
O-RAN Work Group 3 (Near-RT RIC and E2 Interface)

E2 Service Model (E2SM), Lower Layers Control

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Foreword

This Technical Specification (TS) has been produced by WG3 of the O-RAN Alliance.

The content of the present document is 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 version date and an increase in version number as follows:

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Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the O-RAN Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in O-RAN deliverables except when used in direct citation.

1 Scope

The present document describes the E2 service model (E2SM) for the Near RT RIC Lower Layers Control interaction covering layers L1 and L2 interactions.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE 1: While any hyperlinks included in this clause were valid at the time of publication, O-RAN cannot guarantee their long-term validity.

NOTE 2: In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in 3GPP Release 18, or the latest 3GPP release prior to Release 18 that includes that document.

The following referenced documents are necessary for the application of the present document.

- [1] O-RAN.WG3.TS.E2GAP: "O-RAN E2 General Aspects and Principles (E2GAP)".
- [2] O-RAN.WG1.TS.OAD: "O-RAN Architecture Description".
- [3] O-RAN.WG3.TS.E2AP: "O-RAN E2 Application Protocol (E2AP)".
- [4] O-RAN.WG3.TS.E2SM: "O-RAN E2 Service Model (E2SM)".
- [5] 3GPP TS 38.211: "NR; Physical channels and modulation".
- [6] 3GPP TS 38.213: "NR; Physical layer procedures for control".
- [7] IETF RFC 5905 (2010-06): "Network Time Protocol Version 4: Protocol and Algorithms Specification".
- [8] O-RAN.WG4.TS.CUS: "O-RAN Control, User and Synchronization Plane Specification".
- [9] 3GPP TS 38.331: "NR; Radio Resource Control (RRC) Protocol Specification".
- [10] 3GPP TS 25.321: "Medium Access Control (MAC) protocol specification".
- [11] 3GPP TS 37.483: "E1 Application Protocol (E1AP)".
- [12] 3GPP TS 38.323: "NR; Packet Data Convergence Protocol (PDCP) specification".
- [13] 3GPP TS 38.214: "NR; Physical layer procedures for data".
- [14] 3GPP TS 38.212: "NR; Multiplexing and channel coding".
- [15] Recommendation ITU-T X.680 (2002-07): "Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation".
- [16] Recommendation ITU-T X.681 (2002-07): "Information technology – Abstract Syntax Notation One (ASN.1): Information object specification".
- [17] Recommendation ITU-T X.691 (2002-07): "Information technology - ASN.1 encoding rules - Specification of Packed Encoding Rules (PER) ".
- [18] 3GPP TS 36.413: "E-UTRAN; S1 Application Protocol (S1AP)".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE 1: While any hyperlinks included in this clause were valid at the time of publication, O-RAN cannot guarantee their long-term validity.

NOTE 2: In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in 3GPP Release 18, or the latest 3GPP release prior to Release 18 that includes that document.

The following referenced documents are not necessary for the application of the present document, but they assist the user with regard to a particular subject area.

- [i.1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

3 Definition of terms, symbols, and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [i.1], O-RAN WG3.TS.E2GAP [1], O-RAN WG1.TS.OAD [2].

3.2 Symbols

Void

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [i.1], O-RAN WG3.TS.E2GAP [1], O-RAN WG1.TS.OAD [2], and the following apply.

HOL	Head of Line
LLI	Lower Layers Information
PDB	Packet Delay Budget
SMG	Spatial Multiplexing Group
SPS	Semi Persistent Scheduling

4 General

4.1 Procedure specification principles

The procedure specification principles defined in O-RAN WG3.TS.E2AP [3] clause 4 shall apply.

4.2 Forwards and backwards compatibility

The forwards and backwards compatibility of the E2 interface uses the forward and backwards compatibility compatibilities offered by the O-RAN WG3.TS.E2AP [3] protocol.

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 <i>Information Element Name</i> 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. <i>Event Trigger Condition ID IE</i> .
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".

5 E2SM services

As defined in O-RAN WG3.TS.E2GAP [1], a given RAN Function offers a set of services to be exposed over the E2 (REPORT, INSERT, CONTROL, POLICY and/or QUERY) using O-RAN WG3.TS.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 between 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	O-RAN WG3.TS.E2AP [3] clause 9.2.9	RIC Subscription RIC Subscription Modification
RIC Action Definition IE	O-RAN WG3.TS.E2AP [3] clause 9.2.12	RIC Subscription RIC Subscription Modification
RIC Indication Header IE	O-RAN WG3.TS.E2AP [3] clause 9.2.17	RIC Indication
RIC Indication Message IE	O-RAN WG3.TS.E2AP [3] clause 9.2.16	RIC Indication
RIC Call Process ID IE	O-RAN WG3.TS.E2AP [3] clause 9.2.18	RIC Indication RIC Control
RIC Control Header IE	O-RAN WG3.TS.E2AP [3] clause 9.2.20	RIC Control
RIC Control Message IE	O-RAN WG3.TS.E2AP [3] clause 9.2.19	RIC Control
RIC Control Outcome IE	O-RAN WG3.TS.E2AP [3] clause 9.2.25	RIC Control
RIC Query Header IE	O-RAN WG3.TS.E2AP [3] clause 9.2.36	RIC Query
RIC Query Definition IE	O-RAN WG3.TS.E2AP [3] clause 9.2.37	RIC Query
RIC Query Outcome IE	O-RAN WG3.TS.E2AP [3] clause 9.2.38	RIC Query
RAN Function Definition IE	O-RAN WG3.TS.E2AP [3] clause 9.2.23	E2 Setup RIC Service Update

All of these RAN Function specific E2AP IEs are defined in O-RAN WG3.TS.E2AP [3] as “OCTET STRING”.

The purpose of this specification is to define the contents of these fields for the specific RAN function "Lower Layers Control".

6 RAN function service model description

6.1 RAN function overview

For the purposes of this E2 Service Model, E2SM-LLC, the E2 Node terminating the E2 Interface is assumed to host one or more instances of the RAN Function which performs the following functionalities:

- E2 REPORT services used to expose UE related lower layers information

- E2 CONTROL services used to initiate control of UE level lower layers 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 control related call processes or more than one RAN Function in the E2 Node with each instance handling a subset of the RAN control related call processes on the E2 Node.

6.2 RAN function exposure services

6.2.1 REPORT service

The “Lower Layers Control” RAN Function provides selective support of the following **REPORT** services:

- UE level PHY/MAC information, used for estimating the channels
- Traffic status, used for triggering E2 Control

6.2.2 INSERT service

Void

6.2.3 CONTROL service

The “Lower Layers Control” RAN Function provides selective support of the following **CONTROL** services:

- UE level control of handling the scheduling of specific logical channels
- UE level control of parameters for scheduling transmissions

6.2.4 POLICY service

Void

6.2.5 QUERY service

Void

6.3 REPORT service description

The E2SM-LLC REPORT service requirements defined in Clause 6.2.1 are offered using a set of REPORT Styles. All REPORT styles are implemented using a set of IEs for Action Definition, RIC Indication Header and RIC Indication Message and have specific Event Trigger approach.

The following REPORT styles are supported:

- Lower Layers Information (LLI) Copy: This REPORT style is initiated by “Lower Layers Information Event” Event Trigger and is used to report PHY and MAC information received from UEs along with UE associated information when the event trigger conditions are satisfied.
- Lower Layers Measurements: This REPORT style is initiated by “Periodic” Event Trigger and is used to report traffic information per logical channel per UE and to report slot timestamps when the event trigger conditions are satisfied.

6.4 INSERT service description

Void

6.5 CONTROL service description

The E2SM-LLC CONTROL service requirements defined in Clause 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 RAN Control-related CONTROL services. A “CONTROL Action” containing one or more RAN parameters and their associated values can be sent asynchronously from the RIC to the E2 node.

The following CONTROL styles are supported:

- UE level control of handling of scheduling specific logical channels
- UE level control of parameters for scheduling transmissions

6.6 POLICY service description

Void

6.7 QUERY service description

Void

7 RAN function description

7.1 RAN function definition

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.
- **RIC QUERY** 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-LLC”

RAN Function name description “Lower Layers 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 definition styles

7.3.1 RIC Event Trigger Definition IE style list

RIC Style Type	Style Name	Supported RIC Service Style			Style Description
		Report	Insert	Policy	
1	Low Layers Information Event	1	-	-	Triggering conditions are based on arrival of control message or PHY signal.
2	Periodic	2	-	-	Triggered at specific time periods.

7.3.2 RIC Event Trigger Definition IE style 1: Lower Layers Information Event

This *RIC Event Trigger Definition* IE style is used to detect a specific control message or PHY signals received by E2 Node from a UE. The E2 Node can also be configured simultaneously to detect multiple messages and to trigger on any logical combination of the configured message events.

Each message event configured can be further conditioned to be associated only for a certain UE or group of UEs as indicated by the *Associated UE Info* IE if included. In case that the *Global Associated UE Info* IE is included, the information is applied uniformly to all the message events configured and the IE shall override any *Associated UE Info* IE included for some message events.

For each message event configured, Event Trigger Condition ID is assigned so that E2 Node can reply to Near-RT RIC in the RIC INDICATION message to inform which event(s) are the cause for triggering.

This *RIC Event Trigger Definition* IE style uses *E2SM-LLC Event Trigger Definition Format 1* IE (8.2.1.1.1).

7.3.3 RIC Event trigger definition IE style 2: Periodic

This *RIC Event Trigger Definition* IE style is used to trigger an E2 Node to send periodic reports to the Near RT-RIC at a specified time period.

The event configured can be further conditioned to be associated only for a certain UE or group of UEs as indicated by the *Associated UE Info* IE if included.

This *RIC Event Trigger Definition* IE style uses *RIC Event Trigger Definition Format 2* IE (8.2.1.1.2).

7.4 Supported RIC REPORT services

7.4.1 REPORT service style list

RIC Style Type	Style Name	Style Description
1	LLI copy	This style is used to report a copy of LLI received from UE.
2	Periodic	This style is used to report the lower layers measurements collected by the E2 Node

7.4.2 REPORT service style 1: Lower layers information copy

7.4.2.1 REPORT service style description

This **REPORT** Service style provides the copy of PHY and Control information received from UEs to be carried as a transparent container in the *RIC Indication Message* IE.

This **REPORT** Service style is initiated by Event Trigger style 1: Lower Layers Information Event.

7.4.2.2 REPORT service *RIC Action Definition* IE contents

The Action Definition for this service style is used to request E2 Node to report a copy of received UE specific LLI. The action definition indicates which related UE specific LLI is to be reported along with the Control message or PHY signal that triggers this report service.

This **REPORT** Service style uses the *E2SM-LLC Action Definition Format 1* IE (8.2.1.2.1).

7.4.2.3 REPORT service *RIC Indication Header* IE contents

This **REPORT** Service style uses the *E2SM-LLC Indication Header Format 1* IE (8.2.1.3.1)

7.4.2.4 REPORT service *RIC Indication Message* IE contents

The **REPORT** Service *RIC Indication Message* IE carries the content of the received LLI indicated in the *RIC Action Definition* IE.

This **REPORT** Service style uses the *E2SM-LLC Indication Message Format 1* IE (8.2.1.4.1).

7.4.3 REPORT Service Style 2: Lower layers measurements

7.4.3.1 REPORT Service Style description

This **REPORT** Service style provides UE related lower layers information. The information is carried in the *RIC Indication Message* IE along with an associated *RIC Indication Header* IE providing information related event trigger conditions. The required information to be provided is controlled using the associated *RIC Action Definition* IE parameters.

This **REPORT** Service style enables the E2 Node to report:

- L1 per UE measurements including
 - HARQ ACK/NACK/DTX counts
- L2 per UE information including
 - PDCP and RLC buffer statuses
- Time synchronization

This **REPORT** Service style is initiated by Event Trigger style 2: Periodic.

7.4.3.2 REPORT Service *RIC Action Definition* IE contents

The Action Definition for this service style indicates the set of lower layers information parameters to be reported on a periodic basis.

This **REPORT** Service style uses the *E2SM-LLC Action Definition* IE Format 2 (8.2.1.2.2).

7.4.3.3 REPORT Service *RIC Indication Header* IE contents

This **REPORT** Service style uses the *E2SM-LLC Indication Header* IE Format 1 (8.2.1.3.1).

7.4.3.4 REPORT Service *RIC Indication Message* IE contents

The **REPORT** Service *RIC Indication Message* IE carries the requested lower layers measurements indicated in the *RIC Action Definition* IE.

This **REPORT** Service style uses the *E2SM-LLC Indication Message* IE Format 2 (8.2.1.4.2).

7.5 Supported RIC INSERT services

Void

7.6 Supported RIC CONTROL services

7.6.1 CONTROL service style types

RIC Style Type	Style Name	Style Description
1	Logical Channels Handling control	Used for taking control of scheduling specific logical channels. Belongs to Fundamental level CONTROL Services.
2	Scheduling parameters control	Used to provide scheduling related parameters to O-DU for specific data and control flows per slot. Belongs to Fundamental level CONTROL Services.

Each of the Control Service styles listed above points to adopt the following common features:

- Control Action ID: The index ID for the individual control action under a given Control Service style.
- Control Action Name: Indicates the functionality of the E2 node which is controlled by Near-RT RIC
- Control Action Description: Describes the control action and functionality of the receiving E2 Node.

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

7.6.2 CONTROL service style 1: Logical channels handling control

7.6.2.1 CONTROL service style description

This **CONTROL** Service style provides a mechanism to directly control and monitor the handling of logical channels.

Applications of this service include:

- Handover of RLC bearers' scheduling to Near-RT RIC

The supported RAN control actions and the corresponding RAN parameters are as follows.

Control Action ID	Control Action Name	Control Action description	Is UE group-based control action allowed	Associated IE
1	DL Logical Channels Handling control	To control the handling of scheduling specific DL logical channels	NO	8.3.25

7.6.2.2 CONTROL service *RIC Control Header* IE contents

This **CONTROL** service *RIC Control Header* IE contains the *RIC Style Type* IE and *Control Action ID* IE.

This **CONTROL** style uses *E2SM-LLC Control Header Format 1* IE (8.2.1.6.1).

7.6.2.3 CONTROL service *RIC Control Message* IE contents

This **CONTROL** Service *RIC Control Message* IE contains the sequence of RAN parameters, associated with a given Control Action within this Control Service style, controlled by the near-RT RIC along with the values for these parameters, as set by the RIC.

This **CONTROL** style uses *E2SM-LLC Control Message IE Format 1* (8.2.1.7.1).

7.6.2.4 CONTROL service *RIC Call Process ID* IE contents

This **CONTROL** Service *RIC Call Process ID* IE is not supported for this **CONTROL** service style.

7.6.2.5 CONTROL service *RIC Control Outcome* IE contents

This **CONTROL** Service *RIC Control Outcome* IE contains a list of RAN Parameters and is used to carry information concerning the outcome of executing the RIC Control Request.

This **CONTROL** style uses *E2SM-LLC Control Outcome IE Format 1* (8.2.1.8.1).

7.6.3 CONTROL Service Style 2: Scheduling Parameters Control

7.6.3.1 CONTROL Service Style description

This **CONTROL** Service style provides a mechanism to directly control and monitor the application of scheduling and precoding parameters

Applications of this service include:

- Served Radio Bearers scheduling parameters control

The supported RAN control actions and the corresponding RAN parameters are as follows.

Control Action ID	Control Action Name	Control Action description	Is UE group-based control action allowed	Associated IE
1	DL scheduling parameters control	To control the scheduling parameters per slot	NO	8.3.26

7.6.3.2 CONTROL Service *RIC Control Header* IE contents

This **CONTROL** Service *RIC Control Header* IE contains the *RIC Style Type* IE and *Control Action ID* IE.

This **CONTROL** style uses *E2SM-LLC Control Header Format 1* IE (8.2.1.6.1).

7.6.3.3 CONTROL Service *RIC Control Message* IE contents

This **CONTROL** Service *RIC Control Message* IE contains the sequence of RAN parameters, associated with a given Control Action within this Control Service style, controlled by the Near-RT RIC along with the values for these parameters, as set by the RIC.

This **CONTROL** style uses *E2SM-LLC Control Message IE Format 1* (8.2.1.7.1).

7.6.3.4 CONTROL Service *RIC Call Process ID* IE contents

This **CONTROL** Service *RIC Call Process ID* IE is not supported for this **CONTROL** service style.

7.6.3.5 CONTROL Service *RIC Control Outcome* IE contents

This **CONTROL** Service *RIC Control Outcome* IE contains a list of parameters and is used to carry information concerning the outcome of executing the RIC Control Request.

This **CONTROL** style uses *E2SM-LLC Control Outcome IE Format 1* (8.2.1.8.1).

7.7 Supported RIC POLICY services

Void

7.8 Supported RIC QUERY services

Void

7.9 Supported RIC service styles and E2SM IE formats

Table 7.9-1, Table 7.9-2 and Table 7.9-3 provide a summary of the E2SM IE Formats defined to support this E2SM specification.

Table 7.9-1: Summary of the E2SM IE Formats defined to support RIC Event Trigger Styles

RIC Event Trigger Style	Event Trigger Definition Format
Style 1	1
Style 2	2

Table 7.9-2: 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	1	1
POLICY							

Table 7.9-3: Summary of the E2SM IE Formats defined to support RIC Service Styles

RIC Service Style	Query Header Format	Query Definition Format	Query Outcome Format
QUERY			

8 Elements for E2SM service model

8.1 General

8.2 Message functional definition and content

8.2.1 Messages for RIC Functional procedures

8.2.1.1 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 actions.

Direction: NEAR-RT RIC → E2 Node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CHOICE Event Trigger Format				
>E2SM-LLC Event Trigger Definition Format 1	M		8.2.1.1.1	Used for Event Trigger Style 1
>E2SM-LLC Event Trigger Definition Format 2	M		8.2.1.1.2	Used for Event Trigger Style 2

8.2.1.1.1 E2SM-LLC Event Trigger Definition Format 1: Lower Layers Information Event

IE/Group Name	Presence	Range	IE type and reference	Semantics description
List of LLI for Event Trigger		1..<maxnoofLLIs>		
>Event Trigger Condition ID	M		8.3.9	
>Lower Layers Information Type	M		8.3.15	
>Associated UE Info	O		8.3.12	Indicates applicable UE(s) for event triggering associated to each message event ("Any" UE if not included).
>Logical OR	O		8.3.11	
Global Associated UE Info	O		8.3.12	Indicates applicable UE(s) for event triggering, applied to all the message events uniformly. This IE shall override any <i>Associated UE Info</i> IE included for some message events.

Range bound	Explanation
maxnoofLLIs	Maximum number of LLIs in a given E2 node for which event trigger can be defined. The value is <63>.

8.2.1.1.2 E2SM-LLC Event Trigger Definition Format 2: Periodic

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Reporting Period	M		INTEGER (1..65535)	Used to indicate the event triggering period in unit of 1 millisecond
Associated UE Info	O		8.3.12	Indicates applicable UE(s) for event triggering ("Any" UE if not included).

8.2.1.2 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 RIC Action.

Direction: NEAR-RT RIC → E2 Node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Style Type	M		8.3.3	
CHOICE Action Definition Format	M			
>E2SM-LLC Action Definition Format 1			8.2.1.2.1	Used by REPORT Service Style 1
>E2SM-LLC Action Definition Format 2			8.2.1.2.2	Used by REPORT Service Style 2

8.2.1.2.1 E2SM-LLC Action Definition Format 1

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Lower Layers Information Type	M		8.3.15	

8.2.1.2.2 E2SM-LLC Action Definition Format 2

IE/Group Name	Presence	Range	IE type and reference	Semantics description
List of Measurement to Report		1..<maxnoofMeasurementsToReport>		
>Lower Layers Measurement Type	M		8.3.16	

Range bound	Explanation
maxnoofMeasurementsToReport	Maximum no. of lower layers measurements supported by Action Definition Format 2. The value is <65535>.

8.2.1.3 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-LLC Indication Header Format 1	M		8.2.1.3.1	

8.2.1.3.1 E2SM-LLC Indication Header Format 1

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Event Trigger Condition ID	O		8.3.9	Event Trigger Condition ID

8.2.1.4 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	M			
>E2SM-LLC Indication Message Format 1			8.2.1.4.1	
>E2SM-LLC Indication Message Format 2			8.2.1.4.2	

8.2.1.4.1 E2SM-LLC Indication Message Format 1

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Slot Time Stamp	M		8.3.18	Indicates the slot in which the latest received parameter was received by the E2 Node
CHOICE Lower Layers Information Type	M			
>SRS			8.3.19	
>CSI			8.3.20	

8.2.1.4.2 E2SM-LLC Indication Message Format 2

IE/Group Name	Presence	Range	IE type and reference	Semantics description
List of Lower Layers Measurements		1..<maxnoofMeasurements>		
>Slot Time Stamp	M		8.3.18	Indicates the last slot of the collected data in the report. When the Measurement Type is 'Slot Time Stamp', indicates the slot at the time the message is sent.
>CHOICE Lower Layers Measurement Type	M			
>>DL RLC Buffer Status			8.3.21	
>>DL PDCP Buffer Status			8.3.22	
>>DL HARQ Statistics			8.3.23	
>>Slot Time Stamp			NULL	

Range bound	Explanation
maxnoofMeasurements	Maximum number of measurements supported by Indication Message Format 2. The value is <63>.

8.2.1.5 RIC CALL PROCESS ID IE

Void

8.2.1.6 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	M			
>E2SM-LLC Control Header Format 1			8.2.1.6.1	

8.2.1.6.1 E2SM-LLC Control Header Format 1

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Style Type	M		8.3.3	
Control Action ID	M		8.3.6	Refer to clause 7.6

8.2.1.7 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	M			
>E2SM-LLC Control Message Format 1			8.2.1.7.1	

8.2.1.7.1 E2SM-LLC Control Message Format 1

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CHOICE Control Type	M			
>Logical Channel Handling Control			8.3.25	Only applicable to Control Service Style 1 Action ID 1
>DL Scheduling Control			8.3.26	Only applicable to Control Service Style 2 Action ID 1

8.2.1.8 RIC CONTROL OUTCOME IE

This information element is part of the RIC CONTROL ACKNOWLEDGEMENT 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	M			
>E2SM-LLC Control Outcome Format 1			8.2.1.8.1	

8.2.1.8.1 E2SM-LLC Control Outcome Format 1

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CHOICE Control Parameter Type	M			
>Logical Channel Handling			8.3.24	Only applicable for Control Service Style 1 Action ID 1
>DL Scheduling Parameters			8.3.27	Only applicable for Control Service Style 2 Action ID 1

8.2.2 Messages for RIC global procedures

8.2.2.1 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		8.3.2	
RAN Function Definition for EVENT TRIGGER	O		8.2.2.2	
RAN Function Definition for REPORT	O		8.2.2.3	
RAN Function Definition for CONTROL	O		8.2.2.4	

8.2.2.2 RAN Function Definition for EVENT TRIGGER

IE/Group Name	Presence	Range	IE type and reference	Semantics description
List of EVENT TRIGGER styles		1.. <maxnoo fRICStyle s>		
>RIC Event Trigger Style Type	M		8.3.3	
>RIC Event Trigger Style Name	M		8.3.4	
>RIC Event Trigger Format Type	M		8.3.5	

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

8.2.2.3 RAN Function Definition for REPORT

IE/Group Name	Presence	Range	IE type and reference	Semantics description
List of REPORT styles		1.. <maxnoo fRICStyles >		
>RIC Report Style Type	M		8.3.3	
>RIC Report Style Name	M		8.3.4	
>Supported RIC Event Trigger Style Type	M		8.3.3	
>RIC Report Action Format Type	M		8.3.5	Action Definition type used by Report style
>RIC Indication Header Format Type	M		8.3.5	Indication Header type used by Report style
>RIC Indication Message Format Type	M		8.3.5	Indication Message type used by Report style

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

8.2.2.4 RAN Function Definition for CONTROL

IE/Group Name	Presence	Range	IE type and reference	Semantics description

List of CONTROL styles		1.. <maxnoo fRICStyle s>		
>RIC Control Style Type	M		8.3.3	
>RIC Control Style Name	M		8.3.4	
>List of Control Actions		0.. <maxnoo fControlA ction>		
>>Control Action ID	M		8.3.6	
>>Control Action Name	M		8.3.7	
>RIC Control Header Format Type	M		8.3.5	
>RIC Control Message Format Type	M		8.3.5	
>RIC Call Process ID Format Type	O		8.3.5	
>RIC Control Outcome Format Type	M		8.3.5	

Range bound	Explanation
maxnoofRICStyles	Maximum no. of styles supported by RAN Function. The value is <63>.
maxnoofControlAction	Maximum no. of Control actions supported by RAN Function. The value is <65535>.

8.3 Information Element definitions

8.3.1 General

When specifying information elements which are to be represented by bit strings, if not otherwise specifically stated in the semantics description of the concerned IE or elsewhere, the following principle applies with regards to the ordering of bits:

- The first bit (leftmost bit) contains the most significant bit (MSB);
- The last bit (rightmost bit) contains the least significant bit (LSB);
- When importing bit strings from other specifications, the first bit of the bit string contains the first bit of the concerned information.

8.3.2 RAN Function Name

This IE is defined in O-RAN WG3.TS.E2SM [4] clause 6.2.2.1.

8.3.3 RIC Style Type

This IE is defined in O-RAN WG3.TS.E2SM [4] clause 6.2.2.2.

8.3.4 RIC Style Name

This IE is defined in O-RAN WG3.TS.E2SM [4] clause 6.2.2.3.

8.3.5 RIC Format Type

This IE is defined in O-RAN WG3.TS.E2SM [4] clause 6.2.2.4.

8.3.6 Control Action ID

This IE uniquely identifies an action of a given RIC Control style.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Control Action ID	M		INTEGER (1.. 65535, ...)	

8.3.7 Control Action Name

This IE defines the name of a given control action.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Control Action Name	M		PrintableString(SIZE(1..150, ...))	

8.3.8 UE ID

This IE is defined in O-RAN WG3.TS.E2SM [4] clause 6.2.2.6.

8.3.9 Event Trigger Condition ID

This IE defines an identifier for event trigger conditions configured for a specific Event Trigger style.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Event Trigger Condition ID	M		INTEGER (1..65535, ...)	

8.3.10 Event Trigger ID for UE

This IE defines an identifier for a specific UE related condition configured for event triggering.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Event Trigger ID for UE	M		INTEGER (1..65535, ...)	

8.3.11 Logical OR

This IE indicates a logical ("and" or "or") connection of the current condition to the next condition in a given sequence of conditions.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Logical OR	M		ENUMERATED (true, false, ...)	If set to "true", logical connection to the next condition is "or". Otherwise, "and".

8.3.12 Event Trigger UE Information

This IE defines a set of applicable UEs for event triggering.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
List of Associated UE Information		1..<maxnoofUEInfo>		
>Event Trigger ID for UE	M		8.3.10	
>CHOICE UE Type				
>>Individual UE				

>>>UE ID	M		8.3.8	
>>UE Group				
>>>Group of UEs	M		8.3.13	
>Logical OR	O		8.3.11	

Range bound	Explanation
maxnoofUEInfo	Maximum number of UE information in a given E2 node for which event trigger can be defined. The value is <65535>

8.3.13 Group of UEs

This IE uniquely identifies a group of UEs. At least one parameter must be included.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Cell Global ID	O		8.3.14	
List of UE Identifiers		0..<maxnoof UEs>		
> UE ID	M		8.3.8	

Range bound	Explanation
maxnoofUEs	Maximum number of UEs in a given E2 node for which event trigger can be defined. The value is <65535>

8.3.14 Cell Global ID

This IE is defined in O-RAN WG3.TS.E2SM [4] clause 6.2.2.5.

8.3.15 Lower Layers Information Type

This IE defines the type of lower layers information to trigger on and/or report.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Lower Layers Information Type	M		ENUMERATED (SRS, CSI, ...)	SRS refers to received SRS symbols defined in 3GPP TS 38.211 [5] Clause 6.4.1.4. "CSI" Refers to UCI defined in 3GPP TS 38.213 [6] Clause 9.

8.3.16 Lower Layers Measurement Type

This IE defines the type of lower layers measurements to trigger on and/or report.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Lower Layers Measurement Type	M		ENUMERATED (DL_RLC_Buffer_Status, DL_PDCP_Buffer_Status, DL_HARQ_Statistics, Slot_Time_Stamp, ...)	

8.3.17 Slot Information

IE/Group Name	Presence	Range	IE type and reference	Semantics description
System Frame Number	M		INTEGER (0..1023)	
CHOICE Slot Index	M			
>SCS-15				
>>SCS-15	M		INTEGER (0..9)	
>SCS-30				
>>SCS-30	M		INTEGER (0..19)	
>SCS-60				
>>SCS-60 M	M		INTEGER (0..39)	
>SCS-120				
>>SCS-120	M		INTEGER (0..79)	

8.3.18 Slot Time Stamp

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Slot Information	M		8.3.17	
Slot Start Time	M		OCTET STRING (SIZE(8))	Carries UTC time encoded as the 64-bit timestamp format as defined in Clause 6 of IETF RFC 5905 [7] containing both seconds and fraction parts. Represents the start time of the slot

8.3.19 SRS

IE/Group Name	Presence	Range	IE type and reference	Semantics description
List of SRS Receive Antennas		1..<maxnoofReceiveAntennas>		Antennas used to receive the SRS. The antennas shall be listed in the order as defined in O-RAN WG4.TS.CUS [8] Clause 12.5.4.
>List of SRS Symbols		<1, 2, 4>		Symbols of the received raw SRS starting with the symbol in position l_0 as defined in 3GPP TS 38.211 [5] Clause 6.4.1.4.1.

>>SRS Compression Header	C-ifStaticSR S		OCTET STRING (SIZE(1))	Compression method and IQ width defined in the M-Plane when the static IQ format and compression method is configured via the M-Plane, formatted as udCompHdr in O-RAN WG4.TS.CUS [8] Clause 8.3.3.13. This parameter shall be included only when SRS related IQ data is transferred from the O-RU with IQ data transfer procedure without C-Plane (see O-RAN WG4.TS.CUS [8] clause 8.3.5.4).
>>Raw SRS	M		OCTET STRING	As defined in O-RAN WG4.TS.CUS [8] Table 8.3.2-1 starting from Octet 13.

Range bound	Explanation
maxnoofReceiveAntennas	Maximum number of receive antennas supported. The value is <65535>.

Condition	Explanation
ifStaticSRS	This IE shall be present if the configuration of the SRS transfer over the FH is configured as static. Otherwise, it shall not be present.

8.3.20 CSI

IE/Group Name	Presence	Range	IE type and reference	Semantics description
List of CSI UE Identifiers		1..<maxnoofUEID>		
>UE ID	M		8.3.8	
>Channel carrying the UCI	M		ENUMERATED (PUCCH, PUSCH)	
>List of CSI Reports		1..<maxnoofCSIReportS>		
>>CSI Report Config ID	M		INTEGER (0..47)	<i>CSI-ReportConfigID</i> IE in 3GPP TS 38.331 [9] Clause. The ID of this CSI report.
>>CSI Fields of CSI Report Part 1	M		BIT STRING	3GPP TS 38.212 [14] Tables 6.3.1.2-7/8/8-A/9. CSI fields of CSI part 1 if the CSI report is of two parts, or the CSI report if it is not of two parts.
>>CSI Fields of CSI Report Part 2	C-ifCsiPart2		BIT STRING	3GPP TS 38.212 [14] Tables 6.3.1.2-10/11. CSI fields of CSI part 2 if the CSI report is of two parts

Range bound	Explanation
maxnoofUEID	Maximum number of UE Identifiers supported. The value is <65535>.
maxnoofCSIReports	Maximum number of CSI reports per UE supported. The value is <255>

Condition	Explanation
ifCsiPart2	This IE shall be present if the CSI report received from the UE includes part 2. Otherwise, it shall not be present.

8.3.21 DL RLC Buffer Status

IE/Group Name	Presence	Range	IE type and reference	Semantics description
List of DL RLC UE Identifiers		1..<maxnoofUEID>		
>UE ID	M		8.3.8	
>List of DL RLC UE Bearers		1..<maxnoofUEBearerS>		
>>LCID	M		INTEGER (1..32, ...)	<i>logicalChannelId entity</i> IE in 3GPP TS 38.331 [9] Sec 6. Logical Channel ID
>>DL RLC Buffer Occupancy	M		INTEGER	Buffer Occupancy (BO) in number of bytes as defined in 3GPP TS 25.321 [10] clause 8.2.2(c).
>>DL RLC HOL Time To Live	M		INTEGER (0..1023, ...)	Time in units of 0.5ms. The time available for the PDU at the head of the line in the RLC buffer to be transmitted without violating the PDB associated with this LCID.

Range bound	Explanation
maxnoofUEID	Maximum number of UE Identifiers supported. The value is <65535>.
maxnoofUEBearers	Maximum number of reported bearers per UE supported. The value is <255>

8.3.22 DL PDCP Buffer Status

IE/Group Name	Presence	Range	IE type and reference	Semantics description
List of DL PDCP UE Identifiers		1..<maxnoofUEID>		
>UE ID	M		8.3.8	
>List of DL PDCP UE Bearers		1..<maxnoofUEBearers>		
>>DRB ID	M		INTEGER (1..32, ...)	DRB ID IE in 3GPP TS 37.483 [11] clause 9.3.1.16
>>DL PDCP Buffer Occupancy	M		INTEGER	PDCP data volume in number of bytes as defined in 3GPP TS 38.323 [12] clause 5.6.
>>DL PDCP HOL Time To Live	M		INTEGER (0..1023, ...)	Time in units of 0.5ms. The time available for the PDU at the head of the line in the PDCP buffer to be transmitted without violating the PDB associated with this DRB ID.

Range bound	Explanation
<i>maxnoofUEID</i>	Maximum number of UE Identifiers supported. The value is <65535>.
<i>maxnoofUEBearers</i>	Maximum number of reported bearers per UE supported. The value is <255>

8.3.23 DL HARQ Statistics

IE/Group Name	Presence	Range	IE type and reference	Semantics description
List of DL HARQ UE Identifiers		1..<maxnoofUEID>		
>HARQ UE ID	M		8.3.8	
>List of DL HARQ Codewords		<1, 2>		
>>DL SU ACK Count	M		INTEGER	Number of ACKs counted for non-MU-MIMO DL transmissions since the last report
>>DL SU NACK Count	M		INTEGER	Number of NACKs counted for non-MU-MIMO DL transmissions since the last report
>>DL SU DTX Count	M		INTEGER	Number of DTXs counted for non-MU-MIMO DL transmissions since the last report
>>DL MU ACK Count	M		INTEGER	Number of ACKs counted for MU-MIMO DL transmissions since the last report
>>DL MU NACK Count	M		INTEGER	Number of NACKs counted for MU-MIMO DL transmissions since the last report
>>DL MU DTX Count	M		INTEGER	Number of DTXs counted for MU-MIMO DL transmissions since the last report

Range bound	Explanation
maxnoofUEID	Maximum number of UE Identifiers supported. The value is <65535>.

8.3.24 Received Timestamp

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Received Timestamp	M		OCTET STRING (SIZE(8))	<p>Time RIC Control Request message received by RAN Function over E2 interface.</p> <p>Carries UTC time encoded as the 64-bit timestamp format as defined in Clause 6 of IETF RFC 5905 [7] containing both seconds and fraction parts.</p>

8.3.25 Logical Channel Handling Control

IE/Group Name	Presence	Range	IE type and reference	Semantics description
List of Logical Channel UE Identifiers		1..<maxnoofUEID>		
>UE ID	M		8.3.8	
>List of logical channels controlled by Near-RT RIC to add		0..<maxnoofLogicalChannels>		The list of bearers for which the O-DU is requested to delegate scheduling decisions to the Near-RT RIC (in addition to the ones already delegated)
>>Logical Channel ID	M		INTEGER (1..32)	<i>LogicalChannelId entity</i> IE in 3GPP TS 38.331 [9] clause 6
>>Starting Slot number	M		8.3.17	The slot number from which the control of scheduling the logical channel starts
>List of logical channels to release		0..<maxnoofLogicalChannels>		The list of bearers the Near-RT RIC will no longer schedule
>>Logical Channel ID	M		INTEGER (1..32)	<i>LogicalChannelId entity</i> IE in 3GPP TS 38.331 [9] clause 6

>>Starting Slot number	M		8.3.17	The slot number from which the control of scheduling the logical channel is being released back to the O-DU
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Range bound	Explanation
maxnoofUEID	Maximum number of UE Identifiers supported by E2SM-LLC Indication Message Format 1 IE to be reported. The value is <65535>.
maxnoofLogicalChannels	Maximum no. of logical channels. The value is <63>.

8.3.26 DL Scheduling Control

IE/Group Name	Presence	Range	IE type and reference	Semantics description
List of DL Slots to be scheduled		1..<maxnoofScheduledDLSlots>		
>Slot Information	M		8.3.17	
>List of DL Grants		1..<maxnoofDLGrants>		
>>Grant ID	M		INTEGER (1..63, ...)	This is the ID used by the RIC for the grant it seeks to add to the PDCCH
>>BWP ID	O		INTEGER (0..4, ...)	BWP-Id IE in 3GPP TS 38.331 [9]. Identifies the BWP in which to include the grant. Value of 0 or field not included, indicate the DL Initial BWP
>>UE ID	M		8.3.8	
>>List of Logical Channels		1..<maxnoofLogicalChannels>		
>>>Logical Channel ID	M		INTEGER (1..32, ...)	LogicalChannelId entity IE in 3GPP TS 38.331 [9] clause 6
>>>TB1 Number of Bytes	M		INTEGER	The number of bytes of the logical channel to be included in TB1 of the grant
>>>TB2 Number of Bytes	O		INTEGER	The number of bytes of the logical channel to be included in TB2 of the grant
>> CHOICE Downlink Control Information Type	M			
>> DCI 1_0				

4>Use CS-RNTI	O			Indicates the use of CS-RNTI in the DCI to activate/deactivate SPS. CS-RNTI not used when not included.
5>SPS Config Index	C-ifSPSList		INTEGER (0..7, ...)	sps-ConfigIndex IE in 3GPP TS 38.331 [9]. Indicates the index of one of multiple SPS configurations when there are multiple SPS configurations in the SPS-Config IE (3GPP TS 38.331 [9]) of the UE.
5>Activation	M		ENUMERATED (Activate, Deactivate)	Indicates whether to activate or deactivate the SPS
4>Freq Domain Resources	M		INTEGER	Representing DL frequency resource allocation type 1 as defined in Clause 5.1.2.2.2 of 3GPP TS 38.214 [13]
4>Time Domain Resources	M		INTEGER (0..15, ...)	4 bits of representing resource allocation in time domain as defined in Clause 5.1.2.1 of 3GPP TS 38.214 [13]
4>VRB to PRB Mapping	O		ENUMERATED (Interleaved, ...)	Not interleaved if not included
4>MCS	M		INTEGER (0..31, ...)	5 bits representing the MCS as defined in Clause 5.1.3.1 of 3GPP TS 38.214 [13]
4>Redundancy Version	M		INTEGER (0..3, ...)	2 bits as defined in Table 7.3.1.1.1-2 of 3GPP TS 38.212 [14]
>>>DCI 1_1				
4>Use CS-RNTI	O			Indicates the use of CS-RNTI in the DCI to activate SPS. CS-RNTI not used when not included.

5>SPS Config Index	C-ifSPSList		INTEGER (0..7, ...)	<i>sps-ConfigIndex</i> IE in 3GPP TS 38.331 [9]. Indicates the index of one of multiple SPS configurations when there are multiple SPS configurations in the <i>SPS-Config</i> IE (3GPP TS 38.331 [9]) of the UE.
4>Carrier Indicator	O		INTEGER (1..7, ...)	As defined in Clause 10.1 of 3GPP TS 38.213 [6]. If not included, indicates the UE serving cell.
4>Freq Domain Resources	M		BIT STRING	Representing DL frequency resource allocation type 0 or 1 as defined in Clause 7.3.1.2.2 of 3GPP TS 38.212 [14] and Clause 5.1.2.2 of TS 38.214 [13]
4>Time Domain Resources	M		INTEGER (0..15, ...)	4 bits representing resource allocation in time domain as defined in Clause 5.1.2.1 of 3GPP TS 38.214 [13]
4>VRB to PRB Mapping	O		ENUMERATED (Interleaved, ...)	Not interleaved if not included
4>PRB Bundling Size Indicator	O		INTEGER(0..1, ...)	Only applicable when <i>prb-BundlingType</i> (3GPP TS 38.331 [9]) is set to 'dynamicBundling'. Indicates which of the two bundle size sets configured by <i>dynamicBundling</i> IE to use as specified in Clause 5.1.2.3 of 3GPP TS 38.214 [13].
4>TB1 MCS	M		INTEGER (0..31, ...)	5 bits representing the MCS as defined in Clause 5.1.3.1 of 3GPP TS 38.214 [13]

4>TB1 Redundancy Version	M		INTEGER (0..3, ...)	2 bits as defined in Table 7.3.1.1.2 of 3GPP TS 38.212 [14]
4>TB2 MCS	O		INTEGER (0..31, ...)	5 bits representing the MCS as defined in Clause 5.1.3.1 of 3GPP TS 38.214 [13]
4>TB2 Redundancy Version	O		INTEGER (0..3, ...)	2 bits as defined in Table 7.3.1.1.2 of 3GPP TS 38.212 [14]
4>Antenna ports	M		BIT STRING (SIZE(4..6))	As defined in Clause 7.3.1.2.2 of 3GPP TS 38.212 [14]
4>Transmission Configuration Indication	O		INTEGER (0..7)	As defined in Clause 7.4.3.1.2.2 of TS 38.212 [14]
4>SRS Request	O		BIT STRING (SIZE(2..3))	If included, identifies the SRS resource set(s) to trigger as defined in Clause 7.3.1.2.2 of 3GPP TS 38.212 [14]. No aperiodic SRS triggering if not included (or set to 0).
4>DMRS Sequence Initialization	M		INTEGER(0..1)	Selects between two ways of initializing the DMRS sequence as defined in clause 7.4.1.1.1 of 3GPP TS 38.211 [5].
>>>Semi Persistence			NULL	Indicates SPS resources being allocated without DCI
>List of PDSCH SMGs		1..<maxnoofPdschSMGs>		
>>Precoder ID	M		INTEGER (0..63, ...)	An index to the position in the Sequence of PDSCH Precoders
>>SMG Priority	O		INTEGER (0..31, ...)	Indicates priority of avoiding overwrites, where 0 represents highest priority and 31 represents lowest priority.

>>Start RB	M		INTEGER	Identifies the lowest virtual RB of the SMG
>>Number of RBs	M		INTEGER	Indicates the number of contiguous virtual RBs, starting from the Start RB, that construct the SMG
>>Start Symbol	M		INTEGER	Identifies the lowest symbol of the SMG
>>Number of Symbols	M		INTEGER	Indicates the number of contiguous symbols that construct the SMG
>List of CSI-RS Precoding Bands		0..<maxnoofCsiRsPrecodingBands>		
>>Precoder ID	M		INTEGER (0..63, ...)	An index to the position in the Sequence of Precoders
>>UE ID	M		8.3.8	
>>NZP CSI-RS Resource ID	M		INTEGER (0..191, ...)	NZP-CSI-RS-ResourceID IE in 3GPP TS 38.331 [9]. Identifies the NZP CSI-RS resource
>>Start RB	M		INTEGER	Identifies the lowest RB of the CSI-RS precoding band
>>Number of RBs	M		INTEGER	Indicates the number of contiguous RBs, starting from the Start RB, that construct the CSI-RS precoding band
>List of Precoders		1..<maxnoofPrecoders>		
>> Compression Information	O			
>>> Precoder Compression Header	M		OCTET STRING	As defined in Clause 7.7.1.2 of O-RAN WG4.TS.CUS [8]
>>> Precoder Compression Parameters	M		OCTET STRING	As defined in Clause 7.7.1.3 of O-RAN WG4.TS.CUS [8]
>>List of Precoder Coefficients	M	1..<maxnoofPrecoder Coefficients>		The mapping of the coefficients to layers and antenna elements is as defined in Clause 12.5.3 of O-RAN WG4.TS.CUS [8]

>>> Precoder Coefficient I	M		INTEGER	The precoder coefficient I value. As defined in Clause 7.7.1.4 of O-RAN WG4.TS.CUS [8].
>>> Precoder Coefficient Q	M		INTEGER	The precoder coefficient Q value. As defined in Clause 7.7.1.5 of O-RAN WG4.TS.CUS [8].

Condition	Explanation
ifSPSList	This IE shall be present if there are multiple SPS configurations in the <i>SPS-Config</i> IE (3GPP TS 38.331 [9]) of the UE.

Range bound	Explanation
maxnoofScheduledDLSlots	Maximum no. of slots to be scheduled. The value is <63>.
maxnoofDLGrants	Maximum no. of grants per slots. The value is <63>.
maxnoofLogicalChannels	Maximum no. of logical channels. The value is <63>.
maxnoofPdschSMGs	Maximum no. of spatial multiplexing groups. The value is <63>.
maxnoofCsiRsPrecodingBands	Maximum no. of CSI-RS precoding bands. The value is <63>.
maxnoofPrecoders	Maximum no. of precoders. The value is <255>.
maxnoofPrecoderCoefficients	Maximum no. of precoder coefficients. The value is <65535>.

8.3.27 DL Scheduling Control Outcome

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Received Timestamp	M		8.3.24	
Processing Time Margin	M		INTEGER (-32,767..32,767)	Time margin after processing the information for the first slot included in the Control Message. A negative value indicates by how much time the Control Message was too late to arrive at the E2 Node. Carries signed 16-bit fraction of a second resolving ~30 microseconds.
List of Slots		1..<maxnoofScheduledDLSlots>		
>Slot Information	M		8.3.17	

>List of DL Grants		1..< <i>maxnoofDLGrants</i> >		The full list of grants included in the Control Message
>>Grant ID	M			ID of the grant included in the Control Message
>>CHOICE Execution Level	M			
>>>Fully Executed	O		NULL	
>>>Not Fully Executed	O			
4>List of Scheduled Logical Channels		1..< <i>maxnoofLogicalChannels</i> >		Shall include the list of all logical channels included in the Control Message for the same Grant ID.
5>Logical Channel ID	M		INTEGER (1..32, ...)	<i>logicalChannelId entity</i> IE in 3GPP TS 38.331 [9] Sec 6
5>Number of Bytes Scheduled	M		INTEGER	Indicates the number of bytes actually scheduled from the logical channel
5>Cause	M		INTEGER	Identifies the cause of not sending the number of bytes requested in the Control Message. 0= Other 1= Information arrived too late 2= LCID overwritten by other transmissions. 3= Reached maximum number of DCIs for the slot. 4= UE not available. 5= Resources used for retransmission/s 6= Insufficient RLC queue depth
>List of Additional DL Allocations		0..< <i>maxnoofDLGrants</i> >		Shall include the list of all DL PDSCH allocations not included in the Control Message and used slot resources.
>>UE ID	O		8.3.8	Shall be included if granted to a specific UE

>>Logical Channel ID	O		INTEGER (1..32, ...)	<i>logicalChannelId</i> entity IE in 3GPP TS 38.331 [9] Sec 6. Shall be included if it exists for the logical channel.
>>Number of Bytes Scheduled	M		INTEGER	Indicates the number of bytes scheduled
>>Start Symbol	O		INTEGER	Should be included when Logical Channel ID doesn't apply to this allocation
>>Number of Symbols	O		INTEGER	Should be included when Logical Channel ID doesn't apply to this allocation
>>Start RB	O		INTEGER	Should be included when Logical Channel ID doesn't apply to this allocation
>>Number of RBs	O		INTEGER	Should be included when Logical Channel ID doesn't apply to this allocation
>>List of CSI-RS Precoding Bands Not Executed		0..<MaxnoofCsiRsPrecodingBands>		Shall include the list of all CSI-RS precoding bands included in the Control Message that were not executed
>>CSI-RS Precoding Band ID	M		INTEGER (0..maxnoofCsiRsPrecodingBands)	Identifies the position of the CSI-RS Precoding Band Item in the List of CSI-RS Precoding Bands. The value "0" represents the first CSI-RS Precoding Band Item, "1" the second, etc.
>>Cause	M		INTEGER	0= Other 1= Information arrived too late 2= Unrecognized UE ID 3= Unrecognized NZP CSI-RS Resource ID 4= invalid RB range 5= Invalid number of Coef. 6= Coef gain is too high

8.4 Information Element abstract syntax (with ASN.1)

8.4.1 General

E2SM-LLC ASN.1 definition conforms to ITU-T Recommendation X.680 [15], ITU-T Recommendation X.681 [16].

Clause 8.4.2 presents the Abstract Syntax of the E2SM information elements to be carried within the O-RAN WG3.TS.E2AP [3] protocol messages with ASN.1. In case there is contradiction between the ASN.1 definition in this clause and the tabular format in clauses 8.2 and 8.3, the ASN.1 shall take precedence, except for the definition of conditions for the presence of conditional elements, in which the tabular format shall take precedence.

If an E2SM information element carried as an OCTET STRING in an O-RAN WG3.TS.E2AP [3] message that is not constructed as defined above is received, this shall be considered as Abstract Syntax Error, and the message shall be handled as defined for Abstract Syntax Error in clause 8.

8.4.2 Information Element Definitions

```
-- ASN1START
-- ****
-- E2SM-LLC Information Element Definitions
-- ****

E2SM-LLC-IEs {
    iso(1) identified-organization(3) dod(6) internet(1) private(4) enterprise(1) 53148 e2(1) version1(1)
    e2sm(2) e2sm-LLC-IEs (5)
}

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

-- ****
-- E2SM Common IEs
-- ****

IMPORTS
    RANfunction-Name,
    RIC-Style-Name,
    RIC-Style-Type,
    RIC-Format-Type,
    CGI,
    UEID
FROM E2SM-COMMON-IES;

-- ****
-- CONSTANTS
-- ****

maxnoofLLIs                                INTEGER ::= 63
maxnoofMeasurementsToReport                 INTEGER ::= 65535
maxnoofMeasurements                          INTEGER ::= 63
maxnoofRICStyles                            INTEGER ::= 63
maxnoofControlAction                        INTEGER ::= 65535
maxnoofUEInfo                               INTEGER ::= 65535
maxnoofUEs                                  INTEGER ::= 65535
maxnoofReceiveAntennas                      INTEGER ::= 65535
maxnoofUEID                                 INTEGER ::= 65535
maxnoofCSIReports                           INTEGER ::= 255
maxnoofUEBearers                            INTEGER ::= 255
maxnoofLogicalChannels                      INTEGER ::= 63
maxnoofScheduledDLSlots                     INTEGER ::= 63
maxnoofDLGrants                             INTEGER ::= 63
maxnoofPdschSMGs                            INTEGER ::= 63
maxnoofCsiRsPrecodingBands                 INTEGER ::= 63
maxnoofPrecoders                            INTEGER ::= 255
maxnoofPrecoderCoefficients                INTEGER ::= 65535
```

```

-- ****
-- IEs
-- ****

LogicalOR ::= ENUMERATED {true, false, ...}

LowerLayers-Info-Type ::= ENUMERATED {srs, csi,...}

LowerLayers-Meas-Type ::= ENUMERATED { dl-rlc-buffer-status, dl-pdcp-buffer-status, dl-harq-statistics, slot-time-stamp, ...}

LogicalChannelID ::= INTEGER (1..32, ...)

SpsConfigIndex ::= INTEGER (0..7, ...)

ReceivedTimestamp ::= OCTET STRING (SIZE(8))

-----
-- Event Trigger related IEs
-----

EventTrigger-UE-Info ::= SEQUENCE {
    ueInfo-List                               SEQUENCE (SIZE(1..maxnoofUEInfo)) OF EventTrigger-UE-Info-Item,
    ...
}

EventTrigger-UE-Info-Item ::= SEQUENCE {
    eventTriggerUEID                         RIC-EventTrigger-UE-ID,
    ueType                                CHOICE {
        ueType-Choice-Individual           EventTrigger-UE-Info-Item-Choice-Individual,
        ueType-Choice-Group               EventTrigger-UE-Info-Item-Choice-Group,
        ...
    },
    logicalOR                             LogicalOR
                                            OPTIONAL,
    ...
}

EventTrigger-UE-Info-Item-Choice-Individual ::= SEQUENCE {
    ueID                                  UEID,
    ...
}

EventTrigger-UE-Info-Item-Choice-Group ::= SEQUENCE {
    groupOfUEs                           GroupOfUEs,
    ...
}

GroupOfUEs ::= SEQUENCE {
    cellGlobalID                         OPTIONAL,
    ueIdentifier-List                   Sequence (SIZE(0..maxnoofUEs)) OF UeIdentifier-Item,
    ...
}

UeIdentifier-Item ::= SEQUENCE {
    ueID                                 UEID,
    ...
}

-----
-- RIC Service related IEs
-----

RIC-ControlAction-ID ::= INTEGER (1..65535, ...)

RIC-ControlAction-Name ::= PrintableString (SIZE(1..150, ...))

RIC-EventTriggerCondition-ID ::= INTEGER (1..65535, ...)

RIC-EventTrigger-UE-ID ::= INTEGER (1..65535, ...)

SlotTimeStamp ::= SEQUENCE {
    slotInfo                            SlotInfo,
    ...
}

```

```

slotStartTime          OCTET STRING (SIZE(8)),
...
}

SlotInfo ::= SEQUENCE {
    systemFrameNumber      INTEGER (0..1023, ...),
    slotIndex              CHOICE {
        scs-15                INTEGER (0..9),
        scs-30                INTEGER (0..19),
        scs-60                INTEGER (0..39),
        scs-120               INTEGER (0..79),
        ...
    },
    ...
}

SRS ::= SEQUENCE {
    srsReceiveAntenna-List   SEQUENCE (SIZE(1..maxnoofReceiveAntennas)) OF SrsReceiveAntenna-
Item,
    ...
}

SrsReceiveAntenna-Item ::= SEQUENCE {
    srsSymbol-List           SEQUENCE (SIZE(1|2|4,...)) OF SrsSymbol-Item,
    ...
}

SrsSymbol-Item ::= SEQUENCE {
    srsCompressionHeader     OCTET STRING (SIZE(1)),
    rawSRS                  OCTET STRING,
    ...
}

CSI ::= SEQUENCE {
    csiUeIdentifier-List     SEQUENCE (SIZE(1.. maxnoofUEID)) OF CsiUeIdentifier-Item,
    ...
}

CsiUeIdentifier-Item ::= SEQUENCE {
    ueID                    UEID,
    channelCarryingUCI      ENUMERATED {pucch, pushch, ...},
    csiReport-List           SEQUENCE (SIZE(1.. maxnoofCSIReports)) OF CsiReport-Item,
    ...
}

CsiReport-Item ::= SEQUENCE {
    csiReportConfigID        INTEGER,
    csiFieldsCsiReport-Part1 BIT STRING,
    csiFieldsCsiReport-Part2 BIT STRING
                                OPTIONAL,
    ...
}

DlRlcBufferStatus ::= SEQUENCE {
    dlRlcUeIdentifiers-List   SEQUENCE (SIZE(1.. maxnoofUEID)) OF DlRlcUeIdentifiers-Item,
    ...
}

DlRlcUeIdentifiers-Item ::= SEQUENCE {
    ueID                    UEID,
    dlRlcUeBearers-List      SEQUENCE (SIZE(1.. maxnoofUEBearers)) OF DlRlcUeBearers-Item,
    ...
}

DlRlcUeBearers-Item ::= SEQUENCE {
    lcID                     INTEGER (1..32, ...),
    dlRlcBufferOccupancy     INTEGER,
    dlRlcHolTimeToLive       INTEGER (0..1032, ...),
    ...
}

DlPdcpBufferStatus ::= SEQUENCE {
    dlPdcpUeIdentifiers-List   SEQUENCE (SIZE(1.. maxnoofUEID)) OF DlPdcpUeIdentifiers-Item,
    ...
}

DlPdcpUeIdentifiers-Item ::= SEQUENCE {

```

```

ueID                               UEID,
dlPdcpUeBearers-List           SEQUENCE (SIZE(1.. maxnoofUEBearers)) OF DlPdcpUeBearers-Item,
...
}

DlPdcpUeBearers-Item    ::= SEQUENCE {
    drbID                         INTEGER (1..32, ...),
    dlPdcpBufferOccupancy        INTEGER,
    dlPdcpHolTimeToLive          INTEGER (0..1032, ...),
...
}

DlHarqStatistics      ::= SEQUENCE {
    dlHargUeIdentifier-List     SEQUENCE (SIZE(1.. maxnoofUEID)) OF DlHargUeIdentifier-Item,
...
}

DlHargUeIdentifier-Item ::= SEQUENCE {
    harqUeID                      UEID,
    dlHargCodeword-List           SEQUENCE (SIZE(1|2,...)) OF DlHargCodeword-Item,
...
}

DlHargCodeword-Item ::= SEQUENCE {
    dlSu-ACK-Count                INTEGER,
    dlSu-NACK-Count               INTEGER,
    dlSu-DTX-Count                INTEGER,
    dlMu-ACK-Count                INTEGER,
    dlMu-NACK-Count               INTEGER,
    dlMu-DTX-Count                INTEGER,
...
}

LogicalChannelHandlingControl   ::= SEQUENCE {
    logicalChannelUEID-List       SEQUENCE (SIZE(1.. maxnoofUEID)) OF LogicalChannelUEID-Item,
...
}

LogicalChannelUEID-Item ::= SEQUENCE {
    ueID                           UEID,
    logicalChanContByNearRTRicToAdd-List SEQUENCE (SIZE(1.. maxnoofLogicalChannels)) OF
LogicalChanContByNearRTRicToAdd-Item,
    logicalChanContByNearRTRicToRel-List SEQUENCE (SIZE(1.. maxnoofLogicalChannels)) OF
LogicalChanContByNearRTRicToRel-Item,
...
}

LogicalChanContByNearRTRicToAdd-Item ::= SEQUENCE {
    logicalChannelID              LogicalChannelID,
    startingSlotNumber            SlotInfo,
...
}

LogicalChanContByNearRTRicToRel-Item ::= SEQUENCE {
    logicalChannelID              LogicalChannelID,
    startingSlotNumber            SlotInfo,
...
}

DlSchedulingControl ::= SEQUENCE {
    d1SlotToBeScheduled-List       SEQUENCE (SIZE(1.. maxnoofScheduledDLSlots)) OF
DlSlotToBeScheduled-Item,
...
}

DlSlotToBeScheduled-Item    ::= SEQUENCE {
    slotInfo                      SlotInfo,
    dlGrant-List                  SEQUENCE (SIZE(1.. maxnoofDLGrants)) OF DlGrant-Item,
    pdschSMG-List                 SEQUENCE (SIZE(1.. maxnoofPdschSMGs)) OF PdschSMG-Item,
    csiRsPrecodingBand-List       SEQUENCE (SIZE(0.. maxnoofCsiRsPrecodingBands)) OF
CsiRsPrecodingBand-Item,
    precoder-List                 SEQUENCE (SIZE(1.. maxnoofPrecoders)) OF Precoder-Item,
...
}

DlGrant-Item      ::= SEQUENCE {

```

```

grantID                                INTEGER (1..63, ...),
bwpID                                  INTEGER (0..4, ...)                               OPTIONAL,
ueID                                    UEID,
logicalChannel-List                   SEQUENCE (SIZE(1.. maxnoofLogicalChannels)) OF LogicalChannel-
Item,
dlControlInfoType                     CHOICE {
    dci-10                           Dci-10,
    dci-11                           Dci-11,
    semiPersistence                  NULL,
    ...
},
...
}

LogicalChannel-Item ::= SEQUENCE {
    logicalChannelID,                LogicalChannelID,
    noofBytes-TB1,                  INTEGER,
    noofBytes-TB2,                  INTEGER                               OPTIONAL,
    ...
}

Dci-10 ::= SEQUENCE {
    useCsiRnti                      SEQUENCE {
        spsConfigIndex               SpsConfigIndex                               OPTIONAL,
-- C-ifSPSList: This IE shall be present if there are multiple SPS configurations in the SPS-Config IE
(3GPP TS 38.331) of the UE. It shall not be present otherwise.
        activation                    ENUMERATED {activate, deactivate},
        ...
    }
    freqDomainResources              INTEGER,                                     OPTIONAL,
    timeDomainResources              INTEGER (0..15, ...),
    vrbToPrbMapping                 ENUMERATED {interleaved, ...}   OPTIONAL,
    mcs                            INTEGER (0..31, ...),
    redundancyVersion               INTEGER (0..3, ...),
    ...
}

Dci-11 ::= SEQUENCE {
    useCsiRnti                      SEQUENCE {
        spsConfigIndex               SpsConfigIndex                               OPTIONAL,
-- C-ifSPSList: This IE shall be present if there are multiple SPS configurations in the SPS-Config IE
(3GPP TS 38.331) of the UE. It shall not be present otherwise.
        ...
    }
    carrierIndicator                 INTEGER (1..7, ...)                               OPTIONAL,
    freqDomainResources              BIT STRING,                               OPTIONAL,
    timeDomainResources              INTEGER (0..15, ...),
    vrbToPrbMapping                 ENUMERATED {interleaved, ...}   OPTIONAL,
    prbBundlingSizeIndicagor       INTEGER (0..1, ...),
    mcs-TB1                         INTEGER (0..31, ...),
    redundancyVersion-TB1           INTEGER (0..3, ...),
    mcs-TB2                         INTEGER (0..31, ...),                               OPTIONAL,
    redundancyVersion-TB2           INTEGER (0..3, ...),                               OPTIONAL,
    antennaPorts                    BIT STRING (SIZE(4..6)),
    transmissionConfigIndication  INTEGER (0..7, ...),                               OPTIONAL,
    srsRequest                      BIT STRING (SIZE(2..3))                               OPTIONAL,
    dmrsSequenceInit                INTEGER (0..1),
    ...
}

PdschSMG-Item ::= SEQUENCE {
    precoderID                      INTEGER (0..63, ...),
    smgPriority                      INTEGER (0..31, ...)                               OPTIONAL,
    startRB                          INTEGER,
    noofRBs                          INTEGER,
    startSymbol                      INTEGER,
    noofSymbols                      INTEGER,
    ...
}

CsiRsPrecodingBand-Item ::= SEQUENCE {
    precoderID                      INTEGER (0..63, ...),
    ueid                            UEID,
    nzpCsiRsResourceID              INTEGER (0..191, ...),
    startRB                          INTEGER,
    noofRBs                          INTEGER,
    ...
}

```

```

}
}

Precoder-Item ::= SEQUENCE {
    compressionInformation
        precoderCompressionHeader
        precoderCompressionParam
        ...
    }
    precoderCoeff-List
Item,
    ...
}

PrecoderCoeff-Item ::= SEQUENCE {
    precoderCoeff-I
        INTEGER,
    precoderCoeff-Q
        INTEGER,
    ...
}

DlSchedulingControlOutcome ::= SEQUENCE {
    receivedTimestamp
        ReceivedTimestamp,
    processingTimeMargin
        INTEGER (-32767..32767),
    scheduledSlotOutcome-List
        SEQUENCE (SIZE(1.. maxnoofScheduledDLSlots)) OF
DlScheduledSlotOutcome-Item,
    ...
}

DlScheduledSlotOutcome-Item ::= SEQUENCE {
    slotInfo
        SlotInfo,
    dlGrantOutcome-List
        SEQUENCE (SIZE(1.. maxnoofDLGrants)) OF DlGrantOutcome-Item,
    additionalDlAllocation-List
        SEQUENCE (SIZE(0.. maxnoofDLGrants)) OF AdditionalDlAllocation-
Item,
    csiRsPrecodingBandsNotExecuted-List
        SEQUENCE (SIZE(0.. maxnoofCsiRsPrecodingBands)) OF
CsiRsPrecodingBandsNotExecuted-Item,
    ...
}

DlGrantOutcome-Item ::= SEQUENCE {
    grantID
        INTEGER (1..63, ...),
    executionLevel
        CHOICE {
            fullyExecuted
                NULL,
            notFullyExecuted
                SEQUENCE {
                    scheduledLogicalChannelOutcome-List
                        SEQUENCE (SIZE(1.. maxnoofLogicalChannels)) OF
ScheduledLogicalChannelOutcome-Item,
                    ...
                },
            ...
        }
}

ScheduledLogicalChannelOutcome-Item ::= SEQUENCE {
    logicalChannelID
        LogicalChannelID,
    noofBytesScheduled
        INTEGER,
    cause
        INTEGER,
    ...
}

AdditionalDlAllocation-Item ::= SEQUENCE {
    ueid
        UEID
        OPTIONAL,
    logicalChannelID
        LogicalChannelID
        OPTIONAL,
    noofBytesScheduled
        INTEGER,
    startSymbol
        INTEGER
        OPTIONAL,
    noofSymbols
        INTEGER
        OPTIONAL,
    startRB
        INTEGER
        OPTIONAL,
    noofRBs
        INTEGER
        OPTIONAL,
    ...
}

CsiRsPrecodingBandsNotExecuted-Item ::= SEQUENCE {
    csiRsPrecodingBandID
        INTEGER (0..63, ...),
    cause
        INTEGER,
    ...
}

```

```
-- ****
-- E2SM-LLC Service Model IEs
-- ****

-- ****
-- Event Trigger OCTET STRING contents
-- ****

E2SM-LLC-EventTrigger ::= SEQUENCE {
    ric-eventTrigger-formats
        CHOICE {
            eventTrigger-Format1
                E2SM-LLC-EventTrigger-Format1,
            eventTrigger-Format2
                E2SM-LLC-EventTrigger-Format2,
            ...
        },
    ...
}

E2SM-LLC-EventTrigger-Format1 ::= SEQUENCE {
    message-List
        SEQUENCE (SIZE(1..maxnoofLLIs)) OF E2SM-LLC-EventTrigger-Format1-
Item,
    globalAssociatedUEInfo
        EventTrigger-UE-Info
        OPTIONAL,
    ...
}

E2SM-LLC-EventTrigger-Format1-Item ::= SEQUENCE {
    ric-eventTriggerCondition-ID
        RIC-EventTriggerCondition-ID,
    lowerLayersInfoType
        LowerLayers-Info-Type,
    associatedUEInfo
        EventTrigger-UE-Info
        OPTIONAL,
    logicalOR
        LogicalOR
        OPTIONAL,
    ...
}

E2SM-LLC-EventTrigger-Format2 ::= SEQUENCE {
    reportingPeriod
        INTEGER (1.. 65535),
    associatedUEInfo
        EventTrigger-UE-Info
        OPTIONAL,
    ...
}

-- ****
-- Action Definition OCTET STRING contents
-- ****

E2SM-LLC-ActionDefinition ::= SEQUENCE {
    ric-Style-Type
        RIC-Style-Type,
    ric-actionDefinition-formats
        CHOICE {
            actionDefinition-Format1
                E2SM-LLC-ActionDefinition-Format1,
            actionDefinition-Format2
                E2SM-LLC-ActionDefinition-Format2,
            ...
        },
    ...
}

E2SM-LLC-ActionDefinition-Format1 ::= SEQUENCE {
    lowerLayersInfoType
        LowerLayers-Info-Type,
    ...
}

E2SM-LLC-ActionDefinition-Format2 ::= SEQUENCE {
    measurementToReport-List
        SEQUENCE (SIZE(1.. maxnoofMeasurementsToReport)) OF
MeasurementToReport-Item,
    ...
}

MeasurementToReport-Item ::= SEQUENCE {
    lowerLayers-Meas-Type
        LowerLayers-Meas-Type,
    ...
}

-- ****
-- Indication Header OCTET STRING contents
-- ****

E2SM-LLC-IndicationHeader ::= SEQUENCE {
```

```

ric-indicationHeader-formats      CHOICE {
    indicationHeader-Format1      E2SM-LLC-IndicationHeader-Format1,
    ...
},
...
}

E2SM-LLC-IndicationHeader-Format1 ::= SEQUENCE {
    ric-eventTriggerCondition-ID      RIC-EventTriggerCondition-ID           OPTIONAL,
    ...
}

-- *****
-- Indication Message OCTET STRING contents
-- *****

E2SM-LLC-IndicationMessage ::= SEQUENCE {
    ric-indicationMessage-formats      CHOICE {
        indicationMessage-Format1      E2SM-LLC-IndicationMessage-Format1,
        indicationMessage-Format2      E2SM-LLC-IndicationMessage-Format2,
        ...
    },
    ...
}

E2SM-LLC-IndicationMessage-Format1 ::= SEQUENCE {
    slotTimeStamp                  SlotTimeStamp,
    lowerLayersInfoType            CHOICE {
        SRS                         SRS,
        cSI                         CSI,
        ...
    },
    ...
}

E2SM-LLC-IndicationMessage-Format2 ::= SEQUENCE {
    lowerLayersMeasurement-List      SEQUENCE (SIZE(1.. maxnoofMeasurements)) OF
    LowerLayersMeasurement-Item,
    ...
}

LowerLayersMeasurement-Item ::= SEQUENCE {
    slotTimeStamp                  SlotTimeStamp,
    lowerLayersMeasurementType      CHOICE {
        dlRlcBufferStatus          DlRlcBufferStatus,
        dlPdcpBufferStatus         DlPdcpBufferStatus,
        dlHarqStatistics           DlHarqStatistics,
        slotTimeStamp                NULL,
        ...
    },
    ...
}

-- *****
-- Control Header OCTET STRING contents
-- *****

E2SM-LLC-ControlHeader ::= SEQUENCE {
    ric-controlHeader-formats      CHOICE {
        controlHeader-Format1      E2SM-LLC-ControlHeader-Format1,
        ...
    },
    ...
}

E2SM-LLC-ControlHeader-Format1 ::= SEQUENCE {
    ric-StyleType                  RIC-Style-Type,
    ric-ControlAction-ID           RIC-ControlAction-ID,
    ...
}

-- *****
-- Control Message OCTET STRING contents

```

```
-- ****
E2SM-LLC-ControlMessage ::= SEQUENCE {
    ric-controlMessage-formats           CHOICE {
        controlMessage-Format1          E2SM-LLC-ControlMessage-Format1,
        ...
    },
    ...
}

E2SM-LLC-ControlMessage-Format1 ::= SEQUENCE {
    controlType                      CHOICE {
        logicalChannelHandlingControl   LogicalChannelHandlingControl,
        dlSchedulingControl            DlSchedulingControl,
        ...
    },
    ...
}

-- ****
-- Control Outcome OCTET STRING contents
-- ****

E2SM-LLC-ControlOutcome ::= SEQUENCE {
    ric-controlOutcome-formats         CHOICE {
        controlOutcome-Format1          E2SM-LLC-ControlOutcome-Format1,
        ...
    },
    ...
}

E2SM-LLC-ControlOutcome-Format1 ::= SEQUENCE {
    controlType                      CHOICE {
        logicalChannelHandling          ReceivedTimestamp,
        dlSchedulingParameters          DlSchedulingControlOutcome,
        ...
    },
    ...
}

-- ****
-- RAN Function Definition IEs
-- ****

E2SM-LLC-RANFunctionDefinition ::= SEQUENCE{
    ranFunction-Name                  RANfunction-Name,
    ranFunctionDefinition-EventTrigger RANFunctionDefinition-EventTrigger           OPTIONAL,
    ranFunctionDefinition-Report      RANFunctionDefinition-Report             OPTIONAL,
    ranFunctionDefinition-Control     RANFunctionDefinition-Control            OPTIONAL,
    ...
}

-----
-- Event Trigger
-----

RANFunctionDefinition-EventTrigger ::= SEQUENCE {
    ric-EventTriggerStyle-List        SEQUENCE (SIZE(1..maxnoofRICStyles)) OF RANFunctionDefinition-
EventTrigger-Style-Item,
    ...
}

RANFunctionDefinition-EventTrigger-Style-Item ::= SEQUENCE {
    ric-EventTriggerStyle-Type        RIC-Style-Type,
    ric-EventTriggerStyle-Name        RIC-Style-Name,
    ric-EventTriggerFormat-Type      RIC-Format-Type,
    ...
}

-----
-- Report
-----

RANFunctionDefinition-Report ::= SEQUENCE {
```

```

    ric-ReportStyle-List           SEQUENCE (SIZE(1..maxnoofRICStyles)) OF RANFunctionDefinition-
Report-Item,
    ...
}

RANFunctionDefinition-Report-Item ::= SEQUENCE {
    ric-ReportStyle-Type          RIC-Style-Type,
    ric-ReportStyle-Name          RIC-Style-Name,
    ric-SupportedEventTriggerStyle-Type RIC-Style-Type,
    ric-ReportActionFormat-Type   RIC-Format-Type,
    ric-IndicationHeaderFormat-Type RIC-Format-Type,
    ric-IndicationMessageFormat-Type RIC-Format-Type,
    ...
}

-----
-- Control
-----

RANFunctionDefinition-Control ::= SEQUENCE {
    ric-ControlStyle-List         SEQUENCE (SIZE(1..maxnoofRICStyles)) OF RANFunctionDefinition-
Control-Item,
    ...
}

RANFunctionDefinition-Control-Item ::= SEQUENCE {
    ric-ControlStyle-Type          RIC-Style-Type,
    ric-ControlStyle-Name          RIC-Style-Name,
    ric-ControlAction-List         SEQUENCE (SIZE(1..maxnoofControlAction)) OF
                                    OPTIONAL,
    RANFunctionDefinition-Control-Action-Item
        ric-ControlHeaderFormat-Type RIC-Format-Type,
        ric-ControlMessageFormat-Type RIC-Format-Type,
        ric-CallProcessIDFormat-Type RIC-Format-Type
                                    OPTIONAL,
        ric-ControlOutcomeFormat-Type RIC-Format-Type,
    ...
}

RANFunctionDefinition-Control-Action-Item ::= SEQUENCE {
    ric-ControlAction-ID           RIC-ControlAction-ID,
    ric-ControlAction-Name          RIC-ControlAction-Name,
    ...
}

END
-- ASN1STOP

```

8.5 Message transfer syntax

E2SM-LLC shall use the ASN.1 Basic Packed Encoding Rules (BASIC-PER) Aligned Variant as transfer syntax, as specified in Recommendation ITU-T X.691 [17].

9 Handling of unknown, unforeseen and erroneous protocol data

Clause 10 of TS 36.413 [18] is applicable for the purposes of the present document.

Annex (informative): Change history

Date	Revision	Description
2024.06.19	00.00.01	Initial template approval at W3#227

Date	Revision	Description
2024.07.24	00.00.02	Addition of CR <COT-2024.06.28-WG3-CR-0008-E2SM-LLC-Template-Cleanup-v01.docx> approved at WG3#230
2024.08.14	00.00.03	Addition of CR < COT-2024.07.19-WG3-CR-0009-E2SM-LLC-Clauses-3-4-5-8.2.2-v03.docx> approved at WG3#234
2024.10.16	00.00.04	Addition of CR < COT-2024.08.22-WG3-CR-0010-E2SM-LLC-Support-REPORT-Service-Style-1-LLI-v03> approved at WG3#239
2024.11.13	00.00.05	Addition of CRs: <COT-2024.10.08-WG3-CR-0012-E2SM-LLC-Support-REPORT-Service-Style-2-Lower-Layers-Measurements-v03> <COT-2024.10.08-WG3-CR-0013-E2SM-LLC-Support-CONTROL-Service-Style-1-Logical-Channel-Handling-v03> <COT-2024.10.14-WG3-CR-0014-E2SM-LLC-Support-CONTROL-Service-Style-2-Scheduling-Parameters-v04> <COT-2024.10.14-WG3-CR-0015-E2SM-LLC-Clauses-6.1-7.1-7.2-7.9-ClauseVoids-v03> approved at Montreal F2F meeting 31/10/2024.
2024.11.26	00.00.06	Addition of CRs: < COT-2024.11.04-WG3-CR-0016-E2SM-LLC-Add-RIC-Call_Process-ID-to-Control-Function-Definition-v02> approved at WG3#244 < COT-2024.11.04-WG3-CR-0017-E2SM-LLC-Clauses-8.4-8.5-9-v03> approved at WG3#245
2024.12.03	00.00.07	Correction of typos
2024.12.04	01.00	Initial version