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Contents

Foreword

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Introduction

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

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

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

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

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 V15.2.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].

XML file: file containing an XML document

XML document: composed of the succession of an optional XML declaration followed by a root XML element

NOTE: See [8]; in the scope of the present document.

XML declaration: it specifies the version of XML being used

NOTE: See [8].

XML element: has a type, is identified by a name, may have a set of XML attribute specifications and is either composed of the succession of an XML start-tag followed by the XML content of the XML element followed by an XML end-tag, or composed simply of an XML empty-element tag; each XML element may contain other XML elements

NOTE: See [8].

empty XML element: having an empty XML content; an empty XML element still possibly has a set of XML attribute specifications; an empty XML element is either composed of the succession of an XML start-tag directly followed by an XML end-tag, or composed simply of an XML empty-element tag

NOTE: See [8].

XML content (of an XML element): empty if the XML element is simply composed of an XML empty-element tag; otherwise the part, possibly empty, of the XML element between its XML start-tag and its XML end-tag

XML start-tag: the beginning of a non-empty XML element is marked by an XML start-tag containing the name and the set of XML attribute specifications of the XML element

NOTE: See [8].

XML end-tag: the end of a non-empty XML element is marked by an XML end-tag containing the name of the XML element

NOTE: See [8].

XML empty-element tag: composed simply of an empty-element tag containing the name and the set of XML attribute specifications of the XML element.

NOTE: See [8].

XML attribute specification: has a name and a value

NOTE: See [8].

DTD: defines structure and content constraints to be respected by an XML document to be valid with regard to this DTD

NOTE: See [8].

XML schema: more powerful than a DTD, an XML schema defines structure and content constraints to be respected by an XML document to conform with this XML schema; through the use of XML namespaces several XML schemas can be used together by a single XML document; an XML schema is itself also an XML document that shall conform with the XML schema for XML schemas

NOTE: See [10] and [11].

XML namespace: enables qualifying element and attribute names used in XML documents by associating them with namespaces identified by different XML schemas

NOTE: See [12], in the scope of the present document.

XML complex type: defined in an XML schema; cannot be directly used in an XML document; can be the concrete type or the derivation base type for an XML element type or for another XML complex type; ultimately defines constraints for an XML element on its XML attribute specifications and/or its XML content

NOTE: See [10] and [11].

XML element type: declared by an XML schema; can be directly used in an XML document; as the concrete type of an XML element, directly or indirectly defines constraints on its XML attribute specifications and/or its XML content; can also be the concrete type or the derivation base type for another XML element type

NOTE: See [10] and [11].

For additional terms and definitions please refer to 3GPP TS 32.101 [1], 3GPP TS 32.102 [2], 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] 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].

CM	Configuration Management
DN	Distinguished Name
DTD	Document Type Definition
JSON	JavaScript Object Notation
MO	Managed Object
MOC	Managed Object Class
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).

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.3 Solution Set 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;
```

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

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

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



};

    /**
     *  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 PMOperationalStateType
    {
       ENABLED,
       DISABLED
    };

    typedef MOReferenceSet ManagedObjectDNsType;

    typedef MOReferenceSet 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";
         const string measurements = "measurements";
      };

      /**
       *  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";
         const string measurements = "measurements";
      };

      /**
       *  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";
   const string measurements = "measurements";
};

/**
 *  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";
        const string measurements = "measurements";
      };

    /**
     * Definitions for MO class MeasurementControl
     */
    interface MeasurementControl: GenericNetworkResourcesNRMDefs::Top
    {
        const string CLASS = "MeasurementControl";
        // Attribute Names
        //
        const string id= "id";
        const string pMAdministrativeState = "pMAdministrativeState";
        const string pMOperationalState = "pMOperationalState";
        const string defaultFileBasedGP = "defaultFileBasedGP";
        const string defaultFileReportingPeriod = "defaultFileReportingPeriod";
        const string defaultFileLocation = "defaultFileLocation";
        const string defaultStreamBasedGP = "defaultStreamBasedGP";
        const string defaultStreamTarget = "defaultStreamTarget";
    };

    /**
     * Definitions for MO class MeasurementReader
     */
    interface MeasurementReader: GenericNetworkResourcesNRMDefs::Top
    {
        const string CLASS = "MeasurementReader";
        // Attribute Names
        //
        const string id= "id";
        const string measurementTypes = "measurementTypes";
        const string fileBasedGP = "fileBasedGP";
        const string fileReportingPeriod = "fileReportingPeriod";
        const string fileLocation = "fileLocation";
        const string streamBasedGP = "streamBasedGP";
        const string streamTarget = "streamTarget";
        const string managedObjectDNsBasic = "managedObjectDNsBasic";
        const string managedObjectDNs = "managedObjectDNs";
    };



      /**
       *  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 [4].

The XML file formats are based on XML [8], XML Schema [10] [11] and XML Namespace [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 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"/>
```

```
      <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>

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

  <complexType name="MeasurementTypesAndGPsList">
    <sequence>
      <element name="measurementTypesAndGPs" type="xn:MeasurementTypesAndGPs" minOccurs="1"
maxOccurs="unbounded"/>
    </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" type="string"/>
                  <element name="userDefinedNetworkType"/>
                  <element name="setOfMcc" minOccurs="0"/>
                  <element name="priority" type="integer" minOccurs="0"/>
                  <element name="measurements" type="xn:MeasurementTypesAndGPsList" 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"/>
            </choice>
            <choice minOccurs="0" maxOccurs="unbounded">
              <element ref="xn:MeasurementControl"/>
            </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" type="string"/>
                  <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="measurements" type="xn:MeasurementTypesAndGPsList" minOccurs="0"/>
                </all>
              </complexType>
            </element>
            <choice minOccurs="0" maxOccurs="unbounded">
              <element ref="xn:IRPAgent"/>
              <element ref="xn:ManagedElementOptionallyContainedNrmClass"/>
              <element ref="xn:VsDataContainer"/>
            </choice>
            <choice minOccurs="0" maxOccurs="unbounded">
              <element ref="xn:MeasurementControl"/>
            </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="measurements" type="xn:MeasurementTypesAndGPsList" minOccurs="0"/>

              </all>
            </complexType>
          </element>
          <choice minOccurs="0" maxOccurs="unbounded">
            <element ref="xn:VsDataContainer"/>
            <element ref="xn:EP_RP"/>
          </choice>
          <choice minOccurs="0" maxOccurs="unbounded">
            <element ref="xn:MeasurementControl"/>
          </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" type="string"/>
                <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"/>
                <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"/>
              </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>

<!--
  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"
/>

</schema>
```

Annex C (normative): JSON definitions

C.1 General

This annex contains the JSON Definitions for the Generic NRM, in accordance with Generic NRM IRP IS definitions [4].

C.2 Architectural features

C.2.1 Introduction

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

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

C.2.2 Syntax for Distinguished Names

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

C.3 Mapping

Refer to TS 32.160 [x].

C.4 Solution Set (SS) definitions

C.4.1 JSON definition structure

JSON is used as resource representations format carried in the HTTP request and HTTP response message bodies. The properties (key-value pairs) on an object are defined using the properties keyword.

The definition of the JSON resource object complies with the generic rules defined in 3GPP TS 32.158 [13].

C.4.2 Graphical representation

None.

C.4.3 JSON schema "genericNrm.json"

```
{
  "openapi": "3.0.1",
  "info": {
    "title": "3GPP generic NRM",
    "version": "15.3.0",
    "description": "OAS 3.0.1 specification compatible schema for 3GPP generic NRM"
  },
  "paths": {},
  "components": {
    "schemas": {
```

```
"Dn": {
  "type": "string",
  "maxLength": 400
},
"DnList": {
  "type": "array",
  "items": {
    "$ref": "#/components/schemas/Dn"
  }
},
"Mcc": {
  "type": "string",
  "pattern": "^[0-9]{3}$"
},
"AdministrativeState": {
  "type": "string",
  "enum": [
    "LOCKED",
    "SHUTTING_DOWN",
    "UNLOCKED"
  ]
},
"OperationalState": {
  "type": "string",
  "enum": [
    "ENABLED",
    "DISABLED"
  ]
},
"SetOfMcc": {
  "type": "array",
  "items": {
    "$ref": "#/components/schemas/Mcc"
  }
},
"ManagedElementType": {
  "type": "string"
},
"ManagedElementTypeList": {
  "type": "array",
  "items": {
    "$ref": "#/components/schemas/ManagedElementType"
  }
},
"VnfParameter": {
  "type": "object",
  "properties": {
    "vnfInstanceId": {
      "type": "string"
    },
    "vnfdId": {
      "type": "string"
    },
    "flavourId": {
      "type": "string"
    },
    "autoScalable": {
      "type": "boolean"
    }
  }
},
"VnfParametersList": {
  "type": "array",
  "items": {
    "$ref": "#/components/schemas/VnfParameter"
  }
},
"SiteLatitude": {
  "type": "number",
  "format": "float",
  "minimum": -90,
  "maximum": 90
},
"SiteLongitude": {
  "type": "number",
  "format": "float",
  "minimum": -180,
  "maximum": 180
```

```
      },
      "PeeParameter": {
        "type": "object",
        "properties": {
          "siteIdentification": {
            "type": "string"
          },
          "siteDescription": {
            "type": "string"
          },
          "siteLatitude": {
            "$ref": "#/components/schemas/SiteLatitude"
          },
          "siteLongitude": {
            "$ref": "#/components/schemas/SiteLongitude"
          },
          "equipmentType": {
            "type": "string"
          },
          "environmentType": {
            "type": "string"
          },
          "powerInterface": {
            "type": "string"
          }
        }
      },
      "PeeParametersList": {
        "type": "array",
        "items": {
          "$ref": "#/components/schemas/PeeParameter"
        }
      },
      "Ipv4Addr": {
        "type": "string",
        "pattern": "^(([0-9]|[1-9][0-9]|1[0-9][0-9]|2[0-4][0-9]|25[0-5])\\.){3}([0-9]|[1-9][0-
9]|1[0-9][0-9]|2[0-4][0-9]|25[0-5])$",
        "example": "198.51.100.1"
      },
      "Ipv4AddrRm": {
        "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])$",
        "example": "198.51.100.1",
        "nullable": true
      },
      "Ipv6Addr": {
        "type": "string",
        "allOf": [
          {
            "pattern": "^((:|(0?|([1-9a-f][0-9a-f]{0,3}))):)((0?|([1-9a-f][0-9a-
f]{0,3})):){0,6}(:|(0?|([1-9a-f][0-9a-f]{0,3})))$"
          },
          {
            "pattern": "^((([^:]+:){7}([^:]+))|((([^:]+:)*[^:]+)?::(([^:]+:)*[^:]+)?))$"
          }
        ],
        "example": "2001:db8:85a3::8a2e:370:7334"
      },
      "Ipv6AddrRm": {
        "type": "string",
        "allOf": [
          {
            "pattern": "^((:|(0?|([1-9a-f][0-9a-f]{0,3}))):)((0?|([1-9a-f][0-9a-
f]{0,3})):){0,6}(:|(0?|([1-9a-f][0-9a-f]{0,3})))$"
          },
          {
            "pattern": "^((([^:]+:){7}([^:]+))|((([^:]+:)*[^:]+)?::(([^:]+:)*[^:]+)?))$"
          }
        ],
        "example": "2001:db8:85a3::8a2e:370:7334",
        "nullable": true
      },
      "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])|([0-9]{2})|(1[0-1][0-9])|(12[0-8])))$"
          },
          {
            "pattern": "^((([^:]+:){7}([^:]+))|((([^:]+:)*[^:]+)?::(([^:]+:)*[^:]+)?))(\\/.+)$"
          }
        ],
        "example": "2001:db8:abcd:12::0/64"
      },
      "TransportProtocol": {
        "anyOf": [
          {
            "type": "string",
            "enum": [
              "TCP"
            ]
          },
          {
            "type": "string"
          }
        ]
      },
      "MeasurementTypeAndGPs": {
        "type": "object",
        "properties": {
          "measurementType": {
            "type": "string"
          },
          "gPs": {
            "type": "array",
            "items": {
              "type": "integer"
            }
          }
        }
      },
      "Top-Attributes": {
        "type": "object",
        "properties": {
          "id": {
            "type": "string"
          }
        }
      },
      "SubNetwork-Attributes": {
        "type": "object",
        "properties": {
          "dnPrefix": {
            "type": "string"
          },
          "userLabel": {
            "type": "string"
          },
          "userDefinedNetworkType": {
            "type": "string"
          },
          "setOfMcc": {
            "$ref": "#/components/schemas/SetOfMcc"
          },
          "priorityLabel": {
            "type": "integer"
          },
          "measurements": {
            "type": "array",
            "items": {
              "$ref": "#/components/schemas/MeasurementTypeAndGPs"
            }
          }
        }
      },
      "ManagedElement-Attributes": {
        "type": "object",
        "properties": {
          "dnPrefix": {
            "type": "string"
          },
          "managedElementTypeList": {
            "$ref": "#/components/schemas/ManagedElementTypeList"
```

```
      },
      "userLabel": {
        "type": "string"
      },
      "locationName": {
        "type": "string"
      },
      "managedBy": {
        "$ref": "#/components/schemas/DnList"
      },
      "vendorName": {
        "type": "string"
      },
      "userDefinedState": {
        "type": "string"
      },
      "swVersion": {
        "type": "string"
      },
      "priorityLabel": {
        "type": "integer"
      },
      "measurements": {
        "type": "array",
        "items": {
          "$ref": "#/components/schemas/MeasurementTypeAndGPs"
        }
      }
    }
  },
  "ManagedFunction-Attributes": {
    "type": "object",
    "properties": {
      "userLabel": {
        "type": "string"
      },
      "vnfParametersList": {
        "$ref": "#/components/schemas/VnfParametersList"
      },
      "peeParametersList": {
        "$ref": "#/components/schemas/PeeParametersList"
      },
      "priorityLabel": {
        "type": "integer"
      },
      "measurements": {
        "type": "array",
        "items": {
          "$ref": "#/components/schemas/MeasurementTypeAndGPs"
        }
      }
    }
  },
  "EP_RP-Attributes": {
    "type": "object",
    "properties": {
      "userLabel": {
        "type": "string"
      },
      "farEndEntity": {
        "type": "string"
      },
      "measurements": {
        "type": "array",
        "items": {
          "$ref": "#/components/schemas/MeasurementTypeAndGPs"
        }
      }
    }
  },
  "SubNetwork-ContainingObjects": {
    "type": "object",
    "properties": {
      "ManagementNode": {
        "$ref": "#/components/schemas/ManagementNode-Multiple"
      },
      "MeContext": {
        "$ref": "#/components/schemas/MeContext-Multiple"
```

```
      },
      "MeasurementControl": {
        "$ref": "#/components/schemas/MeasurementControl-Multiple"
      },
      "VsDataContainer": {
        "$ref": "#/components/schemas/VsDataContainer-Multiple"
      }
    }
  },
  "ManagedElement-ContainingObjects": {
    "type": "object",
    "properties": {
      "MeasurementControl": {
        "$ref": "#/components/schemas/MeasurementControl-Multiple"
      },
      "VsDataContainer": {
        "$ref": "#/components/schemas/VsDataContainer-Multiple"
      }
    }
  },
  "ManagedFunction-ContainingObjects": {
    "type": "object",
    "properties": {
      "MeasurementControl": {
        "$ref": "#/components/schemas/MeasurementControl-Multiple"
      },
      "VsDataContainer": {
        "$ref": "#/components/schemas/VsDataContainer-Multiple"
      }
    }
  },
  "ManagementNode-Single": {
    "type": "object",
    "required": [
      "id"
    ],
    "properties": {
      "id": {
        "type": "string"
      },
      "attributes": {
        "type": "object",
        "properties": {
          "userLabel": {
            "type": "string"
          },
          "managedElements": {
            "$ref": "#/components/schemas/DnList"
          },
          "vendorName": {
            "type": "string"
          },
          "userDefinedState": {
            "type": "string"
          },
          "locationName": {
            "type": "string"
          },
          "swVersion": {
            "type": "string"
          }
        }
      }
    }
  },
  "ManagementNode-Multiple": {
    "type": "array",
    "items": {
      "$ref": "#/components/schemas/ManagementNode-Single"
    }
  },
  "MeContext-Single": {
    "type": "object",
    "required": [
      "id"
    ],
    "properties": {
      "id": {
```

```
        "type": "string"
      },
      "attributes": {
        "type": "object",
        "properties": {
          "dnPrefix": {
            "type": "string"
          }
        }
      }
    }
  },
  "MeContext-Multiple": {
    "type": "array",
    "items": {
      "$ref": "#/components/schemas/MeContext-Single"
    }
  },
  "VsDataContainer-Single": {
    "type": "object",
    "required": [
      "id"
    ],
    "properties": {
      "id": {
        "type": "string"
      },
      "attributes": {
        "type": "object",
        "properties": {
          "vsDataType": {
            "type": "string"
          },
          "vsDataFormatVersion": {
            "type": "string"
          },
          "vsData": {
            "type": "object",
            "properties": {}
          }
        }
      }
    }
  },
  "VsDataContainer-Multiple": {
    "type": "array",
    "items": {
      "$ref": "#/components/schemas/VsDataContainer-Single"
    }
  },
  "MeasurementControl-Single": {
    "type": "object",
    "properties": {
      "id": {
        "type": "string"
      },
      "attributes": {
        "type": "object",
        "properties": {
          "pMAdministrativeState": {
            "$ref": "#/components/schemas/AdministrativeState"
          },
          "pMOperationalState": {
            "$ref": "#/components/schemas/OperationalState"
          },
          "defaultFileBasedGp": {
            "type": "integer"
          },
          "defaultFileReportPeriod": {
            "type": "integer"
          },
          "defaultStreamBasedGp": {
            "type": "integer"
          },
          "defaultFileLocation": {
            "type": "string"
          },
          "defaultStreamTarget": {
```

```
                "type": "string"
              }
            }
          },
          "MeasurementReader": {
            "$ref": "#/components/schemas/MeasurementReader-Multiple"
          }
        }
      },
      "MeasurementControl-Multiple": {
        "type": "array",
        "items": {
          "$ref": "#/components/schemas/MeasurementControl-Single"
        }
      },
      "MeasurementReader-Single": {
        "type": "object",
        "properties": {
          "id": {
            "type": "string"
          },
          "attributes": {
            "type": "object",
            "properties": {
              "measurementTypes": {
                "type": "string"
              },
              "fileBasedGp": {
                "type": "integer"
              },
              "fileReportingPeriod": {
                "type": "integer"
              },
              "streamBasedGp": {
                "type": "integer"
              },
              "fileLocation": {
                "type": "string"
              },
              "streamTarget": {
                "type": "string"
              },
              "managementObjectDNsBasic": {
                "$ref": "#/components/schemas/DnList"
              },
              "managementObjectDNs": {
                "$ref": "#/components/schemas/DnList"
              }
            }
          }
        }
      },
      "MeasurementReader-Multiple": {
        "type": "array",
        "items": {
          "$ref": "#/components/schemas/MeasurementReader-Single"
        }
      }
    }
  }
}
```

Annex D (normative): YANG definitions

D.1 General

This annex contains the YANG definitions for the Generic NRM.

D.2 Modules

This is the list of YANG modules for the Generic NRM.

```
_3gpp-common-ep-rp.yang
_3gpp-common-managed-element.yang
_3gpp-common-managed-function.yang
_3gpp-common-measurements.yang
_3gpp-common-subnetwork.yang
_3gpp-common-top.yang
_3gpp-common-yang-extensions.yang
_3gpp-common-yang-types.yang
```

This is the YANG modules for the Generic NRM.

```
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";
  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 2019-06-17 {
    description "Initial revision";
    reference "Based on
      3GPP TS 28.620 V15.X.XX
      3GPP TS 28.622 V15.X.XX";
  }

  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:Measurements;
    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;
    }
  }
}
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; }

  organization "3GPP SA5";
  description "Defines ManagedElement which will be augmented
      by other IOCs";
  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";
    reference "Based on
      3GPP TS 28.620 V15.X.XX
      3GPP TS 28.622 V15.X.XX";
   }

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

  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 Distingushed 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:Measurements {
    if-feature MeasurementsUnderManagedElement ;
  }

  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 ME communicates with a manager (directly or indirectly) over one or
    more management interfaces for the purpose of being monitored and/or
    controlled. MEs may or may not additionally perform element management
    functionality.
    An ME contains equipment that may or may not be geographically
```

```
      distributed. An ME is often referred to as a Network Element.
      A telecommunication equipment has software and hardware components.
      The IOC described above represents the case when the software component
      is designed to run on dedicated hardware component. In the case when the
      software is designed to run on ETSI NFV defined NFVI [15], the 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 ManagedElement IOC may be used to represent combined ME functionalit
      y (as indicated by the managedElementType attribute and the contained
      instances of different functional IOCs).";

    key id;   // TODO: should this have a min-element/max-elements?
    uses top3gpp:Top_Grp;
    container attributes {
      uses ManagedElementGrp;
    }

    uses meas3gpp:MeasurementSubtree {
      if-feature MeasurementsUnderManagedElement ;
    }
  }
}
module _3gpp-common-managed-function {
  yang-version 1.1;
  namespace urn:3gpp:sa5:_3gpp-common-managed-function;
  prefix mf3gpp;

  organization "3GPP SA5";
  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 2019-06-18 {
    description "Initial revision";
    reference "Based on
      3GPP TS 28.620 V15.X.XX
      3GPP TS 28.622 V15.X.XX ";
  }

  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.";

    uses Function_Grp;

    container vnfParametersList {
      description "Contains the parameter set of the VNF
        instance(s) corresponding to an NE.";
      presence "The presence of this container indicates that the ManagedFunction
        represented is realized by one or more VNF instance(s). Otherwise it
        shall be absent.";

      leaf vnfInstanceId {
        type string ;
        mandatory true;
        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;
        Ve-Vnfm reference point - Interface and Information Model Specification
        section 9.4.3";
    }

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

  container peeParametersList {
    description "Contains the parameter set for the control
      and monitoring of power, energy and environmental parameters of
      ManagedFunction instance(s).";
    presence "Present supported if the control and monitoring of PEE
      parameters is supported by the ManagedFunction or sub-class instance.";

    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;
    }
  }
}
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";

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

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

    B) include the attribute supportedMeasurementsGPs indicating the
      supported measurmentTypes and GPs. Note that for classes inheriting from
      ManagedFunction, EP_RP or SubNetwork this attribute is already inherited,
      so there is no need to include it once more.E.g.

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

    C) include the classes MeasurementControl & MeasuremntReader to
      control the measurements. 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 EP_RP, Subnetwork or
    ManagedFunction.";

  reference "3GPP TS 28.622
      Generic Network Resource Model (NRM)
```

```
    Integration Reference Point (IRP);
    Information Service (IS)";

  revision 2019-06-17 {
    reference "Based on
      3GPP TS 28.622 V15.X.XX";
  }

  feature StreamingSupported {
    description "The delivery of measurement data using streaming is supported.";
  }

  grouping Measurements {
    description "Identifies the supported Measurement types and their
      supported GPs.";

    list supportedMeasurementsGPs {
      config false;
      key measurementType;
      description "List of supported Measurement types and their
        supported GPs for the parent function/class";

      leaf measurementType {
        type string;
      }

      leaf-list supportedGPs {
      type uint32 ;
      min-elements 1;
      units second;
      description "GP (granularity period) is the time between the initiation
          of two successive gatherings of measurement data.";
      }
    }
  }

  grouping MeasurementControlGrp {
    description "represents the capabilities to produce and deliver Measurements
      identified by a MeasurementReader.
      There are two delivery methods (i.e. file-based and stream-based) via
      which the consumer(s) can receive the Measurements.";

    leaf pMAdministrativeState {
      default LOCKED;
      type types3gpp:AdministrativeState ;
      description "It describes the permission to use or prohibition against
        using the capability of MeasurementControl, imposed through the consumer
        of OAM services produced by MeasurementControl,

        The measurement report production would begin when pMadministrativeState
        is UNLOCKED and pMoperationalState is ENABLED.";
    }

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

    leaf defaultFileLocation {
      type string ;
      description "It is the path to the location where produced
        measurement reports (containing PM data) are stored. File based
        measurement delivery will not start if this leaf does not have a
        valid value.

        It is the path to a location on either the producer's file system or a
        URI to a network file location that is not part of the producer's file
        system. In case it points to a location on the producer's file system,
        it is a relative path based on a vendor-specified root directory for
        measurement files.

        The size of this fileLocation is decided by consumer and producer.
        The producer is expected to remove old files to make room for
        new files, when necessary.

        This value is ignored in case the fileLocation leaf in the
```

```
        MeasurementReader is defined.";
    }

    leaf defaultFileBasedGP {
      when '../defaultFileLocation' ;
      mandatory true;
      type uint32 ;
      units second;
      description "GP (granularity period) defines the frequency of producing
        measurement data. Measurement data would be produced immediately at the
        end of each fileBasedGP.

        This value is ignored in case the fileBasedGP leaf in the
        MeasurementReader is defined.";
    }

    leaf defaultFileReportingPeriod {
      when '../defaultFileLocation' ;
      must '. *60 >= ../defaultFileBasedGP' {
        error-message "defaultFileBasedGP must not be greater than defaultFileReportingPeriod";
      }
      mandatory true;
      type uint32 ;
      units minute;
      description "The frequency of producing the measurement report files.
        A measurement report file contains multiple measurement data.

        This value is ignored in case the fileReportingPeriod leaf in the
        MeasurementReader is defined.";
    }

    leaf defaultStreamTarget {
      if-feature StreamingSupported ;
      type string ;
      description "Identifies the target of the notifications carrying the
        content of the measurement report.

        This value is ignored in case the streamTarget leaf in the
        MeasurementReader is defined.";
    }

    leaf defaultStreamBasedGP {
      if-feature StreamingSupported ;
      when '../defaultStreamTarget' ;
      mandatory true;
      type uint32 ;
      units second;
      description "It defines the frequency of producing and sending the
        Measurement to the streamTargets.

        This value is ignored in case the streamBasedGP leaf in the
        MeasurementReader is defined.";
    }
  }

  grouping MeasurementReaderGrp {
    description "Identifies the entity whose Measurements are required by
    consumer, the types of Measurements required and the delivery method for
    the measurements.";

    leaf-list measurementTypes {
      type string ;
      description "The Measurement type to be reported. It must be one of the
        measurmentTypes supported by the containing function/class.
        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-list managedObjectDNsBasic {
      type types3gpp:DistinguishedName ;
      description "Identifies the managed functions whose Measurements are
        required to be produced.

        It identifies specific managed entities (say X, Y, Z). It would mean
        Measurements type specified in MeasurementReader.measurementTypes,
        are required to be produced if X, Y, Z are capable of supporting
        the Measurement types.
```

```
      If managedObjectDNs of the same MeasurementReader instance has valid
      information, the information of this leaf-list is ignored.";
    }

    leaf-list managedObjectDNs {
      type types3gpp:DistinguishedName ;
      description "Identifies the managed entities whose Measurements are
        required to be produced.

        In case the base is SubNetwork, it identifies all, including the base,
        managed entities that are subordinates, in the sense of name-containment,
        of the base.

        In case the base is NetworkSliceSubnet, it identifies all, including
        the base, managed entities that has aggregation association relation
        with the base.

        We called the identified entities a collection. It would mean
        Measurement types specified in attribute
        MeasurementReader.measurementTypes, are required to be produced if the
        member (of the collection) is capable of supporting the Measurement
        types.";
    }

    leaf fileLocation {
      type string ;
      description "It is the path to the location where produced
        measurement reports (containing PM data) are stored. File based
        measurement delivery will not start if this leaf does not have a
        valid value.

        It is the path to a location on either the producer's file system or a
        URI to a network file location that is not part of the producer's file
        system. In case it points to a location on the producer's file system,
        it is a relative path based on a vendor-specified root directory for
        measurement files.

        The size of this fileLocation is decided by consumer and producer.
        The producer is expected to remove old files to make room for
        new files, when necessary.

        If defined this value overrides the value of defaultFileLocation in the
        parent MeasuremnetControl.";
    }

    leaf fileBasedGP {
      when '../fileLocation' ;
      mandatory true;
      type uint32 ;
      units second;
      description "GP (granularity period) defines the frequency of producing
        measurement data.";
    }

    leaf fileReportingPeriod {
      when '../fileLocation' ;
      must '.  *60 >= ../fileBasedGP' {
        error-message "fileBasedGP must not be greater than fileReportingPeriod";
      }
      mandatory true;
      type uint32 ;
      units minute;
      description "The frequency of producing the measurement report files.";
    }

    leaf streamTarget {
      when 'not(../fileLocation)' ;
      type string ;
      description "Identifies the target of the notification carrying the
        content of the measurement report.
        There are two delivery methods (i.e. file-based and stream-based) via
        which the consumer(s) can receive the Measurements. This attribute
        is used for the stream-based delivery method.";
    }

    leaf streamBasedGP {
      when '../streamTarget' ;
```

```
      mandatory true;
      type uint32 ;
      units second;
      description "Defines the frequency of producing and sending the
        Measurement to the consumer.";
    }
  }

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

      If some YAM 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 Measurements to add supportedMeasurementsGPs as
      an attribute to its grouping";

    list MeasurementControl {
      description "Represents the properties of the file-based and stream-based
        measurement delivery methods.

        The file-based delivery method has properties for the file location,
        the file reporting period and the file-based GP.
        The stream-based delivery method has properties for the stream target
        and the stream-based GP.
        These properties are labelled as default (e.g. defaultFileBasedGP) in
        that they will be ignored in case the same properties captured in
        MeasurementReader are used.

        Instance of this list shall not be created nor deleted by client. It
        shall be created and deleted by the system.

        Depending on particular deployment context and agreement between
        operator and vendor, all attributes could be config=false.";

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

      list MeasurementReader {
        description "Identifies the entity (derivatives of ManagedFunction)
          whose Measurements are required by consumer to be produced and
          captured. The types of Measurements required are identified by the
          measurementNames.

          It captures the properties of the two delivery methods for delivering
          the Measurements.
          The file-based delivery method has properties: fileLocation,
          reportingPeriod and fileBasedGP.
          The stream-based delivery method has properties: streamTarget and
          streamBasedGP.
          The parent MeasurementControl list entry also can capture the
          properties of the file-based and stream-based delivery methods.
          If the MeasurementReader instance’s file-based delivery method has
          valid properties, the file-based delivery method is used and the
          MeasurementControl instance’s file-based delivery method is ignored.
          If the MeasurementReader instance’s stream-based delivery method has
          valid properties, the stream-based delivery method is used and the
          MeasurementControl instance’s stream-based delivery is ignored.
          The file-based and stream-based delivery methods can be active at the
          same time for a MeasurementReader instance.

          The activity of a MeasurementReader instance is independent of that
          of other MeasurementReader instances.

          This IOC uses managedObjectDNs or managedObjectDNsBasic to identify
          specific managed entities whose Measurements are required by consumer.";

        key id;
```

```
        uses top3gpp:Top_Grp ;
        container attributes {
          uses MeasurementReaderGrp;
        }
      }
    }
  }
}

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 ietf-yang-schema-mount { prefix yangmnt; }

  organization "3GPP SA5";

  description "Defines basic SubNetwork which will be augmented by other IOCs";
  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";
    reference "Based on
      3GPP TS 28.620 V15.X.XX
      3GPP TS 28.622 V15.X.XX";
  }

  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";
  }

  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:Measurements;

    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 ;
    }

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

    // augment external parts here
  }
} 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";
    reference "Based on
      3GPP TS 28.620 V15.X.XX
      3GPP TS 28.622 V15.X.XX";
  }

  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";
    }
  }
}
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 substatements 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 substatements 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";
  }
}
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; }

  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 28.541";

  revision 2019-06-23 {
    description "Initial version.";
    reference "Based on
      3GPP TS 28.541 V15.X.XX";
  }

  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 SNssai {
  type union {
    type uint8;
    type uint32;
  }
  description "Single Network Slice Selection Assistance Information.";
  reference "TS 23.501 clause 5.15.2";
}

typedef Sst {
  type uint8;
}

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 excaped : \\ > < ; \" + , (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.3 Graphical representation

This is the YANG module tree diagram whose syntax is defined in [x].

```
module: _3gpp-common-managed-element
  +--rw ManagedElement* [id]
     +--rw id                    string
     +--rw attributes
     |  +--rw dnPrefix?                  types3gpp:DistinguishedName
     |  +--rw userLabel?                 string
     |  +--ro locationName?              string
     |  +--ro managedBy*                 types3gpp:DistinguishedName
     |  +--ro managedElementTypeList*    string
     |  +--ro supportedMeasurementsGPs* [measurementType] {MeasurementsUnderManagedElement}?
     |  |  +--ro measurementType    string
     |  |  +--ro supportedGPs*      uint32
     |  +--ro vendorName?                string
     |  +--rw userDefinedState?          string
     |  +--ro swVersion?                 string
     |  +--rw priorityLabel              uint32
     +--rw MeasurementControl* [id] {MeasurementsUnderManagedElement}?
        +--rw id                   string
        +--rw attributes
        |  +--rw pMAdministrativeState?        types3gpp:AdministrativeState
        |  +--ro pMOperationalState            types3gpp:OperationalState
        |  +--rw defaultFileLocation?          string
        |  +--rw defaultFileBasedGP            uint32
        |  +--rw defaultFileReportingPeriod    uint32
        |  +--rw defaultStreamTarget?          string {StreamingSupported}?
        |  +--rw defaultStreamBasedGP          uint32 {StreamingSupported}?
        +--rw MeasurementReader* [id]
           +--rw id            string
           +--rw attributes
              +--rw measurementTypes*        string
              +--rw managedObjectDNsBasic*   types3gpp:DistinguishedName
              +--rw managedObjectDNs*        types3gpp:DistinguishedName
              +--rw fileLocation?            string
              +--rw fileBasedGP              uint32
```

```
             +--rw fileReportingPeriod      uint32
             +--rw streamTarget?            string
             +--rw streamBasedGP            uint32
module: _3gpp-common-subnetwork
  +--rw SubNetwork* [id]
     +--rw id                    string
     +--rw attributes
     |  +--rw dnPrefix?                   types3gpp:DistinguishedName
     |  +--rw userLabel?                  string
     |  +--rw userDefinedNetworkType?     string
     |  +--ro supportedMeasurementsGPs* [measurementType]
     |  |  +--ro measurementType    string
     |  |  +--ro supportedGPs*      uint32
     |  +--rw setOfMcc*                   types3gpp:Mcc
     |  +--rw priorityLabel               uint32
     |  +--rw parents*                    -> ../../../SubNetwork/id
     |  +--rw containedChildren*          -> ../../../SubNetwork/id
     +--rw MeasurementControl* [id] {MeasurementsUnderSubNetwork}?
        +--rw id                   string
        +--rw attributes
        |  +--rw pMAdministrativeState?        types3gpp:AdministrativeState
        |  +--ro pMOperationalState            types3gpp:OperationalState
        |  +--rw defaultFileLocation?          string
        |  +--rw defaultFileBasedGP            uint32
        |  +--rw defaultFileReportingPeriod    uint32
        |  +--rw defaultStreamTarget?          string {StreamingSupported}?
        |  +--rw defaultStreamBasedGP          uint32 {StreamingSupported}?
        +--rw MeasurementReader* [id]
           +--rw id            string
           +--rw attributes
              +--rw measurementTypes*        string
              +--rw managedObjectDNsBasic*   types3gpp:DistinguishedName
              +--rw managedObjectDNs*        types3gpp:DistinguishedName
              +--rw fileLocation?            string
              +--rw fileBasedGP              uint32
              +--rw fileReportingPeriod      uint32
              +--rw streamTarget?            string
              +--rw streamBasedGP            uint32
```

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
2019-09	SA#85	SP-190744	0022	2	F	Add IDL XML YANG solution	15.3.0
2019-09	SA#85	SP-190744	0023	3	F	generate JSON definition for generic NRM based on new style guideline	15.3.0
2019-09	SA#85	SP-190751	0028	-	F	Correct references and remove not need abbreviations	15.3.0

History

Document history		
V15.0.0	July 2018	Publication
V15.1.0	April 2019	Publication
V15.2.0	May 2019	Publication
V15.3.0	October 2019	Publication