



**Network Functions Virtualisation (NFV) Release 3;
Protocols and Data Models;
Report on protocol and data model solutions for
Multi-site Connectivity Services**

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Foreword

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

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1 Scope

The present document reports about the network connectivity protocols and data model solutions that are available in the industry (as specified by other organizations) and analyses the extent to which these solutions address the functional, interface and descriptor requirements specified in ETSI GS NFV-IFA 032 [i.2], ETSI GS NFV-IFA 010 [i.3], ETSI GS NFV-IFA 005 [i.4], ETSI GS NFV-IFA 007 [i.5], ETSI GS NFV-IFA 013 [i.6] and ETSI GS NFV-IFA 014 [i.7] for the management and support of multi-site connectivity services.

The present document concludes with a set of recommendations about the protocol and data model specification work required for addressing the gaps and requirements set specified in the above mentioned specifications.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

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

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- <https://standards.iteh.ai/catalog/standards/sist/62fd736f-e89d-41db-adcb-0035-Net9b1c1e90-0000-41d0-8000-000000000000>
- [i.1] ETSI GS NFV-IFA 003: "Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV".
 - [i.2] ETSI GS NFV-IFA 032: "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Interface and Information Model Specification for Multi-Site Connectivity Services".
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 - [i.4] ETSI GS NFV-IFA 005: "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Or-Vi reference point - Interface and Information Model Specification".
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 - [i.6] ETSI GS NFV-IFA 013: "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Os-Ma-Nfvo reference point - Interface and Information Model Specification".
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NOTE: Available at <https://github.com/OpenNetworkingFoundation/TAPI/tree/v2.2.0/YANG>.

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- [i.37] IETF RFC 8650: "Dynamic Subscription to YANG Events and Datastores over RESTCONF".
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- [i.40] IETF RFC 6241: "Network Configuration Protocol (NETCONF)".
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- [i.43] ETSI GS NFV-SOL 003: "Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Or-Vnfm Reference Point".
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- [i.45] ETSI GS NFV-SOL 013: "Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; Specification of common aspects for RESTful NFV MANO APIs".
- [i.46] IETF RFC 8776: "Common YANG Data Types for Traffic Engineering".
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3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI GS NFV 003 [i.1] and ETSI GS NFV-IFA 032 [i.2] apply.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI GS NFV 003 [i.1], ETSI GS NFV-IFA 032 [i.2] and the following apply:

ACTN	Abstraction and Control of Traffic Engineered Network
CE	Customer Edge
CNC	Customer Network Controller
FD	Forwarding-Domain
L2NM	L2VPN Network Model
L2SM	L2VPN Service Model
L3NM	L3VPN Network Model
L3SM	L3VPN Service Model
MDSC	Multi-Domain Service Coordinator
ONF	Open Networking Foundation
OTCC	Open Transport Configuration & Control
PE	Provider Edge
PNC	Provisioning Network Controller
SBI	South Bound Interface
TAPI	Transport API
TE	Traffic Engineering
TEAS	Traffic Engineering, Architecture and Signalling
VNS	Virtual Network Services

4 Overview of protocols and data models for network connectivity

4.1 Introduction

As specified in ETSI GS NFV-IFA 032 [i.2], a multi-site connectivity service between different NFVI-PoPs is realized by establishing connectivity between the virtual resources in different NFVI-PoPs via the WAN resources connecting these NFVI-PoP sites. Virtual resources at each NFVI-PoP are managed by a VIM and WAN resources and connectivity are managed by WAN Infrastructure Manager (WIM) and as part of end-to-end connectivity, coordination takes place between the VIMs and WIM. An overview of different network connectivity protocols and data model solutions that are available in the industry (as specified by other organizations) for supporting multi-site connectivity services and a summary of interface operations in ETSI GS NFV-IFA 032 [i.2] are listed in clause 4.

4.2 Summary of ETSI GS NFV-IFA 032

4.2.1 Overview

ETSI GS NFV-IFA 032 [i.2] specifies the following interfaces for multi-site connectivity services (MSCS), which are produced by the WAN Infrastructure Manager (WIM):

- 1) MSCS Management interface.
- 2) Capacity Management interface.
- 3) Fault Management interface.
- 4) Performance Management interface.

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ETSI GS NFV-IFA 032 [i.2] further highlights the requirements applicable to these interfaces and describes the operations and information elements exchanged over them.

<https://standards.iteh.ai/catalog/standards/sist/6261736f-e89d-41db-adc8-36835105401d/etsi-gr-nfv-sol-017-v3-3-1-2021-05>

These interfaces are produced by the WIM to enable consumers (e.g. NFVO) to request the establishment of network connectivity between different end-points of different NFVI-PoPs. The WIM can rely on underlying network controllers to handle the fulfilment of the requested connectivity at lower level, potentially making use of different network technologies and protocols. However, such interactions between the WIM and the network controllers are not specified in the ETSI GS NFV-IFA 032 [i.2]. The WIM, via these interfaces, thus exposes/offers the consumers an abstraction of the underlying network connectivity to ease its provisioning and monitoring.

The WIM interfaces and information elements as described in ETSI GS NFV-IFA 032 [i.2] are summarized in the subsequent clauses.

4.2.2 Summary of MSCS Management interface

4.2.2.1 Overview of interface operations

This interface allows an authorized consumer to perform operations related to MSCS.

The following operations are defined for this interface in ETSI GS NFV-IFA 032 [i.2]:

- **Create MSCS operation:** This operation allows an authorized consumer to request the creation of a MSCS from the WIM.
- **Query MSCS operation:** This operation allows querying information about instantiated MSCSs from the WIM.

- **Update MSCS operation:** This operation allows updating the information of an instantiated MSCS, e.g. name and description, as well as properties of the instantiated MSCS, such as adding/removing MSCS endpoints or changing the MSCS profile.
- **Terminate MSCS operation:** This operation allows terminating one instantiated MSCS.
- **Subscribe operation:** This operation enables an authorized consumer to subscribe with a filter in order to receive notifications sent by the WIM which are related to MSCS changes or MSCS reservation changes.
- **Notify operation:** This operation distributes notifications to subscribers. It is a one-way operation issued by the WIM that cannot be invoked as an operation by the consumer. In order to receive notifications, the consumer is expected to have a subscription.
- **Query Subscription Info operation:** This operation enables the consumer to query information about subscriptions
- **Terminate Subscription operation:** This operation enables the consumer to terminate a particular subscription.
- **Create MSCS Reservation operation:** This operation allows an authorized consumer to request the reservation of MSCS from the WIM.
- **Query MSCS Reservation operation:** This operation allows querying information about reserved MSCS that the consumer has access to.
- **Update MSCS Reservation operation:** This operation allows updating MSCS reservations, such as the timing schedule (start, end and expiry time), adding/removing MSCS endpoints to the reserved set or changing the MSCS profile of the reserved MSCS.
- **Terminate MSCS Reservation:** This operation allows an authorized consumer to request the termination of MSCS reservations.

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4.2.2.2 Overview of information elements

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<https://standards.iteh.ai/catalog/standards/sist/62fd736f-e89d-41db-adcb->

The following information elements that encapsulate information related to MSCS are specified in ETSI GS NFV-IFA 032 [i.2]:

- **MscsData:** This information element encapsulates information needed for creating or updating a MSCS.
- **MscsEndpointData:** This information element encapsulates information about the MSCS endpoint and the network configuration necessary to setup the connectivity to/from MSCS endpoint to the multi-site (WAN) network edge point.
- **MscsProfile:** This information element encapsulates information determining the connectivity constraints and requirements for the MSCS.
- **Mscs:** This information element encapsulates information about an established MSCS.
- **Msnrc:** This information element encapsulates information about an established Multi-site Network Connection (MSNC) on the multi-site network, partly or fully, realizing the MSCS.
- **MsnrcProfile:** This information element encapsulates information about the connectivity constraints and requirements of a particular MSNC realizing the MSCS.
- **MscsEndpointInfo:** This information element encapsulates information about network configuration of the MSCS endpoint of an MSCS. The MSCS Endpoint relates a connectivity service endpoint with the MSCS.
- **MscsReservationData:** This information element encapsulates information for creating a MSCS reservation.
- **ReservedMscs:** This information element provides information about the properties of a reserved MSCS including references to the MSCS endpoints, profile, protocol layer information, etc.
- **MscsChangeNotification:** This notification informs the receiver of changes related to the MSCSs managed by the WIM.

- **MscsReservationChangeNotification:** This notification informs the receiver of changes related to the MSCS reservations managed by the WIM.

4.2.3 Summary of Capacity Management Interface

4.2.3.1 Overview of interface operations

This interface allows providing to the Consumer information about the resources capacity (e.g. bandwidth, virtual network identifiers, etc.), topology, and network edge points of the network in between different NFVI-PoPs.

The following operations are defined for Capacity Management interface in ETSI GS NFV-IFA 032 [i.2]:

- **Query Capacity operation:** This operation enables a Consumer to retrieve information about the capacity of the network in between the NFVI-PoPs.
- **Create Capacity Threshold operation:** This operation enables a Consumer to create a threshold and specify threshold levels on the capacity of the network resources managed by the WIM.
- **Delete Capacity Thresholds operation:** This operation enables a Consumer to delete one or more existing threshold(s) managed by the WIM about capacity management.
- **Query Capacity Threshold operation:** This operation enables a Consumer to query the details of one or more existing capacity thresholds on the WIM.
- **Query Topology Information operation:** This operation enables a Consumer to query information about the one or more topologies of the network in between the NFVI-PoPs.
- **Query Node Information operation:** This operation enables a Consumer to query information about a node participating in a topology of the network in between the NFVI-PoPs.
- **Query Link Information operation:** This operation enables a Consumer to query information about a link participating in a topology of the network in between the NFVI-PoPs.
- **Query Network Edge Point Information operation:** This operation enables a Consumer to query information about network edge points of the network between the NFVI-PoPs.
- **Subscribe operation:** This operation enables the Consumer to subscribe with a filter for the notifications related to capacity and topology changes sent by the WIM.
- **Notify operation:** This operation distributes notifications to subscribers. It is a one-way operation issued by the WIM and cannot be invoked as an operation by the Consumer.
- **Terminate Subscription operation:** This operation enables the Consumer to terminate a particular subscription.

Query Subscription Information operation: This operation enables the Consumer to query information about subscriptions.

4.2.3.2 Overview of information elements

The following information elements and notifications related to capacity and topology management are specified in ETSI GS NFV-IFA 032 [i.2]:

- **CapacityInfo:** This information element encapsulates information about capacity of the network in between the NFVI-PoPs (sites).
- **CapacityValueEntry:** This information element encapsulates values about a capacity metric.
- **TimePeriodInformation:** This information element specifies a time period for which capacity is queried.
- **CapacityThreshold:** This information element defines threshold for triggering capacity change notifications.

- **CapacityChangeNotification:** This notification informs the receiver of changes in the capacity of the network in between the NFVI-PoPs managed by the WIM.
- **NetworkInfo:** This information element encapsulates information about a network in between the NFVI-PoPs (sites).
- **TopologyInfo:** This information element encapsulates information about a topology of the network in between the NFVI-PoPs (sites).
- **NodeInfo:** This information element encapsulates information about a node of the network in between the NFVI-PoPs (sites).
- **LinkInfo:** This information element encapsulates information about a point to point link in between two nodes of the network in between the NFVI-PoPs (sites), or a point to point link at the edge of the network enabling the connectivity between the connectivity service endpoint of the NFVI-PoP and the WAN.
- **NetworkEdgePointInfo:** This information element encapsulates information about a network edge point of the network in between the NFVI-PoPs (sites). The network edge points represent the ingress/egress ports of the network in between the NFVI-PoPs.
- **ConnectivityServiceEndpointInfo:** This information element encapsulates information about a connectivity service endpoint of an NFVI-PoP on which a MSCS can be terminated.
- **TopologyChangeNotification:** This notification informs the receiver of changes in the network in between the NFVI-PoPs managed by the WIM in terms of topology, nodes and/or links.

4.2.4 Summary of Fault Management Interface

4.2.4.1 Overview of interface operations

This interface allows the WIM to provide alarms related to the MSCSs visible to the consumer.

The following operations are defined for Fault Management interface in ETSI GS NFV-IFA 032 [i.2]:

- **Subscribe operation:** This operation enables the consumer to subscribe with a filter for the notifications related to MSCS alarms sent by the WIM.
- **Notify operation:** This operation distributes notifications of alarms or alarm state change to subscribers.
- **Terminate Subscription operation:** This operation enables the consumer to terminate a particular subscription.
- **Query Subscription Info operation:** This operation enables the consumer to query information about subscriptions.
- **Get alarm list operation:** This operation enables the consumers to query the active alarms from the WIM.
- **Acknowledge Alarms operation:** This operation enables the consumer to acknowledge alarms at WIM.

4.2.4.2 Overview of information elements

The following information elements and notifications related to fault management are specified in ETSI GS NFV-IFA 032 [i.2]:

- **Alarm:** This information element encapsulates information about an alarm.
- **AlarmNotification:** This notification informs the receiver of alarms related to the MSCSs managed by the WIM.
- **AlarmClearedNotification:** This notification informs the receiver of the clearing of an alarm related to the MSCSs managed by the WIM.