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LTE;
5G;
Telecommunication management;
Generic Network Resource Model (NRM)
Integration Reference Point (IRP);
Information Service (IS)
(3GPP TS 28.622 version 16.7.1 Release 16)**



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Foreword

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Introduction

The present document is part of a TS-family covering the 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Telecommunication management; as identified below:

28.621 Generic Network Resource Model (NRM) Integration Reference Point (IRP); Requirements;

28.622 Generic Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)
;

28.623 Generic Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions.

The interface Itf-N, defined in 3GPP TS 32.102 [2], is built up by a number of Integration Reference Points (IRPs) and a related Name Convention, which realise the functional capabilities over this interface. The basic structure of the IRPs is defined in 3GPP TS 32.150 [4].

The present document is part of a set that has been developed for converged management solutions.

The present document is part of a set that is used for management and orchestration of 5G networks and network slicing.

1 Scope

The present document specifies the Generic network resource information that can be communicated between an IRP Agent and an IRP Manager for telecommunication network management purposes, including management of converged networks and networks that include virtualized network functions.

This document specifies the semantics of information object class attributes and relations visible across the reference point in a protocol and technology neutral way. It does not define their syntax and encoding.

This document supports the Federated Network Information Model (FNIM) concept described in [8] in that the relevant Information Object Class (IOC)s defined in this specification are directly or indirectly inherited from those specified in the Umbrella Information Model (UIM) of [9].

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TS 32.101: "Telecommunication management; Principles and high level requirements".
- [2] 3GPP TS 32.102: "Telecommunication management; Architecture".
- [3] 3GPP TS 32.302: "Telecommunication management; Configuration Management (CM); Notification Integration Reference Point (IRP): Information Service (IS)".
- [4] 3GPP TS 32.150: "Telecommunication management; Integration Reference Point (IRP) Concept and Definitions".
- [5] 3GPP TS 23.003: "Technical Specification Group Core Network and Terminals; Numbering, addressing and identification"
- [6] 3GPP TS 32.532: " Telecommunication management; Software Management Integration Reference Point (IRP); Information Service (IS) "
- [7] ITU-T Recommendation X.710 (1991): "Common Management Information Service Definition for CCITT Applications".
- [8] TS 32.107: "Telecommunication management; Fixed Mobile Convergence (FMC) Federated Network Information Model (FNIM)"
- [9] TS 28.620: "Telecommunication management; Fixed Mobile Convergence (FMC) Federated Network Information Model (FNIM) Umbrella Information Model (UIM)"
- [10] TS 32.156: "Telecommunication management; Fixed Mobile Convergence (FMC) Model Repertoire"
- [11] 3GPP TS 32.111-2: "Telecommunication management; Fault Management; Part 2: Alarm Integration Reference Point (IRP): Information Service (IS)".
- [12] 3GPP TS 32.662: "Telecommunication management; Configuration Management (CM); Kernel CM Information Service (IS)".
- [13] 3GPP TS 32.300: "Telecommunication management; Configuration Management (CM); Name convention for Managed Objects".

- [14] 3GPP TS 32.600: "Telecommunication management; Configuration Management (CM); Concept and high-level requirements".
- [15] ETSI GS NFV 003 V1.1.1: "Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV".
- [16] ETSI GS NFV-IFA 008 v2.1.1: "Network Functions Virtualisation (NFV); Management and Orchestration; Ve-Vnfm reference point - Interface and Information Model Specification".
- [17] ETSI GS NFV-IFA 015 v2.1.2: "Network Functions Virtualisation (NFV); Management and Orchestration; Report on NFV Information Model".
- [18] ETSI ES 202 336-12 V1.1.1: "Environmental Engineering (EE); Monitoring and control interface for infrastructure equipment (power, cooling and building environment systems used in telecommunication networks); Part 12: ICT equipment power, energy and environmental parameters monitoring information model".
- [19] ITU-T Recommendation X.731: "Information technology - Open Systems Interconnection - Systems Management: State management function".
- [20] 3GPP TS 28.552: "Management and orchestration; 5G performance measurements".
- [21] 3GPP TS 28.625: "State Management Data Definition Integration Reference Point (IRP); Information Service (IS) ".
- [22] 3GPP TS 23.501: "System Architecture for the 5G System".
- [23] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".
- [24] IETF RFC 791: "Internet Protocol".
- [25] IETF RFC 2373: "IP Version 6 Addressing Architecture".
- [26] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [27] 3GPP TS 28.532: "Management and orchestration; Generic management services".
- [28] 3GPP TS 28.554: "Management and orchestration; 5G end to end Key Performance Indicators (KPI)".
- [29] 3GPP TS 32.421: "Telecommunication management; Subscriber and equipment trace; Trace concepts and requirements".
- [30] 3GPP TS 32.422: "Telecommunication management; Subscriber and equipment trace; Trace control and configuration management".
- [31] ITU-T Recommendation X.733 (02/92): "Information technology - Open Systems Interconnection - Systems Management: Alarm reporting function".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply. For terms and definitions not found here, please refer to 3GPP TS 32.101 [1], 3GPP TS 32.102 [2], 3GPP TS 32.150 [4] and 3GPP TS 32.600 [14].

Association: In general, it is used to model relationships between Managed Objects. Associations can be implemented in several ways, such as:

- 1) name bindings,
- 2) reference attributes, and

3) association objects.

This IRP stipulates that name containment associations shall be expressed through name bindings, but it does not stipulate the implementation for other types of associations as a general rule. These are specified as separate entities in the object models (UML diagrams). Currently however, all (non-containment) associations are modelled by means of reference attributes of the participating MOs.

Information Object Class (IOC): An IOC represents the management aspect of a network resource. It describes the information that can be passed/used in management interfaces. Their representations are technology agnostic software objects. IOC has attributes that represents the various properties of the class of objects. See the term "attribute" defined in [10]. Furthermore, IOC can support operations providing network management services invocable on demand for that class of objects. An IOC may support notifications that report event occurrences relevant for that class of objects. It is modelled using the stereotype "Class" in the UML meta-model. See TS 32.156 [10] for additional information on IOC.

Managed Object (MO): A MO is an instance of a Managed Object Class (MOC) representing the management aspects of a network resource. Its representation is a technology specific software object. It is sometimes called MO instance (MOI). The MOC is a class of such technology specific software objects. An MOC is the same as an IOC except that the former is defined in technology specific terms and the latter is defined in technology agnostic terms. MOCs are used/defined in SS level specifications. IOCs are used/defined in IS level specifications.

Management Information Base (MIB): A MIB is an instance of an NRM and has some values on the defined attributes and associations specific for that instance. In the context of the present document, an MIB consists of:

- 1) a Name space (describing the MO containment hierarchy in the MIB through Distinguished Names),
- 2) a number of Managed Objects with their attributes and
- 3) a number of Associations between these MOs. Also note that TMN (ITU-T Recommendation X.710 [7]) defines a concept of a Management Information Tree (also known as a Naming Tree) that corresponds to the name space (containment hierarchy) portion of this MIB definition. Figure 3.1 depicts the relationships between a Name space and a number of participating MOs (the shown association is of a non-containment type)

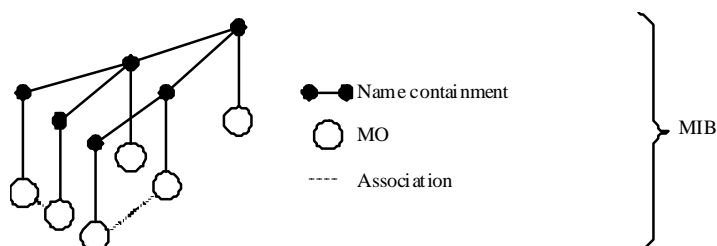


Figure 3.1: Relationships between a Name space and a number of participating MOs

Name space: A name space is a collection of names. The IRP name convention (see 3GPP TS 32.300 [13]) restricts the name space to a hierarchical containment structure, including its simplest form - the one-level, flat name space.

All Managed Objects in a MIB are included in the corresponding name space and the MIB/name space shall only support a strict hierarchical containment structure (with one root object). A Managed Object that contains another is said to be the superior (parent); the contained Managed Object is referred to as the subordinate (child). The parent of all MOs in a single name space is called a Local Root. The ultimate parent of all MOs of all managed systems is called the Global Root.

Network resource: discrete entity represented by an Information Object Class (IOC) for the purpose of network and service management.

NOTE: A network resource may represent intelligence, information, hardware and software of a telecommunication network.

Network Resource Model (NRM): A collection of IOCs, inclusive of their associations, attributes and operations, representing a set of network resources under management.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [26] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [26].

| | |
|------|--|
| DN | Distinguished Name (see 3GPP TS 32.300 [13]) |
| IOC | Information Object Class |
| MO | Managed Object |
| MOC | Managed Object Class |
| MOI | Managed Object Instance |
| NFVI | Network Functions Virtualisation Infrastructure (NFVI): Defined in ETSI GS NFV 003 [15]. |
| RDN | Relative Distinguished Name (see 3GPP TS 32.300 [13]) |
| SS | Solution Set |
| VNF | Virtualised Network Function |

4 Model

4.1 Imported information entities and local labels

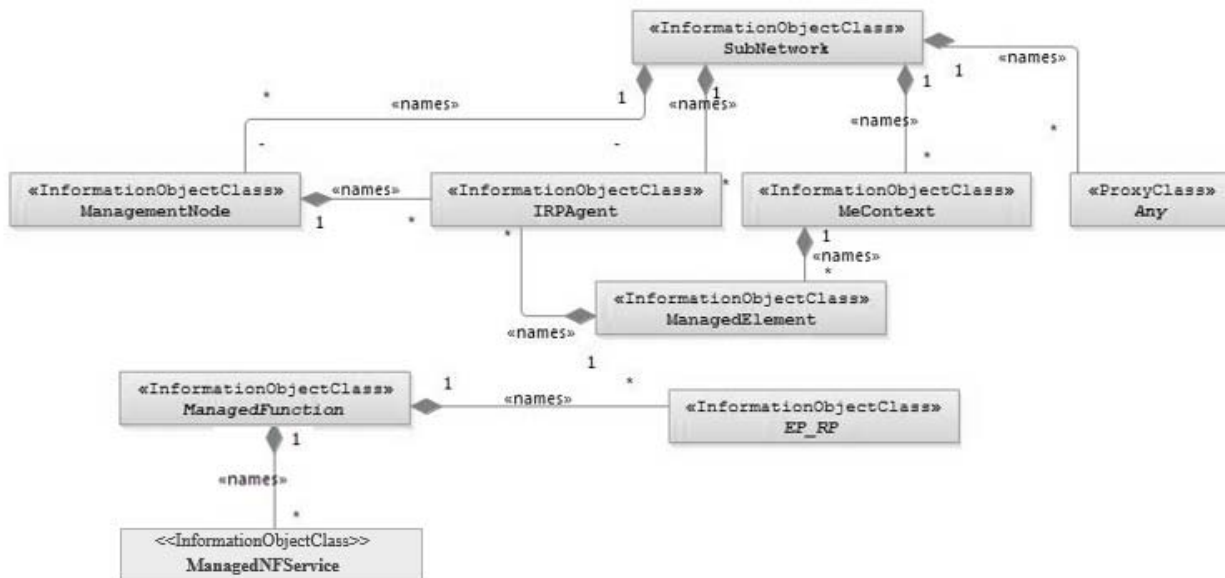
| Label reference | Local label |
|--|-------------------------------------|
| 3GPP TS 28.532 [27], notification, notifyMOICreation | notifyMOICreation |
| 3GPP TS 28.532 [27], notification, notifyMOIDeletion | notifyMOIDeletion |
| 3GPP TS 28.532 [6], notification, notifyMOIAttributeValueChanges | notifyMOIAttributeValueChanges |
| 3GPP TS 28.532 [27], notification, notifyMOIChanges | notifyMOIChanges |
| 3GPP TS 28.532 [27], notification, notifyNewAlarm | notifyNewAlarm |
| 3GPP TS 28.532 [27], notification, notifyNewSecurityAlarm | notifyNewSecurityAlarm |
| 3GPP TS 28.532 [27], notification, notifyClearedAlarm | notifyClearedAlarm |
| 3GPP TS 28.532 [27], notification, notifyChangedAlarm | notifyChangedAlarm |
| 3GPP TS 28.532 [27], notification, notifyChangedAlarmGeneral | notifyChangedAlarmGeneral |
| 3GPP TS 28.532 [27], notification, notifyCorrelatedNotificationChanged | notifyCorrelatedNotificationChanged |
| 3GPP TS 28.532 [27], notification, notifyAckStateChanged | notifyAckStateChanged |
| 3GPP TS 28.532 [27], notification, notifyComments | notifyComments |
| 3GPP TS 28.532 [27], notification, notifyPotentialFaultyAlarmList | notifyPotentialFaultyAlarmList |
| 3GPP TS 28.532 [6], notification, notifyAlarmListRebuilt | notifyAlarmListRebuilt |
| 3GPP TS 28.620 [9], IOC, <i>Domain_</i> | <i>Domain_</i> |
| 3GPP TS 28.620 [9], IOC, <i>ManagedElement_</i> | <i>ManagedElement_</i> |
| 3GPP TS 28.620 [9], IOC, <i>Function_</i> | <i>Function_</i> |
| 3GPP TS 28.620 [9], IOC, <i>ManagementSystem_</i> | <i>ManagementSystem_</i> |
| 3GPP TS 28.620 [9], IOC, <i>TopologicalLink_</i> | <i>TopologicalLink_</i> |
| 3GPP TS 28.620 [9], IOC, <i>Top_</i> | <i>Top_</i> |
| 3GPP TS 28.532 [27], SupportIOC, AlarmInformation | AlarmRecord |
| 3GPP TS 28.532 [6], notification, notifyFileReady | notifyFileReady |
| 3GPP TS 28.532 [6], notification, notifyFilePreparationError | notifyFilePreparationError |

4.2 Class diagrams

4.2.1 Relationships

This clause depicts the set of classes (e.g. IOCs) that encapsulates the information relevant for this IRP. This clause provides the overview of the relationships of relevant classes in UML. Subsequent clauses provide more detailed specification of various aspects of these classes.

The following figure shows the containment/naming hierarchy and the associations of the classes defined in the present document. See Annex A of a class diagram that combines this figure with Figure 1 of [2], the class diagram of UIM.



NOTE 1: ManagedElement may be contained either
 -in a SubNetwork (since SubNetwork inherits from Domain_ and ManagedElement inherits from ManagedElement_ and Domain_ name-contained ManagedElement_ as observed in the figure of Annex A) or
 -in a MeContext instance as observed by the above figure or in the figure of Annex A.
 This either-or relation cannot be shown by using an {xor} constraint in the above figure.
 ManagedElement may also have no parent instance at all.

NOTE 2: Void

NOTE 3: If the configuration contains several instances of SubNetwork, exactly one SubNetwork instance shall directly or indirectly contain all the other SubNetwork instances.

NOTE 4: The SubNetwork instance not contained in any other instance of SubNetwork is referred to as "the root SubNetwork instance".

NOTE 5: ManagementNode shall be contained in the root SubNetwork instance.

NOTE 6: If contained in a SubNetwork instance, IRPAgent shall be contained in the root SubNetwork instance.

NOTE 7: For a clarification on the choice of containment of the IRPAgent (since it has three possible parents), see the def. of IRPAgent.

NOTE 8: Cardinality * is identical to multiplicity 0..*.

Figure 4.2.1-1: Containment/Naming and Association NRM fragment

Each Managed Object is identified with a Distinguished Name (DN) according to 3GPP TS 32.300 [13] that expresses its containment hierarchy. As an example, the DN of a ManagedElement instance could have a format like:

SubNetwork=Sweden,MeContext=MEC-Gbg-1,ManagedElement=RNC-Gbg-1.



NOTE 8: Void

NOTE 9: Void

Figure 4.2.1-2: Vendor specific data container NRM fragment

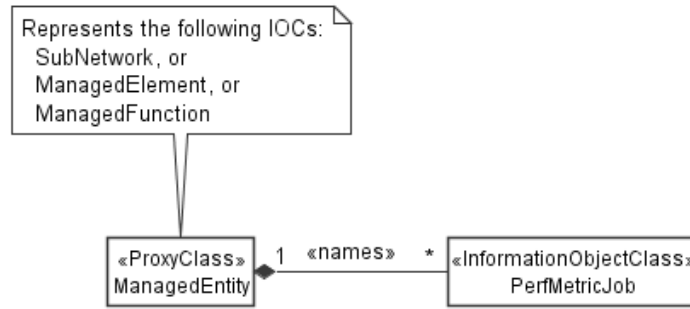


Figure 4.2.1-3: PM control NRM fragment

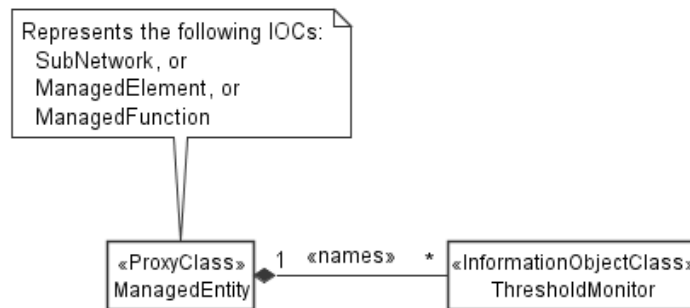


Figure 4.2.1-4: Threshold monitoring control NRM fragment



Figure 4.2.1-5: Notification subscription and heartbeat notification control NRM fragment

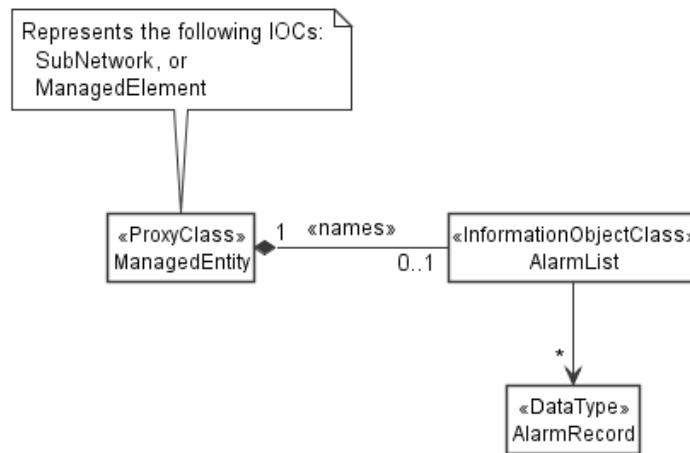


Figure 4.2.1-6: FM control NRM fragment

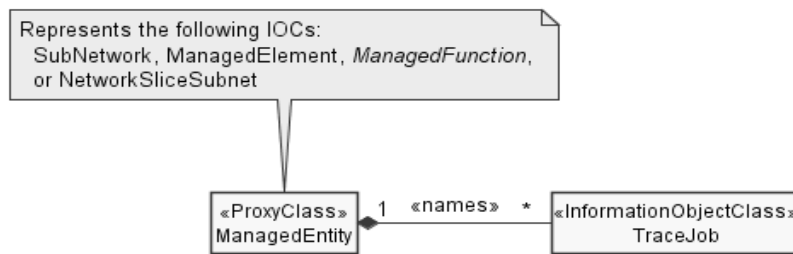


Figure 4.2.1-7: Trace control NRM fragment

4.2.2 Inheritance

This clause depicts the inheritance relationships.

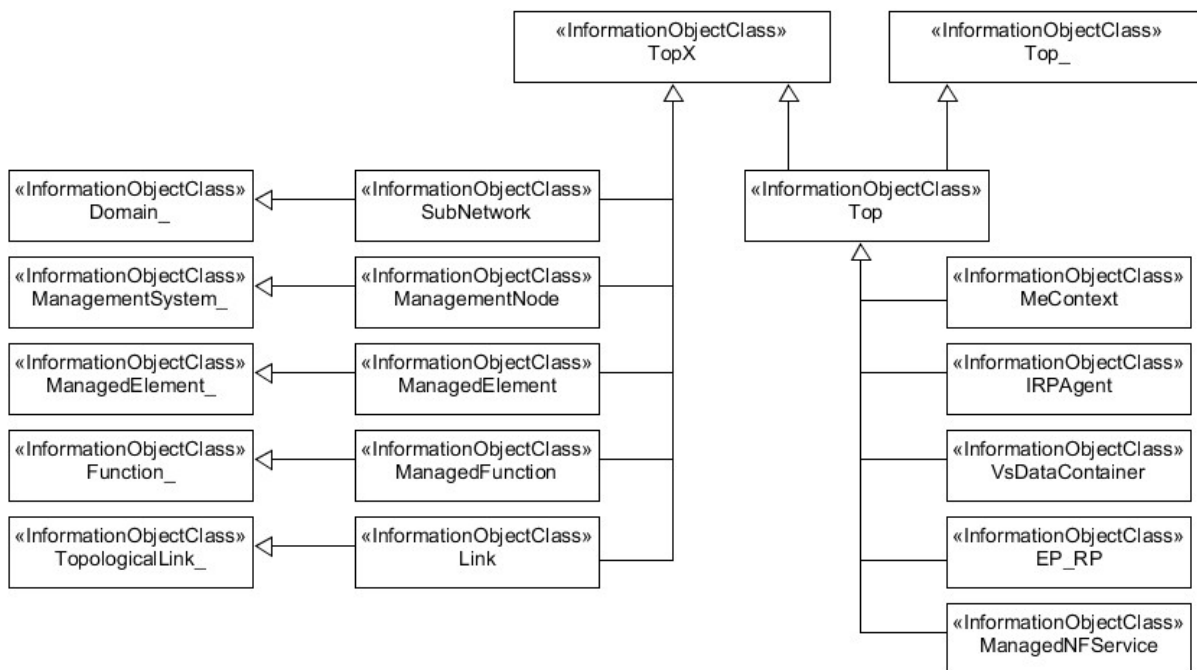


Figure 4.2.2-1: Inheritance Hierarchy NRM fragment

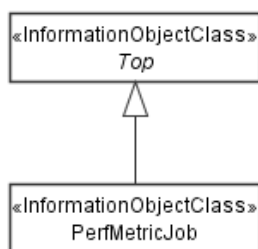


Figure 4.2.2-2: PM control NRM fragment

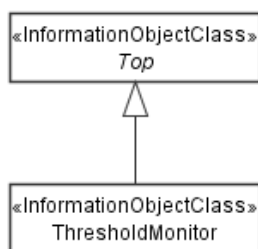


Figure 4.2.2-3: Threshold monitoring control NRM fragment

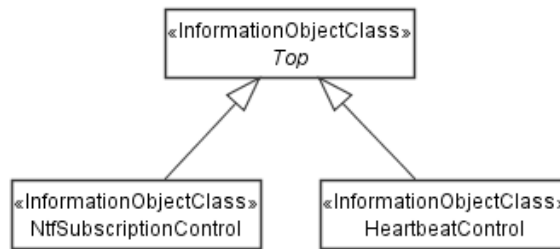


Figure 4.2.2-4: Notification subscription and heartbeat notification control NRM fragment

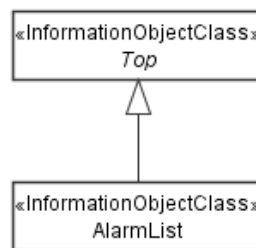


Figure 4.2.2-5: FM control NRM fragment

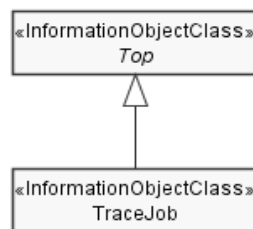


Figure 4.2.2-6: Trace control NRM fragment

4.3 Class definitions

4.3.1 Any

4.3.1.1 Definition

This class represents the classes (e.g. IOC) that are not defined in this specification but are or will be defined in other IRP specification(s).

4.3.1.2 Attributes

None

4.3.1.3 Attribute constraints

None

4.3.1.4 Notifications

This class does not support any notification.

4.3.2 IRPAgent

4.3.2.1 Definition

This IOC represents the functionality of an IRPAgent. It shall be present. For a definition of IRPAgent, see 3GPP TS 32.102 [2].

The IRPAgent will be contained under an IOC as follows (only one of the options shall be used):

- 1) ManagementNode, if the configuration contains a ManagementNode;
- 2) SubNetwork, if the configuration contains a SubNetwork and no ManagementNode;
- 3) ManagedElement, if the configuration contains no ManagementNode or SubNetwork.

4.3.2.2 Attributes

The IRPAgent IOC includes the attributes inherited from Top IOC (defined in clause 4.3.29) and the following attributes:

| Attribute Name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifiable |
|----------------|-------------------|------------|------------|-------------|--------------|
| systemDN | M | T | F | F | T |

4.3.2.3 Attribute constraints

None

4.3.2.4 Notifications

The common notifications defined in clause 4.5 are valid for this IOC, without exceptions or additions

4.3.3 ManagedElement

4.3.3.1 Definition

This IOC represents telecommunications equipment or TMN entities within the telecommunications network providing support and/or service to the subscriber.

A ManagedElement IOC is used to represent a Network Element defined in TS 32.101[1] including virtualization or non-virtualization scenario. ManagementElement instance is used for communicating with a manager (directly or indirectly) over one or more management interfaces for the purpose of being monitored and/or controlled.

ManagedElement may or may not additionally perform element management functionality. A ManagedElement contains equipment that may or may not be geographically distributed.

A telecommunication equipment has software and hardware components. The ManagedElement IOC described above represents the following two cases:

- In the case when the software component is designed to run on dedicated hardware component, the ManagedElement IOC description includes both software and hardware component.
- In the case when the software is designed to run on ETSI NFV defined NFVI [15], the ManagedElement IOC description would exclude the NFVI component supporting the above mentioned subject software.

A ManagedElement may be contained in either a SubNetwork or in a MeContext instance. A ManagedElement may also exist stand-alone with no parent at all.

The relation of ManagedElement IOC and ManagedFunction IOC can be described as following:

- A ManagedElement instance may have 1..1 containment relationship to a ManagedFunction instance. In this case, the ManagedElement IOC may be used to represent a NE with single ManagedFunction functionality. For example, a ManagedElement is used to represent the 3GPP defined RNC node.
- A ManagedElement instances may have 1..N containment relationship to multiple ManagedFunction IOC instances. In this case, the ManagedElement IOC may be used to represent a NE with combined ManagedFunction functionality (as indicated by the managedElementType attribute and the contained instances of different ManagedFunction IOCs). For example, a ManagedElement is used to represent the combined functionality of 3GPP defined gNBCUCPFunction, gNBCUUPFunction and gNBDUFunction.

NOTE: For some specific functional IOCs a 1..N containment relationship is permitted. The specific functional entities are identified in the NRMs that define subclasses of ManagedFunction.

4.3.3.2 Attributes

The ManagedElement IOC includes the attributes inherited from ManagedElement_IOC (defined in TS 28.620 [9]), attributes inherited from TopX IOC (defined in clause 4.3.8) and the following attributes:

| Attribute Name | S | isReadable | isWritable | isInvariant | isNotifyable |
|---------------------------|---|------------|------------|-------------|--------------|
| vendorName | M | T | F | F | T |
| userDefinedState | M | T | T | F | T |
| swVersion | M | T | F | F | T |
| priorityLabel | O | T | T | F | T |
| supportedPerfMetricGroups | O | T | F | F | T |

4.3.3.3 Attribute constraints

Attribute constrains for dnPrefix: The attribute dnPrefix shall be supported if an instance of ManagedElement is the local root instance of the MIB. Otherwise the attribute shall be absent or carry no information.

4.3.3.4 Notifications

The common notifications defined in clause 4.5 are valid for this IOC. In addition, the following set of notifications is also valid.

| Name | S | Notes |
|---------------------------------|---|-------|
| notifyFileReady | M | -- |
| notifyFilePreparationError | M | -- |
| notifyDownloadNESwStatusChanged | M | -- |
| notifyInstallNESwStatusChanged | O | -- |
| notifyActivateNESwStatusChanged | M | -- |

4.3.4 ManagedFunction

4.3.4.1 Definition

This IOC is provided for sub-classing only. It provides attribute(s) that are common to functional IOCs. Note that a ManagedElement may contain several managed functions, a managed function may contain other managed functions as specified for the specific subclass.. The ManagedFunction may be extended in the future if more common characteristics to functional objects are identified.

This IOC can represent a telecommunication function either realized by software running on dedicated hardware or realized by software running on NFVI. Each ManagedFunction instance communicates with a manager (directly or indirectly) over one or more management interfaces exposed via its containing ME instance.

4.3.4.2 Attributes

The `ManagedFunction` IOC includes the attributes inherited from `Function_IOC` (defined in TS 28.620 [9]), attributes inherited from `TopX` IOC (defined in clause 4.3.8) and the following attributes:

| Attribute Name | S | isReadable | isWritable | isInvariant | isNotifyable |
|--|----|------------|------------|-------------|--------------|
| <code>vnfParametersList</code> | CM | T | T | F | T |
| <code>peeParametersList</code> | CM | T | T | F | T |
| <code>priorityLabel</code> | O | T | T | F | T |
| <code>supportedPerfMetricGroups</code> | O | T | F | F | T |

4.3.4.3 Attribute constraints

| Name | Definition |
|---|--|
| <code>vnfParametersList</code> Support Qualifier | Condition: The <code>ManagedFunction</code> instance is realized by one or more VNF instance(s). Otherwise this attribute shall be absent. |
| <code>peeParametersList</code> Support Qualifier | Condition: The control and monitoring of PEE parameters is supported by the <code>ManagedFunction</code> or sub-class instance. |

4.3.4.4 Notifications

There is no notification defined.

4.3.5 ManagementNode

4.3.5.1 Definition

This IOC represents a telecommunications management system (EM) within the TMN that contains functionality for managing a number of `ManagedElements` (MEs). The management system communicates with the MEs directly or indirectly over one or more interfaces for the purpose of monitoring and/or controlling these MEs.

This class has similar characteristics as the `ManagedElement`. The main difference between these two classes is that the `ManagementNode` has a special association to the managed elements that it is responsible for managing.

4.3.5.2 Attributes

The `ManagementNode` IOC includes the attributes inherited from `ManagementSystem_IOC` (defined in TS 28.620 [9]), attributes inherited from `TopX` IOC (defined in clause 4.3.8) and the following attributes:

| Attribute Name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifyable |
|-------------------------------|-------------------|------------|------------|-------------|--------------|
| <code>vendorName</code> | M | T | F | F | T |
| <code>userDefinedState</code> | M | T | T | F | T |
| <code>locationName</code> | M | T | F | F | T |
| <code>swVersion</code> | M | T | F | F | T |

4.3.5.3 Attribute constraints

None

4.3.5.4 Notifications

The common notifications defined in clause 4.5 are valid for this IOC. In addition, the following set of notifications is also valid.

| Name | S | Notes |
|----------------------------|---|-------|
| notifyFileReady | M | -- |
| notifyFilePreparationError | M | -- |

4.3.6 MeContext

4.3.6.1 Definition

This IOC is introduced for naming purposes. It may support creation of unique DNs in scenarios when some MEs have the same RDNs due to the fact that they have been manufacturer pre-configured.

If some MEs have the same RDNs (for the above mentioned reason) and they are contained in the same SubNetwork instance, some measure shall be taken in order to assure the global uniqueness of DNs for all IOC instances under those MEs. One way could be to set different dnPrefix for those NEs, but that would require either that:

- all LDNs or DNs are locally modified using the new dnPrefix for the upper portion of the DNs, or
- a mapping (translation) of the old LDNs or DNs to the new DNs every time they are used externally, e.g. in alarm notifications.

As both the two alternatives above may involve unacceptable drawbacks (as the old RDNs for the MEs then would have to be changed or mapped to new values), using MeContext offers a new alternative to resolve the DN creation. Using MeContext as part of the naming tree (and thus the DN) means that the dnPrefix, including a unique MeContext for each ME, may be directly concatenated with the LDNs, without any need to change or map the existing ME RDNs to new values.

MeContext have 0..N instances. It may exist even if no SubNetwork exists. Every instance of MeContext contains exactly one ManagedElement during steady-state operations.

4.3.6.2 Attributes

The MeContext IOC includes the attributes inherited from Top IOC (defined in clause 4.3.29) and the following attributes:

| Attribute Name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifiable |
|----------------|-------------------|------------|------------|-------------|--------------|
| dnPrefix | CM | T | F | F | T |

4.3.6.3 Attribute constraints

| Name | Definition |
|-------------------------------|--|
| dnPrefix Support Qualifier | Condition: The instance of MeContext is the local root instance of the MIB. Otherwise the attribute shall be absent or carry no information. |

4.3.6.4 Notifications

The common notifications defined in clause 4.5 are valid for this IOC, without exceptions or additions.

4.3.7 SubNetwork

4.3.7.1 Definition

This IOC represents a set of managed entities. There may be zero or more instances of a SubNetwork. It shall be present if either a ManagementNode or multiple ManagedElements are present (i.e. ManagementNode and multiple ManagedElement instances shall have SubNetwork as parent).

The SubNetwork instance not contained in any other instance of SubNetwork is referred to as the "root" SubNetwork instance.

4.3.7.2 Attributes

The `SubNetwork` IOC includes the attributes inherited from `Domain_Ioc` (defined in TS 28.620 [9]), attributes inherited from `TopX` IOC (defined in clause 4.3.8) and the following attributes:

| Attribute Name | S | isReadable | isWritable | isInvariant | isNotifiable |
|--|----|------------|------------|-------------|--------------|
| <code>setOfMcc</code> | CM | T | F | F | T |
| <code>priorityLabel</code> | O | T | T | F | T |
| <code>supportedPerfMetricGroups</code> | O | T | F | F | T |

4.3.7.3 Attribute constraints

| Name | Definition |
|---|--|
| <code>dnPrefix</code> (inherited from <code>Domain_</code>) Support Qualifier | Condition: The instance of <code>SubNetwork</code> is the local root instance of the MIB. Otherwise the attribute shall be absent or carry no information. |
| <code>setOfMcc</code> Support Qualifier | Condition: There is more than one value in <code>setOfMcc</code> of the <code>SubNetwork</code> ; otherwise the support is optional. |

4.3.7.4 Notifications

The common notifications defined in clause 4.5 are valid for this IOC, without exceptions or additions

4.3.8 TopX

4.3.8.1 Definition

This IOC is provided for sub-classing only. All information object classes defined in all TS that claim to be conformant to 32.102 [2] shall inherit from `TopX`.

4.3.8.2 Attributes

| Attribute Name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifiable |
|-----------------------------|-------------------|------------|------------|-------------|--------------|
| <code>objectClass</code> | M | T | T | T | T |
| <code>objectInstance</code> | M | T | T | T | T |

4.3.8.3 Attribute constraints

None

4.3.8.4 Notifications

There is no notification defined.

4.3.9 VsDataContainer

4.3.9.1 Definition

The `VsDataContainer` is a container for vendor specific data. The `VsDataContainer` is contained by `Top` and hence optionally name-contained by each IOC.

4.3.9.2 Attributes

The `VsDataContainer` IOC includes the attributes inherited from `Top` IOC (defined in clause 4.3.29) and the following attributes:

| Attribute Name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifiable |
|---------------------|-------------------|------------|------------|-------------|--------------|
| vsDataType | M | T | F | F | O |
| vsData | M | T | O | F | O |
| vsDataFormatVersion | M | T | F | F | O |

4.3.9.3 Attribute constraints

None

4.3.9.4 Notifications

Support for notification on the change of attribute value is vendor-specific.

4.3.10 *Link*

4.3.10.1 Definition

This IOC is provided for sub-classing only. This IOC represents a communication link or reference point between two network entities. The Link IOC does not indicate whether the represented communication link or reference point is a physical or logical entity.

For the subclasses of Link, the following rules apply:

- 1) The subclass names shall have the form “Link_<X>_<Y>”, where <X> is a string that represents the IOC at one end of the association related to the particular Link subclass, and <Y> is a string that represents the IOC at the other end of the association. For the order of the two strings, <X> shall come alphabetically before <Y>.
- 2) In case <X> and <Y> are YyyFunction IOCs (inheriting from ManagedFunction and on first level below ManagedElement), the <X> and <Y> strings shall have the same form as the legal values of the managedElementType attribute (see clause 4.5.1), e.g. “Auc”. Otherwise <X> and <Y> shall be the full IOC names.

Thus, two valid examples of Link subclass names would be: Link_As_Cscf and Link_Mrfc_Mrfp.

4.3.10.2 Attributes

The Link IOC includes the attributes inherited from TopologicalLink_ (defined in TS 28.620 [9]), attributes inherited from TopX IOC (defined in clause 4.3.8) and the following attributes:

| Attribute Name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifiable |
|-----------------|-------------------|------------|------------|-------------|--------------|
| userLabel | M | T | T | F | T |
| linkType | O | T | F | F | T |
| protocolVersion | O | T | F | F | T |

4.3.10.3 Attribute constraints

| Name | Definition |
|--|--|
| aEnd and zEnd (inherited from <i>TopologicalLink_</i>) Support Qualifier | Condition: The property multiplicity is 1. |

4.3.10.4 Notifications

The common notifications defined in subclause 4.5 are valid for this IOC, without exceptions or additions

4.3.11 *EP_RP*

4.3.11.1 Definition

This IOC is provided for sub-classing only. This IOC represents an end point of a link used across a reference point between two network entities.

For naming the subclasses of *EP_RP*, the following rules shall apply:

- The name of the subclassed IOC shall have the form “EP_<rp>”, where <rp> is a string that represents the name of the reference point.

Thus, two valid examples of *EP_RP* subclassed IOC names would be: *EP_S1* and *EP_X2*.

4.3.11.2 Attributes

The *EP_RP* IOC includes the attributes inherited from *Top* IOC (defined in clause 4.3.29) and the following attributes:

| Attribute Name | S | isReadable | isWritable | isInvariant | isNotifiable |
|---------------------------|---|------------|------------|-------------|--------------|
| farEndEntity | O | T | F | F | T |
| userLabel | O | T | T | F | T |
| supportedPerfMetricGroups | O | T | F | F | T |

4.3.11.3 Attribute constraints

None

4.3.11.4 Notifications

This class does not support any notification.

4.3.12 Void

4.3.13 Void

4.3.14 Void

4.3.15 Void

4.3.16 *ThresholdMonitor*

4.3.16.1 Definition

This IOC represents a threshold monitor for performance metrics. It can be name-contained by *SubNetwork*, *ManagedElement*, or *ManagedFunction*. A threshold monitor checks for threshold crossings of performance metric values and generates a notification when that happens.

To activate threshold monitoring, a MnS consumer needs to create a *ThresholdMonitor* instance on the MnS producer. For ultimate deactivation of threshold monitoring, the MnS consumer should delete the monitor to free up resources on the MnS producer.

For temporary suspension of threshold monitoring, the MnS consumer can manipulate the value of the administrative state attribute. The MnS producer may disable threshold monitoring as well, for example in overload situations. This situation is indicated by the MnS producer with setting the operational state attribute to disabled. When monitoring is resumed the operational state is set again to enabled.

All object instances below and including the instance name-containing the `ThresholdMonitor` (base object instance) are scoped for performance metric production. Performance metrics are monitored only on those object instances whose object class matches the object class associated to the performance metrics to be monitored.

The optional attributes `objectInstances` and `rootObjectInstances` allow to restrict the scope. When the attribute `objectInstances` is present, only the object instances identified by this attribute are scoped. When the attribute `rootObjectInstances` is present, then the subtrees whose root objects are identified by this attribute are scoped. Both attributes may be present at the same time meaning the total scope is equal to the sum of both scopes. Object instances may be scoped by both the `objectInstances` and `rootObjectInstances` attributes. This shall not be considered as an error by the MnS producer.

Multiple thresholds can be defined for multiple performance metric sets in a single monitor using `thresholdInfoList`. The attribute `monitorGranularityPeriod` defines the granularity period to be applied.

A threshold is defined using the attributes `thresholdValue`, `thresholdDirection` and `hysteresis`.

When `hysteresis` is absent or carries no information, a threshold is triggered when the `thresholdValue` is reached or crossed. When `hysteresis` is present, two threshold values are specified for the threshold as follows: A high threshold value equal to the threshold value plus the hysteresis value, and a low threshold value equal to the threshold value minus the hysteresis value. When the monitored performance metric increases, the threshold is triggered when the high threshold value is reached or crossed. When the monitored performance metric decreases, the threshold is triggered when the low threshold value is reached or crossed. The hysteresis ensures that the performance metric value can oscillate around a comparison value without triggering each time the threshold when the threshold value is crossed.

Using the `thresholdDirection` attribute a threshold can be configured in such a manner that it is triggered only when the monitored performance metric is going up or down upon reaching or crossing the threshold.

A `ThresholdMonitor` creation request shall be rejected, if the performance metrics requested to be monitored, the requested granularity period, or the requested combination thereof is not supported by the MnS producer. A creation request may fail, when the performance metrics requested to be monitored are not produced by a `PerfMetricJob`.

Creation and deletion of `ThresholdMonitor` instances by MnS consumers is optional; when not supported, `ThresholdMonitor` instances may be created and deleted by the system or be pre-installed.

4.3.16.2 Attributes

The `ThresholdMonitor` IOC includes attributes inherited from Top IOC (defined in clause 4.3.29) and the following attributes:

| Attribute name | SQ | isReadable | isWritable | isInvariant | isNotifyable |
|---------------------------------------|----|------------|------------|-------------|--------------|
| <code>administrativeState</code> | M | T | T | F | T |
| <code>operationalState</code> | M | T | F | F | T |
| <code>thresholdInfoList</code> | M | T | T | F | T |
| <code>monitorGranularityPeriod</code> | M | T | T | F | T |
| <code>objectInstances</code> | O | T | T | F | F |
| <code>rootObjectInstances</code> | O | T | T | F | F |

4.3.16.3 Attribute constraints

None.

4.3.16.4 Notifications

The common notifications defined in clause 4.5 are valid for this IOC.

4.3.17 ManagedNFService

4.3.17.1 Definition

A ManagedNFService represents a Network Function (NF) service as defined in clause 7 of 3GPP TS 23.501[22].

4.3.17.2 Attributes

The ManagedNFService IOC includes attributes inherited from Top IOC (defined in clause 4.3.29) and the following attributes:

| Attribute Name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifyable |
|---------------------|-------------------|------------|------------|-------------|--------------|
| administrativeState | M | T | T | F | T |
| operationalState | M | T | F | T | T |
| userLabel | O | T | T | F | T |
| nFServiceType | M | T | F | T | F |
| sAP | M | T | T | F | T |
| operations | M | T | T | F | T |
| usageState | M | T | F | T | T |
| registrationState | CM | T | F | F | T |

4.3.17.3 Attribute constraints

Attribute constraint for registrationState: The attribute registrationState should be supported by instance of a ManagedNFService if the service is designed for being published and discovered by other NFs, and need to be registered to a repository function. E.g. Authentication service provided by AUSF should include this attribute. NF management services provided by NRF don't include this attribute.

4.3.17.4 Notifications

The common notifications defined in clause 4.5 are valid for this IOC, without exceptions or additions

4.3.18 Operation <<dataType>>

4.3.18.1 Definition

This data type represents an Operation. An Operation is comprised of a name, an allowedNFType and an operationSemantics (See TS 23.502 [23]).

4.3.18.2 Attributes

| Attribute Name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifyable |
|--------------------|-------------------|------------|------------|-------------|--------------|
| name | M | T | F | T | F |
| allowedNFTypes | M | T | T | F | T |
| operationSemantics | M | T | F | T | T |

4.3.18.3 Attribute constraints

None

4.3.18.4 Notifications

The subclause 4.5 of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

4.3.19 SAP <<dataType>>

4.3.19.1 Definition

This data type represents the access point of a managed NF service which is comprised of a host and a port.

4.3.19.2 Attributes

| Attribute Name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifiable |
|----------------|-------------------|------------|------------|-------------|--------------|
| host | M | T | T | F | T |
| port | M | T | T | F | T |

4.3.19.3 Attribute constraints

None

4.3.19.4 Notifications

The subclause 4.5 of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

4.3.20 ManagedEntity <<ProxyClass>>

4.3.20.1 Definition

This <<ProxyClass>> represents one or multiple IOCs. The IOCs the <<ProxyClass>> represents are defined where the <<ProxyClass>> is used.

4.3.20.2 Attributes

See respective IOCs.

4.3.20.3 Attribute constraints

See respective IOCs.

4.3.20.4 Notifications

See respective IOCs.

4.3.21 HeartbeatControl

4.3.21.1 Definition

MnS consumers (i.e. notification recipients) use heartbeat notifications to monitor the communication channels between them and data report MnS producers emitting notifications such as `notifyNewAlarm` and `notifyFileReady`.

A `HeartbeatControl` instance allows controlling the emission of heartbeat notifications by MnS producers. The recipients of heartbeat notifications are specified by the `notificationRecipientAddress` attribute of the `NtfSubscriptionControl` instance name containing the `HeartbeatControl` instance.

Note that the MnS consumer managing the `HeartbeatControl` instance and the MnS consumer receiving the heartbeat notifications may not be the same.

As a pre-condition for the emission of heartbeat notifications, a `HeartbeatControl` instance needs to be created. Creation of an instance with an initial non-zero value of the `heartbeatNtfPeriod` attribute triggers an immediate heartbeat notification emission. Creation of an instance with an initial zero value of the `heartbeatPeriod` attribute

does not trigger an emission of a heartbeat notification. Deletion of an instance does not trigger an emission of a heartbeat notification.

Once the instance is created, heartbeat notifications are emitted with a periodicity defined by the value of the `heartbeatNtfPeriod` attribute. No heartbeat notifications are emitted if the value is equal to zero. Setting a zero value to a non zero value, or a non zero value to a different non zero value, triggers an immediate heartbeat notification, that is the base for the new heartbeat period. Setting a non zero value to a zero value stops emitting heartbeats immediately; no final heartbeat notification is sent.

The attribute `triggerHeartbeatNtf` allows MnS consumers to trigger the emission of an immediate additional heartbeat notification. The emission of heartbeat notifications according to the heartbeat period is not impacted by this additional notification.

Creation and deletion of `HeartbeatControl` instances by MnS Consumers is optional; when not supported, the `HeartbeatControl` instances may be created and deleted by the system or be pre-installed.

The emission of heartbeat notifications is fully controlled by `HeartbeatControl` instances. Subscription for heartbeat notifications is not supported by `NtfSubscriptionControl`.

4.3.21.2 Attributes

The `HeartbeatControl` IOC includes attributes inherited from Top IOC (defined in clause 4.3.29) and the following attributes:

| Attribute Name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifiable |
|----------------------------------|-------------------|------------|------------|-------------|--------------|
| <code>heartbeatNtfPeriod</code> | M | T | T | F | T |
| <code>triggerHeartbeatNtf</code> | M | F | T | F | F |

4.3.21.3 Attribute constraints

None.

4.3.21.4 Notifications

The common notifications defined in clause 4.5 are valid for this IOC. In addition, the following set of notifications is also valid.

| Name | Qualifier | Notes |
|------------------------------|-----------|-------|
| <code>notifyHeartbeat</code> | M | -- |

4.3.22 NtfSubscriptionControl

4.3.22.1 Definition

`NtfSubscriptionControl` represents a notification subscription of a notification recipient. It can be name-contained by `SubNetwork` or `ManagedElement`.

The `scope` attribute is used to select managed object instances included in the subscription. The base object instance of the scope (see clause 4.3.23) is the object instance name-containing the `NtfSubscriptionControl` instance. When the `subscriptionScope` attribute is absent, all objects below and including the base object are scoped. The notifications related to the selected managed object instances are candidates to be sent to the address specified by the `notificationRecipientAddress` attribute.

The `notificationType` attribute and `notificationFilter` attribute allow MnS consumers to control which candidate notifications are sent to the `notificationRecipientAddress`.

If the `notificationType` attribute is present, its value identifies the notification types that are candidates to be sent to the `notificationRecipientAddress`. If the `notificationType` attribute is absent, all types of notifications are candidate to be sent to `notificationRecipientAddress`.

If supported, the `notificationFilter` attribute defines a filter that is applied to the set of candidate notifications. Only candidate notifications that pass the filter criteria are sent to the `notificationRecipientAddress`. If the `notificationFilter` attribute is absent all candidate notifications are sent to the `notificationRecipientAddress`.

To receive notifications, a MnS consumer has to create a `NtfSubscriptionControl` instance on the MnS producer. A MnS consumer can create a subscription for another MnS consumer since it is not required the `notificationRecipientAddress` be his own address.

When a MnS consumer does not wish to receive notifications any more the MnS consumer shall delete the corresponding `NtfSubscriptionControl` instance.

Creation and deletion of `NtfSubscriptionControl` instances by MnS consumers is optional; when not supported, the `NtfSubscriptionControl` instances may be created and deleted by the system or be pre-installed.

4.3.22.2 Attributes

The `NtfSubscriptionControl` IOC includes attributes inherited from Top IOC (defined in clause 4.3.29) and the following attributes:

| Attribute Name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifiable |
|---|-------------------|------------|------------|-------------|--------------|
| <code>notificationRecipientAddress</code> | M | T | T | F | T |
| <code>notificationTypes</code> | O | T | T | F | T |
| <code>scope</code> | O | T | T | F | T |
| <code>notificationFilter</code> | O | T | T | F | T |

4.3.22.3 Attribute constraints

None.

4.3.22.4 Notifications

The common notifications defined in clause 4.5 are valid for this IOC, without exceptions or additions

4.3.23 Scope <<dataType>>

4.3.23.1 Definition

This <<dataType>> defines a scope for selecting managed object instances below and including a base managed object instance. The scope is specified with the scope type and a scope level attributes. The specification of the base object instance is not part of this <<dataType>> and needs to be specified by other means.

4.3.23.2 Attributes

| Attribute Name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifiable |
|-------------------------|-------------------|------------|------------|-------------|--------------|
| <code>scopeType</code> | M | T | T | F | T |
| <code>scopeLevel</code> | O | T | T | F | T |

4.3.23.3 Attribute constraints

None.

4.3.23.4 Notifications

The subclause 4.5 of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

4.3.24 Void

4.3.25 Void

4.3.26 AlarmList

4.3.26.1 Definition

The `AlarmList` represents the capability to store and manage alarm records. It can be name-contained by `SubNetwork` and `ManagedElement`. The management scope of an `AlarmList` is defined by all descendant objects of the base managed object, which is the object name-containing the `AlarmList`, and the base object itself.

`AlarmList` instances are created by the system or are pre-installed. They cannot be created nor deleted by MnS consumers.

An instance of `SubNetwork` or `ManagedElement` has at most one name-contained instance of `AlarmList`.

When the alarm list is locked or disabled, the existing alarm records are not updated, and new alarm records are not added to the alarm list.

4.3.26.2 Attributes

The `AlarmList` IOC includes attributes inherited from Top IOC (defined in clause 4.3.29) and the following attributes:

| Attribute Name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifiable |
|----------------------------------|-------------------|------------|------------|-------------|--------------|
| <code>administrativeState</code> | M | T | T | F | T |
| <code>operationalState</code> | M | T | F | F | T |
| <code>numOfAlarmRecords</code> | M | T | F | F | F |
| <code>lastModification</code> | M | T | F | F | F |
| <code>alarmRecords</code> | M | T | T | F | F |

4.3.26.3 Attribute constraints

None

4.3.26.4 Notifications

The common notifications defined in clause 4.5 are valid for this IOC, without exceptions or additions.

4.3.27 AlarmRecord <<dataType>>

4.3.27.1 Definition

An `AlarmRecord` contains alarm information of an alarmed object instance. A new record is created in the alarm list when an alarmed object instance generates an alarm and no alarm record exists with the same values for `objectInstance`, `alarmType`, `probableCause` and `specificProblem`. When a new record is created the MnS producer creates an `alarmId`, that unambiguously identifies an alarm record in the `AlarmList`.

Alarm records are maintained only for active alarms. Inactive alarms are automatically deleted by the MnS producer from the `AlarmList`. Active alarms are alarms whose

- a) `perceivedSeverity` is not "CLEARED", or whose
- b) `perceivedSeverity` is "CLEARED" and its `ackState` is not "ACKNOWLEDDED".

4.3.27.2 Attributes

The attributes are defined in clause 11.2.2.1.5.1 of TS 28.532 [27]. Many of them are based on definitions in ITU-T X.733 [31].

| Attribute name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifyable |
|------------------------------------|-------------------|------------|------------|-------------|--------------|
| <code>alarmId</code> | M | T | F | T | F |
| <code>objectInstance</code> | M | T | F | T | F |
| <code>notificationId</code> | M | T | F | T | F |
| <code>alarmRaisedTime</code> | M | T | F | F | F (note 5) |
| <code>alarmChangedTime</code> | O | T | F | F | F (note 6) |
| <code>alarmClearedTime</code> | M | T | F | F | F (note 7) |
| <code>alarmType</code> | M | T | F | T | F |
| <code>probableCause</code> | M | T | F | T | F |
| <code>specificProblem</code> | O | T | F | T | F |
| <code>perceivedSeverity</code> | M | T | T (note 4) | F | F (note 6) |
| <code>backedUpStatus</code> | O | T | F | F | F |
| <code>backUpObject</code> | O | T | F | F | F |
| <code>trendIndication</code> | O | T | F | F | F |
| <code>thresholdInfo</code> | O | T | F | F | F |
| <code>stateChangeDefinition</code> | O | T | F | F | F |
| <code>monitoredAttributes</code> | O | T | F | F | F |
| <code>proposedRepairActions</code> | O | T | F | F | F |
| <code>additionalText</code> | O | T | F | F | F |
| <code>additionalInformation</code> | O (see note 3) | T | F | F | F |
| <code>rootCauseIndicator</code> | O | T | F | F | F |
| <code>ackTime</code> | M | T | F | F | F |
| <code>ackUserId</code> | M | T | T | F | F |
| <code>ackSystemId</code> | O | T | T | F | F |
| <code>ackState</code> | M | T | T | F | F |
| <code>clearUserId</code> | O (see note 1) | T | T | F | F |
| <code>clearSystemId</code> | O (see note 1) | T | T | F | F |
| <code>serviceUser</code> | O (see note 2) | T | F | F | F |
| <code>serviceProvider</code> | O (see note 2) | T | F | F | F |
| <code>securityAlarmDetector</code> | O (see note 2) | T | F | F | F |

NOTE 1: These attributes and qualifiers are applicable only if producer supports consumer to set `perceivedSeverity` to CLEARED.

NOTE 2: These attributes are supported if the producer emits `notifyNewAlarm` that carries security alarm information.

NOTE 3: This attribute is supported to carry vendor specific information.

NOTE 4: This `isWritable` property is True only if producer supports consumer to set `perceivedSeverity` to CLEARED

NOTE 5: Emit `notifyNewAlarm`.

NOTE 6: Emit `notifyChangedAlarm`

NOTE 7: Emit `notifyClearedAlarm`

4.3.27.3 Attribute constraints

None.

4.3.27.4 Notifications

See subclause 4.5.1.

4.3.28 Void

4.3.29 *Top*

4.3.29.1 Definition

This IOC is provided for sub-classing only. All information object classes defined in all TS that claim to be conformant to 32.102 [2] and support the Federated Network Information Model (FNIM) concept shall inherit from *Top*.

4.3.29.2 Attributes

This IOC includes attributes inherited from *TopX* IOC (defined in clause 4.3.8) and the attributes inherited from *Top_* IOC (defined in TS 28.620 [9]).

4.3.29.3 Attribute constraints

None

4.3.29.4 Notifications

There is no notification defined.

4.3.30 TraceJob

4.3.30.1 Definition

A *TraceJob* instance represents the Trace Control and Configuration parameters of a particular Trace Job (see TS 32.421 [29] and TS 32.422 [30] for details).

To activate Trace Jobs, a MnS consumer has to create *TraceJob* object instances on the MnS producer. A MnS consumer can activate a Trace Job for another MnS consumer since it is not required the value of *tjTraceCollectionEntityAddress* or *tjStreamingTraceConsumerUri* to be his own.

For the details of Trace Job activation see clauses 4.1.1.1.2 and 4.1.2.1.2 of TS 32.422 [30].

When a MnS consumer wishes to deactivate a Trace Job, the MnS consumer shall delete the corresponding *TraceJob* instance. For details of management Trace Job deactivation see clause 4.1.1.1.2 of TS 32.422 [30].

Creation and deletion of *TraceJob* instances by MnS consumers is optional; when not supported, the *TraceJob* instances may be created and deleted by the system or be pre-installed.

4.3.30.2 Attributes

The *TraceJob* IOC includes attributes inherited from *Top* IOC (defined in clause 4.3.29) and the following attributes:

| Attribute Name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifiable |
|---------------------------------------|-------------------|------------|------------|-------------|--------------|
| tjJobType | M | T | T | F | T |
| tjListOfInterfaces | O | T | T | F | T |
| tjListOfNeTypes | CM | T | T | F | T |
| tjPLMNTarget | CM | T | T | F | T |
| tjStreamingTraceConsumerURI | CM | T | T | F | T |
| tjTraceCollectionEntityAddress | CM | T | T | F | T |
| tjTraceDepth | CM | T | T | F | T |
| tjTraceReference | M | T | T | F | T |
| tjTraceReportingFormat | M | T | T | F | T |
| tjTraceTarget | CM | T | T | F | T |
| tjTriggeringEvent | CM | T | T | F | T |
| tjMDTAnonymizationOfData | CM | T | T | F | T |
| tjMDTAreaConfigurationForNeighCell | CM | T | T | F | T |
| tjMDTAreaScope | CM | T | T | F | T |
| tjMDTCollectionPeriodRrmLte | CM | T | T | F | T |
| tjMDTCollectionPeriodRrmUmts | CM | T | T | F | T |
| tjMDTCollectionPeriodRrmNR | CM | T | T | F | T |
| tjMDTEventListForTriggeredMeasurement | CM | T | T | F | T |
| tjMDTEventThreshold | CM | T | T | F | T |
| tjMDTListOfMeasurements | CM | T | T | F | T |
| tjMDTLoggingDuration | CM | T | T | F | T |
| tjMDTLoggingInterval | CM | T | T | F | T |
| tjMDTMBSFNAreaList | CM | T | T | F | T |
| tjMDTMeasurementPeriodLTE | CM | T | T | F | T |
| tjMDTMeasurementPeriodUMTS | CM | T | T | F | T |
| tjMDTMeasurementQuantity | CM | T | T | F | T |
| tjMDTPLMList | CM | T | T | F | T |
| tjMDTPositioningMethod | CM | T | T | F | T |
| tjMDTReportAmount | CM | T | T | F | T |
| tjMDTReportingTrigger | CM | T | T | F | T |
| tjMDTReportInterval | CM | T | T | F | T |
| tjMDTReportType | CM | T | T | F | T |
| tjMDTSensorInformation | CM | T | T | F | T |
| tjMDTTraceCollectionEntityID | CM | T | T | F | T |

4.3.30.3 Attribute constraints

| Name | Definition |
|---|--|
| tjListOfNeTypes (support qualifier) | Attribute shall be present only for Signalling Based Activation |
| tjTriggeringEvent (support qualifier) | This attribute shall be present only if Trace is supported. |
| tjPLMNTarget (support qualifier) | This attribute shall be present for management based activation when several PLMNs are supported in the RAN. |
| tjStreamingTraceConsumerURI (support qualifier) | This attribute shall be present if streaming trace data reporting is supported and tjTraceReportingFormat set to "streaming". |
| tjTraceCollectionEntityAddress (support qualifier) | This attribute shall be present if file based trace data reporting is supported and tjTraceReportingFormat set to "file based" or when tjJobType is set to Logged MDT or Logged MBSFN MDT. |
| tjTraceDepth (support qualifier) | This attribute shall be present when tjJobType includes Trace. |
| tjTriggeringEvent (support qualifier) | This attribute shall be present when tjJobType includes Trace. |
| tjMDTAnonymizationOfData (support qualifier) | This attribute shall be present only if MDT is supported and the tjMDTAreaScope attribute is present. |
| tjMDTAreaConfigurationForNeighCell (support qualifier) | This attribute shall be present only if NR MDT is supported and the tjJobType attribute is set to Logged MDT. |
| tjMDTAreaScope (support qualifier) | This attribute shall be present if MDT is supported. |
| tjMDTCollectionPeriodRrmLte (support qualifier) | This attribute shall be present only if MDT is supported and the tjJobType attribute is set to Immediate MDT or combine Trace and Immediate MDT and the tjMDTListOfMeasurements attribute has any of M2, M3 measurement set in case of LTE. |
| tjMDTCollectionPeriodRrmUmts (support qualifier) | This attribute shall be present only if MDT is supported and the tjJobType attribute is set to Immediate MDT or combine Trace and Immediate MDT and the tjMDTListOfMeasurements attribute has any of M3, M4, M5 measurement set in case of UMTS. |
| tjMDTEventListForTriggeredMeasurement (support qualifier) | This attribute shall be present only if NR MDT is supported and the tjJobType attribute is set to Logged MDT. |
| tjMDTEventThreshold (support qualifier) | This attribute shall be present only if MDT is supported and the tjJobType attribute is set to Immediate MDT and the tjMDTReportingTrigger attribute is configured for A2EventReporting in LTE or 1F/1IEventReporting in UMTS. |
| tjMDTListOfMeasurements (support qualifier) | This attribute shall be present only if MDT is supported and the tjJobType attribute is set to Immediate MDT. |
| tjMDTLoggingDuration (support qualifier) | This attribute shall be present only if MDT is supported and the tjJobType attribute is set to Logged MDT or Logged MBSFN MDT. |
| tjMDTLoggingInterval (support qualifier) | This attribute shall be present only if MDT is supported and the tjJobType attribute is set to Logged MDT or Logged MBSFN MDT. |
| tjMDTMBSFNAreaList (support qualifier) | This attribute shall be present only if Logged MBSFN MDT is supported and the tjJobType attribute is set to Logged MBSFN MDT. This is applicable only for eUTRAN. |
| tjMDTMeasurementPeriodLTE (support qualifier) | This attribute shall be present only if MDT is supported and the tjJobType attribute is set to Immediate MDT or combine Trace and Immediate MDT and the tjMDTListOfMeasurements attribute for LTE has either M4 or M5 measurement set. |
| tjMDTMeasurementPeriodUMTS (support qualifier) | This attribute shall be present only if MDT is supported and the tjJobType attribute is set to Immediate MDT or combine Trace and Immediate MDT and the tjMDTListOfMeasurements attribute for UMTS has M6 or M7 measurements set. |
| tjMDTCollectionPeriodRrmNR (support qualifier) | This attribute shall be present only if MDT is supported and the tjJobType attribute is set to Immediate MDT or combine Trace and Immediate MDT and the tjMDTListOfMeasurements attribute has any of M4, M5 measurement set in case of NR. |

| | |
|--|---|
| tjMDTMeasurementQuantity (support qualifier) | This attribute shall be present only if MDT is supported and the tjJobType attribute is set to Immediate MDT or combined Trace and Immediate MDT and the tjMDTReportingTrigger parameter is set to event 1F. |
| tjMDTPLMLList (support qualifier) | This attribute shall be present only if MDT is supported, several PLMNs are supported in the RAN and the tjJobType attribute is set to Logged MDT. |
| tjMDTPositioningMethod (support qualifier) | This attribute shall be present only if MDT is supported and the tjJobType attribute is set to Immediate MDT or combine Trace and Immediate MDT. |
| tjMDTReportAmount (support qualifier) | This attribute shall be present only if MDT is supported and the tjJobType attribute is set to Immediate MDT and the tjMDTReportingTrigger attribute is configured for Periodic Measurements. |
| tjMDTReportingTrigger (support qualifier) | This attribute shall be present only if MDT is supported and the tjJobType attribute is set to Immediate MDT and the tjMDTListOfMeasurements attribute is configured for M1 (for both UMTS and LTE) or M2 (only for UMTS). |
| tjMDTReportInterval (support qualifier) | This attribute shall be present only if MDT is supported and the tjJobType attribute is set to Immediate MDT and the tjMDTReportingTrigger is configured for Periodic Measurements |
| tjMDTReportType (support qualifier) | This attribute shall be present only if NR MDT is supported and the tjJobType attribute is set to Logged MDT. |
| tjMDTSensorInformation (support qualifier) | This attribute shall be present only if NR MDT is supported. |
| tjMDTTraceCollectionEntityID (support qualifier) | This attribute shall be present only if MDT is supported and the tjJobType attribute is set to Logged MDT. |
| tjTraceTarget, tjMDTAreaScope (values) | <p>The tjTraceTarget shall be public ID in case of a Management Based Activation is done to an ScscfFunction. The tjTraceTarget shall be cell only in case of the UTRAN cell traffic trace function. The tjTraceTarget shall be E-UtranCell only in case of E-UTRAN cell traffic trace function. The tjTraceTarget shall be either IMSI or IMEI(SV) if the Trace Session is activated to any of the following ManagedEntity(ies):</p> <ul style="list-style-type: none"> - HssFunction - MscServerFunction - SgsnFunction - GgsnFunction - BmscFunction - RncFunction - MmeFunction <p>The tjTraceTarget shall be IMSI if the Trace Session is activated to a ManagedEntity playing a role of ServinGWFunction.</p> <p>In case of signaling based MDT, the tjTraceTarget attribute shall be able to carry (IMSI or IMEI(SV)), the tjMDTAreaScope attribute shall be able to carry a list of (cell or E-UtranCell or TA/LA/RA).</p> <p>In case of management based Immediate MDT, the tjTraceTarget attribute shall be null value, the tjMDTAreaScope attribute shall carry a list of (Utrancell or E-UtranCell).</p> <p>In case of management based Logged MDT, the tjTraceTarget attribute shall carry an eNodeBs or a RNC. The Logged MDT should be initiated on the specified eNodeB/RNC in tjTraceTarget. The tjMDTAreaScope attribute shall carry a list of (Utrancell or E-UtranCell or TA/LA/RA)..</p> <p>In case of RLF reporting, or RCEF reporting, the tjTraceTarget attribute shall be null value, the tjMDTAreaScope attribute shall carry one or list of eNBs.</p> |

4.3.30.4 Notifications

The common notifications defined in clause 4.5 are valid for this IOC, without exceptions.

4.3.31 PerfMetricJob

4.3.31.1 Definition

This IOC represents a performance metric production job. It can be name-contained by `SubNetwork`, `ManagedElement`, or `ManagedFunction`.

To activate the production of the specified performance metrics, a MnS consumer needs to create a `PerfMetricJob` instance on the MnS producer. For ultimate deactivation of metric production, the MnS consumer should delete the job to free up resources on the MnS producer.

For temporary suspension of metric production, the MnS consumer can manipulate the value of the administrative state attribute. The MnS producer may disable metric production as well, for example in overload situations. This situation is indicated by the MnS producer with setting the operational state attribute to disabled. When production is resumed the operational state is set again to enabled.

The `jobId` attribute can be used to associate metrics from multiple `PerfMetricJob` instances. The `jobId` can be included when reporting performance metrics to allow a MnS consumer to associate received metrics for the same purpose. For example, it is possible to configure the same `jobId` value for multiple `PerfMetricJob` instances required to produce the measurements for a specific KPI.

The attribute `performanceMetrics` defines the performance metrics to be produced and the attribute `granularityPeriod` defines the granularity period to be applied.

All object instances below and including the instance name-containing the `PerfMetricJob` (base object instance) are scoped for performance metric production. Performance metrics are produced only on those object instances whose object class matches the object class associated to the performance metrics to be produced.

The optional attributes `objectInstances` and `rootObjectInstances` allow to restrict the scope. When the attribute `objectInstances` is present, only the object instances identified by this attribute are scoped. When the attribute `rootObjectInstances` is present, then the subtrees whose root objects are identified by this attribute are scoped. Both attributes may be present at the same time meaning the total scope is equal to the sum of both scopes. Object instances may be scoped by both the `objectInstances` and `rootObjectInstances` attributes. This shall not be considered as an error by the MnS producer.

When the performance metric requires performance metric production on multiple managed objects, which is for example the case for KPIs, the MnS consumer needs to ensure all required objects are scoped. Otherwise a `PerfMetricJob` creation request shall fail.

The attribute `reportingCtrl` specifies the method and associated control parameters for reporting the produced measurements to MnS consumers. Three methods are available: file-based reporting with selection of the file location by the MnS producer, file-based reporting with selection of the file location by the MnS consumer and stream-based reporting.

A `PerfMetricJob` creation request shall be rejected, if the requested performance metrics, the requested granularity period, the requested reporting method, or the requested combination thereof is not supported by the MnS producer.

Creation and deletion of `PerfMetricJob` instances by MnS consumers is optional; when not supported, `PerfMetricJob` instances may be created and deleted by the system or be pre-installed.

4.3.31.2 Attributes

The `PerfMetricJob` IOC includes attributes inherited from Top IOC (defined in clause 4.3.29) and the following attributes:

| Attribute name | S | isReadable | isWritable | isInvariant | isNotifiable |
|---------------------|---|------------|------------|-------------|--------------|
| administrativeState | M | T | T | F | T |
| operationalState | M | T | F | F | T |
| jobId | M | T | T | T | T |
| performanceMetrics | M | T | T | F | T |
| granularityPeriod | M | T | T | F | T |
| objectInstances | O | T | T | F | T |
| rootObjectInstances | O | T | T | F | T |
| reportingCtrl | M | T | T | F | T |

4.3.31.3 Attribute constraints

None.

4.3.31.4 Notifications

The common notifications defined in clause 4.5 are valid for this IOC. In addition, the following set of notifications is also valid.

| Name | S | Notes |
|----------------------------|---|-------|
| notifyFileReady | M | -- |
| notifyFilePreparationError | M | -- |

4.3.32 SupportedPerfMetricGroup <<dataType>>

4.3.32.1 Definition

This <<dataType>> captures a group of supported performance metrics, and associated (production and monitoring) granularity periods and reporting methods that are supported for the specified performance metric group.

4.3.32.2 Attributes

| Attribute name | S | isReadable | isWritable | isInvariant | isNotifiable |
|---------------------------|---|------------|------------|-------------|--------------|
| performanceMetrics | M | T | F | F | T |
| granularityPeriods | M | T | F | F | T |
| reportingMethods | M | T | F | F | T |
| monitorGranularityPeriods | M | T | F | F | T |

4.3.32.3 Attribute constraints

None

4.3.32.4 Notifications

Not applicable.

4.3.33 ReportingCtrl <<choice>>

4.3.33.1 Definition

This <<choice>> defines the method for reporting collected performance metrics to MnS consumers as well as the parameters for configuring the reporting function. It is a choice between the control parameter required for the reporting methods, whose presence selects the reporting method as follows:

When only the `fileReportingPeriod` attribute is present, the MnS producer shall store files on the MnS producer at a location selected by the MnS producer and inform the MnS consumer about the availability of new files and the file location using the `notifyFileReady` notification.

When only the `fileReportingPeriod` and `fileLocation` attributes are present, the MnS producer shall store the files on the MnS consumer at the location specified by `fileLocation`. No notification is emitted by the MnS producer.

When only the `streamTarget` attribute is present, the MnS producer shall stream the data to the location specified by `streamTarget`.

For the file-based reporting methods the `fileReportingPeriod` attribute specifies the time window during which collected measurements are stored into the same file before the file is closed and a new file is opened.

4.3.33.2 Attributes

| Attribute name | S | isReadable | isWritable | isInvariant | isNotifiable |
|---|----|------------|------------|-------------|--------------|
| CHOICE_1.1 <code>fileReportingPeriod</code> | CM | T | T | F | T |
| CHOICE_2.1 <code>fileReportingPeriod</code> | CM | T | T | F | T |
| CHOICE_2.2 <code>fileLocation</code> | CM | T | T | F | T |
| CHOICE_3.1 <code>streamTarget</code> | CM | T | T | F | T |

4.3.33.3 Attribute constraints

| Name | Definition |
|---|---|
| CHOICE_1.1 <code>fileReportingPeriod</code> | This attribute shall be supported, when the file-based reporting method is supported, and the files are stored on the MnS producer. |
| CHOICE_2.1 <code>fileReportingPeriod</code> CHOICE_2.2 <code>fileLocation</code> | These attributes shall be supported, when the file-based reporting method is supported, and the files are stored on the MnS consumer. |
| CHOICE_3.1 <code>streamTarget</code> | This attribute shall be supported, when the stream-based reporting method is supported |

4.3.33.4 Notifications

The subclause 4.5 of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

4.3.34 ThresholdInfo <<dataType>>

4.3.34.1 Definition

This data type defines a single threshold level.

4.3.34.2 Attributes

| Attribute name | S | isReadable | isWritable | isInvariant | isNotifiable |
|---------------------------------|---|------------|------------|-------------|--------------|
| <code>performanceMetrics</code> | M | T | T | F | T |
| <code>thresholdDirection</code> | M | T | T | F | T |
| <code>thresholdValue</code> | M | T | T | F | T |
| <code>hysteresis</code> | O | T | T | F | T |

4.4 Attribute definitions

4.4.1 Attribute properties

The following table defines the properties of attributes specified in the present document.

| Attribute Name | Documentation and Allowed Values | Properties |
|------------------------------|--|--|
| heartbeatNtfPeriod | <p>Periodicity of the heartbeat notification emission. The value of zero has the special meaning of stopping the heartbeat notification emission.</p> <p>Unit is in seconds.</p> <p>AllowedValues: non-negative integers</p> | <p>type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: 0 isNullable: False</p> |
| triggerHeartbeatNtf | <p>Setting this attribute to TRUE triggers an immediate additional heartbeat notification emission. Setting the value to FALSE has no observable result.</p> <p>The periodicity of <code>notifyHeartbeat</code> emission is not changed.</p> <p>AllowedValues: TRUE, FALSE</p> | <p>type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: FALSE isNullable: False</p> |
| notificationRecipientAddress | <p>Address of the notification recipient.</p> <p>allowedValues: N/A</p> | <p>type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False</p> |
| notificationTypes | <p>Notification types of notifications that are candidates for being forwarding to the notification recipient. If this attribute is absent, notifications of all types are candidates for being forwarding to the notification recipient.</p> <p>If the <code>notificationFilter</code> attribute is absent, all candidate notifications are forwarded to the notification recipient, otherwise the candidate notifications are discriminated by the filter specified by the <code>notificationFilter</code> attribute.</p> <p>AllowedValues:</p> <ul style="list-style-type: none"> - notifyMOICreation - notifyMOIDeletion - notifyMOIAttributeValueChanges - notifyMOIChanges - notifyEvent - notifyNewAlarm - notifyChangedAlarm - notifyAckStateChanged - notifyComments - notifyCorrelatedNotificationChanged - notifyChangedAlarmGeneral - notifyAlarmListRebuilt - notifyPotentialFaultyAlarmList - notifyFileReady - notifyFilePreparationError - notifyThresholdCrossing | <p>type: ENUM multiplicity: * isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False</p> |
| notificationFilter | <p>Filter to be applied to candidate notifications identified by the <code>notificationTypes</code> attribute. Only notifications that pass the filter criteria are forwarded to the notification recipient. All other notifications are discarded.</p> <p>The filter can be applied to any field of a notification.</p> <p>allowedValues: N/A</p> | <p>type: String multiplicity: 0..1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False</p> |
| scope | <p>Scopes the managed object instances included in the notification subscription. If this attribute is absent, all objects below and including the base object are scoped.</p> <p>allowedValues: N/A</p> | <p>type: Scope multiplicity: 0..1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False</p> |

| Attribute Name | Documentation and Allowed Values | Properties |
|---------------------------|--|---|
| scopeType | <p>If the optional <code>scopeLevel</code> attribute is not supported or absent, allowed values of <code>scopeType</code> are <code>BASE_ONLY</code> and <code>BASE_ALL</code>.</p> <p>The value <code>BASE_ONLY</code> indicates only the base object is selected.</p> <p>The value <code>BASE_ALL</code> indicates the base object and all of its subordinate objects (incl. the leaf objects) are selected.</p> <p>If the <code>scopeLevel</code> attribute is supported and present, allowed values of <code>scopeType</code> are <code>BASE_NTH_LEVEL</code> and <code>BASE_SUBTREE</code>.</p> <p>The value <code>BASE_NTH_LEVEL</code> indicates all objects on the level, which is specified by the <code>scopeLevel</code> attribute, below the base object are selected. The base object is at <code>scopeLevel</code> zero.</p> <p>The value <code>BASE_SUBTREE</code> indicates the base object and all subordinate objects down to and including the objects on the level, which is specified by the <code>scopeLevel</code> attribute, are selected. The base object is at <code>scopeLevel</code> zero.</p> <p>allowedValues: N/A</p> | <p>type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False</p> |
| scopeLevel | <p>See definition of <code>scopeType</code> attribute.</p> <p>allowedValues: N/A</p> | <p>type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False</p> |
| farEndEntity | <p>The value of this attribute shall be the Distinguished Name of the far end network entity to which the reference point is related. As an example, with <code>EP_Iucs</code>, if the instance of <code>EP_Iucs</code> is contained by one <code>RncFunction</code> instance, the <code>farEndEntity</code> is the Distinguished Name of the <code>MscServerFunction</code> instance to which this <code>Iucs</code> reference point is related.</p> <p>allowedValues: N/A</p> | <p>type: DN multiplicity: 0..1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False</p> |
| linkType | <p>This attribute defines the type of the link.</p> <p>allowedValues: Signalling, Bearer, OAM&P, Other or multiple combinations of this type.</p> | <p>type: String multiplicity: 0..* isOrdered: False isUnique: True defaultValue: No isNullable: False</p> |
| locationName | <p>The physical location of this entity (e.g. an address).</p> <p>allowedValues: N/A</p> | <p>type: String multiplicity: 0..1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False</p> |
| monitorGranularityPeriod | <p>Granularity period used to monitor measurements for threshold crossings. The period is defined in seconds.</p> <p>See Note 5</p> <p>allowedValues: Integer with a minimum value of 1</p> | <p>type: Integer multiplicity: 1 isOrdered: False isUnique: True defaultValue: None isNullable: False</p> |
| monitorGranularityPeriods | <p>Granularity periods supported for the monitoring of associated measurement types for thresholds. The period is defined in seconds.</p> <p>allowedValues: Integer with a minimum value of 1</p> | <p>type: Integer multiplicity: * isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False</p> |

| Attribute Name | Documentation and Allowed Values | Properties |
|--------------------|--|--|
| thresholdInfoList | List of threshold infos. | type: ThresholdInfo multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False |
| thresholdValue | Value against which the monitored performance metric is compared at a threshold level in case the hysteresis is zero. allowedValues: float or integer | type: Union multiplicity: 1 isOrdered: NA isUnique: NA defaultValue: None isNullable: False |
| hysteresis | Hysteresis of a threshold. If this attribute is present the monitored performance metric is not compared against the threshold value as specified by the <code>thresholdValue</code> attribute but against a high and low threshold value given by highThresholdValue- = thresholdValue + hysteresis lowThresholdValue = thresholdValue - hysteresis When going up, the threshold is triggered when the performance metric reaches or crosses the high threshold value. When going down, the threshold is triggered when the performance metric reaches or crosses the low threshold value. A hysteresis may be present only when the monitored performance metric is not of type counter that can go up only. If present for a performance metric of type counter, it shall be ignored. allowedValues: non-negative float or integer | type: Union multiplicity: 0..1 isOrdered: NA isUnique: NA defaultValue: None isNullable: False |
| thresholdDirection | Direction of a threshold indicating the direction for which a threshold crossing triggers a threshold. When the threshold direction is configured to "UP", the associated threshold is triggered only when the performance metric value is going up upon reaching or crossing the threshold value. The threshold is not triggered, when the performance metric is going down upon reaching or crossing the threshold value. Vice versa, when the threshold direction is configured to "DOWN", the associated threshold is triggered only when the performance metric is going down upon reaching or crossing the threshold value. The threshold is not triggered, when the performance metric is going up upon reaching or crossing the threshold value. When the threshold direction is set to "UP_AND_DOWN" the threshold is active in both directions. In case a threshold with hysteresis is configured, the threshold direction attribute shall be set to "UP_AND_DOWN". allowedValues: - UP - DOWN - UP_AND_DOWN | type: ENUM multiplicity: 1 isOrdered: NA isUnique: NA defaultValue: None isNullable: False |
| objectClass | Class of a managed object instance. allowedValues: N/A | type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |

| Attribute Name | Documentation and Allowed Values | Properties |
|-----------------|---|---|
| objectInstance | Managed object instance identified by its DN. allowedValues: N/A | type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| objectInstances | List of managed object instances. Each object instance is identified by its DN. allowedValues: N/A | type: Dn multiplicity: * isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |

| Attribute Name | Documentation and Allowed Values | Properties |
|--------------------------|--|---|
| <p>peeParametersList</p> | <p>This attribute contains the parameter list for the control and monitoring of power, energy and environmental parameters of ManagedFunction instance(s). This list contains the following parameters:</p> <ul style="list-style-type: none"> - siteIdentification - siteLatitude (optional) - siteLongitude (optional) - siteDescription - equipmentType - environmentType - powerInterface <p>siteIdentification: The identification of the site where the ManagedFunction resides.</p> <p>allowedValues: N/A</p> <p>siteLatitude: The latitude of the site where the ManagedFunction instance resides, based on World Geodetic System (1984 version) global reference frame (WGS 84). Positive values correspond to the northern hemisphere. This attribute is optional in case of BTSFunction and RNCFunction instance(s).</p> <p>allowedValues: -90.0000 to +90.0000</p> <p>siteLongitude: The longitude of the site where the ManagedFunction instance resides, based on World Geodetic System (1984 version) global reference frame (WGS 84). Positive values correspond to degrees east of 0 degrees longitude. This attribute is optional in case of BTSFunction and RNCFunction instance(s).</p> <p>allowedValues: -180.0000 to +180.0000</p> <p>siteDescription: An operator defined description of the site where the ManagedFunction instance resides.</p> <p>allowedValues: N/A</p> <p>equipmentType: The type of equipment where the managedFunction instance resides.</p> <p>allowedValues: see clause 4.4.1 of ETSI ES 202 336-12 [18].</p> <p>environmentType: The type of environment where the managedFunction instance resides.</p> <p>allowedValues: see clause 4.4.1 of ETSI ES 202 336-12 [18].</p> <p>powerInterface: The type of power.</p> <p>allowedValues: see clause 4.4.1 of ETSI ES 202 336-12 [18].</p> | <p>type: String multiplicity: 0..* isOrdered: N/A isUnique: True defaultValue: None isNullable: True</p> |

| | | |
|----------------------|--|---|
| <p>priorityLabel</p> | <p>This is a label that consumer would assign a value on a concrete instance of the managed object. The management system takes the value of this attribute into account. The effect of this attribute value to the subject managed entity is not standardized</p> | <p>type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False</p> |
|----------------------|--|---|

| Attribute Name | Documentation and Allowed Values | Properties |
|------------------|---|--|
| protocolVersion | Versions(s) and additional descriptive information for the protocol(s) used for the associated communication link. Syntax and semantic is not specified. allowedValues: N/A | type: String multiplicity: * isOrdered: False isUnique: True defaultValue: None isNullable: False |
| setOfMcc | Set of Mobile Country Code (MCC). The MCC uniquely identifies the country of domicile of the mobile subscriber. MCC is part of the IMSI (TS 23.003 [5]) This list contains all the MCC values in subordinate object instances to this <i>SubNetwork</i> instance. allowedValues: See clause 2.3 of TS 23.003 [5] for MCC allocation principles. | type: Integer multiplicity: 1..* isOrdered: False isUnique: True defaultValue: No default value isNullable: False |
| swVersion | The software version of the <i>ManagementNode</i> or <i>ManagedElement</i> (this is used for determining which version of the vendor specific information is valid for the <i>ManagementNode</i> or <i>ManagedElement</i>). allowedValues: N/A | type: String multiplicity: 0..1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| systemDN | The Distinguished Name (DN) of <i>IRPAgent</i> (or consumer). Defined in 3GPP TS 32.300. allowedValues: N/A | type: DN multiplicity: 0..1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| userDefinedState | An operator defined state for operator specific usage. allowedValues: N/A | type: String multiplicity: 0..1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| userLabel | A user-friendly (and user assignable) name of this object. allowedValues: N/A | type: String multiplicity: 0..1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| vendorName | The name of the vendor. allowedValues: N/A | type: String multiplicity: 0..1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |

| Attribute Name | Documentation and Allowed Values | Properties |
|---------------------|---|---|
| vnfParametersList | <p>This attribute contains the parameter set of the VNF instance(s) corresponding to an NE. Each entry in the list contains:</p> <ul style="list-style-type: none"> - vnfInstanceId - vnfdId (optional) - flavourId (optional) - autoScalable <p>vnfInstanceId: VNF instance identifier (vnfInstanceId, see section 9.4.2 of [16] and section B2.4.2.1.2.3 of [17]).</p> <p>See Note 1.</p> <p>vnfdId: Identifier of the VNFD on which the VNF instance is based, see section 9.4.2 of [16]. This attribute is optional. Note: the value of this attribute is identical to that of the same attribute in clause 9.4.2 of ETSI GS NFV-IFA 008 [16].</p> <p>flavourId: Identifier of the VNF Deployment Flavour applied to this VNF instance, see section 9.4.3 of [16]. This attribute is optional. Note: the value of this attribute is identical to that of the same attribute in clause 9.4.3 of ETSI GS NFV-IFA 008 [16].</p> <p>autoScalable: Indicator of whether the auto-scaling of this VNF instance is enabled or disabled. The type is Boolean.</p> <p>See Note2.</p> <p>The presence of this attribute indicates that the ManagedFunction represented by the MOI is a virtualized function.</p> <p>See Note 3.</p> <p>allowedValues: N/A</p> <p>A string length of zero for vnfInstanceId means the VNF instance(s) corresponding to the MOI does not exist (e.g. has not been instantiated yet, has already been terminated).</p> | <p>type: String multiplicity: * isOrdered: N/A isUnique: True defaultValue: None isNullable: True</p> |
| vsData | <p>Vendor specific attributes of the type vsDataType. The attribute definitions including constraints (value ranges, data types, etc.) are specified in a vendor specific data format file.</p> <p>allowedValues: --</p> | <p>type: -- multiplicity: -- isOrdered: -- isUnique: -- defaultValue: -- isNullable: False</p> |
| vsDataFormatVersion | <p>Name of the data format file, including version.</p> <p>allowedValues: N/A</p> | <p>type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False</p> |
| vsDataType | <p>Type of vendor specific data contained by this instance, e.g. relation specific algorithm parameters, cell specific parameters for power control or re-selection or a timer. The type itself is also vendor specific.</p> <p>allowedValues: N/A</p> | <p>type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False</p> |

| Attribute Name | Documentation and Allowed Values | Properties |
|---------------------------|---|---|
| supportedPerfMetricGroups | A set of performance metric groups. When this attribute is contained in a managed object it may define performance metrics for this object and all descendant objects. allowedValues: N/A | type: SupportedPerfMetricGroup multiplicity: * isOrdered: N/A isUnique: N/A defaultValue: None allowedValues: N/A isNullable: False |
| performanceMetrics | List of performance metrics. Performance metrics include measurements defined in TS 28.552 [20] and KPIs defined in TS 28.554 [28]. Performance metrics can also be those specified by other SDOs or vendor specific metrics. Performance metrics are identified with their names. A name can also identify a vendor specific group of performance metrics. For measurements defined in TS 28.552 [20] the name is constructed as follows: <ul style="list-style-type: none"> - "family.measurementName.subcounter" for measurement types with subcounters - "family.measurementName" for measurement types without subcounters - "family" for measurement families For KPIs defined in TS 28.554 [28] the name is defined in the KPI definitions template as the component designated with e). allowedValues: N/A | type: String multiplicity: * isOrdered: N/A isUnique: True defaultValue: None isNullable: False |
| rootObjectInstances | List of object instances. Each object instance is identified by its DN and designates the root of a subtree that contains the root object and all descendant objects. | Type: Dn multiplicity: * isOrdered: N/A isUnique: True defaultValue: None isNullable: False |
| reportingMethods | List of reporting methods for performance metrics allowedValues: <ul style="list-style-type: none"> - "FILE_BASED_LOC_SET_BY_PRODUCER", - "FILE_BASED_LOC_SET_BY_CONSUMER", - "STREAM_BASED" | Type: ENUM multiplicity: * isOrdered: N/A isUnique: True defaultValue: None isNullable: False |
| nFServiceType | The parameter defines the type of the managed NF service instance allowedValues: See clause 7.2 of TS 23.501[22] | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: True defaultValue: None isNullable: False |
| operations | This parameter defines set of operations supported by the managed NF service instance. allowedValues: See TS 23.502[23] for supporting operations | type: Operation multiplicity: 1..* isOrdered: False isUnique: False defaultValue: No default value isNullable: False |
| Operation.name | This parameter defines the name of the operation of the managed NF service instance. allowedValues: N/A | type: String multiplicity: 1 isOrdered: False isUnique: False defaultValue: None isNullable: True |

| Attribute Name | Documentation and Allowed Values | Properties |
|--------------------|---|---|
| allowedNFTypes | This parameter identifies the type of network functions allowed to access the operation of the managed NF service instance. allowedValues: See TS 23.501[22] for NF types | type: ENUM multiplicity: 1..* isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| operationSemantics | This parameter identifies the semantics type of the operation. See TS 23.502[23] allowedValues: "Request/Response", "Subscribe/Notify". | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| sAP | This parameter specifies the service access point of the managed NF service instance. allowedValues: N/A | type: SAP multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| host | This parameter specifies the host address of the managed NF service instance. It can be FQDN (See TS 23.003 [5]) or an IPv4 address (See RFC 791 [24]) or an IPv6 address (See RFC 2373 [25]). allowedValues: N/A | type: String multiplicity: 1 isOrdered: False isUnique: N/A defaultValue: None isNullable: False |
| port | This parameter specifies the transport port of the managed NF service instance. allowedValues: 1 - 65535 | type: Integer multiplicity: 1 isOrdered: False isUnique: False defaultValue: None isNullable: False |
| usageStae | Usage state of a managed object instance. It describes whether the resource is actively in use at a specific instant, and if so, whether or not it has spare capacity for additional users at that instant. allowedValues: "IDLE", "ACTIVE", "BUSY". The meaning of these values is as defined in 3GPP TS 28.625 [21] and ITU-T X.731 [19]. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| registrationState | This parameter defines the registration status of the managed NF service instance. allowedValues: "Registered", "Deregistered". | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: Deregistered isNullable: False |
| jobId | Id for a PerfMetricJob job. | type: String multiplicity: 0..1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| granularityPeriod | Granularity period used to produce measurements. The period is defined in seconds. See Note 4. allowedValues: Integer with a minimum value of 1 | type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| granularityPeriods | Granularity periods supported for the production of associated measurement types. The period is defined in seconds. allowedValues: Integer with a minimum value of 1 | type: Integer multiplicity: * isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |

| Attribute Name | Documentation and Allowed Values | Properties |
|---------------------|--|--|
| reportingCtrl | Selecting the reporting method and defining associated control parameters. | type: ReportingCtrl multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| fileReportingPeriod | For the file-based reporting method this is the time window during which collected measurements are stored into the same file before the file is closed and a new file is opened. The period is defined in minutes. allowedValues: Multiples of granularityPeriod | type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| fileLocation | File location allowedValues: Not applicable. | type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: True |
| streamTarget | The stream target for the stream-based reporting method. allowedValues: N/A | type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: True |
| administrativeState | Administrative state of a managed object instance. The administrative state describes the permission to use or prohibition against using the object instance. The administrative state is set by the MnS consumer. allowedValues: LOCKED, UNLOCKED. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: LOCKED isNullable: False |
| operationalState | Operational state of managed object instance. The operational state describes if an object instance is operable ("ENABLED") or inoperable ("DISABLED"). This state is set by the object instance or the MnS producer and is hence READ-ONLY. allowedValues: ENABLED, DISABLED. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: DISABLED isNullable: False |
| alarmRecords | List of alarm records allowedValues: N/A | type: AlarmRecord multiplicity: * isOrdered: N/A isUnique: True default value: None isNullable: True |
| numOfAlarmRecords | Number of alarm records in the AlarmList. allowedValues: 0 to x where x is vendor specific. | type: integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| lastModification | Time an alarm record was modified the last time allowedValues: N/A | type: DateTime multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| tjJobType | It specifies the MDT mode and it specifies also whether the TraceJob represents only MDT, Logged MBSFN MDT, Trace or a combined Trace and MDT job. The attribute is applicable for Trace, MDT, RCEF and RLF reporting. See the clause 5.9a of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: TRACE_ONLY isNullable: False |
| tjListOfInterfaces | It specifies the interfaces that need to be traced in the given ManagedEntityFunction. The attribute is applicable only for Trace. In case this attribute is not used, it carries a null semantic. See the clause 5.5 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1..* isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |

| Attribute Name | Documentation and Allowed Values | Properties |
|--------------------------------|---|---|
| tjListOfNeTypes | It specifies in which type of <code>ManagedFunction</code> the trace should be activated. The attribute is applicable only for Trace with Signalling Based Trace activation. In case this attribute is not used, it carries a null semantic. See the clause 5.4 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1..* isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjPLMNTarget | It specifies which PLMN that the subscriber of the session to be recorded uses as selected PLMN. PLMN Target might differ from the PLMN specified in the Trace Reference. See the clause 5.9b of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: String multiplicity: 1 isOrdered: N/A isUnique: True defaultValue: No isNullable: True |
| tjStreamingTraceConsumerURL | It specifies the URI of the Streaming Trace data reporting MnS consumer (a.k.a. streaming target). See the clause 5.9 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjTraceCollectionEntityAddress | It specifies the address of the Trace Collection Entity when the attribute <code>tjTraceReportingFormat</code> is configured for the file-based reporting. The attribute is applicable for both Trace and MDT. See the clause 5.9 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjTraceDepth | It specifies the trace depth. The attribute is applicable only for Trace. In case this attribute is not used, it carries a null semantic. See the clause 5.3 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: MAXIMUM isNullable: True |
| tjTraceReference | A globally unique identifier, which uniquely identifies the Trace Session that is created by the TraceJob. In case of shared network, it is the MCC and MNC of the Participating Operator that request the trace session that shall be provided. The attribute is applicable for both Trace and MDT. See the clause 5.6 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: Integer multiplicity: 1 isOrdered: N/A isUnique: True defaultValue: None isNullable: False |
| tjTraceReportingFormat | It specifies the trace reporting format - streaming trace reporting or file-based trace reporting. See the clause 5.11 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: FILE isNullable: False |
| tjTraceTarget | It specifies the target object of the Trace and MDT. The attribute is applicable for both Trace and MDT. This attribute includes the ID type of the target as an enumeration and the ID value. See the 3GPP TS 32.422 [30] for additional details on the allowed values. | type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjTriggeringEvent | It specifies the triggering event parameter of the trace session. The attribute is applicable only for Trace. In case this attribute is not used, it carries a null semantic. See the clause 5.1 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTAnonymizationOfData | It specifies the level of anonymization for management based MDT. See the clause 5.10.12 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: NO_IDENTITY isNullable: True |

| Attribute Name | Documentation and Allowed Values | Properties |
|--|--|---|
| tjMDTAreaConfigurationForNeighbourCell | It specifies the area for which UE is requested to perform measurement logging for neighbour cells which have list of frequencies. If it is not configured, the UE shall perform measurement logging for all the neighbour cells. Applicable only to NR Logged MDT. See the clause 5.10.26 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: String multiplicity: 1..* isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTAreaScope | It specifies MDT area scope when activates an MDT job. For RLF and RCEF reporting it specifies the eNB or list of eNBs where the RLF or RCEF reports should be collected. List of cells/TA/LA/RA for signaling based MDT or management based Logged MDT. List of cells for management based Immediate MDT. Cell, TA, LA, RA are mutually exclusive. One or list of eNBs for RLF and RCEFreporting See the clause 5.10.2 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: String multiplicity: 1..* isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTCollectionPeriodRrmLte | It specifies the collection period for collecting RRM configured measurement samples for M2, M3 in LTE. The attribute is applicable only for Immediate MDT. In case this attribute is not used, it carries a null semantic. See the clause 5.10.20 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTCollectionPeriodRrmUmts | It specifies the collection period for collecting RRM configured measurement samples for M3, M4, M5 in UMTS. The attribute is applicable only for Immediate MDT. In case this attribute is not used, it carries a null semantic. See the clause 5.10.21 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTEventListForTriggeredMeasurement | It specifies event types for event triggered measurement in the case of logged NR MDT. Each trace session may configure at most one event. The UE shall perform logging of measurements only upon certain condition being fulfilled: - Out of coverage. - A2 event. See the clause 5.10.28 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTEventThreshold | It specifies the threshold which should trigger the reporting in case A2 event reporting in LTE or 1F/1I event in UMTS. The attribute is applicable only for Immediate MDT and when reportingTrigger is configured for A2 event in LTE or 1F event or 1I event in UMTS. In case this attribute is not used, it carries a null semantic. See the clauses 5.10.7 and 5.10.7a of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTListOfMeasurements | It specifies the UE measurements that shall be collected in an Immediate MDT job. The attribute is applicable only for Immediate MDT. In case this attribute is not used, it carries a null semantic. See the clause 5.10.3 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTLoggingDuration | It specifies how long the MDT configuration is valid at the UE in case of Logged MDT. The attribute is applicable only for Logged MDT and Logged MBSFN MDT. In case this attribute is not used, it carries a null semantic. See the clause 5.10.9 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTLoggingInterval | It specifies the periodicity for Logged MDT. The attribute is applicable only for Logged MDT and Logged MBSFN MDT. In case this attribute is not used, it carries a null semantic. See the clause 5.10.8 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |

| Attribute Name | Documentation and Allowed Values | Properties |
|----------------------------|--|---|
| tjMDTMBSFNAreaList | The MBSFN Area consists of a MBSFN Area ID and Carrier Frequency (EARFCN). The target MBSFN area List can have up to 8 entries. This parameter is applicable only if the job type is Logged MBSFN MDT. See the clause 5.10.25 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: String multiplicity: 1..8 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTMeasurementPeriodLTE | It specifies the measurement period for the Data Volume and Scheduled IP throughput measurements for MDT taken by the eNB. The attribute is applicable only for Immediate MDT. In case this attribute is not used, it carries a null semantic. See the clause 5.10.23 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTMeasurementPeriodUMTS | It specifies the measurement period for the Data Volume and Throughput measurements for MDT taken by RNC. The attribute is applicable only for Immediate MDT. In case this attribute is not used, it carries a null semantic. See the clause 5.10.22 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTCollectionPeriodRrmNR | It specifies the collection period for collecting RRM configured measurement samples for M4, M5 in NR. The attribute is applicable only for Immediate MDT. In case this attribute is not used, it carries a null semantic. See the clause 5.10.30 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTMeasurementQuantity | It specifies the measurements that are collected in an MDT job for a UMTS MDT configured for event triggered reporting. See the clause 5.10.15 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTPLMList | It indicates the PLMNs where measurement collection, status indication and log reporting is allowed. See the clause 5.10.24 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: PLMN multiplicity: 1..16 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTPositioningMethod | It specifies what positioning method should be used in the MDT job. See the clause 5.10.19 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTReportAmount | It specifies the number of measurement reports that shall be taken for periodic reporting while the UE is in connected. The attribute is applicable only for Immediate MDT and when tjMDTReportingTrigger is configured for periodical measurements. In case this attribute is not used, it carries a null semantic. See the clause 5.10.6 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTReportingTrigger | It specifies whether periodic or event based measurements should be collected. The attribute is applicable only for Immediate MDT and when the tjMDTListOfMeasurements is configured for M1 (for both UMTS and LTE) or M2 (only for UMTS). In case this attribute is not used, it carries a null semantic. See the clause 5.10.4 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTReportInterval | It specifies the interval between the periodical measurements that shall be taken when the UE is in connected mode. The attribute is applicable only for Immediate MDT and when tjMDTReportingTrigger is configured for periodical measurements. In case this attribute is not used, it carries a null semantic. See the clause 5.10.5 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |

| Attribute Name | Documentation and Allowed Values | Properties |
|--|--|---|
| tjMDTReportType | It specifies report type for logged NR MDT as: - periodical. - event triggered. See the clause 5.10.27 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTSensorInformation | It specifies which sensor information shall be included in logged NR MDT and immediate NR MDT measurement if they are available. The following sensor measurement can be included or excluded for the UE: - Barometric pressure. - UE speed. - UE orientation. See the clause 5.10.29 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: ENUM multiplicity: 1..* isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| tjMDTTraceCollectionEntityID | It specifies the TCE Id which is sent to the UE in Logged MDT. See the clause 5.10.11 of 3GPP TS 32.422 [30] for additional details on the allowed values. | type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: No isNullable: True |
| NOTE 1: The value of this attribute is identical to that of the same attribute in clause 9.4.2 of ETSI GS NFV-IFA 008 [16]. | | |
| NOTE 2: The value of this attribute is identical to that of the same attribute included in vnfConfigurableProperty in clause 9.4.2 of ETSI GS NFV-IFA 008 [16]. | | |
| NOTE 3: The presence of the attribute vnfParametersList, whose vnfInstanceId with a string length of zero, in createMO operation can trigger the instantiation of the related VNF/VNFC instances. | | |
| NOTE 4: The GP defines the measurement data production rate. The supported rates are dependent on the capacity of the producer involved (e.g. the processing power of the producer, the complexity of the measurement type involved etc) and therefore, it cannot be standardized for all producers involved. The supported GPs reflects the agreement between producer and the consumer involved. | | |
| NOTE 5: The monitoring granularity period defines the measurements monitoring period. The supported monitoring periods are dependent on the capacity of the producer involved (e.g. the processing power of the producer, the complexity of the measurement type involved etc) and therefore, it cannot be standardized for all producers involved. The supported monitoring GPs reflect the agreement between producer and the consumer involved. | | |
| NOTE 6: The supported threshold levels are dependent on the capacity of the producer involved (e.g. the processing power of the producer, number of measurements being measured by the producer at the time, the complexity of the measurement type involved etc) and therefore, it cannot be standardized for all producers involved. The supported levels can only reflect the negotiated agreement between producer and the consumer involved. | | |

4.4.2 Constraints

None

4.5 Common notifications

4.5.1 Alarm notifications

This clause presents a list of notifications, defined in [27], that a MnS consumer can receive. The notification header attribute `objectClass/objectInstance`, defined in [3], captures the DN of an instance of an IOC defined in the present document.

| Name | Qualifier | Notes |
|-------------------------------------|-----------|-------|
| notifyNewAlarm | M | |
| notifyNewSecurityAlarm | M | |
| notifyClearedAlarm | M | |
| notifyChangedAlarm | O | |
| notifyChangedAlarmGeneral | O | |
| notifyCorrelatedNotificationChanged | O | |
| notifyAckStateChanged | O | |
| notifyComments | O | |
| notifyPotentialFaultyAlarmList | O | |
| notifyAlarmListRebuilt | M | |

4.5.2 Configuration notifications

This clause presents a list of notifications, defined in [27], that a MnS consumer can receive. The notification header attribute `objectClass/objectInstance`, defined in [3], captures the DN of an instance of an IOC defined in the present document.

| Name | Qualifier | Notes |
|--------------------------------|-----------|-------|
| notifyMOIObjectCreation | O | |
| notifyMOIObjectDeletion | O | |
| notifyMOIAttributeValueChanges | O | |
| notifyMOIChanges | O | |
| notifyEvent | O | |

4.5.3 Threshold Crossing notifications

This clause presents a list of notifications, defined in TS 28.532 [27], that an MnS consumer may receive. The notification header attribute `objectClass/objectInstance`, defined in TS 28.541 [7], shall capture the DN of an instance of a class defined in the present document.

| Name | Qualifier | Notes |
|-------------------------|-----------|-------|
| notifyThresholdCrossing | M | |

Annex A (informative): Alternate class diagram

This class diagram combines the Figure 4.2.1-1 of this document with Figure 1 of [9], the class diagram of UIM.

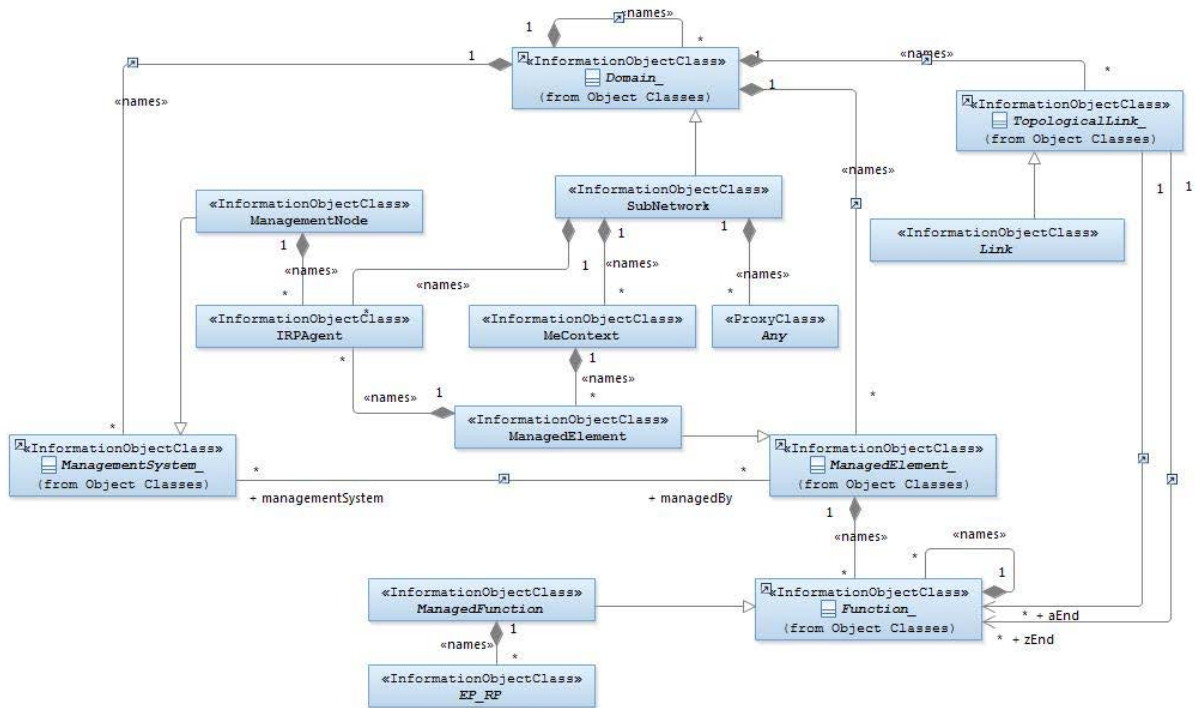


Figure A-1: Alternate class diagram

Annex B (informative): Change history

| Change history | | | | | | | |
|----------------|-------|-----------|-----|-----|---------------------------------------|--------|--------|
| Date | TSG # | TSG Doc. | CR | Rev | Subject/Comment | Old | New |
| 2012-12 | | | | | New version after approval | 2.0.0 | 11.0.0 |
| 2012-02 | | | | | MCC update of TOC | 11.0.0 | 11.0.1 |
| 2014-06 | SA#64 | SP-140332 | 001 | - | Correction of reference | 11.0.1 | 11.1.0 |
| | | SP-140358 | 002 | - | Remove the feature support statements | | |
| 2014-09 | SA#65 | | | | Upgrade to Rel-12 | 11.1.0 | 12.0.0 |
| 2015-12 | SA#70 | SP-150691 | 005 | 1 | Add missing id attribute for 28.622 | 12.0.0 | 12.1.0 |
| 2016-01 | | | | | Upgrade to Rel-13 (MCC) | 12.1.0 | 13.0.0 |

| Change history | | | | | | | |
|----------------|---------|-----------|------|-----|-----|---|-------------|
| Date | Meeting | TDoc | CR | Rev | Cat | Subject/Comment | New version |
| 2016-12 | SA#74 | SP-160853 | 0010 | - | A | Clarification on the need to show VsDataContainer self-containing itself several times | 13.1.0 |
| 2017-03 | SA#75 | SP-170139 | 0012 | 2 | A | Clarify notification triggered by VsDataContainer change | 13.2.0 |
| 2017-03 | SA#75 | SP-170143 | 0015 | 1 | B | Modify definitions of ME and MF to support virtualized network element | 14.0.0 |
| 2017-03 | SA#75 | SP-170142 | 0016 | 3 | B | Adding an attribute for ManagedFunction to support management of virtualized NE | 14.0.0 |
| 2017-06 | SA#76 | SP-170510 | 0019 | 2 | B | Add VNFInfo related attributes in IOC ManagedFunction | 14.1.0 |
| 2018-01 | SA#78 | SP-170969 | 0021 | - | F | Missing note in table of Attribute Properties | 14.2.0 |
| 2018-03 | SA#79 | SP-180060 | 0022 | - | B | Add new attribute peeParametersList to IOC ManagedFunction | 15.0.0 |
| 2018-06 | SA#80 | SP-180421 | 0024 | 1 | B | Remove references to ltf-N | 15.1.0 |
| 2018-12 | SA#82 | SP-181156 | 0027 | - | F | Add the missing NRM fragment supporting network performance management | 15.2.0 |
| 2018-12 | SA#82 | SP-181042 | 0028 | 1 | F | Replace MF with ManagedFunction | 15.2.0 |
| 2018-12 | SA#82 | SP-181042 | 0029 | 1 | F | Update NRM root IOCs to support slice priority | 15.2.0 |
| 2019-06 | SA#84 | SP-190371 | 0031 | 2 | B | Add IOCs for threshold monitoring control | 16.0.0 |
| 2019-06 | SA#84 | SP-190373 | 0033 | 2 | B | Update generic NRM Information Service to support Managed NF Service Object | 16.0.0 |
| 2019-09 | SA#85 | SP-190744 | 0038 | 2 | A | Update class definition with inheritance information | 16.1.0 |
| 2019-09 | SA#85 | SP-190744 | 0043 | 1 | A | Correct PMControl (Add report period attribute and disambiguate the delivery method attributes) | 16.1.0 |
| 2019-09 | SA#85 | SP-190751 | 0044 | - | A | Correct NR definition to avoid misalignment with RAN2 and add NRM definition | 16.1.0 |
| 2019-09 | SA#85 | SP-190744 | 0046 | 1 | A | Correct definitions of granularity period. | 16.1.0 |
| 2019-09 | SA#85 | | | | | Correction in implementation of CR0043 | 16.1.1 |
| 2019-12 | SA#86 | SP-191158 | 0057 | 2 | A | Correct definition of network resource | 16.2.0 |
| 2019-12 | SA#86 | SP-191173 | 0059 | - | A | Add measurementsList attribute into related IOCs | 16.2.0 |
| 2019-12 | SA#86 | SP-191166 | 0062 | 2 | B | Add heartbeat control NRM fragment | 16.2.0 |
| 2019-12 | SA#86 | SP-191166 | 0063 | 2 | B | Add notification subscription control fragment | 16.2.0 |
| 2020-03 | SA#87E | SP-200169 | 0066 | - | B | Add configurable FM. | 16.3.0 |
| 2020-03 | SA#87E | SP-200163 | 0069 | 1 | B | Add configurable KPI control NRM | 16.3.0 |
| 2020-03 | SA#87E | SP-200169 | 0071 | 1 | F | Correct definition of HeartbeatControl and attribute NotificationType | 16.3.0 |
| 2020-07 | SA#88-e | SP-200489 | 0074 | 1 | F | Add TOP_ as parent IOC | 16.4.0 |
| 2020-07 | SA#88-e | SP-200489 | 0075 | 1 | F | Update concept of ME and MF | 16.4.0 |
| 2020-07 | SA#88-e | SP-200489 | 0076 | - | F | Update the attribute priorityLabel for several IOCs | 16.4.0 |
| 2020-07 | SA#88-e | SP-200489 | 0077 | - | F | Updated MF description with nested clarification | 16.4.0 |
| 2020-07 | SA#88-e | SP-200483 | 0078 | 1 | B | Add trace control NRM fragment stage 2 | 16.4.0 |
| 2020-07 | SA#88-e | SP-200484 | 0080 | 1 | D | Fix inconsistent formatting | 16.4.0 |
| 2020-07 | SA#88-e | SP-200490 | 0083 | 1 | F | Combine class diagrams of subscription and heartbeat NRM control fragments (stage 2) | 16.4.0 |
| 2020-07 | SA#88-e | SP-200490 | 0084 | 1 | F | Update PM control fragment (stage 2) | 16.4.0 |
| 2020-07 | SA#88-e | SP-200490 | 0085 | - | F | Clarify usage of the VsDataContainer (stage 2) | 16.4.0 |
| 2020-07 | SA#88-e | SP-200490 | 0086 | 1 | F | Update FM control fragment (stage 2) | 16.4.0 |
| 2020-09 | SA#89e | SP-200729 | 0087 | 1 | F | Correct ThresholdMonitor definition (stage 2) | 16.5.0 |
| 2020-09 | SA#89e | SP-200729 | 0088 | - | F | Correct HeartbeatControl definition and some other smaller issues (stage 2) | 16.5.0 |
| 2020-09 | SA#90e | SP-201063 | 0089 | 1 | F | Add new MDT specific parameter collection period for NR aligning with 32.422 | 16.6.0 |
| 2020-09 | SA#90e | SP-201057 | 0090 | 1 | F | Remove thresholdLevel attribute from ThresholdMonitor (stage 2) | 16.6.0 |
| 2020-09 | SA#90e | SP-201057 | 0091 | 1 | F | Update the perfMetricJobGroupId attribute | 16.6.0 |
| 2020-09 | SA#90e | SP-201057 | 0092 | - | F | Remove value handling from the granularityPeriod description. | 16.6.0 |
| 2020-09 | SA#90e | SP-201088 | 0093 | - | F | Correct the attributes description of the IOCs inherited from Top and Top_ | 16.6.0 |
| 2020-09 | SA#90e | SP-201063 | 0094 | | F | Correct 5G trace parameter for trace control | 16.6.0 |
| 2020-09 | SA#90e | SP-201089 | 0095 | - | F | Update notifyThresholdCrossing to be a common notification. | 16.6.0 |
| 2021-03 | SA#91e | SP-210150 | 0097 | - | F | Correct notification support table for ManagedElement and ManagementNode | 16.7.0 |
| 2021-03 | SA#91e | SP-210153 | 0099 | 1 | F | Correction of attribute properties and IOC inheritance description | 16.7.0 |
| 2021-04 | SA#91e | | | | | Editorial cleanup with the help of the Rapporteur | 16.7.1 |

History

| Document history | | |
|-------------------------|---------------|-------------------------|
| V16.4.0 | August 2020 | Publication |
| V16.5.0 | November 2020 | Publication |
| V16.6.0 | January 2021 | Publication |
| V16.7.0 | April 2021 | Publication (withdrawn) |
| V16.7.1 | May 2021 | Publication |