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\\

Technical Specification

O-RAN Working Group 3

Near-Real-time RAN Intelligent Controller  
E2 Service Model (E2SM), Cell Configuration and Control

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# 1 Scope

This Technical Specification has been produced by the O-RAN Alliance.

The contents of the present document are subject to continuing work within O-RAN and may change following formal O-RAN approval. Should the O-RAN Alliance modify the contents of the present document, it will be re-released by O-RAN with an identifying change of release date and an increase in version number as follows:

Release x.y.z

where:

x the first digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc. (the initial approved document will have x=01).

y the second digit is incremented when editorial only changes have been incorporated in the document.

z the third digit included only in working versions of the document indicating incremental changes during the editing process.

The present document specifies the E2 Service Model (E2SM) for the Near RT RIC Cell Configuration and Control.

# 2 References

1. 3GPP TR 21.905: “Vocabulary for 3GPP Specifications”.
2. O-RAN Working Group 3, Near-Real-time RAN Intelligent Controller, Architecture & E2 General Aspects and Principles (E2GAP).
3. ORAN Working Group 3, Near-Real-time RAN Intelligent Controller, E2 Application Protocol (E2AP).
4. O-RAN Working Group 3, Near-Real-time RAN Intelligent Controller, E2 Service Model (E2SM).
5. IETF RFC 5905 (2010-06): “Network Time Protocol Version 4: Protocol and Algorithms Specification”.
6. 3GPP TS 28.541: “Management and orchestration; 5G Network Resource Model (NRM); Stage 2 and stage 3”.

# 3 Definitions and Abbreviations

## 3.1 Definitions

**E2 Node**: as defined in E2GAP [2].

**RAN Function**: as defined in E2GAP [2].

**E2 Service Model**: The description of the Services exposed by a specific RAN function within an E2 node over the E2 interface towards the Near-RT RIC.

## 3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply.

O-CU O-RAN Central Unit

O-CU-CP O-RAN Central Unit – Control Plane

O-CU-UP O-RAN Central Unit – User Plane

O-DU O-RAN Distributed Unit

Near-RT RICNear-real-time RAN Intelligent Controller

# 4 General

## 4.1 Procedure Specification Principles

The principle for specifying the procedure logic is to specify the functional behaviour of the terminating node exactly and completely. Any rule that specifies the behaviour of the originating node shall be possible to be verified with information that is visible within the system.

The following specification principles have been applied for the procedure text in clause 8:

- The procedure text discriminates between:

1) Functionality which "shall" be executed.

The procedure text indicates that the receiving node "shall" perform a certain function Y under a certain condition. If the receiving node supports procedure X but cannot perform functionality Y requested in the REQUEST message of a Class 1 EP, the receiving node shall respond with the message used to report unsuccessful outcome for this procedure, containing an appropriate cause value.

2) Functionality which "shall, if supported" be executed.

The procedure text indicates that the receiving node "shall, if supported," perform a certain function Y under a certain condition. If the receiving node supports procedure X, but does not support functionality Y, the receiving node shall proceed with the execution of the EP, possibly informing the requesting node about the not supported functionality.

- Any required inclusion of an optional IE in a response message is explicitly indicated in the procedure text. If the procedure text does not explicitly indicate that an optional IE shall be included in a response message, the optional IE shall not be included. For requirements on including *Criticality Diagnostics* IE, see clause 10.

## 4.2 Forwards and Backwards Compatibility

The forwards and backwards compatibility of the protocol is assured by a mechanism where all current and future messages, and IEs or groups of related IEs, include ID and criticality fields that are coded in a standard format that will not be changed in the future. These parts can always be decoded regardless of the standard version.

## 4.3 Specification Notations

For the purposes of the present document, the following notations apply:

Service when referring to a Service in the specification the **SERVICE NAME** is written with upper case characters and in bold followed by the word "service", e.g., **REPORT** service.

Procedure When referring to an elementary procedure in the specification the Procedure Name is written with the first letters in each word in upper case characters followed by the word "procedure", e.g., Handover Preparation procedure.

Message When referring to a message in the specification the MESSAGE NAME is written with all letters in upper case characters followed by the word "message", e.g., HANDOVER REQUEST message.

IE When referring to an information element (IE) in the specification the *Information Element Name* is written with the first letters in each word in upper case characters and all letters in Italic font followed by the abbreviation "IE", e.g., *E-RAB ID* IE.

Value of an IE When referring to the value of an information element (IE) in the specification the "Value" is written as it is specified in the specification enclosed by quotation marks, e.g., "Value".

## 4.4 Identifiers

For the purposes of the present document, the following identifiers are defined:

Style Type The identifier used to nominate a specific approach or Style used to exposing a given RIC Service (REPORT, INSERT, CONTROL and POLICY). The same E2SM may support more than one Style for each RIC Service.

Format Type The identifier used to nominate a specific formatting approach used to encode one of the E2AP IEs defined in this E2SM. The same E2SM may support more than one encoding Formats for each E2AP IE and each E2AP IE message encoding Format may be used by one or more RIC Service Styles.

# 5 E2SM Services

As defined in E2 General Aspects and Principles [1], a given RAN Function offers a set of services to be exposed over the E2 (**REPORT**, **INSERT**, **CONTROL** and/or **POLICY**) using E2AP [3] defined procedures. Each of the E2AP Procedures listed in table 5-1 contains specific E2 Node RAN Function dependent Information Elements (IEs).

Table 5-1: Relationship RAN Function specific E2AP Information elements and E2AP Procedures

|  |  |  |
| --- | --- | --- |
| RAN Function specific E2AP Information Elements | E2AP Information Element reference | Related E2AP Procedures |
| *RIC Event Trigger Definition* IE | E2AP [3] Section 9.2.9 | RIC Subscription |
| *RIC Action Definition* IE | E2AP [3] Section 9.2.12 | RIC Subscription |
| *RIC Indication Header* IE | E2AP [3] Section 9.2.17 | RIC Indication |
| *RIC Indication Message* IE | E2AP [3] Section 9.2.16 | RIC Indication |
| *RIC Call Process ID* IE | E2AP [3] Section 9.2.18 | RIC Indication  RIC Control |
| *RIC Control Header* IE | E2AP [3] Section 9.2.20 | RIC Control |
| *RIC Control Message* IE | E2AP [3] Section 9.2.19 | RIC Control |
| *RIC Control Outcome IE* | E2AP [3] Section 9.2.25 | RIC Control |
| *RAN Function Definition* IE | E2AP [3] Section 9.2.23 | E2 Setup  RIC Service Update |

All of these RAN Function specific E2AP IEs are defined in E2AP [3] as “OCTET STRING”.

The purpose of this specification is to define the contents of these fields for the specific RAN function “Cell Configuration and Control”.

# 6 RAN Function Service Model Description

## 6.1 RAN Function Overview

For the purposes of this E2 Service Model, E2SM-CCC, the E2 Node terminating the E2 Interface is assumed to host one or more instances of the RAN Function “Cell Configuration and Control” which performs the following functionalities:

- E2 REPORT services used to expose node level and cell level configuration information

- E2 CONTROL services used to initiate control and/or configuration of node level and cell level parameters

This E2SM specification provides a set of RAN Function exposure services described in clause 6.2 and has been prepared with the assumption that the same E2SM may be used to describe either a single RAN Function in the E2 Node handling all RAN cell configuration and control related processes or more than one RAN Function in the E2 Node with each instance handling a subset of the cell configuration and control related processes on the E2 Node.

## 6.2 RAN Function exposure services

### 6.2.1 REPORT service

The “Cell Configuration and Control” RAN Function provides selective support of the following **REPORT** services:

- Node level configuration information in E2 Nodes

- Cell level configuration information in E2 Nodes

### 6.2.2 INSERT service

FFS

### 6.2.3 CONTROL service

The “Cell Configuration and Control” RAN Function provides selective support of the following **CONTROL** services:

- Node level configuration and control in E2 Nodes

- Cell level configuration and control in E2 Nodes

### 6.2.4 POLICY service

FFS

## 6.3 REPORT service description

The E2SM-CCC REPORT service requirements defined in Section 6.2.1 are offered using a set of REPORT Styles. All REPORT styles are implemented using a set of Ies that constitute “Action Definition”, “RIC Indication Header” and “RIC Indication Message” to deliver “Cell Configuration and Control” related REPORT services. Each REPORT service style is associated with a specific “Event Trigger” approach. For each Report style, a single RAN Parameter table is used to specify the required information to be reported.

The following REPORT styles are supported:

- Node level configuration information in E2 Nodes

- Cell level configuration information in E2 Nodes

## 6.4 INSERT service description

## 6.5 CONTROL service description

The E2SM-CCC CONTROL service requirements defined in Section 6.2.3 are offered using a set of CONTROL Styles. Each style corresponds to a set of “CONTROL Action”, where each “CONTROL Action” deals with a specific functionality and has a set of associated RAN parameters, provided in a mapping table. All CONTROL Service styles are implemented using a set of Ies constituting a “RIC Control Request Header” and a “RIC Control Request Message” to deliver “Cell Configuration and Control” related CONTROL services. A “CONTROL Action” containing one or more RAN parameters and their associated values can either be sent from the RIC, either asynchronously to the E2 node or as a response to a previous “INSERT Indication” from the E2 node.

The following CONTROL styles are supported:

- Node level configuration and control in E2 Nodes

- Cell level configuration and control in E2 Nodes

## 6.6 POLICY service description

# 7 RAN Function Description

## 7.1 Description

The E2AP [3] procedures E2 Setup and RIC Service Update are used to transport the RAN Function Description.

For the specific RAN Function, the *RAN Function Definition* IE shall report the following information:

- RAN Function name along with associated information on E2SM definition

- Event trigger styles list along with the corresponding encoding type for each associated E2AP IE.

- RIC **REPORT** Service styles list along with the corresponding encoding type for each associated E2AP IE.

- RIC **INSERT** Service styles list along with the corresponding encoding type for each associated E2AP IE.

- RIC **CONTROL** Service styles list along with the corresponding encoding type for each associated E2AP IE.

- RIC **POLICY** Service styles list along with the corresponding encoding type for each associated E2AP IE.

## 7.2 RAN Function name

RAN Function Short Name “ORAN-E2SM-CCC”

RAN Function name description “Cell Configuration and Control”

RAN Function Instance, required when and if E2 Node exposes more than one instance of a RAN Function based on this E2SM.

## 7.3 Event trigger styles

### 7.3.1 Event trigger style list

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **RIC Style Type** | **Style Name** | **Supported RIC Service Style** | | | **Style Description** |
| **Report** | **Insert** | **Policy** |
| 1 | E2 Node Configuration Change | 1,2 | - | - | Triggered upon subscription and when a configuration change within the E2 Node occurs. |
| 2 | Periodic | 1,2 | - | - | Triggered in a specified period of time. |

The details of the individual Event trigger Styles are provided in subsequent sections.

### 7.3.2 Event trigger style 1: E2 Node Configuration Change

This Event trigger style is used to detect configuration changes on the subscribed E2 Node. The configuration changes can occur at node-level and/or cell-level. A node-level configuration change event occurs when addition, modification or deletion related to at least one attribute within the RAN Configuration Structures defined in Section 8.3.1 associated with the node occurs. Similarly, a cell-level configuration change event occurs when addition, modification or deletion related to at least one attribute within the RAN Configuration Structures defined in Section 8.3.2 occurs on cells within the E2 Node. The E2 Node can also be configured to detect cell-level configuration changes at a certain cell.

The E2 Node can be configured to detect node-level or cell-level changes. The following table provides the configuration changes that are supported for event triggering along with associated RAN Configuration Structures and respective *RIC Event Trigger Definition* IE Formats.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **E2 Node Configuration Change Type** | **Associated RAN Configuration Structures** | **Supported RIC REPORT Service Style** | ***RIC Event Trigger Definition* IE Format** | **Description** |
| Node-level Configuration Change | 8.3.1.1 | 1 | *RIC Event Trigger Definition* IE Format 1 (9.2.1.1.1) | Triggered upon subscription and when a node-level configuration change occurs. |
| Cell-level Configuration Change | 8.3.1.2 | 2 | *RIC Event Trigger Definition* IE Format 2 (9.2.1.1.2) | Triggered upon subscription and when a cell-level configuration change occurs. |

Table 7.3.2-1: Event Trigger Definition Style 1 – E2 Node configuration change types, the associated RAN Configuration Structures for event triggering and respective *RIC Event Trigger Definition* IE Formats

7.3.3 Event trigger style 2: Periodic

This Event trigger style is used to trigger events within the E2 Node in a certain period of time. The following table provides the associated RAN Configuration Structures and respective *RIC Event Trigger Definition* IE Format.

|  |  |  |  |
| --- | --- | --- | --- |
| **Periodic Type** | **Associated RAN Configuration Structures** | ***RIC Event Trigger Definition* IE Format** | **Description** |
| Periodic | 8.3.2 | *RIC Event Trigger Definition* IE Format 3 (9.2.1.1.3) | Triggered periodically in a certain period of time. |

Table 7.3.3-1: Event Trigger Definition Style 2 – Periodic type, the associated RAN Configuration Structures for event triggering and respective *RIC Event Trigger Definition* IE Format

## 7.4 Supported RIC REPORT Services

### 7.4.1 REPORT Service style list

|  |  |  |
| --- | --- | --- |
| RIC Style Type | Style Name | Style Description |
| 1 | Node-Level Configuration | This style is used to report node-level E2 Node configuration information |
| 2 | Cell-Level Configuration | This style is used to report cell-level E2 Node configuration information |

The details of the individual REPORT Service Styles are provided in subsequent sections.

### 7.4.2 REPORT Service Style 1: Node-Level Configuration

#### 7.4.2.1 REPORT Service Style description

This **REPORT** Service style provides node-level E2 Node related configuration information. E2 Node configuration information is sent to Near-RT RIC as a RIC INDICATION message which includes the information within *RIC Indication Message* IE along with an associated *RIC Indication Header* IE. Node-level configuration information includes the RAN Configuration Structures defined in Section 8.4.1 and their attributes provided in Section 8.8.1.

This **REPORT** Service style is initiated by Event Trigger style 1: E2 Node Configuration Change or by Event Trigger style 2: Periodic and configured using *RIC Action Definition* IE.

#### 7.4.2.2 REPORT Service *RIC Action Definition* IE contents

This **REPORT** Service style uses the *RIC Action Definition* IE Format 1 (9.2.1.2.1).

The supported RAN Configuration Structures for this style are provided inSection 8.4.1 and respective attributes are provided in Section 8.8.1*.*

#### 7.4.2.3 REPORT Service *RIC Indication Header* IE contents

This **REPORT** Service style uses the *RIC Indication Header* IE Format 1 (9.2.1.3.1).

#### 7.4.2.4 REPORT Service *RIC Indication Message* IE contents

The **REPORT** Service style uses the *RIC Indication Message* IE Format 1 (9.2.1.4.1).

The supported RAN Configuration Structures for this style are provided inSection 8.4.1 and respective attributes are provided in Section 8.8.1*.*

### 7.4.3 REPORT Service Style 2: Cell-Level Configuration

#### 7.4.3.1 REPORT Service Style description

This **REPORT** Service style provides cell related configuration information. Cell configuration information is sent to Near-RT RIC as a RIC INDICATION message which includes the information within *RIC Indication Message* IE along with an associated *RIC Indication Header* IE. Cell configuration information includes the RAN Configuration Structures defined in Section 8.4.2 and their attributes provided in Section 8.8.2.

This **REPORT** Service style is initiated by Event Trigger style 1: E2 Node Configuration Change or by Event Trigger style 2: Periodic and configured using *RIC Action Definition* IE.

#### 7.4.2.2 REPORT Service *RIC Action Definition* IE contents

This **REPORT** Service style uses the *RIC Action Definition* IE Format 2 (9.2.1.2.2).

The supported RAN Configuration Structures for this style are provided inSection 8.4.2 and respective attributes are provided in Section 8.8.2*.*

#### 7.4.2.3 REPORT Service *RIC Indication Header* IE contents

This **REPORT** Service style uses the *RIC Indication Header* IE Format 1 (9.2.1.3.1).

#### 7.4.2.4 REPORT Service *RIC Indication Message* IE contents

The **REPORT** Service style uses the *RIC Indication Message* IE Format 2 (9.2.1.4.2).

The supported RAN Configuration Structures for this style are provided inSection 8.4.2 and respective attributes are provided in Section 8.8.2*.*

## 7.5 Supported RIC INSERT Services

## 7.6 Supported RIC CONTROL Services

### 7.6.1 CONTROL Service Style Types

|  |  |  |
| --- | --- | --- |
| **RIC Style Type** | **Style Name** | **Style Description** |
| 1 | Node Configuration and Control | Used to perform node-level configuration and control at the E2 Node |
| 2 | Cell Configuration and Control | Used to perform cell-level configuration and control at the E2 Node |

The details of the individual Control Service Styles are provided in subsequent sections

### 7.6.2 CONTROL Service Style 1: Node Configuration and Control

#### 7.6.2.1 CONTROL Service Style description

This **CONTROL** Service style provides a mechanism to modify RAN configuration (based on various triggers, such as the receipt of an A1 policy enforcement or detection of slice SLA violation conditions) at the E2 Node using the *RIC Control Header* IE and *RIC Control Message* IE.

#### 7.6.2.2 CONTROL Service *RIC Control Header* IE contents

This **CONTROL** style uses *RIC* *Control Header* IE Format 1 (9.2.1.6.1).

#### 7.6.2.3 CONTROL Service *RIC Control Message* IE contents

This **CONTROL** style uses *RIC* *Control Message* IE Format 1 (9.2.1.7.1).

#### 7.6.2.4 CONTROL Service *RIC Call Process ID* IE contents

#### 7.6.2.5 CONTROL Service *RIC Control Outcome* IE contents

This **CONTROL** Service *RIC Control Outcome* IE contains a transparent container that is used to carry the outcome of processing the incoming *RIC Control Request* message.

This **CONTROL** style uses *RIC Control Outcome* IE Format 1 (9.2.1.8.1).

### 7.6.3 CONTROL Service Style 2: Cell Configuration and Control

#### 7.6.3.1 CONTROL Service Style description

This **CONTROL** Service style provides a mechanism to modify RAN configuration (based on various triggers, such as the receipt of an A1 policy enforcement or detection of slice SLA violation conditions) at the cells of the E2 Node using the *RIC Control Header* IE and *RIC Control Message* IE.

#### 7.6.3.2 CONTROL Service *RIC Control Header* IE contents

This **CONTROL** style uses *RIC* *Control Header* IE Format 1 (9.2.1.6.1).

#### 7.6.3.3 CONTROL Service *RIC Control Message* IE contents

This **CONTROL** style uses *RIC* *Control Message* IE Format 2 (9.2.1.7.2).

#### 7.6.3.4 CONTROL Service *RIC Call Process ID* IE contents

#### 7.6.3.5 CONTROL Service *RIC Control Outcome* IE contents

This **CONTROL** Service *RIC Control Outcome* IE contains a transparent container that is used to carry the outcome of processing the incoming *RIC Control Request* message.

This **CONTROL** style uses *RIC Control Outcome* IE Format 2 (9.2.1.8.2).

## 7.7 Supported RIC POLICY Services

## 7.8 Supported RIC Service Styles and E2SM IE Formats

Table 7.8-1 and 7.8-2 provide a summary of the E2SM IE Formats defined to support this E2SM specification.

Table 7.8-1: Summary of the E2SM IE Formats defined to support RIC Event Trigger Styles

|  |  |
| --- | --- |
| RIC Event Trigger Style | Event Trigger Definition Format |
| Style 1 | 1, 2 |
| Style 2 | 3 |

Table 7.8-1: Summary of the E2SM IE Formats defined to support RIC Service Styles

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| RIC Service Style | Action Definition Format | Indication Header Format | Indication Message Format | Call Process ID Format | Control Header Format | Control Message Format | Control Outcome Format |
| **REPORT** | | | | | | |  |
| Style 1 | 1 | 1 | 1 |  |  |  |  |
| Style 2 | 2 | 1 | 2 |  |  |  |  |
|  |  |  |  |  |  |  |  |
| **INSERT** | | | | | | |  |
|  |  |  |  |  |  |  |  |
| **CONTROL** | | | | | | |  |
| Style 1 |  |  |  |  | 1 | 1 | 1 |
| Style 2 |  |  |  |  | 1 | 2 | 2 |
|  |  |  |  |  |  |  |  |
| **POLICY** | | | | | | |  |
|  |  |  |  |  |  |  |  |

# 8 RAN Configuration Structures

## 8.1 Approach

The RAN Configuration Structures associated with each RIC Service described in Section 7 are listed here in Section 8. RAN Configuration Structures are groupings of RAN configuration attributes, which can either be based on the NRM definitions in 3GPP TS 28.541 [6] where applicable or extended / newly introduced by O-RAN specifications. RAN Configuration Structures and their corresponding set of attributes are used by the E2SM-CCC RIC services.

The following subsections introduce E2SM-CCC RAN Configuration Structures and their attributes as well as the necessary information to enable their support in each RIC service. Section 8.8 provides the definitions for each RAN Configuration Structure and its respective attributes. The attributes of RAN Configuration Structures which are based on 3GPP NRM definitions include respective 3GPP standard definitions of these RAN configuration structure attributes as referenced in the tables below under the “Semantics Description” column. These attributes, which have 3GPP standard definitions, are not freshly defined or redefined in this specification.

The attributes, whose corresponding value in the “Is Writable”column in the configuration structureis FALSE, shall not be modified by the Near-RT RIC; however, such attributes shall serve as a reference to other attributes, which are bound to the same configuration structure.

For e.g., in the RAN configuration structure O-RRMPolicyRatio (in Sections 8.8.1.4 and 8.8.2.4), the value of the “Is Writable” field for the *resourceType* attribute is FALSE since the *resourceType* IE indicates the type of the RRM policy resource, which could be a) PRB DL or PRB UL for the O-NRCellDU defined in Section 8.8.2.2 or the O-GNBDUFunction defined in Section 8.8.1.1 or b) number of RRC connected UEs for the O-NRCellCU defined in Section 8.8.2.1 or the O-GNBCUCPFunction defined in Section 8.8.1.2 or c) the DRB for the O-GNBCUUPFunction defined in Section 8.8.1.3. Therefore, the attribute value for the *resourceType* IE cannot be modified by the Near-RT RIC, but can be used within the RIC CONTROL Service for other purposes (e.g., serving as a reference to the other attributes; *rRMPolicyMaxRatio*, *rRMPolicyMinRatio*, *rRMPolicyDedicatedRatio*, *rRMPolicyMemberList* within the structure O-RRMPolicyRatio for any given instance of the RAN configuration structure).

### 8.1.1 RIC Event Trigger Definition

Node-level and cell-level event triggers can be configured periodically or upon a configuration change within the E2 Node based on the RAN Configuration Structures defined in Section 8.3. In the E2 node RAN function “CCC”, there can be one or more instances of these RAN configuration structures, where a local copy of the attributes for each instance shall be maintained for modifying and managing their values. If Near-RT RIC subscribes to periodic events (see event trigger style 2 defined in Section 7.3.3), the RAN function “CCC” in the E2 node shall trigger events in a certain period defined in the *RIC Event Trigger Definition* IE. On the other hand, if Near-RT RIC subscribes to E2 configuration changes (see event trigger style 1 defined in Section 7.3.2), the RAN function “CCC” in the E2 node shall trigger an event upon subscription and when the specified list of the configuration attributes pertaining to any instance of the RAN configuration structures (listed here in Section 8), provided by the Near-RT RIC in the *RIC Event Trigger Definition* IE, undergoes a change (e.g. modification in its value). If the list of configuration attributes is not provided for any RAN configuration structure by the Near-RT RIC in the *RIC Event Trigger Definition* IE, then the RAN function “CCC” in the E2 node shall trigger an event when any attribute in the listed configuration structures in the *RIC Event Trigger Definition* IE undergoes a change. This change in the value of the configuration attribute can be caused either by an internal operation in the E2 node or due to a management operation carried out by a management function (such as the SMO) over a management interface (such as O1) or a dSON operation, etc.

An example use case for configuration change event triggers is when O-RRMPolicyRatio RAN configuration structure is used for managing radio resources for two different slices (e.g., eMBB and URLLC) in the same NR Cell. In this case, there will be two instances of the O-RRMPolicyRatio (in Section 8.8.2.4) created for the same NR Cell, with one instance (e.g., O-RRMPolicyRatio\_PRB\_1) used for managing PRB resource allocation of the eMBB slice and another instance (e.g., O-RRMPolicyRatio\_PRB\_2) used for managing the PRB resource allocation of the URLLC slice of the same NR Cell. During subscription, if the Near-RT RIC includes O-RRMPolicyRatioin the *RAN Configuration Structure Name* IE under the *List of RAN Configuration Structures* IE corresponding to the NR Cell in the *RIC Event Trigger Definition* IE (Section 9.2.1.1.2) and includes *rRMPolicyMinRatio* attribute and *rRMPolicyMaxRatio* attribute for the *Attribute Name* IE under the *List of Attributes* IE in the *RIC Event Trigger Definition* IE, then the RAN function “CCC” in the E2 node shall trigger the RIC event whenever *rRMPolicyMinRatio* attribute or *rRMPolicyMaxRatio* attribute changes in O-RRMPolicyRatio\_PRB\_1 for the NR cell and/or whenever any of these attributeschange in O-RRMPolicyRatio\_PRB\_2 for the same NR cell.

In the E2 node, the RAN function “CCC” shall also trigger an event in case of other configuration changes pertaining to the node or the cells, such as creation of a new instance or deletion of an existing instance of any configuration structure (listed here in Section 8), as specified by the Near-RT RIC in the *RIC Event Trigger Definition* IE.

Examples include triggering an event in the E2 node when a new instance of the O-NRCellCU is created, which happens whenever a new NR cell is added to the E2 node, or triggering an event in the E2 node when a new instance of the O-BWP is created, which happens whenever a new bandwidth part (BWP) is added to the NR cell, given by the *Global Cell Id* IE (in Section 9.2.1.1.2), in the E2 node. Additional examples include triggering an event in the E2 node when an existing instance of the O-RRMPolicyRatio is deleted, which happens when an existing RRM policy pertaining to the E2 node (related to the RRC connected users for the O-CU-CP E2 node or the DRB policy for the O-CU-UP E2 node) is deleted.

### 8.1.2 RIC Action Definition

When an event is triggered by the RAN function “CCC” within the E2 node pertaining to one or more RAN configuration structures, the RAN function “CCC” in the E2 Node shall execute the actions as defined in *RIC Action Definition* IE in Section 9.2.1.2.

Using E2SM-CCC Action Definition Formats 1 and 2 (Section 9.2.1.2.1 and 9.2.1.2.2), the Near-RT RIC shall specify which RAN configuration structures and which attributes pertaining to these structures shall have to be reported, when the corresponding event is triggered in the E2 node. The requested RAN configuration structures are provided in the *RAN Configuration Structure Name* IE listed under the *List of Node-level Configuration Structures* IE in Section 9.2.1.2.1 or under the *List of Cell-level Configuration Structures* IE in Section 9.2.1.2.2. The requested attributes for that specific RAN configuration structure are provided in *List of Attributes* IE.

When the *Report Type* IE is ‘All’, then the E2 node shall generate a report indication action involving every instance of the respective RAN configuration structure whether there has been a configuration change (addition/deletion/modification, as discussed in Section 8.1.1) or not. If the *List of Attributes* IE is not included in the *RIC Action Definition* IE, then the E2 node shall report the attribute-value pair for all the attributes defined within the respective RAN configuration structure, pertaining to each instance of the configuration structure; whereas, if the *List of Attributes* IE is included in the *RIC Action Definition* IE, then the E2 node shall only report the attribute-value pair for the specific list of attributes within the respective RAN configuration structure, pertaining to each instance of the configuration structure.

When the *Report Type* IE is ‘Change’, then the E2 node shall generate a report indication action involving only those instances of the respective RAN configuration structure that underwent a configuration change among all. Depending on the inclusion of *List of Attributes* IE, all or specified list of attribute-value pairs shall be present for those changed RAN configuration structure instances. Finally, when *Global Cell Id* IE is present, then the reporting shall be done only for the specified cell(s).

For e.g., An NR Cell has two instances of O-RRMPolicyRatio configuration structure, namely O-RRMPolicyRatio\_PRB\_1 and O-RRMPolicyRatio\_PRB\_2, for managing the RRM policy ratio of PRB allocation in the cell for eMBB and URLLC slices, respectively. The RIC Event Trigger Definition IE is defined such that the event must be triggered when the rRMPolicyMinRatio attribute of any instance, O-RRMPolicyRatio\_PRB\_1 and/or O-RRMPolicyRatio\_PRB\_2, undergoes a change. The following cases present details of how the E2 node shall generate the report actions for different RIC Action Definition IE contents, for this example.

Case 1: In the *RIC Action Definition* IE, *Cell Global ID* IE of the NR Cell is specified (Section 9.2.1.2.2), *Report Type* IE is ‘All’ and *List of Attributes* IE is not included, and the instance O-RRMPolicyRatio\_PRB\_1 underwent a configuration change. In this case, the E2 node shall generate a report action including both the instances, O-RRMPolicyRatio\_PRB\_1 and O-RRMPolicyRatio\_PRB\_2 (irrespective of whether any of their attributes has changed or not) within the *List of Configuration Structures Reported* IE and include allattribute-value pairs as defined in Section 8.8.2.4, in respective IEs; For the unchanged O-RRMPolicyRatio instance(s), i.e. O-RRMPolicyRatio\_PRB\_2, current values for allattributes shall be present in *Values of Attributes* IE whereas for the modified O-RRMPolicyRatio instance(s), i.e. O-RRMPolicyRatio\_PRB\_1, in addition to reporting the current values for allattributes in *Values of Attributes* IE, the old values of all attributes shall be reported in *Old Values of Attributes* IE.

Case 2: In the RIC Action Definition IE, Cell Global ID IE of the NR Cell is specified (Section 9.2.1.2.2), Report Type IE is ‘All’ and List of Attributes IE is mentioned in the RIC Action Definition IE and includes the resourceType, rRMPolicyMemberList, rRMPolicyMinRatio, and the rRMPolicyMaxRatio attribute. In this case, again the E2 node shall generate a report action including both the instances, O-RRMPolicyRatio\_PRB\_1 and O-RRMPolicyRatio\_PRB\_2 (irrespective of whether any of their attributes has changed or not) within List of Configuration Structures Reported IE, but shall now include only the resourceType, rRMPolicyMemberList, rRMPolicyMinRatio, rRMPolicyMaxRatio attribute-value pairs in respective IEs since only those attributes are listed to be reported in the List of Attributes IE. For the unchanged O-RRMPolicyRatio instance(s), i.e., O-RRMPolicyRatio\_PRB\_2, current values for these four attributes shall be present in Values of Attributes IE whereas, for the modified O-RRMPolicyRatio instance(s), i.e., O-RRMPolicyRatio\_PRB\_1, in addition to reporting the current values for these four attributes in Values of Attributes IE, the old values of these four attributes shall be reported in Old Values of Attributes IE.

Case 3: In the RIC Action Definition IE, Cell Global ID IE of the NR Cell is specified (Section 9.2.1.2.2), Report Type IE is ‘Change’ and List of Attributes IE is not included. In this case the E2 node shall generate a report indication action only involving the changed instance of O-RRMPolicyRatio, i.e., O-RRMPolicyRatio\_PRB\_1, within the List of Configuration Structures Reported IE and include all attribute-value pairs as defined in Section 8.8.2.4 for the instance O-RRMPolicyRatio\_PRB\_1, reporting the current values for all attributes in Values of Attributes IE and reporting the old values of all attributes for the same instance in Old Values of Attributes IE.

Case 4: In the RIC Action Definition IE, Cell Global ID IE of the NR Cell is specified (Section 9.2.1.2.2), Report Type IE is ‘Change’ and List of Attributes IE is mentioned in the RIC Action Definition IE and includes the resourceType, rRMPolicyMemberList, rRMPolicyMinRatio, and the rRMPolicyMaxRatio attribute. In this case again the E2 node shall generate a report indication action only involving the changed instance(s) of O-RRMPolicyRatio, i.e., O-RRMPolicyRatio\_PRB\_1, within the List of Configuration Structures Reported IE, but shall now include only the resourceType, rRMPolicyMemberList, rRMPolicyMinRatio, rRMPolicyMaxRatio attribute-value pairs in respective IEs since only those attributes are listed to be reported in the List of Attributes IE. The E2 Node shall report current values for these four attributes for the instance O-RRMPolicyRatio\_PRB\_1 in Values of Attributes IE and shall report the old values of these four attributes for the same instance in Old Values of Attributes IE.

The details of the approach for the Report Indication action, Insert Indication action and the Policy action are discussed in Sections 8.1.3, 8.1.4 and 8.1.6, respectively.

### 8.1.3 Report Indication

When the E2 node executes a Report Indication action, it shall report the attribute-value pairs for the relevant list of attributes (as detailed in Section 8.1.2 and Section 9.2.1.2) from the instances of the configuration structures. The *Change Type* IE provided by the E2 Node in the *RIC Indication Message* IE (Sections 9.2.1.4.1 and 9.2.1.4.2) corresponds to the type of the event. As discussed in Section 7.3 and Section 8.1.1, the RAN function “CCC” in the E2 node shall generate events by any of the following triggers: modification in the value of the configuration attributes in the instances of the configuration structures (*Change Type* IE is ‘Modification’), addition of new instances of configuration structures pertaining to the E2 nodes or the cells (*Change Type* IE is ‘Addition’), deletion of existing instances of configuration structures pertaining to E2 nodes or cells (*Change Type* IE is ‘Deletion’), upon subscription, and/or periodic timer events (*Change Type* IE is ‘None’).

In case of attribute-value modifications within the E2 Node, then the E2 node shall report the attribute-value pairs for the list of attributes (specified in the *RIC Action Definition* IE) before the modification as well as after the modification using the *Old Values of Attributes* IE and the *Values of Attributes* IE, respectively (*Change Type* IE is ‘Modification’). These IEs contain the structure of the attribute-value pairs for the relevant list of attributes. Since there can be multiple instances for any RAN configuration structure (as detailed in Section 8.1.1) pertaining to the E2 nodes or cells, the E2 node shall include both the *Old Values of Attributes* IE as well as the *Values of Attributes* IE in order to enable the Near-RT RIC to discover the correct instances of the configuration structures, for which the E2 node reports the relevant list of attribute-value pairs.

For illustrative purposes, the example O-RRMPolicyRatio use case presented in Section 8.1.1 can be used again where there are 2 instances of the O-RRMPolicyRatio RAN configuration structure, namely O-RRMPolicyRatio\_PRB\_1 and O-RRMPolicyRatio\_PRB\_2, that are used for managing PRB resource allocation of the eMBB and URLLC slices in the same NR Cell. When the RIC event trigger is caused due to modification in the values of O-RRMPolicyRatio\_PRB\_1, if the *RIC Action Definition* IE includes the *Report Type* IE whose value is set to ‘All’ and the *List of Attributes* IE which includes the *resourceType, rRMPolicyMemberList, rRMPolicyMinRatio*, and *rRMPolicyMaxRatio* attributes, then the E2 node shall report these four attributes for both O-RRMPolicyRatio\_PRB\_1 and O-RRMPolicyRatio\_PRB\_2.

For O-RRMPolicyRatio\_PRB\_1, the E2 node shall report the value of *ChangeType* IE as ‘Modification’ and report old values for *resourceType, rRMPolicyMemberList, rRMPolicyMinRatio, rRMPolicyMaxRatio* attributes (before modification) for the eMBB slice served by the NR Cell in the *Old Value of Attributes* IE and shall report the new values for these attributes in the *Value of Attributes* IE. However, for O-RRMPolicyRatio\_2, the E2 node shall report the value of *ChangeType* IE as ‘None’ and the current values of the *resourceType, rRMPolicyMemberList, rRMPolicyMinRatio, rRMPolicyMaxRatio* attributes for O-RRMPolicyRatio\_PRB\_2, pertaining to the uRLLC slice served by the same cell, shall be reported in the *Value of Attributes* IE in the E2SM-CCC *RIC Indication message* IE contents since there has been no modification in O-RRMPolicyRatio\_PRB\_2.

This reporting of attribute-value pairs for the list of attributes in both the *Old Value of Attributes* IE and the *Value of Attributes* IE, in the case of modification, enables the Near-RT RIC to discover the correct instance of the RAN configuration structure, when there is more than one instance of the same RAN configuration structure assuming key attributes are configured to be present in Report Indication action which depends on the use case and the RAN configuration structure. In order to guarantee identification of the correct instance within the Near-RT RIC in all cases, during subscription Near-RT RIC should not include *List of Attributes IE* in *RIC Action Definition* IE for all attributes to be reported in RIC Indication.

As another example, when a new instance of the O-RRMPolicyRatio RAN configuration structure is created (e.g., O-RRMPolicyRatio\_DRB\_3) due to the creation of a new RRM policy for the resource type DRB, within the E2 node O-CU-UP, and when the *RIC Action Definition* IE includes the *Report Type* IE whose value is set to ‘Change’ and the *List of Attributes* IE, which includes the *resourceType, rRMPolicyMemberList, rRMPolicyMinRatio, rRMPolicyMaxRatio* attributes, then the E2 node shall report the value of *ChangeType* IE as ‘Addition’ and shall report the attribute-value pair of all these attributes in the *Value of Attributes* IE. Since the configuration change is not due to modification in the value of an attribute but due to the creation of a new O-RRMPolicyRatio in the E2 node, the E2 node shall not report the *Old Value of Attributes* IE. Likewise, if an instance of the O-RRMPolicyRatio RAN configuration structure is deleted, then the E2 node shall report the value of *ChangeType* IE as ‘Deletion’ and shall only report the attribute-value pair of all these attributes in the *Value of Attributes* IE pertaining to the deleted O-RRMPolicyRatio instance.

### 8.1.4 Insert Indication

FFS

### 8.1.5 Control Action

When the Near-RT RIC executes a control action, it shall provide the attribute-value pairs for the list of attributes that the Near-RT RIC shall control for the instances of the RAN configuration structures. The Near-RT RIC shall specify the RAN configuration structures that it controls using the *RAN Configuration Structure Name* IE (in *RIC Control Message* IE, specified in Section 9.2.1.7) under the *List of Configuration Structures* IE for the E2 node or for the list of cells specified using the *List of Cells* IE (in Section 9.2.1.7.2).

For each RAN configuration structure, the Near-RT RIC shall include the *Old Values of Attributes* IE and the *New Values of Attributes* IE. These IEs contain the structure of the attribute-value pairs for the entire list of attributes of the configuration structures that the Near-RT RIC shall control on the E2 nodes. Since there can be multiple instances for any RAN configuration structure (as detailed in Section 8.1.1) pertaining to the E2 nodes or cells that the Near-RT RIC controls, the Near-RT RIC shall include both the *Old Values of Attributes* IE as well as the *New Values of Attributes* IE in order to enable the E2 node to determine the correct instances of the RAN configuration structures for which the values of the attributes shall be modified by the RIC.

The RAN function “CCC” in the E2 node shall determine the correct instances of the RAN configuration structures using the *Old Values of Attributes* IE containing the current attribute-value pairs and replace them with the attribute-value pairs in the *New Values of Attributes* IE, as specified by the Near-RT RIC, for those instances.

As an example, similar to the O-RRMPolicyRatio use case presented in Section 8.1.1 where there are 2 instances of the O-RRMPolicyRatio RAN configuration structure, namely O-RRMPolicyRatio\_PRB\_1 and O-RRMPolicyRatio\_PRB\_2, the Near-RT RIC can control PRB resource allocation for these eMBB and URLLC slices in the same NR Cell by utilizing the RIC CONTROL Service. In order to do so, the Near-RT RIC shall modify the values of the O-RRMPolicyRatio attributes (e.g., *rRMPolicyMinRatio, rRMPolicyMaxRatio, rRMPolicyDedicatedRatio*) for O-RRMPolicyRatio\_PRB\_1 and O-RRMPolicyRatio\_PRB\_2 for the same NR cell (of type O-NRCellDU). For each O-RRMPolicyRatio instance, the Near-RT RIC shall first include the old values of the respective O-RRMPolicyRatio attributes (*resourceType, rRMPolicyMemberList, RMPolicyMinRatio, rRMPolicyMaxRatio, rRMPolicyDedicatedRatio*) of the NR cell in the *Old Value of Attributes* IE. Second, the Near-RT RIC shall include all the unchanged and new values of the respective O-RRMPolicyRatio attributes requested by the Near-RT RIC that the E2 node shall replace with, in the *New Value of Attributes* IE. When there is more than one instance of the RAN configuration structure (e.g. O-RRMPolicyRatio\_PRB\_1 and O-RRMPolicyRatio\_PRB\_2 in this example scenario), the E2 node shall determine the correct instance of the RAN configuration structure from the attribute-value pairs included in the list of attributes in both the *Old Value of Attributes* IE and the *New Value of Attributes* IE to be able to modify the correct instance and its respective attribute values.

### 8.1.6 Policy Action

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## 8.2 Common RAN Configuration Structures

The configuration structures, referencing the corresponding attributes, that can be commonly used across multiple service styles are listed here.

### 8.2.1 Node-Level RAN Configuration Structures

|  |  |  |
| --- | --- | --- |
| RAN Configuration Structure Name | RAN Configuration Structure Definition | Semantics Description |
| O-GNBDUFunction | 8.8.1.1 | Represents O-GNBDUFunction attributes defined in 8.8.1.1. |
| O-GNBCUCPFunction | 8.8.1.2 | Represents O-GNBCUCPFunction attributes defined in 8.8.1.2. |
| O-GNBCUUPFunction | 8.8.1.3 | Represents O-GNBCUUPFunction attributes defined in 8.8.1.3. |
| O-RRMPolicyRatio | 8.8.1.4 | Represents O-RRMPolicyRatio attributes defined in 8.8.1.4. |

### 8.2.2 Cell-Level RAN Configuration Structures

|  |  |  |
| --- | --- | --- |
| RAN Configuration Structure Name | RAN Configuration Structure Definition | Semantics Description |
| O-NRCellCU | 8.8.2.1 | Represents O-NRCellCU attributes defined in 8.8.2.1. |
| O-NRCellDU | 8.8.2.2 | Represents O-NRCellDU attributes defined in 8.8.2.2. |
| O-BWP | 8.8.2.3 | Represents O-BWP attributes defined in 8.8.2.3. |
| O-RRMPolicyRatio | 8.8.2.4 | Represents O-RRMPolicyRatio attributes defined in 8.8.2.4. |

## 8.3 RAN Configuration Structures for Event Trigger

### 8.3.1 RAN Configuration Structures for Event Trigger Style 1

#### 8.3.1.1 RAN Configuration Structures for Node-level Configuration Change

Common node-level RAN Configuration Structures defined in Section 8.2.1 shall be used when defining event triggers.

#### 8.3.1.2 RAN Configuration Structures for Cell-level Configuration Change

Common cell-level RAN Configuration Structures defined in Section 8.2.2 shall be used when defining event triggers.

### 8.3.2 RAN Configuration Structures for Event Trigger Style 2

Common node-level and cell-level RAN Configuration Structures defined in Section 8.2.1 and 8.2.2 shall be used when defining event triggers.

## 8.4 RAN Configuration Structures for Report services

### 8.4.1 RAN Configuration Structures for Report Service Style 1

Common node-level RAN Configuration Structures defined in Section 8.2.1 shall be used for REPORT Service Style 1.

### 8.4.2 RAN Configuration Structures for Report Service Style 2

Common cell-level RAN Configuration Structures defined in Section 8.2.2 shall be used for REPORT Service Style 2.

## 8.5 RAN Configuration Structures for Insert services

## 8.6 RAN Configuration Structures for Control services

### 8.6.1 RAN Configuration Structures for Control Service Style 1

Common node-level RAN Configuration Structures defined in Section 8.2.1 shall be used for CONTROL Service Style 1.

### 8.6.2 RAN Configuration Structures for Control Service Style 2

Common cell-level RAN Configuration Structures defined in Section 8.2.2 shall be used for CONTROL Service Style 2.

## 8.7 RAN Configuration Structures for Policy services

## 8.8 Attribute Definitions

### 8.8.1 Attribute Definitions for Node-Level RAN Configuration Structures

#### 8.8.1.1 O-GNBDUFunction

The E2 node O-DU is represented by the O-GNBDUFunction configuration structure.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Supported Services | Is writable | IE type and reference | Semantics description |
| gNBDUId | REPORT | FALSE | INTEGER (0..236-1) | Please refer to [6] Clause 4.4.1, “gNBDUId” attribute |
| gNBDUName | REPORT | FALSE | STRING | Please refer to [6] Clause 4.4.1, “gNBDUName” attribute |
| gNBId | REPORT | FALSE | INTEGER (0..4294967295) | Please refer to [6] Clause 4.4.1, “gNBId” attribute |
| gNBIdLength | REPORT | FALSE | INTEGER (22..32) | Please refer to [6] Clause 4.4.1, “gNBIdLength” attribute |

#### 8.8.1.2 O-GNBCUCPFunction

The E2 node O-CU-CP is represented by the O-GNBCUCPFunction configuration structure.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Supported Services | Is writable | IE type and reference | Semantics description |
| gNBId | REPORT, CONTROL | FALSE | INTEGER (0..4294967295) | Please refer to [6] Clause 4.4.1, “gNBId” attribute |
| gNBIdLength | REPORT, CONTROL | FALSE | INTEGER (22..32) | Please refer to [6] Clause 4.4.1, “gNBIdLength” attribute |
| gNBCUName | REPORT, CONTROL | FALSE | STRING | Please refer to [6] Clause 4.4.1, “gNBCUName” attribute |
| pLMNId | REPORT, CONTROL | FALSE | 9.3.12 | Please refer to [6] Clause 4.4.1, “GNBCUCPFunction.pLMNId” attribute |
| x2ExcludeList | REPORT, CONTROL | TRUE | STRING | Please refer to [6] Clause 4.4.1, “x2BlackList” attribute |
| x2IncludeList | REPORT, CONTROL | TRUE | STRING | Please refer to [6] Clause 4.4.1, “x2WhiteList” attribute |
| xnExcludeList | REPORT, CONTROL | TRUE | STRING | Please refer to [6] Clause 4.4.1, “xnBlackList” attribute |
| xnIncludeList | REPORT, CONTROL | TRUE | STRING | Please refer to [6] Clause 4.4.1, “xnWhiteList” attribute |
| x2XnHOExcludeList | REPORT, CONTROL | TRUE | STRING | Please refer to [6] Clause 4.4.1, “x2XnHOBlackList” attribute |

#### 8.8.1.3 O-GNBCUUPFunction

The E2 node O-CU-UP is represented by the O-GNBCUUPFunction configuration structure.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Supported Services | Is writable | IE type and reference | Semantics description |
| gNBId | REPORT | FALSE | INTEGER (0..4294967295) | Please refer to [6] Clause 4.4.1, “gNBId” attribute |
| gNBIdLength | REPORT | FALSE | INTEGER (22..32) | Please refer to [6] Clause 4.4.1, “gNBIdLength” attribute |
| gNBCUUPId | REPORT | FALSE | INTEGER (0..236-1) | Please refer to [6] Clause 4.4.1, “gNBCUUPId” attribute |
| pLMNInfoList | REPORT | FALSE | 9.3.15 | The PLMNInfoList is a list of PLMNInfo data type. It defines which PLMNs that can be served by the GNBCUUPFunction [6] and which S-NSSAIs can be supported by the GNBCUUPFunction [6] for corresponding PLMN in case of network slicing feature is supported. |

#### 8.8.1.4 O-RRMPolicyRatio

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Supported Services | Is writable | IE type and reference | Semantics description |
| resourceType | REPORT, CONTROL | FALSE | ENUMERATED (PRB UL, PRB DL, DRB, RRC) | Please refer to [6] Clause 4.4.1, “resourceType” attribute. This IE should be included in RIC Services for enabling association with the correct instance of the O-RRMPolicyRatio RAN configuration structure. |
| rRMPolicyMemberList | REPORT, CONTROL | TRUE | 9.3.17 | Please refer to [6] Clause 4.4.1, “rRMPolicyMemberList” attribute. This IE should be included in RIC Services for enabling association with the correct instance of the O-RRMPolicyRatio RAN configuration structure. |
| rRMPolicyMaxRatio | REPORT, CONTROL | TRUE | INTEGER (0..100) | Please refer to [6] Clause 4.4.1, “rRMPolicyMaxRatio” attribute |
| rRMPolicyMinRatio | REPORT, CONTROL | TRUE | INTEGER (0..100) | Please refer to [6] Clause 4.4.1, “rRMPolicyMinRatio” attribute |
| rRMPolicyDedicatedRatio | REPORT, CONTROL | TRUE | INTEGER (0..100) | Please refer to [6] Clause 4.4.1, “rRMPolicyDedicatedRatio” attribute |

#### 8.8.2 Attribute Definitions for Cell-Level RAN Configuration Structures

#### 8.8.2.1 O-NRCellCU

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Supported Services | Is writable | IE type and reference | Semantics description |
| cellLocalId | REPORT, CONTROL | FALSE | INTEGER | Please refer to [6] Clause 4.4.1, “cellLocalId” attribute |
| pLMNInfoList | REPORT, CONTORL | FFS | 9.3.15 | Please refer to [6] Clause 4.4.1, “NRCellCU.pLMNInfoList” attribute |

#### 8.8.2.2 O-NRCellDU

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Supported Services | Is writable | IE type and reference | Semantics description |
| cellLocalId | REPORT | FFS | INTEGER | Please refer to [6] Clause 4.4.1, “cellLocalId” attribute |
| operationalState | REPORT | FFS | ENUMERATED (ENABLED, DISABLED) | Please refer to [6] Clause 4.4.1, “operationalState” attribute |
| administrativeState | REPORT | FFS | ENUMERATED (LOCKED, SHUTTING DOWN, UNLOCKED) | Please refer to [6] Clause 4.4.1, “administrativeState” attribute |
| cellState | REPORT | FFS | ENUMERATED (IDLE, INACTIVE, ACTIVE) | Please refer to [6] Clause 4.4.1, “cellState” attribute |
| pLMNInfoList | REPORT | FFS | 9.3.15 | Please refer to [6] Clause 4.4.1, “NRCellDU.pLMNInfoList” attribute |
| nRPCI | REPORT | FFS | INTEGER (0..503) | Please refer to [6] Clause 4.4.1, “nRPCI” attribute |
| nRTAC | REPORT | FFS | INTEGER (0..16777215) | Please refer to [6] Clause 4.4.1, “nRTAC” attribute |
| arfcnDL | REPORT | FFS | INTEGER | Please refer to [6] Clause 4.4.1, “arfcnDL” attribute |
| arfcnUL | REPORT | FFS | INTEGER | Please refer to [6] Clause 4.4.1, “arfcnUL” attribute |
| arfcnSUL | REPORT | FFS | INTEGER | Please refer to [6] Clause 4.4.1, “arfcnSUL” attribute |
| bSChannelBwDL | REPORT | FFS | INTEGER | Please refer to [6] Clause 4.4.1, “bSChannelBwDL” attribute |
| ssbFrequency | REPORT | FFS | INTEGER (0..3279165) | Please refer to [6] Clause 4.4.1, “ssbFrequency” attribute |
| ssbPeriodicity | REPORT | FFS | ENUMERATED (5, 10, 20, 40, 80, 160) | Please refer to [6] Clause 4.4.1, “ssbPeriodicity” attribute |
| ssbSubCarrierSpacing | REPORT | FFS | ENUMERATED (15, 30, 120, 240) | Please refer to [6] Clause 4.4.1, “ssbSubCarrierSpacing” attribute |
| ssbOffset | REPORT | FFS | INTEGER (0..159) | Please refer to [6] Clause 4.4.1, “ssbOffset” attribute |
| ssbDuration | REPORT | FFS | ENUMERATED (1, 2, 3, 4, 5) | Please refer to [6] Clause 4.4.1, “ssbDuration” attribute |
| bSChannelBwUL | REPORT | FFS | INTEGER | Please refer to [6] Clause 4.4.1, “bSChannelBwUL” attribute |
| bSChannelBwSUL | REPORT | FFS | INTEGER | Please refer to [6] Clause 4.4.1, “bSChannelBwSUL” attribute |
| bWPList | REPORT | FFS | 9.3.18 | This attribute contains the list of O-BWPs. See Section 8.8.2.3 for O-BWP definition. |

#### 8.8.2.3 O-BWP

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Is writable | IE type and reference | Semantics description |
| bwpContext | REPORT, CONTROL | FFS | ENUMERATED (DL, UL, SUL) | Please refer to [6] Clause 4.4.1, “bwpContext” attribute |
| isInitialBwp | REPORT, CONTROL | FFS | ENUMERATED (INITIAL, OTHER) | Please refer to [6] Clause 4.4.1, “isInitialBwp” attribute |
| subCarrierSpacing | REPORT, CONTROL | FFS | ENUMERATED (15, 30, 60, 120) | Please refer to [6] Clause 4.4.1, “subCarrierSpacing” attribute |
| cyclicPrefix | REPORT, CONTROL | FFS | ENUMERATED (NORMAL, EXTENDED) | Please refer to [6] Clause 4.4.1, “cyclicPrefix” attribute |
| startRB | REPORT, CONTROL | FFS | INTEGER | Please refer to [6] Clause 4.4.1, “startRB” attribute |
| numberOfRBs | REPORT, CONTROL | FFS | INTEGER | Please refer to [6] Clause 4.4.1, “numberOfRBs” attribute |

#### 8.8.2.4 O-RRMPolicyRatio

Please refer to Section 8.8.1.4 for O-RRMPolicyRatio attribute definitions.

# 9 Elements for E2SM Service Model

## 9.1 General

## 9.2 Message Functional Definition and Content

### 9.2.1 Messages for RIC Functional procedures

#### 9.2.1.1 RIC Event Trigger Definition IE

This information element is part of the RIC SUBSCRIPTION REQUEST message sent by the Near-RT RIC to an E2 Node and is required for event triggers used to initiate REPORT, INSERT and POLICY actions.

Direction: NEAR-RT RIC → E2 Node.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **IE/Group Name** | **Presence** | **Range** | **IE type and reference** | **Semantics description** |
| **CHOICE** *Event Trigger Definition Format* |  |  |  |  |
| >E2SM-CCC Event Trigger Definition Format 1 | M |  | 9.2.1.1.1 | Triggered upon subscription and when a node-level configuration change occurs. |
| >E2SM-CCC Event Trigger Definition Format 2 | M |  | 9.2.1.1.2 | Triggered upon subscription and when a cell-level configuration change occurs. |
| >E2SM-CCC Event Trigger Definition Format 3 | M |  | 9.2.1.1.3 | Used for periodic event triggering |

##### 9.2.1.1.1 E2SM-CCC Event Trigger Definition Format 1: Node-Level Configuration Change

This event trigger definition format is used to configure E2 Nodes to trigger events when a node-level configuration change occurs. The list of RAN Configuration Structures defined in Section 8.3.1 shall be included. Any changes (addition, modification, deletion) regarding the listed RAN Configuration Structures shall trigger an event within the E2 Node. Optionally specific attributes for a certain RAN Configuration Structure can be configured to trigger an event if specified with *Attribute Name* IE within *List of Attributes* for that RAN Configuration Structure*.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **IE/Group Name** | **Presence** | **Range** | **IE type and reference** | **Semantics description** |
| List of Node-level Configuration Structures |  | *1..<maxnoofNodeLevelConfigStructures>* |  |  |
| >RAN Configuration Structure Name | M |  | 9.3.7 | Specifies the name of the node-level RAN configuration structure that the event will be triggered when a configuration change (addition, modification, deletion) occurs. Valid RAN Configuration Structures for this event trigger are defined in 8.3.1. |
| >List of Attributes |  | *0..<maxnoofAttributesToReport>* |  | Optionally specifies the list of attributes within the RAN Configuration Structure that will only cause an event trigger upon change. Absence of this IE indicates that all attributes of the specified RAN Configuration Structure will trigger the event upon change. |
| >>Attribute Name | M |  | 9.3.8 | Specifies the name of the attribute under the RAN Configuration Structure that will trigger the event upon change. Valid attributes for each node-level RAN Configuration Structure are defined in 8.8.1. |

|  |  |
| --- | --- |
| **Range bound** | **Explanation** |
| maxnoofNodeLevelConfigStructures | Maximum number of E2 Node level configuration structures that can be listed for the event triggering. The value is *<256>.* |
| maxnoofAttributesToReport | Maximum no. of attributes supported by Event Trigger Definition Format 1. The value is 65535. |

##### 9.2.1.1.2 E2SM-CCC Event Trigger Definition Format 2: Cell-Level Configuration Change

This event trigger definition format is used to configure E2 Nodes to trigger events when a cell-level configuration change occurs. The list of RAN Configuration Structures defined in Section 8.3.2 shall be included. Any changes (addition, modification, deletion) regarding the listed RAN Configuration Structures shall trigger an event for any cell within the E2 Node. The list of RAN Configuration Structures for event triggering can optionally be configured to be triggered for a specific cell, if indicated by the *Global Cell Id* IE. In addition, optionally specific attributes for a certain RAN Configuration Structure can be configured to trigger an event if specified with *Attribute Name* IE within *List of Attributes* for that RAN Configuration Structure*.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **IE/Group Name** | **Presence** | **Range** | **IE type and reference** | **Semantics description** |
| List of Cell-level Configuration Structures |  | *1..<maxnoofCells>* |  |  |
| > Cell Global Id | O |  | 9.3.6 | Specifies the global cell id of the cell the event will be triggered for. Absence of this IE indicates that a configuration change (addition, modification, deletion) in any cell regarding the listed RAN Configuration Structures shall trigger an event. |
| >List of RAN Configuration Structures |  | *1..<maxnoofCellLevelConfigStructures>* |  |  |
| >>RAN Configuration Structure Name | M |  | 9.3.7 | Specifies the name of the cell-level RAN configuration structure that the event will be triggered when a configuration change (addition, modification, deletion) occurs. Valid RAN Configuration Structures for this event trigger are defined in 8.3.2. |
| >>List of Attributes |  | *0..<maxnoofAttributesToReport>* |  | Optionally specifies the list of attributes within the RAN Configuration Structure that will only cause an event trigger upon change. Absence of this IE indicates that all attributes of the specified RAN Configuration Structure will trigger the event upon change. |
| >>>Attribute Name | M |  | 9.3.8 | Specifies the name of the attribute under the RAN Configuration Structure that will trigger the event upon change. Valid attributes for each cell-level RAN Configuration Structure are defined in 8.8.2. |

|  |  |
| --- | --- |
| **Range bound** | **Explanation** |
| maxnoofCells | Maximum number of cells that can be listed for the event triggering. The value is *<1024>.* |
| maxnoofCellLevelConfigStructures | Maximum number of E2 Node level configuration structures that can be listed for the event triggering. The value is *<1024>.* |
| maxnoofAttributesToReport | Maximum no. of attributes supported by Event Trigger Definition Format 2. The value is 65535. |

##### 9.2.1.1.3 E2SM-CCC Event Trigger Definition Format 3: Periodic Event Trigger

This event trigger definition format is used to configure E2 Nodes to trigger events in a certain period.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **IE/Group Name** | **Presence** | **Range** | **IE type and reference** | **Semantics description** |
| Period | M |  | INTEGER (10..4294967295) | Used to indicate the event triggering period in unit of 1 millisecond |

9.2.1.2 RIC ACTION DEFINITION IE

This information element is part of the RIC SUBSCRIPTION REQUEST message sent by the Near-RT RIC to an E2 Node. In this service model, this information element provides additional information for the nominated Action (Report).

Direction: NEAR-RT RIC → E2 Node.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **IE/Group Name** | **Presence** | **Range** | **IE type and reference** | **Semantics description** |
| RIC Style Type | M |  | 9.3.3 |  |
| **CHOICE** *Action Definition Format* |  |  |  |  |
| >E2SM-CCC Action Definition Format 1 | M |  | 9.2.1.2.1 | Used by REPORT service to report node-level configuration structures |
| >E2SM-CCC Action Definition Format 2 | M |  | 9.2.1.2.2 | Used by REPORT service to report cell-level configuration structures |

##### 9.2.1.2.1 E2SM-CCC Action Definition Format 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| List of Node-level RAN Configuration Structures | M | *1..<maxnoofConfigurationsToReport>* |  |  |
| >Report Type | M |  | 9.3.9 | Indicates whether:  - the values for the configuration structures listed shall be reported regardless there has been a change or not  - the values for the configuration structures listed shall be reported only if its value has been changed (modification, addition, deletion) |
| >RAN Configuration Structure Name | M |  | 9.3.7 | Specifies the name of the node-level RAN configuration structure that shall be reported. Valid RAN Configuration Structures for this action definition are defined in 8.4.1. |
| >List of Attributes |  | *0..<maxnoofAttributesToReport>* |  |  |
| >>Attribute Name | M |  | 9.3.8 | Specifies the name of the required attribute. The value of the attribute shall be reported. Valid attributes for this action definition are defined in 8.8.1. |

|  |  |
| --- | --- |
| Range bound | Explanation |
| maxnoofConfigurationsToReport | Maximum no. of configurations supported by Action Definition Format 1. The value is 256. |
| maxnoofAttributesToReport | Maximum no. of attributes supported by Action Definition Format 1. The value is 65535. |

##### 9.2.1.2.2 E2SM-CCC Action Definition Format 2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| List of Cell Configurations To Be Reported |  | *1..<maxnoofCellsToReport>* |  |  |
| > Cell Global Id | O |  | 9.3.6 | Indicates the global cell id of the cell that cell-level configuration structure list applies for. Absence of this IE indicates that listed cell-level configuration structures apply for all cells within the E2 Node. |
| >List of Cell-level RAN Configuration Structures |  | *1..<maxnoofConfigurationsToReport>* |  |  |
| >>Report Type | M |  | 9.3.9 | Indicates whether:  - the values for the configuration structures listed shall be reported regardless there has been a change or not  - the values for the configuration structures listed shall be reported only if its value has been changed (modification, addition, deletion) |
| >>RAN Configuration Structure Name | M |  | 9.3.7 | Specifies the name of the cell-level RAN configuration structure that shall be reported. Valid RAN Configuration Structures for this action definition are defined in 8.4.2. |
| >>List of Attributes |  | *0..<maxnoofAttributesToReport>* |  |  |
| >>>Attribute Name | M |  | 9.3.8 | Specifies the name of the required attribute. The value of the attribute shall be reported. Valid attributes for this action definition are defined in 8.8.2. |

|  |  |
| --- | --- |
| Range bound | Explanation |
| maxnoofCellsToReport | Maximum no. of cells supported by Action Definition Format 2. The value is 1024. |
| maxnoofConfigurationsToReport | Maximum no. of configurations supported by Action Definition Format 2. The value is 1024. |
| maxnoofAttributesToReport | Maximum no. of attributes supported by Action Definition Format 2. The value is 65535. |

9.2.1.3 RIC INDICATION HEADER IE

This information element is part of the RIC INDICATION message sent by the E2 Node to the Near-RT RIC and is required for REPORT action.

Direction: E2 Node → NEAR-RT RIC.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| **CHOICE** *Indication Header Format* |  |  |  |  |
| >E2SM-CCC Indication Header Format 1 | M |  |  |  |

##### 9.2.1.3.1 E2SM-CCC Indication Header Format 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| Indication Reason | M |  | ENUMERATED (Upon Subscription, Upon Change, Periodic) | Provides the cause of the event trigger |
| Event Time | M |  | 9.3.10 | Provides the time of the event trigger. |

9.2.1.4 RIC INDICATION MESSAGE IE

This information element is part of the RIC INDICATION message sent by the E2 Node to the Near-RT RIC and is required for REPORT action.

Direction: E2 Node → NEAR-RT RIC.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| **CHOICE** *Indication Message Format* |  |  |  |  |
| >E2SM-CCC Indication Message Format 1 | M |  |  |  |
| >E2SM-CCC Indication Message Format 2 | M |  |  |  |

##### 9.2.1.4.1 E2SM-CCC Indication Message Format 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| List of Configuration Structures Reported |  | *1..<maxnoofConfigurationsReported>* |  | Indicates the configuration structures that are reported within the message. |
| >Change Type | M |  | ENUMERATED (None, Modification, Addition, Deletion) | None - no change occurred in reported RAN configuration structure attributes – e.g., due to periodic reporting or initial subscription. Values of attributes shall be reported through “Values of Attributes”.  Modification - a modification of value occurred in at least one attribute of the RAN configuration structure. New values shall be reported through “Values of Attributes” and old attribute values shall be reported through “Old Values of Attributes”.  Addition - Notification of addition of a new RAN configuration structure. Values of its attributes shall be reported through “Values of Attributes”.  Deletion - Notification of deletion of a RAN configuration structure. Deleted attribute values shall be reported through “Values of Attributes”. |
| >RAN Configuration Structure Name | M |  | 9.3.7 | Indicates the RAN Configuration Structure name. |
| >Values of Attributes | M |  | OCTET STRING | Provides the attribute values for the respective RAN Configuration Structure defined in Section 8.4.1. |
| >Old Values of Attributes | O |  | OCTET STRING | Provides the old values of the attributes for the respective RAN Configuration Structure defined in Section 8.4.1 and shall be included if “Change Type” equals to “Modification”. |

|  |  |
| --- | --- |
| Range bound | Explanation |
| maxnoofConfigurationsReported | Maximum no. of configurations supported by Indication Message Format 1. The value is 65535. |

##### 9.2.1.4.2 E2SM-CCC Indication Message Format 2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| List of Cells Reported |  | *1..<maxnoofCellsReported>* |  | Indicates the cells and respective configuration structures that are reported within the message. |
| >Cell Global Id | M |  | 9.3.6 | Indicates the cell the event was triggered for. |
| >List of Configuration Structures Reported |  | *1..<maxnoofConfigurationsReported>* |  | Indicates the configuration structures that are reported within the message that belong to the cell. |
| >>Change Type | M |  | ENUMERATED (None, Modification, Addition, Deletion) | None - no change occurred in reported RAN configuration structure attributes – e.g., due to periodic reporting or initial subscription. Values of attributes shall be reported through “Values of Attributes”.  Modification - a modification of value occurred in at least one attribute of the RAN configuration structure. New values shall be reported through “Values of Attributes” and old attribute values shall be reported through “Old Values of Attributes”.  Addition - Notification of addition of a new RAN configuration structure. Values of its attributes shall be reported through “Values of Attributes”.  Deletion - Notification of deletion of a RAN configuration structure. Deleted attribute values shall be reported through “Values of Attributes”. |
| >>RAN Configuration Structure Name | M |  | 9.3.7 | Indicates the RAN Configuration Structure name. |
| >>Values of Attributes | M |  | OCTET STRING | Provides the attribute values for the respective RAN Configuration Structure defined in Section 8.4.2. |
| >>Old Values of Attributes | O |  | OCTET STRING | Provides the old values of the attributes for the respective RAN Configuration Structure defined in Section 8.4.2 and shall be included if “Change Type” equals to “Modification”. |

|  |  |
| --- | --- |
| Range bound | Explanation |
| maxnoofCellsReported | Maximum no. of cells supported by Indication Message Format 2. The value is 65535. |
| maxnoofConfigurationsReported | Maximum no. of configurations supported by Indication Message Format 2. The value is 65535. |

9.2.1.6 RIC CONTROL HEADER IE

This information element is part of the RIC CONTROL message sent by the Near-RT RIC to an E2 Node and is required for RIC Control Procedure.

Direction: Near-RT RIC ® E2 Node.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| **CHOICE** *Control Header Format* |  |  |  |  |
| >E2SM-CCC Control Header Format 1 | M |  | 9.2.1.6.1 |  |

##### 9.2.1.6.1 E2SM-CCC Control Header Format 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| RIC Style Type | M |  | 9.3.3 | Refer to Section 7.6.1 |

9.2.1.7 RIC CONTROL MESSAGE IE

This information element is part of the RIC CONTROL message sent by the Near-RT RIC to an E2 Node and is required for RIC Control Procedure.

Direction: Near-RT RIC ® E2 Node.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| **CHOICE** *Control Message Format* |  |  |  |  |
| >E2SM-CCC Control Message Format 1 | M |  | 9.2.1.7.1 |  |
| >E2SM-CCC Control Message Format 2 | M |  | 9.2.1.7.2 |  |

##### 9.2.1.7.1 E2SM-CCC Control Message Format 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| List of Configuration Structures |  | *1..<maxnoofConfigurations>* |  | Indicates the configuration structures that are controlled within the message. |
| >RAN Configuration Structure Name | M |  | 9.3.7 | Indicates the RAN Configuration Structure name. |
| >Old Values of Attributes | M |  | OCTET STRING | Provides the old attribute values for the respective RAN Configuration Structure defined in Section 8.6.1. |
| >New Values of Attributes | M |  | OCTET STRING | Provides the new attribute values for the respective RAN Configuration Structure defined in Section 8.6.1. |

|  |  |
| --- | --- |
| Range bound | Explanation |
| maxnoofConfigurations | Maximum no. of configurations supported by Control Message Format 1. The value is 65535. |

##### 9.2.1.7.2 E2SM-CCC Control Message Format 2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| List of Cells |  | *1..<maxnoofCells>* |  |  |
| >Cell Global Id | M |  | 9.3.6 | Indicates the target cell for control. |
| >List of Configuration Structures |  | *1..<maxnoofConfigurations>* |  |  |
| >>RAN Configuration Structure Name | M |  | 9.3.7 | Indicates the RAN Configuration Structure name. |
| >>Old Values of Attributes | M |  | OCTET STRING | Provides the old attribute values for the respective RAN Configuration Structure defined in Section 8.6.2. |
| >>New Values of Attributes | M |  | OCTET STRING | Provides the new attribute values for the respective RAN Configuration Structure defined in Section 8.6.2. |

|  |  |
| --- | --- |
| Range bound | Explanation |
| maxnoofCells | Maximum no. of cells supported by Control Message Format 2. The value is 65535. |
| maxnoofConfigurations | Maximum no. of configurations supported by Control Message Format 2. The value is 65535. |

9.2.1.8 RIC CONTROL OUTCOME IE

This information element is part of the RIC CONTROL ACKOWLEDGEMENT and RIC CONTROL FAILURE messages and is sent by the E2 Node to the Near-RT RIC and is required for RIC Control Procedure.

Direction: E2 Node ® Near-RT RIC

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| **CHOICE** *Control Outcome Format* |  |  |  |  |
| >E2SM-CCC Control Outcome Format 1 | M |  | 9.2.1.8.1 |  |
| >E2SM-CCC Control Outcome Format 2 | M |  | 9.2.1.8.2 |  |

##### 9.2.1.8.1 E2SM-CCC Control Outcome Format 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| Received Timestamp | O |  | OCTET STRING | Time RIC Control Request message received by RAN Function over E2 interface.    Carries UTC time encoded as the 64-bit timestamp format as defined in section Section 6 of IETF RFC 5905 [5] containing both seconds and fraction parts. |
| RAN Configuration Structures Accepted List |  | *0..<maxnoofConfigurations>* |  | Indicates the list of configuration structure changes that are accepted by the E2 Node. |
| >RAN Configuration Structure Name | M |  | 9.3.7 | Indicates the RAN Configuration Structure name. |
| >Old Values of Attributes | M |  | OCTET STRING | Provides the old attribute values for the respective RAN Configuration Structure defined in Section 8.6.1. |
| >Current Values of Attributes | M |  | OCTET STRING | Provides the current attribute values for the respective RAN Configuration Structure defined in Section 8.6.1. |
| >Applied Timestamp | O |  | OCTET STRING | Time RAN configuration change was applied by the RAN Function.    Carries UTC time encoded as the 64-bit timestamp format as defined in section Section 6 of IETF RFC 5905 [5] containing both seconds and fraction parts. |
| RAN Configuration Structures Failed List |  | *0..<maxnoofConfigurations>* |  | Indicates the list of configuration structure changes that are failed by the E2 Node. |
| >RAN Configuration Structure Name | M |  | 9.3.7 | Indicates the RAN Configuration Structure name. |
| >Old Values of Attributes | M |  | OCTET STRING | Provides the old attribute values for the respective RAN Configuration Structure defined in Section 8.6.1. |
| >Requested Values of Attributes | M |  | OCTET STRING | Provides the requested attribute values for the respective RAN Configuration Structure defined in Section 8.6.1. |
| >Cause | M |  | 9.3.11 | Provides the cause of the failure |

|  |  |
| --- | --- |
| Range bound | Explanation |
| maxnoofConfigurations | Maximum no. of configurations supported by Control Outcome Format 1. The value is 65535. |

##### 9.2.1.8.2 E2SM-CCC Control Outcome Format 2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| Received Timestamp | O |  | OCTET STRING | Time RIC Control Request message received by RAN Function over E2 interface.    Carries UTC time encoded as the 64-bit timestamp format as defined in section Section 6 of IETF RFC 5905 [5] containing both seconds and fraction parts. |
| List of Cells |  | *1..<maxnoofCells>* |  |  |
| >Cell Global Id | M |  | 9.3.6 | Indicates the target cell for control. |
| >RAN Configuration Structures Accepted List |  | *0..<maxnoofConfigurations>* |  | Indicates the list of configuration structure changes that are accepted by the Cell. |
| >>RAN Configuration Structure Name | M |  | 9.3.7 | Indicates the RAN Configuration Structure name. |
| >>Old Values of Attributes | M |  | OCTET STRING | Provides the old attribute values for the respective RAN Configuration Structure defined in Section 8.6.2. |
| >>Current Values of Attributes | M |  | OCTET STRING | Provides the current attribute values for the respective RAN Configuration Structure defined in Section 8.6.2. |
| >>Applied Timestamp | O |  | OCTET STRING | Time RAN configuration change was applied by the RAN Function.    Carries UTC time encoded as the 64-bit timestamp format as defined in section Section 6 of IETF RFC 5905 [5] containing both seconds and fraction parts. |
| >RAN Configuration Structures Failed List |  | *0..<maxnoofConfigurations>* |  | Indicates the list of configuration structure changes that are failed by the Cell. |
| >>RAN Configuration Structure Name | M |  | 9.3.7 | Indicates the RAN Configuration Structure name. |
| >>Old Values of Attributes | M |  | OCTET STRING | Provides the old attribute values for the respective RAN Configuration Structure defined in Section 8.6.2. |
| >>Requested Values of Attributes | M |  | OCTET STRING | Provides the requested attribute values for the respective RAN Configuration Structure defined in Section 8.6.2. |
| >>Cause | M |  | 9.3.11 | Provides the cause of the failure |

|  |  |
| --- | --- |
| Range bound | Explanation |
| maxnoofCells | Maximum no. of cells supported by Control Outcome Format 2. The value is 65535. |
| maxnoofConfigurations | Maximum no. of configurations supported by Control Outcome Format 2. The value is 65535. |

### 9.2.2 Messages for RIC Global Procedures

#### 9.2.2.1 RAN Function Definition IE

This information element is part of the E2 SETUP REQUEST, and RIC SERVICE UPDATE message sent by the E2 Node to the Near-RT RIC and is used to provide all required information for the Near-RT RIC to determine how a given E2 Node has been configured to support a given RAN Function specific E2SM.

Direction: E2 Node → NEAR-RT RIC.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **IE/Group Name** | **Presence** | **Range** | **IE type and reference** | **Semantics description** |
| RAN Function Name | M |  | 9.3.2 |  |
| List of Supported Node-level RAN Configuration Structures |  | *0..<maxnoofConfigurations>* |  | Indicates the list of Node-level RAN Configuration Structures that are supported by the E2 Node. |
| >RAN Configuration Structure Name | M |  | 9.3.7 |  |
| >List of Supported Attributes |  | *0..<maxnoofAttributes>* |  | Provides the supported attributes for the respective RAN Configuration Structure defined in Section 8.6.1. |
| >>Attribute Name | M |  | 9.3.8 |  |
| >>Supported Services | M |  | 9.2.2.2 |  |
| List of Cells |  | *0..<maxnoofCells>* |  | Provides the list of cells and supported RAN Configuration Structures and attributes corresponding to each cell. |
| >Cell Global Id | M |  | 9.3.6 |  |
| >List of Supported Cell-level RAN Configuration Structures |  | *0..<maxnoofConfigurations>* |  | Indicates the list of Cell-level RAN Configuration Structures that are supported by the cell. |
| >>RAN Configuration Structure Name | M |  | 9.3.7 |  |
| >>List of Supported Attributes |  | *0..<maxnoofAttributes>* |  | Provides the supported attributes for the respective RAN Configuration Structure defined in Section 8.6.2. |
| >>>Attribute Name | M |  | 9.3.8 |  |
| >>>Supported Services | M |  | 9.2.2.2 |  |

|  |  |
| --- | --- |
| Range bound | Explanation |
| maxnoofCells | Maximum no. of cells supported by RAN Function Definition. The value is 1024. |
| maxnoofConfigurations | Maximum no. of RAN Configuration Structures supported by RAN Function Definition. The value is 1024. |
| maxnoofAttributes | Maximum no. of attributes supported by RAN Function Definition. The value is 65535. |

#### 9.2.2.2 Supported Services

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **IE/Group Name** | **Presence** | **Range** | **IE type and reference** | **Semantics description** |
| Event Trigger | O |  | 9.2.2.2.1 |  |
| Report Service | O |  | 9.2.2.2.2 |  |
| Insert Service | O |  | 9.2.2.2.3 |  |
| Control Service | O |  | 9.2.2.2.4 |  |
| Policy Service | O |  | 9.2.2.2.5 |  |

##### 9.2.2.2.1 Event Trigger

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **IE/Group Name** | **Presence** | **Range** | **IE type and reference** | **Semantics description** |
| List of Supported Event Trigger Styles |  | *1..<maxnoofRICstyles>* |  |  |
| >Event Trigger Style Type | M |  | 9.3.3 |  |
| >Event Trigger Style Name | M |  | 9.3.4 |  |
| >Event Trigger Format Type | M |  | 9.3.5 |  |

|  |  |
| --- | --- |
| Range bound | Explanation |
| maxnoofRICStyles | Maximum no. of styles supported by RAN Function. The value is <*63*>. |

##### 9.2.2.2.2 Report Service

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| List of Supported Report Styles |  | *1.. <maxnoofRICStyles>* |  |  |
| >Report Service Style Type | M |  | 9.3.3 |  |
| >Report Service Style Name | M |  | 9.3.4 |  |
| >List of Supported Event Trigger Styles | M | *1.. <maxnoofEventTriggerStyles>* |  |  |
| >>Event Trigger Style Type | M |  | 9.3.3 |  |
| >Report Service Action Definition Format Type | M |  | 9.3.5 |  |
| >Report Service Indication Header Format Type | M |  | 9.3.5 |  |
| >Report Service Indication Message Format Type | M |  | 9.3.5 |  |

|  |  |
| --- | --- |
| Range bound | Explanation |
| maxnoofRICStyles | Maximum no. of styles supported by RAN Function. The value is <*63*>. |
| *maxnoofEventTriggerStyles* | Maximum no. of styles supported by RAN Function. The value is <*63*>. |

##### 9.2.2.2.3 Insert Service

FFS

##### 9.2.2.2.4 Control Service

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| List of Supported Control Styles |  | *1.. <maxnoofRICStyles>* |  |  |
| >Control Service Style Type | M |  | 9.3.3 |  |
| >Control Service Style Name | M |  | 9.3.4 |  |
| >Control Service Header Format Type | M |  | 9.3.5 |  |
| >Control Service Message Format Type | M |  | 9.3.5 |  |
| >RIC Call Process ID Format Type | O |  | 9.3.5 |  |
| >Control Service Control Outcome Format Type | M |  | 9.3.5 |  |

.

|  |  |
| --- | --- |
| Range bound | Explanation |
| maxnoofRICStyles | Maximum no. of styles supported by RAN Function. The value is <*63*>. |

##### 9.2.2.2.5 Policy Service

FFS

## 9.3 Information Element definitions

### 9.3.1 General

Void

### 9.3.2 RAN Function Name

This IE is defined in [4] clause 6.2.2.1.

### 9.3.3 RIC Style Type

This IE is defined in [4] clause 6.2.2.2.

### 9.3.4 RIC Style Name

This IE is defined in [4] clause 6.2.2.3.

### 9.3.5 RIC Format Type

This IE is defined in [4] clause 6.2.2.4.

### 9.3.6 Cell Global ID

This IE is defined in [4] clause 6.2.2.5.

### 9.3.7 RAN Configuration Structure Name

This IE defines the name of a given RAN Configuration Structure which are defined in Section 8.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| RAN Configuration Structure Name | M |  | OCTET STRING |  |

### 9.3.8 Attribute Name

This IE defines the name of a given attribute which are defined for each RAN Configuration Structure in Section 8.8.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| Attribute Name | M |  | OCTET STRING |  |

### 9.3.9 Report Type

This IE defines the reporting type of the RAN Configuration Structures. There are 2 types of reporting:

- All: the RAN Configuration Structure shall be reported regardless there has been a change or not in its value

- Change: the RAN Configuration Structure shall be reported only if its value has been changed (e.g. modified, added, deleted)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| Report Type | M |  | ENUMERATED (All, Change) |  |

### 9.3.10 Event Time

This IE defines the time of the event.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| Event Time | M |  | OCTET STRING | Carries UTC time encoded as the 64-bit timestamp format as defined in section Section 6 of IETF RFC 5905 [5] containing both seconds and fraction parts. |

### 9.3.11 Cause

This IE defines the cause of the failure for a control action within a RIC Control Outcome IE.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| Cause | M |  | ENUMERATED (Not supported, Not available, Incompatible state, JSON error, Semantic error, Unspecified) |  |

The meaning of the different cause values is presented in the following table.

|  |  |
| --- | --- |
| Cause | Meaning |
| Not supported | Related capability is not supported within E2 Node |
| Not available | Resources are not available to perform the required action |
| Incompatible state | The received message is not compatible with current E2 Node state (e.g. Old value mismatch) |
| JSON error | The received message contains invalid JSON |
| Semantic error | The requested action included a semantic error |
| Unspecified | None of the above cause values applies |

### 9.3.12 pLMNId

This IE indicates the PLMN Identity and is defined in [4] clause 6.2.3.1.

### 9.3.13 sNSSAI

This IE indicates the S-NSSAI and is defined in [4] clause 6.2.3.12.

### 9.3.14 pLMNInfo

This IE is used to represent PLMN ID and S-NSSAI pair.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| pLMNId | M |  | 9.3.12 |  |
| sNSSAI | O |  | 9.3.13 | This IE shall be present if network slicing feature is supported |

### 9.3.15 pLMNInfoList

This IE is used to represent list of pLMNInfo defined in 9.3.14.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| pLMNInfoList |  | *1..<maxnoofPLMNInfo>* |  |  |
| >pLMNInfo | M |  | 9.3.14 |  |

|  |  |
| --- | --- |
| Range bound | Explanation |
| maxnoofPLMNInfo | Maximum no. of PLMNInfo supported for an E2 Node. Value is 65536. |

### 9.3.16 rRMPolicyMember

This IE is used to represent RRM Policy member information.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| pLMNId | M |  | 9.3.12 |  |
| sNSSAI | O |  | 9.3.13 | This IE shall be present if network slicing feature is supported |

### 9.3.17 rRMPolicyMemberList

This IE is used to represent list of rRMPolicyMember defined in 9.3.14.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| rRMPolicyMemberList |  | *1..<maxnoofRRMPolicyMember>* |  |  |
| >rRMPolicyMember | M |  | 9.3.16 |  |

|  |  |
| --- | --- |
| Range bound | Explanation |
| maxnoofRRMPolicyMember | Maximum no. of RRMPolicyMember supported. Value is 65536. |

### 9.3.18 bWPList

This IE is used to represent list of O-BWP defined in 8.8.2.3.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| bWPList |  | *1..<maxnoofBWP>* |  |  |
| >O-BWP | M |  | 8.8.2.3 |  |

|  |  |
| --- | --- |
| Range bound | Explanation |
| maxnoofBWP | Maximum no. of O-BWP supported. Value is 256. |

## 9.4 JSON Schema

### 9.4.1 General

E2SM-CCC JSON Schema definitions conforms to JSON Draft 07 and Draft 2019-09. Section 9.4.2 contains the JSON Schema definitions of the E2SM information elements and the RAN Configuration Structures to be carried within the E2AP [3] protocol messages as an OCTET STRING with JSON encoding.

If an E2SM information element carried as an OCTET STRING in an E2AP [3] message that is not constructed as defined in this specification is received, this shall be considered as an encoding error and if applicable, the respective *Cause* IE shall be included in the response message.

### 9.4.2 JSON Schema Definitions

{

"openapi": "3.0.1",

"info": {

"title": "E2SM-CCC",

"version": "1.0.0",

"description": "OAS 3.0.1 specification compatible schema for O-RAN WG3 E2SM-CCC"

},

"paths": {},

"components": {

"schemas": {

"GnbId": {

"type": "integer",

"minimum": 0,

"maximum": 4294967295

},

"GnbIdLength": {

"type": "integer",

"minimum": 22,

"maximum": 32

},

"GnbName": {

"type": "string",

"maxLength": 150

},

"GnbDuId": {

"type": "number",

"minimum": 0,

"maximum": 68719476735

},

"GnbCuUpId": {

"type": "number",

"minimum": 0,

"maximum": 68719476735

},

"Sst": {

"type": "integer",

"maximum": 255

},

"Snssai": {

"type": "object",

"properties": {

"sst": {

"$ref": "#/components/schemas/Sst"

},

"sd": {

"type": "string"

}

}

},

"SnssaiList": {

"type": "array",

"items": {

"$ref": "#/components/schemas/Snssai"

}

},

"Mcc": {

"type": "string",

"pattern": "[0-9]{3}"

},

"Mnc": {

"type": "string",

"pattern": "[0-9]{3}|[0-9]{2}"

},

"PlmnId": {

"type": "object",

"properties": {

"mcc": {

"$ref": "#/components/schemas/Mcc"

},

"mnc": {

"$ref": "#/components/schemas/Mnc"

}

}

},

"PlmnIdList": {

"type": "array",

"items": {

"$ref": "#/components/schemas/PlmnId"

}

},

"PlmnInfo": {

"type": "object",

"properties": {

"plmnId": {

"$ref": "#/components/schemas/PlmnId"

},

"snssai": {

"$ref": "#/components/schemas/Snssai"

}

}

},

"PlmnInfoList": {

"type": "array",

"items": {

"$ref": "#/components/schemas/PlmnInfo"

}

},

"GGnbId": {

"type": "string",

"pattern": "^[0-9]{3}[0-9]{2,3}-(22|23|24|25|26|27|28|29|30|31|32)-[0-9]{1,10}"

},

"GEnbId": {

"type": "string",

"pattern": "^[0-9]{3}[0-9]{2,3}-(18|20|21|22)-[0-9]{1,7}"

},

"GGnbIdList": {

"type": "array",

"items": {

"$ref": "#/components/schemas/GGnbId"

}

},

"GEnbIdList": {

"type": "array",

"items": {

"$ref": "#/components/schemas/GEnbId"

}

},

"NrPci": {

"type": "integer",

"minimum": 0,

"maximum": 503

},

"NrTac": {

"type": "integer",

"minimum": 0,

"maximum": 16777215

},

"OperationalState": {

"type": "string",

"enum": [

"ENABLED",

"DISABLED"

]

},

"AdministrativeState": {

"type": "string",

"enum": [

"LOCKED",

"SHUTTINGDOWN",

"UNLOCKED"

]

},

"CellState": {

"type": "string",

"enum": [

"IDLE",

"INACTIVE",

"ACTIVE"

]

},

"CyclicPrefix": {

"type": "string",

"enum": [

"15",

"30",

"60",

"120"

]

},

"BwpContext": {

"type": "string",

"enum": [

"DL",

"UL",

"SUL"

]

},

"IsInitialBwp": {

"type": "string",

"enum": [

"INITIAL",

"OTHER",

"SUL"

]

},

"SubCarrierSpacing": {

"type": "integer",

"enum": [

15,

30,

60,

120

]

},

"SsbPeriodicity": {

"type": "integer",

"enum": [

5,

10,

20,

40,

80,

160

]

},

"SsbDuration": {

"type": "integer",

"enum": [

1,

2,

3,

4,

5

]

},

"SsbSubCarrierSpacing": {

"type": "integer",

"enum": [

15,

30,

120,

240

]

},

"ResourceType": {

"type": "string",

"enum": [

"PRB\_DL",

"PRB\_UL",

"DRB",

"RRC"

]

},

"RrmPolicyMember": {

"type": "object",

"properties": {

"plmnId": {

"$ref": "#/components/schemas/PlmnId"

},

"snssai": {

"$ref": "#/components/schemas/Snssai"

}

}

},

"RrmPolicyMemberList": {

"type": "array",

"items": {

"$ref": "#/components/schemas/RrmPolicyMember"

}

},

"O-GnbCuCpFunction": {

"type": "object",

"properties": {

"gnbId": {"$ref": "#/components/schemas/GnbId"},

"gnbIdLength": {"$ref": "#/components/schemas/GnbIdLength"},

"gnbCuName": {"$ref": "#/components/schemas/GnbName"},

"plmnId": {"$ref": "#/components/schemas/PlmnId"},

"x2ExcludeList": {"$ref": "#/components/schemas/GGnbIdList"},

"xnExcludeList": {"$ref": "#/components/schemas/GGnbIdList"},

"x2IncludeList": {"$ref": "#/components/schemas/GGnbIdList"},

"xnIncludeList": {"$ref": "#/components/schemas/GGnbIdList"},

"x2XnHOExcludeList": {"$ref": "#/components/schemas/GEnbIdList"}

}

},

"O-GnbCuUpFunction": {

"type": "object",

"properties": {

"gnbId": {"$ref": "#/components/schemas/GnbId"},

"gnbIdLength": {"$ref": "#/components/schemas/GnbIdLength"},

"gnbCuUpId": {"$ref": "#/components/schemas/GnbCuUpId"},

"plmnInfoList": {"$ref": "#/components/schemas/PlmnInfoList"}

}

},

"O-GnbDuFunction": {

"type": "object",

"properties": {

"gnbDuId": {"$ref": "#/components/schemas/GnbDuId"},

"gnbDuName": {"$ref": "#/components/schemas/GnbName"},

"gnbId": {"$ref": "#/components/schemas/GnbId"},

"gnbIdLength": {"$ref": "#/components/schemas/GnbIdLength"}

}

},

"O-NrCellCu": {

"type": "object",

"properties": {

"cellLocalId": {"type": "integer"},

"plmnInfoList": {"$ref": "#/components/schemas/PlmnInfoList"}

}

},

"O-NrCellDu": {

"type": "object",

"properties": {

"cellLocalId": {"type": "integer"},

"operationalState": {"$ref": "#/components/schemas/OperationalState"},

"administrativeState": {"$ref": "#/components/schemas/AdministrativeState"},

"cellState": {"$ref": "#/components/schemas/CellState"},

"plmnInfoList": {"$ref": "#/components/schemas/PlmnInfoList"},

"nrPci": {"$ref": "#/components/schemas/NrPci"},

"nrTac": {"$ref": "#/components/schemas/NrTac"},

"arfcnDL": {"type": "integer"},

"arfcnUL": {"type": "integer"},

"arfcnSUL": {"type": "integer"},

"bSChannelBwDL": {"type": "integer"},

"ssbFrequency": {

"type": "integer",

"minimum": 0,

"maximum": 3279165

},

"ssbPeriodicity": {"$ref": "#/components/schemas/SsbPeriodicity"},

"ssbSubCarrierSpacing": {"$ref": "#/components/schemas/SsbSubCarrierSpacing"},

"ssbOffset": {

"type": "integer",

"minimum": 0,

"maximum": 159

},

"ssbDuration": {"$ref": "#/components/schemas/SsbDuration"},

"bSChannelBwUL": {"type": "integer"},

"bSChannelBwSUL": {"type": "integer"},

"bwpList": {"type": "array","items": {"$ref": "#/components/schemas/O-Bwp"}}

}

},

"O-RRMPolicyRatio": {

"type": "object",

"properties": {

"resourceType": {"$ref": "#/components/schemas/ResourceType"},

"rRMPolicyMemberList": {"$ref": "#/components/schemas/RrmPolicyMemberList"},

"rRMPolicyMaxRatio": {"type": "integer"},

"rRMPolicyMinRatio": {"type": "integer"},

"rRMPolicyDedicatedRatio": {"type": "integer"}

}

},

"O-Bwp": {

"type": "object",

"properties": {

"bwpContext": {"$ref": "#/components/schemas/BwpContext"},

"isInitialBwp": {"$ref": "#/components/schemas/IsInitialBwp"},

"subCarrierSpacing": {"$ref": "#/components/schemas/SubCarrierSpacing"},

"cyclicPrefix": {"$ref": "#/components/schemas/CyclicPrefix"},

"startRB": {"type": "integer"},

"numberOfRBs": {"type": "integer"}

}

},

"E2SM-CCC-RAN-Configuration-Structure": {

"oneOf": [

{

"$ref": "#/components/schemas/O-GnbCuCpFunction"

},

{

"$ref": "#/components/schemas/O-GnbCuUpFunction"

},

{

"$ref": "#/components/schemas/O-GnbDuFunction"

},

{

"$ref": "#/components/schemas/O-NrCellCu"

},

{

"$ref": "#/components/schemas/O-NrCellDu"

},

{

"$ref": "#/components/schemas/O-RRMPolicyRatio"

},

{

"$ref": "#/components/schemas/O-Bwp"

}

]

},

"RIC-Indication-Header": {

"type": "object",

"properties": {

"indicationHeaderFormat": {"$ref": "#/components/schemas/IndicationHeaderFormat"}

},

"required": ["indicationHeaderFormat"]

},

"IndicationHeaderFormat": {

"oneOf": [

{

"$ref": "#/components/schemas/E2SM-CCC-IndicationHeaderFormat1"

}

]

},

"E2SM-CCC-IndicationHeaderFormat1": {

"type": "object",

"properties": {

"indicationReason": {"enum": ["uponSubscription", "uponChange", "periodic"] },

"eventTime": {"type": "string"}

},

"required": ["indicationReason", "eventTime"]

},

"RIC-Indication-Message": {

"type": "object",

"properties": {

"indicationMessageFormat": {"$ref": "#/components/schemas/IndicationMessageFormat"}

},

"required": ["indicationMessageFormat"]

},

"IndicationMessageFormat": {

"oneOf": [

{

"$ref": "#/components/schemas/E2SM-CCC-IndicationMessageFormat1"

},

{

"$ref": "#/components/schemas/E2SM-CCC-IndicationMessageFormat2"

}

]

},

"E2SM-CCC-IndicationMessageFormat1": {

"type": "object",

"properties": {

"listOfConfigurationStructuresReported": {"$ref": "#/components/schemas/ListOfConfigurationsReported"}

},

"required": ["listOfConfigurationStructuresReported"]

},

"ListOfConfigurationsReported": {

"type": "array",

"items": {

"$ref": "#/components/schemas/ConfigurationStructure"

}

},

"ConfigurationStructure": {

"type": "object",

"properties": {

"changeType": { "enum": ["none", "modification", "addition", "deletion"] },

"ranConfigurationStructureName": {"type": "string"},

"valuesOfAttributes": { "$ref": "#/components/schemas/ValuesOfAttributes" },

"oldValuesOfAttributes": {"$ref": "#/components/schemas/ValuesOfAttributes"}

},

"required": ["changeType", "ranConfigurationStructureName", "valuesOfAttributes"]

},

"ValuesOfAttributes": {

"type": "object",

"properties": {

"ranConfigurationStructure": { "$ref": "#/components/schemas/E2SM-CCC-RAN-Configuration-Structure" }

},

"required": ["ranConfigurationStructure"]

},

"E2SM-CCC-IndicationMessageFormat2": {

"type": "object",

"properties": {

"listOfCellsReported": {"$ref": "#/components/schemas/ListOfCellsReported"}

},

"required": ["listOfCellsReported"]

},

"ListOfCellsReported": {

"type": "array",

"items": {

"$ref": "#/components/schemas/CellReported"

}

},

"CellReported": {

"type": "object",

"properties": {

"cellGlobalId": {"$ref": "#/components/schemas/CellGlobalId" },

"listOfConfigurationStructuresReported": {"$ref": "#/components/schemas/ListOfConfigurationsReported"}

},

"required": ["cellGlobalId", "listOfConfigurationStructuresReported"]

},

"CellGlobalId": {

"type": "object",

"oneOf": [

{

"$ref": "#/components/schemas/NR-CGI"

},

{

"$ref": "#/components/schemas/EUTRA-CGI"

}

]

},

"NR-CGI": {

"type": "object",

"properties": {

"plmnIdentity": {"$ref": "#/components/schemas/PlmnId" },

"nRCellIdentity": {"$ref": "#/components/schemas/NRCellIdentity"}

},

"required": ["plmnIdentity", "nRCellIdentity"]

},

"NRCellIdentity": {

"type": "string"

},

"EUTRA-CGI": {

"type": "object",

"properties": {

"plmnIdentity": {"$ref": "#/components/schemas/PlmnId"},

"eUTRACellIdentity": {"$ref": "#/components/schemas/EUTRACellIdentity"}

},

"required": ["plmnIdentity", "eUTRACellIdentity"]

},

"EUTRACellIdentity": {

"type": "string"

},

"RIC-Control-Header": {

"type": "object",

"properties": {

"controlHeaderFormat": {"$ref": "#/components/schemas/ControlHeaderFormat"}

},

"required": ["controlHeaderFormat"]

},

"ControlHeaderFormat": {

"oneOf": [

{

"$ref": "#/components/schemas/E2SM-CCC-ControlHeaderFormat1"

}

]

},

"E2SM-CCC-ControlHeaderFormat1": {

"type": "object",

"properties": {

"ricStyleType": { "type": "integer" }

},

"required": ["ricStyleType"]

},

"RIC-Control-Message": {

"type": "object",

"properties": {

"controlMessageFormat": {"$ref": "#/components/schemas/ControlMessageFormat"}

},

"required": ["controlMessageFormat"]

},

"ControlMessageFormat": {

"oneOf": [

{

"$ref": "#/components/schemas/E2SM-CCC-ControlMessageFormat1"

},

{

"$ref": "#/components/schemas/E2SM-CCC-ControlMessageFormat2"

}

]

},

"E2SM-CCC-ControlMessageFormat1": {

"type": "object",

"properties": {

"listOfConfigurationStructures": {"$ref": "#/components/schemas/ListOfConfigurationStructures"}

},

"required": ["listOfConfigurationStructures"]

},

"ListOfConfigurationStructures": {

"type": "array",

"items": {

"$ref": "#/components/schemas/ConfigurationStructureWrite"

}

},

"ConfigurationStructureWrite": {

"type": "object",

"properties": {

"ranConfigurationStructureName": {"type": "string"},

"oldValuesOfAttributes": {"$ref": "#/components/schemas/ValuesOfAttributes"},

"newValuesOfAttributes": { "$ref": "#/components/schemas/ValuesOfAttributes" }

},

"required": ["ranConfigurationStructureName", "oldValuesOfAttributes", "newValuesOfAttributes"]

},

"E2SM-CCC-ControlMessageFormat2": {

"type": "object",

"properties": {

"listOfCellsReported": {"$ref": "#/components/schemas/ListOfCells"}

},

"required": ["listOfCellsReported"]

},

"ListOfCells": {

"type": "array",

"items": {

"$ref": "#/components/schemas/CellControlled"

}

},

"CellControlled": {

"type": "object",

"properties": {

"cellGlobalId": {"$ref": "#/components/schemas/CellGlobalId" },

"listOfConfigurationStructures": {"$ref": "#/components/schemas/ListOfConfigurationStructures"}

},

"required": ["cellGlobalId", "listOfConfigurationStructures"]

},

"RANFunctionDefinition": {

"type": "object",

"properties": {

"ranFunctionName": {"$ref": "#/components/schemas/RANFunctionName" },

"listOfSupportedNodeLevelConfigurationStructures": {"$ref": "#/components/schemas/ListOfSupportedRANConfigurationStructures"},

"listOfCellsForRANFunctionDefinition": {"$ref": "#/components/schemas/ListOfCellsForRANFunctionDefinition"}

},

"required": ["ranFunctionName"]

},

"RANFunctionName": {

"type": "object",

"properties": {

"ranFunctionShortName": {"type": "string"},

"ranFunctionServiceModelOID": {"type": "string"},

"ranFunctionDescription": {"type": "string"},

"ranFunctionInstance": {"type": "integer"}

},

"required": ["ranFunctionShortName", "ranFunctionServiceModelOID", "ranFunctionDescription"]

},

"ListOfSupportedRANConfigurationStructures": {

"type": "array",

"items": {

"$ref": "#/components/schemas/RANConfigurationStructure"

}

},

"RANConfigurationStructure": {

"type": "object",

"properties": {

"ranConfigurationStructureName": {"type": "string"},

"listOfSupportedAttributes": {"$ref": "#/components/schemas/ListOfSupportedAttributes"}

},

"required": ["ranConfigurationStructureName"]

},

"ListOfSupportedAttributes": {

"type": "array",

"items": {

"$ref": "#/components/schemas/Attribute"

}

},

"Attribute": {

"type": "object",

"properties": {

"attributeName": {"type": "string"},

"supportedServices": {"$ref": "#/components/schemas/RICServices"}

},

"required": ["attributeName","supportedServices"]

},

"RICServices": {

"type": "object",

"properties": {

"eventTrigger": {"$ref": "#/components/schemas/EventTrigger"},

"reportService": {"$ref": "#/components/schemas/ReportService"},

"insertService": {"$ref": "#/components/schemas/InsertService"},

"controlService": {"$ref": "#/components/schemas/ControlService"},

"policyService": {"$ref": "#/components/schemas/PolicyService"}

}

},

"EventTrigger": {

"type": "object",

"properties": {

"listOfSupportedEventTriggerStyles": {"$ref": "#/components/schemas/ListOfSupportedEventTriggerStyles"}

},

"required": ["listOfSupportedEventTriggerStyles"]

},

"ListOfSupportedEventTriggerStyles": {

"type": "array",

"items": {

"$ref": "#/components/schemas/EventTriggerStyle"

}

},

"EventTriggerStyle": {

"type": "object",

"properties": {

"eventTriggerStyleType": {"type": "integer"},

"eventTriggerStyleName": {"type": "string"},

"eventTriggerFormatType": {"type": "integer"}

},

"required": ["eventTriggerStyleType", "eventTriggerStyleName", "eventTriggerFormatType"]

},

"ReportService": {

"type": "object",

"properties": {

"listOfSupportedReportStyles": {"$ref": "#/components/schemas/ListOfSupportedReportStyles"}

},

"required": ["listOfSupportedReportStyles"]

},

"ListOfSupportedReportStyles": {

"type": "array",

"items": {

"$ref": "#/components/schemas/ReportStyle"

}

},

"ReportStyle": {

"type": "object",

"properties": {

"reportServiceStyleType": {"type": "integer"},

"reportServiceStyleName": {"type": "string"},

"listOfSupportedEventTriggerStylesForReportStyle": {

"type": "array",

"items": {

"$ref": "#/components/schemas/EventTriggerStyleType"

}

},

"reportServiceActionDefinitionFormatType": {"type": "integer"},

"reportServiceIndicationHeaderFormatType": {"type": "integer"},

"reportServiceIndicationMessageFormatType": {"type": "integer"}

},

"required": ["reportServiceStyleType", "reportServiceStyleName", "listOfSupportedEventTriggerStylesForReportStyle", "reportServiceActionDefinitionFormatType", "reportServiceIndicationHeaderFormatType", "reportServiceIndicationMessageFormatType"]

},

"EventTriggerStyleType": {

"type": "object",

"properties": {

"eventTriggerStyleType": {"type": "integer"}

},

"required": ["eventTriggerStyleType"]

},

"InsertService": {

"type": "object"

},

"ControlService": {

"type": "object",

"properties": {

"listOfSupportedControlStyles": {"$ref": "#/components/schemas/ListOfSupportedControlStyles"}

},

"required": ["listOfSupportedControlStyles"]

},

"ListOfSupportedControlStyles": {

"type": "array",

"items": {

"$ref": "#/components/schemas/ControlStyle"

}

},

"ControlStyle": {

"type": "object",

"properties": {

"controlServiceStyleType": {"type": "integer"},

"controlServiceStyleName": {"type": "string"},

"controlServiceHeaderFormatType": {"type": "integer"},

"controlServiceMessageFormatType": {"type": "integer"},

"ricCallProcessIDFormatType": {"type": "integer"},

"controlServiceControlOutcomeFormatType": {"type": "integer"}

},

"required": ["controlServiceStyleType", "controlServiceStyleName", "controlServiceHeaderFormatType", "controlServiceMessageFormatType", "controlServiceControlOutcomeFormatType"]

},

"PolicyService": {

"type": "object"

},

"ListOfCellsForRANFunctionDefinition": {

"type": "array",

"items": {

"$ref": "#/components/schemas/CellForRANFunctionDefinition"

}

},

"CellForRANFunctionDefinition": {

"type": "object",

"properties": {

"cellGlobalID": {"$ref": "#/components/schemas/NR-CGI"},

"listOfSupportedCellLevelRANConfigurationStructures": {"$ref": "#/components/schemas/ListOfSupportedRANConfigurationStructures"}

},

"required": ["cellGlobalID"]

},

"RICEventTriggerDefinition": {

"type": "object",

"properties": {

"eventTriggerDefinitionFormat": {"$ref": "#/components/schemas/EventTriggerDefinitionFormat"}

},

"required": ["eventTriggerDefinitionFormat"]

},

"EventTriggerDefinitionFormat": {

"oneOf": [

{

"$ref": "#/components/schemas/E2SM-CCC-EventTriggerDefinition-Format1"

},

{

"$ref": "#/components/schemas/E2SM-CCC-EventTriggerDefinition-Format2"

},

{

"$ref": "#/components/schemas/E2SM-CCC-EventTriggerDefinition-Format3"

}

]

},

"E2SM-CCC-EventTriggerDefinition-Format1": {

"type": "object",

"properties": {

"listOfNodeLevelConfigurationStructuresForEventTrigger": {"$ref": "#/components/schemas/ListOfRANConfigurationStructuresForEventTrigger"}

},

"required": ["listOfNodeLevelConfigurationStructuresForEventTrigger"]

},

"ListOfRANConfigurationStructuresForEventTrigger": {

"type": "array",

"items": {

"$ref": "#/components/schemas/RANConfigurationStructureForEventTrigger"

}

},

"RANConfigurationStructureForEventTrigger": {

"type": "object",

"properties": {

"ranConfigurationStructureName": {"type": "string"},

"listOfAttributes": {

"type": "array",

"items": {

"type": "string"

}

}

},

"required": ["ranConfigurationStructureName"]

},

"E2SM-CCC-EventTriggerDefinition-Format2": {

"type": "object",

"properties": {

"listOfCellLevelConfigurationStructuresForEventTrigger": {

"$ref": "#/components/schemas/ListOfCellLevelConfigurationStructuresForEventTrigger"

}

},

"required": ["listOfCellLevelConfigurationStructuresForEventTrigger"]

},

"ListOfCellLevelConfigurationStructuresForEventTrigger": {

"type": "array",

"items": {

"$ref": "#/components/schemas/CellLevelConfigurationStructureForEventTrigger"

}

},

"CellLevelConfigurationStructureForEventTrigger": {

"type": "object",

"properties": {

"cellGlobalId": {"$ref": "#/components/schemas/NR-CGI"},

"listOfRANConfigurationStructuresForEventTrigger": {"$ref": "#/components/schemas/ListOfRANConfigurationStructuresForEventTrigger"}

},

"required": ["listOfRANConfigurationStructuresForEventTrigger"]

},

"E2SM-CCC-EventTriggerDefinition-Format3": {

"type": "object",

"properties": {

"period": {"type": "integer"}

},

"required": ["period"]

},

"RICActionDefinition": {

"type": "object",

"properties": {

"ricStyleType": {"type": "integer"},

"actionDefinitionFormat": {"$ref": "#/components/schemas/ActionDefinitionFormat"}

},

"required": ["ricStyleType", "actionDefinitionFormat"]

},

"ActionDefinitionFormat": {

"oneOf": [

{

"$ref": "#/components/schemas/E2SM-CCC-ActionDefinitionFormat1"

},

{

"$ref": "#/components/schemas/E2SM-CCC-ActionDefinitionFormat2"

}

]

},

"E2SM-CCC-ActionDefinitionFormat1": {

"type": "object",

"properties": {

"listOfNodeLevelRANConfigurationStructuresForADF": {"$ref": "#/components/schemas/ListOfRANConfigurationStructuresForADF"}

},

"required": ["listOfNodeLevelRANConfigurationStructuresForADF"]

},

"ListOfRANConfigurationStructuresForADF": {

"type": "array",

"items": {

"$ref": "#/components/schemas/RANConfigurationStructureForADF"

}

},

"RANConfigurationStructureForADF": {

"type": "object",

"properties": {

"reportType": {"enum": ["all", "change"]},

"ranConfigurationStructureName": {"type": "string"},

"listOfAttributes": {

"type": "array",

"items": {

"$ref": "#/components/schemas/AttributeName"

}

}

},

"required": ["reportType", "ranConfigurationStructureName"]

},

"AttributeName": {

"type": "object",

"properties": {

"attributeName": {"type": "string"}

},

"required": ["attributeName"]

},

"E2SM-CCC-ActionDefinitionFormat2": {

"type": "object",

"properties": {

"listOfCellConfigurationsToBeReportedForADF": {"$ref": "#/components/schemas/ListOfCellConfigurationsToBeReportedForADF"}

},

"required": ["listOfCellConfigurationsToBeReported"]

},

"ListOfCellConfigurationsToBeReportedForADF": {

"type": "array",

"items": {

"$ref": "#/components/schemas/CellConfigurationToBeReportedForADF"

}

},

"CellConfigurationToBeReportedForADF": {

"type": "object",

"properties": {

"cellGlobalId": {"$ref": "#/components/schemas/NR-CGI"},

"listOfCellLevelRANConfigurationStructuresForADF": {

"$ref": "#/components/schemas/ListOfRANConfigurationStructuresForADF"

}

}

},

"RIC-Control-Outcome": {

"type": "object",

"properties": {

"controlOutcomeFormat": {"$ref": "#/components/schemas/ControlOutcomeFormat"}

},

"required": ["controlOutcomeFormat"]

},

"ControlOutcomeFormat": {

"oneOf": [

{

"$ref": "#/components/schemas/E2SM-CCC-ControlOutcomeFormat1"

},

{

"$ref": "#/components/schemas/E2SM-CCC-ControlOutcomeFormat2"

}

]

},

"E2SM-CCC-ControlOutcomeFormat1": {

"type": "object",

"properties": {

"receivedTimestamp": {"type": "string"},

"ranConfigurationStructuresAcceptedList": {"$ref": "#/components/schemas/RanConfigurationStructuresAcceptedList"},

"ranConfigurationStructuresFailedList": {"$ref": "#/components/schemas/RanConfigurationStructuresFailedList"}

}

},

"RanConfigurationStructuresAcceptedList": {

"type": "array",

"items": {

"$ref": "#/components/schemas/ConfigurationStructureAccepted"

}

},

"ConfigurationStructureAccepted": {

"type": "object",

"properties": {

"ranConfigurationStructureName": {"type": "string"},

"oldValuesOfAttributes": {"$ref": "#/components/schemas/ValuesOfAttributes"},

"currentValuesOfAttributes": { "$ref": "#/components/schemas/ValuesOfAttributes" },

"appliedTimestamp": {"type": "string"}

},

"required": ["ranConfigurationStructureName", "oldValuesOfAttributes", "currentValuesOfAttributes"]

},

"RanConfigurationStructuresFailedList": {

"type": "array",

"items": {

"$ref": "#/components/schemas/ConfigurationStructureFailed"

}

},

"ConfigurationStructureFailed": {

"type": "object",

"properties": {

"ranConfigurationStructureName": {"type": "string"},

"oldValuesOfAttributes": {"$ref": "#/components/schemas/ValuesOfAttributes"},

"requestedValuesOfAttributes": { "$ref": "#/components/schemas/ValuesOfAttributes"},

"cause": { "$ref": "#/components/schemas/Cause"}

},

"required": ["ranConfigurationStructureName", "oldValuesOfAttributes", "requestedValuesOfAttributes", "cause"]

},

"Cause": {

"type": "string",

"enum": [

"NotSupported",

"NotAvailable",

"IncompatibleState",

"JsonError",

"SemanticError",

"Unspecified"

]

},

"E2SM-CCC-ControlOutcomeFormat2": {

"type": "object",

"properties": {

"receivedTimestamp": {"type": "string"},

"listOfCellsForControlOutcome": {"$ref": "#/components/schemas/ListOfCellsForControlOutcome"}

},

"required": ["listOfCellsForControlOutcome"]

},

"ListOfCellsForControlOutcome": {

"type": "array",

"items": {

"$ref": "#/components/schemas/CellControlOutcome"

}

},

"CellControlOutcome": {

"type": "object",

"properties": {

"cellGlobalId": {"$ref": "#/components/schemas/CellGlobalId" },

"ranConfigurationStructuresAcceptedList": {"$ref": "#/components/schemas/RanConfigurationStructuresAcceptedList"},

"ranConfigurationStructuresFailedList": {"$ref": "#/components/schemas/RanConfigurationStructuresFailedList"}

},

"required": ["cellGlobalId"]

}

}

}

}

## 9.5 Message transfer syntax

# 10 Handling of Unknown, Unforeseen and Erroneous Protocol Data

# Annex A: Examples on IE Contents

# Revision History

|  |  |  |
| --- | --- | --- |
| **Date** | **Revision** | **Description** |
| 2022.11.04 | 01.00.01 | Removed v01.00 revision history  Addition of CRs agreed in WG3#164:   * JNPR-2022.10.13-WG3-CR-0018-E2SM-CCC-ControlOutcomeJSONSchema * JNPR-2022.10.13-WG3-CR-0019-E2SM-CCC-JSONSchemaFixes   Note: This version contains non-backward compatible change with respect to v01.00. |
| 2022.11.18 | 01.00.02 | Added R003 to file name  Updated copyright year  Editorial changes:   * Section 7.1: Corrected IE name to align with section 9.2.2.1 *RAN Function Definition* IE definition. |
| 2022.11.18 | 01.01 | Ready for TSC approval and publication |

# History

|  |  |  |
| --- | --- | --- |
| Date | Revision | Description |
| 2022.08.02 | 01.00 | v01.00 publication |