances in NS lifecycle management operations.

The approach uses the basic NS lifecycle management operations and within the NS lifecycle management operations additional attributes are created to support the fine grained VNF lifecycle management tasks.

Table C.1-1 provides the mapping of all identified use cases and proposed solutions.

Table C.1-1

Existing Use Cases in annex B	Solutions in annex C
Clause B.1 Re-use of VNFs from a terminated NS	"Terminating an NS with retained VNF instance(s)"
Clause B.2 Creation of VNFs in anticipation of future NS demand	"VNF pool creation"
Clause B.3 Bottom-up NS instantiation	"VNF pool creation" (steps 6 and 7)
Clause B.4 Shared VNF instances	"Terminating an NS with retained VNF instance(s)" (steps 1a, 1b and 2) and "New NS with existing VNF instance(s)"

C.2 New NS with VNF pools

A VNF pool NS can be utilized for the use case of creation of VNF instances in anticipation of future NS demand. (The associated use case is defined in clause B.2.)

The VNF Pool NS is just a normal NS which contains VNF instances and may not have any connectivity between the VNF instances. There are many ways how the VNF Pool NS can be "filled up" with VNF instances. VNFs can be instantiated when an NS is instantiated or OSS/BSS can add VNF instances to the NS instance by the Update NS operation or OSS/BSS can associates existing VNF instances to the NS with the Update NS operation.

Figure C.2-1 shows the flow how a VNF pool NS can be created.

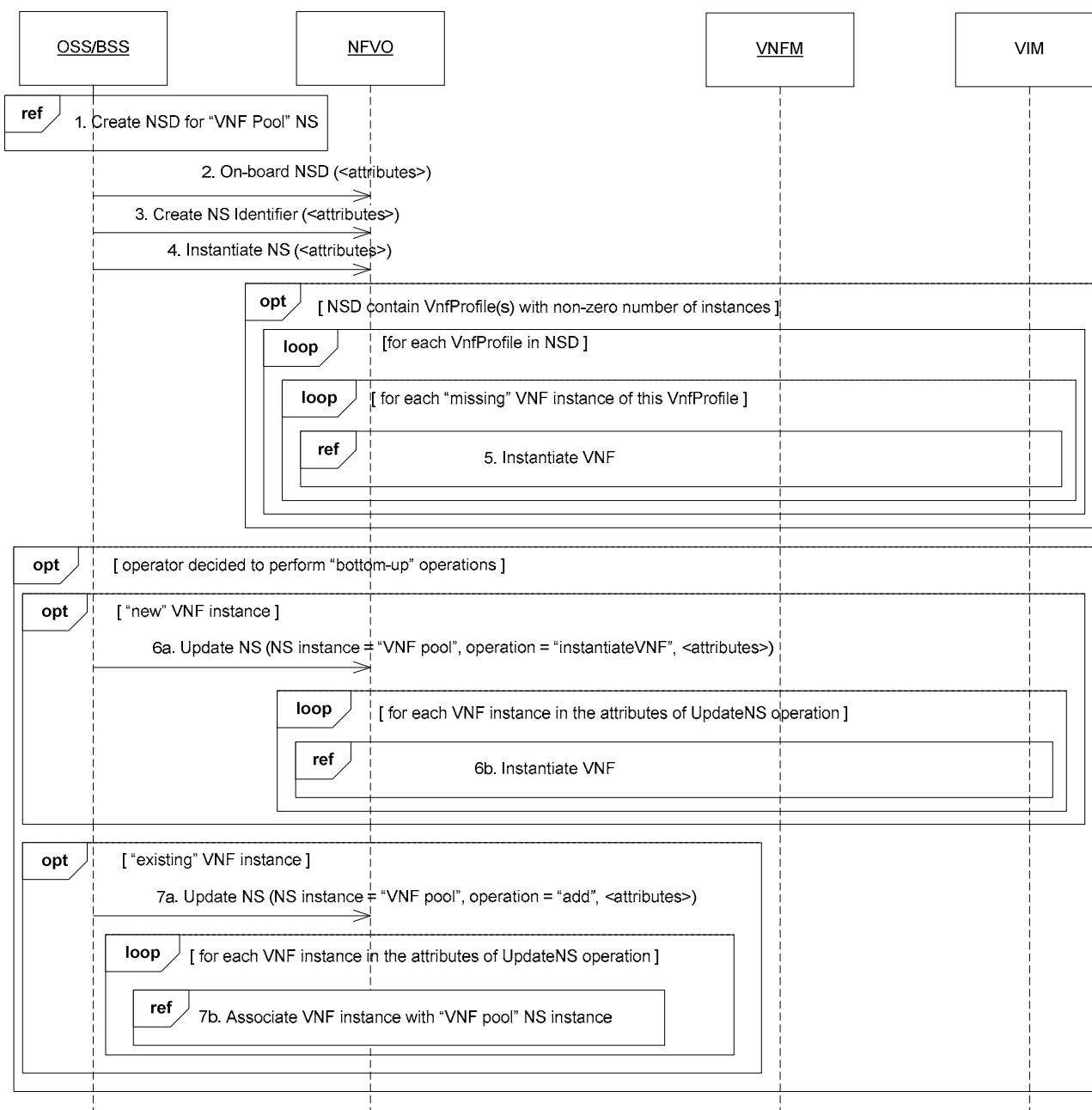


Figure C.2-1: VNF Pool NS creation

- 1) As a pre-requisite for instantiation of an NS, the corresponding NSD has to be created.
- 2) The NSD is on-boarded to the NFVO. It is assumed that all VNF Packages whose VNFs are referred in the NSD have already been on-boarded to the NFVO.
- 3) The OSS/BSS issues the Create NS Identifier operation to the NFVO.
- 4) The OSS/BSS issues the Instantiate NS operation to the NFVO.
- 5) If the NSD contains VNF Profiles with a non-zero number of VNF instances to be instantiated in the NS, then the NFVO performs the instantiation procedure for each VNF that requires instantiation.

- 6) When the NS is instantiated and an NS instance ID is available, the OSS/BSS may request additional VNF instances to be added to the "VNF pool" NS instance either by instantiating them (steps 6a and 6b) or by associating the existing VNF instances with the "VNF pool" NS instance (steps 7a and 7b). This allows the operator to perform a "bottom-up" NS instantiation - complete (if no VNF instances were instantiated in step 5, according to the numbers in the NSD) or partial (in addition to those VNF instances that were instantiated in step 5).
- 6a) In this operation the OSS/BSS tells what new VNF instances should be added to the "VNF pool" NS instance.
- 6b) The NFVO performs the VNF instantiation(s) according to the request received from the OSS/BSS.
- 7a) In this operation the OSS/BSS tells what existing VNF instances(e.g. those that are associated with other NS instances) should be added (or possibly removed) to (from) the "VNF pool" NS instance.
- 7b) The NFVO associates the VNF instance to the "VNF Pool" NS instance according to the request received from the OSS/BSS.

C.3 New NS utilizing VNF instances from a VNF pool NS

In this clause the flow is described how an NS can be built up from existing VNF instances.

The sequence diagram of the case is shown in figure C.3-1.

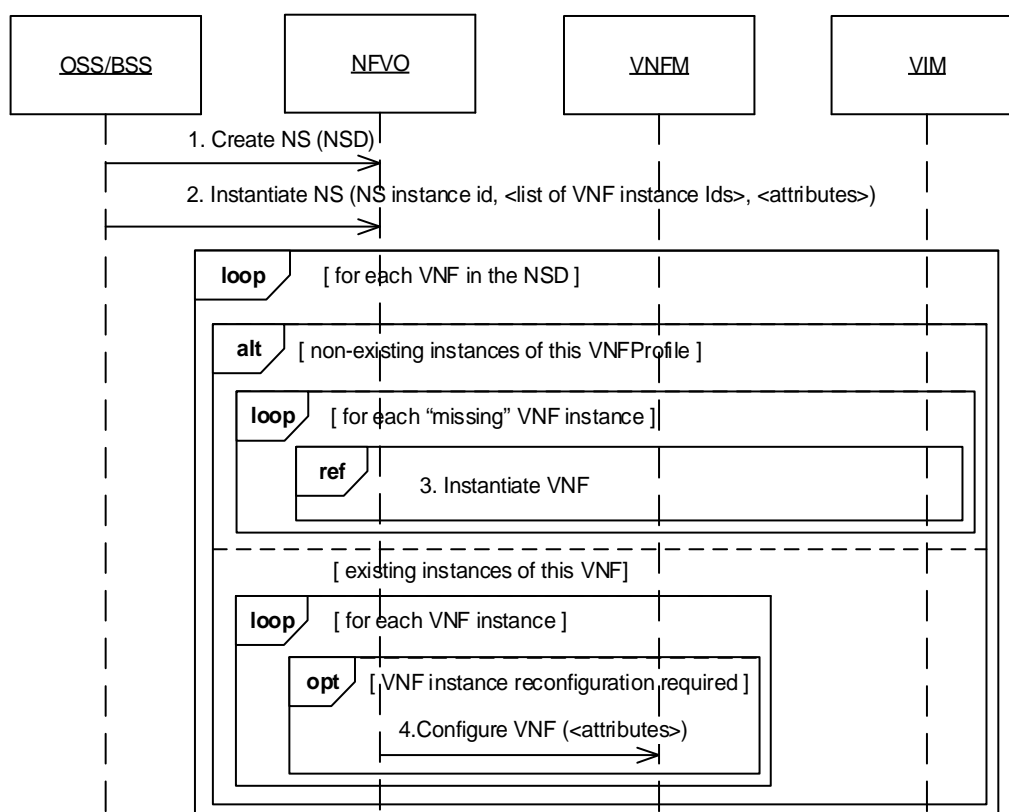


Figure C.3-1: Creating NS with existing VNF instance(s)

- 0) It is assumed, that there is already an existing "VNF pool" NS instance with some VNF instances in it (see "VNF Pool Creation" use case for details). It is also assumed, that the NSD of a "real" NS has been created and on-boarded to the NFVO.
- 1) The OSS/BSS requests the creation of an NS instance for the "real" network service.
- 2) The OSS/BSS requests the instantiation of the NS. As part of the Instantiate NS operation the OSS/BSS can indicate the VNF instances (by listing their ids) to be used in the newly instantiated NS. These VNFs become shared between the "VNF Pool" NS and the "real" NS that is being instantiated.

- 3) The NFVO performs VNF instantiation procedure for each VNFs that is "missing" (does not have an already existing instance) according to the NSD of the NS.
- 4) The NFVO may need to request VNFM to reconfigure the "existing" VNF instances (e.g. those from the "VNF pool") according to the attributes of the NS lifecycle management operation.

C.4 Terminating NS instance with retained VNF instances

In this scenario an NS is terminated, while certain VNF instances need to be retained. The VNFs to be retained are added to the VNF Pool NS before the "normal" NS is terminated. The flow is described in figure C.4-1.

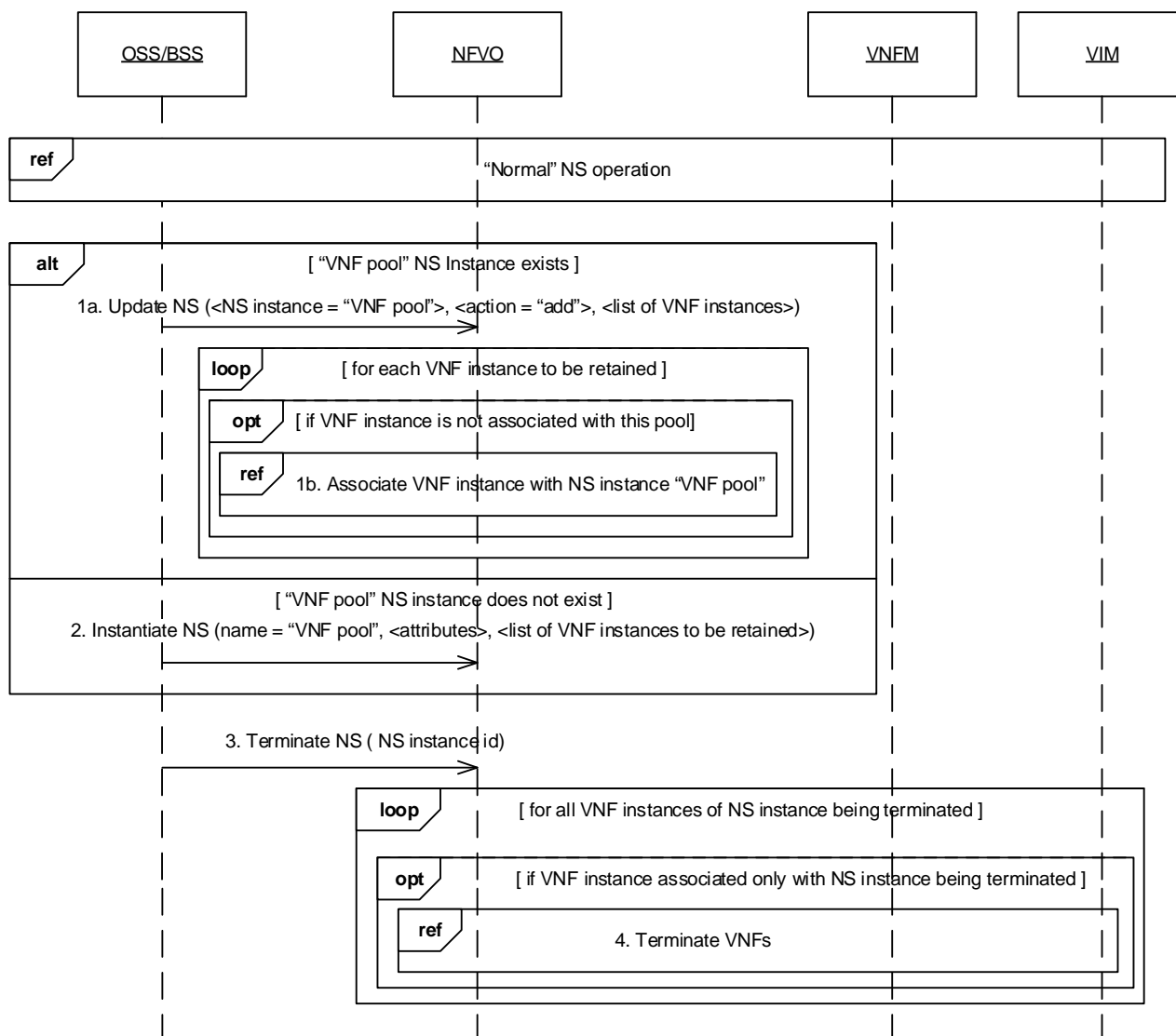


Figure C.4-1: Terminating an NS with retained VNF instance(s)

- 0) It is assumed, that there is an existing instance of an NS.
- 1a) If operator decides to use an existing "VNF pool" NS instance to retain the VNF instances from the NS being terminated, then the OSS/BSS issues an Update NS operation indicating the NS instance Id to be the "VNF Pool" NS and the list of VNF Instance Ids (to be retained) that should be added to the "VNF Pool" NS. Based on operator's decision, there could be multiple "VNF pool" NS instances (e.g. one per VNF type or one per operator's intention) - in such cases, there will be a separate Update NS operation per "VNF pool" NS instance.

- 1b) The NFVO associates each VNF instance being retained to the "VNF Pool" NS instance, according to the Update NS operation.
- 2) If operator decides to use a new "VNF Pool" NS instance, then OSS/BSS needs to create one. In the Instantiate NS operation, OSS/BSS can provide the list of VNF instance Ids to be retained.
- 3) OSS/BSS issues the Terminate NS operation indicating the NS instance Id to be terminated. The VNF instances being retained are already associated with more than one NS (the NS instance being terminated and "VNF pool" NS instance).
- 4) The NFVO terminates all those VNF instances associated only with the NS instance that is being terminated.

Annex D (informative): State models

D.1 VNF Package state model

D.1.1 Introduction

This annex proposes a state model a given VNF Package in the NFVO, including both on-boarding phase and operational phase.

All the steps before the on-boarding of the VNF Package are not part of this state model.

D.1.2 State model

A given VNF Package has three states, i.e. on-boarding state, operational state and usage state.

The on-boarding state is represented by the "onboardingState" attribute in the "VnfPkgInfo" information element with below values:

- **CREATED:** The VNF Package information object is created.
- **UPLOADING:** The VNF Package is being uploaded.
- **PROCESSING:** The VNF Package is being processed, e.g. validation.
- **ONBOARDED:** The VNF Package is successfully on-boarded.

The operational state is represented by the "operationalState" attribute in the "VnfPkgInfo" information element with below values:

- **ENABLED:** The VNF Package is enabled.
- **DISABLED:** The VNF Package is disabled.

The usage state is represented by the "usageState" attribute in the "VnfPkgInfo" information element with below values:

- **IN_USE:** The VNF Package is in use.
- **NOT_IN_USE:** The VNF Package is not in use.

The state model of on-boarding phase in figure D.1.2-1 applies to a given VNF Package being on-boarded. Besides the operations and conditions specified in the figure, below operations are also considered as available during the on-boarding phase:

- Query VNF Package Info.
- Update VNF Package Info (with user defined data only).

The state model of operational phase in figure D.1.2-1 applies to an on-boarded VNF Package. Besides the operations and conditions specified in the figure, below operations are also considered as available during the operational phase:

- Query VNF Package Info.
- Update VNF Package Info (with user defined data only).
- Fetch VNF Package.
- Fetch VNF Package Artifacts.

The "onboardingState" details the state changes during the VNF Package on-boarding phase. The value of this attribute during the VNF Package operational phase is "ONBOARDED".

The "operationalState" and "usageState" detail the state changes during the VNF Package operational phase. During the VNF Package on-boarding phase, the value of the "operationalState" is "DISABLED" and the value of the "usageState" is "NOT_IN_USE". Right after the VNF Package becomes on-boarded, the value of the "operationalState" is changed to "ENABLED" and the value of the "usageState" is kept as "NOT_IN_USE", as shown in figure D.1.2-1.

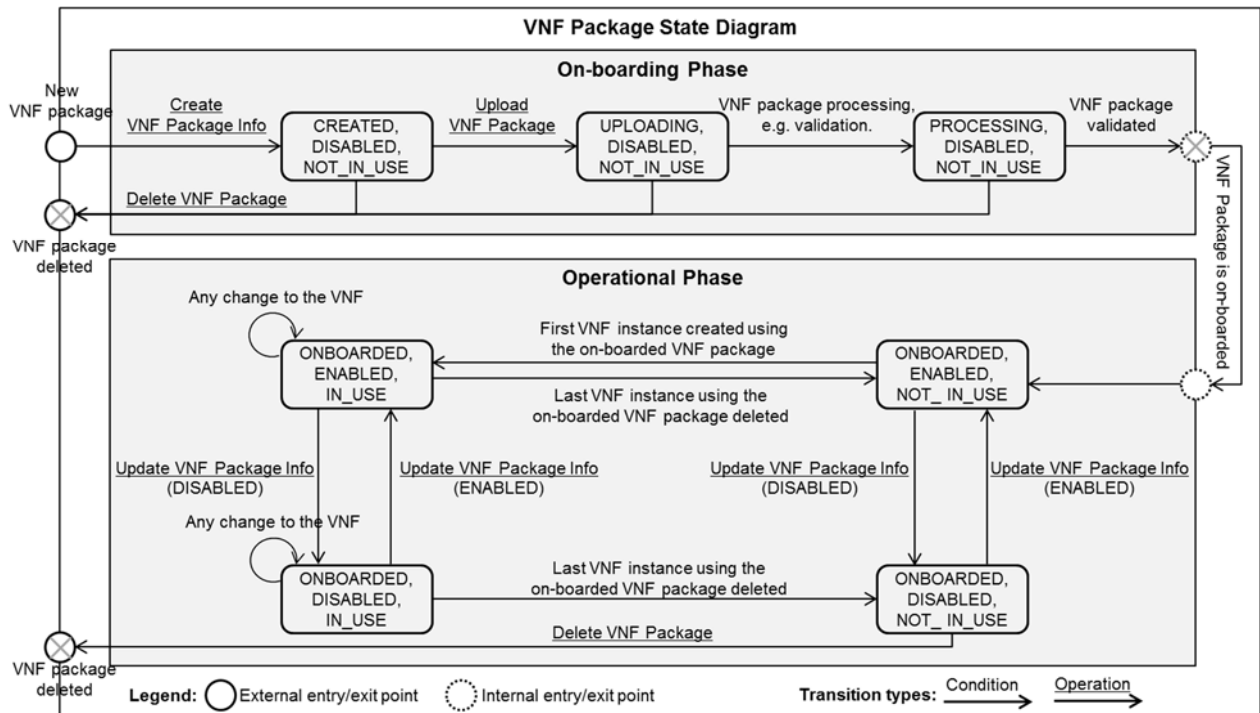


Figure D.1.2-1: VNF Package state model

D.2 NSD state model

D.2.1 Introduction

This clause proposes a state model for a given NSD in the NFVO, including both on-boarding phase and operational phase.

D.2.2 State model

A given NSD has three states, i.e. on-boarding state, operational state and usage state.

The on-boarding state is represented by the "onboardingState" attribute in the "NsdInfo" information element with below values:

- **CREATED:** The NSD information object is created.
- **UPLOADING:** The NSD is being uploaded.
- **PROCESSING:** The NSD is being processed, e.g. validation.
- **ONBOARDED:** The NSD is successfully on-boarded.

The operational state is represented by the "operationalState" attribute in the "NsdInfo" information element with below values:

- ENABLED: The NSD is enabled.
- DISABLED: The NSD is disabled.

The usage state is represented by the "usageState" attribute in the "NsdInfo" information element with below values:

- IN_USE: The NSD is in use.
- NOT_IN_USE: The NSD is not in use.

The state model of on-boarding phase in figure D.2.2-1 applies to a given NSD being on-boarded. Besides the operations and conditions specified in the figure, below operations are also considered as available during the on-boarding phase:

- Query NSD Info.
- Update NSD Info (with user defined data only).

The state model of operational phase in figure D.2.2-1 applies to an on-boarded NSD. Besides the operations and conditions specified in the figure, below operations are also considered as available during the operational phase:

- Query NSD Info.
- Update NSD Info (with user defined data only).
- Fetch NSD.

The "onboardingState" details the state changes during the NSD on-boarding phase. The value of this attribute during the NSD operational phase is "ONBOARDED".

The "operationalState" and "usageState" detail the state changes during the NSD operational phase. During the NSD on-boarding phase, the value of the "operationalState" is "DISABLED" and the value of the "usageState" is "NOT_IN_USE". Right after the NSD becomes on-boarded, the value of the "operationalState" is changed to "ENABLED" and the value of the "usageState" is kept as "NOT_IN_USE", as shown in figure D.2.2-1.

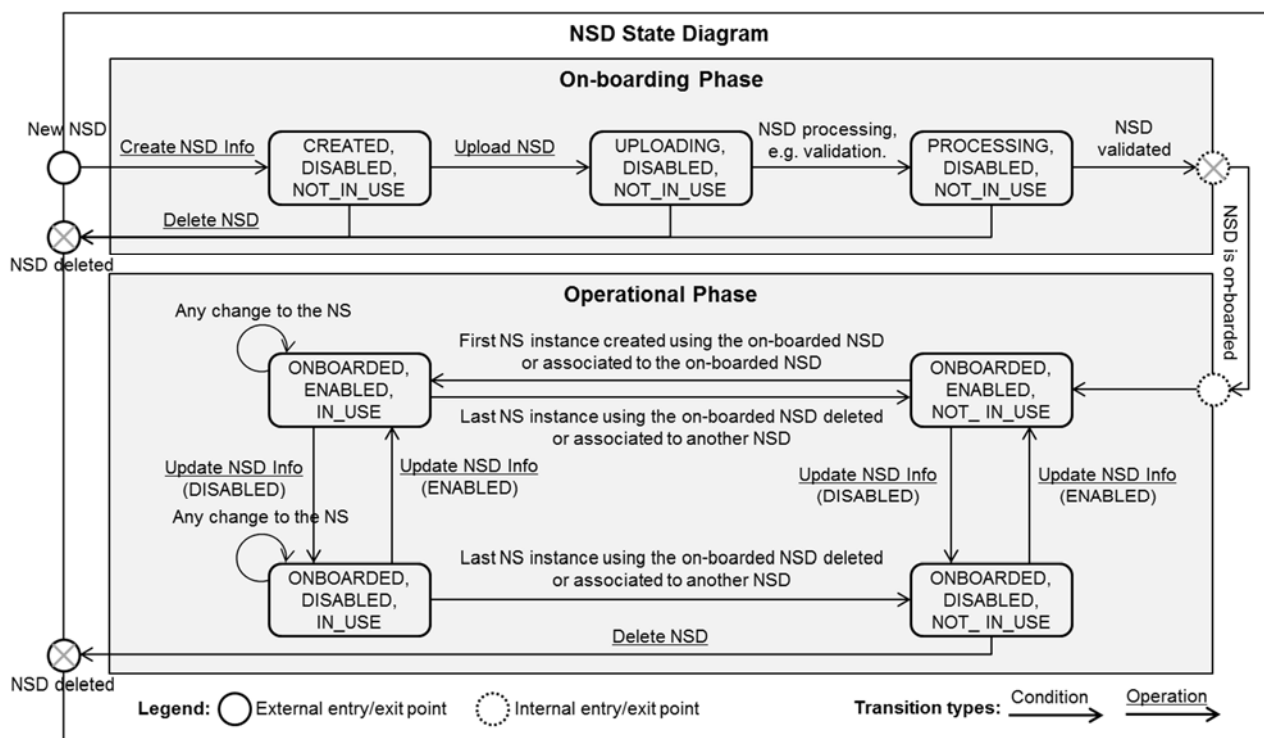


Figure D.2.2-1: NSD state model

D.3 NS state model

D.3.1 Introduction

This clause proposes a state model for the NS instance in the NFVO.

All the steps before the initial Create NS Identifier are not part of this state model.

D.3.2 State model

A given NS instance has 2 elementary state values in the NFVO: INSTANTIATED, NOT_INSTANTIATED.

The state model, shown in figure D.3.2-1, applies to a given NS instance.

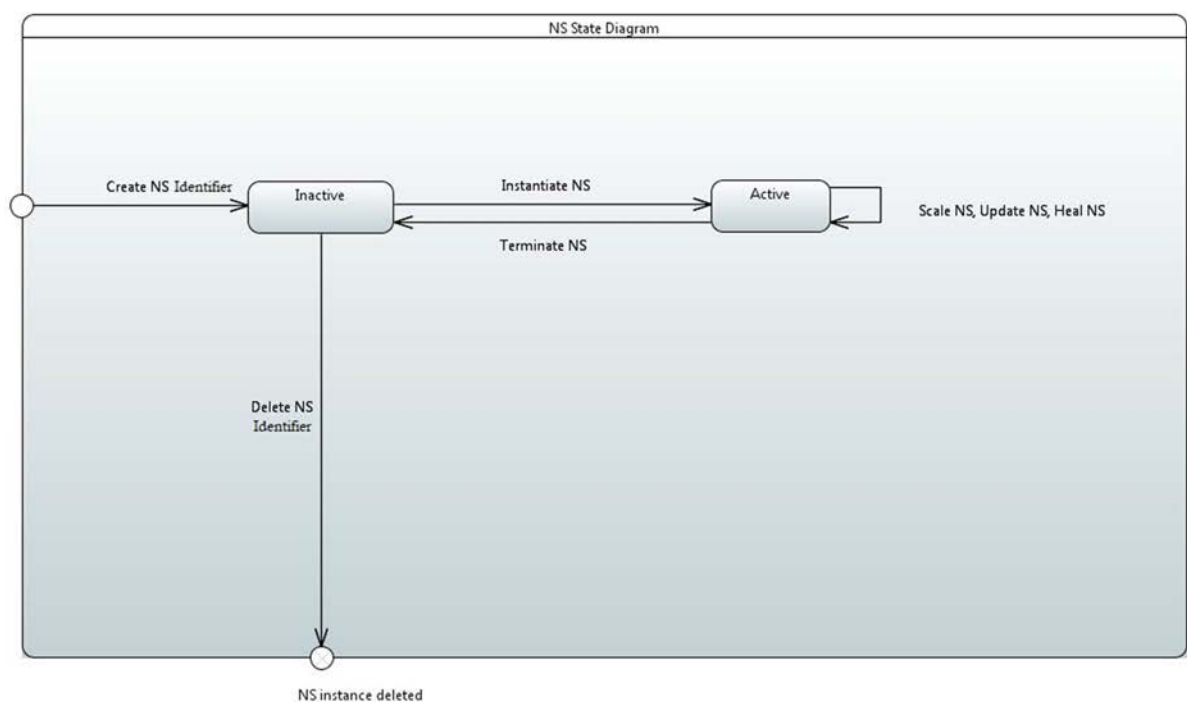


Figure D.3.2-1: Network Service instance state model

The query NS operation is considered as available in all the states above.

Annex E (informative): NS scaling

E.1 Forms of NS scaling

The aim of NS scaling is to increase or decrease the capacity of a network Service instance. This can be achieved in various ways:

- **Scaling a VNF instance:** If a constituent VNF instance in the NS instance is not yet scaled to its limits. However it is also possible that either the VNF instance is already scaled to its limits or the VNF instance does not support scaling, then VNF scale cannot be used as part of NS scale operation.
- **Changing the DF of a VNF instance:** If a VNF is already scaled to its limits, then the next step of increasing the capacity of a VNF is to use the DF change (if there is a higher/lower capacity DF of the VNF). If the DF change of the VNF requires topology changes, NFVO can create/modify the required VLs. Also the VNF DF changes may require application level configuration task, which is done by the traditional management system therefore interaction with OSS/BSS or EM may be required.
- **Adding/removing VNF instance(s) to/from the NS:** In this scenario the capacity of the NS is changed by adding/removing VNF instance(s) to/from the NS instance. In this scenario the NFVO need to take care of creating the necessary links between the VNF instances according to the connectivity requirements defined in the NSD. This type of NS scaling may also require application level configuration task, which needs to be performed by the traditional management system (by OSS/BSS or EM).
- **Scaling to a new NS DF:** In this scenario the NS DF is changed to a new one, which contains higher/lower capacities. The NFVO may require instantiation/termination of VNF instances according to the NSD of the new NS DF.
- **Scaling a nested NS:** The capacity of an NS can also be changed by changing the capacity of a nested NS if the network service contains a nested network service.
- **Scaling of a VL:** It may also be necessary as part of the capacity change need of an NS to change the capacity of a VL in an NS. This may be achieved either by changing the properties of a VL or by adding/removing VL in an NS. The latter may require application level configuration as well, therefore interaction with OSS/BSS may be required.

E.2 NS scaling triggers

E.2.1 NS auto-scale

In this case the NS scale decision is made at NFVO based on the information provided in the NSD. The main attributes to be used for the NS auto-scale functionality is the monitoring parameter and the indicators that are re-exposed in the Or-Vnm reference point specified in the NSD and the associated auto-scale rule.

E.2.2 NS scale triggered by OSS/BSS

In this case the NS scale operation is requested by OSS/BSS via the Os-Ma-nfvo reference point. OSS/BSS can specify what to scale by providing the scale rules to NFVO (similar to the auto-scale rules defined in the NSD). The OSS/BSS may also provide explicit guidance to the NFVO what to scale and in what way, i.e. the OSS/BSS may tell to NFVO to scale a specific VNF instance to a specific scale level.

E.3 Relation to NS DF

The NS scale operates either within the boundaries of a network service DF as specified in the NSD or by changing the NS DF. The NS DF provides the minimum and maximum number of instances of each VNFs the NS is built upon. Each VNF in the NSD references to a specific VNF DF as specified in the VNFD.

As a consequence of the above an NS scale can operate via a VNF scale within the boundaries of a VNF DF as specified in the VNFD or by adding/removing VNF instances within the boundaries of an NS DF as specified in the NSD.

The capacity of an NS may be changed by changing or moving from one NS DF to another DF.

If an NS contains a nested NS, the change of the capacity can be achieved by scaling the nested NS.

E.4 Input and tools for NS auto-scaling

E.4.1 Monitoring parameter

Monitoring parameters are defined in NSD and may be used to trigger the necessary NS scaling actions at NFVO. Monitoring parameters can specify the values/threshold of a PM counter that is available at NFVO (e.g. derived from virtualised resource performance metrics) and the associated auto-scaling rules/policies.

E.4.2 VNF indicator

VNF indicators are declared in the VNFD and are provided either by the VNF or by the EM managing the VNF. These VNF indicators are forwarded to the NFVO by the VNFM managing the VNFs. These VNF indicators may also be used by the NFVO for its NS auto-scale functionality.

E.4.3 Auto-scale policies/rules

This should define the required scaling actions based on the monitoring parameters and/or VNF indicators. It should define in priority order e.g. what VNFs to scale or whether a VNF instance to be added or removed to the NS instance. In case of VNF scale it should specify also the Scale aspect of the VNF scale operation that can be used from NFVO towards the VNFM.

Annex F (informative): Example interaction flows

F.1 LCM Coordination flow

Figure F.1-1 illustrates the use of LCM Coordination interface (specified in clause 6.1).

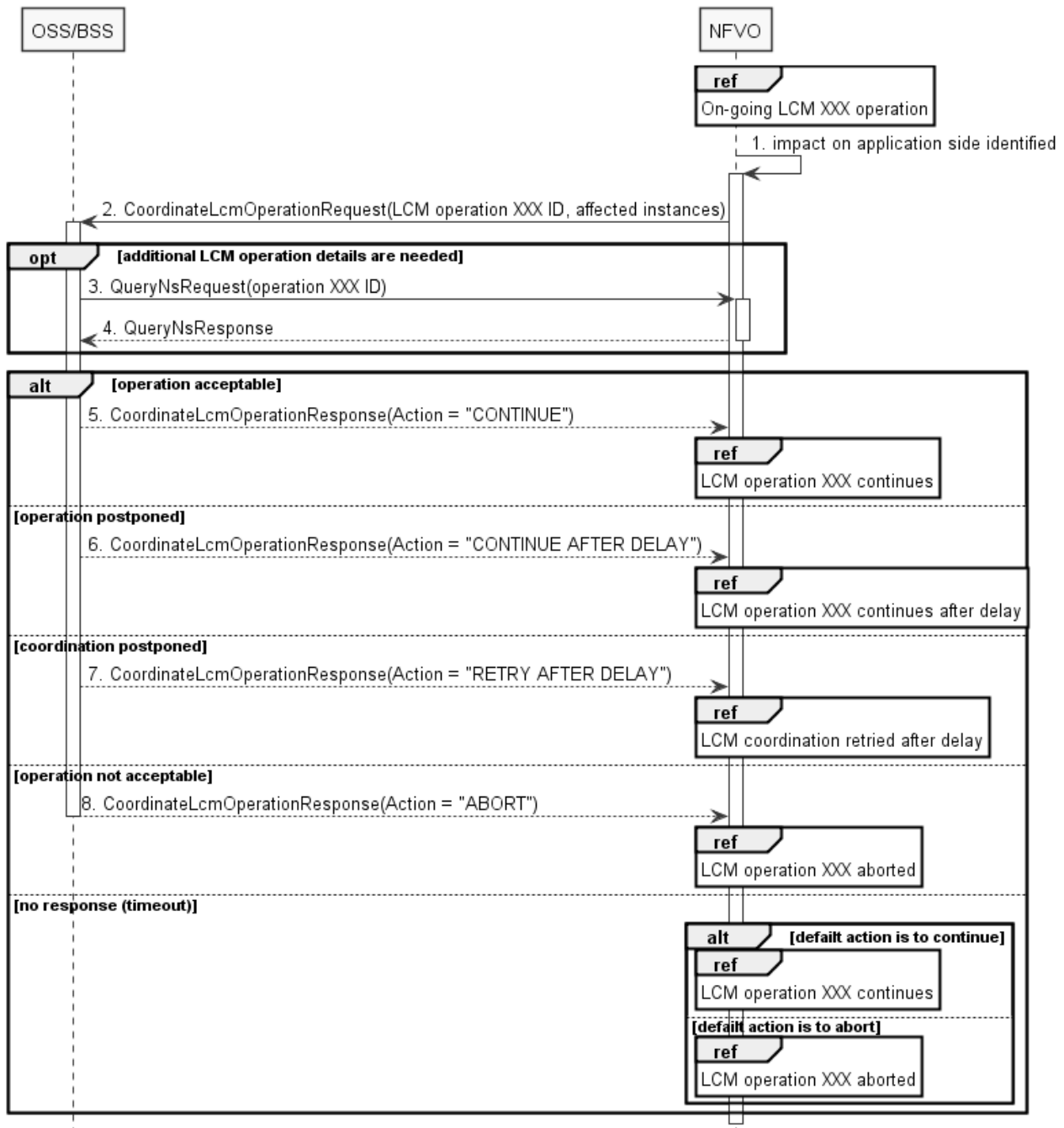


Figure F.1-1: LCM Coordination example interaction flow

Annex G (informative): Change history

Date	Version	Information about changes
9 October 2017	V2.3.2	NFVIFA(17)000839r3, IFA013ed241: Refactor the NSD Management Interface NFVIFA(17)000762r1, IFA013 Change of description of nsdId attribute in NsInfo NFVIFA(17)000682r1, IFA013ed241: Rename "NsLifecycleChangeNotification" to "NsLcmOperationOccurrenceNotification" NFVIFA(17)000737, IFA013ed231: Enhance NS Fault Management Interface NFVIFA(17)000742r1, IFA013ed241: Update Alarm IE on NS Fault Management Interface
November 2017	V2.3.3	NFVIFA(17)000805r2, IFA013 Adding NfpRule specification NFVIFA(17)000876r1, IFA013ed241: Refactor NSD management interface - fixing the consistency issues NFVIFA(17)000903, IFA013ed241: Add NS fault management related requirements NFVIFA(17)000931r1, IFA013ed241: NsInfo information element fix NFVIFA(17)000941r1, IFA013ed241: Clarify actionsHealing parameter in the HealNsData information element NFVIFA(17)000943, IFA013ed241: Harmonize NFP related Information Elements NFVIFA(17)000859r5, IFA013ed241: Refactor the VNF Package Management Interface NFVIFA(17)000878r3, IFA013ed241: Refactor PNFD management
December 2017	V2.3.4	NFVIFA(17)000932r3, IFA013ed241: Update NsLcmOperationOccurrenceNotification IE NFVIFA(17)0001040r3, IFA013ed241: Update ResourceHandle IE NFVIFA(17)0001080r13, IFA013v020303_Add_PNF_Updating_Operation_in_Update_NS_Operation_And_Add_New_IEs_For_PNF NFVIFA(17)0001092, IFA013ed241 Add fetching and updating related interface requirements NFVIFA(17)0001093, IFA013ed241 Correction on inconsistent change of on-board NSD and VNF package NFVIFA(17)0001096, IFA013ed241: Query filter design on NSD and VNF package management Interface NFVIFA(17)0001097, IFA013ed241: Remove the port number from the SapData/SapInfo/PnfExtCplInfo IE NFVIFA(17)0001098, IFA013ed241: Update the NSD state diagram NFVIFA(17)0001103, IFA013ed241 Clarification of ExtManagedVirtualLink and ExtVirtualLink NFVIFA(17)0001104r2, IFA013ed241 Interface requirement fix for update NSD/VNF package operations NFVIFA(17)0001105, IFA013ed241 Align description of VNF Package Change Notification NFVIFA(17)0001113r3, IFA013ed241 - Corrections related to multiple layer protocol support NFVIFA(17)0001118r1, IFA013ed241 Correction on notes in clause 5.3.2 NFVIFA(17)0001119, IFA013ed241 Correction on notes in clauses 8.2.2.2 and 8.2.4.2 NFVIFA(17)0001132r1, IFA013ed241 Correction on the name of NS lifecycle change notification interface NFVIFA(17)0001095r3, IFA013ed241: Add new NS Change Notification on NS LCM interface NFVIFA(17)0001117r1, IFA013ed241 LCM operation response and notification in operation results (mirror of 1111) NFVIFA(17)0001139r1, IFA013ed241: Add Notification for PNFD Management NFVIFA(17)0001145r1, IFA013ed241 - Clarifications on NsVL, NsLinkPort and ExtVL, ExtLinkPort NFVIFA(17)0001150r1, IFA013ed241: Add "changedVnfInfo" parameter to the AffectedVnf information element NFVIFA(17)001152, IFA013ed241 Remove redundant description of vnfConfigurableProperty NFVIFA(17)0001153r1, IFA013ed241: Mirror from IFA#1037 about external connectivity and address data NFVIFA(17)001008r2, IFA013ed241: Update AffectedXXX IE NFVIFA(17)0001165, IFA013ed241: Rename NsVirtualLink and NsLinkPort
March 2018	V2.4.2	NFVIFA(18)000171, IFA013ed251 - Add profile id for NsVirtualLinkInfo NFVIFA(18)000176, IFA013ed251 - Remove IFA012 references
May 2018	V2.4.3	NFVIFA(18)000191r1, IFA013ed251 Add monitoringParameter attribute to NsInfo IE
May 2018	V3.0.0	V3.0.0 created from V2.4.3 NFVIFA(18)000119r1 already included as NFVIFA000171 NFVIFA(18)000177r1 already included as NFVIFA(18)000176
May 2018	V3.0.1	NFVIFA(18)000422r2, IFA013 MegaCR FEAT04 Compute Host Reservation
June 2108	V3.0.2	NFVIFA(18)000429r1, FEAT07 IFA013 MegaCR Support of policy management interface

Date	Version	Information about changes
June 2018	V3.0.3	NFVIFA(18)000534, IFA013ed311 - Mirror - Linking VNFC CP and VnfExt CP NFVIFA(18)000537r1, IFA013ed311 - Mirror - Clarifying association from VnfLinkPort to VnfcCp and VnfExtCp NFVIFA(18)000566, IFA013ed311: Remove the current values of the monitoringParameter attribute from the NS LCM interface NFVIFA(18)000603, IFA013ed311 Rel3Mirror different names for virtual link descriptor ids NFVIFA(18)000616r1, IFA013ed311 - Rel3Mirror - Fixing sentence related to PM delivery mechanism NFVIFA(18)000625, IFA013ed311 Rel3Mirror Add NestedNsInstanceData for NS LCM operation NFVIFA(18)000626, IFA013ed311 Rel3Mirror Add ParamsForNestedNs for InstantiateNs operation NFVIFA(18)000639r2, IFA013ed311 - Fixing NFP management NFVIFA(18)000641, IFA013ed311 Rel3Mirror of 435r2 metadata for CP IEs NFVIFA(18)000541r1, IFA013 MegaCR FEAT15 VNF Snapshot
August 2018	V3.1.2	NFVIFA(18)000719r4: associate PNF or VNF instance with Profile
November 2018	V3.1.3	NFVIFA(18)000819 - IFA013ed321 Use on vnfProfile in Instantiate NS operation NFVIFA(18)000836 - IFA013ed321 Mirror of 834 (IFA007ed321 Mirror for SOL contribution on making the API surface consistent for bootData) NFVIFA(18)000883r1 - IFA013ed321 Fix bug 7760: Inconsistency between IFA013 and SOL005 NFVIFA(18)000896 - IFA013ed321 Add pfld in Policy Transfer operation NFVIFA(18)000889r2 - IFA013ed321_update_of_IEs_related_to_PM_interface_for_IFA027
December 2018	V3.1.4	NFVIFA(18)000961_IFA013ed321_Metadata_Extension_ConfigurableProps_clarificati.docx NFVIFA(18)0001001_IFA013ed321_CR_add_policy_associate_disassociate_operations.docx NFVIFA(18)0001083r1 - IFA013ed321 - Add LCM Coordination interface NFVIFA(18)0001057 - IFA013ed321 Fix bug 7815 Superfluous word NFVIFA(18)0001034 - IFA013 VNF snapshot createdAt and userDefinedData
January 2019	V3.1.5	NFVIFA(19)000021 - IFA013ed321 small improvements in Clause 4-1 NFVIFA(19)000028 - IFA013 Small bugfix clause 538 NFVIFA(19)000014r1 - IFA013 MegaCR FEAT05 Slicing
February 2019	V3.1.6	NFVIFA(18)0001110r4 - FEAT10 IFA013 MegaCR NFVIFA(19)000077r3 - FEAT02 IFA013 Adding Changing VNF Package NFVIFA(19)000121 - IFA013ed321_editorial_improvements_for_DateTime Some editorial changes
February 2019	V3.1.7	NFVIFA(19)000137r2 - IFA013ed321 PNF Package operations NFVIFA(19)000138 - IFA013ed321 Fix references to other documents NFVIFA(19)000148r1 - FEAT02 IFA013 mirror of 142r2 NFVIFA(19)000159r1 - IFA013ed321 Clause 8-3-2-3 adding changeType values
May 2019	V3.2.2	Base Line for Release 3 Drop 3 created from published version 3.2.1
June 2019	V3.2.3	NFVIFA(19)000362r2 - IFA013ed331 Mirror - Correction cardinality VnfcSnapshotInfo and description VnfSnapshotInfo NFVIFA(19)000508 - IFA013 Alignment with Stage 3 work on VNF snapshot feature NFVIFA(19)000546r1 - IFA013 capacity threshold management NFVIFA(19)000552r2 - IFA013ed331 capacity threshold management
July 2019	V3.2.4	NFVIFA(19)000584 - IFA013ed331 Fix bug 7850 (correctly_implement_639r2) NFVIFA(19)000623 - IFA013ed331 Rel3Mirror 8.3.4.13 ExtVirtualLinkData IE NFVIFA(19)000637 - IFA013ed331 VnfLinkPortInfo IE NFVIFA(19)000638 - IFA013ed331 VnfSnapshotPkgInfo IE NFVIFA(19)000642 - IFA013ed331 Rel3Mirror 8.3.4.36 VnfExtCpConfig IE NFVIFA(19)000666 - IFA013ed331 Rel3Mirror 8.6.4 VnfPackageSoftwareImageInformation IE Some editorial changes
October 2019	V3.3.2	Initial version for maintenance Fix capitalization of OS-Ma-Nfvo to Os-Ma-nfvo
October 2019	V3.3.3	NFVIFA(19)000762 - IFA013ed341 measurementContext in ThresholdCrossedNotification NFVIFA(19)000809r1 - IFA013ed341 improving several IE descriptions NFVIFA(19)000819 - IFA013ed341 modifying VNF package references
November 2019	V3.3.4	NFVIFA(19)000850 IFA013ed341 Support upload of VNF Package as separate files NFVIFA(19)000853r1 IFA013ed341 Clarifying usage of pfld in Transfer Policy operation NFVIFA(19)000862 IFA013ed341 Provide additional description in VnfInfo NFVIFA(19)000885 IFA013ed341 mirror of 825r1 exposing maxScaleLevels NFVIFA(19)000889 IFA013ed341 mirror of 841 relaxing PM subscriptions NFVIFA(19)000892 IFA013-Remove Annex -Authors and contributors

Date	Version	Information about changes	
December 2019	V3.3.5	NFVIFA(19)000874r3 NFVIFA(19)000936 NFVIFA(19)000949 NFVIFA(19)000944r5 NFVIFA(19)000925r4	IFA013ed341 Enhancements in ChangeExtVnfConnectivity IFA013ed341 FEAT10 Bugs and clarifications multi-site connectivity IFA013ed341 Add update VNF snapshot package operation IFA013 Improve wording left for protocol design stage IFA013ed341 Support for dynamic creation and deletion of NsVirtualLink instances
January 2020	V3.3.6	NFVIFA(20)000001 NFVIFA(20)000022r1	IFA013ed341 mirror of 1004 adding vnfConfProps to ChangeCurrentVnfPackage IFA013ed341 Fetch PNFD and NSD artifact operations Rapporteur's action to use NFV-MANO consistently (one remaining case)
March 2020	V3.3.7	NFVIFA(19)0001020 NFVIFA(20)000061 NFVIFA(20)000064r1 NFVIFA(20)000014r1 NFVIFA(20)000132 NFVIFA(20)000135r1	IFA013ed341 add 2 small notes for consistency IFA013ed341 FEAT10 Handling of WAN connectivity information IFA013ed341 locationConstraints for nested NS IFA013ed341 mirror of 12 adding missing extensions and vnfConfigurableProperties to ChangeVnfFlavour IFA013ed341 sync to IFA015 work according to 942r13 part4 IFA013ed341 editorial changes
March 2020	V3.3.8	NFVIFA(20)000043r3 NFVIFA(20)000130r2 NFVIFA(20)000131r1 NFVIFA(20)000138 NFVIFA(20)000165r1 NFVIFA(20)000183 NFVIFA(20)000174r2 NFVIFA(20)000133r4 NFVIFA(20)000166r3 NFVIFA(20)000195r1 NFVIFA(20)000196r1	IFA013ed341 sync to IFA015 work according to 942r1 part1 IFA013ed341 sync to IFA015 work according to 942r13 part2 IFA013ed341 sync to IFA015 work according to 942r13 part3 IFA013ed341 Labelling conditional mandatory IFA013 fix enum values part 1 IFA013ed341_locationConstraints_for_nested_NS_additional_changes IFA013ed341 FEAT15 alignment with stage 3 IFA013ed341 sync to IFA015 work according to 942r13 part5 IFA013 fix enum values part 2 IFA013 fix enum values part 3 IFA013 fix enum values part 4
April 2020	V3.3.9	NFVIFA(20)000231r1	IFA013ed341 FEAT15 Moving VNF snapshot package API
April 2020	V3.3.10	NFVIFA(20)000275 NFVIFA(20)000277 NFVIFA(20)000278r1 NFVIFA(20)000293 NFVIFA(20)000294r1	IFA013 alignment efforts fix typos part 1 IFA013 alignment efforts fix typos part 2 IFA013ed341 align location constraints to SOL169r5 (some editorial corrections in 8.3.4.47) IFA013ed341 Fix notes in Clause 8.3.4.16 IFA013ed341 FEAT15 Alignment of VnfcSnapshotInfo
April 2020	V3.3.11	NFVIFA(20)000315	IFA013ed341 Relaxing NFVI capacity notification subscriptions
June 2020	V4.0.1	Initial version for Release 4	
September 2020	V4.0.2	NFVIFA(20)000475 NFVIFA(20)000476 NFVIFA(20)000505 NFVIFA(20)000528r1 NFVIFA(20)000531 NFVIFA(20)000535	IFA013ed4111 Mirror of 382 Fix Type mismatch VnfDeployemtnFlavour IFA013ed411 Mirror of 454 FEAT15 Addressing gap additionalParams VNF snapshots IFA013ed411 mirror of 494 Adding Trunk Logical Topology between VNFC CPs IFA013ed411 mirror of 379r3 Modifications to NsLcmOperationOccurrenceNotification IFA013ed411 Mirror of 333r3 Changes in Terminate NS operation IFA013edr411 Mirror of NFVIFA(20)000534 fix usage of NFV003
October 2020	V4.0.3	NFVIFA(20)000675 NFVIFA(20)000699	IFA013ed411 Rel4 mirror of 666 VipCp related changes in linkport referencing IFA013ed421 Rel-4 mirror of 608, VIP and external connectivity related updates
December 2020	V4.0.4	NFVIFA(20)000662r2 NFVIFA(20)000778 NFVIFA(20)000823	IFA013ed421 MegaCR ENH02.02 NS feasibility check IFA013ed421 (forward mirror of 775) Aligning with SOL317 fixing notifying information about extLinkPort IFA013ed421 Rel-4 Mirror of 802, VnfExtCpInfo update
March 2021	V4.0.5	NFVIFA(20)000819r2 NFVIFA(20)000924 NFVIFA(20)000845r3	IFA013ed421 mirror of 818 Adding vnfProfileId to InstantiateVnfData IFA013ed411 Rel4 mirror of 862 VipCp related small fix ENH02.05 IFA013ed421 Introduction of nsScaleInfo complementing nsInstantionLevelId (overlap with 819r2 resolved by rapporteur)
March 2021	V4.0.6	NFVIFA(21)000126r1 NFVIFA(21)000154r1 NFVIFA(21)000188 NFVIFA(21)000219r1 NFVIFA(20)000838r3	IFA013ed421 mirror of 118 Cross stages alignment w.r.t. LCM coordination IFA013ed421 Rel4 mirror of 152 Cross stages alignment coordination delay IFA013ed421 Rel4 mirror of 144 adding additional attributes in Terminate NS and Update NS IFA013ed421 Mirror of 218 Avoid Reference to MAN001 Enh02.04-IFA013ed421 Adding descriptor Ids to NS LCM operations
March 2021	V4.0.7	NFVIFA(21)000204	IFA013ed421 MegaCR FEAT17 Cloud-native VNFs

Date	Version	Information about changes	
June 2021	V4.2.2	Initial version for Release 4 drop 3	
October 2021	V4.2.3	NFVIFA(21)000828r1	IFA013ed431 (Mirror of 827) Clause 7 Adding subscription management to PM interface
		NFVIFA(21)000851r1	IFA013ed431 Add ExtInvariantId in VnfPkgInfo, NsdInfo and PnfdInfo
		NFVIFA(21)000853r6	ENH02_03_IFA013_release_4_MegaCR
November 2021	V4.2.4	NFVIFA(21)000894	IFA013ed431 Rel4 mirror of 893 NsChangeNotification bugfix
		NFVIFA(21)000908	IFA013ed431 Rel.4 mirror of 907 vnfld in resource info elements
		NFVIFA(21)000918	IFA013ed431 (mirror of 916) FEAT17 Runtime modelling of VirtualCp
March 2022	V4.2.5	NFVIFA(21)0001065r1	IFA013ed431_Correction_for_Create_Delete_NS_identifier_operation
		NFVIFA(22)000187r2	IFA013ed431 FEAT21 MegaCR
		NFVIFA(22)000198r1	IFA013ed431 MegaCR FEAT17 Cloud-native VNFs
April 2022	V4.2.6	NFVIFA(22)000259	FEAT17 IFA013 Mirror of 257 - MciInfo alignment with stage 3
June 2022	V4.3.2	Initial version for Release 4 drop 4	
November 2022	V4.3.3	NFVIFA(22)000649r1	IFA013ed441 Error information related to NS feasibility check
		NFVIFA(22)000693	IFA013ed441 Add targetScaleLevelInfo to ParamsForVnf information element
		NFVIFA(22)000841r4	IFA013ed441 Modify AssocNewNsdVersionData
		NFVIFA(22)000903	IFA013ed441_correct_netAttDefResourceNamespace
		As rapporteur action fix the reference to notes in table 8.3.4.19.2-1	
January 2023	V4.3.4	NFVIFA(23)000024r1	IFA013ed441 Policy management alignment with IFA048
March 2023	V4.4.2	Initial version for Release 4 drop 5	
July 2023	V4.4.3	NFVIFA(22)000892r5	IFA013ed451 Feasibility Check Response Improvements (ENH 02.02 related)
		NFVIFA(23)000154r1	IFA013ed451 Enhance NFVI Capacity Interface with CIS Cluster Capacity
		NFVIFA(23)000363	IFA013ed451 Mirror of 309 Support for DaemonSets
		NFVIFA(23)000418r2	IFA013ed451 FEAT21 MegaCR for PaaS Services aspects
July 2023	V4.4.4	NFVIFA(23)000523	FEAT31 IFA013ed451 Mega CR for deployable modules support
		NFVIFA(23)000528	IFA013ed451 FEAT21 MegaCR for other enhancements
		NFVIFA(23)000492r4	IFA013ed451 Enh01.01 MegaCR
November 2023	V5.0.1	Base line for Release 5	
February 2024	V5.0.2	NFVIFA(23)000718r2	IFA013ed511 Add creating/deleting policy group operations
		NFVIFA(23)000719r2	IFA013ed511 Add policy group related IE in Activate Policy operation
		NFVIFA(23)000775r1	IFA013ed511 Add policy group related IE in Deactivate Policy operation
		NFVIFA(23)000776r1	IFA013ed511 Delete Policy operation changes when applying policy
		NFVIFA(23)000784r2	IFA013ed511 Add updating policy group operation
		NFVIFA(23)000820r1	IFA013ed511 Add querying policy group operation
		NFVIFA(23)000840	IFA013ed511 update content type of policy (mirror of 695r1)
		NFVIFA(24)000016r1	IFA013ed511 Completing policy group management specification
		NFVIFA(24)000030	(mirror (23)688r1) IFA013ed511 FEAT28 add reference to IFA045
		NFVIFA(24)000048	(mirror (23)754) IFA013ed511 FEAT21 maintenance networking aspects
		NFVIFA(24)000076	(mirror (23)684r1) IFA013ed511 Enh01.01 align with SOL
March 2024	V5.0.3	NFVIFA(24)000164r1	IFA013ed511_support_of_CIS_cluster_capacity_management
		NFVIFA(24)000167	IFA013ed511 Mirror of NFVIFA(23)000689 Fix VnfScaleInfo
		NFVIFA(24)000195	FEAT30 IFA013ed511 MegaCR
March 2024	V5.0.4	NFVIFA(24)000213r1	FEAT35 IFA013ed511 MegaCR
April 2024	V5.0.5	NFVIFA(24)000251	IFA013ed511 Multiple clauses Update references

History

Document history		
V5.1.1	June 2024	Publication