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Foreword

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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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1 Scope

The present document specifies the radio network layer signalling procedures of the control plane between eNBs in E-UTRAN. X2AP supports the functions of X2 interface by signalling procedures defined in this document. X2AP is developed in accordance to the general principles stated in [2] and [3].

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

[3] 3GPP TS 36.420: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); X2 General Aspects and Principles".

[4] 3GPP TS 36.413: " Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP)".

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

[6] 3GPP TS 32.422: "Telecommunication Management; Subscriber and Equipment Trace; Trace Control and Configuration Management".

[7] 3GPP TS 32.421: "Telecommunication Management; Subscriber and Equipment Trace; Trace concepts and requirements".

[8] 3GPP TS 36.424: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); X2 data transport".

[9] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRAN); Radio Resource Control (RRC) Protocol Specification".

[10] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation".

[11] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures ".

[12] 3GPP TS 23.401: "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access".

[13] 3GPP TS 23.203: "Policy and charging control architecture".

[14] 3GPP TS 24.301: "Non-Access-Stratum (NAS) protocol for Evolved Packet System; Stage 3".

[15] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA), Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; stage 2".

[16] 3GPP TS 36.104: " Base Station (BS) radio transmission and reception ".

[17] 3GPP TS 24.008: "Mobile Radio Interface Layer 3 Specification; Core Network Protocols; Stage 3".

[18] 3GPP TS 33.401: "Security architecture".

[19] 3GPP TS 36.414: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 data transport".

[20] 3GPP TS 23.216: "Single Radio Voice Call Continuity (SRVCC)".

[21] 3GPP TS 36.422: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); X2 signaling transport".

[22] 3GPP TS 36.314: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Layer 2 - Measurements".

[23] 3GPP TS 23.203: " Policy and charging control architecture".

[24] 3GPP TS 25.413: "UTRAN Iu interface RANAP signalling"

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in [1].

Elementary Procedure: X2AP protocol consists of Elementary Procedures (EPs). An X2AP Elementary Procedure is a unit of interaction between two eNBs. An EP consists of an initiating message and possibly a response message. Two kinds of EPs are used:

- **Class 1:** Elementary Procedures with response (success or failure),
- **Class 2:** Elementary Procedures without response.

E-RAB: Defined in [2].

3.2 Symbols

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

<symbol> <Explanation>

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in [1].

DL	Downlink
EARFCN	E-UTRA Absolute Radio Frequency Channel Number
eNB	E-UTRAN NodeB
EP	Elementary Procedure
EPC	Evolved Packet Core
E-RAB	E-UTRAN Radio Access Bearer
E-UTRAN	Evolved UTRAN

GUMMEI	Globally Unique MME Identifier
HFN	Hyper Frame Number
IE	Information Element
MME	Mobility Management Entity
PDCP	Packet Data Convergence Protocol
PLMN	Public Land Mobile Network
S-GW	Serving Gateway
SN	Sequence Number
TAC	Tracking Area Code
UE	User Equipment
UL	Uplink

4 General

4.1 Procedure specification principles

The principle for specifying the procedure logic is to specify the functional behaviour of the terminating eNB exactly and completely. Any rule that specifies the behaviour of the originating eNB 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 initiating 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 section 10.

4.2 Forwards and backwards compatibility

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

4.3 Specification notations

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

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 sub clause 9.2 enclosed by quotation marks, e.g. "Value".

5 X2AP services

The present clause describes the services an eNB offers to its neighbours.

5.1 X2AP procedure modules

The X2 interface X2AP procedures are divided into two modules as follows:

1. X2AP Basic Mobility Procedures;
2. X2AP Global Procedures;

The X2AP Basic Mobility Procedures module contains procedures used to handle the UE mobility within E-UTRAN.

The Global Procedures module contains procedures that are not related to a specific UE. The procedures in this module are in contrast to the above module involving two peer eNBs.

5.2 Parallel transactions

Unless explicitly indicated in the procedure specification, at any instance in time one protocol peer shall have a maximum of one ongoing X2AP procedure related to a certain UE.

6 Services expected from signalling transport

The signalling connection shall provide in sequence delivery of X2AP messages. X2AP shall be notified if the signalling connection breaks.

X2 signalling transport is described in [21].

7 Functions of X2AP

The X2AP protocol provides the following functions:

- Mobility Management. This function allows the eNB to move the responsibility of a certain UE to another eNB. Forwarding of user plane data, Status Transfer and UE Context Release function are parts of the mobility management.
- Load Management. This function is used by eNBs to indicate resource status, overload and traffic load to each other.
- Reporting of General Error Situations. This function allows reporting of general error situations, for which function specific error messages have not been defined.
- Resetting the X2. This function is used to reset the X2 interface.
- Setting up the X2. This function is used to exchange necessary data for the eNB for setup the X2 interface and implicitly perform an X2 Reset.
- eNB Configuration Update. This function allows updating of application level data needed for two eNBs to interoperate correctly over the X2 interface.

The mapping between the above functions and X2 EPs is shown in the table below.

Table 7-1: Mapping between X2AP functions and X2AP EPs

Function	Elementary Procedure(s)
Mobility Management	a) Handover Preparation b) SN Status Transfer c) UE Context Release d) Handover Cancel
Load Management	a) Load Indication b) Resource Status Reporting Initiation c) Resource Status Reporting
Reporting of General Error Situations	Error Indication
Resetting the X2	Reset
Setting up the X2	X2 Setup
eNB Configuration Update	eNB Configuration Update

8 X2AP 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

Elementary Procedure	Initiating Message	Successful Outcome	Unsuccessful Outcome
		Response message	Response message
Handover Preparation	HANDOVER REQUEST	HANDOVER REQUEST ACKNOWLEDGE	HANDOVER PREPARATION FAILURE
Reset	RESET REQUEST	RESET RESPONSE	
X2 Setup	X2 SETUP REQUEST	X2 SETUP RESPONSE	X2 SETUP FAILURE
eNB Configuration Update	ENB CONFIGURATION UPDATE	ENB CONFIGURATION UPDATE ACKNOWLEDGE	ENB CONFIGURATION UPDATE FAILURE
Resource Status Reporting Initiation	RESOURCE STATUS REQUEST	RESOURCE STATUS RESPONSE	RESOURCE STATUS FAILURE

Table 8.1-2: Class 2 Elementary Procedures

Elementary Procedure	Initiating Message
Load Indication	LOAD INFORMATION
Handover Cancel	HANDOVER CANCEL
SN Status Transfer	SN STATUS TRANSFER
UE Context Release	UE CONTEXT RELEASE
Resource Status Reporting	RESOURCE STATUS UPDATE
Error Indication	ERROR INDICATION

8.2 Basic mobility procedures

8.2.1 Handover Preparation

8.2.1.1 General

This procedure is used to establish necessary resources in an eNB for an incoming handover.

The procedure uses UE-associated signalling.

8.2.1.2 Successful Operation

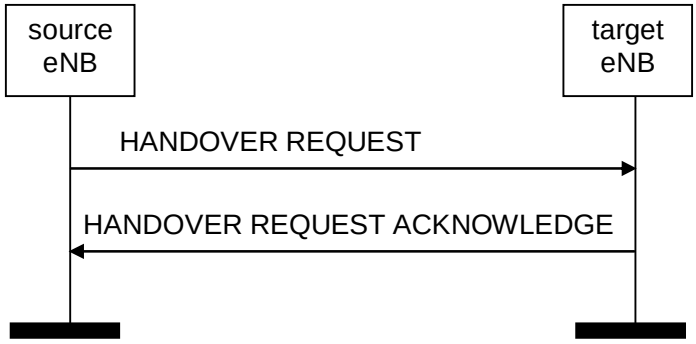

Figure 8.2.1.2-1: Handover Preparation, successful operation

The source eNB initiates the procedure by sending the HANDOVER REQUEST message to the target eNB. When the source eNB sends the HANDOVER REQUEST message, it shall start the timer $T_{RELOCprep.}$

The allocation of resources according to the values of the *Allocation and Retention Priority* IE shall follow the principles described for the E-RAB Setup procedure in [4].

If at least one of the requested E-RABs is admitted to the cell indicated by the *Target Cell ID* IE, the target eNB shall reserve necessary resources, and send the HANDOVER REQUEST ACKNOWLEDGE message back to the source eNB. The target eNB shall include the E-RABs for which resources have been prepared at the target cell in the *E-RABs Admitted List* IE. The target eNB shall include the E-RABs that have not been admitted in the *E-RABs Not Admitted List* IE with an appropriate cause value.

At reception of the HANDOVER REQUEST message the target eNB shall:

- prepare configuration of the AS security relation between UE and target eNB using the information in *UE Security Capabilities* IE and the *AS Security Information* IE in the *UE Context Information* IE**.**

For each E-RAB for which the source eNB proposes to do forwarding of downlink data, the source eNB shall include the *DL Forwarding* IE within the *E-RABs To be Setup Item* IE of the HANDOVER REQUEST message. For each E-RAB that it has decided to admit, the target eNB may include the *DL GTP Tunnel Endpoint* IE within the *E-RABs Admitted Item* IE of the HANDOVER REQUEST ACKNOWLEDGE message to indicate that it accepts the proposed forwarding of downlink data for this bearer. This GTP tunnel endpoint may be different from the corresponding *GTP TEID* IE in the *E-RAB To Be Switched in Downlink List* IE of the PATH SWITCH REQUEST message (see [4]) depending on implementation choice.

For each bearer in the *E-RABs Admitted List* IE, the target eNB may include the *UL GTP Tunnel Endpoint* IE to indicate that it requests data forwarding of uplink packets to be performed for that bearer.

Upon reception of the HANDOVER REQUEST ACKNOWLEDGE message the source eNB shall stop the timer $T_{RELOCprep}$, start the timer $TX2_{RELOCoverall}$ and terminate the Handover Preparation procedure. The source eNB is then defined to have a Prepared Handover for that X2 UE-associated signalling.

If the *Trace Activation* IE is included in the HANDOVER REQUEST message then the target eNB shall, if supported initiate the requested trace function as described in [6].

If the *Handover Restriction List* IE is

- contained in the HANDOVER REQUEST message, the target eNB shall store the information received in the *Handover Restriction List* IE in the UE context and the target eNB shall use this information to determine a target cell for the UE during subsequent handover attempts.

- not contained in the HANDOVER REQUEST message, the target eNB shall consider that no roaming, no area and no access restriction applies to the UE.

If the *Location Reporting Information* IE is included in the HANDOVER REQUEST message then the eNB should initiate the requested location reporting functionality as defined in [4].

If the *SRVCC Operation Possible* IE is included in the HANDOVER REQUEST message, the target eNB shall store the received "SRVCC Operation Possible" in the UE context and use it as defined in [20].

The HANDOVER REQUEST message shall contain the *Subscriber Profile ID for RAT/Frequency priority* IE, if available.

If the *Subscriber Profile ID for RAT/Frequency priority* IE is

- contained in the HANDOVER REQUEST message, the target eNB shall store this information and the target eNB should use the information as defined in [15].

Upon reception of *UE History Information* IE in the HANDOVER REQUEST message, the target eNB shall collect the information defined as mandatory in the *UE History Information* IE, for as long as the UE stays in one of its cells, and store the collected information to be used for future handover preparations.

8.2.1.3 Unsuccessful Operation

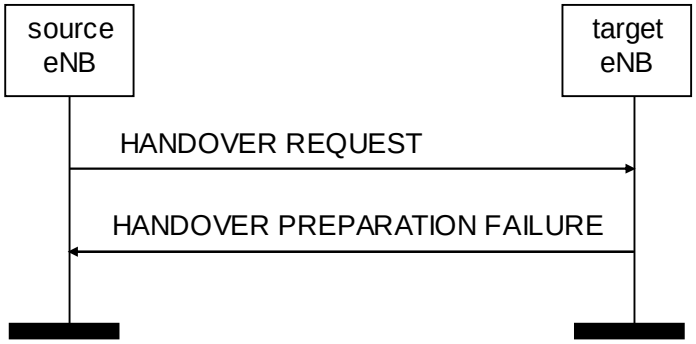

Figure 8.2.1.3-1: Handover Preparation, unsuccessful operation

If the target eNB is not able to accept any of the E-RABs or a failure occurs during the Handover Preparation, the target eNB shall send the HANDOVER PREPARATION FAILURE message to the source eNB. The message shall contain the *Cause* IE with an appropriate value.

If the target eNB receives a HANDOVER REQUEST message containing *RRC Context* IE that does not include required information as specified in [9], the target eNB shall send the HANDOVER PREPARATION FAILURE message to the source eNB.

Interactions with Handover Cancel procedure:

If there is no response from the target eNB to the HANDOVER REQUEST message before timer $T_{RELOCprep}$ expires in the source eNB, the source eNB should cancel the Handover Preparation procedure towards the target eNB by initiating the Handover Cancel procedure with the appropriate value for the *Cause* IE. The source eNB shall ignore any HANDOVER REQUEST ACKNOWLEDGE or HANDOVER PREPARATION FAILURE message received after the initiation of the Handover Cancel procedure and remove any reference and release any resources related to the concerned X2 UE-associated signalling.

8.2.1.4 Abnormal Conditions

If the target eNB receives a HANDOVER REQUEST message containing several *E-RAB ID* IEs (in the *E-RABs To Be Setup List* IE) set to the same value, the target eNB shall not admit the corresponding E-RABs.

If the target eNB receives a HANDOVER REQUEST message containing a *E-RAB Level QoS Parameters* IE which contains a *QCI* IE indicating a GBR bearer (as defined in [13]), and which does not contain the *GBR QoS Information* IE, the target eNB shall not admit the corresponding E-RAB.

If the supported algorithms for encryption defined in the *Encryption Algorithms* IE in the in the *UE Security Capabilities* IE in the *UE Context Information* IE, plus the mandated support of EEA0 in all UEs [18], do not match any algorithms defined in the configured list of allowed encryption algorithms in the eNB [18], the eNB shall reject the procedure using the HANDOVER PREPARATION FAILURE message.

If the supported algorithms for integrity defined in the *Integrity Protection Algorithms* IE in the *UE Security Capabilities* IE in the *UE Context Information* IE, do not match any algorithms defined in the configured list of allowed integrity protection algorithms in the eNB [18] or if all bits in *Integrity Protection Algorithms* IE are equal to 0, the eNB shall reject the procedure using the HANDOVER PREPARATION FAILURE message.

8.2.2 SN Status Transfer

8.2.2.1 General

The purpose of the SN Status Transfer procedure is to transfer the uplink PDCP SN and HFN receiver status and the downlink PDCP SN and HFN transmitter status from the source to the target eNB during an X2 handover for each respective E-RAB for which PDCP SN and HFN status preservation applies.

The procedure uses UE-associated signalling.

8.2.2.2 Successful Operation

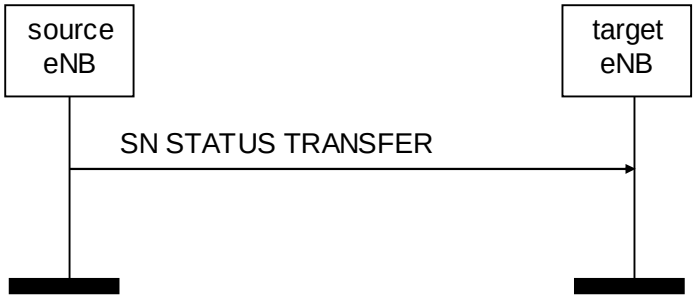

Figure 8.2.2.2-1: SN Status Transfer, successful operation

The source eNB initiates the procedure by stop assigning PDCP SNs to downlink SDUs and stop delivering UL SDUs towards the EPC and sending the SN STATUS TRANSFER message to the target eNB at the time point when it considers the transmitter/receiver status to be frozen.

The *E-RABs Subject To Status Transfer List* IE included in the SN STATUS TRANSFER message contains the E-RAB ID(s) corresponding to the E-RAB(s) for which PDCP SN and HFN status preservation shall be applied.

If the source eNB includes in the SN STATUS TRANSFER message, the information on the missing and received uplink SDUs in the *Receive Status Of UL PDCP SDUs* IE for each E-RAB for which the source eNB has accepted the request from the target eNB for uplink forwarding, then the target eNB may use it in a Status Report message sent to the UE over the radio.

For each E-RAB for which the *DL COUNT Value* IE is received in the SN STATUS TRANSFER message, the target eNB shall use it to mark with the value contained in the *PDCP-SN* IE of this IE the first downlink packet for which there is no PDCP SN yet assigned.

For each E-RAB for which the *UL COUNT Value* IE is received in the SN STATUS TRANSFER message, the target eNB shall not deliver any uplink packet which has a PDCP SN lower than the value contained in the *PDCP-SN* IE of this IE.

8.2.2.3 Abnormal Conditions

If the target eNB receives this message for a UE for which no prepared handover exists at the target eNB, the target eNB shall ignore the message.

8.2.3 UE Context Release

8.2.3.1 General

The UE Context Release procedure is initiated by the target eNB to signal to indicate the source eNB that radio and control plane resources for the handed over UE context are allowed to be released.

The procedure uses UE-associated signalling.

8.2.3.2 Successful Operation

Figure 8.2.3.2-1: UE Context Release, successful operation

The UE Context Release procedure is initiated by the target eNB. By sending the UE CONTEXT RELEASE message the target eNB informs the source eNB of Handover success and triggers the release of resources.

Upon reception of the UE CONTEXT RELEASE message, the source eNB may release radio and control plane related resources associated to the UE context. For E-RABs for which data forwarding has been performed, the source eNB should continue forwarding of U-plane data as long as packets are received at the source eNB from the EPC or the source eNB buffer has not been emptied (an implementation dependent mechanism decides that data forwarding can be stopped).

8.2.3.3 Unsuccessful Operation

Not applicable.

8.2.3.4 Abnormal Conditions

If the UE Context Release procedure is not initiated towards the source eNB from any prepared eNB before the expiry of the timer $TX2_{RELOCoverall}$, the source eNB shall release all resources associated to the UE context and request the MME to release the UE context.

If the UE returns to source eNB before the reception of the UE CONTEXT RELEASE message or the expiry of the timer $TX2_{RELOCoverall}$, the source eNB shall stop the $TX2_{RELOCoverall}$ and continue to serve the UE.

8.2.4 Handover Cancel

8.2.4.1 General

The Handover Cancel procedure is used to enable a source eNB to cancel an ongoing handover preparation or an already prepared handover.

The procedure uses UE-associated signalling.

8.2.4.2 Successful Operation

Figure 8.2.4.2-1: Handover Cancel, successful operation

The source eNB initiates the procedure by sending the HANDOVER CANCEL message to the target eNB. The source eNB shall indicate the reason for cancelling the handover by means of an appropriate cause value.

At the reception of the HANDOVER CANCEL message, the target eNB shall remove any reference to, and release any resources previously reserved to the concerned UE context.

The *New eNB UE X2AP ID* IE shall be included if it has been obtained from the target eNB.

8.2.4.3 Unsuccessful Operation

Not applicable.

8.2.4.4 Abnormal Conditions

Should the HANDOVER CANCEL message refer to a context that does not exist, the target eNB shall ignore the message.

8.3 Global Procedures

8.3.1 Load Indication

8.3.1.1 General

The purpose of the Load Indication procedure is to transfer load and interference co-ordination information between eNBs controlling intra-frequency neighboring cells.

The procedure uses non UE-associated signalling.

8.3.1.2 Successful Operation

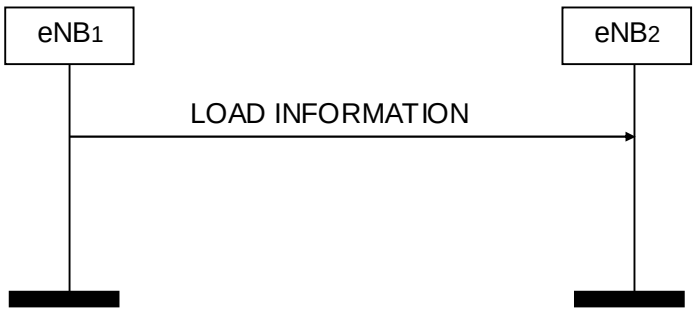

Figure 8.3.1.2-1: Load Indication, successful operation

An eNB initiates the procedure by sending LOAD INFORMATION message to eNBs controlling intra-frequency neighbouring cells .

If the *UL Interference Overload Indication* IE is received in the LOAD INFORMATION message, it indicates the interference level experienced by the indicated cell on all resource blocks, per PRB. The receiving eNB may take such information into account when setting its scheduling policy and shall consider the received *UL Interference Overload Indication* IE value valid until reception of a new LOAD INFORMATION message carrying an update of the same IE.

If the *UL High Interference Indication* IE is received in the LOAD INFORMATION message, it indicates, per PRB, the occurrence of high interference sensitivity, as seen from the sending eNB. The receiving eNB should try to avoid scheduling cell edge UEs in its cells for the concerned PRBs. The *Target Cell ID* IE received within the *UL High Interference Information* IE group in the LOAD INFORMATION message indicates the cell for which the corresponding UL High Interference Indication is meant. The receiving eNB shall consider the value of the *UL High Interference Information* IE group valid until reception of a new LOAD INFORMATION message carrying an update.

If the *Relative Narrowband Tx Power (RNTP)* IE is received in the LOAD INFORMATION message, it indicates, per PRB, whether downlink transmission power is lower than the value indicated by the *RNTP Threshold* IE. The receiving eNB may take such information into account when setting its scheduling policy and shall consider the received *Relative Narrowband Tx Power (RNTP)* IE value valid until reception of a new LOAD INFORMATION message carrying an update.

8.3.1.3 Unsuccessful Operation

Not applicable.

8.3.1.4 Abnormal Conditions

Void.

8.3.2 Error Indication

Editor Note: Used by peer node to report detected errors in a received message.

8.3.2.1 General

The Error Indication procedure is initiated by an eNB to report detected errors in one incoming message, provided they cannot be reported by an appropriate failure message.

If the error situation arises due to reception of a message utilising UE associated signalling, then the Error Indication procedure uses UE-associated signalling. Otherwise the procedure uses non UE-associated signalling.

8.3.2.2 Successful Operation

Figure 8.3.2.2-1: Error Indication, 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.

In case the Error Indication procedure is triggered by UE associated signalling the *Old eNB UE X2AP ID* IE and *New eNB UE X2AP ID* IE shall be included in the ERROR INDICATION message. If one or both of *Old eNB UE X2AP ID*

IE and *New eNB UE X2AP ID* IE are not correct, the cause shall be set to appropriate value e.g. " unknown Old eNB UE X2AP ID", "unknown New eNB UE X2AP ID" or "unknown pair of UE X2AP ID".

8.3.2.3 Unsuccessful Operation

Not applicable.

8.3.2.4 Abnormal Conditions

Not applicable.

8.3.3 X2 Setup

8.3.3.1 General

The purpose of the X2 Setup procedure is to exchange application level configuration data needed for two eNBs to interoperate correctly over the X2 interface. 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 X2 interface like a Reset procedure would do.

The procedure uses non UE-associated signalling.

8.3.3.2 Successful Operation

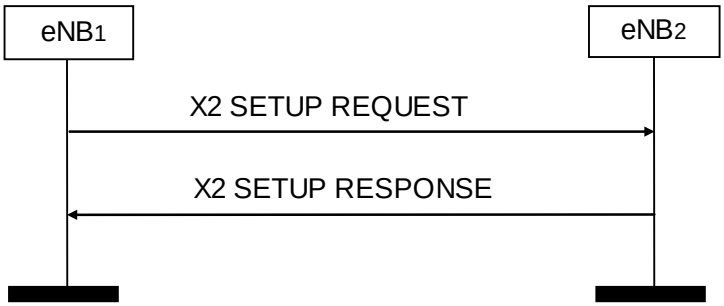

Figure 8.3.3.2-1: X2 Setup, successful operation

An eNB initiates the procedure by sending the X2 SETUP REQUEST message to a candidate eNB. The candidate eNB replies with the X2 SETUP RESPONSE message. The initiating eNB transfers a list of served cells and, if available, a list of supported GU Group Ids to the candidate eNB. The candidate eNB replies with a list of its served cells and shall include, if available, a list of supported GU Group Ids in the reply.

The initiating eNB may include the *Neighbour Information* IE in the X2 SETUP REQUEST message. The candidate eNB may also include the *Neighbour Information* IE in the X2 SETUP RESPONSE message. The *Neighbour Information* IE shall only include E-UTRAN cells that are direct neighbours of cells in the reporting eNB.

8.3.3.3 Unsuccessful Operation

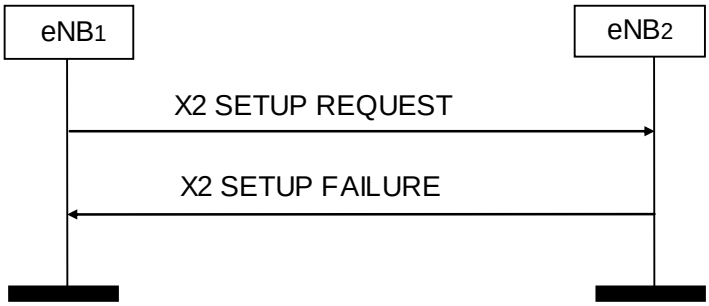

Figure 8.3.3.3-1: X2 Setup, unsuccessful operation

If the candidate eNB cannot accept the setup it shall respond with an X2 SETUP FAILURE message with appropriate cause value.

If the X2 SETUP FAILURE messages includes the *Time To Wait* IE the initiating eNB shall wait at least for the indicated time before reinitiating the X2 Setup procedure towards the same eNB.

8.3.3.4 Abnormal Conditions

If the X2 SETUP REQUEST message is not the first message received for a specific TNL association then this shall be treated as a logical error.

If the initiating eNB1 does not receive either X2 SETUP RESPONSE message or X2 SETUP FAILURE message, the eNB1 may reinitiate the X2 Setup procedure towards the same eNB, provided that the content of the new X2 SETUP REQUEST message is identical to the content of the previously unacknowledged X2 SETUP REQUEST message.

8.3.4 Reset

8.3.4.1 General

The purpose of the Reset procedure is to align the resources in eNB_1 and eNB_2 in the event of an abnormal failure. The procedure resets the X2 interface. This procedure doesn"t affect the application level configuration data exchanged during the X2 Setup procedure.

The procedure uses non UE-associated signalling.

8.3.4.2 Successful Operation

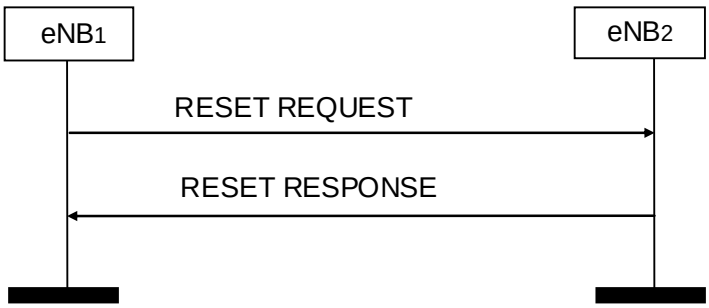

Figure 8.3.4.2-1: Reset, successful operation

The procedure is initiated with a RESET REQUEST message sent from the eNB_1 to the eNB_2. Upon receipt of this message, eNB_2 shall abort any other ongoing procedures over X2 between eNB_1 and eNB_2. The eNB_2 shall delete all the context information related to the eNB_1, except the application level configuration data exchanged during the X2 Setup or eNB Configuration Update procedures, and release the corresponding resources. After completion of release of the resources, the eNB_2 shall respond with a RESET RESPONSE message.

8.3.4.3 Unsuccessful Operation

Void.

8.3.4.4 Abnormal Conditions

If the RESET REQUEST message is received, any other ongoing procedure (except another Reset procedure) on the same X2 interface shall be aborted.

If Reset procedure is ongoing and the eNB_2 receives the RESET REQUEST message from the peer entity on the same X2 interface, the eNB_2 shall respond with the RESET RESPONSE message as described in 8.3.4.2.

If the initiating eNB does not receive RESET RESPONSE message, the eNB1 may reinitiate the Reset procedure towards the same eNB, provided that the content of the new RESET REQUEST message is identical to the content of the previously unacknowledged RESET REQUEST message.

8.3.5 eNB Configuration Update

8.3.5.1 General

The purpose of the eNB Configuration Update procedure is to update application level configuration data needed for two eNBs to interoperate correctly over the X2 interface.

The procedure uses non UE-associated signalling.

8.3.5.2 Successful Operation

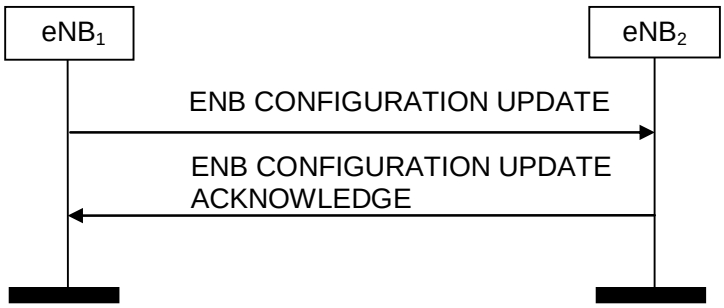

Figure 8.3.5.2-1: eNB Configuration Update, successful operation

An eNB_1 initiates the procedure by sending an ENB CONFIGURATION UPDATE message to a peer eNB_2.

Upon reception of an ENB CONFIGURATION UPDATE message, eNB2 shall update the information for eNB1 as follows:

Update of Served Cell Information:

- If *Served Cells To Add* IE is contained in the ENB CONFIGURATION UPDATE message, eNB_2 shall add cell information according to the information in the *Served Cell Information* IE.
- If *Served Cells To Modify* IE is contained in the ENB CONFIGURATION UPDATE message, eNB_2 shall modify information of cell indicated by *Old ECGI* IE according to the information in the *Served Cell Information* IE.

  When either served cell information or neighbour information of an existing served cell in eNB1 need to be updated, the whole list of neighbouring cells, if any, shall be contained in the Neighbour Information IE.

  The eNB2 shall overwrite the served cell information and the whole list of neighbour cell information for the affected served cell.

- If *Served Cells To Delete* IE is contained in the ENB CONFIGURATION UPDATE message, eNB_2 shall delete information of cell indicated by *Old ECGI* IE.

Update of GU Group ID List:

- If *GU Group Id To Add List* IE is contained in the ENB CONFIGURATION UPDATE message, eNB_2 shall add the GU Group Id to its GU Group Id List.

- If *GU Group Id To Delete List* IE is contained in the ENB CONFIGURATION UPDATE message, eNB_2 shall remove the GU Group Id from its GU Group Id List.

If *Neighbour Information* IE is contained in the ENB CONFIGURATION UPDATE message, eNB_2 may use this information to update its neighbour cell relations, or use it for other functions, like PCI selection. The *Neighbour Information* IE shall only include E-UTRAN cells that are direct neighbours of cells in the reporting eNB.

After successful update of requested information, eNB_2 shall reply with the ENB CONFIGURATION UPDATE ACKNOWLEDGE message to inform the initiating eNB_1 that the requested update of application data was performed successfully. In case the peer eNB_2 receives an ENB CONFIGURATION UPDATE without any IE except for *Message Type* IE it shall reply with ENB CONFIGURATION UPDATE ACKNOWLEDGE message without performing any updates to the existing configuration.

The eNB_1 may initiate a further eNB Configuration Update procedure only after a previous eNB Configuration Update procedure has been completed.

8.3.5.3 Unsuccessful Operation

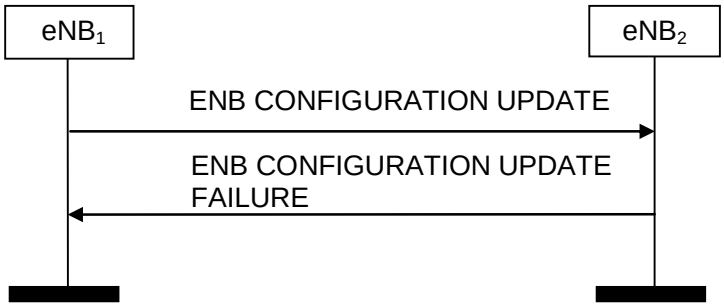

Figure 8.3.5.3-1: eNBConfiguration Update, unsuccessful operation

If the eNB_2 can not accept the update it shall respond with an ENB CONFIGURATION UPDATE FAILURE message and appropriate cause value.

If the ENB CONFIGURATION UPDATE FAILURE message includes the *Time To Wait* IE the eNB_1 shall wait at least for the indicated time before reinitiating the eNB Configuration Update procedure towards the same eNB_2. Both nodes shall continue to operate the X2 with the existing configuration data.

8.3.5.4 Abnormal Conditions

If the eNB_1 after initiating eNB Configuration Update procedure receives neither ENB CONFIGURATION UPDATE ACKNOWLEDGE message nor ENB CONFIGURATION UPDATE FAILURE message, the eNB_1 may reinitiate the eNB Configuration Update procedure towards the same eNB_2, provided that the content of the new ENB CONFIGURATION UPDATE message is identical to the content of the previously unacknowledged ENB CONFIGURATION UPDATE message.

8.3.6 Resource Status Reporting Initiation

8.3.6.1 General

This procedure is used by an eNB to request the reporting of load measurements to another eNB.

The procedure uses non UE-associated signalling.

8.3.6.2 Successful Operation

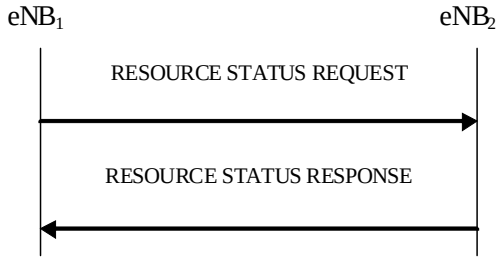

Figure 8.3.6.2-1: Resource Status Reporting Initiation, successful operation

The procedure is initiated with a RESOURCE STATUS REQUEST message sent from eNB_1 to eNB_2. Upon receipt, eNB_2 shall initiate the requested measurement according to the parameters given in the request in case the *Registration Request* IE set to "start" and shall terminate the reporting in case the *Registration Request* IE is set to 'stop".

If the *Registration Request* IE is set to "start" then the *Report Characteristics* IE shall be included in RESOURCE STATUS REQUEST message.

The *Report Characteristics* IE indicates the type of measurements eNB2 shall perform.

For each request cell, the eNB2 shall include in the RESOURCE STATUS UPDATE message;

- the *Radio Resource Status* IE, if the first bit, 'PRB Periodic' of the *Report Characteristics* IE included in the RESOURCE STATUS REQUEST message is set to 1,
- the *S1 TNL Load Indicator* IE, if the second bit, 'TNL Load Ind Periodic' of the *Report Characteristics* IE included in the RESOURCE STATUS REQUEST message is set to 1,
- the *Hardware Load Indicator* IE, if the third bit, 'HW Load Ind Periodic' of the *Report Characteristics* IE included in the RESOURCE STATUS REQUEST message is set to 1,

If the *Reporting Periodicity* IE is included in the RESOURCE STATUS REQUEST message, eNB2 shall use its value as the time interval between two subsequent measurement reports.

If eNB2 is capable to provide resource status information, it shall initiate the measurements as requested by eNB1, and respond with the RESOURCE STATUS RESPONSE message.

8.3.6.3 Unsuccessful Operation

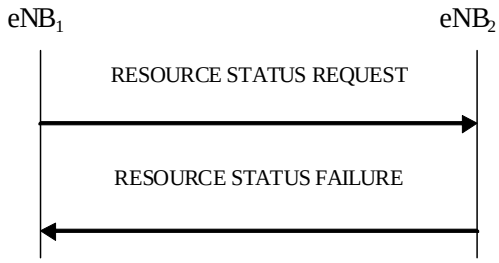

Figure 8.3.6.3-1: Resource Status Reporting Initiation, unsuccessful operation

If the requested measurement cannot be initiated, eNB_2 shall send a RESOURCE STATUS FAILURE message. The Cause IE shall be set to an appropriate value e.g. 'Measurement Temporarily not Available'.

8.3.6.4 Abnormal Conditions

If the initiating eNB1 does not receive either RESOURCE STATUS RESPONSE message or RESOURCE STATUS FAILURE message, the eNB1 may reinitiate the Resource Status Reporting Initiation procedure towards the same eNB, provided that the content of the new RESOURCE STATUS REQUEST message is identical to the content of the previously unacknowledged RESOURCE STATUS REQUEST message.

If the *Report Characteristics* IE bitmap is set to 0 (all bits are set to 0) in the RESOURCE STATUS REQUEST message then eNB2 shall initiate a RESOURCE STATUS FAILURE message, the cause shall be set to appropriate value e.g. 'ReportCharacteristicsEmpty'.

If *Report Periodicity* IE value is not specified when either the first and/or the second and or the third bit of the *Report Characteristics* IE is set to 1 then eNB2 shall initiate a RESOURCE STATUS FAILURE message, the cause shall be set to appropriate value e.g. 'NoReportPeriodicity'.

If the eNB2 received a RESOURCE STATUS REQUEST message which includes the *Registration Request* IE set to "start" and a *eNB1Measurement ID* IE corresponding to an existing on-going load measurement reporting, then eNB2 shall initiate a RESOURCE STATUS FAILURE message, the cause shall be set to appropriate value e.g. 'ExistingMeasurementID'.

If the *Registration Request* IE is set to "stop" and the RESOURCE STATUS REQUEST message does not contain both *eNB1 Measurement ID* IE and *eNB2 Measurement ID* IE, eNB_2 shall consider the procedure as failed and respond with the RESOURCE STATUS FAILURE message, the cause shall be set to appropriate value e.g. 'Unknown eNB Measurement ID.

8.3.7 Resource Status Reporting

8.3.7.1 General

This procedure is initiated by eNB_2 to report the result of measurements requested by eNB_1 using the Resource Status Reporting Initiation.

The procedure uses non UE-associated signalling.

8.3.7.2 Successful Operation

Figure 8.3.7.2-1: Resource Status Reporting, successful operation

The eNB_2 shall report the results of the measurements in RESOURCE STATUS UPDATE message for each requested cell.

9 Elements for X2AP Communication

9.0 General

Sub clauses 9.1 and 9.2 describe the structure of the messages and information elements required for the X2AP 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 [4].

9.1 Message Functional Definition and Content

9.1.1 Messages for Basic Mobility Procedures

9.1.1.1 HANDOVER REQUEST

This message is sent by the source eNB to the target eNB to request the preparation of resources for a handover.

Direction: source eNB → target eNB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	reject
Old eNB UE X2AP ID	M		eNB UE X2AP ID 9.2.24	Allocated at the source eNB	YES	reject
Cause	M		9.2.6		YES	ignore
Target Cell ID	M		ECGI 9.2.14		YES	reject
GUMMEI	M		9.2.16		YES	reject
UE Context Information		1			YES	reject
> MME UE S1AP ID	M		INTEGER ($0..2^{32}-1$)	MME UE S1AP ID allocated at the MME	–	–
> UE Security Capabilities	M		9.2.29		–	–
>AS Security Information	M		9.2.30		–	–
> UE Aggregate Maximum Bit Rate	M		9.2.12		–	–
> Subscriber Profile ID for RAT/Frequency priority	O		9.2.25		–	–
>E-RABs To Be Setup List		1			–	–
>>E-RABs To Be Setup Item		*1 to <maxnoof Bearers>*			EACH	ignore
>>> E-RAB ID	M		9.2.23		–	–
>>> E-RAB Level QoS Parameters	M		9.2.9	Inlcudes necessary QoS parameters	–	–
>>> DL Forwarding	O		9.2.5		–	–
>>> UL GTP Tunnel Endpoint	M		GTP Tunnel Endpoint 9.2.1	SGW endpoint of the S1 transport bearer. For delivery of UL PDUs	–	–
> RRC Context	M		OCTET STRING	Includes the RRC Handover Preparation Information message as defined in subclause 10.2.2 of [9].	–	–
>Handover Restriction List	O		9.2.3		–	–
>Location Reporting Information	O		9.2.21	Includes the necessary parameters for location reporting	–	–
UE History Information	M		9.2.38	Same definition as in [4].	YES	ignore
Trace Activation	O		9.2.2		YES	ignore
SRVCC Operation Possible	O		9.2.33		YES	ignore

Range bound	Explanation
maxnoofBearers	Maximum no. of E-RABs. Value is 256

9.1.1.2 HANDOVER REQUEST ACKNOWLEDGE

This message is sent by the target eNB to inform the source eNB about the prepared resources at the target.

Direction: target eNB → source eNB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	reject
Old eNB UE X2AP ID	M		eNB UE X2AP ID 9.2.24	Allocated at the source eNB	YES	ignore
New eNB UE X2AP ID	M		eNB UE X2AP ID 9.2.24	Allocated at the target eNB	YES	ignore
E-RABs Admitted List		1			YES	ignore
> E-RABs Admitted Item		*1 to <maxnoof Bearers>*			EACH	ignore
>> E-RAB ID	M		9.2.23		–	–
>> UL GTP Tunnel Endpoint	O		GTP Tunnel Endpoint 9.2.1	Identifies the X2 transport bearer used for forwarding of UL PDUs	–	–
>> DL GTP Tunnel Endpoint	O		GTP Tunnel Endpoint 9.2.1	Identifies the X2 transport bearer. used for forwarding of DL PDUs	–	–
E-RABs Not Admitted List	O		E-RAB List 9.2.28		YES	ignore
Target eNB To Source eNB Transparent Container	M		OCTET STRING	Includes the RRC E-UTRA Handover Command message as defined in subclause 10.2.2 in [9].	YES	ignore
Criticality Diagnostics	O		9.2.7		YES	ignore

Range bound	Explanation
maxnoofBearers	Maximum no. of E-RABs. Value is 256

9.1.1.3 HANDOVER PREPARATION FAILURE

This message is sent by the target eNB to inform the source eNB that the Handover Preparation has failed.

Direction: target eNB → source eNB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	reject
Old eNB UE X2AP ID	M		eNB UE X2AP ID 9.2.24	Allocated at the source eNB	YES	ignore
Cause	M		9.2.6		YES	ignore
Criticality Diagnostics	O		9.2.7		YES	ignore

9.1.1.4 SN STATUS TRANSFER

This message is sent by the source eNB to the target eNB to transfer the uplink/downlink PDCP SN and HFN status during a handover.

Direction: source eNB → target eNB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	ignore
Old eNB UE X2AP ID	M		eNB UE X2AP ID 9.2.24	Allocated at the source eNB	YES	reject
New eNB UE X2AP ID	M		eNB UE X2AP ID 9.2.24	Allocated at the target eNB	YES	reject
E-RABs Subject To Status Transfer List		*1*			YES	ignore
>E-RABs Subject To Status Transfer Item		*1 to <maxnoof Bearers>*			EACH	ignore
>> E-RAB ID	M		9.2.23		–	–
>>Receive Status Of UL PDCP SDUs	O		BIT STRING (4096)	PDCP Sequence Number = (First Missing SDU Number + bit position) modulo 4096 0: PDCP SDU has not been received. 1: PDCP SDU has been received correctly.	–	–
>> UL COUNT Value	M		COUNT Value 9.2.15	PDCP-SN and Hyper Frame Number of the first missing UL SDU	–	–
>> DL COUNT Value	M		COUNT Value 9.2.15	PDCP-SN and Hyper frame number that the target eNB should assign for the next DL SDU not having an SN yet	–	–

Range bound	Explanation
maxnoofBearers	Maximum no. of E-RABs. Value is 256.

9.1.1.5 UE CONTEXT RELEASE

This message is sent by the target eNB to the source eNB to indicate that resources can be released.

Direction: target eNB → source eNB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	ignore
Old eNB UE X2AP ID	M		eNB UE X2AP ID 9.2.24	Allocated at the source eNB	YES	reject
New eNB UE X2AP ID	M		eNB UE X2AP ID 9.2.24	Allocated at the target eNB	YES	reject

9.1.1.6 HANDOVER CANCEL

This message is sent by the source eNB to the target eNB to cancel an ongoing handover.

Direction: source eNB → target eNB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	ignore
Old eNB UE X2AP ID	M		eNB UE X2AP ID 9.2.24	Allocated at the source eNB	YES	reject
New eNB UE X2AP ID	O		eNB UE X2AP ID 9.2.24	Allocated at the target eNB	YES	ignore
Cause	M		9.2.6		YES	ignore

9.1.2 Messages for global procedures

9.1.2.1 LOAD INFORMATION

This message is sent by an eNB to neighbouring eNBs to transfer load and interference co-ordination information.

Direction: eNB_1 → eNB_2.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	ignore
Cell Information	M				YES	ignore
> Cell Information Item		*1 to maxCellineNB*			EACH	ignore
>>Cell ID	M		ECGI 9.2.14	Id of the source cell	–	–
>>UL Interference Overload Indication	O		9.2.17		–	–
> >UL High Interference Information		*0 to maxCellineNB*			–	–
>>>Target Cell ID	M		ECGI 9.2.14	Id of the cell for which the HII is meant	–	–
>>>UL High Interference Indication	M		9.2.18		–	–
>> Relative Narrowband Tx Power (RNTP)	O		9.2.19		–	–

Range bound	Explanation
maxCellineNB	Maximum no. cells that can be served by an eNB. Value is 256.

9.1.2.2 ERROR INDICATION

This message is used to indicate that some error has been detected in the eNB.

Direction: eNB1 → eNB2

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	ignore
Old eNB UE X2AP ID	O		eNB UE X2AP ID 9.2.24	Allocated at the source eNB	YES	ignore
New eNB UE X2AP ID	O		eNB UE X2AP ID 9.2.24	Allocated at the target eNB	YES	ignore
Cause	O		9.2.6		YES	ignore
Criticality Diagnostics	O		9.2.7		YES	ignore

9.1.2.3 X2 SETUP REQUEST

This message is sent by an eNB to a neighbouring eNB to transfer the initialization information for a TNL association.

Direction: eNB1 → eNB2.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	reject
Global eNB ID	M		9.2.22		YES	reject
Served Cells		*1 to maxCellineNB*		This is all the eNB cells	YES	reject
>Served Cell Information	M		9.2.8		–	–
>Neighbour Information		*0 to maxnoofNeighbours*			–	–
>>ECGI	M		ECGI 9.2.14	E-UTRAN Cell Global Identifier of the neighbour cell	–	–
>>PCI	M		INTEGER (0..503, …)	Physical Cell Identifier of the neighbour cell	–	–
>>EARFCN	M		9.2.26	DL EARFCN for FDD and EARFCN for TDD	–	–
GU Group Id List		*0 to maxfPools*		This is all the pools to which the eNB belongs to	GLOBAL	reject
>GU Group Id	M		9.2.20		-	-

Range bound	Explanation
maxCellineNB	Maximum no. cells that can be served by an eNB. Value is 256.
maxnoofNeighbours	Maximum no. of neighbour cells associated to a given served cell. Value is 512.
maxPools	Maximum no. of pools an eNB can belong to. Value is 16 FFS.

9.1.2.4 X2 SETUP RESPONSE

This message is sent by an eNB to a neighbouring eNB to transfer the initialization information for a TNL association.

Direction: $eNB_2 \rightarrow eNB_1$.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	reject
Global eNB ID	M		9.2.22		YES	reject
Served Cells		*1 to maxCellineNB*		This is all the eNB cells	YES	reject
>Served Cell Information	M		9.2.8		–	–
>Neighbour Information		*0 to maxnoofNeighbours*			–	–
>>ECGI	M		ECGI 9.2.14	E-UTRAN Cell Global Identifier of the neighbour cell	–	–
>>PCI	M		INTEGER (0..503, …)	Physical Cell Identifier of the neighbour cell	–	–
>>EARFCN	M		9.2.26	DL EARFCN for FDD and EARFCN for TDD	–	–
GU Group Id List		*0 to maxPools*		This is all the pools to which the eNB belongs to	GLOBAL	reject
>GU Group Id	M		9.2.20		-	-
Criticality Diagnostics	O		9.2.7		YES	ignore

Range bound	Explanation
maxCellineNB	Maximum no. cells that can be served by an eNB. Value is 256.
maxnoofNeighbours	Maximum no. of neighbour cells associated to a given served cell. Value is 512.
maxPools	Maximum no. of pools an eNB can belong to. Value is 16 FFS.

9.1.2.5 X2 SETUP FAILURE

This message is sent by the eNB to indicate X2 Setup failure.

Direction: $eNB_2 \rightarrow eNB_1$.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	reject
Cause	M		9.2.6		YES	ignore
Time To Wait	O		9.2.32		YES	ignore
Criticality Diagnostics	O		9.2.7		YES	ignore

9.1.2.6 RESET REQUEST

This message is sent from one eNB to another eNB and is used to request the X2 interface between the two eNB to be reset.

Direction: eNB1 → eNB2.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	reject
Cause	M		9.2.6		YES	ignore

9.1.2.7 RESET RESPONSE

This message is sent by a eNB as a response to a RESET REQUEST message.

Direction: eNB2 → eNB1.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	reject
Criticality Diagnostics	O		9.2.7		YES	ignore

9.1.2.8 ENB CONFIGURATION UPDATE

This message is sent by an eNB to a peer eNB to transfer updated information for a TNL association.

Direction: eNB1 → eNB2.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	reject
Served Cells To Add		*0 to maxCellineNB*			GLOBAL	reject
>Served Cell Information	M		9.2.8		–	–
>Neighbour Information		*0 to maxnoofNeighbours*			–	–
>>ECGI	M		ECGI 9.2.14	E-UTRAN Cell Global Identifier of the neighbour cell	–	–
>>PCI	M		INTEGER (0..503, …)	Physical Cell Identifier of the neighbour cell	–	–
>>EARFCN	M		9.2.26	DL EARFCN for FDD and EARFCN for TDD	–	–
Served Cells To Modify		*0 to maxCellineNB*			GLOBAL	reject
>Old ECGI	M		ECGI 9.2.14	This is the old E-UTRAN Cell Global Identifier	-	-
>Served Cell Information	M		9.2.8		–	–
>Neighbour Information		*0 to maxnoofNeighbours*			–	–
>>ECGI	M		ECGI 9.2.14	E-UTRAN Cell Global Identifier of the neighbour cell	–	–
>>PCI	M		INTEGER (0..503, …)	Physical Cell Identifier of the neighbour cell	–	–
>>EARFCN	M		9.2.26	DL EARFCN for FDD and EARFCN for TDD	–	–
Served Cells To Delete		*0 to maxCellineNB*			GLOBAL	reject
>Old ECGI	M		ECGI 9.2.14	This is the old E-UTRAN Cell Global Identifier of the cell to be deleted	-	-
GU Group Id To Add List		*0 to maxPools*			GLOBAL	reject
>GU Group Id	M		9.2.20		-	-
GU Group Id To Delete List		*0 to maxPools*			GLOBAL	reject
>GU Group Id	M		9.2.20		-	-

Range bound	Explanation
maxCellineNB	Maximum no. cells that can be served by an eNB. Value is 256.
maxnoofNeighbours	Maximum no. of neighbour cells associated to a given served cell. Value is 512.
maxPools	Maximum no. of pools an eNB can belong to. Value is 16 FFS.

9.1.2.9 ENB CONFIGURATION UPDATE ACKNOWLEDGE

This message is sent by an eNB to a peer eNB to acknowledge update of information for a TNL association.

Direction: eNB2 → eNB1.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	reject
Criticality Diagnostics	O		9.2.7		YES	ignore

9.1.2.10 ENB CONFIGURATION UPDATE FAILURE

This message is sent by an eNB to a peer eNB to indicate eNB Configuration Update Failure.

Direction: eNB2 → eNB1.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	reject
Cause	M		9.2.6		YES	ignore
Time To Wait	O		9.2.32		YES	ignore
Criticality Diagnostics	O		9.2.7		YES	ignore

9.1.2.11 RESOURCE STATUS REQUEST

This message is sent by an eNB1 to neighbouring eNB2 to initiate the requested measurement according to the parameters given in the message.

Direction: eNB1 → eNB2.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	reject
eNB1 Measurement ID	M		INTEGER (1..4095,...)	Allocated by eNB_1	YES	reject
eNB2 Measurement ID	C-ifRegistrationRequestStop		INTEGER (1..4095,...)	Allocated by eNB_2	YES	ignore
Registration Request	M		ENUMERATED(Start, Stop, …)	In this Release, if the value is set to 'stop', the receiver shall stop all cells measurement.	YES	reject
Report Characteristics	O		BITSTRING (SIZE(32))	Each position in the bitmap indicates measurement object the eNB_2 is requested to report. First Bit = PRB Periodic, Second Bit= TNL load Ind Periodic, Third Bit = HW Load Ind Periodic. Bits 4 to 32 shall be ignored by the eNB_2	YES	reject
Cell To Report		*1 to maxCellineNB*		Cell ID list for which measurement is needed	EACH	ignore
>Cell ID	M		ECGI 9.2.14			
Reporting Periodicity	O		ENUMERATED(1000ms, 2000ms, 5000ms,10000ms, …)		YES	ignore

Range bound	Explanation
maxCellineNB	Maximum no. cells that can be served by an eNB. Value is 256.

Condition	Explanation
ifRegistrationRequestStop	This IE shall be present if the *Registration Request* IE is set to the value 'Stop'.

9.1.2.12 RESOURCE STATUS RESPONSE

This message is sent by the eNB2 to indicate that the requested measurements are successfully initiated. Direction: eNB2 → eNB1.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	reject
eNB1 Measurement ID	M		INTEGER (1..4095,...)		YES	reject
eNB2 Measurement ID	M		INTEGER (1..4095,...)		YES	reject
Criticality Diagnostics	O		9.2.7		YES	ignore

9.1.2.13 RESOURCE STATUS FAILURE

This message is sent by the eNB2 to indicate requested measurements cannot be initiated.

Direction: eNB2 → eNB1.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	reject
eNB1 Measurement ID	M		INTEGER (1..4095,...)		YES	reject
eNB2 Measurement ID	M		INTEGER (1..4095,...)		YES	reject
Cause	M		9.2.6		YES	ignore
Criticality Diagnostics	O		9.2.7		YES	ignore

9.1.2.14 RESOURCE STATUS UPDATE

This message is sent by eNB2 to neighbouring eNB1 to report the results of the requested measurements.

Direction: eNB2 → eNB1.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.13		YES	ignore
eNB1 Measurement ID	M		INTEGER (1..4095,...)		YES	reject
eNB2 Measurement ID	M		INTEGER (1..4095,...)		YES	reject
Cell Measurement Result		*1 to maxCellineNB*			EACH	ignore
>Cell ID	M		ECGI 9.2.14			
>Hardware Load Indicator	O		9.2.34			
>S1 TNL Load Indicator	O		9.2.35			
>Radio Resource Status	O		9.2.37			

Range bound	Explanation
maxCellineNB	Maximum no. cells that can be served by an eNB. Value is 256.

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 GTP Tunnel Endpoint

The *GTP Tunnel Endpoint* IE identifies an X2 transport bearer or the S-GW endpoint of the S1 transport bearer associated to an E-RAB. It contains a Transport Layer Address and a GTP Tunnel Endpoint Identifier. The Transport Layer Address is an IP address to be used for the X2 user plane transport (see [8]) or for the S1 user plane transport (see [19]). The GTP Tunnel Endpoint Identifier is to be used for the user plane transport between eNB and the S-GW or between eNBs.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Transport Layer Address	M		BIT STRING (1..160, ...)	For details on the Transport Layer Address, see ref. [8], [19]	–	–
GTP TEID	M		OCTET STRING (4)		–	–

9.2.2 Trace Activation

Defines parameters related to trace activation.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
E-UTRAN Trace ID	M		OCTET STRING (8)	The E-UTRAN Trace ID IE is composed of the following: Trace Reference defined in [10] (leftmost 6 octets), and Trace Recording Session Reference defined in [10] (last 2 octets)	–	–
Interfaces To Trace	M		BIT STRING (8)	Each position in the bitmap represents a eNB interface first bit =S1-MME, second bit =X2, third bit =Uu other bits reserved for future use.. Value "1" indicates "should be traced" . Value "0" indicates "should not be trace".		
Trace Depth	M		ENUMERATED(minimum, medium, maximum, MinimumWithoutVendorSpecificExtension, MediumWithoutVendorSpecificExtension, MaximumWithoutVendorSpecificExtension, ...)	Defined in [7]	–	–
Trace Collection Entity IP Address	M		BIT STRING (1..160,…)	For details on the Transport Layer Address, see ref. [8], [19]	–	–

9.2.3 Handover Restriction List

This IE defines area roaming or access restrictions for handover.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Serving PLMN	M		PLMN Identity 9.2.4		–	–
Equivalent PLMNs		0..<maxnoofEPLMNs>		Allowed PLMNs in addition to Serving PLMN. This list corresponds to the list of 'equivalent PLMNs list' as defined in [17].	–	–
>PLMN Identity	M		9.2.4		–	–
Forbidden TAs		0..<maxnoofEPLMNsPlusOne>		intra E-UTRAN roaming restrictions	–	–
>PLMN Identity	M		9.2.4	The PLMN of forbidden TACs	–	–
>Forbidden TACs		1..<maxnoofForbTACs>			–	–
>>TAC	M		OCTET STRING(2)	The forbidden TAC	–	–
Forbidden LAs		0..<maxnoofEPLMNsPlusOne>		inter-3GPP RAT roaming restrictions	–	–
>PLMN Identity	M		9.2.4		–	–
>Forbidden LACs		1..<maxnoofForbLACs>			–	–
>>LAC	M		OCTET STRING(2)		–	–
Forbidden inter RATs	O		ENUMERATED(ALL, GERAN, UTRAN, CDMA2000, …)	inter-3GPP and 3GPP2 RAT access restrictions	–	–

Range bound	Explanation
maxnoofEPLMNs	Maximum no. of equivalent PLMN Ids. Value is 15.
maxnoofEPLMNsPlusOne	Maximum no. of equivalent PLMN Ids plus one. Value is 16.
maxnoofForbTACs	Maximum no. of forbidden Tracking Area Codes. Value is 4096.
maxnoofForbLACs	Maximum no. of forbidden Location Area Codes. Value is 4096.

9.2.4 PLMN Identity

This information element indicates the PLMN Identity.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
PLMN Identity	M		OCTET STRING (3)	- digits 0 to 9, encoded 0000 to 1001, - 1111 used as filler digit, two digits per octet, - bits 4 to 1 of octet n encoding digit 2n-1 - bits 8 to 5 of octet n encoding digit 2n -The Selected PLMN identity consists of 3 digits from MCC followed by either -a filler digit plus 2 digits from MNC (in case of 2 digit MNC) or -3 digits from MNC (in case of a 3 digit MNC).

9.2.5 DL Forwarding

This element indicates that the E-RAB is proposed for forwarding of downlink packets.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
DL Forwarding	M		ENUMERATED (DL forwarding proposed, …)	

9.2.6 Cause

The purpose of the cause information element is to indicate the reason for a particular event for the whole protocol.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
CHOICE *Cause Group*	M			
>*Radio Network Layer*				
>>Radio Network Layer Cause	M		ENUMERATED (Handover Desirable for Radio Reasons, Time Critical Handover, Resource Optimisation Handover, Reduce Load in Serving Cell, Partial Handover, Unknown New eNB UE X2AP ID, Unknown Old eNB UE X2AP ID, Unknown Pair of UE X2AP ID, HO Target not Allowed, $TX2_{RELOCoverall}$ Expiry, $T_{RELOCprep}$ Expiry, Cell not Available, No Radio Resources Available in Target Cell, Invalid MME Group ID, Unknown MME Code, Encryption And/Or Integrity Protection Algorithms Not Supported, ReportCharacteristicsEmpty, NoReportPeriodicity, ExistingMeasurementID, Unknown eNB Measurement ID, Measurement Temporarily not Available, Unspecified, ...)	
>*Transport Layer*				
>>Transport Layer Cause	M		ENUMERATED (Transport Resource Unavailable, Unspecified, ...)	
>*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, Unspecified, Abstract Syntax Error (Falsely Constructed Message),...)	
>Misc				
>>Miscellaneous Cause	M		ENUMERATED (Control Processing Overload, Hardware Failure, O&M Intervention, Not enough User Plane Processing Resources, Unspecified,...)	

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

Radio Network Layer cause	Meaning
Cell not Available	The concerned cell is not available.
Handover Desirable for Radio Reasons	The reason for requesting handover is radio related.
Handover Target not Allowed	Handover to the indicated target cell is not allowed for the UE in question
Invalid MME Group ID	The target eNB doesn"t belong to the same pool area of the source eNB i.e. S1 handovers should be attempted instead.
No Radio Resources Available in Target Cell	The target cell doesn"t have sufficient radio resources available.
Partial Handover	Provides a reason for the handover cancellation. The target eNB did not admit all E-RABs included in the HANDOVER REQUEST and the source eNB estimated service continuity for the UE would be better by not proceeding with handover towards this particular target eNB.
Reduce Load in Serving Cell	Load on serving cell needs to be reduced.
Resource Optimisation Handover	The reason for requesting handover is to improve the load distribution with the neighbour cells.
Time Critical Handover	handover is requested for time critical reason i.e. this cause value is reserved to represent all critical cases where the connection is likely to be dropped if handover is not performed.
$TX2_{RELOCoverall}$ Expiry	The reason for the action is expiry of timer $TX2_{RELOCoverall}$
$T_{RELOCprep}$ Expiry	Handover Preparation procedure is cancelled when timer $T_{RELOCprep}$ expires.
Unknown MME Code	The target eNB belongs to the same pool area of the source eNB and recognizes the MME Group ID. However, the MME Code is unknown to the target eNB.
Unknown New eNB UE X2AP ID	The action failed because the New eNB UE X2AP ID is unknown
Unknown Old eNB UE X2AP ID	The action failed because the Old eNB UE X2AP ID is unknown
Unknown Pair of UE X2AP ID	The action failed because the pair of UE X2 AP IDs is unknown
Encryption And/Or Integrity Protection Algorithms Not Supported	The target eNB is unable to support any of the encryption and/or integrity protection algorithms supported by the UE.
ReportCharacteristicsEmpty	The action failed because there is no characteristic reported.
NoReportPeriodicity	The action failed because the periodicity is not defined.
ExistingMeasurementID	The action failed because measurement-ID is already used.
Unknown eNB Measurement ID	The action failed because some eNB Measurement-ID is unknown.
Measurement Temporarily not Available	The eNB can temporarily not provide the requested measurement object.
Unspecified	Sent when none of the above cause values applies but still the cause is Radio Network Layer related
Encryption And/Or Integrity Protection Algorithms Not Supported	The target eNB is unable to support any of the encryption and/or integrity protection algorithms supported by the UE.
ReportCharacteristicsEmpty	The action failed because there is no characteristic reported.
NoReportPeriodicity	The action failed because the periodicity is not defined.
ExistingMeasurementID	The action failed because measurement-ID is already used.
Unknown eNB Measurement ID	The action failed because some eNB Measurement-ID is unknown.

Transport Network Layer cause	Meaning
Transport resource unavailable	The required transport resources are not available
Unspecified	Sent when none of the above cause values applies but still the cause is Transport Network Layer related

Protocol cause	Meaning
Abstract Syntax Error (Reject)	The received message included an abstract syntax error and the concerned criticality indicated "reject" (see sub clause 10.3)
Abstract Syntax Error (Ignore and Notify)	The received message included an abstract syntax error and the concerned criticality indicated "ignore and notify" (see sub clause 10.3)
Abstract syntax error (falsely constructed message)	The received message contained IEs or IE groups in wrong order or with too many occurrences (see sub clause 10.3)
Message not Compatible with Receiver State	The received message was not compatible with the receiver state (see sub clause 10.4)
Semantic Error	The received message included a semantic error (see sub clause 10.4)
Transfer Syntax Error	The received message included a transfer syntax error (see sub clause 10.2)
Unspecified	Sent when none of the above cause values applies but still the cause is Protocol related

Miscellaneous cause	Meaning
Control Processing Overload	eNB control processing overload
Hardware Failure	eNB hardware failure
Not enough User Plane Processing Resources	eNB has insufficient user plane processing resources available
O&M Intervention	Operation and Maintenance intervention related to eNB equipment
Unspecified	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 or Protocol.

9.2.7 Criticality Diagnostics

The *Criticality Diagnostics* IE is sent by the eNB 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.

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).
Information Element Criticality Diagnostics		0 to <maxNrOfErrors>		
>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
maxNrOfErrors	Maximum no. of IE errors allowed to be reported with a single message. The value for maxnooferrors is 256.

9.2.8 Served Cell Information

This IE contains cell configuration information of a cell that a neighbour eNB may need for the X2 AP interface.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
PCI	M		INTEGER (0..503, …)	Physical Cell ID	–	–
Cell ID	M		ECGI 9.2.14		–	–
TAC	M		OCTET STRING(2)	Tracking Area Code	–	–
Broadcast PLMNs		1..<maxnoofBPLMNs>		Broadcast PLMNs	–	–
>PLMN Identity	M		9.2.4		–	–
CHOICE *EUTRA-Mode-Info*	M				–	–
>FDD						
>>FDD Info		1			–	–
>>>UL EARFCN	M		EARFCN 9.2.26	Corresponds to N_{UL} in ref. [16]	–	–
>>>DL EARFCN	M		EARFCN 9.2.26	Corresponds to N_{DL} in ref. [16]	–	–
>>>UL Transmission Bandwidth	M		Transmission Bandwidth 9.2 27		–	–
>>>DL Transmission Bandwidth	M		Transmission Bandwidth 9.2 27	Same as UL Transmission Bandwidth in this release.	–	–
>TDD						
>>TDD Info		1			–	–
>>>EARFCN	M		9.2.26	Corresponds to N_{DL}/N_{UL} in ref. [16]	–	–
>>>Transmission Bandwidth	M		Transmission Bandwidth 9.2 27		–	–
>>>Subframe Assignment	M		ENUMERATED(sa0, sa1, sa2, sa3, sa4, sa5, sa6,…)	Uplink-downlink subframe configuration information defined in ref. [10].	–	–
>>>Special Subframe Info				Special subframe configuration information defined in ref. [10].		
>>>>Special Subframe Patterns	M		ENUMERATED(ssp0, ssp1, ssp2, ssp3, ssp4, ssp5, ssp6, ssp7, ssp8, …)		–	–
>>>>Cyclic Prefix DL	M		ENUMERATED(Normal, Extended,…)		–	–
>>>>Cyclic Prefix UL	M		ENUMERATED(Normal, Extended,…)		–	–

Range bound	Explanation
maxnoofBPLMNs	Maximum no. of Broadcast PLMN Ids. Value is 6.

9.2.9 E-RAB Level QoS Parameters

This IE defines the QoS to be applied to an E-RAB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
QCI	M		INTEGER (0..255)	QoS Class Identifier defined in [12]. Logical range and coding specified in [13].	–	–
Allocation and Retention Priority	M		9.2.31		–	–
GBR QoS Information	O		9.2.10	This IE applies to GBR bearers only and shall be ignored otherwise.	–	–

9.2.10 GBR QoS Information

This IE indicates the maximum and guaranteed bit rates of a GBR E-RAB for downlink and uplink.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
E-RAB Maximum Bit Rate Downlink	M		Bit Rate 9.2.11	Maximum Bit Rate in DL (i.e. from EPC to E-UTRAN) for the bearer. Details in [12].	–	–
E-RAB Maximum Bit Rate Uplink	M		Bit Rate 9.2.11	Maximum Bit Rate in UL (i.e. from E-UTRAN to EPC) for the bearer. Details in [12].	–	–
E-RAB Guaranteed Bit Rate Downlink	M		Bit Rate 9.2.11	Guaranteed Bit Rate (provided that there is data to deliver) in DL (i.e. from EPC to E-UTRAN) for the bearer. Details in [12].	–	–
E-RAB Guaranteed Bit Rate Uplink	M		Bit Rate 9.2.11	Guaranteed Bit Rate (provided that there is data to deliver) in UL (i.e. from E-UTRAN to EPC) for the bearer. Details in [12].	–	–

9.2.11 Bit Rate

This IE indicates the number of bits delivered by E-UTRAN in UL or to E-UTRAN in DL within a period of time, divided by the duration of the period. It is used, for example, to indicate the maximum or guaranteed bit rate for a GBR E-RAB, or an aggregated maximum bit rate.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Bit Rate	M		INTEGER (0..10,000,000,000)	The unit is: bit/s

9.2.12 UE Aggregate Maximum Bit Rate

On Handover Aggregate Maximum Bitrate is transferred to the target eNB. The UE Aggregate Maximum Bitrate is applicable for all Non-GBR bearers per UE which is defined for the Downlink and the Uplink direction and provided by the MME to the eNB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
UE Aggregate Maximum Bit Rate Downlink	M		Bit Rate 9.2.11		–	–
UE Aggregate Maximum Bit Rate Uplink	M		Bit Rate 9.2.11		–	–

9.2.13 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
Procedure Code	M		INTEGER (0..255)	"0" = Handover Preparation "1" = Handover Cancel "2" = Load Indication "3" = Error Indication "4" = SN Status Transfer "5" = UE Context Release "6" = X2 Setup "7" = Reset "8" = eNB Configuration Update "9" = Resource Status Reporting Initiation "10" = Resource Status Reporting '11' = Private Message
Type of Message	M		CHOICE (Initiating Message, Successful Outcome, Unsuccessful Outcome, …)	

9.2.14 ECGI

The E-UTRAN Cell Global Identifier (ECGI) is used to globally identify a cell (see [2]).

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
PLMN Identity	M		9.2.4		–	–
E-UTRAN Cell Identifier	M		BIT STRING (28)	The leftmost bits of the *E-UTRAN Cell Identifier* IE value correspond to the value of the *eNB ID* IE contained in the *Global eNB ID* IE (defined in section 9.2.22) identifying the eNB that controls the cell	–	–

9.2.15 COUNT Value

This information element indicates the 12 bit PDCP sequence number and the corresponding 20 bit Hyper frame number.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
PDCP-SN	M		INTEGER (0..4095)		–	–
HFN	M		INTEGER (0..1048575)		–	–

9.2.16 GUMMEI

This information element indicates the globally unique MME identity.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
GU Group ID	M		9.2.20		–	–
MME code	M		OCTET STRING (1)		–	–

9.2.17 UL Interference Overload Indication

This IE provides, per PRB, a report on interference overload. The interaction between the indication of UL Interference Overload and UL High Interference is implementation specific.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
UL Interference Overload Indication List		1 to <maxnoofPRBs>		
>UL Interference Overload Indication	M		ENUMERATED (high interference, medium interference, low interference, …)	Each PRB is identified by its position in the list: the first element in the list corresponds to PRB 0, the second to PRB 1, etc.

Range bound	Explanation
maxnoofPRBs	Maximum no. Physical Resource Blocks. Value is 110.

9.2.18 UL High Interference Indication

This IE provides, per PRB, a 2 level report on interference sensitivity. The interaction between the indication of UL Overload and UL High Interference is implementation specific.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
HII	M		BIT STRING (1..110, …)	Each position in the bitmap represents a PRB (first bit=PRB 0 and so on), for which value ""1" indicates "high interference sensitivity" and value "0" indicates "low interference sensitivity". The maximum number of Physical Resource Blocks is 110

9.2.19 Relative Narrowband Tx Power (RNTP)

This IE provides an indication on DL power restriction per PRB in a cell and other information needed by a neighbour eNB for interference aware scheduling.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
RNTP Per PRB	M		BIT STRING (6..110, …)	Each position in the bitmap represents a n_{PRB} value (i.e. first bit=PRB 0 and so on), for which the bit value represents *RNTP (n_{PRB})*, defined in [11]. ▪ Value 0 indicates "Tx not exceeding RNTP threshold". Value 1 indicates "no promise on the Tx power is given"	–	–
RNTP Threshold	M		ENUMERATED (-∞, -11, -10, -9, -8, -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, …)	$RNTP_{threshold}$ is defined in [11]	–	–
Number Of Cell-specific Antenna Ports	M		ENUMERATED (1, 2, 4, …)	*P* (number of antenna ports for cell-specific reference signals) defined in [10]	–	–
P_B	M		INTEGER (0..3, …)	P_B is defined in [11]	–	–
PDCCH Interference Impact	M		INTEGER (0..4, …)	Measured by Predicted Number Of Occupied PDCCH OFDM Symbols (see [10]). Value 0 means "no prediction is available"	–	–

9.2.20 GU Group Id

The *GU Group Id* IE is the globally unique group id corresponding to a pool area.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
PLMN Id	M		9.2.4		–	–
MME Group Id	M		OCTET STRING(2)		–	–

9.2.21 Location Reporting Information

This information element indicates how the location information should be reported.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Event	M		ENUMERATED (Change of serving cell, …)		–	–
Report Area	M		ENUMERATED (ECGI, …)		–	–

9.2.22 Global eNB ID

This IE is used to globally identify an eNB (see [2]).

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
PLMN Identity	M		9.2.4		–	–
CHOICE *eNB ID*	M				–	–
>Macro eNB ID			BIT STRING (20)	Equal to the 20 leftmost bits of the value of the *E-UTRAN Cell Identifier* IE contained in the *ECGI* IE (see section 9.2.14) identifying each cell controlled by the eNB		
>Home eNB ID			BIT STRING (28)	Equal to the value of the *E-UTRAN Cell Identifier* IE contained in the *ECGI* IE (see section 9.2.14) identifying the cell controlled by the eNB		

9.2.23 E-RAB ID

This IE uniquely identifies an E-RAB for a UE.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
E-RAB ID	M		INTEGER (0..15, ...)	

9.2.24 eNB UE X2AP ID

This information element uniquely identifies an UE over the X2 interface within an eNB.

The Old eNB UE X2AP ID is allocated by the source eNB and the New eNB UE X2AP ID is allocated by the target eNB, as defined in [2].

IE/Group Name	Presence	Range	IE type and reference	Semantics description
eNB UE X2AP ID	M		INTEGER (0..4095)	

9.2.25 Subscriber Profile ID for RAT/Frequency priority

The *Subscriber Profile ID* IE for RAT/Frequency Selection Priority is used to define camp priorities in Idle mode and to control inter-RAT/inter-frequency handover in Active mode [15].

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Subscriber Profile ID for RAT/Frequency Priority	M		INTEGER (1..256)	

9.2.26 EARFCN

The E-UTRA Absolute Radio Frequency Channel Number defines the carrier frequency used in a cell for a given direction (UL or DL) in FDD or for both UL and DL directions in TDD.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
EARFCN	M		INTEGER (0..maxEARFCN)	The relation between EARFCN and carrier frequency (in MHz) are defined in [16].

Range bound	Explanation
maxEARFCN	Maximum value of EARFCNs. Value is 65535.

9.2.27 Transmission Bandwidth

The *Transmission Bandwidth* IE is used to indicate the UL or DL transmission bandwidth expressed in units of resource blocks " N_{RB} " [16]. The values bw6, bw15, bw25, bw50, bw75, bw100 correspond to the number of resource blocks 'NRB' 6, 15, 25, 50, 75, 100.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Transmission Bandwidth	M		ENUMERATED (bw6, bw15, bw25, bw50, bw75, bw100,...)	

9.2.28 E-RAB List

The IE contains a list of E-RAB identities with a cause value. It is used for example to indicate not admitted bearers.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
E-RAB List Item		1 to < maxnoofBearers >			EACH	ignore
>E-RAB ID	M		9.2.23		–	–
>Cause	M		9.2.6		–	–

Range bound	Explanation
maxnoofBearers	Maximum no. of E-RABs. Value is 256.

9.2.29 UE Security Capabilities

The *UE Security Capabilities* IE defines the supported algorithms for encryption and integrity protection in the UE.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Encryption Algorithms	M		BIT STRING (16, ...)	Each position in the bitmap represents an encryption algorithm: "all bits equal to 0" - UE supports no other algorithm than EEA0 'first bit' - 128-EEA1, 'second bit' - 128-EEA2, other bits reserved for future use. Value "1" indicates support and value '0' indicates no support of the algorithm. Algorithms are defined in [18].
Integrity Protection Algorithms	M		BIT STRING (16, ...)	Each position in the bitmap represents an integrity protection algorithm: 'first bit' - 128-EIA1, 'second bit' - 128-EIA2, other bits reserved for future use. Value "1" indicates support and value '0' indicates no support of the algorithm. Algorithms are defined in [18].

9.2.30 AS Security Information

The *AS Security Information* IE is used to generate the key material to be used for AS security with the UE.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Key eNodeB Star	M		BIT STRING (256)	The KeNB* as defined in [9]
Next Hop Chaining Count	M		INTEGER (0..7)	Next Hop Chaining Count (NCC) defined in [18]

9.2.31 Allocation and Retention Priority

This IE specifies the relative importance compared to other E-RABs for allocation and retention of the E-UTRAN Radio Access Bearer.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Priority Level	M		INTEGER (0..15)	**Desc.:** This IE should be understood as 'priority of allocation and retention' (see [12]). **Usage:** Value 15 means 'no priority'. Values between 1 and 14 are ordered in decreasing order of priority, i.e. 1 is the highest and 14 the lowest. Value 0 shall be treated as a logical error if received.
Pre-emption Capability	M		ENUMERATED(shall not trigger pre-emption, may trigger pre-emption)	**Descr.:** This IE indicates the pre-emption capability of the request on other E-RABs **Usage:** The E-RAB shall not pre-empt other E-RABs or, the E-RAB may pre-empt other E-RABs The Pre-emption Capability indicator applies to the allocation of resources for an E-RAB and as such it provides the trigger to the pre-emption procedures/processes of the eNB.
Pre-emption Vulnerability	M		ENUMERATED(not pre-emptable, pre-emptable)	**Desc.:** This IE indicates the vulnerability of the E-RAB to preemption of other E-RABs. **Usage**: The E-RAB shall not be pre-empted by other E-RABs or the E-RAB may be pre-empted by other RABs. Pre-emption Vulnerability indicator applies for the entire duration of the E-RAB, unless modified and as such indicates whether the E-RAB is a target of the pre-emption procedures/processes of the eNB

9.2.32 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, …)	

9.2.33 SRVCC Operation Possible

The IE indicates that both the UE and the MME are SRVCC-capable. E-UTRAN behaviour on reception of this is specified in [20].

IE/Group Name	Presence	Range	IE type and reference	Semantics description
SRVCC Operation Possible	M		ENUMERATED(Possible, …)	

9.2.34 Hardware Load Indicator

The *Hardware Load Indicator* IE indicates the status of the Hardware Load experienced by the cell.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
DL Hardware Load Indicator	M		9.2.36	
UL Hardware Load Indicator	M		9.2.36	

9.2.35 S1 TNL Load Indicator

The *S1 TNL Load Indicator* IE indicates the status of the S1 Transport Network Load experienced by the cell.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
DL S1TNL Load Indicator	M		9.2.36	
UL S1TNL Load Indicator	M		9.2.36	

9.2.36 Load Indicator

The *Load Indicator* IE indicates the status of Load.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Load Indicator	M		ENUMERATED (LowLoad, MediumLoad, HighLoad, Overload, ...)	

9.2.37 Radio Resource Status

The *Radio Resource Status* IE indicates the usage of the PRBs in Downlink and Uplink [22], [23].

IE/Group Name	Presence	Range	IE type and reference	Semantics description
DL GBR PRB usage	M		INTEGER (0..100)	
UL GBR PRB usage	M		INTEGER (0..100)	
DL non-GBR PRB usage	M		INTEGER (0..100)	
UL non-GBR PRB usage	M		INTEGER (0..100)	
DL Total PRB usage	M		INTEGER (0..100)	
UL Total PRB usage	M		INTEGER (0..100)	

9.2.38 UE History Information

The *UE History Information* IE contains information about cells that a UE has been served by in active state prior to the target cell. The overall mechanism is described in [15].

NOTE: The definition of this IE is aligned with the definition of the *UE History Information* IE in [4].

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Last Visited Cell List		*1 to maxnoofCells*		Most recent information is added to the top of this list	–	–
>Last Visited Cell Information	M		9.2.39		–	–

Range bound	Explanation
maxnoofCells	Maximum number of last visited cell information records that can be reported in the IE. Value is 16.

9.2.39 Last Visited Cell Information

The Last Visited Cell Information may contain E-UTRAN or UTRAN cell specific information.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Choice **Last Visited Cell Information**	M				-	-
>Last Visited E-UTRAN Cell Information	M		9.2.40		-	-
>Last Visited UTRAN Cell Information	M		OCTET STRING	Defined in [24]	-	-
>Last Visited GERAN Cell Information	M		9.2.41			

9.2.40 Last Visited E-UTRAN Cell Information

The Last Visited E-UTRAN Cell Information contains information about a cell that is to be used for RRM purposes.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Global Cell ID	M		ECGI 9.2.14		-	-
Cell Type	M		9.2.42		-	-
Time UE stayed in Cell	M		INTEGER (0..4095)	The duration of the time the UE stayed in the cell in seconds. If the UE stays in a cell more than 4095s, this IE is set to 4095	-	-

9.2.41 Last Visited GERAN Cell Information

The Last Visited Cell Information for GERAN is currently undefined.

NOTE: If in later Releases this is defined, the choice type may be extended with the actual GERAN specific information.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Choice **Last Visited GERAN Cell Information**	M				-	-
>Undefined	M		NULL		-	-

9.2.42 Cell Type

The cell type provides the cell coverage area.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Cell Size	M		ENUMERATED (verysmall, small, medium, large, …)		-	-

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

9.3.1 General

Sub clause 9.3 presents the Abstract Syntax of the X2AP protocol with ASN.1. In case there is contradiction between the ASN.1 definition in this sub clause and the tabular format in sub clause 9.1 and 9.2, the ASN.1 shall take precedence, except for the definition of conditions for the presence of conditional elements, in which the tabular format shall take precedence.

The ASN.1 definition specifies the structure and content of X2AP messages. X2AP 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 a X2AP message according to the PDU definitions module and with the following additional rules (Note that in the following IE means an IE in the object set with an explicit id. If one IE needed to appear more than once in one object set, then the different occurrences have different IE ids):

- 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 in which 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.

If a X2AP message that is not constructed as defined above is received, this shall be considered as Abstract Syntax Error, and the message shall be handled as defined for Abstract Syntax Error in clause 10.

9.3.2 Usage of Private Message Mechanism for Non-standard Use

The private message mechanism for non-standard use may be used:

- for special operator (and/or vendor) specific features considered not to be part of the basic functionality, i.e. the functionality required for a complete and high-quality specification in order to guarantee multivendor inter-operability.
- by vendors for research purposes, e.g. to implement and evaluate new algorithms/features before such features are proposed for standardisation.

The private message mechanism shall not be used for basic functionality. Such functionality shall be standardised.

9.3.3 Elementary Procedure Definitions

```
-- **************************************************************
--
-- Elementary Procedure definitions
--
-- **************************************************************
```

```
X2AP-PDU-Descriptions {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
eps-Access (21) modules (3) x2ap (2) version1 (1) x2ap-PDU-Descriptions (0) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

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

IMPORTS
    Criticality,
    ProcedureCode
FROM X2AP-CommonDataTypes


    ENBConfigurationUpdate,
    ENBConfigurationUpdateAcknowledge,
    ENBConfigurationUpdateFailure,
    ErrorIndication,
    HandoverCancel,
    HandoverPreparationFailure,
    HandoverRequest,
    HandoverRequestAcknowledge,
    LoadInformation,
    PrivateMessage,
    ResetRequest,
    ResetResponse,
    ResourceStatusFailure,
    ResourceStatusRequest,
    ResourceStatusResponse,
    ResourceStatusUpdate,
    SNStatusTransfer,
    UEContextRelease,
    X2SetupFailure, X2SetupRequest,
    X2SetupResponse



FROM X2AP-PDU-Contents

    id-eNBConfigurationUpdate,
    id-errorIndication,
    id-handoverCancel,
    id-handoverPreparation,

    id-loadIndication,
    id-privateMessage,
    id-reset,
```

```
    id-resourceStatusReporting,
    id-resourceStatusReportingInitiation,
    id-snStatusTransfer,
    id-uEContextRelease,
    id-x2Setup



FROM X2AP-Constants;

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

X2AP-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
--
-- ************************************************************

X2AP-PDU ::= CHOICE {
    initiatingMessage   InitiatingMessage,
    successfulOutcome   SuccessfulOutcome,
    unsuccessfulOutcome UnsuccessfulOutcome,
    ...
}

InitiatingMessage ::= SEQUENCE {
    procedureCode   X2AP-ELEMENTARY-PROCEDURE.&procedureCode        ({X2AP-ELEMENTARY-PROCEDURES}),
    criticality     X2AP-ELEMENTARY-PROCEDURE.&criticality          ({X2AP-ELEMENTARY-PROCEDURES}{@procedureCode}),
    value           X2AP-ELEMENTARY-PROCEDURE.&InitiatingMessage    ({X2AP-ELEMENTARY-PROCEDURES}{@procedureCode})
}

SuccessfulOutcome ::= SEQUENCE {
    procedureCode   X2AP-ELEMENTARY-PROCEDURE.&procedureCode        ({X2AP-ELEMENTARY-PROCEDURES}),
```

```
    criticality     X2AP-ELEMENTARY-PROCEDURE.&criticality          ({X2AP-ELEMENTARY-PROCEDURES}{@procedureCode}),
    value           X2AP-ELEMENTARY-PROCEDURE.&SuccessfulOutcome    ({X2AP-ELEMENTARY-PROCEDURES}{@procedureCode})
}

UnsuccessfulOutcome ::= SEQUENCE {
    procedureCode   X2AP-ELEMENTARY-PROCEDURE.&procedureCode        ({X2AP-ELEMENTARY-PROCEDURES}),
    criticality     X2AP-ELEMENTARY-PROCEDURE.&criticality          ({X2AP-ELEMENTARY-PROCEDURES}{@procedureCode}),
    value           X2AP-ELEMENTARY-PROCEDURE.&UnsuccessfulOutcome  ({X2AP-ELEMENTARY-PROCEDURES}{@procedureCode})
}


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

X2AP-ELEMENTARY-PROCEDURES X2AP-ELEMENTARY-PROCEDURE ::= {
    X2AP-ELEMENTARY-PROCEDURES-CLASS-1          |
    X2AP-ELEMENTARY-PROCEDURES-CLASS-2          ,
    ...
}

X2AP-ELEMENTARY-PROCEDURES-CLASS-1 X2AP-ELEMENTARY-PROCEDURE ::= {
    handoverPreparation                                     |
    reset                                                   |
    x2Setup                                                 |
    resourceStatusReportingInitiation                       |
    eNBConfigurationUpdate                                  ,
    ...
}

X2AP-ELEMENTARY-PROCEDURES-CLASS-2 X2AP-ELEMENTARY-PROCEDURE ::= {
    snStatusTransfer                        |
    uEContextRelease                        |
    handoverCancel                          |
    errorIndication                         |
    resourceStatusReporting                 |
    loadIndication                          |
    privateMessage                          ,
    ...

}


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

handoverPreparation X2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      HandoverRequest
    SUCCESSFUL OUTCOME      HandoverRequestAcknowledge
```

```
    UNSUCCESSFUL OUTCOME    HandoverPreparationFailure
    PROCEDURE CODE          id-handoverPreparation
    CRITICALITY             reject
}

snStatusTransfer X2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      SNStatusTransfer
    PROCEDURE CODE          id-snStatusTransfer
    CRITICALITY             ignore
}

uEContextRelease X2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      UEContextRelease
    PROCEDURE CODE          id-uEContextRelease
    CRITICALITY             ignore
}


handoverCancel X2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      HandoverCancel
    PROCEDURE CODE          id-handoverCancel
    CRITICALITY             ignore
}

errorIndication X2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      ErrorIndication
    PROCEDURE CODE          id-errorIndication
    CRITICALITY             ignore
}

reset   X2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      ResetRequest
    SUCCESSFUL OUTCOME      ResetResponse
    PROCEDURE CODE          id-reset
    CRITICALITY             reject
}

x2Setup X2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      X2SetupRequest
    SUCCESSFUL OUTCOME      X2SetupResponse
    UNSUCCESSFUL OUTCOME    X2SetupFailure
    PROCEDURE CODE          id-x2Setup
    CRITICALITY             reject
}


loadIndication X2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      LoadInformation
    PROCEDURE CODE          id-loadIndication
    CRITICALITY             ignore
}

eNBConfigurationUpdate      X2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      ENBConfigurationUpdate
```

```
    SUCCESSFUL OUTCOME      ENBConfigurationUpdateAcknowledge
    UNSUCCESSFUL OUTCOME    ENBConfigurationUpdateFailure
    PROCEDURE CODE          id-eNBConfigurationUpdate
    CRITICALITY             reject
}

resourceStatusReportingInitiation   X2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE              ResourceStatusRequest
    SUCCESSFUL OUTCOME              ResourceStatusResponse
    UNSUCCESSFUL OUTCOME            ResourceStatusFailure
    PROCEDURE CODE                  id-resourceStatusReportingInitiation
    CRITICALITY                     reject
}

resourceStatusReporting X2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      ResourceStatusUpdate
    PROCEDURE CODE          id-resourceStatusReporting
    CRITICALITY             ignore
}

privateMessage          X2AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      PrivateMessage
    PROCEDURE CODE          id-privateMessage
    CRITICALITY             ignore
}

END
```

9.3.4 PDU Definitions

```
-- ****************************************************************
--
-- PDU definitions for X2AP.
--
-- ****************************************************************

X2AP-PDU-Contents {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
eps-Access (21) modules (3) x2ap (2) version1 (1) x2ap-PDU-Contents (1) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

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

IMPORTS

    AS-SecurityInformation,
```

```
    Cause,

    COUNTvalue,
    CriticalityDiagnostics,
    DL-Forwarding,
    ECGI,
    E-RAB-ID,
    E-RAB-Level-QoS-Parameters,
    E-RAB-List,
    EUTRANTraceID,
    GlobalENB-ID,
    GTPtunnelEndpoint,
    GUGroupIDList,
    GUMMEI,
    HandoverRestrictionList,
    LocationReportingInformation,
    Neighbour-Information,
    PDCP-SN,
    PLMN-Identity,
    ReceiveStatusofULPDCPSDUs,
    Registration-Request,
    RelativeNarrowbandTxPower,
    RadioResourceStatus,
    RRC-Context,
    ServedCell-Information,
    ServedCells,
    SRVCCOperationPossible,
    SubscriberProfileIDforRFP,
    TargeteNBtoSource-eNBTransparentContainer,
    TimeToWait,
    TraceActivation,
    TraceDepth,

    TransportLayerAddress,
    UEAggregateMaximumBitRate,
    UE-HistoryInformation,
    UE-S1AP-ID,
    UESecurityCapabilities,
    UE-X2AP-ID,
    UL-HighInterferenceIndicationInfo,
    UL-InterferenceOverloadIndication,
    HWLoadIndicator,
    S1TNLLoadIndicator,
    Measurement-ID,
    ReportCharacteristics



FROM X2AP-IEs

    PrivateIE-Container{},
    ProtocolExtensionContainer{},
    ProtocolIE-Container{},
```

```
    ProtocolIE-ContainerList{},
    ProtocolIE-ContainerPair{},
    ProtocolIE-ContainerPairList{},
    ProtocolIE-Single-Container{},
    X2AP-PRIVATE-IES,
    X2AP-PROTOCOL-EXTENSION,
    X2AP-PROTOCOL-IES,
    X2AP-PROTOCOL-IES-PAIR
FROM X2AP-Containers


    id-Cause,
    id-CellInformation,
    id-CellInformation-Item,
    id-CellMeasurementResult,
    id-CellMeasurementResult-Item,
    id-CellToReport,
    id-CellToReport-Item,
    id-CriticalityDiagnostics,
    id-E-RABs-Admitted-Item,
    id-E-RABs-Admitted-List,
    id-E-RABs-NotAdmitted-List,
    id-E-RABs-SubjectToStatusTransfer-List,
    id-E-RABs-SubjectToStatusTransfer-Item,
    id-E-RABs-ToBeSetup-Item,
    id-GlobalENB-ID,
    id-GUGroupIDList,
    id-GUGroupIDToAddList,
    id-GUGroupIDToDeleteList,
    id-GUMMEI-ID,
    id-New-eNB-UE-X2AP-ID,
    id-Old-eNB-UE-X2AP-ID,
    id-Registration-Request,
    id-ReportingPeriodicity,
    id-ServedCells,
    id-ServedCellsToAdd,
    id-ServedCellsToModify,
    id-ServedCellsToDelete,
    id-SRVCCOperationPossible,
    id-TargetCell-ID,
    id-TargeteNBtoSource-eNBTransparentContainer,
    id-TimeToWait,
    id-TraceActivation,
    id-UE-ContextInformation,
    id-UE-HistoryInformation,
    id-UE-X2AP-ID,
    id-Measurement-ID,
    id-ReportCharacteristics,
    id-ENB1-Measurement-ID,
    id-ENB2-Measurement-ID,


    maxCellineNB,
```

```
    maxnoofBearers,
    maxnoofPDCP-SN

FROM X2AP-Constants;

-- **************************************************************
--
-- HANDOVER REQUEST
--
-- **************************************************************

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

HandoverRequest-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-Old-eNB-UE-X2AP-ID              CRITICALITY reject  TYPE UE-X2AP-ID                PRESENCE mandatory } |
    { ID id-Cause                           CRITICALITY ignore  TYPE Cause                      PRESENCE mandatory } |
    { ID id-TargetCell-ID                   CRITICALITY reject  TYPE ECGI                       PRESENCE mandatory } |
    { ID id-GUMMEI-ID                       CRITICALITY reject  TYPE GUMMEI                     PRESENCE mandatory } |
    { ID id-UE-ContextInformation           CRITICALITY reject  TYPE UE-ContextInformation      PRESENCE mandatory } |
    { ID id-UE-HistoryInformation           CRITICALITY ignore  TYPE UE-HistoryInformation      PRESENCE mandatory } |
    { ID id-TraceActivation                 CRITICALITY ignore  TYPE TraceActivation            PRESENCE optional } |
    { ID id-SRVCCOperationPossible          CRITICALITY ignore  TYPE SRVCCOperationPossible     PRESENCE optional },
    ...
}

UE-ContextInformation ::= SEQUENCE {
    mME-UE-S1AP-ID                  UE-S1AP-ID,
    uESecurityCapabilities          UESecurityCapabilities,
    aS-SecurityInformation          AS-SecurityInformation,
    uEaggregateMaximumBitRate       UEAggregateMaximumBitRate,
      subscriberProfileIDforRFP         SubscriberProfileIDforRFP           OPTIONAL,

    e-RABs-ToBeSetup-List           E-RABs-ToBeSetup-List,
    rRC-Context                     RRC-Context,
    handoverRestrictionList         HandoverRestrictionList     OPTIONAL,
    locationReportingInformation    LocationReportingInformation    OPTIONAL,
    iE-Extensions                   ProtocolExtensionContainer { {UE-ContextInformation-ExtIEs} } OPTIONAL,
    ...
}

UE-ContextInformation-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

E-RABs-ToBeSetup-List ::= SEQUENCE (SIZE(1..maxnoofBearers)) OF ProtocolIE-Single-Container { {E-RABs-ToBeSetup-ItemIEs} }

E-RABs-ToBeSetup-ItemIEs    X2AP-PROTOCOL-IES ::= {
    { ID id-E-RABs-ToBeSetup-Item    CRITICALITY ignore     TYPE E-RABs-ToBeSetup-Item  PRESENCE mandatory },
    ...
}
```

```
E-RABs-ToBeSetup-Item ::= SEQUENCE {
    e-RAB-ID                    E-RAB-ID,
    e-RAB-Level-QoS-Parameters      E-RAB-Level-QoS-Parameters,
    dL-Forwarding                   DL-Forwarding                                           OPTIONAL,
    uL-GTPtunnelEndpoint            GTPtunnelEndpoint,
    iE-Extensions                   ProtocolExtensionContainer { {E-RABs-ToBeSetup-ItemExtIEs} } OPTIONAL,
    ...
}

E-RABs-ToBeSetup-ItemExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}



-- **************************************************************
--
-- HANDOVER REQUEST ACKNOWLEDGE
--
-- **************************************************************

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

HandoverRequestAcknowledge-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-Old-eNB-UE-X2AP-ID                          CRITICALITY ignore  TYPE UE-X2AP-ID                                 PRESENCE mandatory} |
    { ID id-New-eNB-UE-X2AP-ID                          CRITICALITY ignore  TYPE UE-X2AP-ID                                 PRESENCE mandatory} |
    { ID id-E-RABs-Admitted-List                        CRITICALITY ignore  TYPE E-RABs-Admitted-List                       PRESENCE mandatory} |
    { ID id-E-RABs-NotAdmitted-List                     CRITICALITY ignore  TYPE E-RAB-List                                 PRESENCE optional} |
    { ID id-TargeteNBtoSource-eNBTransparentContainer   CRITICALITY ignore  TYPE TargeteNBtoSource-eNBTransparentContainer   PRESENCE mandatory }|
    { ID id-CriticalityDiagnostics                      CRITICALITY ignore  TYPE CriticalityDiagnostics                     PRESENCE optional },
    ...
}

E-RABs-Admitted-List        ::= SEQUENCE (SIZE (1..maxnoofBearers)) OF ProtocolIE-Single-Container { {E-RABs-Admitted-ItemIEs} }

E-RABs-Admitted-ItemIEs X2AP-PROTOCOL-IES ::= {
    { ID id-E-RABs-Admitted-Item    CRITICALITY ignore  TYPE E-RABs-Admitted-Item   PRESENCE mandatory   }
}

E-RABs-Admitted-Item ::= SEQUENCE {
    e-RAB-ID                    E-RAB-ID,
    uL-GTP-TunnelEndpoint           GTPtunnelEndpoint                                       OPTIONAL,
    dL-GTP-TunnelEndpoint           GTPtunnelEndpoint                                       OPTIONAL,
    iE-Extensions                   ProtocolExtensionContainer { {E-RABs-Admitted-Item-ExtIEs} }   OPTIONAL,
    ...
}

E-RABs-Admitted-Item-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}
```

```
-- ********************************************************
--
-- HANDOVER PREPARATION FAILURE
--
-- ********************************************************

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

HandoverPreparationFailure-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-Old-eNB-UE-X2AP-ID          CRITICALITY ignore  TYPE UE-X2AP-ID             PRESENCE mandatory} |
    { ID id-Cause                       CRITICALITY ignore  TYPE Cause                  PRESENCE mandatory} |
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics PRESENCE optional },

    ...
}

-- ********************************************************
--
-- SN Status Transfer
--
-- ********************************************************

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

SNStatusTransfer-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-Old-eNB-UE-X2AP-ID                    CRITICALITY reject  TYPE UE-X2AP-ID                          PRESENCE mandatory} |
    { ID id-New-eNB-UE-X2AP-ID                    CRITICALITY reject  TYPE UE-X2AP-ID                          PRESENCE mandatory} |
    { ID id-E-RABs-SubjectToStatusTransfer-List CRITICALITY ignore  TYPE E-RABs-SubjectToStatusTransfer-List    PRESENCE mandatory} ,
    ...
}

E-RABs-SubjectToStatusTransfer-List ::= SEQUENCE (SIZE (1..maxnoofBearers)) OF ProtocolIE-Single-Container { { E-RABs-SubjectToStatusTransfer-
ItemIEs} }

E-RABs-SubjectToStatusTransfer-ItemIEs X2AP-PROTOCOL-IES ::= {
    { ID id-E-RABs-SubjectToStatusTransfer-Item CRITICALITY ignore  TYPE E-RABs-SubjectToStatusTransfer-Item    PRESENCE mandatory    }
}

E-RABs-SubjectToStatusTransfer-Item ::= SEQUENCE {
    e-RAB-ID                                E-RAB-ID,

    receiveStatusofULPDCPSDUs               ReceiveStatusofULPDCPSDUs          OPTIONAL,
    uL-COUNTvalue                   COUNTvalue,
    dL-COUNTvalue                   COUNTvalue,
    iE-Extensions                           ProtocolExtensionContainer { {E-RABs-SubjectToStatusTransfer-ItemExtIEs} } OPTIONAL,
    ...
```

```
}

E-RABs-SubjectToStatusTransfer-ItemExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}




-- **************************************************************
--
-- UE Context Release
--
-- **************************************************************

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

UEContextRelease-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-Old-eNB-UE-X2AP-ID          CRITICALITY reject  TYPE UE-X2AP-ID             PRESENCE mandatory} |
    { ID id-New-eNB-UE-X2AP-ID          CRITICALITY reject  TYPE UE-X2AP-ID             PRESENCE mandatory} ,
    ...
}


-- **************************************************************
--
-- HANDOVER CANCEL
--
-- **************************************************************

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

HandoverCancel-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-Old-eNB-UE-X2AP-ID          CRITICALITY reject  TYPE UE-X2AP-ID             PRESENCE mandatory} |
    { ID id-New-eNB-UE-X2AP-ID          CRITICALITY ignore  TYPE UE-X2AP-ID             PRESENCE optional} |
    { ID id-Cause                       CRITICALITY ignore  TYPE Cause                  PRESENCE mandatory} ,
    ...
}

-- **************************************************************
--
-- ERROR INDICATION
--
-- **************************************************************

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

```
    ...
}

ErrorIndication-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-Old-eNB-UE-X2AP-ID          CRITICALITY ignore  TYPE UE-X2AP-ID                PRESENCE optional} |
    { ID id-New-eNB-UE-X2AP-ID          CRITICALITY ignore  TYPE UE-X2AP-ID                PRESENCE optional} |
    { ID id-Cause                       CRITICALITY ignore  TYPE Cause                     PRESENCE optional} |
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics     PRESENCE optional} ,
    ...
}

-- **************************************************************
--
-- Reset Request
--
-- **************************************************************

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

ResetRequest-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-Cause                       CRITICALITY ignore  TYPE Cause                     PRESENCE mandatory   },
    ...
}

-- **************************************************************
--
-- Reset Response
--
-- **************************************************************

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

ResetResponse-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-CriticalityDiagnostics  CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional },
    ...
}

-- **************************************************************
--
-- X2 SETUP REQUEST
--
-- **************************************************************

X2SetupRequest ::= SEQUENCE {
    protocolIEs                     ProtocolIE-Container       {{X2SetupRequest-IEs}},
    ...
}
```

```
X2SetupRequest-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-GlobalENB-ID                CRITICALITY reject  TYPE GlobalENB-ID              PRESENCE mandatory} |
    { ID id-ServedCells                     CRITICALITY reject  TYPE ServedCells           PRESENCE mandatory} |
    { ID id-GUGroupIDList                   CRITICALITY reject  TYPE GUGroupIDList         PRESENCE optional},
...
}



-- **************************************************************
--
-- X2 SETUP RESPONSE
--
-- **************************************************************

X2SetupResponse ::= SEQUENCE {
    protocolIEs                     ProtocolIE-Container       {{X2SetupResponse-IEs}},
    ...
}

X2SetupResponse-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-GlobalENB-ID                    CRITICALITY reject  TYPE GlobalENB-ID              PRESENCE mandatory} |
    { ID id-ServedCells                     CRITICALITY reject  TYPE ServedCells               PRESENCE mandatory} |
    { ID id-GUGroupIDList                   CRITICALITY reject  TYPE GUGroupIDList             PRESENCE optional}|
    { ID id-CriticalityDiagnostics          CRITICALITY ignore  TYPE CriticalityDiagnostics    PRESENCE optional },
    ...
}



-- **************************************************************
--
-- X2 SETUP FAILURE
--
-- **************************************************************

X2SetupFailure ::= SEQUENCE {
    protocolIEs                     ProtocolIE-Container       {{X2SetupFailure-IEs}},
    ...
}

X2SetupFailure-IEs X2AP-PROTOCOL-IES ::= {
    { 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 },

    ...
}



-- **************************************************************
--
-- LOAD INFORMATION
```

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

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

LoadInformation-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-CellInformation             CRITICALITY ignore  TYPE CellInformation-List       PRESENCE mandatory} ,
    ...
}

CellInformation-List        ::= SEQUENCE (SIZE (1..maxCellineNB)) OF ProtocolIE-Single-Container { {CellInformation-ItemIEs} }

CellInformation-ItemIEs X2AP-PROTOCOL-IES ::= {
    { ID id-CellInformation-Item    CRITICALITY ignore  TYPE CellInformation-Item   PRESENCE mandatory   }
}

CellInformation-Item ::= SEQUENCE {
    cell-ID                         ECGI,
    ul-InterferenceOverloadIndication       UL-InterferenceOverloadIndication                               OPTIONAL,
    ul-HighInterferenceIndicationInfo       UL-HighInterferenceIndicationInfo                               OPTIONAL,
    relativeNarrowbandTxPower               RelativeNarrowbandTxPower                                       OPTIONAL,
    iE-Extensions                           ProtocolExtensionContainer { {CellInformation-Item-ExtIEs} }   OPTIONAL,
    ...
}

CellInformation-Item-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

-- **************************************************************
--
-- ENB CONFIGURATION UPDATE
--
-- **************************************************************

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

ENBConfigurationUpdate-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-ServedCellsToAdd        CRITICALITY reject  TYPE ServedCells                PRESENCE optional} |
    { ID id-ServedCellsToModify     CRITICALITY reject  TYPE ServedCellsToModify        PRESENCE optional} |
    { ID id-ServedCellsToDelete     CRITICALITY reject  TYPE Old-ECGIs                  PRESENCE optional} |
    { ID id-GUGroupIDToAddList      CRITICALITY reject  TYPE GUGroupIDList              PRESENCE optional} |
    { ID id-GUGroupIDToDeleteList   CRITICALITY reject  TYPE GUGroupIDList              PRESENCE optional},
    ...
}

ServedCellsToModify::= SEQUENCE (SIZE (1..maxCellineNB)) OF ServedCellsToModify-Item
```

```
ServedCellsToModify-Item::= SEQUENCE {
    old-ecgi                        ECGI,
    servedCellInfo                  ServedCell-Information,
    neighbour-Info                  Neighbour-Information           OPTIONAL,
    iE-Extensions                   ProtocolExtensionContainer { { ServedCellsToModify-Item-ExtIEs} } OPTIONAL,
    ...
}

ServedCellsToModify-Item-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}


Old-ECGIs::= SEQUENCE (SIZE (1..maxCellineNB)) OF ECGI

-- **************************************************************
--
-- ENB CONFIGURATION UPDATE ACKNOWLEDGE
--
-- **************************************************************

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

ENBConfigurationUpdateAcknowledge-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional       },
...
}

-- **************************************************************
--
-- ENB CONFIGURATION UPDATE FAIURE
--
-- **************************************************************

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

ENBConfigurationUpdateFailure-IEs X2AP-PROTOCOL-IES ::= {
    { 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 },
    ...
}



-- **************************************************************
--
-- Resource Status Request
```

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

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

ResourceStatusRequest-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-ENB1-Measurement-ID     CRITICALITY reject  TYPE Measurement-ID                PRESENCE mandatory}|
    { ID id-ENB2-Measurement-ID     CRITICALITY ignore  TYPE Measurement-ID                PRESENCE conditional}|-- The IE shall be present if the
Registration Request IE is set to 'Stop'--
    { ID id-Registration-Request    CRITICALITY reject  TYPE Registration-Request          PRESENCE mandatory} |
    { ID id-ReportCharacteristics   CRITICALITY reject  TYPE ReportCharacteristics         PRESENCE optional} |
    { ID id-CellToReport            CRITICALITY ignore  TYPE CellToReport-List             PRESENCE mandatory} |
    { ID id-ReportingPeriodicity    CRITICALITY ignore  TYPE ReportingPeriodicity          PRESENCE optional} ,
    ...
}


CellToReport-List       ::= SEQUENCE (SIZE (1..maxCellineNB)) OF ProtocolIE-Single-Container { {CellToReport-ItemIEs} }

CellToReport-ItemIEs X2AP-PROTOCOL-IES ::= {
    { ID id-CellToReport-Item   CRITICALITY ignore  TYPE CellToReport-Item  PRESENCE mandatory  }
}

CellToReport-Item ::= SEQUENCE {
    cell-ID                             ECGI,
    iE-Extensions                       ProtocolExtensionContainer { {CellToReport-Item-ExtIEs} } OPTIONAL,
    ...
}

CellToReport-Item-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}


ReportingPeriodicity ::= ENUMERATED {
    one-thousand-ms,
    two-thousand-ms,
    five-thousand-ms,
    ten-thousand-ms,
...
}


-- **************************************************************
--
-- Resource Status Response
--
-- **************************************************************

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

```
    ...
}

ResourceStatusResponse-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-ENB1-Measurement-ID     CRITICALITY reject  TYPE Measurement-ID                 PRESENCE mandatory}|
    { ID id-ENB2-Measurement-ID     CRITICALITY reject  TYPE Measurement-ID                 PRESENCE mandatory}|
    { ID id-CriticalityDiagnostics  CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional },
    ...
}


-- **************************************************************
--
-- Resource Status Failure
--
-- **************************************************************

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

ResourceStatusFailure-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-ENB1-Measurement-ID     CRITICALITY reject  TYPE Measurement-ID                 PRESENCE mandatory}|
    { ID id-ENB2-Measurement-ID     CRITICALITY reject  TYPE Measurement-ID                 PRESENCE mandatory}|
    { ID id-Cause                   CRITICALITY ignore  TYPE Cause                          PRESENCE mandatory} |
    { ID id-CriticalityDiagnostics  CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional },
    ...
}


-- **************************************************************
--
-- Resource Status Update
--
-- **************************************************************

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

ResourceStatusUpdate-IEs X2AP-PROTOCOL-IES ::= {
    { ID id-ENB1-Measurement-ID     CRITICALITY reject  TYPE Measurement-ID                 PRESENCE mandatory}|
    { ID id-ENB2-Measurement-ID     CRITICALITY reject  TYPE Measurement-ID                 PRESENCE mandatory}|
    { ID id-CellMeasurementResult   CRITICALITY ignore  TYPE CellMeasurementResult-List     PRESENCE mandatory},
    ...
}

CellMeasurementResult-List      ::= SEQUENCE (SIZE (1..maxCellineNB)) OF ProtocolIE-Single-Container { {CellMeasurementResult-ItemIEs} }

CellMeasurementResult-ItemIEs X2AP-PROTOCOL-IES ::= {
    { ID id-CellMeasurementResult-Item  CRITICALITY ignore  TYPE CellMeasurementResult-Item     PRESENCE mandatory      }
}
```

```
CellMeasurementResult-Item ::= SEQUENCE {
    cell-ID                         ECGI,
    hWOverLoadIndicator             HWLoadIndicator                                                 OPTIONAL,
    s1TNLOverLoadIndicator          S1TNLLoadIndicator                                              OPTIONAL,
    radioresourceStatus             RadioResourceStatus                                             OPTIONAL,
    iE-Extensions                   ProtocolExtensionContainer { {CellMeasurementResult-Item-ExtIEs} }   OPTIONAL,
    ...
}

CellMeasurementResult-Item-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}


-- **************************************************************
--
-- PRIVATE MESSAGE
--
-- **************************************************************

PrivateMessage ::= SEQUENCE {
    privateIEs      PrivateIE-Container  {{PrivateMessage-IEs}},
    ...
}

PrivateMessage-IEs X2AP-PRIVATE-IES ::= {
    ...
}

END
```

9.3.5 Information Element definitions

```
-- **************************************************************
--
-- Information Element Definitions
--
-- **************************************************************

X2AP-IEs {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
eps-Access (21) modules (3) x2ap (2) version1 (1) x2ap-IEs (2) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS

    id-E-RAB-Item,

    maxnoofBearers, maxCellineNB,
```

```
    maxEARFCN,
    maxInterfaces,

    maxnoofBPLMNs,
    maxnoofCells,
    maxnoofEPLMNs,
    maxnoofEPLMNsPlusOne,
    maxnoofForbLACs,
    maxnoofForbTACs,
    maxnoofNeighbours,
    maxnoofPRBs,
    maxNrOfErrors,
    maxPools

FROM X2AP-Constants

    Criticality,
    ProcedureCode,
    ProtocolIE-ID,
    TriggeringMessage
FROM X2AP-CommonDataTypes

    ProtocolExtensionContainer{},
    ProtocolIE-Single-Container{},

    X2AP-PROTOCOL-EXTENSION,
    X2AP-PROTOCOL-IES
FROM X2AP-Containers;

-- A

AS-SecurityInformation ::= SEQUENCE {
    key-eNodeB-star     Key-eNodeB-Star,
    nextHopChainingCount            NextHopChainingCount,
    iE-Extensions                       ProtocolExtensionContainer { { AS-SecurityInformation-ExtIEs} } OPTIONAL,
    ...
}

AS-SecurityInformation-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}


AllocationAndRetentionPriority ::= SEQUENCE {
    priorityLevel               PriorityLevel,
    pre-emptionCapability       Pre-emptionCapability,
    pre-emptionVulnerability    Pre-emptionVulnerability,
    iE-Extensions               ProtocolExtensionContainer { {AllocationAndRetentionPriority-ExtIEs} } OPTIONAL,
    ...
}

AllocationAndRetentionPriority-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}
```

```
-- B


BitRate ::= INTEGER (0..10000000000)
BroadcastPLMNs-Item ::= SEQUENCE (SIZE(1..maxnoofBPLMNs)) OF PLMN-Identity


-- C

Cause ::= CHOICE {
    radioNetwork        CauseRadioNetwork,
    transport           CauseTransport,
    protocol            CauseProtocol,
    misc                CauseMisc,
    ...
}

CauseMisc ::= ENUMERATED {
    control-processing-overload,
    hardware-failure,
    om-intervention,
    not-enough-user-plane-processing-resources,
    unspecified,
    ...
}

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

CauseRadioNetwork ::= ENUMERATED {
    handover-desirable-for-radio-reasons,
    time-critical-handover,
    resource-optimisation-handover,
    reduce-load-in-serving-cell,
    partial-handover,
    unknown-new-eNB-UE-X2AP-ID,
    unknown-old-eNB-UE-X2AP-ID,
    unknown-pair-of-UE-X2AP-ID,
    ho-target-not-allowed,
    tx2relocoverall-expiry,
    trelocprep-expiry,
    cell-not-available,
    no-radio-resources-available-in-target-cell,
    invalid-MME-GroupID,
```

```
    unknown-MME-Code,
    encryption-and-or-integrity-protection-algorithms-not-supported,
    reportCharacteristicsEmpty,
    noReportPeriodicity,
    existingMeasurementID,
    unknown-eNB-Measurement-ID,
    measurement-temporarily-not-available,
    unspecified,
    ...

}

CauseTransport ::= ENUMERATED {
    transport-resource-unavailable,
    unspecified,
    ...
}

Cell-Size ::= ENUMERATED {verysmall, small, medium, large, ... }



CellType ::= SEQUENCE {
    cell-Size                       Cell-Size,
    iE-Extensions                   ProtocolExtensionContainer { { CellType-ExtIEs}}    OPTIONAL,
    ...
}

CellType-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}


COUNTvalue ::= SEQUENCE {
    pDCP-SN                 PDCP-SN,
    hFN                     HFN,
    iE-Extensions           ProtocolExtensionContainer { { COUNTvalue-ExtIEs} } OPTIONAL,
    ...
}

COUNTvalue-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}


CriticalityDiagnostics ::= SEQUENCE {
    procedureCode                   ProcedureCode                                                   OPTIONAL,
    triggeringMessage               TriggeringMessage                                               OPTIONAL,
    procedureCriticality            Criticality                                                     OPTIONAL,
    iEsCriticalityDiagnostics       CriticalityDiagnostics-IE-List                                  OPTIONAL,
    iE-Extensions                   ProtocolExtensionContainer { {CriticalityDiagnostics-ExtIEs} }      OPTIONAL,
    ...
}
```

```
CriticalityDiagnostics-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

CriticalityDiagnostics-IE-List ::= SEQUENCE (SIZE (1..maxNrOfErrors)) OF
    SEQUENCE {
        iECriticality           Criticality,
        iE-ID                   ProtocolIE-ID,
        typeOfError             TypeOfError,
        iE-Extensions           ProtocolExtensionContainer { {CriticalityDiagnostics-IE-List-ExtIEs} } OPTIONAL,
        ...
}

CriticalityDiagnostics-IE-List-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

CyclicPrefixDL ::= ENUMERATED {
    normal,
    extended,
    ...
}

CyclicPrefixUL ::= ENUMERATED {
    normal,
    extended,
    ...
}


-- D


DL-Forwarding ::= ENUMERATED {
    dL-forwardingProposed,
    ...
}

-- E

EARFCN ::= INTEGER (0..maxEARFCN)

FDD-Info ::= SEQUENCE {
    uL-EARFCN                       EARFCN,
    dL-EARFCN                       EARFCN,
    uL-Transmission-Bandwidth       Transmission-Bandwidth,
    dL-Transmission-Bandwidth       Transmission-Bandwidth,
    iE-Extensions               ProtocolExtensionContainer { {FDD-Info-ExtIEs} } OPTIONAL,
    ...
}

FDD-Info-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
```

```
}

TDD-Info ::= SEQUENCE {
    eARFCN                          EARFCN,
    transmission-Bandwidth          Transmission-Bandwidth,
    subframeAssignment              SubframeAssignment,
    specialSubframe-Info                SpecialSubframe-Info,
    iE-Extensions               ProtocolExtensionContainer { {TDD-Info-ExtIEs} } OPTIONAL,
    ...
}
TDD-Info-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

EUTRA-Mode-Info ::= CHOICE {
    fDD     FDD-Info,
    tDD     TDD-Info,
    ...
}

ECGI ::= SEQUENCE {
    pLMN-Identity               PLMN-Identity,
    eUTRANcellIdentifier        EUTRANCellIdentifier,
    iE-Extensions               ProtocolExtensionContainer { {ECGI-ExtIEs} } OPTIONAL,
    ...
}

ECGI-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

ENB-ID ::= CHOICE {
    macro-eNB-ID    BIT STRING (SIZE (20)),
    home-eNB-ID     BIT STRING (SIZE (28)),
    ...
}

EncryptionAlgorithms ::= BIT STRING (SIZE (16, ...))

EPLMNs ::= SEQUENCE (SIZE(1..maxnoofEPLMNs)) OF PLMN-Identity

E-RAB-ID ::= INTEGER (0..15, ...)

E-RAB-Level-QoS-Parameters ::= SEQUENCE {
    qCI                             QCI,
    allocationAndRetentionPriority  AllocationAndRetentionPriority,
    gbrQosInformation               GBR-QosInformation                                          OPTIONAL,
    iE-Extensions                   ProtocolExtensionContainer { { E-RAB-Level-QoS-Parameters-ExtIEs} }  OPTIONAL,
    ...
}

E-RAB-Level-QoS-Parameters-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}
```

```
E-RAB-List ::= SEQUENCE (SIZE(1.. maxnoofBearers)) OF ProtocolIE-Single-Container { {E-RAB-ItemIEs} }

E-RAB-ItemIEs   X2AP-PROTOCOL-IES ::= {
    { ID id-E-RAB-Item   CRITICALITY ignore     TYPE E-RAB-Item     PRESENCE mandatory },
    ...
}

E-RAB-Item ::= SEQUENCE {
    e-RAB-ID                E-RAB-ID,
    cause                       Cause,
    iE-Extensions               ProtocolExtensionContainer { {E-RAB-Item-ExtIEs} } OPTIONAL,
    ...
}

E-RAB-Item-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

EUTRANCellIdentifier ::= BIT STRING (SIZE (28))

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


EventType ::= ENUMERATED{
    change-of-serving-cell,
    ...
}


-- F

ForbiddenInterRATs ::= ENUMERATED {
    all,
    geran,
    utran,
    cdma2000,
    ...
}

ForbiddenTAs ::= SEQUENCE (SIZE(1.. maxnoofEPLMNsPlusOne)) OF ForbiddenTAs-Item

ForbiddenTAs-Item ::= SEQUENCE {
    pLMN-Identity       PLMN-Identity,
    forbiddenTACs       ForbiddenTACs,
    iE-Extensions       ProtocolExtensionContainer { {ForbiddenTAs-Item-ExtIEs} } OPTIONAL,
    ...
}

ForbiddenTAs-Item-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

ForbiddenTACs ::= SEQUENCE (SIZE(1..maxnoofForbTACs)) OF TAC
```

```
ForbiddenLAs ::= SEQUENCE (SIZE(1..maxnoofEPLMNsPlusOne)) OF ForbiddenLAs-Item

ForbiddenLAs-Item ::= SEQUENCE {
    pLMN-Identity       PLMN-Identity,
    forbiddenLACs       ForbiddenLACs,
    iE-Extensions       ProtocolExtensionContainer { {ForbiddenLAs-Item-ExtIEs} } OPTIONAL,
    ...
}

ForbiddenLAs-Item-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

ForbiddenLACs ::= SEQUENCE (SIZE(1..maxnoofForbLACs)) OF LAC



-- G

GBR-QosInformation ::= SEQUENCE {
    e-RAB-MaximumBitrateDL          BitRate,
    e-RAB-MaximumBitrateUL          BitRate,
    e-RAB-GuaranteedBitrateDL       BitRate,
    e-RAB-GuaranteedBitrateUL       BitRate,
    iE-Extensions                   ProtocolExtensionContainer { { GBR-QosInformation-ExtIEs} } OPTIONAL,
    ...
}

GBR-QosInformation-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

GlobalENB-ID ::= SEQUENCE {
    pLMN-Identity           PLMN-Identity,
    eNB-ID                  ENB-ID,
    iE-Extensions           ProtocolExtensionContainer { {GlobalENB-ID-ExtIEs} } OPTIONAL,
    ...
}

GlobalENB-ID-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}
GTPtunnelEndpoint ::= SEQUENCE {
    transportLayerAddress           TransportLayerAddress,
    gTP-TEID                        GTP-TEI,
    iE-Extensions                   ProtocolExtensionContainer { {GTPtunnelEndpoint-ExtIEs} } OPTIONAL,
    ...
}

GTPtunnelEndpoint-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}
```

```
GTP-TEI                 ::= OCTET STRING (SIZE (4))

GUGroupIDList       ::= SEQUENCE (SIZE (1..maxPools)) OF GU-Group-ID


GU-Group-ID         ::= SEQUENCE {
    pLMN-Identity       PLMN-Identity,
    mME-Group-ID        MME-Group-ID,
    iE-Extensions       ProtocolExtensionContainer { {GU-Group-ID-ExtIEs} } OPTIONAL,
    ...
}

GU-Group-ID-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}


GUMMEI          ::= SEQUENCE {

    gU-Group-ID     GU-Group-ID,
    mMME-Code           MME-Code,
    iE-Extensions                   ProtocolExtensionContainer { {GUMMEI-ExtIEs} } OPTIONAL,
    ...
}

GUMMEI-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}



-- H

HandoverRestrictionList ::= SEQUENCE {
    servingPLMN                 PLMN-Identity,
    equivalentPLMNs             EPLMNs                                                  OPTIONAL,
    forbiddenTAs                ForbiddenTAs                                            OPTIONAL,
    forbiddenLAs                ForbiddenLAs                                            OPTIONAL,
    forbiddenInterRATs          ForbiddenInterRATs                                      OPTIONAL,
    iE-Extensions               ProtocolExtensionContainer { {HandoverRestrictionList-ExtIEs} }   OPTIONAL,
    ...
}

HandoverRestrictionList-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

HFN ::= INTEGER (0..1048575)

HWLoadIndicator ::= SEQUENCE {
    dLHWLoadIndicator           LoadIndicator,
    uLHWLoadIndicator           LoadIndicator,
    iE-Extensions               ProtocolExtensionContainer { { HWLoadIndicator-ExtIEs} } OPTIONAL,
    ...
```

```
}

HWLoadIndicator-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}


-- I

IntegrityProtectionAlgorithms ::= BIT STRING (SIZE (16, ...))

InterfacesToTrace ::= BIT STRING (SIZE (8))
-- J
-- K


Key-eNodeB-Star  ::= BIT STRING (SIZE(256))

-- L


LAC                 ::= OCTET STRING (SIZE (2)) --(EXCEPT ('0000'H|'FFFE'H))

LastVisitedCell-Item ::= CHOICE {
    e-UTRAN-Cell                    LastVisitedEUTRANCellInformation,
    uTRAN-Cell                      LastVisitedUTRANCellInformation,
    gERAN-Cell                      LastVisitedGERANCellInformation,
    ...
}

LastVisitedEUTRANCellInformation ::= SEQUENCE {
    global-Cell-ID                  ECGI,
    cellType                        CellType,
    time-UE-StayedInCell            Time-UE-StayedInCell,
    iE-Extensions                   ProtocolExtensionContainer { { LastVisitedEUTRANCellInformation-ExtIEs} } OPTIONAL,
    ...
}

LastVisitedEUTRANCellInformation-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

LastVisitedUTRANCellInformation ::= OCTET STRING

LastVisitedGERANCellInformation ::= CHOICE {
    undefined                       NULL,
    ...
}


LoadIndicator ::= ENUMERATED {
    lowLoad,
    mediumLoad,
    highLoad,
```

```
    overLoad,
    ...
}



LocationReportingInformation ::= SEQUENCE {
    eventType       EventType,
    reportArea      ReportArea,
    iE-Extensions      ProtocolExtensionContainer { {LocationReportingInformation-ExtIEs} } OPTIONAL,
    ...
}

LocationReportingInformation-ExtIEs X2AP-PROTOCOL-EXTENSION ::={
    ...
}

-- M


MME-Group-ID    ::= OCTET STRING (SIZE (2))

MME-Code        ::= OCTET STRING (SIZE (1))

Measurement-ID  ::= INTEGER (1..4095, ...)

-- N

Neighbour-Information ::= SEQUENCE (SIZE (0..maxnoofNeighbours)) OF SEQUENCE {
    eCGI                        ECGI,
    pCI                     PCI,
    eARFCN                      EARFCN,
    iE-Extensions       ProtocolExtensionContainer { {Neighbour-Information-ExtIEs} } OPTIONAL,
    ...
}

Neighbour-Information-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

NextHopChainingCount ::= INTEGER (0..7)

-- O
-- P

PDCP-SN ::= INTEGER (0..4095)

PCI ::= INTEGER (0..503, ...)


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

Pre-emptionCapability ::= ENUMERATED {
    shall-not-trigger-pre-emption,
```

```
    may-trigger-pre-emption
}

Pre-emptionVulnerability ::= ENUMERATED {
    not-pre-emptable,
    pre-emptable
}

PriorityLevel               ::= INTEGER { spare (0), highest (1), lowest (14), no-priority (15) } (0..15)

-- Q

QCI ::= INTEGER (0..255)

-- R


ReceiveStatusofULPDCPSDUs ::= BIT STRING (SIZE(4096))

Registration-Request    ::= ENUMERATED {
    start,
    stop,
    ...
}

RelativeNarrowbandTxPower ::= SEQUENCE {

    rNTP-PerPRB                         BIT STRING (SIZE(6..110, ...)),
    rNTP-Threshold                      RNTP-Threshold,
    numberOfCellSpecificAntennaPorts    ENUMERATED {one, two, four, ...},
    p-B                                 INTEGER (0..3,...),
    pDCCH-InterferenceImpact            INTEGER (0..4,...),
    iE-Extensions                       ProtocolExtensionContainer { { RelativeNarrowbandTxPower-ExtIEs} } OPTIONAL,
    ...
}

RelativeNarrowbandTxPower-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

ReportArea ::= ENUMERATED{
    ecgi,
    ...
}

ReportCharacteristics   ::= BIT STRING (SIZE (32))

RNTP-Threshold ::= ENUMERATED {
    minusInfinity,
    minusEleven,
    minusTen,
    minusNine,
    minusEight,
    minusSeven,
```

```
    minusSix,
    minusFive,
    minusFour,
    minusThree,
    minusTwo,
    minusOne,
    zero,
    one,
    two,
    three,
    ...
}

RRC-Context ::= OCTET STRING


RadioResourceStatus ::= SEQUENCE {
    dL-GBR-PRB-usage                    DL-GBR-PRB-usage,
    uL-GBR-PRB-usage                    UL-GBR-PRB-usage,
    dL-non-GBR-PRB-usage                DL-non-GBR-PRB-usage,
    uL-non-GBR-PRB-usage                UL-non-GBR-PRB-usage,
    dL-Total-PRB-usage                  DL-Total-PRB-usage,
    uL-Total-PRB-usage                  UL-Total-PRB-usage,
    iE-Extensions                       ProtocolExtensionContainer { {RadioResourceStatus-ExtIEs} } OPTIONAL,
    ...
}

RadioResourceStatus-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

DL-GBR-PRB-usage::= INTEGER (0..100)

UL-GBR-PRB-usage::= INTEGER (0..100)

DL-non-GBR-PRB-usage::= INTEGER (0..100)

UL-non-GBR-PRB-usage::= INTEGER (0..100)

DL-Total-PRB-usage::= INTEGER (0..100)

UL-Total-PRB-usage::= INTEGER (0..100)


-- S

S1TNLLoadIndicator ::= SEQUENCE {
    dLS1TNLLoadIndicator            LoadIndicator,
    uLS1TNLLoadIndicator            LoadIndicator,
    iE-Extensions                   ProtocolExtensionContainer { { S1TNLLoadIndicator-ExtIEs} } OPTIONAL,
    ...
}

S1TNLLoadIndicator-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
```

```
    ...
}



ServedCells ::= SEQUENCE (SIZE (1.. maxCellineNB)) OF SEQUENCE {
    servedCellInfo                  ServedCell-Information,
    neighbour-Info                  Neighbour-Information           OPTIONAL,
    iE-Extensions                   ProtocolExtensionContainer { {ServedCell-ExtIEs} } OPTIONAL,
    ...
}

ServedCell-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

ServedCell-Information ::= SEQUENCE {
    pCI                 PCI,
    cellId              ECGI,
    tAC                 TAC,
    broadcastPLMNs      BroadcastPLMNs-Item,
    eUTRA-Mode-Info     EUTRA-Mode-Info,
    iE-Extensions       ProtocolExtensionContainer { {ServedCell-Information-ExtIEs} } OPTIONAL,
    ...
}

ServedCell-Information-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

SRVCCOperationPossible ::= ENUMERATED {
    possible,
    ...
}

SubframeAssignment ::= ENUMERATED {
    sa0,
    sa1,
    sa2,
    sa3,
    sa4,
    sa5,
    sa6,
    ...
}

SpecialSubframe-Info ::=        SEQUENCE {
    specialSubframePatterns     SpecialSubframePatterns,
    cyclicPrefixDL              CyclicPrefixDL,
    cyclicPrefixUL              CyclicPrefixUL,
    iE-Extensions               ProtocolExtensionContainer { { SpecialSubframe-Info-ExtIEs} } OPTIONAL,
    ...
}
```

```
SpecialSubframe-Info-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}


SpecialSubframePatterns ::= ENUMERATED {
    ssp0,
    ssp1,
    ssp2,
    ssp3,
    ssp4,
    ssp5,
    ssp6,
    ssp7,
    ssp8,
    ...
}

SubscriberProfileIDforRFP ::= INTEGER (1..256)


-- T

TAC ::= OCTET STRING (SIZE (2))

TargeteNBtoSource-eNBTransparentContainer   ::= OCTET STRING


TimeToWait ::= ENUMERATED {
    v1s,
    v2s,
    v5s,
    v10s,
    v20s,
    v60s,
    ...
}

Time-UE-StayedInCell ::= INTEGER (0..4095)


TraceActivation ::= SEQUENCE {
    eUTRANTraceID                   EUTRANTraceID,
    interfacesToTrace               InterfacesToTrace,
    traceDepth                      TraceDepth,
    traceCollectionEntityIPAddress  TraceCollectionEntityIPAddress,
    iE-Extensions                   ProtocolExtensionContainer { {TraceActivation-ExtIEs} } OPTIONAL,
    ...
}

TraceActivation-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}
```

```
TraceCollectionEntityIPAddress ::= BIT STRING (SIZE(1..160, ...))

TraceDepth      ::= ENUMERATED {
    minimum,
    medium,
    maximum,
    minimumWithoutVendorSpecificExtension,
    mediumWithoutVendorSpecificExtension,
    maximumWithoutVendorSpecificExtension,
    ...
}



Transmission-Bandwidth ::= ENUMERATED {
        bw6,
        bw15,
        bw25,
        bw50,
        bw75,
        bw100,
        ...
}

TransportLayerAddress           ::= BIT STRING (SIZE(1..160, ...))

TypeOfError ::= ENUMERATED {
    not-understood,
    missing,
    ...
}


-- U

UE-HistoryInformation ::= SEQUENCE (SIZE(1..maxnoofCells)) OF LastVisitedCell-Item


UE-S1AP-ID                  ::= INTEGER (0.. 4294967295)

UE-X2AP-ID                  ::= INTEGER (0..4095) -- Value FFS

UEAggregateMaximumBitRate ::= SEQUENCE {
    uEaggregateMaximumBitRateDownlink   BitRate,
    uEaggregateMaximumBitRateUplink     BitRate,
    iE-Extensions                       ProtocolExtensionContainer { {UEAggregate-MaximumBitrate-ExtIEs} } OPTIONAL,
    ...
}

UEAggregate-MaximumBitrate-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}
```

```
UESecurityCapabilities ::= SEQUENCE {
    encryptionAlgorithms                EncryptionAlgorithms,
    integrityProtectionAlgorithms       IntegrityProtectionAlgorithms,
    iE-Extensions                       ProtocolExtensionContainer { { UESecurityCapabilities-ExtIEs} }         OPTIONAL,
...
}

UESecurityCapabilities-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}

UL-InterferenceOverloadIndication ::= SEQUENCE (SIZE(1..maxnoofPRBs)) OF UL-InterferenceOverloadIndication-Item

UL-InterferenceOverloadIndication-Item ::= ENUMERATED {
    high-interference,
    medium-interference,
    low-interference,
    ...
}

UL-HighInterferenceIndicationInfo ::= SEQUENCE (SIZE(1..maxCellineNB)) OF UL-HighInterferenceIndicationInfo-Item

UL-HighInterferenceIndicationInfo-Item ::= SEQUENCE {
    target-Cell-ID                  ECGI,
    ul-interferenceindication       UL-HighInterferenceIndication,
    iE-Extensions                   ProtocolExtensionContainer { { UL-HighInterferenceIndicationInfo-Item-ExtIEs} } OPTIONAL,
    ...
}

UL-HighInterferenceIndicationInfo-Item-ExtIEs X2AP-PROTOCOL-EXTENSION ::= {
    ...
}


UL-HighInterferenceIndication ::= BIT STRING (SIZE(1..110, ...))


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

END
```

9.3.6 Common definitions

```
-- **************************************************************
--
-- Common definitions
--
-- **************************************************************
```

```
X2AP-CommonDataTypes {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
eps-Access (21) modules (3) x2ap (2) version1 (1) x2ap-CommonDataTypes (3)  }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

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

maxPrivateIEs                                   INTEGER ::= 65535
maxProtocolExtensions                           INTEGER ::= 65535
maxProtocolIEs                                  INTEGER ::= 65535

-- ************************************************************
--
-- Common Data Types
--
-- ************************************************************

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

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

PrivateIE-ID    ::= CHOICE {
    local               INTEGER (0.. maxPrivateIEs),
    global              OBJECT IDENTIFIER
}

ProcedureCode       ::= INTEGER (0..255)


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


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

END
```

9.3.7 Constant definitions

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

X2AP-Constants {
```

```
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
eps-Access (21) modules (3) x2ap (2) version1 (1) x2ap-Constants (4) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS
    ProcedureCode,
    ProtocolIE-ID
FROM X2AP-CommonDataTypes;

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

id-handoverPreparation                                  ProcedureCode ::= 0
id-handoverCancel                                       ProcedureCode ::= 1
id-loadIndication                                       ProcedureCode ::= 2
id-errorIndication                                      ProcedureCode ::= 3
id-snStatusTransfer                                     ProcedureCode ::= 4
id-uEContextRelease                                     ProcedureCode ::= 5
id-x2Setup                                              ProcedureCode ::= 6
id-reset                                                ProcedureCode ::= 7
id-eNBConfigurationUpdate                               ProcedureCode ::= 8
id-resourceStatusReportingInitiation                    ProcedureCode ::= 9
id-resourceStatusReporting                              ProcedureCode ::= 10
id-privateMessage                                       ProcedureCode ::= 11



-- ************************************************************
--
-- Lists
--
-- ************************************************************

maxEARFCN                               INTEGER ::= 65535
maxInterfaces                           INTEGER ::= 16
maxCellineNB                            INTEGER ::= 256
maxnoofBearers                          INTEGER ::= 256
maxNrOfErrors                           INTEGER ::= 256
maxnoofPDCP-SN                          INTEGER ::= 16      -- FFS Value to be checked
maxnoofEPLMNs                           INTEGER ::= 15
maxnoofEPLMNsPlusOne                    INTEGER ::= 16
maxnoofForbLACs                         INTEGER ::= 4096
maxnoofForbTACs                         INTEGER ::= 4096
maxnoofBPLMNs                           INTEGER ::= 6
maxnoofNeighbours                       INTEGER ::= 512
maxnoofPRBs                             INTEGER ::= 110
maxPools                                INTEGER ::= 16      -- FFS Value to be checked
```

```
maxnoofCells                                INTEGER ::= 16



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

id-E-RABs-Admitted-Item                                                 ProtocolIE-ID ::= 0
id-E-RABs-Admitted-List                                                 ProtocolIE-ID ::= 1
id-E-RAB-Item                                                           ProtocolIE-ID ::= 2
id-E-RABs-NotAdmitted-List                                              ProtocolIE-ID ::= 3
id-E-RABs-ToBeSetup-Item                                                ProtocolIE-ID ::= 4
id-Cause                                                                ProtocolIE-ID ::= 5
id-CellInformation                                                      ProtocolIE-ID ::= 6
id-CellInformation-Item                                                 ProtocolIE-ID ::= 7
id-New-eNB-UE-X2AP-ID                                                   ProtocolIE-ID ::= 9
id-Old-eNB-UE-X2AP-ID                                                   ProtocolIE-ID ::= 10
id-TargetCell-ID                                                        ProtocolIE-ID ::= 11
id-TargeteNBtoSource-eNBTransparentContainer                            ProtocolIE-ID ::= 12
id-TraceActivation                                                      ProtocolIE-ID ::= 13
id-UE-ContextInformation                                                ProtocolIE-ID ::= 14
id-UE-HistoryInformation                                                ProtocolIE-ID ::= 15
id-UE-X2AP-ID                                                           ProtocolIE-ID ::= 16
id-CriticalityDiagnostics                                               ProtocolIE-ID ::= 17
id-E-RABs-SubjectToStatusTransfer-List                                  ProtocolIE-ID ::= 18
id-E-RABs-SubjectToStatusTransfer-Item                                  ProtocolIE-ID ::= 19
id-ServedCells                                                          ProtocolIE-ID ::= 20
id-GlobalENB-ID                                                         ProtocolIE-ID ::= 21
id-TimeToWait                                                           ProtocolIE-ID ::= 22
id-GUMMEI-ID                                                            ProtocolIE-ID ::= 23
id-GUGroupIDList                                                        ProtocolIE-ID ::= 24
id-ServedCellsToAdd                                                     ProtocolIE-ID ::= 25
id-ServedCellsToModify                                                  ProtocolIE-ID ::= 26
id-ServedCellsToDelete                                                  ProtocolIE-ID ::= 27
id-Registration-Request                                                 ProtocolIE-ID ::= 28
id-CellToReport                                                         ProtocolIE-ID ::= 29
id-ReportingPeriodicity                                                 ProtocolIE-ID ::= 30
id-CellToReport-Item                                                    ProtocolIE-ID ::= 31
id-CellMeasurementResult                                                ProtocolIE-ID ::= 32
id-CellMeasurementResult-Item                                           ProtocolIE-ID ::= 33
id-GUGroupIDToAddList                                                   ProtocolIE-ID ::= 34
id-GUGroupIDToDeleteList                                                ProtocolIE-ID ::= 35
id-SRVCCOperationPossible                                               ProtocolIE-ID ::= 36
id-Measurement-ID                                                       ProtocolIE-ID ::= 37
id-ReportCharacteristics                                                ProtocolIE-ID ::= 38
id-ENB1-Measurement-ID                                                  ProtocolIE-ID ::= 39
id-ENB2-Measurement-ID                                                  ProtocolIE-ID ::= 40
```

```
END
```

9.3.8 Container definitions

```
-- **************************************************************
--
-- Container definitions
--
-- **************************************************************

X2AP-Containers {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
eps-Access (21) modules (3) x2ap (2) version1 (1) x2ap-Containers (5)  }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

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

IMPORTS
    maxPrivateIEs,
    maxProtocolExtensions,
    maxProtocolIEs,
    Criticality,
    Presence,
    PrivateIE-ID,
    ProtocolIE-ID
FROM X2AP-CommonDataTypes;

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

X2AP-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
--
-- ********************************************************************

X2AP-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
}

-- ********************************************************************
--
-- Class Definition for Protocol Extensions
--
-- ********************************************************************

X2AP-PROTOCOL-EXTENSION ::= CLASS {
    &id                 ProtocolIE-ID       UNIQUE,
    &criticality        Criticality,
    &Extension,
    &presence           Presence
}
WITH SYNTAX {
    ID                  &id
    CRITICALITY         &criticality
    EXTENSION           &Extension
    PRESENCE            &presence
}

-- ********************************************************************
--
-- Class Definition for Private IEs
--
-- ********************************************************************

X2AP-PRIVATE-IES ::= CLASS {
    &id                 PrivateIE-ID,
    &criticality        Criticality,
    &Value,
    &presence           Presence
}
```

```
WITH SYNTAX {
    ID                  &id
    CRITICALITY         &criticality
    TYPE                &Value
    PRESENCE            &presence
}

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

ProtocolIE-Container {X2AP-PROTOCOL-IES : IEsSetParam} ::=
    SEQUENCE (SIZE (0..maxProtocolIEs)) OF
    ProtocolIE-Field {{IEsSetParam}}

ProtocolIE-Single-Container {X2AP-PROTOCOL-IES : IEsSetParam} ::=
    ProtocolIE-Field {{IEsSetParam}}

ProtocolIE-Field {X2AP-PROTOCOL-IES : IEsSetParam} ::= SEQUENCE {
    id              X2AP-PROTOCOL-IES.&id                   ({IEsSetParam}),
    criticality     X2AP-PROTOCOL-IES.&criticality          ({IEsSetParam}{@id}),
    value           X2AP-PROTOCOL-IES.&Value                ({IEsSetParam}{@id})
}

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

ProtocolIE-ContainerPair {X2AP-PROTOCOL-IES-PAIR : IEsSetParam} ::=
    SEQUENCE (SIZE (0..maxProtocolIEs)) OF
    ProtocolIE-FieldPair {{IEsSetParam}}

ProtocolIE-FieldPair {X2AP-PROTOCOL-IES-PAIR : IEsSetParam} ::= SEQUENCE {
    id                  X2AP-PROTOCOL-IES-PAIR.&id                  ({IEsSetParam}),
    firstCriticality    X2AP-PROTOCOL-IES-PAIR.&firstCriticality    ({IEsSetParam}{@id}),
    firstValue          X2AP-PROTOCOL-IES-PAIR.&FirstValue          ({IEsSetParam}{@id}),
    secondCriticality   X2AP-PROTOCOL-IES-PAIR.&secondCriticality   ({IEsSetParam}{@id}),
    secondValue         X2AP-PROTOCOL-IES-PAIR.&SecondValue         ({IEsSetParam}{@id})
}

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

ProtocolIE-ContainerList {INTEGER : lowerBound, INTEGER : upperBound, X2AP-PROTOCOL-IES : IEsSetParam} ::=
    SEQUENCE (SIZE (lowerBound..upperBound)) OF
    ProtocolIE-Container {{IEsSetParam}}
```

```
ProtocolIE-ContainerPairList {INTEGER : lowerBound, INTEGER : upperBound, X2AP-PROTOCOL-IES-PAIR : IEsSetParam} ::=
    SEQUENCE (SIZE (lowerBound..upperBound)) OF
    ProtocolIE-ContainerPair {{IEsSetParam}}

-- ************************************************************
--
-- Container for Protocol Extensions
--
-- ************************************************************

ProtocolExtensionContainer {X2AP-PROTOCOL-EXTENSION : ExtensionSetParam} ::=
    SEQUENCE (SIZE (1..maxProtocolExtensions)) OF
    ProtocolExtensionField {{ExtensionSetParam}}

ProtocolExtensionField {X2AP-PROTOCOL-EXTENSION : ExtensionSetParam} ::= SEQUENCE {
    id                  X2AP-PROTOCOL-EXTENSION.&id             ({ExtensionSetParam}),
    criticality         X2AP-PROTOCOL-EXTENSION.&criticality    ({ExtensionSetParam}{@id}),
    extensionValue      X2AP-PROTOCOL-EXTENSION.&Extension      ({ExtensionSetParam}{@id})
}

-- ************************************************************
--
-- Container for Private IEs
--
-- ************************************************************

PrivateIE-Container {X2AP-PRIVATE-IES : IEsSetParam} ::=
    SEQUENCE (SIZE (1..maxPrivateIEs)) OF
    PrivateIE-Field {{IEsSetParam}}

PrivateIE-Field {X2AP-PRIVATE-IES : IEsSetParam} ::= SEQUENCE {
    id              X2AP-PRIVATE-IES.&id            ({IEsSetParam}),
    criticality     X2AP-PRIVATE-IES.&criticality   ({IEsSetParam}{@id}),
    value           X2AP-PRIVATE-IES.&Value         ({IEsSetParam}{@id})
}

END
```

9.4 Message transfer syntax

X2AP shall use the ASN.1 Basic Packed Encoding Rules (BASIC-PER) Aligned Variant as transfer syntax as specified in ref. [5].

9.5 Timers

$T_{RELOCprep}$

- Specifies the maximum time for the Handover Preparation procedure in the source eNB.

$TX2_{RELOCoverall}$

- Specifies the maximum time for the protection of the overall handover procedure in the source eNB.

10 Handling of unknown, unforeseen and erroneous protocol data

Section 10 of [4] is applicable for the purposes of the present document.

Annex A (informative): Change History

TSG #	TSG Doc.	CR	Rev	Subject/Comment	New
38				Approved at TSG-RAN and placed under change control	8.0.0
39	RP-080081	0041		RAN3 agreed changes for TS 36.423	8.1.0
40	RP-080305	0042	1	RAN3 agreed changes for TS 36.423	8.2.0
41	RP-080585	0144		changes to TS36.423 agreed in RAN3#61	8.3.0
42	RP-080847	0207		changes to TS36.423 agreed in RAN3#62	8.4.0
43	RP-090083	0209		Adding extension container in SEQUENCE type for forward compatibility	8.5.0
43	RP-090246	0213	1	Consistency in procedure text for retransmission of request messages	8.5.0
43	RP-090091	0216	2	Modification to ENB CONFIGURATION UPDATE message	8.5.0
43	RP-090083	0218		Modification of RRC context indexing	8.5.0
43	RP-090087	0221	1	Corrections on FDD and TDD elements	8.5.0
43	RP-090087	0225	1	X2AP Review on SN Status Transfer procedure	8.5.0
43	RP-090089	0227	1	Definition on parameters related to a trace activation	8.5.0
43	RP-090087	0228	1	X2AP Review: X2 Handover Cancel procedure	8.5.0
43	RP-090085	0231	1	Abnormal condition related to UE Security Capabilities	8.5.0
43	RP-090245	0233		Corrections following review of X2 AP	8.5.0
43	RP-090086	0235	1	Clarification on Load Indication	8.5.0
43	RP-090086	0237	1	X2 Security Clean up	8.5.0
43	RP-090245	0238		X2 handover Clean up	8.5.0
43	RP-090246	0239	1	UE Context Release word changes in Procedures section	8.5.0
43	RP-090246	0242	1	Criticality corrections in 36.423	8.5.0
43	RP-090091	0243	5	Load Balancing Information Exchange	8.5.0
43	RP-090087	0244		Clarifications on access control at handover	8.5.0
43	RP-090087	0245		Support blocking 3GPP2 handover	8.5.0
43	RP-090086	0246	1	Corrections for the procedure concurrency	8.5.0
43	RP-090089	0247		Alignment of QCI range	8.5.0
43	RP-090090	0248	1	Rename Trace Reference	8.5.0
43	RP-090261	0249		Coding of UE History in X2AP	8.5.0

History

Document history		
V8.2.0	November 2008	Publication
V8.3.0	November 2008	Publication
V8.4.0	January 2009	Publication
V8.5.0	April 2009	Publication