The Consultative Committee for Space Data Systems

FUNCTIONAL RESOURCE REGISTRY AT SANA

RECORD

CCSDS 901.31-Y-1

YELLOW BOOK

May 2024

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FOREWORD

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DOCUMENT CONTROL

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1 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to describe how Functional Resources (FRs) are registered at SANA.

A second aspect of this document is the interface definition for FRs between the CCSDS CSS Area and SANA. In the context of this interface the CSS Area produces the Functional Resource Model (FRM) and provides it to SANA for registry and publication as an XML file.

The background of FRs is described in reference [1].

1.2 SCOPE

The scope of this document is the description and definition of how FRs as defined by the CCSDS CSS Area are registered in a registry administered by SANA.

Furthermore, this document provides the definition of the interface the CCSDS Area uses to deliver FR specifications to SANA for registration and publication.

1.3 DOCUMENT ORGANIZATION

Section 2 provides an introductory text to be used for the FR Registry.

Section 3, FR SANA Registry Structure, describes the structure by which FRs shall be organized in the SANA registry.

Section 4 describes the labels which shall be used in the OID tree used at SANA for FRs.

Section 5 describes the structure of the FR OIDs.

Section 6 outlines the hierarchy of the FRs for the visual presentation at SANA.

Section 7 introduces a concept to exchange the FRM between CCSDS and SANA.

Annex A provides an XML (machine readable) example of the FRM.

Annex B provides the XML schema for the XML format of the FRM.

Annex C lists XML elements and their children that are not imported into the SANA registry.

Annex D lists abbreviations and acronyms.

1.4 REFERENCES

The following documents are referenced in this Technical Note. At the time of publication, the editions indicated were valid. All documents are subject to revision, and users of this Report are encouraged to investigate the possibility of applying the most recent editions of the documents indicated below. The CCSDS Secretariat maintains a register of currently valid CCSDS documents.

[1] *Functional Resource Model*. Issue 1. Recommendation for Space Data System Practices (Magenta Book), CCSDS 901.3-M-1. Washington, D.C.: CCSDS, February 2024.

2 FUNCTIONAL RESOURCE REGISTRY INTRODUCTION

To ease the use of the FR Registry, the FR Registry shall provide the following introductory text:

Functional Resources are abstract representations of the functionality needed to provide space communication and navigation services provided by a Tracking, Telemetry, and Command (TT&C) service provider (e.g., a ground station), defined at a level of granularity sufficient to specify the configuration parameters, monitored parameters, notifiable events, and control actions associated with that functionality. Functional Resources contain the information that configures, controls, and/or monitors the characteristics of the interfaces between the TT&C service provider and the user ground element(s) (e.g., spaceflight Mission Operation Center) and user space elements (e.g., Mission spacecraft), for example, frequencies, modulation schemes, coding schemes, virtual channel organization, and terrestrial transfer services. Real implementations of TT&C service provider systems map these Functional Resource parameters, events, and directives onto the physical equipment that actually performs these functions.

Functional Resources provide a standard representation of TT&C service provider functionality in CCSDS standards for cross support transfer services and cross support service management. The Monitored Data Cross Support Transfer Service (https://public.ccsds.org/Pubs/922x1b1.pdf) is fundamentally reliant on the use of Functional Resources to represent cross support functionality.

NOTE – Implementation-specific internal functions of a TT&C service provider that have no externally visible effect on the services at the cross support interfaces, for example, a technology-specific interface between the encoder and the transmitter, are by definition not standard for the purposes of cross support and therefore are not represented by Functional Resources.

In the above introductory text, the reference to the Monitored Data standard (https://public.ccsds.org/Pubs/922x1b1.pdf) shall be a hyperlink.

3 FUNCTIONAL RESOURCE SANA REGISTRY STRUCTURE

The FRs available in the corresponding SANA registry are presented to the user in a tree. Each FR shall have the following (possibly empty) expandable tree nodes:

- Parameters (P);
- Events (E);
- Directives (D).

For each FR, Parameter, Event, and Directive, the details are presented in a table-like structure. Table 3-1 governs which fields are displayed for each element of a FR.

Furthermore, Events may have a child elements OID, an external type OID, and a 'Value' in the tree. Directives are allowed to have an OID, an external type OID, and a 'Qualifier' as child elements in the tree. Each Event/Value and Directive/Qualifier has in turn a subset of properties subject to registration at SANA.

All FR elements and subordinates are presented in the same table of the SANA registry; the column headings are defined below in the context of the presented elements. For better readability, table 3-1 has been organized to show the SANA column headings as lines.

Details of the structure of FRM XML file are displayed in figure 8-1. Some elements of the FRM XML shall be ignored for the time being when imported into SANA. A list of ignored elements is provided in annex C.

Table 3-1: Functional Resource Fields to Display

	Functional Resource Stratum	Functional Resource Set	Functional Resource	Parameter	Event	Event/ Value	Directive	Directive/ Qualifier
OID			X	X	X		X	
External OID[1]								
Type OID				X		X		X
Name	X	X						
External Type OID				X		X		X
Element Type (FR/P/E/D/Q/V)			X	X	X	X	X	X
Semantic Description			X	X	X	X	X	X
Classifier			X	X	X	X	X	X

[1] During review of this document, the validity of the concept of the external OID has been raised. The concern addresses, basically, the question of which instance of an entity (e.g., an FR) denoted by the external OID is addressed. For that reason, the presentation of an external OID has been excluded until this is decided.

	Functional Resource Stratum	Functional Resource Set	Functional Resource	Parameter	Event	Event/ Value	Directive	Directive/ Qualifier
String Identifier			X	X	X	X	X	X
Version			X	X	X	X	X	X
Creation Date								
Authorizing Entity[2]								
Deprecated			X	X	X	X	X	X
Engineering Unit				X		X		X
Type Definition				X		X		X
Configured				X				
Guard Condition				X			X	

NOTES

1 OID and External OID are mutually exclusive. As long as external OIDs can be distinguished from OIDs of this registry they may appear in the same column.

2 External OIDs should be hyperlinks to OIDs registered in different SANA registries.

The FRs shall be published as a SANA separate registry under the OID node.

iso(1).identifiedOrganization(3).standardProducingOrganization(112).ccsds(4).css(4).crossSupportResources(2).crossSupportFunctionalities(1)

A candidate registry has been created and is available at

https://sanaregistry.org/r/functional_resources.

[2] According to discussions of the CSTS WG, the Authorizing Entity is information internal to CCSDS. For SANA users, SANA is the entity in charge.

4 FUNCTIONAL RESOURCE TREE LABELS

4.1 OVERVIEW

Figure 4-1 shows what is ~~meant~~ by 'Tree Labels', and it is intended to aid the users of the FR Registry to understand the presented FRs.

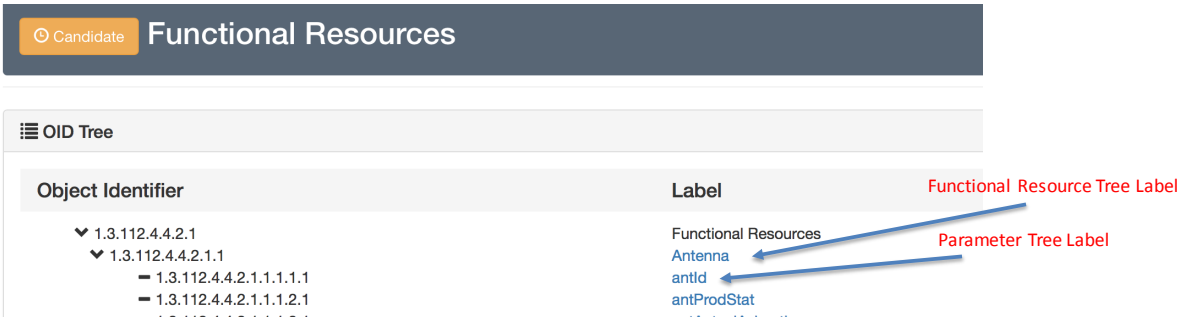

Figure 4-1: Functional Resource Tree Labels

In the remainder of this section, the rules to construct the Tree Labels for the various FR Elements are provided.

4.2 FUNCTIONAL RESOURCE STRATUM TREE LABEL

For each FR Stratum, the Tree Label shall be constructed by the values of the following fields:

```
Name
```

4.3 FUNCTIONAL RESOURCE SET TREE LABEL

For each FR Set, the Tree Label shall be constructed by the values of the following fields:

```
Name
```

4.4 FUNCTIONAL RESOURCE TREE LABEL

For each FR, the Tree Label shall be constructed by the values of the following fields:

```
Classifier <tab> String Identifier
```

4.5 PARAMETER TREE LABEL

For each Parameter, the Tree shall be constructed by the values of the following fields:

```
Classifier <tab> String Identifier <tab> "configurable: "
Configured
```

4.6 EVENT TREE LABEL

For each Event, the Tree Label shall be constructed by the values of the following fields:

```
Classifier <tab> String Identifier
```

4.7 DIRECTIVE TREE LABEL

For each Directive, the Tree Label shall be constructed by the values of the following fields:

```
Classifier <tab> String Identifier
```

4.8 VALUE TREE LABEL

For each Value appearing under an Event, the Tree Label shall be constructed by the values of the following fields:

```
Classifier <tab> String Identifier
```

4.9 QUALIFIER TREE LABEL

For each Qualifier appearing under a Directive, the Tree Label shall be constructed by the values of the following fields:

```
Classifier <tab> String Identifier
```

5 FUNCTIONAL RESOURCE OID STRUCTURE

This section presents the structure of the OIDs used to identify FRs and their sub-items. Figure 5-1 identifies and describes the parts of the FR OIDs and describes specific items of the FRs.

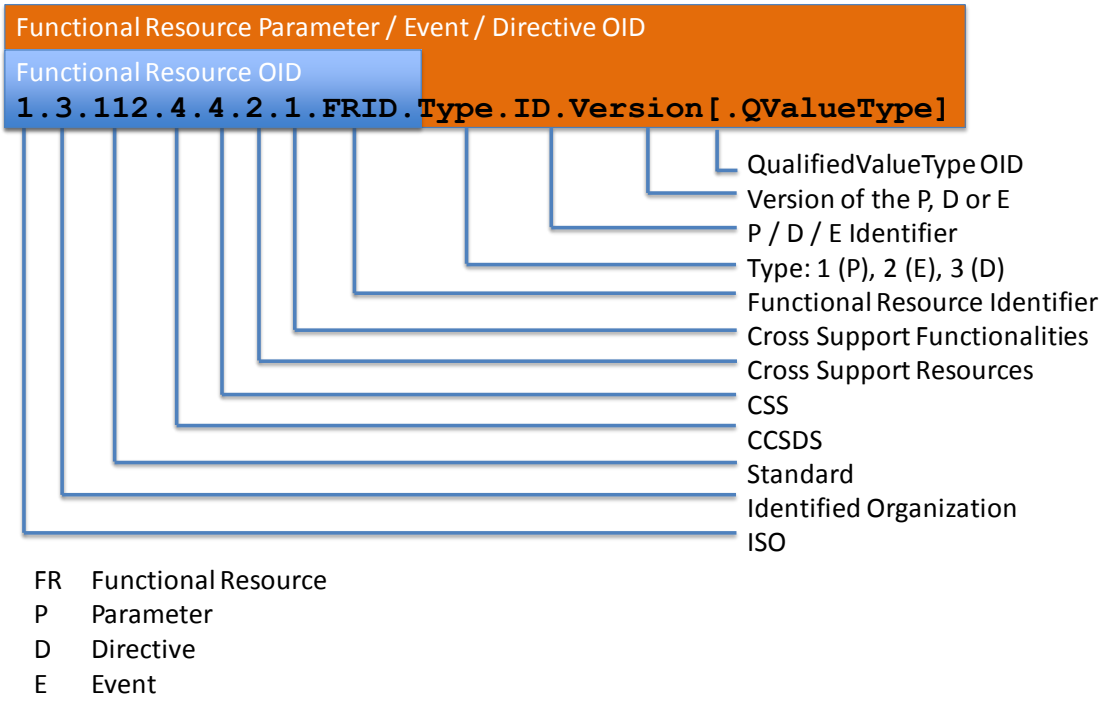

Figure 5-1: Functional Resource OID Structure

6 FUNCTIONAL RESOURCE MODEL VISUAL PRESENTATION AT SANA

This section does not describe the interface of the FR interface between SANA and the CCSDS CSS. Rather, it states some requirements for how FRs shall be presented at SANA.

In general, the FRs shall be presented in a hierarchical way with the FRs being the top level. Figure 6-1 illustrates the three foreseen levels of the FR hierarchy.

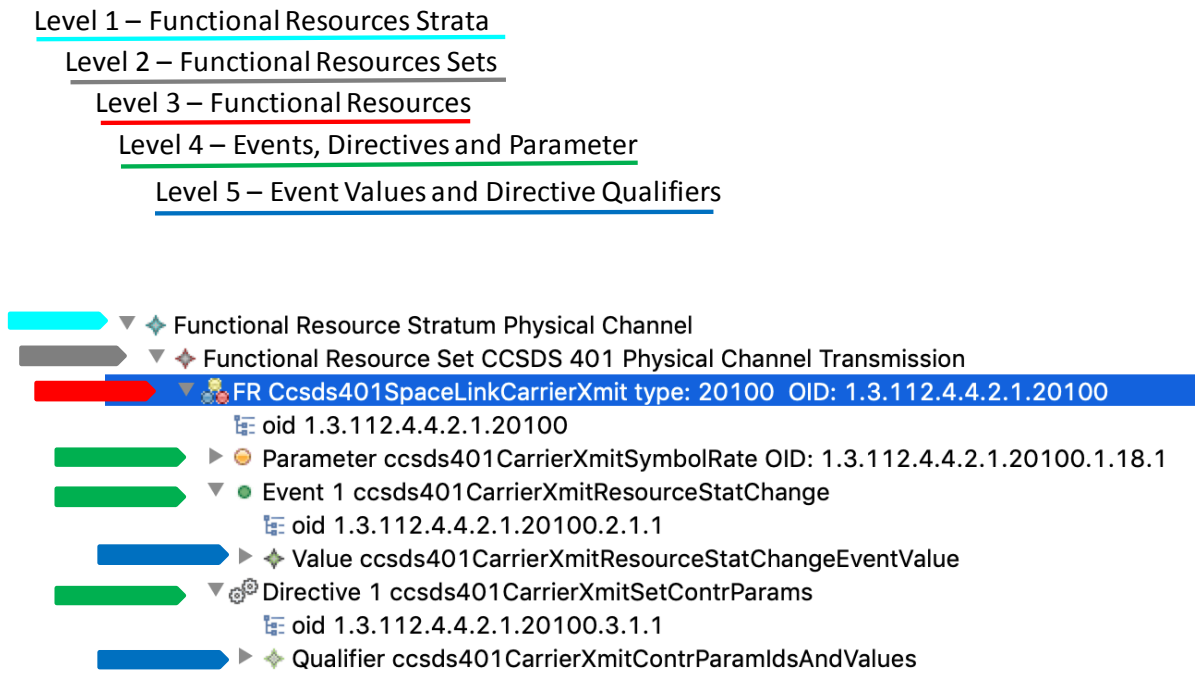

Figure 6-1: Functional Resource Hierarchy

NOTE – Figure 6-1 illustrates the hierarchical organization. It does not impose the layout or look and feel of the FR Registry.

7 FUNCTIONAL RESOURCE ASN.1 FILE

The FRs provide type definitions in ASN.1 within the records accessible within the SANA FR Registry. To ease the reading and, finally, an implementation relying on SANA registered FRM types, the SANA FR Registry shall provide a link to the ASN.1 file provided along with the FR XML file. This FR ASN.1 file contains all type definitions in an ASN.1 module ready for processing, for example, with an ASN.1 compiler.

The FR Registry shall visually provide the link to that ASN.1 file labeled ‘Functional Resource ASN.1 Definitions’.

8 INTERFACE CSS AREA – SANA FOR FUNCTIONAL RESOURCES

The FRs are delivered from the CSS Area to SANA as an XML document. The XML document structure is depicted in figure 8-1. The XML schema of the FR XML representation is provided in annex B.

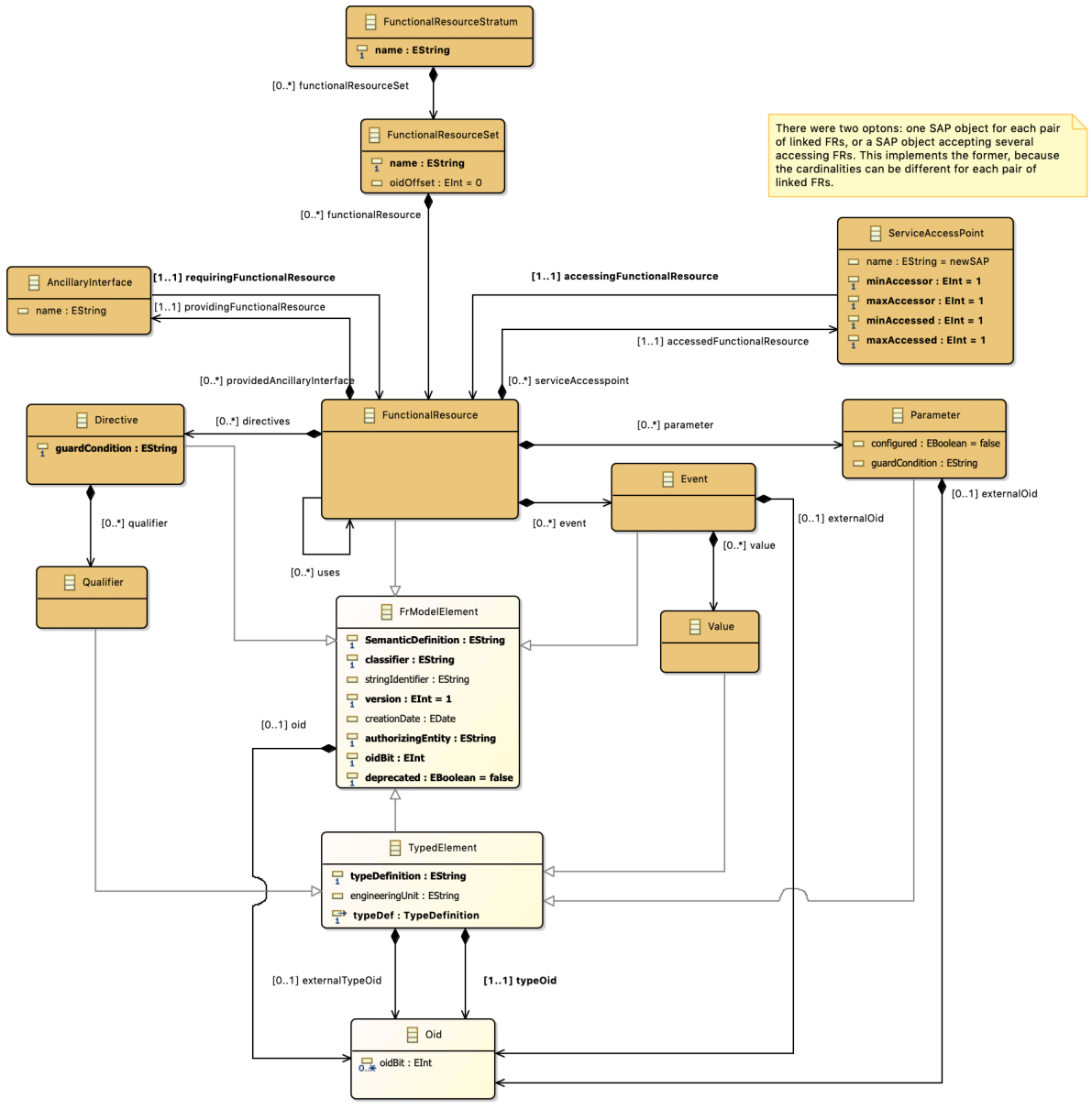

Figure 8-1: Structure of XML Representation of Functional Resources

ANNEX A

FUNCTIONAL RESOURCE MODEL EXAMPLE

The example below is a simplified example of the FRM with three FRs. These example shall demonstrate the different elements of the FRM, such as FRs, Parameters, Events, and Directives. Furthermore, the OIDs attached to the elements are representative.

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet href="frm.xsl" type="text/xsl" ?>
<fr:FunctionalResourceModel xmlns:fr="http://iso.org.dod.ccsds">
  <rootOid>
    <oidBit>1</oidBit>
    <oidBit>3</oidBit>
    <oidBit>112</oidBit>
    <oidBit>4</oidBit>
    <oidBit>4</oidBit>
    <oidBit>2</oidBit>
    <oidBit>1</oidBit>
  </rootOid>
  <functionalResource SemanticDefinition="The Antenna FR accepts as input the
carrier signal that shall either be radiated into space or into a water load,
provided the given FR instance has the transmit capability. &#xD;&#xA;It provides
as output the carrier signal received from space to the
Rtn401SpaceLinkCarrierReception FR and the azimuth and elevation pointing angles
to the TdmSegmentGeneration FR and to the RawRadiometricDataCollection FR,
provided the given FR instance has the receive capability. The pointing angles
are provided only while the antenna is in some form of auto-track
mode.&#xD;&#xA;Note: An Antenna FR may be limited to 'transmit-only' or 'receive-
only'." classifier="Antenna" stringIdentifier="Antenna" version="1"
creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area"
oidBit="1" uses="//@functionalResource.1">
    <oid>
      <oidBit>1</oidBit>
      <oidBit>3</oidBit>
      <oidBit>112</oidBit>
      <oidBit>4</oidBit>
      <oidBit>4</oidBit>
      <oidBit>2</oidBit>
      <oidBit>1</oidBit>
      <oidBit>1</oidBit>
      <oidBit>1</oidBit>
    </oid>
    <event SemanticDefinition="This event notifies any change of the
antennaProductionStatus." classifier="antennaProductionStatusChange"
stringIdentifier="antenna-production-status-change" version="1"
creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area"
oidBit="1">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
```

```
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
      </oid>
      <value SemanticDefinition="The event value reports the
antennaProductionStatus value that applies since the notified
antennaProductionStatusChange event occurred."
classifier="antennaProductionStatusValue" stringIdentifier="antenna-production-
status-value" version="1" creationDate="2016-02-07T00:00:00.000+0100"
authorizingEntity="CSS Area" typeDefinition="'eventValue': 'EventValue':
'qualifiedValues': 'SequenceOfQualifiedValues': 'SEQUENCE OF QualifiedValues':
'qualifiedValues': 'TypeAndValueComplexQualified': 'typeAndValue':
'TypeAndValue': 'enumerated': SEQUENCE (SIZE (1)) OF Enumerated (0 ..
3)&#xD;&#xA;{   configured   (0)&#xD;&#xA;,   operational   (1)&#xD;&#xA;,
interrupted   (2)&#xD;&#xA;,   halted   (3)&#xD;&#xA;}" engineeringUnit="none">
        <externalTypeOid>
          <oidBit>1</oidBit>
          <oidBit>3</oidBit>
          <oidBit>112</oidBit>
          <oidBit>4</oidBit>
          <oidBit>4</oidBit>
          <oidBit>2</oidBit>
          <oidBit>3</oidBit>
          <oidBit>1</oidBit>
          <oidBit>1</oidBit>
          <oidBit>1</oidBit>
          <oidBit>2</oidBit>
          <oidBit>1</oidBit>
        </externalTypeOid>
      </value>
    </event>
    <event SemanticDefinition="This event notifies the loss of lock of the
tracking receiver." classifier="antennaTrackingReceiverLossOfLock"
stringIdentifier="antenna-tracking-receiver-loss-of-lock" version="1"
creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area"
oidBit="2">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
      </oid>
```

```
    </event>
    <event SemanticDefinition="This event notifies that gusts exceed the nominal
wind speed the antenna can withstand in operation and therefore the antenna may
have to be moved to its stow position." classifier="antennaWindSpeedWarning"
stringIdentifier="antenna-wind-speed-warning" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="3">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </event>
    <directives SemanticDefinition="This directive permits setting of the
controllable parameters of the Antenna FR type. "
classifier="antennaSetControlParameters" stringIdentifier="antenna-set-control-
parameters" version="1" creationDate="2016-02-07T00:00:00.000+0100"
authorizingEntity="CSS Area" oidBit="1" guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
      </oid>
      <qualifier SemanticDefinition="The directive qualifier specifies the FR
instance the directive shall act on and contains a set of parameter identifier
and parameter value pairs. To be valid, the parameter identifier must reference a
controllable parameter of the antenna FR and the parameter value must be of the
same type as the parameter value that shall be set."
classifier="antennaControlledParameterIdsAndValues" stringIdentifier="antenna-
controlled-parameter-identifiers-and-values" version="1" creationDate="2016-02-
07T23:00:00.000+0100" authorizingEntity="CSS Area" typeDefinition="For the
identification of the FR instance: &#xD;&#xA;'directiveQualifier':
'functResourceDirQualifier': 'functResourceInstanceNumber':
'FunctionalResourceInstanceNumber': 'IntPos'&#xD;&#xA;For the identification of
the parameter to be set:&#xD;&#xA;'directiveQualifier':
'functResourceDirQualifier': 'functionalResourceQualifiers':
'DirectiveQualifierValues': 'setOfParamIdsAndValues':
'SetOfParameterIdsAndValues': 'parameterIdentifier':
```

'PublishedIdentifier'
For the parameter value:
'directiveQualifier': 'functResourceDirQualifier': 'functionalResourceQualifiers': 'DirectiveQualifierValues': 'setOfParamIdsAndValues': 'SetOfParameterIdsAndValues': 'parameterValue': 'TypeAndValueComplexQualified'
The remainder of the path depends on the type of the value of the parameter that shall be set." engineeringUnit="depends on the specific paramter(s) being set"/>
    </directives>
    <parameter SemanticDefinition="This parameter identifies the antenna that is involved in providing a given support. So far, these antenna identifiers are typically defined by the operating agency so that no guarantee can be given that the identifier is globally unique. Knowledge of which antenna is being used is needed for a number of aspects, e.g. to assess the observed signal levels with respect to the antenna performance or to perform time correlation that requires knowledge of the exact location of the given antenna.
Note: In case the antennas used for uplink and downlink are not identical, the Functional Resource (FR) instance number shall be used to differentiate them. As concerns antenna arraying, it is assumed that each array is associated with a name constituting a single functional resource." classifier="antennaId" stringIdentifier="antenna-identifier" version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="1" typeDefinition="SEQUENCE (SIZE (1)) OF VisibleString (SIZE(3..16))" engineeringUnit="none" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This enumerated parameter reports the overall status of the antenna and can take on four values:
- 'configured': the antenna system has been configured, but is not yet tracking because it is still moving to the initial pointing or the spacecraft is not yet or no longer in view;
 - 'operational': the antenna is tracking in the reported pointing mode (cf. antennaPointingMode);
 - 'interrupted': a failure has been detected that prevents the antenna from tracking nominally;
 - 'halted': the antenna has been taken out of service, e.g. due to wind speed requiring the antenna to be put into stow position." classifier="antennaProductionStatus" stringIdentifier="antenna-production-status" version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="2" typeDefinition="SEQUENCE (SIZE (1)) OF Enumerated (0 .. 3)
{ configured (0)
, operational (1)
, interrupted (2)
, halted (3)
}" engineeringUnit="none" configured="true" guardCondition="Setting of the antennaProductionStatus to 'operational' or 'interrupted' by means of the directive antennaSetControlParameters is not permissible.">
      <oid>

```
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the current antenna
azimuth pointing in 1/1000 degrees, where 0 degrees corresponds to pointing north
and 90 degrees corresponds to pointing east. Depending on the way the antenna is
built, values above 360 degrees may be reported in cases where the antenna
enables such azimuth range as to mitigate the cable unwrap issue. For antennas
with a mount different from elevation over azimuth (e.g. x/y mount), the antenna
pointing shall be converted to the azimuth/elevation presentation. This also
applies to antennas having a tilt mode as to overcome the zenith track
singularity.&#xD;&#xA;Note: Time-tagged antenna pointing is regarded a
radiometric product and therefore not part of monitoring. "
classifier="antennaActualAzimuth" stringIdentifier="antenna-actual-azimuth"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="3" typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 ..
540000)" engineeringUnit="1/1000 degree" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the current antenna
elevation pointing in 1/1000 degrees, where 0 degrees corresponds to pointing to
the horizon and 90 degrees corresponds to zenith pointing. Depending on the way
the antenna is built, values above 90 degrees may be reported in cases where the
antenna enables such elevation range as to mitigate the azimuth singularity at
zenith. For antennas with a mount different from elevation over azimuth (e.g. x/y
mount), the antenna pointing shall be converted to the azimuth/elevation
presentation. This also applies to antennas having a tilt mode as to overcome the
zenith track singularity." classifier="antennaActualElevation"
stringIdentifier="antenna-actual-elevation" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="4"
```

```
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 .. 180000)"
engineeringUnit="1/1000 degree" configured="false">
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      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the azimuth pointing in
1/1000 degrees commanded to the servo system, where 0 degrees corresponds to
pointing north and 90 degrees corresponds to pointing east. Depending on the way
the antenna is built, values above 360 degrees may be reported in cases where the
antenna enables such azimuth range as to mitigate the cable unwrap issue. For
antennas with a mount different from elevation over azimuth (e.g. x/y mount), the
antenna pointing shall be converted to the azimuth/elevation presentation. This
also applies to antennas having a tilt mode as to overcome the zenith track
singularity." classifier="antennaCommandedAzimuth" stringIdentifier="antenna-
commanded-azimuth" version="1" creationDate="2016-02-07T00:00:00.000+0100"
authorizingEntity="CSS Area" oidBit="5" typeDefinition="SEQUENCE (SIZE (1)) OF
IntUnsigned (0  .. 540000)" engineeringUnit="1/1000 degree" configured="false">
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      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the antenna elevation
pointing in 1/1000 degrees commanded to the servo system, where 0 degrees
corresponds to pointing to the horizon and 90 degrees corresponds to zenith
pointing. Depending on the way the antenna is built, values above 90 degrees may
be reported in cases where the antenna enables such elevation range as to
mitigate the azimuth singularity at zenith. For antennas with a mount different
from elevation over azimuth (e.g. x/y mount), the antenna pointing shall be
converted to the azimuth/elevation presentation. This also applies to antennas
having a tilt mode as to overcome the zenith track singularity."
classifier="antennaCommandedElevation" stringIdentifier="antenna-commanded-
elevation" version="1" creationDate="2016-02-07T00:00:00.000+0100"
```

```
authorizingEntity="CSS Area" oidBit="6" typeDefinition="SEQUENCE (SIZE (1)) OF
IntUnsigned (0 .. 180000)" engineeringUnit="1/1000 degree" configured="false">
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        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>6</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the azimuth in 1/1000
degrees the antenna shall point to when the pointing-mode is set to 'point',
where 0 degrees corresponds to pointing north and 90 degrees corresponds to
pointing east. Depending on the way the antenna is built, values above 360
degrees may be supported in cases where the antenna enables such azimuth range as
to mitigate the cable unwrap issue. For antennas with a mount different from
elevation over azimuth (e.g. x/y mount), the antenna pointing shall be converted
to the azimuth/elevation presentation. This also applies to antennas having a
tilt mode as to overcome the zenith track singularity."
classifier="antennaControlledAzimuth" stringIdentifier="antenna-controlled-
azimuth" version="1" creationDate="2016-02-07T00:00:00.000+0100"
authorizingEntity="CSS Area" oidBit="7" typeDefinition="SEQUENCE (SIZE (1)) OF
IntUnsigned (0  .. 540000)" engineeringUnit="1/1000 degrees" configured="true"
guardCondition="None">
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        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>7</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the elevation in 1/1000
degrees the antenna shall point to when the pointing-mode is set to 'point',
where 0 degrees corresponds to pointing to the local horizon and 90 degrees
corresponds to zenith pointing. Depending on the way the antenna is built, values
above 90 degrees may be reported in cases where the antenna enables such
elevation range as to mitigate the azimuth singularity at zenith. For antennas
with a mount different from elevation over azimuth (e.g. x/y mount), the antenna
pointing shall be converted to the azimuth/elevation presentation. This also
applies to antennas having a tilt mode as to overcome the zenith track
```

```
singularity. " classifier="antennaControlledElevation" stringIdentifier="antenna-
controlled-elevation" version="1" creationDate="2016-02-07T00:00:00.000+0100"
authorizingEntity="CSS Area" oidBit="8" typeDefinition="SEQUENCE (SIZE (1)) OF
IntUnsigned (0 .. 180000)" engineeringUnit="1/1000 degrees" configured="true"
guardCondition="None">
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        <oidBit>4</oidBit>
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        <oidBit>8</oidBit>
        <oidBit>1</oidBit>
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    </parameter>
    <parameter SemanticDefinition="The parameter reports the azimuth angular rate
in 1/1000 degrees per second at which the antenna shall move when  pointing-mode
is set to 'slew'. " classifier="antennaControlledAzimuthRate"
stringIdentifier="antenna-controlled-azimuth-rate" version="1"
creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area"
oidBit="9" typeDefinition="SEQUENCE (SIZE (1)) OF INTEGER"
engineeringUnit="1/1000 degrees/s" configured="true" guardCondition="None">
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        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="The parameter reports the elevation angular
rate in 1/1000 degrees per second at which the antenna shall move when the
antennaPointingMode is set to 'slew'. "
classifier="antennaControlledElevationRate" stringIdentifier="antenna-controlled-
elevation-rate" version="1" creationDate="2016-02-07T00:00:00.000+0100"
authorizingEntity="CSS Area" oidBit="10" typeDefinition="SEQUENCE (SIZE (1)) OF
INTEGER" engineeringUnit="1/1000 degrees/s" configured="true"
guardCondition="None">
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1/1000 degrees between the actual and the predicted azimuth. Consequently this
parameter will only be valid if antennaPointingMode = ('auto-track' OR 'conical
scan'). Antennas not having or not being operated in any closed-loop tracking
mode cannot provide this parameter and in this case the parameter shall be
flagged as unavailable. &#xD;&#xA;Note: Time-tagged antenna pointing is regarded
a radiometric product and therfore not part of monitoring.  "
classifier="antennaAzimuthError" stringIdentifier="antenna-azimuth-error"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="11" typeDefinition="SEQUENCE (SIZE (1)) OF INTEGER (-54000  ..
540000)" engineeringUnit="1/1000 degree" configured="false">
      <oid>
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        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
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        <oidBit>4</oidBit>
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    </parameter>
    <parameter SemanticDefinition="This parameter reports the difference in
1/1000 degrees between the actual and the predicted elevation. Consequently this
parameter will only be valid if antennaPointingMode = ('auto-track' ORÂ  'conical
scan'). Antennas not having or not being operated in any closed-loop tracking
mode cannot provide this parameter and in this case the parameter shall be
flagged as unavailable." classifier="antennaElevationError"
stringIdentifier="antenna-elevation-error" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="12"
typeDefinition="SEQUENCE (SIZE (1)) OF INTEGER (-18000 .. 180000)"
engineeringUnit="1/1000 degree" configured="false">
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        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
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```

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        <oidBit>1</oidBit>
        <oidBit>12</oidBit>
        <oidBit>1</oidBit>
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    <parameter SemanticDefinition="This enumerated parameter reports the pointing
mode of the antenna servo system. The values this parameter can take on
are:&#xD;&#xA;- 'stow': the antenna is in or is moving to its stow
position;&#xD;&#xA;- 'halt': the antenna has been stopped in its current
position;&#xD;&#xA;- 'point': the antenna is moving or has moved to the specified
azimuth and elevation;&#xD;&#xA;- 'slew': the antenna is moving at commanded
angular rates;&#xD;&#xA;- 'program-track': the antenna is pointed in accordance
with spacecraft trajectory predicts;&#xD;&#xA;- 'conical scan': the antenna is
performing a conical scan around the nominal pointing and applies offsets with
respect to the predicts such that the observed signal strength is constant
throughout the scan;&#xD;&#xA;- 'auto-track': the antenna pointing is driven by a
tracking receiver that by means of a suitable feed (e.g. monopulse) determines an
error signal both for azimuth and elevation.&#xD;&#xA;Antenna implementations
will typically support only a subset of the above listed pointing modes."
classifier="antennaPointingMode" stringIdentifier="antenna-pointing-mode"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="13" typeDefinition="SEQUENCE (SIZE (1)) OF Enumerated (0 ..
5)&#xD;&#xA;{   stow   (0)&#xD;&#xA;,   halt   (1)&#xD;&#xA;,   point
(2)&#xD;&#xA;,   slew   (3)&#xD;&#xA;,   programTrack   (4)&#xD;&#xA;,
conicalScan   (5)&#xD;&#xA;,   autoTrack   (6)&#xD;&#xA;}" engineeringUnit="none"
configured="true" guardCondition="If the antenna servo system does not support
the pointing mode commanded by means of the antennaSetControlParameters
directive, the Functional Resource will reject the setting of the
antennaPointingMode parameter with the diagnostic 'parameter out of
range'.&#xD;&#xA;antennaProductionStatus â‰  'halted'&#xD;&#xA;Setting
antennaPointingMode to 'point' shall be rejected except if the parameters
antennaControlledAzimuth and antennaControlledElevation have valid
values.&#xD;&#xA;Setting antennaPointingMode to 'slew' shall be rejected except
if the parameters antennaControlledAzimuthRate and antennaControlledElevationRate
have valid values.  ">
      <oid>
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        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
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        <oidBit>13</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This enumerated parameter reports the lock
status of the tracking receiver and as such is only supported by antennas that
support and are configured to operate in antennaPointingMode = 'auto-track' mode.
The values the parameter may have are:&#xD;&#xA;- 'locked': the tracking receiver
```

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has locked on the return link signal and consequently is driving the antenna
pointing;&#xD;&#xA;- 'not locked': the tracking receiver is not locked on the
return link signal and therefore cannot drive the antenna pointing. &#xD;&#xA;As
a consequence, the antennaPointingMode will have changed to 'program-track' and
won't return to 'auto-track' until tracking receiver lock is (re-)acquired. If a
tracking receiver is not available or not used, this parameter shall be flagged
as undefined." classifier="antennaTrackingReceiverLockStatus"
stringIdentifier="antenna-tracking-receiver-lock-status" version="1"
creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area"
oidBit="14" typeDefinition="SEQUENCE (SIZE (1)) OF Enumerated (0 .. 1)&#xD;&#xA;{
locked   (0)&#xD;&#xA;,   notLocked   (1)&#xD;&#xA;}" engineeringUnit="none"
configured="false">
      <oid>
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        <oidBit>14</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This enumerated parameter reports the
configuration of the tracking receiver and as such is only supported by antennas
that support and are configured to operate in antennaPointingMode = 'auto-track'
mode. The values the parameter may have are:&#xD;&#xA;- 'carrier tracking loop':
the tracking receiver tracks the remnant carrier by means of a carrier tracking
PLL;&#xD;&#xA;- 'cross-correlation mode': the tracking receiver tracks the return
link signal by means of checking for the spectral symmetry (e.g. in case of
suppressed carrier modulation schemes).&#xD;&#xA;If a tracking receiver is not
available or not used, this parameter shall be flagged as undefined."
classifier="antennaTrackingReceiverMode" stringIdentifier="antenna-tracking-
receiver-mode" version="1" creationDate="2016-02-07T00:00:00.000+0100"
authorizingEntity="CSS Area" oidBit="15" typeDefinition="SEQUENCE (SIZE (1)) OF
Enumerated (0 .. 1)&#xD;&#xA;{   carrierTrackingLoop   (0)&#xD;&#xA;,
crossCorrelationMode   (1)&#xD;&#xA;}" engineeringUnit="none" configured="true"
guardCondition="If the antenna servo system does not have a tracking receiver or
if the tracking receiver is not used, a directive attempting the setting of this
parameter shall be rejected with the diagnostic â€˜invalid Functional Resource
parameterâ€™.">
      <oid>
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        <oidBit>112</oidBit>
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        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
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```

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        <oidBit>1</oidBit>
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    </parameter>
    <parameter SemanticDefinition="This parameter reports the return link signal
level in tenth of dBm as observed by the tracking receiver, i.e., the signal
level derived from the tracking receiver AGC reading. As to have comparable, i.e.
station level plan independent, values the level reading should be calibrated to
the LNA input. Due to the levels to be expected, the numbers will always be
negative." classifier="antennaTrackingReceiverInputLevel"
stringIdentifier="antenna-tracking-receiver-input-level" version="1"
creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area"
oidBit="16" typeDefinition="SEQUENCE (SIZE (1)) OF INTEGER (-2000 .. -30)"
engineeringUnit="1/10 dBm" configured="false">
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        <oidBit>4</oidBit>
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        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the tracking receiver's
dual-sided tracking loop bandwidth in tenth Hz. Depending on the mode the
tracking receiver operates in, this is either the bandwidth of the PLL tracking
the remnant carrier or the frequency range observed for checking spectral
symmetry." classifier="antennaTrackingReceiverLoopBandwidth"
stringIdentifier="antenna-tracking-receiver-loop-bandwidth" version="1"
creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area"
oidBit="17" typeDefinition="SEQUENCE (SIZE (1)) OF IntPos (1 .. 1000000)"
engineeringUnit="1/10 Hz" configured="true" guardCondition="If the antenna servo
system does not have a tracking receiver or if the tracking receiver is not used,
a directive attempting the setting of this parameter shall be rejected with the
diagnostic â€˜invalid Functional Resource parameterâ€™.">
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```

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      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the wind speed as
observed close to the antenna. This parameter is measured in tenth m/s and
averaged over the most recent minute." classifier="antennaMeanWindSpeed"
stringIdentifier="antenna-mean-wind-speed " version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="18"
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 .. 100)"
engineeringUnit="1/10 m/s" configured="false">
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        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the highest wind speed
observed close to the antenna during the most recent 10 minutes. This parameter
is measured in tenth m/s." classifier="antennaPeakWindSpeed"
stringIdentifier="antenna-peak-wind-speed" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="19"
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 .. 100)"
engineeringUnit="1/10 m/s" configured="false">
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        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the current wind
direction in degrees, where 0 degrees corresponds to north and 90 degrees to
east." classifier="antennaWindDirection" stringIdentifier="antenna-wind-
direction" version="1" creationDate="2016-02-07T00:00:00.000+0100"
authorizingEntity="CSS Area" oidBit="20" typeDefinition="SEQUENCE (SIZE (1)) OF
IntUnsigned (0 .. 359)" engineeringUnit="degree" configured="false">
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        <oidBit>1</oidBit>
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    </parameter>
    <parameter SemanticDefinition="This parameter reports the amount of
precipitation in mm that accumulated since 0:00 UTC of the current day."
classifier="antennaAccumulatedPrecipitation" stringIdentifier="antenna-
accumulated-precipitation" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="21"
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 .. 100)"
engineeringUnit="mm" configured="false">
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        <oidBit>1</oidBit>
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    </parameter>
    <parameter SemanticDefinition="This parameter reports the precipitation rate
in mm/h as observed during the most recent hour."
classifier="antennaPrecipitationRate" stringIdentifier="antenna-precipitation-
rate" version="1" creationDate="2016-02-07T00:00:00.000+0100"
authorizingEntity="CSS Area" oidBit="22" typeDefinition="SEQUENCE (SIZE (1)) OF
IntUnsigned (0 .. 100)" engineeringUnit="mm/h" configured="false">
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        <oidBit>112</oidBit>
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        <oidBit>1</oidBit>
        <oidBit>22</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
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    <parameter SemanticDefinition="This parameter reports the relative humidity
in % as observed by an outdoor meteorological sensor at the station. This
parameter shall be flagged as invalid if the value from the meteo unit is invalid
and it shall be flagged as unavailable if this parameter is not available at this
time.&#xD;&#xA;Note: Time-tagged meteo data (relative humidity, atmospheric
pressure, temperature) is regarded a radiometric product and therefore not part
of the monitoring data." classifier="antennaRelativeHumidity"
stringIdentifier="antenna-relative-humidity" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="23"
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 .. 100)"
engineeringUnit="%" configured="false">
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        <oidBit>1</oidBit>
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    </parameter>
    <parameter SemanticDefinition="This parameter reports the atmospheric
pressure in 1/100 Pa as observed by an outdoor meteorological sensor at the
station. This parameter shall be flagged as invalid if the value from the meteo
unit is invalid and it shall be flagged as unavailable if this parameter is not
available at this time." classifier="antennaAtmosphericPressure"
stringIdentifier="antenna-atmospheric-pressure " version="1" creationDate="2016-
02-07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="24"
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (800 .. 1100)"
engineeringUnit="0.01 Pa" configured="false">
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        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>24</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the temperature in Â°C
as observed by an outdoor meteorological sensor at the station. This parameter
shall be flagged as invalid if the value from the meteo unit is invalid and it
shall be flagged as unavailable if this parameter is not available at this
instant in time." classifier="antennaAmbientTemperature"
```

```
stringIdentifier="antenna-ambient-temperature" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="25"
typeDefinition="SEQUENCE (SIZE (1)) OF INTEGER (-100 ..  100)"
engineeringUnit="Â°C" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>25</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
  </functionalResource>
  <functionalResource SemanticDefinition="The Fwd401SpaceLinkCarrierTransmission
FR accepts as input for modulation of the carrier the optionally convolutionally
encoded physical channel symbol stream from the FwdAosSyncAndChannelEncoding FR
or from the TcSyncAndChannelEncoding FR. It also accepts from the
ForwardLinkRanging FR the ranging signal for modulation of the forward
carrier.&#xD;&#xA;The Fwd401SpaceLinkCarrierTransmission FR provides the to be
radiated carrier signal to the Antenna FR and the actual carrier frequency to the
RawRadiometricDataCollection FR. &#x9;"
classifier="Fwd401SpaceLinkCarrierTransmission" stringIdentifier="Forward 401
Space Link Carrier Transmission" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="2">
    <oid>
      <oidBit>1</oidBit>
      <oidBit>3</oidBit>
      <oidBit>112</oidBit>
      <oidBit>4</oidBit>
      <oidBit>4</oidBit>
      <oidBit>2</oidBit>
      <oidBit>1</oidBit>
      <oidBit>2</oidBit>
      <oidBit>1</oidBit>
    </oid>
    <event SemanticDefinition="This event notifies any change of the
fwd401CarrierTransmissionProductionStatus parameter."
classifier="fwd401CarrierTransmissionProductionStatusChange"
stringIdentifier="forward-401-carrier-transmission-production-status-change"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="1">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
```

```
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
      </oid>
      <value SemanticDefinition="The event value reports the
fwd401CarrierTransmissionProductionStatus value that applies since the notified
fwd401CarrierTransmissionProductionStatusChange event occurred."
classifier="fwd401CarrierTransmissionProductionStatusValue"
stringIdentifier="forward-401-carrier-transmission-production-status-value"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" typeDefinition="'eventValue': 'EventValue': 'qualifiedValues':
'SequenceOfQualifiedValues': 'SEQUENCE OF QualifiedValues': 'qualifiedValues':
'TypeAndValueComplexQualified': 'typeAndValue': 'TypeAndValue': 'enumerated':
SEQUENCE (SIZE (1)) OF Enumerated (0 .. 3)&#xD;&#xA;{   configured
(0)&#xD;&#xA;,   operational   (1)&#xD;&#xA;,   interrupted   (2)&#xD;&#xA;,
halted   (3)&#xD;&#xA;}" engineeringUnit="none">
        <externalTypeOid>
          <oidBit>1</oidBit>
          <oidBit>3</oidBit>
          <oidBit>112</oidBit>
          <oidBit>4</oidBit>
          <oidBit>4</oidBit>
          <oidBit>2</oidBit>
          <oidBit>3</oidBit>
          <oidBit>2</oidBit>
          <oidBit>1</oidBit>
          <oidBit>1</oidBit>
          <oidBit>1</oidBit>
          <oidBit>1</oidBit>
        </externalTypeOid>
      </value>
    </event>
    <directives SemanticDefinition="This directive permits setting of the
controllable parameters of the Fwd401SpaceLinkCarrierTransmission FR type. "
classifier="fwd401CarrierTransmissionSetControlParameters"
stringIdentifier="forward-401-carrier-transmission-set-control-parameters"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="1" guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
      </oid>
```

```
      <qualifier SemanticDefinition="The directive qualifier specifies the FR
instance the directive shall act on and contains a set of parameter identifier
and parameter value pairs. To be valid, the parameter identifier must reference a
controllable parameter of the Fwd401SpaceLinkCarrierTransmission FR and the
parameter value must be of the same type as the parameter value that shall be
set.&#xD;&#xA;"
classifier="Fwd401CarrierTransmissionControlledParameterIdsAndValues"
stringIdentifier="forward-401-carrier-transmission-controlled-parameter-
identifiers-and-values" version="1" creationDate="2016-02-07T00:00:00.000+0100"
authorizingEntity="CSS Area" oidBit="1" typeDefinition="For the identification of
the FR instance: &#xD;&#xA;'directiveQualifier': 'functResourceDirQualifier':
'functResourceInstanceNumber': 'FunctionalResourceInstanceNumber':
'IntPos'&#xD;&#xA;For the identification of the parameter to be
set:&#xD;&#xA;'directiveQualifier': 'functResourceDirQualifier':
'functionalResourceQualifiers': 'DirectiveQualifierValues':
'setOfParamIdsAndValues': 'SetOfParameterIdsAndValues': 'parameterIdentifier':
'PublishedIdentifier'&#xD;&#xA;For the parameter
value:&#xD;&#xA;'directiveQualifier': 'functResourceDirQualifier':
'functionalResourceQualifiers': 'DirectiveQualifierValues':
'setOfParamIdsAndValues': 'SetOfParameterIdsAndValues': 'parameterValue':
'TypeAndValueComplexQualified'&#xD;&#xA;The remainder of the path depends on the
type of the value of the parameter that shall be set." engineeringUnit="depends
on the specific paramter(s) being set "/>
    </directives>
    <parameter SemanticDefinition="This enumerated parameter reports the
Fwd401SpaceLinkCarrierTransmission FR production status and can take on four
values:&#xD;&#xA;- 'configured': the forward link equipment has been configured,
but the carrier has not been brought up or has been stopped;&#xD;&#xA;-
'operational': the forward link is active, i.e., the carrier is up;&#xD;&#xA;-
'interrupted': a failure has been detected, e.g. carrier still on outside the
transmission mask, that resulted in the carrier being shut down;&#xD;&#xA;-
'halted': the forward link has been taken out of service, e.g. due to failed HPA
cooling." classifier="fwd401CarrierTransmissionProductionStatus"
stringIdentifier="forward-401-carrier-transmission-production-status" version="1"
creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area"
oidBit="1" typeDefinition="SEQUENCE (SIZE (1)) OF Enumerated (0 .. 3)&#xD;&#xA;{
configured   (0)&#xD;&#xA;,   operational   (1)&#xD;&#xA;,   interrupted
(2)&#xD;&#xA;,   halted   (3)&#xD;&#xA;}" engineeringUnit="none"
configured="true" guardCondition="Setting of the
fwd401CarrierTransmissionProductionStatus to 'operational' or 'interrupted' by
means of the directive fwd401CarrierTransmissionSetControlParameters is not
permissible.">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
```

```
      </oid>
    </parameter>
    <parameter SemanticDefinition="This enumerated parameter reports the current
state of the carrier radiation and can take on three values:&#xD;&#xA;- 'up': the
carrier is presently up and the signal is radiated via the antenna;&#xD;&#xA;-
'test': the carrier is presently up and the signal is radiated into the water
load;&#xD;&#xA;- 'down': the carrier is presently down, i.e., no signal is being
radiated." classifier="fwd401CarrierTransmissionStatus"
stringIdentifier="forward-401-carrier-transmission-status" version="1"
creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area"
oidBit="2" typeDefinition="SEQUENCE (SIZE (1)) OF Enumerated (0 .. 2)&#xD;&#xA;{
up   (0)&#xD;&#xA;,   test   (1)&#xD;&#xA;,   down   (2)&#xD;&#xA;}"
engineeringUnit="none" configured="true" guardCondition="The
fwd401CarrierTransmissionStatus can be set to 'up' only if - in view of the given
antenna pointing, the EIRP and the spectrum of the radiated signal - the ITU
limits regarding the permitted spectral power density are
respected.&#xD;&#xA;Furthermore, the following parameters must have a valid
value:&#xD;&#xA;- fwd401CarrierTransmissionEirp;&#xD;&#xA;-
fwd401CarrierTransmissionPolarization;&#xD;&#xA;-
fwd401CarrierTransmissionControlledNominalCarrierFrequency.  ">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the current forward
link signal level expressed as Equivalent Isotropically Radiated Power (EIRP) in
dBW." classifier="fwd401CarrierTransmissionEirp" stringIdentifier="forward-401-
carrier-transmission-eirp" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="3"
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 .. 150)"
engineeringUnit="dBW" configured="true" guardCondition="The commanded signal
level must not result in a radiated signal that exceeds the spectral power
density limits defined in the pertinent ITU regulations.&#xD;&#xA;Note: The
applicable limit depends on the pointing of the antenna and the local horizon.">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
```

```
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This enumerated parameter reports the
configured forward link polarization and can take on two values:&#xD;&#xA;-
'lcp': the carrier is radiated with left hand circular polarization;&#xD;&#xA;-
'rcp': the carrier is radiated in right hand circular
polarization.&#xD;&#xA;Note: Polarization is defined from the point of view of
the source, i.e., in the direction of the wave propagation."
classifier="fwd401CarrierTransmissionPolarization" stringIdentifier="forward-401-
carrier-transmission-polarization" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="4"
typeDefinition="SEQUENCE (SIZE (1)) OF Enumerated (0 .. 1)&#xD;&#xA;{   lhc
(0)&#xD;&#xA;,   rhc   (1)&#xD;&#xA;}" engineeringUnit="none" configured="true"
guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>4</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the current forward
link frequency in Hz. In general, the frequency will be constant, except during
the forward link sweep and for Category B missions in case the forward link is
being ramped as to compensate for the Doppler shift and rate on the forward
link." classifier="fwd401CarrierTransmissionActualCarrierFrequency"
stringIdentifier="forward-401-carrier-transmission-actual-carrier-frequency"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="5" typeDefinition="SEQUENCE (SIZE (1)) OF IntPos (2025000000 ..
40500000000)" engineeringUnit="Hz" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>5</oidBit>
        <oidBit>1</oidBit>
      </oid>
```

```
    </parameter>
    <parameter SemanticDefinition="This parameter reports the controlled nominal
forward link frequency in Hz. "
classifier="fwd401CarrierTransmissionControlledNominalCarrierFrequency"
stringIdentifier="forward-401-carrier-transmission-controlled-nominal-carrier-
frequency" version="1" creationDate="2016-02-07T00:00:00.000+0100"
authorizingEntity="CSS Area" oidBit="6" typeDefinition="SEQUENCE (SIZE (1)) OF
IntPos (2025000000 .. 40500000000)" engineeringUnit="Hz" configured="true"
guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>6</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This enumerated parameter reports the current
state of the carrier modulation and can take on two values:&#xD;&#xA;- 'on': the
carrier is presently being modulated;&#xD;&#xA;- 'off': the carrier is presently
not being modulated.&#xD;&#xA;Note: This parameter reports the modulation being
off also when this is not explicitly commanded, e.g. when it is forced off
automatically because the forward link sweep is active (sweep-procedure =
'active')." classifier="fwd401CarrierTransmissionModulation"
stringIdentifier="forward-401-carrier-transmission-modulation" version="1"
creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area"
oidBit="7" typeDefinition="SEQUENCE (SIZE (1)) OF Enumerated (0 .. 1)&#xD;&#xA;{
on   (0)&#xD;&#xA;,   off   (1)&#xD;&#xA;}" engineeringUnit="none"
configured="true" guardCondition="Turning on of the modulation is not permitted
while fwd401CarrierTransmissionSweepProcedure = 'active'.&#xD;&#xA;Turning off
the modulation must not result in exceeding the ITU spectral power density
limits.&#xD;&#xA;Furthermore, the modulation can be turned on only if at least
one of the two sets of parameters listed below comprises only parameters of which
all values are valid:&#xD;&#xA;Set 1:&#xD;&#xA;-
fwd401CarrierTransmissionDataModulationType;&#xD;&#xA;-
fwd401CarrierTransmissionDataModulationIndex;&#xD;&#xA;-
fwd401CarrierTransmissionSubcarrierFfrequency;&#xD;&#xA;-
fwd401CarrierTransmissionDataClock;&#xD;&#xA;-
fwd401CarrierTransmissionBasebandWaveform.&#xD;&#xA;Set 2:&#xD;&#xA;-
fwd401CarrierTransmissionRngModulationIindex.">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
```

```
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>7</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This enumerated parameter reports whether the
symbol stream directly modulates the forward carrier or modulates a subcarrier
that in turn modulates the forward carrier. It can take on two values:&#xD;&#xA;-
'direct': the carrier is directly modulated by the input data symbol
stream;&#xD;&#xA;- 'subcarrier': the carrier modulating signal is the subcarrier
which in turn is modulated by the to be radiated symbol stream."
classifier="fwd401CarrierTransmissionSymbolStreamModulationType"
stringIdentifier="forward-401-carrier-transmission-symbol-stream-modulation-type"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="8" typeDefinition="SEQUENCE (SIZE (1)) OF Enumerated (0 ..
1)&#xD;&#xA;{  direct   (0)&#xD;&#xA;,   subcarrier   (1)&#xD;&#xA;}"
engineeringUnit="none" configured="true" guardCondition="Setting the
fwd401CarrierTransmissionSymbolStreamModulationType to 'direct' is only possible
if fwd401CarrierTransmissionSubcarrierFrequency = 0 and the following parameters
have all a valid value:&#xD;&#xA;-
fwd401CarrierTransmissionSymbolStreamModulationIindex;&#xD;&#xA;-
fwd401CarrierTransmissionSymbolClock;&#xD;&#xA;-
fwd401CarrierTransmissionBasebandWaveform.&#xD;&#xA;Setting the
fwd401CarrierTransmissionSymbolStreamModulationType to 'subcarrier' is only
possible if fwd401CarrierTransmissionSubcarrierFrequency â‰  0 and the following
parameters have all a valid value:&#xD;&#xA;-
fwd401CarrierTransmissionSymbolStreamModulationIindex;&#xD;&#xA;-
fwd401CarrierTransmissionSubcarrierFrequencyToSymbolClockCoherency;&#xD;&#xA;-
fwd401CarrierTransmissionSymbolClock;&#xD;&#xA;-
fwd401CarrierTransmissionBasebandWaveform.">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>8</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the configured peak
modulation index for the forward symbol stream in 1/100 radians. It applies
either to the carrier modulation by the symbol stream or in case the symbol strem
modulates a subcarrier to the modulation of the carrier by the subcarrier. In
case of suppressed carrier, this parameter shall report &quot;-1&quot;."
classifier="fwd401CarrierTransmissionSymbolStreamModulationIndex"
stringIdentifier="forward-401-carrier-transmission-symbol-stream-modulation-
index" version="1" creationDate="2016-02-07T00:00:00.000+0100"
```

```
authorizingEntity="CSS Area" oidBit="9" typeDefinition="SEQUENCE (SIZE (1)) OF
INTEGER (0 .. 140, -1)" engineeringUnit="1/100 rad" configured="true"
guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>9</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the configured peak
modulation index for the ranging signal in 1/100 radians."
classifier="fwd401CarrierTransmissionRngModulationIndex"
stringIdentifier="forward-401-carrier-transmission-ranging-modulation-index"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="10" typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 .. 140)"
engineeringUnit="1/100 rad" configured="true" guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>10</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This enumerated parameter reports the current
state of the carrier sweep and can take on two values:&#xD;&#xA;- 'active': the
carrier is presently being swept;&#xD;&#xA;- 'not active': the carrier is
presently not being swept, i.e., the nominal frequency is being radiated.
&#xD;&#xA;Modulation shall be forced off, whenever the sweep is active. In case
the forward link frequency is being ramped as to compensate for Doppler shift and
rate on the forward link (Category B missions only), this is not regarded to be a
sweep." classifier="fwd401CarrierTransmissionSweepProcedureStatus"
stringIdentifier="forward-401-carrier-transmission-sweep-procedure-status"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="11" typeDefinition="SEQUENCE (SIZE (1)) OF Enumerated (0 ..
1)&#xD;&#xA;{   active   (0)&#xD;&#xA;,   notActive   (1)&#xD;&#xA;}"
engineeringUnit="none" configured="true"
guardCondition="fwd401CarrierTransmissionStatus â‰  'down'&#xD;&#xA;Furthermore,
the parameter fwd401CarrierTransmissionSweepProfile must have a valid value.">
```

```
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
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        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>11</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This complex parameter reports on the start
frequency in Hz of the first leg of the sweep. For each leg it then specifies the
stop frequency in Hz, the sweep rate in Hz/s and the duration of the dwell period
in seconds (i.e., the time during which the carrier frequency is not changed)
before the next leg is started. The assumption is that there are no frequency
discontinuities, i.e., the start frequency of a sweep leg is always equal to the
stop frequency of the previous leg."
classifier="fwd401CarrierTransmissionSweepProfile" stringIdentifier="forward-401-
carrier-transmission-sweep-profile" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="12"
typeDefinition="SEQUENCE OF IntUnsigned, where the first element specifies the
start frequency of the first leg of the sweep profile and has a range of
(2025000000 .. 40500000000). The remainder of the sequence consist of three
elements for each leg of the sweep profile as follows:&#xD;&#xA;- stop frequency
with a range of (2025000000 .. 40500000000);&#xD;&#xA;- sweep rate with a range
of (1 .. 32000);&#xD;&#xA;- dwell time with a range of (0 .. 20)."
engineeringUnit="Hz, Hz/s, s (see Semantic Definition for details)"
configured="true" guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>12</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the configured
subcarrier frequency in 1/1000 Hz. As per CCSDS 401.0-B-25, only 8 kHz or 16 kHz
are permissible. The fine resolution is specified here as to enable fine tuning
of the subcarrier frequency in cases where this is necessary to compensate the
forward link Doppler shift. In case that direct modulation is used
(fwd401CarrierTransmissionSymbolStreamModulationType = 'direct'), this parameter
shall report '0'.  &#xD;&#xA;Note: The specified range is intended to also cover
```

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the case of non-CCSDS missions. "
classifier="fwd401CarrierTransmissionSubcarrierFrequency"
stringIdentifier="forward-401-carrier-transmission-subcarrier-frequency"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="13" typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned  (0 ..
300000000)" engineeringUnit="1/1000 Hz" configured="true" guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>13</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This enumerated parameter reports if the
subcarrier is currently being modulated and can take on two values:&#xD;&#xA;-
'on': the subcarrier is currently being modulated;&#xD;&#xA;- 'off': the
subcarrier is currently not being modulated.&#xD;&#xA;In case no subcarrier is
used (fwd401CarrierTransmissionSymbolStreamModulationType = 'direct'), this
parameter shall be flagged as undefined."
classifier="fwd401CarrierTransmissionSubcarrierModulation"
stringIdentifier="forward-401-carrier-transmission-subcarrier-modulation"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="14" typeDefinition="SEQUENCE (SIZE (1)) OF Enumerated (0 ..
1)&#xD;&#xA;{   on   (0)&#xD;&#xA;,   off   (1)&#xD;&#xA;}"
engineeringUnit="none" configured="true"
guardCondition="fwd401CarrierTransmissionSymbolStreamModulationType =
'subcarrier'.">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>14</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This enumerated parameter reports if the
coherency between the subcarrier frequency and symbol clock is given in case a
subcarrier is used. This parameter can take on 2 values:&#xD;&#xA;- 'yes': the
subcarrier frequency is coherent with the symbol clock;&#xD;&#xA;- 'no': the
subcarrier frequency is not coherent with the symbol clock.&#xD;&#xA;In case no
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subcarrier is used (fwd401CarrierTransmissionSymbolStreamModulationType =
'direct'), this parameter shall be flagged as undefined."
classifier="fwd401CarrierTransmissionSubcarrierFrequencyCoherency"
stringIdentifier="forward-401-carrier-transmission-subcarrier-frequency-
coherency" version="1" creationDate="2016-02-07T00:00:00.000+0100"
authorizingEntity="CSS Area" oidBit="15" typeDefinition="SEQUENCE (SIZE (1)) OF
Enumerated (0 .. 1)&#xD;&#xA;{   yes   (0)&#xD;&#xA;,   no   (1)&#xD;&#xA;}"
engineeringUnit="none" configured="true" guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>15</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the configured forward
link symbol rate in 1/10000 Hz, where the range is 78125 to 2560000000."
classifier="fwd401CarrierTransmissionSymbolClock" stringIdentifier="forward-401-
carrier-transmission-symbol-clock" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="16"
typeDefinition="SEQUENCE (SIZE (1)) OF IntPos (78125 .. 2560000000)"
engineeringUnit="1/10000 Hz" configured="true" guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>16</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This enumerated parameter reports the baseband
waveform used to modulate the subcarrier or carrier of the forward link. It can
take on the following values:&#xD;&#xA;- 'nrz-l';&#xD;&#xA;- 'nrz-m';&#xD;&#xA;-
'sp-l'." classifier="fwd401CarrierTransmissionBasebandWaveform"
stringIdentifier="forward-401-carrier-transmission-baseband-waveform" version="1"
creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area"
oidBit="17" deprecated="true" typeDefinition="SEQUENCE (SIZE (1)) OF Enumerated
(0 .. 2)&#xD;&#xA;{   nrzL   (0)&#xD;&#xA;,    nrzM   (1)&#xD;&#xA;,   spL
(2)&#xD;&#xA;}" engineeringUnit="none" configured="true" guardCondition="None">
      <oid>
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        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>17</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
  </functionalResource>
  <functionalResource SemanticDefinition="The Rtn401SpaceLinkCarrierReception FR
accepts as input the carrier signal from the Antenna FR.&#xD;&#xA;It provides the
symbol stream demodulated from the physical channel to the
RtnTmSyncAndChannelDecoding FR. It provides observables needed for the creation
of radiometric data to the RangeAndDopplerExtraction FR, the TdmSegmentGeneration
FR and to the RawRadiometricDataCollection FR.&#xD;&#xA;It provides the carrier
waveform to the D-DOR Raw Data Collection FR and to the Open Loop
Receiver/Formatter FR. " classifier="Rtn401SpaceLinkCarrierReception"
stringIdentifier="Return 401 Space Link Carrier Reception" version="1"
creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area"
oidBit="3" uses="//@functionalResource.0">
    <oid>
      <oidBit>1</oidBit>
      <oidBit>3</oidBit>
      <oidBit>112</oidBit>
      <oidBit>4</oidBit>
      <oidBit>4</oidBit>
      <oidBit>2</oidBit>
      <oidBit>1</oidBit>
      <oidBit>3</oidBit>
      <oidBit>1</oidBit>
    </oid>
    <event SemanticDefinition="This event notifies any change of the
rtn401CarrierReceptionProductionStatus."
classifier="rtn401CarrierReceptionProductionStatusChange"
stringIdentifier="return-401-carrier-reception-production-status-change"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="1">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
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        <oidBit>1</oidBit>
      </oid>
      <value SemanticDefinition="The event value reports the
rtn401CarrierReceptionProductionStatus value that applies since the notified
rtn401CarrierReceptionProductionStatusChange event occurred."
classifier="rtn401CarrierReceptionProductionStatus" stringIdentifier="return-401-
carrier-reception-production-status" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" typeDefinition="'eventValue':
'EventValue': 'qualifiedValues': 'SequenceOfQualifiedValues': 'SEQUENCE OF
QualifiedValues': 'qualifiedValues': 'TypeAndValueComplexQualified':
'typeAndValue': 'TypeAndValue': 'enumerated': SEQUENCE (SIZE (1)) OF Enumerated
(0 .. 3)&#xD;&#xA;{   configured   (0)&#xD;&#xA;,   operational   (1)&#xD;&#xA;,
interrupted   (2)&#xD;&#xA;,   halted   (3)&#xD;&#xA;}" engineeringUnit="none">
        <externalTypeOid>
          <oidBit>1</oidBit>
          <oidBit>3</oidBit>
          <oidBit>112</oidBit>
          <oidBit>4</oidBit>
          <oidBit>4</oidBit>
          <oidBit>2</oidBit>
          <oidBit>3</oidBit>
          <oidBit>21</oidBit>
          <oidBit>1</oidBit>
          <oidBit>1</oidBit>
          <oidBit>2</oidBit>
          <oidBit>1</oidBit>
        </externalTypeOid>
      </value>
    </event>
    <event SemanticDefinition="This event norifies any loss of lock occurring
when receiving the return carrier." classifier="rtn401CarrierReceptionLossOfLock"
stringIdentifier="return-401-carrier-reception-loss-of-lock" version="1"
creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area"
oidBit="2">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
      </oid>
      <value SemanticDefinition="The event value reports which lock or locks have
been lost. It should be noted that loss of carrier lock implies loss of
subcarrier lock if a subcarrier is used and loss of symbol lock. Only the loss of
carrier lock is reported in this case. Loss of subcarrier lock, if a subcarrier
is used, implies loss of symbol lock. Only the loss of subcarrier lock is
reported in this case." classifier="rtn401CarrierReceptionLockType"
stringIdentifier="return-401-carrier-reception-lock-type" version="1"
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creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area"
typeDefinition="'eventValue': 'EventValue': 'qualifiedValues':
'SequenceOfQualifiedValues': 'SEQUENCE OF QualifiedValues': 'qualifiedValues':
'TypeAndValueComplexQualified': 'typeAndValue': 'TypeAndVlue': 'enumerated':
SEQUENCE (SIZE (1)) OF Enumerated (0 .. 2)&#xD;&#xA;{   carrierLockLost
(0)&#xD;&#xA;,   subcarrierLockLost   (1)&#xD;&#xA;,   symbolLockLost
(2)&#xD;&#xA;}" engineeringUnit="none"/>
    </event>
    <directives SemanticDefinition="This directive permits setting of the
controllable parameters of the Rtn401SpaceLinkCarrierReception FR type. "
classifier="rtn401CarrierReceptionSetControlParameters" stringIdentifier="rtn-
401-carrier-reception-set-control-parameters" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="1"
guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
      </oid>
      <qualifier SemanticDefinition="The directive qualifier specifies the FR
instance the directive shall act on and contains a set of parameter identifier
and parameter value pairs. To be valid, the parameter identifier must reference a
controllable parameter of the Rtn401SpaceLinkCarrierReception FR and the
parameter value must be of the same type as the parameter value that shall be
set.&#xD;&#xA;"
classifier="rtn401SpaceLinkCarrierReceptionControlledParameterIdsAndValues"
stringIdentifier="rtn-401-carrier-reception-controlled-parameter-ids-and-values"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" typeDefinition="For the identification of the FR instance:
&#xD;&#xA;'directiveQualifier': 'functResourceDirQualifier':
'functResourceInstanceNumber': 'FunctionalResourceInstanceNumber':
'IntPos'&#xD;&#xA;For the identification of the parameter to be
set:&#xD;&#xA;'directiveQualifier': 'functResourceDirQualifier':
'functionalResourceQualifiers': 'DirectiveQualifierValues':
'setOfParamIdsAndValues': 'SetOfParameterIdsAndValues': 'parameterIdentifier':
'PublishedIdentifier'&#xD;&#xA;For the parameter
value:&#xD;&#xA;'directiveQualifier': 'functResourceDirQualifier':
'functionalResourceQualifiers': 'DirectiveQualifierValues':
'setOfParamIdsAndValues': 'SetOfParameterIdsAndValues':
'parameterValue':&#x9;&#x9;&#x9;&#x9;&#x9;'TypeAndValueComplexQualified'&#xD;&#xA
;The remainder of the path depends on the type of the value of the parameter that
shall be set." engineeringUnit="depends on the specific paramter(s) being set "/>
    </directives>
    <parameter SemanticDefinition="This enumerated parameter reports the
subcarrier wave form. The values the parameter may have are:&#xD;&#xA;- 'sine':
the subcarrier is a sinusodial wave;&#xD;&#xA;- 'square': the subcarrier is a
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square wave.&#xD;&#xA;If the applicable modulation scheme does not use a
subcarrier, this parameter shall be flagged as 'undefined'."
classifier="rtn401CarrierReceptionSubcarrierWaveform" stringIdentifier="return-
401-carrier-reception-subcarrier-waveform" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="1"
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 .. 1)&#xD;&#xA;{  sine
(0)&#xD;&#xA;,   square   (1)&#xD;&#xA;}" engineeringUnit="none"
configured="true" guardCondition="nominal-subcarrier-frequency is valid and â‰
0">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This enumerated parameter reports on the
return link carrier production status and can take on four values:&#xD;&#xA;-
'configured': the return link equipment has been configured and the antenna moved
to point, but due to geometry or spacecraft timeline, no carrier signal is
expected to be seen at this time or the expected LOS time has passed where again
LOS may be due to geometry or due to the spacecraft timeline;&#xD;&#xA;-
'operational': the return link is active, i.e., all receiving equipment is in
nominal condition, the expected AOS time has passed and the expected LOS has not
yet been reached;&#xD;&#xA;- 'interrupted': a failure has been detected, e.g. a
receiver malfunction, that prevents the reception of the carrier
signal;&#xD;&#xA;- 'halted': the return link has been taken out of service, e.g.
due to a power failure affecting the return link string."
classifier="rtn401CarrierReceptionProductionStatus" stringIdentifier="return-401-
carrier-reception-production-status" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="2"
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 .. 3)&#xA;{   configured
(0)&#xA;,   operational   (1)&#xA;,   interrupted   (2)&#xA;,   halted
(3)&#xA;}" engineeringUnit="none" configured="true" guardCondition="Setting of
the rtn401CarrierReceptionProductionStatus to 'operational' or 'interrupted' by
means of the directive rtn401CarrierReceptionSetControlParameters is not
permissible.">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
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        <oidBit>1</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the level of the
received signal in dBm as observed at the LNA input. When the Automatic Gain
Control (AGC) is in coherent mode and the modulation scheme uses a remnant
carrier, then the reported level refers to the carrier power. In all other cases,
the reported level refers to the total signal power. "
classifier="rtn401CarrierReceptionSignalLevel" stringIdentifier="return-401-
carrier-reception-signal-level" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="3"
typeDefinition="SEQUENCE (SIZE (1)) OF INTEGER (-250 ..  -30)"
engineeringUnit="dBm" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the system noise
temperature in K derived from the noise density observed at the receiver input.
As such, it takes into account all contributions to the noise temperature such as
antenna microwave components, atmospheric noise and cosmic microwave background
noise. The noise temperature varies with weather conditions and antenna elevation
due to variation of the path length through the atmosphere and ground noise
received by the antenna side lobes."
classifier="rtn401CarrierReceptionSystemNoiseTemperature"
stringIdentifier="return-401-carrier-reception-system-noise-temperature"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="4" typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (1 ..  1000)"
engineeringUnit="K" configured="false">
      <oid>
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        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>4</oidBit>
        <oidBit>1</oidBit>
```

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      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports (after acquisition of
signal) on the power ratio of the signal received with left hand circular (LHC)
polarization and the signal received with the orthogonal, i.e., right hand
circular (RHC) polarization. If the angle reported is 0 degrees, then the full
power is received via the LHC channel. At 45 degrees, the power in the LHC and
RHC channels is equal, as if the input signal were linearly polarized. At 90
degrees, the full power is received with RHC polarization.&#xD;&#xA;Only stations
supporting concurrent reception of LHC and RHC polarization provide this
information. When this is not possible or the station is configured to use a
single channel only, this parameter shall be flagged as unavailable. "
classifier="rtn401CarrierReceptionPolarizationAngle" stringIdentifier="return-
401-carrier-reception-polarization-angle" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="5"
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 .. 90)"
engineeringUnit="degree" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>5</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the nominal return
carrier frequency disregarding any Doppler shift.&#xD;&#xA;Note: This parameter
shall also be used to configure the tracking receiver, if the spacecraft shall be
tracked using this carrier signal."
classifier="rtn401CarrierReceptionNominalFrequency" stringIdentifier="return-401-
carrier-reception-nominal-frequency" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="6"
typeDefinition="SEQUENCE (SIZE (1)) OF IntPos (2200000000 .. 32300000000)"
engineeringUnit="Hz" configured="true" guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>6</oidBit>
        <oidBit>1</oidBit>
      </oid>
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    </parameter>
    <parameter SemanticDefinition="This parameter specifies the band in Hz
centered around the tn401CarrierReceptionNominalFrequency, possibly corrected for
the expected Doppler offset, in which the receiver shall search for the carrier
signal. This parameter is also valid in case of a suppressed carrier modulation
scheme.&#xD;&#xA;Note: This parameter shall also be used to configure the
tracking receiver, if the spacecraft shall be tracked using this carrier signal."
classifier="rtn401CarrierReceptionFrequencyUncertainty" stringIdentifier="return-
401-carrier-reception-frequency-uncertainty" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="7"
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 .. 1500000)"
engineeringUnit="Hz" configured="true" guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>7</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This enumerated parameter specifies for which
condition the Doppler predicts have been calculated. It can take on three
values:&#xD;&#xA;- 1-way: this mode will be used when the spacecraft is not
locked to a forward link signal or while the spacecraft transponder is commanded
to non-coherent mode or when the spacecraft receiver is in 'coherency enabled'
mode and the forward link carrier frequency is ramped such that the Doppler on
the forward link is compensated, i.e., the spacecraft always 'sees' the nominal
forward link frequency; in this case it does not matter if the forward link is
radiated by the same station that is receiving the return link or a different
station; &#xD;&#xA;- 2-way: this mode is applied when the spacecraft receiver is
commanded to 'coherency enabled' mode and the station that is receiving the
return link also radiates the forward link, the latter at a constant
frequency;&#xD;&#xA;- 3-way: this mode is applied when the spacecraft receiver is
in 'coherency enabled' mode and a station different from the one receiving the
return link is radiating the forward link signal at a known constant frequency."
classifier="rtn401CarrierReceptionPredictMode" stringIdentifier="return-401-
carrier-reception-predict-mode" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="8"
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 .. 2)&#xD;&#xA;{   oneWay
(0)&#xD;&#xA;,   twoWay   (1)&#xD;&#xA;,   threeWay   (2)&#xD;&#xA;}"
engineeringUnit="none" configured="true" guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
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        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>8</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the dual-sided tracking
loop bandwidth in tenth Hz of the receiver."
classifier="rtn401CarrierReceptionTrackingLoopBandwidth"
stringIdentifier="return-401-carrier-reception-tracking-loop-bandwidth"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="9" typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (1 .. 30000)"
engineeringUnit="1/10 Hz" configured="true" guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>9</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This enumerated parameter reports the order of
the carrier tracking loop. It can take on the following values:&#xD;&#xA;- 'first
order': such loop is hardly ever used as it has a static phase error even in case
of a constant return link carrier frequency;&#xD;&#xA;- 'second order': this is
the most commonly used loop as it has no static phase error for a constant return
link carrier frequency;&#xD;&#xA;- 'third order': such configuration may have to
be used in case of high Doppler rates, as such loop has no static phase error
even when the return link carrier frequency is sweeping, but initial acquisition
is more difficult with such loop. "
classifier="rtn401CarrierReceptionOrderOfLoop" stringIdentifier="return-401-
carrier-reception-order-of-loop" version="1" creationDate="2015-12-
14T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="10"
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 .. 2)&#xD;&#xA;{
firstOrder   (0)&#xD;&#xA;,   secondOrder   (1)&#xD;&#xA;,   thirdOrder
(2)&#xD;&#xA;}" engineeringUnit="none" configured="true" guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
```

```
        <oidBit>1</oidBit>
        <oidBit>10</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This enumerated parameter reports the lock
status of the receiver used for telemetry and possibly ranging. The values the
parameter may have are:&#xD;&#xA;- 'locked': the receiver has locked on the
return link signal;&#xD;&#xA;- 'not locked': the receiver has not locked on the
return link signal and therefore cannot deliver telemetry and Doppler
measurements.&#xD;&#xA;This parameter is valid also in case of a suppressed
carrier modulation scheme." classifier="rtn401CarrierReceptionCarrierLock"
stringIdentifier="return-401-carrier-reception-carrier-lock" version="1"
creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area"
oidBit="11" typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 ..
1)&#xD;&#xA;{   locked   (0)&#xD;&#xA;,   notLocked   (1)&#xD;&#xA;}"
engineeringUnit="none" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>11</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the mean value of the
phase error in 1/100 radians in the carrier tracking loop by accumulating the
loop errors Ei over a period of n samples and then dividing by n. The mean M
should be zero unless the loop is subject to a static phase error.&#xA;A given
implementation shall specify the number of samples used to calculate this
paramter. This shall be recorded in the Service Agreement."
classifier="rtn401CarrierReceptionLoopMeanPhaseError" stringIdentifier="return-
401-carrier-reception-loop-mean-phase-error" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="12"
typeDefinition="SEQUENCE (SIZE (1)) OF INTEGER (-629 .. 629)"
engineeringUnit="1/100 rad" configured="false">
      <oid>
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        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>12</oidBit>
```

```
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the peak absolute value
of the phase error |Ei - M| in 1/100 radians in the carrier tracking loop
observed in the most recent n samples.&#xD;&#xA;A given implementation shall
specify the number of samples used to calculate this parameter. This shall be
recorded in the Service Agreement."
classifier="rtn401CarrierReceptionLoopPeakPhaseError" stringIdentifier="return-
401-carrier-reception-loop-peak-phase-error" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="13"
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 .. 629)"
engineeringUnit="1/100 rad" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>13</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter is derived from the carrier-
loop-phase-error-std-deviation (std) as follows: SNR in 1/100 dB is given by
1000 log (2/(2PI std)^2) where log is to the base of 10. The carrier loop phase
error standard deviation (or rms value) in rad over n samples, i.e. the sum of
(Ei - M)^2 for i = 1 .. n is calculated, then divided by n and then the square
root taken.&#xD;&#xA;A given implementation shall specify the number of samples
used to calculate this parameter. This shall be recorded in the Service
Agreement." classifier="rtn401CarrierReceptionLoopSnr" stringIdentifier="return-
401-carrier-reception-loop-snr" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="14"
typeDefinition="SEQUENCE (SIZE (1)) OF INTEGER (- 2800 .. 10000)"
engineeringUnit="1/100 dB" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>14</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
```

```
    <parameter SemanticDefinition="This parameter reports the observed carrier
return link frequency in Hz. This parameter therefore varies with the Doppler
shift induced by the radial velocity of the spacecraft relative to the ground
based antenna. In 1-way mode, the Doppler shift applies only once, but also the
onboard oscillator drift affects the observed return link carrier frequency. In
2-way mode in combination with a constant forward link frequency, the Doppler
shift approximately doubles with respect to the 1-way case, but the contribution
of the onboard oscillator drift is eliminated."
classifier="rtn401CarrierReceptionActualFrequency" stringIdentifier="return-401-
carrier-reception-actual-frequency" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="15"
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (2199700000 ..  38500000000)"
engineeringUnit="Hz" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>15</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the observed carrier
return link offset in Hz with respect to the nominal return link carrier
frequency. As such it reports on the onboard oscillator drift (in case of 1-way
operation) plus the Doppler shift induced by the radial velocity between
spacecraft and the ground-based antenna. In 2-way mode, the effect of the onboard
oscillator drift is eliminated. In combination with a constant forward link
frequency, the Doppler shift approximately doubles compared to the 1-way case."
classifier="rtn401CarrierReceptionFrequencyOffset" stringIdentifier="return-401-
carrier-reception-frequency-offset" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="16"
typeDefinition="SEQUENCE (SIZE (1)) OF INTEGER (-5000000 ..  5000000)"
engineeringUnit="Hz" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>16</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
```

```
    <parameter SemanticDefinition="This parameter reports the forward link
frequency in Hz that corresponds to the non-coherent return link frequency
divided by the transponder turnaround ratio in the Doppler free case. The
spacecraft is expected to lock on the forward link, when it 'sees' this
frequency. " classifier="rtn401CarrierReceptionBestLockFrequency"
stringIdentifier="return-401-carrier-reception-best-lock-frequency" version="1"
creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS Area"
oidBit="17" typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (2024956000 ..
40501863000)" engineeringUnit="Hz" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>17</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the Doppler offset
standard deviation in Hz over n samples. Each sample Si is the difference between
the actual return link frequency and the predicted return link frequency where
the predict takes into account the expected Doppler shift. Based on these
samples, the mean Doppler offset M is calculated by forming the sum of n samples
Si and dividing it by n. Then the sum of (Si - M)^2 for i = 1 .. n is calculated,
then divided by n and then the square root taken."
classifier="rtn401CarrierReceptionDopplerStdDeviation" stringIdentifier="return-
401-carrier-reception-doppler-std-deviation" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="18"
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 .. 629)"
engineeringUnit="Hz" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>18</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the subcarrier
demodulator loop bandwidth expressed as symbol rate to subcarrier frequency
ratio. If the applicable modulation scheme does not use a subcarrier, this
parameter shall be flagged as undefined."
```

```
classifier="rtn401CarrierReceptionSubcarrierDemodLoopBandwidth"
stringIdentifier="return-401-carrier-reception-subcarrier-demod-loop-bandwidth"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="19" typeDefinition="SEQUENCE (SIZE (1)) OF REAL (10^-5 .. 10^-1)"
engineeringUnit="none" configured="true"
guardCondition="rtn401CarrierReceptionNominalSubcarrierFrequency is valid and â‰
0">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>19</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the subcarrier to
carrier power ratio expressed in 1/100 dBc. If the applicable modulation scheme
does not use a subcarrier, this parameter shall be flagged as 'undefined'."
classifier="rtn401CarrierReceptionSubcarrierLevelEstimate"
stringIdentifier="return-401-carrier-reception-subcarrier-level-estimate"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="20" typeDefinition="SEQUENCE (SIZE (1)) OF INTEGER (-20000 .. 0)"
engineeringUnit="1/100 dBc" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>20</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This enumerated parameter reports on the
subcarrier lock status of the BPSK subcarrier demodulator. The values the
parameter may have are:&#xD;&#xA;- 'locked': the demodulator has locked on the
return link subcarrier;&#xD;&#xA;- 'not locked': the demodulator has not locked
on the return link subcarrier and therefore cannot deliver telemetry.&#xD;&#xA;If
the applicable modulation scheme does not use a subcarrier, this parameter shall
be flagged as undefined." classifier="rtn401CarrierReceptionSubcarrierLockStatus"
stringIdentifier="return-401-carrier-reception-subcarrier-lock-status"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="21" typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 ..
```

```
1)&#xD;&#xA;{   locked   (0)&#xD;&#xA;,   notLocked   (1)&#xD;&#xA;}"
engineeringUnit="none" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>21</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the nominal subcarrier
frequency in 1/1000 Hz, i.e., this parameter does not take into account Doppler
shift of the subcarrier frequency. If the applicable modulation scheme does not
use a subcarrier, this parameter shall be be set to 0."
classifier="rtn401CarrierReceptionNominalSubcarrierFrequency"
stringIdentifier="return-401-carrier-reception-nominal-subcarrier-frequency"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="22" typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (2000 ..
300000)" engineeringUnit="1/1000 Hz" configured="true" guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>22</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the actually received
subcarrier frequency in 1/1000 Hz, i.e., this parameter reflects the Doppler
shift of the subcarrier frequency. If the applicable modulation scheme does not
use a subcarrier, this parameter shall be flagged as 'undefined'."
classifier="rtn401CarrierReceptionActualSubcarrierFrequency"
stringIdentifier="return-401-carrier-reception-actual-subcarrier-frequency"
version="1" creationDate="2016-02-06T23:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="23" typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (2000 ..
300000)" engineeringUnit="1/1000 Hz" configured="false">
      <oid>
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        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
```

```
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>23</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the symbol synchronizer
loop bandwidth expressed as dual-sided symbol synchronizer loop bandwidth to
symbol rate ratio. "
classifier="rtn401CarrierReceptionSymbolSynchronizerLoopBandwidth"
stringIdentifier="return-401-carrier-reception-symbol-synchronizer-loop-
bandwidth" version="1" creationDate="2016-02-07T00:00:00.000+0100"
authorizingEntity="CSS Area" oidBit="24" typeDefinition="SEQUENCE (SIZE (1)) OF
REAL (10^-5 .. 10^-2)" engineeringUnit="none" configured="true"
guardCondition="None">
      <oid>
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        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>24</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This enumerated parameter reports the symbol
stream synchronizer lock status. The values the parameter may have
are:&#xD;&#xA;- 'locked': the symbol synchronizer has locked on the return link
symbol stream;&#xD;&#xA;- 'not locked': the symbol synchronizer has not locked on
the symbol stream."
classifier="rtn401CarrierReceptionSymbolSynchronizerLockStatus"
stringIdentifier="return-401-carrier-reception-symbol-synchronizer-lock-status"
version="1" creationDate="2016-02-07T00:00:00.000+0100" authorizingEntity="CSS
Area" oidBit="25" typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (0 ..
1)&#xD;&#xA;{   locked   (0)&#xD;&#xA;,   notLocked   (1)&#xD;&#xA;}"
engineeringUnit="none" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
        <oidBit>2</oidBit>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
```

```
        <oidBit>1</oidBit>
        <oidBit>25</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the nominally received
symbol stream rate in 1/1000 symbols/second, i.e., this parameter does not
reflect the Doppler shift of the symbol rate."
classifier="rtn401CarrierReceptionNominalSymbolRate" stringIdentifier="return-
401-carrier-reception-nominal-symbol-rate" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="26"
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (4000 .. 20000000000)"
engineeringUnit="1/1000 symbols/s" configured="true" guardCondition="None">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>26</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the actually received
symbol stream rate in 1/1000 symbols/second, i.e., this parameter reflects the
Doppler shift of the symbol rate."
classifier="rtn401CarrierReceptionActualSymbolRate" stringIdentifier="return-401-
carrier-reception-actual-symbol-rate" version="1" creationDate="2016-02-
07T00:00:00.000+0100" authorizingEntity="CSS Area" oidBit="27"
typeDefinition="SEQUENCE (SIZE (1)) OF IntUnsigned (4000 .. 20000000000)"
engineeringUnit="1/1000 symbols/s" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>3</oidBit>
        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>27</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
    <parameter SemanticDefinition="This parameter reports the estimated symbol
energy over noise density ratio (Es/No) in 1/100 dB. The algorithms used to
calculate this estimate tend to saturate at a certain Es/No level so that the
reported estimate may be significantly too low. However, this saturation happens
```

```
at levels that are so high that the telemetry is anyway virtually error free."
classifier="rtn401CarrierReceptionEsOverNo" stringIdentifier="return-401-carrier-
reception-es-over-no" version="1" creationDate="2016-02-07T00:00:00.000+0100"
authorizingEntity="CSS Area" oidBit="28" typeDefinition="SEQUENCE (SIZE (1)) OF
INTEGER (-1000 .. 60000)" engineeringUnit="1/100 dB" configured="false">
      <oid>
        <oidBit>1</oidBit>
        <oidBit>3</oidBit>
        <oidBit>112</oidBit>
        <oidBit>4</oidBit>
        <oidBit>4</oidBit>
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        <oidBit>1</oidBit>
        <oidBit>1</oidBit>
        <oidBit>28</oidBit>
        <oidBit>1</oidBit>
      </oid>
    </parameter>
  </functionalResource>
</fr:FunctionalResourceModel>
```

ANNEX B

FUNCTIONAL RESOURCE SCHEMA

The FR XML format is governed by two XSD files:

a) functional_resource.xsd;

b) frtypes.xsd.

functional_resource.xsd

```
<?xml version="1.0" encoding="UTF-8"?><xsd:schema
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:ecore="http://www.eclipse.org/emf/2002/Ecore"
xmlns:fr="http://iso.org.dod.ccsds" xmlns:frtypes="http://ccsds.fr/types"
xmlns:org.eclipse.emf._2002.ecore.ocl.pivot="http://www.eclipse.org/emf/2002/Ecore/
OCL/Pivot" xmlns:org.eclipse.ocl.import="http://www.eclipse.org/OCL/Import"
org.eclipse.ocl.import:ecore="http://www.eclipse.org/emf/2002/Ecore"
targetNamespace="http://iso.org.dod.ccsds">
  <xsd:import namespace="http://www.eclipse.org/emf/2002/Ecore"
schemaLocation="platform:/plugin/org.eclipse.emf.ecore/model/Ecore.xsd"/>
  <xsd:import namespace="http://ccsds.fr/types" schemaLocation="frtypes.xsd"/>
  <xsd:element name="FunctionalResourceModel" type="fr:FunctionalResourceModel"/>

  <xsd:complexType name="FunctionalResourceModel">
    <xsd:sequence>
      <xsd:element name="rootOid" type="fr:Oid"/>
      <xsd:element name="asnTypeModule" type="frtypes:Module"/>
      <xsd:element maxOccurs="unbounded" minOccurs="0"
name="functionalResourceStratum" type="fr:FunctionalResourceStratum"/>
      <xsd:element maxOccurs="unbounded" minOccurs="0" name="functionalResourceSet"
type="fr:FunctionalResourceSet"/>
      <xsd:element maxOccurs="unbounded" minOccurs="0" name="functionalResource"
type="fr:FunctionalResource"/>
    </xsd:sequence>
  </xsd:complexType>
  <xsd:complexType name="FunctionalResourceStratum">
    <xsd:sequence>
      <xsd:element maxOccurs="unbounded" minOccurs="0" name="functionalResourceSet"
type="fr:FunctionalResourceSet"/>
    </xsd:sequence>
    <xsd:attribute name="name" type="ecore:EString" use="required"/>
  </xsd:complexType>
  <xsd:complexType name="FunctionalResourceSet">
    <xsd:sequence>
      <xsd:element maxOccurs="unbounded" minOccurs="0" name="functionalResource"
type="fr:FunctionalResource"/>
    </xsd:sequence>
    <xsd:attribute name="name" type="ecore:EString" use="required"/>
    <xsd:attribute default="0" name="oidOffset" type="ecore:EInt"/>
  </xsd:complexType>
  <xsd:complexType name="FrModelElement">
    <xsd:sequence>
      <xsd:element minOccurs="0" name="oid" type="fr:Oid"/>
    </xsd:sequence>
    <xsd:attribute name="SemanticDefinition" type="ecore:EString" use="required"/>
    <xsd:attribute name="classifier" type="ecore:EString" use="required"/>
    <xsd:attribute name="stringIdentifier" type="ecore:EString"/>
    <xsd:attribute name="version" type="ecore:EInt" use="required">
      <xsd:annotation>
```

```
        <xsd:documentation>The version will be, if present, appended to the OID of
this element.</xsd:documentation>
      </xsd:annotation>
    </xsd:attribute>
    <xsd:attribute name="creationDate" type="ecore:EDate"/>
    <xsd:attribute name="authorizingEntity" type="ecore:EString" use="required"/>
    <xsd:attribute name="oidBit" type="ecore:EInt" use="required"/>
    <xsd:attribute name="deprecated" type="ecore:EBoolean" use="required"/>
  </xsd:complexType>
  <xsd:complexType name="Oid">
    <xsd:sequence>
      <xsd:element maxOccurs="unbounded" minOccurs="0" name="oidBit"
type="ecore:EInt"/>
    </xsd:sequence>
  </xsd:complexType>
  <xsd:complexType name="FunctionalResource">
    <xsd:complexContent>
      <xsd:extension base="fr:FrModelElement">
        <xsd:sequence>
          <xsd:element maxOccurs="unbounded" minOccurs="0" name="parameter"
type="fr:Parameter"/>
          <xsd:element maxOccurs="unbounded" minOccurs="0" name="event"
type="fr:Event"/>
          <xsd:element maxOccurs="unbounded" minOccurs="0" name="directives"
type="fr:Directive"/>
          <xsd:element maxOccurs="unbounded" minOccurs="0"
name="serviceAccesspoint" type="fr:ServiceAccessPoint"/>
          <xsd:element maxOccurs="unbounded" minOccurs="0"
name="providedAncillaryInterface" type="fr:AncillaryInterface"/>
        </xsd:sequence>
        <xsd:attribute name="uses">
          <xsd:simpleType>
            <xsd:list itemType="xsd:anyURI"/>
          </xsd:simpleType>
        </xsd:attribute>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="Event">
    <xsd:complexContent>
      <xsd:extension base="fr:FrModelElement">
        <xsd:sequence>
          <xsd:element minOccurs="0" name="externalOid" type="fr:Oid"/>
          <xsd:element maxOccurs="unbounded" minOccurs="0" name="value"
type="fr:Value"/>
        </xsd:sequence>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="Directive">
    <xsd:complexContent>
      <xsd:extension base="fr:FrModelElement">
        <xsd:sequence>
          <xsd:element maxOccurs="unbounded" minOccurs="0" name="qualifier"
type="fr:Qualifier"/>
        </xsd:sequence>
        <xsd:attribute name="guardCondition" type="ecore:EString" use="required"/>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="Parameter"
org.eclipse.emf._2002.ecore.ocl.pivot:GuardConditionInv="self.configured = true
implies self.guardCondition-&gt;notEmpty()">
    <xsd:complexContent>
      <xsd:extension base="fr:TypedElement">
        <xsd:sequence>
```

```
          <xsd:element minOccurs="0" name="externalOid" type="fr:Oid"/>
        </xsd:sequence>
        <xsd:attribute default="false" name="configured" type="ecore:EBoolean"/>
        <xsd:attribute name="guardCondition" type="ecore:EString"/>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="Value">
    <xsd:complexContent>
      <xsd:extension base="fr:TypedElement"/>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="Qualifier">
    <xsd:complexContent>
      <xsd:extension base="fr:TypedElement"/>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="TypedElement">
    <xsd:complexContent>
      <xsd:extension base="fr:FrModelElement">
        <xsd:sequence>
          <xsd:element minOccurs="0" name="externalTypeOid" type="fr:Oid"/>
          <xsd:element name="typeOid" type="fr:Oid">
            <xsd:annotation>
              <xsd:documentation>CSTS WG decided to have a dedicated type OID to
denote the OID of the ASN.1 type definition used for encoding.

The type OID is constructed by using the OID of the P/E/D and add a digit. This is
necessary for Event/Vaues and Directive/Qualifiers which have a 1 - 0..n
relationship.</xsd:documentation>
            </xsd:annotation>
          </xsd:element>
          <xsd:element name="typeDef" type="frtypes:TypeDefinition"/>
        </xsd:sequence>
        <xsd:attribute name="typeDefinition" type="ecore:EString" use="required"/>
        <xsd:attribute name="engineeringUnit" type="ecore:EString"/>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="ServiceAccessPoint">
    <xsd:attribute default="newSAP" name="name" type="ecore:EString"/>
    <xsd:attribute name="minAccessor" type="ecore:EInt" use="required"/>
    <xsd:attribute name="maxAccessor" type="ecore:EInt" use="required"/>
    <xsd:attribute name="minAccessed" type="ecore:EInt" use="required"/>
    <xsd:attribute name="maxAccessed" type="ecore:EInt" use="required"/>
    <xsd:attribute name="accessedFunctionalResource" type="xsd:anyURI"
use="required"/>
    <xsd:attribute name="accessingFunctionalResource" type="xsd:anyURI"
use="required"/>
  </xsd:complexType>
  <xsd:complexType name="AncillaryInterface">
    <xsd:attribute name="name" type="ecore:EString"/>
    <xsd:attribute name="providingFunctionalResource" type="xsd:anyURI"
use="required"/>
    <xsd:attribute name="requiringFunctionalResource" type="xsd:anyURI"
use="required"/>
  </xsd:complexType>
</xsd:schema>
```

frtypes.xsd

```
<?xml version="1.0" encoding="UTF-8"?><xsd:schema
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:ecore="http://www.eclipse.org/emf/2002/Ecore"
xmlns:frtypes="http://ccsds.fr/types" targetNamespace="http://ccsds.fr/types">
  <xsd:import namespace="http://www.eclipse.org/emf/2002/Ecore"
schemaLocation="platform:/plugin/org.eclipse.emf.ecore/model/Ecore.xsd"/>

  <xsd:complexType name="TypeDefinition">
    <xsd:complexContent>
      <xsd:extension base="frtypes:ExportWriter">
        <xsd:sequence>
          <xsd:element name="type" type="frtypes:Type"/>
        </xsd:sequence>
        <xsd:attribute name="name" type="ecore:EString"/>
        <xsd:attribute name="comment" type="ecore:EString"/>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType abstract="true" name="Type">
    <xsd:complexContent>
      <xsd:extension base="frtypes:ExportWriter">
        <xsd:sequence>
          <xsd:element minOccurs="0" name="singleValueConstraint"
type="frtypes:SingleValueConstraint"/>
        </xsd:sequence>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType abstract="true" name="SimpleType">
    <xsd:complexContent>
      <xsd:extension base="frtypes:Type"/>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType abstract="true" name="StructuredType">
    <xsd:complexContent>
      <xsd:extension base="frtypes:Type"/>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="Boolean">
    <xsd:complexContent>
      <xsd:extension base="frtypes:SimpleType"/>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="IntegerType">
    <xsd:complexContent>
      <xsd:extension base="frtypes:SimpleRangeType">
        <xsd:sequence>
          <xsd:element maxOccurs="unbounded" minOccurs="0" name="namedValues"
type="frtypes:NamedValue"/>
        </xsd:sequence>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="BitString">
    <xsd:complexContent>
      <xsd:extension base="frtypes:SimpleSizeConstrainedType"/>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="OctetString">
    <xsd:complexContent>
      <xsd:extension base="frtypes:SimpleSizeConstrainedType"/>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="Real">
```

```
    <xsd:complexContent>
      <xsd:extension base="frtypes:SimpleRangeType"/>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="Enumerated">
    <xsd:complexContent>
      <xsd:extension base="frtypes:SimpleType">
        <xsd:sequence>
          <xsd:element maxOccurs="unbounded" name="values"
type="frtypes:NamedValue"/>
        </xsd:sequence>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="CharacterString">
    <xsd:complexContent>
      <xsd:extension base="frtypes:SimpleSizeConstrainedType">
        <xsd:sequence>
          <xsd:element minOccurs="0" name="permittedAlphabetConstraint"
type="frtypes:PermittedAlphabetConstraint"/>
        </xsd:sequence>
        <xsd:attribute default="VisibleString" name="type"
type="frtypes:StringType"/>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="Sequence">
    <xsd:complexContent>
      <xsd:extension base="frtypes:StructuredDifferentType"/>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="SequenceOf">
    <xsd:complexContent>
      <xsd:extension base="frtypes:StructuredSizeConstrainedType"/>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="Set">
    <xsd:complexContent>
      <xsd:extension base="frtypes:StructuredDifferentType"/>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="SetOf">
    <xsd:complexContent>
      <xsd:extension base="frtypes:StructuredSizeConstrainedType"/>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType abstract="true" name="Constraint">
    <xsd:annotation>
      <xsd:documentation>Constraints: This is drastically simplified approach
compared to what ASn.1 allows.</xsd:documentation>
    </xsd:annotation>
    <xsd:complexContent>
      <xsd:extension base="frtypes:ExportWriter"/>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="SizeConstraint">
    <xsd:complexContent>
      <xsd:extension base="frtypes:Constraint">
        <xsd:attribute name="min" type="ecore:ELong" use="required"/>
        <xsd:attribute name="max" type="ecore:ELong" use="required"/>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="ValueRangeConstraint">
    <xsd:complexContent>
      <xsd:extension base="frtypes:Constraint">
        <xsd:attribute name="min" type="ecore:EString" use="required"/>
```

```
        <xsd:attribute name="max" type="ecore:EString" use="required"/>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType abstract="true" name="SimpleRangeType">
    <xsd:complexContent>
      <xsd:extension base="frtypes:SimpleType">
        <xsd:sequence>
          <xsd:element maxOccurs="unbounded" minOccurs="0" name="rangeConstraint"
type="frtypes:ValueRangeConstraint"/>
        </xsd:sequence>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType abstract="true" name="SimpleSizeConstrainedType">
    <xsd:complexContent>
      <xsd:extension base="frtypes:SimpleType"/>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="NamedValue">
    <xsd:complexContent>
      <xsd:extension base="frtypes:ExportWriter">
        <xsd:attribute name="name" type="ecore:EString"/>
        <xsd:attribute name="value" type="ecore:EInt"/>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType abstract="true" name="StructuredSizeConstrainedType">
    <xsd:complexContent>
      <xsd:extension base="frtypes:StructuredType">
        <xsd:sequence>
          <xsd:element name="elements" type="frtypes:Type"/>
        </xsd:sequence>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="Choice">
    <xsd:complexContent>
      <xsd:extension base="frtypes:StructuredDifferentType"/>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="TypeReferenceLocal">
    <xsd:complexContent>
      <xsd:extension base="frtypes:Type">
        <xsd:attribute name="typeDefinition" type="xsd:anyURI" use="required"/>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="SingleValueConstraint">
    <xsd:complexContent>
      <xsd:extension base="frtypes:Constraint">
        <xsd:sequence>
          <xsd:element maxOccurs="unbounded" name="values" nillable="true"
type="ecore:EString"/>
        </xsd:sequence>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="PermittedAlphabetConstraint">
    <xsd:complexContent>
      <xsd:extension base="frtypes:Constraint">
        <xsd:sequence>
          <xsd:element maxOccurs="unbounded" name="values" nillable="true"
type="ecore:EString"/>
        </xsd:sequence>
        <xsd:attribute default="RANGE" name="type" type="frtypes:ConstraintType"/>
      </xsd:extension>
```

```
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="Module">
    <xsd:complexContent>
      <xsd:extension base="frtypes:ExportWriter">
        <xsd:sequence>
          <xsd:element maxOccurs="unbounded" minOccurs="0" name="typeDefinition"
type="frtypes:TypeDefinition"/>
          <xsd:element maxOccurs="unbounded" minOccurs="0" name="exports"
nillable="true" type="ecore:EString"/>
          <xsd:element maxOccurs="unbounded" minOccurs="0" name="imports"
type="frtypes:FromModule"/>
        </xsd:sequence>
        <xsd:attribute name="oid" type="ecore:EString"/>
        <xsd:attribute name="name" type="ecore:EString" use="required"/>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="ObjectIdentifier">
    <xsd:complexContent>
      <xsd:extension base="frtypes:SimpleType"/>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:simpleType name="StringType">
    <xsd:restriction base="xsd:string">
      <xsd:enumeration value="BMPString"/>
      <xsd:enumeration value="IA5String"/>
      <xsd:enumeration value="GeneralString"/>
      <xsd:enumeration value="GraphicString"/>
      <xsd:enumeration value="NumericString"/>
      <xsd:enumeration value="PrintableString"/>
      <xsd:enumeration value="TeletexString"/>
      <xsd:enumeration value="UniversalString"/>
      <xsd:enumeration value="UTF8String"/>
      <xsd:enumeration value="VideotexString"/>
      <xsd:enumeration value="VisibleString"/>
    </xsd:restriction>
  </xsd:simpleType>
  <xsd:complexType name="Element">
    <xsd:complexContent>
      <xsd:extension base="frtypes:Type">
        <xsd:sequence>
          <xsd:element name="type" type="frtypes:Type"/>
        </xsd:sequence>
        <xsd:attribute name="name" type="ecore:EString" use="required"/>
        <xsd:attribute name="tag" type="ecore:EString"/>
        <xsd:attribute default="false" name="optional" type="ecore:EBoolean"/>
        <xsd:attribute name="comment" type="ecore:EString"/>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="TypeReferenceExternal">
    <xsd:complexContent>
      <xsd:extension base="frtypes:Type">
        <xsd:attribute name="name" type="ecore:EString" use="required"/>
        <xsd:attribute default="false" name="complexType" type="ecore:EBoolean"/>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="Null">
    <xsd:complexContent>
      <xsd:extension base="frtypes:SimpleType"/>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:simpleType name="StringBuffer">
    <xsd:restriction base="xsd:string"/>
```

```
  </xsd:simpleType>
  <xsd:complexType abstract="true" name="ExportWriter">
    <xsd:annotation>
      <xsd:appinfo source="http://www.eclipse.org/emf/2002/Ecore">
        <operation name="writeAsn1">
          <parameter name="indentLevel" type="ecore:EInt"/>
          <parameter name="output" type="frtypes:StringBuffer"/>
        </operation>
        <operation name="writeXsd">
          <parameter name="indentLevel" type="ecore:EInt"/>
          <parameter name="output" type="frtypes:StringBuffer"/>
          <parameter name="oid" type="frtypes:ObjectIdentifier"/>
        </operation>
      </xsd:appinfo>
    </xsd:annotation>
  </xsd:complexType>
  <xsd:complexType abstract="true" name="SizeConstrainedType">
    <xsd:complexContent>
      <xsd:extension base="frtypes:ExportWriter">
        <xsd:sequence>
          <xsd:element maxOccurs="unbounded" minOccurs="0" name="sizeConstraint"
type="frtypes:SizeConstraint"/>
        </xsd:sequence>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:simpleType name="ConstraintType">
    <xsd:restriction base="xsd:string">
      <xsd:enumeration value="RANGE"/>
      <xsd:enumeration value="OR"/>
    </xsd:restriction>
  </xsd:simpleType>
  <xsd:complexType abstract="true" name="StructuredDifferentType">
    <xsd:complexContent>
      <xsd:extension base="frtypes:StructuredType">
        <xsd:sequence>
          <xsd:element maxOccurs="unbounded" name="elements" type="frtypes:Type"/>
        </xsd:sequence>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
  <xsd:complexType name="FromModule">
    <xsd:complexContent>
      <xsd:extension base="frtypes:ExportWriter">
        <xsd:sequence>
          <xsd:element maxOccurs="unbounded" minOccurs="0" name="importedTypes"
nillable="true" type="ecore:EString"/>
        </xsd:sequence>
        <xsd:attribute name="name" type="ecore:EString"/>
      </xsd:extension>
    </xsd:complexContent>
  </xsd:complexType>
</xsd:schema>
```

ANNEX C

XML ELEMENTS TO IGNORE

The following XML elements and their children shall be ignored, that is, not imported into the SANA registry:

a) typeDef;

b) serviceAccesspoint;

c) providedAncillaryInterface.

ANNEX D

ABBREVIATIONS AND ACRONYMS

AGC	automatic gain control
CCSDS	Consultative Committee for Space Data Systems
EIRP	equivalent isotropically radiated power
FR	functional resource
FRM	Functional Resource Model
LHC	left hand circular
OID	object identifier
RHC	right hand circular
SANA	Space Assigned Numbers Authority
std	standard deviation
TT&C	Tracking, Telemetry, and Command
XML	Extensible Markup Language