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**Universal Mobile Telecommunications System (UMTS);
LTE;
5G;
Telecommunication management;
Generic Network Resource Model (NRM)
Integration Reference Point (IRP);
Solution Set (SS) definitions
(3GPP TS 28.623 version 16.9.0 Release 16)**



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Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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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.

1 Scope

The TS 28.62x-series (Generic Network Resources IRP) define an Integration Reference Point (IRP) through which an "IRPAgent" (typically an Element Manager or Network Element) can communicate Network Management related information to one or several "IRPManagers" (typically Network Managers).

This TS-family specifies a generic Network Resource Model, NRM (also referred to as a Management Information Model - MIM) with definitions of Information Object Classes (IOCs) and Managed Object Classes (MOCs).

The present document specifies the Solution Set definition for the Generic NRM IRP.

The Solution Set definition is related to 3GPP TS 28.622 V16.4.X [4].

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 32.600: "Telecommunication management; Configuration Management (CM); Concept and high-level requirements".
- [4] 3GPP TS 28.622: "Generic Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".
- [5] 3GPP TS 32.300: "Telecommunication management; Configuration Management (CM); Name convention for Managed Objects".
- [6] Void
- [7] 3GPP TS 32.616: "Telecommunication management; Configuration Management (CM); Bulk CM Integration Reference Point (IRP); Solution Set (SS) definitions".
- [8] W3C REC-xml11-20060816: "Extensible Markup Language (XML) 1.1 (Second Edition)".
- [9] Void.
- [10] W3C XML Schema Definition Language (XSD) 1.1 Part 1: Structures.
- [11] W3C XML Schema Definition Language (XSD) 1.1 Part 2: Datatypes.
- [12] W3C REC-xml-names-20060816: "Namespaces in XML 1.1 (Second Edition)".
- [13] 3GPP TS 32.158: "Management and orchestration; Design rules for REpresentational State Transfer (REST) Solution Sets (SS) ".
- [14] 3GPP TS 32.160: "Management and orchestration; Management Service Template".
- [15] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [15], 3GPP TS 32.101 [1], 3GPP TS 32.102 [2], 3GPP TS 32.600 [3], 3GPP TS 28.622 [4] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [15] and 3GPP TS 32.101 [1], 3GPP TS 32.102 [2] and 3GPP TS 32.600 [3] and 3GPP TS 28.622 [4].

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [15], 3GPP TS 32.600 [3] 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 [15] and 3GPP TS 32.600 [3].

| | |
|------|----------------------------|
| JSON | JavaScript Object Notation |
| SS | Solution Set |

4 Solution Set (SS) definitions

This specification defines the following 3GPP Generic NRM IRP Solution Set Definitions:

- 3GPP Generic NRM IRP CORBA SS (Annex A).
- 3GPP Generic NRM IRP XML Definitions (Annex B).
- 3GPP Generic NRM IRP JSON Definitions (Annex C).
- 3GPP Generic NRM IRP YANG Definitions (Annex D).

Annex A (normative): CORBA Solution Set

A.0 General

This annex contains the CORBA Solution Set for the IRP whose semantics is specified in Generic NRM IRP: Information Service (3GPP TS 28.622 [4]).

A.1 Architectural features

The overall architectural feature of Generic Network Resources IRP is specified in 3GPP TS 28.622 [4]. This clause specifies features that are specific to the CORBA SS.

A.1.1 Syntax for Distinguished Names

The syntax of a Distinguished Name is defined in 3GPP TS 32.300 [5].

A.1.2 Rules for NRM extensions

A.1.2.0 Introduction

This clause discusses how the models and IDL definitions provided in the present document can be extended for a particular implementation and still remain compliant with 3GPP SA5's specifications.

A.1.2.1 Allowed extensions

Vendor-specific MOCs may be supported. The vendor-specific MOCs may support new types of attributes. The 3GPP SA5-specified notifications may be issued referring to the vendor-specific MOCs and vendor-specific attributes. New MOCs shall be distinguishable from 3GPP SA5 MOCs by name. 3GPP SA5-specified and vendor-specific attributes may be used in vendor-specific MOCs. Vendor-specific attribute names shall be distinguishable from existing attribute names.

NRM MOCs may be subclassed. Subclassed MOCs shall maintain the specified behaviour of the 3GPP SA5's superior classes. They may add vendor-specific behaviour with vendor-specific attributes. When subclassing, naming attributes cannot be changed. The subclassed MOC shall support all attributes of its superior class. Vendor-specific attributes cannot be added to 3GPP SA5 NRM MOCs without subclassing.

When subclassing, the 3GPP SA5-specified containment rules and their specified cardinality shall still be followed. As an example, ManagementNode (or its subclasses) shall be contained under SubNetwork (or its subclasses).

Managed Object Instances may be instantiated as CORBA objects. This requires that the MOCs be represented in IDL. 3GPP SA5's NRM MOCs are not currently specified in IDL, but may be specified in IDL for instantiation or subclassing purposes. However, management information models should not require that IRPManagers access the instantiated managed objects other than through supported methods in the present document.

Extension rules related to notifications (Notification categories, Event Types, Extended Event Types etc.) are for further study.

A.1.2.2 Extensions not allowed

The IDL specifications in the present document cannot be edited or altered. Any additional IDL specifications shall be specified in separate IDL files.

IDL interfaces (note: not MOCs) specified in the present document may not be subclassed or extended. New interfaces may be defined with vendor-specific methods.

A.2 Mapping

A.2.1 General mapping

Attributes modelling associations as defined in the NRM (here also called "reference attributes") are in this SS mapped to attributes. The names of the reference attributes in the NRM are mapped to the corresponding attribute names in the MOC. When the cardinality for an association is 0..1 or 1..1 the datatype for the reference attribute is defined as an MOReference. The value of an MO reference contains the distinguished name of the associated MO. When the cardinality for an association allows more than one referred MO, the reference attribute will be of type MOReferenceSet, which contains a sequence of MO references.

A.2.2 Information Object Class (IOC) mapping

This Solution Set supports reference attributes for relations other than containment relations between objects. Reference attributes are therefore introduced in each MOC where needed.

A.2.2.1 IOC SubNetwork

Mapping from NRM IOC SubNetwork attributes to SS equivalent MOC SubNetwork attributes

| IS Attributes | SS Attributes | SS Type |
|------------------------|------------------------|---|
| id | id | string |
| dnPrefix | dnPrefix | string |
| userLabel | userLabel | string |
| userDefinedNetworkType | userDefinedNetworkType | string |
| setOfMcc | setOfMcc | GenericNetworkResourcesIRPSystem::AttributeTypes::StringSet |

A.2.2.2 IOC ManagedElement

Mapping from NRM IOC ManagedElement attributes and association roles to SS equivalent MOC ManagedElement attributes

| IS Attributes | SS Attributes | SS Type |
|--------------------|--------------------|--|
| id | id | string |
| dnPrefix | dnPrefix | string |
| userLabel | userLabel | string |
| locationName | locationName | string |
| vendorName | vendorName | string |
| userDefinedState | userDefinedState | string |
| managedElementType | managedElementType | GenericNetworkResourcesIRPSystem::AttributeTypes::StringSet |
| managedBy | managedBy | GenericNetworkResourcesIRPSystem::AttributeTypes::MOReferenceSet |
| swVersion | swVersion | string |

A.2.2.3 IOC MeContext

Mapping from NRM IOC MeContext attributes to SS equivalent MOC MeContext attributes

| IS Attributes | SS Attributes | SS Type |
|---------------|---------------|---------|
| id | id | string |
| dnPrefix | dnPrefix | string |

A.2.2.4 IOC ManagementNode

Mapping from NRM IOC ManagementNode attributes and association roles to SS equivalent MOC ManagementNode attributes

| IS Attributes | SS Attributes | SS Type |
|------------------|------------------|--|
| id | id | string |
| userLabel | userLabel | string |
| locationName | locationName | string |
| vendorName | vendorName | string |
| userDefinedState | userDefinedState | string |
| managedElements | managedElements | GenericNetworkResourcesIRPSystem::AttributeTypes::MOReferenceSet |
| swVersion | swVersion | string |

A.2.2.5 IOC VsDataContainer

Mapping from NRM IOC VsDataContainer attributes and association roles to SS equivalent MOC VsDataContainer attributes

| IS Attributes | SS Attributes | SS Type |
|---------------------|---------------------|---------|
| id | id | string |
| vsDataType | vsDataType | string |
| vsData | vsData | any |
| vsDataFormatVersion | vsDataFormatVersion | string |

A.2.2.6 IOC ManagedFunction

Mapping from NRM IOC ManagedFunction attributes and association roles to SS equivalent MOC ManagedFunction attributes

| IS Attributes | SS Attributes | SS Type |
|-------------------|-------------------|---|
| id | id | string |
| peeParametersList | peeParametersList | GenericNetworkResourcesIRPSystem::AttributeTypes::PEEParametersListType |
| userLabel | userLabel | string |
| vnfParametersList | vnfParametersList | GenericNetworkResourcesIRPSystem::AttributeTypes::VNFParametersListType |

A.2.2.7 IOC IRPAgent

Mapping from NRM IOC IRPAgent attributes to SS equivalent MOC IRPAgent attributes

| IS Attributes | SS Attributes | SS Type |
|---------------|---------------|---------|
| id | id | string |
| systemDN | systemDN | string |

A.2.2.8 IOC Top

Mapping from NRM IOC Top attributes to SS equivalent attributes in all MOCs

| IS Attributes | SS Attributes | SS Type |
|----------------|-------------------|---------|
| objectClass | CLASS | string |
| objectInstance | No direct mapping | |

A.2.2.9 IOC Link

Mapping from NRM IOC Link attributes to SS equivalent MOC IRPAgent attributes

| IS Attributes | SS Attributes | SS Type |
|------------------------|-----------------|---|
| id | id | string |
| userLabel (see note 2) | userLabel | string |
| aEnd | aEnd | GenericNetworkResourcesIRPSystem::AttributeTypes::MOReference |
| zEnd | zEnd | GenericNetworkResourcesIRPSystem::AttributeTypes::MOReference |
| linkType | linkType | LinkTypeType |
| protocolName | protocolName | string |
| protocolVersion | protocolVersion | string |

NOTE 1: Void.

NOTE 2: Void.

A.2.2.10 IOC EP_RP

Mapping from NRM IOC EP_RP attributes to SS equivalent MOC EP_RP attributes

| IS Attributes | SS Attributes | SS Type |
|---------------|---------------|---|
| id | id | string |
| userLabel | userLabel | string |
| farEndEntity | farEndEntity | GenericNetworkResourcesIRPSystem::AttributeTypes::MOReference |

A.2.2.11 IOC ThresholdMonitoringCapability

Mapping from NRM IOC ThresholdMonitoringCapability attributes to SS equivalent MOC ThresholdMonitoringCapability attributes

| IS Attributes | SS Attributes | SS Type |
|-----------------------|-----------------------|--|
| supportedMonitoringGP | supportedMonitoringGP | GenericNetworkResourcesIRPSystem::AttributeTypes::LongSets |

A.2.2.12 IOC ThresholdMonitor

Mapping from NRM IOC ThresholdMonitor attributes to SS equivalent MOC ThresholdMonitor attributes

| IS Attributes | SS Attributes | SS Type |
|-----------------------|-----------------------|---|
| thresholdInfoList | thresholdInfoList | GenericNetworkResourcesIRPSystem::AttributeTypes::ThresholdInfoListType |
| monitoringGP | monitoringGP | long |
| monitoringNotifTarget | monitoringNotifTarget | string |
| monitoredIOCName | monitoredIOCName | string |
| monitoredObjectDNS | monitoredObjectDNS | GenericNetworkResourcesIRPSystem::AttributeTypes::DNListType |

A.2.2.13 IOC TraceJob

Mapping from NRM IOC TraceJob attributes to SS equivalent MOC TraceJob attributes

| IS Attributes | SS Attributes | SS Type |
|---------------------------------------|---------------------------------------|--|
| tjJobType | tjJobType | tjJobType-Type |
| tjListOfInterfaces | tjListOfInterfaces | tjListOfInterfaces-Type |
| tjListOfNeTypes | tjListOfNeTypes | tjListOfNeTypes-Type |
| tjPLMNTarget | tjPLMNTarget | tjPLMNTarget-Type |
| tjStreamingTraceConsumerURI | tjTraceConsumer | StreamingTraceConsumerURI-Type |
| tjTraceCollectionEntityAddress | tjTraceConsumer | TraceCollectionEntityAddress-Type |
| tjTraceDepth | tjTraceDepth | tjTraceDepth-Type |
| tjTraceReference | tjTraceReference | tjTraceReference-Type |
| tjTraceReportingFormat | tjTraceReportingFormat | tjTraceReportingFormat-Type |
| tjTraceTarget | tjTraceTarget | tjTraceTarget-Type |
| tjTriggeringEvent | tjTriggeringEvent | tjTriggeringEvent-Type |
| tjMDTAnonymizationOfData | tjMDTAnonymizationOfData | tjMDTAnonymizationOfData-Type |
| tjMDTAreaConfigurationForNeighCell | tjMDTAreaConfigurationForNeighCell | tjMDTAreaConfigurationForNeighCell-Type |
| tjMDTAreaScope | tjMDTAreaScope | tjMDTAreaScope-Type |
| tjMDTCollectionPeriodRrmLte | tjMDTCollectionPeriodRrmLte | tjMDTCollectionPeriodRrmLte-Type |
| tjMDTCollectionPeriodRrmUmts | tjMDTCollectionPeriodRrmUmts | tjMDTCollectionPeriodRrmUmts-Type |
| tjMDTCollectionPeriodRrmNR | tjMDTCollectionPeriodRrmNR | tjMDTCollectionPeriodRrmNR-Type |
| tjMDTEventListForTriggeredMeasurement | tjMDTEventListForTriggeredMeasurement | tjMDTEventListForTriggeredMeasurement-Type |
| tjMDTEventThreshold | tjMDTEventThreshold | tjMDTEventThreshold-Type |
| tjMDTListOfMeasurements | tjMDTListOfMeasurements | tjMDTListOfMeasurements-Type |
| tjMDTLoggingDuration | tjMDTLoggingDuration | tjMDTLoggingDuration-Type |
| tjMDTLoggingInterval | tjMDTLoggingInterval | tjMDTLoggingInterval-Type |
| tjMDTMBSFNAreaList | tjMDTMBSFNAreaList | tjMDTMBSFNAreaList-Type |
| tjMDTMeasurementPeriodLTE | tjMDTMeasurementPeriodLTE | tjMDTMeasurementPeriodLTE-Type |
| tjMDTMeasurementPeriodUMTS | tjMDTMeasurementPeriodUMTS | tjMDTMeasurementPeriodUMTS-Type |
| tjMDTMeasurementQuantity | tjMDTMeasurementQuantity | tjMDTMeasurementQuantity-Type |
| tjMDTPLMList | tjMDTPLMList | tjMDTPLMList-Type |
| tjMDTPositioningMethod | tjMDTPositioningMethod | tjMDTPositioningMethod-Type |
| tjMDTReportAmount | tjMDTReportAmount | tjMDTReportAmount-Type |
| tjMDTReportingTrigger | tjMDTReportingTrigger | tjMDTReportingTrigger-Type |
| tjMDTReportInterval | tjMDTReportInterval | tjMDTReportInterval-Type |
| tjMDTReportType | tjMDTReportType | tjMDTReportType-Type |
| tjMDTSensorInformation | tjMDTSensorInformation | tjMDTSensorInformation-Type |
| tjMDTTraceCollectionEntityID | tjMDTTraceCollectionEntityID | tjMDTTraceCollectionEntityID-Type |

A.3 Solution Set (SS) definitions

A.3.1 IDL definition structure

Clause A.3.2 defines the types which are used by the Generic NRM IRP.

Clause A.3.3 defines the MO classes for the Generic NRM IRP.

A.3.2 IDL specification "GenericNetworkResourcesIRPSystem.idl"

```
//File: GenericNetworkResourcesIRPSystem.idl
#ifndef _GENERIC_NETWORK_RESOURCES_IRP_SYSTEM_IDL_
#define _GENERIC_NETWORK_RESOURCES_IRP_SYSTEM_IDL_

// This statement must appear after all include statements
#pragma prefix "3gppsa5.org"

module GenericNetworkResourcesIRPSystem
{
    /**
     * The format of Distinguished Name (DN) is specified in "Name Convention
     * for Managed Objects (3GPP TS 32.300 [5])".
     */
    typedef string DN;

    /**
     * This module adds datatype definitions for types
     * used in the NRM which are not basic datatypes defined
     * already in CORBA.
     */
    module AttributeTypes
    {
        /**
         * An MO reference refers to an MO instance.
         * "otherMO" contains the distinguished name of the referred MO.
         * A conceptual "null" reference (meaning no MO is referenced)
         * is represented as an empty string ("").
         */
        struct MOReference
        {
            DN otherMO;
        };

        /**
         * MOReferenceSet represents a set of MO references.
         * This type is used to hold 0..n MO references.
         * A referred MO is not allowed to be repeated (therefore
         * it is denoted as a "Set")
         */
        typedef sequence<MOReference> MOReferenceSet;

        /**
         * A set of strings.
         */
        typedef sequence<string> StringSet;

        /**
         * A set of long.
         */
        typedef sequence<long> LongSet;

        /**
         * The LinkListSet represents the Link_X_Y objects (or subclasses of
         * Link_X_Y objects) that have a relationship with this object instance.
         * Each Link_X_Y object models interface(s) between objects of class X and
         * Y. The object containing this attribute must either be a class of type X,
         * Y, XFunction, YFunction or a subclass of one of those classes. The
         * LinkListSet may be empty, or there may be no instances for a particular
         * Link_X_Y class name.
         */
        typedef MOReferenceSet LinkListSet;
    }
}
```

```

/**
 * VNFPParameters includes several attributes of a VNF instance.
 * The detailed definition of the attributes, see clause 4.4.1 of [4].
 */
struct VNFPParameters
{
    string vnfInstanceId;
    string vnfdId;
    string flavourId;
    boolean autoScalable;
};

/**
 * VNFPParametersListType represents a list of VNFPParameters.
 * The detailed definition of vnfParametersListType, see clause 4.4.1 of [4].
 */
typedef sequence<VNFPParameters> VNFPParametersListType;
struct PEEPParameters
{
    string siteIdentification;
    float siteLatitude;
    float siteLongitude;
    string siteDescription;
    string equipmentType;
    string environmentType;
    string powerInterface;
};

/**
 * PEEPParametersListType represents a list of PEEPParameters.
 * The detailed definition of PEEPParametersListType, see clause 4.4.1 of [4].
 */
typedef sequence<PEEPParameters> PEEPParametersListType;

typedef any ThresholdValueType;
enum Direction {INCREASING, DECREASING};
union HysteresisType switch(boolean)
{
    case TRUE: long long_value;
    case FALSE: float float_value;
};
struct ThresholdPackElement
{
    ThresholdValueType thresholdValue;
    short thresholdLevel;
    HysteresisType hysteresis;
};
typedef sequence<ThresholdPackElement> ThresholdPackType;
struct ThresholdInfo
{
    string measurementType;
    Direction direction_;
    ThresholdPackType thresholdPack;
};
typedef sequence<ThresholdInfo> ThresholdInfoListType;
};

/**
 * This module adds datatype definitions for PM Control
 */
module PMControlTypes
{
    Struct Measurements
    {
        measurementTypes StringSet,
        gPs LongSet
    };
    typedef sequence <Measurements> Measurements;

    enum PMAdministrativeStateType
    {
        LOCKED,
        SHUTTINGDOWN,
        UNLOCKED
    };
};

```



```
enum PMSOperationalStateType
{
    ENABLED,
    DISABLED
};

typedef MReferenceSet ManagedObjectDNsType;

typedef MReferenceSet ManagedObjectDNsBasicType;

typedef integer DefaultFileBasedGPType;
typedef integer DefaultFileReportPeriodType;
typedef string DefaultFileLocationType;
typedef integer DefaultStreamBasedGPType;
typedef string DefaultStreamTargetType;

typedef integer FileBasedGPType;
typedef integer FileReportingPeriodType;
typedef string FileLocationType;
typedef integer StreamBasedGPType;
typedef string StreamTargetType;

};

};

#endif // _GENERIC_NETWORK_RESOURCES_IRP_SYSTEM_IDL_
```

A.3.3 IDL specification "GenericNetworkResourcesNRMDefs.idl"

```

//File: GenericNetworkResourcesNRMDefs.idl
#ifndef _GENERIC_NETWORK_RESOURCES_NRM_DEFS_IDL_
#define _GENERIC_NETWORK_RESOURCES_NRM_DEFS_IDL_
// This statement must appear after all include statements
#pragma prefix "3gppsa5.org"
/**
 * This module defines constants for each MO class name and
 * the attribute names for each defined MO class.
 */
module GenericNetworkResourcesNRMDefs
{
    /**
     * Definitions for MO class Top
     */
    interface Top
    {
        // Attribute Names
        //
        const string CLASS = "Top";
    };
    /**
     * Definitions for MO class SubNetwork
     */
    interface SubNetwork : Top
    {
        const string CLASS = "SubNetwork";
        // Attribute Names
        //
        const string id = "id";
        const string dnPrefix = "dnPrefix";
        const string userLabel = "userLabel";
        const string userDefinedNetworkType = "userDefinedNetworkType";
        const string setOfMcc = "setOfMcc";
    };
    /**
     * Definitions for MO class ManagedElement
     */
    interface ManagedElement : Top
    {
        const string CLASS = "ManagedElement";
        // Attribute Names
        //
        const string id = "id";
        const string dnPrefix = "dnPrefix";
        const string managedElementType = "managedElementType";
        const string userLabel = "userLabel";
        const string vendorName = "vendorName";
        const string userDefinedState = "userDefinedState";
        const string locationName = "locationName";
        const string managedBy = "managedBy";
        const string swVersion = "swVersion";
    };
    /**
     * Definitions for MO class MeContext
     */
    interface MeContext : Top
    {
        const string CLASS = "MeContext";
        // Attribute Names
        //
        const string id = "id";
        const string dnPrefix = "dnPrefix";
    };
    /**
     * Definitions for MO class ManagementNode
     */
    interface ManagementNode : Top
    {
        const string CLASS = "ManagementNode";

        // Attribute Names
        //
        const string id = "id";
    };
}

```

```

    const string userLabel = "userLabel";
    const string vendorName = "vendorName";
    const string userDefinedState = "userDefinedState";
    const string locationName = "locationName";
    const string managedElements = "managedElements";
    const string swVersion = "swVersion";
};

/**
 * Definitions for abstract MO class ManagedFunction
 *
 */
interface ManagedFunction : Top
{
    const string CLASS = "ManagedFunction";
    // Attribute Names
    //
    const string id = "id";
    const string peeParametersList = "peeParametersList";
    const string userLabel = "userLabel";
    const string vnfParametersList = "vnfParametersList";
};

/**
 * Definitions for MO class IRPAgent
 */
interface IRPAgent : Top
{
    const string CLASS = "IRPAgent";
    // Attribute Names
    //
    const string id = "id";
    const string systemDN = "systemDN";
};

/**
 * Definitions for abstract MO class Link
 * This inherits from ManagedFunction
 * The attributes aEnd and zEnd are populated with the DNs
 * of the entities associated via the link class.
 * The aEnd takes the DN of the 1st entity in alphabetical order,
 * the zEnd takes the 2nd entity in alphabetical order of the class
 * names.
 */
interface Link : ManagedFunction
{
    const string CLASS = "Link";
    // Attribute Names
    //
    const string aEnd = "aEnd";
    const string zEnd = "zEnd";
    const string linkType = "linkType";
    const string protocolName = "protocolName";
    const string protocolVersion = "protocolVersion";
};

/**
 * Definitions for MO class VsDataContainer
 */
interface VsDataContainer : Top
{
    const string CLASS = "VsDataContainer";
    // Attribute Names
    //
    const string id = "id";
    const string vsDataType = "vsDataType";
    const string vsData = "vsData";
    const string vsDataFormatVersion = "vsDataFormatVersion";
};

/**
 * Definitions for abstract MO class EP_RP
 */
interface EP_RP : Top
{
    const string CLASS = "EP_RP";
    // Attribute Names
    //
    const string farEndEntity = "farEndEntity";
    const string id = "id";
    const string userLabel = "userLabel";
};

```

```
};

/**
 * Definitions for MO class ThresholdMonitoringCapability
 */
interface ThresholdMonitoringCapability : Top
{
    const string CLASS = "ThresholdMonitoringCapability";
    // Attribute Names
    //
    const string supportedMonitoringGPs = "supportedMonitoringGPs";
};

/**
 * Definitions for MO class ThresholdMonitor
 */
interface ThresholdMonitor : Top
{
    const string CLASS = "ThresholdMonitor";
    // Attribute Names
    //
    const string thresholdInfoList = "thresholdInfoList";
    const string monitoringGP = "monitoringGP";
    const string monitoringNotifTarget = "monitoringNotifTarget";
    const string monitoredIOCName = "monitoredIOCName";
    const string monitoredObjectDNs = "monitoredObjectDNs";
};

/**
 * This module adds datatypes definitions for the Link Class
 * These attributes are not the basic datatypes already defined
 */
module LinkAttributeTypes
{
    enum LinkType
    {
        SIGNALLING,
        BEARER,
        OAM_AND_P,
        OTHER
    };
    typedef sequence <LinkType> LinkTypeType;
};
};
#endif // _GENERIC_NETWORK_RESOURCES_NRM_DEFS_IDL_
```

Annex B (normative): XML Definitions

B.0 General

This annex contains the XML Definitions for the Generic NRM IRP as it applies to Itf-N, in accordance with Generic NRM IRP IS definitions TS 28.622 [4].

The XML file formats are based on XML W3C REC-xml11-20060816 [8], W3C XML Schema Definition Language (XSD) 1.1 Part 1: Structures [10] W3C XML Schema Definition Language (XSD) 1.1 Part 2: Datatypes [11] and W3C REC-xml-names-20060816 [12] standards.

B.1 Architectural features

B.1.0 Introduction

The overall architectural feature of Generic Network Resources IRP is specified in 3GPP TS 28.622 [4].

This clause specifies features that are specific to the Schema definitions.

B.1.1 Syntax for Distinguished Names

The syntax of a Distinguished Name is defined in 3GPP TS 32.300 [5].

B.2 Mapping

B.2.1 General mapping

An IOC maps to an XML element of the same name as the IOC's name in the IS. An IOC attribute maps to a sub-element of the corresponding IOC's XML element, and the name of this sub-element is the same as the attribute's name in the IS.

B.2.2 Information Object Class (IOC) mapping

The mapping is not present in the current version of this specification.

B.3 Solution Set (SS) definitions

B.3.1 XML definition structure

The overall description of the file format of configuration data XML files is provided by 3GPP TS 28.616 [7].

Annex B.3.3 of the present document defines the NRM-specific XML schema `genericNrm.xsd` for the Generic Network Resources IRP NRM defined in 3GPP TS 28.622 [4].

XML schema `genericNrm.xsd` explicitly declares NRM-specific XML element types for the related NRM.

The definition of those NRM-specific XML element types complies with the generic mapping rules defined in 3GPP TS 28.616 [7], with the following exception: as defined in 3GPP TS 28.616 [7], the `vsData` XML element type has an empty XML content.

Additionally, XML schema `genericNrm.xsd` also provides the following global XML declarations and definitions:

- XML complex type `NrmClass`: derivation base type (see [8], [10] and [11]) for all NRM class associated XML element types (see 3GPP TS 28.616 [7]);
- XML element type `vsData`: derivation base type (see [8], [10] and [11]) for all vendor-specific XML element types (see 3GPP TS 28.616 [7]);
- XML element type `SubNetworkOptionallyContainedNrmClass`: substitution group head (see [8], [10] and [11]) for all XML element types associated to further NRM classes optionally contained under `SubNetwork` NRM class;
- XML element type `ManagedElementOptionallyContainedNrmClass`: substitution group head (see [8], [10] and [11]) for all XML element types associated to further NRM classes optionally contained under `ManagedElement` NRM class.

B.3.2 Graphical Representation

The graphical representation is not present in the current version of this specification.

B.3.3 XML schema "genericNrm.xsd"

```

<?xml version="1.1" encoding="UTF-8"?>

<!--
 3GPP TS 28.623 Generic Network Resources IRP
 Bulk CM Configuration data file NRM-specific XML schema
 genericNrm.xsd
-->

<schema
 targetNamespace="http://www.3gpp.org/ftp/specs/archive/28_series/28.623#genericNrm"
 elementFormDefault="qualified"
 attributeFormDefault="unqualified"
 xmlns="http://www.w3.org/2001/XMLSchema"
 xmlns:xn="http://www.3gpp.org/ftp/specs/archive/28_series/28.623#genericNrm"
 xmlns:sp="http://www.3gpp.org/ftp/specs/archive/28_series/28.629#sonPolicyNrm"
 >
<import namespace="http://www.3gpp.org/ftp/specs/archive/28_series/28.629#sonPolicyNrm"/>
<!-- Base XML type for all NRM class associated XML elements -->

<complexType name="NrmClass">
  <attribute name="id" type="string" use="required"/>
  <attribute name="modifier" use="optional">
    <simpleType>
      <restriction base="string">
        <enumeration value="create"/>
        <enumeration value="delete"/>
        <enumeration value="update"/>
      </restriction>
    </simpleType>
  </attribute>
</complexType>

<!-- Generic Network Resources IRP NRM attribute related XML types -->

<simpleType name="dn">
  <restriction base="string">
    <maxLength value="400"/>
  </restriction>
</simpleType>

<complexType name="dnList">
  <sequence minOccurs="0" maxOccurs="unbounded">
    <element name="dn" type="xn:dn"/>
  </sequence>
</complexType>

<simpleType name="linkType">
  <list>
    <simpleType>
      <restriction base="string">
        <enumeration value="Signalling"/>
        <enumeration value="Bearer"/>
        <enumeration value="OAM_AND_P"/>
        <enumeration value="Other"/>
      </restriction>
    </simpleType>
  </list>
</simpleType>

<complexType name="linkListType">
  <sequence minOccurs="0" maxOccurs="unbounded">
    <element name="dn" type="xn:dn"/>
  </sequence>
</complexType>

<complexType name="managedElementTypeListType">
  <sequence minOccurs="0" maxOccurs="unbounded">
    <element name="managedElementType" type="string"/>
  </sequence>
</complexType>

<complexType name="vnfParametersListType">
  <sequence minOccurs="1" maxOccurs="unbounded">
    <element name="vnfInstanceId" type="string"/>
    <element name="vnfdId" type="string" minOccurs="0"/>
  </sequence>
</complexType>

```

```

    <element name="flavourId" type="string" minOccurs="0"/>
    <element name="autoScalable" type="boolean"/>
  </sequence>
</complexType>

<simpleType name="latitude">
  <restriction base="decimal">
    <fractionDigits value="4"/>
    <minInclusive value="-90.0000"/>
    <maxInclusive value="90.0000"/>
  </restriction>
</simpleType>

<simpleType name="longitude">
  <restriction base="decimal">
    <fractionDigits value="4"/>
    <minInclusive value="-180.0000"/>
    <maxInclusive value="180.0000"/>
  </restriction>
</simpleType>

<complexType name="peeParametersListType">
  <sequence minOccurs="1" maxOccurs="unbounded">
    <element name="siteIdentification" type="string"/>
    <element name="siteLatitude" type="xn:latitude" minOccurs="0"/>
    <element name="siteLongitude" type="xn:longitude" minOccurs="0"/>
    <element name="siteDescription" type="string"/>
    <element name="equipmentType" type="string"/>
    <element name="environmentType" type="string"/>
    <element name="powerInterface" type="string"/>
  </sequence>
</complexType>

<simpleType name="pMAdministrativeStateType">
  <restriction base="string">
    <enumeration value="LOCKED"/>
    <enumeration value="SHUTTINGDOWN"/>
    <enumeration value="UNLOCKED"/>
  </restriction>
</simpleType>

<simpleType name="pMOperationalStateType">
  <restriction base="string">
    <enumeration value="ENABLED"/>
    <enumeration value="DISABLED"/>
  </restriction>
</simpleType>

<simpleType name="nFServiceType">
  <restriction base="string">
    <enumeration value="Namf_Communication"/>
    <enumeration value="Namf_EventExposure"/>
    <enumeration value="Namf_MT"/>
    <enumeration value="Namf_Location"/>
    <enumeration value="Nsmf_PDUSession"/>
    <enumeration value="Nsmf_EventExposure"/>
    <enumeration value="others"/>
  </restriction>
</simpleType>

<simpleType name="usageStateType">
  <restriction base="string">
    <enumeration value="IDEL"/>
    <enumeration value="ACTIVE"/>
    <enumeration value="BUSY"/>
  </restriction>
</simpleType>

<simpleType name="registrationStateType">
  <restriction base="string">
    <enumeration value="LOCKED"/>
    <enumeration value="SHUTTING_DOWN"/>
    <enumeration value="UNLOCKED"/>
  </restriction>
</simpleType>

<simpleType name="NFType">

```



```

    <restriction base="string">
      <enumeration value="NRF" />
      <enumeration value="UDM" />
      <enumeration value="AMF" />
      <enumeration value="SMF" />
      <enumeration value="AUSF" />
      <enumeration value="NEF" />
      <enumeration value="PCF" />
      <enumeration value="SMSF" />
      <enumeration value="NSSF" />
      <enumeration value="UDR" />
      <enumeration value="GMLC" />
      <enumeration value="5G EIR" />
      <enumeration value="SEPP" />
      <enumeration value="UPF" />
      <enumeration value="N3IWF" />
      <enumeration value="AF" />
      <enumeration value="UDSF" />
      <enumeration value="DN" />
    </restriction>
  </simpleType>

  <simpleType name="operationSemanticsType">
    <restriction base="string">
      <enumeration value="REQUEST_RESPONSE" />
      <enumeration value="SUBSCRIBE_NOTIFY" />
    </restriction>
  </simpleType>

  <complexType name="SAP">
    <sequence>
      <element name="host" type="xn:hostType" />
      <element name="port" type="integer" />
    </sequence>
  </complexType>

  <complexType name="hostType">
    <sequence>
      <element name="ipv4Address" type="string" />
      <element name="ipv6Address" type="string" />
      <element name="fqdn" type="string" />
    </sequence>
  </complexType>

  <complexType name="operationsList">
    <sequence>
      <element name="operation" type="xn:operationType" minOccurs="1" maxOccurs="unbounded" />
    </sequence>
  </complexType>

  <complexType name="operationType">
    <sequence>
      <element name="name" type="string" />
      <element name="allowedNFTypes" type="xn:NFTYPE" />
      <element name="operationSemantics" type="xn:operationSemanticsType" />
    </sequence>
  </complexType>

  <complexType name="MeasurementTypeList">
    <sequence minOccurs="1" maxOccurs="unbounded">
      <element name="measurementType" type="string" />
    </sequence>
  </complexType>

  <complexType name="GPList">
    <sequence minOccurs="1" maxOccurs="unbounded">
      <element name="gP" type="integer" />
    </sequence>
  </complexType>

  <complexType name="Measurements">
    <sequence>
      <element name="measurementTypes" type="xn:MeasurementTypeList" />
      <element name="GPs" type="xn:GPList" />
    </sequence>
  </complexType>

  <complexType name="MeasurementsList">

```

```

    <sequence>
      <element name="measurements" type="xn:Measurements" minOccurs="1" maxOccurs="unbounded" />
    </sequence>
  </complexType>

<complexType name="GPListType">
  <sequence minOccurs="1" maxOccurs="unbounded">
    <element name="GP" type="integer" />
  </sequence>
</complexType>

<complexType name="KPINameList">
  <sequence minOccurs="1" maxOccurs="unbounded">
    <element name="kPIName" type="string" />
  </sequence>
</complexType>

<complexType name="KPIs">
  <sequence>
    <element name="kPITypes" type="xn:KPINameList" />
    <element name="GPs" type="xn:GPList" />
  </sequence>
</complexType>

<complexType name="KPIsList">
  <sequence>
    <element name="kPIs" type="xn:KPIs" minOccurs="1" maxOccurs="unbounded" />
  </sequence>
</complexType>

<simpleType name="directionType">
  <list>
    <simpleType>
      <restriction base="string">
        <enumeration value="increasing" />
        <enumeration value="decreasing" />
      </restriction>
    </simpleType>
  </list>
</simpleType>

<complexType name="thrsholdPackType">
  <sequence minOccurs="1" maxOccurs="unbounded">
    <element name="thresholdPackElement" type="xn:thresholdPackElementType" />
  </sequence>
</complexType>

<complexType name="thresholdPackElementType">
  <all>
    <element name="thresholdValue" type="string" />
    <element name="thresholdLevel" type="integer" />
    <element name="hysteresis" type="decimal" minOccurs="0" />
  </all>
</complexType>

<complexType name="thresholdInfoType">
  <all>
    <element name="measurementType" type="string" />
    <element name="direction" type="xn:directionType" />
    <element name="thresholdPack" type="xn:thrsholdPackType" />
  </all>
</complexType>

<complexType name="thresholdInfoListType">
  <sequence minOccurs="1" maxOccurs="unbounded">
    <element name="ThresholdInfoElement" type="xn:thresholdInfoType" />
  </sequence>
</complexType>

<simpleType name="ScopeType">
  <restriction base="string">
    <enumeration value="BASE_ONLY" />
    <enumeration value="BASE_ALL" />
    <enumeration value="BASE_NTH_LEVEL" />
    <enumeration value="BASE_SUBTREE" />
  </restriction>

```

```

</simpleType>

<complexType name="Scope">
  <sequence>
    <element name="scopeType" type="xn:ScopeType"/>
    <element name="scopeLevel" type="integer" minOccurs="0"/>
  </sequence>
</complexType>

<!-- Generic Network Resources IRP NRM class associated XML elements -->

<element name="SubNetwork">
  <complexType>
    <complexContent>
      <extension base="xn:NrmClass">
        <sequence>
          <element name="attributes" minOccurs="0">
            <complexType>
              <all>
                <element name="dnPrefix" minOccurs="0"/>
                <element name="userLabel"/>
                <element name="userDefinedNetworkType"/>
                <element name="setOfMcc" minOccurs="0"/>
                <element name="priority" type="integer" minOccurs="0"/>
                <element name="measurementsList" type="xn:MeasurementsList" minOccurs="0"/>
                <element name="kPisList" type="xn:KPIsList" minOccurs="0"/>
              </all>
            </complexType>
          </element>
          <choice minOccurs="0" maxOccurs="unbounded">
            <element ref="xn:SubNetwork"/>
            <element ref="xn:ManagedElement"/>
            <element ref="xn:MeContext"/>
            <element ref="xn:ManagementNode"/>
            <element ref="xn:IRPAgent"/>
            <element ref="xn:SubNetworkOptionallyContainedNrmClass"/>
            <element ref="xn:VsDataContainer"/>
            <element ref="xn:ThresholdMonitoringCapability"/>
            <element ref="xn:ThresholdMonitor"/>
            <element ref="xn:MeasurementControl"/>
            <element ref="xn:NtfSubscriptionControl"/>
          </choice>
          <choice minOccurs="0" maxOccurs="1">
            <element ref="sp:ESPolicies"/>
          </choice>
        </sequence>
      </extension>
    </complexContent>
  </complexType>
</element>

<element name="ManagedElement">
  <complexType>
    <complexContent>
      <extension base="xn:NrmClass">
        <sequence>
          <element name="attributes" minOccurs="0">
            <complexType>
              <all>
                <element name="dnPrefix"/>
                <element name="managedElementTypeList" type="xn:managedElementTypeListType"
minOccurs="0"/>
                <element name="userLabel"/>
                <element name="vendorName"/>
                <element name="userDefinedState"/>
                <element name="locationName"/>
                <element name="swVersion"/>
                <element name="managedBy" type="xn:dnList" minOccurs="0"/>
                <element name="priority" type="integer" minOccurs="0"/>
                <element name="measurementsList" type="xn:MeasurementsList" minOccurs="0"/>
              </all>
            </complexType>
          </element>
          <choice minOccurs="0" maxOccurs="unbounded">
            <element ref="xn:IRPAgent"/>
            <element ref="xn:ManagedElementOptionallyContainedNrmClass"/>
            <element ref="xn:VsDataContainer"/>
          </choice>
        </sequence>
      </extension>
    </complexContent>
  </complexType>
</element>

```

```

        <element ref="xn:ThresholdMonitoringCapability"/>
        <element ref="xn:ThresholdMonitor"/>
        <element ref="xn:MeasurementControl"/>
        <element ref="xn:NtfSubscriptionControl"/>
    </choice>

    </sequence>
</extension>
</complexContent>
</complexType>
</element>

<element name="ManagedFunction">
    <complexType>
        <complexContent>
            <extension base="xn:NrmClass">
                <sequence>
                    <element name="attributes" minOccurs="0">
                        <complexType>
                            <all>
                                <element name="userLabel" type="string"/>
                                <element name="vnfParametersList" type="xn:vnfParametersListType"/>
                                <element name="peeParametersList" type="xn:peeParametersListType"/>
                                <element name="priority" type="integer" minOccurs="0"/>
                                <element name="measurementsList" type="xn:MeasurementsList" minOccurs="0"/>
                            </all>
                        </complexType>
                    </element>
                    <choice minOccurs="0" maxOccurs="unbounded">
                        <element ref="xn:VsDataContainer"/>
                        <element ref="xn:EP_RP"/>
                        <element ref="xn:ThresholdMonitoringCapability"/>
                        <element ref="xn:ThresholdMonitor"/>
                        <element ref="xn:MeasurementControl"/>
                    </choice>
                </sequence>
            </extension>
        </complexContent>
    </complexType>
</element>

<element name="ManagedNFService">
    <complexType>
        <complexContent>
            <extension base="xn:NrmClass">
                <sequence>
                    <element name="attributes" minOccurs="0">
                        <complexType>
                            <all>
                                <element name="userLabel" type="string"/>
                                <element name="nfServiceType" type="xn:nfServiceType"/>
                                <element name="AdministrativeState" type="xn:pMAdministrativeStateType"/>
                                <element name="OperationalState" type="xn:pMOperationalStateType"/>
                                <element name="usageState" type="xn:usageStateType"/>
                                <element name="registrationState" type="xn:registrationStateType"/>
                                <element name="sAP" type="xn:SAP" minOccurs="0"/>
                                <element name="operations" type="xn:operationsList" minOccurs="0"/>
                            </all>
                        </complexType>
                    </element>
                    <choice minOccurs="0" maxOccurs="unbounded">
                        <element ref="xn:VsDataContainer"/>
                        <element ref="xn:ThresholdMonitoringCapability"/>
                        <element ref="xn:ThresholdMonitor"/>
                    </choice>
                </sequence>
            </extension>
        </complexContent>
    </complexType>
</element>

<element name="MeContext">
    <complexType>
        <complexContent>
            <extension base="xn:NrmClass">
                <sequence>
                    <element name="attributes" minOccurs="0">
                        <complexType>

```

```

    <all>
      <element name="dnPrefix" minOccurs="0"/>
    </all>
  </complexType>
</element>
<choice minOccurs="0" maxOccurs="unbounded">
  <element ref="xn:ManagedElement"/>
</choice>
</sequence>
</extension>
</complexContent>
</complexType>
</element>

<element name="ManagementNode">
  <complexType>
    <complexContent>
      <extension base="xn:NrmClass">
        <sequence>
          <element name="attributes" minOccurs="0">
            <complexType>
              <all>
                <element name="userLabel"/>
                <element name="vendorName"/>
                <element name="locationName"/>
                <element name="managedElements" type="xn:dnList" minOccurs="0"/>
                <element name="swVersion"/>
                <element name="userDefinedState"/>
              </all>
            </complexType>
          </element>
          <choice minOccurs="0" maxOccurs="unbounded">
            <element ref="xn:IRPAgent"/>
            <element ref="xn:VsDataContainer"/>
          </choice>
        </sequence>
      </extension>
    </complexContent>
  </complexType>
</element>

<element name="MeasurementControl">
  <complexType>
    <complexContent>
      <extension base="xn:NrmClass">
        <sequence>
          <element name="attributes" minOccurs="0">
            <complexType>
              <all>
                <element name="pMAdministrativeState" type="xn:pMAdministrativeStateType"/>
                <element name="pMOperationalState" type="xn:pMOperationalStateType"/>
                <element name="defaultFileBasedGP" type="integer"/>
                <element name="defaultFileReportingPeriod" type="integer"/>
                <element name="defaultFileLocation" type="string"/>
                <element name="defaultStreamBasedGP" type="integer"/>
                <element name="defaultStreamTarget" type="string"/>
              </all>
            </complexType>
          </element>
          <choice minOccurs="0" maxOccurs="unbounded">
            <element ref="xn:MeasurementReader"/>
          </choice>
        </sequence>
      </extension>
    </complexContent>
  </complexType>
</element>

<element name="MeasurementReader">
  <complexType>
    <complexContent>
      <extension base="xn:NrmClass">
        <sequence>
          <element name="attributes" minOccurs="0">
            <complexType>
              <all>
                <element name="measurementTypes"/>
                <element name="fileBasedGP" type="integer" minOccurs="0"/>
              </all>
            </complexType>
          </element>
        </sequence>
      </extension>
    </complexContent>
  </complexType>
</element>

```

```

        <element name="fileReportingPeriod" type="integer" minOccurs="0"/>
        <element name="fileLocation" type="string" minOccurs="0"/>
        <element name="streamBasedGP" type="integer" minOccurs="0"/>
        <element name="streamTarget" type="string" minOccurs="0"/>
        <element name="managedObjectDNSBasic" type="xn:dnList" minOccurs="0"/>
        <element name="managedObjectDNS" type="xn:dnList" minOccurs="0"/>
    </all>
</complexType>
</element>
</sequence>
</extension>
</complexContent>
</complexType>
</element>

<element name="IRPAgent">
    <complexType>
        <complexContent>
            <extension base="xn:NrmClass">
                <sequence>
                    <element name="attributes" minOccurs="0">
                        <complexType>
                            <all>
                                <element ref="xn:systemDN" minOccurs="0"/>
                            </all>
                        </complexType>
                    </element>
                </sequence>
            </extension>
        </complexContent>
    </complexType>
</element>

<element name="EP_RP">
    <complexType>
        <complexContent>
            <extension base="xn:NrmClass">
                <sequence>
                    <element name="attributes" minOccurs="0">
                        <complexType>
                            <all>
                                <element name="farEndEntity" type="xn:dn" minOccurs="0"/>
                                <element name="userLabel" type="string" minOccurs="0"/>
                                <element name="measurementsList" type="xn:MeasurementsList" minOccurs="0"/>
                            </all>
                        </complexType>
                    </element>
                </sequence>
            </extension>
        </complexContent>
    </complexType>
</element>

<element name="VsDataContainer">
    <complexType>
        <complexContent>
            <extension base="xn:NrmClass">
                <sequence>
                    <element name="attributes" minOccurs="0">
                        <complexType>
                            <all>
                                <element name="vsDataType"/>
                                <element name="vsDataFormatVersion"/>
                                <element ref="xn:vsData"/>
                            </all>
                        </complexType>
                    </element>
                    <choice minOccurs="0" maxOccurs="unbounded">
                        <element ref="xn:VsDataContainer"/>
                    </choice>
                </sequence>
            </extension>
        </complexContent>
    </complexType>
</element>

<element name="ThresholdMonitoringCapability">
    <complexType>

```

```

<complexContent>
  <extension base="xn:NrmClass">
    <sequence>
      <element name="attributes" minOccurs="0">
        <complexType>
          <all>
            <element name="supportedMonitoringGPs" type="xn:GPListType"/>
          </all>
        </complexType>
      </element>
      <choice minOccurs="0" maxOccurs="unbounded">
        <element ref="xn:ThresholdMonitoringCapabilityOptionallyContainedNrmClass"/>
      </choice>
    </sequence>
  </extension>
</complexContent>
</complexType>
</element>

<element name="HeartbeatControl">
  <complexType>
    <complexContent>
      <extension base="xn:NrmClass">
        <sequence>
          <element name="attributes" minOccurs="0">
            <complexType>
              <all>
                <element name="heartbeatNtfPeriod" type="integer"/>
                <element name="triggerHeartbeatNtf" type="boolean"/>
              </all>
            </complexType>
          </element>
        </sequence>
      </extension>
    </complexContent>
  </complexType>
</element>

<element name="ThresholdMonitor">
  <complexType>
    <complexContent>
      <extension base="xn:NrmClass">
        <sequence>
          <element name="attributes" minOccurs="0">
            <complexType>
              <all>
                <element name="thresholdInfoList" type="xn:thresholdInfoListType"/>
                <element name="monitoringGP" type="integer"/>
                <element name="monitoringNotifTarget" type="string"/>
                <element name="monitoredIOCName" type="string"/>
                <element name="monitoredObjectDNs" type="xn:dnList"/>
              </all>
            </complexType>
          </element>
          <choice minOccurs="0" maxOccurs="unbounded">
            <element ref="xn:ThresholdMonitorOptionallyContainedNrmClass"/>
          </choice>
        </sequence>
      </extension>
    </complexContent>
  </complexType>
</element>

<element name="NtfSubscriptionControl">
  <complexType>
    <complexContent>
      <extension base="xn:NrmClass">
        <sequence>
          <element name="attributes" minOccurs="0">
            <complexType>
              <all>
                <element name="notificationRecipientAddress" type="string"/>
                <element name="notificationTypes" type="string" minOccurs="0" />
                <element name="scope" type="xn:Scope"/>
                <element name="notificationFilter" type="string" minOccurs="0" />
              </all>
            </complexType>
          </element>
        </sequence>
      </extension>
    </complexContent>
  </complexType>
</element>

```

```
        <choice minOccurs="0" maxOccurs="1">
          <element ref="xn:HeartbeatControl"/>
        </choice>
      </sequence>
    </extension>
  </complexContent>
</complexType>
</element>

<!--
  IRPAgent IOC attributes
-->

<element name="systemDN" type="xn:dn"/>

<!--
  VsDataContainer NRM class vsData attribute associated empty XML element
-->

<complexType name="vsData"/>
<element name="vsData" type="xn:vsData"/>

<!--
  Abstract head XML element for all XML elements associated to further
  NRM classes optionally contained under SubNetwork NRM class
-->

<element
  name="SubNetworkOptionallyContainedNrmClass"
  type="xn:NrmClass"
  abstract="true"
/>

<!--
  Abstract head XML element for all XML elements associated to further
  NRM classes optionally contained under ManagedElement NRM class
-->

<element
  name="ManagedElementOptionallyContainedNrmClass"
  type="xn:NrmClass"
  abstract="true"
/>

<!--
  Abstract head XML element for all XML elements associated to further
  NRM classes optionally contained under ThresholdMonitoringCapability NRM class
-->

<element
  name="ThresholdMonitoringCapabilityOptionallyContainedNrmClass"
  type="xn:NrmClass"
  abstract="true"
/>

<!--
  Abstract head XML element for all XML elements associated to further
  NRM classes optionally contained under ThresholdMonitor NRM class
-->

<element
  name="ThresholdMonitorOptionallyContainedNrmClass"
  type="xn:NrmClass"
  abstract="true"
/>

</schema>
```

Annex C (normative): OpenAPI definitions

C.1 General

This annex contains the OpenAPI definition of the Generic NRM in YAML format.

The Information Service (IS) of the Generic NRM is defined in 3GPP TS 28.622 [4].

Mapping rules to produce the OpenAPI definition based on the IS are defined in 3GPP TS 32.160 [14].

C.2 Void

C.3 Void

C.4 Solution Set (SS) definitions

C.4.1 Void

C.4.2 Void

C.4.2a OpenAPI document "comDefs.yaml"

```
openapi: 3.0.1
info:
  title: Common Type Definitions
  version: 16.8.0
  description: >-
    OAS 3.0.1 specification of common type definitions in the Generic NRM
    © 2021, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.
externalDocs:
  description: 3GPP TS 28.623; Generic NRM; Common type definitions
  url: http://www.3gpp.org/ftp/Specs/archive/28_series/28.623/
paths: {}
components:
  schemas:

  Float:
    type: number
    format: float
  DateTime:
    type: string
    format: date-time
  Latitude:
    type: number
    format: float
    minimum: -90
    maximum: 90
  Longitude:
    type: number
    format: float
    minimum: -180
    maximum: 180

  Dn:
    type: string
  DnList:
```

```

    type: array
    items:
      $ref: '#/components/schemas/Dn'

Mcc:
  type: string
  pattern: '^[0-9]{3}$'
Mnc:
  type: string
  pattern: '^[0-9]{2,3}$'
Nid:
  type: string
  pattern: '^[A-Fa-f0-9]{11}$'
PlmnId:
  type: object
  properties:
    mcc:
      $ref: '#/components/schemas/Mcc'
    mnc:
      $ref: '#/components/schemas/Mnc'
Tac:
  type: string
  pattern: '^[A-Fa-f0-9]{4}$|^[A-Fa-f0-9]{6}$'
EutraCellId:
  type: string
  pattern: '^[A-Fa-f0-9]{7}$'
NrCellId:
  type: string
  pattern: '^[A-Fa-f0-9]{9}$'

Fqdn:
  type: string
Ipv4Addr:
  type: string
  pattern: '^((([0-9]|[1-9][0-9]|1[0-9][0-9]|2[0-4][0-9]|25[0-5])\.)}{3}([0-9]|[1-9][0-9]|1[0-9][0-9]|2[0-4][0-9]|25[0-5])$)'
  example: '198.51.100.1'
Ipv6Addr:
  type: string
  allOf:
    - pattern: '^((:|0?|([1-9a-f][0-9a-f]{0,3}))*):((0?|([1-9a-f][0-9a-f]{0,3}))*):{0,6}(:|0?|([1-9a-f][0-9a-f]{0,3}))*$'
    - pattern: '^((([:]+){7}([[:]])|((([:]+)*[[:]]+)??:(([:]+)*[[:]]+)?))$'
  example: '2001:db8:85a3::8a2e:370:7334'
Ipv6Prefix:
  type: string
  allOf:
    - pattern: '^((:|0?|([1-9a-f][0-9a-f]{0,3}))*):((0?|([1-9a-f][0-9a-f]{0,3}))*):{0,6}(:|0?|([1-9a-f][0-9a-f]{0,3}))*(\|/((([0-9]|[1-9]{2})|(1[0-1][0-9])|(12[0-8])))$)'
    - pattern: '^((([:]+){7}([[:]])|((([:]+)*[[:]]+)??:(([:]+)*[[:]]+)?))(\|/.)$'
  example: '2001:db8:abcd:12::0/64'
IpAddr:
  oneOf:
    - $ref: '#/components/schemas/Ipv4Addr'
    - $ref: '#/components/schemas/Ipv6Addr'
HostAddr:
  # This definition will be deprecated, when all occurrences of HostAddr
  # are replaced by Host.
  oneOf:
    - $ref: '#/components/schemas/Ipv4Addr'
    - $ref: '#/components/schemas/Ipv6Addr'
    - $ref: '#/components/schemas/Fqdn'
Host:
  oneOf:
    - $ref: '#/components/schemas/IpAddr'
    - $ref: '#/components/schemas/Fqdn'
Uri:
  type: string

AdministrativeState:
  type: string
  enum:
    - LOCKED
    - UNLOCKED
OperationalState:
  type: string
  enum:
    - ENABLED

```

```

    - DISABLED
UsageState:
  type: string
  enum:
    - IDEL
    - ACTIVE
    - BUSY

AttributeNameValuePairSet:
  description: >-
    The key of this map is the attribute name, and the value the attribute value.
  type: object
  minProperties: 1
  additionalProperties:
    nullable: true
AttributeValueChangeSet:
  description: >-
    The first array item contains the attribute name value pairs with the new values,
    and the second array item the attribute name value pairs with the optional old values.
  type: array
  items:
    $ref: '#/components/schemas/AttributeNameValuePairSet'
  minItems: 1
  maxItems: 2

Filter:
  description: >-
    The filter format shall be compliant to XPath 1.0.
  type: string
SystemDN:
  type: string

NotificationId:
  type: integer
NotificationType:
  oneOf:
    - $ref: 'faultMnS.yaml#/components/schemas/AlarmNotificationTypes'
    - $ref: 'provMnS.yaml#/components/schemas/CmNotificationTypes'
    - $ref: 'perfMnS.yaml#/components/schemas/PerfNotificationTypes'
    - $ref: 'heartbeatNtf.yaml#/components/schemas/HeartbeatNotificationTypes'
    - $ref: 'fileDataReportingMnS.yaml#/components/schemas/FileNotificationTypes'
NotificationHeader:
  type: object
  properties:
    href:
      $ref: '#/components/schemas/Uri'
    notificationId:
      $ref: '#/components/schemas/NotificationId'
    notificationType:
      $ref: '#/components/schemas/NotificationType'
    eventTime:
      $ref: '#/components/schemas/DateTime'
    systemDN:
      $ref: '#/components/schemas/SystemDN'
  required:
    - href
    - notificationId
    - notificationType
    - eventTime
    - systemDN

ErrorResponse:
  description: >-
    Default schema for the response message body in case the request
    is not successful.
  type: object
  properties:
    error:
      type: object
      properties:
        errorInfo:
          type: string

```

C.4.3 OpenAPI document "genericNrm.yaml"

openapi: 3.0.1

```

info:
  title: Generic NRM
  version: 16.9.0
  description: >-
    OAS 3.0.1 definition of the Generic NRM
    © 2021, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.
externalDocs:
  description: 3GPP TS 28.623; Generic NRM
  url: http://www.3gpp.org/ftp/Specs/archive/28_series/28.623/
paths: {}
components:
  schemas:

```

```
#----- Definition of types-----
```

```

RegistrationState:
  type: string
  enum:
    - REGISTERED
    - DEREGISTERED
VnfParameter:
  type: object
  properties:
    vnfInstanceId:
      type: string
    vnfId:
      type: string
    flavourId:
      type: string
    autoScalable:
      type: boolean
PeeParameter:
  type: object
  properties:
    siteIdentification:
      type: string
    siteDescription:
      type: string
    siteLatitude:
      $ref: 'comDefs.yaml#/components/schemas/Latitude'
    siteLongitude:
      $ref: 'comDefs.yaml#/components/schemas/Longitude'
    equipmentType:
      type: string
    environmentType:
      type: string
    powerInterface:
      type: string
ThresholdInfo:
  type: object
  properties:
    thresholdDirection:
      type: string
      enum:
        - UP
        - DOWN
        - UP_AND_DOWN
    thresholdValue:
      oneOf:
        - type: integer
        - $ref: 'comDefs.yaml#/components/schemas/Float'
    hysteresis:
      oneOf:
        - type: integer
          minimum: 0
        - type: number
          format: float
          minimum: 0
Operation:
  type: object
  properties:
    name:
      type: string
    allowedNFTypes:
      $ref: '#/components/schemas/NFType'
    operationSemantics:
      $ref: '#/components/schemas/OperationSemantics'

```

```

NFType:
  type: string
  description: ' NF name defined in TS 23.501'
  enum:
    - NRF
    - UDM
    - AMF
    - SMF
    - AUSF
    - NEF
    - PCF
    - SMSF
    - NSSF
    - UDR
    - LMF
    - GMLC
    - 5G_EIR
    - SEPP
    - UPF
    - N3IWF
    - AF
    - UDSF
    - DN
OperationSemantics:
  type: string
  enum:
    - REQUEST_RESPONSE
    - SUBSCRIBE_NOTIFY
SAP:
  type: object
  properties:
    host:
      $ref: 'comDefs.yaml#/components/schemas/HostAddr'
    port:
      type: integer
NFServiceType:
  type: string
  enum:
    - Namf_Communication
    - Namf_EventExposure
    - Namf_MT
    - Namf_Location
    - Nsmf_PDUSession
    - Nsmf_EventExposure
    - Others
TransportProtocol:
  anyOf:
    - type: string
      enum:
        - TCP
    - type: string
SupportedPerfMetricGroup:
  type: object
  properties:
    performanceMetrics:
      type: array
      items:
        type: string
    granularityPeriods:
      type: array
      items:
        type: integer
        minimum: 1
    reportingMethods:
      type: array
      items:
        type: string
        enum:
          - FILE_BASED_LOC_SET_BY_PRODUCER
          - FILE_BASED_LOC_SET_BY_CONSUMER
          - STREAM_BASED
    monitorGranularityPeriods:
      type: array
      items:
        type: integer
        minimum: 1
ReportingCtrl:
  oneOf:

```

```

- type: object
  properties:
    fileReportingPeriod:
      type: integer
- type: object
  properties:
    fileReportingPeriod:
      type: integer
    fileLocation:
      $ref: 'comDefs.yaml#/components/schemas/Uri'
- type: object
  properties:
    streamTarget:
      $ref: 'comDefs.yaml#/components/schemas/Uri'
Scope:
  type: object
  properties:
    scopeType:
      type: string
      enum:
        - BASE_ONLY
        - BASE_ALL
        - BASE_NTH_LEVEL
        - BASE_SUBTREE
    scopeLevel:
      type: integer
AreaScope:
  oneOf:
    - type: array
      items:
        $ref: '#/components/schemas/EutraCellId'
    - type: array
      items:
        $ref: '#/components/schemas/NrCellId'
    - type: array
      items:
        $ref: '#/components/schemas/Tac'
    - type: array
      items:
        $ref: '#/components/schemas/Tai'
Tai:
  type: object
  properties:
    mcc:
      $ref: 'comDefs.yaml#/components/schemas/Mcc'
    mnc:
      $ref: 'comDefs.yaml#/components/schemas/Mnc'
    tac:
      $ref: '#/components/schemas/Tac'
AreaConfig:
  type: object
  properties:
    freqInfo:
      $ref: '#/components/schemas/FreqInfo'
    pciList:
      type: array
      items:
        type: integer
FreqInfo:
  description: specifies the carrier frequency and bands used in a cell.
  type: object
  properties:
    arfcn:
      type: integer
    freqBands:
      type: array
      items:
        type: integer
MbsfnArea:
  type: object
  properties:
    mbsfnAreaId:
      type: integer
      minimum: 1
    earfcn:
      type: integer
      minimum: 1
Tac:

```

```

    type: string
    pattern: '^[A-Fa-f0-9]{4}$|^[A-Fa-f0-9]{6}$'
EutraCellId:
  type: string
  pattern: '^[A-Fa-f0-9]{7}$'
NrCellId:
  type: string
  pattern: '^[A-Fa-f0-9]{9}$'
IpAddr:
  oneOf:
    - $ref: 'comDefs.yaml#/components/schemas/Ipv4Addr'
    - $ref: 'comDefs.yaml#/components/schemas/Ipv6Addr'

```

#----- Definition of types used in Trace control NRM fragment-----

```

tjJobType-Type:
  type: string
  description: Specifies whether the TraceJob represents only MDT, Logged MBSFN MDT, Trace or a
combined Trace and MDT job. Applicable for Trace, MDT, RCEF and RLF reporting. See 3GPP TS 32.422
clause 5.9a for additional details.
  enum:
    - IMMEDIATE_MDT_ONLY
    - LOGGED_MDT_ONLY
    - TRACE_ONLY
    - IMMEDIATE_MDT AND TRACE
    - RLF_REPORT_ONLY
    - RCEF_REPORT_ONLY
    - LOGGED_MBSFN_MDT

tjListOfInterfaces-Type:
  description: The interfaces to be recorded in the Network Element. See 3GPP TS 32.422 clause
5.5 for additional details.
  type: object
  properties:
    MSCServerInterfaces:
      type: array
      items:
        type: string
        enum:
          - A
          - Iu-CS
          - Mc
          - MAP-G
          - MAP-B
          - MAP-E
          - MAP-F
          - MAP-D
          - MAP-C
          - CAP
    MGWInterfaces:
      type: array
      items:
        type: string
        enum:
          - Mc
          - Nb-UP
          - Iu-UP
    RNCInterfaces:
      type: array
      items:
        type: string
        enum:
          - Iu-CS
          - Iu-PS
          - Iur
          - Iub
          - Uu
    SGSNInterfaces:
      type: array
      items:
        type: string
        enum:
          - Gb
          - Iu-PS
          - Gn
          - MAP-Gr
          - MAP-Gd

```

```
- MAP-Gf
- Ge
- Gs
- S6d
- S4
- S3
- S13
GGSNInterfaces:
  type: array
  items:
    type: string
    enum:
      - Gn
      - Gi
      - Gmb
S-CSCFInterfaces:
  type: array
  items:
    type: string
    enum:
      - Mw
      - Mg
      - Mr
      - Mi
P-CSCFInterfaces:
  type: array
  items:
    type: string
    enum:
      - Gm
      - Mw
I-CSCFInterfaces:
  type: array
  items:
    type: string
    enum:
      - Cx
      - Dx
      - Mg
      - Mw
MRFCInterfaces:
  type: array
  items:
    type: string
    enum:
      - Mp
      - Mr
MGCFInterfaces:
  type: array
  items:
    type: string
    enum:
      - Mg
      - Mj
      - Mn
IBCFInterfaces:
  type: array
  items:
    type: string
    enum:
      - Ix
      - Mx
E-CSCFInterfaces:
  type: array
  items:
    type: string
    enum:
      - Mw
      - Ml
      - Mm
      - Mi/Mg
BGCFInterfaces:
  type: array
  items:
    type: string
    enum:
      - Mi
      - Mj
```



```
- Mk
ASInterfaces:
  type: array
  items:
    type: string
    enum:
      - Dh
      - Sh
      - ISC
      - Ut
HSSInterfaces:
  type: array
  items:
    type: string
    enum:
      - MAP-C
      - MAP-D
      - Gc
      - Gr
      - Cx
      - S6d
      - S6a
      - Sh
EIRInterfaces:
  type: array
  items:
    type: string
    enum:
      - MAP-F
      - S13
      - MAP-Gf
BM-SCInterfaces:
  type: array
  items:
    type: string
    enum:
      - Gmb
MMEInterfaces:
  type: array
  items:
    type: string
    enum:
      - S1-MME
      - S3
      - S6a
      - S10
      - S11
      - S13
SGWInterfaces:
  type: array
  items:
    type: string
    enum:
      - S4
      - S5
      - S8
      - S11
      - Gxc
PDN_GWInterfaces:
  type: array
  items:
    type: string
    enum:
      - S2a
      - S2b
      - S2c
      - S5
      - S6b
      - Gx
      - S8
      - SGi
eNBInterfaces:
  type: array
  items:
    type: string
    enum:
      - S1-MME
      - X2
```

```
en-gNBInterfaces:
  type: array
  items:
    type: string
    enum:
      - S1-MME
      - X2
      - Uu
      - F1-C
      - E1
AMFInterfaces:
  type: array
  items:
    type: string
    enum:
      - N1
      - N2
      - N8
      - N11
      - N12
      - N14
      - N15
      - N20
      - N22
      - N26
AUSFInterfaces:
  type: array
  items:
    type: string
    enum:
      - N12
      - N13
NEFInterfaces:
  type: array
  items:
    type: string
    enum:
      - N29
      - N30
      - N33
NRFInterfaces:
  type: array
  items:
    type: string
    enum:
      - N27
NSSFInterfaces:
  type: array
  items:
    type: string
    enum:
      - N22
      - N31
PCFInterfaces:
  type: array
  items:
    type: string
    enum:
      - N5
      - N7
      - N15
SMFInterfaces:
  type: array
  items:
    type: string
    enum:
      - N4
      - N7
      - N10
      - N11
      - S5-C
SMSFInterfaces:
  type: array
  items:
    type: string
    enum:
      - N20
      - N21
```

```
UDMInterfaces:
  type: array
  items:
    type: string
    enum:
      - N8
      - N10
      - N13
      - N21
UPFInterfaces:
  type: array
  items:
    type: string
    enum:
      - N4
ng-eNBInterfaces:
  type: array
  items:
    type: string
    enum:
      - NG-C
      - Xn-C
      - Uu
gNB-CU-CPInterfaces:
  type: array
  items:
    type: string
    enum:
      - NG-C
      - Xn-C
      - Uu
      - F1-C
      - E1
      - X2-C
gNB-CU-UPInterfaces:
  type: array
  items:
    type: string
    enum:
      - E1
gNB-DUInterfaces:
  type: array
  items:
    type: string
    enum:
      - F1-C

tjListOfNeTypes-Type:
  description: The Network Element types where Trace Session activation is needed. See 3GPP TS
32.422 clause 5.4 for additional details.
  type: array
  items:
    type: string
    enum:
      - MSC_SERVER
      - SGSN
      - MGW
      - GGSN
      - RNC
      - BM_SC
      - MME
      - SGW
      - PGW
      - ENB
      - EN_GNB
      - GNB_CU_CP
      - GNB_CU_UP
      - GNB_DU
      - AMF
      - PCF
      - SMF
      - UPF
      - AUSF
      - SMSF

tjPLMNTarget-Type:
  type: object
```

description: The PLMN for which sessions shall be selected in the Trace Session in case of management based activation when several PLMNs are supported in the RAN (this means that shared cells and not shared cells are allowed for the specified PLMN. Note that the PLMN Target might differ from the PLMN specified in the Trace Reference, as that specifies the PLMN that is containing the management system requesting the Trace Session from the NE. See 3GPP TS 32.422 clause 5.9b for additional details.

```
properties:
  mcc:
    $ref: 'comDefs.yaml#/components/schemas/Mcc'
  mnc:
    $ref: 'comDefs.yaml#/components/schemas/Mnc'
required:
- mcc
- mnc
```

tjTraceDepth-Type:

description: Specifies how detailed information should be recorded in the Network Element. The Trace Depth is a parameter for Trace Session level, i.e., the Trace Depth is the same for all of the NEs to be traced in the same Trace Session. See 3GPP TS 32.422 clause 5.3 for additional details.

```
type: string
enum:
- MINIMUM
- MEDIUM
- MAXIMUM
- VENDORMINIMUM
- VENDORMEDIUM
- VENDORMAXIMUM
```

tjTraceReference-Type:

```
type: object
```

description: The Trace Reference parameter shall be globally unique, therefore the Trace Reference shall compose as follows - MCC+MNC+Trace ID, where the MCC and MNC are coming with the Trace activation request from the management system to identify one PLMN containing the management system, and Trace ID is a 3 byte Octet String. See 3GPP TS 32.422 clause 5.6 for additional details.

```
properties:
  mcc:
    $ref: 'comDefs.yaml#/components/schemas/Mcc'
  mnc:
    $ref: 'comDefs.yaml#/components/schemas/Mnc'
  traceId:
    type: string
required:
- mcc
- mnc
- traceId
```

tjTraceReportingFormat-Type:

```
type: string
```

description: Specifies whether file-based or streaming reporting shall be used for this Trace Session. See 3GPP TS 32.422 clause 5.11 for additional details.

```
enum:
- FILE-BASED
- STREAMING
```

tjTraceTarget-Type:

```
type: object
```

description: Trace target conveying both the type and value of the target ID. For additional details see 3GPP TS 32.422

```
properties:
  TargetIdType:
    type: string
    enum:
      - IMSI
      - IMEI
      - IMEISV
      - PUBLIC_ID
      - UTRAN_CELL
      - E-UTRAN_CELL
      - NG-RAN_CELL
      - eNB
      - RNC
      - gNB
      - SUPI
  TargetIdValue:
    type: string
required:
- TargetIdType
- TargetIdValue
```

```
tjTriggeringEvent-Type:
  type: object
  description: Specifies when to start a Trace Recording Session and which message shall be
  recorded first, when to stop a Trace Recording Session and which message shall be recorded last
  respectively. See 3GPP TS 32.422 clause 5.1 for additional details.
  properties:
    NetworkElement:
      type: string
      enum:
        - MSC_SERVER
        - SGSN
        - MGW
        - GGSN
        - BM_SC
        - MME
        - SGW
        - PGW
        - AMF
        - SMF
        - PCF
        - UPF
        - AUSF
        - NEF
        - NRF
        - NSSF
        - SMSF
        - UDM
    EventBitmap:
      type: integer
  required:
    - NetworkElement
    - EventBitmap

tjMDTAnonymizationOfData-Type:
  description: Specifies level of MDT anonymization. For additional details see 3GPP TS 32.422
  clause 5.10.12.
  type: string
  enum:
    - NO_IDENTITY
    - TAC_OF_IMEI

tjMDTCollectionPeriodRrmLte-Type:
  description: See details in 3GPP TS 32.422 clause 5.10.20.
  type: string
  enum:
    - 100ms
    - 1000ms
    - 1024ms
    - 1280ms
    - 2048ms
    - 2560ms
    - 5120ms
    - 10000ms
    - 10240ms
    - 60000ms

tjMDTCollectionPeriodM6Lte-Type:
  description: See details in 3GPP TS 32.422 clause 5.10.32.
  type: string
  enum:
    - 1024ms
    - 2048ms
    - 5120ms
    - 10240ms

tjMDTCollectionPeriodM7Lte-Type:
  description: See details in 3GPP TS 32.422 clause 5.10.33.
  type: integer
  minimum: 1
  maximum: 60

tjMDTCollectionPeriodRrmUmts-Type:
  description: See details in 3GPP TS 32.422 clause 5.10.21.
  type: string
  enum:
    - 100ms
    - 250ms
```

- 500ms
- 1000ms
- 2000ms
- 3000ms
- 4000ms
- 6000ms

tjMDTCollectionPeriodRrmNR-Type:

description: See details in 3GPP TS 32.422 clause 5.10.30.

type: string

enum:

- 1024ms
- 2048ms
- 5120ms
- 10240ms
- 60000ms

tjMDTCollectionPeriodM6NR-Type:

description: See details in 3GPP TS 32.422 clause 5.10.34.

type: string

enum:

- 120ms
- 240ms
- 480ms
- 640ms
- 1024ms
- 2048ms
- 5120ms
- 10240ms
- 20480ms
- 40960ms
- 1min
- 6min
- 12min
- 30min

tjMDTCollectionPeriodM7NR-Type:

description: See details in 3GPP TS 32.422 clause 5.10.35.

type: integer

minimum: 1

maximum: 60

tjMDTEventListForTriggeredMeasurement-Type:

description: See details in 3GPP TS 32.422 clause 5.10.28.

type: string

enum:

- OUT_OF_COVERAGE
- A2_EVENT

tjMDTEventThreshold-Type:

description: See details in 3GPP TS 32.422 clause 5.10.7, 5.10.7a, 5.10.13 and 5.10.14.

type: object

properties:

EventThresholdRSRP:

oneOf:

- type: integer
minimum: 0
maximum: 97
- type: integer
minimum: 0
maximum: 127

EventThresholdRSRQ:

oneOf:

- type: integer
minimum: 0
maximum: 34
- type: integer
minimum: 0
maximum: 127

EventThreshold1F:

type: object

properties:

CPICH_RSCP:

- type: integer
minimum: -120
maximum: 25

CPICH_EcNo:

- type: integer

```
        minimum: -24
        maximum: 0
    PathLoss:
        type: integer
        minimum: 30
        maximum: 165
    EventThreshold1I:
        type: integer
        minimum: -120
        maximum: 25

tjMDTListOfMeasurements-Type:
description: See details in 3GPP TS 32.422 clause 5.10.3 for details.
type: object
properties:
    UMTS:
        type: array
        items:
            type: string
            enum:
                - M1
                - M2
                - M3
                - M4
                - M5
                - M6_DL
                - M6_UL
                - M7_DL
                - M7_UL
    LTE:
        type: array
        items:
            type: string
            enum:
                - M1
                - M2
                - M3
                - M4
                - M5
                - M1_EVENT_TRIGGERED
                - M6
                - M7
                - M8
                - M9
    NR:
        type: array
        items:
            type: string
            enum:
                - M1
                - M2
                - M3
                - M4
                - M5
                - M6
                - M7
                - M1_EVENT_TRIGGERED
                - M8
                - M9

tjMDTLoggingDuration-Type:
description: See details in 3GPP TS 32.422 clause 5.10.9.
type: string
enum:
    - 600s
    - 1200s
    - 2400s
    - 3600s
    - 5400s
    - 7200s

tjMDTLoggingInterval-Type:
description: See details in 3GPP TS 32.422 clause 5.10.8.
type: object
properties:
    UMTS:
        type: array
        items:
```

```
    type: string
    enum:
      - 1.28s
      - 2.56s
      - 5.12s
      - 10.24s
      - 20.48s
      - 30.72s
      - 40.96s
      - 61.44s
  LTE:
    type: array
    items:
      type: string
      enum:
        - 1.28s
        - 2.56s
        - 5.12s
        - 10.24s
        - 20.48s
        - 30.72s
        - 40.96s
        - 61.44s
  NR:
    type: array
    items:
      type: string
      enum:
        - 0.32s
        - 0.64s
        - 1.28s
        - 2.56s
        - 5.12s
        - 10.24s
        - 20.48s
        - 30.72s
        - 40.96s
        - 61.44s
        - INFINITY

tjMDTLoggingEventThreshold-Type:
  description: See details in 3GPP TS 32.422 clause 5.10.X.
  type: object
  properties:
    RSRP:
      type: integer
      minimum: 0
      maximum: 127
    RSRQ:
      type: integer
      minimum: 0
      maximum: 127

tjMDTLoggingHysteresis-Type:
  description: See details in 3GPP TS 32.422 clause 5.10.Y.
  type: integer
  minimum: 0
  maximum: 30

tjMDTLoggingTimeToTrigger-Type:
  description: See details in 3GPP TS 32.422 clause 5.10.Z.
  type: string
  enum:
    - 0ms
    - 40ms
    - 64ms
    - 80ms
    - 100ms
    - 128ms
    - 160ms
    - 256ms
    - 320ms
    - 480ms
    - 512ms
    - 640ms
    - 1024ms
    - 1280ms
    - 2560ms
```


- 5120ms

tjMDTMeasurementPeriodLTE-Type:
description: See details in 3GPP TS 32.422 clause 5.10.23.
type: string
enum:

- 1024ms
- 2048ms
- 5120ms
- 10240ms
- 1min

tjMDTMeasurementPeriodUMTS-Type:
description: See details in 3GPP TS 32.422 clause 5.10.22.
type: string
enum:

- 1000ms
- 2000ms
- 3000ms
- 4000ms
- 6000ms
- 8000ms
- 12000ms
- 16000ms
- 20000ms
- 24000ms
- 28000ms
- 32000ms
- 64000ms

tjMDTMeasurementQuantity-Type:
description: See details in 3GPP TS 32.422 clause 5.10.15.
type: string
enum:

- CPICH_EcNo
- CPICH_RSCP
- PathLoss

tjMDTM4ThresholdUmts-Type:
description: See details in 3GPP TS 32.422 clause 5.10.A.
type: integer
minimum: 0
maximum: 31

tjMDTPLMNList-Type:
description: See details in 3GPP TS 32.422 clause 5.10.24.
type: array
items:

- type: object
- properties:
 - mcc:
 - \$ref: 'comDefs.yaml#/components/schemas/Mcc'
 - mnc:
 - \$ref: 'comDefs.yaml#/components/schemas/Mnc'
- required:
 - mcc
 - mnc

maxItems: 16

tjMDTPositioningMethod-Type:
description: See details in 3GPP TS 32.422 clause 5.10.19.
type: string
enum:

- GNSS
- E-CELL_ID

tjMDTReportAmount-Type:
description: See details in 3GPP TS 32.422 clause 5.10.6.
type: string
enum:

- 1
- 2
- 4
- 8
- 16
- 32
- 64
- INFINITY

tjMDTReportingTrigger-Type:

description: See details in 3GPP TS 32.422 clause 5.10.4.

type: array

items:

type: string

enum:

- PERIODICAL
- A2_FOR_LTE_NR
- 1F_FOR_UMTS
- 1I_FOR_UMTS_MCPS_TDD
- A2_TRIGGERED_PERIODIC_FOR_LTE_NR
- ALL_CONFIGURED_RRM_FOR_LTE_NR
- ALL_CONFIGURED_RRM_FOR_UMTS

tjMDTReportInterval-Type:

description: See details in 3GPP TS 32.422 clause 5.10.5.

type: object

properties:

UMTS:

type: array

items:

type: string

enum:

- 250ms
- 500ms
- 1000ms
- 2000ms
- 3000ms
- 4000ms
- 6000ms
- 8000ms
- 12000ms
- 16000ms
- 20000ms
- 24000ms
- 28000ms
- 32000ms
- 64000ms

LTE:

type: array

items:

type: string

enum:

- 120ms
- 240ms
- 480ms
- 640ms
- 1024ms
- 2048ms
- 5120ms
- 10240ms
- 60000ms
- 360000ms
- 720000ms
- 1800000ms
- 3600000ms

NR:

type: array

items:

type: string

enum:

- 120ms
- 240ms
- 480ms
- 640ms
- 1024ms
- 2048ms
- 5120ms
- 10240ms
- 60000ms
- 360000ms
- 720000ms
- 1800000ms

tjMDTReportType-Type:

description: Report type for logged NR MDT. See details in 3GPP TS 32.422 clause 5.10.27.

type: string

```

enum:
  - PERIODICAL
  - EVENT_TRIGGERED

tjMDTSensorInformation-Type:
  description: See details in 3GPP TS 32.422 clause 5.10.29.
  type: array
  items:
    type: string
    enum:
      - BAROMETRIC_PRESSURE
      - UE_SPEED
      - UE_ORIENTATION

tjMDTTraceCollectionEntityID-Type:
  description: See details in 3GPP TS 32.422 clause 5.10.11. Only TCE Id value may be sent over
the air to the UE being configured for Logged MDT.
  type: integer

#----- end of Definition of types used in Trace control NRM fragment -----

#----- Definition of abstract IOC Top -----

Top-Attr:
# This definition will be deprecated, when all occurrences of Top-Attr
# are replaced by Top.
type: object
properties:
  id:
    type: string
    nullable: true
  objectClass:
    type: string
  objectInstance:
    $ref: 'comDefs.yaml#/components/schemas/Dn'
  VsDataContainer:
    $ref: '#/components/schemas/VsDataContainer-Multiple'
required:
  - id
Top:
type: object
properties:
  id:
    type: string
    nullable: true
  objectClass:
    type: string
  objectInstance:
    $ref: 'comDefs.yaml#/components/schemas/Dn'
  VsDataContainer:
    $ref: '#/components/schemas/VsDataContainer-Multiple'
required:
  - id

#----- Definition of IOCs with new name-containments defined in other TS -----

SubNetwork-Attr:
type: object
properties:
  dnPrefix:
    type: string
  userLabel:
    type: string
  userDefinedNetworkType:
    type: string
  setOfMcc:
    type: array
    items:
      $ref: 'comDefs.yaml#/components/schemas/Mcc'
  priorityLabel:
    type: integer
  supportedPerfMetricGroups:
    type: array
    items:
      $ref: '#/components/schemas/SupportedPerfMetricGroup'
ManagedElement-Attr:

```

```

type: object
properties:
  dnPrefix:
    type: string
  managedElementTypeInfoList:
    type: array
    items:
      type: string
  userLabel:
    type: string
  locationName:
    type: string
  managedBy:
    $ref: 'comDefs.yaml#/components/schemas/DnList'
  vendorName:
    type: string
  userDefinedState:
    type: string
  swVersion:
    type: string
  priorityLabel:
    type: integer
  supportedPerfMetricGroups:
    type: array
    items:
      $ref: '#/components/schemas/SupportedPerfMetricGroup'

SubNetwork-nc0:
type: object
properties:
  ManagementNode:
    $ref: '#/components/schemas/ManagementNode-Multiple'
  MnsAgent:
    $ref: '#/components/schemas/MnsAgent-Multiple'
  MeContext:
    $ref: '#/components/schemas/MeContext-Multiple'
  PerfMetricJob:
    $ref: '#/components/schemas/PerfMetricJob-Multiple'
  ThresholdMonitor:
    $ref: '#/components/schemas/ThresholdMonitor-Multiple'
  NtfSubscriptionControl:
    $ref: '#/components/schemas/NtfSubscriptionControl-Multiple'
  TraceJob:
    $ref: '#/components/schemas/TraceJob-Multiple'
  AlarmList:
    $ref: '#/components/schemas/AlarmList-Single'
ManagedElement-nc0:
type: object
properties:
  MnsAgent:
    $ref: '#/components/schemas/MnsAgent-Multiple'
  PerfMetricJob:
    $ref: '#/components/schemas/PerfMetricJob-Multiple'
  ThresholdMonitor:
    $ref: '#/components/schemas/ThresholdMonitor-Multiple'
  NtfSubscriptionControl:
    $ref: '#/components/schemas/NtfSubscriptionControl-Multiple'
  TraceJob:
    $ref: '#/components/schemas/TraceJob-Multiple'
  AlarmList:
    $ref: '#/components/schemas/AlarmList-Single'

```

#----- Definition of abstract IOCs -----

```

ManagedFunction-Attr:
type: object
properties:
  userLabel:
    type: string
  vnfParametersList:
    type: array
    items:
      $ref: '#/components/schemas/VnfParameter'
  peeParametersList:
    type: array
    items:
      $ref: '#/components/schemas/PeeParameter'
  priorityLabel:

```

```

    type: integer
  supportedPerfMetricGroups:
    type: array
    items:
      $ref: '#/components/schemas/SupportedPerfMetricGroup'
EP_RP-Attr:
  type: object
  properties:
    userLabel:
      type: string
    farEndEntity:
      type: string
    supportedPerfMetricGroups:
      type: array
      items:
        $ref: '#/components/schemas/SupportedPerfMetricGroup'

TraceJob-Attr:
  type: object
  description: abstract class used as a container of all TraceJob attributes
  properties:
    tjJobType:
      $ref: '#/components/schemas/tjJobType-Type'
    tjListOfInterfaces:
      $ref: '#/components/schemas/tjListOfInterfaces-Type'
    tjListOfNeTypes:
      $ref: '#/components/schemas/tjListOfNeTypes-Type'
    tjPLMNTarget:
      $ref: '#/components/schemas/tjPLMNTarget-Type'
    tjStreamingTraceConsumerURI:
      $ref: 'comDef.yaml#/components/schemas/Uri'
    tjTraceCollectionEntityAddress:
      $ref: '#/components/schemas/IpAddr'
    tjTraceDepth:
      $ref: '#/components/schemas/tjTraceDepth-Type'
    tjTraceReference:
      $ref: '#/components/schemas/tjTraceReference-Type'
    tjTraceRecordSessionReference:
      type: string
    tjTraceReportingFormat:
      $ref: '#/components/schemas/tjTraceReportingFormat-Type'
    tjTraceTarget:
      $ref: '#/components/schemas/tjTraceTarget-Type'
    tjTriggeringEvent:
      $ref: '#/components/schemas/tjTriggeringEvent-Type'
    tjMDTAnonymizationOfData:
      $ref: '#/components/schemas/tjMDTAnonymizationOfData-Type'
    tjMDTAreaConfigurationForNeighCell:
      $ref: '#/components/schemas/AreaConfig'
    tjMDTAreaScope:
      type: array
      items:
        $ref: '#/components/schemas/AreaScope'
    tjMDTCollectionPeriodRrmLte:
      $ref: '#/components/schemas/tjMDTCollectionPeriodRrmLte-Type'
    tjMDTCollectionPeriodM6Lte:
      $ref: '#/components/schemas/tjMDTCollectionPeriodM6Lte-Type'
    tjMDTCollectionPeriodM7Lte:
      $ref: '#/components/schemas/tjMDTCollectionPeriodM7Lte-Type'
    tjMDTCollectionPeriodRrmUmts:
      $ref: '#/components/schemas/tjMDTCollectionPeriodRrmUmts-Type'
    tjMDTCollectionPeriodRrmNR:
      $ref: '#/components/schemas/tjMDTCollectionPeriodRrmNR-Type'
    tjMDTCollectionPeriodM6NR:
      $ref: '#/components/schemas/tjMDTCollectionPeriodM6NR-Type'
    tjMDTCollectionPeriodM7NR:
      $ref: '#/components/schemas/tjMDTCollectionPeriodM7NR-Type'
    tjMDTEventListForTriggeredMeasurement:
      $ref: '#/components/schemas/tjMDTEventListForTriggeredMeasurement-Type'
    tjMDTEventThreshold:
      $ref: '#/components/schemas/tjMDTEventThreshold-Type'
    tjMDTListOfMeasurements:
      $ref: '#/components/schemas/tjMDTListOfMeasurements-Type'
    tjMDTLoggingDuration:
      $ref: '#/components/schemas/tjMDTLoggingDuration-Type'
    tjMDTLoggingInterval:
      $ref: '#/components/schemas/tjMDTLoggingInterval-Type'
    tjMDTLoggingEventThreshold:

```

```

    $ref: '#/components/schemas/tjMDTLoggingEventThreshold-Type'
  tjMDTLoggingHysteresis:
    $ref: '#/components/schemas/tjMDTLoggingHysteresis-Type'
  tjMDTLoggingTimeToTrigger:
    $ref: '#/components/schemas/tjMDTLoggingTimeToTrigger-Type'
  tjMDTMBSFNAreaList:
    type: array
    items:
      $ref: '#/components/schemas/MbsfnArea'
  tjMDTMeasurementPeriodLTE:
    $ref: '#/components/schemas/tjMDTMeasurementPeriodLTE-Type'
  tjMDTMeasurementPeriodUMTS:
    $ref: '#/components/schemas/tjMDTMeasurementPeriodUMTS-Type'
  tjMDTMeasurementQuantity:
    $ref: '#/components/schemas/tjMDTMeasurementQuantity-Type'
  tjMDTM4ThresholdUmts:
    $ref: '#/components/schemas/tjMDTM4ThresholdUmts-Type'
  tjMDTPLMNList:
    $ref: '#/components/schemas/tjMDTPLMNList-Type'
  tjMDTPositioningMethod:
    $ref: '#/components/schemas/tjMDTPositioningMethod-Type'
  tjMDTReportAmount:
    $ref: '#/components/schemas/tjMDTReportAmount-Type'
  tjMDTReportingTrigger:
    $ref: '#/components/schemas/tjMDTReportingTrigger-Type'
  tjMDTReportInterval:
    $ref: '#/components/schemas/tjMDTReportInterval-Type'
  tjMDTReportType:
    $ref: '#/components/schemas/tjMDTReportType-Type'
  tjMDTSensorInformation:
    $ref: '#/components/schemas/tjMDTSensorInformation-Type'
  tjMDTTraceCollectionEntityID:
    $ref: '#/components/schemas/tjMDTTraceCollectionEntityID-Type'

ManagedFunction-nc0:
  type: object
  properties:
    PerfMetricJob:
      $ref: '#/components/schemas/PerfMetricJob-Multiple'
    ThresholdMonitor:
      $ref: '#/components/schemas/ThresholdMonitor-Multiple'
    ManagedNFService:
      $ref: '#/components/schemas/ManagedNFService-Multiple'
    TraceJob:
      $ref: '#/components/schemas/TraceJob-Multiple'

#----- Definition of concrete IOCs -----

VsDataContainer-Single:
  type: object
  properties:
    id:
      type: string
    attributes:
      type: object
      properties:
        vsDataType:
          type: string
        vsDataFormatVersion:
          type: string
        vsData:
          nullable: true
    VsDataContainer:
      $ref: '#/components/schemas/VsDataContainer-Multiple'
ManagedNFService-Single:
  allOf:
    - $ref: '#/components/schemas/Top'
    - type: object
      properties:
        attributes:
          type: object
          properties:
            userLabel:
              type: string
            nFServiceType:
              $ref: '#/components/schemas/NFServiceType'
            SAP:
              $ref: '#/components/schemas/SAP'

```

```

    operations:
      type: array
      items:
        $ref: '#/components/schemas/Operation'
    administrativeState:
      $ref: 'comDefs.yaml#/components/schemas/AdministrativeState'
    operationalState:
      $ref: 'comDefs.yaml#/components/schemas/OperationalState'
    usageState:
      $ref: 'comDefs.yaml#/components/schemas/UsageState'
    registrationState:
      $ref: '#/components/schemas/RegistrationState'
ManagementNode-Single:
  allOf:
    - $ref: '#/components/schemas/Top'
    - type: object
      properties:
        attributes:
          type: object
          properties:
            userLabel:
              type: string
            managedElements:
              $ref: 'comDefs.yaml#/components/schemas/DnList'
            vendorName:
              type: string
            userDefinedState:
              type: string
            locationName:
              type: string
            swVersion:
              type: string
        MnsAgent:
          $ref: '#/components/schemas/MnsAgent-Multiple'
MnsAgent-Single:
  allOf:
    - $ref: '#/components/schemas/Top'
    - type: object
      properties:
        attributes:
          type: object
          properties:
            systemDN:
              $ref: 'comDefs.yaml#/components/schemas/Dn'
MeContext-Single:
  allOf:
    - $ref: '#/components/schemas/Top'
    - type: object
      properties:
        attributes:
          type: object
          properties:
            dnPrefix:
              type: string
PerfMetricJob-Single:
  allOf:
    - $ref: '#/components/schemas/Top'
    - type: object
      properties:
        attributes:
          type: object
          properties:
            administrativeState:
              $ref: 'comDefs.yaml#/components/schemas/AdministrativeState'
            operationalState:
              $ref: 'comDefs.yaml#/components/schemas/OperationalState'
            jobId:
              type: string
            performanceMetrics:
              type: array
              items:
                type: string
            granularityPeriod:
              type: integer
              minimum: 1
            objectInstances:
              $ref: 'comDefs.yaml#/components/schemas/DnList'
            rootObjectInstances:

```

```

        $ref: 'comDefs.yaml#/components/schemas/DnList'
      reportingCtrl:
        $ref: '#/components/schemas/ReportingCtrl'
ThresholdMonitor-Single:
  allOf:
  - $ref: '#/components/schemas/Top'
  - type: object
    properties:
      attributes:
        type: object
        properties:
          administrativeState:
            $ref: 'comDefs.yaml#/components/schemas/AdministrativeState'
          operationalState:
            $ref: 'comDefs.yaml#/components/schemas/OperationalState'
          performanceMetrics:
            type: array
            items:
              type: string
          thresholdInfoList:
            type: array
            items:
              $ref: '#/components/schemas/ThresholdInfo'
          monitorGranularityPeriod:
            type: integer
            minimum: 1
          objectInstances:
            $ref: 'comDefs.yaml#/components/schemas/DnList'
          rootObjectInstances:
            $ref: 'comDefs.yaml#/components/schemas/DnList'
NtfSubscriptionControl-Single:
  allOf:
  - $ref: '#/components/schemas/Top'
  - type: object
    properties:
      attributes:
        type: object
        properties:
          notificationRecipientAddress:
            $ref: 'comDefs.yaml#/components/schemas/Uri'
          notificationTypes:
            type: array
            items:
              $ref: 'comDefs.yaml#/components/schemas/NotificationType'
          scope:
            $ref: '#/components/schemas/Scope'
          notificationFilter:
            $ref: 'comDefs.yaml#/components/schemas/Filter'
      HeartbeatControl:
        $ref: '#/components/schemas/HeartbeatControl-Single'
HeartbeatControl-Single:
  allOf:
  - $ref: '#/components/schemas/Top'
  - type: object
    properties:
      attributes:
        type: object
        properties:
          heartbeatNtfPeriod:
            type: integer
            minimum: 0
          triggerHeartbeatNtf:
            type: boolean
TraceJob-Single:
  allOf:
  - $ref: '#/components/schemas/Top'
  - type: object
    properties:
      attributes:
        $ref: '#/components/schemas/TraceJob-Attr'
AlarmList-Single:
  allOf:
  - $ref: '#/components/schemas/Top'
  - type: object
    properties:
      attributes:
        type: object

```



```

properties:
  administrativeState:
    $ref: 'comDefs.yaml#/components/schemas/AdministrativeState'
  operationalState:
    $ref: 'comDefs.yaml#/components/schemas/OperationalState'
  numOfAlarmRecords:
    type: integer
  lastModification:
    $ref: 'comDefs.yaml#/components/schemas/DateTime'
  alarmRecords:
    description: >-
      This resource represents a map of alarm records.
      The alarmIds are used as keys in the map.
    type: object
  additionalProperties:
    $ref: 'faultMnS.yaml#/components/schemas/AlarmRecord'

```

#----- Definition of YAML arrays for name-contained IOCs -----

```

VsDataContainer-Multiple:
  type: array
  items:
    $ref: '#/components/schemas/VsDataContainer-Single'
ManagedNFService-Multiple:
  type: array
  items:
    $ref: '#/components/schemas/ManagedNFService-Single'
ManagementNode-Multiple:
  type: array
  items:
    $ref: '#/components/schemas/ManagementNode-Single'
MnsAgent-Multiple:
  type: array
  items:
    $ref: '#/components/schemas/MnsAgent-Single'
MeContext-Multiple:
  type: array
  items:
    $ref: '#/components/schemas/MeContext-Single'
PerfMetricJob-Multiple:
  type: array
  items:
    $ref: '#/components/schemas/PerfMetricJob-Single'
ThresholdMonitor-Multiple:
  type: array
  items:
    $ref: '#/components/schemas/ThresholdMonitor-Single'
TraceJob-Multiple:
  type: array
  items:
    $ref: '#/components/schemas/TraceJob-Single'
NtfSubscriptionControl-Multiple:
  type: array
  items:
    $ref: '#/components/schemas/NtfSubscriptionControl-Single'

```

#----- Definitions in TS 28.623 for TS 28.532 -----

```

resources-genericNrm:
  oneOf:
    - $ref: '#/components/schemas/VsDataContainer-Single'
    - $ref: '#/components/schemas/ManagementNode-Single'
    - $ref: '#/components/schemas/MnsAgent-Single'
    - $ref: '#/components/schemas/MeContext-Single'
    - $ref: '#/components/schemas/ManagedNFService-Single'
    - $ref: '#/components/schemas/PerfMetricJob-Single'
    - $ref: '#/components/schemas/ThresholdMonitor-Single'
    - $ref: '#/components/schemas/TraceJob-Single'
    - $ref: '#/components/schemas/NtfSubscriptionControl-Single'
    - $ref: '#/components/schemas/HeartbeatControl-Single'
    - $ref: '#/components/schemas/AlarmList-Single'

```

Annex D (normative): YANG definitions

D.1 General

This annex contains the YANG definitions for the Generic NRM.

D.2 Modules

D.2.1 module _3gpp-common-ep-rp.yang

```

module _3gpp-common-ep-rp {
  yang-version 1.1;
  namespace "urn:3gpp:sa5:_3gpp-common-ep-rp";
  prefix "eprp3gpp";

  import _3gpp-common-yang-types { prefix types3gpp ; }
  import ietf-inet-types { prefix inet; }
  import _3gpp-common-measurements { prefix meas3gpp; }

  organization "3GPP SA5";
  contact "https://www.3gpp.org/DynaReport/TSG-WG--S5--officials.htm?Itemid=464";
  description "Common/basic class/grouping to be inherited/reused.
  This IOC represents an end point of a link used across a reference
  point between two network entities.";
  reference
    "3GPP TS 28.622
    Generic Network Resource Model (NRM)
    Integration Reference Point (IRP);
    Information Service (IS)

    3GPP TS 28.620
    Umbrella Information Model (UIM)";

  revision 2020-06-08 { reference "CR-0092"; }

  revision 2019-06-17 {
    description "Initial revision";
  }

  grouping EP_RPGrp {
    description "Abstract class, 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.";

    leaf userLabel {
      type string;
      description "A user-friendly (and user assignable) name of this object.";
    }

    leaf farEndEntity {
      config false;
      type types3gpp:DistinguishedName;
    }
  }

  grouping EP_Common {
    uses EP_RPGrp;
    uses meas3gpp:SupportedPerfMetricGroupGrp;
    list localAddress {
      description "Local IP address and VLAN ID.";
      key "ipAddress vlanId";
    }
  }
}

```

```

    min-elements 1;
    max-elements 1;
    uses types3gpp:AddressWithVlan;
  }

  leaf remoteAddress {
    description "Remote IP address.";
    mandatory true;
    type inet:ip-address;
  }
}
}

```

D.2.2 module _3gpp-common-managed-element.yang

```

<CODE BEGINS>
module _3gpp-common-managed-element {
  yang-version 1.1;
  namespace urn:3gpp:sa5:_3gpp-common-managed-element;
  prefix "me3gpp";

  import _3gpp-common-yang-types { prefix types3gpp ; }
  import _3gpp-common-top { prefix top3gpp; }
  import _3gpp-common-measurements { prefix meas3gpp; }
  import _3gpp-common-subscription-control { prefix subscr3gpp; }
  import _3gpp-common-fm { prefix fm3gpp; }
  import _3gpp-common-trace { prefix trace3gpp; }

  organization "3GPP SA5";
  contact "https://www.3gpp.org/DynaReport/TSG-WG--S5--officials.htm?Itemid=464";

  description "Defines ManagedElement which will be augmented
    by other IOCs";
  reference "3GPP TS 28.623
    Generic Network Resource Model (NRM)
    Integration Reference Point (IRP);
    Solution Set (SS) definitions

    3GPP TS 28.622
    Generic Network Resource Model (NRM)
    Integration Reference Point (IRP);
    Information Service (IS)

    3GPP TS 28.620
    Umbrella Information Model (UIM)";

  revision 2021-01-16 { reference "CR-0120"; }
  revision 2020-08-06 { reference "CR-0102"; }
  revision 2020-08-03 { reference "CR-0095"; }
  revision 2020-06-08 { reference "CR-0092"; }
  revision 2020-05-12 { reference "CR0084"; }
  revision 2020-02-24 { reference "S5-201365"; }
  revision 2019-06-17 { reference " S5-203316"; }
  revision 2019-05-08 { reference "Initial revision"; }

  feature MeasurementsUnderManagedElement {
    description "The MeasurementSubtree shall be contained under
      ManagedElement";
  }

  feature SubscriptionControlUnderManagedElement {
    description "The SubscriptionControlSubtree shall be contained under
      ManagedElement";
  }

  feature FmUnderManagedElement {
    description "The FmSubtree shall be contained under ManagedElement";
  }

  feature TraceUnderManagedElement {
    description "The TraceSubtree shall be contained under ManageElement";
  }

  feature DESManagementFunction {
    description "Class representing Distributed SON or Domain-Centralized SON
      Energy Saving feature. The DESManagementFunction shall be contained under

```

```

    ManagedElement.";
}

feature DMROFunction {
    description "Class representing D-SON function of MRO feature. The
    DMROFunction shall be contained under ManagedElement.";
}

feature DRACHOptimizationFunction {
    description "Class representing D-SON function of RACH optimization
    feature. The DRACHOptimizationFunction shall be contained under
    ManagedElement.";
}

feature DPCICongfigurationFunction {
    description "Class representing Distributed SON or Domain-Centralized SON
    function of PCI configuration feature. The DPCICongfigurationFunction shall
    be contained under ManagedElement.";
}

feature CPCICongfigurationFunction {
    description "Class representing Cross Domain-Centralized SON function of PCI
    configuration feature. The CPCICongfigurationFunction shall be contained
    under ManagedElement.";
}

feature CESManagementFunction {
    description "Class representing Cross Domain-Centralized SON Energy Saving
    feature. The CESManagementFunction shall be contained under
    ManagedElement.";
}

grouping ManagedElement_Grp {
    description "Abstract class representing telecommunications resources.
    An ME communicates with a manager (directly or indirectly) for the
    purpose of being monitored and/or controlled. MEs may perform element
    management functionality.
    An ME (and its contained Function_(s)) may or may not be geographically
    distributed. An ME (and its contained Function_(s)) is often referred
    to as a Network Element";

    leaf dnPrefix {
        description "Provides naming context that allows the Managed
        Elements to be partitioned into logical domains.
        A Distinguished Name(DN) is defined by 3GPP TS 32.300,
        which splits the DN into a DN Prefix and Local DN";
        type types3gpp:DistinguishedName;
    }

    leaf userLabel {
        description "A user-friendly (and user assignable) name of this object.";
        type string;
    }

    leaf locationName {
        description "The physical location (e.g. an address) of an entity
        represented by a (derivative of) ManagedElement_. It may contain no
        information to support the case where the derivative of
        ManagedElement_ needs to represent a distributed multi-location NE.";
        config false;
        type string;
    }

    leaf-list managedBy {
        description "Relates to the role played by ManagementSystem_ in the
        between ManagedSystem_ and ManagedElement_. This attribute contains
        a list of the DN(s) of the related subclasses of
        ManagementSystem_ instance(s).";

        config false;
        type types3gpp:DistinguishedName;
    }

    leaf-list managedElementTypeList {
        description "The type of functionality provided by the ManagedElement.
        It may represent one ME functionality or a combination of
        more than one functionality.
        1) The allowed values of this attribute are the names of the IOC(s)

```

- that are (a) derived/subclassed from ManagedFunction and (b) directly name-contained by ManagedElement IOC (on the first level below ManagedElement), but with the string 'Function' excluded.
- 2) If a ManagedElement contains multiple instances of a ManagedFunction this attribute will not contain repeated values.
 - 3) The capitalisation (usage of upper/lower case) of characters in this attribute is insignificant. Thus, the NodeB should be case insensitive when reading these values.
 - 4) Two examples of allowed values are:
 - NodeB;
 - HLR, VLR."

```

    config false;
    min-elements 1;
    type string;
  }
}

grouping ManagedElementGrp {
  description "Represents telecommunications equipment or
    TMN entities within the telecommunications network providing support
    and/or service to the subscriber.";

  uses ManagedElement_Grp;
  uses meas3gpp:SupportedPerfMetricGroupGrp;

  leaf vendorName {
    config false;
    type string;
  }

  leaf userDefinedState {
    type string;
    description "An operator defined state for operator specific usage";
  }

  leaf swVersion {
    config false;
    type string;
  }

  leaf priorityLabel {
    type uint32;
    mandatory true;
  }
}

list ManagedElement {
  description "Represents telecommunications equipment or TMN entities within
    the telecommunications network providing support and/or service to the
    subscriber. An ManagedElement IOC is used to represent a Network Element
    defined in TS 32.101 including virtualization or non-virtualization
    scenario. An ManagedElement 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.
    An 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 following two case:
    - In the case when the software component is designed to run on dedicated
      hardware component, the ManagedElement IOC description includes both
      software and hardware components.
    - 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 single 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 functionality. For example, a
      ManagedElement is used to represent the 3GPP defined RNC node;

```

- A ManagedElement instance 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 gNBCUCPFuntion, gNBCUUPFunction and gNBDFuntion";

```

key id;
uses top3gpp:Top_Grp;
container attributes {
  uses ManagedElementGrp;
}

uses meas3gpp:MeasurementSubtree {
  if-feature MeasurementsUnderManagedElement;
}

uses subscr3gpp:SubscriptionControlSubtree {
  if-feature SubscriptionControlUnderManagedElement;
}

uses fm3gpp:FmSubtree {
  if-feature FmUnderManagedElement;
}

uses trace3gpp:TraceSubtree {
  if-feature TraceUnderManagedElement;
}
}
}
<CODE ENDS>

```

D.2.3 module _3gpp-common-managed-function.yang

```

<CODE BEGINS>
module _3gpp-common-managed-function {
  yang-version 1.1;
  namespace urn:3gpp:sa5:_3gpp-common-managed-function;
  prefix mf3gpp;

  import _3gpp-common-yang-types { prefix types3gpp; }
  import _3gpp-common-top { prefix top3gpp; }
  import _3gpp-common-measurements { prefix meas3gpp; }
  import _3gpp-common-trace { prefix trace3gpp; }

  organization "3GPP SA5";
  contact "https://www.3gpp.org/DynaReport/TSG-WG--S5--officials.htm?Itemid=464";
  description "The module defines a base class/grouping for major 3GPP
  functions.";
  reference
    "3GPP TS 28.622
    Generic Network Resource Model (NRM)
    Integration Reference Point (IRP);
    Information Service (IS)

    3GPP TS 28.620
    Umbrella Information Model (UIM)";

  revision 2021-01-25 { reference "CR-0122"; }
  revision 2020-09-30 { reference "CR-bbbb"; }
  revision 2020-08-06 { reference "CR-0102"; }
  revision 2020-08-03 { reference "CR-0095"; }
  revision 2020-06-23 { reference "CR-085"; }
  revision 2020-06-08 { reference "CR-0092"; }
  revision 2019-11-21 { reference "S5-197275, S5-197735"; }
  revision 2019-10-28 { reference S5-193518 ; }
  revision 2019-06-18 { reference "Initial revision"; }

  feature MeasurementsUnderManagedFunction {
    description "The MeasurementSubtree shall be contained under ManageElement";
  }

  feature TraceUnderManagedFunction {
    description "The TraceSubtree shall be contained under ManagedFunction";
  }
}

```

```
grouping Operation {
  description "This data type represents an Operation.";
  reference "3gpp TS 28.622";

  leaf name {
    type string;
    mandatory true;
  }

  leaf-list allowedNFTypes {
    type string;
    min-elements 1;
    description "The type of the managed NF service instance
      The specific values allowed are described in TS 23.501";
  }

  leaf operationSemantics {
    type enumeration {
      enum REQUEST_RESPONSE;
      enum SUBSCRIBE_NOTIFY;
    }
    config false;
    mandatory true;
    description "Semantics type of the operation.";
    reference "3GPP TS 23.502";
  }
}

grouping ManagedNFServiceGrp {
  description "A ManagedNFService represents a Network Function (NF) service.";
  reference "Clause 7 of 3GPP TS 23.501.";

  leaf userLabel {
    type string;
    description "A user-friendly (and user assignable) name of this object.";
  }

  leaf nFServiceType {
    config false;
    mandatory true;
    type string;
    description "The type of the managed NF service instance
      The specific values allowed are described in clause 7.2 of TS 23.501";
  }

  list sAP {
    key "host port";
    min-elements 1;
    max-elements 1;
    description "The service access point of the managed NF service instance";
    uses types3gpp:SAP;
  }

  list operations {
    key name;
    min-elements 1;
    uses Operation ;
    description "Set of operations supported by the managed NF
      service instance";
  }

  leaf administrativeState {
    type types3gpp:AdministrativeState;
    mandatory true;
    description "Permission to use or prohibition against using the instance";
  }

  leaf operationalState {
    type types3gpp:OperationalState;
    config false;
    mandatory true;
    description "Describes whether the resource is installed and working";
  }

  leaf usageState {
    type types3gpp:usageState ;
  }
}
```

```

    config false;
    mandatory true;
    description "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.";
}

leaf registrationState {
    type enumeration {
        enum REGISTERED;
        enum DEREGISTERED;
    }
    config false;
}
}

grouping Function_Grp {
    description "A base grouping for 3GPP functions.";

    leaf userLabel {
        type string;
        description "A user-friendly (and user assignable) name of this object.";
    }
}

grouping ManagedFunctionGrp {
    description "Abstract root class to be inherited/reused by classes
        representing 3GPP functions.

    Anywhere this grouping is used by classes inheriting from ManagedFunction
    the list representing the inheriting class needs to include all
    contained classes of ManagedFunction too. Contained classes are
    either
    - augmented into the Function class or
    - shall be included in the list representing the inheriting class
    using the grouping ManagedFunctionContainedClasses:
        1) EP_RP solved using augment
        2) uses mf3gpp:ManagedFunctionContainedClasses;
    ";

    uses Function_Grp;

    list vnfParametersList {
        key vnfInstanceId;
        description "Contains the parameter set of the VNF
            instance(s) corresponding to an NE.
            The presence of this list indicates that the ManagedFunction
            represented is realized by one or more VNF instance(s). Otherwise it
            shall be absent.
            The presence of a vnfParametersList entry, whose vnfInstanceId with a
            string length of zero, in createMO operation can trigger the
            instantiation of the related VNF/VNFC instances.";

        leaf vnfInstanceId {
            type string ;
            description "VNF instance identifier";
            reference "ETSI GS NFV-IFA 008 v2.1.1:
                Network Functions Virtualisation (NFV); Management and Orchestration;
                Ve-Vnfm reference point - Interface and Information Model Specification
                section 9.4.2

                ETSI GS NFV-IFA 015 v2.1.2: Network Functions Virtualisation (NFV);
                Management and Orchestration; Report on NFV Information Model
                section B2.4.2.1.2.3";
        }

        leaf vnfdId {
            type string ;
            description "Identifier of the VNFD on which the VNF instance is based.
                The absence of the leaf or a string length of zero for vnfInstanceId
                means the VNF instance(s) does not exist (e.g. has not been
                instantiated yet, has already been terminated).";
            reference "ETSI GS NFV-IFA 008 v2.1.1:
                Network Functions Virtualisation (NFV); Management and Orchestration;
                Ve-Vnfm reference point - Interface and Information Model Specification
                section 9.4.2";
        }
    }
}

```



```
leaf flavourId {
  type string ;
  description "Identifier of the VNF Deployment Flavour applied to this
  VNF instance.";
  reference "ETSI GS NFV-IFA 008 v2.1.1:
  Network Functions Virtualisation (NFV) Management and Orchestration";
}

leaf autoScalable {
  type boolean ;
  mandatory true;
  description "Indicator of whether the auto-scaling of this
  VNF instance is enabled or disabled.";
}
}

list peeParametersList {
  key idx;
  description "Contains the parameter set for the control
  and monitoring of power, energy and environmental parameters of
  ManagedFunction instance(s).";

  leaf idx { type uint32; }

  leaf siteIdentification {
    type string;
    mandatory true;
    description "The identification of the site where the
    ManagedFunction resides.";
  }

  leaf siteLatitude {
    type decimal64 {
      fraction-digits 4;
      range "-90.0000..+90.0000";
    }
    description "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).";
  }

  leaf siteLongitude {
    type decimal64 {
      fraction-digits 4;
      range "-180.0000..+180.0000";
    }
    description "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).";
  }

  leaf siteDescription {
    type string;
    mandatory true;
    description "An operator defined description of the site where
    the ManagedFunction instance resides.";
  }

  leaf equipmentType {
    type string;
    mandatory true;
    description "The type of equipment where the managedFunction
    instance resides.";
    reference "clause 4.4.1 of ETSI ES 202 336-12";
  }

  leaf environmentType {
    type string;
    mandatory true;
    description "The type of environment where the managedFunction
    instance resides.";
    reference "clause 4.4.1 of ETSI ES 202 336-12";
  }
}
```

```

    leaf powerInterface {
      type string;
      mandatory true;
      description "The type of power.";
      reference "clause 4.4.1 of ETSI ES 202 336-12";
    }
  }

  leaf priorityLabel {
    mandatory true;
    type uint32;
  }
  uses meas3gpp:SupportedPerfMetricGroupGrp;
}

grouping ManagedFunctionContainedClasses {
  description "A grouping used to contain classes (lists) contained by
  the abstract IOC ManagedFunction";
  list ManagedNFService {
    description "Represents a Network Function (NF)";
    reference "3GPP TS 23.501";
    key id;
    uses top3gpp:Top_Grp;
    container attributes {
      uses ManagedNFServiceGrp;
    }
  }

  uses meas3gpp:MeasurementSubtree {
    if-feature MeasurementsUnderManagedFunction ;
  }

  uses trace3gpp:TraceSubtree {
    if-feature TraceUnderManagedFunction ;
  }
}
}
}
<CODE ENDS>

```

D.2.4 module _3gpp-common-measurements.yang

```

<CODE BEGINS>
module _3gpp-common-measurements {
  yang-version 1.1;
  namespace "urn:3gpp:sa5:_3gpp-common-measurements";
  prefix "meas3gpp";

  import _3gpp-common-top { prefix top3gpp; }
  import _3gpp-common-yang-types { prefix types3gpp; }

  organization "3GPP SA5";
  contact "https://www.3gpp.org/DynaReport/TSG-WG--S5--officials.htm?Itemid=464";

  description "Defines Measurement and KPI related groupings
  Any list/class intending to use this should include 2 or 3 uses statements
  controlled by a feature:

  A)
  +++   feature MeasurementsUnderMyClass {
  +++     description 'Indicates whether measurements and/or KPIs are supported
  +++       for this class.';
  +++   }

  B) include the attribute measurementsList and/or kPIsList indicating the
  supported measurement and KPI types and GPs. Note that for classes
  inheriting from ManagedFunction, EP_RP or SubNetwork these attributes are
  already inherited, so there is no need to include them once more. E.g.

  +++   grouping MyClassGrp {
  +++     uses meas3gpp:SupportedPerfMetricGroup;
  +++   }

  C) include the class PerfmetricJob to control the measurements/KPIs. E.g.

  list MyClass {

```

```

        container attributes {
            uses MyClassGrp;
        }
+++     uses meas3gpp:MeasurementSubtree {
+++         if-feature MeasurementsUnderMyClass ;
+++     }
    }

```

Measurements can be contained under ManagedElement, SubNetwork, or any list representing a class inheriting from Subnetwork or ManagedFunction. Note: KPIs will only be supported under SubNetwork";

reference "3GPP TS 28.623

```

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

```

3GPP TS 28.622

```

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

```

```

revision 2021-07-22 { reference "CR-0137"; }
revision 2020-11-06 { reference "CR-0118"; }
revision 2020-09-04 { reference "CR-000107"; }
revision 2020-06-08 { reference "CR-0092"; }
revision 2020-05-31 { reference "CR-0084"; }
revision 2020-03-11 { reference "S5-201581, SP-200229"; }
revision 2019-11-21 { reference "S5-197275, S5-197735"; }
revision 2019-10-28 { reference "S5-193516"; }
revision 2019-06-17 { reference " "; }

```

grouping ThresholdInfoGrp {

```

description "Defines a single threshold level.";

```

leaf-list measurementTypes {

```

type string;

```

```

description "The Measurement type can be those specified in TS 28.552,
TS 32.404 and can be those specified by other SDOs or can be
vendor-specific.";
}

```

leaf thresholdLevel {

```

type uint64;

```

```

mandatory true;

```

```

description "Number (key) for a single threshold in the threshold list
applicable to the monitored performance metric.";
}

```

leaf thresholdDirection {

```

type enumeration {

```

```

enum UP;

```

```

enum DOWN;

```

```

enum UP_AND_DOWN;
}

```

```

must '. = "UP_AND_DOWN" or not(..hysteresis)' {

```

```

error-message "In case a threshold with hysteresis is configured, the "
+"threshold direction attribute shall be set to 'UP_AND_DOWN'.";
}

```

```

mandatory true;

```

```

description "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'.";
}

leaf thresholdValue {
  type union {
    type int64;
    type decimal64 {
      fraction-digits 2;
    }
  }
  mandatory true;
  description "Value against which the monitored performance metric is
  compared at a threshold level in case the hysteresis is zero";
}

leaf hysteresis {
  type union {
    type uint64;
    type decimal64 {
      fraction-digits 2;
      range "0..max";
    }
  }
  description "Hysteresis of a threshold. If this attribute is present
  the monitored performance metric is not compared against the
  threshold value as specified by the thresholdValue attribute but
  against a high and low threshold value given by

      threshold-high = thresholdValue + hysteresis
      threshold-low = thresholdValue - hysteresis

  When going up, the threshold is triggered when the performance metric
  reaches or crosses the high threshold value. When going down, the
  hreshold 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.";
}

grouping SupportedPerfMetricGroupGrp {
  list SupportedPerfMetricGroup {
    config false;
    description "Captures a group of supported performance metrics and
    associated parameters related to their production and reporting.
    A SupportedPerfMetricGroup attribute which is part of an MOI may
    define performanceMetrics for any MOI under the subtree contained
    under that MOI, e.g. SupportedPerfMetricGroup on a ManagedElement
    can specify supported metrics for contained ManagedFunctions
    like a GNBDFunction.";

    leaf-list performanceMetrics {
      type string;
      min-elements 1;
      description "Performance metrics include measurements defined in
      TS 28.552 and KPIs defined in TS 28.554. Performance metrics can
      also be specified by other SDOs or be vendor specific.
      Performance metrics are identified with their names.

      For measurements defined in TS 28.552 the name is constructed as
      follows:
      - '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 the name is defined in the KPI
      definitions template as the component designated with e).

      A name can also identify a vendor specific performance metric or a
      group of vendor specific performance metrics.";
    }

    leaf-list granularityPeriods {
      type uint32 {

```

```

        range 1..max ;
    }
    units seconds;
}

leaf-list reportingMethods {
    type enumeration {
        enum FILE_BASED_LOC_SET_BY_PRODUCER;
        enum FILE_BASED_LOC_SET_BY_CONSUMER;
        enum STREAM_BASED;
    }
    min-elements 1;
}

leaf-list monitorGranularityPeriods {
    type uint32 {
        range 1..max ;
    }
    units seconds;
    description "Granularity periods supported for the monitoring of
        associated measurement types for thresholds";
}
}
}

grouping PerfMetricJobGrp {
    description "Represents the attributes of the IOC PerfMetricJob";

    leaf administrativeState {
        default UNLOCKED;
        type types3gpp:AdministrativeState ;
        description "Enable or disables production of the metrics";
    }

    leaf operationalState {
        config false;
        mandatory true;
        type types3gpp:OperationalState ;
        description "Indicates whether the PerfMetricJob is working.";
    }

    leaf jobId {
        type string;
        description "Id for a PerfMetricJob job.";
    }

    leaf-list performanceMetrics {
        type string;
        min-elements 1;
        description "Performance metrics include measurements defined in
            TS 28.552 and KPIs defined in TS 28.554. 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 the name is constructed as
            follows:
            - '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 the name is defined in the KPI
            definitions template as the component designated with e).";
    }

    leaf granularityPeriod {
        type uint32 {
            range 1..max ;
        }
        units seconds;
        mandatory true;
        description "Granularity period used to produce measurements. The value
            must be one of the supported granularity periods for the metric.";
    }

    leaf-list objectInstances {
        type types3gpp:DistinguishedName;
    }
}

```

```

}

leaf-list rootObjectInstances {
  type types3gpp:DistinguishedName;
  description "Each object instance designates the root of a subtree that
  contains the root object and all descendant objects.";
}

choice reportingCtrl {
  mandatory true;
  description "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.";

  case file-based-reporting {
    leaf fileReportingPeriod {
      type uint32 {
        range 1..max;
      }
      units minutes;
      must '(number(..)*"60") mod number(../granularityPeriod) = "0"' {
        error-message
          "The time-period must be a multiple of the granularityPeriod.";
      }
      mandatory true;
      description "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 time-period must be a multiple of the granularityPeriod.

      Applicable when the file-based reporting method is supported";
    }

    leaf fileLocation {
      type string ;
      description "Applicable and must be present when the file-based
      reporting method is supported, and the files are stored on the MnS
      consumer.";
    }
  }

  case stream-based-reporting {
    leaf streamTarget {
      type string;
      mandatory true;
      description "Applicable when stream-based reporting method is
      supported.";
    }
  }
}

grouping ThresholdMonitorGrp {
  description "A threshold monitor that is created by the consumer for
  the monitored entities whose measurements are required by consumer
  to monitor.";

  leaf administrativeState {
    default UNLOCKED;
    type types3gpp:AdministrativeState ;
    description "Enables or disables the ThresholdMonitor.";
  }
}

```

```

}

leaf operationalState {
  config false;
  mandatory true;
  type types3gpp:OperationalState ;
  description "Indicates whether the ThresholdMonitor is working.";
}

list thresholdInfoList {
  key idx;
  min-elements 1;
  leaf idx { type uint32 ; }
  uses ThresholdInfoGrp;
}

leaf monitorGranularityPeriod {
  type uint32 {
    range "1..max";
  }
  units second;
  mandatory true;
  description " Granularity period used to monitor measurements for
  threshold crossings. ";
}

leaf-list objectInstances {
  type types3gpp:DistinguishedName;
}

leaf-list rootObjectInstances {
  type types3gpp:DistinguishedName;
  description "Each object instance designates the root of a subtree that
  contains the root object and all descendant objects.";
}
}

grouping MeasurementSubtree {
  description "Contains classes that define measurements.
  Should be used in all classes (or classes inheriting from)
  - SubNnetwork
  - ManagedElement
  - ManagedFunction

  If a YANG module wants to augment these classes/list/groupings they must
  augment all user classes!

  If a class uses this grouping in its list it shall also use the
  grouping SupportedPerfMetricGroupGrp to add SupportedPerfMetricGroup as
  an attribute to its grouping";
}

list PerfMetricJob {
  description "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 back 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 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.

For file-based reporting, all performance metrics that are produced related to a 'PerfMetricJob' instance for a reporting period shall be stored in a single reporting file.

When the administrative state is set to 'UNLOCKED' after the creation of a 'PerfMetricJob' the first granularity period shall start. When the administrative state is set to 'LOCKED' or the operational state to 'DISABLED', the ongoing reporting period shall be aborted, for streaming the ongoing granularity period. When the administrative state is set back to 'UNLOCKED' or the operational state to 'ENABLED' a new reporting period shall start, in case of streaming a new granularity period.

Changes of all other configurable attributes shall take effect only at the beginning of the next reporting period, for streaming at the beginning of the next granularity period.

When the 'PerfMetricJob' is deleted, the ongoing reporting period shall be aborted, for streaming the ongoing granularity period.

A PerfMetricJob creation request shall fail, when 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.";

```
key id;
uses top3gpp:Top_Grp ;
container attributes {
  uses PerfMetricJobGrp ;
}
}
```

```
list ThresholdMonitor {
  key id;
  description "Represents a threshold monitor for performance metrics.
  It can be 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 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.

Each threshold is identified with a number (key) called thresholdLevel. 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."

```

uses top3gpp:Top_Grp ;
container attributes {
  uses ThresholdMonitorGrp ;
}
}
}
}
}
<CODE ENDS>

```

D.2.5 module _3gpp-common-subnetwork.yang

```

<CODE BEGINS>
module _3gpp-common-subnetwork {
  yang-version 1.1;
  namespace "urn:3gpp:sa5:_3gpp-common-subnetwork";
  prefix "subnet3gpp";

  import _3gpp-common-yang-types { prefix types3gpp; }
  import _3gpp-common-top { prefix top3gpp; }
  import _3gpp-common-measurements { prefix meas3gpp; }
  import _3gpp-common-subscription-control { prefix subscr3gpp; }
}

```

```
import _3gpp-common-fm { prefix fm3gpp; }
import _3gpp-common-trace { prefix trace3gpp; }
import ietf-yang-schema-mount { prefix yangmnt; }

organization "3GPP SA5";
contact "https://www.3gpp.org/DynaReport/TSG-WG--S5--officials.htm?Itemid=464";

description "Defines basic SubNetwork which will be augmented by other IOCs";
reference "3GPP TS 28.623
  Generic Network Resource Model (NRM)
  Integration Reference Point (IRP);
  Solution Set (SS) definitions

  3GPP TS 28.622
  Generic Network Resource Model (NRM)
  Integration Reference Point (IRP);
  Information Service (IS)

  3GPP TS 28.620
  Umbrella Information Model (UIM)";

revision 2021-01-16 { reference "CR-0120"; }
revision 2020-08-06 { reference "CR-0102"; }
revision 2020-06-08 { reference "CR-0092"; }
revision 2020-05-08 {
  reference "S5-203316";
}

revision 2020-03-11 {
  description "Added KPIs and corrections";
  reference "S5-201365, S5-201581, SP-200229";
}

revision 2020-02-24 {
  reference "S5-201365";
}

revision 2019-06-17 {
  reference "Initial revision";
}

feature ExternalsUnderSubNetwork {
  description "Classes representing external entities like EUTranFrequency,
  ExternalGNBCUCPFunction, ExternalENBFunction
  are contained under a Subnetwork list/class.";
}

feature MeasurementsUnderSubNetwork {
  description "The MeasurementSubtree shall be contained under SubNetwork";
}

feature SubscriptionControlUnderSubNetwork {
  description "The SubscriptionControlSubtree shall be contained under
  SubNetwork";
}

feature FmUnderSubNetwork {
  description "The FmSubtree shall be contained under SubNetwork";
}

feature TraceUnderSubNetwork {
  description "The TraceSubtree shall be contained under SubNetwork";
}

feature DESManagementFunction {
  description "Class representing Distributed SON or Domain-Centralized SON
  Energy Saving feature. The DESManagementFunction shall be contained under
  SubNetwork.";
}

feature DMROFunction {
  description "Class representing D-SON function of MRO feature. The
  DMROFunction shall be contained under SubNetwork.";
}

feature DRACHOptimizationFunction {
  description "Class representing D-SON function of RACH optimization feature.
```

```

    The DRACHOptimizationFunction shall be contained under SubNetwork.";
}

feature DPCICongfigurationFunction {
    description "Class representing Distributed SON or Domain-Centralized SON
        function of PCI configuration feature. The DPCICongfigurationFunction shall
        be contained under SubNetwork.";
}

feature CPCICongfigurationFunction {
    description "Class representing Cross Domain-Centralized SON function of PCI
        configuration feature. The CPCICongfigurationFunction shall be contained
        under SubNetwork.";
}

feature CESManagementFunction {
    description "Class representing Cross Domain-Centralized SON Energy Saving
        feature. The CESManagementFunction shall be contained under SubNetwork.";
}

grouping Domain_Grp {
    description "A domain is a partition of instances of managed entities
        such that :
        - the group represents a topological structure which describes the
        potential for connectivity
        - Subject to common administration
        - With common characteristics";

    leaf dnPrefix {
        type types3gpp:DistinguishedName;
        reference "Annex C of 32.300 ";
    }

    leaf userLabel {
        type string;
        description "A user-friendly (and user assignable) name of this object.";
    }

    leaf userDefinedNetworkType {
        type string;
        description "Textual information indicating network type, e.g. 'UTRAN'.";
    }
}

grouping SubNetworkGrp {
    uses Domain_Grp;
    uses meas3gpp:SupportedPerfMetricGroupGrp;

    leaf-list setOfMcc {
        description "Set of Mobile Country Code (MCC).
            The MCC uniquely identifies the country of domicile
            of the mobile subscriber. MCC is part of the IMSI (3GPP TS 23.003)

            This list contains all the MCC values in subordinate object
            instances to this SubNetwork instance.

            See clause 2.3 of 3GPP TS 23.003 for MCC allocation principles.

            It shall be supported if there is more than one value in setOfMcc
            of the SubNetwork. Otherwise the support is optional.";
        type types3gpp:Mcc;
    }

    leaf priorityLabel {
        mandatory true;
        type uint32;
    }
}

list SubNetwork {
    key id;
    description "Represents a set of managed entities";

    uses top3gpp:Top_Grp;
    container attributes {
        uses SubNetworkGrp;
    }
}

```

```

leaf-list parents {
  description "Reference to all containg SubNetwork instances
in strict order from the root subnetwork down to the immediate
parent subnetwork.
If subnetworks form a containment hierarchy this is
modeled using references between the child SubNetwork and the parent
SubNetworks.
This reference MUST NOT be present for the top level SubNetwork and
MUST be present for other SubNetworks.";
  type leafref {
    path "../.././SubNetwork/id";
  }
}

leaf-list containedChildren{
  description "Reference to all directly contained SubNetwork instances.
If subnetworks form a containment hierarchy this is
modeled using references between the child SubNetwork and the parent
SubNetwork.";
  type leafref {
    path "../.././SubNetwork/id";
  }
}

uses meas3gpp:MeasurementSubtree {
  if-feature MeasurementsUnderSubNetwork;
}

uses subscr3gpp:SubscriptionControlSubtree {
  if-feature SubscriptionControlUnderSubNetwork;
}

uses fm3gpp:FmSubtree {
  if-feature FmUnderSubNetwork;
}

uses trace3gpp:TraceSubtree {
  if-feature TraceUnderSubNetwork;
}

yangmnt:mount-point children-of-SubNetwork {
  description "Mountpoint for ManagedElement";
  reference "RFC8528 YANG Schema Mount";
}

// augment external parts here
}
}
<CODE ENDS>

```

D.2.6 module _3gpp-common-top@2019-06-17.yang

```

module _3gpp-common-top {
  yang-version 1.1;

  namespace urn:3gpp:sa5:_3gpp-common-top;
  prefix top3gpp;

  organization "3gpp SA5";
  description "The model defines a YANG mapping of the top level
information classes used for management of 5G networks and
network slicing.";
  reference
    "3GPP TS 28.622
Generic Network Resource Model (NRM)
Integration Reference Point (IRP);
Information Service (IS)

3GPP TS 28.620
Umbrella Information Model (UIM)";

  revision 2019-06-17 {
    description "Initial revision";
  }

  grouping Top_Grp {

```

```

description "Abstract class supplying a naming attribute";
reference "3GPP TS 28.620";

leaf id {
  type string;
  description "Key leaf (namingAttribute) for a class/list.
  Should be used as a key leaf for lists representing
  stage 2 classes.";
  reference "3GPP TS 32.300 Name convention for managed objects";
}
}
}

```

D.2.6a module _3gpp-common-subscription-control.yang

```

<CODE BEGINS>
module _3gpp-common-subscription-control {
  yang-version 1.1;
  namespace "urn:3gpp:sa5:_3gpp-common-subscription-control";
  prefix "subscr3gpp";

  import _3gpp-common-top { prefix top3gpp; }

  organization "3GPP SA5";
  contact "https://www.3gpp.org/DynaReport/TSG-WG--S5--officials.htm?Itemid=464";

  description "Defines IOCs for subscription and heartbeat control.";
  reference "3GPP TS 28.623
  Generic Network Resource Model (NRM)
  Integration Reference Point (IRP);
  Solution Set (SS) definitions
  3GPP TS 28.623";

  revision 2021-01-16 { reference "CR-0120"; }
  revision 2020-08-26 { reference "CR-0106"; }
  revision 2019-11-29 { reference "S5-197648 S5-197647 S5-197829 S5-197828"; }

  grouping NtfSubscriptionControlGrp {
    description "Attributes of a specific notification subscription";

    leaf notificationRecipientAddress {
      type string;
      mandatory true;
    }

    leaf-list notificationTypes {
      type string;
      description "Defines the types of notifications that are candidates
      for being forwarded to the notification recipient.
      If the notificationFilter attribute is not supported or not present
      all candidate notifications types are forwarded to the notification;
      discriminated by notificationFilter attribute.";
    }

    list scope {
      key "scopeType";
      min-elements 1;
      max-elements 1;
      description "Describes which object instances are selected with
      respect to a base object instance.";

      leaf scopeType {
        type enumeration {
          enum BASE_ONLY;
          enum BASE_ALL;
          enum BASE_NTH_LEVEL;
          enum BASE_SUBTREE;
        }
      }
      description "If the optional scopeLevel parameter is not supported
      or absent, allowed values of scopeType are BASE_ONLY and BASE_ALL.

      The value BASE_ONLY indicates only the base object is selected.
      The value BASE_ALL indicates the base object and all of its
      subordinate objects (incl. the leaf objects) are selected.

      If the scopeLevel parameter is supported and present, allowed

```

```

values of scopeType are BASE_ALL, BASE_ONLY, BASE_NTH_LEVEL
and BASE_SUBTREE.

The value BASE_NTH_LEVEL indicates all objects on the level,
which is specified by the scopeLevel parameter, below the base
object are selected. The base object is at scopeLevel zero.
The value BASE_SUBTREE indicates the base object and all of its
subordinate objects down to and including the objects on the level,
which is specified by the scopeLevel parameter, are selected.
The base object is at scopeLevel zero.";
}

leaf scopeLevel {
  when '../scopeType = "BASE_NTH_LEVEL" or ../scopeType = "BASE_SUBTREE"';
  type uint16;
  mandatory true;
  description "See description of scopeType.";
}

leaf notificationFilter {
  type string;
  description "Defines a filter to be applied to candidate notifications
  identified by the notificationTypes attribute.
  If notificationFilter is present, only notifications that pass the
  filter criteria are forwarded to the notification recipient; all other
  notifications are discarded.
  The filter can be applied to any field of a notification.";
}

grouping HeartbeatControlGrp {
  description "Attributes of HeartbeatControl. Note the triggerHeartbeatNtf
  attribute has no mapping in the present release.";

  leaf heartbeatNtfPeriod {
    type uint32;
    mandatory true;
    units seconds;
    description "Specifies the periodicity of heartbeat notification emission.
    The value of zero has the special meaning of stopping the heartbeat
    notification emission.";
  }
}

grouping SubscriptionControlSubtree {
  description "Contains notification subscription related classes.
  Should be used in all classes (or classes inheriting from)
  - SubNetwork
  - ManagedElement

  If some YAM wants to augment these classes/list/groupings they must
  augment all user classes!";

  list NtfSubscriptionControl {
    description "A NtfSubscriptionControl instance represents the
    notification subscription of a particular notification recipient.
    The scope attribute is used to select managed object instances.
    The base object instance of the scope is the object instance
    name-containing the NtfSubscriptionControl instance.
    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 exercise control over which candidate
    notifications are sent to the notificationRecipientAddress.
    If the notificationType attribute is supported and present, its
    value identifies the
    types of notifications that are candidate to be sent to the
    notificationRecipientAddress. If the notificationType attribute is
    not supported or not present, 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
    not supported all candidate notificatios are sent to the
    notificationRecipientAddress."
  }
}

```

To receive notifications, a MnS consumer has to create NtfSubscriptionControl object instances 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.";

```
key id;
uses top3gpp:Top_Grp;
container attributes {
  uses NtfSubscriptionControlGrp;
}
```

```
list HeartbeatControl {
  description "MnS consumers (i.e. notification recipients) use heartbeat
  notifications to monitor the communication channels between them and
  data reporting 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 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.

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.

Whether and when to emit heartbeat notifications is controlled by HeartbeatControl. Subscription for heartbeat is not supported via the NtfSubscriptionControl.";

```
max-elements 1;
key id;
uses top3gpp:Top_Grp;

container attributes {
  uses HeartbeatControlGrp;
}
}
}
}
}
<CODE ENDS>
```

D.2.7 module _3gpp-common-yang-extensions@2019-06-23.yang

```

module _3gpp-common-yang-extensions {
  yang-version 1.1;
  namespace urn:3gpp:sa5:_3gpp-common-yang-extensions ;
  prefix yext3gpp ;

  organization "3GPP SA5";
  description "The module defines YANG extensions needed
    3GPP YANG modeling.

    Copyright (c) 2019 3GPP. All rights reserved.

    Extensions MUST be defined with the following structure in the
    description statement:
      - What is this statement.
      - Newline,
      - This statement can be a substatement of the xxx statements with
      cardinality x..y.
      - This statement can have the following substataments with
      cardinality x..y.
      - Newline
      - Is changing this statement an editorial, BC(backwards compatible)
      or NBC(non-BC) change?
      - Newline.
      - The argument its meaning and type. Preferably use YANG types and
      constraints to define the argument's type.

    Any extension statement can be added with a
    deviation/deviate add statement. In this case the restriction about
    the parent statement of the extension SHALL be evaluated based on the
    target of the deviation statement.

    Support for this module does not mean that a YANG server implements
    support for each of these extensions.
    Implementers of each specific module using an extensions MUST check
    if the server implements support for the used extension.
    Note: modules use many extensions which individual
    implementations MAY or MAY NOT support.
    If support for an extension is missing the extension statement needs
    individual handling or it SHOULD be removed from the module using
    the extension e.g. with a deviation.
    ";

  revision "2019-06-23" {
    description "Initial version";
  }

  extension inVariant {
    description
      "Indicates that the value for the data node can only be set when its
      parent data node is being created. To change the value after that, the
      parent data node must be deleted and recreated with the data node
      having the new value.

      It is unnecessary to use and MUST NOT be used for key leafs.

      The statement MUST only be a substatement of a leaf, leaf-list, list
      statements that is config=true.
      Zero or one inVariant statement is allowed per parent statement.
      NO substataments are allowed.

      Adding this statement is an NBC change, removing it is BC.";
  }

  extension initial-value {
    description "Specifies a value that the system will set for a leaf
      leaf-list if a value is not specified for it when its parent list
      or container is created. The value has no effect in any other
      modification e.g. changing or removing the value.

      The description statement of the parent statement SHOULD contain
      the label 'Initial-value: ' followed by the text from the argument.

      The statement MUST only be a substatement of a leaf or leaf-list.

```


The statement MUST NOT be present if the leaf or the leaf-list has a default statement or the type used for the data node has a default value.

The statement MUST NOT be used for config=false data or in an action, rpc or notification.

Zero or one initial-value statements are allowed for a leaf parent statement. Zero or more initial-value statements are allowed for a leaf-list parent statement. If the leaf-list is ordered-by user, the initial values are stored in the order they appear in the YANG definition. NO substatements are allowed.

Always consider using a YANG-default statement instead.

Modification of the initial-value is a non-backwards-compatible change.

The argument specifies a single initial value for a leaf or leaf-list. The value MUST be part of the valuespace of the leaf/leaf-list. It follows the same rules as the argument of the default statement.";

```
    argument "initial-value";
  }
}
```

D.2.8 module _3gpp-common-yang-types.yang

```
module _3gpp-common-yang-types {
  yang-version 1.1;
  namespace "urn:3gpp:sa5:_3gpp-common-yang-types";
  prefix "types3gpp";

  import ietf-inet-types { prefix inet; }
  import ietf-yang-types { prefix yang; }

  organization "3GPP SA5";
  contact "https://www.3gpp.org/DynaReport/TSG-WG--S5--officials.htm?Itemid=464";
  description "The model defines a YANG mapping of the top level
  information classes used for management of 5G networks and
  network slicing.";
  reference "3GPP TS 28.541";

  revision 2020-11-06 {
    description "Removed incorrect S-NSSAI definitions.";
    reference "CR-0118";
  }

  revision 2020-03-10 {
    description "Removed faulty when statements.";
    reference "SP-200229";
  }

  revision 2019-10-25 {
    description "Added ManagedNFProfile.";
    reference "S5-194457";
  }

  revision 2019-10-16 {
    description "Added SAP and usageState.";
    reference "S5-193518";
  }

  revision 2019-06-23 {
    reference "Initial version.";
  }

  grouping ManagedNFProfile {
    description "Defines profile for managed NF";
    reference "3GPP TS 23.501";

    leaf idx { type uint32 ; }

    leaf nfInstanceID {
      config false;
      mandatory true;
      type yang:uuid ;
      description "This parameter defines profile for managed NF.
      The format of the NF Instance ID shall be a
```

```
    Universally Unique Identifier (UUID) version 4,
    as described in IETF RFC 4122 " ;
}

leaf-list nfType {
  config false;
  min-elements 1;
  type NfType;
  description "Type of the Network Function" ;
}

leaf hostAddr {
  mandatory true;
  type inet:host ;
  description "Host address of a NF";
}

leaf authzInfo {
  type string ;
  description "This parameter defines NF Specific Service authorization
  information. It shall include the NF type (s) and NF realms/origins
  allowed to consume NF Service(s) of NF Service Producer.";
  reference "See TS 23.501" ;
}

leaf location {
  type string ;
  description "Information about the location of the NF instance
  (e.g. geographic location, data center) defined by operator";
  reference "TS 29.510" ;
}

leaf capacity {
  mandatory true;
  type uint16 ;
  description "This parameter defines static capacity information
  in the range of 0-65535, expressed as a weight relative to other
  NF instances of the same type; if capacity is also present in the
  nfServiceList parameters, those will have precedence over this value.";
  reference "TS 29.510" ;
}

leaf nFSrvGroupId {
  type string ;
  description "This parameter defines identity of the group that is
  served by the NF instance.
  May be config false or true depending on the ManagedFunction.
  Config=true for UdrInfo. Config=false for UdmInfo and AusfInfo.
  Shall be present if ../nfType = UDM or AUSF or UDR. ";
  reference "TS 29.510" ;
}

leaf-list supportedDataSetIds {
  type enumeration {
    enum SUBSCRIPTION;
    enum POLICY;
    enum EXPOSURE;
    enum APPLICATION;
  }
  description "List of supported data sets in the UDR instance.
  May be present if ../nfType = UDR";
  reference "TS 29.510" ;
}

leaf-list smfServingAreas {
  type string ;
  description "Defines the SMF service area(s) the UPF can serve.
  Shall be present if ../nfType = UPF";
  reference "TS 29.510" ;
}

leaf priority {
  type uint16;
  description "This parameter defines Priority (relative to other NFs
  of the same type) in the range of 0-65535, to be used for NF selection;
  lower values indicate a higher priority. If priority is also present
  in the nfServiceList parameters, those will have precedence over
  this value. Shall be present if ../nfType = AMF " ;
}
```

```

    reference "TS 29.510" ;
  }
}

typedef usageState {
  type enumeration {
    enum IDLE;
    enum ACTIVE;
    enum BUSY;
  }
  description "It describes whether or not 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. The value is READ-ONLY.";
  reference "ITU T Recommendation X.731";
}

grouping SAP {
  leaf host {
    type inet:host;
    mandatory true;
  }
  leaf port {
    type inet:port-number;
    mandatory true;
  }
  description "Service access point.";
  reference "TS 28.622";
}

typedef Mcc {
  description "The mobile country code consists of three decimal digits,
  The first digit of the mobile country code identifies the geographic
  region (the digits 1 and 8 are not used).";
  type string {
    pattern '[02-79][0-9][0-9]';
  }
  reference "3GPP TS 23.003 subclause 2.2 and 12.1";
}

typedef Mnc {
  description "The mobile network code consists of two or three
  decimal digits (for example: MNC of 001 is not the same as MNC of 01)";
  type string {
    pattern '[0-9][0-9][0-9]|[0-9][0-9]';
  }
  reference "3GPP TS 23.003 subclause 2.2 and 12.1";
}

grouping PLMNid {
  leaf mcc {
    mandatory true;
    type Mcc;
  }
  leaf mnc {
    mandatory true;
    type Mnc;
  }
  reference "TS 23.658";
}

typedef Nci {
  description "NR Cell Identity. The NCI shall be of fixed length of 36 bits
  and shall be coded using full hexadecimal representation.
  The exact coding of the NCI is the responsibility of each PLMN operator";
  reference "TS 23.003";
  type union {
    type string {
      length 36;
      pattern '[01]+';
    }
    type string {
      length 9;
      pattern '[a-fA-F0-9]*';
    }
  }
}

typedef OperationalState {

```

```
reference "3GPP TS 28.625 and ITU-T X.731";
type enumeration {
    enum DISABLED {
        value 0;
        description "The resource is totally inoperable.";
    }

    enum ENABLED {
        value 1;
        description "The resource is partially or fully operable.";
    }
}

typedef AdministrativeState {
    reference "3GPP TS 28.625 and ITU-T X.731";
    type enumeration {
        enum LOCKED {
            value 0;
            description "The resource is administratively prohibited from performing
                services for its users.";
        }

        enum UNLOCKED {
            value 1;
            description "The resource is administratively permitted to perform
                services for its users. This is independent of its inherent
                operability.";
        }

        enum SHUTTINGDOWN {
            value 2;
            description "Use of the resource is administratively permitted to
                existing instances of use only. While the system remains in
                the shutting down state the manager or the managed element
                may at any time cause the resource to transition to the
                locked state.";
        }
    }
}

typedef AvailabilityStatus {
    type enumeration {
        enum IN_TEST;
        enum FAILED;
        enum POWER_OFF;
        enum OFF_LINE;
        enum OFF_DUTY;
        enum DEPENDENCY;
        enum DEGRADED;
        enum NOT_INSTALLED;
        enum LOG_FULL;
    }
}

typedef CellState {
    type enumeration {
        enum IDLE;
        enum INACTIVE;
        enum ACTIVE;
    }
}

typedef Nrpci {
    type uint32;
    description "Physical Cell Identity (PCI) of the NR cell.";
    reference "TS 36.211 subclause 6.11";
}

typedef Tac {
    type int32 {
        range 0..16777215 ;
    }
    description "Tracking Area Code";
    reference "TS 23.003 clause 19.4.2.3";
}
```

```

typedef AmfRegionId {
    type union {
        type uint8 ;
        type string {
            length 8;
            pattern '[01]*';
        }
    }
    reference "clause 2.10.1 of 3GPP TS 23.003";
}

typedef AmfSetId {
    type union {
        type uint16 {
            range '0..1023';
        }
        type string {
            length 8;
            pattern '[01]*';
        }
    }
    reference "clause 2.10.1 of 3GPP TS 23.003";
}

typedef AmfPointer {
    type union {
        type uint8 {
            range '0..63';
        }
        type string {
            length 6;
            pattern '[01]*';
        }
    }
    reference "clause 2.10.1 of 3GPP TS 23.003";
}

grouping AmfIdentifier {
    leaf amfRegionId {
        type AmfRegionId;
    }
    leaf amfSetId {
        type AmfSetId;
    }
    leaf amfPointer {
        type AmfPointer;
    }
    description "The AMFI is constructed from an AMF Region ID,
    an AMF Set ID and an AMF Pointer.
    The AMF Region ID identifies the region,
    the AMF Set ID uniquely identifies the AMF Set within the AMF Region, and
    the AMF Pointer uniquely identifies the AMF within the AMF Set. ";
}

// type definitions especially for core NFs

typedef NfType {
    type enumeration {
        enum NRF;
        enum UDM;
        enum AMF;
        enum SMF;
        enum AUSF;
        enum NEF;
        enum PCF;
        enum SMSF;
        enum NSSF;
        enum UDR;
        enum LMF;
        enum GMLC;
        enum 5G_EIR;
        enum SEPP;
        enum UPF;
        enum N3IWF;
        enum AF;
        enum UDSF;
        enum BSF;
        enum CHF;
    }
}

```

```

    }
  }

typedef NotificationType {
  type enumeration {
    enum N1_MESSAGES;
    enum N2_INFORMATION;
    enum LOCATION_NOTIFICATION;
  }
}

typedef Load {
  description "Latest known load information of the NF, percentage ";
  type uint8 {
    range 0..100;
  }
}

typedef N1MessageClass {
  type enumeration {
    enum 5GMM;
    enum SM;
    enum LPP;
    enum SMS;
  }
}

typedef N2InformationClass {
  type enumeration {
    enum SM;
    enum NRPPA;
    enum PWS;
    enum PWS_BCAL;
    enum PWS_RF;
  }
}

grouping DefaultNotificationSubscription {

  leaf notificationType {
    type NotificationType;
  }

  leaf callbackUri {
    type inet:uri;
  }

  leaf n1MessageClass {
    type N1MessageClass;
  }

  leaf n2InformationClass {
    type N2InformationClass;
  }
}

grouping Ipv4AddressRange {
  leaf start {
    type inet:ipv4-address;
  }
  leaf end {
    type inet:ipv4-address;
  }
}

grouping Ipv6PrefixRange {
  leaf start {
    type inet:ipv6-prefix;
  }
  leaf end {
    type inet:ipv6-prefix;
  }
}

typedef NsiId {
  type string;
}

```

```

typedef UeMobilityLevel {
    type enumeration {
        enum STATIONARY;
        enum NOMADIC;
        enum RESTRICTED_MOBILITY;
        enum FULLY_MOBILITY;
    }
}

typedef ResourceSharingLevel {
    type enumeration {
        enum SHARED;
        enum NOT_SHARED;
    }
}

typedef TxDirection {
    type enumeration {
        enum DL;
        enum UL;
        enum DL_AND_UL;
    }
}

grouping AddressWithVlan {
    leaf ipAddress {
        type inet:ip-address;
    }
    leaf vlanId {
        type uint16;
    }
}

typedef DistinguishedName { // TODO is this equivalent to TS 32.300 ?
    type string {
        pattern '([a-zA-Z][a-zA-Z0-9-]*=(\\( |#|\\|>|<|;|"|\+|,|[a-fA-F0-9]{2})|[\^\\><;"+, # ])'
            + '(\( |#|\\|>|<|;|"|\+|,|[a-fA-F0-9]{2})|[\^\\><;"+, ])*'
            + '(\( |#|\\|>|<|;|"|\+|,|[a-fA-F0-9]{2})|[\^\\><;"+, ])?'
            + '[,\+]*[a-zA-Z][a-zA-Z0-9-]*=(\\( |#|\\|>|<|;|"|\+|,|[a-fA-F0-9]{2})|[\^\\><;"+, # ])'
            + '(\( |#|\\|>|<|;|"|\+|,|[a-fA-F0-9]{2})|[\^\\><;"+, ])*'
            + '([\^\\><;"+, ])*(\( |#|\\|>|<|;|"|\+|,|[a-fA-F0-9]{2})|[\^\\><;"+, ])?';
    }
    description "Represents the international standard for the representation
of Distinguished Name (RFC 4512).
The format of the DistinguishedName REGEX is:
{AttributeType = AttributeValue}

AttributeType consists of alphanumeric and hyphen (OIDs not allowed).
All other characters are restricted.
The Attribute value cannot contain control characters or the
following characters : \ > < ; \ " + , (Comma) and White space
The Attribute value can contain the following characters if they
are escaped : \ \ > < ; \ " + , (Comma) and White space
The Attribute value can contain control characters if its an escaped
double digit hex number.
Examples could be
    UID=nobody@example.com,DC=example,DC=com
    CN=John Smith,OU=Sales,O=ACME Limited,L=Moab,ST=Utah,C=US";
    reference "RFC 4512 Lightweight Directory Access Protocol (LDAP):
Directory Information Models";
} // recheck regexp it doesn't handle posix [:cntrl:]

typedef QOffsetRange {
    type int8 {
        range "-24 | -22 | -20 | -18 | -16 | -14 | -12 | -10 | -8 | -6 | " +
            " -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 8 | 10 | " +
            " 12 | 14 | 16 | 18 | 20 | 22 | 24";
    }
    units dB;
}
}

```

D.2.9 module _3gpp-common-fm.yang

```

<CODE BEGINS>
module _3gpp-common-fm {

```

```

yang-version 1.1;
namespace "urn:3gpp:sa5:_3gpp-common-fm";
prefix "fm3gpp";

import ietf-yang-types { prefix yang; }
import _3gpp-common-top { prefix top3gpp; }
import _3gpp-common-yang-types { prefix types3gpp; }

organization "3GPP SA5";
contact "https://www.3gpp.org/DynaReport/TSG-WG--S5--officials.htm?Itemid=464";

description "Defines a Fault Management model";

reference "3GPP TS 28.623
  Generic Network Resource Model (NRM)
  Integration Reference Point (IRP);
  Solution Set (SS) definitions

  3GPP TS 28.622
  Generic Network Resource Model (NRM)
  Integration Reference Point (IRP);
  Information Service (IS)";

revision 2021-08-08 { reference "CR-0132"; }
revision 2021-06-02 { reference "CR-0130"; }
revision 2020-06-03 { reference "CR-0091"; }
revision 2020-02-24 {
  reference "S5-201365";
}

typedef eventType {
  type enumeration {
    enum COMMUNICATIONS_ALARM {
      value 2;
    }

    enum QUALITY_OF_SERVICE_ALARM {
      value 3;
    }

    enum PROCESSING_ERROR_ALARM {
      value 4;
    }

    enum EQUIPMENT_ALARM {
      value 5;
    }

    enum ENVIRONMENTAL_ALARM {
      value 6;
    }

    enum INTEGRITY_VIOLATION {
      value 7;
    }

    enum OPERATIONAL_VIOLATION {
      value 8;
    }

    enum PHYSICAL_VIOLATIONu {
      value 9;
    }

    enum SECURITY_SERVICE_OR_MECHANISM_VIOLATION {
      value 10;
    }

    enum TIME_DOMAIN_VIOLATION {
      value 11;
    }
  }
  description "General category for the alarm.";
}

typedef severity-level {
  type enumeration {

```



```

        enum CRITICAL { value 3; }
        enum MAJOR { value 4; }
        enum MINOR { value 5; }
        enum WARNING { value 6; }
        enum INDETERMINATE { value 7; }
        enum CLEARED { value 8; }
    }

    description "The possible alarm severities.
        Aligned with ERICSSON-ALARM-MIB.";
}

grouping AlarmRecordGrp {
    description "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 ACKNOWLEDED.";

    leaf alarmId {
        type string;
        mandatory true;
        description "Identifies the alarmRecord";
    }

    leaf objectInstance {
        type string;
        config false ;
        mandatory true;
    }

    leaf notificationId {
        type int32;
        config false ;
        mandatory true;
    }

    leaf alarmRaisedTime {
        type yang:date-and-time ;
        config false ;
    }

    leaf alarmChangedTime {
        type yang:date-and-time ;
        config false ;
        description "not applicable if related alarm has not changed";
    }

    leaf alarmClearedTime {
        type yang:date-and-time ;
        config false ;
        description "not applicable if related alarm was not cleared";
    }

    leaf alarmType {
        type eventType;
        config false ;
        description "General category for the alarm.";
    }

    leaf probableCause {
        type string;
        config false ;
    }

    leaf specificProblem {
        type string;
        config false ;
        reference "ITU-T Recommendation X.733 clause 8.1.2.2.";
    }
}

```

```
leaf perceivedSeverity {
  type severity-level;
  description "This is Writable only if producer supports consumer
  to set perceivedSeverity to CLEARED";
}

leaf backedUpStatus {
  type string;
  config false ;
  description "Indicates if an object (the MonitoredEntity) has a back
  up. See definition in ITU-T Recommendation X.733 clause 8.1.2.4.";
}

leaf backUpObject {
  type string;
  config false ;
}

leaf trendIndication {
  type string;
  config false ;
  description "Indicates if some observed condition is getting better,
  worse, or not changing. ";
  reference "ITU-T Recommendation X.733 clause 8.1.2.6.";
}

grouping ThresholdPackGrp {
  leaf thresholdLevel {
    type string;
  }
  leaf thresholdValue {
    type string;
  }
  leaf hysteresis {
    type string;
    description "The hysteresis has a threshold high and a threshold
    low value that are different from the threshold value.
    A hysteresis, therefore, defines the threshold-high and
    threshold-low levels within which the measurementType value is
    allowed to oscillate without triggering the threshold crossing
    notification.";
  }
}

grouping ThresholdInfoGrp {
  leaf measurementType {
    type string;
    mandatory true;
  }

  leaf direction {
    type enumeration {
      enum INCREASING;
      enum DECREASING;
    }
    mandatory true;
    description "
    If it is 'Increasing', the threshold crossing notification is
    triggered when the measurement value equals or exceeds a
    thresholdValue.

    If it is 'Decreasing', the threshold crossing notification is
    triggered when the measurement value equals or below a
    thresholdValue.";
  }
}

uses ThresholdPackGrp;
}

list thresholdInfo {
  config false ;
  uses ThresholdInfoGrp;
}

leaf stateChangeDefinition {
  type string;
  config false ;
  description "Indicates MO attribute value changes. See definition
```

```
    in ITU-T Recommendation X.733 clause 8.1.2.11.";
  }

  leaf monitoredAttributes {
    type string;
    config false ;
    description "Indicates MO attributes whose value changes are being
    monitored. ";
    reference " ITU-T Recommendation X.733 clause 8.1.2.11.";
  }

  leaf proposedRepairActions {
    type string;
    config false ;
    description "Indicates proposed repair actions. See definition in
    ITU-T Recommendation X.733 clause 8.1.2.12.";
  }

  leaf additionalText {
    type string;
    config false ;
  }

  anydata additionalInformation {
    config false ;
  }

  leaf rootCauseIndicator {
    type enumeration {
      enum YES;
      enum NO;
    }
    config false ;
    description "It indicates that this AlarmInformation is the root cause
    of the events captured by the notifications whose identifiers are in
    the related CorrelatedNotification instances.";
  }

  leaf ackTime {
    type yang:date-and-time ;
    config false ;
    description "It identifies the time when the alarm has been
    acknowledged or unacknowledged the last time, i.e. it registers the
    time when ackState changes.";
  }

  leaf ackUserId {
    type string;
    description "It identifies the last user who has changed the
    Acknowledgement State.";
  }

  leaf ackSystemId {
    type string;
    description "It identifies the system (Management System) that last
    changed the ackState of an alarm, i.e. acknowledged or unacknowledged
    the alarm.";
  }

  leaf ackState {
    type enumeration {
      enum ACKNOWLEDGED {
        description "The alarm has been acknowledged.";
      }
      enum UNACKNOWLEDGED {
        description "The alarm has unacknowledged or the alarm has never
        been acknowledged.";
      }
    }
  }

  leaf clearUserId {
    type string;
    description "Carries the identity of the user who invokes the
    clearAlarms operation.";
  }

  leaf clearSystemId {
```

```

    type string;
  }

  leaf serviceUser {
    type string;
    config false ;
    description "It identifies the service-user whose request for service
      provided by the serviceProvider led to the generation of the
      security alarm.";
  }

  leaf serviceProvider {
    type string;
    config false ;
    description "It identifies the service-provider whose service is
      requested by the serviceUser and the service request provokes the
      generation of the security alarm.";
  }

  leaf securityAlarmDetector {
    type string;
    config false ;
  }
}

grouping AlarmListGrp {
  description "Represents the AlarmList IOC.";

  leaf administrativeState {
    type types3gpp:AdministrativeState ;
    default LOCKED;
    description "When set to UNLOCKED, the alarm list is updated.
      When the set to LOCKED, the existing alarm records are not
      updated, and new alarm records are not added to the alarm list.";
  }

  leaf operationalState {
    type types3gpp:OperationalState ;
    default DISABLED;
    config false;
    description "The producer sets this attribute to ENABLED, indicating
      that it has the resource and ability to record alarm in AlarmList
      else, it sets the attribute to DISABLED.";
  }

  leaf numOfAlarmRecords {
    type uint32 ;
    config false;
    mandatory true;
    description "The number of alarm records in the AlarmList";
  }

  leaf lastModification {
    type yang:date-and-time ;
    config false;
    description "The last time when an alarm record was modified";
  }

  list alarmRecords {
    key alarmId;
    description "List of alarmRecords";
    uses AlarmRecordGrp;
  }
}

grouping FmSubtree {
  description "Contains FM related classes.
    Should be used in all classes (or classes inheriting from)
    - SubNetwork
    - ManagedElement

    If some YAM wants to augment these classes/list/groupings they must
    augment all user classes!";

  list AlarmList {
    key id;
    max-elements 1;
    description "The AlarmList represents the capability to store and manage

```

alarm records. 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.

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";

```

    uses top3gpp:Top_Grp ;
    container attributes {
      uses AlarmListGrp ;
    }
  }
}
<CODE ENDS>

```

D.2.10 module _3gpp-common-trace.yang

```

<CODE BEGINS>
module _3gpp-common-trace {
  yang-version 1.1;
  namespace "urn:3gpp:sa5:_3gpp-common-trace";
  prefix "trace3gpp";

  import _3gpp-common-top { prefix top3gpp; }
  import _3gpp-common-yang-types {prefix types3gpp; }
  import ietf-inet-types { prefix inet; }

  organization "3GPP SA5";
  contact "https://www.3gpp.org/DynaReport/TSG-WG--S5--officials.htm?Itemid=464";

  description "Trace handling";

  reference "3GPP TS 28.623
    Generic Network Resource Model (NRM)
    Integration Reference Point (IRP);
    Solution Set (SS) definitions

    3GPP TS 28.622
    Generic Network Resource Model (NRM)
    Integration Reference Point (IRP);
    Information Service (IS)";

  revision 2021-07-22 { reference "CR-0137"; }
  revision 2021-01-25 { reference "CR-0122"; }
  revision 2020-11-16 { reference "CR-0117"; }
  revision 2020-08-06 { reference "CR-0102"; }

  grouping TraceJobGrp {
    leaf tjJobType {
      type enumeration {
        enum IMMEDIATE_MDT_ONLY;
        enum LOGGED_MDT_ONLY;
        enum TRACE_ONLY;
        enum IMMEDIATE_MDT_AND_TRACE;
        enum RLF_REPORT_ONLY;
        enum RCEF_REPORT_ONLY;
        enum LOGGED_MBSFN_MDT;
      }
      default TRACE_ONLY;
      description "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.";
      reference "Clause 5.9a of 3GPP TS 32.422 for additional details on the
        allowed values.";
    }
  }

  list tjListOfInterfaces {
    key idx;
    must 'count(MSCServerInterfaces)+count(MGWInterfaces)+count(RNCInterfaces)';
  }
}

```

```

'+count(SGSNInterfaces)+count(GGSNInterfaces)+count(S-CSCFInterfaces)'
'+count(P-CSCFInterfaces)+count(I-CSCFInterfaces)+count(MRFCInterfaces)'
'+count(MGCFInterfaces)+count(IBCInterfaces)+count(E-CSCFInterfaces)'
'+count(BGCFInterfaces)+count(ASInterfaces)+count(HSSInterfaces)'
'+count(EIRInterfaces)+count(BM-SCInterfaces)+count(MMEInterfaces)'
'+count(SGWInterfaces)+count(PDN_GWInterfaces)+count(eNBInterfaces)'
'+count(en-gNBInterfaces)+count(AMFInterfaces)+count(AUSFInterfaces)'
'+count(NEFInterfaces)+count(NRFInterfaces)+count(NSSFInterfaces)'
'+count(PCFInterfaces)+count(SMFInterfaces)+count(SMSFInterfaces)'
'+count(UDMInterfaces)+count(UPFInterfaces)+count(ng-eNBInterfaces)'
'+count(gNB-CU-CPInterfaces)+count(gNB-CU-UPInterfaces)'
'+count(gNB-DUInterfaces)';

```

description "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."
reference "Clause 5.5 of 3GPP TS 32.422 for additional details on the allowed values.";

```
leaf idx { type uint32 ; }
```

```
leaf-list MSCServerInterfaces {
```

```

  type enumeration {
    enum A ;
    enum Iu-CS ;
    enum Mc ;
    enum MAP-G ;
    enum MAP-B ;
    enum MAP-E ;
    enum MAP-F ;
    enum MAP-D ;
    enum MAP-C ;
    enum CAP ;
  }
}

```

```
leaf-list MGWInterfaces {
```

```

  type enumeration {
    enum Mc ;
    enum Nb-UP ;
    enum Iu-UP ;
  }
}

```

```
leaf-list RNCInterfaces {
```

```

  type enumeration {
    enum Iu-CS ;
    enum Iu-PS ;
    enum Iur ;
    enum Iub ;
    enum Uu ;
  }
}

```

```
leaf-list SGSNInterfaces {
```

```

  type enumeration {
    enum Gb ;
    enum Iu-PS ;
    enum Gn ;
    enum MAP-Gr ;
    enum MAP-Gd ;
    enum MAP-Gf ;
    enum Ge ;
    enum Gs ;
    enum S6d ;
    enum S4 ;
    enum S3 ;
    enum S13 ;
  }
}

```

```
leaf-list GGSNInterfaces {
```

```

  type enumeration {
    enum Gn ;
    enum Gi ;
    enum Gmb ;
  }
}

```

```
leaf-list S-CSCFInterfaces {
```

```

  type enumeration {
    enum Mw ;
    enum Mg ;
  }
}

```

```
        enum Mr ;
        enum Mi ;
    }
}
leaf-list P-CSCFInterfaces {
    type enumeration {
        enum Gm ;
        enum Mw ;
    }
}
leaf-list I-CSCFInterfaces {
    type enumeration {
        enum Cx ;
        enum Dx ;
        enum Mg ;
        enum Mw ;
    }
}
leaf-list MRFCInterfaces {
    type enumeration {
        enum Mp ;
        enum Mr ;
    }
}
leaf-list MGCFInterfaces {
    type enumeration {
        enum Mg ;
        enum Mj ;
        enum Mn ;
    }
}
leaf-list IBCFInterfaces {
    type enumeration {
        enum Ix ;
        enum Mx ;
    }
}
leaf-list E-CSCFInterfaces {
    type enumeration {
        enum Mw ;
        enum Ml ;
        enum Mn ;
        enum Mi-Mg ;
    }
}
leaf-list BGCFInterfaces {
    type enumeration {
        enum Mi ;
        enum Mj ;
        enum Mk ;
    }
}
leaf-list ASInterfaces {
    type enumeration {
        enum Dh ;
        enum Sh ;
        enum ISC ;
        enum Ut ;
    }
}
leaf-list HSSInterfaces {
    type enumeration {
        enum MAP-C ;
        enum MAP-D ;
        enum Gc ;
        enum Gr ;
        enum Cx ;
        enum S6d ;
        enum S6a ;
        enum Sh ;
    }
}
leaf-list EIRInterfaces {
    type enumeration {
        enum MAP-F ;
        enum S13 ;
        enum MAP-Gf ;
    }
}
```

```
}
leaf-list BM-SCInterfaces {
  type enumeration {
    enum Gmb ;
  }
}
leaf-list MMEInterfaces {
  type enumeration {
    enum S1-MME ;
    enum S3 ;
    enum S6a ;
    enum S10 ;
    enum S11 ;
    enum S13 ;
  }
}
leaf-list SGWInterfaces {
  type enumeration {
    enum S4 ;
    enum S5 ;
    enum S8 ;
    enum S11 ;
    enum Gxc ;
  }
}
leaf-list PDN_GWInterfaces {
  type enumeration {
    enum S2a ;
    enum S2b ;
    enum S2c ;
    enum S5 ;
    enum S6b ;
    enum Gx ;
    enum S8 ;
    enum SGi ;
  }
}
leaf-list eNBInterfaces {
  type enumeration {
    enum S1-MME ;
    enum X2 ;
  }
}
leaf-list en-gNBInterfaces {
  type enumeration {
    enum S1-MME ;
    enum X2 ;
    enum Uu ;
    enum F1-C ;
    enum E1 ;
  }
}
leaf-list AMFInterfaces {
  type enumeration {
    enum N1 ;
    enum N2 ;
    enum N8 ;
    enum N11 ;
    enum N12 ;
    enum N14 ;
    enum N15 ;
    enum N20 ;
    enum N22 ;
    enum N26 ;
  }
}
leaf-list AUSFInterfaces {
  type enumeration {
    enum N12 ;
    enum N13 ;
  }
}
leaf-list NEFInterfaces {
  type enumeration {
    enum N29 ;
    enum N30 ;
    enum N33 ;
  }
}
```



```
}
leaf-list NRFInterfaces {
  type enumeration {
    enum N27 ;
  }
}
leaf-list NSSFInterfaces {
  type enumeration {
    enum N22 ;
    enum N31 ;
  }
}
leaf-list PCFInterfaces {
  type enumeration {
    enum N5 ;
    enum N7 ;
    enum N15 ;
  }
}
leaf-list SMFInterfaces {
  type enumeration {
    enum N4 ;
    enum N7 ;
    enum N10 ;
    enum N11 ;
    enum S5-C ;
  }
}
leaf-list SMSFInterfaces {
  type enumeration {
    enum N20 ;
    enum N21 ;
  }
}
leaf-list UDMInterfaces {
  type enumeration {
    enum N8 ;
    enum N10 ;
    enum N13 ;
    enum N21 ;
  }
}
leaf-list UPFInterfaces {
  type enumeration {
    enum N4 ;
  }
}
leaf-list ng-eNBInterfaces {
  type enumeration {
    enum NG-C ;
    enum Xn-C ;
    enum Uu ;
  }
}
leaf-list gNB-CU-CPInterfaces {
  type enumeration {
    enum NG-C ;
    enum Xn-C ;
    enum Uu ;
    enum F1-C ;
    enum E1 ;
    enum X2-C ;
  }
}
leaf-list gNB-CU-UPInterfaces {
  type enumeration {
    enum E1 ;
  }
}
leaf-list gNB-DUInterfaces {
  type enumeration {
    enum F1-C ;
  }
}
}
}
leaf-list tjListOfNeTypes {
  type enumeration {
```

```

    enum MSC_SERVER;
    enum SGSN;
    enum MGW;
    enum GGSN;
    enum RNC;
    enum BM_SC;
    enum MME;
    enum SGW;
    enum PGW;
    enum ENB;
    enum EN_GNB;
    enum GNB_CU_CP;
    enum GNB_CU_UP;
    enum GNB_DU;
}
description "Specifies in which type of ManagedFunction 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";
reference "Clause 5.4 of 3GPP TS 32.422 for additional details on the
allowed values";
}

leaf tjPLMNTarget {
    type string;
    mandatory true;
    description "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";
    reference "Clause 5.9b of 3GPP TS 32.422";
}

leaf tjStreamingTraceConsumerURI {
    when './tjTraceReportingFormat = "STREAMING"';
    type inet:uri;
    mandatory true;
    description "URI of the Streaming Trace data reporting MnS consumer
(a.k.a. streaming target).
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.";
    reference "Clause 5.9 of 3GPP TS 32.422";
}

leaf tjTraceCollectionEntityAddress {
    when './tjTraceReportingFormat = "FILE_BASED" or '
+'./tjJobType = "LOGGED_MDT_ONLY" or ./tjJobType = "LOGGED_MBSFN_MDT"';
    type union {
        type inet:uri;
        type inet:ip-address;
    }
    mandatory true;
    description "Specifies the address of the Trace Collection Entity when
the attribute tjTraceReportingFormat is configured for the file-based
reporting. The attribute is applicable for both Trace and MDT.";
    reference "Clause 5.9 of 3GPP TS 32.422";
}

leaf tjTraceDepth {
    when './tjJobType = "TRACE_ONLY"
+ ' or ./tjJobType = "IMMEDIATE_MDT_AND_TRACE"';
    type enumeration {
        enum MINIMUM;
        enum MEDIUM;
        enum MAXIMUM;
        enum VENDORMINIMUM;
        enum VENDORMEDIUM;
        enum VENDORMAXIMUM;
    }
    default MAXIMUM;
    description "Specifies how detailed information should be recorded in the
Network Element. The Trace Depth is a parameter for Trace Session level,
i.e., the Trace Depth is the same for all of the NEs to be traced in
the same Trace Session.
The attribute is applicable only for Trace, otherwise it carries a null
semantic.";
    reference "Clause 5.3 of 3GPP TS 32.422";
}

```

```

leaf tjTraceReference {
  type uint64;
  mandatory true;
  description "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.";
}

leaf tjTraceRecordSessionReference {
  type string;
  mandatory true;
  description "An identifier, which identifies the Trace Recording Session.
  The attribute is applicable for both Trace and MDT.
  See the clause 5.7 of 3GPP TS 32.422 for additional details on the
  allowed values.";
}

leaf tjTraceReportingFormat {
  type enumeration {
    enum FILE_BASED;
    enum STREAMING;
  }
  default FILE_BASED;
  description "Specifies the trace reporting format - streaming trace
  reporting or file-based trace reporting";
  reference "3GPP TS 32.422 clause 5.11";
}

list tjTraceTarget {
  key "targetIdType targetIdValue";
  max-elements 1;

  leaf targetIdType {
    type enumeration {
      enum IMSI;
      enum IMEI;
      enum IMEISV;
      enum PUBLIC_ID;
      enum UTRAN_CELL;
      enum E_UTRAN_CELL;
      enum NG_RAN_CELL;
      enum ENB;
      enum RNC;
      enum GNB;
      enum SUPI;
    }
  }

  leaf targetIdValue {
    type string;
  }
}

```

description "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.

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):

- HssFunction
- MscServerFunction
- SgsnFunction
- GgsnFunction
- BmScFunction
- RncFunction
- MmeFunction

The tjTraceTarget shall be IMSI if the Trace Session is activated to a ManagedEntity playing a role of ServinGWFunction.

In case of signaling based Trace/MDT, the tjTraceTarget attribute shall

be able to carry (IMSI or IMEI(SV) or SUPI), the tjMDTAreaScope attribute shall be able to carry a list of (cell or E-UtranCell or NRCellDU or TA/LA/RA).

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 or NRCellDU).

In case of management based Logged MDT, the tjTraceTarget attribute shall carry an eNB or a RNC or gNBs. The Logged MDT should be initiated on the specified eNB or RNC or gNB in tjTraceTarget. The tjMDTAreaScope attribute shall carry a list of (UtranCell or E-UtranCell or NRCellDU or TA/LA/RA).

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/gNBs";
reference "3GPP TS 32.422";
}

```
leaf tjTriggeringEvent {
  when './tjJobType = "TRACE" or ./tjJobType = "IMMEDIATE_MDT_AND_TRACE"';
  type string ;
  mandatory true;
  description "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.";
  reference "Clause 5.1 of 3GPP TS 32.422";
}
```

```
leaf tjMDTAnonymizationOfData {
  when './tjMDTAreaScope ;
  type enumeration {
    enum NO_IDENTITY;
    enum TAC_OF_IMEI;
  }
  default NO_IDENTITY;
  description "Specifies level of MDT anonymization.";
  reference "3GPP TS 32.422 clause 5.10.12.";
}
```

```
list tjMDTAreaConfigurationForNeighCell {
  when './tjJobType = "LOGGED_MDT_ONLY"';
  key "idx";
  min-elements 1;
  leaf idx { type uint32 ; }

  description "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.";
  reference "3GPP TS 32.422 clause 5.10.26.";

  leaf frequency {
    type string;
  }

  leaf cell {
    type string;
  }
}
```

```
leaf-list tjMDTAreaScope {
  type string;
  description "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";
    reference "Clause 5.10.2 of 3GPP TS 32.422";
}

leaf tjMDTCollectionPeriodRrmLte {
    when './tjJobType = "IMMEDIATE_MDT_ONLY"'
        + ' or ./tjJobType = "IMMEDIATE_MDT_AND_TRACE"';
    type uint32 {
        range "250|500|1000|2000|3000|4000|6000|8000|12000|16000|20000|"
            +"24000|28000|32000|64000";
    }
    units milliseconds;
    description "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.";
    reference "Clause 5.10.20 of 3GPP TS 32.422";
}

leaf tjMDTCollectionPeriodRrmUmts {
    when './tjJobType = "IMMEDIATE_MDT_ONLY"'
        + ' or ./tjJobType = "IMMEDIATE_MDT_AND_TRACE"';
    type uint32 {
        range "1024|1280|2048|2560|5120|"
            +"10240|60000";
    }
    units milliseconds;
    description "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";
    reference "Clause 5.10.21 of 3GPP TS 32.422";
}

leaf tjMDTCollectionPeriodRrmNR {
    when './tjJobType = "IMMEDIATE_MDT_ONLY"'
        + ' or ./tjJobType = "IMMEDIATE_MDT_AND_TRACE"';
    type uint32 {
        range "1024|2048|5120|10240|60000";
    }
    units milliseconds;
    description "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.";
    reference "Clause 5.10.30 of 3GPP TS 32.422";
}

leaf tjMDTEventListForTriggeredMeasurement {
    when './tjJobType = "LOGGED_MDT_ONLY"';
    type enumeration {
        enum OUT_OF_COVERAGE ;
        enum A2_EVENT ;
    }
    mandatory true;
    description "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.";
    reference "Clause 5.10.28 of 3GPP TS 32.422";
}

leaf tjMDTEventThreshold {
    type int64;
    description "Specifies the threshold which should trigger the reporting
        in case A2 event reporting in LTE or 1F/1l 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 1l event in UMTS. In
        case this attribute is not used, it carries a null semantic.";
    reference "Clauses 5.10.7 and 5.10.7a of 3GPP TS 32.422";
}

leaf tjMDTListOfMeasurements {
    when './tjJobType = "IMMEDIATE_MDT"';
    type int64;
}

```

```

    mandatory true;
    description "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.";
    reference "3GPP TS 32.422 clause 5.10.3";
}

leaf tjMDTLoggingDuration {
    when './tjJobType = "LOGGED_MDT_ONLY" or ./tjJobType = "LOGGED_MBSFN_MDT"';
    type uint32 {
        range "600|1200|2400|3600|5400|7200";
    }
    units seconds;
    mandatory true;
    description "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.";
    reference "5.10.9 of 3GPP TS 32.422";
}

leaf tjMDTLoggingInterval {
    when './tjJobType = "LOGGED_MDT_ONLY" or ./tjJobType = "LOGGED_MBSFN_MDT"';
    type uint32 {
        range "1280|2560|5120|10240|20480|"
            +"30720|40960|61440";
    }
    units milliseconds;
    mandatory true;
    description "Specifies the periodicty 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";
    reference "5.10.8 of 3GPP TS 32.422";
}

leaf-list tjMDTMBSFNAreaList {
    when './tjJobType = "LOGGED_MBSFN_MDT"';
    type string;
    min-elements 1;
    max-elements 8;
    description "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.";
    reference "5.10.25 of 3GPP TS 32.422";
}

leaf tjMDTMeasurementPeriodLTE {
    when './tjJobType = "IMMEDIATE_MDT_ONLY"
    + ' or ./tjJobType = "IMMEDIATE_MDT_AND_TRACE"';
    type uint32 {
        range "1024|1280|2048|2560|5120|"
            +"10240|60000";
    }
    units milliseconds;
    mandatory true;
    description "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.";
    reference "Clause 5.10.23 of 3GPP TS 32.422";
}

leaf tjMDTMeasurementPeriodUMTS {
    when './tjJobType = "IMMEDIATE_MDT_ONLY"
    + ' or ./tjJobType = "IMMEDIATE_MDT_AND_TRACE"';
    type uint32 {
        range "250|500|1000|2000|3000|4000|6000|8000|12000|16000|20000|"
            +"24000|28000|32000|64000";
    }
    units milliseconds;
    mandatory true;
    description "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.";
    reference "Clause 5.10.22 of 3GPP TS 32.422";
}

```

```

leaf tjMDTMeasurementQuantity {
  when './tjJobType = "IMMEDIATE_MDT_ONLY"'
    + ' or ./tjJobType = "IMMEDIATE_MDT_AND_TRACE"';
  type uint64 ;
  mandatory true;
  description "It specifies the measurements that are collected in an MDT
  job for a UMTS MDT configured for event triggered reporting.";
  reference "Clause 5.10.15 of 3GPP TS 32.422";
}

list tjMDTPLMList {
  when './tjJobType = "LOGGED_MDT_ONLY"';
  key "mcc mnc";
  uses types3gpp:PLMNId;
  min-elements 1;
  max-elements 16;
  description "It indicates the PLMNs where measurement collection, status
  indication and log reporting is allowed.";
  reference "Clause 5.10.24 of 3GPP TS 32.422";
}

leaf tjMDTPositioningMethod {
  when './tjJobType = "IMMEDIATE_MDT_ONLY"'
    + ' or ./tjJobType = "IMMEDIATE_MDT_AND_TRACE"';
  type enumeration {
    enum GNSS;
    enum E_CELL_ID;
  }
  mandatory true;
  description "It specifies what positioning method should be used in the
  MDT job.";
  reference "Clause 5.10.19 of 3GPP TS 32.422";
}

leaf tjMDTReportAmount {
  when './tjJobType = "IMMEDIATE_MDT_ONLY"'
    + ' and ./tjMDTReportingTrigger = "PERIODICAL"';
  type union {
    type uint32 {
      range "1|4|8|16|32|64" ;
    }
    type enumeration {
      enum INFINITY;
    }
  }
  mandatory true;
  description "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.";
  reference "Clause 5.10.6 of 3GPP TS 32.422";
}

leaf tjMDTReportingTrigger {
  when './tjJobType = "IMMEDIATE_MDT_ONLY"';
  type enumeration {
    enum PERIODICAL;
    enum A2_FOR_LTE;
    enum 1F_FOR_UMTS;
    enum 1I_FOR_UMTS_MCPS_TDD;
    enum A2_TRIGGERED_PERIODIC_FOR_LTE;
    enum ALL_CONFIGURED_RRM_FOR_LTE;
    enum ALL_CONFIGURED_RRM_FOR_UMTS;
  }
  description "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.";
  reference "Clause 5.10.4 of 3GPP TS 32.422";
}

leaf tjMDTReportInterval {
  when './tjJobType = "IMMEDIATE_MDT_ONLY"'
    + ' and ./tjMDTReportingTrigger = "PERIODICAL"';
  type uint32 {

```

```

    range "120|240|250|480|500|640|1000|1024|2000|2048|3000|4000|"
      +"5120|6000|8000|10240|12000|16000|20000|"
      +"24000|28000|32000|60000|64000|"
      +"360000|720000|1800000|3600000";
  }
  units milliseconds;
  mandatory true;
  description "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.";
  reference "5.10.5 of 3GPP TS 32.422";
}

leaf tjMDTReportType {
  when './tjJobType = "LOGGED_MDT_ONLY"';
  type enumeration {
    enum PERIODICAL;
    enum EVENT_TRIGGERED;
  }
  mandatory true;
  description "It specifies report type for logged NR MDT";
  reference "Clause 5.10.27 of 3GPP TS 32.422";
}

leaf tjMDTSensorInformation {
  type bits {
    bit BAROMETRIC_PRESSURE;
    bit UE_SPEED;
    bit UE_ORIENTATION;
  }
  default "";
  description "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.";
  reference "Clause 5.10.29 of 3GPP TS 32.422";
}

leaf tjMDTTraceCollectionEntityID {
  when './tjJobType = "LOGGED_MDT_ONLY" or ./tjJobType = "LOGGED_MBSFN_MDT"';
  type uint8;
  mandatory true;
  description "It specifies the TCE Id which is sent to the UE in
    Logged MDT.";
  reference "Clause 5.10.11 of 3GPP TS 32.422";
}
}

grouping TraceSubtree {
  description "Contains classes that manage Tracing.
    Should be used in all classes (or classes inheriting from)
    - SubNnetwork
    - ManagedElement
    - ManagedFunction

    If a YANG module wants to augment these classes/list/groupings they must
    augment all user classes!";
}

list TraceJob {
  description "Represents the Trace Control and Configuration parameters of a
    particular Trace Job (see TS 32.421 and TS 32.422 for details).
    It can be name-contained by SubNetwork, ManagedElement, ManagedFunction
    or NetworkSliceSubnet.

    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.

    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 activation/deactivation see clause
    4.1.1.1.2 of TS 32.422."
}

```


The attribute `tjJobType` specifies the kind of data to collect. Dependent on the selected type various parameters shall be available. The attributes `tjJobType`, `tjTraceReference`, `tjTraceRecordSessionReference`, `tjTraceCollectionEntityAddress` and `tjTraceReportingFormat` are mandatory for all job types. If streaming reporting is selected for `tjTraceReportingFormat`, `tjStreamingTraceConsumerURI` shall be present additionally. The attribute `tjPLMNTarget` shall be present if trace activation method is management based.

For the different job types the attributes are differentiated as follows:

- In case of `TRACE_ONLY` additionally the following attributes shall be available: `tjListOfNeTypes`, `tjTraceDepth`, `tjTraceTarget` and `tjTriggeringEvent`.

For this case the optional attribute `tjListOfInterfaces` allows to specify the interfaces to be recorded.

- In case of `IMMEDIATE_MDT_ONLY` additionally the following attributes shall be available:
 - `tjTraceTarget`
 - `tjMDTAnonymizationOfData`,
 - `tjMDTListOfMeasurements`,
 - `tjMDTCollectionPeriodRrmUmts` (conditional for M3, M4 and M5 in UMTS),
 - `tjMDTMeasurementPeriodUMTS` (conditional for M6 and M7 in UMTS),
 - `tjMDTCollectionPeriodRrmLte` (conditional for M2 and M3 in LTE),
 - `tjMDTMeasurementPeriodLTE` (conditional for M4 and M5 in LTE),
 - `tjMDTCollectionPeriodM6Lte` (conditional for M6 in LTE),
 - `tjMDTCollectionPeriodM7Lte` (conditional for M7 in LTE),
 - `tjMDTCollectionPeriodRrmNR` (conditional for M4 and M5 in NR),
 - `tjMDTCollectionPeriodM6NR` (conditional for M6 in NR),
 - `tjMDTCollectionPeriodM7NR` (conditional for M7 in NR),
 - `tjMDTReportInterval` (conditional for M1 in LTE or NR and M1/M2 in UMTS),
 - `tjMDTReportAmount` (conditional for M1 in LTE or NR and M1/M2 in UMTS),
 - `tjMDTReportingTrigger` (conditional for M1 in LTE or NR and M1/M2 in UMTS),
 - `tjMDTEventThreshold` (conditional for A2 event reporting or A2 event triggered periodic reporting),
 - `tjMDTMeasurementQuantity` (conditional for 1F event reporting).

For this case the optional attribute `tjMDTAreaScope` allows to specify the area in terms of cells or Tracking Area/Routing Area/Location area where the MDT data collection shall take place and the optional attributes `tjMDTPositioningMethod`, `tjMDTSensorInformation` allow to specify the positioning methods to use or the sensor information to include.

- In case of `IMMEDIATE_MDT_AND_TRACE` both additional attributes of `TRACE_ONLY` and `IMMEDIATE_MDT_ONLY` shall apply.

- In case of `LOGGED_MDT_ONLY` additionally the following attributes shall be available: `tjTraceTarget`, `tjMDTAnonymizationOfData`, `tjMDTTraceCollectionEntityID`, `tjMDTLoggingInterval`, `tjMDTLoggingDuration`, `tjMDTReportType`, `tjMDTEventListForTriggeredMeasurements`.

For this case the optional attribute `tjMDTAreaScope` allows to specify the area in terms of cells or Tracking Area/Routing Area/Location area where the MDT data collection shall take place, the optional attribute `tjMDTPLMNList` allows to specify the PLMNs where measurement collection, status indication and log reporting is allowed, the optional attribute `tjMDTAreaConfigurationForNeighCell` allows to specify the area for which UE is requested to perform measurements logging for neighbour cells which have list of frequencies and the optional attribute `tjMDTSensorInformation` allows to specify the sensor information to include.

- In case of `RLF_REPORT_ONLY` and `RCEF_REPORT_ONLY` additionally the attribute `tjTraceTarget` shall be available, the optional attribute `tjMDTAreaScope` allows to specify the eNB or list of eNBs or gNB or list of gNBs where the reports should be collected.

- In case of `LOGGED_MBSFN_MDT` additionally the following attributes shall be available: `tjMDTAnonymizationOfData`, `tjMDTLoggingInterval`, `tjMDTLoggingDuration`, `tjMDTMBSFNAreaList`.

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.";

```
key id;
uses top3gpp:Top_Grp ;
container attributes {
  uses TraceJobGrp ;
}
}
}<CODE ENDS>
```

D.3 Void

Annex E (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 |
| 2013-06 | SA#60 | SP-130304 | 002 | 2 | Correction of XML schema | 11.0.0 | 11.1.0 |
| 2014-06 | SA#64 | SP-140332 | 003 | 1 | upgrade XSD | 11.1.0 | 11.2.0 |
| | | SP-140358 | 004 | - | remove the feature support statements | | |
| 2014-09 | SA#65 | SP-140560 | 005 | - | Update the link from Solution Set to Information Service due to the end of Release 12 | 11.2.0 | 12.0.0 |
| 2015-12 | SA#70 | SP-150691 | 006 | 1 | Add missing id attribute | 12.0.0 | 12.1.0 |
| 2016-01 | | | | | Upgrade to Rel-13 (MCC) | 12.1.0 | 13.0.0 |
| 2016-03 | SA#71 | SP-160031 | 010 | 1 | Make the XML schema well formed | 13.0.0 | 13.1.0 |

| Change history | | | | | | | |
|----------------|---------|-----------|------|-----|-----|---|-------------|
| Date | Meeting | TDoc | CR | Rev | Cat | Subject/Comment | New version |
| 2016-06 | SA#72 | SP-160407 | 0011 | - | F | Update the link from IRP Solution Set to IRP Information Service | 13.2.0 |
| 2017-03 | SA#75 | - | - | - | | Promotion to Release 14 without technical change | 14.0.0 |
| 2017-06 | SA#76 | SP-170510 | 0015 | 2 | B | Modifications to align with IS to support Configuration Management for mobile networks that include virtualized network functions | 14.1.0 |
| 2018-03 | SA#79 | SP-180060 | 0016 | 1 | B | Add attribute peeParametersList to Solution Set definitions | 15.0.0 |
| 2018-12 | SA#82 | SP-181042 | 0018 | 1 | F | Update NRM root IOCs Solution Set to support priority | 15.1.0 |
| 2019-03 | SA#83 | SP-190121 | 0020 | 1 | F | Update Generic NRM Solution Set to support JSON | 15.2.0 |
| 2019-06 | SA#84 | SP-190371 | 0021 | - | B | Add IOCs for threshold monitoring control | 16.0.0 |
| 2019-09 | SA#85 | SP-190745 | 0026 | 1 | F | generate JSON definition for generic NRM based on new style guideline | 16.1.0 |
| 2019-09 | SA#85 | SP-190744 | 0027 | - | A | Add IDL XML YANG solutions | 16.1.0 |
| 2019-09 | SA#85 | SP-190751 | 0029 | - | A | Correct references and remove not need abbreviations | 16.1.0 |
| 2019-12 | SA#86 | SP-191166 | 0031 | 1 | F | Correct XML solution set for generic NRM | 16.2.0 |
| 2019-12 | SA#86 | SP-191166 | 0035 | - | B | Updates to YANG SS | 16.2.0 |
| 2019-12 | SA#86 | SP-191173 | 0037 | 1 | A | Add the definition of attribute measurementsList | 16.2.0 |
| 2019-12 | SA#86 | SP-191166 | 0039 | - | B | Add heartbeat control NRM fragment - Stage 3 | 16.2.0 |
| 2019-12 | SA#86 | SP-191166 | 0040 | - | B | Add notification subscription control NRM fragment - Stage 3 | 16.2.0 |
| 2020-03 | SA#87E | SP-200163 | 0041 | 2 | B | Add configurable KPI control NRM | 16.3.0 |
| 2020-03 | SA#87E | SP-200163 | 0042 | - | B | Add configurable FM - YANG Solution | 16.3.0 |
| 2020-03 | SA#87E | SP-200230 | 0043 | 1 | F | Add OpenAPI definitions required by the ProvMnS | 16.3.0 |
| 2020-03 | SA#87E | SP-200169 | 0045 | | F | Correct errors in yang solution set | 16.3.0 |
| 2020-03 | SA#87E | | | | | Correction in the implementation of CR0041 | 16.3.1 |
| 2020-03 | SA#87E | | | | | Correction of implementation | 16.3.2 |
| 2020-07 | SA#88E | SP-200490 | 0046 | 2 | B | Add OpenAPI definitions for the FM control fragment | 16.4.0 |
| 2020-07 | SA#88E | SP-200489 | 0047 | - | F | Correct OpenAPI definition for notificationTypes | 16.4.0 |
| 2020-07 | SA#88E | SP-200483 | 0079 | 2 | B | Add trace control NRM fragment stage 3 | 16.4.0 |
| 2020-07 | SA#88E | SP-200484 | 0080 | - | D | Fix inconsistent formatting | 16.4.0 |
| 2020-07 | SA#88E | SP-200493 | 0081 | - | B | Stage3 add the NRM fragment for SON management | 16.4.0 |
| 2020-07 | SA#88E | SP-200485 | 0082 | - | F | Update the definition of SNssai | 16.4.0 |
| 2020-07 | SA#88E | SP-200490 | 0084 | - | F | Update ManagedElement YANG module | 16.4.0 |
| 2020-07 | SA#88E | SP-200596 | 0085 | 1 | F | Update Nrm YANG | 16.4.0 |
| 2020-07 | SA#88E | SP-200490 | 0087 | 2 | F | Update PM control fragment (OpenAPI definitions) | 16.4.0 |
| 2020-07 | SA#88E | SP-200490 | 0088 | - | F | Clarify usage of the VsDataContainer (OpenAPI definitions) | 16.4.0 |
| 2020-07 | SA#88E | SP-200490 | 0089 | - | F | Add common data definitions (OpenAPI definitions) | 16.4.0 |
| 2020-07 | SA#88E | SP-200490 | 0091 | - | F | Update FM control fragment (YANG definitions) | 16.4.0 |
| 2020-07 | SA#88E | SP-200490 | 0092 | - | F | Update PM Control fragment (YANG definitions) | 16.4.0 |
| 2020-07 | SA#88E | SP-200490 | 0093 | 1 | F | Correct genericNRM definition in XML solution | 16.4.0 |
| 2020-09 | SA#89e | SP-200729 | 0095 | - | F | Correction of YANG errors | 16.5.0 |
| 2020-09 | SA#89e | SP-200727 | 0101 | 1 | A | Clean-up definitions and references | 16.5.0 |
| 2020-09 | SA#89e | SP-200729 | 0102 | - | B | YANG SS for Trace Control | 16.5.0 |
| 2020-09 | SA#89e | SP-200724 | 0103 | - | F | Add missing definitions to comDefs.yaml (OpenAPI definitions) | 16.5.0 |
| 2020-09 | SA#89e | SP-200724 | 0104 | - | F | Correct various smaller errors (e.g. validation errors) in genericNRM.yaml (OpenAPI definitions) | 16.5.0 |
| 2020-09 | SA#89e | SP-200729 | 0105 | 1 | F | Correct ThresholdMonitor definition (OpenAPI definitions) | 16.5.0 |
| 2020-09 | SA#89e | SP-200729 | 0106 | - | F | Update HeartbeatControl YANG definition | 16.5.0 |
| 2020-09 | SA#89e | SP-200729 | 0107 | - | F | Update ThresholdMonitor YANG definition | 16.5.0 |
| 2020-12 | SA#90e | SP-201057 | 0108 | - | F | Correction of NRM YANG errors | 16.6.0 |
| 2020-12 | SA#90e | SP-201063 | 0109 | 1 | F | Add new MDT specific parameter collection period for NR aligning with 28.622 for stage 3 | 16.6.0 |
| 2020-12 | SA#90e | SP-201057 | 0110 | - | F | Remove thresholdLevel attribute from ThresholdMonitor (OpenAPI definition) | 16.6.0 |
| 2020-12 | SA#90e | SP-201050 | 0111 | 1 | F | Correct and add types in comDefs.yaml (OpenAPI definition) | 16.6.0 |
| 2020-12 | SA#90e | SP-201050 | 0112 | 1 | F | Use comDefs.yaml instead of local definitions in genericNrm.yaml (OpenAPI definition) | 16.6.0 |
| 2020-12 | SA#90e | SP-201057 | 0113 | 1 | F | Update attribute perfMetricJobGroupId. | 16.6.0 |
| 2020-12 | SA#90e | SP-201057 | 0114 | - | F | Remove value handling from the granularityPeriod description | 16.6.0 |
| 2020-12 | SA#90e | SP-201088 | 0115 | - | F | Correct and add types in comDefs.yaml (OpenAPI definition) | 16.6.0 |
| 2020-12 | SA#90e | SP-201063 | 0117 | | F | Correct trace target parameter for trace control in stage 3 | 16.6.0 |
| 2020-12 | SA#90e | SP-201089 | 0118 | 1 | F | Remove incorrect S-NSSAI definition from YANG SS | 16.6.0 |
| 2021-03 | SA#91e | SP-210146 | 0121 | - | F | Fix compilation errors | 16.7.0 |
| 2021-03 | SA#91e | SP-210153 | 0125 | - | F | YANG compilation error and missing stage 2 corrections | 16.7.0 |
| 2021-06 | SA#92e | SP-210406 | 0119 | 2 | F | Replace legacy IRPAgent with MnsAgent (OpenAPI definition) | 16.8.0 |
| 2021-06 | SA#92e | SP-210397 | 0127 | 1 | F | Correction of Trace/MDT related parameters (OpenAPI definition) | 16.8.0 |

| | | | | | | | |
|---------|--------|-----------|------|---|---|---|--------|
| 2021-06 | SA#92e | SP-210397 | 0128 | 1 | F | Align Trace/MDT related parameters to TS 32.422 (OpenAPI definition) | 16.8.0 |
| 2021-06 | SA#92e | SP-210406 | 0129 | 1 | F | Clean up regarding common data types (OpenAPI definition) | 16.8.0 |
| 2021-06 | SA#92e | SP-210411 | 0130 | - | F | Correct definition of additionalInformation (YANG) | 16.8.0 |
| 2021-09 | SA#93e | SP-210886 | 0131 | 1 | F | Replace local data type definition for notificationFilter by common filter definition | 16.9.0 |
| 2021-09 | SA#93e | SP-210886 | 0132 | 1 | F | Correct data type of notificationId (YANG definitions) | 16.9.0 |
| 2021-09 | SA#93e | SP-210886 | 0133 | 1 | F | Clarify resource id is required and nullable (OpenAPI definitions) | 16.9.0 |
| 2021-09 | SA#93e | SP-210865 | 0134 | - | F | Correction and clarification of reporting in TraceJob (stage3) | 16.9.0 |
| 2021-09 | SA#93e | SP-210865 | 0135 | - | F | Adaptation and cleanup of Trace/MDT related parameters (stage3) | 16.9.0 |
| 2021-09 | SA#93e | SP-210871 | 0136 | - | F | YANG updates to correct YANG merging problems | 16.9.0 |
| 2021-09 | SA#93e | SP-210867 | 0137 | 1 | F | Correction of YANG Solution set | 16.9.0 |

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 |
| V16.8.0 | August 2021 | Publication |
| V16.9.0 | October 2021 | Publication |