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GROUP SPECIFICATION

**Network Functions Virtualisation (NFV) Release 3;
Management and Orchestration;
Multiple Administrative Domain
Aspect Interfaces Specification**

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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).

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

1   Scope

The present document specifies the functional requirements, interfaces and operations to support the provision of network services across multiple administrative domains based on the interactions between NFVOs in different administrative domains (supported over the Or-Or reference point).

The present document also specifies the information elements exchanged over the specified interfaces.

The different aspects specified in the present document are derived from ETSI GR NFV-IFA 028 [i.1].

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 013: "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Os-Ma-Nfvo reference point - Interface and Information Model Specification".

[2]   ETSI GS NFV-IFA 010: "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Functional requirements 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-IFA 028: "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Report on architecture options to support multiple administrative domains".

[i.2]   ISO/IEC 9646-7: "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 7: Implementation Conformance Statements".

[i.3]   ETSI GR NFV 003: "Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV".

[i.4]   ETSI GS NFV-SEC 004 (V1.1.1): "Network Functions Virtualisation (NFV); NFV Security; Privacy and Regulation; Report on Lawful Interception Implications".

[i.5]   ETSI GS NFV-SEC 006 (V1.1.1): "Network Functions Virtualisation (NFV); Security Guide; Report on Security Aspects and Regulatory Concerns".

[i.6]   ETSI GS NFV-SEC 010 (V1.1.1): "Network Functions Virtualisation (NFV); NFV Security; Report on Retained Data problem statement and requirements".

[i.7]   ETSI GS NFV-SEC 012 (V3.1.1): "Network Functions Virtualisation (NFV) Release 3; Security; System architecture specification for execution of sensitive NFV components".

[i.8]   ETSI GS NFV-SEC 014 (V3.1.1): "Network Functions Virtualisation (NFV) Release 3; NFV Security; Security Specification for MANO Components and Reference Points".

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.3] and the following apply:

NFVO-C: NFVO that manages a composite NS instance that has one or more nested NS instances as constituents which are managed by an NFVO in another administrative domain

NFVO-N: NFVO that manages an NS instance which is used as a nested NS of a composite NS instance managed by an NFVO in another administrative domain

3.2   Symbols

Void.

3.3   Abbreviations

For the purposes of the present document, the abbreviations given in ETSI GR NFV 003 [i.3] 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.3].

LCM   Life Cycle Management

4   Overview of interfaces for the provisioning of network services across multiple administrative domains

4.1   Introduction

NFV-MANO services can be offered and consumed across multiple administrative domains. Those administrative domains can be mapped to different organizations, e.g. different network operators or different departments of the same network operator.

Based on the study output of ETSI GR NFV-IFA 028 [i.1], multiple administrative domain aspect includes the case of network service offered by multiple administrative domains. The concept of composite NS and nested NS as specified in ETSI GS NFV-IFA 010 [2] is utilized. Reference point Or-Or is provided in NFV-MANO architecture for supporting the interoperability in this case.

The Or-Or reference point is used for the exchanges between NFVOs in different administrative domains, and supports the following interfaces:

- Network Service Descriptor (NSD) Management;

- Network Service (NS) Lifecycle Management;

- NS Lifecycle Operation Granting;

- NS Instance Usage Notification;

- NS Performance Management;

- NS Fault Management;

- Policy Management.

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 - Functional requirements specification ETSI GS NFV-IFA 010 [2]:

  - Interfaces associated with the Or-Or reference point are based on the functional requirements specified in ETSI GS NFV-IFA 010 [2] for the NFVO.

- Management and Orchestration - Os-Ma-Nfvo reference point - Interface and Information Model Specification ETSI GS NFV-IFA 013 [1]:

  - The NSD Management, NS Lifecycle Management, NS Performance Management, NS Fault Management interface and Policy Management on the Or-Or reference point are based on corresponding interfaces defined in ETSI GS NFV-IFA 013 [1]. For NSD Management and NS Lifecycle Management interface, only a subset of operations in ETSI GS NFV-IFA 013 [1] is applied on the related interfaces of the Or-Or reference point.

4.3   Conventions

The following notations, defined in ISO/IEC 9646-7 [i.2], 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 points and interface requirements

5.1   Introduction

This clause defines requirements applicable to interfaces in the context of the Or-Or reference point for the provisioning of network service across multiple administrative domains. In this case, the NFVO managing the composite NS is indicated as NFVO-C, and the NFVO managing the nested NS is indicated as NFVO-N.

5.2   Or-Or reference point requirements

Table 5.2-1 specifies requirements applicable to the Or-Or reference point.

Table 5.2-1: Or-Or reference point requirements

Numbering	Functional requirement description
Or-Or.001	The Or-Or reference point shall support the NSD Management interface produced by NFVO-N.
Or-Or.002	The Or-Or reference point shall support the NS Lifecycle Management interface produced by NFVO-N.
Or-Or.003	The Or-Or reference point shall support the NS Performance Management interface produced by NFVO-N.
Or-Or.004	The Or-Or reference point shall support the NS Fault Management interface produced by NFVO-N.
Or-Or.005	The Or-Or reference point shall support the NS Lifecycle Operation Granting interface produced by NFVO-C.
Or-Or.006	The Or-Or reference point shall support the NS Instance Usage Notification interface produced by NFVO-C.
Or-Or.007	The Or-Or reference point shall support the Policy Management interface produced by NFVO-N.

5.3   Or-Or interface requirements

5.3.1   NSD Management interface requirements

The Or-Or reference point shall support the requirement Os-Ma-nfvo.Nsd.005 defined in ETSI GS NFV-IFA 013 [1], clause 5.3.1. The NFVO producing the interface is NFVO-N.

5.3.2   NS Lifecycle Management interface requirements

The Or-Or reference point shall support Requirement Os-Ma-nfvo.NsLcm.001, Os-Ma-nfvo.NsLcm.002, Os-Ma-nfvo.NsLcm.003, Os-Ma-nfvo.NsLcm.004, Os-Ma-nfvo.NsLcm.010, Os-Ma-nfvo.NsLcm.035, Os-Ma-nfvo.NsLcm.022 and Os-Ma-nfvo.NsLcm.028 defined in ETSI GS NFV-IFA 013 [1], clause 5.3.2. The NFVO producing the interface is NFVO-N.

Table 5.3.2-1 specifies additional requirements applicable to the network service lifecycle management interface produced by NFVO-N on the Or-Or reference point.

Table 5.3.2-1: Network service lifecycle management interface requirements

Numbering	Functional requirement description
Or-Or.NsLcm.001	The NS lifecycle management interface produced by NFVO-N on the Or-Or reference point shall support sharing a nested NS instance among multiple NS instances. See note.
Or-Or.NsLcm.002	The NS lifecycle management interface produced by NFVO-N on the Or-Or reference point shall support providing notifications about changes of an NS instance that are related to NS lifecycle management operations.
Or-Or.NsLcm.003	The NS lifecycle management interface produced by NFVO-N on the Or-Or reference point shall support subscribing to NS lifecycle change notifications.
NOTE: A nested NS instance can be shared among NS instances managed by the same or other NFVO.	

The mechanism of tracking a tenancy (e.g. the composite NS) in another administrative domain is not defined in the present document.

5.3.3 NS Lifecycle Operation Granting interface requirements

Table 5.3.3-1 specifies requirements applicable to the NS Lifecycle Operation Granting interface produced by NFVO-C on the Or-Or reference point.

Table 5.3.3-1: NS Lifecycle Operation Granting interface requirements

Numbering	Requirement
Or-Or.NSLcog.001	The NS Lifecycle Operation Granting interface produced by NFVO-C on the Or-Or reference point shall support granting NS lifecycle operations.

5.3.4 NS Instance Usage Notification interface requirements

Table 5.3.4-1 specifies requirements applicable to the NS Instance Usage Notification interface produced by NFVO-C on the Or-Or reference point (see clause 6.1.6 for more illustration on NS instance usage).

Table 5.3.4-1: NS Instance Usage Notification interface requirements

Numbering	Requirement
Or-Or.NSIun.001	The NS Instance Usage Notification interface produced by NFVO-C on the Or-Or reference point shall support notifying the usage of the NS.

5.3.5 NS Performance Management interface requirements

The Or-Or reference point shall support NS Performance Management interface requirements defined in ETSI GS NFV-IFA 013 [1], clause 5.3.4. The NFVO producing the interface is NFVO-N.

5.3.6 NS Fault Management interface requirements

The Or-Or reference point shall support NS Fault Management interface requirements defined in ETSI GS NFV-IFA 013 [1], clause 5.3.5. The NFVO producing the interface is NFVO-N.

5.3.7 Policy Management interface requirements

The Or-Or reference point shall support Policy Management interface requirements defined in ETSI GS NFV-IFA 013 [1], clause 5.3.8. The NFVO producing the interface is NFVO-N.

NOTE: For interface requirements related to transferring policy, the case that NFVO-C transfers policies to the VNFM or the VIM in the administrative domain of NFVO-N via NFVO-N does not apply.

6 Interfaces related to multiple administrative domains

6.1 NFVO exposed interfaces

6.1.1 Introduction

This clause defines the interfaces exposed by NFVO-N towards NFVO-C or exposed by NFVO-C towards NFVO-N over the Or-Or reference point.

Interface operations of NSD management, NS lifecycle management, NS performance management and NS fault management can be reused from corresponding definitions in ETSI GS NFV-IFA 013 [1]. Interface operations of NS lifecycle operation granting and NS instance usage notification which cannot be directly reused from ETSI GS NFV-IFA 013 [1] are specified in the present document in details.

6.1.2   NSD Management interface

This interface allows NFVO-C to invoke NSD management operations towards NFVO-N.

Only one operation of query NSD Info is supported by this interface. The definition of query NSD Info operation in clause 7.2.7 of ETSI GS NFV-IFA 013 [1] applies for the Or-Or reference point, except that the producer is NFVO-N and the consumer is NFVO-C.

6.1.3   NS Lifecycle Management interface

This interface allows NFVO-C to invoke NS lifecycle management operations towards NFVO-N.

The following operations are defined for this interface, and these operations are reused from ETSI GS NFV-IFA 013 [1], except that the producer is NFVO-N and the consumer is NFVO-C. Other operations of NS lifecycle management interface in ETSI GS NFV-IFA 013 [1] are not supported over Or-Or reference point:

- Create NS Identifier (refer to clause 7.3.2 of ETSI GS NFV-IFA 013 [1]).

- Delete NS Identifier (refer to clause 7.3.8 of ETSI GS NFV-IFA 013 [1]).

- Instantiate NS (refer to clause 7.3.3 of ETSI GS NFV-IFA 013 [1]).

- Terminate NS (refer to clause 7.3.7 of ETSI GS NFV-IFA 013 [1]).

- Scale NS (refer to clause 7.3.4 of ETSI GS NFV-IFA 013 [1]).

- Heal NS (refer to clause 7.3.9 of ETSI GS NFV-IFA 013 [1]).

- Query NS (refer to clause 7.3.6 of ETSI GS NFV-IFA 013 [1]).

- Get Operation Status (refer to clause 7.3.10 of ETSI GS NFV-IFA 013 [1]).

- Subscription/Notification (refer to clause 7.3.11 to clause 7.3.14 of ETSI GS NFV-IFA 013 [1]).

NOTE: There may be a need to restrict information about NS instance exposed in the NS query operation in the nested NS sharing scenario. The resolution is related to the isolation of information in multiple tenancy management and out of the scope of the present document.

6.1.4   NS Performance Management interface

This interface allows providing of performance information related to network services.

The operations in clause 7.5 of ETSI GS NFV-IFA 013 [1] apply for the Or-Or reference point, except that the producer is NFVO-N and the consumer is NFVO-C.

6.1.5   NS Fault Management interface

This interface allows NFVO-N to provide alarms related to the NS visible to NFVO-C.

The operations in clause 7.6 of ETSI GS NFV-IFA 013 [1] apply for the Or-Or reference point, except that the producer is NFVO-N and the consumer is NFVO-C.

6.1.6   NS Instance Usage Notification Interface

6.1.6.1   Description

This interface allows NFVO-N managing an existing instance of an NS to receive notifications from NFVO-C in other administrative domain indicating that this NFVO-C has started or ceased to use this NS instance as a constituent nested NS of a composite NS.

The existing NS instance is "in use" by NFVO-C when it is associated to a composite NS instance managed by that NFVO-C. That is, the former NS instance is nested into the composite NS.

The existing NS instance is "not is use" by NFVO-C when it is not associated to a composite NS instance managed by that NFVO-C. That is, the NS instance is not nested into a composite NS managed by that NFVO-C.

6.1.6.2   Subscribe operation

6.1.6.2.1   Description

This operation enables NFVO-N to subscribe with a filter for the notifications related to the start or end of usage of an NS instance by NFVO-C. The related NS instance is managed by NFVO-N subscribing to the notifications.

Table 6.1.6.2.1-1: Subscribe operation

Message	Requirement	Direction
SubscribeRequest	Mandatory	NFVO-N → NFVO-C
SubscribeResponse	Mandatory	NFVO-C → NFVO-N

6.1.6.2.2   Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 6.1.6.2.2-1.

Table 6.1.6.2.2-1: Subscribe operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
filter	M	1	Filter	Input filter for selecting the existing NS instances being managed by the sender of the subscribe operation for which notifications are required.

6.1.6.2.3   Output parameters

The output parameters returned by the operation shall follow the indications provided in table 6.1.6.2.3-1.

Table 6.1.6.2.3-1: Subscribe operation output parameters

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

6.1.6.2.4   Operation results

After successful subscription, the consumer (NFVO-N) is registered to receive notifications from another NFVO (NFVO-C) if NFVO-C starts or ceases to use this NS instance as part of a composite NS.

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.

6.1.6.3   Notify operation

6.1.6.3.1   Description

This operation distributes notifications to subscribers related to NS instance usage changes. It is a one-way operation issued by NFVO-C that cannot be invoked as an operation by the consumer (NFVO-N).

In order to receive notifications, NFVO-N shall have a subscription.

Table 6.1.6.3.1-1 lists the information flow exchanged between NFVO-C and NFVO-N.

Table 6.1.6.3.1-1: Notify operation

Message	Requirement	Direction
Notify	Mandatory	NFVO-C → NFVO-N

The following notification is sent by this operation:

- NsInstanceUsageNotification. See clause 7.2.2.

6.1.6.4   Terminate Subscription operation

6.1.6.4.1   Description

This operation enables NFVO-N to terminate a particular subscription.

Table 6.1.6.4.1-1 lists the information flow exchanged between NFVO-N and NFVO-C.

Table 6.1.6.4.1-1: Terminate Subscription operation

Message	Requirement	Direction
TerminateSubscriptionRequest	Mandatory	NFVO-N → NFVO-C
TerminateSubscriptionResponse	Mandatory	NFVO-C → NFVO-N

6.1.6.4.2   Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 6.1.6.4.2-1.

Table 6.1.6.4.2-1: Terminate Subscription operation input parameters

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

6.1.6.4.3   Output parameters

No output parameter.

6.1.6.4.4   Operation results

After successful termination of a subscription, the identified subscription does not exist anymore, and NFVO-N 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.

6.1.6.5   Query Subscription Info operation

6.1.6.5.1   Description

This operation enables NFVO-N to query information about subscriptions.

Table 6.1.6.5.1-1 lists the information flow exchanged between NFVO-N and NFVO-C.

Table 6.1.6.5.1-1: Query Subscription operation

Message	Requirement	Direction
QuerySubscriptionInfoRequest	Mandatory	NFVO-N → NFVO-C
QuerySubscriptionInfoResponse	Mandatory	NFVO-C → NFVO-N

6.1.6.5.2   Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 6.1.6.5.2-1.

Table 6.1.6.5.2-1: 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.

6.1.6.5.3   Output parameters

The output parameters returned by the operation shall follow the indications provided in table 6.1.6.5.3-1.

Table 6.1.6.5.3-1: 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.

6.1.6.5.4   Operation results

After successful operation, the NFVO-C 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 instance usage that the NFVO-N has access to and that are matching the filter shall be returned.

6.1.7   Policy Management interface

This interface allows NFVO-C to invoke policy management operations towards NFVO-N.

The operations in clause 7.9 of ETSI GS NFV-IFA 013 [1] apply for the Or-Or reference point, except that the producer is NFVO-N and the consumer is NFVO-C.

For interface operation of transferring policy, the pfId attribute in the table of input parameters (table 7.9.2.2-1 of ETSI GS NFV-IFA 013 [1]) does not apply.

6.1.8   NS Lifecycle Operation Granting interface

6.1.8.1   Description

This interface defines one operation that allows NFVO-C to grant NS lifecycle operations.

6.1.8.2   Grant NS Lifecycle Operation

6.1.8.2.1   Description

This operation allows NFVO-N to request a grant for authorization of an NS lifecycle operation. This interface supports the following use case:

- NFVO-C can approve or reject a request based on dependencies between the nested NS and the entities (NSs or VNFs) in the administrative domain of NFVO-C.

Table 6.1.8.2.1-1 lists the information flow exchanged between NFVO-C and NFVO-N.

Table 6.1.8.2.1-1: Grant NS Lifecycle Operation

Message	Requirement	Direction
GrantNSLifecycleOperationRequest	Mandatory	NFVO-N→ NFVO-C
GrantNSLifecycleOperationResponse	Mandatory	NFVO-C → NFVO-N

6.1.8.2.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 6.1.8.2.2-1.

Table 6.1.8.2.2-1: Grant NS Lifecycle Operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
nsInstanceId	M	1	Identifier	Identifier of the NS instance which this grant request is related to.
nsdId	M	1	Identifier (Reference to Nsd)	Identifier of the NSD that defines the NS for which the LCM operation is to be granted.
lifecycleOperation	M	1	Enum	The lifecycle management operation for which granting is requested. VALUES: • SCALE_NS • TERMINATE_NS • HEAL_NS See note.
additionalParam	M	0..N	KeyValuePair	Additional parameters passed by NFVO-N, specific to the NS and the LCM operation.
NOTE: The NS LCM operations InstantiateNs, CreateNsIdentifier, DeleteNsIdentifier and QueryNs can be executed by NFVO-N without requesting granting.				

6.1.8.2.3 Output parameters

No output parameter.

6.1.8.2.4 Operation results

In case of success, NFVO-C returns to NFVO-N with a success indicator to permit the NS lifecycle management operation. In addition to failure situations, NFVO-C can reject a GrantNSLifecycleOperationRequest due to various reasons. In case of rejecting the operation or in case of failure, NFVO-C returns to NFVO-N appropriate error information, describing the reason of rejection or failure.

6.2 Void

7 Information elements

7.1 Introduction

This clause specifies, or references definitions of information elements used by the interfaces in the present document.

The specification of the following information elements is part of the protocol design:

- Identifier.
- Filter.
- KeyValuePair.

7.2   Information elements and notifications related to NS instance usage notification

7.2.1   Introduction

This clause defines information elements and notifications related to NS instance usage notification.

7.2.2   NsInstanceUsageNotification

7.2.2.1   Description

This notification informs NFVO-N that NFVO-C has started using or ceased to use an NS instance managed by NFVO-N as part of a composite NS managed by NFVO-C. The support of the notification is mandatory.

7.2.2.2   Trigger conditions

The trigger conditions include:

- Start of usage of the NS instance as part of a composite NS managed by NFVO-C.

- End of usage of the NS instance as part of a composite NS managed by NFVO-C.

7.2.2.3   Attributes

The attributes of the NsInstanceUsageNotification notification shall follow the indications provided in table 7.2.2.3-1.

Table 7.2.2.3-1: Attributes of the NsInstanceUsageNotification

Attribute	Qualifier	Cardinality	Content	Description
nsInstanceId	M	1	Identifier	Identifier of the NS instance affected.
status	M	1	Enum	Indicates whether this notification reports about the start of the usage of an NS instance or about the end of the usage of an NS instance. VALUES: • START • END

8   Security considerations and requirements

8.1   Introduction

The support of network services across multiple administrative domains relies on the use of NFV-MANO functional blocks and NFV architecture as well as the functionality and operations defined in other reference points, like the Os-Ma-Nfvo specified in ETSI GS NFV-IFA 013 [1]. Hence security analysis and considerations for NFV-MANO components and reference points as specified in ETSI GS NFV-SEC 014 [i.8] and the system architecture for sensitive NFV components as specified in ETSI GS NFV-SEC 012 [i.7] are also applicable, but not specific, to the present document.

The functionality specified by the present document however introduces a new Or-Or reference point across multiple administrative domains and the capabilities to manage NS instances and NSDs as well as to grant certain NS LCM operations across this reference point. The new Or-Or reference point introduces potential security threats and vulnerabilities that are specific to this feature. The requirements for security measures to mitigate or prevent these threats are the subject of this clause.

Furthermore, the exposure of the NFVO to external connectivity inherently adds a security risk as this connectivity may be exploited to perform actions beyond the operations and interfaces supported by the NFVO in this feature.

8.2   Security assessment

A threat, risk and security analysis is provided in Annex A.

8.3   Security requirements

Table 8.3-1 lists the set of applicable requirements related to security in the realization of support of network services across multiple administrative domains.

Table 8.3-1: Security requirements for support of NSs across multiple administrative domains

Identifier	Requirement description
Or-Or.sec.001	The NFVO that produces an interface in the Or-Or reference point shall verify the authenticity of another NFVO consuming the interface and shall only accept requests from authorized consumers.
Or-Or.sec.002	The NFVO that consumes an interface in the Or-Or reference point shall verify the authenticity of another NFVO producing the interface and shall only send requests to authorized producers.
Or-Or.sec.003	The NFVO that consumes or produces an interface in the Or-Or reference point shall have a mechanism to ensure the integrity and authenticity of the information sent across the reference point.
Or-Or.sec.004	There shall be a mechanism that prevents illegal interception of data and information sent across the Or-Or reference point.
Or-Or.sec.005	The NFVO exposing connectivity to other administrative domains shall have mechanisms to protect the NFVO against access or requests beyond those management operations supported in the Or-Or reference point.

Annex A (informative):
Security assessment

This annex provides a threat, risk and vulnerability analysis of the support of network services across multiple administrative domains, with consideration to the scope of the present document (see clause 1).

The use case "Network Services provided using multiple administrative domains" described in the present document relies on functionality specified in ETSI GS NFV-IFA 013 [1]. Hence, many of the assets, threats, threat agents, security objectives, etc., are common to those derived from ETSI GS NFV-IFA 013 [1]. The present risk analysis and assessment focuses on those that are specific to this use case and not common to ETSI GS NFV-IFA 013 [1].

Table A-1: Threat, Risk, Vulnerability Analysis
(from the template defined in Annex A of ETSI GS NFV-SEC 006 [i.5])

A Security Environment		
a.1 Assumptions		
a.1.1	External attackers may intend and be able to masquerade as one of the sides involved in the communication across multiple administrative domains	
a.1.2	External attackers may intend and be able to intercept and modify the information sent across multiple administrative domains	
a.1.3	External attackers may intend and be able to use the connectivity between administrative domains to access and perform actions on the NFVOs beyond the operations supported in the Or-Or reference point	
a.2 Assets		
a.2.1	NS instances	See clause 6 and Annex A in ETSI GR NFV-IFA 028 [i.1]. Vulnerable to attacks from threat agents: a.3.1 a.3.2 a.3.3 a.3.4 a.3.5
a.2.2	NSDs	See Annex A in ETSI GR NFV-IFA 028 [i.1]. Vulnerable to attacks from threat agents: a.3.2 a.3.4
a.2.3	NFV-MANO functional blocks: NFVO, VNFM, VIM	Vulnerable to attacks from threat agents: a.3.2 a.3.4
a.2.4	OSS/BSS	Vulnerable to attacks from threat agents: a.3.2 a.3.4
a.2.5	Virtualised resources	Vulnerable to attacks from threat agents: a.3.2 a.3.4
a.2.6	Performance metrics	Vulnerable to attacks from threat agents: a.3.2
a.2.7	Alarm information	Vulnerable to attacks from threat agents: a.3.2
a.2.8	Management interfaces: - In Or-Or reference point - In Or-Vnfm and Or-Vi reference points	Vulnerable to attacks from threat agents: a.3.4

A Security Environment		
a.3 Threat agents (see note 1)		
a.3.1	Unauthorized user of NSs in another administrative domain	See clause A.1.2b in ETSI GR NFV-IFA 028 [i.1]. Threats: a.4.1
a.3.2	Industrial espionage agent in other administrative domain as assets	Threats: a.4.4 a.4.6 a.4.7 a.4.9 a.4.15
a.3.3	Industrial espionage agent in same administrative domain as assets but impacting consumer in other administrative domain	Threats: a.4.8
a.3.4	Sabotage agent in other administrative domain as assets	Threats: a.4.2 a.4.3 a.4.5 a.4.9 a.4.10 a.4.11 a.4.12 a.4.13
a.3.5	Sabotage agent in same administrative domain as assets, but impacting assets of other administrative domain	Threats: a.4.14
a.4 Threats		
a.4.1	Unauthorized use of existing NS instances in another administrative domain. For example, fraudulent use of nested NS to offer a composite NS to end-users	See clause A.1.2b in ETSI GR NFV-IFA 028 [i.1]. Countermeasures by security objectives: b.1.1 b.1.2
a.4.2	Exhaustion of NS resources by illegal and excessive use	Countermeasures by security objectives: b.1.1 b.1.2
a.4.3	Exhaustion of virtualised resources by illegal and excessive scaling of NSs	Countermeasures by security objectives: b.1.2
a.4.4	Inappropriate information disclosure: illegal interception in the Or-Or reference point	See clause 7 and Annex A in ETSI GR NFV-IFA 028 [i.1]. Countermeasures by security objectives: b.1.4
a.4.5	Denial of service: refusal of grant requests e.g. for scaling and healing nested NS instances (masquerade of NFVO-C)	See clause A.1.3b, clause A.1.7b in ETSI GR NFV-IFA 028 [i.1]. Countermeasures by security objective: b.1.5
a.4.6	Inappropriate information disclosure: illegal query of NSDs	See clause A.1.1 in ETSI GR NFV-IFA 028 [i.1]. Countermeasures by security objectives: b.1.3
a.4.7	Inappropriate information disclosure: illegal query or access to content of the resource information models (e.g. NsInfo) in the Or-Or reference point	Countermeasures by security objectives: b.1.2.1

A Security Environment		
a.4.8	Inappropriate information disclosure within one administrative domain of assets owned or used by consumer in other administrative domain: illegal query or access to content of the resource information models (e.g. NsInfo) in Os-Ma-Nfvo reference point	Countermeasures by security objectives: b.1.10
a.4.9	Compromising the NFVO functional block exploiting security holes in the Or-Or connectivity (beyond the operations supported in the interfaces)	Countermeasures by security objectives: b.1.7 b.1.8
a.4.10	Malicious actions performed on VNFM and VIM by a compromised NFVO	Countermeasures by security objectives: b.1.7 b.1.8
a.4.11	Malfunctioning of OSS/BSS due to false notifications triggered by a compromised NFVO or to notifications triggered by false notifications in Or-Or	Countermeasures by security objectives: b.1.6 b.1.7 b.1.8
a.4.12	Malfunctioning of the interfaces e.g. by massive false notifications or other operations requests or responses	Countermeasures by security objectives: b.1.2 b.1.2.1 b.1.6 b.1.9
a.4.13	Malfunctioning of (composite) NS by false notifications (e.g. alarms) related to the nested NS (see note 2)	Countermeasures by security objectives: b.1.6
a.4.14	Malfunctioning of (composite) NS by compromised (nested) NSs, VNFs, virtualised resources in the other administrative domain (see note 3)	Countermeasures by security objectives: b.1.10
a.4.15	Inappropriate information disclosure: access to information stored in NFVO or in OSS/BSS or accessible from these functional blocks	Countermeasures by security objectives: b.1.8
B Security Objectives		
b.1 Security objectives for the asset		
b.1.1	It should be ensured that NS instances are used only by authorized and authenticated users	
b.1.2	It should be ensured that LCM operations of NS instances are requested only by authorized and authenticated users	
b.1.2.1	It should be ensured that NS information or specific attributes of it are retrieved only by authorized and authenticated users. (see note 4)	
b.1.3	It should be ensured that NSDs are retrieved only by authorized and authenticated users	
b.1.4	It should be ensured that interception in the Or-Or reference point is not possible except when required to support regulatory requirements (such as Lawful Interception, see ETSI GS NFV-SEC 004 [i.4], and Retained Data, see ETSI GS NFV-SEC 010 [i.6])	
b.1.5	The authenticity of the provider of the NS lifecycle operation granting interface should be ensured	
b.1.6	The authenticity of the sender of NS LCM, PM and FM related notifications should be ensured	
b.1.7	It should be ensured that the NFVOs having connectivity to external administrative domains do not expose any management capability beyond the operations and interfaces required for the support of the feature	
b.1.8	It should be ensured that the NFVOs having connectivity to external administrative domains implement necessary security measures to prevent malicious control of the NFVO or access to information stored in the NFVO through this external connectivity	
b.1.9	Interfaces in the Or-Or reference point across multiple administrative domains should be protected against malicious avalanches of traffic	
b.1.10	The administrative domain exposing NSs to another administrative domains should implement all security measures applicable to single administrative domain to prevent NS instances, VNF instances and virtualised resources in this domain from being compromised	

NOTE 1:	Threat agents considered in this analysis are located either:
	    1) in the other administrative domain as the assets under attack; or
	    2) in the same administrative domain as the assets under attack but, in doing so, compromising assets in
	       the other administrative domain.

NOTE 2:	In this threat there is no real malfunctioning of the nested NSs, but an attacker, e.g. masquerading as NFVO-N will send these false notifications to NFVO-C, which may lead to NFVO-C taking inadequate actions.
NOTE 3:	In this threat there is a real malfunctioning of the nested NS or its constituents (VNFs, virtualised resources) due to an internal attack within the administrative domain of NFVO-N.
NOTE 4:	This is a particular case of b.1.2, as the Query NS operation is part of the NS LCM interface.

Annex B (informative):
Change History

Date	Version	Information about changes
January 2018	V0.0.1	Skeleton of the GS is created.
February 2018	V0.1.0	Implementation of approved contributions from IFA#84 meeting: NFVIFA(18)000041r2 and NFVIFA(18)000056r1.
March 2018	V0.2.0	Implementation of approved contributions from IFA#88 and IFA#89 meeting: NFVIFA(18)000077r1 and NFVIFA(18)000167.
April 2018	V0.3.0	Implementation of approved contributions from IFA#97 meeting: NFVIFA(18)000097r3, NFVIFA(18)000112r2, NFVIFA(18)000337 and NFVIFA(18)000338.
May 2018	V0.4.0	Implementation of approved contributions from IFA#100 F2F meeting and IFA#102 meeting: NFVIFA(18)000441r1, NFVIFA(18)000442r1, NFVIFA(18)000443, NFVIFA(18)000444r1 and NFVIFA(18)000447.
July 2018	V0.5.0	Implementation of approved contributions from IFA#104 F2F meeting, IFA#107 and IFA#108 meeting: NFVIFA(18)000605, NFVIFA(18)000570, NFVIFA(18)000571r1, NFVIFA(18)000655r5 and NFVIFA(18)000696.
October 2018	V3.1.2	Implementation of approved contributions from IFA#118 F2F meeting: NFVIFA(18)000793.
December 2018	V3.1.3	Implementation of approved contributions from IFA#123 meeting: NFVIFA(18)000893.
May 2019	V3.2.2	Starting version for 1H2019 specification work. Unmodified with respect to published version 3.2.1.
October 2019	V3.3.2	Starting version for 2H2019 specification work. Unmodified with respect to published version 3.3.1.
December 2019	V3.3.3	Implementation of approved contributions from IFA#171 F2F and IFA#177 F2F meeting: NFVIFA(19)000855r1, NFVIFA(19))00899, NFVIFA(19)000990.
February 2020	V3.3.4	Implementation of approved contributions from IFA#179 and IFA#182 meeting: NFVIFA(19)000997, NFVIFA(20)000031.
April 2020	V3.3.5	Implementation of approved contributions from IFA#189 meeting: NFVIFA(20)000181r1.
August 2020	V3.4.2	Initial draft version on ed351 maintenance created from published version 3.4.1.
July 2021	V3.5.2	Initial draft version on ed361 maintenance created from published version 3.5.1.

History

Document history		
V3.1.1	September 2018	Publication
V3.2.1	April 2019	Publication
V3.3.1	September 2019	Publication
V3.4.1	June 2020	Publication
V3.5.1	May 2021	Publication
V3.6.1	January 2022	Publication