O-RAN.WG3.E2AP-v02.02

Technical Specification

O-RAN Working Group 3, Near-Real-time RAN Intelligent Controller, E2 Application Protocol (E2AP)

This is a re-published version of the attached final specification.

For this re-published version, the prior versions of the IPR Policy will apply, except that the previous requirement for Adopters (as defined in the earlier IPR Policy) to agree to an O-RAN Adopter License Agreement to access and use Final Specifications shall no longer apply or be required for these Final Specifications after 1st July 2022.

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Technical Specification

O-RAN Working Group 3, Near-Real-time RAN Intelligent Controller, E2 Application Protocol (E2AP)

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2022.04.04	02.02.03	Editorial changes based on remarks during WG3 approval
2022.06.29	**02.02**	Version ready for March22 publication

Contents

Foreward

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.

1 Scope

The present document specifies the Near-RT RIC layer signalling protocol for the E2 interface.

The E2 interface provides means for interconnecting a Near-RT RIC and an E2 Node. The E2 Application Protocol (E2AP) supports the functions of E2 interface by signalling procedures defined in the present document. E2AP is developed in accordance to the general principles stated in O-RAN E2 General Aspects & Principles [2].

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

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

[2] O-RAN-WG3.E2GAP: “O-RAN Working Group 3 Near-Real-time RAN Intelligent Controller, E2 General Aspects and Principles”.

[3] O-RAN-WG3.E2SM: “O-RAN Working Group 3, Near-Real-time RAN Intelligent Controller, E2 Service Model (E2SM)”.

[4] ORAN-WG2.A1.GA&P: “O-RAN Working Group 2, A1 interface: General Aspects and Principles”.

[6] 3GPP TS 36.401: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Architecture Description".

[7] 3GPP TS 38.401: "NG-RAN; Architecture description".

[8] 3GPP TS 36.420: “X2 general aspects and principles”.

[9] O-RAN-WG1.OAM Architecture: “O-RAN Operations and Maintenance Architecture”.

[10] 3GPP TS 38.410: “NG general aspects and principles”.

[11] 3GPP TS 38.420: “Xn general aspects and principles”.

[12] 3GPP TS 38.470: “F1 general aspects and principles”.

[13] 3GPP TS 36.410: “S1 general aspects and principles”.

[14] 3GPP TS 25.921: “Guidelines and principles for protocol description and error handling”.

[15] ITU-T Recommendation X.691 (07/2002): "Information technology – ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)".

[16] ITU-T Recommendation X.680 (07/2002): "Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation".

[17] ITU-T Recommendation X.681 (07/2002): "Information technology – Abstract Syntax Notation One (ASN.1): Information object specification".

[18] 3GPP TS 38.300: “NR; NR and NG-RAN Overall Description; Stage 2”.

[19] 3GPP TS 38.413: "NG-RAN; NG Application Protocol (NGAP)"

[20] 3GPP TS 38.423: "NG-RAN; Xn application protocol (XnAP)"

[21] 3GPP TS 38.463: "NG-RAN; E1 Application Protocol (E1AP)"

[22] 3GPP TS 38.473: "NG-RAN; F1 application protocol (F1AP)"

[23] 3GPP TS 37.473: "W1 interface; Application Protocol (W1AP)"

[24] 3GPP TS 36.413: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP)"

[25] 3GPP TS 36.423: “Evolved Universal Terrestrial Radio Access Network (E-UTRAN); X2 application protocol (X2AP)”

3 Definitions and Abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply.

A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

A1: Interface between non-RT RIC and Near-RT RIC to enable policy-driven guidance of Near-RT RIC applications/functions, and support AI/ML workflow [4].

E2: Interface connecting the Near-RT RIC and one or more O-CU-CPs, one or more O-CU-UPs, and one or more O-DUs [2].

E2 Node: a logical node terminating E2 interface. In this version of the specification, ORAN nodes terminating E2 interface are:

- for NR access: O-CU-CP, O-CU-UP, O-DU or any combination as defined in [9];
- for E-UTRA access: O-eNB.

non-RT RIC (O-RAN non-real-time RAN Intelligent Controller): a logical function that enables non-real-time control and optimization of RAN elements and resources, AI/ML workflow including model training and updates, and policy-based guidance of applications/features in Near-RT RIC.

Near-RT RIC (O-RAN near-real-time RAN Intelligent Controller): a logical function that enables near-real-time control and optimization of RAN elements and resources via fine-grained (e.g. UE basis, Cell basis) data collection and actions over E2 interface.

O-CU: (O-RAN Central Unit): a logical node hosting RRC, SDAP and PDCP protocols [7].

O-CU-CP: (O-RAN Central Unit – Control Plane): a logical node hosting the RRC and the control plane part of the PDCP protocol [7].

O-CU-UP: (O-RAN Central Unit – User Plane): a logical node hosting the user plane part of the PDCP protocol and the SDAP protocol [7].

O-DU: (O-RAN Distributed Unit): a logical node hosting RLC/MAC/High-PHY layers based on a lower layer functional split.

O-eNB: an eNB **Error! Reference source not found.** or ng-eNB [18] that supports E2 interface.

O-RU: (O-RAN Radio Unit): a logical node hosting Low-PHY layer and RF processing based on a lower layer functional split. This is similar to 3GPP’s “TRP” or “RRH” but more specific in including the Low-PHY layer (FFT/iFFT, PRACH extraction).

O1: Interface between orchestration & management entities (Orchestration/NMS) and O-RAN managed elements, for operation and management, by which FCAPS management, Software management, File management and other similar functions shall be achieved.

RAN Function: A specific Function in a E2 Node; examples include termination of network interfaces (i.e. X2 [8], F1 [12], S1 [13], Xn [11], NGc [10]) and RAN internal functions handling UEs, Cells, etc.

RIC Service: A Service provided on an E2 Node to provide access to messages and measurements and / or enable control of the E2 Node from the Near-RT RIC.

3.2 Abbreviations

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

Near-RT RIC	near-real-time RAN Intelligent Controller
non-RT RIC	non-real-time RAN Intelligent Controller:
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
O-RU	O-RAN Radio Unit

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 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:

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 apply:

Global E2 Node ID: Global identifier of an E2 Node. Defined as the global eNB or gNB identifier and an optional local identifier of an CU-UP or DU which is required when and if an individual DU or CU-UP supports a direct E2 interface.

Global RIC ID: Global identifier of a Near-RT RIC.

RAN Function ID: Local identifier of a specific RAN Function within an E2 Node that supports one or more RIC Services using a specific E2 Service Model. Note that same E2SM may be used by more than one RAN Function in the same E2 Node.

RAN Function OID: RAN Function Object Identifier. Used to identify specific RAN function definition (i.e. E2SM used by specific RAN Function).

RIC Action ID: Local identifier used Near-RT RIC to identify a specific Action within a specific RIC Subscription Request, used by E2 Node in subsequent RIC Indication messages.

RIC Call Process ID: Local identifier used by E2 Node to identify the suspended associated procedure instance during a RIC Service “Insert”, used by Near-RT RIC in subsequent RIC Control procedure.

RIC Request ID: Local identifier used by the Near-RT RIC to identify a specific RIC Subscription procedure or RIC Control procedure, used by E2 Node in subsequent RIC Indication messages.

5 E2AP Services

The present clause describes the services an E2 Node offers to the Near-RT RIC.

5.1 E2AP procedure modules

The E2 interface E2AP procedures are divided into two modules as follows:

1. E2AP Near-RT RIC Functional Procedures;
2. E2AP Global Procedures;

The E2AP Near-RT RIC functional procedures module contains procedures used to pass application specific messages between Near-RT RIC applications and a target function in an E2 node [2]

The Global Procedures module contains procedures that are not directly related to a specific application.

5.2 Parallel transactions

Parallel transactions, that is, multiple ongoing E2AP procedures related to the same Application and E2 node, are supported.

6 Services expected from Signalling Transport

The signalling connection shall provide in sequence delivery of E2AP messages. E2AP shall be notified if the signalling connection breaks.

7 Functions of E2AP

The functions of E2AP are described in O-RAN Working Group 3 Near-Real-time RAN Intelligent Controller, E2 General Aspects and Principles [2].

8 E2AP Procedures

8.1 Elementary Procedures

In the following tables, all EPs are divided into Class 1 and Class 2 EPs.

Table 8.1-1: Class 1 Elementary Procedures

Initiated by	Elementary Procedure	Initiating Message	Successful Outcome	Unsuccessful Outcome
			Response message	Response message
Near-RT RIC	RIC Subscription	RIC SUBSCRIPTION REQUEST	RIC SUBSCRIPTION RESPONSE	RIC SUBSCRIPTION FAILURE
Near-RT RIC	RIC Subscription Delete	RIC SUBSCRIPTION DELETE REQUEST	RIC SUBSCRIPTION DELETE RESPONSE	RIC SUBSCRIPTION DELETE FAILURE
E2 Node	RIC Service Update	RIC SERVICE UPDATE	RIC SERVICE UPDATE ACKNOWLEDGE	RIC SERVICE UPDATE FAILURE
Near-RT RIC	RIC Control	RIC CONTROL REQUEST	RIC CONTROL ACKNOWLEDGE	RIC CONTROL FAILURE
E2 Node	E2 Setup	E2 SETUP REQUEST	E2 SETUP RESPONSE	E2 SETUP FAILURE
E2 Node	E2 Node Configuration Update	E2 NODE CONFIGURATION UPDATE	E2 NODE CONFIGURATION UPDATE ACKNOWLEDGE	E2 NODE CONFIGURATION UPDATE FAILURE
Near-RT RIC	E2 Connection Update	E2 CONNECTION UPDATE	E2 CONNECTION UPDATE ACKNOWLEDGE	E2 CONNECTION UPDATE FAILURE
Near-RT RIC or E2 Node	Reset	RESET REQUEST	RESET RESPONSE	
Near-RT RIC or E2 Node	E2 Removal	E2 REMOVAL REQUEST	E2 REMOVAL RESPONSE	E2 REMOVAL FAILURE

Table 8.1-2: Class 2 Elementary Procedures

Initiated by	Elementary Procedure	Initiating Message
E2 Node	RIC Indication	RIC INDICATION
Near-RT RIC	RIC Service Query	RIC SERVICE QUERY
E2 Node	RIC Subscription Delete Required	RIC SUBSCRIPTION DELETE REQUIRED
E2 Node or Near-RT RIC	Error Indication	ERROR INDICATION

8.2 Near-RT RIC Functional Procedures

8.2.1 RIC Subscription procedure

8.2.1.1 General

This procedure is used to establish E2 subscriptions on E2 Node consisting of an event trigger and a sequence of actions, each with a corresponding subsequent action.

8.2.1.2 Successful Operation

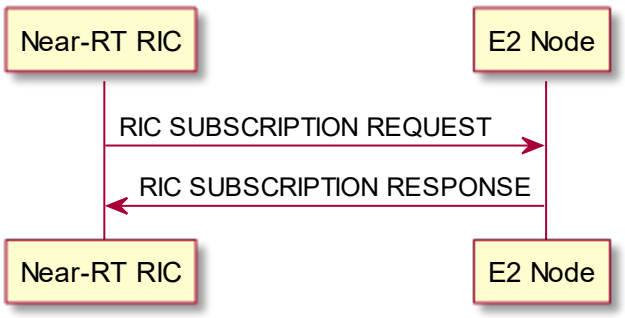

Figure 8.2.1.2-1: Near-RT RIC Subscription procedure, successful operation

The Near-RT RIC initiates the procedure by sending the RIC SUBSCRIPTION REQUEST message containing a unique RIC Request ID to the target E2 Node. When the Near-RT RIC sends the RIC SUBSCRIPTION message, it shall start the timer $T_{RICEVENTcreate}$.

At reception of the RIC SUBSCRIPTION REQUEST message the target E2 Node shall:

- Determine the target function using the information in the *RAN Function ID* IE and configure the requested event trigger using information in the *RIC Subscription Details* IE.
- If one or more **Report**, **Insert** and/or **Policy** RIC service actions are included in the *RIC Subscription Details* IE then the target function shall validate the event trigger and requested action sequence and, if accepted, store the required *RIC Request ID, RIC Event Trigger Definition* IE and sequence of *RIC Action ID* IE, *RIC Action Type* IE, *RIC Action Definition* IE, if included, and *RIC Subsequent Action* IE, if included.

If the requested trigger and at least one required action are accepted by the target E2 Node, the target E2 Node shall reserve necessary resources and send the RIC SUBSCRIPTION RESPONSE message back to the Near-RT RIC. The target E2 Node shall include in the response message the actions for which resources have been prepared at the target E2 Node in the *RIC Actions Admitted List* IE. The target E2 Node shall include the actions that have not been admitted in the *RIC Actions Not Admitted List* IE with an appropriate cause value.

Upon reception of the RIC SUBSCRIPTION RESPONSE message the Near-RT RIC shall stop the timer $T_{RICEVENTcreate}$ and terminate the Subscription Request procedure.

8.2.1.3 Unsuccessful Operation

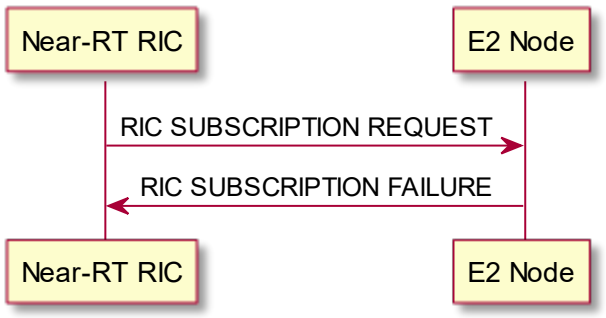

Figure 8.2.1.3-1: Near-RT RIC Subscription procedure, unsuccessful operation

If the target E2 Node does not admit at least one requested action, or detects an inconsistency in the sequence of actions or in the subsequent action definitions, or a failure occurs during the RIC Subscription procedure, the target E2 Node shall send the RIC SUBSCRIPTION FAILURE message to the Near-RT RIC with an appropriate cause value.

Upon reception of the RIC SUBSCRIPTION FAILURE message the Near-RT RIC shall stop the timer $T_{RICEVENTcreate}$ and terminate the RIC Subscription procedure.

Interactions with RIC Subscription Delete procedure:

If there is no response from the target E2 Node to the RIC SUBSCRIPTION REQUEST message before the timer $T_{RICEVENTcreate}$ expires in the Near-RT RIC, the Near-RT RIC shall cancel the RIC Subscription towards the target E2 Node by initiating the RIC Subscription Delete procedure with an appropriate cause value. The Near-RT RIC shall ignore any RIC SUBSCRIPTION RESPONSE or RIC SUBSCRIPTION FAILURE message received after the initiation of the RIC Subscription Delete procedure and remove any reference and release any resources related to the concerned E2.

8.2.1.4 Abnormal Conditions

If the target E2 Node receives a RIC SUBSCRIPTION REQUEST message containing *RIC Subscription Details* IE that does not align with the Near-RT RIC Service Model [3], the target E2 Node shall send the RIC SUBSCRIPTION FAILURE message to the Near-RT RIC with an appropriate cause value.

If the target E2 Node receives a RIC SUBSCRIPTION REQUEST message which contains a *RAN Function ID* IE that was not previously announced as a supported RAN function in the E2 Setup procedure or the RIC Service Update procedure, the target E2 Node shall send the RIC SUBSCRIPTION FAILURE message to the Near-RT RIC with an appropriate cause value.

If the target E2 Node receives a RIC SUBSCRIPTION REQUEST message containing identical contents, that is, same *RAN Function ID* IE, same *RIC Event Trigger Definition* IE and same sequence of actions, the target E2 Node shall send the RIC SUBSCRIPTION FAILURE message to the Near-RT RIC with an appropriate cause value.

8.2.2 RIC Subscription Delete procedure

8.2.2.1 General

This procedure is used to delete E2 subscriptions on E2 Node.

8.2.2.2 Successful Operation

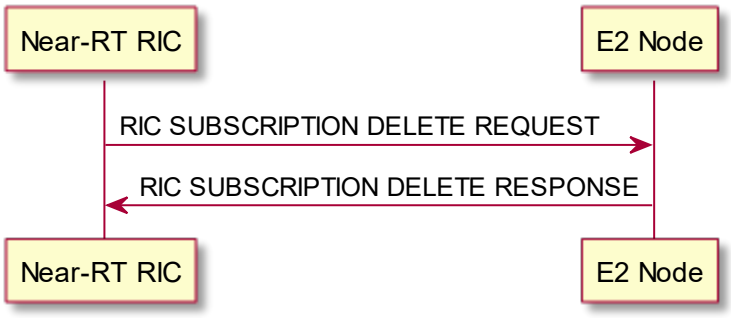

Figure 8.2.1.2-1: Near-RT RIC Subscription Delete procedure, successful operation

The Near-RT RIC initiates the procedure by sending the RIC SUBSCRIPTION DELETE REQUEST message to the target E2 Node. When the Near-RT RIC sends the RIC SUBSCRIPTION DELETE REQUEST message, it shall start the timer $T_{RICEVENTdelete}$.

At reception of the RIC SUBSCRIPTION DELETE REQUEST message the target E2 Node shall:

- Determine the target function using the information in the *RAN Function ID* IE and delete the corresponding RIC EVENT trigger using information in the *RIC Request ID* IE.

- If one or more subsequent actions were included in the previously received RIC Subscription, then the target function shall delete the required actions along with the corresponding *RIC Request ID* IE.

The target E2 Node shall release necessary resources and send the RIC SUBSCRIPTION DELETE RESPONSE message back to the Near-RT RIC.

Upon reception of the RIC SUBSCRIPTION DELETE RESPONSE message the Near-RT RIC shall stop the timer $T_{RICEVENTdelete}$, and terminate the RIC Subscription Delete procedure.

8.2.2.3 Unsuccessful Operation

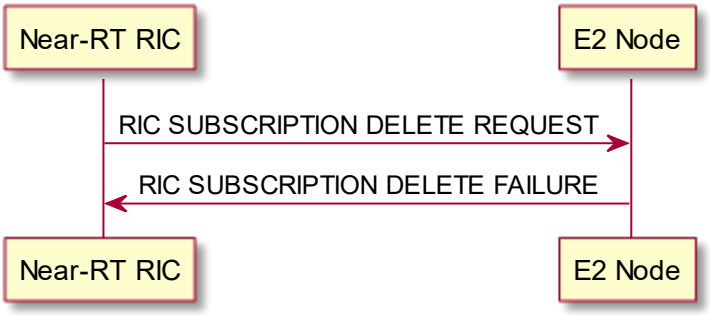

Figure 8.2.1.3-1: RIC Subscription Delete procedure, unsuccessful operation

If the target E2 Node has no stored subscription for the same *RIC Request ID* IE included in the RIC SUBSCRIPTION DELETE REQUEST message, or a failure occurs during the RIC Subscription Delete procedure, the target E2 Node shall send the RIC SUBSCRIPTION DELETE FAILURE message to the Near-RT RIC. The message shall contain with an appropriate cause value.

Upon reception of the RIC SUBSCRIPTION DELETE FAILURE message the Near-RT RIC shall stop the timer $T_{RICEVENTdelete}$, and terminate the RIC Subscription Delete procedure.

8.2.2.4 Abnormal Conditions

If the target E2 Node receives a RIC SUBSCRIPTION DELETE REQUEST message containing a *RIC Request ID* IE that is not known, the target E2 Node shall send the RIC SUBSCRIPTION DELETE FAILURE message to the Near-RT RIC. The message shall contain with an appropriate cause value.

If the target E2 Node receives a RIC SUBSCRIPTION DELETE REQUEST message contains a *RAN Function ID* IE that was not previously announced as a supported RAN function in the E2 Setup procedure or the RIC Service Update procedure, the target E2 Node shall send the RIC SUBSCRIPTION DELETE FAILURE message to the Near-RT RIC. The message shall contain with an appropriate cause value.

8.2.2A RIC Subscription Delete Required procedure

8.2.2A.1 General

This procedure is used to enable the E2 Node to request deletion of the existing RIC Subscriptions in the E2 Node previously created for the Near-RT RIC.

8.2.2A.2 Successful Operation

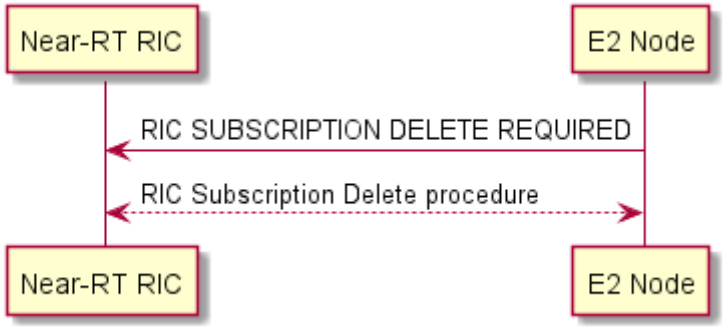

Figure 8.2.2A.2-1: Near-RT RIC Subscription Delete Required procedure, successful operation

The E2 Node initiates the procedure by sending the RIC SUBSCRIPTION DELTE REQUIRED message to the Near-RT RIC. The message shall contain an appropriate cause value for each RIC Subscription requesting to remove. The E2 Node shall not remove RIC Subscription(s) on its own until indicated by the Near-RT RIC to do so.

At reception of the RIC SUBSCRIPTION DELETE REQUIRED message, for each RIC Subscription associated with the included *RIC Request ID* IE and *RAN Function ID* IE, the Near-RT RIC may:

- Release necessary resources related to that RIC Subscription and initiate the RIC Subscription Delete procedure toward the E2 Node.

8.2.2A.3 Abnormal Conditions

If the Near-RT RIC receives a RIC SUBSCRIPTION DELETE REQUIRED message for which the included *RIC Request ID* IE and *RAN Function ID* IE are not associated with the previously subscribed, the Near-RT RIC shall ignore the message.

8.2.3 RIC Indication procedure

8.2.3.1 General

The purpose of the RIC Indication procedure is to transfer a message associated with a **Report** and/or **Insert** RIC Service to the Near-RT RIC corresponding to a previously successful RIC Subscription procedure and the corresponding detection of the Event Trigger.

8.2.3.2 Successful Operation

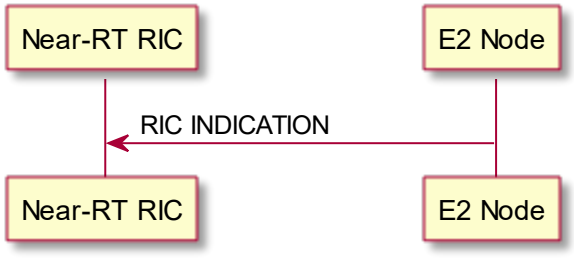

Figure 8.2.3.2-1: Near-RT RIC Indication procedure, successful operation

An E2 Node initiates the procedure by sending RIC INDICATION message containing the associated *RIC Request ID* IE, *RAN Function ID* IE, *RIC Action ID* IE, optionally sequence number *RIC Indication SN* IE, *RIC Indication Type* IE, *RIC Indication Header* IE, *RIC Indication Message* IE and optionally a *RIC Call Process ID* IE to the Near-RT RIC.

- If the RIC Indication message is in response to RIC Subscription with *RIC Action Type* IE as "Insert", then the E2 Node shall provide the *RIC Call Process ID* IE within the RIC INDICATION message, and the E2 Node

shall store current call state, start the associated *RIC Time to Wait* timer, and suspend further processing of the associated RAN function.

The receiving Near-RT RIC shall use the *RIC Request ID* IE to route the Indication to the Near-RT RIC functionality that originated the corresponding RIC Subscription procedure.

If present, the receiving Near-RT RIC may use the *RIC Call Process ID* IE in a subsequent RIC Control procedure.

If the E2 Node had stored an associated *RIC Subsequent Action* IE then, after successful transmission of the RIC INDICATION message, the originating E2 Node shall progress accordingly:

- If the *RIC Subsequent Action Type* IE was set to Continue or Halt, the associated *RIC Time to Wait* timer has not yet expired, and a RIC CONTROL REQUEST message is received with the same *RIC Call Process ID* IE, then the E2 Node shall use the RIC CONTROL REQUEST information along with the stored call state and continue to execute any remaining actions in the sequence of RIC Actions defined in the RIC Subscription procedure prior to resuming normal functionality of the associated RAN function.

- If the *RIC Subsequent Action Type* IE was set to Continue and the associated *RIC Time to Wait* timer has expired, then the E2 Node shall use the stored call state and continue to execute any remaining actions in the sequence of RIC Actions defined in the RIC Subscription procedure prior to resuming normal functionality of the associated RAN function.

- If the *RIC Subsequent Action Type* IE was set to Halt and the associated *RIC Time to Wait* timer has expired, then the E2 Node shall abort normal functionality of the associated RAN function. In this case, any remaining actions in the sequence of RIC Actions defined in the RIC Subscription procedure shall also be aborted.

Subsequent Action	*RIC Time to Wait* timer	Condition	Outcome
Continue or Halt	required	E2 Node detected the event trigger in the *RIC Event Trigger Definition* IE.	RIC INDICATION message shall provide the *RIC Call Process ID* IE and E2 Node shall store current call state, start the associated *RIC Time to Wait* timer, and suspend further processing of the associated RAN function.
Continue or Halt	not yet expired	E2 Node received the RIC CONTROL REQUEST message with the same *RIC call process ID* IE.	E2 Node shall use the RIC CONTROL information along with the stored call state and continue to execute any remaining actions in the sequence of RIC Actions defined in the RIC Subscription procedure prior to resuming normal functionality of the associated RAN function.
Continue	expired		E2 Node shall use the stored call state and continue to execute any remaining actions in the sequence of RIC Actions defined in the RIC Subscription procedure prior to resuming normal functionality of the associated RAN function.
Halt	expired		E2 Node shall abort normal functionality of the associated RAN function.

Table 8.2.3.2-1: RIC Indication procedure, successful operation

8.2.3.3 Unsuccessful Operation

Not applicable.

8.2.3.4 Abnormal Conditions

Not applicable.

8.2.4 RIC Control procedure

8.2.4.1 General

The purpose of the RIC Control procedure is to initiate or resume a specific functionality in the E2 Node.

8.2.4.2 Successful Operation

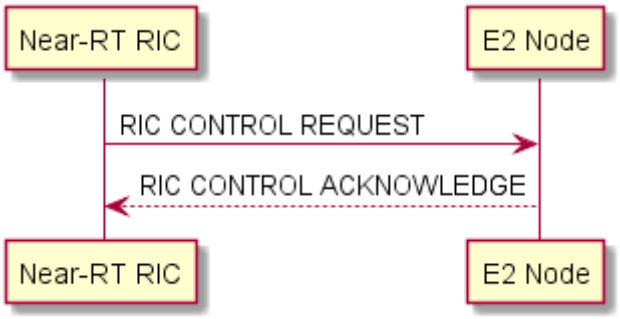

Figure 8.2.4.2-1: RIC Control procedure, successful operation

The Near-RT RIC initiates the procedure by sending the RIC CONTROL REQUEST message containing the associated *RIC Request ID* IE, *RAN Function ID* IE, optionally *RIC Call Process ID* IE, *RIC Control Header* IE, *RIC Control Message* IE and optionally *RIC Control Ack Request* IE to the E2 Node.

When the Near-RT RIC sends the RIC CONTROL REQUEST message and the optional *RIC Control Ack Request* IE has been set to "Ack", or is not present, the Near-RT RIC, it shall start the timer $T_{RICcontrol.}$

At reception of the RIC CONTROL REQUEST message the target E2 Node shall:

- Determine the target function using the information in the *RAN Function ID* IE and initiate the requested RIC Control procedure action using information in the *RIC Control Message* IE.

- If the *RIC Call Process ID* IE is included in the RIC CONTROL REQUEST message, the E2 Node shall use this IE to identify a specific call process that was previously announced in the RIC INDICATION message and, after confirming that the request has arrived prior to the *RIC Time to Wait* timer had expired, clear the timer.

- If the RIC CONTROL REQUEST message contains the optional *RIC Control Ack Request* IE set to “Ack”, or if the optional *RIC Control Ack Request* IE is not present, and the E2 Node has successfully processed the requested RIC Control procedure action, then the E2 Node shall respond with the RIC CONTROL ACKNOWLEDGE message and continue call processing.

- If the RIC CONTROL REQUEST message contains the optional *RIC Control Ack Request* IE set to “NoAck” and the E2 Node has successfully processed the requested RIC Control procedure action, then the E2 Node shall continue call processing.

Upon reception of the RIC CONTROL ACKNOWLEDGE message, the Near-RT RIC shall stop the timer $T_{RICcontrol}$ and terminate the RIC Control procedure. The Near-RT RIC may use the information contained in the optional *RIC Control Outcome* IE to determine subsequent actions.

8.2.4.3 Unsuccessful Operation

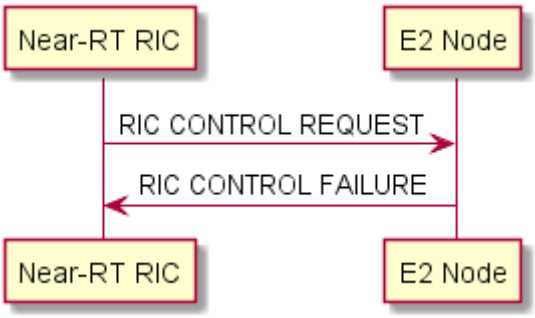

Figure 8.2.4.3-1: RIC Control procedure, unsuccessful operation

If the RIC CONTROL REQUEST message contains an optional *RIC Call Process ID* IE that is invalid then the E2 Node shall respond with the RIC CONTROL FAILURE message with an appropriate cause value.

If the RIC CONTROL REQUEST message contains the optional *RIC Call Process ID* IE for which the associated *RIC Time to Wait* timer had expired, then the E2 Node shall respond with the RIC CONTROL FAILURE message with an appropriate cause value.

If the E2 Node fails to execute the requested RIC Control procedure E2SM specific action, then the E2 Node shall respond with the RIC CONTROL FAILURE message with an appropriate cause value.

If the E2 Node detects an encoding or functional error in the E2SM specific IEs contained in the RIC CONTROL REQUEST message, then the E2 Node shall respond with the RIC CONTROL FAILURE message with an appropriate cause value.

If the E2 Node receives a RIC CONTROL REQUEST message which contains a *RAN Function ID* IE that was not previously announced as a supported RAN function in the E2 Setup procedure or the RIC Service Update procedure, or the E2 Node does not support the specific RIC Control procedure action, then the E2 Node shall respond with the RIC CONTROL FAILURE message with an appropriate cause value..

Upon reception of the RIC CONTROL FAILURE message the Near-RT RIC shall stop the timer $T_{RICcontrol,}$ if running, and terminate the RIC Control procedure. The Near-RT RIC may use the information contained in the *Cause* IE and optional *RIC Control Outcome* IE to determine subsequent actions.

8.2.4.4 Abnormal Conditions

Upon reception of the ERROR INDICATION message including the *RIC Request ID* IE corresponding to the previous RIC CONTROL REQUEST message, the Near-RT RIC shall stop the timer $T_{RICcontrol}$, if running, and terminate the RIC Control procedure.

If the timer $T_{RICcontrol}$ was set when sending the RIC CONTROL REQUEST message and there was no response from the E2 node before the timer has expired, the Near-RT RIC shall send an ERROR INDICATION with the appropriate value for the *Cause* IE.

8.3 Global Procedures

8.3.1 E2 Setup procedure

8.3.1.1 General

The purpose of the E2 Setup procedure is to establish the signaling connection between E2 Node and Near-RT RIC. This procedure erases any existing application level configuration data in the two nodes and replaces it by the one received. This procedure also resets the E2 interface like a Reset procedure would do.

Note that this procedure performs the basic interface setup and transfers E2 Node specific configuration information to the Near-RT RIC.

This procedure shall be initiated by the E2 Node.

8.3.1.2 Successful Operation

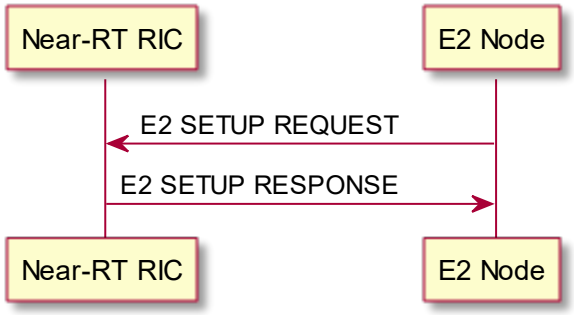

Figure 8.3.1.2-1: E2 Setup procedure, successful operation

An E2 Node initiates the procedure by sending the E2 SETUP REQUEST message including the appropriate data to a Near-RT RIC. The Near-RT RIC replies with the E2 SETUP RESPONSE message including the appropriate data.

If the Near-RT RIC has successfully processed the *RAN Functions Added List* IE, also present in the RIC SERVICE UPDATE message, then Near-RT RIC shall contain, in the E2 SETUP RESPONSE message, the *RAN Functions Accepted List* IE and/or the *RAN Functions Rejected List* IE, also present in the RIC SERVICE UPDATE ACKNOWLEDGE message.

If the Near-RT RIC has successfully processed the *E2 Node Component Configuration Addition List* IE, also present in the E2 NODE CONFIGURATION UPDATE message, then Near-RT RIC shall contain, in the E2 SETUP RESPONSE message, the *E2 Node Component Configuration Addition Acknowledge List* IE, also present in the E2 NODE CONFIGURATION UPDATE ACKNOWLEDGE message.

Note that the RIC Service Update procedure is defined in section 8.3.4 and the E2 Node Configuration Update procedure is defined in section 8.3.5.

8.3.1.3 Unsuccessful Operation

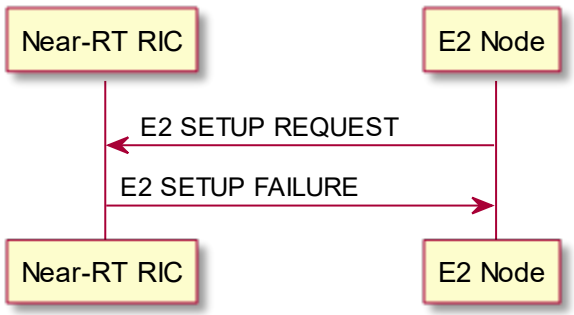

Figure 8.3.1.3-1: E2 Setup procedure, unsuccessful operation

If the Near-RT RIC cannot accept the setup it shall respond with an E2 SETUP FAILURE message with an appropriate cause value. The Near-RT RIC may provide an alternative *Transport Layer Information* IE for the E2 Node to use when reinitiating the E2 Setup procedure towards the Near-RT RIC.

If the E2 SETUP FAILURE message includes the *Time To Wait* IE, the E2 node shall wait at least for the indicated time before reinitiating the E2 Setup procedure towards the Near-RT RIC.

8.3.1.4 Abnormal Conditions

If the first message received for a specific TNL association is not an E2 SETUP REQUEST, E2 SETUP RESPONSE, E2 SETUP FAILURE or E2 NODE CONFIGURATION UPDATE message then this shall be treated as a logical error.

If the E2 node does not receive either the E2 SETUP RESPONSE message or the E2 SETUP FAILURE message, the E2 node may reinitiate the E2 Setup procedure towards the same Near-RT RIC using the same TNL association, provided that the content of the new E2 SETUP REQUEST message is identical to the content of the previously unacknowledged E2 SETUP REQUEST message.

8.3.2 Reset procedure

8.3.2.1 General

The purpose of the Reset procedure is to align the resources in E2 Node and Near-RT RIC in the event of an abnormal failure. The procedure resets the E2 interface. This procedure doesn't affect the application level configuration data exchanged during the E2 Setup procedure, E2 Node Configuration Update procedure and RIC Service Update procedure.

8.3.2.2 Successful Operation

This procedure may be initiated by either Near-RT RIC or E2 Node.

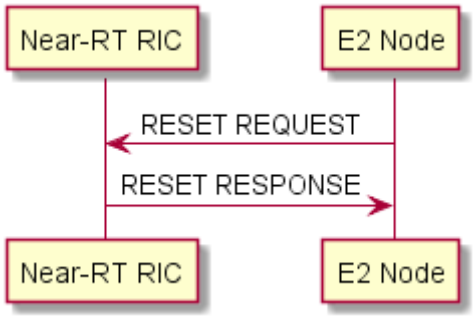

Figure 8.3.2.2-1: Reset, successful operation (E2 Node Initiated)

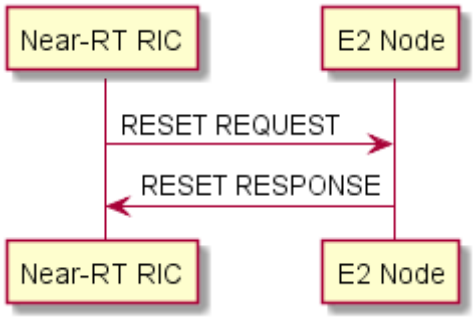

Figure 8.3.2.2-2: Reset, successful operation (Near-RT RIC Initiated)

When the Reset procedure is initiated, the Near-RT RIC and E2 Node shall:

- Delete any pre-established RIC Subscriptions,
- Gracefully terminate any ongoing Near-RT RIC call processes using **INSERT**, **CONTROL** or **POLICY** services while ensuring that impact to ongoing calls for connected UE is minimized.

After the Reset has been completed, the Near-RT RIC shall re-issue any required Subscriptions.

Interactions with other procedures:

If the RESET REQUEST message is received, any other ongoing procedure (except for another Reset procedure) on the same E2 interface related to ongoing RIC Services shall be aborted.

8.3.2.3 Unsuccessful Operation

Void.

8.3.2.4 Abnormal Conditions

If the initiating node does not receive the RESET RESPONSE message, the initiating node may reinitiate the Reset procedure towards the same target node, provided that the content of the new RESET REQUEST message is identical to the content of the previously unacknowledged RESET REQUEST message.

8.3.3 Error Indication

8.3.3.1 General

The Error Indication procedure is initiated by either the E2 Node or the Near-RT RIC to report detected errors in one incoming message, provided they cannot be reported by an appropriate failure message.

8.3.3.2 Successful Operation

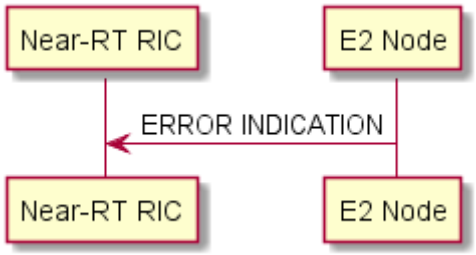

Figure 8.3.3.2-1: Error Indication, (E2 Node initiated) successful operation.

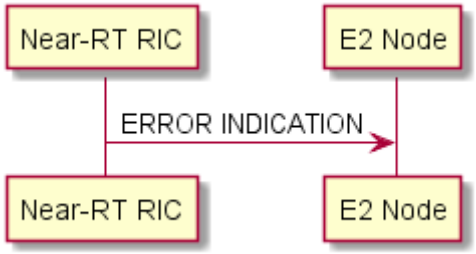

Figure 8.3.3.2-2: Error Indication, (Near-RT RIC Initiated) successful operation.

When the conditions defined in clause 10 are fulfilled, the Error Indication procedure is initiated by an ERROR INDICATION message sent from the node detecting the error situation.

The ERROR INDICATION message shall contain at least either the *Cause* IE or the *Criticality Diagnostics* IE and may include *RAN Function ID* IE and *RIC Request ID* IE.

8.3.3.3 Unsuccessful Operation

Not applicable.

8.3.3.4 Abnormal Conditions

Not applicable.

8.3.4 RIC Service Update procedure

8.3.4.1 General

The purpose of the RIC Service Update procedure is to update application level configuration data needed for E2 Node and Near-RT RIC to interoperate correctly over the E2 interface.

8.3.4.2 Successful Operation

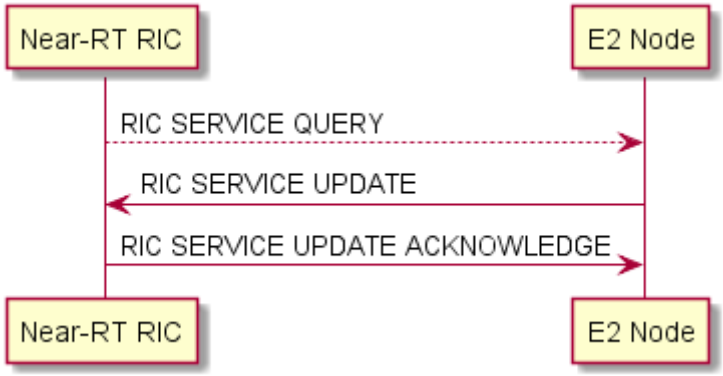

Figure 8.3.4.2-1: RIC Service Update procedure, successful operation

An E2 Node initiates the procedure by sending a RIC SERVICE UPDATE message to the Near-RT RIC. Such message shall include an appropriate set of up-to-date Near-RT RIC service-related configuration data, including, but not limited to, the complete lists of added, modified and deleted supported Near-RT RIC Service functions that E2 Node has just taken into operational use along with a revision counter for each item in each list.

Upon reception of a RIC SERVICE UPDATE message, Near-RT RIC shall update the information for E2 Node as follows:

Update of Supported Near-RT RIC service Information:

- If the *RAN Function Added List* IE is contained in the RIC SERVICE UPDATE message, Near-RT RIC shall add each listed accepted function information according to the information in the *RAN Function ID* IE and *RAN Function Definition* IE and store the corresponding *RAN Function Revision* IE.

- If the *RAN Function Modified List* IE is contained in the RIC SERVICE UPDATE message, Near-RT RIC shall modify accepted information of supported functions according to the information in the *RAN Function Definition* IE and update the corresponding *RAN Function Revision* IE.

- If the *RAN Function Deleted List* IE is contained in the RIC SERVICE UPDATE message, Near-RT RIC shall delete information of RAN Function indicated by the *RAN Function ID* IE along with the corresponding *RAN Function Revision* IE.

These changes may be processed in the Near-RT-RIC and may be used when issuing RIC SUBSCRIPTION REQUEST and RIC CONTROL to provide valid *RAN Function ID* IE.

If at least one RAN Function update request is successful, then the Near-RT RIC shall send the RIC SERVICE UPDATE ACKNOWLEDGE message to the initiating E2 Node with the *RAN Functions Accepted List* IE indicating accepted requests to add, modify, and/or delete the corresponding RAN Function information and, if required, the *RAN Functions Rejected List* IE indicating rejected requests to add, modify, and/or delete the corresponding RAN Function information. In case the Near-RT RIC receives a RIC SERVICE UPDATE message without any IE except for *Message Type* IE, it shall reply with RIC SERVICE UPDATE ACKNOWLEDGE message without performing any updates to the existing configuration.

Optionally, the RIC SERVICE UPDATE message to the Near-RT RIC may have been sent as a response to the Near-RT RIC initiated RIC SERVICE QUERY message. Upon reception of the RIC SERVICE QUERY message:

- If the *RAN Function Accepted List* IE is not present, the E2 Node shall send the RIC SERVICE UPDATE message with the complete list of supported RAN Functions in the *RAN Function Added List* IE
- If the *RAN Function Accepted List* IE is present and aligns with the list of supported RAN Functions at the E2 Node, the E2 Node shall send the RIC SERVICE UPDATE message without the *RAN Function Added List* IE, *RAN Function Modified List* IE and *RAN Function Deleted List* IE.
- If the *RAN Function Accepted List* IE is present and the list of RAN Functions in the *RAN Function Accepted List* IE does not align with the list of supported RAN Functions at the E2 node, the E2 Node shall send the RIC SERVICE UPDATE message with the *RAN Function Added List* IE, *RAN Function Modified List* IE and/or *RAN Function Deleted List* IE to ensure realignment of RAN Functions between the E2 Node and the Near-RT RIC.

8.3.4.3 Unsuccessful Operation

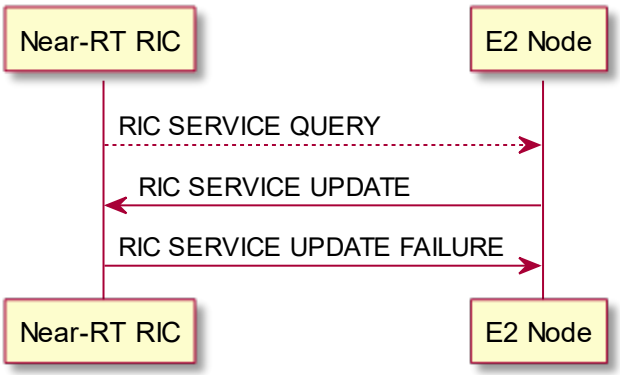

Figure 8.3.4.3-1: RIC Service Update procedure, unsuccessful operation

If the Near-RT RIC cannot accept the update it shall respond with a RIC SERVICE UPDATE FAILURE message and appropriate cause value.

If the RIC SERVICE UPDATE FAILURE message includes the *Time To Wait* IE, the E2 Node shall wait at least for the indicated time before reinitiating the RIC Service Update procedure towards the same Near-RT RIC. Both nodes shall continue to operate the E2 with their existing Near-RT RIC Service data.

8.3.4.4 Abnormal Conditions

If the E2 Node after initiating a RIC Service Update procedure receives neither the RIC SERVICE UPDATE ACKNOWLEDGE message nor the RIC SERVICE UPDATE FAILURE message, the E2 Node may reinitiate the RIC Service Update procedure towards the same Near-RT RIC, provided that the content of the new RIC SERVICE UPDATE message is identical to the content of the previously unacknowledged RIC SERVICE UPDATE message.

8.3.5 E2 Node Configuration Update procedure

8.3.5.1 General

The purpose of the E2 Node Configuration Update procedure is to update application level E2 Node configuration data needed for E2 Node and Near-RT RIC to interoperate correctly over the E2 interface and to support E2 Node initiated TNL association removal.

8.3.5.2 Successful Operation

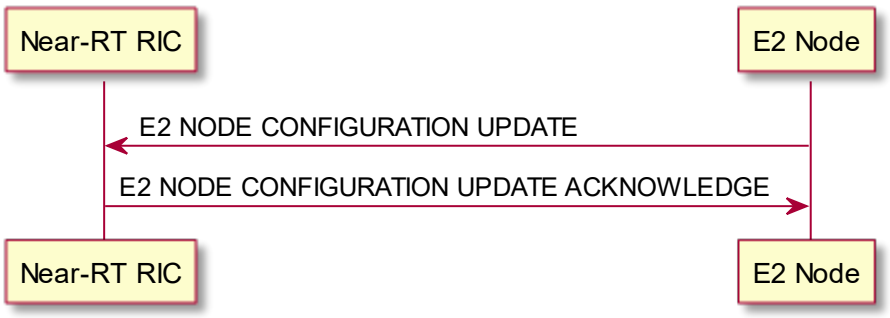

Figure 8.3.5.2-1: E2 Node Configuration Update procedure, successful operation

An E2 Node initiates the procedure by sending a E2 NODE CONFIGURATION UPDATE message to the Near-RT RIC. Such message shall include an appropriate set of up-to-date E2 Node-related configuration data that the E2 Node has just taken into operational use.

Upon reception of the E2 NODE CONFIGURATION UPDATE message, Near-RT RIC shall update the information for the E2 Node as follows:

Update of E2 Node configuration information in Near-RT RIC:

- If *E2 Node Component Configuration Addition List* IE is contained in the E2 NODE CONFIGURATION UPDATE message, Near-RT RIC shall add the E2 Node Component Configuration information accordingly.

- If *E2 Node Component Configuration Update List* IE is contained in the E2 NODE CONFIGURATION UPDATE message, Near-RT RIC shall modify the E2 Node Component Configuration information accordingly.

- If *E2 Node Component Configuration Removal List* IE is contained in the E2 NODE CONFIGURATION UPDATE message, Near-RT RIC shall remove the E2 Node Component Configuration information accordingly

If *Global E2 Node ID* IE is contained in the E2 NODE CONFIGURATION UPDATE message for a newly established SCTP association, the Near-RT RIC will associate this association with the related E2 Node.

If the E2 NODE CONFIGURATION UPDATE message includes *E2 Node TNL Association To Remove List* IE, and the *Endpoint IP address* IE and the *Port Number* IE for both TNL endpoints of the TNL association(s) are included in the *E2 Node TNL Association To Remove List* IE, the Near-RT RIC shall, if supported, consider that the TNL association(s) indicated by both received TNL endpoints will be removed by the E2 Node. If the *Endpoint IP address* IE, or the *Endpoint IP address* IE and the *Port Number* IE for one or both of the TNL endpoints is included in the *E2 Node TNL Association To Remove List* IE in E2 NODE CONFIGURATION UPDATE message, the Near-RT RIC shall, if supported, consider that the TNL association(s) indicated by the received endpoint IP address(es) will be removed by the E2 Node.

After successful update of requested information, Near-RT RIC shall reply with the E2 NODE CONFIGURATION UPDATE ACKNOWLEDGE message to inform the initiating E2 Node that the requested update of application data was performed successfully. In case the Near-RT RIC receives a E2 NODE CONFIGURATION UPDATE message without any IE except for *Message Type* IE and *Transaction ID* IE it shall reply with the E2 NODE CONFIGURATION UPDATE ACKNOWLEDGE message without performing any updates to the existing configuration. In the case where the Near-RT RIC receives an *E2 Node Component Configuration Update Item* IE for an E2 Node component that was not previously declared by an *E2 Node Component Configuration Addition Item* IE then the Near-RT RIC shall indicate to the E2 Node that the update failed with appropriate cause value.

8.3.5.3 Unsuccessful Operation

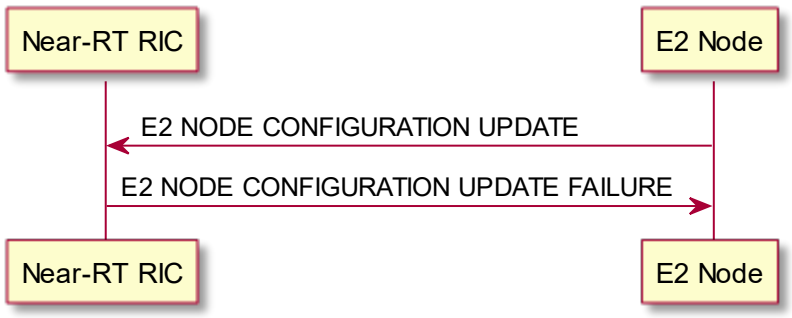

Figure 8.3.5.3-1: E2 Node Configuration Update procedure, unsuccessful operation

If Near-RT RIC cannot accept the E2 NODE CONFIGURATION UPDATE message it shall respond with the E2 NODE CONFIGURATION UPDATE FAILURE message and appropriate cause value.

If the E2 NODE CONFIGURATION UPDATE FAILURE message includes the *Time To Wait* IE the E2 Node shall wait at least for the indicated time before reinitiating the E2 Node Configuration Update procedure towards the same Near-RT RIC. Both nodes shall continue to operate with their existing configuration data.

8.3.5.4 Abnormal Conditions

If an E2 Node, after initiating the E2 Node Configuration Update procedure, receives neither the E2 NODE CONFIGURATION UPDATE ACKNOWLEDGE message nor the E2 NODE CONFIGURATION UPDATE FAILURE message, the E2 Node may reinitiate the E2 Node Configuration Update procedure towards the same Near-RT RIC, provided that the content of the new E2 NODE CONFIGURATION UPDATE message is identical to the content of the previously unacknowledged E2 NODE CONFIGURATION UPDATE message.

8.3.6 E2 Connection Update procedure

8.3.6.1 General

The purpose of the E2 Connection Update procedure is to allow the Near-RT RIC to update the E2 interface connection between the E2 Node and Near-RT RIC.

8.3.6.2 Successful Operation

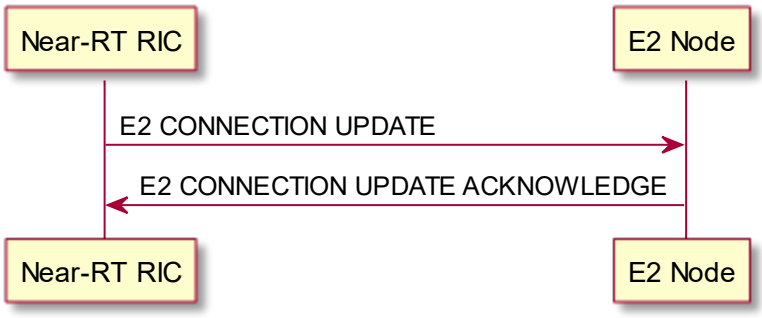

Figure 8.3.6.2-1: E2 Connection Update procedure, successful operation

The Near-RT RIC initiates the procedure by sending a E2 CONNECTION UPDATE message to the E2 Node. Such message shall include an appropriate set of up-to-date E2 interface connection data that the E2 Node shall take into account when modifying the E2 interface connection.

Upon reception of a E2 CONNECTION UPDATE message, the E2 Node shall update as follows:

If *E2 Connection To Add List* IE is contained in the E2 CONNECTION UPDATE message, then the E2 Node shall, if supported, use it to establish additional TNL Association(s) and configure for use for RIC services and/or E2 support functions according to the *TNL Association Usage* IE in the message.

If *E2 Connection To Modify List* IE is contained in the E2 CONNECTION UPDATE message, then the E2 Node shall, if supported, use it to modify the existing usage for RIC services and/or E2 support functions, according to the *TNL Association Usage* IE in the message.

If *E2 Connection To Remove List* IE is contained in the E2 CONNECTION UPDATE message, then the E2 Node shall, if supported, use it to remove the existing connection(s). If only one connection remains after successful removal of other connections, the E2 Node shall use this remaining connection for all the RIC services and E2 support functions.

After successful update of E2 interface connection(s), the E2 Node shall reply with the E2 CONNECTION UPDATE ACKNOWLEDGE message to inform the initiating Near-RT RIC that the requested E2 connection update was performed successfully. In case the E2 Node receives a E2 CONNECTION UPDATE message without any IE except for *Message Type* IE and *Transaction ID* IE, it shall reply with the E2 CONNECTION ACKNOWLEDGE message without performing any updates to the existing connections.

E2 NODE CONFIGURATION UPDATE procedure shall be the first E2AP procedure triggered on an additional TNLA of an already setup E2 interface instance after the TNL association has become operational, and the Near-RT RIC shall associate the TNLA to the E2 interface instance using the included *Global E2 Node ID*. An empty E2 NODE CONFIGURATION UPDATE message (i.e. without any IE expect for *Message Type* IE and *Transaction ID* IE) shall be sent as the first E2AP procedure on the new TNLA, if the E2 Node does not have any Configuration to be updated to Near-RT RIC.

8.3.6.3 Unsuccessful Operation

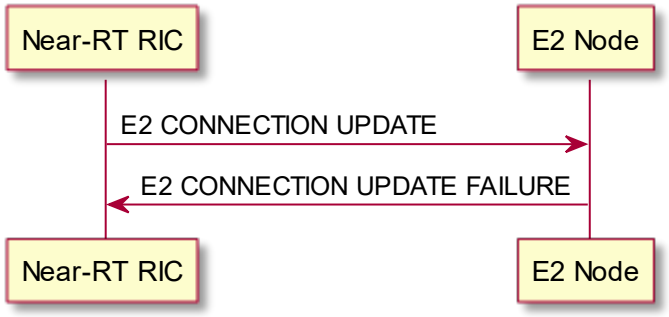

Figure 8.3.6.3-1: E2 Connection Update procedure, unsuccessful operation

If the E2 Node cannot accept the update, it shall respond with a E2 CONNECTION UPDATE FAILURE message and appropriate cause value.

If the E2 CONNECTION UPDATE FAILURE message includes the *Time To Wait* IE, the Near-RT RIC shall wait at least for the indicated time before reinitiating the E2 Connection Update procedure towards the same E2 Node. Both nodes shall continue to operate with their existing connection(s).

8.3.6.4 Abnormal Conditions

If the Near-RT RIC, after initiating E2 Connection Update procedure, receives neither the E2 CONNECTION UPDATE ACKNOWLEDGE message nor the E2 CONNECTION UPDATE FAILURE message, the Near-RT RIC may reinitiate the E2 Connection Update procedure towards the same E2 Node, provided that the content of the new E2 CONNECTION UPDATE message is identical to the content of the previously unacknowledged E2 CONNECTION UPDATE message.

8.3.7 E2 Removal procedure

8.3.7.1 General

The purpose of the E2 removal procedure is to remove the E2 signaling connection between the Near-RT RIC and the E2 node in a controlled manner. If successful, this procedure erases any existing application level configuration data in the Near-RT RIC and the E2 node, respectively.

8.3.7.2 Successful Operation

This procedure may be initiated by either Near-RT RIC or E2 Node.

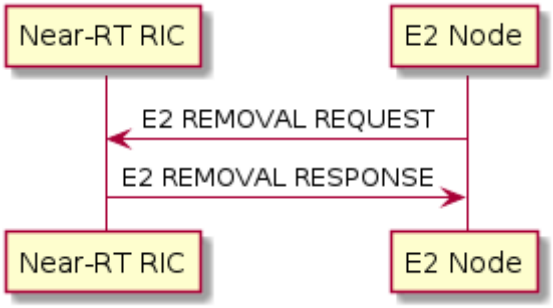

Figure 8.3.7.2-1: E2 Removal, successful operation (E2 Node Initiated)

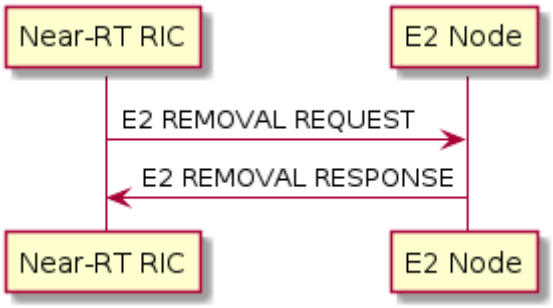

Figure 8.3.7.2-2: E2 Removal, successful operation (Near-RT RIC Initiated)

Successful E2 Removal, E2 Node initiated

The E2 Node initiates the procedure by sending the E2 REMOVAL REQUEST message to the Near-RT RIC. Upon reception of the E2 REMOVAL REQUEST message, the Near-RT RIC shall reply with the E2 REMOVAL RESPONSE message. After receiving the E2 REMOVAL RESPONSE message, the E2 Node shall initiate removal of the TNL association towards the Near-RT RIC, and shall remove all resources associated with that E2 signaling connection. The Near-RT RIC shall then remove all resources associated with that E2 signaling connection.

Successful E2 Removal, Near-RT RIC initiated

The Near-RT RIC initiates the procedure by sending the E2 REMOVAL REQUEST message to the E2 node. Upon reception of the E2 REMOVAL REQUEST message the E2 node shall reply with the E2 REMOVAL RESPONSE message. After receiving the E2 REMOVAL RESPONSE message, the Near-RT RIC may initiate removal of the TNL association towards the E2 node, and shall remove all resources associated with that E2 signaling connection. The E2 node shall then remove all resources associated with that E2 signaling connection.

Interactions with other procedures:

If the E2 REMOVAL REQUEST message is received, any other ongoing procedure on the same E2 interface related to ongoing RIC Services shall be aborted.

8.3.7.3 Unsuccessful Operation

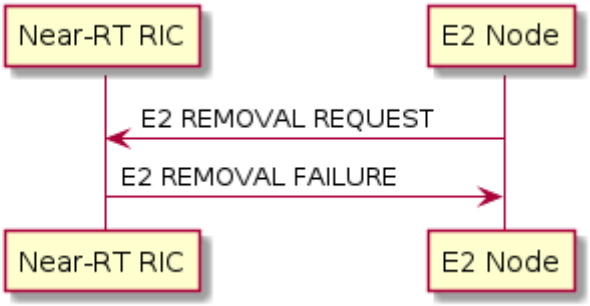

Figure 8.3.7.3-1: E2 Removal procedure (E2 Node Initiated), unsuccessful operation

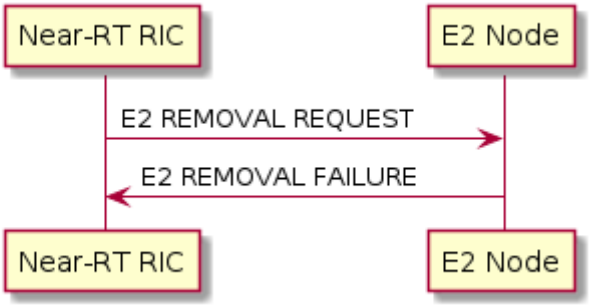

Figure 8.3.7.3-2: E2 Removal procedure (Near-RT RIC Initiated), unsuccessful operation

If the E2 Node cannot accept the E2 REMOVAL REQUEST it shall respond with E2 REMOVAL FAILURE message with an appropriate cause value.

If the Near-RT RIC cannot accept the E2 REMOVAL REQUEST it shall respond with E2 REMOVAL FAILURE message with an appropriate cause value.

8.3.7.4 Abnormal Conditions

If the Near-RT RIC, after initiating E2 Removal procedure, receives neither the E2 REMOVAL RESPONSE message nor the E2 REMOVAL FAILURE message, the Near-RT RIC may reinitiate the E2 Removal procedure towards the same E2 Node, provided that the content of the new E2 REMOVAL REQUEST message is identical to the content of the previously unacknowledged E2 REMOVAL REQUEST message.

If the E2 Node, after initiating E2 Removal procedure, receives neither the E2 REMOVAL RESPONSE message nor the E2 REMOVAL FAILURE message, the E2 Node may reinitiate the E2 Removal procedure towards theNear-RT RIC, provided that the content of the new E2 REMOVAL REQUEST message is identical to the content of the previously unacknowledged E2 REMOVAL REQUEST message.

9 Elements for E2AP Communication

9.0 General

Sub clauses 9.1 and 9.2 describe the structure of the messages and information elements required for the E2AP protocol in tabular format. Sub clause 9.3 provides the corresponding ASN.1 definition.

The following attributes are used for the tabular description of the messages and information elements: Presence, Range Criticality and Assigned Criticality. Their definition and use can be found in TS 36.413 [24].

NOTE: The messages have been defined in accordance to the guidelines specified in TR 25.921 [14].

9.1 Message Functional Definition and Content

9.1.1 Messages for Near-RT RIC Functional Procedures

9.1.1.1 RIC SUBSCRIPTION REQUEST

This message is sent by the Near-RT RIC to an E2 Node to create a new Subscription in the E2 Node.

Direction: Near-RT RIC → E2 Node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
RIC Request ID	M		9.2.7		YES	reject
RAN Function ID	M		9.2.8		YES	reject
RIC Subscription Details	M				YES	reject
>RIC Event Trigger Definition	M		9.2.9		-	
>Sequence of Actions		1.. <maxofRICactionID>			EACH	ignore
>>RIC Action ID	M		9.2.10		-	
>>RIC Action Type	M		9.2.11		-	
>>RIC Action Definition	O		9.2.12		-	
>>RIC Subsequent Action	O		9.2.13		-	

Range bound	Explanation
maxofRICActionID	Maximum no. of Actions to be requested by Near-RT RIC. Value is 16.

9.1.1.2 RIC SUBSCRIPTION RESPONSE

This message is sent by the E2 Node to accept the request from the Near-RT RIC to create a new Subscription in the E2 Node.

Direction: E2 Node → Near-RT RIC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
RIC Request ID	M		9.2.7		YES	reject
RAN Function ID	M		9.2.8		YES	reject
RIC Actions Admitted List		1.. <maxofRICactionID>			YES	reject
>RIC Action ID	M		9.2.10		-	
RIC Actions Not Admitted List		0.. <maxofRICactionID>			YES	reject
>RIC Action ID	M		9.2.10		-	
>Cause	M		9.2.1		-	

Range bound	Explanation
maxofRICActionID	Maximum no. of Actions to be requested by Near-RT RIC. Value is 16.

9.1.1.3 RIC SUBSCRIPTION FAILURE

This message is sent by the E2 Node to inform the Near-RT RIC that the request to create a new Subscription in the E2 Node failed.

Direction: E2 Node → Near-RT RIC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
RIC Request ID	M		9.2.7		YES	reject
RAN Function ID	M		9.2.8		YES	reject
Cause	M		9.2.1		YES	reject
Criticality Diagnostics	O		9.2.2		YES	ignore

9.1.1.4 RIC SUBSCRIPTION DELETE REQUEST

This message is sent by the Near-RT RIC to an E2 Node to request the deletion of an existing Subscription in the E2 Node previously created for the Near-RT RIC.

Direction: Near-RT RIC → E2 Node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
RIC Request ID	M		9.2.7		YES	reject
RAN Function ID	M		9.2.8		YES	reject

9.1.1.5 RIC SUBSCRIPTION DELETE RESPONSE

This message is sent by the E2 Node to accept the request from a Near-RT RIC to delete an existing Subscriptionin the E2 Node

Direction: E2 Node → Near-RT RIC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
RIC Request ID	M		9.2.7		YES	reject
RAN Function ID	M		9.2.8		YES	reject

9.1.1.6 RIC SUBSCRIPTION DELETE FAILURE

This message is sent by the E2 Node to inform the Near-RT RIC that the request to delete an existing Subscription in the E2 Node failed.

Direction: E2 Node → Near-RT RIC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
RIC Request ID	M		9.2.7		YES	reject
RAN Function ID	M		9.2.8		YES	reject
Cause	M		9.2.1		YES	ignore
Criticality Diagnostics	O		9.2.2		YES	ignore

9.1.1.6A RIC SUBSCRIPTION DELETE REQUIRED

This message is sent by the E2 Node to request deletion of the existing RIC Subscriptions in the E2 Node previously created for the Near-RT RIC.

Direction: E2 Node → Near-RT RIC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
List of RIC Subscriptions To Be Removed		*1.. <maxofRICrequestID>*			EACH	ignore
>RIC Request ID	M		9.2.7		-	-
>RAN Function ID	M		9.2.8		-	-
>Cause	M		9.2.1		-	-

Range bound	Explanation
maxofRICrequestID	Maximum no. of RIC subscription requests supported by Near-RT RIC toward an E2 Node. Value is <1024>.

9.1.1.7 RIC INDICATION

This message is sent by an E2 Node to transfer Report information to a Near-RT RIC.

Direction: E2 Node → Near-RT RIC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
RIC Request ID	M		9.2.7		YES	reject
RAN Function ID	M		9.2.8		YES	reject
RIC Action ID	M		9.2.10		YES	reject
RIC Indication SN	O		9.2.14		YES	reject
RIC Indication Type	M		9.2.15		YES	reject
RIC Indication Header	M		9.2.17		YES	reject
RIC Indication Message	M		9.2.16		YES	reject
RIC Call process ID	O		9.2.18		YES	reject

9.1.1.8 RIC CONTROL REQUEST

This message is sent by a Near-RT RIC to an E2 Node to initiate or resume a control function logic.

Direction: Near-RT RIC → E2 Node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
RIC Request ID	M		9.2.7		YES	reject
RAN Function ID	M		9.2.8		YES	reject
RIC Call Process ID	O		9.2.18		YES	reject
RIC Control Header	M		9.2.20		YES	reject
RIC Control Message	M		9.2.19		YES	reject
RIC Control Ack Request	O		9.2.21		YES	reject

9.1.1.9 RIC CONTROL ACKNOWLEDGE

This message is sent by the E2 Node to inform the Near-RT RIC that the RIC CONTROL REQUEST message was received and to provide information on the outcome of the request.

Direction: E2 Node → Near-RT RIC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
RIC Request ID	M		9.2.7		YES	reject
RAN Function ID	M		9.2.8		YES	reject
RIC Call process ID	O		9.2.18		YES	reject
RIC Control Outcome	O		9.2.25		YES	reject

9.1.1.10 RIC CONTROL FAILURE

This message is sent by the E2 Node to inform the Near-RT RIC that the RIC CONTROL REQUEST message has failed to be executed.

Direction: E2 Node → Near-RT RIC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
RIC Request ID	M		9.2.7		YES	reject
RAN Function ID	M		9.2.8		YES	reject
RIC Call process ID	O		9.2.18		YES	reject
Cause	M		9.2.1		YES	ignore
RIC Control Outcome	O		9.2.25		YES	Reject
Criticality Diagnostics	O		9.2.2		YES	ignore

9.1.2 Messages for Global Procedures

9.1.2.1 ERROR INDICATION

This message is used to indicate that some error has been detected in the E2 Node or Near-RT RIC.

Direction: E2 Node → Near-RT RIC or Near-RT RIC → E2 Node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	ignore
Transaction ID	O		9.2.33	Required if *RIC Request ID* IE is not present	YES	reject
RIC Request ID	O		9.2.7	Required if *Transaction ID* IE is not present	YES	reject
RAN Function ID	O		9.2.8		YES	reject
Cause	O		9.2.1		YES	ignore
Criticality Diagnostics	O		9.2.2		YES	ignore

9.1.2.2 E2 SETUP REQUEST

This message is sent by an E2 Node to a Near-RT RIC to transfer the initialization information.

Direction: E2 Node → Near-RT RIC

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33	.	YES	reject
Global E2 Node ID	M		9.2.6		YES	reject
RAN Functions Added List		*1*		List of RAN functions in E2 node	YES	reject
>RAN Function item		*1.. <maxofRANfunctionID>*				
>>RAN Function ID	M		9.2.8	Id of the declared Function	-	
>>RAN Function Definition	M		9.2.23	Definition of Function	-	
>>RAN Function Revision	M		9.2.24	Revision counter	-	
>>RAN Function OID	M		9.2.31	Object identifier of corresponding E2SM	-	
E2 Node Component Configuration Addition List		*1*		List of E2 Node component configuration information	YES	reject
>E2 Node Component Configuration Addition Item		*1.. <maxofE2nodeComponents>*			EACH	reject
>>E2 Node Component Interface Type	M		9.2.26	E2 Node component interface type	-	
>>E2 Node Component ID	O		9.2.32	E2 Node Component Identifier	-	
>>E2 Node Component Configuration	M		9.2.27	Contents depends on component interface type	-	

Range bound	Explanation
maxofRANfunctionID	Maximum no. of RAN Functions supported by E2 Node. Value is 256.
maxofE2nodeComponents	Maximum no. of E2 Node components supported by E2 Node. Value is 1024

9.1.2.3 E2 SETUP RESPONSE

This message is sent by a Near-RT RIC to an E2 Node to transfer the initialization information.

Direction: Near-RT RIC →E2 Node

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33	.	YES	reject
Global RIC ID	M		9.2.4		YES	reject
RAN Functions Accepted List		*0..1*		Complete list of Functions accepted by Near-RT RIC		
>RAN Functions ID item		*1 .. <maxofRANfunctionID>*			YES	Reject
>>RAN Function ID	M		9.2.8	Id of the declared Function	-	
>>RAN Function Revision	M		9.2.24	Revision counter	-	
RAN Functions Rejected List		*0..1*		Complete list of Functions not accepted by Near-RT RIC		
RAN Functions ID Cause Item		*1 .. <maxofRANfunctionID>*			YES	reject
>>RAN Function ID	M		9.2.8	Id of the declared Function	-	
>>Cause	M		9.2.1	Reason for not accepting function	-	
E2 Node Component Configuration Addition Acknowledge List		*1*		Complete list of E2 Node Components in the E2 SETUP REQUEST message	YES	reject
>E2 Node Component Configuration Addition Acknowledge Item		*1.. <maxofE2nodeComponents>*			EACH	reject
>>E2 Node Component Interface Type	M		9.2.26	E2 Node component interface type	-	
>>E2 Node Component ID	M		9.2.32	E2 Node Component Identifier	-	
>>E2 Node Component Configuration Acknowledge	M		9.2.28	Success or failure with Cause	-	

Range bound	Explanation
maxofRANfunctionID	Maximum no. of RAN Functions supported by E2 Node. Value is 256.
maxofE2nodeComponents	Maximum no. of E2 Node components supported by E2 Node. Value is 1024

9.1.2.4 E2 SETUP FAILURE

This message is sent by the Near-RT RIC to indicate E2 Setup failure.

Direction: Near-RT RIC → E2 Node

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33	.	YES	reject
Cause	M		9.2.1		YES	ignore
Time To Wait	O		9.2.5		YES	ignore
Criticality Diagnostics	O		9.2.2		YES	Ignore
Transport Layer Information	O		9.2.29		YES	ignore

9.1.2.5 RESET REQUEST

This message is sent from a Near-RT RIC to an E2 Node or from an E2 Node to a Near-RT RIC and is used to request the E2 interface between the E2 node and the Near-RT RIC to be reset.

Direction: Near-RT RIC → E2 Node, or E2 Node → Near-RT RIC

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33	.	YES	reject
Cause	M		9.2.1		YES	ignore

9.1.2.6 RESET RESPONSE

This message is sent by an E2 Node to a Near-RT RIC or from a Near-RT RIC to an E2 Node as a response to a RESET REQUEST message.

Direction: Near-RT RIC → E2 Node, or E2 Node → Near-RT RIC

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33	.	YES	reject
Criticality Diagnostics	O		9.2.2		YES	ignore

9.1.2.7 RIC SERVICE UPDATE

This message is sent by an E2 Node to the Near-RT RIC to transfer updated information on RIC Services supported by the E2 Node.

Direction: E2 Node → Near-RT RIC

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33	.	YES	reject
RAN Functions Added List		*0..1*		List of added RAN functions in E2 node		
>RAN Functions Item		*1 .. <maxofRANfunctionID>*			YES	reject
>>RAN Function ID	M		9.2.8	Id of the declared Function	-	
>>RAN Function Definition	M		9.2.23	Definition of Function	-	
>>RAN Function Revision	M		9.2.24	Revision counter	-	
>>RAN Function OID	M		9.2.31	Object identifier of corresponding E2SM	-	
RAN Functions Modified List		*0..1*		List of Modified RAN functions in E2 node		
>RAN Functions Item		*1 .. <maxofRANfunctionID>*			YES	reject
>>RAN Function ID	M		9.2.8	Id of the declared Function	-	
>>RAN Function Definition	M		9.2.23	Definition of Function	-	
>>RAN Function Revision	M		9.2.24	Revision counter	-	
>>RAN Function OID	M		9.2.31	Object identifier of corresponding E2SM	-	
RAN Functions Deleted List		*0..1*		List of deleted RAN functions in E2 node		
>RAN Functions ID Item		*1 .. <maxofRANfunctionID>*			YES	reject
>>RAN Function ID	M		9.2.8	Id of the declared Function	-	
>>RAN Function Revision	M		9.2.24	Revision counter	-	

Range bound	Explanation
maxofRANfunctionID	Maximum no. of Functions accepted by Near-RT RIC. Value is 256.

9.1.2.8 RIC SERVICE UPDATE ACKNOWLEDGE

This message is sent by the Near-RT RIC to the E2 Node to acknowledge update of RIC Services supported by the E2 Node.

Direction: Near-RT RIC → E2 Node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33	.	YES	reject
RAN Functions Accepted List		*0..1*		List of Functions accepted by Near-RT RIC		
>RAN Functions ID Item		*1 .. <maxofRANfunctionID>*			YES	reject
>>RAN Function ID	M		9.2.8	Id of the declared Function	-	
>>RAN Function Revision	M		9.2.24	Revision counter	-	
RAN Functions Rejected List		*0..1*		List of Functions not accepted by Near-RT RIC		
>RAN Functions Cause Item		*1 .. <maxofRANfunctionID>*			YES	reject
>>RAN Function ID	M		9.2.8	Id of the declared Function	-	
>>Cause	M		9.2.1	Reason for not accepting function	-	

Range bound	Explanation
maxofRANfunctionID	Maximum no. of Functions accepted by Near-RT RIC. Value is 256.

9.1.2.9 RIC SERVICE UPDATE FAILURE

This message is sent by the Near-RT RIC to the E2 Node to indicate RIC SERVICE Update Failure.

Direction: Near-RT RIC → E2 Node

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33	.	YES	reject
Cause	M		9.2.1	Reason for failure	YES	reject
Time To Wait	O		9.2.5		YES	ignore
Criticality Diagnostics	O		9.2.2		YES	ignore

9.1.2.10 RIC SERVICE QUERY

This message is sent by a Near-RT RIC to an E2 Node to request a E2 Node initiated RIC Service Update procedure.

Direction: Near-RT RIC → E2 Node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33	.	YES	reject
RAN Functions Accepted List		*0..1*		Complete list of Functions previously accepted by Near-RT RIC		
>RAN Functions ID Item		*1 .. <maxofRANfunctionID>*			YES	reject
>>RAN Function ID	M		9.2.8	Id of the declared Function	-	
>>RAN Function Revision	M		9.2.24	Revision counter	-	

Range bound	Explanation
maxofRANfunctionID	Maximum no. of Functions accepted by Near-RT RIC. Value is 256.

9.1.2.11 E2 NODE CONFIGURATION UPDATE

This message is sent by an E2 Node to the Near-RT RIC to transfer updated information on the E2 Node Configuration information.

Direction: E2 Node → Near-RT RIC

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33		YES	reject
Global E2 Node ID	O		9.2.6	Required when sent as first message on new TNL association	YES	reject
E2 Node Component Configuration Addition List		*0..1*			YES	reject
>E2 Node Component Configuration Addition Item		*1.. <maxofE2nodeComponents>*			EACH	reject
>>E2 Node Component Interface Type	M		9.2.26	E2 Node component interface type	-	
>>E2 Node Component ID	M		9.2.32	E2 Node Component Identifier	-	
>>E2 Node Component Configuration	M		9.2.27	Contents depends on component type	-	
E2 Node Component Configuration Update List		*0..1*			YES	reject
>E2 Node Component Configuration Update Item		*1.. <maxofE2nodeComponents>*			EACH	reject
>>E2 Node Component Interface Type	M		9.2.26	E2 Node component interface type	-	
>>E2 Node Component ID	M		9.2.32	E2 Node Component Identifier	-	
>>E2 Node Component Configuration	M		9.2.27	Contents depends on component type	-	
E2 Node Component Configuration Removal List		*0..1*			YES	reject
>E2 Node Component Configuration Removal Item		*1.. <maxofE2nodeComponents>*			EACH	reject
>>E2 Node Component Interface Type	M		9.2.26	E2 Node component interface type	-	
>>E2 Node Component ID	M		9.2.32	E2 Node Component Identifier	-	
E2 Node TNL Association To Remove List		*0..1*			YES	reject
>E2 Node TNL Association To Remove Item IEs		*1..<maxofTNLA>*			EACH	reject
>> Transport Layer Information	M		9.2.29	Transport Layer Address of the E2 node.	-	-
>> Transport Layer Information Near-RT RIC	O		9.2.29	Transport Layer Address of the Near-RT RIC.	-	-

1

Range bound	Explanation
maxofE2nodeComponents	Maximum no. of E2 Node components supported by E2 Node. Value is 1024.
maxofTNLA	Maximum no. of TNL Associations supported by E2 Node. Value is 32.

9.1.2.12 E2 NODE CONFIGURATION UPDATE ACKNOWLEDGE

This message is sent by Near-RT RIC to E2 Node to acknowledge update of E2 Node Configuration supported by the E2 Node.

Direction: Near-RT RIC → E2 Node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33	.	YES	reject
E2 Node Component Configuration Addition Acknowledge List		*0..1*			YES	reject
>E2 Node Component Configuration Addition Acknowledge Item		*1.. <maxofE2node Components>*			EACH	reject
>>E2 Node Component Interface Type	M		9.2.26	E2 Node component interface type	-	
>>E2 Node Component ID	M		9.2.32	E2 Node Component Identifier	-	
>>E2 Node Component Configuration Acknowledge	M		9.2.28	Success or failure with Cause	-	
E2 Node Component Configuration Update Acknowledge List		*0..1*			YES	reject
>E2 Node Component Configuration Update Acknowledge Item		*1.. <maxofE2node Components>*			EACH	reject
>>E2 Node Component Interface Type	M		9.2.26	E2 Node component interface type	-	
>>E2 Node Component ID	O		9.2.32	E2 Node Component Identifier	-	
>>E2 Node Component Configuration Update Acknowledge	M		9.2.28	Success or failure with Cause	-	
E2 Node Component Configuration Removal Acknowledge List		*0..1*			YES	reject
>E2 Node Component Configuration Removal Acknowledge Item		*1.. <maxofE2node Components>*			EACH	reject
>>E2 Node Component Interface Type	M		9.2.26	E2 Node component interface type	-	
>>E2 Node Component ID	M		9.2.32	E2 Node Component Identifier	-	
>>E2 Node Component Configuration Acknowledge	M		9.2.28	Success or failure with Cause	-	

Range bound	Explanation
maxofE2nodeComponents	Maximum no. of E2 Node components supported by E2 Node. Value is 1024.

9.1.2.13 E2 NODE CONFIGURATION UPDATE FAILURE

This message is sent by Near-RT RIC to E2 Node to indicate E2 Node Configuration Update Failure.

Direction: Near-RT RIC → E2 Node

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33	.	YES	reject
Cause	M		9.2.1	Cause	YES	reject
Time To Wait	O		9.2.5		YES	ignore
Criticality Diagnostics	O		9.2.2		YES	ignore

9.1.2.14 E2 CONNECTION UPDATE

This message is sent by Near-RT RIC to E2 Node to initiate update of E2 Connection supported by the E2 Node.

Direction: Near-RT RIC → E2 Node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33	.	YES	reject
E2 Connection To Add List		*0..1*			YES	ignore
>E2 Connection to Add Item IEs		*1.. <maxofTNLA>*			EACH	ignore
>>Transport Layer Information	M		9.2.29	Transport layer address and port number of Near-RT RIC		
>>TNL Association Usage	M		9.2.30	Indicates how E2 connection is to be used		
E2 Connection To Remove List		*0..1*			YES	ignore
>E2 Connection to Remove Item IEs		*1.. <maxofTNLA>*			EACH	ignore
>>Transport Layer Information	M		9.2.29	Transport layer address and port number of Near-RT RIC		
E2 Connection To Modify List		*0..1*			YES	ignore
>E2 Connection to Modify Item IEs		*1.. <maxofTNLA>*			EACH	ignore
>>Transport Layer Information	M		9.2.29	Transport layer address and port number of Near-RT RIC		
>>TNL Association Usage	M		9.2.30	Indicates how E2 connection is to be used		

Range bound	Explanation
maxofTNLA	Maximum no. of TNL Associations supported by E2 Node. Value is 32.

9.1.2.15 E2 CONNECTION UPDATE ACKNOWLEDGE

This message is sent by E2 Node to the Near-RT RIC to acknowledge update of E2 Connection supported by the E2 Node.

Direction: E2 Node → Near-RT RIC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33	.	YES	reject
E2 Connection Setup List		*0..1*			YES	ignore
>E2 Connection Setup Item IEs		*1.. <maxofTNLA>*			EACH	ignore
>>Transport Layer Information	M		9.2.29	Transport layer address and port number of Near-RT RIC		
>>TNL Association Usage	M		9.2.30	Indicates how E2 connection is to be used		
E2 Connection Failed to Setup List		*0..1*			YES	ignore
>E2 Connection failed to setup Item IEs		*1.. <maxofTNLA>*			EACH	ignore
>>Transport Layer Information	M		9.2.29	Transport layer address and port number of Near-RT RIC		
>>Cause	M		9.2.1			

Range bound	Explanation
maxofTNLA	Maximum no. of TNL Associations supported by E2 Node. Value is 32.

9.1.2.16 E2 CONNECTION UPDATE FAILURE

This message is sent by E2 Node to the Near-RT RIC to inform failure of the requested E2 Connection updates.

Direction: E2 Node → Near-RT RIC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33	.	YES	reject
Cause	M		9.2.1		YES	reject
Time To Wait	O		9.2.5		YES	ignore
Criticality Diagnostics	O		9.2.2		YES	ignore

9.1.2.17 E2 REMOVAL REQUEST

This message is sent by either the E2 Node or the Near-RT RIC to initiate the removal of the E2 signaling connection and the related resources.

Direction: Near-RT RIC → E2 Node, or E2 Node → Near-RT RIC

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33		YES	reject

9.1.2.18 E2 REMOVAL RESPONSE

This message is sent by either the E2 Node or the Near-RT RIC to acknowledge the initiation of removal of the E2 signaling connection and the related resources.

Direction: Near-RT RIC → E2 Node, or E2 Node → Near-RT RIC

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33	.	YES	reject
Criticality Diagnostics	O		9.2.2		YES	ignore

9.1.2.19 E2 REMOVAL FAILURE

This message is sent by either the E2 Node or the Near-RT RIC to indicate that removing the E2 signaling connection and the related resources cannot be accepted.

Direction: Near-RT RIC → E2 Node, or E2 Node → Near-RT RIC

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.3		YES	reject
Transaction ID	M		9.2.33	.	YES	reject
Cause	M		9.2.1		YES	ignore
Criticality Diagnostics	O		9.2.2		YES	ignore

9.2 Information Element definitions

9.2.0 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.

9.2.1 Cause

The purpose of the *Cause* IE is to indicate the reason for a particular event for the E2AP protocol.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
CHOICE *Cause Group*	M			
>RIC services				
>>RIC Request	O		ENUMERATED (RAN Function ID invalid, Action not supported, Excessive actions, Duplicate action, Duplicate Event Trigger, Function resource limit, RIC Request ID unknown, Inconsistent Action/subsequent Action sequence, Control message invalid, RIC Call process ID invalid, Control timer expired, Control failed to execute,	

			System not ready, unspecified, …)	
>>RIC Service	O		ENUMERATED RAN Function not supported, Excessive functions, RIC resource limit,…)	
>>E2 Node	O		ENUMERATED (E2 node component unknown, …)	
>Transport Layer				
>>Transport Layer Cause	M		ENUMERATED (Unspecified, Transport Resource Unavailable, ...)	
>Protocol				
>>Protocol Cause	M		ENUMERATED (Transfer Syntax Error, Abstract Syntax Error (Reject), Abstract Syntax Error (Ignore and Notify), Message not Compatible with Receiver State, Semantic Error, Abstract Syntax Error (Falsely Constructed Message), Unspecified, ...)	
>Misc				
>>Miscellaneous Cause	M		ENUMERATED (Control Processing Overload, Hardware Failure, O&M Intervention, Unspecified, ...)	

The meaning of the different cause values is described in the following table. In general, "not supported" cause values indicate that the related capability is missing. On the other hand, "not available" cause values indicate that the related capability is present, but insufficient resources were available to perform the requested action.

RIC Request cause	Meaning
Unspecified	Sent for RIC service cause when none of the specified cause values applies.
RAN Function ID invalid	Requested function Id invalid or not known by E2 Node
Action not supported	Requested Action not supported by RAN function
Excessive actions	Excessive number of actions requested for RAN Function
Duplicate action	Same action requested more than once in same subscription request
Duplicate Event Trigger	Subscription request has same event trigger as previously accepted subscription request
Function resource limit	RAN function has reached resource limit
RIC Request ID unknown	RIC Request ID sent to Near-RT RIC is unknown
Inconsistent Action/subsequent Action sequence	RAN Function has detected inconsistent sequence of requested Action and Subsequent Action
Control message invalid	RAN Function has detected invalid RIC CONTROL REQUEST message
RIC Call process ID invalid	RAN function has detected invalid RIC Call Process ID in RIC CONTROL REQUEST
Control timer expired	RIC Control Request received by E2 Node after the associated RIC Time to Wait timer had expired
Control failed to execute	Requested control procedure initiated by RIC Control Request failed to be executed in the E2 Node
System not ready	RAN Function is not ready to receive RIC Subscription or RIC Control message

RIC Service cause	Meaning
RAN Function not supported	The RAN Function described by E2 Node is not supported by Near-RT RIC
Excessive functions	RIC has reached a limit on the number of declared RAN functions
RIC resource limit	RIC has reached a resource limit

E2 Node configuration cause	Meaning
E2 Node component unknown	The received message refers to an unknown E2 Node component

Transport Layer cause	Meaning
Unspecified	Sent when none of the cause values below applies but still the cause is Transport Network Layer related.
Transport Resource Unavailable	The required transport resources are not available.

Protocol cause	Meaning
Transfer Syntax Error	The received message included a transfer syntax error.
Abstract Syntax Error (Reject)	The received message included an abstract syntax error and the concerning criticality indicated "reject".
Abstract Syntax Error (Ignore And Notify)	The received message included an abstract syntax error and the concerning criticality indicated "ignore and notify".
Message Not Compatible With Receiver State	The received message was not compatible with the receiver state.
Semantic Error	The received message included a semantic error.
Abstract Syntax Error (Falsely Constructed Message)	The received message contained IEs or IE groups in wrong order or with too many occurrences.
Unspecified	Sent when none of the above cause values applies but still the cause is Protocol related.

Miscellaneous cause	Meaning
Control Processing Overload	Control processing overload.
Not Enough User Plane Processing Resources Available	Not enough resources are available related to user plane processing.
Hardware Failure	Action related to hardware failure.
O&M Intervention	The action is due to O&M intervention.
Unspecified Failure	Sent when none of the above cause values applies and the cause is not related to any of the categories Radio Network Layer, Transport Network Layer, NAS or Protocol.

9.2.2 Criticality Diagnostics

The *Criticality Diagnostics* IE is sent by the E2 Node or the Near-RT RIC when parts of a received message have not been comprehended or were missing, or if the message contained logical errors. When applicable, it contains information about which IEs were not comprehended or were missing.

For further details on how to use the *Criticality Diagnostics* IE, (see clause 10). The conditions for inclusion of the *Transaction ID* IE are described in clause 10.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Procedure Code	O		INTEGER (0..255)	Procedure Code is to be used if Criticality Diagnostics is part of Error Indication procedure, and not within the response message of the same procedure that caused the error.
Triggering Message	O		ENUMERATED (initiating message, successful outcome, unsuccessful outcome)	The Triggering Message is used only if the Criticality Diagnostics is part of Error Indication procedure.
Procedure Criticality	O		ENUMERATED (reject, ignore, notify)	This Procedure Criticality is used for reporting the Criticality of the Triggering message (Procedure).
RIC Request ID	O		9.2.7	
Information Element Criticality Diagnostics		*0 .. <maxnoof Errors>*		
>IE Criticality	M		ENUMERATED (reject, ignore, notify)	The IE Criticality is used for reporting the criticality of the triggering IE. The value 'ignore' shall not be used.
>IE ID	M		INTEGER (0..65535)	The IE ID of the not understood or missing IE.
>Type of Error	M		ENUMERATED (not understood, missing, ...)	

Range bound	Explanation
maxnoofErrors	Maximum no. of IE errors allowed to be reported with a single message. The value for maxnoofErrors is 256.

9.2.3 Message Type

The *Message Type* IE uniquely identifies the message being sent. It is mandatory for all messages.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Message Type				
>Procedure Code	M		INTEGER (0..255)	
>Type of Message	M		CHOICE (Initiating Message, Successful Outcome, Unsuccessful Outcome, ...)	

9.2.4 Global RIC ID

This IE is used to globally identify an Near-RT RIC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
PLMN Identity	M		3GPP 38.423 clause 9.2.2.4	
Near-RT RIC ID	M		BIT STRING (SIZE(20))	

9.2.5 Time to wait

This IE defines the minimum allowed waiting times.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Time to wait	M		ENUMERATED(1s, 2s, 5s, 10s, 20s, 60s)	

9.2.6 Global E2 Node ID

This IE is used to globally identify an E2 node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CHOICE	M			
>gNB				To be used when E2 Node supports gNB mode or both gNB and en-gNB modes
>>Global gNB ID	M		3GPP 38.423 clause 9.2.2.1	Required when E2 node supports NR with gNB mode
>>Global en-gNB ID	O		3GPP 36.423 clause 9.2.112	Required when E2 node supports NR with en-gNB mode
>>gNB-CU-UP ID	O		3GPP 38.463 clause 9.3.1.15	Required when E2 Node of type gNB-CU-UP
>>gNB-DU ID	O		3GPP 38.473 clause 9.3.1.9	Required when E2 Node of type gNB-DU
>en-gNB				To be used when E2 Node supports en-gNB mode only
>>Global en-gNB ID	M		3GPP 36.423 clause 9.2.112	
>>en-gNB-CU-UP ID	O		3GPP 38.463 clause 9.3.1.15	Required when E2 Node of type gNB-CU-UP
>>en-gNB-DU ID	O		3GPP 38.473 clause 9.3.1.9	Required when E2 Node of type gNB-DU
>ng-eNB				To be used when E2 Node supports ng-eNB mode or both ng-eNB and eNB modes
>>Global ng-eNB ID	M		3GPP 38.423 clause 9.2.2.2	Required when E2 Node supports E-UTRA with ng-eNB mode
>>Global eNB ID	O		3GPP 36.423 clause 9.2.22	Required when E2 Node supports E-UTRA with eNB mode
>>ng-eNB-DU ID	O		3GPP 37.473 clause 9.3.1.9	Required when E2 node of type ng-eNB DU
>eNB				To be used when E2 Node supports eNB mode only
>>Global eNB ID	M		3GPP 36.423 clause 9.2.22	

9.2.7 RIC Request ID

This information element indicates the REQUEST ID number.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Requestor ID	M		INTEGER (0.. 65535)	
RIC Instance ID	M		INTEGER (0..65535)	

9.2.8 RAN Function ID

This information element indicates the RAN Function ID number, to be unique within a given E2 Node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RAN Function ID	M		INTEGER (0..4095)	Value 0 reserved for Near-RT RIC internal usage

9.2.9 RIC Event Trigger Definition

This information element indicates the RIC event trigger description used by the RIC Subscription procedure.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Event Trigger Definition	M		OCTET STRING	Defined in RAN Function specific E2 Service Model [3]

9.2.10 RIC Action ID

This information element indicates the Action ID number, to be unique within the given RIC Request ID.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Action ID	M		INTEGER (0..255)	

9.2.11 RIC Action Type

This IE defines the type of action to be executed.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Action Type	M		ENUMERATED (Insert, Report, Policy, …)	

9.2.12 RIC Action Definition

This information element provides parameters to used when executed a **REPORT**, **INSERT** or **POLICY** service.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Action Definition	M		OCTET STRING	Defined in RAN Function specific E2 Service Model [3]

9.2.13 RIC Subsequent Action

This IE defines the subsequent action to be taken after completing a particular Action. Shall be present when RIC Action Type set to **Insert**.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Subsequent Action Type	M		ENUMERATED (Continue, Halt, …)	
RIC Time to Wait	M		ENUMERATED (1ms, 2ms, 5ms, 10ms, 20ms, 30ms, 40ms, 50ms, 100ms, 200ms, 500ms, 1s, 2s, 5s, 10s, 20s, 60s, …)	

9.2.14 RIC Indication Sequence Number (SN)

This information element indicates the Indication Sequence Number (SN).

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Indication SN	M		INTEGER (0..65535)	

9.2.15 RIC Indication Type

This IE defines the Indication Type.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Indication Type	M		ENUMERATED (Insert, Report, …)	

9.2.16 RIC Indication message

This information element carries the RIC indication message used for INSERT and REPORT procedures.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Indication message	M		OCTET STRING	Defined in RAN Function specific E2 Service Model [3]

9.2.17 RIC Indication header

This information element carries the RIC indication header used for INSERT and REPORT procedures.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Indication header	M		OCTET STRING	Defined in RAN Function specific E2 Service Model [3]

9.2.18 RIC Call Process ID

This information element carries the RIC Call Process ID, meaning shall be unique within a given Function on a given E2 Node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Call Process ID	M		OCTET STRING	Defined in RAN Function specific E2 Service model [3]

9.2.19 RIC Control message

This information element carries the RIC control message for the RIC CONTROL procedure.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Control Message	M		OCTET STRING	Defined in RAN Function specific E2 Service model [3]

9.2.20 RIC Control header

This information element carries the RIC control header used for CONTROL procedures.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Control header	M		OCTET STRING	Defined in RAN Function specific E2 Service Model [3]

9.2.21 RIC Control Ack Request

This IE defines whether and when the RIC CONTROL ACKNOWLEDGE message should be replied as described in the below table.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Control Ack Request	M		ENUMERATED (NoAck, Ack, …)	

The meaning of the different values is described in the following table.

RIC Service cause	Meaning
NoAck	Optional RIC Control Acknowledgement is not required
Ack	Optional RIC Control Acknowledgement is required

9.2.22 Void

9.2.23 RAN Function Definition

This information element carries the RAN Function Definition.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RAN Function Definition	M		OCTET STRING	Defined in RAN Function specific E2 Service Model [3]

9.2.24 RAN Function Revision

This information element carries the RAN Function Revision.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RAN Function Revision	M		INTEGER (0..4095)	

9.2.25 RIC Control Outcome

This information element carries the RIC Control Outcome.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIC Control Outcome	M		OCTET STRING	Defined in RAN Function specific E2 Service Model [3]

9.2.26 E2 Node Component Interface Type

This IE is used to identify an E2 node component type.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
E2 node component interface type	M		ENUMERATED (ng, xn, e1, f1, w1, s1, x2, …)	

9.2.27 E2 Node Component Configuration

This IE is used to carry the E2 Node component configuration update information of a specific E2 Node component. In all cases the information is a data structure defined by the appropriate 3GPP specification and carried as an OCTET STRING.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
SEQUENCE	M			
>E2 Node Component Request Part	M		OCTET STRING	Contents depend on component type and used to carry new or updated component configuration. See the table below.
>E2 Node Component Response Part	M		OCTET STRING	Contents depend on component type and used to carry new or updated component configuration. See the table below.

The following table presents how this IE should be used for the E2 SETUP REQUEST and E2 NODE CONFIGURATION UPDATE REQUEST messages.

	Component Addition list		Component Update list	
E2 Node component message content	**Request part**	**Response part**	**Request part**	**Response part**
gNB case				
>NG (AMF Name)	NG SETUP REQUEST, 3GPP 38.413 [19] clause 9.2.6.1	NG SETUP RESPONSE, 3GPP 38.413 [19] clause 9.2.6.2	RAN CONFIGURATION UPDATE, 3GPP 38.413 [19] clause 9.2.6.4 Or AMF CONFIGURATION UPDATE, 3GPP 38.413 [19] clause 9.2.6.7	RAN CONFIGURATION UPDATE ACKNOWLEDGE, 3GPP 38.413 [19] clause 9.2.6.5 Or AMF CONFIGURATION UPDATE ACKNOWLEDGE, 3GPP 38.413 [19] clause 9.2.6.8
>Xn (Neighbour Global NG-RAN Node ID)	XN SETUP REQUEST, 3GPP 38.423 [20] clause 9.1.3.1	XN SETUP RESPONSE, 3GPP 38.423 [20] clause 9.1.3.2	NG-RAN NODE CONFIGURATION UPDATE, 3GPP 38.423 [20] clause 9.1.3.4	NG-RAN NODE CONFIGURATION UPDATE ACKNOWLEDGE, 3GPP 38.423 [20] clause 9.1.3.5
>E1 (gNB-CU-UP ID)	GNB-CU-UP E1 SETUP REQUEST, 3GPP 38.463 [21] clause 9.2.1.4 Or GNB-CU-CP E1 SETUP REQUEST, 3GPP 38.463 [21] clause 9.2.1.7	GNB-CU-UP E1 SETUP RESPONSE, 3GPP 38.463 [21] clause 9.2.1.5 Or GNB-CU-CP E1 SETUP RESPONSE, 3GPP 38.463 [21] clause 9.2.1.8	GNB-CU-UP CONFIGRATION UPDATE, 3GPP 38.463 [21] clause 9.2.1.10 Or GNB-CU-CP CONFIGURATION UPDATE, 3GPP 38.463 [21] clause 9.2.1.13	GNB-CU-UP CONFIGRATION UPDATE ACKNOWLEDGE, 3GPP 38.463 [21] clause 9.2.1.11 Or GNB-CU-CP CONFIGURATION UPDATE ACKNOWLEDGE, 3GPP 38.463 [21] clause 9.2.1.14
>F1 (gNB-DU ID)	F1 SETUP REQUEST, 3GPP 38.473 [22] clause 9.2.1.4	F1 SETUP RESPONSE, 3GPP 38.473 [22] clause 9.2.1.5	GNB-DU CONFIGRATION UPDATE, 3GPP 38.473 [22] clause 9.2.1.7 Or GNB-CU CONFIGURATION UPDATE, 3GPP 38.473 [22] clause 9.2.1.10	GNB-DU CONFIGRATION UPDATE ACKNOWLEDGE, 3GPP 38.473 [22] clause 9.2.1.8 Or GNB-CU CONFIGURATION UPDATE ACKNOWLEDGE, 3GPP 38.473 [22] clause 9.2.1.11
>X2 (Neighbour Global eNB ID)	EN-DC X2 SETUP REQUEST, 3GPP 36.423 [25] clause 9.1.2.31	EN-DC X2 SETUP RESPONSE, 3GPP 36.423 [25] clause 9.1.2.32	EN-DC CONFIGURATION UPDATE, 3GPP 36.423 [25] clause 9.1.2.34	EN-DC CONFIGURATION UPDATE ACKNOWLEDGE, 3GPP 36.423 [25] clause 9.1.2.35

	Component Addition list		Component Update list	
E2 Node component message content	**Request part**	**Response part**	**Request part**	**Response part**
eNB case				
>NG (AMF Name)	NG SETUP REQUEST, 3GPP 38.413 [19] clause 9.2.6.1	NG SETUP RESPONSE, 3GPP 38.413 [19] clause 9.2.6.2	RAN CONFIGURATION UPDATE, 3GPP 38.413 [19] clause 9.2.6.4 Or AMF CONFIGURATION UPDATE, 3GPP 38.413 [19] clause 9.2.6.7	RAN CONFIGURATION UPDATE ACKNOWLEDGE, 3GPP 38.413 [19] clause 9.2.6.5 Or AMF CONFIGURATION UPDATE ACKNOWLEDGE, 3GPP 38.413 [19] clause 9.2.6.8
>Xn (Neighbour Global NG-RAN Node ID)	XN SETUP REQUEST, 3GPP 38.423 [20] clause 9.1.3.1	XN SETUP RESPONSE, 3GPP 38.423 [20] clause 9.1.3.2	NG-RAN NODE CONFIGURATION UPDATE, 3GPP 38.423 [20] clause 9.1.3.4	NG-RAN NODE CONFIGURATION UPDATE ACKNOWLEDGE, 3GPP 38.423 [20] clause 9.1.3.5
>W1 (ng-eNB-DU ID)	W1 SETUP REQUEST, 3GPP 37.473 [23] clause 9.2.1.4	W1 SETUP RESPONSE, 3GPP 37.473 [23] clause 9.2.1.5	NG-ENB-DU CONFIGURATION UPDATE, 3GPP 37.473 [23] clause 9.2.1.7 Or NG-ENB-CU CONFIGURATION UPDATE, 3GPP 37.473 [23] clause 9.2.1.10	NG-ENB-DU CONFIGURATION UPDATE ACKNOWLEDGE, 3GPP 37.473 [23] clause 9.2.1.8 Or NG-ENB-CU CONFIGURATION UPDATE ACKNOWLEDGE, 3GPP 37.473 [23] clause 9.2.1.11
>S1 (MME Name)	S1 SETUP REQUEST, 3GPP 36.413 [24] clause 9.1.8.4	S1 SETUP RESPONSE, 3GPP 36.413 [24] clause 9.1.8.5	ENB CONFIGURATION UPDATE, 3GPP 36.413 [24] clause 9.1.8.7 Or MME CONFIGURATION UPDATE, 3GPP 36.413 [24] clause 9.1.8.10	ENB CONFIGRATION UPDATE ACKNOWLEDGE, 3GPP 36.413 [24] clause 9.1.8.8 Or MME CONFIGURATION UPDATE ACKNOWLEDGE, 3GPP 36.413 [24] clause 9.1.8.11
>X2 (when neighbour is eNB) (Neighbour Global eNB ID)	X2 SETUP REQUEST, 3GPP 36.423 [25] clause 9.1.2.3	X2 SETUP RESPONSE, 3GPP 36.423 [25] clause 9.1.2.4	ENB CONFIGURATION UPDATE, 3GPP 36.423 [25] clause 9.1.2.8	ENB CONFIGRATION UPDATE ACKNOWLEDGE, 3GPP 36.423 [25] clause 9.1.2.9
>X2 (when neighbour is en-gNB) (Neighbour Global eNB ID)	EN-DC X2 SETUP REQUEST, 3GPP 36.423 [25] clause 9.1.2.31	EN-DC X2 SETUP RESPONSE, 3GPP 36.423 [25] clause 9.1.2.32	EN-DC CONFIGURATION UPDATE, 3GPP 36.423 [25] clause 9.1.2.34	EN-DC CONFIGURATION UPDATE ACKNOWLEDGE, 3GPP 36.423 [25] clause 9.1.2.35

1

9.2.28 E2 Node Component Configuration Acknowledge

This IE is used to carry the E2 Node component configuration update acknowledge of a specific E2 Node component.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Outcome	M		ENUMERATED (success, failure,…)	
Cause	O		9.2.1	Cause for failure

9.2.29 Transport Layer Information

This information element provides Near-RT RIC address and optionally port number to be used by an E2 Node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Transport Layer Address	M		BIT STRING (SIZE(1..160,…))	To be passed to transport layer without interpretation
Transport Layer Port	O		BIT STRING (SIZE(16))	To be passed to transport layer without interpretation

9.2.30 TNL Association Usage

This information element provides TNL association usage.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
TNL Association Usage	M		ENUMERATED (ric service, support functions, both,..)	Indicates whether E2 connection to be used for RIC services only, or E2 support functions only, or both

9.2.31 RAN Function OID

This information element carries the RAN Function OID

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RAN Function Service Model OID	M		PrintableString(SIZE(1..1000,...))	Object Identifier of the specific RAN Function definition. Formatted as per OID (e.g. 1.3.6.1.4.1.53148.1.2.1 for E2SM-NI)

9.2.32 E2 Node Component ID

This IE is used to locally identify an E2 node component.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CHOICE *E2 node component interface type*	M			
>NG				
>>AMF name	M		3GPP 38.413 [19] clause 9.3.3.21	Serving AMF
>Xn				
>>Global NG-RAN Node ID	M		3GPP 38.423 [20] clause 9.2.2.3	Neighbour gNB or ng-eNB
>E1				
>>gNB-CU-UP ID	M		3GPP 38.463 [21] clause 9.3.1.15	
>F1				
>>gNB-DU ID	M		3GPP 38.473 [22] clause 9.3.1.9	
>W1				
>>ng-eNB-DU ID	M		3GPP 37.473 [23] clause	
>S1				
>>MME name	M		3GPP 36.413 [24], clause 9.1.8.5	Serving MME
>X2				
>>Global eNB ID	O		3GPP 36.423 [25] clause 9.2.22	Neighbour eNB
>>Global en-gNB ID	O		3GPP 36.423 [25] clause 9.2.112	Neighbour en-gNB

9.2.33 Transaction ID

The *Transaction ID* IE uniquely identifies a procedure among all ongoing parallel procedures of the same type initiated by the same protocol peer. Messages belonging to the same procedure shall use the same Transaction ID. The Transaction ID is determined by the initiating peer of a procedure.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Transaction ID	M		INTEGER (0..255, …)	

9.3 Message and Information Element Abstract Syntax (with ASN.1)

9.3.1 General

E2AP ASN.1 definition conforms to ITU-T Rec. X.691 [15], ITU-T Rec. X.680 [16] and ITU-T Rec. X.681 [17].

The ASN.1 definition specifies the structure and content of E2AP messages. E2AP messages can contain any IEs specified in the object set definitions for that message without the order or number of occurrence being restricted by ASN.1. However, for this version of the standard, a sending entity shall construct an E2AP message according to the PDU definitions module and with the following additional rules:

- IEs shall be ordered (in an IE container) in the order they appear in object set definitions.

- Object set definitions specify how many times IEs may appear. An IE shall appear exactly once if the presence field in an object has value "mandatory". An IE may appear at most once if the presence field in an object has value "optional" or "conditional". If in a tabular format there is multiplicity specified for an IE (i.e., an IE list) then in the corresponding ASN.1 definition the list definition is separated into two parts. The first part defines an IE container list

where the list elements reside. The second part defines list elements. The IE container list appears as an IE of its own. For this version of the standard an IE container list may contain only one kind of list elements.

NOTE: In the above "IE" means an IE in the object set with an explicit ID. If one IE needs to appear more than once in one object set, then the different occurrences will have different IE IDs.

If an E2AP 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 subclause 10.3.6.

9.3.2 Usage of private message mechanism for non-standard use

The private message mechanism for non-standard are not supported with E2AP.

9.3.3 Elementary Procedure Definitions

```
-- ASN1START
-- **************************************************************
--
-- Elementary Procedure definitions
-- Derived from 3GPP 38.413 v15.4.0 NGAP
-- **************************************************************

E2AP-PDU-Descriptions {
iso(1) identified-organization(3) dod(6) internet(1) private(4) enterprise(1) 53148 e2(1) version2
(2) e2ap(1) e2ap-PDU-Descriptions (0) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

-- **************************************************************
--
-- IE parameter types from other modules.
--
-- **************************************************************

IMPORTS
    Criticality,
    ProcedureCode
FROM E2AP-CommonDataTypes



    E2connectionUpdate,
    E2connectionUpdateAcknowledge,
    E2connectionUpdateFailure,
    E2nodeConfigurationUpdate,
    E2nodeConfigurationUpdateAcknowledge,
    E2nodeConfigurationUpdateFailure,
    E2setupFailure,
    E2setupRequest,
    E2setupResponse,
    ErrorIndication,
    ResetRequest,
    ResetResponse,
    RICcontrolAcknowledge,
    RICcontrolFailure,
    RICcontrolRequest,
    RICindication,
    RICserviceQuery,
    RICserviceUpdate,
    RICserviceUpdateAcknowledge,
    RICserviceUpdateFailure,
    RICsubscriptionFailure,
    RICsubscriptionRequest,
    RICsubscriptionResponse,
    RICsubscriptionDeleteFailure,
    RICsubscriptionDeleteRequest,
    RICsubscriptionDeleteResponse,
    RICsubscriptionDeleteRequired,
    E2RemovalFailure,
    E2RemovalRequest,
    E2RemovalResponse
```

```
FROM E2AP-PDU-Contents

    id-E2connectionUpdate,
    id-E2nodeConfigurationUpdate,
    id-E2setup,
    id-ErrorIndication,
    id-Reset,
    id-RICcontrol,
    id-RICindication,
    id-RICserviceQuery,
    id-RICserviceUpdate,
    id-RICsubscription,
    id-RICsubscriptionDelete,
    id-RICsubscriptionDeleteRequired,
    id-E2removal
FROM E2AP-Constants;

-- ************************************************************
--
-- Interface Elementary Procedure Class
--
-- ************************************************************

E2AP-ELEMENTARY-PROCEDURE ::= CLASS {
    &InitiatingMessage                              ,
    &SuccessfulOutcome                OPTIONAL      ,
    &UnsuccessfulOutcome              OPTIONAL      ,
    &procedureCode          ProcedureCode UNIQUE    ,
    &criticality            Criticality   DEFAULT ignore
}

WITH SYNTAX {
    INITIATING MESSAGE          &InitiatingMessage
    [SUCCESSFUL OUTCOME         &SuccessfulOutcome]
    [UNSUCCESSFUL OUTCOME       &UnsuccessfulOutcome]
    PROCEDURE CODE              &procedureCode
    [CRITICALITY                &criticality]
}

-- ************************************************************
--
-- Interface PDU Definition
--
-- ************************************************************

E2AP-PDU ::= CHOICE {
    initiatingMessage           InitiatingMessage,
    successfulOutcome           SuccessfulOutcome,
    unsuccessfulOutcome         UnsuccessfulOutcome,
    ...
}

InitiatingMessage ::= SEQUENCE {
    procedureCode   E2AP-ELEMENTARY-PROCEDURE.&procedureCode        ({E2AP-ELEMENTARY-PROCEDURES}),
    criticality     E2AP-ELEMENTARY-PROCEDURE.&criticality          ({E2AP-ELEMENTARY-
PROCEDURES}{@procedureCode}),
    value           E2AP-ELEMENTARY-PROCEDURE.&InitiatingMessage    ({E2AP-ELEMENTARY-
PROCEDURES}{@procedureCode})
}

SuccessfulOutcome ::= SEQUENCE {
    procedureCode   E2AP-ELEMENTARY-PROCEDURE.&procedureCode        ({E2AP-ELEMENTARY-PROCEDURES}),
    criticality     E2AP-ELEMENTARY-PROCEDURE.&criticality          ({E2AP-ELEMENTARY-
PROCEDURES}{@procedureCode}),
    value           E2AP-ELEMENTARY-PROCEDURE.&SuccessfulOutcome    ({E2AP-ELEMENTARY-
PROCEDURES}{@procedureCode})
}

UnsuccessfulOutcome ::= SEQUENCE {
    procedureCode   E2AP-ELEMENTARY-PROCEDURE.&procedureCode        ({E2AP-ELEMENTARY-PROCEDURES}),
    criticality     E2AP-ELEMENTARY-PROCEDURE.&criticality          ({E2AP-ELEMENTARY-
PROCEDURES}{@procedureCode}),
    value           E2AP-ELEMENTARY-PROCEDURE.&UnsuccessfulOutcome  ({E2AP-ELEMENTARY-
PROCEDURES}{@procedureCode})
}

-- ************************************************************
--
```

```
-- Interface Elementary Procedure List
--
-- **************************************************************

E2AP-ELEMENTARY-PROCEDURES E2AP-ELEMENTARY-PROCEDURE ::= {
    E2AP-ELEMENTARY-PROCEDURES-CLASS-1                  |
    E2AP-ELEMENTARY-PROCEDURES-CLASS-2,
    ...
}

E2AP-ELEMENTARY-PROCEDURES-CLASS-1 E2AP-ELEMENTARY-PROCEDURE ::= {
    ricSubscription                                     |
    ricSubscriptionDelete                               |
    ricServiceUpdate                                    |
    ricControl                                          |
    e2setup                                             |
    e2nodeConfigurationUpdate                           |
    e2connectionUpdate                                  |
    reset                                               |
    e2removal,
    ...
}

E2AP-ELEMENTARY-PROCEDURES-CLASS-2 E2AP-ELEMENTARY-PROCEDURE ::= {
    ricIndication                                       |
    ricServiceQuery                                     |
    errorIndication                                     |
    ricSubscriptionDeleteRequired,
    ...
}

-- **************************************************************
--
-- Interface Elementary Procedures
--
-- **************************************************************

-- New for v01.01
e2connectionUpdate      E2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      E2connectionUpdate
    SUCCESSFUL OUTCOME      E2connectionUpdateAcknowledge
    UNSUCCESSFUL OUTCOME    E2connectionUpdateFailure
    PROCEDURE CODE          id-E2connectionUpdate
    CRITICALITY             reject
}

e2nodeConfigurationUpdate   E2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      E2nodeConfigurationUpdate
    SUCCESSFUL OUTCOME      E2nodeConfigurationUpdateAcknowledge
    UNSUCCESSFUL OUTCOME    E2nodeConfigurationUpdateFailure
    PROCEDURE CODE          id-E2nodeConfigurationUpdate
    CRITICALITY             reject
}

-- New for v02.01
e2removal   E2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      E2RemovalRequest
    SUCCESSFUL OUTCOME      E2RemovalResponse
    UNSUCCESSFUL OUTCOME    E2RemovalFailure
    PROCEDURE CODE          id-E2removal
    CRITICALITY             reject
}

e2setup E2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      E2setupRequest
    SUCCESSFUL OUTCOME      E2setupResponse
    UNSUCCESSFUL OUTCOME    E2setupFailure
    PROCEDURE CODE          id-E2setup
    CRITICALITY             reject
}

errorIndication E2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      ErrorIndication
    PROCEDURE CODE          id-ErrorIndication
    CRITICALITY             ignore
}

reset   E2AP-ELEMENTARY-PROCEDURE ::= {
```

```
    INITIATING MESSAGE      ResetRequest
    SUCCESSFUL OUTCOME      ResetResponse
    PROCEDURE CODE          id-Reset
    CRITICALITY             reject
}

ricControl E2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      RICcontrolRequest
    SUCCESSFUL OUTCOME      RICcontrolAcknowledge
    UNSUCCESSFUL OUTCOME    RICcontrolFailure
    PROCEDURE CODE          id-RICcontrol
    CRITICALITY             reject
}

ricIndication E2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      RICindication
    PROCEDURE CODE          id-RICindication
    CRITICALITY             ignore
}

ricServiceQuery E2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      RICserviceQuery
    PROCEDURE CODE          id-RICserviceQuery
    CRITICALITY             ignore
}

ricServiceUpdate E2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      RICserviceUpdate
    SUCCESSFUL OUTCOME      RICserviceUpdateAcknowledge
    UNSUCCESSFUL OUTCOME    RICserviceUpdateFailure
    PROCEDURE CODE          id-RICserviceUpdate
    CRITICALITY             reject
}

ricSubscription E2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      RICsubscriptionRequest
    SUCCESSFUL OUTCOME      RICsubscriptionResponse
    UNSUCCESSFUL OUTCOME    RICsubscriptionFailure
    PROCEDURE CODE          id-RICsubscription
    CRITICALITY             reject
}

ricSubscriptionDelete E2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      RICsubscriptionDeleteRequest
    SUCCESSFUL OUTCOME      RICsubscriptionDeleteResponse
    UNSUCCESSFUL OUTCOME    RICsubscriptionDeleteFailure
    PROCEDURE CODE          id-RICsubscriptionDelete
    CRITICALITY             reject
}

ricSubscriptionDeleteRequired E2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      RICsubscriptionDeleteRequired
    PROCEDURE CODE          id-RICsubscriptionDeleteRequired
    CRITICALITY             ignore
}

END
-- ASN1STOP
```

9.3.4 PDU definitions

```
-- ASN1START
-- **************************************************************
--
-- PDU definitions for E2AP
-- Derived from 3GPP 38.413 (NGAP)
--
-- **************************************************************

E2AP-PDU-Contents {
iso(1) identified-organization(3) dod(6) internet(1) private(4) enterprise(1) 53148 e2(1) version2
(2) e2ap(1) e2ap-PDU-Contents (1) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN
```

```
-- ****************************************************************
--
-- IE parameter types from other modules.
--
-- ****************************************************************

IMPORTS
    Cause,
    CriticalityDiagnostics,
    E2nodeComponentConfiguration,
    E2nodeComponentConfigurationAck,
    E2nodeComponentID,
    E2nodeComponentInterfaceType,
    GlobalE2node-ID,
    GlobalRIC-ID,
    RANfunctionDefinition,
    RANfunctionID,
    RANfunctionOID,
    RANfunctionRevision,
    RICactionDefinition,
    RICactionID,
    RICactionType,
    RICcallProcessID,
    RICcontrolAckRequest,
    RICcontrolHeader,
    RICcontrolMessage,
    RICcontrolOutcome,
    RICeventTriggerDefinition,
    RICindicationHeader,
    RICindicationMessage,
    RICindicationSN,
    RICindicationType,
    RICrequestID,
    RICsubsequentAction,
    TimeToWait,
    TNLinformation,
    TNLusage,
    TransactionID
FROM E2AP-IEs

    ProtocolIE-Container{},
    ProtocolIE-ContainerList{},
    ProtocolIE-SingleContainer{},
    E2AP-PROTOCOL-IES,
    E2AP-PROTOCOL-IES-PAIR
FROM E2AP-Containers

    id-Cause,
    id-CriticalityDiagnostics,
    id-E2connectionSetup,
    id-E2connectionSetupFailed,
    id-E2connectionSetupFailed-Item,
    id-E2connectionFailed-Item,
    id-E2connectionUpdate-Item,
    id-E2connectionUpdateAdd,
    id-E2connectionUpdateModify,
    id-E2connectionUpdateRemove,
    id-E2connectionUpdateRemove-Item,
    id-E2nodeComponentConfigAddition,
    id-E2nodeComponentConfigAddition-Item,
    id-E2nodeComponentConfigAdditionAck,
    id-E2nodeComponentConfigAdditionAck-Item,
    id-E2nodeComponentConfigRemoval,
    id-E2nodeComponentConfigRemoval-Item,
    id-E2nodeComponentConfigRemovalAck,
    id-E2nodeComponentConfigRemovalAck-Item,
    id-E2nodeComponentConfigUpdate,
    id-E2nodeComponentConfigUpdate-Item,
    id-E2nodeComponentConfigUpdateAck,
    id-E2nodeComponentConfigUpdateAck-Item,
    id-E2nodeTNLassociationRemoval,
    id-E2nodeTNLassociationRemoval-Item,
    id-GlobalE2node-ID,
    id-GlobalRIC-ID,
    id-RANfunctionID,
    id-RANfunctionID-Item,
    id-RANfunctionIEcause-Item,
```

```
    id-RANfunction-Item,
    id-RANfunctionsAccepted,
    id-RANfunctionsAdded,
    id-RANfunctionsDeleted,
    id-RANfunctionsModified,
    id-RANfunctionsRejected,
    id-RICaction-Admitted-Item,
    id-RICactionID,
    id-RICaction-NotAdmitted-Item,
    id-RICactions-Admitted,
    id-RICactions-NotAdmitted,
    id-RICaction-ToBeSetup-Item,
    id-RICcallProcessID,
    id-RICcontrolAckRequest,
    id-RICcontrolHeader,
    id-RICcontrolMessage,
    id-RICcontrolOutcome,
    id-RICindicationHeader,
    id-RICindicationMessage,
    id-RICindicationSN,
    id-RICindicationType,
    id-RICrequestID,
    id-RICserviceQuery,
    id-RICsubscriptionDetails,
    id-RICsubscriptionToBeRemoved,
    id-RICsubscription-withCause-Item,
    id-TimeToWait,
    id-TNLinformation,
    id-TransactionID,

    maxofE2nodeComponents,
    maxofRANfunctionID,
    maxofRICactionID,
    maxofRICrequestID,
    maxofTNLA
FROM E2AP-Constants;


-- **************************************************************
--
-- MESSAGES FOR NEAR-RT RIC FUNCTIONAL PROCEDURES
--
-- **************************************************************

-- **************************************************************
--
-- RIC Subscription Elementary Procedure
--
-- **************************************************************
-- **************************************************************
--
-- RIC SUBSCRIPTION REQUEST
--
-- **************************************************************
RICsubscriptionRequest ::= SEQUENCE {
    protocolIEs                ProtocolIE-Container    {{RICsubscriptionRequest-IEs}},
    ...
}

RICsubscriptionRequest-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-RICrequestID               CRITICALITY reject  TYPE RICrequestID
    PRESENCE mandatory}|
    { ID id-RANfunctionID              CRITICALITY reject  TYPE RANfunctionID
    PRESENCE mandatory}|
    { ID id-RICsubscriptionDetails     CRITICALITY reject  TYPE RICsubscriptionDetails
    PRESENCE mandatory},
    ...
}


RICsubscriptionDetails ::= SEQUENCE {
    ricEventTriggerDefinition   RICeventTriggerDefinition,
    ricAction-ToBeSetup-List    RICactions-ToBeSetup-List,
    ...
}

RICactions-ToBeSetup-List ::= SEQUENCE (SIZE(1..maxofRICactionID)) OF ProtocolIE-SingleContainer {
{RICaction-ToBeSetup-ItemIEs} }
```

```
RICaction-ToBeSetup-ItemIEs     E2AP-PROTOCOL-IES ::= {
    { ID id-RICaction-ToBeSetup-Item    CRITICALITY ignore  TYPE RICaction-ToBeSetup-Item   PRESENCE
mandatory },
    ...
}

RICaction-ToBeSetup-Item ::= SEQUENCE {
    ricActionID                 RICactionID,
    ricActionType               RICactionType,
    ricActionDefinition         RICactionDefinition     OPTIONAL,
    ricSubsequentAction         RICsubsequentAction     OPTIONAL,
    ...
}

-- **************************************************************
--
-- RIC SUBSCRIPTION RESPONSE
--
-- **************************************************************
RICsubscriptionResponse ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container{{RICsubscriptionResponse-IEs}},
    ...
}

RICsubscriptionResponse-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-RICrequestID                CRITICALITY reject      TYPE RICrequestID
    PRESENCE mandatory } |
    { ID id-RANfunctionID               CRITICALITY reject      TYPE RANfunctionID
    PRESENCE mandatory } |
    { ID id-RICactions-Admitted         CRITICALITY reject      TYPE RICaction-Admitted-List
    PRESENCE mandatory } |
    { ID id-RICactions-NotAdmitted      CRITICALITY reject      TYPE RICaction-NotAdmitted-List
    PRESENCE optional },
    ...
}



RICaction-Admitted-List ::= SEQUENCE (SIZE(1..maxofRICactionID)) OF ProtocolIE-
SingleContainer{{RICaction-Admitted-ItemIEs}}

RICaction-Admitted-ItemIEs E2AP-PROTOCOL-IES ::= {
    { ID id-RICaction-Admitted-Item     CRITICALITY ignore      TYPE RICaction-Admitted-Item
    PRESENCE mandatory },
    ...
}

RICaction-Admitted-Item ::= SEQUENCE {
    ricActionID                 RICactionID,
    ...
}

RICaction-NotAdmitted-List ::= SEQUENCE (SIZE(0..maxofRICactionID)) OF ProtocolIE-SingleContainer {
{RICaction-NotAdmitted-ItemIEs} }

RICaction-NotAdmitted-ItemIEs E2AP-PROTOCOL-IES ::= {
    { ID id-RICaction-NotAdmitted-Item  CRITICALITY ignore  TYPE RICaction-NotAdmitted-Item
    PRESENCE mandatory },
    ...
}

RICaction-NotAdmitted-Item ::= SEQUENCE {
    ricActionID                 RICactionID,
    cause                       Cause,
    ...
}

-- **************************************************************
--
-- RIC SUBSCRIPTION FAILURE
--
-- **************************************************************
RICsubscriptionFailure ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    {{RICsubscriptionFailure-IEs}},
    ...
}
```

```
RICsubscriptionFailure-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-RICrequestID                CRITICALITY reject  TYPE RICrequestID
    PRESENCE mandatory  }|
    { ID id-RANfunctionID               CRITICALITY reject  TYPE RANfunctionID
    PRESENCE mandatory  }|
    { ID id-Cause       CRITICALITY reject  TYPE Cause      PRESENCE mandatory  }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics
    PRESENCE optional   },
    ...
}

-- **************************************************************
--
-- RIC Subscription Delete Elementary Procedure
--
-- **************************************************************
-- **************************************************************
--
-- RIC SUBSCRIPTION DELETE REQUEST
--
-- **************************************************************
RICsubscriptionDeleteRequest ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    {{RICsubscriptionDeleteRequest-IEs}},
    ...
}

RICsubscriptionDeleteRequest-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-RICrequestID                CRITICALITY reject  TYPE RICrequestID
    PRESENCE mandatory  }|
    { ID id-RANfunctionID               CRITICALITY reject  TYPE RANfunctionID
    PRESENCE mandatory  },
    ...
}

-- **************************************************************
--
-- RIC SUBSCRIPTION DELETE RESPONSE
--
-- **************************************************************
RICsubscriptionDeleteResponse ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    {{RICsubscriptionDeleteResponse-IEs}},
    ...
}

RICsubscriptionDeleteResponse-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-RICrequestID                CRITICALITY reject  TYPE RICrequestID
    PRESENCE mandatory  }|
    { ID id-RANfunctionID               CRITICALITY reject  TYPE RANfunctionID
    PRESENCE mandatory  },
    ...
}
-- **************************************************************
--
-- RIC SUBSCRIPTION DELETE FAILURE
--
-- **************************************************************
RICsubscriptionDeleteFailure ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    {{RICsubscriptionDeleteFailure-IEs}},
    ...
}

RICsubscriptionDeleteFailure-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-RICrequestID                CRITICALITY reject  TYPE RICrequestID
    PRESENCE mandatory  }|
    { ID id-RANfunctionID               CRITICALITY reject  TYPE RANfunctionID
    PRESENCE mandatory  }|
    { ID id-Cause                       CRITICALITY ignore  TYPE Cause
    PRESENCE mandatory  }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics
    PRESENCE optional   },
    ...
}

-- **************************************************************
--
-- RIC Subscription Delete Required Elementary Procedure
--
-- **************************************************************
```

```
-- **************************************************************
--
-- RIC SUBSCRIPTION DELETE REQUIRED
--
-- **************************************************************

RICsubscriptionDeleteRequired ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    {{RICsubscriptionDeleteRequired-IEs}},
    ...
}

RICsubscriptionDeleteRequired-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-RICsubscriptionToBeRemoved      CRITICALITY ignore  TYPE RICsubscription-List-withCause
    PRESENCE mandatory  },
    ...
}

RICsubscription-List-withCause ::= SEQUENCE (SIZE(1..maxofRICrequestID)) OF ProtocolIE-
SingleContainer { {RICsubscription-withCause-ItemIEs} }

RICsubscription-withCause-ItemIEs   E2AP-PROTOCOL-IES ::= {
    { ID id-RICsubscription-withCause-Item  CRITICALITY ignore  TYPE RICsubscription-withCause-Item
    PRESENCE mandatory  },
    ...
}

RICsubscription-withCause-Item ::= SEQUENCE {
    ricRequestID                RICrequestID,
    ranFunctionID               RANfunctionID,
    cause                       Cause,
    ...
}

-- **************************************************************
--
-- RIC Indication Elementary Procedure
--
-- **************************************************************
-- **************************************************************
--
-- RIC INDICATION
--
-- **************************************************************
RICindication ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    {{RICindication-IEs}},
    ...
}

RICindication-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-RICrequestID                CRITICALITY reject  TYPE RICrequestID
    PRESENCE mandatory  }|
    { ID id-RANfunctionID               CRITICALITY reject  TYPE RANfunctionID
    PRESENCE mandatory  }|
    { ID id-RICactionID                 CRITICALITY reject  TYPE RICactionID
    PRESENCE mandatory  }|
    { ID id-RICindicationSN             CRITICALITY reject  TYPE RICindicationSN
    PRESENCE optional   }|
    { ID id-RICindicationType           CRITICALITY reject  TYPE RICindicationType
    PRESENCE mandatory  }|
    { ID id-RICindicationHeader         CRITICALITY reject  TYPE RICindicationHeader
    PRESENCE mandatory  }|
    { ID id-RICindicationMessage        CRITICALITY reject  TYPE RICindicationMessage
    PRESENCE mandatory  }|
    { ID id-RICcallProcessID            CRITICALITY reject  TYPE RICcallProcessID
    PRESENCE optional   },
    ...
}

-- **************************************************************
--
-- RIC Control Elementary Procedure
--
-- **************************************************************
-- **************************************************************
--
-- RIC CONTROL REQUEST
--
-- **************************************************************
```

```
RICcontrolRequest ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    {{RICcontrolRequest-IEs}},
    ...
}

RICcontrolRequest-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-RICrequestID                CRITICALITY reject  TYPE RICrequestID
    PRESENCE mandatory  }|
    { ID id-RANfunctionID               CRITICALITY reject  TYPE RANfunctionID
    PRESENCE mandatory  }|
    { ID id-RICcallProcessID            CRITICALITY reject  TYPE RICcallProcessID
    PRESENCE optional   }|
    { ID id-RICcontrolHeader            CRITICALITY reject  TYPE RICcontrolHeader
    PRESENCE mandatory  }|
    { ID id-RICcontrolMessage           CRITICALITY reject  TYPE RICcontrolMessage
    PRESENCE mandatory  }|
    { ID id-RICcontrolAckRequest        CRITICALITY reject  TYPE RICcontrolAckRequest
    PRESENCE optional   },
    ...
}
-- **************************************************************
--
-- RIC CONTROL ACKNOWLEDGE
--
-- **************************************************************
RICcontrolAcknowledge ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    {{RICcontrolAcknowledge-IEs}},
    ...
}

RICcontrolAcknowledge-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-RICrequestID                CRITICALITY reject  TYPE RICrequestID
    PRESENCE mandatory  }|
    { ID id-RANfunctionID               CRITICALITY reject  TYPE RANfunctionID
    PRESENCE mandatory  }|
    { ID id-RICcallProcessID            CRITICALITY reject  TYPE RICcallProcessID
    PRESENCE optional   }|
    { ID id-RICcontrolOutcome           CRITICALITY reject  TYPE RICcontrolOutcome
    PRESENCE optional   },
    ...
}
-- **************************************************************
--
-- RIC CONTROL FAILURE
--
-- **************************************************************
RICcontrolFailure ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    {{RICcontrolFailure-IEs}},
    ...
}

RICcontrolFailure-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-RICrequestID                CRITICALITY reject  TYPE RICrequestID
    PRESENCE mandatory  }|
    { ID id-RANfunctionID               CRITICALITY reject  TYPE RANfunctionID
    PRESENCE mandatory  }|
    { ID id-RICcallProcessID            CRITICALITY reject  TYPE RICcallProcessID
    PRESENCE optional   }|
    { ID id-Cause                       CRITICALITY ignore  TYPE Cause
    PRESENCE mandatory  }|
    { ID id-RICcontrolOutcome           CRITICALITY reject  TYPE RICcontrolOutcome
    PRESENCE optional   },
    ...,
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics
    PRESENCE optional   }
}

-- **************************************************************
--
-- MESSAGES FOR GLOBAL PROCEDURES
--
-- **************************************************************

-- **************************************************************
--
-- Error Indication Elementary Procedure
--
-- **************************************************************
```

```
-- **************************************************************
--
-- ERROR INDICATION
--
-- **************************************************************
ErrorIndication ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    {{ErrorIndication-IEs}},
    ...
}

ErrorIndication-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-TransactionID               CRITICALITY reject  TYPE TransactionID              PRESENCE
optional    }|
    { ID id-RICrequestID                CRITICALITY reject  TYPE RICrequestID               PRESENCE
optional    }|
    { ID id-RANfunctionID               CRITICALITY reject  TYPE RANfunctionID              PRESENCE
optional    }|
    { ID id-Cause                       CRITICALITY ignore  TYPE Cause                      PRESENCE
optional    }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics     PRESENCE
optional    },
    ...
}

-- **************************************************************
--
-- E2 Setup Elementary Procedure
--
-- **************************************************************
-- **************************************************************
--
-- E2 SETUP REQUEST
--
-- **************************************************************

E2setupRequest ::= SEQUENCE {
    protocolIEs     ProtocolIE-Container        { {E2setupRequestIEs} },
    ...
}

E2setupRequestIEs E2AP-PROTOCOL-IES ::= {
    { ID id-TransactionID                   CRITICALITY reject  TYPE TransactionID
    PRESENCE mandatory  }|
    { ID id-GlobalE2node-ID                 CRITICALITY reject  TYPE GlobalE2node-ID
    PRESENCE mandatory  }|
    { ID id-RANfunctionsAdded               CRITICALITY reject  TYPE RANfunctions-List
    PRESENCE mandatory  }|
    { ID id-E2nodeComponentConfigAddition   CRITICALITY reject  TYPE E2nodeComponentConfigAddition-
List    PRESENCE mandatory  },
    ...
}

-- **************************************************************
--
-- E2 SETUP RESPONSE
--
-- **************************************************************

E2setupResponse ::= SEQUENCE {
    protocolIEs     ProtocolIE-Container        { {E2setupResponseIEs} },
    ...
}

E2setupResponseIEs E2AP-PROTOCOL-IES ::= {
    { ID id-TransactionID                       CRITICALITY reject  TYPE TransactionID
            PRESENCE mandatory  }|
    { ID id-GlobalRIC-ID                        CRITICALITY reject  TYPE GlobalRIC-ID
            PRESENCE mandatory  }|
    { ID id-RANfunctionsAccepted                CRITICALITY reject  TYPE RANfunctionsID-List
            PRESENCE optional   }|
    { ID id-RANfunctionsRejected                CRITICALITY reject  TYPE RANfunctionsIDcause-List
            PRESENCE optional   }|
    { ID id-E2nodeComponentConfigAdditionAck    CRITICALITY reject  TYPE
E2nodeComponentConfigAdditionAck-List   PRESENCE mandatory  },
    ...
}

-- **************************************************************
```

```
--
-- E2 SETUP FAILURE
--
-- **************************************************************

E2setupFailure ::= SEQUENCE {
    protocolIEs     ProtocolIE-Container        { {E2setupFailureIEs} },
    ...
}

E2setupFailureIEs E2AP-PROTOCOL-IES ::= {
    { ID id-TransactionID               CRITICALITY reject  TYPE TransactionID              PRESENCE
mandatory   }|
    { ID id-Cause                       CRITICALITY ignore  TYPE Cause                      PRESENCE
mandatory   }|
    { ID id-TimeToWait                  CRITICALITY ignore  TYPE TimeToWait                 PRESENCE
optional    }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics     PRESENCE
optional    }|
    { ID id-TNLinformation              CRITICALITY ignore  TYPE TNLinformation             PRESENCE
optional    },
    ...
}

-- **************************************************************
--
-- E2 Connection Update Elementary Procedure
--
-- **************************************************************
-- **************************************************************
--
-- E2 CONNECTION UPDATE
--
-- **************************************************************
E2connectionUpdate ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    {{E2connectionUpdate-IEs}},
    ...
}

E2connectionUpdate-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-TransactionID               CRITICALITY reject  TYPE TransactionID
    PRESENCE mandatory  }|
    { ID id-E2connectionUpdateAdd       CRITICALITY reject  TYPE E2connectionUpdate-List
    PRESENCE optional   }|
    { ID id-E2connectionUpdateRemove    CRITICALITY reject  TYPE E2connectionUpdateRemove-List
    PRESENCE optional   }|
    { ID id-E2connectionUpdateModify    CRITICALITY reject  TYPE E2connectionUpdate-List
    PRESENCE optional   },
    ...
}

E2connectionUpdate-List ::= SEQUENCE (SIZE(1..maxofTNLA)) OF ProtocolIE-SingleContainer {
{E2connectionUpdate-ItemIEs} }

E2connectionUpdate-ItemIEs  E2AP-PROTOCOL-IES ::= {
    { ID id-E2connectionUpdate-Item         CRITICALITY ignore  TYPE E2connectionUpdate-Item
    PRESENCE mandatory  },
    ...
}

E2connectionUpdate-Item ::= SEQUENCE {
    tnlInformation                  TNLinformation,
    tnlUsage                        TNLusage,
    ...
}

E2connectionUpdateRemove-List ::= SEQUENCE (SIZE(1..maxofTNLA)) OF ProtocolIE-SingleContainer {
{E2connectionUpdateRemove-ItemIEs} }

E2connectionUpdateRemove-ItemIEs    E2AP-PROTOCOL-IES ::= {
    { ID id-E2connectionUpdateRemove-Item   CRITICALITY ignore  TYPE E2connectionUpdateRemove-Item
    PRESENCE mandatory  },
    ...
}

E2connectionUpdateRemove-Item ::= SEQUENCE {
    tnlInformation                  TNLinformation,
    ...
```

```
}



-- **************************************************************
--
-- E2 CONNECTION UPDATE ACKNOWLEDGE
--
-- **************************************************************
E2connectionUpdateAcknowledge ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    {{E2connectionUpdateAck-IEs}},
    ...
}

E2connectionUpdateAck-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-TransactionID               CRITICALITY reject  TYPE TransactionID
    PRESENCE mandatory  }|
    { ID id-E2connectionSetup           CRITICALITY reject  TYPE E2connectionUpdate-List
    PRESENCE optional   }|
    { ID id-E2connectionSetupFailed     CRITICALITY reject  TYPE E2connectionSetupFailed-List
    PRESENCE optional   },
    ...
}

E2connectionSetupFailed-List ::= SEQUENCE (SIZE(1..maxofTNLA)) OF ProtocolIE-SingleContainer {
{E2connectionSetupFailed-ItemIEs} }

E2connectionSetupFailed-ItemIEs     E2AP-PROTOCOL-IES ::= {
    { ID id-E2connectionSetupFailed-Item            CRITICALITY ignore  TYPE
E2connectionSetupFailed-Item        PRESENCE mandatory  },
    ...
}

E2connectionSetupFailed-Item ::= SEQUENCE {
    tnlInformation                  TNLinformation,
    cause                           Cause,
    ...
}

-- **************************************************************
--
-- E2 CONNECTION UPDATE FAILURE
--
-- **************************************************************
E2connectionUpdateFailure ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container    {{E2connectionUpdateFailure-IEs}},
    ...
}

E2connectionUpdateFailure-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-TransactionID                       CRITICALITY reject  TYPE TransactionID
            PRESENCE mandatory  }|
    { ID id-Cause                               CRITICALITY reject  TYPE Cause
            PRESENCE optional   }|
    { ID id-TimeToWait                          CRITICALITY ignore  TYPE TimeToWait
            PRESENCE optional   }|
    { ID id-CriticalityDiagnostics              CRITICALITY ignore  TYPE CriticalityDiagnostics
            PRESENCE optional   },
    ...
}

-- **************************************************************
--
-- E2 Node Configuration Update Elementary Procedure
--
-- **************************************************************
-- **************************************************************
--
-- E2 NODE CONFIGURATION UPDATE
--
-- **************************************************************
E2nodeConfigurationUpdate ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    {{E2nodeConfigurationUpdate-IEs}},
    ...
}

E2nodeConfigurationUpdate-IEs E2AP-PROTOCOL-IES ::= {
```

```
    { ID id-TransactionID                   CRITICALITY reject  TYPE TransactionID
            PRESENCE mandatory  }|
    { ID id-GlobalE2node-ID                 CRITICALITY reject  TYPE GlobalE2node-ID
            PRESENCE optional   }|
    { ID id-E2nodeComponentConfigAddition   CRITICALITY reject  TYPE E2nodeComponentConfigAddition-
List            PRESENCE optional   }|
    { ID id-E2nodeComponentConfigUpdate     CRITICALITY reject  TYPE E2nodeComponentConfigUpdate-
List            PRESENCE optional   }|
    { ID id-E2nodeComponentConfigRemoval    CRITICALITY reject  TYPE E2nodeComponentConfigRemoval-
List            PRESENCE optional   }|
    { ID id-E2nodeTNLassociationRemoval     CRITICALITY reject  TYPE E2nodeTNLassociationRemoval-
List            PRESENCE optional   },
    ...
}

E2nodeComponentConfigAddition-List ::= SEQUENCE (SIZE(1..maxofE2nodeComponents)) OF ProtocolIE-
SingleContainer { {E2nodeComponentConfigAddition-ItemIEs} }

E2nodeComponentConfigAddition-ItemIEs   E2AP-PROTOCOL-IES ::= {
    { ID id-E2nodeComponentConfigAddition-Item  CRITICALITY reject  TYPE
E2nodeComponentConfigAddition-Item      PRESENCE mandatory  },
    ...
}

E2nodeComponentConfigAddition-Item ::= SEQUENCE {
    e2nodeComponentInterfaceType        E2nodeComponentInterfaceType,
    e2nodeComponentID                   E2nodeComponentID,
    e2nodeComponentConfiguration        E2nodeComponentConfiguration,
    ...
}

E2nodeComponentConfigUpdate-List ::= SEQUENCE (SIZE(1..maxofE2nodeComponents)) OF ProtocolIE-
SingleContainer { {E2nodeComponentConfigUpdate-ItemIEs} }

E2nodeComponentConfigUpdate-ItemIEs     E2AP-PROTOCOL-IES ::= {
    { ID id-E2nodeComponentConfigUpdate-Item    CRITICALITY reject  TYPE
E2nodeComponentConfigUpdate-Item        PRESENCE mandatory  },
    ...
}

E2nodeComponentConfigUpdate-Item ::= SEQUENCE {
    e2nodeComponentInterfaceType        E2nodeComponentInterfaceType,
    e2nodeComponentID                   E2nodeComponentID,
    e2nodeComponentConfiguration        E2nodeComponentConfiguration,
    ...
}

E2nodeComponentConfigRemoval-List ::= SEQUENCE (SIZE(1..maxofE2nodeComponents)) OF ProtocolIE-
SingleContainer { {E2nodeComponentConfigRemoval-ItemIEs} }

E2nodeComponentConfigRemoval-ItemIEs    E2AP-PROTOCOL-IES ::= {
    { ID id-E2nodeComponentConfigRemoval-Item   CRITICALITY reject  TYPE
E2nodeComponentConfigRemoval-Item       PRESENCE mandatory  },
    ...
}

E2nodeComponentConfigRemoval-Item ::= SEQUENCE {
    e2nodeComponentInterfaceType        E2nodeComponentInterfaceType,
    e2nodeComponentID                   E2nodeComponentID,
    ...
}

E2nodeTNLassociationRemoval-List ::= SEQUENCE (SIZE(1..maxofTNLA)) OF ProtocolIE-SingleContainer {
{E2nodeTNLassociationRemoval-ItemIEs} }

E2nodeTNLassociationRemoval-ItemIEs     E2AP-PROTOCOL-IES ::= {
    { ID id-E2nodeTNLassociationRemoval-Item    CRITICALITY reject  TYPE
E2nodeTNLassociationRemoval-Item        PRESENCE mandatory  },
    ...
}

E2nodeTNLassociationRemoval-Item ::= SEQUENCE {
    tnlInformation                      TNLinformation,
    tnlInformationRIC                   TNLinformation,
    ...
}

-- **************************************************************
```

```
--
-- E2 NODE CONFIGURATION UPDATE ACKNOWLEDGE
--
-- **************************************************************
E2nodeConfigurationUpdateAcknowledge ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    {{E2nodeConfigurationUpdateAcknowledge-
IEs}},
    ...
}

E2nodeConfigurationUpdateAcknowledge-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-TransactionID                               CRITICALITY reject  TYPE TransactionID
                    PRESENCE mandatory  }|
    { ID id-E2nodeComponentConfigAdditionAck        CRITICALITY reject  TYPE
E2nodeComponentConfigAdditionAck-List       PRESENCE optional   }|
    { ID id-E2nodeComponentConfigUpdateAck          CRITICALITY reject  TYPE
E2nodeComponentConfigUpdateAck-List     PRESENCE optional   }|
    { ID id-E2nodeComponentConfigRemovalAck         CRITICALITY reject  TYPE
E2nodeComponentConfigRemovalAck-List        PRESENCE optional   },
    ...
}

E2nodeComponentConfigAdditionAck-List ::= SEQUENCE (SIZE(1..maxofE2nodeComponents)) OF ProtocolIE-
SingleContainer { {E2nodeComponentConfigAdditionAck-ItemIEs} }

E2nodeComponentConfigAdditionAck-ItemIEs    E2AP-PROTOCOL-IES ::= {
    { ID id-E2nodeComponentConfigAdditionAck-Item           CRITICALITY reject  TYPE
E2nodeComponentConfigAdditionAck-Item   PRESENCE mandatory  },
    ...
}

E2nodeComponentConfigAdditionAck-Item ::= SEQUENCE {
    e2nodeComponentInterfaceType        E2nodeComponentInterfaceType,
    e2nodeComponentID                   E2nodeComponentID,
    e2nodeComponentConfigurationAck     E2nodeComponentConfigurationAck,
    ...
}

E2nodeComponentConfigUpdateAck-List ::= SEQUENCE (SIZE(1..maxofE2nodeComponents)) OF ProtocolIE-
SingleContainer { {E2nodeComponentConfigUpdateAck-ItemIEs} }

E2nodeComponentConfigUpdateAck-ItemIEs  E2AP-PROTOCOL-IES ::= {
    { ID id-E2nodeComponentConfigUpdateAck-Item         CRITICALITY reject  TYPE
E2nodeComponentConfigUpdateAck-Item     PRESENCE mandatory  },
    ...
}

E2nodeComponentConfigUpdateAck-Item ::= SEQUENCE {
    e2nodeComponentInterfaceType        E2nodeComponentInterfaceType,
    e2nodeComponentID                   E2nodeComponentID,
    e2nodeComponentConfigurationAck     E2nodeComponentConfigurationAck,
    ...
}

E2nodeComponentConfigRemovalAck-List ::= SEQUENCE (SIZE(1..maxofE2nodeComponents)) OF ProtocolIE-
SingleContainer { {E2nodeComponentConfigRemovalAck-ItemIEs} }

E2nodeComponentConfigRemovalAck-ItemIEs     E2AP-PROTOCOL-IES ::= {
    { ID id-E2nodeComponentConfigRemovalAck-Item            CRITICALITY reject  TYPE
E2nodeComponentConfigRemovalAck-Item    PRESENCE mandatory  },
    ...
}

E2nodeComponentConfigRemovalAck-Item ::= SEQUENCE {
    e2nodeComponentInterfaceType        E2nodeComponentInterfaceType,
    e2nodeComponentID                   E2nodeComponentID,
    e2nodeComponentConfigurationAck     E2nodeComponentConfigurationAck,
    ...
}

-- **************************************************************
--
-- E2 NODE CONFIGURATION UPDATE FAILURE
--
-- **************************************************************
E2nodeConfigurationUpdateFailure ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container    {{E2nodeConfigurationUpdateFailure-IEs}},
    ...
```

```
}

E2nodeConfigurationUpdateFailure-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-TransactionID                       CRITICALITY reject  TYPE TransactionID
                PRESENCE mandatory  }|
    { ID id-Cause                               CRITICALITY ignore  TYPE Cause
                PRESENCE mandatory  }|
    { ID id-TimeToWait                          CRITICALITY ignore  TYPE TimeToWait
                PRESENCE optional   }|
    { ID id-CriticalityDiagnostics              CRITICALITY ignore  TYPE CriticalityDiagnostics
                PRESENCE optional   },
    ...
}

-- **************************************************************
--
-- Reset Elementary Procedure
--
-- **************************************************************

-- **************************************************************
--
-- RESET REQUEST
--
-- **************************************************************

ResetRequest ::= SEQUENCE {
    protocolIEs     ProtocolIE-Container        { {ResetRequestIEs} },
    ...
}

ResetRequestIEs E2AP-PROTOCOL-IES ::= {
    { ID id-TransactionID               CRITICALITY reject  TYPE TransactionID              PRESENCE
mandatory   }|
    { ID id-Cause                       CRITICALITY ignore  TYPE Cause                      PRESENCE
mandatory   },
    ...
}

-- **************************************************************
--
-- RESET RESPONSE
--
-- **************************************************************

ResetResponse ::= SEQUENCE {
    protocolIEs     ProtocolIE-Container        { {ResetResponseIEs} },
    ...
}

ResetResponseIEs E2AP-PROTOCOL-IES ::= {
    { ID id-TransactionID               CRITICALITY reject  TYPE TransactionID              PRESENCE
mandatory   }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics     PRESENCE
optional    },
    ...
}

-- **************************************************************
--
-- RIC Service Update Elementary Procedure
--
-- **************************************************************
-- **************************************************************
--
-- RIC SERVICE UPDATE
--
-- **************************************************************
RICserviceUpdate ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    {{RICserviceUpdate-IEs}},
    ...
}

RICserviceUpdate-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-TransactionID               CRITICALITY reject  TYPE TransactionID
    PRESENCE mandatory  }|
    { ID id-RANfunctionsAdded           CRITICALITY reject  TYPE RANfunctions-List
    PRESENCE optional   }|
```

```
    { ID id-RANfunctionsModified        CRITICALITY reject  TYPE RANfunctions-List
    PRESENCE optional   }|
    { ID id-RANfunctionsDeleted         CRITICALITY reject  TYPE RANfunctionsID-List
    PRESENCE optional   },
    ...
}

RANfunctions-List ::= SEQUENCE (SIZE(1..maxofRANfunctionID)) OF ProtocolIE-SingleContainer {
{RANfunction-ItemIEs} }

RANfunction-ItemIEs     E2AP-PROTOCOL-IES ::= {
    { ID id-RANfunction-Item            CRITICALITY ignore  TYPE RANfunction-Item
    PRESENCE mandatory  },
    ...
}


RANfunction-Item ::= SEQUENCE {
    ranFunctionID               RANfunctionID,
    ranFunctionDefinition       RANfunctionDefinition,
    ranFunctionRevision         RANfunctionRevision,
    ranFunctionOID              RANfunctionOID,
    ...
}

RANfunctionsID-List ::= SEQUENCE (SIZE(1..maxofRANfunctionID)) OF ProtocolIE-
SingleContainer{{RANfunctionID-ItemIEs}}

RANfunctionID-ItemIEs E2AP-PROTOCOL-IES ::= {
    { ID id-RANfunctionID-Item          CRITICALITY ignore      TYPE RANfunctionID-Item
    PRESENCE mandatory  },
    ...
}

RANfunctionID-Item ::= SEQUENCE {
    ranFunctionID               RANfunctionID,
    ranFunctionRevision         RANfunctionRevision,
    ...
}

-- ************************************************************
--
-- RIC SERVICE UPDATE ACKNOWLEDGE
--
-- ************************************************************
RICserviceUpdateAcknowledge ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    {{RICserviceUpdateAcknowledge-IEs}},
    ...
}

RICserviceUpdateAcknowledge-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-TransactionID               CRITICALITY reject  TYPE TransactionID
    PRESENCE mandatory  }|
    { ID id-RANfunctionsAccepted        CRITICALITY reject  TYPE RANfunctionsID-List
    PRESENCE mandatory  }|
    { ID id-RANfunctionsRejected        CRITICALITY reject  TYPE RANfunctionsIDcause-List
    PRESENCE optional   },
    ...
}

RANfunctionsIDcause-List ::= SEQUENCE (SIZE(1..maxofRANfunctionID)) OF ProtocolIE-SingleContainer {
{RANfunctionIDcause-ItemIEs} }

RANfunctionIDcause-ItemIEs  E2AP-PROTOCOL-IES ::= {
    { ID id-RANfunctionIEcause-Item     CRITICALITY ignore  TYPE RANfunctionIDcause-Item
    PRESENCE mandatory  },
    ...
}


RANfunctionIDcause-Item ::= SEQUENCE {
    ranFunctionID               RANfunctionID,
    cause                       Cause,
    ...
}


-- ************************************************************
```

```
--
-- RIC SERVICE UPDATE FAILURE
--
-- **************************************************************
RICserviceUpdateFailure ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container    {{RICserviceUpdateFailure-IEs}},
    ...
}

RICserviceUpdateFailure-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-TransactionID               CRITICALITY reject  TYPE TransactionID
    PRESENCE mandatory  }|
    { ID id-Cause                       CRITICALITY reject  TYPE Cause
    PRESENCE mandatory  }|
    { ID id-TimeToWait                  CRITICALITY ignore  TYPE TimeToWait
    PRESENCE optional   }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics
    PRESENCE optional   },
    ...
}

-- **************************************************************
--
-- RIC Service Query Elementary Procedure
--
-- **************************************************************
-- **************************************************************
--
-- RIC SERVICE QUERY
--
-- **************************************************************
RICserviceQuery ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    {{RICserviceQuery-IEs}},
    ...
}

RICserviceQuery-IEs E2AP-PROTOCOL-IES ::= {
    { ID id-TransactionID               CRITICALITY reject  TYPE TransactionID
    PRESENCE mandatory  }|
    { ID id-RANfunctionsAccepted        CRITICALITY reject  TYPE RANfunctionsID-List
    PRESENCE optional   },
    ...
}

-- **************************************************************
--
-- E2 Removal Elementary Procedure
--
-- **************************************************************
-- **************************************************************
--
-- E2 REMOVAL REQUEST
--
-- **************************************************************

E2RemovalRequest ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    { {E2RemovalRequestIEs} },
    ...
}

E2RemovalRequestIEs E2AP-PROTOCOL-IES ::= {
    { ID id-TransactionID               CRITICALITY reject  TYPE TransactionID
    PRESENCE mandatory  },
    ...
}

-- **************************************************************
--
-- E2 REMOVAL RESPONSE
--
-- **************************************************************

E2RemovalResponse ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    { {E2RemovalResponseIEs} },
    ...
}

E2RemovalResponseIEs  E2AP-PROTOCOL-IES ::= {
```

```
    { ID id-TransactionID               CRITICALITY reject  TYPE TransactionID
    PRESENCE mandatory  }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics     PRESENCE
optional    },
    ...
}

-- **************************************************************
--
-- E2 REMOVAL FAILURE
--
-- **************************************************************

E2RemovalFailure ::= SEQUENCE {
    protocolIEs                 ProtocolIE-Container    { {E2RemovalFailureIEs} },
    ...
}

E2RemovalFailureIEs E2AP-PROTOCOL-IES ::= {
    { ID id-TransactionID               CRITICALITY reject  TYPE TransactionID              PRESENCE
mandatory   }|
    { ID id-Cause                       CRITICALITY ignore  TYPE Cause                      PRESENCE
mandatory   }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics     PRESENCE
optional    },
    ...
}

END
-- ASN1STOP
```

9.3.5 Information Element Definitions

```
-- ASN1START
-- **************************************************************
-- E2AP
-- Information Element Definitions
--
-- **************************************************************

E2AP-IEs {
iso(1) identified-organization(3) dod(6) internet(1) private(4) enterprise(1) 53148 e2(1) version2
(2) e2ap(1) e2ap-IEs (2)}

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS
    Criticality,
    Presence,
    ProcedureCode,
    ProtocolIE-ID,
    TriggeringMessage
FROM E2AP-CommonDataTypes

    maxnoofErrors,
    maxProtocolIEs
FROM E2AP-Constants;

-- A

-- **************************************************************
-- [New for E2AP v02.00] copied from 3GPP 38.413 (NGAP) IEs
-- **************************************************************
AMFName ::= PrintableString (SIZE(1..150, ...))

-- B
-- C
Cause ::= CHOICE {
    ricRequest          CauseRICrequest,
    ricService          CauseRICservice,
    e2Node              CauseE2node,
    transport           CauseTransport,
    protocol            CauseProtocol,
    misc                CauseMisc,
    ...
```

```
}

CauseE2node ::= ENUMERATED {
    e2node-component-unknown,
    ...
}

CauseMisc ::= ENUMERATED {
    control-processing-overload,
    hardware-failure,
    om-intervention,
    unspecified,
    ...
}

CauseProtocol ::= ENUMERATED {
    transfer-syntax-error,
    abstract-syntax-error-reject,
    abstract-syntax-error-ignore-and-notify,
    message-not-compatible-with-receiver-state,
    semantic-error,
    abstract-syntax-error-falsely-constructed-message,
    unspecified,
    ...
}

CauseRICrequest ::= ENUMERATED {
    ran-function-id-invalid,
    action-not-supported,
    excessive-actions,
    duplicate-action,
    duplicate-event-trigger,
    function-resource-limit,
    request-id-unknown,
    inconsistent-action-subsequent-action-sequence,
    control-message-invalid,
    ric-call-process-id-invalid,
    control-timer-expired,
    control-failed-to-execute,
    system-not-ready,
    unspecified,
    ...
}

CauseRICservice ::= ENUMERATED{
    ran-function-not-supported,
    excessive-functions,
    ric-resource-limit,
    ...
}
CauseTransport ::= ENUMERATED {
    unspecified,
    transport-resource-unavailable,
    ...
}

-- **************************************************************
-- copied from 3GPP 38.413 (NGAP) IEs
-- note: ie-Extensions removed
-- **************************************************************
CriticalityDiagnostics ::= SEQUENCE {
    procedureCode                   ProcedureCode                           OPTIONAL,
    triggeringMessage               TriggeringMessage                       OPTIONAL,
    procedureCriticality            Criticality                             OPTIONAL,
    ricRequestorID                  RICrequestID                            OPTIONAL,
    iEsCriticalityDiagnostics       CriticalityDiagnostics-IE-List          OPTIONAL,
    ...
}

CriticalityDiagnostics-IE-List ::= SEQUENCE (SIZE(1..maxnoofErrors)) OF CriticalityDiagnostics-IE-
Item

CriticalityDiagnostics-IE-Item ::= SEQUENCE {
    iECriticality       Criticality,
    iE-ID               ProtocolIE-ID,
    typeOfError         TypeOfError,
    ...
}
```

```
-- D
-- E

-- Following IE used to carry 3GPP defined SETUP and RAN Configuration messages defined in F1AP,
E1AP, XnAP, etc.
E2nodeComponentConfiguration ::= SEQUENCE{
    e2nodeComponentRequestPart      OCTET STRING,
    e2nodeComponentResponsePart     OCTET STRING,
    ...
}

E2nodeComponentConfigurationAck ::= SEQUENCE{
    updateOutcome       ENUMERATED {success, failure, ...},
    failureCause        Cause           OPTIONAL,
    ...
}

E2nodeComponentInterfaceType ::= ENUMERATED {ng, xn, e1, f1, w1, s1, x2,...}

E2nodeComponentID ::= CHOICE{
    e2nodeComponentInterfaceTypeNG  E2nodeComponentInterfaceNG,
    e2nodeComponentInterfaceTypeXn  E2nodeComponentInterfaceXn,
    e2nodeComponentInterfaceTypeE1  E2nodeComponentInterfaceE1,
    e2nodeComponentInterfaceTypeF1  E2nodeComponentInterfaceF1,
    e2nodeComponentInterfaceTypeW1  E2nodeComponentInterfaceW1,
    e2nodeComponentInterfaceTypeS1  E2nodeComponentInterfaceS1,
    e2nodeComponentInterfaceTypeX2  E2nodeComponentInterfaceX2,
    ...
}

E2nodeComponentInterfaceE1 ::= SEQUENCE{
    gNB-CU-CP-ID        GNB-CU-UP-ID,
    ...
}

E2nodeComponentInterfaceF1 ::= SEQUENCE{
    gNB-DU-ID           GNB-DU-ID,
    ...
}

E2nodeComponentInterfaceNG ::= SEQUENCE{
    amf-name            AMFName,
    ...
}

E2nodeComponentInterfaceS1 ::= SEQUENCE{
    mme-name            MMEname,
    ...
}

E2nodeComponentInterfaceX2 ::= SEQUENCE{
    global-eNB-ID       GlobalENB-ID    OPTIONAL,
    global-en-gNB-ID    GlobalenGNB-ID  OPTIONAL,
    ...
}

E2nodeComponentInterfaceXn ::= SEQUENCE{
    global-NG-RAN-Node-ID       GlobalNG-RANNode-ID,
    ...
}

E2nodeComponentInterfaceW1 ::= SEQUENCE{
    ng-eNB-DU-ID        NGENB-DU-ID,
    ...
}

-- ************************************************************
-- copied from 3GPP 36.423 (X2AP) IEs
-- note: ie-Extensions removed
-- ************************************************************
ENB-ID ::= CHOICE {
    macro-eNB-ID            BIT STRING (SIZE (20)),
    home-eNB-ID             BIT STRING (SIZE (28)),
    ... ,
    short-Macro-eNB-ID      BIT STRING (SIZE(18)),
    long-Macro-eNB-ID       BIT STRING (SIZE(21))
}
```

```
-- **************************************************************
-- copied from 3GPP 38.423 (XnAP) IEs
-- note: choice-extension removed
-- **************************************************************
ENB-ID-Choice ::= CHOICE {
    enb-ID-macro            BIT STRING (SIZE(20)),
    enb-ID-shortmacro       BIT STRING (SIZE(18)),
    enb-ID-longmacro        BIT STRING (SIZE(21)),
    ...
}

-- **************************************************************
-- copied from 3GPP 36.423 (X2AP) IEs
-- note: ie-Extensions removed
-- Note: to avoid duplicate names with XnAP, GNB-ID renamed ENGNB-ID, GlobalGNB-ID renamed
GlobalenGNB-ID
-- **************************************************************
ENGNB-ID ::= CHOICE {
    gNB-ID  BIT STRING (SIZE (22..32)),
    ...
}

-- F
-- G
GlobalE2node-ID ::= CHOICE{
    gNB                 GlobalE2node-gNB-ID,
    en-gNB              GlobalE2node-en-gNB-ID,
    ng-eNB              GlobalE2node-ng-eNB-ID,
    eNB                 GlobalE2node-eNB-ID,
    ...
}

GlobalE2node-en-gNB-ID ::= SEQUENCE{
    global-en-gNB-ID    GlobalenGNB-ID,
    en-gNB-CU-UP-ID     GNB-CU-UP-ID    OPTIONAL,
    en-gNB-DU-ID        GNB-DU-ID       OPTIONAL,
    ...
}
GlobalE2node-eNB-ID ::= SEQUENCE{
    global-eNB-ID       GlobalENB-ID,
    ...
}
GlobalE2node-gNB-ID ::= SEQUENCE{
    global-gNB-ID       GlobalgNB-ID,
    global-en-gNB-ID    GlobalenGNB-ID  OPTIONAL,
    gNB-CU-UP-ID        GNB-CU-UP-ID    OPTIONAL,
    gNB-DU-ID           GNB-DU-ID       OPTIONAL,
    ...
}
GlobalE2node-ng-eNB-ID ::= SEQUENCE{
    global-ng-eNB-ID    GlobalngeNB-ID,
    global-eNB-ID       GlobalENB-ID    OPTIONAL,
    ngENB-DU-ID         NGENB-DU-ID     OPTIONAL,
    ...
}
-- **************************************************************
-- copied from 3GPP 36.423 (X2AP) IEs
-- note: ie-Extensions removed
-- **************************************************************

GlobalENB-ID ::= SEQUENCE {
    pLMN-Identity       PLMN-Identity,
    eNB-ID              ENB-ID,
    ...
}
-- **************************************************************
-- copied from 3GPP 36.423 (X2AP) IEs
-- Note: to avoid duplicate names with XnAP, GNB-ID renamed ENGNB-ID, GlobalGNB-ID renamed
GlobalenGNB-ID
-- **************************************************************
GlobalenGNB-ID ::= SEQUENCE {
    pLMN-Identity       PLMN-Identity,
    gNB-ID              ENGNB-ID,
    ...
}
-- **************************************************************
-- copied from 3GPP 38.423 (XnAP) IEs
-- note: choice-extension removed
```

```
-- **************************************************************
GlobalgNB-ID    ::= SEQUENCE {
    plmn-id             PLMN-Identity,
    gnb-id              GNB-ID-Choice,
    ...
}


-- **************************************************************
-- copied from 3GPP 38.423 (XnAP) IEs
-- note: choice-extension removed
-- **************************************************************
GlobalngeNB-ID  ::= SEQUENCE {
    plmn-id         PLMN-Identity,
    enb-id          ENB-ID-Choice,
    ...
}

-- **************************************************************
-- [NEW for E2AP v02.00] copied from 3GPP 38.423 (XnAP) IEs
-- Note: extension field removed
-- **************************************************************

GlobalNG-RANNode-ID ::= CHOICE {
    gNB                     GlobalgNB-ID,
    ng-eNB                  GlobalngeNB-ID,
    ...
}

GlobalRIC-ID ::= SEQUENCE{
    pLMN-Identity           PLMN-Identity,
    ric-ID                  BIT STRING (SIZE (20)),
    ...
}

-- **************************************************************
-- copied from 3GPP 38.463 (E1AP) IEs
-- **************************************************************
GNB-CU-UP-ID::=     INTEGER (0..68719476735)

-- **************************************************************
-- copied from 3GPP 38.473 (F1AP) IEs
-- **************************************************************
GNB-DU-ID::=        INTEGER (0..68719476735)

-- **************************************************************
-- copied from 3GPP 38.423 (XnAP) IEs
-- note: choice-extension removed
-- **************************************************************
GNB-ID-Choice ::= CHOICE {
    gnb-ID                  BIT STRING (SIZE(22..32)),
    ...
}
-- H
-- I
-- J
-- K
-- L
-- M

-- **************************************************************
-- [New for E2AP v02.00] copied from 3GPP 36.413 (S1AP) IEs
-- **************************************************************
MMEname ::= PrintableString (SIZE (1..150,...))

-- N

-- **************************************************************
-- copied from 3GPP 37.473 (W1AP) IEs
-- **************************************************************
NGENB-DU-ID ::= INTEGER (0..68719476735)


-- O
-- P
-- **************************************************************
-- copied from 3GPP 36.423 (X2AP) IEs
-- **************************************************************
```

```
PLMN-Identity ::= OCTET STRING (SIZE(3))

-- Q
-- R
-- **************************************************************
-- Following IE defined in E2SM
-- **************************************************************
RANfunctionDefinition ::= OCTET STRING

RANfunctionID ::= INTEGER (0..4095)

RANfunctionOID ::= PrintableString(SIZE(1..1000,...))

RANfunctionRevision ::= INTEGER (0..4095)

-- **************************************************************
-- Following IE defined in E2SM
-- **************************************************************
RICactionDefinition ::= OCTET STRING

RICactionID ::= INTEGER (0..255)

RICactionType ::= ENUMERATED{
    report,
    insert,
    policy,
    ...
}

-- **************************************************************
-- Following IE defined in E2SM
-- **************************************************************
RICcallProcessID ::= OCTET STRING

RICcontrolAckRequest ::= ENUMERATED{
    noAck,
    ack,
    ...
}

-- **************************************************************
-- Following IE defined in E2SM
-- **************************************************************
RICcontrolHeader ::= OCTET STRING

-- **************************************************************
-- Following IE defined in E2SM
-- **************************************************************
RICcontrolMessage ::= OCTET STRING

-- **************************************************************
-- Following IE defined in E2SM
-- **************************************************************
RICcontrolOutcome ::= OCTET STRING

-- **************************************************************
-- Following IE defined in E2SM
-- **************************************************************
RICeventTriggerDefinition ::= OCTET STRING

-- **************************************************************
-- Following IE defined in E2SM
-- **************************************************************
RICindicationHeader ::= OCTET STRING

-- **************************************************************
-- Following IE defined in E2SM
-- **************************************************************
RICindicationMessage ::= OCTET STRING

RICindicationSN ::= INTEGER (0..65535)

RICindicationType ::= ENUMERATED{
    report,
    insert,
    ...
}
```

```
RICrequestID ::= SEQUENCE {
    ricRequestorID              INTEGER (0..65535),
    ricInstanceID   INTEGER (0..65535),
    ...
}

RICsubsequentAction ::=SEQUENCE{
    ricSubsequentActionType     RICsubsequentActionType,
    ricTimeToWait               RICtimeToWait,
    ...
}

RICsubsequentActionType ::= ENUMERATED{
    continue,
    wait,
    ...
}

RICtimeToWait ::= ENUMERATED{
    w1ms,
    w2ms,
    w5ms,
    w10ms,
    w20ms,
    w30ms,
    w40ms,
    w50ms,
    w100ms,
    w200ms,
    w500ms,
    w1s,
    w2s,
    w5s,
    w10s,
    w20s,
    w60s,
    ...
}
-- S
-- T
-- **************************************************************
-- copied from 3GPP 38.413 (NGAP) IEs
-- **************************************************************
TimeToWait ::= ENUMERATED {v1s, v2s, v5s, v10s, v20s, v60s, ...}


TNLinformation ::= SEQUENCE{
    tnlAddress          BIT STRING (SIZE(1..160,...)),
    tnlPort             BIT STRING (SIZE(16))   OPTIONAL,
    ...
}

TNLusage ::= ENUMERATED{ric-service, support-function, both, ...}

TransactionID ::= INTEGER (0..255,...)

-- **************************************************************
-- copied from 3GPP 38.413 (NGAP) IEs
-- **************************************************************
TypeOfError ::= ENUMERATED {
    not-understood,
    missing,
    ...
}

-- U
-- V
-- W
-- X
-- Y
-- Z

END
-- ASN1STOP
```

9.3.6 Common definitions

```
-- ASN1START
-- **************************************************************
--
-- Common definitions
-- Derived from 3GPP 38.413 (NGAP)
--
-- **************************************************************

E2AP-CommonDataTypes {
iso(1) identified-organization(3) dod(6) internet(1) private(4) enterprise(1) 53148 e2(1) version2
(2) e2ap(1) e2ap-CommonDataTypes (3) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

Criticality     ::= ENUMERATED { reject, ignore, notify }

Presence        ::= ENUMERATED { optional, conditional, mandatory }

ProcedureCode       ::= INTEGER (0..255)

ProtocolIE-ID       ::= INTEGER (0..65535)

TriggeringMessage   ::= ENUMERATED { initiating-message, successful-outcome, unsuccessfull-outcome }

END
-- ASN1STOP
```

9.3.7 Constant definitions

```
-- ASN1START
-- **************************************************************
--
-- Constant definitions
--
-- **************************************************************

E2AP-Constants {
iso(1) identified-organization(3) dod(6) internet(1) private(4) enterprise(1) 53148 e2(1) version2
(2) e2ap(1) e2ap-Constants (4) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS
    ProcedureCode,
    ProtocolIE-ID
FROM E2AP-CommonDataTypes;

-- **************************************************************
--
-- Elementary Procedures
--
-- **************************************************************
id-E2setup                                  ProcedureCode ::= 1
id-ErrorIndication                          ProcedureCode ::= 2
id-Reset                                    ProcedureCode ::= 3
id-RICcontrol                               ProcedureCode ::= 4
id-RICindication                            ProcedureCode ::= 5
id-RICserviceQuery                          ProcedureCode ::= 6
id-RICserviceUpdate                         ProcedureCode ::= 7
id-RICsubscription                          ProcedureCode ::= 8
id-RICsubscriptionDelete                    ProcedureCode ::= 9
id-E2nodeConfigurationUpdate                ProcedureCode ::= 10
id-E2connectionUpdate                       ProcedureCode ::= 11
id-RICsubscriptionDeleteRequired            ProcedureCode ::= 12
id-E2removal                                ProcedureCode ::= 13

-- **************************************************************
--
-- Extension constants
--
```

```
-- **************************************************************

maxProtocolIEs                              INTEGER ::= 65535


-- **************************************************************
--
-- Lists
--
-- **************************************************************
maxnoofErrors                               INTEGER ::= 256
maxofE2nodeComponents                       INTEGER ::= 1024
maxofRANfunctionID                          INTEGER ::= 256
maxofRICactionID                            INTEGER ::= 16
maxofTNLA                                   INTEGER ::= 32
maxofRICrequestID                           INTEGER ::= 1024


-- **************************************************************
--
-- IEs
--
-- **************************************************************
id-Cause                                    ProtocolIE-ID ::= 1
id-CriticalityDiagnostics                   ProtocolIE-ID ::= 2
id-GlobalE2node-ID                          ProtocolIE-ID ::= 3
id-GlobalRIC-ID                             ProtocolIE-ID ::= 4
id-RANfunctionID                            ProtocolIE-ID ::= 5
id-RANfunctionID-Item                       ProtocolIE-ID ::= 6
id-RANfunctionIEcause-Item                  ProtocolIE-ID ::= 7
id-RANfunction-Item                         ProtocolIE-ID ::= 8
id-RANfunctionsAccepted                     ProtocolIE-ID ::= 9
id-RANfunctionsAdded                        ProtocolIE-ID ::= 10
id-RANfunctionsDeleted                      ProtocolIE-ID ::= 11
id-RANfunctionsModified                     ProtocolIE-ID ::= 12
id-RANfunctionsRejected                     ProtocolIE-ID ::= 13
id-RICaction-Admitted-Item                  ProtocolIE-ID ::= 14
id-RICactionID                              ProtocolIE-ID ::= 15
id-RICaction-NotAdmitted-Item               ProtocolIE-ID ::= 16
id-RICactions-Admitted                      ProtocolIE-ID ::= 17
id-RICactions-NotAdmitted                   ProtocolIE-ID ::= 18
id-RICaction-ToBeSetup-Item                 ProtocolIE-ID ::= 19
id-RICcallProcessID                         ProtocolIE-ID ::= 20
id-RICcontrolAckRequest                     ProtocolIE-ID ::= 21
id-RICcontrolHeader                         ProtocolIE-ID ::= 22
id-RICcontrolMessage                        ProtocolIE-ID ::= 23
id-RICcontrolStatus                         ProtocolIE-ID ::= 24
id-RICindicationHeader                      ProtocolIE-ID ::= 25
id-RICindicationMessage                     ProtocolIE-ID ::= 26
id-RICindicationSN                          ProtocolIE-ID ::= 27
id-RICindicationType                        ProtocolIE-ID ::= 28
id-RICrequestID                             ProtocolIE-ID ::= 29
id-RICsubscriptionDetails                   ProtocolIE-ID ::= 30
id-TimeToWait                               ProtocolIE-ID ::= 31
id-RICcontrolOutcome                        ProtocolIE-ID ::= 32
id-E2nodeComponentConfigUpdate              ProtocolIE-ID ::= 33
id-E2nodeComponentConfigUpdate-Item         ProtocolIE-ID ::= 34
id-E2nodeComponentConfigUpdateAck           ProtocolIE-ID ::= 35
id-E2nodeComponentConfigUpdateAck-Item      ProtocolIE-ID ::= 36
id-E2connectionSetup                        ProtocolIE-ID ::= 39
id-E2connectionSetupFailed                  ProtocolIE-ID ::= 40
id-E2connectionSetupFailed-Item             ProtocolIE-ID ::= 41
id-E2connectionFailed-Item                  ProtocolIE-ID ::= 42
id-E2connectionUpdate-Item                  ProtocolIE-ID ::= 43
id-E2connectionUpdateAdd                    ProtocolIE-ID ::= 44
id-E2connectionUpdateModify                 ProtocolIE-ID ::= 45
id-E2connectionUpdateRemove                 ProtocolIE-ID ::= 46
id-E2connectionUpdateRemove-Item            ProtocolIE-ID ::= 47
id-TNLinformation                           ProtocolIE-ID ::= 48
id-TransactionID                            ProtocolIE-ID ::= 49
id-E2nodeComponentConfigAddition            ProtocolIE-ID ::= 50
id-E2nodeComponentConfigAddition-Item       ProtocolIE-ID ::= 51
id-E2nodeComponentConfigAdditionAck         ProtocolIE-ID ::= 52
id-E2nodeComponentConfigAdditionAck-Item    ProtocolIE-ID ::= 53
id-E2nodeComponentConfigRemoval             ProtocolIE-ID ::= 54
id-E2nodeComponentConfigRemoval-Item        ProtocolIE-ID ::= 55
id-E2nodeComponentConfigRemovalAck          ProtocolIE-ID ::= 56
id-E2nodeComponentConfigRemovalAck-Item     ProtocolIE-ID ::= 57
```

```
id-E2nodeTNLassociationRemoval              ProtocolIE-ID ::= 58
id-E2nodeTNLassociationRemoval-Item         ProtocolIE-ID ::= 59
id-RICsubscriptionToBeRemoved               ProtocolIE-ID ::= 60
id-RICsubscription-withCause-Item           ProtocolIE-ID ::= 61

END
-- ASN1STOP
```

9.3.8 Container definitions

```
-- ASN1START
-- **************************************************************
--
-- Container definitions
--
-- derived from 3GPP 38.413 (NGAP)
-- **************************************************************

E2AP-Containers {
iso(1) identified-organization(3) dod(6) internet(1) private(4) enterprise(1) 53148 e2(1) version2
(2) e2ap(1) e2ap-Containers (5) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

-- **************************************************************
--
-- IE parameter types from other modules.
--
-- **************************************************************

IMPORTS

    Criticality,
    Presence,
    ProtocolIE-ID
FROM E2AP-CommonDataTypes

    maxProtocolIEs
FROM E2AP-Constants;

-- **************************************************************
--
-- Class Definition for Protocol IEs
--
-- **************************************************************

E2AP-PROTOCOL-IES ::= CLASS {
    &id             ProtocolIE-ID                   UNIQUE,
    &criticality    Criticality,
    &Value,
    &presence       Presence
}
WITH SYNTAX {
    ID              &id
    CRITICALITY     &criticality
    TYPE            &Value
    PRESENCE        &presence
}

-- **************************************************************
--
-- Class Definition for Protocol IEs
--
-- **************************************************************

E2AP-PROTOCOL-IES-PAIR ::= CLASS {
    &id                 ProtocolIE-ID               UNIQUE,
    &firstCriticality   Criticality,
    &FirstValue,
    &secondCriticality  Criticality,
    &SecondValue,
    &presence           Presence
}
WITH SYNTAX {
    ID                      &id
```

```
    FIRST CRITICALITY       &firstCriticality
    FIRST TYPE              &FirstValue
    SECOND CRITICALITY      &secondCriticality
    SECOND TYPE             &SecondValue
    PRESENCE                &presence
}




-- ************************************************************
--
-- Container for Protocol IEs
--
-- ************************************************************

ProtocolIE-Container {E2AP-PROTOCOL-IES : IEsSetParam} ::=
    SEQUENCE (SIZE (0..maxProtocolIEs)) OF
    ProtocolIE-Field {{IEsSetParam}}

ProtocolIE-SingleContainer {E2AP-PROTOCOL-IES : IEsSetParam} ::=
    ProtocolIE-Field {{IEsSetParam}}

ProtocolIE-Field {E2AP-PROTOCOL-IES : IEsSetParam} ::= SEQUENCE {
    id              E2AP-PROTOCOL-IES.&id               ({IEsSetParam}),
    criticality     E2AP-PROTOCOL-IES.&criticality      ({IEsSetParam}{@id}),
    value           E2AP-PROTOCOL-IES.&Value            ({IEsSetParam}{@id})
}

-- ************************************************************
--
-- Container for Protocol IE Pairs
--
-- ************************************************************

ProtocolIE-ContainerPair {E2AP-PROTOCOL-IES-PAIR : IEsSetParam} ::=
    SEQUENCE (SIZE (0..maxProtocolIEs)) OF
    ProtocolIE-FieldPair {{IEsSetParam}}

ProtocolIE-FieldPair {E2AP-PROTOCOL-IES-PAIR : IEsSetParam} ::= SEQUENCE {
    id                  E2AP-PROTOCOL-IES-PAIR.&id                  ({IEsSetParam}),
    firstCriticality    E2AP-PROTOCOL-IES-PAIR.&firstCriticality    ({IEsSetParam}{@id}),
    firstValue          E2AP-PROTOCOL-IES-PAIR.&FirstValue          ({IEsSetParam}{@id}),
    secondCriticality   E2AP-PROTOCOL-IES-PAIR.&secondCriticality   ({IEsSetParam}{@id}),
    secondValue         E2AP-PROTOCOL-IES-PAIR.&SecondValue         ({IEsSetParam}{@id})
}

-- ************************************************************
--
-- Container Lists for Protocol IE Containers
--
-- ************************************************************

ProtocolIE-ContainerList {INTEGER : lowerBound, INTEGER : upperBound, E2AP-PROTOCOL-IES :
IEsSetParam} ::=
    SEQUENCE (SIZE (lowerBound..upperBound)) OF
    ProtocolIE-SingleContainer {{IEsSetParam}}

ProtocolIE-ContainerPairList {INTEGER : lowerBound, INTEGER : upperBound, E2AP-PROTOCOL-IES-PAIR :
IEsSetParam} ::=
    SEQUENCE (SIZE (lowerBound..upperBound)) OF
    ProtocolIE-ContainerPair {{IEsSetParam}}


END
-- ASN1STOP
```

9.4 Message transfer syntax

E2AP shall use the ASN.1 Basic Packed Encoding Rules (BASIC-PER) Aligned Variant as transfer syntax, as specified in ITU-T Rec. X.691 [15].

9.5 Timers

The following Timers are defined for use over the E2 interface in Near-RT RIC and E2 Node.

$T_{RICEVENTcreate}$

- Specifies the maximum time for the RIC Subscription Request event creation procedure in the E2 Node.

$T_{RICEVENTdelete}$

- Specifies the maximum time for the RIC Subscription Request event deletion procedure in the E2 Node.

$T_{RICcontrol}$

- Specifies the maximum time for the RIC Control Request event request procedure in the E2 Node.

Time To Wait

- Specifies the time to wait used in failure cases for E2 Setup procedure and RIC Service Update procedure. It is also used in the *RIC Subsequent Action* IE.

10 Handling of Unknown, Unforeseen and Erroneous Protocol Data

Section 10 of TS 36.413 [24] is applicable for the purposes of the present document.

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Section 1: DEFINITIONS

1.1 "Affiliate" means an entity that directly or indirectly controls, is controlled by, or is under common control with another entity, so long as such control exists. For the purpose of this Section, "Control" means beneficial ownership of fifty (50%) percent or more of the voting stock or equity in an entity.

1.2 "Compliant Implementation" means any system, device, method or operation (whether implemented in hardware, software or combinations thereof) that fully conforms to a Final Specification.

1.3 "Adopter(s)" means all entities, who are not Members, Contributors or Academic Contributors, including their Affiliates, who wish to download, use or otherwise access O-RAN Specifications.

1.4 "Minor Update" means an update or revision to an O-RAN Specification published by O-RAN Alliance that does not add any significant new features or functionality and remains interoperable with the prior version of an O-RAN Specification. The term "O-RAN Specifications" includes Minor Updates.

1.5 "Necessary Claims" means those claims of all present and future patents and patent applications, other than design patents and design registrations, throughout the world, which (i) are owned or otherwise licensable by a Member, Contributor or Academic Contributor during the term of its Member, Contributor or Academic Contributorship; (ii) such Member, Contributor or Academic Contributor has the right to grant a license without the payment of consideration to a third party; and (iii) are necessarily infringed by a Compliant Implementation (without considering any Contributions not included in the Final Specification). A claim is necessarily infringed only when it is not possible on technical (but not commercial) grounds, taking into account normal technical practice and the state of the art generally available at the date any Final Specification was published by the O-RAN Alliance or the date the patent claim first came into existence, whichever last occurred, to make, sell, lease, otherwise dispose of, repair, use or operate a Compliant Implementation without infringing that claim. For the avoidance of doubt in exceptional cases where a Final Specification can only be implemented by technical solutions, all of which infringe patent claims, all such patent claims shall be considered Necessary Claims.

1.6 "Defensive Suspension" means for the purposes of any license grant pursuant to Section 3, Member, Contributor, Academic Contributor, Adopter, or any of their Affiliates, may have the discretion to include in their license a term allowing the licensor to suspend the license against a licensee who brings a patent infringement suit against the licensing Member, Contributor, Academic Contributor, Adopter, or any of their Affiliates.

Section 2: COPYRIGHT LICENSE

2.1 Subject to the terms and conditions of this Agreement, O-RAN Alliance hereby grants to Adopter a nonexclusive, nontransferable, irrevocable, non-sublicensable, worldwide copyright license to obtain, use and modify O-RAN Specifications, but not to further distribute such O-RAN Specification in any modified or unmodified way, solely in furtherance of implementations of an O-RAN

Specification.

2.2 Adopter shall not use O-RAN Specifications except as expressly set forth in this Agreement or in a separate written agreement with O-RAN Alliance.

Section 3: FRAND LICENSE

3.1 Members, Contributors and Academic Contributors and their Affiliates are prepared to grant based on a separate Patent License Agreement to each Adopter under Fair Reasonable And Non- Discriminatory (FRAND) terms and conditions with or without compensation (royalties) a nonexclusive, non-transferable, irrevocable (but subject to Defensive Suspension), non-sublicensable, worldwide patent license under their Necessary Claims to make, have made, use, import, offer to sell, lease, sell and otherwise distribute Compliant Implementations; provided, however, that such license shall not extend: (a) to any part or function of a product in which a Compliant Implementation is incorporated

that is not itself part of the Compliant Implementation; or (b) to any Adopter if that Adopter is not making a reciprocal grant to Members, Contributors and Academic Contributors, as set forth in Section 3.3. For the avoidance of doubt, the foregoing licensing commitment includes the distribution by the Adopter's distributors and the use by the Adopter's customers of such licensed Compliant Implementations.

3.2 Notwithstanding the above, if any Member, Contributor or Academic Contributor, Adopter or their Affiliates has reserved the right to charge a FRAND royalty or other fee for its license of Necessary Claims to Adopter, then Adopter is entitled to charge a FRAND royalty or other fee to such Member, Contributor or Academic Contributor, Adopter and its Affiliates for its license of Necessary Claims to its licensees.

3.3 Adopter, on behalf of itself and its Affiliates, shall be prepared to grant based on a separate Patent License Agreement to each Members, Contributors, Academic Contributors, Adopters and their Affiliates under Fair Reasonable And Non-Discriminatory (FRAND) terms and conditions with or without compensation (royalties) a nonexclusive, non-transferable, irrevocable (but subject to Defensive Suspension), non-sublicensable, worldwide patent license under their Necessary Claims to make, have made, use, import, offer to sell, lease, sell and otherwise distribute Compliant Implementations; provided, however, that such license will not extend: (a) to any part or function of a product in which a Compliant Implementation is incorporated that is not itself part of the Compliant Implementation; or (b) to any Members, Contributors, Academic Contributors, Adopters and their Affiliates that is not making a reciprocal grant to Adopter, as set forth in Section 3.1. For the avoidance of doubt, the foregoing licensing commitment includes the distribution by the Members', Contributors', Academic Contributors', Adopters' and their Affiliates' distributors and the use by the Members', Contributors', Academic Contributors', Adopters' and their Affiliates' customers of such licensed Compliant Implementations.

Section 4: TERM AND TERMINATION

4.1 This Agreement shall remain in force, unless early terminated according to this Section 4.

4.2 O-RAN Alliance on behalf of its Members, Contributors and Academic Contributors may terminate this Agreement if Adopter materially breaches this Agreement and does not cure or is not capable of curing such breach within thirty (30) days after being given notice specifying the breach.

4.3 Sections 1, 3, 5 - 11 of this Agreement shall survive any termination of this Agreement. Under surviving Section 3, after termination of this Agreement, Adopter will continue to grant licenses (a) to entities who become Adopters after the date of termination; and (b) for future versions of O-RAN Specifications that are backwards compatible with the version that was current as of the date of termination.

Section 5: CONFIDENTIALITY

Adopter will use the same care and discretion to avoid disclosure, publication, and dissemination of O-RAN Specifications to third parties, as Adopter employs with its own confidential information, but no less than reasonable care. Any disclosure by Adopter to its Affiliates, contractors and consultants should be subject to an obligation of confidentiality at least as restrictive as those contained in this Section. The foregoing obligation shall not apply to any information which is: (1) rightfully known by Adopter without any limitation on use or disclosure prior to disclosure; (2) publicly available through no fault of Adopter; (3) rightfully received without a duty of confidentiality; (4) disclosed by O-RAN Alliance or a Member, Contributor or Academic Contributor to a third party without a duty of confidentiality on such third party; (5) independently developed by Adopter; (6) disclosed pursuant to the order of a court or other authorized governmental body, or as required by law, provided that Adopter provides reasonable prior written notice to O-RAN Alliance, and cooperates with O-RAN Alliance and/or the applicable Member, Contributor or Academic Contributor to have the opportunity to oppose any such order; or (7) disclosed by Adopter with O-RAN Alliance's prior written approval.

Section 6: INDEMNIFICATION

Adopter shall indemnify, defend, and hold harmless the O-RAN Alliance, its Members, Contributors or Academic Contributors, and their employees, and agents and their respective successors, heirs and assigns (the "Indemnitees"), against any liability, damage, loss, or expense (including reasonable attorneys' fees and expenses) incurred by or imposed upon any of the Indemnitees in connection with any claims, suits, investigations, actions, demands or judgments arising out of Adopter's use of the licensed O-RAN Specifications or Adopter's commercialization of products that comply with O-RAN Specifications.

Section 7: LIMITATIONS ON LIABILITY; NO WARRANTY

EXCEPT FOR BREACH OF CONFIDENTIALITY, ADOPTER'S BREACH OF SECTION 3, AND ADOPTER'S INDEMNIFICATION OBLIGATIONS, IN NO EVENT SHALL ANY PARTY BE LIABLE TO ANY OTHER PARTY OR THIRD PARTY FOR ANY INDIRECT, SPECIAL, INCIDENTAL, PUNITIVE OR CONSEQUENTIAL DAMAGES RESULTING FROM ITS PERFORMANCE OR NON-PERFORMANCE UNDER THIS AGREEMENT, IN EACH CASE WHETHER UNDER CONTRACT, TORT, WARRANTY, OR OTHERWISE, AND WHETHER OR NOT SUCH PARTY HAD ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES. O-RAN SPECIFICATIONS ARE PROVIDED "AS IS" WITH NO WARRANTIES OR CONDITIONS WHATSOEVER, WHETHER EXPRESS, IMPLIED, STATUTORY, OR OTHERWISE. THE O-RAN ALLIANCE AND THE MEMBERS, CONTRIBUTORS OR ACADEMIC CONTRIBUTORS EXPRESSLY DISCLAIM ANY WARRANTY OR CONDITION OF MERCHANTABILITY, SECURITY, SATISFACTORY QUALITY, NONINFRINGEMENT, FITNESS FOR ANY PARTICULAR PURPOSE, ERROR-FREE OPERATION, OR ANY WARRANTY OR CONDITION FOR O-RAN SPECIFICATIONS.

Section 8: ASSIGNMENT

Adopter may not assign the Agreement or any of its rights or obligations under this Agreement or make any grants or other sublicenses to this Agreement, except as expressly authorized hereunder, without having first received the prior, written consent of the O-RAN Alliance, which consent may be withheld in O-RAN Alliance's sole discretion. O-RAN Alliance may freely assign this Agreement.

Section 9: THIRD-PARTY BENEFICIARY RIGHTS

Adopter acknowledges and agrees that Members, Contributors and Academic Contributors (including future Members, Contributors and Academic Contributors) are entitled to rights as a third-party beneficiary under this Agreement, including as licensees under Section 3.

Section 10: BINDING ON AFFILIATES

Execution of this Agreement by Adopter in its capacity as a legal entity or association constitutes that legal entity's or association's agreement that its Affiliates are likewise bound to the obligations that are applicable to Adopter hereunder and are also entitled to the benefits of the rights of Adopter hereunder.

Section 11: GENERAL

This Agreement is governed by the laws of Germany without regard to its conflict or choice of law provisions.

This Agreement constitutes the entire agreement between the parties as to its express subject matter and expressly supersedes and replaces any prior or contemporaneous agreements between the parties, whether written or oral, relating to the subject matter of this Agreement.

Adopter, on behalf of itself and its Affiliates, agrees to comply at all times with all applicable laws, rules and regulations with respect to its and its Affiliates' performance under this Agreement, including without limitation, export control and antitrust laws. Without limiting the generality of the foregoing, Adopter acknowledges that this Agreement prohibits any communication that would violate the antitrust laws.

By execution hereof, no form of any partnership, joint venture or other special relationship is created between Adopter, or O-RAN Alliance or its Members, Contributors or Academic Contributors. Except as expressly set forth in this Agreement, no party is authorized to make any commitment on behalf of Adopter, or O-RAN Alliance or its Members, Contributors or Academic Contributors.

In the event that any provision of this Agreement conflicts with governing law or if any provision is held to be null, void or otherwise ineffective or invalid by a court of competent jurisdiction, (i) such provisions will be deemed stricken from the contract, and (ii) the remaining terms, provisions, covenants and restrictions of this Agreement will remain in full force and effect.

Any failure by a party or third party beneficiary to insist upon or enforce performance by another party of any of the provisions of this Agreement or to exercise any rights or remedies under this Agreement or otherwise by law shall not be construed as a waiver or relinquishment to any extent of the other parties' or third party beneficiary's right to assert

or rely upon any such provision, right or remedy in that or any other instance; rather the same shall be and remain in full force and effect.