ETSI TS 136 413 V8.4.0 (2009-01)

Technical Specification

LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA) ;
S1 Application Protocol (S1AP)
(3GPP TS 36.413 version 8.4.0 Release 8)

Reference
RTS/TSGR-0336413v840

Keywords
LTE

ETSI

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Sous-Préfecture de Grasse (06) N° 7803/88

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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 E-UTRAN radio network layer signalling protocol for the S1 interface. The S1 Application Protocol (S1AP) supports the functions of S1 interface by signalling procedures defined in this document. S1AP 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: 'E-UTRAN Architecture Description'.

[3] 3GPP TS 36.410: 'S1 General Aspects and Principles'.

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

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

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

[7] 3GPP TS 32.421: "Trace concepts and requirements".

[8] 3GPP TS 23.402: "Architecture enhancements for non-3GPP accesses".

[9] 3GPP TS 23.216: "Single Radio Voice Call Continuity (SRVCC)".

[10] 3GPP TS 32.422: "Trace control and configuration management".

[11] 3GPP TS 23.401: "General Packet Radio Service (GPRS) enhancements for E-UTRAN access".

[12] 3GPP TS 36.414: 'Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 data transport'.

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

[14] 3GPP TS 36.300: 'Evolved Universal Terrestrial Radio Access (E-UTRA), Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; stage 2'.

[15] 3GPP TS 33.401: 'Security architecture'.

[16] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRAN); Radio Resource Control (RRC) Protocol Specification".

[17] 3GPP TS 23.272: "Circuit Switched Fallback in Evolved Packet System; stage 2".

[18] 3GPP TS 48.018: "General Packet Radio Service (GPRS); BSS GPRS Protocol (BSSGP)".

[19] 3GPP TS 25.413: "UTRAN Iu interface RANAP signalling"

[20] 3GPP TS 36.304: 'Evolved Universal Terrestrial Radio Access (E-UTRA), User Equipment (UE) procedures in idle mode'.

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

CSG Cell: an E-UTRAN cell broadcasting a CSG Identifier.

Elementary Procedure: S1AP consists of Elementary Procedures (EPs). An Elementary Procedure is a unit of interaction between eNBs and the EPC. These Elementary Procedures are defined separately and are intended to be used to build up complete sequences in a flexible manner. If the independence between some EPs is restricted, it is described under the relevant EP description. Unless otherwise stated by the restrictions, the EPs may be invoked independently of each other as stand alone procedures, which can be active in parallel. Examples on using several S1AP EPs together with each other and EPs from other interfaces can be found in reference [FFS].

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 and/or failure).
- **Class 2:** Elementary Procedures without response.

For Class 1 EPs, the types of responses can be as follows:

Successful:

- A signalling message explicitly indicates that the elementary procedure successfully completed with the receipt of the response.

Unsuccessful:

- A signalling message explicitly indicates that the EP failed.
- On time supervision expiry (i.e. absence of expected response).

Successful and Unsuccessful:

- One signalling message reports both successful and unsuccessful outcome for the different included requests. The response message used is the one defined for successful outcome.

Class 2 EPs are considered always successful.

eNB UE S1AP ID: according to definition in 23.401.

[Note (to be removed once captured in another TS): The eNB UE S1AP ID shall be allocated so as to uniquely identify the UE over the S1 interface within the eNB. When MME receives eNB UE S1AP ID it shall store it for the duration of the UE-associated logical S1-connection for this UE. Once known to MME his IE is included in all UE associated S1-AP signalling (UL as well as DL).]

MME UE S1AP ID: according to definition in 23.401.

[Note (to be removed once captured in another TS): The MME UE S1AP ID shall be allocated so as to uniquely identify the UE over the S1 interface within the MME. When eNB receives MME UE S1AP ID it shall store it for the duration of the UE-associated logical S1-connection for this UE. Once known to eNB this IE is included in all UE associated S1-AP signalling (UL as well as DL).]

E-RAB: as defined in [2].

Note: The E-RAB is either a default E-RAB or a dedicated E-RAB.

E-RAB identity: the E-RABidentity uniquely identifies an E-RABfor one UE.

Note: The E-RAB identity remains unique for the UE even if the UE-associated logical S1-connection is released during periods of user inactivity.

Data Radio Bearer: the Data Radio bearer transports the packets of an E-RAB between a UE and an eNB. There is an one-to-one mapping between the E-RAB and the Data Radio Bearer.

UE-associated signalling: When S1-AP messages associated to one UE uses the UE-associated logical S1-connection for association of the message to the UE in eNB and EPC.

UE-associated logical S1-connection: The UE-associated logical S1-connection uses the identities *MME UE S1AP ID* and *eNB UE S1AP ID* according to definition in [23.401]. For a received UE associated S1-AP message the MME identifies the associated UE based on the MME UE S1AP ID IE and the eNB identifies the associated UE based on the *eNB UE S1AP ID* IE. The UE-associated logical S1-connection may exist before the S1 UE context is setup in eNB.

3.2 Symbols

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3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

CDMA	Code Division Multiple Access
CS	Circuit Switched
CSG	Closed Subscriber Group
CN	Core Network
DL	Downlink
ECGI	E-UTRAN Cell Global Identifier
E-RAB	E-UTRAN Radio Access Bearer
eNB	E-UTRAN NodeB
EP	Elementary Procedure
EPC	Evolved Packet Core
E-UTRAN	Evolved UTRAN
GBR	Guaranteed Bit Rate
GUMMEI	Globally Unique MME Identifier
GTP	GTP Tunneling Protocol
HFN	Hyper Frame Number
HRPD	High Rate Packet Data
IE	Information Element
MME	Mobility Management Entity
NAS	Non Access Stratum
PS	Packet Switched
PDCP	Packet Data Convergence Protocol
PLMN	Public Land Mobile Network
PS	Packet Switched
RRC	Radio Resource Control
RIM	RAN Information Management
SN	Sequence Number
S-TMSI	S-Temporary Mobile Subscriber Identity
TAI	Tracking Area Identity
TEID	Tunnel Endpoint Identifier
UE	User Equipment
UE-AMBR	UE-Aggregate Maximum Bitrate
UL	Uplink

4 General

Editor"s Note: Section captures procedure specification principles, forward/backward compatibility issue and specification notations.

4.1 Procedure Specification Principles

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

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

- The procedure text discriminates between:

  1) Functionality which "shall" be executed

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

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

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

- Any required inclusion of an optional IE in a response message is explicitly indicated in the procedure text. If the procedure text does not explicitly indicate that an optional IE shall be included in a response message, the optional IE shall not be included. For requirements on including *Criticality Diagnostics* IE, see section 10. For examples on how to use the *Criticality Diagnostics* IE, see Annex A.2.

4.2 Forwards and Backwards Compatibility

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

4.3 Specification Notations

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

Procedure	When referring to an elementary procedure in the specification the Procedure Name is written with the first letters in each word in upper case characters followed by the word "procedure", e.g. E-RAB 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. MESSAGE NAME 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. *Information Element* 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 subclause 9.2 enclosed by quotation marks, e.g. "Value".

5 S1AP Services

S1AP provides the signalling service between E-UTRAN and the evolved packet core (EPC) that is required to fulfil the S1AP functions described in clause 7. S1AP services are divided into two groups:

1. Non UE-associated services: They are related to the whole S1 interface instance between the eNB and MME utilising a non UE-associated signalling connection.

2. UE-associated services: They are related to one UE. S1AP functions that provide these services are associated with a UE-associated signalling connection that is maintained for the UE in question.

6 Services Expected from Signalling Transport

The signalling connection shall provide in sequence delivery of S1AP messages. S1AP shall be notified if the signalling connection breaks.

7 Functions of S1AP

Editor"s Note: Description of S1AP functions.

S1AP protocol has the following functions:

- E-RAB management function: This overall functionality is responsible for setting up, modifying and releasing E-RABs, which are triggered by the MME The release of E-RABs may be triggered by the eNB as well.
- Initial Context Transfer function: This functionality is used to establish an S1UE context in the eNB, to setup the default IP connectivity, to setup one or more E-RAB(s) if requested by the MME, and to transfer NAS signalling related information to the eNB if needed.
- UE Capability Info Indication function: This functionality is used to provide the UE Capability Info when received from the UE to the MME.
- Mobility Functions for UEs in LTE_ACTIVE in order to enable
  - a change of eNBs within SAE/LTE (Inter MME/Serving SAE-GW Handovers) via the S1 interface (with EPC involvement).
  - a change of RAN nodes between different RATs (Inter-3GPP-RAT Handovers) via the S1 interface (with EPC involvement).
- Paging: This functionality provides the EPC the capability to page the UE.
- S1 interface management functions comprise the:
  - Reset functionality to ensure a well defined initialisation on the S1 interface.
  - Error Indication functionality to allow a proper error reporting/handling in cases where no failure messages are defined.
  - Overload function to indicate the load situation in the control plane of the S1 interface.
  - Load balancing function to ensure equally loaded MMEs within an MME pool area
  - S1 Setup functionality for initial S1 interface setup for providing configuration information
  - eNB and MME Configuration Update functions are to update application level configuration data needed for the eNB and MME to interoperate correctly on the S1 interface.
- NAS Signalling transport function between the UE and the MME is used:
  - to transfer NAS signalling related information and to establish the S1 UE context in the eNB.
  - to transfer NAS signalling related information when the S1 UE context in the eNB is already established.
- S1 UE context Release function: This functionality is responsible to manage the release of UE specific context in the eNB and the MME.
- UE Context Modification function: This functionality allows to modify the established UE Context partly.
- Status Transfer: This functionality transfers PDCP SN Status information from source eNB to target eNB in support of in-sequence delivery and duplication avoidance for intra LTE handover.
- Trace function: This functionality is to control a trace recording for a UE in ECM_CONNECTED.
- Location Reporting: This functionality allows MME to be aware of the UE"s current location.
- S1 CDMA2000 Tunneling function: This functionality is to carry CDMA2000 signalling between UE and CDMA2000 RAT over the S1 Interface.
- Warning message transmission function:
  This functionality provides the means to start and overwrite the broadcasting of warning message.

8 S1AP Procedures

8.1 List of S1AP Elementary procedures

In the following tables, all EPs are divided into Class 1 and Class 2 EPs (see subclause 3.1 for explanation of the different classes):

Table 1: Class 1 procedures

Elementary Procedure	Initiating Message	Successful Outcome	Unsuccessful Outcome
		Response message	Response message
Handover Preparation	HANDOVER REQUIRED	HANDOVER COMMAND	HANDOVER PREPARATION FAILURE
Handover Resource Allocation	HANDOVER REQUEST	HANDOVER REQUEST ACKNOWLEDGE	HANDOVER FAILURE
Path Switch Request	PATH SWITCH REQUEST	PATH SWITCH REQUEST ACKNOWLEDGE	PATH SWITCH REQUEST FAILURE
Handover Cancellation	HANDOVER CANCEL	HANDOVER CANCEL ACKNOWLEDGE	
E-RAB Setup	E-RAB SETUP REQUEST	E-RAB SETUP RESPONSE	
E-RAB Modify	E-RAB MODIFY REQUEST	E-RAB MODIFY RESPONSE	
E-RAB Release	E-RAB RELEASE COMMAND	E-RAB RELEASE RESPONSE	
Initial Context Setup	INITIAL CONTEXT SETUP REQUEST	INITIAL CONTEXT SETUP RESPONSE	INITIAL CONTEXT SETUP FAILURE
Reset	RESET	RESET ACKNOWLEDGE	
S1 Setup	S1 SETUP REQUEST	S1 SETUP RESPONSE	S1 SETUP FAILURE
UE Context Release	UE CONTEXT RELEASE COMMAND	UE CONTEXT RELEASE COMPLETE	
UE Context Modification	UE CONTEXT MODIFICATION REQUEST	UE CONTEXT MODIFICATION RESPONSE	UE CONTEXT MODIFICATION FAILURE
eNB Configuration Update	ENB CONFIGURATION UPDATE	ENB UPDATE CONFIGURATION ACKNOWLEDGE	ENB CONFIGURATION UPDATE FAILURE
MME Configuration Update	MME CONFIGURATION UPDATE	MME CONFIGURAION UPDATE ACKNOWLEDGE	MME CONFIGURATION UPDATE FAILURE
Write-Replace Warning	WRITE-REPLACE WARNING REQUEST	WRITE-REPLACE WARNING RESPONSE	

Table 2: Class 2 procedures

Elementary Procedure	Message
Handover Notification	HANDOVER NOTIFY
E-RAB Release Request	E-RAB RELEASE REQUEST
Paging	PAGING
Initial UE Message	INITIAL UE MESSAGE
Downlink NAS Transport	DOWNLINK NAS TRANSPORT
Uplink NAS Transport	UPLINK NAS TRANSPORT
NAS non delivery indication	NAS NON DELIVERY INDICATION
Error Indication	ERROR INDICATION
UE Context Release Request	UE CONTEXT RELEASE REQUEST
DownlinkS1 CDMA2000 Tunneling	DOWNLINK S1 CDMA2000 TUNNELING
Uplink S1 CDMA2000 Tunneling	UPLINK S1 CDMA2000 TUNNELING
UE Capability Info Indication	UE CAPABILITY INFO INDICATION
eNB Status Transfer	eNB STATUS TRANSFER
MME Status Transfer	MME STATUS TRANSFER
Deactivate Trace	DEACTIVATE TRACE
Trace Start	TRACE START
Trace Failure Indication	TRACE FAILURE INDICATION
Location Reporting Control	LOCATION REPORTING CONTROL
Location Reporting Failure Indication	LOCATION REPORTING FAILURE INDICATION
Location Report	LOCATION REPORT
Overload Start	OVERLOAD START
Overload Stop	OVERLOAD STOP
eNB Direct Information Transfer	eNB DIRECT INFORMATION TRANSFER
MME Direct Information Transfer	MME DIRECT INFORMATION TRANSFER

The following applies concerning interference between Elementary Procedures:

- The Reset procedure takes precedence over all other EPs.
- The UE Context Release procedure takes precedence over all other EPs that are using the UE-associated signalling.

8.2 E-RAB Management procedures

8.2.1 E-RAB Setup

8.2.1.1 General

The purpose of the E-RAB Setup procedure is to assign resources on Uu and S1 for one or several E-RABs and to setup corresponding Data Radio Bearers for a given UE. The procedure uses UE-associated signalling.

8.2.1.2 Successful Operation

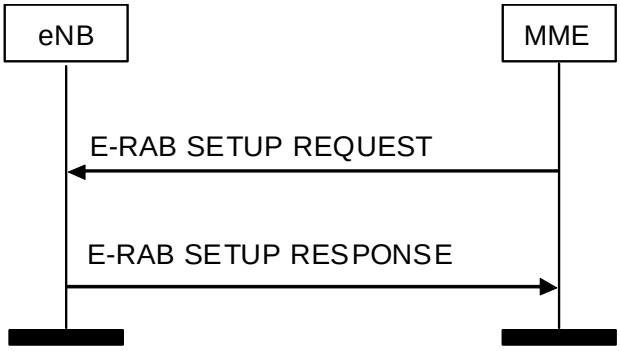

Figure 8.2.1.2-1: E-RAB Setup procedure. Successful operation.

The MME initiates the procedure by sending an E-RAB SETUP REQUEST message to the eNB.

- The E-RAB SETUP REQUEST message shall contain the information required by the eNB to build the E-RAB configuration consisting of at least one additional E-RAB including for each E-RAB to setup in the *E-RAB to be Setup List* IE.

Upon reception of the E-RAB SETUP REQUEST message, and if resources are available for the requested configuration, the eNB shall execute the requested E-RAB configuration. For each E-RAB and based on the *E-RAB level QoS parameters* IE the eNB shall establish an Data Radio Bearer and allocate the required resources on Uu. The eNB shall pass the *NAS-PDU* IE and the value contained in the *E-RAB identity* IE received for the E-RAB for each established Data Radio Bearer to the UE. The eNB does not send the NAS PDUs associated to the failed Data radio bearers to the UE. The eNB shall allocate the required resources on S1 for the E-RABs requested to be established.

The E-RAB SETUP REQUEST message may contain

- the *UE Aggregate Maximum Bit Rate* IE

If the *UE Aggregate Maximum Bit Rate* IE is included in the E-RAB SETUP REQUEST the eNB shall

- replace the previously provided UE Aggregate Maximum Bit Rate by the received UE Aggregate Maximum Bit Rate in the UE context; the eNB shall use the received UE Aggregate Maximum Bit Rate for non-GBR Bearers for the concerned UE.

If the *UE Aggregate Maximum Bit Rate* IE is not contained in the E-RAB SETUP REQUEST message, the eNB shall use the previously provided UE Aggregate Maximum Bit Rate which is stored in the UE context.

The eNB shall establish or modify the resources according to the values of the *Allocation and Retention Priority* IE (priority level and pre-emption indicators) and the resource situation as follows:

- The eNB shall consider the priority level of the requested E-RAB, when deciding on the resource allocation.
- The priority levels and the pre-emption indicators may (singularly or in combination) be used to determine whether the E-RAB setup has to be performed unconditionally and immediately. If the requested E-RAB is marked as "may trigger pre-emption" and the resource situation requires so, the eNB may trigger the pre-emption procedure which may then cause the forced release of a lower priority E-RAB which is marked as "pre-emptable". Whilst the process and the extent of the pre-emption procedure is operator-dependent, the pre-emption indicators shall be treated as follows:

  1. The values of the last received *Pre-emption Vulnerability* IE and *Priority Level* IE shall prevail.
  2. If the *Pre-emption Capability* IE is set to "may trigger pre-emption", then this allocation request may trigger the pre-emption procedure.
  3. If the *Pre-emption Capability* IE is set to "shall not trigger pre-emption", then this allocation request shall not trigger the pre-emption procedure.
  4. If the *Pre-emption Vulnerability* IE is set to "pre-emptable", then this E-RAB shall be included in the pre-emption process.
  5. If the *Pre-emption Vulnerability* IE is set to "not pre-emptable", then this E-RAB shall not be included in the pre-emption process.

6. If the *Priority Level* IE is set to "no priority" the given values for the *Pre-emption Capability* IE and *Pre-emption Vulnerability* IE shall not be considered. Instead the values "shall not trigger pre-emption" and "not pre-emptable" shall prevail.

- The E-UTRAN pre-emption process shall keep the following rules:

1. E-UTRAN shall only pre-empt E-RABs with lower priority, in ascending order of priority.

2. The pre-emption may be done for E-RABs belonging to the same UE or to other UEs.

The eNB shall report to the MME, in the E-RAB SETUP RESPONSE message, the result for all the requested E-RABs.

A list of E-RABs which are successfully established shall be included in the *E-RAB Setup List* IE.

A list of E-RABs which failed to be established shall be included in the *E-RAB Failed to Setup List* IE. In case of the establishment of an E-RAB the EPC must be prepared to receive user data before the E-RAB SETUP RESPONSE message has been received.

When the eNB reports unsuccessful establishment of an E-RAB, the cause value should be precise enough to enable the MME to know the reason for an unsuccessful establishment e.g.: "Radio resources not available", "Failure in the Radio Interface Procedure".

Interactions with Handover Preparation procedure:

If a handover becomes necessary during E-RAB setup, the eNB may interrupt the ongoing E-RAB Setup procedure and initiate the Handover Preparation procedure as follows:

1. The eNB shall send the E-RAB SETUP RESPONSE message in which the eNB shall indicate, if necessary

   - all the E-RABs fail with the cause "handover triggered"

2. The eNB shall trigger the handover procedure.

8.2.1.3 Unsuccessful Operation

The unsuccessful operation is specified in the successful operation section.

8.2.1.4 Abnormal Conditions

If the eNB receives a E-RAB SETUP 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 eNB shall consider the establishment of the corresponding E-RAB as failed.

If the eNB receives an E-RAB SETUP REQUEST message containing several *E-RAB ID* IEs (in the *E-RAB To Be Setup List* IE) set to the same value, the eNB shall consider the establishment of the corresponding E-RABs as failed.

If the eNB receives an E-RAB SETUP REQUEST message containing a *E-RAB ID* IE (in the *E-RAB To Be Setup List* IE) set to the value that identifies an active E-RAB (established before the E-RAB SETUP REQUEST message was received), the eNB shall consider the establishment of the new E-RAB as failed.

Editor"s Note: Further Assessment required.

8.2.2 E-RAB Modify

8.2.2.1 General

The purpose of the E-RAB Modify procedure is to enable modifications of already established E-RABs for a given UE. The procedure uses UE-associated signalling.

8.2.2.2 Successful Operation

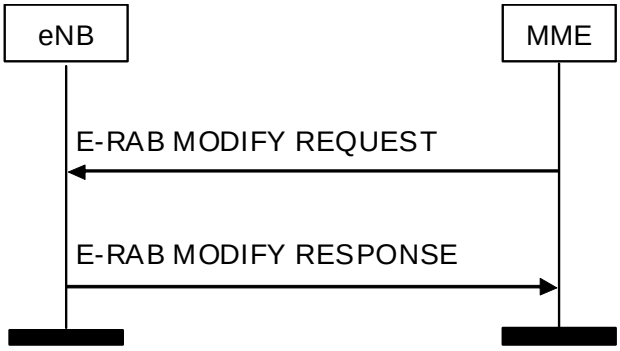

Figure 8.2.2.2-1: E-RAB Modify procedure. Successful operation.

The MME initiates the procedure by sending an E-RAB MODIFY REQUEST message to the eNB.

The E-RAB MODIFY REQUEST message shall contain the information required by the eNB to modify one or several E-RABs of the existing E-RAB configuration.

Information shall be present in the E-RAB MODIFY REQUEST message only when any previously set value for the E-RAB configuration is requested to be modified.

Upon reception of the E-RAB MODIFY REQUEST message, and if resources are available for the requested target configuration, the eNB shall execute the modification of the requested E-RAB configuration. For each E-RAB that shall be modified and based on the new *E-RAB level QoS parameters* IE the eNB shall modify the Data Radio Bearer configuration and change allocation of resources on Uu according to the new resource request. The eNB shall pass the *NAS-PDU* IE and the value contained in the *E-RAB identity* IE received for the E-RAB to the UE when modifying the Data Radio Bearer configuration. The eNB does not send the NAS PDUs associated to the failed Data radio bearers to the UE. The eNB shall change allocation of resources on S1 according to the new resource request.

If the E-UTRAN failed to modify an E-RAB the E-UTRAN shall keep the E-RAB configuration as it was configured prior the E-RAB MODIFY REQUEST.

The E-RAB MODIFY REQUEST message may contain the

- the *UE Aggregate Maximum Bit Rate* IE.

If the *UE Aggregate Maximum Bit Rate* IE is included in the E-RAB MODIFY REQUEST the eNB shall

- replace the previously provided UE Aggregate Maximum Bit Rate by the received UE Aggregate Maximum Bit Rate in the UE context; the eNB shall use the received UE Aggregate Maximum Bit Rate for non-GBR Bearers for the concerned UE.

If the *UE Aggregate Maximum Bit Rate* IE is not contained in the E-RAB MODIFY REQUEST message, the eNB shall use the previously provided UE Aggregate Maximum Bit Rate which is stored in the UE context.

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

The eNB shall report to the MME, in the E-RAB MODIFY RESPONSE message, the result for all the requested E-RABs to be modified.

A list of E-RABs which are successfully modified shall be included in the *E-RAB Modify List* IE.

A list of E-RABs which failed to be modified shall be included in the *E-RAB Failed to Modify List* IE.

When the eNB reports unsuccessful establishment of an E-RAB, the cause value should be precise enough to enable the MME to know the reason for an unsuccessful establishment e.g.: "Radio resources not available", "Failure in the Radio Interface Procedure".

In case of a modification of an E-RAB the EPC must be prepared to receive user data according to the modified E-RAB profile prior to the E-RAB MODIFY RESPONSE message.

Interactions with Handover Preparation procedure:

If a handover becomes necessary during E-RAB modify, the eNB may interrupt the ongoing E-RAB Modify procedure and initiate the Handover Preparation procedure as follows:

1. The eNB shall send the E-RAB MODIFY RESPONSE message in which the eNB shall indicate, if necessary
   - all the E-RABs fail with the cause "handover triggered"
2. The eNB shall trigger the handover procedure.

8.2.2.3 Unsuccessful Operation

The unsuccessful operation is specified in the successful operation section.

8.2.2.4 Abnormal Conditions

If the eNB receives a E-RAB MODIFY REQUEST message containing a *E-RAB Level QoS Parameters* IE which contains a *QCI* IE indicating a GBR bearer (as defined in [13]) for a E-RAB previously configured as a non-GBR bearer (as defined in [13]), and which does not contain the *GBR QoS Information* IE, the eNB shall consider the modification of the corresponding E-RAB as failed.

If the eNB receives an E-RAB MODIFY REQUEST message containing several *E-RAB ID* IEs (in the *E-RAB to be Modified List* IE) set to the same value, the eNB shall consider the modification of the corresponding E-RABs as failed.

Editor"s Note: Further Assessment required.

8.2.3 E-RAB Release

8.2.3.1 General

The purpose of the E-RAB Release procedure is to enable the release of already established E-RABs for a given UE. The procedure uses UE-associated signalling.

8.2.3.2 Successful Operation

8.2.3.2.1 E-RAB Release - MME initiated

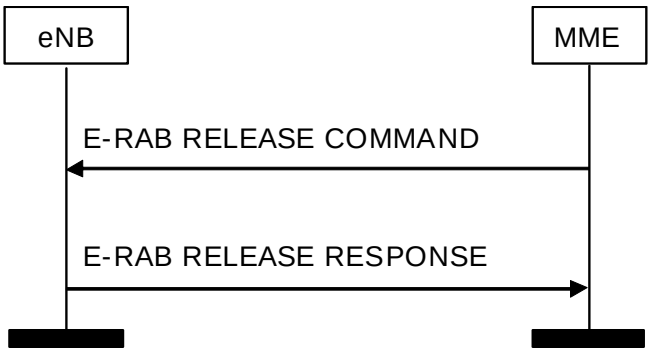

Figure 8.2.3.2.1-1: E-RAB Release procedure. Successful operation.

The MME initiates the procedure by sending an E-RAB RELEASE COMMAND message.

The E-RAB RELEASE COMMAND message shall contain the information required by the eNB to release at least one E-RAB in the *E-RAB To Be Released List* IE. It may also contain a *NAS-PDU* IE corresponding to the released E-RAB. If so, the eNB shall pass the *NAS-PDU* IE to the UE

Upon reception of the E-RAB RELEASE COMMAND message the eNB shall execute the release of the requested E-RABs. For each E-RAB to be released the eNB shall release the corresponding Data Radio Bearer and release the allocated resources on Uu. The eNB shall pass the value contained in the *E-RAB identity* IE received for the E-RAB to

the radio interface protocol for each Data Radio Bearer to be released. eNB shall release allocate resources on S1 for the E-RABs requested to be released.

The E-RAB RELEASE COMMAND message may contain the

- the *UE Aggregate Maximum Bit Rate* IE

If the *UE Aggregate Maximum Bit Rate* IE is included in the E-RAB RELEASE COMMAND the eNB shall

- replace the previously provided UE Aggregate Maximum Bit Rate by the received UE Aggregate Maximum Bit Rate in the UE context; the eNB shall use the received UE Aggregate Maximum Bit Rate for non-GBR Bearers for the concerned UE.

If the *UE Aggregate Maximum Bit Rate* IE is not contained in the E-RAB RELEASE COMMAND message, the eNB shall use the previously provided UE Aggregate Maximum Bit Rate which is stored in the UE context.

The eNB shall report to the MME, in the E-RAB RELEASE RESPONSE message, the result for all the E-RABs to be released.

A list of E-RABs which are released successfully shall be included in the *E-RAB Release List* IE.

A list of E-RABs which failed to be released shall be included in the *E-RAB Failed to Release List* IE.,

The eNB shall be prepared to receive an E-RAB RELEASE COMMAND message on an established UE-associated logical S1-connection containing an *E-RAB Release List* IE at any time and shall always reply to it with an E-RAB RELEASE RESPONSE message.

After sending an E-RAB RELEASE RESPONSE message containing an E-RAB identity within the *E-RAB Release List* IE , the eNB shall be prepared to receive an E-RAB SETUP REQUEST message requesting establishment of an E-RAB with this E-RAB identity.

8.2.3.2.2 E-RAB Release Indication - eNB initiated

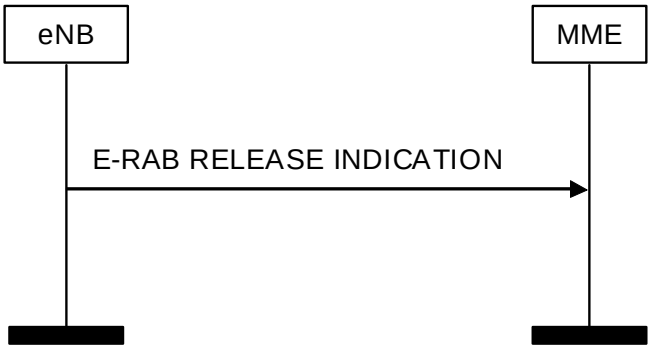

Figure 8.2.3.2.2-1: E-RAB Release Request INDICATION procedure. Successful operation.

The eNB initiates the procedure by sending an E-RAB RELEASE INDICATION message towards the MME.

The E-RAB RELEASE INDICATION message shall contain at least one E-RAB released at the eNB, in the *E-RAB Released List* IE.

Upon reception of the E-RAB RELEASE INDICATION message the MME shall normally initiate the appropriate release procedure on the core network side for the E-RABs identified in the E-RAB RELEASE REQUEST message.
Interaction with UE Context Release Request procedure:

If the eNB wants to remove all remaining E-RABs e.g. for user inactivity, the UE Context Release Request procedure shall be used instead.

8.2.3.3 Abnormal Conditions

If the eNB receives an E-RAB RELEASE COMMAND message containing several *E-RAB ID* IEs (in the *E-RAB Released List* IE) set to the same value, the eNB shall consider the release of the corresponding E-RABs as failed.

If the MME receives an E-RAB RELEASE INDICATION message containing several *E-RAB ID* IEs (in the *E-RAB Released List* IE) set to the same value, the MME shall initiate the release of the corresponding E-RAB.

Editor"s Note: Further Assessment required.

8.3 Context Management procedures

8.3.1 Initial Context Setup

8.3.1.1 General

The purpose of the Initial Context Setup procedure is to establish the necessary overall initial UE Context including E-RAB context, the Security Key, Handover Restriction List, UE radio and security capabilities information etc. The procedure uses UE-associated signalling.

8.3.1.2 Successful Operation

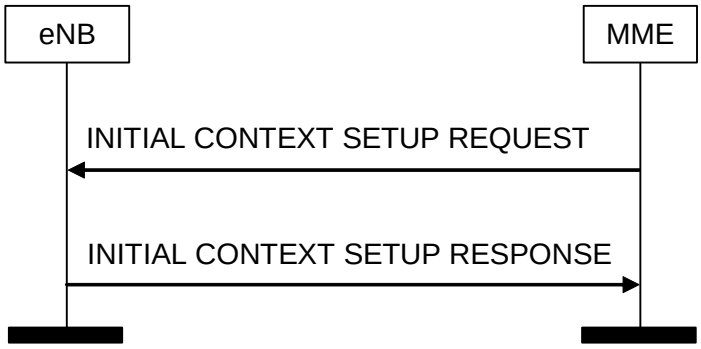

Figure 8.3.1.2-1: Initial Context Setup procedure. Successful operation.

In case of the establishment of an E-RAB the MME must be prepared to receive user data before the INITIAL CONTEXT SETUP RESPONSE message has been received.

The INITIAL CONTEXT SETUP REQUEST message shall contain within the *E-RAB to be Setup List* IE the information required by the eNB to build the new E-RAB configuration consisting of at least one additional E-RAB.

The *E-RAB to be Setup List* IE may contain:

- the E-RAB level QoS parameters IE
- the NAS PDU IE

The INITIAL CONTEXT SETUP REQUEST message may contain

- the *Handover Restriction List* IE, which may contain roaming, area or access restrictions
- the *UE Radio Capability* IE.
- the *Subscriber Profile ID for RAT/Frequency priority* IE
- the *CS Fallback Indicator* IE.
- the SRVCC operation possible IE

The INITIAL CONTEXT SETUP REQUEST message shall contain the *Subscriber Profile ID for RAT/Frequency priority* IE, if available in the MME.

Upon receipt of the INITIAL CONTEXT SETUP REQUEST the eNB shall

- attempt to execute the requested E-RAB configuration.
- pass the value contained in the *E-RAB ID* IE and the *NAS PDU* IE received for the E-RAB for each established Data radio bearer to the radio interface protocol. The eNB does not send the NAS PDUs associated to the failed Data radio bearers to the UE.

  store the Handover restriction List in the UE context.

  store the received UE Radio Capabilities in the UE context.

- store the received Subscriber Profile ID for RAT/Frequency priority in the UE context and use it as defined in [14].
- store the received SRVCC operation possible in the UE context and use it as defined in [9].
- store the received UE Security Capabilities in the UE context
- store the received *Security Key* IE and take it into use as defined in [15]

For the intial context setup an initial value for the Next Hop Chaining Count is stored in the UE context.

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.

The eNB should use the information in *Handover Restriction List* IE to determine a target cell for handover. If the *Handover Restriction List* IE is not contained in the INITIAL CONTEXT SETUP REQUEST message, the target eNB shall consider that no access restriction applies to the UE.

If the *Trace activation* IE is included in the INITIAL CONTEXT SETUP REQUEST message then eNB shall, if supported, initiate the requested trace function as described in [10].

If the *CS Fallback Indicator* IE is included in the INITIAL CONTEXT SETUP REQUEST message, it indicates that the UE Context to be set-up is subject to CS Fallback. The eNB shall then act as defined in [17].

The eNB shall report to the MME, in the INITIAL CONTEXT SETUP RESPONSE message, the successful establishment of the security procedures with the UE, and, the result for all the requested E-RABs in the following way:

A list of E-RABs which are successfully established shall be included in the *E-RAB Setup List* IE

A list of E-RABs which failed to be established shall be included in the *E-RAB Failed to Setup List* IE.

When the eNB reports unsuccessful establishment of an E-RAB, the cause value should be precise enough to enable the MME to know the reason for an unsuccessful establishment e.g.: "Radio resources not available", "Failure in the Radio Interface Procedure".

After sending the INITIAL CONTEXT SETUP RESPONSE message, the procedure is terminated in the eNB.

8.3.1.3 Unsuccessful Operation

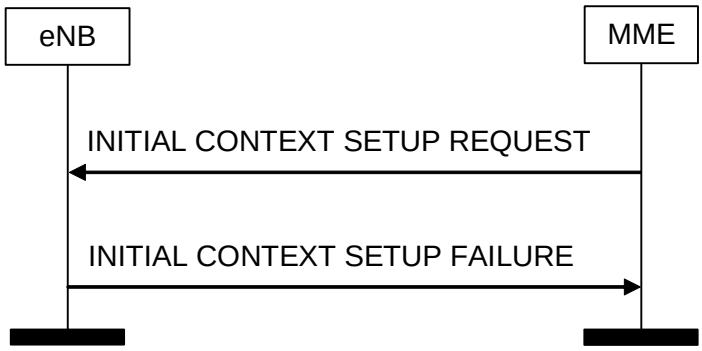

Figure 8.3.1.3-1: Initial Context Setup procedure. Unsuccessful operation.

If the eNB is not able to establish an S1 UE context, or cannot even establish one non GBR bearer it shall consider the procedure as failed and reply with the INITIAL CONTEXT SETUP FAILURE message

8.3.1.4 Abnormal Conditions

If the eNB receives an INITIAL CONTEXT SETUP 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 eNB shall consider the establishment of the corresponding E-RAB as failed.

If the eNB receives an INITIAL CONTEXT SETUP REQUEST message containing several *E-RAB ID* IEs (in the *E-RAB to Be Setup List* IE) set to the same value, the eNB shall consider the establishment of the corresponding E-RABs as failed.

Editor"s Note: Further Assessment required.

8.3.2 UE Context Release Request - eNB initiated

8.3.2.1 General

The purpose of the UE Context Release Request procedure is to enable the eNB to request the MME to release the UE-associated logical S1-connection due to EUTRAN generated reason (e.g. '$TX2_{RELOCOverall}$ Expiry'). The procedure uses UE-associated signalling.

8.3.2.2 Successful Operation

Figure 8.3.2.2-1: UE Context Release Request procedure. Successful operation.

The eNB controlling a UE-associated logical S1-connection initiates the procedure by generating an UE CONTEXT RELEASE REQUEST message towards the affected MME node.

The UE CONTEXT RELEASE REQUEST message shall indicate the appropriate cause value e.g. "User Inactivity", "Radio Connection With UE Lost" for the requested UE-associated logical S1-connection release.

8.3.3 UE Context Release (MME initiated)

8.3.3.1 General

The purpose of the UE Context Release procedure is to enable to MME to order the release of the UE-associated logical connection due to various reasons, for example completion of a transaction between the UE and the EPC or completion of successful handover or completion of handover cancellation. The MME initiated UE Context Release procedure may be initiated in response to the eNB initiated UE Context Release Request procedure. The procedure uses UE-associated signalling.

Editor"s Note:The usage of this procedure to handle detection of two UE-associated logical connections towards one UE is FFS.

8.3.3.2 Successful Operation

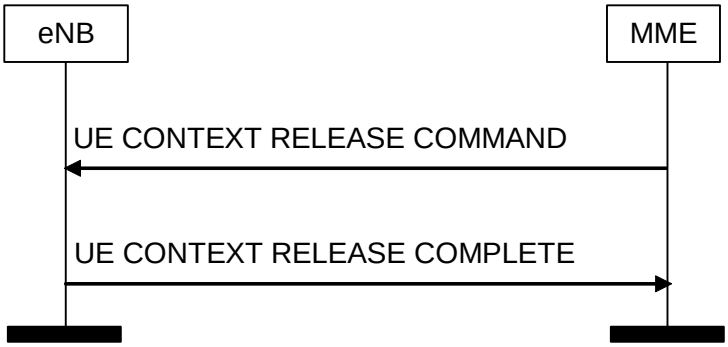

Figure 8.3.3.2-1: UE Context Release procedure. Successful operation.

The MME initiates the procedure by sending the UE CONTEXT RELEASE COMMAND message to the eNB.
The UE CONTEXT RELEASE COMMAND message shall contain the *UE S1 AP ID pair* if available, otherwise the message shall contain MME UE S1AP ID.

The MME provides the *cause* IE set to "Load Balancing TAU Required" in the UE CONTEXT RELEASE COMMAND sent to the eNB for all load balancing and offload cases in the MME.

Upon reception of the UE CONTEXT RELEASE COMMAND message, the eNB shall release all related signalling and user data transport resources and reply with the UE CONTEXT RELEASE COMPLETE message.

8.3.4 UE Context Modification

8.3.4.1 General

The purpose of the UE Context Modification procedure is to modify the established UE Context partly (e.g. with the Security Key or Subscriber Profile ID for RAT/Frequency priority). The procedure uses UE-associated signalling.

8.3.4.2 Successful Operation

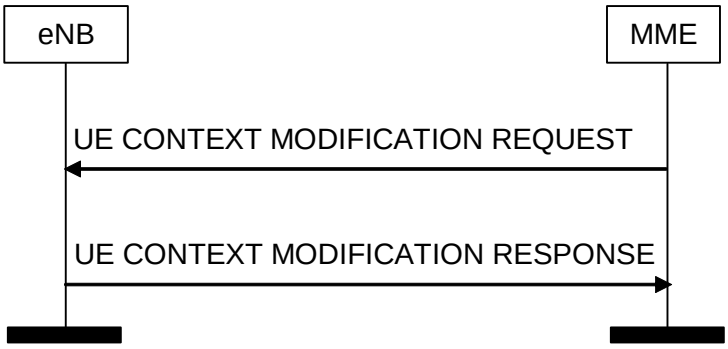

Figure 8.3.4.2-1: UE Context Modification procedure. Successful operation.

The UE CONTEXT MODIFICATION REQUEST message may contain

- the S*ecurity Key* IE
- the *Subscriber Profile ID for RAT/Frequency priority* IE
- the *UE Aggregate Maximum Bit Rate* IE
- the *CS Fallback Indicator* IE.

Upon receipt of the UE CONTEXT MODIFICATION REQUEST the eNB shall

- store the received S*ecurityKey* IE and take it into use as defined in [15].
- store the *Subscriber Profile ID for RAT/Frequency priority* IE and use it as defined in [14].

If the *UE Aggregate Maximum Bit Rate* IE is included in the UE CONTEXT MODIFICATION REQUEST the eNB shall

- replace the previously provided UE Aggregate Maximum Bit Rate by the received UE Aggregate Maximum Bit Rate in the UE context; the eNB shall use the received UE Aggregate Maximum Bit Rate for non-GBR Bearers for the concerned UE.

If the *UE Aggregate Maximum Bit Rate* IE is not contained in the UE CONTEXT MODIFICATION REQUEST message, the eNB shall use the previously provided UE Aggregate Maximum Bit Rate which is stored in the UE context.

If the *CS Fallback Indicator* IE is included in the UE CONTEXT MODIFICATION REQUEST message, it indicates that the concerned UE Context is subject to CS Fallback. The eNB shall then act as defined in [17].

The eNB shall report, in the UE CONTEXT MODIFICATION RESPONSE message to the MME, the successful update of the UE context:

After sending the UE CONTEXT MODIFICATION RESPONSE message, the procedure is terminated in the eNB.

8.3.4.3 Unsuccessful Operation

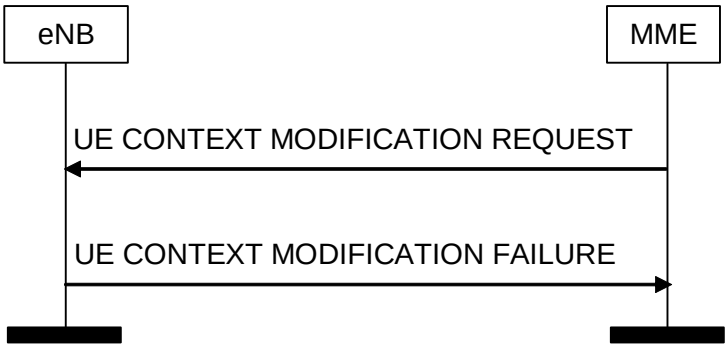

Figure 8.3.4.3-1: UE Context Modification procedure. Unsuccessful operation.

In case the UE context update cannot be performed successfully the eNB shall respond with the UE CONTEXT MODIFICATION FAILURE message to the MME with an appropriate cause value in the *Cause* IE.

8.4 Handover Signalling

8.4.1 Handover Preparation

8.4.1.1 General

The purpose of the Handover Preparation procedure is to request the preparation of resources at the target side via the EPC. There is only one Handover Preparation procedure ongoing at the same time for a certain UE.

Editor"s Note: It is FFS whether the eNodeB is allowed to initiate this procedure in case there is an already prepared handover for this particular UE either on S1or on any of its X2 interfaces.

8.4.1.2 Successful Operation

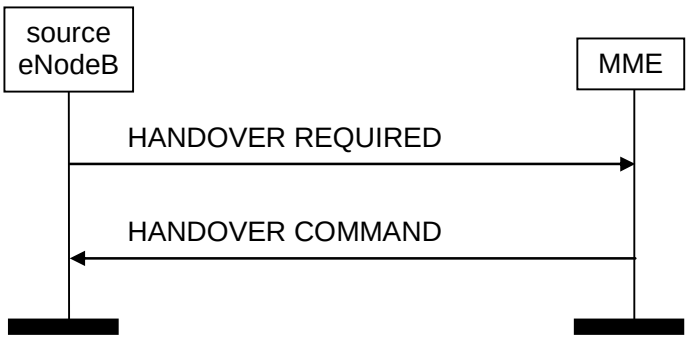

Figure 8.4.1.2-1: Handover preparation: successful operation

The source eNodeB initiates the handover preparation by sending the HANDOVER REQUIRED message to the serving MME. When the source eNodeB sends the HANDOVER REQUIRED message, it shall start the timer $TS1_{RELOCprep}$. The source eNodeB shall indicate the appropriate cause value for the handover in the *Cause* IE.

The source eNodeB shall include the *Source to Target Transparent Container* IE in the HANDOVER REQUIRED message.

In case of intra-system handover, the container shall be encoded according to the definition of the *Source eNB to Target eNB Transparent Container* IE. In case of handover to UTRAN, the information in the *Source to Target Transparent Container* IE shall be encoded according to the *Source RNC to Target RNC Transparent Container* IE definition as

specified in [19]. If the handover is to GERAN A/Gb mode then the *Source to Target Transparent Container* IE shall be encoded according to the definition of the *Source BSS to Target BSS Transparent Container* IE.

Editor"s note: How to handle and control data forwarding is FFS.

When the preparation, including the reservation of resources at the target side is ready, the MME responds with the HANDOVER COMMAND message to the source eNodeB.

If the *Target to Source Transparent Container* IE has been received by the MME from the handover target then the transparent container shall be included in the HANDOVER COMMAND message.

Upon reception of the HANDOVER COMMAND message the source eNodeB shall stop the timer $TS1_{RELOCprep}$ and start the timer $TS1_{RELOCOverall}$.

In case of intra-system handover, the information in the *Target to Source Transparent Container* IE shall be encoded according to the definition of the *Target eNB to Source eNB Transparent Container* IE. In case of inter-system handover to UTRAN, the *Target to Source Transparent Container* IE shall be encoded according to the *Target RNC to Source RNC Transparent Container* IE definition as specified in [19]. In case of inter-system handover to GERAN A/Gb mode, the *Target to Source Transparent Container* IE shall be encoded according to the *Target BSS to Source BSS Transparent Container* IE definition as described in [18].

If there are any E-RABs that could not be admitted in the target, they shall be indicated in the *E-RABs to Release List* IE.

If the *DL forwarding* IE is included within the *Source eNodeB to Target eNodeB Transparent Container* IE of the HANDOVER REQUIRED message and it is set to 'DL forwarding proposed', it indicates that the source eNodeB proposes forwarding of downlink data.

The source eNodeB may include the *Direct Forwarding Path Availability* IE in the HANDOVER REQUIRED message if a direct data path is available.

If the HANDOVER REQUIRED message does not contain the *Direct Forwarding Path Availability* IE then indirect forwarding may be applied, if available.

The source eNodeB may include the *SRVCC HO Indication* IE in the HANDOVER REQUIRED message if the SRVCC operation is needed as defined in [9]. The source eNodeB shall indicate to the MME in the *SRVCC HO Indication* IE if the handover shall be prepared for PS and CS domain or only for CS domain. In case of inter-system handover from E-UTRAN, the source eNodeB shall indicate in the *Target ID* IE, in case of inter-system handover to UTRAN, the Target RNC-ID of the RNC, in case of inter-system handover to GERAN A/Gb mode the Cell Global Identity (including the Routing Area Code) of the cell in the target system.

If the HANDOVER COMMAND message contains *DL GTP TEID* IE and *DL Transport Layer Address* IE for a bearer in *E-RABs Subject to Forwarding List* IE then the target eNB accepts the forwarding of downlink data for this bearer, proposed by the source eNB.

If the HANDOVER COMMAND message contains *UL GTP TEID* IE and *UL Transport Layer Address* IE for a bearer in *E-RABs Subject to Forwarding List* IE then the target eNB requests forwarding of uplink data for this bearer.

For handover to an external system the eNB shall use the *NAS downlink COUNT* IE received in the HANDOVER COMMAND message as specified in [15].

Interactions with E-RAB Management procedures:

If, after a HANDOVER REQUIRED message is sent and before the Handover Preparation procedure is terminated, the source eNB receives a MME initiated E-RAB Management procedure on the same UE associated signaling connection, the source eNB shall either:

1. cancel the Handover Preparation procedure by executing the Handover Cancel procedure with an appropriate cause value "Interaction with other procedure'. After successful completion of the Handover Cancel procedure, the source eNB shall continue the MME initiated E-RAB Management procedure

or

2. terminate the MME initiated E-RAB Management procedure by sending the appropriate response message with the cause value 'Handover Triggered' to the MME and then the source eNB shall continue with the handover procedure.

8.4.1.3 Unsuccessful Operation

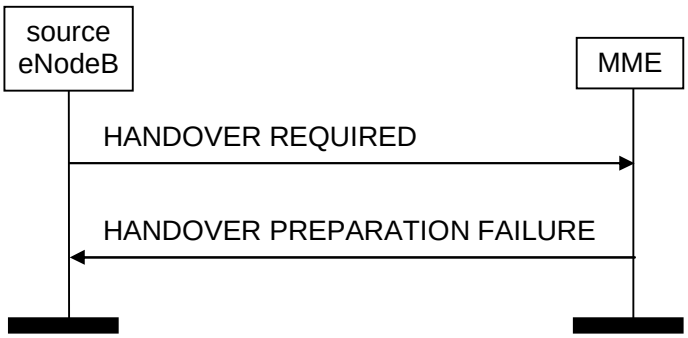

Figure 8.4.1.3-1: Handover preparation: unsuccessful operation

If the EPC or the target system is not able to accept any of the bearers or a failure occurs during the Handover Preparation, the MME sends the HANDOVER PREPARATION FAILURE message with an appropriate cause value to the source eNodeB.

8.4.1.4 Abnormal Conditions

8.4.2 Handover Resource Allocation

8.4.2.1 General

The purpose of the Handover Resource Allocation procedure is to reserve resources at the target eNodeB for the handover of a UE.

8.4.2.2 Successful Operation

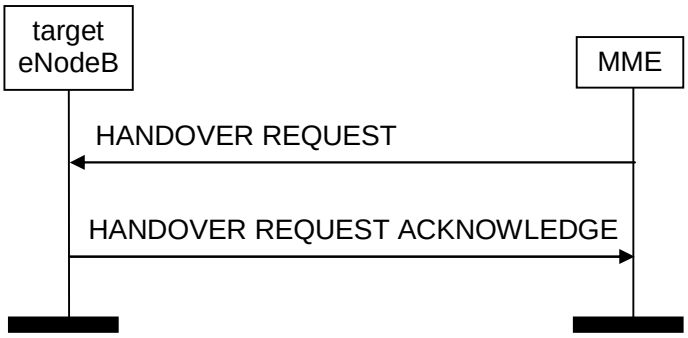

Figure 8.4.2.2-1: Handover resource allocation: successful operation

The MME initiates the procedure by sending the HANDOVER REQUEST message to the target eNodeB. The HANDOVER REQUEST message may contain the *Handover Restriction List* IE, which may contain roaming area or access restrictions.

If the *Handover Restriction List* IE is contained in the HANDOVER REQUEST message, the target eNB shall store this information in the UE context.

The eNB should use the information in *Handover Restriction List* IE to determine a target cell for handover. If the *Handover Restriction List* IE is not contained in the HANDOVER REQUEST message, the target eNB shall consider that no access restriction applies to the UE.

Upon receiption of the HANDOVER REQUEST message the eNB shall store the received *UE Security Capabilities* IE in the UE context and use it to prepare the configuration of the AS security relation with the UE.

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 [9].

Upon reception of the HANDOVER REQUEST message the eNB shall store the received *Security Context* IE in the UE context and the eNB shall use to derive the security configuration as specified in [15]

If the *Trace activation* IE is included in the HANDOVER REQUEST message, the target eNB shall if supported, initiate the requested trace function as described in [10].

If the *Subscriber Profile ID for RAT/Frequency priority* IE is contained in the *Source eNodeB to Target eNodeB Transparent Container* IE, the target eNB shall store the received Subscriber Profile ID for RAT/Frequency priority in the UE context and use it as defined in [14].

Upon reception of the *UE History Information* IE, which is included within the *Source eNodeB to Target eNodeB Transparent Container* IE in the HANDOVER REQUEST message, the target eNB shall collect the information defined as mandatory and may collect the information defined as optional 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.

After all necessary resources for the admitted E-RABs have been allocated the target eNodeB generates the HANDOVER REQUEST ACKNOWLEDGE message. The target eNodeB shall include in the *E-RABs Admitted List* IE the E-RABs for which resources have been prepared at the target cell. The E-RABs that have not been admitted in the target cell shall be included in the *E-RABs Failed to Setup List* IE.

For each bearer that target eNB has decided to admit and for which *DL forwarding* IE is set to 'DL forwarding proposed', the target eNB may include the *DL GTP TEID* IE and the *DL Transport Layer Address* IE IE within the *E-RABs Admitted List IEs* IE of the HANDOVER REQUEST ACKNOWLEDGE message indicating that it accepts the proposed forwarding of downlink data for this bearer.

If the HANDOVER REQUEST ACKNOWLEDGE message contains *UL GTP TEID* IE and *UL Transport Layer Address* IE for a bearer in *E-RABs Admitted List* IE then the target eNB requests forwarding of uplink data for this bearer.

If the *Request Type* IE is included in the HANDOVER REQUEST message then the target eNB should perform the requested location reporting functionality for the UE as described in section 8.11.

8.4.2.3 Unsuccessful Operation

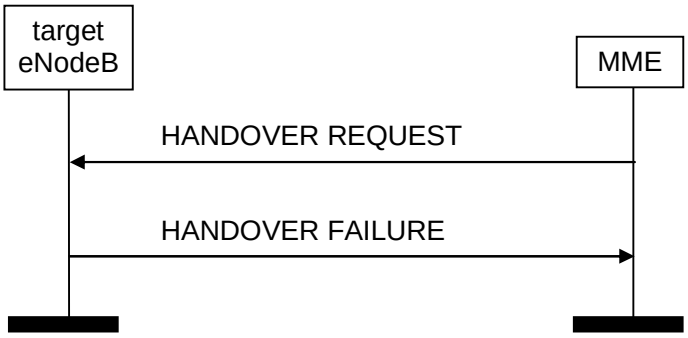

Figure 8.4.2.3-1: Handover resource allocation: unsuccessful operation

If the target eNodeB is not able to admit any of the E-RABs or a failure occurs during the Handover Preparation, it shall send the HANDOVER FAILURE message to the MME with an appropriate cause value.

If the target eNodeB receives a HANDOVER REQUEST message containing RRC Container IE that does not include required information as specified in [16], the target eNodeB shall send the HANDOVER PREPARATION FAILURE message to the MME.

8.4.2.4 Abnormal Conditions

If the 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 eNB shall not admit the corresponding E-RAB.

If the 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 eNB shall not admit the corresponding E-RABs.

If the *Subscriber Profile ID for RAT/Frequency priority* IE is not contained in the *Source eNodeB to Target eNodeB Transparent Container* IE whereas available in the source eNB, the target eNB shall trigger a local error handling.

8.4.3 Handover Notification

8.4.3.1 General

The purpose of the Handover Notification procedure is to indicate to the MME that the UE has arrived to the target cell and the S1 handover has been successfully completed.

8.4.3.2 Successful Operation

Figure 8.4.3.2-1: Handover notification

The target eNodeB shall send the HANDOVER NOTIFY message to the MME when the UE has been identified in the target cell and the S1 handover has been successfully completed.

8.4.3.3 Abnormal Conditions

8.4.4 Path Switch Request

8.4.4.1 General

The purpose of the Path Switch Request procedure is to request the switch of a downlink GTP tunnel towards a new GTP tunnel endpoint.

8.4.4.2 Successful Operation

Figure 8.4.4.2-1: Path switch request: successful operation

The eNodeB initiates the procedure by sending the PATH SWITCH REQUEST message to the MME.

If the *E-RAB To Be Switched in Downlink List* IE in the PATH SWITCH REQUEST message does not include all E-RABs previously included in the Ue Context, the MME shall consider the non included E-RABs as implicitly released by the eNB.

After all necessary updates including the UP path switch have been successfully completed in the EPC for at least one of the E-RABs included in the PATH SWITCH REQUEST *E-RAB To Be Switched in Downlink List* IE, the MME shall send the PATH SWITCH REQUEST ACKNOWLEDGE message to the eNodeB and the procedure ends.

In case the EPC failed to perform the UP path switch for at least one, but not all, of the E-RABs included in the PATH SWITCH REQUEST *E-RAB To Be Switched in Downlink List* IE, the MME shall include the E-RABs it failed to perform UP path switch in the PATH SWITCH REQUEST ACKNOWLEDGE *E-RAB t To Be Released List* IE. In this case, the eNB shall release the corresponding data radio bearers, and the eNB shall regard the E-RABs indicated in the *E-RAB To Be Released List* IE as being fully released.

Upon reception of the PATH SWITCH REQUEST ACKNOWLEDGE message the eNB shall store the received *Security Context* IE in the UE context and the eNB shall use it for next X2 or Intra eNB handovers as specified in [15].

The PATH SWITCH REQUEST ACKNOWLEDGE message may contain

- the *UE Aggregate Maximum Bit Rate* IE

If the *UE Aggregate Maximum Bit Rate* IE is included in the PATH SWITCH REQUEST ACKNOWLEDGE the eNB shall

- replace the previously provided UE Aggregate Maximum Bit Rate by the received UE Aggregate Maximum Bit Rate in the UE context; the eNB shall use the received UE Aggregate Maximum Bit Rate for non-GBR Bearers for the concerned UE.

If the *UE Aggregate Maximum Bit Rate* IE is not contained in the PATH SWITCH REQUEST ACKNOWLEDGE message, the eNB shall use the previously provided UE Aggregate Maximum Bit Rate which is stored in the UE context.

In case the EPC decides to change the uplink termination point of the tunnels it may include the *E-RAB To Be Switched in Uplink List* IE in the PATH SWITCH REQUEST ACKNOWLEDGE message to specify a new uplink transport layer address and uplink GTP-TEID for each respective E-RAB for which it wants to change the uplink tunnel termination point.

When the eNodeB receives the PATH SWITCH REQUEST ACKNOWLEDGE message and if this message includes the *E-RAB To Be Switched in Uplink List* IE, the eNodeB shall start delivering the uplink packets of the concerned E-RABs to the new uplink tunnel endpoints as indicated in the message.

8.4.4.3 Unsuccessful Operation

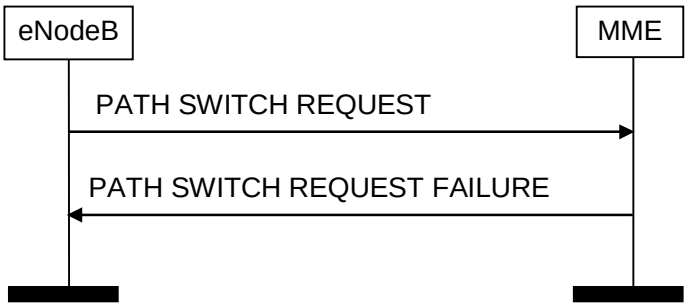

Figure 8.4.4.3-1: Path switch request: unsuccessful operation

If the EPC fails to switch the downlink GTP tunnel endpoint towards a new GTP tunnel endpoint for all E-RAB included in the *E-RAB To Be Switched in Downlink List* IE during the execution of the Path Switch Request procedure, the MME shall send the PATH SWITCH REQUEST FAILURE message to the eNodeB with an appropriate cause value.

8.4.4.4 Abnormal Conditions

If the MME receives a PATH SWITCH REQUEST message containing several *E-RAB ID* IEs (in the *E-RAB To Be Switched in Uplink List* IE) set to the same value, the MME shall send the PATH SWITCH REQUEST FAILURE message to the eNB.

8.4.5 Handover Cancellation

8.4.5.1 General

The purpose of the Handover Cancel procedure is to enable a source eNB to cancel an ongoing handover. The Handover Cancel procedure may not be initiated by the source eNB during the Handover Preparation procedure after

- the source eNB has initiated the execution of the handover via the Uu interface

except if

- the UE has returned to the source eNB by transmitting an RRC message which indicates that the UE considers the source eNB as its serving eNB

The procedure uses UE-associated logical S1-connection.

8.4.5.2 Successful Operation

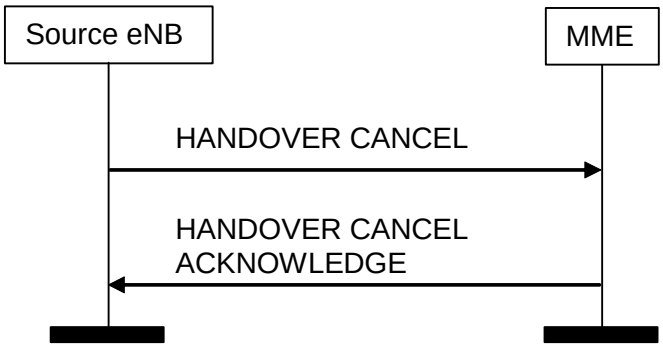

Figure 8.4.5.2-1: Handover Cancel procedure. Successful operation.

Editor"s Note: Whether a HANDOVER CANCEL ACKNOWLEDGE message is needed is FFS.

The source eNB initiates the procedure by sending a HANDOVER CANCEL message to the EPC.

The HANDOVER CANCEL message shall indicate the reason for cancelling the handover by the appropriate value of the *Cause* IE

Upon reception of a HANDOVER CANCEL message, the EPC shall terminate the ongoing Handover Preparation procedure, release any resources associated with the handover preparation and send a HANDOVER CANCEL ACKNOWLEDGE message to the source eNB.

Transmission and reception of a HANDOVER CANCEL ACKNOWLEDGE message terminate the procedure in the EPC and in the source eNB. After this, the source eNB does not have a prepared handover for that UE-associated logical S1-connection.

8.4.5.3 Unsuccessful Operation

Not applicable.

8.4.5.4 Abnormal Conditions

Not applicable.

8.4.6 eNB Status Transfer

8.4.6.1 General

The purpose of the eNB 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 eNodeB via the MME during an intra LTE S1 handover for each respective E-RAB for which PDCP SN and HFN status preservation applies.

8.4.6.2 Successful Operation

Figure 8.4.6.2-1: eNB Status Transfer procedure

The source eNodeB initiates the procedure by stop assigning PDCP SNs to downlink SDUs and sending the eNB STATUS TRANSFER message to the MME at the time point when it considers the transmitter/receiver status to be freezed.

At that point of time, the source eNodeB either:

- discard the uplink packets received out of sequence for a bearer and include the bearer in the *E-RABs Subject to Status Transfer List* IE to indicate that PDCP SN status preservation applies for the bearer,
- forward the uplink packets received out of sequence for a bearer and, if status preservation applies for the bearer, include the bearer in the *E-RABs Subject to Status Transfer List* IE to indicate that PDCP SN status preservation applies for the bearer,
- send the uplink packets received out of sequence to the EPC for each bearer for which the PDCP SN status preservation doesn"t apply.

The source eNB may also include in the eNB STATUS TRANSFER message the missing and received uplink SDUs in the *Receive Status Of UL PDCP SDUs* IE for each bearer for which the source eNB has accepted the request from the target eNB for uplink forwarding.

8.4.6.3 Unsuccessful Operation

Not applicable.

8.4.6.4 Abnormal Conditions

Editor"s Note: Further Assessment required.

8.4.7 MME Status Transfer

8.4.7.1 General

The purpose of the MME 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 eNodeB via the MME during an S1 handover for each respective E-RAB for which PDCP SN and HFN status preservation applies.

8.4.7.2 Successful Operation

Figure 8.4.7.2-1: MME Status Transfer procedure

The MME initiates the procedure by sending the MME STATUS TRANSFER message to the eNB.

For each bearer within the *E-RABs Subject to Status Transfer List* IE within the *eNB Status Transfer Transparent Container* IE for which the *UL COUNT value* IE is received in the MME STATUS TRANSFER message, the target eNodeB shall use it and not deliver any uplink packet which has a PDCP SN lower than the value contained in the *PDCP SN* IE of this IE.

For each bearer in *E-RABs Subject to Status Transfer List* IE within the *eNB Status Transfer Transparent Container* IE received in the MME STATUS TRANSFER message, the target eNodeB shall use *DL COUNT value*IE for the first downlink packet for which there is no PDCP SN yet assigned.

If the *Receive Status Of UL PDCP SDUs* IE is included for at least one bearer in the *eNB Status Transfer Transparent Container* IE of the MME STATUS TRANSFER message, the target eNB may use it in a Status Report message sent to the UE over the radio.

8.4.7.3 Unsuccessful Operation

Not applicable.

8.4.7.4 Abnormal Conditions

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

8.5 Paging

8.5.1 General

The purpose of the Paging procedure is to enable the MME to page a UE in the specific eNB.

8.5.2 Successful Operation

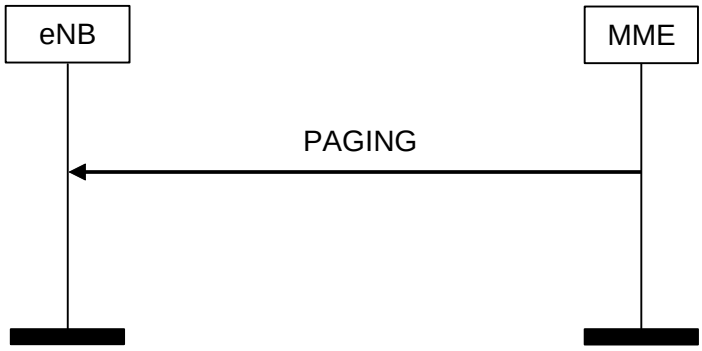

Figure 8.5.2-1: Paging procedure

The MME initiates the paging procedure by sending the PAGING message to the eNB.

At the reception of the PAGING message, the eNB shall perform paging of the UE in cells which belong to tracking areas as indicated in the *List of TAIs* IE. The *CN Domain* IE shall be transferred transparently to the UE.

The *Paging DRX* IE may be included in the PAGING message, and if present the eNB shall use it according to [20].

For each cell that belongs to any of the TA indicated in the *List of TAIs* IE, the eNodeB shall generate one page on the radio interface.

8.5.3 Unsuccessful Operation

Not applicable.

8.5.4 Abnormal Conditions

Not applicable.

8.6 NAS transport

8.6.1 General

The purpose of the NAS Transport procedure is to carry UE – MME signalling over the S1 Interface. The NAS messages are not interpreted by the eNB, and their content is outside the scope of this specification. The procedure may use an existing UE-associated logical S1-connection. If no UE-associated logical S1-connection exists, the establishment of the UE-associated logical S1-connection is initiated (and may be established) as part of the procedure.

The NAS messages are transported in an IE of the INITIAL UE MESSAGE, DOWNLINK NAS TRANSPORT or UPLINK NAS TRANSPORT messages.

8.6.2 Successful Operations

8.6.2.1 Initial UE Message

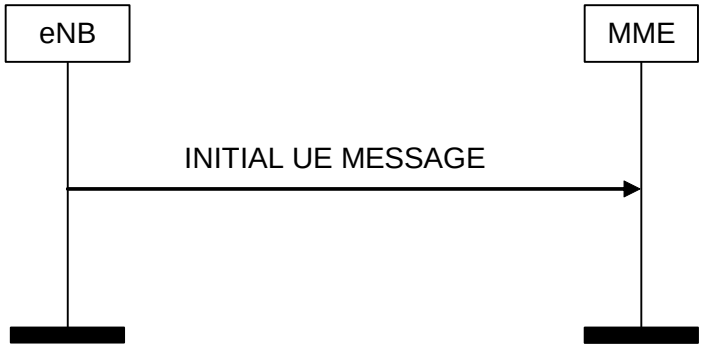

Figure 8.6.2.1-1: Initial UE Message procedure

When the eNB has received from the radio interface the first UL NAS message transmitted on an RRC connection to be forwarded to an MME, the eNB shall invoke the NAS Transport procedure and send the INITIAL UE MESSAGE to the MME including the NAS message as a *NAS-PDU* IE. The eNB shall allocate a unique eNB UE S1AP ID to be used for the UE and the eNB shall include this identity in the INITIAL UE MESSAGE message. In case of network sharing, the selected PLMN is indicated by the PLMN ID part of the *TAI* IE included in the INITIAL UE MESSAGE message. When the eNB has received from the radio interface the *S-TMSI* IE, it shall include it in the INITIAL UE MESSAGE message.

If the establishment of the UE-associated signalling connection towards the CN is performed due to an RRC connection establishment originating from a CSG cell, the *CSG Id* IE shall be included in the INITIAL UE MESSAGE message.

Note: the first UL NAS message is always received in the RRC CONNECTION SETUP COMPLETE message.

8.6.2.2 DOWNLINK NAS TRANSPORT

Figure 8.6.2.2-1: DOWNLINK NAS Transport Procedure

If the MME only need to send a NAS message transparently via the eNB to the UE and a UE-associated logical S1-connection exists for the UE or if the MME have received the *eNB UE S1AP ID* IE in an INITIAL UE MESSAGE message, the MME shall send a DOWNLINK NAS TRANSPORT message to the eNB including the NAS message as a *NAS-PDU* IE. If the UE-associated logical S1-connection is not established the MME shall allocate a unique MME UE S1AP ID to be used for the UE and include that in the DOWNLINK NAS TRANSPORT message. By the reception of *MME UE S1AP ID* IE in eNB the UE-associated logical S1-connection is established.

The *NAS-PDU* IE contains an MME – UE message that is transferred without interpretation in the eNB.

The DOWNLINK NAS TRANSPORT message may contain the *Handover Restriction List* IE, which may contain roaming area or access restrictions.

If the *Handover Restriction List* IE is contained in the DOWNLINK NAS TRANSPORT message, the target eNB shall store this information in the UE context.

The eNB should use the information in *Handover Restriction List* IE to determine a target cell for handover. If the *Handover Restriction List* IE is not contained in the DOWNLINK NAS TRANSPORT message and there is no previously stored Handover restriction information, the target eNB shall consider that no access restriction applies to the UE.

8.6.2.3 UPLINK NAS TRANSPORT

Figure 8.6.2.3-1: UPLINK NAS TRANSPORT Procedure

When the eNB has received from the radio interface a NAS message to be forwarded to the MME to which an UE-associated logical S1-connection for the UE exists, the eNB shall send the UPLINK NAS TRANSPORT message to the MME including the NAS message as a *NAS-PDU* IE. The eNodeB shall include the TAI and ECGI of the current cell in every S1-AP UPLINK NAS TRANSPORT message.

The *NAS-PDU* IE contains an UE - MME message that is transferred without interpretation in the eNB.

8.6.2.4 NAS NON DELIVERY INDICATION

Figure 8.6.2.4-1: NAS NON DELIVERY INDICATION Procedure

When the eNB decides to not start the delivery of a NAS message that has been received over an UE-associated logical S1-connection or the eNB is unable to ensure that the message has been received by the UE, it shall report the non-delivery of this NAS message by sending a NAS NON DELIVERY INDICATION message to the MME including the non-delivered NAS message within the *NAS-PDU* IE and an appropriate cause value within the *Cause* IE e.g. handover triggered'.

8.6.3 Unsuccessful Operation

Not applicable

8.6.4 Abnormal Conditions

If the S-TMSI is not received by the MME in the INITIAL UE MESSAGE message whereas expected, the MME shall consider the procedure as failed.

8.7 Management procedures

Editor"s Note: Placeholder for a procedure description of common procedures as defined in TS 36.300

8.7.1 Reset

8.7.1.1 General

The purpose of the Reset procedure is to initialise or re-initialise the E-UTRAN, or part of E-UTRAN S1AP UE-related contexts, in the event of a failure in the EPC or vice versa. . This procedure doesn"t affect the application level configuration data exchanged during the S1 Setup procedure.

The procedure uses non-UE associated signalling.

8.7.1.2 Successful Operation

8.7.1.2.1 Reset Procedure Initiated from the MME

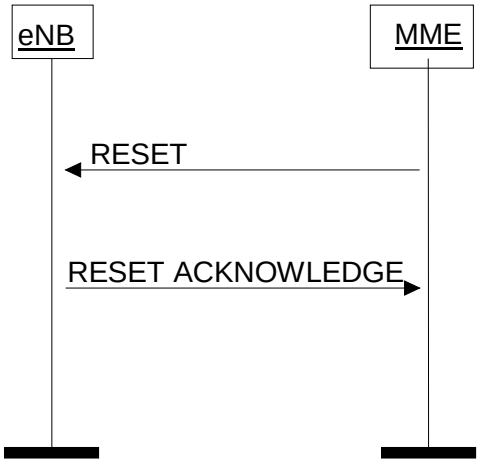

Figure 8.7.1.2.1-1: Reset procedure initiated from the MME. Successful operation.

In the event of a failure at the MME, which has resulted in the loss of some or all transaction reference information, a RESET message shall be sent to the eNB.

At reception of RESET message the eNB shall release all allocated resources on S1 and Uu related to the UE association(s) indicated explicitly or implicitly in the RESET message and remove the indicated UE contexts including S1AP ID.

After the eNB has released all assigned S1 resources and the UE S1AP IDs for all indicated UE associations can be used for new UE-associated logical S1-connections over the S1 interface, the eNB shall respond with the RESET ACKNOWLEDGE message. The eNB does not need to wait for the release of radio resources to be completed before returning the RESET ACKNOWLEDGE message.

If the RESET message contains the *UE-associated logical S1-connection list* IE, then:

- The eNB shall use the *MME UE S1AP ID* IE and/or the *eNB UE S1AP ID* IE to explicitly identify the UE association(s) to be reset.

- The eNB shall in the RESET ACKNOWLEDGE message include, for each UE association to reset, the *UE-associated logical S1-connection Item* IE in the*UE-associated logical S1-connection list* IE. The *UE-associated logical S1-connection Item* IEs shall be in the same order as received in the RESET message and shall include also unknown UE-associated logical S1-connections. Empty *UE-associated logical S1-connection Item* IEs, received in the RESET message, may be omitted in the RESET ACKNOWLEDGE message.

- If the *MME UE S1AP ID* IE is included in the *UE-associated logical S1-connection Item* IE for a UE association, the eNB shall include the *MME UE S1AP ID* IE in the corresponding *UE-associated logical S1-connection Item* IE in the RESET ACKNOWLEDGE message.

- If the *eNB UE S1AP ID* IE is included in the *UE-associated logical S1-connection Item* IE for a UE association, the eNB shall include the *eNB UE S1AP ID* IE in the corresponding *UE-associated logical S1-connection Item* IE in the RESET ACKNOWLEDGE message.

Interactions with other procedures:

If the RESET message is received, any other ongoing procedure (except another Reset procedure) on the same S1 interface related to a UE association, indicated explicitly or implicitly in the RESET message, shall be aborted.

8.7.1.2.2 Reset Procedure Initiated from the E-UTRAN

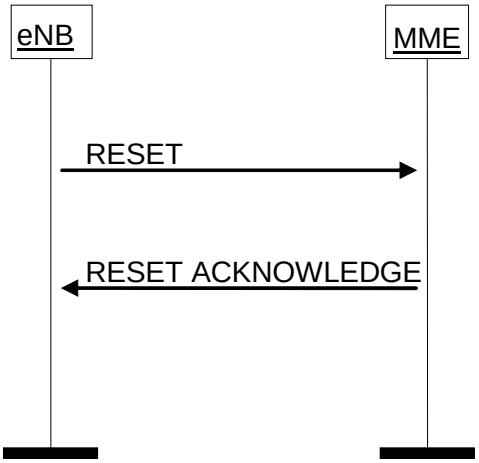

Figure 8.7.1.2.2-1: Reset procedure initiated from the E-UTRAN. Successful operation.

In the event of a failure at the eNB, which has resulted in the loss of some or all transaction reference information, a RESET message shall be sent to the MME.

At reception of RESET message the MME shall release all allocated resources on S1 related to the UE association(s) indicated explicitly or implicitly in the RESET message and remove the S1AP ID for the indicated UE associations.

After the MME has released all assigned S1 resources and the UE S1AP IDs for all indicated UE associations can be used for new UE-associated logical S1-connections over the S1 interface, the MME shall respond with the RESET ACKNOWLEDGE message.

If the RESET message contains the *UE-associated logical S1-connection list* IE, then:

- The MME shall use the *MME UE S1AP ID* IE and/or the *eNB UE S1AP ID* IE to explicitly identify the UE association(s) to be reset.

- The MME shall in the RESET ACKNOWLEDGE message include, for each UE association to reset, the *UE-associated logical S1-connection Item* IE in the*UE-associated logical S1-connection list* IE. The *UE-associated logical S1-connection Item* IEs shall be in the same order as received in the RESET message and shall include also unknown UE-associated logical S1-connections. Empty *UE-associated logical S1-connection Item* IEs, received in the RESET message, may be omitted in the RESET ACKNOWLEDGE message.

- If the *MME UE S1AP ID* IE is included in the *UE-associated logical S1-connection Item* IE for a UE association, the MME shall include the *MME UE S1AP ID* IE in the corresponding *UE-associated logical S1-connection Item* IE in the RESET ACKNOWLEDGE message.

- If the *eNB UE S1AP ID* IE is included in a *UE-associated logical S1-connection Item* IE for a UE association, the MME shall include the eNB *UE S1AP ID* IE in the corresponding *UE-associated logical S1-connection Item* IE in the RESET ACKNOWLEDGE message.

Interactions with other procedures:

If the RESET message is received, any other ongoing procedure (except another Reset procedure) on the same S1 interface related to a UE association, indicated explicitly or implicitly in the RESET message, shall be aborted.

8.7.1.3 Abnormal Conditions

8.7.1.3.1 Abnormal Condition at the EPC

If the RESET message includes the *UE-associated logical S1-connection list* IE, but neither the *MME UE S1AP ID* IE nor the *eNB UE S1AP ID* IE is present for a *UE-associated logical S1-connection Item* IE, then the MME shall ignore the *UE-associated logical S1-connection Item* IE. The MME may return the empty *UE-associated logical S1-connection Item* IE in the *UE-associated logical S1-connection list* IE in the RESET ACKNOWLEDGE message.

8.7.1.3.2 Abnormal Condition at the E-UTRAN

If the RESET message includes the *UE-associated logical S1-connection list* IE, but neither the *MME UE S1AP ID* IE nor the *eNB UE S1AP ID* IE is present for a *UE-associated logical S1-connection Item* IE, then the eNB shall ignore the *UE-associated logical S1-connection Item* IE. The eNB may return the empty *UE-associated logical S1-connection Item* IE in the *UE-associated logical S1-connection list* IE in the RESET ACKNOWLEDGE message.

8.7.1.3.3 Crossing of Reset Messages

If Reset procedure is ongoing in eNB and the eNB receives a RESET message from the peer entity on the same S1 interface related to one or several UE associations previously requested to be reset, indicated explicitly or implicitly in the received RESET message, the eNB shall respond with RESET ACKNOWLEDGE message as described in 8.7.1.2.1.

If Reset procedure is ongoing in MME and the MME receives a RESET message from the peer entity on the same S1 interface related to one or several UE associations previously requested to be reset, indicated explicitly or implicitly in the received RESET message, the MME shall respond with RESET ACKNOWLEDGE message as described in 8.7.1.2.2.

8.7.2 Error Indication

8.7.2.1 General

The Error Indication procedure is initiated by a node 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.

8.7.2.2 Successful Operation

Figure 8.7.2.2-1: Error Indication procedure, MME originated. Successful operation.

Figure 8.7.2.2-2: Error Indication procedure, eNB originated. 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 receiving node.

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 utilising UE associated signalling the *MME UE S1AP ID* IE and the *eNB UE S1AP* IE shall be included in the ERROR INDICATION message. If one or both of *MME UE S1AP ID* IE and the *eNB UE S1AP* IE are not correct, the cause shall be set to appropriate value e.g. "Unknown MME UE S1AP ID", "Unknown eNB UE S1AP" or "Unknown pair of UE S1AP ID".

8.7.2.3 Abnormal Conditions

Not applicable.

8.7.3 S1 Setup

8.7.3.1 General

The purpose of the S1 Setup procedure is to exchange application level data needed for the eNodeB and MME to interoperate correctly on the S1 interface. This procedure shall be the first S1AP procedure triggered after the TNL association has become operational. This procedure erases any existing application level configuration data in the two nodes and replaces it by the one received. This procedure also re-initialises the E-UTRAN S1AP UE-related contexts (if any) and erases all related signalling connections in the two nodes like a Reset procedure would do. If the eNB or Home eNB initiating the S1 Setup procedure supports a CSG cell, the procedure shall report the CSG ID(s) of the supported CSGs.

8.7.3.2 Successful Operation

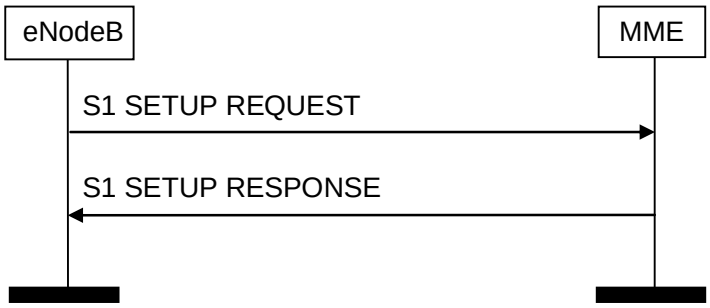

Figure 8.7.3.2-1: S1 Setup procedure: Successful Operation.

The eNodeB initiates the procedure by sending a S1 SETUP REQUEST message including the appropriate data to the MME. The MME responds with S1 SETUP RESPONSE including the appropriate data.

The exchanged data shall be stored in respective node and used for the duration of the TNL association. When this procedure is finished S1 interface is operational and other S1 messages can be exchanged.

If the eNB initiating the S1 SETUP procedure supports one (or more) CSG cell(s), the S1 SETUP REQUEST shall contain the CSG ID(s) of the supported CSG(s).

8.7.3.3 Unsuccessful Operation

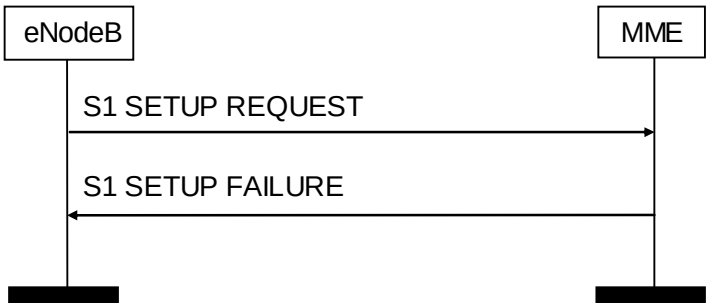

Figure 8.7.3.3-1: S1 Setup procedure: Unsuccessful Operation.

If the MME can not accept the setup it should respond with a S1 SETUP FAILURE and appropriate cause value.

If the S1 SETUP FAILURE messages include the *Time To Wait* IE the eNodeB shall wait at least for the indicated time before reinitiating the S1 setup towards the same MME.

8.7.3.4 Abnormal Conditions

If the eNB initiates the procedure by sending a S1 SETUP REQUEST message including the *PLMN Identity* IEs and the MME is not able to identify at least one of the PLMN provided by the eNB, then the MME shall reject the eNB S1 Setup Request procedure with the appropriate cause value e.g "Unknown PLMN".

8.7.4 eNB Configuration Update

8.7.4.1 General

The purpose of the eNB Configuration Update procedure is to update application level configuration data needed for the eNB and MME to interoperate correctly on the S1 interface. This procedure doesn"t affect existing UE-related contexts, if any.

8.7.4.2 Successful Operation

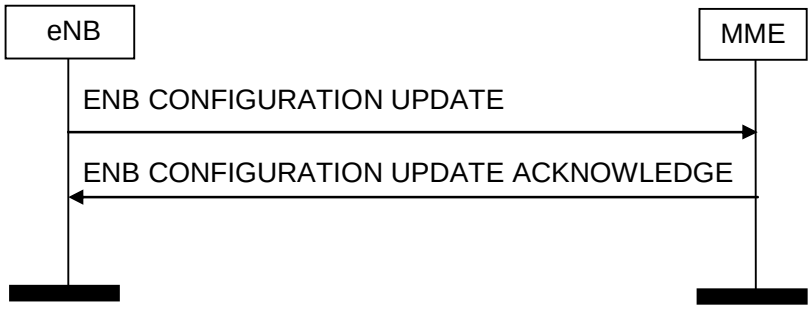

Figure 8.7.4.2-1: NB Configuration Update procedure: Successful Operation.

The eNB initiates the procedure by sending an ENB CONFIGURATION UPDATE message including the appropriate updated configuration data to the MME. The MME responds with ENB CONFIGURATION UPDATE ACKNOWLEDGE to acknowledge that it successfully updated the configuration data. If information element(s) is/are not included in the ENB CONFIGURATION UPDATE message, the MME shall interpret that the corresponding configuration data is/are not changed and shall continue to operate the S1 with the existing related configuration data.

If the supported TA(s) is(are) to be updatedthe MME shall overwrite the whole list of TAs.

If the supported CSG ID(s) is(are) to be updated, the whole list of supported CSG IDs including those that are not to be updated shall be included in the *Supported CSG IDs* IE.

The updated configuration data shall be stored in respective node and used for the duration of the TNL association or until any further update is performed from the eNB.

The eNB may intiate a further eNB configuration update only after a previous eNB configuration update procedure has been completed.

8.7.4.3 Unsuccessful Operation

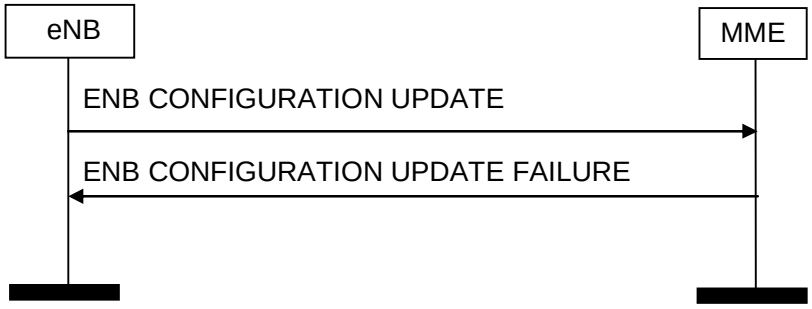

Figure 8.7.4.3-1: NB Configuration Update procedure: Unsuccessful Operation.

If the MME 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 messages includes the *Time To Wait* IE the eNB shall wait at least for the indicated time before reinitiating the NB Configuration Update procedure towards the same MME. Both nodes shall continue to operate the S1 with the existing configuration data.

8.7.4.4 Abnormal Conditions

If the eNB neither receives an ENB CONFIGURATION UPDATE ACKOWLEDGE nor an ENB CONFIGURATION UPDATE FAILURE message, the eNB may reinitiate a further eNB Configuration Update procedure towards the same MME.

8.7.5 MME Configuration Update

8.7.5.1 General

The purpose of the MME Configuration Update procedure is to update application level configuration data needed for the eNB and MME to interoperate correctly on the S1 interface. This procedure doesn"t affect existing UE-related contexts, if any.

8.7.5.2 Successful Operation

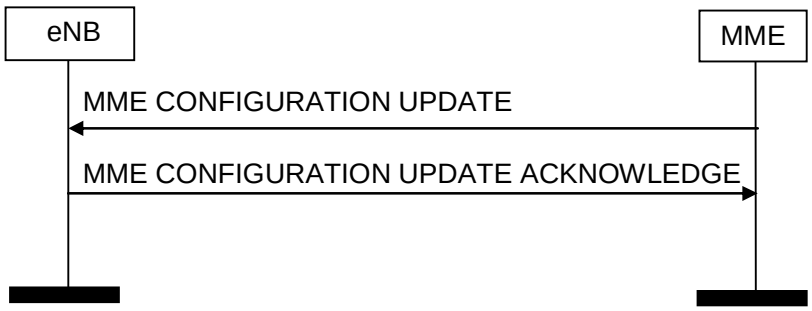

Figure 8.7.5.2-1: MME Configuration Update procedure: Successful Operation.

The MME initiates the procedure by sending an MME CONFIGURATION UPDATE message including the appropriate updated configuration data to the eNB. The eNB responds with MME CONFIGURATION UPDATE ACKNOWLEDGE to acknowledge that it successfully updated the configuration data. If information element(s) is/are not included in the MME CONFIGURATION UPDATE message, the eNB shall interpret that the corresponding configuration data is/are not changed and shall continue to operate the S1 with the existing related configuration data.

If the served PLMNs is(are) to be updated, the eNB shall overwrite the whole list of PLMNs.

The updated configuration data shall be stored in respective node and used for the duration of the TNL association or until any further update is performed from the MME.

The MME may intiate a further MME configuration update only after a previous MME configuration update procedure has been completed.

8.7.5.3 Unsuccessful Operation

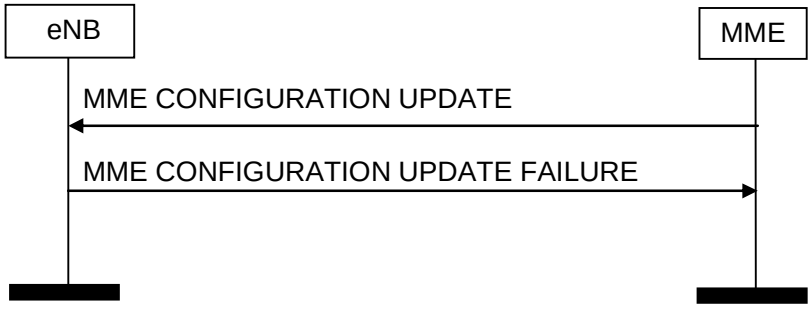

Figure 8.7.5.3-1: MME Configuration Update: Unsuccessful Operation.

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

If the MME CONFIGURATION UPDATE FAILURE message includes the *Time To Wait* IE the MME shall wait at least for the indicated time before reinitiating the MME Configuration Update procedure towards the same eNB. Both nodes shall continue to operate the S1 with the existing configuration data.

8.7.5.4 Abnormal Conditions

If the MME neither receives a MME CONFIGURATION UPDATE ACKOWLEDGE nor a MME CONFIGURATION UPDATE FAILURE message, the MME may reinitiate a further MME Configuration Update procedure towards the same eNB.

8.7.6 Overload Start

8.7.6.1 General

The purpose of the Overload Start procedure is to inform an eNB to reduce the signalling load towards the concerned MME.

The procedure uses non-UE associated signalling.

8.7.6.2 Successful Operation

Figure 8.7.6.2-1: Overload Start procedure

The eNB receiving the OVERLOAD START message shall assume the MME from which it receives the message as being in an overloaded state.

If the *Overload Action* IE in the OVERLOAD START message is set to

- "reject all RRC connection requests for non-emergency mobile originated data transfer ", or
- "reject all new RRC connection requests for signalling ",or
- "only permit RRC connection establishments for emergency sessions".

the eNB shall reject/permit the indicated signalling traffic.

8.7.6.3 Unsuccessful Operation

Not applicable.

8.7.7 Overload Stop

8.7.7.1 General

The purpose of the Overload Stop procedure is to signal to an eNB the MME is connected to that the overload situation at the MME has ended and normal operation shall resume.

The procedure uses non-UE associated signalling.

8.7.7.2 Successful Operation

Figure 8.7.7.2.-1: Overload Stop procedure

The eNB receiving the OVERLOAD STOP message shall assume that the overload situation at the MME from which it receives the message has ended and shall resume normal operation towards this MME.

8.7.7.3 Unsuccessful Operation

Not applicable.

8.8 S1 CDMA2000 Tunneling Procedures

8.8.1 General

The purpose of S1 CDMA2000 Tunneling procedures is to carry CDMA2000 signalling between UE and CDMA2000 RAT over the S1 Interface. This includes signalling for pre-registration of UE with CDMA2000 HRPD network, signalling for handover preparation for handover from E-UTRAN to CDMA2000 HRPD/1xRTT and pre-registration and paging of UE with CDMA2000 1xRTT CS system. The CDMA2000 messages are not interpreted by the eNB, and their content is outside the scope of this specification, however, additional information may be sent along with the tunnelled CDMA2000 message to assist the eNodeB and MME in the tunneling procedure. These procedures use an established UE-associated logical S1-connection.

The CDMA2000 messages are transported in an IE of the DOWNLINK S1 CDMA2000 TUNNELING or UPLINK S1 CDMA2000 TUNNELING messages.

8.8.2 Successful Operations

8.8.2.1 Downlink S1 CDMA2000 Tunneling

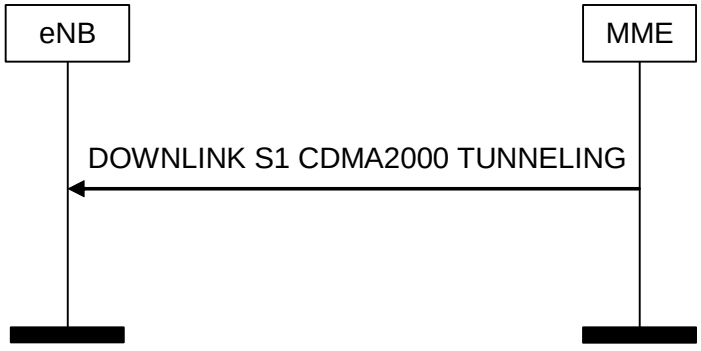

Figure 8.8.2.1-1: Downlink S1 CDMA2000 Tunneling Procedure

If a CDMA2000 message shall be sent from the MME to the UE and a UE-associated logical S1-connection exists for the UE the MME should send a DOWNLINK S1 CDMA2000 TUNNELING message to the eNB including the CDMA2000 message in the *CDMA2000-PDU* IE. The eNB forwards the received *CDMA2000-PDU* IE and *CDMA2000 RAT Type* IE to the UE.

If the MME receives handover status information along with the tunnelled downlink CDMA2000 message the MME should include the handover status information in *CDMA2000 HO Status* IE in the DOWNLINK S1 CDMA2000 TUNNELING message.

If the DOWNLINK S1 CDMA2000 TUNNELING message contains the *E-RABs Subject to Forwarding List* IE it indicates that DL forwarding is available for the indicated E-RABs towards the tunnel endpoint identified by the *DL GTP TEID* IE for those E-RABs.

Editor"s Note: The DL data forwarding behaviour of the eNB for handover to CDMA2000 HRPD/1xRTT should be aligned to the DL data forwarding behaviour of eNB for 3GPP inter-RAT handover.

8.8.2.2 Uplink S1 CDMA2000 Tunneling

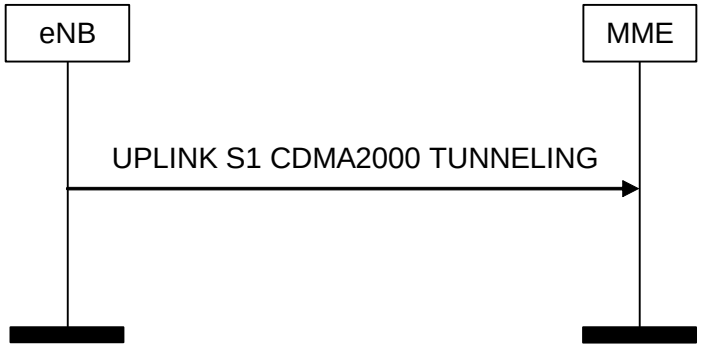

Figure 8.8.2.2-1: Uplink S1 CDMA2000 Tunneling Procedure

When the eNB has received from the radio interface a CDMA2000 message to be forwarded to the MME to which an UE-associated logical S1-connection for the UE exists, the eNB shall send the UPLINK S1 CDMA2000 TUNNELING message to the MME including the CDMA2000 message in the *CDMA2000-PDU* IE.

If the MME receives the *CDMA2000 HO Required Indication* IE set to "true" in UPLINK S1 CDMA2000 TUNNELING message the MME should send the necessary handover preparation information to the CDMA2000 target RAT.

If the MME receives any of the *CDMA2000 1xRTT SRVCC Info*IE, or the *CDMA2000 1xRTT RAND* IE in the UPLINK S1 CDMA2000 TUNNELING message the MME should forward the received information to the CDMA2000 1xRTT RAT.

Interactions with E-RAB Management procedures:

If, after an UPLINK S1 CDMA2000 TUNNELING message with *CDMA2000 HO Required Indication* IE set to 'true' is sent but before the DOWNLINK S1 CDMA2000 TUNNELING message with *CDMA2000 HO Status* IE is received, the source eNB receives a MME initiated E-RAB Management procedure on the same UE associated signaling connection, the source eNB shall terminate the MME initiated E-RAB Management procedure by sending the appropriate response message with the cause value 'Handover Triggered' to the MME.

8.8.3 Unsuccessful Operation

Not applicable

8.8.4 Abnormal Conditions

Editor"s Note: Further Assessment required.

8.9 UE Capability Info Indication

8.9.1 General

The purpose of the UE Capability Info Indication procedure is used to enable the eNB to provide this information and relevant updates of this information within the eNB that took place without MME notice within the E-UTRAN to the MME.

8.9.2 Successful Operation

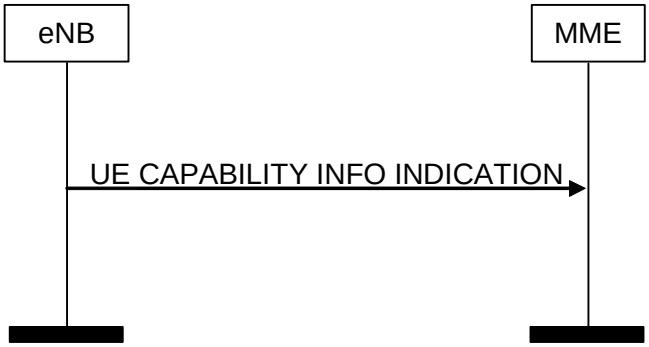

Figure 8.9.2-1: UE Capability Info Indication procedure. Successful operation.

The eNB controlling a UE-associated logical S1-connection initiates the procedure by generating an UE CAPABILITY INFO INDICATION message towards the affected MME node including UE capability information. The UE capability information provided to the MME should overwrite respective UE capability related information stored in the MME.

8.10 Trace Procedures

8.10.1 Trace Start

8.10.1.1 General

The Trace Start procedure is initiated by a MME in order to start a trace recording for a UE in LTE_ACTIVE. The procedure uses UE-associated signalling.

8.10.1.2 Successful Operation

Figure 8.10.1.2-1: Trace Start procedure.

On receipt of a TRACE START message the eNB shall initiate the requested trace function as described in [10].

8.10.2 Trace Failure Indication

8.10.2.1 General

The Trace Start Failure Indication procedure is initiated by an eNB in order to inform the MME that a Trace Start procedure or a Deactivate Trace procedure has failed. The procedure uses UE-associated signalling.

8.10.2.2 Successful Operation

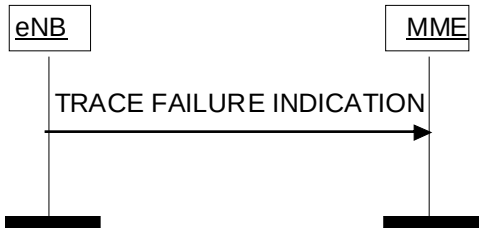

Figure 8.10.2.2-1: Trace Failure Indication procedure.

Upon reception of the TRACE FAILRE INDICATION message the MME shall based on the failure reason indicated by the *Cause* IE take appropriate action.

8.10.3 Deactivate Trace

8.10.3.1 General

The purpose of the Deactivate Trace procedure is to inform the eNB to stop the trace session, for the indicated trace reference.

8.10.3.2 Successful Operation

Figure 8.10.3.2-1: Deactivate Trace procedure. Successful operation.

The MME invokes the Deactivate Trace procedure by sending a DEACTIVATE TRACE message to the eNB.

The eNB shall stop the trace session for the indicated trace reference in the *Trace Reference* IE.

8.11 Location Reporting Procedures

8.11.1 Location Reporting Control

8.11.1.1 General

The purpose of Location Reporting Control procedure is to allow the MME to request the eNB to report where the UE is currently located. The procedure uses UE-associated signalling.

8.11.1.2 Successful Operation

Figure 8.11.1.2-1: Location Reporting Control procedure. Successful operation.

The MME initiates the procedure by sending a LOCATION REPORTING CONTROL message. On receipt of a LOCATION REPORTING CONTROL message the eNB shall perform the requested location reporting control action for the UE.

The *Request Type* IE indicates to the eNB whether:

- to report directly;
- to report upon change of serving cell, or
- to stop reporting at change of serving cell.

If reporting upon change of serving cell is requested, the eNB shall report whenever the UE changes its serving cell to another cell belonging to the eNB.

The *Request Type* IE also indicates what type of location information the eNB shall report. The location information is E-UTRAN CGI and TAI.

8.11.1.3 Abnormal Conditions

Not applicable.

8.11.2 Location Report Failure Indication

8.11.2.1 General

The Location Report Failure Indication procedure is initiated by an eNB in order to inform the MME that a Location Reporting Control procedure has failed. The procedure uses UE-associated signalling.

8.11.2.2 Successful Operation

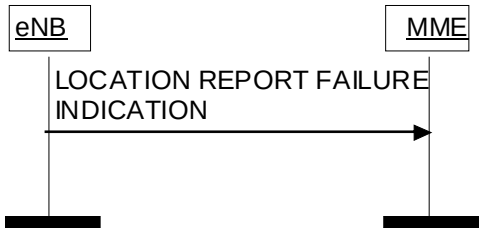

Figure 8.11.2.2-1: Location Report Failure Indication procedure.

Upon reception of the LOCATION REPORT FAILRE INDICATION message the MME shall based on the failure reason indicated by the *Cause* IE take appropriate action.

8.11.3 Location Report

8.11.3.1 General

The purpose of Location Report procedure is to provide the UE's current location to the MME. The procedure uses UE-associated signalling.

8.11.3.2 Successful Operation

Figure 8.11.3.2-1: Location Report procedure. Successful operation.

The eNB initiates the procedure by generating a LOCATION REPORT message. The LOCATION REPORT message may be used as a response to a LOCATION REPORTING CONTROL message.

In case reporting at change of serving cell has been requested, the eNB shall send a LOCATION REPORT message whenever the information given to the EPC in any S1AP message is not anymore valid.

8.11.3.3 Abnormal Conditions

Not applicable.

8.12 Warning Message Transmission Procedures

8.12.1 Write-Replace Warning

8.12.1.1 General

The purpose of Write-Replace Warning procedure is to start and overwrite the broadcasting of warning message.

The procedure uses non UE-associated logical S1 connection.

8.12.1.2 Successful Operation

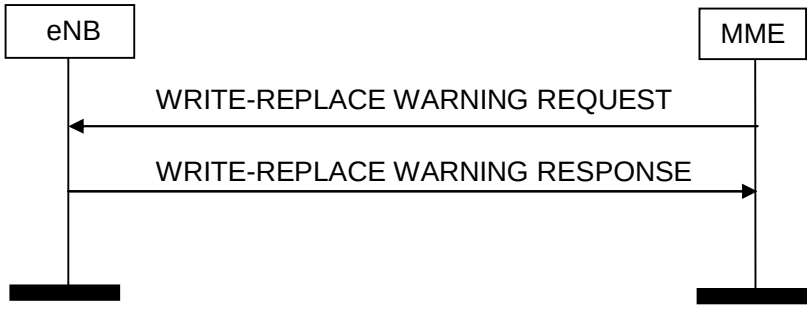

Figure 8.12.1.2-1: Write-Replace Warning procedure. Successful operation.

The MME initiates the procedure by sending a WRITE-REPLACE WARNING REQUEST message to the eNB.

If WRITE-REPLACE WARNING REQUEST is received, eNB shall prioritise its resources to process the warning message.

If , in a certain area, broadcast of a warning message is already ongoing, the eNB shall replace the warning message being broadcast with the newly received one for that area.

If *Warning Area* IE is not included in WRITE-REPLACE WARNING REQUEST message, the eNB shall broadcast the indicated message in all of the cells within the eNB.

If *Warning Type* IE is included in WRITE-REPLACE WARNING REQUEST message, the eNB shall send the Paging to inform the UE about the availability of Primary Notification.

The eNB ends the procedure by sending WRITE-REPLACE WARNING RESPONSE to the MME.

8.13 eNB Direct Information Transfer

8.13.1 General

The purpose of the eNB Direct Information Transfer procedure is to transfer RAN information from the eNB to the MME in unacknowledged mode. The MME does not interpret the transferred RAN information.

This procedure uses non-UE associated signalling.

8.13.2 Successful Operation

8.13.2.1 eNB Direct Information Transfer

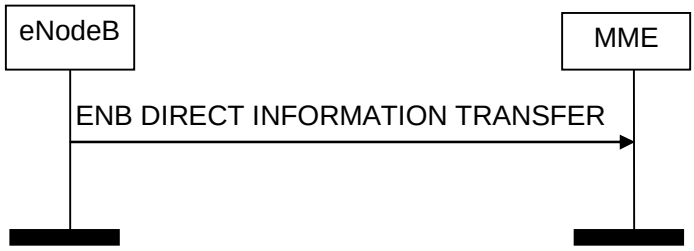

Figure 8.13.1.2-1: Information Request procedure. Successful operation.

The procedure is initiated with a ENB DIRECT INFORMATION TRANSFER message sent from the eNB to the MME.

The *RIM Transfer* IE shall contain *RIM Routing Address* IE that identifies the final RAN destination node where the RIM information needs to be transferred by the core network.

8.13.3 Abnormal Conditions

Not applicable.

8.14 MME Direct Information Transfer

8.14.1 General

The purpose of the MME Direct Information Transfer procedure is to transfer RAN information from the MME to the eNB in unacknowledged mode.

This procedure uses non-UE associated signalling.

8.14.2 Successful Operation

8.14.2.1 MME Direct Information Transfer

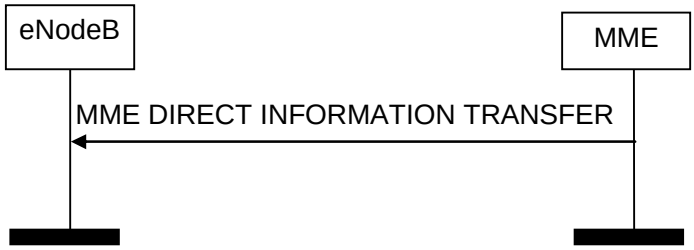

Figure 8.14.1.2-1: Information Request procedure. Successful operation.

The procedure is initiated with a DIRECT INFORMATION TRANSFER message sent from the MME to the eNB.

8.14.3 Abnormal Conditions

Not applicable.

9 Elements for S1AP Communication

9.1 Message Functional Definition and Content

Editor"s Note: Description of functional definition and content.

Editor"s note: Tabular format tables content (e.g. semantic description, criticality assignment, etc.) will be updated in forthcoming meetings.

9.1.1 General

9.1.2 Message Contents

9.1.2.1 Presence

All information elements in the message descriptions below are marked mandatory, optional or conditional according to table 4.

Table 4: Meaning of abbreviations used in S1AP messages

Abbreviation	Meaning
M	IEs marked as Mandatory (M) shall always be included in the message.
O	IEs marked as Optional (O) may or may not be included in the message.
C	IEs marked as Conditional (C) shall be included in a message only if the condition is satisfied. Otherwise the IE shall not be included.

9.1.2.2 Criticality

Each Information Element or Group of Information Elements may have criticality information applied to it. Following cases are possible:

Table 5: Meaning of content within 'Criticality' column

Abbreviation	Meaning
–	No criticality information is applied explicitly.
YES	Criticality information is applied. This is usable only for non-repeatable IEs
GLOBAL	The IE and all its repetitions together have one common criticality information. This is usable only for repeatable IEs.
EACH	Each repetition of the IE has its own criticality information. It is not allowed to assign different criticality values to the repetitions. This is usable only for repeatable IEs.

9.1.2.3 Range

The Range column indicates the allowed number of copies of repetitive IEs/IE groups.

9.1.2.4 Assigned Criticality

This column provides the actual criticality information as defined in subclause 10.3.2, if applicable.

9.1.3 E-RAB Management Messages

9.1.3.1 E-RAB SETUP REQUEST

This message is sent by the MME and is used for request the eNB to assign resources on Uu and S1 for one or several E-RABs.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
UE Aggregate Maximum Bit Rate	O		9.2.1.20		YES	reject
E-RAB to be Setup List	M				YES	reject
>E-RAB To Be Setup Item IEs		1 to <maxnoof E-RABs>			EACH	reject
>> E-RAB ID	M		9.2.1.2		-	
>> E-RAB Level QoS parameters	M		9.2.1.15	Includes necessary QoS parameters	-	
>> Transport Layer Address	M		9.2.2.1		-	
>> GTP-TEID	M		9.2.2.2	note: EPC TEID, UDP port	-	
>>NAS-PDU	M		9.2.3.5		YES	ignore

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RAB allowed towards one UE, the maximum value is 256.

9.1.3.2 E-RAB SETUP RESPONSE

This message is sent by the eNB and is used to report the outcome of the request from the E-RAB SETUP REQUEST message.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	ignore
eNB UE S1AP ID	M		9.2.3.4		YES	ignore
E-RAB Setup List	O				YES	ignore
>E-RAB Setup Item IEs		1 to <maxnoof E-RABs>			EACH	ignore
>> E-RAB ID	M				-	
>> Transport Layer Address	M		9.2.2.1		-	
>> GTP-TEID	M		9.2.2.2	note: eNB TEID, UDP port	-	
E-RAB Failed to Setup List	O		E-RAB List 9.2.1.36	a value for *E-RAB identity* shall only be present once in *E-RAB Failed to Setup List* IE	YES	ignore
Criticality Diagnostics	O		9.2.1.21		YES	ignore

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RAB allowed towards one UE, the maximum value is 256.

9.1.3.3 E-RAB MODIFY REQUEST

This message is sent by the MME and is used to request the eNB to modify the Data Radio Bearers and the allocated resources on Uu and S1 for one or several E-RABs.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
UE Aggregate Maximum Bit Rate	O		9.2.1.20		YES	reject
E-RAB to be Modified List	M				YES	reject
>E-RAB To Be Modified Item IEs		1 to <maxnoof E-RABs>			EACH	reject
>> E-RAB ID	M		9.2.1.2		-	
>> E-RAB Level QoS Parameters	M		9.2.1.15	Includes necessary QoS parameters	-	
>> NAS-PDU	M		9.2.3.5		YES	ignore

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RAB allowed towards one UE, the maximum value is 256.

9.1.3.4 E-RAB MODIFY RESPONSE

This message is sent by the eNB and is used to report the outcome of the request from the E-RAB MODIFY REQUEST message.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	ignore
eNB UE S1AP ID	M		9.2.3.4		YES	ignore
E-RAB Modify List	O				YES	ignore
>E-RAB Modify Item IEs		1 to <maxnoof E-RABs>			EACH	ignore
>> E-RABID	M		9.2.1.2		-	
E-RAB Failed to Modify List	O		E-RAB List 9.2.1.36	a value for *E-RAB identity* shall only be present once in *E-RAB Modifiy List* IE + *E-RAB Failed to Modify List*	YES	ignore
Criticality Diagnostics	O		9.2.1.21		YES	ignore

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RAB allowed towards one UE, the maximum value is 256.

9.1.3.5 E-RAB RELEASE COMMAND

This message is sent by the MME and is used to request the eNB to release allocated resources on Uu and S1 for one or several E-RABs..

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
UE Aggregate Maximum Bit Rate	O		9.2.1.20		YES	reject
E-RAB To Be Released List	M		E-RAB List 9.2.1.36	a value for E-RAB identity shall only be present once in E-RAB To Be Released List IE	YES	ignore
NAS PDU	O		9.1.3.5		YES	ignore

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RAB allowed towards one UE, the maximum value is 256.

9.1.3.6 E-RAB RELEASE RESPONSE

This message is sent by the eNB and is used to report the outcome of the request from the E-RAB RELEASE COMMAND message.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	ignore
eNB UE S1AP ID	M		9.2.3.4		YES	ignore
E-RAB Release List	O				YES	ignore
>E-RAB Release Item IEs		1 to <maxnoof E-RABs>			EACH	ignore
>> E-RAB ID	M		9.2.1.2		-	
E-RAB Failed to Release List	O		E-RAB List 9.2.1.36	a value for *E-RAB identity* shall only be present once in *E-RAB Release List* IE + *E-RAB Failed to Release List* IE	YES	ignore
Criticality Diagnostics	O		9.2.1.21		YES	ignore

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RAB allowed towards one UE, the maximum value is 256.

9.1.3.7 E-RAB RELEASE INDICATION

This message is sent by the eNB and is used to indicate the MME to release one or several E-RABs for one UE.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
E-RAB Released List	M		E-RAB List 9.2.1.36	a value for *E-RAB identity* shall only be present once in *E-RAB Released List* IE	YES	ignore

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RAB allowed towards one UE, the maximum value is 256.

9.1.4 Context Management Messages

9.1.4.1 INITIAL CONTEXT SETUP REQUEST

This message is sent by the MME to request a setup of a UE context.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
UE Aggregate Maximum Bit Rate	M		9.2.1.20		YES	reject
E-RAB to Be Setup List	M				YES	reject
> E-RAB to Be Setup Item IEs		1 to <maxnoofE-RABs>			EACH	reject
>>E-RAB ID	M		9.2.1.2		-	
>>E-RAB Level QoS Parameters	M		9.2.1.15	Includes necessary QoS parameters	-	
>>Transport Layer Address	M		9.2.2.1		-	
>> GTP TEID	M		9.2.2.2		-	
>> NAS-PDU	O		9.2.3.5		YES	ignore
UE Security Capabilities	M		9.2.1.40		YES	reject
Security Key	M		9.2.1.41	The KeNB is provided after the key-generation in the MME, see [15]	YES	reject
Trace Activation	O		9.2.1.4		YES	ignore
Handover Restriction List	O		9.2.1.22		YES	ignore
UE Radio Capability	O		9.2.1.27		YES	ignore
Subscriber Profile ID for RAT/Frequency priority	O		9.2.1.39		YES	ignore
CS Fallback Indicator	O		9.2.3.21		YES	reject
SRVCC operation possible	O		9.2.1.58		YES	ignore

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RAB allowed towards one UE, the maximum value is 256.

9.1.4.2 INITIAL CONTEXT SETUP RESPONSE

This message is sent by the eNB to confirm the setup of a UE context.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	ignore
eNB UE S1AP ID	M		9.2.3.4		YES	ignore
E-RAB Setup List	M				YES	ignore
> E-RAB Setup Item IEs		1 to <maxnoofE-RABs>			EACH	ignore
>>E-RAB Identity	M		9.2.1.2		-	
>>Transport Layer Address	M		9.2.2.1		-	
>>GTP TEID	M		9.2.2.2		-	
E-RAB Failed to Setup List	O		E-RAB List 9.2.1.36		YES	ignore
Criticality Diagnostics	O		9.2.1.21		YES	ignore

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RAB allowed towards one UE, the maximum value is 256.

9.1.4.3 INITIAL CONTEXT SETUP FAILURE

This message is sent by the eNB to indicate that the setup of the UE context was unsuccessful.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	ignore
eNB UE S1AP ID	M		9.2.3.4		YES	ignore
Cause	M		9.2.1.3		YES	ignore
Criticality Diagnostics	O		9.2.1.21		YES	ignore

9.1.4.5 UE CONTEXT RELEASE REQUEST

This message is sent by the eNB to request the release of the UE-associated S1-logical connection over the S1 interface.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
Cause	M		9.2.1.3		YES	ignore

9.1.4.6 UE CONTEXT RELEASE COMMAND

This message is sent by the MME to request the release of the UE-associated S1-logical connection over the S1 interface.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
CHOICE *UE S1 AP IDs*	M				YES	reject
>UE S1 AP ID pair	M		9.2.3.18			
>MME UE S1AP ID	M		9.2.3.3			
Cause	M		9.2.1.3		YES	ignore

9.1.4.7 UE CONTEXT RELEASE COMPLETE

This message is sent by the eNB to confirm the release of the UE-associated S1-logical connection over the S1 interface.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	ignore
eNB UE S1AP ID	M		9.2.3.4		YES	reject
Criticality Diagnostics	O		9.2.1.21		YES	ignore

9.1.4.8 UE CONTEXT MODIFICATION REQUEST

This message is sent by the MME to provide UE Context information changes to the eNB.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
Security Key	O		9.2.1.41	A fresh KeNB is provided after performing a key-change on the fly procedure in the MME, see [15]	YES	reject
Subscriber Profile ID for RAT/Frequency priority	O		9.2.1.39		YES	ignore
UE Aggregate Maximum Bit Rate	O		9.2.1.20		YES	ignore
CS Fallback Indicator	O		9.2.3.21		YES	reject

9.1.4.9 UE CONTEXT MODIFICATION RESPONSE

This message is sent by the eNB to confirm the performed UE context updates.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	ignore
eNB UE S1AP ID	M		9.2.3.4		YES	ignore
Criticality Diagnostics	O		9.2.1.21		YES	ignore

9.1.4.10 UE CONTEXT MODIFICATION FAILURE

This message is sent by the eNB in case the performed UE context update is not successful.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	ignore
eNB UE S1AP ID	M		9.2.3.4		YES	ignore
Cause	M		9.1.2.3		YES	ignore
Criticality Diagnostics	O		9.2.1.21		YES	ignore

9.1.5 Handover Signalling Messages

9.1.5.1 HANDOVER REQUIRED

This message is sent by the source eNodeB to the MME to request the preparation of resources at the target.

Direction: eNodeB → MME.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
Handover Type	M	<IntraLTE, LTEtoUTRAN, LTEtoGERAN>	9.2.1.13		YES	reject
Cause	M		9.2.1.3		YES	ignore
Target ID	M		9.2.1.6		YES	reject
Direct Forwarding Path Availability	O		9.2.3.15		YES	ignore
SRVCC HO Indication	O		9.2.1.59		YES	reject
Source to Target Transparent Container	M		9.2.1.56		YES	reject

Condition	Explanation
ifIntraLTE	This IE shall be present if the *Handover Type* IE is set to the 'Value' IntraLTE.
ifLTEtoUTRAN	This IE shall be present if the *Handover Type* IE is set to the 'Value' LTEtoUTRAN.
ifLTEtoGERAN	This IE shall be present if the *Handover Type* IE is set to the 'Value' LTEtoGERAN.

9.1.5.2 HANDOVER COMMAND

This message is sent by the MME to inform the source eNodeB that resources for the handover have been prepared at the target side.

Direction: MME → eNodeB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
Handover Type	M	<IntraLTE, LTEtoUTRAN, LTEtoGERAN>	9.2.1.13		YES	reject
NAS downlink COUNT	C-ifNotIntraLTE		BIT STRING (4) [length is FFS]	Four LSB of the NAS downlink count [15]	YES	reject
E-RABs Subject to Forwarding List	O				YES	ignore
>E-RABs Subject to Forwarding Item IEs		1 to <maxnoof E-RABs>			EACH	ignore
>> E-RAB ID	M		9.2.1.2		-	
>> DL Transport Layer Address	O		9.2.2.1		-	
>> DL GTP TEID	O		9.2.2.2	To deliver forwarded DL PDCP SDUs	-	
>> UL Transport Layer Address	O		9.2.2.1			
>> UL GTP TEID	O		9.2.2.2	To deliver forwarded UL PDCP SDUs		
E-RABs to Release List	O		E-RAB List 9.2.1.36		YES	ignore
Target to Source Transparent Container	M		9.2.1.57		YES	reject
Criticality Diagnostics	O		9.2.1.21		YES	ignore

Editor"s Note: How to handle and control data forwarding is FFS. This means that the existence of, and the definition of the E-RABs Subject to Forwarding List IE is FFS.

Condition	Explanation
ifIntraLTE	This IE shall be present if the *Handover Type* IE is set to the 'Value' IntraLTE.
ifLTEtoUTRAN	This IE shall be present if the *Handover Type* IE is set to the 'Value' LTEtoUTRAN.
ifLTEtoGERAN	This IE shall be present if the *Handover Type* IE is set to the 'Value' LTEtoGERAN.
if ifNotIntraLTE	This IE shall be present if the Handover Type IE is not set to the value "IntraLTE"

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RABs for one UE. Value is 256.

9.1.5.3 HANDOVER PREPARATION FAILURE

This message is sent by the MME to inform the source eNodeB that the Handover Preparation has failed.

Direction: MME → eNodeB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	ignore
eNB UE S1AP ID	M		9.2.3.4		YES	ignore
Cause	M		9.2.1.3		YES	ignore
Criticality Diagnostics	O		9.2.1.21		YES	ignore

9.1.5.4 HANDOVER REQUEST

This message is sent by the MME to the target eNodeB to request the preparation of resources.

Direction: MME → eNodeB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	reject
Handover Type	M	<IntraLTE, UTRANtoLTE, GERANtoLTE>	9.2.1.13		YES	reject
Cause	M		9.2.1.3		YES	ignore
UE Aggregate Maximum Bit Rate	M		9.2.1.20		YES	reject
E-RABs To Be Setup List	M				YES	reject
>E-RABs To Be Setup Item IEs		1 to <maxnoof E-RABs>			EACH	reject
>> E-RAB ID	M		9.2.1.2		-	
>> Transport Layer Address	M		9.2.2.1		-	
>> GTP TEID	M		9.2.2.2	To deliver UL PDUs	-	
>> E-RAB Level QoS Parameters	M		9.2.1.15	Includes necessary QoS parameters	-	
Source to Target Transparent Container	M		9.2.1.56		YES	reject
UE Security Capabilities	M		9.2.1.40		YES	reject
Handover Restriction List	O		9.2.1.22		YES	ignore
Trace Activation	O		9.2.1.4		YES	ignore
Request Type	O		9.2.1.34		YES	ignore
SRVCC operation possible	O		9.2.1.58		YES	ignore
Security Context	M		9.2.1.26	One pair of { NH, NCC} are provided for 1-hop security, see [15]	YES	reject

Editor"s Note: The details of required IEs to indicate security parameters in the message (e.g., encryption and integrity protection information) are FFS.

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RABs for one UE. Value is 256.

9.1.5.5 HANDOVER REQUEST ACKNOWLEDGE

This message is sent by the target eNodeB to inform the MME about the prepared resources at the target.

Direction: eNodeB → MME.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	ignore
eNB UE S1AP ID	M		9.2.3.4	allocated at the target eNodeB	YES	ignore
Handover Type	M	<IntraLTE, UTRANtoLTE, GERANtoLTE>	9.2.1.13		YES	ignore
E-RABs Admitted List	M				YES	ignore
>E-RABs Admitted Item IEs		1 to <maxnoof E-RABs>			EACH	ignore
>> E-RAB ID	M		9.2.1.2		-	
>> Transport Layer Address	M		9.2.2.1		-	
>> GTP TEID	M		9.2.2.2	To deliver DL PDUs	-	
>> DL Transport Layer Address	O		9.2.2.1		-	
>> DL GTP TEID	O		9.2.2.2	To deliver forwarded DL PDCP SDUs.	-	
>> UL Transport Layer Address	O		9.2.2.1		-	
>> UL GTP TEID	O		9.2.2.2	To deliver forwarded UL PDCP SDUs.	-	
E-RABs Failed to Setup List	O		E-RAB List 9.2.1.36		YES	ignore
Target to Source Transparent Container	M		9.2.1.57		YES	reject
Criticality Diagnostics	O		9.2.1.21		YES	ignore

Condition	Explanation
ifIntraLTE	This IE shall be present if the *Handover Type* IE is set to the 'Value' IntraLTE.
ifUTRANtoLTE	This IE shall be present if the *Handover Type* IE is set to the 'Value' UTRANtoLTE.
ifGERANtoLTE	This IE shall be present if the *Handover Type* IE is set to the 'Value' GERANtoLTE.

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RABs for one UE. Value is 256.

9.1.5.6 HANDOVER FAILURE

This message is sent by the target eNodeB to inform the MME that the preparation of resources has failed.

Direction: eNodeB → MME.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	ignore
Cause	M		9.2.1.3		YES	ignore
Criticality Diagnostics	O		9.2.1.21		YES	ignore

9.1.5.7 HANDOVER NOTIFY

This message is sent by the target eNodeB to inform the MME that the UE has been identified in the target cell and the S1 handover has been completed.

Direction: eNodeB → MME.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
E-UTRAN CGI	M		9.2.1.38		YES	ignore
TAI	M		9.2.3.16		YES	ignore
UE Security Capabilities	M		9.2.1.40		YES	ignore

9.1.5.8 PATH SWITCH REQUEST

This message is sent by the eNodeB to request the MME to switch DL GTP tunnel termination point(s) from one end-point to another.

Direction: eNodeB → MME.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
E-RAB To Be Switched in Downlink List	M				YES	reject
>E-RABs Switched in Downlink Item IEs		1 to <maxnoof E-RABs>			EACH	reject
>> E-RAB ID	M		9.2.1.2		-	
>> Transport layer address	M		9.2.2.1		-	
>> GTP TEID	M		9.2.2.2	To deliver DL PDUs	-	
Source MME UE S1AP ID	M		9.2.3.3		YES	reject
E-UTRAN CGI	M		9.2.1.38		YES	ignore
TAI	M		9.2.3.16		YES	ignore
UE Security Capabilities	M		9.2.1.40		YES	ignore

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RABs for one UE. Value is 256.

9.1.5.9 PATH SWITCH REQUEST ACKNOWLEDGE

This message is sent by the MME to inform the eNodeB that the path switch has been successfully completed in the EPC.

Direction: MME → eNodeB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	ignore
eNB UE S1AP ID	M		9.2.3.4		YES	ignore
UE Aggregate Maximum Bit Rate	O		9.2.1.20		YES	ignore
E-RAB To Be Switched in Uplink List	O				YES	ignore
> E-RABs Switched in Uplink Item IEs		1 to <maxnoof E-RABs>			EACH	ignore
>> E-RAB ID	M		9.2.1.2		-	
>> Transport layer address	M		9.2.2.1		-	
>> GTP TEID	M		9.2.2.2		-	
E-RAB To Be Released List	O		E-RAB List 9.2.1.36		YES	ignore
Security Context	M		9.2.1.26	One pair of {NCC, NH} is provided	YES	reject
Criticality Diagnostics	O		9.2.1.21		YES	ignore

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RABs for one UE. Value is 256.

9.1.5.10 PATH SWITCH REQUEST FAILURE

This message is sent by the MME to inform the eNodeB that a failure has occurred in the EPC during the Path switch request procedure.

Direction: MME → eNodeB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	ignore
eNB UE S1AP ID	M		9.2.3.4		YES	ignore
Cause	M		9.2.1.3		YES	ignore
Criticality Diagnostics	O		9.2.1.21		YES	ignore

9.1.5.11 HANDOVER CANCEL

This message is sent by the source eNodeB to the MME to request the cancellation of an ongoing handover.

Direction: eNodeB → MME.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
Cause	M		9.2.1.3		YES	ignore

9.1.5.12 HANDOVER CANCEL ACKNOWLEDGE

This message is sent by the MME to the source eNodeB to confirm that the ongoing handover was cancelled.

Direction: MME → eNodeB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME UE S1AP ID	M		9.2.3.3		YES	ignore
eNB UE S1AP ID	M		9.2.3.4		YES	ignore
Criticality Diagnostics	O		9.2.1.21		YES	ignore

9.1.5.13 eNB STATUS TRANSFER

This message is sent by the source eNodeB to transfer the PDCP SN receiver and transmitter status.

Direction: eNodeB → MME.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.11		YES	ignore
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
eNB Status Transfer Transparent Container	M		9.2.1.31		YES	reject

Editor"s note: it is FFS if the procedure may be triggered more than once time during the handover preparation.

9.1.5.14 MME STATUS TRANSFER

This message is sent by the MME to transfer the PDCP SN receiver and transmitter status.

Direction: MME → eNodeB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.15		YES	ignore
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
eNB Status Transfer Transparent Container	M		9.2.1.31		YES	reject

9.1.6 PAGING

This message is sent by the MME and is used to page a UE in one or several tracking areas.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
UE Identity Index value	M		9.2.3.10		YES	ignore
UE Paging ID	M		9.2.3.13		YES	ignore
Paging DRX	O		9.2.1.16		YES	ignore
CN Domain	M		9.2.3.22		YES	ignore
List of TAIs	M				YES	ignore
>TAI List Item		1 to < maxnoofTAI >			EACH	ignore
>>TAI	M		9.2.3.16		-	

Range bound	Explanation
maxnoofTAI	Maximum no. of TAI Identity for one UE. Value is 256.

9.1.7 NAS Transport Messages

9.1.7.1 INITIAL UE MESSAGE

This message is sent by the eNB to transfer the initial layer 3 message to the MME over the S1 interface.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
eNB UE S1AP ID	M		9.2.3.4		YES	reject
NAS-PDU	M		9.2.3.5		YES	reject
TAI	M		9.2.3.16	Indicating the Tracking Area from which the UE has sent the NAS message.	YES	reject
E-UTRAN CGI	M		9.2.1.38	Indicating the E-UTRAN CGI from which the UE has sent the NAS message.	YES	ignore
S-TMSI	O		9.2.3.6		YES	reject
CSG Id	O		9.2.1.62		YES	reject

9.1.7.2 DOWNLINK NAS TRANSPORT

This message is sent by the MME and is used for carrying NAS information over the S1 interface.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
NAS-PDU	M		9.2.3.5		YES	reject
Handover Restriction List	O		9.2.1.22		YES	ignore

9.1.7.3 UPLINK NAS TRANSPORT

This message is sent by the eNB and is used for carrying NAS information over the S1 interface.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
NAS-PDU	M		9.2.3.5		YES	reject
E-UTRAN CGI	M		9.2.1.38		YES	ignore
TAI	M		9.2.3.16		YES	ignore

9.1.7.4 NAS NON DELIVERY INDICATION

This message is sent by the eNB and is used for reporting the non delivery of a NAS PDU previously received within a DOWNLINK NAS TRANSPORT message over the S1 interface.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
NAS-PDU	M		9.2.3.5		YES	ignore
Cause	M		9.2.1.3		YES	ignore

9.1.8 Management messages

9.1.8.1 RESET

This message is sent by both the MME and the eNB and is used to request that the S1 interface, or parts of the S1 interface, to be reset.

Direction: MME → eNB and eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
Cause	M		9.2.1.3		YES	ignore
Choice **Reset Type**	M				YES	reject
>S1 interface						
>> Reset All	M		ENUMERATED (Reset all,…)		–	–
>Part of S1 interface						
>> UE-associated logical S1-connection list	M				–	–
>>>UE-associated logical S1-connection Item		1 to < maxnoofIndividualS1ConnectionsToReset >			EACH	reject
>>>> MME UE S1AP ID	O		9.2.3.3		–	–
>>>> eNB UE S1AP ID	O		9.2.3.4		–	–

Range bound	Explanation
maxnoofIndividualS1ConnectionsToReset	Maximum no. of UE-associated logical S1-connections allowed to reset in one message. Value is 256.

9.1.8.2 RESET ACKNOWLEDGE

This message is sent by both the MME and the eNB as a response to a RESET message.

Direction: eNB → MME and MME → eNB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
UE-associated logical S1-connection list	O				YES	ignore
>UE-associated logical S1-connection Item		1 to < maxnoofIndividualS1ConnectionsToReset >			EACH	ignore
>>MME UE S1AP ID	O		9.2.3.3		–	–
>>eNB UE S1AP ID	O		9.2.3.4		–	–
Criticality Diagnostics	O		9.2.1.21		YES	ignore

Range bound	Explanation
maxnoofIndividualS1ConnectionsToReset	Maximum no. of UE-associated logical S1-connections allowed to reset in one message. Value is 256.

9.1.8.3 ERROR INDICATION

This message is sent by both the MME and the eNB and is used to indicate that some error has been detected in the node.

Direction: MME → eNB and eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
MME UE S1AP ID	O		9.2.3.3		YES	ignore
eNB UE S1AP ID	O		9.2.3.4		YES	ignore
Cause	O		9.2.1.3		YES	ignore
Criticality Diagnostics	O		9.2.1.21		YES	ignore

9.1.8.4 S1 SETUP REQUEST

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

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
Global eNB ID	M		9.2.1.37		YES	reject
eNB Name	M		OCTET STRING	FSS if IE is optional	YES	ignore
Supported TAs		1..<maxnoofTACs>		Supported TAs in the eNB	GLOBAL	reject
>TAC	M		9.2.3.7	Broadcast TAC	-	
>Broadcast PLMNs		1..<maxnoofBPLMNs>		Broadcast PLMNs	-	
>>PLMN Identity	M		9.2.3.8		-	
CSG Id List					YES	ignore
>CSG Id List Item		1 to < maxnoofCSGId >			EACH	ignore
>>CSG Id	O		9.2.1.63			

Range bound	Explanation
maxnoofTACs	Maximum no. of TACs. Value is 256.

Range bound	Explanation
maxnoofBPLMNs	Maximum no. of Broadcasted PLMNs. Value is 6.

Range bound	Explanation
maxnoofCSGIds	Maximum no. of CSG Ids within the CSG Id List. Value is 256.

9.1.8.5 S1 SETUP RESPONSE

This message is sent by the MME to transfer information for a TNL association.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME Name	M		OCTET STRING	FSS if IE is optional	YES	ignore
Served PLMNs		1..<maxnoofPLMNsPerMME>			GLOBAL	ignore

>PLMN Identity	M		9.2.3.8		-	
Served GUMMEIs		1..<maxnoofGUMMEIs>			GLOBAL	ignore
>GUMMEI	M		9.2.3.9		-	-
Relative MME Capacity	M		9.2.3.17		YES	ignore
Criticality Diagnostics	O		9.2.1.21		YES	ignore

Range bound	Explanation
maxnoofPLMNsPer MME	Maximum no. of PLMNs per MME. Value is FFS.
maxnoofGUMMEIs	Maximum no. of GUMMEI per MME. Value is FFS.

9.1.8.6 S1 SETUP FAILURE

This message is sent by the MME to indicate S1 Setup failure.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
Cause	M		9.2.1.3		YES	ignore
Time to wait	O		9.2.1.61		YES	ignore
Criticality Diagnostics	O		9.2.1.21		YES	ignore

9.1.8.7 ENB CONFIGURATION UPDATE

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

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
eNB Name	O		OCTET STRING	FSS if IE is optional	YES	ignore
Supported TAs		0..<maxnoofTACs>		Supported TAs in the eNB	GLOBAL	reject
>TAC	M		9.2.3.7	Broadcasted TAC	-	
>Broadcast PLMNs		1..<maxnoofBPLMNs>		Broadcast PLMNs	-	
>>PLMN Identity	M		9.2.3.8		-	
CSG Id List					YES	ignore
>CSG Id List Item		1 to < maxnoofCSGId >			EACH	ignore
>>CSG Id	O		9.2.1.63			

Range bound	Explanation
maxnoofTACs	Maximum no. of TACs. Value is 256.
maxnoofBPLMNs	Maximum no. of Broadcasted PLMNs. Value is 6.
maxnoofCSGIds	Maximum no. of CSG Ids within the CSG Id List. Value is 256.

9.1.8.8 ENB CONFIGURATION UPDATE ACKNOWLEDGE

This message is sent by the MME to acknowledge the eNB transfer updated information for a TNL association.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
Criticality Diagnostics	O		9.2.1.21		YES	ignore

9.1.8.9 ENB CONFIGURATION UPDATE FAILURE

This message is sent by the MME to indicate S1 eNB Configuration Update failure.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
Cause	M		9.2.1.3		YES	ignore
Time to wait	O		9.2.1.61		YES	ignore
Criticality Diagnostics	O		9.2.1.21		YES	ignore

9.1.8.10 MME CONFIGURATION UPDATE

This message is sent by the MME to transfer updated information for a TNL association.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
MME Name	O		OCTET STRING	FSS if IE is optional	YES	ignore
Served PLMNs		0..<maxnoofPLMNsPerMME>			GLOBAL	reject
>PLMN Identity	M		9.2.3.8		-	
Served GUMMEIs		0..<maxnoofGUMMEIs>			GLOBAL	reject
>GUMMEI	O		9.2.3.9		-	
Relative MME Capacity	O		9.2.3.17		YES	reject

Range bound	Explanation
maxnoofPLMNsPer MME	Maximum no. of PLMNs per MME. Value is FFS.
maxnoofGUMMEIs	Maximum no. of GUMMEI per MME. Value is FFS.

9.1.8.11 MME CONFIGURATION UPDATE ACKNOWLEDGE

This message is sent by the eNB to acknowledge the MME transfer updated information for a TNL association.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
Criticality Diagnostics	O		9.2.1.21		YES	ignore

9.1.8.12 MME CONFIGURATION UPDATE FAILURE

This message is sent by the eNB to indicate S1 MME Configuration Update failure.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject
Cause	M		9.2.1.3		YES	ignore
Time to wait	O		9.2.1.61		YES	ignore
Criticality Diagnostics	O		9.2.1.21		YES	ignore

9.1.8.13 OVERLOAD START

This message is sent by the MME and is used to indicate to the eNB that the MME is overloaded.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
Overload Response	M		9.2.3.19		YES	reject

9.1.8.14 OVERLOAD STOP

This message is sent by the MME and is used to indicate that the MME is no longer overloaded.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	reject

9.1.9 S1 CDMA2000 Tunneling Messages

9.1.9.1 DOWNLINK S1 CDMA2000 TUNNELING

This message is sent by the MME and is used for carrying CDMA2000 information over the S1 interface.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
E-RABs Subject to Forwarding List	O				YES	ignore
>E-RABs Subject to Forwarding Item IEs		1 to <maxnoof E-RABs>			EACH	ignore
>> E-RAB ID	M		9.2.1.2		-	
>> DL Transport Layer Address	M		9.2.2.1		-	
>> DL GTP TEID	M		9.2.2.2	This IE indicates the tunnel endpoint for forwarding of DL data.	-	
CDMA2000 HO Status	O		9.2.1.28		YES	ignore
CDMA2000 RAT Type	M		9.2.1.24		YES	reject
CDMA2000-PDU	M		9.2.1.23		YES	reject

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RABs for one UE. Value is 256.

9.1.9.2 UPLINK S1 CDMA2000 TUNNELING

This message is sent by the eNB and is used for carrying CDMA2000 information over the S1 interface.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
CDMA2000 RAT Type	M		9.2.1.24		YES	reject
CDMA2000 Sector ID	M		9.2.1.25		YES	reject
CDMA2000 HO Required Indication	O		9.2.1.29		YES	ignore
CDMA2000 1xRTT SRVCC Info	O		9.2.1.35		YES	ignore
CDMA2000 1xRTT RAND	O		9.2.1.33		YES	ignore
CDMA2000-PDU	M		9.2.1.23		YES	reject

9.1.10 UE CAPABILITY INFO INDICATION

This message is sent by the eNB to provide UE Radio Capability information to the MME.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
UE Radio Capability	M		9.2.1.27		YES	ignore

9.1.11 Trace Messages

9.1.11.1 TRACE START

This message is sent by the MME to initiate trace recording for a UE.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
Trace Activation	M		9.2.1.4		YES	ignore

9.1.11.2 TRACE FAILURE INDICATION

This message is sent by the eNB to indicate that a Trace Start procedure or a Deactivate Trace procedure has failed for a UE.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
Trace Reference	M		OCTET STRING (8)		YES	ignore
Cause	M		9.2.1.3		YES	ignore

9.1.11.3 DEACTIVATE TRACE

This message is sent by the MME to deactivate trace.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
Trace Reference	M		OCTET STRING (8)		YES	ignore

9.1.12 Location Reporting Messages

9.1.12.1 LOCATION REPORTING CONTROL

This message is sent by the MME and is used to request the eNB to report where the UE is currently located.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
Request Type	M		9.2.1.34		YES	ignore

9.1.12.2 LOCATION REPORT FAILURE INDICATION

This message is sent by the eNB and is used to indicate the failure of location report.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
Cause	O		9.2.1.3		YES	ignore

9.1.12.3 LOCATION REPORT

This message is sent by the eNB and is used to provide the UE's location to the MME.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
MME UE S1AP ID	M		9.2.3.3		YES	reject
eNB UE S1AP ID	M		9.2.3.4		YES	reject
E-UTRAN CGI	M		9.2.1.38		YES	ignore
TAI	M		9.2.3.16		YES	ignore
Request Type	M		9.2.1.34		YES	ignore

9.1.13 Warning Message Transmission Messages

9.1.13.1 WRITE-REPLACE WARNING REQUEST

This message is sent by the MME to request the start or overwrite the broadcast of a warning message.

Direction: MME → eNB

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
Message Identifier	M		9.2.1.44		YES	reject
Serial Number	M		9.2.1.45		YES	reject
Warning Area List	O		9.2.1.46		YES	ignore
Repetition Period	M		9.2.1.48		YES	reject
Number of Broadcasts Requested	M		9.2.1.49		YES	reject
Warning Type	O		9.2.1.50		YES	ignore
Warning Security Information	O		9.2.1.51		YES	ignore
Data Coding Scheme	M		9.2.1.52		YES	reject
Warning Message Contents	M		9.2.1.53		YES	reject

9.1.13.2 WRITE-REPLACE WARNING RESPONSE

This message is sent by the eNB to acknowledge the MME on the start or overwrite request of a warning message.

Direction: eNB → MME

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
Message Identifier	M		9.2.1.44		YES	reject
Serial Number	M		9.2.1.45		YES	reject
Broadcast Completed Area List	O		9.2.1.54		YES	ignore
Criticality Diagnostics	O		9.2.1.21		YES	ignore

9.1.14 eNB DIRECT INFORMATION TRANSFER

This message is sent by the eNB in order to transfer specific information.

Direction: eNB → MME.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
Inter-system Information Transfer Type	M		9.2.1.55		YES	ignore

9.1.15 MME DIRECT INFORMATION TRANSFER

This message is sent by the MME in order to transfer specific information.

Direction: MME → eNB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.1		YES	ignore
Inter-system Information Transfer Type	M		9.2.1.55		YES	ignore

9.2 Information Element Definitions

Editor"s Note: Information element definitions.

9.2.0 General

Subclause 9.2 presents the S1AP IE definitions in tabular format. The corresponding ASN.1 definition is presented in subclause 9.3. In case there is contradiction between the tabular format in subclause 9.2 and the ASN.1 definition, the ASN.1 shall take precedence, except for the definition of conditions for the presence of conditional elements, where the tabular format shall take precedence.

When specifying information elements which are to be represented by bitstrings, 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 bitstrings from other specifications, the first bit of the bitstring contains the first bit of the concerned information;

9.2.1 Radio Network Layer Related IEs

9.2.1.1 Message Type

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

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Message Type				Assumed max no of messages is 256.
>Procedure Code	M		(Handover Preparation, Handover Resource Allocation, Handover Notification, Patch Switch Request, Handover Cancel, E-RAB Setup, E-RAB Modify, E-RAB Release, E-RAB Release Request, Initial Context Setup, Paging, Downlink NAS transport, Initial UE Message, Uplink NAS transport, Reset, Error Indication, NAS Non Delivery Indication, S1 Setup, UE Context Release Request , UE Context Release, Downlink S1 CDMA2000 Tunneling, Uplink S1 CDMA2000 Tunneling; UE Context Modification, UE Capability Info Indication, eNB Status Transfer, MME Status Transfer, Deactivate Trace, Trace Start, Trace Failure Indication, eNB Configuraton Update, MME Configuration Update, Location Reporting Control, Location Reporting Failure Indication, Location Report, Overload Start, Overload Stop, Private Message, Write-Replace Warning, eNB Direct Information Transfer, MME Direct Information Transfer…)	
>Type of Message	M		CHOICE (Initiating Message, Successful Outcome, Unsuccessful Outcome, …)	

9.2.1.2 E-RAB ID

This element uniquely identifies a radio access bearer for a particular UE, which makes the E-RAB ID unique over one S1 connection. The E-RAB ID shall remain the same for the duration of the E-RAB even if the UE-associated logical S1-connection is released or moved using S1 handover

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

9.2.1.3 Cause

The purpose of the *Cause* IE is to indicate the reason for a particular event for the S1AP 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 (Unspecified, Handover triggered, $TX2_{RELOCOverall}$ Expiry, Successful Handover, Release due to E-UTRAN Generated Reason, Handover Cancelled, Partial Handover, Handover Failure In Target EPC/eNB Or Target System, Handover Target not allowed, $TS1_{RELOCoverall}$ Expiry, $TS1_{RELOCprep}$ Expiry, Cell not available,, Unknown Target ID, No Radio Resources Available in Target Cell, Unknown or already allocated MME UE S1AP ID, Unknown or already allocated eNB UE S1AP ID, Unknown or inconsistent pair of UE S1AP ID, Handover desirable for radio reasons, Time critical handover, Resource optimisation handover, Reduce load in serving cell, User inactivity, Radio Connection With UE Lost, Load Balancing TAU Required, CS Fallback Triggered, UE Not Available For PS Service, Radio resources not available, Failure in the Radio Interface Procedure, …)	
>Transport Layer				
>>Transport Layer Cause	M		ENUMERATED (Transport Resource Unavailable, Unspecified, ...)	
> NAS				
>> NAS Cause	M		ENUMERATED (Normal Release, Authentication failure, Detach, 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, Abstract Syntax Error (Falsely Constructed Message), Unspecified,...)	
>Misc				
>>Miscellaneous Cause	M		ENUMERATED (Control Processing Overload, Not enough User Plane Processing Resources,	

			Hardware Failure, O&M Intervention, Unspecified, Unknown PLMN, ...)	

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

Radio Network Layer cause	Meaning
Unspecified	Sent for radio network layer cause when none of the specified cause values applies
Handover triggered	The action is due to a handover that has been triggered.
TX2RELOCOverall Expiry	The timer guarding the handover that takes place over X2 has abnormally expired.
Successful Handover	Successful handover.
Release due to E-UTRAN generated reason	Release is initiated due to E-UTRAN generated reason.
Handover Cancelled	The reason for the action is cancellation of Handover
Partial Handover	Provides a reason for the handover cancellation. The HANDOVER COMMAND message from MME contained *E-RABs to Release List* IE and the source eNB estimated service continuity for the UE would be better by not proceeding with handover towards this particular target eNB.
Handover Failure In Target EPC/eNB Or Target System	The handover failed due to a failure in target EPC/eNB or target system.
Handover Target not allowed	Handover to the indicated target cell is not allowed for the UE in question.
$TS1_{RELOCoverall}$ Expiry	The reason for the action is expiry of timer $TS1_{RELOCoverall}$.
$TS1_{RELOCprep}$ Expiry	Handover Preparation procedure is cancelled when timer $TS1_{RELOCprep}$ expires.
Cell not available	The concerned cell is not available.
Unknown Target ID	Handover rejected because the target ID is not known to the EPC.
No radio resources available in target cell	Load on target cell is too high.
Unknown or already allocated MME UE S1AP ID	The action failed because the MME UE S1AP ID is either unknown, or (for a first message received at the eNB) is known and already allocated to an existing context.
Unknown or already allocated eNB UE S1AP ID	The action failed because the eNB UE S1AP ID is either unknown, or (for a first message received at the MME) is known and already allocated to an existing context.
Unknown or inconsistent pair of UE S1AP ID	The action failed because both UE S1AP IDs are unknown, or are known but do not define a single UE context.
Handover Desirable for Radio Reasons	The reason for requesting handover is radio related.
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.
Resource Optimisation Handover	The reason for requesting handover is to improve the load distribution with the neighbour cells.
Reduce Load in Serving Cell	Load on serving cell needs to be reduced.
User Inactivity	The action is requested due to user inactivity on all E-RABs e.g. S1 is requested to be released in order to optimise the radio resources.
Radio Connection With UE Lost	The action is requested due to loosing the radio connection to the UE.
Load Balancing TAU Required	The action is requested for all load balancing and offload cases in the MME.
CS Fallback triggered	The action is due to a CS fallback that has been triggered
UE Not Available for PS Service	The action is requested due to a Cell Change Order that has been triggered
Radio resources not available	No requested radio resources are available
Failure in the Radio Interface Procedure	Radio interface procedure has failed

Transport 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

NAS cause	Meaning
Normal Release	The release is normal
Authentication Failure	The action is due to authentication failure.
Detach	The action is due to detach.
Unspecified	Sent when none of the above cause values applies but still the cause is NAS related

Protocol cause	Meaning
Transfer Syntax Error	The received message included a transfer syntax error.
Abstract Syntax Error (Reject)	The received message included an abstract syntax error and the concerning criticality indicated "reject".
Abstract Syntax Error (Ignore And Notify)	The received message included an abstract syntax error and the concerning criticality indicated "ignore and notify".
Message Not Compatible With Receiver State	The received message was not compatible with the receiver state.
Semantic Error	The received message included a semantic error.
Abstract Syntax Error (Falsely Constructed Message)	The received message contained IEs or IE groups in wrong order or with too many occurrences.
Unspecified	Sent when none of the above cause values applies but still the cause is Protocol related
Miscellaneous cause	**Meaning**
Control Processing Overload	Control processing overload
Not Enough User Plane Processing Resources Available	No enough resources are available related to user plane processing.
Hardware Failure	Action related to hardware failure
O&M Intervention	The action is due to O&M intervention.
Unspecified Failure	Sent when none of the above cause values applies and the cause is not related to any of the categories Radio Network Layer, Transport Network Layer, NAS or Protocol.
Unknown PLMN	The MME doesn"t identify at least one of the PLMN provided by the eNB

9.2.1.4 Trace activation

Defines parameters related to a trace activation.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Trace Reference	M		OCTET STRING (8)			
Interfaces To Trace		1 to <maxInterfaces>				
>Interface	M		ENUMERATED (s1, x2 Uu, ...)			
>Trace depth	M		ENUMERATED(minimum, medium, maximum, vendorMinimum, vendorMedium, vendorMaximum,...)	Defined in [10]		

9.2.1.5 Source ID

Void.

9.2.1.6 Target ID

The *Target ID* IE identifies the target for the handover. The target ID may be e.g. the target Global eNB-ID (for intra SAE/LTE), the RNC-ID (for SAE/LTE-UMTS handover) or the Cell Global ID of the handover target (in case of SAE/LTE to GERAN A/Gb mode handover).

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Choice **Target ID**					-	
>Target eNB-ID						
>> Global eNB ID	M		9.2.1.37			
>> Selected TAI	M		TAI 9.2.3.16			
>Target RNC-ID					-	
>>LAI	M		9.2.3.1		-	
>>RAC	O		9.2.3.2		-	
>>RNC-ID	M		INTEGER (0..4095)	If the *Extended RNC-ID* IE is included in the *Target ID* IE, the *RNC-ID* IE shall be ignored.	-	
>>Extended RNC-ID	O		9.2.1.14	The *Extended RNC-ID* IE shall be used if the RNC identity has a value larger than 4095.		
>CGI					-	
>> PLMN identity	M		OCTET STRING (SIZE (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 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).	-	
>> LAC	M		OCTET STRING (2)	0000 and FFFE not allowed.	-	
>>CI	M		OCTET STRING (2)		-	
>>RAC	O		9.2.3.2			

9.2.1.7 Source eNB to Target eNB Transparent Container

The *Source eNB to target eNB Transparent Container* IE is an information element that is produced by the source eNB and is transmitted to the target eNB. . For inter-system handovers to E-UTRAN, the IE is transmitted from the external handover source to the target eNB.

This IE is transparent to the EPC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
RRC Container	M		OCTET STRING	Includes the RRC Handover Preparation Information message as defined in subclause 10.2.3 of [16].	-	-
Target Cell ID	M		E-UTRAN CGI 9.2.1.38		-	-
Subscriber Profile ID for RAT/Frequency priority	O		9.2.1.39		-	-
E-RABs Information List	O					
> E-RABs Information Item		1 to <maxnoof E-RABs>			EACH	ignore
>> E-RAB ID	M		9.2.1.2		-	-
>> DL Forwarding	O		9.2.3.14		-	-
UE History Information	M		9.2.1.41		-	-

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RABs for one UE. Value is 256.

9.2.1.8 Target eNB to Source eNB Transparent Container

The *Target eNB to Source eNB Transparent Container* IE is an information element that is produced by the target eNB and is transmitted to the source eNB. For inter-system handovers to E-UTRAN, the IE is transmitted from the target eNB to the external relocation source.

This IE is transparent to EPC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
RRC Container	M		OCTET STRING	Includes the RRC E-UTRA Handover Command message as defined in subclause 10.2.2 of [16].	-	-

9.2.1.9 Source RNC to Target RNC Transparent Container

This IE is used to transparently pass radio related information between the handover source and the handover target through the EPC. This container is used for inter 3GPP RAT handovers from SAE/LTE to UTRAN and vice versa.

This IE defined in TS 25.413.

9.2.1.10 Target RNC to Source RNC Transparent Container

This container is used to transparently pass radio related information between the handover target and the handover source through the EPC. This container is used inter 3GPP RAT handovers from SAE/LTE to UTRAN and vice versa.

This IE is defined in TS 25.413.

9.2.1.11 Source BSS to Target BSS Transparent Container

This container is used to transparently pass radio related information between the handover source and the handover target through the EPC. This container is used for inter 3GPP RAT handovers from SAE/LTE to GERAN A/Gb mode and vice versa.

This IE is defined in TS 48.018.

9.2.1.12 Target BSS to Source BSS Transparent Container

This container is used to transparently pass radio related information between the handover source and the handover target through the EPC. This container is used for inter 3GPP RAT handovers from SAE/LTE to GERAN A/Gb mode and vice versa.

This IE is defined in TS 48.018.

9.2.1.13 Handover Type

This IE indicates which kind of handover was triggered in the source side.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Handover Type	M		ENUMERATED (IntraLTE, LTEtoUTRAN, LTEtoGERAN, UTRANtoLTE, GERANtoTLE)	

9.2.1.14 Extended RNC-ID

The Extended RNC-ID is used to identify an RNC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Extended RNC-ID	M		INTEGER (4096..65535)	The *Extended RNC-ID* IE shall be used if the RNC identity has a value larger than 4095. Note: Application of the *Extended RNC-ID* IE to very large networks is FFS.

9.2.1.15 E-RAB Level QoS Parameters

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

IE/Group Name	Presence	Range	IE type and reference	Semantics description
E-RAB Level QoS Parameters				
>QCI	M		INTEGER (1..256)	QoS Class Identifier defined in [11]. Logical range and coding specified in [13]
>Allocation and Retention Priority	M		9.2.1.60	
>GBR QoS Information	O		9.2.1.18	This IE applies to GBR bearers only and shall be ignored otherwise.

9.2.1.16 Paging DRX

This IE indicates the Paging DRX as defined in [20].

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Paging DRX	M		ENUMERATED(32, 64, 128, 256, ...)			

9.2.1.17 Paging Cause

Void

9.2.1.18 GBR QoS Information

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

IE/Group Name	Presence	Range	IE type and reference	Semantics description
E-RAB Maximum Bit Rate Downlink	M		Bit Rate 9.2.1.19	**Desc**.: This IE indicates the maximum downlink E-RAB Bit Rate (i.e. from the EPC to E-UTRAN) for this bearer.
E-RAB Maximum Bit Rate Uplink	M		Bit Rate 9.2.1.19	**Desc** This IE indicates the maximum uplink E-RAB Bit Rate (i.e. from the E-UTRAN to the EPC) for this bearer.
E-RAB Guaranteed Bit Rate Downlink	M		Bit Rate 9.2.1.19	**Desc**.: This IE indicates the downlink guaranteed E-RAB Bit Rate (provided that there is data to deliver) from the EPC to the E-UTRAN for this bearer.
E-RAB Guaranteed Bit Rate Uplink	M		Bit Rate 9.2.1.19	**Desc**.: This IE indicates the uplink guaranteed E-RAB Bit Rate (provided that there is data to deliver) from the E-UTRAN to the EPC for this bearer

9.2.1.19 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 SAE GBR bearer, or an aggregated maximum bit rate.

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

9.2.1.20 UE Aggregate Maximum Bit Rate

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
UE Aggregate Maximum Bit Rate				**Desc**.: Applicable for non-GBR E-RABs
>UE Aggregate Maximum Bit Rate Downlink	M		Bit Rate 9.2.1.19	**Desc**.: to be added
>UE Aggregate Maximum Bit Rate Uplink	M		Bit Rate 9.2.1.19	**Desc**.: to be added

9.2.1.21 Criticality Diagnostics

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

For further details on how to use the *Criticality Diagnostics* IE, (see Annex A.2 – FFS).

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, 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 <maxnoof errors>		
>IE Criticality	M		ENUMERATED(reject, ignore, notify)	The IE Criticality is used for reporting the criticality of the triggering IE. The value 'ignore' shall not be used.
>IE ID	M		INTEGER (0..65535)	The IE ID of the not understood or missing IE
>Type of Error	M		ENUMERATED(not understood, missing, …)	

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

9.2.1.22 Handover Restriction List

This IE defines area roaming or access restrictions for handover. If the eNB receives the Handover Restriction List, it shall overwrite previously received restriction information.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Serving PLMN	M		9.2.3.8	
Equivalent PLMNs		0..<maxnoofEPLMNs>		Allowed PLMNs in addition to Serving PLMN. This list corresponds to the list of 'equivalent PLMNs' as defined in [TS 24.008].
>PLMN Identity	M		9.2.3.8	
Forbidden TAs		0..<maxnoofEPLMNsPlusOne>		intra LTE roaming restrictions
>PLMN Identity	M		9.2.3.8	The PLMN of forbidden TACs
>Forbidden TACs		1..<maxnoofForbTACs>		
>>TAC	M		9.2.3.7	The TAC of the forbidden TAI
Forbidden LAs		0..<maxnoofEPLMNsPlusOne>		inter-3GPP RAT roaming restrictions
>PLMN Identity	M		9.2.3.8	
>Forbidden LACs		1..<maxnoofForbLACs>		
>>LAC	M		OCTET STRING(2)	
Forbidden inter RATs	O		ENUMERATED(ALL, GERAN, UTRAN, ...)	inter-3GPP 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.

9.2.1.23 CDMA2000-PDU

This information element contains a CDMA2000 message between the UE and CDMA2000 RAT that is transferred without interpretation in the eNB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CDMA2000-PDU	M		OCTET STRING	

9.2.1.24 CDMA2000 RAT Type

In the uplink, this information element , along with the *CDMA2000 Sector ID* IE is used for routing the tunnelled CDMA2000 message to the proper destination node in the CDMA2000 RAT and is set by the eNB to the CDMA2000 RAT type received from the UE.

Note: In the downlink, this information element is forwarded to the UE to help it route the tunnelled downlink CDMA2000 message to the appropriate CDMA upper layer.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CDMA2000 RAT Type	M		ENUMERATED (HRPD, 1xRTT,…)	This IE is used to identify which CDMA2000 RAT the tunnelled CDMA2000 signalling is associated with. The source of this information in the uplink is the UE and in the downlink it is the CDMA2000 system.

9.2.1.25 CDMA2000 Sector ID

This information element , along with the *RAT Type* IE is used for routing the tunnelled CDMA2000 message to the proper destination node in the CDMA2000 RAT.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CDMA2000 Sector ID	M		OCTET STRING	This IE is set to CDMA2000 Reference Cell ID corresponding to the HRPD/1xRTT sector under the HRPD AN/1xBS to which the eNB has initiated the UE to handover to. The CDMA2000 Reference Cell ID is statically configured in the eNB.

9.2.1.26 Security Context

The purpose of the *Security Context* IE is to provide security related parameters to eNB which are used to derive security keys for user plane traffic and RRC signalling messages and for security parameter generation for subsequent X2 or intra eNB Handovers.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Next Hop Chaining Count	M		BIT STRING (3)	Next Hop Chaining Counter (NCC) defined in [15].
Next-Hop NH	M		9.2.1.41 Security Key	The NH together with the NCC is used to derive the security configuration

9.2.1.27 UE Radio Capability

This IE contains UE Radio Capability information.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
UE Radio Capability	M		OCTET STRING	Includes the UECapabilityInformation message as defined in 6.2.2 of [16].]

9.2.1.28 CDMA2000 HO Status

This IE is used to indicate to the eNB which initiated an inter-RAT HO towards CDMA2000 about the outcome of the handover preparation to CDMA2000.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CDMA2000 HO Status	M		ENUMERATED (HO Success, HO Failure,…)	This IE indicates the status of the handover resource allocation in the CDMA2000 RAT.

9.2.1.29 CDMA2000 HO Required Indication

This information element is set by the eNB to provide an indication about whether the UE has initiated the handover preparation with the CDMA2000 RAT.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CDMA2000 HO Required Indication	M		ENUMERATED (true,…)	This IE indicates to MME that handover preparation to CDMA2000 has been started. It helps MME to decide when to send certain handover preparation information [8] to the CDMA2000 RAT.

9.2.1.30 1xRTT MEID

Void.

9.2.1.31 eNB Status Transfer Transparent Container

The *eNB Status Transfer Transparent Container* IE is an information element that is produced by the source eNB and is transmitted to the target eNB. This IE is used for the intra SAE/LTE S1 handover case.

This IE is transparent to the EPC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
E-RABs Subject to Status Transfer List	M				–	–
>E-RABs Subject to Status Transfer Item		1 to <maxnoof E-RABs>			EACH	ignore
>> E-RAB ID	M		9.2.1.2		–	–
>> UL COUNT value	M		COUNT Value 9.2.1.32	PDCP-SN and HFN of first missing UL PDCP SDU	–	–
>> DL COUNT value	M		COUNT Value 9.2.1.32	PDCP-SN and HFN that the target eNB should assign for the next DL SDU not having an SN yet	–	–
>>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.		

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RABs for one UE. Value is 256.

9.2.1.32 COUNT value

This IE contains a PDCP sequence number and a 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)		–	–

9.2.1.33 CDMA2000 1xRTT RAND

This information element is a random number generated by the eNB and tunnelled to the 1xCS IWS [8] and is transparent to MME.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CDMA2000 1xRTT RAND	M		OCTET STRING	This IE is a Random Challenge that is used for authentication of UE during handover from E-UTRAN to CDMA2000 1xRTT RAT.

9.2.1.34 Request Type

The purpose of the *Request Type* IE is to indicate the type of location request to be handled by the eNB.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Request Type				
>Event	M		ENUMERATED(Direct, Change of service cell, Stop Change of service cell)	
>Report Area	M		E-UTRAN CGI	

9.2.1.35 CDMA2000 1xRTT SRVCC Info

This IE defines SRVCC related information elements that are assembled by the MME to be tunnelled transparently to the 1xCS IWS [8] system.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CDMA2000 1xRTT SRVCC Info				
>CDMA2000 1xRTT MEID	M		OCTET STRING	This information element is the Mobile Equipment Identifier or Hardware ID that is tunnelled from the UE and is transparent to the eNB. This IE is used to derive a MEID-based PLCM that is used for channelization in CDMA2000 1xRTT network.
>CDMA2000 1xRTT Mobile Subscription Information	M		OCTET STRING	This IE provides the list of UE supported 1x RTT Band classes and Band Subclasses. It is provided by the UE to the eNB as part of the UE capability.It is transparent to the eNB.
>CDMA2000 1xRTT Pilot List	M		OCTET STRING	This IE provides the measured pilot information.

9.2.1.36 E-RAB List

This IE contains a list of E-RAB identities with a cause value. It is used for example to indicate failed bearers or bearers to be released.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
E-RAB List Item		1 to <maxnoof E-RABs>			EACH	ignore
>E-RAB ID	M		9.2.1.2		–	–
>Cause	M		9.2.1.3		–	–

Range bound	Explanation
maxnoofE-RABs	Maximum no. of E-RAB allowed towards one UE, the maximum value is 256.

9.2.1.37 Global eNB ID

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

IE/Group Name	Presence	Range	IE type and reference	Semantics description
PLMN Identity	M		9.2.3.8	
CHOICE *eNB ID*	M			
>Macro eNB ID			BIT STRING (20)	Equal to the 20 leftmost bits of the *Cell Identity* IE contained in the *E-UTRAN CGI* IE (see section 9.2.1.38) of each cell served by the eNB
>Home eNB ID			BIT STRING (28)	Equal to the *Cell Identity* IE contained in the *E-UTRAN CGI* IE (see section 9.2.1.38) of the cell served by the eNB

9.2.1.38 E-UTRAN CGI

This element is used to globally identify a cell (see [2]).

IE/Group Name	Presence	Range	IE type and reference	Semantics description
PLMN Identity	M		9.2.3.8	
Cell Identity	M		BIT STRING (28)	The leftmost bits of the Cell Identity correspond to the eNB ID (defined in section 9.2.1.37).

9.2.1.39 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 [14].

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

9.2.1.40 UE Security Capabilities

The *UE AS Security Capabilities* IE defines the supported algorithms for encryption and integrity protection in the UE. If for the IE *Encryption Algorithms* or IE *Integrity Protection Algorithms* all bits are equal to 0 no algorithms are supported. [Note: FFS if this setting is allowed, e.g. for emergency calls]

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
UE Security Capabilities				
>Encryption Algorithms	M		BIT STRING (16, ...)	Each position in the bitmap represents an encryption algorithm: 'first bit' - 128-EEA0, 'second bit' - 128-EEA1, 'third 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 [15] *[FFS if 128-EEA0 shall be included in the bitmap.]*
> 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 [15].

9.2.1.41 Security key

The security key IE is used to apply security in the eNB for different scenarios as defined in [15].

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Security Key	M		BIT STRING (SIZE(256))	Key material for KeNB or Next Hop Key as defined in [15]

9.2.1.42 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.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Last Visited Cell List		1 to MaxNrOfCells		Most recent information is added to the top of this list	-	-
>Last Visited Cell Information	M		9.2.1.43		-	-

Range bound	Explanation
MaxNrOfCells	Maximum length of the list. Value is 16.

9.2.1.43 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		9.2.1.43a		-	-
>Last Visited UTRAN Cell Information	M		OCTET STRING	Defined in [19]	-	-

9.2.1.43a 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		E-UTRAN CGI 9.2.1.38		-	-
Cell Type	M		FFS		-	-
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	-	-

9.2.1.44 Message Identifier

The purpose of the *Message Identifier* IE is to indentify the warning message. Message Identifier IE is set by the EPC and transfered to the UE by the eNB

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Message Identifier	M		OCTET STRING (16)	This IE is set by the EPC, transferred to the UE by the eNB. The eNB shall treat it as an identifier of the message.

9.2.1.45 Serial Number

Serial Number IE identifies a particular message from the source and type indicated by the Message Identifier and is altered every time the message with a given Message Identifier is changed.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Serial Number	M		BIT STRING(16)	

9.2.1.46 Warning Area List

Warning Area List IE indicates the areas where the warning message needs to be broadcast.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Choice **Warning Area**				
>Cell ID List		1 to <maxnoofCellID>		
>>E-CGI	M		9.2.1.38	
>TAI List		1 to <maxnoofTAIs>		
>>TAI	M		9.2.3.16	
>Emergency Area ID List		1 to <maxnoofEmergencyAreaID>		
>>Emergency Area ID	M		9.2.1.47	

Range bound	Explanation
maxnoofCellID	Maximum no. of Cell ID subject for warning message broadcast. Value is 65535 (FFS).
maxnoofTAI	Maximum no. of TAI subject for warning message broadcast. Value is 65535 (FFS).
maxnoofEmergencyAreaID	Maximum no. of Emergency Area ID subject for warning message broadcast. Value is 65535 (FFS).

9.2.1.47 Emergency Area ID

Emergency Area ID IE is used to indicate the area which has the emergency impact.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Emergency Area ID	M		OCTET STRING(16)	Emergency Area ID may consist of several cells. Emergency Area ID is defined by the operator.

9.2.1.48 Repetition Period

Repetition Period IE indicates the periodicity of the warning message to be broadcast.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Repetition Period	M		INTEGER (1..4096)	Range is 1 to 4096 where each unit will represent a repetition of one second to a maximum of once per ~1 hour

9.2.1.49 Number of Broadcasts Requested

Number of Broadcast Requested IE indicates the number of times a message is to be broadcast.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Number of Broadcasts Requested	M		INTEGER (0..65535)	This specifies the number of times the message is to be broadcast.

9.2.1.50 Warning Type

Warning Type IE indicates types of the disaster. This IE also indicates that a Primary Notification is included.This IE can be used by the UE to differentiate the type of alert according to the type of disaster.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Warning Type	M		OCTET STRING(82)	

9.2.1.51 Warning Security Information

Warning Security Information IE provides the security information needed for securing the Primary Notification.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Warning Security Information	M		OCTET STRING(50)	

9.2.1.52 Data Coding Scheme

Data Coding Scheme IE identifies the alphabet or coding employed for the message characters and message handling at the UE (it is passed transparently from the EPC to the UE).

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Data Coding Scheme	M		BIT STRING(8)	

9.2.1.53 Warning Message Contents

Warning Message Content IE contains user information e.g. the message with warning contents, and will be broadcast over the radio interface.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Broadcast Message Contents	M		OCTET STRING (SIZE(1..9600))	The length of this IE varies between 1 to 9600 bytes.

9.2.1.54 Broadcast Completed Area List

Broadcast Completed Area List IE indicates the areas where broadcast was performed successfully.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description
Choice **Broadcast Completed Area**				
>Cell ID Broadcast		01 to <maxnoofCellID>		
>E-CGI	M		9.2.1.38	
>TAI Broadcast		01 to <maxnoofTAIs>		
>>TAI	M		9.2.3.16	
>>Completed Cell in TAI List		1 to <maxnoofCellIDinTA>		
>>>E-CGI	M			
>Emergency Area ID Broadcast		01 to <maxnoofEmergencyAreaID>		
>>Emergency Area ID	M		9.2.1.47	
>>Completed Cell in Emergency Area ID List		1 to <maxnoofCellinEA>		
> >>E-CGI	M			

Range bound	Explanation
maxnoofCellID	Maximum no. of Cell ID subject for warning message broadcast. Value is 65535(FFS).
maxnoofTAI	Maximum no. of TAI subject for warning message broadcast. Value is 65535(FFS).
maxnoofEmergencyAreaID	Maximum no. of Emergency Area ID subject for warning message broadcast. Value is 65535(FFS).
maxnoofCellIDinTA	Maximum no. of Cel ID within a TAI. Value is 65535 (FFS).
maxnoofCellIDinEA	Maximum no. of Cell ID within an Emergency Area. Value is 65535 (FFS).

9.2.1.55 Inter-system Information Transfer Type

Indicates the type of information that the eNB requests to transfer.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Choice **Inter-system Information Transfer Type**				
>RIM Transfer			9.2.3.23	

9.2.1.56 Source To Target Transparent Container

The *Source to Target Transparent Container* IE is an information element that is used to transparently pass radio related information from the handover source to the handover target through the EPC; it is produced by the source RAN node and is transmitted to the target RAN node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Source to Target Transparent Container	M		OCTET STRING	This IE includes a transparent container from the source RAN node to the target RAN node. In inter-system handovers from E-UTRAN, the IE is encoded according to the specifications of the target system.

9.2.1.57 Target To Source Transparent Container

The *Target to Source Transparent Container* IE is an information element that is used to transparently pass radio related information from the handover target to the handover source through the EPC; it is produced by the target RAN node and is transmitted to the source RAN node.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Target to Source Transparent Container	M		OCTET STRING	

9.2.1.58 SRVCC Operation Possible

This element indicates that both UE and MME are SRVCC-capable. E-UTRAN behaviour on receipt of this IE is specified in [9].

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

9.2.1.59 SRVCC HO Indication

This information element is set by the source eNB to provide an indication that E-RAB may be subjected to handover via SRVCC means.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
SRVCC HO Indication	M		ENUMERATED (PS and CS, CS only,…)	

9.2.1.60 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
Allocation/Retention Priority				
>Priority Level	M		INTEGER (0..15)	**Desc.:** This IE should be understood as 'priority of allocation and retention' (see [11]). **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

9.2.1.61 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)	

9.2.1.62 CSG Id

This information element indicates the identifier of the closed subscriber group, as defined in [FFS].

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CSG Id	M		BIT STRING (SIZE (28))	

9.2.1.63 CSG Id List

This information element indicates a list of closed subscriber group identifiers.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CSG Id List		1 to <maxnoofCSGIds>		
> CSG Id	M		9.2.1.62	

Range bound	Explanation
maxnoofCSGIds	Maximum no. of CSG Ids within the CSG Id List. Value is 256.

9.2.2 Transport Network Layer Related IEs

9.2.2.1 Transport Layer Address

This information element is an IP address to be used for the user plane transport.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Transport Layer Address	M		BIT STRING (1..160, …)	The Radio Network Layer is not supposed to interpret the address information. It should pass it to the transport layer for interpretation. For details on the Transport Layer Address, see ref. [12].

9.2.2.2 GTP-TEID

This information element is the GTP Tunnel Endpoint Identifier to be used for the user plane transport between eNB and the serving gateway.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
GTP TEID	M		OCTET STRING (4)	

9.2.3 NAS Related IEs

9.2.3.1 LAI

This element is used to uniquely identify a Location Area.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
LAI				
>PLMN identity	M		OCTET STRING (SIZE (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 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).
>LAC	M		OCTET STRING (2)	0000 and FFFE not allowed.

9.2.3.2 RAC

This element is used to identify a Routing Area within a Location Area. It is used for PS services.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RAC	M		OCTET STRING (1)	

9.2.3.3 MME UE S1AP ID

The MME UE S1AP ID uniquely identify the UE association over the S1 interface within the MME.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
MME UE S1AP ID	M		INTEGER (0 .. 2^{32} -1)	

9.2.3.4 eNB UE S1AP ID

The eNB UE S1AP ID uniquely identify the UE association over the S1 interface within the eNB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
eNB UE S1AP ID	M		INTEGER (0 .. 2^{24} -1)	

9.2.3.5 NAS-PDU

This information element contains an EPC – UE or UE – EPC message that is transferred without interpretation in the eNB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
NAS-PDU	M		OCTET STRING	

9.2.3.6 S-TMSI

Temporary Mobile Subscriber Identity, used for security reasons to hide the identity of a subscriber.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
MMEC	M		9.2.3.12			
M-TMSI	M		OCTET STRING (SIZE (4))	M-TMSI is unique within MME that allocated it.		

9.2.3.7 TAC

This element is used to uniquely identify a Tracking Area Code.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
TAC	M		OCTET STRING (SIZE (2))	

9.2.3.8 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 (SIZE (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).

9.2.3.9 GUMMEI

This information element indicates the globally unique MME identity.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
GUMMEI				
>PLMN identity	M		OCTET STRING (SIZE (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).
>MME Group ID	M		OCTET STRING (2)	FFS
>MME code	M		9.2.3.12	

9.2.3.10 UE Identity Index value

The *UE Identity Index value* IE is used at paging.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
UE identity Index Value	M		BIT STRING (10)	IMSI mod 1024, which equals to the 10 rightmost bits of the IMSI

9.2.3.11 IMSI

This information element contains an International Mobile Subscriber Identity, which is commonly used to identify the UE in the CN.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
IMSI	M		OCTET STRING (SIZE (3..8))	- digits 0 to 9, encoded 0000 to 1001, - 1111 used as filler digit, two digits per octet, - bit 4 to 1 of octet n encoding digit 2n-1 - bit 8 to 5 of octet n encoding digit 2n -Number of decimal digits shall be from 6 to 15 starting with the digits from the PLMN identity. When the IMSI is made of an odd number of digits, the filler digit shall be added at the end to make an even number of digits of length 2N. The filler digit shall then be consequently encoded as bit 8 to 5 of octet N.

9.2.3.12 MMEC

This element represents the MME Code to uniquely identify a MME within an MME pool area.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
MMEC	M		OCTET STRING (SIZE (1))	

9.2.3.13 UE Paging Identity

This IE represents the Identity with which the UE is paged.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Choice **UE Paging Identity**				
>IMSI	M		9.2.3.11	
>S-TMSI	M		9.2.3.6	

9.2.3.14 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				
>DL Forwarding	M		ENUMERATED (DL forwarding proposed, …)	

9.2.3.15 Direct Forwarding Path Availability

The availability of a direct forwarding path shall be determined by the source eNB. EPC behaviour on receipt of this IE is specified in [11].

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Direct Forwarding Path Availability	M		ENUMERATED (Direct Path Available, …)	

9.2.3.16 TAI

This element is used to uniquely identify a Tracking Area.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
TAI				
>PLMN identity	M		9.2.3.8	
>TAC	M		9.2.3.7	

9.2.3.17 Relative MME Capacity

This IE indicates the relative processing capacity of an MME with respect to the other MMEs in the pool in order to load-balance MMEs within a pool [defined 11].

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Relative MME Capacity	M		INTEGER (0..255)	

9.2.3.18 UE S1 AP ID pair

This IE contains a pair of UE S1 AP identities.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
MME UE S1AP ID	M		9.2.3.3		-	-
eNB UE S1AP ID	M		9.2.3.4		-	-

9.2.3.19 Overload Response

The *Overload Response* IE indicates the required behaviour of the eNB in an overload situation.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Choice **Overload Response**				
>Overload Action	M		9.2.3.20	

9.2.3.20 Overload Action

The *Overload Action* IE indicates which signalling traffic needs to be rejected/permitted by the eNB in an MME overload situation as defined in [11],

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Overload Action	M		ENUMERATED (Reject RRC connection requests for non-emergency MO DT, Reject all connection requests for Signalling, Permit Emergency Sessions only, …)	

9.2.3.21 CS Fallback Indicator

The IE indicates that a fallback to the CS domain is needed.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CS Fallback Indicator	M		ENUMERATED(CS Fallback required, ...)	

9.2.3.22 CN Domain

The IE indicates whether Paging is originated from the CS or PS domain.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
CN Domain	M		ENUMERATED(CS, PS)	

9.2.3.23 RIM Transfer

This IE contains the RIM Information (e.g. NACC information) and additionally in uplink transfer the RIM routing address of the destination of this RIM information.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIM Transfer				
>RIM Information	M		9.2.3.24	
>RIM Routing Address	O		9.2.3.25	

9.2.3.24 RIM Information

This IE contains the RIM Information (e.g. NACC information) i.e. the BSSGP RIM PDU from the RIM application part contained in the eNB, or the BSSGP RIM PDU to be forwarded to the RIM application part in the eNB.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
RIM Information				
>RIM Information	M		OCTET STRING	Contains the BSSGP RIM PDU as defined in ref [15].

9.2.3.25 RIM Routing Address

This IE identifies the destination node where the RIM Information needs to be routed by the CN.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Choice **RIM Routing Address**					-	
>GERAN-Cell-ID					-	
>>LAI	M		9.2.3.1		-	
>>RAC	M		9.2.3.2		-	
>>CI	M		OCTET STRING (2)		-	

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

9.3.0 General

S1AP ASN.1 definition conforms with [4] and [5].

The ASN.1 definition specifies the structure and content of S1AP messages. S1AP 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 S1AP 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 where the list elements reside. The second part defines list elements. The IE container list appears as an IE of its own. For this version of the standard an IE container list may contain only one kind of list elements.

If a S1AP message that is not constructed as defined above is received, this shall be considered as Abstract Syntax Error, and the message shall be handled as defined for Abstract Syntax Error in subclause 10.3.6.

Subclause 9.3 presents the Abstract Syntax of S1AP protocol with ASN.1. In case there is contradiction between the ASN.1 definition in this subclause and the tabular format in subclause 9.1 and 9.2, the ASN.1 shall take precedence, except for the definition of conditions for the presence of conditional elements, where the tabular format shall take precedence.

9.3.1 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 interoperability;
- 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.

9.3.2 Elementary Procedure Definitions

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

S1AP-PDU-Descriptions  {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
eps-Access (20) modules (3) s1ap (1) version1 (1) s1ap-PDU-Descriptions (0)}

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

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

IMPORTS
    Criticality,
    ProcedureCode
FROM S1AP-CommonDataTypes

    DeactivateTrace,
    DownlinkNASTransport,
    DownlinkS1cdma2000tunneling,
    ENBDirectInformationTransfer,
    ENBStatusTransfer,
    ENBConfigurationUpdate,
    ENBConfigurationUpdateAcknowledge,
    ENBConfigurationUpdateFailure,
    ErrorIndication,
    HandoverCancel,
    HandoverCancelAcknowledge,
    HandoverCommand,
    HandoverFailure,
    HandoverNotify,
    HandoverPreparationFailure,
    HandoverRequest,
    HandoverRequestAcknowledge,
    HandoverRequired,
    InitialContextSetupFailure,
    InitialContextSetupRequest,
    InitialContextSetupResponse,
    InitialUEMessage,
    LocationReportingControl,
    LocationReportingFailureIndication,
    LocationReport,
    MMEConfigurationUpdate,
```

```
    MMEConfigurationUpdateAcknowledge,
    MMEConfigurationUpdateFailure,
    MMEDirectInformationTransfer,
    MMEStatusTransfer,
    NASNonDeliveryIndication,
    OverloadStart,
    OverloadStop,
    Paging,
    PathSwitchRequest,
    PathSwitchRequestAcknowledge,
    PathSwitchRequestFailure,
    PrivateMessage,
    Reset,
    ResetAcknowledge,
    S1SetupFailure,
    S1SetupRequest,
    S1SetupResponse,
    E-RABModifyRequest,
    E-RABModifyResponse,
    E-RABReleaseCommand,
    E-RABReleaseResponse,
    E-RABReleaseIndication,
    E-RABSetupRequest,
    E-RABSetupResponse,
    TraceFailureIndication,
    TraceStart,
    UECapabilityInfoIndication,
    UEContextModificationFailure,
    UEContextModificationRequest,
    UEContextModificationResponse,
    UEContextReleaseCommand,
    UEContextReleaseComplete,
    UEContextReleaseRequest,
    UplinkNASTransport,
    UplinkS1cdma2000tunneling,
    WriteReplaceWarningRequest,
    WriteReplaceWarningResponse


FROM S1AP-PDU-Contents

    id-DeactivateTrace,
    id-downlinkNASTransport,
    id-DownlinkS1cdma2000tunneling,
    id-eNBStatusTransfer,
    id-ErrorIndication,
    id-HandoverCancel,
    id-HandoverNotification,
    id-HandoverPreparation,
    id-HandoverResourceAllocation,
    id-InitialContextSetup,
    id-initialUEMessage,
    id-ENBConfigurationUpdate,
    id-LocationReportingControl,
```

```
    id-LocationReportingFailureIndication,
    id-LocationReport,
    id-eNBDirectInformationTransfer,
    id-MMEConfigurationUpdate,
    id-MMEDirectInformationTransfer,
    id-MMEStatusTransfer,
    id-NASNonDeliveryIndication,
    id-OverloadStart,
    id-OverloadStop,
    id-Paging,
    id-PathSwitchRequest,
    id-PrivateMessage,
    id-Reset,
    id-S1Setup,
    id-E-RABModify,
    id-E-RABRelease,
    id-E-RABReleaseIndication,
    id-E-RABSetup,
    id-TraceFailureIndication,
    id-TraceStart,
    id-UECapabilityInfoIndication,
    id-UEContextModification,
    id-UEContextRelease,
    id-UEContextReleaseRequest,
    id-uplinkNASTransport,
    id-UplinkS1cdma2000tunneling,
    id-WriteReplaceWarning
FROM S1AP-Constants;


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

S1AP-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
```

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

S1AP-PDU ::= CHOICE {
    initiatingMessage   InitiatingMessage,
    successfulOutcome   SuccessfulOutcome,
    unsuccessfulOutcome UnsuccessfulOutcome,
    ...
}

InitiatingMessage ::= SEQUENCE {
    procedureCode   S1AP-ELEMENTARY-PROCEDURE.&procedureCode    ({S1AP-ELEMENTARY-PROCEDURES}),
    criticality S1AP-ELEMENTARY-PROCEDURE.&criticality      ({S1AP-ELEMENTARY-PROCEDURES}{@procedureCode}),
    value       S1AP-ELEMENTARY-PROCEDURE.&InitiatingMessage    ({S1AP-ELEMENTARY-PROCEDURES}{@procedureCode})
}

SuccessfulOutcome ::= SEQUENCE {
    procedureCode   S1AP-ELEMENTARY-PROCEDURE.&procedureCode    ({S1AP-ELEMENTARY-PROCEDURES}),
    criticality S1AP-ELEMENTARY-PROCEDURE.&criticality      ({S1AP-ELEMENTARY-PROCEDURES}{@procedureCode}),
    value       S1AP-ELEMENTARY-PROCEDURE.&SuccessfulOutcome    ({S1AP-ELEMENTARY-PROCEDURES}{@procedureCode})
}

UnsuccessfulOutcome ::= SEQUENCE {
    procedureCode   S1AP-ELEMENTARY-PROCEDURE.&procedureCode    ({S1AP-ELEMENTARY-PROCEDURES}),
    criticality S1AP-ELEMENTARY-PROCEDURE.&criticality      ({S1AP-ELEMENTARY-PROCEDURES}{@procedureCode}),
    value       S1AP-ELEMENTARY-PROCEDURE.&UnsuccessfulOutcome  ({S1AP-ELEMENTARY-PROCEDURES}{@procedureCode})
}

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

S1AP-ELEMENTARY-PROCEDURES S1AP-ELEMENTARY-PROCEDURE ::= {
    S1AP-ELEMENTARY-PROCEDURES-CLASS-1      |
    S1AP-ELEMENTARY-PROCEDURES-CLASS-2,
    ...
}


S1AP-ELEMENTARY-PROCEDURES-CLASS-1 S1AP-ELEMENTARY-PROCEDURE ::= {
    handoverPreparation             |
    handoverResourceAllocation      |
    pathSwitchRequest               |
    e-RABSetup                  |
    e-RABModify                 |
    e-RABRelease                |
    initialContextSetup             |
    handoverCancel                  |
    reset                           |
    s1Setup                         |
    uEContextModification           |
    uEContextRelease                |
```

```
    eNBConfigurationUpdate          |
    mMEConfigurationUpdate          |
    writeReplaceWarning             ,
    ...
}

S1AP-ELEMENTARY-PROCEDURES-CLASS-2 S1AP-ELEMENTARY-PROCEDURE ::= {
    handoverNotification            |
    e-RABReleaseIndication          |
    paging                          |
    downlinkNASTransport                        |
    initialUEMessage                            |
    uplinkNASTransport              |
    errorIndication                 |
    nASNonDeliveryIndication        |
    uEContextReleaseRequest         |
    downlinkS1cdma2000tunneling     |
    uplinkS1cdma2000tunneling       |
    uECapabilityInfoIndication      |
    eNBStatusTransfer               |
    mMEStatusTransfer               |
    deactivateTrace                 |
    traceStart                      |
    traceFailureIndication          |
    locationReportingControl        |
    locationReportingFailureIndication      |
    locationReport                  |
    overloadStart                   |
    overloadStop                    |
    eNBDirectInformationTransfer    |
    mMEDirectInformationTransfer    |
    privateMessage                  ,
    ...
}

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

handoverPreparation S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  HandoverRequired
    SUCCESSFUL OUTCOME  HandoverCommand
    UNSUCCESSFUL OUTCOME    HandoverPreparationFailure
    PROCEDURE CODE          id-HandoverPreparation
    CRITICALITY     reject
}

handoverResourceAllocation S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  HandoverRequest
    SUCCESSFUL OUTCOME  HandoverRequestAcknowledge
    UNSUCCESSFUL OUTCOME    HandoverFailure
    PROCEDURE CODE          id-HandoverResourceAllocation
```

```
    CRITICALITY     reject
}

handoverNotification S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  HandoverNotify
    PROCEDURE CODE          id-HandoverNotification
    CRITICALITY     ignore
}

pathSwitchRequest S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  PathSwitchRequest
    SUCCESSFUL OUTCOME  PathSwitchRequestAcknowledge
    UNSUCCESSFUL OUTCOME    PathSwitchRequestFailure
    PROCEDURE CODE          id-PathSwitchRequest
    CRITICALITY     reject
}

e-RABSetup S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  E-RABSetupRequest
    SUCCESSFUL OUTCOME  E-RABSetupResponse
    PROCEDURE CODE      id-E-RABSetup
    CRITICALITY     reject
}

e-RABModify S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  E-RABModifyRequest
    SUCCESSFUL OUTCOME  E-RABModifyResponse
    PROCEDURE CODE      id-E-RABModify
    CRITICALITY     reject
}

e-RABRelease S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  E-RABReleaseCommand
    SUCCESSFUL OUTCOME  E-RABReleaseResponse
    PROCEDURE CODE      id-E-RABRelease
    CRITICALITY     reject
}

e-RABReleaseIndication S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  E-RABReleaseIndication
    PROCEDURE CODE      id-E-RABReleaseIndication
    CRITICALITY     ignore
}

initialContextSetup S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  InitialContextSetupRequest
    SUCCESSFUL OUTCOME  InitialContextSetupResponse
    UNSUCCESSFUL OUTCOME InitialContextSetupFailure
    PROCEDURE CODE      id-InitialContextSetup
    CRITICALITY     reject
}

uEContextReleaseRequest S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      UEContextReleaseRequest
```

```
    PROCEDURE CODE          id-UEContextReleaseRequest
    CRITICALITY             ignore
}

paging S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  Paging
    PROCEDURE CODE      id-Paging
    CRITICALITY         ignore
}

downlinkNASTransport S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      DownlinkNASTransport
    PROCEDURE CODE          id-downlinkNASTransport
    CRITICALITY             ignore
}

initialUEMessage S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      InitialUEMessage
    PROCEDURE CODE          id-initialUEMessage
    CRITICALITY             ignore
}

uplinkNASTransport S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      UplinkNASTransport
    PROCEDURE CODE          id-uplinkNASTransport
    CRITICALITY             ignore
}
nASNonDeliveryIndication S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      NASNonDeliveryIndication
    PROCEDURE CODE          id-NASNonDeliveryIndication
    CRITICALITY             ignore
}

handoverCancel S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  HandoverCancel
    SUCCESSFUL OUTCOME  HandoverCancelAcknowledge
    PROCEDURE CODE          id-HandoverCancel
    CRITICALITY     reject
}

reset S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  Reset
    SUCCESSFUL OUTCOME  ResetAcknowledge
    PROCEDURE CODE      id-Reset
    CRITICALITY         reject
}

errorIndication S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  ErrorIndication
    PROCEDURE CODE      id-ErrorIndication
    CRITICALITY     ignore
}

s1Setup S1AP-ELEMENTARY-PROCEDURE ::= {
```

```
    INITIATING MESSAGE      S1SetupRequest
    SUCCESSFUL OUTCOME      S1SetupResponse
    UNSUCCESSFUL OUTCOME    S1SetupFailure
    PROCEDURE CODE          id-S1Setup
    CRITICALITY             reject
}

eNBConfigurationUpdate S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      ENBConfigurationUpdate
    SUCCESSFUL OUTCOME      ENBConfigurationUpdateAcknowledge
    UNSUCCESSFUL OUTCOME    ENBConfigurationUpdateFailure
    PROCEDURE CODE          id-ENBConfigurationUpdate
    CRITICALITY             reject
}

mMEConfigurationUpdate S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      MMEConfigurationUpdate
    SUCCESSFUL OUTCOME      MMEConfigurationUpdateAcknowledge
    UNSUCCESSFUL OUTCOME    MMEConfigurationUpdateFailure
    PROCEDURE CODE          id-MMEConfigurationUpdate
    CRITICALITY             reject
}

downlinkS1cdma2000tunneling S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      DownlinkS1cdma2000tunneling
    PROCEDURE CODE          id-DownlinkS1cdma2000tunneling
    CRITICALITY             ignore
}

uplinkS1cdma2000tunneling S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      UplinkS1cdma2000tunneling
    PROCEDURE CODE          id-UplinkS1cdma2000tunneling
    CRITICALITY             ignore
}

uEContextModification S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      UEContextModificationRequest
    SUCCESSFUL OUTCOME      UEContextModificationResponse
    UNSUCCESSFUL OUTCOME    UEContextModificationFailure

    PROCEDURE CODE      id-UEContextModification
    CRITICALITY     reject
}

uECapabilityInfoIndication S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      UECapabilityInfoIndication
    PROCEDURE CODE          id-UECapabilityInfoIndication
    CRITICALITY             ignore
}

uEContextRelease S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      UEContextReleaseCommand
    SUCCESSFUL OUTCOME      UEContextReleaseComplete
    PROCEDURE CODE          id-UEContextRelease
```

```
    CRITICALITY             reject
}

eNBStatusTransfer S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      ENBStatusTransfer
    PROCEDURE CODE          id-eNBStatusTransfer
    CRITICALITY             ignore
}

mMEStatusTransfer S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      MMEStatusTransfer
    PROCEDURE CODE          id-MMEStatusTransfer
    CRITICALITY             ignore
}

deactivateTrace S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      DeactivateTrace
    PROCEDURE CODE          id-DeactivateTrace
    CRITICALITY             ignore
}

traceStart S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  TraceStart
    PROCEDURE CODE      id-TraceStart
    CRITICALITY         ignore
}

traceFailureIndication S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  TraceFailureIndication
    PROCEDURE CODE      id-TraceFailureIndication
    CRITICALITY         ignore
}

locationReportingControl S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      LocationReportingControl
    PROCEDURE CODE          id-LocationReportingControl
    CRITICALITY             ignore
}

locationReportingFailureIndication S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      LocationReportingFailureIndication
    PROCEDURE CODE          id-LocationReportingFailureIndication
    CRITICALITY             ignore
}

locationReport S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE      LocationReport
    PROCEDURE CODE          id-LocationReport
    CRITICALITY             ignore
}

overloadStart S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  OverloadStart
    PROCEDURE CODE      id-OverloadStart
```

```
    CRITICALITY     ignore
}

overloadStop S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  OverloadStop
    PROCEDURE CODE      id-OverloadStop
    CRITICALITY     reject
}

writeReplaceWarning S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  WriteReplaceWarningRequest
    SUCCESSFUL OUTCOME  WriteReplaceWarningResponse
    PROCEDURE CODE      id-WriteReplaceWarning
    CRITICALITY         reject
}

eNBDirectInformationTransfer S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  ENBDirectInformationTransfer
    PROCEDURE CODE      id-eNBDirectInformationTransfer
    CRITICALITY         ignore
}

mMEDirectInformationTransfer S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  MMEDirectInformationTransfer
    PROCEDURE CODE      id-MMEDirectInformationTransfer
    CRITICALITY         ignore
}

privateMessage S1AP-ELEMENTARY-PROCEDURE ::= {
    INITIATING MESSAGE  PrivateMessage
    PROCEDURE CODE      id-PrivateMessage
    CRITICALITY         ignore
}

END
```

9.3.3 PDU Definitions

```
-- **************************************************************
--
-- PDU definitions for S1AP.
--
-- **************************************************************

S1AP-PDU-Contents {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
eps-Access (20) modules (3) s1ap (1) version1 (1) s1ap-PDU-Contents (1) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

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

IMPORTS

    UEAggregateMaximumBitrate,
    Cause,
    Cdma2000HORequiredIndication,
    Cdma2000HOStatus,
    Cdma2000OneXSRVCCInfo,
    Cdma2000OneXRAND,
    Cdma2000PDU,
    Cdma2000RATType,
    Cdma2000SectorID,
    CNDomain,
    CriticalityDiagnostics,
    CSFallbackIndicator,
    CSG-Id,
    CSG-IdList,
    Direct-Forwarding-Path-Availability,
    Global-ENB-ID,
    EUTRAN-CGI,
    ENBname,
    ENB-StatusTransfer-TransparentContainer,
    ENB-UE-S1AP-ID,
    GTP-TEID,
    GUMMEI,
    HandoverRestrictionList,
    HandoverType,
    MMEname,
    MME-UE-S1AP-ID,
    NAS-PDU,
    OverloadResponse,
    PagingDRX,
```

```
    PLMNidentity,
    RIMTransfer,
    RelativeMMECapacity,
    RequestType,
    E-RAB-ID,
    E-RABLevelQoSParameters,
    E-RABList,
    SecurityKey,
    SecurityContext,
    ServedGUMMEIs,
    ServedPLMNs,
    Source-ToTarget-TransparentContainer,
    SourceBSS-ToTargetBSS-TransparentContainer,
    SourceeNodeB-ToTargeteNodeB-TransparentContainer,
    SourceRNC-ToTargetRNC-TransparentContainer,
    SubscriberProfileIDforRFP,
    SRVCCOperationPossible,
    SRVCCHOIndication,
    SupportedTAs,
    TAI,
    Target-ToSource-TransparentContainer,
    TargetBSS-ToSourceBSS-TransparentContainer,
    TargeteNodeB-ToSourceeNodeB-TransparentContainer,
    TargetID,
    TargetRNC-ToSourceRNC-TransparentContainer,
    TimeToWait,
    TraceActivation,
    TraceReference,
    TransportLayerAddress,
    UEIdentityIndexValue,
    UEPagingID,
    UERadioCapability,
    UE-S1AP-IDs,
    UE-associatedLogicalS1-ConnectionItem,
    UESecurityCapabilities,
    S-TMSI,
    MessageIdentifier,
    SerialNumber,
    WarningAreaList,
    RepetitionPeriod,
    NumberofBroadcastRequest,
    WarningType,
    WarningSecurityInfo,
    DataCodingScheme,
    WarningMessageContents,
    BroadcastCompletedAreaList

FROM S1AP-IEs

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

```
    ProtocolIE-ContainerPairList{},
    ProtocolIE-SingleContainer{},
    S1AP-PRIVATE-IES,
    S1AP-PROTOCOL-EXTENSION,
    S1AP-PROTOCOL-IES,
    S1AP-PROTOCOL-IES-PAIR
FROM S1AP-Containers


    id-uEaggregateMaximumBitrate,
    id-Cause,
    id-cdma2000HORequiredIndication,
    id-cdma2000HOStatus,
    id-cdma2000OneXSRVCCInfo,
    id-cdma2000OneXRAND,
    id-cdma2000PDU,
    id-cdma2000RATType,
    id-cdma2000SectorID,
    id-CNDomain,
    id-CriticalityDiagnostics,
    id-CSFallbackIndicator,
    id-CSG-Id,
    id-CSG-IdList,
    id-Direct-Forwarding-Path-Availability,
    id-Global-ENB-ID,
    id-EUTRAN-CGI,
    id-eNBname,
    id-eNB-StatusTransfer-TransparentContainer,
    id-eNB-UE-S1AP-ID,
    id-GERANtoLTEHOInformationRes,
    id-GUMMEI-ID,
    id-HandoverRestrictionList,
    id-HandoverType,
    id-InitialContextSetup,
    id-Inter-SystemInformationTransferTypeEDT,  id-Inter-SystemInformationTransferTypeMDT,
    id-NAS-DownlinkCount,
    id-MMEname,
    id-MME-UE-S1AP-ID,
    id-NAS-PDU,
    id-OverloadResponse,
    id-pagingDRX,
    id-RelativeMMECapacity,
    id-RequestType,
    id-E-RABAdmittedItem,
    id-E-RABAdmittedList,
    id-E-RABDataForwardingItem,
    id-E-RABFailedToModifyList,
    id-E-RABFailedToReleaseList,
    id-E-RABFailedtoSetupItemHOReqAck,
    id-E-RABFailedToSetupListBearerSURes,
    id-E-RABFailedToSetupListCtxtSURes,
    id-E-RABFailedToSetupListHOReqAck,
    id-E-RABFailedToBeReleasedList,
    id-E-RABModify,
```

```
    id-E-RABModifyItemBearerModRes,
    id-E-RABModifyListBearerModRes,
    id-E-RABRelease,
    id-E-RABReleaseItemBearerRelComp,
    id-E-RABReleaseItemHOCmd,
    id-E-RABReleaseListBearerRelComp,
    id-E-RABReleaseIndication,
    id-E-RABSetup,
    id-E-RABSetupItemBearerSURes,
    id-E-RABSetupItemCtxtSURes,
    id-E-RABSetupListBearerSURes,
    id-E-RABSetupListCtxtSURes,
    id-E-RABSubjecttoDataForwardingList,
    id-E-RABToBeModifiedItemBearerModReq,
    id-E-RABToBeModifiedListBearerModReq,
    id-E-RABToBeReleasedList,
    id-E-RABReleasedList,
    id-E-RABToBeSetupItemBearerSUReq,
    id-E-RABToBeSetupItemCtxtSUReq,
    id-E-RABToBeSetupItemHOReq,
    id-E-RABToBeSetupListBearerSUReq,
    id-E-RABToBeSetupListCtxtSUReq,
    id-E-RABToBeSetupListHOReq,
    id-E-RABToBeSwitchedDLItem,
    id-E-RABToBeSwitchedDLList,
    id-E-RABToBeSwitchedULList,
    id-E-RABToBeSwitchedULItem,
    id-E-RABtoReleaseListHOCmd,
    id-SecurityKey,
    id-SecurityContext,
    id-ServedGUMMEIs,
    id-ServedPLMNs,
    id-Source-ToTarget-TransparentContainer,
    id-SourceMME-UE-S1AP-ID,
    id-SRVCCOperationPossible,
    id-SRVCCHOIndication,
    id-SubscriberProfileIDforRFP,
    id-SupportedTAs,
    id-S-TMSI,
    id-TAI,
    id-TAIItem,
    id-TAIList,
    id-Target-ToSource-TransparentContainer,
    id-TargetID,
    id-TimeToWait,
    id-TraceActivation,
    id-TraceReference,
    id-UEIdentityIndexValue,
    id-UEPagingID,
    id-UERadioCapability,
    id-UTRANtoLTEHOInformationRes,
    id-UE-associatedLogicalS1-ConnectionListResAck,
    id-UE-associatedLogicalS1-ConnectionItem,
    id-UESecurityCapabilities,
```

```
    id-UE-S1AP-IDs,
    id-ResetType,
    id-MessageIdentifier,
    id-SerialNumber,
    id-WarningAreaList,
    id-RepetitionPeriod,
    id-NumberofBroadcastRequest,
    id-WarningType,
    id-WarningSecurityInfo,
    id-DataCodingScheme,
    id-WarningMessageContents,
    id-BroadcastCompletedAreaList,
    maxnoofTAI,
    maxNrOfErrors,
    maxNrOfE-RABs,
    maxNrOfIndividualS1ConnectionsToReset,
    maxnoofEmergencyAreaID,
    maxnoofCellID,
    maxnoofTAIforWarning,
    maxnoofCellinTAI,
    maxnoofCellinEAI


FROM S1AP-Constants;

-- ************************************************************
--
-- Common Container Lists
--
-- ************************************************************

E-RAB-IE-ContainerList                 { S1AP-PROTOCOL-IES      : IEsSetParam }    ::= ProtocolIE-ContainerList     { 1, maxNrOfE-RABs,
{IEsSetParam} }
E-RAB-IE-ContainerPairList             { S1AP-PROTOCOL-IES-PAIR : IEsSetParam }    ::= ProtocolIE-ContainerPairList { 1, maxNrOfE-RABs,
{IEsSetParam} }
ProtocolError-IE-ContainerList        { S1AP-PROTOCOL-IES      : IEsSetParam }  ::= ProtocolIE-ContainerList     { 1, maxNrOfE-RABs,
{IEsSetParam} }

-- ************************************************************
--
-- HANDOVER PREPARATION ELEMTARY PROCEDURE
--
-- ************************************************************

-- ************************************************************
--
-- Handover Required
--
-- ************************************************************

HandoverRequired ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { { HandoverRequiredIEs} },
    ...
}
```

```
HandoverRequiredIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID                  CRITICALITY reject  TYPE MME-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-eNB-UE-S1AP-ID                  CRITICALITY reject  TYPE ENB-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-HandoverType                    CRITICALITY reject  TYPE HandoverType                PRESENCE mandatory   } |
    { ID id-Cause                  CRITICALITY ignore  TYPE Cause                  PRESENCE mandatory  } |
    { ID id-TargetID               CRITICALITY reject  TYPE TargetID                   PRESENCE mandatory} |
    { ID id-Direct-Forwarding-Path-Availability CRITICALITY ignore  TYPE Direct-Forwarding-Path-Availability  PRESENCE optional } |
    { ID id-SRVCCHOIndication           CRITICALITY reject   TYPE    SRVCCHOIndication       PRESENCE optional }|
    { ID id-Source-ToTarget-TransparentContainer CRITICALITY reject TYPE Source-ToTarget-TransparentContainer PRESENCE mandatory },

    ...
}


-- **************************************************************
--
-- Handover Command
--
-- **************************************************************

HandoverCommand ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container { { HandoverCommandIEs} },
    ...
}

HandoverCommandIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID                  CRITICALITY reject  TYPE MME-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-eNB-UE-S1AP-ID                  CRITICALITY reject  TYPE ENB-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-HandoverType                    CRITICALITY reject  TYPE HandoverType                PRESENCE mandatory   } |
    { ID id-NAS-DownlinkCount                   CRITICALITY reject  TYPE NAS-DownlinkCount            PRESENCE conditional
    -- This IE shall be present if Handover Type IE is not set to value "IntraLTE" --          }|
    { ID id-E-RABSubjecttoDataForwardingList                    CRITICALITY ignore  TYPE E-RABSubjecttoDataForwardingList            PRESENCE
optional    } |
    { ID id-E-RABtoReleaseListHOCmd                CRITICALITY ignore  TYPE E-RABList              PRESENCE optional } |
    { ID id-Target-ToSource-TransparentContainer           CRITICALITY reject  TYPE Target-ToSource-TransparentContainer   PRESENCE mandatory }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional   },
    ...
}

NAS-DownlinkCount ::= BIT STRING (SIZE (4))

E-RABSubjecttoDataForwardingList ::= E-RAB-IE-ContainerList { {E-RABDataForwardingItemIEs} }

E-RABDataForwardingItemIEs S1AP-PROTOCOL-IES ::= {
    { ID id-E-RABDataForwardingItem         CRITICALITY ignore  TYPE E-RABDataForwardingItem        PRESENCE mandatory   },
    ...
}

E-RABDataForwardingItem ::= SEQUENCE {
    e-RAB-ID                        E-RAB-ID,
    dL-transportLayerAddress                TransportLayerAddress   OPTIONAL,
    dL-gTP-TEID                GTP-TEID    OPTIONAL,
    uL-TransportLayerAddress            TransportLayerAddress   OPTIONAL,
```

```
    uL-GTP-TEID                         GTP-TEID    OPTIONAL,
    iE-Extensions                   ProtocolExtensionContainer { { E-RABDataForwardingItem-ExtIEs} }      OPTIONAL,
    ...
}

E-RABDataForwardingItem-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}



-- **************************************************************
--
-- Handover Preparation Failure
--
-- **************************************************************

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

HandoverPreparationFailureIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID                  CRITICALITY ignore  TYPE MME-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-eNB-UE-S1AP-ID                  CRITICALITY ignore  TYPE ENB-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-Cause                   CRITICALITY ignore  TYPE Cause                  PRESENCE mandatory  }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional   },
    ...
}

-- **************************************************************
--
-- HANDOVER RESOURCE ALLOCATION ELEMTARY PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- Handover Request
--
-- **************************************************************

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

HandoverRequestIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID                  CRITICALITY reject  TYPE MME-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-HandoverType                    CRITICALITY reject  TYPE HandoverType                PRESENCE mandatory   } |
    { ID id-Cause                   CRITICALITY ignore  TYPE Cause                  PRESENCE mandatory  } |
    { ID id-uEaggregateMaximumBitrate       CRITICALITY reject  TYPE UEAggregateMaximumBitrate    PRESENCE mandatory   }|
    { ID id-E-RABToBeSetupListHOReq                 CRITICALITY reject  TYPE E-RABToBeSetupListHOReq            PRESENCE mandatory   } |
```

```
    { ID id-Source-ToTarget-TransparentContainer        CRITICALITY reject  TYPE Source-ToTarget-TransparentContainer            PRESENCE
mandatory   } |
    { ID id-UESecurityCapabilities      CRITICALITY reject  TYPE UESecurityCapabilities         PRESENCE mandatory  }|
    { ID id-HandoverRestrictionList     CRITICALITY ignore  TYPE HandoverRestrictionList    PRESENCE optional }|
    { ID id-TraceActivation             CRITICALITY ignore  TYPE TraceActivation            PRESENCE optional }|
    { ID id-RequestType                 CRITICALITY ignore  TYPE    RequestType             PRESENCE optional }|
    { ID id-SRVCCOperationPossible      CRITICALITY ignore  TYPE    SRVCCOperationPossible  PRESENCE optional }|
    { ID id-SecurityContext             CRITICALITY reject  TYPE    SecurityContext         PRESENCE mandatory},
    ...
}

E-RABToBeSetupListHOReq                     ::= E-RAB-IE-ContainerList { {E-RABToBeSetupItemHOReqIEs} }

E-RABToBeSetupItemHOReqIEs S1AP-PROTOCOL-IES ::= {
    { ID id-E-RABToBeSetupItemHOReq         CRITICALITY reject  TYPE E-RABToBeSetupItemHOReq        PRESENCE mandatory   },
    ...
}

E-RABToBeSetupItemHOReq ::= SEQUENCE {
    e-RAB-ID                        E-RAB-ID,
    transportLayerAddress               TransportLayerAddress,
    gTP-TEID                    GTP-TEID,
    e-RABlevelQosParameters             E-RABLevelQoSParameters,
    iE-Extensions                   ProtocolExtensionContainer { {E-RABToBeSetupItemHOReq-ExtIEs} }       OPTIONAL,
    ...
}

E-RABToBeSetupItemHOReq-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

-- **************************************************************
--
-- Handover Request Acknowledge
--
-- **************************************************************

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

HandoverRequestAcknowledgeIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID                  CRITICALITY ignore  TYPE MME-UE-S1AP-ID             PRESENCE mandatory   } |
    { ID id-eNB-UE-S1AP-ID                  CRITICALITY ignore  TYPE ENB-UE-S1AP-ID             PRESENCE mandatory   } |
    { ID id-HandoverType                    CRITICALITY ignore  TYPE HandoverType               PRESENCE mandatory   } |
    { ID id-E-RABAdmittedList                   CRITICALITY ignore  TYPE E-RABAdmittedList           PRESENCE mandatory   } |
    { ID id-E-RABFailedToSetupListHOReqAck                  CRITICALITY ignore  TYPE E-RABFailedtoSetupListHOReqAck          PRESENCE optional }
|
    { ID id-Target-ToSource-TransparentContainer    CRITICALITY reject TYPE Target-ToSource-TransparentContainer PRESENCE mandatory }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional   },
    ...
}
```

```
E-RABAdmittedList                   ::= E-RAB-IE-ContainerList { {E-RABAdmittedItemIEs} }

E-RABAdmittedItemIEs S1AP-PROTOCOL-IES ::= {
    { ID id-E-RABAdmittedItem           CRITICALITY ignore  TYPE E-RABAdmittedItem          PRESENCE mandatory   },
    ...
}

E-RABAdmittedItem ::= SEQUENCE {
    e-RAB-ID                        E-RAB-ID,
    transportLayerAddress               TransportLayerAddress,
    gTP-TEID                    GTP-TEID,
    dL-transportLayerAddress                TransportLayerAddress   OPTIONAL,
    dL-gTP-TEID                             GTP-TEID    OPTIONAL,
    uL-TransportLayerAddress                TransportLayerAddress   OPTIONAL,
    uL-GTP-TEID                             GTP-TEID                OPTIONAL,
    iE-Extensions                   ProtocolExtensionContainer { {E-RABAdmittedItem-ExtIEs} }       OPTIONAL,
    ...
}

E-RABAdmittedItem-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

E-RABFailedtoSetupListHOReqAck                  ::= E-RAB-IE-ContainerList { {E-RABFailedtoSetupItemHOReqAckIEs} }

E-RABFailedtoSetupItemHOReqAckIEs S1AP-PROTOCOL-IES ::= {
    { ID id-E-RABFailedtoSetupItemHOReqAck          CRITICALITY ignore  TYPE E-RABFailedToSetupItemHOReqAck        PRESENCE mandatory   },
    ...
}

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

E-RABFailedToSetupItemHOReqAckExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}


-- **************************************************************
--
-- Handover Failure
--
-- **************************************************************

HandoverFailure ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { { HandoverFailureIEs} },
    ...
}

HandoverFailureIEs S1AP-PROTOCOL-IES ::= {
```

```
    { ID id-MME-UE-S1AP-ID                  CRITICALITY ignore  TYPE MME-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-Cause                    CRITICALITY ignore  TYPE Cause                   PRESENCE mandatory  }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional   },
    ...
}

-- **************************************************************
--
-- HANDOVER NOTIFICATION ELEMTARY PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- Handover Notify
--
-- **************************************************************

HandoverNotify ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { { HandoverNotifyIEs} },
    ...
}

HandoverNotifyIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID                  CRITICALITY reject  TYPE MME-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-eNB-UE-S1AP-ID                  CRITICALITY reject  TYPE ENB-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-EUTRAN-CGI          CRITICALITY ignore  TYPE EUTRAN-CGI         PRESENCE mandatory}|
    { ID id-TAI                 CRITICALITY ignore  TYPE TAI                        PRESENCE mandatory}|
    { ID id-UESecurityCapabilities          CRITICALITY ignore  TYPE UESecurityCapabilities      PRESENCE mandatory   },
    ...
}

-- **************************************************************
--
-- PATH SWITCH REQUEST ELEMTARY PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- Path Switch Request
--
-- **************************************************************

PathSwitchRequest ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { { PathSwitchRequestIEs} },
    ...
}

PathSwitchRequestIEs S1AP-PROTOCOL-IES ::= {
    { ID id-eNB-UE-S1AP-ID                  CRITICALITY reject  TYPE ENB-UE-S1AP-ID             PRESENCE mandatory  }|
    { ID id-E-RABToBeSwitchedDLList                 CRITICALITY reject  TYPE E-RABToBeSwitchedDLList             PRESENCE mandatory   }|
    { ID id-SourceMME-UE-S1AP-ID                    CRITICALITY reject  TYPE MME-UE-S1AP-ID          PRESENCE mandatory   }|
    { ID id-EUTRAN-CGI          CRITICALITY ignore  TYPE EUTRAN-CGI         PRESENCE mandatory}|
```

```
    { ID id-TAI                 CRITICALITY ignore  TYPE TAI                        PRESENCE mandatory}|
    { ID id-UESecurityCapabilities          CRITICALITY ignore  TYPE UESecurityCapabilities       PRESENCE mandatory   },
    ...
}

E-RABToBeSwitchedDLList                     ::= E-RAB-IE-ContainerList { {E-RABToBeSwitchedDLItemIEs} }

E-RABToBeSwitchedDLItemIEs S1AP-PROTOCOL-IES ::= {
    { ID id-E-RABToBeSwitchedDLItem         CRITICALITY reject  TYPE E-RABToBeSwitchedDLItem        PRESENCE mandatory   },
    ...
}

E-RABToBeSwitchedDLItem ::= SEQUENCE {
    e-RAB-ID                        E-RAB-ID,
    transportLayerAddress               TransportLayerAddress,
    gTP-TEID                    GTP-TEID,
    iE-Extensions                   ProtocolExtensionContainer { { E-RABToBeSwitchedDLItem-ExtIEs} }      OPTIONAL,
    ...
}

E-RABToBeSwitchedDLItem-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

-- **************************************************************
--
-- Path Switch Request Acknowledge
--
-- **************************************************************

PathSwitchRequestAcknowledge ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { { PathSwitchRequestAcknowledgeIEs} },
    ...
}

PathSwitchRequestAcknowledgeIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID                  CRITICALITY ignore  TYPE MME-UE-S1AP-ID             PRESENCE mandatory   } |
    { ID id-eNB-UE-S1AP-ID                  CRITICALITY ignore  TYPE ENB-UE-S1AP-ID            PRESENCE mandatory }|
    { ID id-uEaggregateMaximumBitrate       CRITICALITY ignore  TYPE UEAggregateMaximumBitrate   PRESENCE optional }|
    { ID id-E-RABToBeSwitchedULList     CRITICALITY ignore  TYPE E-RABToBeSwitchedULList    PRESENCE optional }|
    { ID id-E-RABToBeReleasedList       CRITICALITY ignore  TYPE E-RABList              PRESENCE optional  }|
    { ID id-SecurityContext             CRITICALITY reject  TYPE    SecurityContext         PRESENCE mandatory}|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional   },
    ...
}

E-RABToBeSwitchedULList ::= E-RAB-IE-ContainerList { {E-RABToBeSwitchedULItemIEs} }

E-RABToBeSwitchedULItemIEs S1AP-PROTOCOL-IES ::= {
    { ID id-E-RABToBeSwitchedULItem     CRITICALITY ignore  TYPE E-RABToBeSwitchedULItem    PRESENCE mandatory   },
    ...
}

E-RABToBeSwitchedULItem ::= SEQUENCE {
```

```
    e-RAB-ID                        E-RAB-ID,
    transportLayerAddress               TransportLayerAddress,
    gTP-TEID                            GTP-TEID,
    iE-Extensions                       ProtocolExtensionContainer { { E-RABToBeSwitchedULItem-ExtIEs} }        OPTIONAL,
    ...
}

E-RABToBeSwitchedULItem-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}


-- **************************************************************
--
-- Path Switch Request Failure
--
-- **************************************************************

PathSwitchRequestFailure ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { { PathSwitchRequestFailureIEs} },
    ...
}

PathSwitchRequestFailureIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID                  CRITICALITY ignore  TYPE MME-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-eNB-UE-S1AP-ID                  CRITICALITY ignore  TYPE ENB-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-Cause                           CRITICALITY ignore  TYPE Cause                       PRESENCE mandatory   }|
    { ID id-CriticalityDiagnostics          CRITICALITY ignore  TYPE CriticalityDiagnostics      PRESENCE optional },
    ...
}

-- **************************************************************
--
-- HANDOVER CANCEL ELEMTARY PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- Handover Cancel
--
-- **************************************************************

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

HandoverCancelIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID                  CRITICALITY reject  TYPE MME-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-eNB-UE-S1AP-ID                  CRITICALITY reject  TYPE ENB-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-Cause                   CRITICALITY ignore  TYPE Cause                  PRESENCE mandatory  },
    ...
}
```

```
-- ********************************************************
--
-- Handover Cancel Request Acknowledge
--
-- ********************************************************

HandoverCancelAcknowledge ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { { HandoverCancelAcknowledgeIEs} },
    ...
}

HandoverCancelAcknowledgeIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID                  CRITICALITY ignore  TYPE MME-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-eNB-UE-S1AP-ID                  CRITICALITY ignore  TYPE ENB-UE-S1AP-ID              PRESENCE mandatory   }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional   },
    ...
}

-- ********************************************************
--
-- E-RAB SETUP ELEMENTARY PROCEDURE
--
-- ********************************************************

-- ********************************************************
--
-- E-RAB Setup Request
--
-- ********************************************************

E-RABSetupRequest ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {E-RABSetupRequestIEs} },
    ...
}

E-RABSetupRequestIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID              CRITICALITY reject  TYPE MME-UE-S1AP-ID                 PRESENCE mandatory }|
    { ID id-eNB-UE-S1AP-ID              CRITICALITY reject  TYPE ENB-UE-S1AP-ID                 PRESENCE mandatory }|
    { ID id-uEaggregateMaximumBitrate       CRITICALITY reject  TYPE UEAggregateMaximumBitrate    PRESENCE optional }|
    { ID id-E-RABToBeSetupListBearerSUReq           CRITICALITY reject  TYPE E-RABToBeSetupListBearerSUReq    PRESENCE mandatory   },
    ...
}

E-RABToBeSetupListBearerSUReq ::= SEQUENCE (SIZE(1.. maxNrOfE-RABs)) OF ProtocolIE-SingleContainer { {E-RABToBeSetupItemBearerSUReqIEs} }

E-RABToBeSetupItemBearerSUReqIEs    S1AP-PROTOCOL-IES ::= {
    { ID id-E-RABToBeSetupItemBearerSUReq    CRITICALITY reject     TYPE E-RABToBeSetupItemBearerSUReq  PRESENCE mandatory },
    ...
}

E-RABToBeSetupItemBearerSUReq ::= SEQUENCE {
    e-RAB-ID                    E-RAB-ID,
    e-RABlevelQoSParameters                 E-RABLevelQoSParameters,
```

```
    transportLayerAddress           TransportLayerAddress,
    gTP-TEID                    GTP-TEID,
    nAS-PDU                         NAS-PDU,
    iE-Extensions                   ProtocolExtensionContainer { {E-RABToBeSetupItemBearerSUReqExtIEs} } OPTIONAL,
    ...
}


E-RABToBeSetupItemBearerSUReqExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}


-- **************************************************************
--
-- E-RAB Setup Response
--
-- **************************************************************

E-RABSetupResponse ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {E-RABSetupResponseIEs} },
    ...
}

E-RABSetupResponseIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID              CRITICALITY ignore  TYPE MME-UE-S1AP-ID                 PRESENCE mandatory }|
    { ID id-eNB-UE-S1AP-ID              CRITICALITY ignore  TYPE ENB-UE-S1AP-ID                 PRESENCE mandatory }|
    { ID id-E-RABSetupListBearerSURes               CRITICALITY ignore  TYPE E-RABSetupListBearerSURes       PRESENCE optional }|
    { ID id-E-RABFailedToSetupListBearerSURes       CRITICALITY ignore  TYPE E-RABList              PRESENCE optional }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional   },
    ...
}


E-RABSetupListBearerSURes ::= SEQUENCE (SIZE(1.. maxNrOfE-RABs)) OF ProtocolIE-SingleContainer { {E-RABSetupItemBearerSUResIEs} }

E-RABSetupItemBearerSUResIEs    S1AP-PROTOCOL-IES ::= {
    { ID id-E-RABSetupItemBearerSURes    CRITICALITY ignore     TYPE E-RABSetupItemBearerSURes  PRESENCE mandatory },
    ...
}

E-RABSetupItemBearerSURes ::= SEQUENCE {
    e-RAB-ID                    E-RAB-ID,
    transportLayerAddress           TransportLayerAddress,
    gTP-TEID                    GTP-TEID,
    iE-Extensions                   ProtocolExtensionContainer { {E-RABSetupItemBearerSUResExtIEs} } OPTIONAL,
    ...
}


E-RABSetupItemBearerSUResExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}
```

```
-- ************************************************************
--
-- E-RAB MODIFY ELEMENTARY PROCEDURE
--
-- ************************************************************

-- ************************************************************
--
-- E-RAB Modify Request
--
-- ************************************************************

E-RABModifyRequest ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {E-RABModifyRequestIEs} },
    ...
}

E-RABModifyRequestIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID              CRITICALITY reject  TYPE MME-UE-S1AP-ID                PRESENCE mandatory }|
    { ID id-eNB-UE-S1AP-ID              CRITICALITY reject  TYPE ENB-UE-S1AP-ID                PRESENCE mandatory }|
    { ID id-uEaggregateMaximumBitrate       CRITICALITY reject  TYPE UEAggregateMaximumBitrate    PRESENCE optional }|
    { ID id-E-RABToBeModifiedListBearerModReq       CRITICALITY reject  TYPE E-RABToBeModifiedListBearerModReq     PRESENCE mandatory   },
    ...
}

E-RABToBeModifiedListBearerModReq ::= SEQUENCE (SIZE(1.. maxNrOfE-RABs)) OF ProtocolIE-SingleContainer { {E-RABToBeModifiedItemBearerModReqIEs} }

E-RABToBeModifiedItemBearerModReqIEs    S1AP-PROTOCOL-IES ::= {
    { ID id-E-RABToBeModifiedItemBearerModReq    CRITICALITY reject     TYPE E-RABToBeModifiedItemBearerModReq   PRESENCE mandatory },
    ...
}

E-RABToBeModifiedItemBearerModReq ::= SEQUENCE {
    e-RAB-ID                    E-RAB-ID,
    e-RABLevelQoSParameters                 E-RABLevelQoSParameters,
    nAS-PDU                     NAS-PDU,
    iE-Extensions               ProtocolExtensionContainer { {E-RABToBeModifyItemBearerModReqExtIEs} } OPTIONAL,
    ...
}


E-RABToBeModifyItemBearerModReqExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}
```

```
-- **************************************************************
--
-- E-RAB Modify Response
--
-- **************************************************************

E-RABModifyResponse ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {E-RABModifyResponseIEs} },
    ...
}

E-RABModifyResponseIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID              CRITICALITY ignore  TYPE MME-UE-S1AP-ID                PRESENCE mandatory }|
    { ID id-eNB-UE-S1AP-ID              CRITICALITY ignore  TYPE ENB-UE-S1AP-ID                PRESENCE mandatory }|
    { ID id-E-RABModifyListBearerModRes             CRITICALITY ignore  TYPE E-RABModifyListBearerModRes     PRESENCE optional }|
    { ID id-E-RABFailedToModifyList     CRITICALITY ignore  TYPE E-RABList              PRESENCE optional  }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional  },
    ...
}


E-RABModifyListBearerModRes ::= SEQUENCE (SIZE(1.. maxNrOfE-RABs)) OF ProtocolIE-SingleContainer { {E-RABModifyItemBearerModResIEs} }

E-RABModifyItemBearerModResIEs  S1AP-PROTOCOL-IES ::= {
    { ID id-E-RABModifyItemBearerModRes  CRITICALITY ignore     TYPE E-RABModifyItemBearerModRes  PRESENCE mandatory },
    ...
}

E-RABModifyItemBearerModRes ::= SEQUENCE {
    e-RAB-ID                    E-RAB-ID,
    iE-Extensions                   ProtocolExtensionContainer { {E-RABModifyItemBearerModResExtIEs} } OPTIONAL,
    ...
}


E-RABModifyItemBearerModResExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}
```

```
-- ****************************************************************
--
-- E-RAB RELEASE ELEMENTARY PROCEDURE
--
-- ****************************************************************

-- ****************************************************************
--
-- E-RAB Release Command
--
-- ****************************************************************

E-RABReleaseCommand ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {E-RABReleaseCommandIEs} },
    ...
}

E-RABReleaseCommandIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID              CRITICALITY reject  TYPE MME-UE-S1AP-ID                 PRESENCE mandatory }|
    { ID id-eNB-UE-S1AP-ID              CRITICALITY reject  TYPE ENB-UE-S1AP-ID                 PRESENCE mandatory }|
    { ID id-uEaggregateMaximumBitrate       CRITICALITY reject  TYPE UEAggregateMaximumBitrate    PRESENCE optional }|
    { ID id-E-RABToBeReleasedList       CRITICALITY ignore  TYPE E-RABList                  PRESENCE mandatory  }|
    { ID id-NAS-PDU                         CRITICALITY ignore  TYPE NAS-PDU                    PRESENCE optional },
    ...
}


-- ****************************************************************
--
-- E-RAB Release Response
--
-- ****************************************************************

E-RABReleaseResponse ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { { E-RABReleaseResponseIEs } },
    ...
}

E-RABReleaseResponseIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID              CRITICALITY ignore  TYPE MME-UE-S1AP-ID                 PRESENCE mandatory }|
    { ID id-eNB-UE-S1AP-ID              CRITICALITY ignore  TYPE ENB-UE-S1AP-ID                 PRESENCE mandatory }|
    { ID id-E-RABReleaseListBearerRelComp               CRITICALITY ignore  TYPE E-RABReleaseListBearerRelComp     PRESENCE optional }|
    { ID id-E-RABFailedToReleaseList        CRITICALITY ignore  TYPE E-RABList              PRESENCE optional }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional  },
    ...
}


E-RABReleaseListBearerRelComp ::= SEQUENCE (SIZE(1.. maxNrOfE-RABs)) OF ProtocolIE-SingleContainer { {E-RABReleaseItemBearerRelCompIEs} }

E-RABReleaseItemBearerRelCompIEs    S1AP-PROTOCOL-IES ::= {
    { ID id-E-RABReleaseItemBearerRelComp    CRITICALITY ignore     TYPE E-RABReleaseItemBearerRelComp  PRESENCE mandatory },
    ...
}
```

```
E-RABReleaseItemBearerRelComp ::= SEQUENCE {
    e-RAB-ID                    E-RAB-ID,
    iE-Extensions                   ProtocolExtensionContainer { {E-RABReleaseItemBearerRelCompExtIEs} } OPTIONAL,
    ...
}


E-RABReleaseItemBearerRelCompExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}



-- **************************************************************
--
-- E-RAB RELEASE REQUEST ELEMENTARY PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- E-RAB Release Indication
--
-- **************************************************************

E-RABReleaseIndication ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {E-RABReleaseIndicationIEs} },
    ...
}

E-RABReleaseIndicationIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID              CRITICALITY reject  TYPE MME-UE-S1AP-ID                PRESENCE mandatory }|
    { ID id-eNB-UE-S1AP-ID              CRITICALITY reject  TYPE ENB-UE-S1AP-ID                PRESENCE mandatory }|
    { ID id-E-RABReleasedList       CRITICALITY ignore  TYPE E-RABList                  PRESENCE mandatory },
    ...
}
-- **************************************************************
--
-- INITIAL CONTEXT SETUP ELEMENTARY PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- Initial Context Setup Request
--
-- **************************************************************

InitialContextSetupRequest ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {InitialContextSetupRequestIEs} },
    ...
}
```

```
InitialContextSetupRequestIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID              CRITICALITY reject  TYPE MME-UE-S1AP-ID                 PRESENCE mandatory }|
    { ID id-eNB-UE-S1AP-ID              CRITICALITY reject  TYPE ENB-UE-S1AP-ID                 PRESENCE mandatory }|
    { ID id-uEaggregateMaximumBitrate       CRITICALITY reject  TYPE UEAggregateMaximumBitrate    PRESENCE mandatory   }|
    { ID id-E-RABToBeSetupListCtxtSUReq         CRITICALITY reject  TYPE E-RABToBeSetupListCtxtSUReq    PRESENCE mandatory   }|
    { ID id-UESecurityCapabilities      CRITICALITY reject  TYPE UESecurityCapabilities         PRESENCE mandatory }|
    { ID id-SecurityKey     CRITICALITY reject  TYPE SecurityKey            PRESENCE mandatory  }|
    { ID id-TraceActivation             CRITICALITY ignore  TYPE TraceActivation                PRESENCE optional  }|
    { ID id-HandoverRestrictionList     CRITICALITY ignore  TYPE HandoverRestrictionList        PRESENCE optional  }|
    { ID id-UERadioCapability           CRITICALITY ignore  TYPE UERadioCapability              PRESENCE optional  }|
    { ID id-SubscriberProfileIDforRFP   CRITICALITY ignore  TYPE SubscriberProfileIDforRFP  PRESENCE optional }|
    { ID id-CSFallbackIndicator         CRITICALITY reject      TYPE CSFallbackIndicator        PRESENCE optional  }|
    { ID id-SRVCCOperationPossible          CRITICALITY ignore  TYPE SRVCCOperationPossible     PRESENCE optional  },
    ...
}



E-RABToBeSetupListCtxtSUReq ::= SEQUENCE (SIZE(1.. maxNrOfE-RABs)) OF ProtocolIE-SingleContainer { {E-RABToBeSetupItemCtxtSUReqIEs} }

E-RABToBeSetupItemCtxtSUReqIEs  S1AP-PROTOCOL-IES ::= {
    { ID id-E-RABToBeSetupItemCtxtSUReq  CRITICALITY reject     TYPE E-RABToBeSetupItemCtxtSUReq  PRESENCE mandatory },
    ...
}

E-RABToBeSetupItemCtxtSUReq ::= SEQUENCE {
    e-RAB-ID                    E-RAB-ID,
    e-RABlevelQoSParameters             E-RABLevelQoSParameters,
    transportLayerAddress           TransportLayerAddress,
    gTP-TEID            GTP-TEID,
    nAS-PDU             NAS-PDU,
    iE-Extensions                   ProtocolExtensionContainer { {E-RABToBeSetupItemCtxtSUReqExtIEs} } OPTIONAL,
    ...
}


E-RABToBeSetupItemCtxtSUReqExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}


-- **************************************************************
--
-- Initial Context Setup Response
--
-- **************************************************************

InitialContextSetupResponse ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container        { {InitialContextSetupResponseIEs} },
    ...
}

InitialContextSetupResponseIEs S1AP-PROTOCOL-IES ::= {
```

```
    { ID id-MME-UE-S1AP-ID              CRITICALITY ignore  TYPE MME-UE-S1AP-ID                PRESENCE mandatory }|
    { ID id-eNB-UE-S1AP-ID              CRITICALITY ignore  TYPE ENB-UE-S1AP-ID                PRESENCE mandatory }|
    { ID id-E-RABSetupListCtxtSURes             CRITICALITY ignore  TYPE E-RABSetupListCtxtSURes        PRESENCE mandatory   }|
    { ID id-E-RABFailedToSetupListCtxtSURes     CRITICALITY ignore  TYPE E-RABList                PRESENCE optional }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional   },
    ...
}


E-RABSetupListCtxtSURes ::= SEQUENCE (SIZE(1.. maxNrOfE-RABs)) OF ProtocolIE-SingleContainer { {E-RABSetupItemCtxtSUResIEs} }

E-RABSetupItemCtxtSUResIEs  S1AP-PROTOCOL-IES ::= {
    { ID id-E-RABSetupItemCtxtSURes  CRITICALITY ignore     TYPE E-RABSetupItemCtxtSURes    PRESENCE mandatory },
    ...
}

E-RABSetupItemCtxtSURes ::= SEQUENCE {
    e-RAB-ID                    E-RAB-ID,
    transportLayerAddress           TransportLayerAddress,
    gTP-TEID            GTP-TEID,
    iE-Extensions                   ProtocolExtensionContainer { {E-RABSetupItemCtxtSUResExtIEs} } OPTIONAL,
    ...
}


E-RABSetupItemCtxtSUResExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}


-- **************************************************************
--
-- Initial Context Setup Failure
--
-- **************************************************************

InitialContextSetupFailure ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {InitialContextSetupFailureIEs} },
    ...
}

InitialContextSetupFailureIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID              CRITICALITY ignore  TYPE MME-UE-S1AP-ID                PRESENCE mandatory }|
    { ID id-eNB-UE-S1AP-ID              CRITICALITY ignore  TYPE ENB-UE-S1AP-ID                PRESENCE mandatory }|
    { ID id-Cause                       CRITICALITY ignore  TYPE Cause                      PRESENCE mandatory   }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional   },
    ...
}

-- **************************************************************
--
-- Paging
--
-- **************************************************************
```

```
Paging ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       {{PagingIEs}},
    ...
}

PagingIEs S1AP-PROTOCOL-IES ::= {
    { ID id-UEIdentityIndexValue        CRITICALITY ignore  TYPE UEIdentityIndexValue   PRESENCE mandatory } |
    { ID id-UEPagingID                      CRITICALITY ignore  TYPE UEPagingID             PRESENCE mandatory   } |
    { ID id-pagingDRX                   CRITICALITY ignore  TYPE PagingDRX          PRESENCE optional   } |
    { ID id-CNDomain                    CRITICALITY ignore      TYPE CNDomain       PRESENCE mandatory  } |
    { ID id-TAIList                CRITICALITY ignore  TYPE TAIList            PRESENCE mandatory   },
    ...
}

TAIList::= SEQUENCE (SIZE(1.. maxnoofTAI)) OF ProtocolIE-SingleContainer {{TAIItemIEs}}

TAIItemIEs  S1AP-PROTOCOL-IES ::= {
    { ID id-TAIItem  CRITICALITY ignore     TYPE TAIItem    PRESENCE mandatory },
    ...
}

TAIItem ::= SEQUENCE {
    tAI                             TAI,
    iE-Extensions                   ProtocolExtensionContainer { {TAIItemExtIEs} } OPTIONAL,
    ...
}


TAIItemExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

-- **************************************************************
--
-- UE CONTEXT RELEASE ELEMENTARY PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- UE CONTEXT RELEASE REQUEST
--
-- **************************************************************

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

UEContextReleaseRequest-IEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID          CRITICALITY reject  TYPE MME-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-eNB-UE-S1AP-ID          CRITICALITY reject  TYPE ENB-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-Cause                   CRITICALITY ignore  TYPE Cause              PRESENCE mandatory} ,
```

```
    ...
}

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

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

UEContextReleaseCommand-IEs S1AP-PROTOCOL-IES ::= {
    { ID id-UE-S1AP-IDs             CRITICALITY reject  TYPE UE-S1AP-IDs                    PRESENCE mandatory} |

    { ID id-Cause                   CRITICALITY ignore  TYPE Cause                      PRESENCE mandatory} ,
    ...
}

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

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

UEContextReleaseComplete-IEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID          CRITICALITY ignore  TYPE MME-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-eNB-UE-S1AP-ID          CRITICALITY ignore  TYPE ENB-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional   },
    ...
}


-- **************************************************************
--
-- UE Context Modification
--
-- **************************************************************

-- **************************************************************
--
-- UE Context Modification Request
--
-- **************************************************************

UEContextModificationRequest ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { { UEContextModificationRequestIEs} },
```

```
    ...
}

UEContextModificationRequestIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID                  CRITICALITY reject  TYPE MME-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-eNB-UE-S1AP-ID                CRITICALITY reject  TYPE ENB-UE-S1AP-ID            PRESENCE mandatory   } |
    { ID id-SecurityKey                   CRITICALITY reject  TYPE SecurityKey                   PRESENCE optional   }|
    { ID id-SubscriberProfileIDforRFP       CRITICALITY ignore  TYPE SubscriberProfileIDforRFP  PRESENCE optional   }|
    { ID id-uEaggregateMaximumBitrate       CRITICALITY ignore  TYPE UEAggregateMaximumBitrate    PRESENCE optional }|
    { ID id-CSFallbackIndicator             CRITICALITY reject      TYPE CSFallbackIndicator     PRESENCE optional },
    ...
}
-- **************************************************************
--
-- UE Context Modification Response
--
-- **************************************************************

UEContextModificationResponse ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { { UEContextModificationResponseIEs} },
    ...
}

UEContextModificationResponseIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID                  CRITICALITY ignore  TYPE MME-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-eNB-UE-S1AP-ID              CRITICALITY ignore  TYPE ENB-UE-S1AP-ID            PRESENCE mandatory   }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional   },
    ...
}-- **************************************************************
--
-- UE Context Modification Failure
--
-- **************************************************************

UEContextModificationFailure ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { { UEContextModificationFailureIEs} },
    ...
}

UEContextModificationFailureIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID                  CRITICALITY ignore  TYPE MME-UE-S1AP-ID              PRESENCE mandatory   } |
    { ID id-eNB-UE-S1AP-ID              CRITICALITY ignore  TYPE ENB-UE-S1AP-ID            PRESENCE mandatory   } |
    { ID id-Cause               CRITICALITY ignore  TYPE Cause              PRESENCE mandatory  }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional   },
    ...
}

-- **************************************************************
--
-- DOWNLINK NAS TRANSPORT
--
-- **************************************************************

DownlinkNASTransport ::= SEQUENCE {
```

```
    protocolIEs                     ProtocolIE-Container       {{DownlinkNASTransport-IEs}},
    ...
}

DownlinkNASTransport-IEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID          CRITICALITY reject  TYPE MME-UE-S1AP-ID            PRESENCE mandatory} |
    { ID id-eNB-UE-S1AP-ID          CRITICALITY reject  TYPE ENB-UE-S1AP-ID            PRESENCE mandatory} |
    { ID id-NAS-PDU                 CRITICALITY reject  TYPE NAS-PDU               PRESENCE mandatory} |
    { ID id-HandoverRestrictionList     CRITICALITY ignore  TYPE HandoverRestrictionList    PRESENCE optional },
    ...
}


-- **************************************************************
--
-- INITIAL UE MESSAGE
--
-- **************************************************************

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

InitialUEMessage-IEs S1AP-PROTOCOL-IES ::= {
    { ID id-eNB-UE-S1AP-ID          CRITICALITY reject  TYPE ENB-UE-S1AP-ID            PRESENCE mandatory} |
    { ID id-NAS-PDU                 CRITICALITY reject  TYPE NAS-PDU               PRESENCE mandatory} |
    { ID id-TAI                 CRITICALITY reject  TYPE TAI                       PRESENCE mandatory}|
    { ID id-EUTRAN-CGI      CRITICALITY ignore  TYPE EUTRAN-CGI            PRESENCE mandatory} |
    { ID id-S-TMSI                  CRITICALITY reject  TYPE S-TMSI            PRESENCE optional}|
    { ID id-CSG-Id                  CRITICALITY reject  TYPE CSG-Id            PRESENCE optional},
    ...
}


-- **************************************************************
--
-- UPLINK NAS TRANSPORT
--
-- **************************************************************

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

UplinkNASTransport-IEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID          CRITICALITY reject  TYPE MME-UE-S1AP-ID            PRESENCE mandatory} |
    { ID id-eNB-UE-S1AP-ID          CRITICALITY reject  TYPE ENB-UE-S1AP-ID            PRESENCE mandatory} |
    { ID id-NAS-PDU                 CRITICALITY reject  TYPE NAS-PDU               PRESENCE mandatory} |
    { ID id-EUTRAN-CGI          CRITICALITY ignore  TYPE EUTRAN-CGI        PRESENCE mandatory}|
    { ID id-TAI                 CRITICALITY ignore  TYPE TAI                       PRESENCE mandatory},
    ...
}
```

```
-- ********************************************************
--
-- NAS NON DELIVERY INDICATION
--
-- ********************************************************

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

NASNonDeliveryIndication-IEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID          CRITICALITY reject  TYPE MME-UE-S1AP-ID            PRESENCE mandatory} |
    { ID id-eNB-UE-S1AP-ID          CRITICALITY reject  TYPE ENB-UE-S1AP-ID            PRESENCE mandatory} |
    { ID id-NAS-PDU                 CRITICALITY ignore  TYPE NAS-PDU             PRESENCE mandatory} |
    { ID id-Cause                   CRITICALITY ignore  TYPE Cause             PRESENCE mandatory} ,
    ...
}

-- ********************************************************
--
-- RESET ELEMENTARY PROCEDURE
--
-- ********************************************************

-- ********************************************************
--
-- Reset
--
-- ********************************************************

Reset ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {ResetIEs} },
    ...
}

ResetIEs S1AP-PROTOCOL-IES ::= {
    { ID id-Cause                       CRITICALITY ignore  TYPE Cause                      PRESENCE mandatory   }|
    { ID id-ResetType               CRITICALITY reject  TYPE ResetType          PRESENCE mandatory   },
    ...
}

ResetType ::= CHOICE {
    s1-Interface        ResetAll,
    partOfS1-Interface      UE-associatedLogicalS1-ConnectionListRes,
    ...
}



ResetAll ::= ENUMERATED {
    reset-all,
    ...
}
```

```
UE-associatedLogicalS1-ConnectionListRes ::= SEQUENCE (SIZE(1.. maxNrOfIndividualS1ConnectionsToReset)) OF ProtocolIE-SingleContainer { { UE-
associatedLogicalS1-ConnectionItemRes } }

UE-associatedLogicalS1-ConnectionItemRes    S1AP-PROTOCOL-IES ::= {
    { ID id-UE-associatedLogicalS1-ConnectionItem    CRITICALITY reject     TYPE UE-associatedLogicalS1-ConnectionItem    PRESENCE mandatory },
    ...
}


-- **************************************************************
--
-- Reset Acknowledge
--
-- **************************************************************

ResetAcknowledge ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {ResetAcknowledgeIEs} },
    ...
}

ResetAcknowledgeIEs S1AP-PROTOCOL-IES ::= {
    { ID id-UE-associatedLogicalS1-ConnectionListResAck     CRITICALITY ignore  TYPE UE-associatedLogicalS1-ConnectionListResAck        PRESENCE
optional    }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional   },
    ...
}

UE-associatedLogicalS1-ConnectionListResAck ::= SEQUENCE (SIZE(1.. maxNrOfIndividualS1ConnectionsToReset)) OF ProtocolIE-SingleContainer { { UE-
associatedLogicalS1-ConnectionItemResAck } }

UE-associatedLogicalS1-ConnectionItemResAck     S1AP-PROTOCOL-IES ::= {
    { ID id-UE-associatedLogicalS1-ConnectionItem    CRITICALITY ignore     TYPE UE-associatedLogicalS1-ConnectionItem    PRESENCE mandatory },
    ...
}

-- **************************************************************
--
-- ERROR INDICATION ELEMENTARY PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- Error Indication
--
-- **************************************************************

ErrorIndication ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       {{ErrorIndicationIEs}},
    ...
}

ErrorIndicationIEs S1AP-PROTOCOL-IES ::= {
```

```
    { ID id-MME-UE-S1AP-ID              CRITICALITY ignore  TYPE MME-UE-S1AP-ID             PRESENCE optional } |
    { ID id-eNB-UE-S1AP-ID              CRITICALITY ignore  TYPE ENB-UE-S1AP-ID             PRESENCE optional } |
    { ID id-Cause                       CRITICALITY ignore  TYPE Cause                      PRESENCE optional } |
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics     PRESENCE optional } ,
    ...
}

-- **************************************************************
--
-- S1 SETUP ELEMENTARY PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- S1 Setup Request
--
-- **************************************************************

S1SetupRequest ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {S1SetupRequestIEs} },
    ...
}

S1SetupRequestIEs S1AP-PROTOCOL-IES ::= {
    { ID id-Global-ENB-ID               CRITICALITY reject  TYPE Global-ENB-ID              PRESENCE mandatory   }|
    { ID id-eNBname             CRITICALITY ignore  TYPE ENBname            PRESENCE mandatory  }|
    { ID id-SupportedTAs        CRITICALITY reject  TYPE SupportedTAs       PRESENCE mandatory  }|
    { ID id-CSG-IdList                  CRITICALITY reject  TYPE CSG-IdList             PRESENCE optional},
    ...
}

-- **************************************************************
--
-- S1 Setup Response
--
-- **************************************************************

S1SetupResponse ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {S1SetupResponseIEs} },
    ...
}


S1SetupResponseIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MMEname             CRITICALITY ignore  TYPE MMEname            PRESENCE mandatory  }|
    { ID id-ServedPLMNs         CRITICALITY ignore  TYPE ServedPLMNs        PRESENCE mandatory  }|
    { ID id-ServedGUMMEIs               CRITICALITY ignore  TYPE ServedGUMMEIs              PRESENCE mandatory   }|
    { ID id-RelativeMMECapacity                 CRITICALITY ignore  TYPE RelativeMMECapacity              PRESENCE mandatory   }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional   },
    ...
}

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

```
--
-- S1 Setup Failure
--
-- **************************************************************

S1SetupFailure ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {S1SetupFailureIEs} },
    ...
}

S1SetupFailureIEs S1AP-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   },
    ...
}

-- **************************************************************
--
-- ENB CONFIGURATION UPDATE ELEMENTARY PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- eNB Configuration Update
--
-- **************************************************************

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

ENBConfigurationUpdateIEs S1AP-PROTOCOL-IES ::= {
    { ID id-eNBname             CRITICALITY ignore  TYPE ENBname            PRESENCE optional   }|
    { ID id-SupportedTAs        CRITICALITY reject  TYPE SupportedTAs       PRESENCE optional   }|
    { ID id-CSG-IdList                  CRITICALITY reject  TYPE CSG-IdList             PRESENCE optional},
    ...
}

-- **************************************************************
--
-- eNB Configuration Update Acknowledge
--
-- **************************************************************

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


ENBConfigurationUpdateAcknowledgeIEs S1AP-PROTOCOL-IES ::= {
```

```
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional   },
    ...
}

-- **************************************************************
--
-- eNB Configuration Update Failure
--
-- **************************************************************

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

ENBConfigurationUpdateFailureIEs S1AP-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 },
...
}


-- **************************************************************
--
-- MME Configuration UPDATE ELEMENTARY PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- MME Configuration Update
--
-- **************************************************************

MMEConfigurationUpdate ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {MMEConfigurationUpdateIEs} },
    ...
}

MMEConfigurationUpdateIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MMEname             CRITICALITY ignore  TYPE MMEname            PRESENCE optional   }|
    { ID id-ServedPLMNs         CRITICALITY reject  TYPE ServedPLMNs        PRESENCE optional   }|
    { ID id-ServedGUMMEIs           CRITICALITY reject  TYPE ServedGUMMEIs              PRESENCE optional  }|
    { ID id-RelativeMMECapacity CRITICALITY reject  TYPE RelativeMMECapacity    PRESENCE optional},
    ...
}

-- **************************************************************
--
-- MME Configuration Update Acknowledge
--
-- **************************************************************
```

```
MMEConfigurationUpdateAcknowledge ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {MMEConfigurationUpdateAcknowledgeIEs} },
    ...
}


MMEConfigurationUpdateAcknowledgeIEs S1AP-PROTOCOL-IES ::= {
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics         PRESENCE optional   },
    ...
}

-- **************************************************************
--
-- MME Configuration Update Failure
--
-- **************************************************************

MMEConfigurationUpdateFailure ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {MMEConfigurationUpdateFailureIEs} },
    ...
}

MMEConfigurationUpdateFailureIEs S1AP-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   },
    ...
}

-- **************************************************************
--
-- DOWNLINK S1 CDMA2000 TUNNELING ELEMTARY PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- Downlink S1 CDMA2000 Tunneling
--
-- **************************************************************

DownlinkS1cdma2000tunneling ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {DownlinkS1cdma2000tunnelingIEs} },
    ...
}

DownlinkS1cdma2000tunnelingIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID              CRITICALITY reject  TYPE MME-UE-S1AP-ID             PRESENCE mandatory   } |
    { ID id-eNB-UE-S1AP-ID              CRITICALITY reject  TYPE ENB-UE-S1AP-ID             PRESENCE mandatory   } |
    { ID id-E-RABSubjecttoDataForwardingList                    CRITICALITY ignore  TYPE E-RABSubjecttoDataForwardingList            PRESENCE
optional    } |
    { ID id-cdma2000HOStatus                CRITICALITY ignore  TYPE Cdma2000HOStatus           PRESENCE optional   } |
    { ID id-cdma2000RATType             CRITICALITY reject  TYPE Cdma2000RATType            PRESENCE mandatory   } |
    { ID id-cdma2000PDU                 CRITICALITY reject  TYPE Cdma2000PDU                PRESENCE mandatory   },
```

```
    ...
}

-- **************************************************************
--
-- UPLINK S1 CDMA2000 TUNNELING ELEMTARY PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- Uplink S1 CDMA2000 Tunneling
--
-- **************************************************************

UplinkS1cdma2000tunneling ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {UplinkS1cdma2000tunnelingIEs} },
    ...
}

UplinkS1cdma2000tunnelingIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID              CRITICALITY reject  TYPE MME-UE-S1AP-ID             PRESENCE mandatory   } |
    { ID id-eNB-UE-S1AP-ID              CRITICALITY reject  TYPE ENB-UE-S1AP-ID             PRESENCE mandatory   } |
    { ID id-cdma2000RATType             CRITICALITY reject  TYPE Cdma2000RATType            PRESENCE mandatory   } |
    { ID id-cdma2000SectorID            CRITICALITY reject  TYPE Cdma2000SectorID           PRESENCE mandatory   } |
    { ID id-cdma2000HORequiredIndication           CRITICALITY ignore  TYPE Cdma2000HORequiredIndication       PRESENCE optional } |
    { ID id-cdma2000OneXSRVCCInfo           CRITICALITY ignore  TYPE Cdma2000OneXSRVCCInfo       PRESENCE optional } |
    { ID id-cdma2000OneXRAND            CRITICALITY ignore  TYPE Cdma2000OneXRAND           PRESENCE optional } |
    { ID id-cdma2000PDU                 CRITICALITY reject  TYPE Cdma2000PDU                PRESENCE mandatory   },
    ...
}

-- **************************************************************
--
-- UE CAPABILITY INFO INDICATION PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- UE Capability Info Indication
--
-- **************************************************************

UECapabilityInfoIndication ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { { UECapabilityInfoIndicationIEs} },
    ...
}

UECapabilityInfoIndicationIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID              CRITICALITY reject  TYPE MME-UE-S1AP-ID               PRESENCE mandatory } |
    { ID id-eNB-UE-S1AP-ID              CRITICALITY reject  TYPE ENB-UE-S1AP-ID               PRESENCE mandatory } |
    { ID id-UERadioCapability           CRITICALITY ignore  TYPE UERadioCapability            PRESENCE mandatory } ,
    ...
```

```
}

-- **************************************************************
--
-- eNB STATUS TRANSFER
--
-- **************************************************************

-- **************************************************************
--
-- eNB Status Transfer
--
-- **************************************************************

ENBStatusTransfer ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {ENBStatusTransferIEs} },
    ...
}

ENBStatusTransferIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID          CRITICALITY reject  TYPE MME-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-eNB-UE-S1AP-ID          CRITICALITY reject  TYPE ENB-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-eNB-StatusTransfer-TransparentContainer CRITICALITY reject  TYPE ENB-StatusTransfer-TransparentContainer     PRESENCE mandatory} ,
    ...
}


-- **************************************************************
--
-- MME STATUS TRANSFER
--
-- **************************************************************

-- **************************************************************
--
-- MME Status Transfer
--
-- **************************************************************

MMEStatusTransfer ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {MMEStatusTransferIEs} },
    ...
}

MMEStatusTransferIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID          CRITICALITY reject  TYPE MME-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-eNB-UE-S1AP-ID          CRITICALITY reject  TYPE ENB-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-eNB-StatusTransfer-TransparentContainer CRITICALITY reject  TYPE ENB-StatusTransfer-TransparentContainer     PRESENCE mandatory} ,
    ...
}


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

```
-- Trace Procedures
--
-- **************************************************************
-- **************************************************************
--
-- Trace Start
--
-- **************************************************************

TraceStart ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {TraceStartIEs} },
    ...
}

TraceStartIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID              CRITICALITY reject  TYPE MME-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-eNB-UE-S1AP-ID              CRITICALITY reject  TYPE ENB-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-TraceActivation             CRITICALITY ignore  TYPE TraceActivation            PRESENCE mandatory   },
    ...
}

-- **************************************************************
--
-- Trace Failure Indication
--
-- **************************************************************

TraceFailureIndication ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {TraceFailureIndicationIEs} },
    ...
}

TraceFailureIndicationIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID              CRITICALITY reject  TYPE MME-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-eNB-UE-S1AP-ID              CRITICALITY reject  TYPE ENB-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-TraceReference              CRITICALITY ignore  TYPE TraceReference             PRESENCE mandatory} |
    { ID id-Cause                       CRITICALITY ignore  TYPE Cause                      PRESENCE mandatory} ,
    ...
}

-- **************************************************************
--
-- DEACTIVATE TRACE ELEMENTARY PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- DEACTIVATE TRACE
--
-- **************************************************************

DeactivateTrace ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { { DeactivateTraceIEs} },
```

```
    ...
}

DeactivateTraceIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID      CRITICALITY reject  TYPE MME-UE-S1AP-ID     PRESENCE mandatory} |
    { ID id-eNB-UE-S1AP-ID      CRITICALITY reject  TYPE ENB-UE-S1AP-ID     PRESENCE mandatory} |
    { ID id-TraceReference      CRITICALITY ignore  TYPE TraceReference     PRESENCE mandatory  },
    ...
}

-- **************************************************************
--
-- Location Reporting Control
--
-- **************************************************************

LocationReportingControl ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { { LocationReportingControlIEs} },
    ...
}

LocationReportingControlIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID          CRITICALITY reject  TYPE MME-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-eNB-UE-S1AP-ID          CRITICALITY reject  TYPE ENB-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-RequestType             CRITICALITY ignore  TYPE RequestType                PRESENCE mandatory } ,
    ...
}

-- **************************************************************
--
-- Location Report Failure Indication
--
-- **************************************************************

LocationReportingFailureIndication ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { { LocationReportingFailureIndicationIEs} },
    ...
}

LocationReportingFailureIndicationIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID          CRITICALITY reject  TYPE MME-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-eNB-UE-S1AP-ID          CRITICALITY reject  TYPE ENB-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-Cause                   CRITICALITY ignore  TYPE Cause                      PRESENCE optional  } ,
    ...
}

-- **************************************************************
--
-- Location Report
--
-- **************************************************************

LocationReport ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { { LocationReportIEs} },
```

```
    ...
}

LocationReportIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MME-UE-S1AP-ID          CRITICALITY reject  TYPE MME-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-eNB-UE-S1AP-ID          CRITICALITY reject  TYPE ENB-UE-S1AP-ID             PRESENCE mandatory} |
    { ID id-EUTRAN-CGI              CRITICALITY ignore  TYPE EUTRAN-CGI            PRESENCE mandatory} |
    { ID id-TAI                     CRITICALITY ignore  TYPE TAI                        PRESENCE mandatory} |
    { ID id-RequestType             CRITICALITY ignore  TYPE RequestType                PRESENCE mandatory} ,
    ...
}

-- **************************************************************
--
-- Overload Start
--
-- **************************************************************


OverloadStart ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {OverloadStartIEs} },
    ...
}


OverloadStartIEs S1AP-PROTOCOL-IES ::= {
    { ID id-OverloadResponse                    CRITICALITY reject  TYPE OverloadResponse               PRESENCE mandatory   },
    ...
}

-- **************************************************************
--
-- Overload Stop
--
-- **************************************************************

OverloadStop ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {OverloadStopIEs} },
    ...
}

OverloadStopIEs S1AP-PROTOCOL-IES ::= {
    ...
}

-- **************************************************************
--
-- WRITE-REPLACE WARNING PROCEDURE
--
-- **************************************************************

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

```
-- Write-Replace Warning Request
--
-- **************************************************************


WriteReplaceWarningRequest ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       { {WriteReplaceWarningRequestIEs} },
    ...
}

WriteReplaceWarningRequestIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MessageIdentifier           CRITICALITY reject  TYPE MessageIdentifier      PRESENCE mandatory    }|
    { ID id-SerialNumber                CRITICALITY reject  TYPE SerialNumber       PRESENCE mandatory    }|
    { ID id-WarningAreaList             CRITICALITY ignore  TYPE WarningAreaList        PRESENCE optional     }|
    { ID id-RepetitionPeriod            CRITICALITY reject  TYPE RepetitionPeriod       PRESENCE mandatory    }|
    { ID id-NumberofBroadcastRequest    CRITICALITY reject  TYPE NumberofBroadcastRequest   PRESENCE mandatory   }|
    { ID id-WarningType                 CRITICALITY ignore  TYPE WarningType            PRESENCE optional     }|
    { ID id-WarningSecurityInfo         CRITICALITY ignore  TYPE WarningSecurityInfo    PRESENCE optional     }|
    { ID id-DataCodingScheme            CRITICALITY reject  TYPE DataCodingScheme       PRESENCE mandatory    }|
    { ID id-WarningMessageContents      CRITICALITY reject  TYPE WarningMessageContents     PRESENCE mandatory      },
    ...
}

-- **************************************************************
--
-- Write-Replace Warning Response
--
-- **************************************************************

WriteReplaceWarningResponse ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container        { {WriteReplaceWarningResponseIEs} },
    ...
}

WriteReplaceWarningResponseIEs S1AP-PROTOCOL-IES ::= {
    { ID id-MessageIdentifier           CRITICALITY reject  TYPE MessageIdentifier      PRESENCE mandatory    }|
    { ID id-SerialNumber                CRITICALITY reject  TYPE SerialNumber       PRESENCE mandatory    }|
    { ID id-BroadcastCompletedAreaList      CRITICALITY reject  TYPE BroadcastCompletedAreaList   PRESENCE mandatory   }|
    { ID id-CriticalityDiagnostics      CRITICALITY ignore  TYPE CriticalityDiagnostics          PRESENCE optional},
    ...
}

-- **************************************************************
--
-- eNB DIRECT INFORMATION TRANSFER ELEMENTARY PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- eNB Direct Information Transfer
--
-- **************************************************************
```

```
ENBDirectInformationTransfer ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       {{ ENBDirectInformationTransferIEs}},
    ...
}

ENBDirectInformationTransferIEs S1AP-PROTOCOL-IES ::= {
    { ID id-Inter-SystemInformationTransferTypeEDT      CRITICALITY reject  TYPE Inter-SystemInformationTransferType           PRESENCE mandatory}
,
    ...
}

Inter-SystemInformationTransferType ::= CHOICE {
    rIMTransfer     RIMTransfer,
    ...
}

-- **************************************************************
--
-- MME DIRECT INFORMATION TRANSFER ELEMENTARY PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- MME Direct Information Transfer
--
-- **************************************************************

MMEDirectInformationTransfer ::= SEQUENCE {
    protocolIEs         ProtocolIE-Container       {{ MMEDirectInformationTransferIEs}},
    ...
}

MMEDirectInformationTransferIEs S1AP-PROTOCOL-IES ::= {
    { ID id-Inter-SystemInformationTransferTypeMDT      CRITICALITY reject  TYPE Inter-SystemInformationTransferType           PRESENCE mandatory}
,
    ...
}


-- **************************************************************
--
-- PRIVATE MESSAGE ELEMENTARY PROCEDURE
--
-- **************************************************************

-- **************************************************************
--
-- Private Message
--
-- **************************************************************

PrivateMessage ::= SEQUENCE {
    privateIEs          PrivateIE-Container       {{PrivateMessageIEs}},
```

```
    ...
}

PrivateMessageIEs S1AP-PRIVATE-IES ::= {
    ...
}

END
```

9.3.4 Information Element Definitions

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

S1AP-IEs {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
eps-Access (20) modules (3) s1ap (1) version1 (1) s1ap-IEs (2) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS
    id-E-RABInformationListItem,
    id-E-RABItem,
    id-Bearers-SubjectToStatusTransfer-Item,
    maxNrOfCSGs,
    maxNrOfE-RABs,
    maxNrOfInterfaces,
    maxNrOfErrors,
    maxnoofBPLMNs,
    maxnoofPLMNsPerMME,
    maxnoofTACs,
    maxnoofEPLMNs,
    maxnoofEPLMNsPlusOne,
    maxnoofForbLACs,
    maxnoofForbTACs,
    maxnoofTACs,
    maxnoofGUMMEIs,
    maxnoofCells,
    maxnoofCellID,
    maxnoofEmergencyAreaID,
    maxnoofTAIforWarning,
    maxnoofCellinTAI,
    maxnoofCellinEAI



FROM S1AP-Constants

    Criticality,
    ProcedureCode,
    ProtocolIE-ID,
    TriggeringMessage
FROM S1AP-CommonDataTypes

    ProtocolExtensionContainer{},
    S1AP-PROTOCOL-EXTENSION,
    ProtocolIE-SingleContainer{},
```

```
    S1AP-PROTOCOL-IES

FROM S1AP-Containers;

-- A


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

AllocationAndRetentionPriority-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}


-- B

Bearers-SubjectToStatusTransferList ::= SEQUENCE (SIZE(1.. maxNrOfE-RABs)) OF ProtocolIE-SingleContainer { { Bearers-SubjectToStatusTransfer-
ItemIEs } }

Bearers-SubjectToStatusTransfer-ItemIEs S1AP-PROTOCOL-IES ::= {
    { ID id-Bearers-SubjectToStatusTransfer-Item    CRITICALITY ignore  TYPE Bearers-SubjectToStatusTransfer-Item   PRESENCE mandatory   },
    ...
}

Bearers-SubjectToStatusTransfer-Item ::= SEQUENCE {
    e-RAB-ID                                E-RAB-ID,
    uL-COUNTvalue                               COUNTvalue,
    dL-COUNTvalue                               COUNTvalue,
    receiveStatusofULPDCPSDUs                   ReceiveStatusofULPDCPSDUs           OPTIONAL,
    iE-Extensions                           ProtocolExtensionContainer { {Bearers-SubjectToStatusTransfer-ItemExtIEs} } OPTIONAL,
    ...
}

Bearers-SubjectToStatusTransfer-ItemExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

BitRate ::= INTEGER (0..10000000000)

BPLMNs ::= SEQUENCE (SIZE(1.. maxnoofBPLMNs)) OF PLMNidentity

BroadcastCompletedAreaList ::= SEQUENCE {
    cellID-Broadcast                CellID-Broadcast,
    tAI-Broadcast                   TAI-Broadcast,
    emergencyAreaID-Broadcast       EmergencyAreaID-Broadcast,
    ...
}
```

```
-- C

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

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

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

CauseRadioNetwork ::= ENUMERATED {
    unspecified,
    handover-triggered,
    tx2relocoverall-expiry,
    successful-handover,
    release-due-to-eutran-generated-reason,
    handover-cancelled,
    partial-handover,
    ho-failure-in-target-EPC-eNB-or-target-system,
    ho-target-not-allowed,
    tS1relocoverall-expiry,
    tS1relocprep-expiry,
    cell-not-available,
    unknown-targetID,
    no-radio-resources-available-in-target-cell,
    unknown-mme-ue-s1ap-id,
    unknown-enb-ue-s1ap-id,
    unknown-pair-ue-s1ap-id,
    handover-desirable-for-radio-reason,
    time-critical-handover,
    resource-optimisation-handover,
    reduce-load-in-serving-cell,
```

```
    user-inactivity,
    radio-connection-with-ue-lost,
    load-balancing-tau-required,
    cs-fallback-triggered,
    ue-not-available-for-ps-service,
    radio-resources-not-available,
    failure-in-radio-interface-procedure,
    ...

}

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

CauseNas ::= ENUMERATED {
    normal-release,
    authentication-failure,
    detach,
    unspecified,
    ...
}

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

CellID-Broadcast ::= SEQUENCE (SIZE(1..maxnoofCellID)) OF CellID-Broadcast-Item

CellID-Broadcast-Item ::= SEQUENCE {
    eCGI                EUTRAN-CGI,
    ...
}

Cdma2000PDU ::= OCTET STRING

Cdma2000RATType ::= ENUMERATED {
    hRPD,
    onexRTT,
    ...
}

Cdma2000SectorID ::= OCTET STRING

Cdma2000HOStatus ::= ENUMERATED {
    hOSuccess,
    hOFailure,
    ...
}

Cdma2000HORequiredIndication ::= ENUMERATED {
    true,
    ...
}
```

```
Cdma2000OneXSRVCCInfo ::= SEQUENCE {
    cdma2000OneXMEID            Cdma2000OneXMEID,
    cdma2000OneXMSI             Cdma2000OneXMSI,
    cdma2000OneXPilot           Cdma2000OneXPilot,
    iE-Extensions               ProtocolExtensionContainer { {Cdma2000OneXSRVCCInfo-ExtIEs} } OPTIONAL,
    ...
}

Cdma2000OneXSRVCCInfo-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

Cdma2000OneXMEID ::= OCTET STRING

Cdma2000OneXMSI ::= OCTET STRING

Cdma2000OneXPilot ::= OCTET STRING

Cdma2000OneXRAND ::= OCTET STRING

CellType ::= ENUMERATED {ffs,...} -- FFS: The definition of CellType

CGI ::= SEQUENCE {
    pLMNidentity                PLMNidentity,
    lAC             LAC,
    cI              CI,
    rAC             RAC                     OPTIONAL
    }


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

CNDomain ::= ENUMERATED {
    cs,
    ps
}

CSFallbackIndicator ::= ENUMERATED {
    cs-fallback-required,
    ...
}

CSG-Id      ::= BIT STRING (SIZE (28))


CSG-IdList ::= SEQUENCE (SIZE (1..maxNrOfCSGs)) OF CSG-IdList-Item

CSG-IdList-Item ::= SEQUENCE {
    cSG-Id          CSG-Id,
    ...
}
```

```
COUNTvalue ::= SEQUENCE {
    pDCP-SN         PDCP-SN,
    hFN             HFN,
    ...
}

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

CriticalityDiagnostics-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

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

CriticalityDiagnostics-IE-Item ::=  SEQUENCE {
    iECriticality           Criticality,
    iE-ID                   ProtocolIE-ID,
    typeOfError             TypeOfError,
    iE-Extensions           ProtocolExtensionContainer {{CriticalityDiagnostics-IE-Item-ExtIEs}} OPTIONAL,
    ...
}

CriticalityDiagnostics-IE-Item-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}


-- D

DataCodingScheme ::= BIT STRING (SIZE (8))

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

Direct-Forwarding-Path-Availability ::= ENUMERATED {
    directPathAvailable,
    ...
}

-- E

ECGIList ::= SEQUENCE (SIZE(1..maxnoofCellID)) OF EUTRAN-CGI

EmergencyAreaIDList ::= SEQUENCE (SIZE(1..maxnoofEmergencyAreaID)) OF EmergencyAreaID
```

```
EmergencyAreaID ::= OCTET STRING (SIZE (2))

EmergencyAreaID-Broadcast ::= SEQUENCE (SIZE(1..maxnoofEmergencyAreaID)) OF EmergencyAreaID-Broadcast-Item

EmergencyAreaID-Broadcast-Item ::= SEQUENCE {
    emergencyAreaID         EmergencyAreaID,
    completedCellinEAI      CompletedCellinEAI
}

CompletedCellinEAI ::= SEQUENCE (SIZE(1..maxnoofCellinEAI)) OF CompletedCellinEAI-Item

CompletedCellinEAI-Item ::= SEQUENCE {
    eCGI                    EUTRAN-CGI,
    ...
}

ENB-ID ::= CHOICE {
    macroENB-ID         BIT STRING (SIZE(20)),
    homeENB-ID          BIT STRING (SIZE(28)),
    ...
}

GERAN-Cell-ID ::= SEQUENCE {
    lAI             LAI,
    rAC             RAC,
    cI              CI,
    iE-Extensions           ProtocolExtensionContainer { { GERAN-Cell-ID-ExtIEs} } OPTIONAL,
    ...
}

GERAN-Cell-ID-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

Global-ENB-ID ::= SEQUENCE {
    pLMNidentity            PLMNidentity,
    eNB-ID                  ENB-ID,
    iE-Extensions           ProtocolExtensionContainer { {GlobalENB-ID-ExtIEs} } OPTIONAL,
    ...
}

GlobalENB-ID-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}


ENB-StatusTransfer-TransparentContainer     ::= SEQUENCE {
    bearers-SubjectToStatusTransferList     Bearers-SubjectToStatusTransferList     OPTIONAL,
    iE-Extensions           ProtocolExtensionContainer { {ENB-StatusTransfer-TransparentContainer-ExtIEs} } OPTIONAL,
    ...
}

ENB-StatusTransfer-TransparentContainer-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
```

```
    ...
}

ENB-UE-S1AP-ID              ::= INTEGER (0..16777215)

ENBname ::= OCTET STRING


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

EPLMNs ::= SEQUENCE (SIZE(1..maxnoofEPLMNs)) OF PLMNidentity
EventType   ::= ENUMERATED {
    direct,
    change-of-serve-cell,
    stop-change-of-serve-cell,
    ...
}

EUTRAN-CGI ::= SEQUENCE {
    pLMNidentity            PLMNidentity,
    cell-ID                 CellIdentity,
    iE-Extensions           ProtocolExtensionContainer { {EUTRAN-CGI-ExtIEs} } OPTIONAL,
    ...
}

EUTRAN-CGI-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

ExtendedRNC-ID                  ::= INTEGER (4096..65535)

-- F

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

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

ForbiddenTAs-Item ::= SEQUENCE {
    pLMN-Identity       PLMNidentity,
    forbiddenTACs       ForbiddenTACs
}

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

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

ForbiddenLAs-Item ::= SEQUENCE {
    pLMN-Identity       PLMNidentity,
    forbiddenLACs       ForbiddenLACs
```

```
}

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 S1AP-PROTOCOL-EXTENSION ::= {
    ...
}


GTP-TEID                    ::= OCTET STRING (SIZE (4))

GUMMEI          ::= SEQUENCE {
    pLMN-Identity       PLMNidentity,
    mME-Group-ID        MME-Group-ID,
    mME-Code            MME-Code,
    iE-Extensions                   ProtocolExtensionContainer { {GUMMEI-ExtIEs} } OPTIONAL,
    ...
}

GUMMEI-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

-- H

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

HandoverRestrictionList-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

HandoverType ::= ENUMERATED {
    intralte,
    ltetoutran,
    ltetogeran,
```

```
    utrantolte,
    gerantolte,
    ...
}

HFN ::= INTEGER (0..1048575)

-- I

IMSI    ::= OCTET STRING (SIZE (3..8))

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

InterfacesToTraceList ::= SEQUENCE (SIZE (1..maxNrOfInterfaces)) OF InterfacesToTraceItem

InterfacesToTraceItem ::= SEQUENCE {
    interfaceType           InterfaceType,
    traceDepth              TraceDepth,
    iE-Extensions           ProtocolExtensionContainer { {InterfacesToTraceItem-ExtIEs} }   OPTIONAL,
    ...
}

InterfacesToTraceItem-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

InterfaceType ::= ENUMERATED {
    s1,
    x2,
    uu,
...
}

-- J
-- K
-- L


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

LAI ::= SEQUENCE {
    pLMNidentity                PLMNidentity,
    lAC             LAC,
    iE-Extensions           ProtocolExtensionContainer { {LAI-ExtIEs} } OPTIONAL
}

LAI-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

LastVisitedCell-Item ::= CHOICE {
    e-UTRAN-Cell                    LastVisitedEUTRANCellInformation,
    uTRAN-Cell                      LastVisitedUTRANCellInformation,
    ...
```

```
}

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

LastVisitedEUTRANCellInformation-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

LastVisitedUTRANCellInformation ::= OCTET STRING




-- M

MessageIdentifier   ::= OCTET STRING (SIZE (16))

MMEname ::= OCTET STRING

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

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

MME-UE-S1AP-ID              ::= INTEGER (0..4294967295)
M-TMSI          ::= OCTET STRING (SIZE (4))


-- N

NAS-PDU ::=  OCTET STRING

NumberofBroadcastRequest ::= INTEGER (0..65535)

NumberofBroadcast ::= INTEGER (0..65535)

-- O
OverloadAction ::= ENUMERATED {

    reject-non-emergency-mo-dt,

    reject-all-rrc-cr-signalling,

    permit-emergency-sessions-only,

    ...
}
```

```
OverloadResponse ::= CHOICE {
    overloadAction                  OverloadAction,
    ...
}


-- P

PagingDRX ::= ENUMERATED {
    v32,
    v64,
    v128,
    v256,
    ...
   }

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

PLMNidentity                ::= TBCD-STRING

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 (1..256)

-- R

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

RelativeMMECapacity             ::= INTEGER (0..255)

RAC                 ::= OCTET STRING (SIZE (1))


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

```
RequestType-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

RIMTransfer ::= SEQUENCE {
    rIMInformation                  RIMInformation,
    rIMRoutingAddress               RIMRoutingAddress       OPTIONAL,
    iE-Extensions           ProtocolExtensionContainer { { RIMTransfer-ExtIEs} }            OPTIONAL,
...
}


RIMTransfer-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}


RIMInformation ::= OCTET STRING


RIMRoutingAddress ::= CHOICE {
    gERAN-Cell-ID           GERAN-Cell-ID,
    ...
}

ReportArea  ::= OCTET STRING

RepetitionPeriod ::= INTEGER (1..4096)


RNC-ID                  ::= INTEGER (0..4095)

RRC-Container   ::= OCTET STRING

-- S

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

E-RABInformationList    ::= SEQUENCE (SIZE (1.. maxNrOfE-RABs)) OF ProtocolIE-SingleContainer { { E-RABInformationListIEs } }

E-RABInformationListIEs S1AP-PROTOCOL-IES ::= {
    { ID id-E-RABInformationListItem            CRITICALITY ignore  TYPE E-RABInformationListItem       PRESENCE mandatory   },
    ...
}

E-RABInformationListItem ::= SEQUENCE {
    e-RAB-ID                    E-RAB-ID,
    dL-Forwarding                   DL-Forwarding       OPTIONAL,
    iE-Extensions                   ProtocolExtensionContainer { {E-RABInformationListItem-ExtIEs} }       OPTIONAL,
    ...
}
```

```
E-RABInformationListItem-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

E-RABList ::= SEQUENCE (SIZE(1.. maxNrOfE-RABs)) OF ProtocolIE-SingleContainer { {E-RABItemIEs} }

E-RABItemIEs    S1AP-PROTOCOL-IES ::= {
    { ID id-E-RABItem    CRITICALITY ignore     TYPE E-RABItem  PRESENCE mandatory },
    ...
}

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

E-RABItem-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}




E-RABLevelQoSParameters ::= SEQUENCE {
    qCI         QCI,
    allocationRetentionPriority         AllocationAndRetentionPriority,
    gbrQosInformation                   GBR-QosInformation          OPTIONAL,
    iE-Extensions                       ProtocolExtensionContainer { {E-RABQoSParameters-ExtIEs} } OPTIONAL,
    ...
}

E-RABQoSParameters-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}




SecurityKey ::= BIT STRING (SIZE(256))



SecurityContext ::= SEQUENCE {
    nexthopchainingcount        SecurityKey,
    nexthopparameter                                BIT STRING (SIZE(3)),
    iE-Extensions           ProtocolExtensionContainer { { SecurityContext-ExtIEs} } OPTIONAL,
    ...
}


SecurityContext-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
```

```
    ...
}

SerialNumber ::= BIT STRING (SIZE (16))

Source-ToTarget-TransparentContainer ::= OCTET STRING

SourceBSS-ToTargetBSS-TransparentContainer      ::= OCTET STRING

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

SRVCCHOIndication ::= ENUMERATED {
    pSandCS,
    cSonly,
    ...
}

SourceeNodeB-ToTargeteNodeB-TransparentContainer        ::= SEQUENCE {
    rRC-Container                   RRC-Container,
    e-RABInformationList        E-RABInformationList        OPTIONAL,
    targetCell-ID                   EUTRAN-CGI,
    subscriberProfileIDforRFP               SubscriberProfileIDforRFP       OPTIONAL,
    uE-HistoryInformation           UE-HistoryInformation,
    iE-Extensions           ProtocolExtensionContainer { {SourceeNodeB-ToTargeteNodeB-TransparentContainer-ExtIEs} } OPTIONAL,
    ...
}

SourceeNodeB-ToTargeteNodeB-TransparentContainer-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}


SourceRNC-ToTargetRNC-TransparentContainer      ::= OCTET STRING

ServedGUMMEIs ::= SEQUENCE (SIZE(1.. maxnoofGUMMEIs)) OF GUMMEI

ServedPLMNs ::= SEQUENCE (SIZE(1.. maxnoofPLMNsPerMME)) OF PLMNidentity

SubscriberProfileIDforRFP ::= INTEGER (1..256)

SupportedTAs ::= SEQUENCE (SIZE(1.. maxnoofTACs)) OF SupportedTAs-Item

SupportedTAs-Item ::=   SEQUENCE  {
    tAC                 TAC,
    broadcastPLMNs      BPLMNs,
    ...
}

S-TMSI ::= SEQUENCE {
    mMEC    MME-Code,
    m-TMSI  M-TMSI,
```

```
    ...
}


-- T

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

TAIListforWarning ::= SEQUENCE (SIZE(1..maxnoofTAIforWarning)) OF TAI

TAI ::= SEQUENCE {
    pLMNidentity            PLMNidentity,
    tAC                     TAC,
    iE-Extensions           ProtocolExtensionContainer { {TAI-ExtIEs} } OPTIONAL
}

TAI-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

TAI-Broadcast ::= SEQUENCE (SIZE(1..maxnoofTAIforWarning)) OF TAI-Broadcast-Item

TAI-Broadcast-Item ::= SEQUENCE {
    tAI                 TAI,
    completedCellinTAI  CompletedCellinTAI
}

CompletedCellinTAI ::= SEQUENCE (SIZE(0..maxnoofCellinTAI)) OF CompletedCellinTAI-Item

CompletedCellinTAI-Item ::= SEQUENCE{
    eCGI                EUTRAN-CGI,
    ...
}

TBCD-STRING ::= OCTET STRING (SIZE (3))

TargetID ::= CHOICE {
    targeteNB-ID            TargeteNB-ID,
    targetRNC-ID            TargetRNC-ID,
    cGI             CGI,
    ...
}

TargeteNB-ID ::= SEQUENCE {
    global-ENB-ID   Global-ENB-ID,
    selected-TAI    TAI,
    iE-Extensions   ProtocolExtensionContainer { {TargeteNB-ID-ExtIEs} } OPTIONAL
}

TargeteNB-ID-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

TargetRNC-ID ::= SEQUENCE {
```

```
    lAI                 LAI,
    rAC                 RAC         OPTIONAL,
    rNC-ID              RNC-ID,
    extendedRNC-ID      ExtendedRNC-ID      OPTIONAL
    }


TargeteNodeB-ToSourceeNodeB-TransparentContainer        ::= SEQUENCE {
    rRC-Container                   RRC-Container,
    iE-Extensions           ProtocolExtensionContainer { {TargeteNodeB-ToSourceeNodeB-TransparentContainer-ExtIEs} } OPTIONAL,
    ...
}

TargeteNodeB-ToSourceeNodeB-TransparentContainer-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

Target-ToSource-TransparentContainer ::= OCTET STRING
TargetRNC-ToSourceRNC-TransparentContainer      ::= OCTET STRING
TargetBSS-ToSourceBSS-TransparentContainer      ::= OCTET STRING

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

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

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

TraceActivation ::= SEQUENCE {
    traceReference                  TraceReference,
    interfacesToTraceList           InterfacesToTraceList,
    iE-Extensions                   ProtocolExtensionContainer { { TraceActivation-ExtIEs} }      OPTIONAL
}

TraceActivation-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

TraceDepth ::= ENUMERATED {
    minimum,
    medium,
    maximum,
    vendorMinimum,
    vendorMedium,
    vendorMaximum,
    ...
}

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

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

```
-- U

UEAggregateMaximumBitrate ::= SEQUENCE {
    uEaggregateMaximumBitRateDL             BitRate,
    uEaggregateMaximumBitRateUL             BitRate,
    iE-Extensions                           ProtocolExtensionContainer { {UEAggregate-MaximumBitrates-ExtIEs} } OPTIONAL,
    ...
}

UEAggregate-MaximumBitrates-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}



UE-S1AP-IDs ::= CHOICE{
    uE-S1AP-ID-pair     UE-S1AP-ID-pair,
    mME-UE-S1AP-ID      MME-UE-S1AP-ID,
    ...
}

UE-S1AP-ID-pair ::= SEQUENCE{
    mME-UE-S1AP-ID      MME-UE-S1AP-ID,
    eNB-UE-S1AP-ID      ENB-UE-S1AP-ID
}

UE-associatedLogicalS1-ConnectionItem ::= SEQUENCE {
    mME-UE-S1AP-ID                  MME-UE-S1AP-ID OPTIONAL,
    eNB-UE-S1AP-ID                  ENB-UE-S1AP-ID OPTIONAL,
    iE-Extensions                   ProtocolExtensionContainer { { UE-associatedLogicalS1-ConnectionItemExtIEs} } OPTIONAL,
    ...
}


UE-associatedLogicalS1-ConnectionItemExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

UEIdentityIndexValue    ::= BIT STRING (SIZE (10))

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

UEPagingID ::= CHOICE {
    s-TMSI      S-TMSI,
    iMSI        IMSI,
    ...
    }

UERadioCapability ::= OCTET STRING

UESecurityCapabilities ::= SEQUENCE {
    encryptionAlgorithms            EncryptionAlgorithms,
    integrityProtectionAlgorithms       IntegrityProtectionAlgorithms,
```

```
    iE-Extensions               ProtocolExtensionContainer { { UESecurityCapabilities-ExtIEs} }   OPTIONAL,
...
}

UESecurityCapabilities-ExtIEs S1AP-PROTOCOL-EXTENSION ::= {
    ...
}

-- V
-- W

WarningAreaList ::= CHOICE {
    cellIDList                      ECGIList,
    trackingAreaListforWarning      TAIListforWarning,
    emergencyAreaIDList             EmergencyAreaIDList,
    ...
}


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

WarningSecurityInfo ::= OCTET STRING (SIZE (50))


WarningMessageContents ::= OCTET STRING


-- X


-- Y
-- Z

END
```

9.3.5 Common Definitions

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

S1AP-CommonDataTypes {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
eps-Access (20) modules (3) s1ap (1) version1 (1) s1ap-CommonDataTypes (3) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

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

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

PrivateIE-ID    ::= CHOICE {
    local               INTEGER (0..65535),
    global              OBJECT IDENTIFIER
}

ProcedureCode       ::= INTEGER (0..255)

ProtocolExtensionID ::= INTEGER (0..65535)

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

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

END
```

9.3.6 Constant Definitions

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

S1AP-Constants {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
eps-Access (20) modules (3) s1ap (1) version1 (1) s1ap-Constants (4) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN
```

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

IMPORTS
    ProcedureCode,
    ProtocolIE-ID

FROM S1AP-CommonDataTypes;


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

id-HandoverPreparation              ProcedureCode ::= 0
id-HandoverResourceAllocation       ProcedureCode ::= 1
id-HandoverNotification             ProcedureCode ::= 2
id-PathSwitchRequest                ProcedureCode ::= 3
id-HandoverCancel                   ProcedureCode ::= 4
id-E-RABSetup                       ProcedureCode ::= 5
id-E-RABModify                      ProcedureCode ::= 6
id-E-RABRelease                     ProcedureCode ::= 7
id-E-RABReleaseIndication           ProcedureCode ::= 8
id-InitialContextSetup              ProcedureCode ::= 9
id-Paging                           ProcedureCode ::= 10
id-downlinkNASTransport             ProcedureCode ::= 11
id-initialUEMessage                 ProcedureCode ::= 12
id-uplinkNASTransport               ProcedureCode ::= 13
id-Reset                            ProcedureCode::= 14
id-ErrorIndication                  ProcedureCode ::= 15
id-NASNonDeliveryIndication         ProcedureCode ::= 16
id-S1Setup                          ProcedureCode ::= 17
id-UEContextReleaseRequest          ProcedureCode ::= 18
id-DownlinkS1cdma2000tunneling      ProcedureCode ::= 19
id-UplinkS1cdma2000tunneling        ProcedureCode ::= 20
id-UEContextModification            ProcedureCode ::= 21
id-UECapabilityInfoIndication       ProcedureCode ::= 22
id-UEContextRelease                 ProcedureCode ::= 23
id-eNBStatusTransfer                ProcedureCode ::= 24
id-MMEStatusTransfer                ProcedureCode ::= 25
id-DeactivateTrace                  ProcedureCode ::= 26
id-TraceStart                       ProcedureCode ::= 27
id-TraceFailureIndication           ProcedureCode ::= 28
id-ENBConfigurationUpdate           ProcedureCode ::= 29
id-MMEConfigurationUpdate           ProcedureCode ::= 30
id-LocationReportingControl         ProcedureCode ::= 31
id-LocationReportingFailureIndication   ProcedureCode ::= 32
id-LocationReport                   ProcedureCode ::= 33
id-OverloadStart                    ProcedureCode ::= 34
```

```
id-OverloadStop                     ProcedureCode ::= 35
id-WriteReplaceWarning              ProcedureCode ::= 36
id-eNBDirectInformationTransfer         ProcedureCode ::= 37
id-MMEDirectInformationTransfer         ProcedureCode ::= 38
id-PrivateMessage                   ProcedureCode ::= 39


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

maxPrivateIEs                       INTEGER ::= 65535
maxProtocolExtensions               INTEGER ::= 65535
maxProtocolIEs                      INTEGER ::= 65535
-- ************************************************************
--
-- Lists
--
-- ************************************************************

maxNrOfCSGs                             INTEGER ::= 256
maxNrOfE-RABs                           INTEGER ::= 256
maxNrOfInterfaces                       INTEGER ::= 3   --FFS
maxnoofTAI                              INTEGER ::= 256
maxnoofTACs                             INTEGER ::= 256
maxNrOfErrors                           INTEGER ::= 256
maxnoofBPLMNs                           INTEGER ::= 6
maxnoofPLMNsPerMME                      INTEGER ::= 32 -- FFS
maxnoofEPLMNs                           INTEGER ::= 15
maxnoofEPLMNsPlusOne                    INTEGER ::= 16
maxnoofForbLACs                         INTEGER ::= 4096
maxnoofForbTACs                         INTEGER ::= 4096
maxNrOfIndividualS1ConnectionsToReset   INTEGER ::= 256
maxnoofGUMMEIs                          INTEGER ::= 256 -- FFS
maxnoofCells                            INTEGER ::= 16
maxnoofTAIforWarning                    INTEGER ::= 65535 -- FFS
maxnoofCellID                           INTEGER ::= 65535 -- FFS
maxnoofEmergencyAreaID                  INTEGER ::= 65535 -- FFS
maxnoofCellinTAI                        INTEGER ::= 65535 -- FFS
maxnoofCellinEAI                        INTEGER ::= 65535 -- FFS
maxnoofeNBX2TLAs                        INTEGER ::= 2



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

id-MME-UE-S1AP-ID                               ProtocolIE-ID ::= 0
id-HandoverType                               ProtocolIE-ID ::= 1
```

```
id-Cause                                    ProtocolIE-ID ::= 2
id-SourceID                                 ProtocolIE-ID ::= 3
id-TargetID                                 ProtocolIE-ID ::= 4
id-eNB-UE-S1AP-ID                           ProtocolIE-ID ::= 8
id-E-RABSubjecttoDataForwardingList       ProtocolIE-ID ::= 12
id-E-RABtoReleaseListHOCmd                ProtocolIE-ID ::= 13
id-E-RABDataForwardingItem                ProtocolIE-ID ::= 14
id-E-RABReleaseItemBearerRelComp          ProtocolIE-ID ::= 15
id-E-RABToBeSetupListBearerSUReq          ProtocolIE-ID ::= 16
id-E-RABToBeSetupItemBearerSUReq          ProtocolIE-ID ::= 17
id-E-RABAdmittedList                      ProtocolIE-ID ::= 18
id-E-RABFailedToSetupListHOReqAck         ProtocolIE-ID ::= 19
id-E-RABAdmittedItem                      ProtocolIE-ID ::= 20
id-E-RABFailedtoSetupItemHOReqAck         ProtocolIE-ID ::= 21
id-E-RABToBeSwitchedDLList                ProtocolIE-ID ::= 22
id-E-RABToBeSwitchedDLItem                ProtocolIE-ID ::= 23
id-E-RABToBeSetupListCtxtSUReq            ProtocolIE-ID ::= 24
id-TraceActivation                          ProtocolIE-ID ::= 25
id-NAS-PDU                                  ProtocolIE-ID ::= 26
id-E-RABToBeSetupItemHOReq                ProtocolIE-ID ::= 27
id-E-RABSetupListBearerSURes              ProtocolIE-ID ::= 28
id-E-RABFailedToSetupListBearerSURes      ProtocolIE-ID ::= 29
id-E-RABToBeModifiedListBearerModReq      ProtocolIE-ID ::= 30
id-E-RABModifyListBearerModRes            ProtocolIE-ID ::= 31
id-E-RABFailedToModifyList                ProtocolIE-ID ::= 32
id-E-RABToBeReleasedList                  ProtocolIE-ID ::= 33
id-E-RABFailedToReleaseList               ProtocolIE-ID ::= 34
id-E-RABItem                              ProtocolIE-ID ::= 35
id-E-RABToBeModifiedItemBearerModReq      ProtocolIE-ID ::= 36
id-E-RABModifyItemBearerModRes            ProtocolIE-ID ::= 37
id-E-RABReleaseItem                       ProtocolIE-ID ::= 38
id-E-RABSetupItemBearerSURes              ProtocolIE-ID ::= 39
id-SecurityContext                        ProtocolIE-ID ::= 40
id-HandoverRestrictionList                  ProtocolIE-ID ::= 41
id-UEPagingID                               ProtocolIE-ID ::= 43
id-pagingDRX                                ProtocolIE-ID ::= 44
id-TAIList                                  ProtocolIE-ID ::= 46
id-TAIItem                                  ProtocolIE-ID ::= 47
id-E-RABFailedToSetupListCtxtSURes        ProtocolIE-ID ::= 48
id-E-RABReleaseItemHOCmd                  ProtocolIE-ID ::= 49
id-E-RABSetupItemCtxtSURes                ProtocolIE-ID ::= 50
id-E-RABSetupListCtxtSURes                ProtocolIE-ID ::= 51
id-E-RABToBeSetupItemCtxtSUReq            ProtocolIE-ID ::= 52
id-E-RABToBeSetupListHOReq                ProtocolIE-ID ::= 53
id-GERANtoLTEHOInformationRes               ProtocolIE-ID ::= 55
id-UTRANtoLTEHOInformationRes               ProtocolIE-ID ::= 57
id-CriticalityDiagnostics                   ProtocolIE-ID ::= 58
id-Global-ENB-ID                            ProtocolIE-ID ::= 59
id-eNBname                                  ProtocolIE-ID ::= 60
id-MMEname                                  ProtocolIE-ID ::= 61
id-ServedPLMNs                              ProtocolIE-ID ::= 63
id-SupportedTAs                             ProtocolIE-ID ::= 64
id-TimeToWait                               ProtocolIE-ID ::= 65
id-uEaggregateMaximumBitrate                    ProtocolIE-ID ::= 66
```

```
id-TAI                                          ProtocolIE-ID ::= 67
id-E-RABReleaseListBearerRelComp            ProtocolIE-ID ::= 69
id-cdma2000PDU                                  ProtocolIE-ID ::= 70
id-cdma2000RATType                              ProtocolIE-ID ::= 71
id-cdma2000SectorID                             ProtocolIE-ID ::= 72
id-SecurityKey                                  ProtocolIE-ID ::= 73
id-UERadioCapability                            ProtocolIE-ID ::= 74
id-GUMMEI-ID                                    ProtocolIE-ID ::= 75
id-E-RABInformationListItem                 ProtocolIE-ID ::= 78
id-Direct-Forwarding-Path-Availability          ProtocolIE-ID ::= 79
id-UEIdentityIndexValue                         ProtocolIE-ID ::= 80
id-cdma2000HOStatus                             ProtocolIE-ID ::= 83
id-cdma2000HORequiredIndication                 ProtocolIE-ID ::= 84
id-TraceReference                               ProtocolIE-ID ::= 86
id-RelativeMMECapacity                          ProtocolIE-ID ::= 87
id-SourceMME-UE-S1AP-ID                         ProtocolIE-ID ::= 88
id-Bearers-SubjectToStatusTransfer-Item         ProtocolIE-ID ::= 89
id-eNB-StatusTransfer-TransparentContainer      ProtocolIE-ID ::= 90
id-UE-associatedLogicalS1-ConnectionItem        ProtocolIE-ID ::= 91
id-ResetType                                    ProtocolIE-ID ::= 92
id-UE-associatedLogicalS1-ConnectionListResAck  ProtocolIE-ID ::= 93
id-E-RABToBeSwitchedULItem                  ProtocolIE-ID ::= 94
id-E-RABToBeSwitchedULList                  ProtocolIE-ID ::= 95
id-S-TMSI                                       ProtocolIE-ID ::= 96
id-cdma2000OneXRAND                             ProtocolIE-ID ::= 97
id-RequestType                                  ProtocolIE-ID ::= 98
id-UE-S1AP-IDs                                  ProtocolIE-ID ::= 99
id-EUTRAN-CGI                               ProtocolIE-ID ::= 100
id-OverloadResponse                             ProtocolIE-ID ::= 101
id-cdma2000OneXSRVCCInfo                        ProtocolIE-ID ::= 102
id-E-RABFailedToBeReleasedList              ProtocolIE-ID ::= 103
id-Source-ToTarget-TransparentContainer ProtocolIE-ID ::= 104
id-ServedGUMMEIs                                ProtocolIE-ID ::= 105
id-SubscriberProfileIDforRFP                    ProtocolIE-ID ::= 106
id-UESecurityCapabilities                       ProtocolIE-ID ::= 107
id-CSFallbackIndicator                          ProtocolIE-ID ::= 108
id-CNDomain                                     ProtocolIE-ID ::= 109
id-E-RABReleasedList                        ProtocolIE-ID ::= 110
id-MessageIdentifier                            ProtocolIE-ID ::= 111
id-SerialNumber                                 ProtocolIE-ID ::= 112
id-WarningAreaList                              ProtocolIE-ID ::= 113
id-RepetitionPeriod                             ProtocolIE-ID ::= 114
id-NumberofBroadcastRequest                     ProtocolIE-ID ::= 115
id-WarningType                                  ProtocolIE-ID ::= 116
id-WarningSecurityInfo                          ProtocolIE-ID ::= 117
id-DataCodingScheme                             ProtocolIE-ID ::= 118
id-WarningMessageContents                       ProtocolIE-ID ::= 119
id-BroadcastCompletedAreaList                   ProtocolIE-ID ::= 120
id-Inter-SystemInformationTransferTypeEDT           ProtocolIE-ID ::= 121
id-Inter-SystemInformationTransferTypeMDT           ProtocolIE-ID ::= 122
id-Target-ToSource-TransparentContainer         ProtocolIE-ID ::= 123
id-SRVCCOperationPossible                       ProtocolIE-ID ::= 124
id-SRVCCHOIndication                            ProtocolIE-ID ::= 125
id-NAS-DownlinkCount                            ProtocolIE-ID ::= 126
```

```
id-CSG-Id                                   ProtocolIE-ID ::= 127
id-CSG-IdList                               ProtocolIE-ID ::= 128

END
```

9.3.7 Container Definitions

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

S1AP-Containers {
itu-t (0) identified-organization (4) etsi (0) mobileDomain (0)
eps-Access (20) modules (3) s1ap (1) version1 (1) s1ap-Containers (5) }

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

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

IMPORTS
    Criticality,
    Presence,
    PrivateIE-ID,
    ProtocolExtensionID,
    ProtocolIE-ID
FROM S1AP-CommonDataTypes

    maxPrivateIEs,
    maxProtocolExtensions,
    maxProtocolIEs
FROM S1AP-Constants;

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

S1AP-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
--
-- **************************************************************

S1AP-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
--
-- **************************************************************

S1AP-PROTOCOL-EXTENSION ::= CLASS {
    &id             ProtocolExtensionID                 UNIQUE,
    &criticality            Criticality,
    &Extension,
    &presence       Presence
}
WITH SYNTAX {
    ID              &id
    CRITICALITY         &criticality
    EXTENSION           &Extension
    PRESENCE        &presence
}

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

```
S1AP-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 {S1AP-PROTOCOL-IES : IEsSetParam} ::=
    SEQUENCE (SIZE (0..maxProtocolIEs)) OF
    ProtocolIE-Field {{IEsSetParam}}

ProtocolIE-SingleContainer {S1AP-PROTOCOL-IES : IEsSetParam} ::=
    ProtocolIE-Field {{IEsSetParam}}

ProtocolIE-Field {S1AP-PROTOCOL-IES : IEsSetParam} ::= SEQUENCE {
    id              S1AP-PROTOCOL-IES.&id               ({IEsSetParam}),
    criticality         S1AP-PROTOCOL-IES.&criticality          ({IEsSetParam}{@id}),
    value               S1AP-PROTOCOL-IES.&Value                ({IEsSetParam}{@id})
}

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

ProtocolIE-ContainerPair {S1AP-PROTOCOL-IES-PAIR : IEsSetParam} ::=
    SEQUENCE (SIZE (0..maxProtocolIEs)) OF
    ProtocolIE-FieldPair {{IEsSetParam}}

ProtocolIE-FieldPair {S1AP-PROTOCOL-IES-PAIR : IEsSetParam} ::= SEQUENCE {
    id              S1AP-PROTOCOL-IES-PAIR.&id          ({IEsSetParam}),
    firstCriticality        S1AP-PROTOCOL-IES-PAIR.&firstCriticality    ({IEsSetParam}{@id}),
    firstValue          S1AP-PROTOCOL-IES-PAIR.&FirstValue          ({IEsSetParam}{@id}),
    secondCriticality       S1AP-PROTOCOL-IES-PAIR.&secondCriticality   ({IEsSetParam}{@id}),
    secondValue         S1AP-PROTOCOL-IES-PAIR.&SecondValue          ({IEsSetParam}{@id})
}

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

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

ProtocolIE-ContainerList {INTEGER : lowerBound, INTEGER : upperBound, S1AP-PROTOCOL-IES : IEsSetParam} ::=
    SEQUENCE (SIZE (lowerBound..upperBound)) OF
    ProtocolIE-SingleContainer {{IEsSetParam}}

ProtocolIE-ContainerPairList {INTEGER : lowerBound, INTEGER : upperBound, S1AP-PROTOCOL-IES-PAIR : IEsSetParam} ::=
    SEQUENCE (SIZE (lowerBound..upperBound)) OF
    ProtocolIE-ContainerPair {{IEsSetParam}}

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

ProtocolExtensionContainer {S1AP-PROTOCOL-EXTENSION : ExtensionSetParam} ::=
    SEQUENCE (SIZE (1..maxProtocolExtensions)) OF
    ProtocolExtensionField {{ExtensionSetParam}}

ProtocolExtensionField {S1AP-PROTOCOL-EXTENSION : ExtensionSetParam} ::= SEQUENCE {
    id              S1AP-PROTOCOL-EXTENSION.&id         ({ExtensionSetParam}),
    criticality         S1AP-PROTOCOL-EXTENSION.&criticality        ({ExtensionSetParam}{@id}),
    extensionValue          S1AP-PROTOCOL-EXTENSION.&Extension      ({ExtensionSetParam}{@id})
}

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

PrivateIE-Container {S1AP-PRIVATE-IES : IEsSetParam } ::=
    SEQUENCE (SIZE (1.. maxPrivateIEs)) OF
    PrivateIE-Field {{IEsSetParam}}

PrivateIE-Field {S1AP-PRIVATE-IES : IEsSetParam} ::= SEQUENCE {
    id              S1AP-PRIVATE-IES.&id            ({IEsSetParam}),
    criticality         S1AP-PRIVATE-IES.&criticality       ({IEsSetParam}{@id}),
    value           S1AP-PRIVATE-IES.&Value     ({IEsSetParam}{@id})
}

END
```

9.4 Message Transfer Syntax

S1AP shall use the ASN.1 Basic Packed Encoding Rules (BASIC-PER) Aligned Variant as transfer syntax as specified in ref. [3].

9.5 Timers

$TS1_{RELOCprep}$

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

$TS1_{RELOCoverall}$

- 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

10.1 General

Protocol Error cases can be divided into three classes:

- Transfer Syntax Error.
- Abstract Syntax Error.
- Logical Error.

Protocol errors can occur in the following functions within a receiving node:

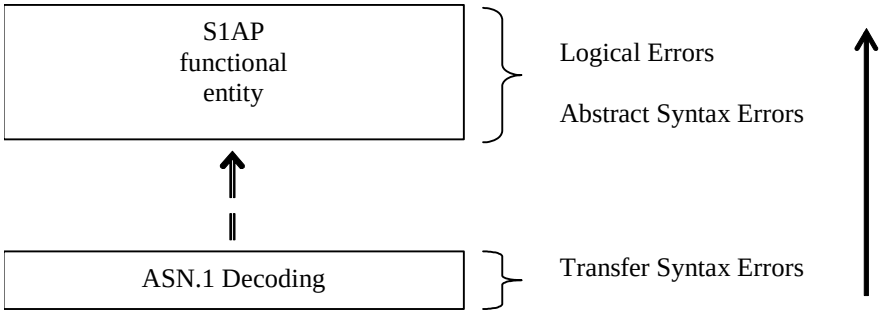

Figure 10.1: Protocol Errors in S1AP.

The information stated in subclauses 10.2, 10.3 and 10.4, to be included in the message used when reporting an error, is what at minimum shall be included. Other optional information elements within the message may also be included, if available. This is also valid for the case when the reporting is done with a response message. The latter is an exception to what is stated in subclause 4.1.

10.2 Transfer Syntax Error

A Transfer Syntax Error occurs when the receiver is not able to decode the received physical message. Transfer syntax errors are always detected in the process of ASN.1 decoding. If a Transfer Syntax Error occurs, the receiver should initiate Error Indication procedure with appropriate cause value for the Transfer Syntax protocol error.

Examples for Transfer Syntax Errors are:

- Violation of value ranges in ASN.1 definition of messages. E.g.: If an IE has a defined value range of 0 to 10 (ASN.1: INTEGER (0..10)), and 12 will be received, then this will be treated as a transfer syntax error.
- Violation in list element constraints. E.g.: If a list is defined as containing 1 to 10 elements, and 12 elements will be received, than this case will be handled as a transfer syntax error.
- Missing mandatory elements in ASN.1 SEQUENCE definitions (as sent by the originator of the message).
- Wrong order of elements in ASN.1 SEQUENCE definitions (as sent by the originator of the message).

10.3 Abstract Syntax Error

10.3.1 General

An Abstract Syntax Error occurs when the receiving functional S1AP entity:

1. receives IEs or IE groups that cannot be understood (unknown IE ID);
2. receives IEs for which the logical range is violated (e.g.: ASN.1 definition: 0 to 15, the logical range is 0 to 10 (values 11 to 15 are undefined), and 12 will be received; this case will be handled as an abstract syntax error using criticality information sent by the originator of the message);
3. does not receive IEs or IE groups but according to the specified presence of the concerning object, the IEs or IE groups should have been present in the received message.
4. receives IEs or IE groups that are defined to be part of that message in wrong order or with too many occurrences of the same IE or IE group;
5. receives IEs or IE groups but according to the conditional presence of the concerning object and the specified condition, the IEs or IE groups should not have been present in the received message.

Cases 1 and 2 (not comprehended IE/IE group) are handled based on received Criticality information. Case 3 (missing IE/IE group) is handled based on Criticality information and Presence information for the missing IE/IE group specified in the version of the specification used by the receiver. Case 4 (IEs or IE groups in wrong order or with too many occurrences) and Case 5 (erroneously present conditional IEs or IE groups) result in rejecting the procedure.

If an Abstract Syntax Error occurs, the receiver shall read the remaining message and shall then for each detected Abstract Syntax Error that belong to cases 1-3 act according to the Criticality Information and Presence Information for the IE/IE group due to which Abstract Syntax Error occurred in accordance with subclauses 10.3.4 and 10.3.5. The handling of cases 4 and 5 is specified in subclause 10.3.6.

10.3.2 Criticality Information

In the S1AP messages there is criticality information set for individual IEs and/or IE groups. This criticality information instructs the receiver how to act when receiving an IE or an IE group that is not comprehended, i.e. the entire item (IE or IE group) which is not (fully or partially) comprehended shall be treated in accordance with its own criticality information as specified in subclause 10.3.4.

In addition, the criticality information is used in case of the missing IE/IE group abstract syntax error (see subclause 10.3.5).

The receiving node shall take different actions depending on the value of the Criticality Information. The three possible values of the Criticality Information for an IE/IE group are:

- Reject IE.
- Ignore IE and Notify Sender.
- Ignore IE.

The following rules restrict when a receiving entity may consider an IE, an IE group, or an EP not comprehended (not implemented), and when action based on criticality information is applicable:

1. IE or IE group: When one new or modified IE or IE group is implemented for one EP from a standard version, then other new or modified IEs or IE groups specified for that EP in that standard version shall be considered comprehended by a receiving entity (some may still remain unsupported).
2. EP: The comprehension of different Eps within a standard version or between different standard versions is not mandated. Any EP that is not supported may be considered not comprehended, even if another EP from that standard version is comprehended, and action based on criticality shall be applied.

10.3.3 Presence Information

For many IEs/IE groups which are optional according to the ASN.1 transfer syntax, S1AP specifies separately if the presence of these IEs/IE groups is optional or mandatory with respect to RNS application by means of the presence field of the concerning object of class S1AP-PROTOCOL-IES, S1AP-PROTOCOL-IES-PAIR, S1AP-PROTOCOL-EXTENSION or S1AP-PRIVATE-IES.

The presence field of the indicated classes supports three values:

1. Optional;
2. Conditional;
3. Mandatory.

If an IE/IE group is not included in a received message and the presence of the IE/IE group is mandatory or the presence is conditional and the condition is true according to the version of the specification used by the receiver, an abstract syntax error occurs due to a missing IE/IE group.

If an IE/IE group is included in a received message and the presence of the IE/IE group is conditional and the condition is false according to the version of the specification used by the receiver, an abstract syntax error occurs due to this erroneously present conditional IE/IE group.

10.3.4 Not comprehended IE/IE group

10.3.4.1 Procedure Code

The receiving node shall treat the different types of received criticality information of the *Procedure Code* IE according to the following:

Reject IE:

- If a message is received with a *Procedure Code* IE marked with "*Reject IE*" which the receiving node does not comprehend, the receiving node shall reject the procedure using the Error Indication procedure.

Ignore IE and Notify Sender:

- If a message is received with a *Procedure Code* IE marked with "*Ignore IE and Notify Sender*" which the receiving node does not comprehend, the receiving node shall ignore the procedure and initiate the Error Indication procedure.

Ignore IE:

- If a message is received with a *Procedure Code* IE marked with "*Ignore IE*" which the receiving node does not comprehend, the receiving node shall ignore the procedure.

When using the Error Indication procedure to reject a procedure or to report an ignored procedure it shall include the *Procedure Code* IE, the *Triggering Message* IE, and the *Procedure Criticality* IE in the *Criticality Diagnostics* IE.

10.3.4.1A Type of Message

When the receiving node cannot decode the *Type of Message* IE, the Error Indication procedure shall be initiated with an appropriate cause value.

10.3.4.2 IEs other than the Procedure Code and Type of Message

The receiving node shall treat the different types of received criticality information of an IE/IE group other than the *Procedure Code* IE and *Type of Message* IE according to the following:

Reject IE:

- If a message *initiating* a procedure is received containing one or more IEs/IE group marked with "*Reject IE*" which the receiving node does not comprehend; none of the functional requests of the message shall be executed.

The receiving node shall reject the procedure and report the rejection of one or more IEs/IE group using the message normally used to report unsuccessful outcome of the procedure. In case the information received in the initiating message was insufficient to determine a value for all IEs that are required to be present in the message used to report the unsuccessful outcome of the procedure, the receiving node shall instead terminate the procedure and initiate the Error Indication procedure.

- If a message *initiating* a procedure that does not have a message to report unsuccessful outcome is received containing one or more IEs/IE groups marked with "*Reject IE*" which the receiving node does not comprehend, the receiving node shall terminate the procedure and initiate the Error Indication procedure.

- If a *response* message is received containing one or more IEs marked with "*Reject IE*", that the receiving node does not comprehend, the receiving node shall consider the procedure as unsuccessfully terminated and initiate local error handling.

Ignore IE and Notify Sender:

- If a message *initiating* a procedure is received containing one or more IEs/IE groups marked with "*Ignore IE and Notify Sender*" which the receiving node does not comprehend, the receiving node shall ignore the content of the not comprehended IEs/IE groups, continue with the procedure as if the not comprehended IEs/IE groups were not received (except for the reporting) using the understood IEs/IE groups, and report in the response message of the procedure that one or more IEs/IE groups have been ignored. In case the information received in the initiating message was insufficient to determine a value for all IEs that are required to be present in the response message, the receiving node shall instead terminate the procedure and initiate the Error Indication procedure.

- if a message *initiating* a procedure that does not have a message to report the outcome of the procedure is received containing one or more IEs/IE groups marked with "*Ignore IE and Notify Sender*" which the receiving node does not comprehend, the receiving node shall ignore the content of the not comprehended IEs/IE groups, continue with the procedure as if the not comprehended IEs/IE groups were not received (except for the reporting) using the understood IEs/IE groups, and initiate the Error Indication procedure to report that one or more IEs/IE groups have been ignored.

- If a *response* message is received containing one or more IEs/IE groups marked with "*Ignore IE and Notify Sender*" which the receiving node does not comprehend, the receiving node shall ignore the content of the not comprehended IEs/IE groups, continue with the procedure as if the not comprehended IEs/IE groups were not received (except for the reporting) using the understood IEs/IE groups and initiate the Error Indication procedure.

Ignore IE:

- If a message *initiating* a procedure is received containing one or more IEs/IE groups marked with "*Ignore IE*" which the receiving node does not comprehend, the receiving node shall ignore the content of the not comprehended IEs/IE groups and continue with the procedure as if the not comprehended IEs/IE groups were not received using the understood IEs/IE groups.

- If a *response* message is received containing one or more IEs/IE groups marked with "*Ignore IE*" which the receiving node does not comprehend, the receiving node shall ignore the content of the not comprehended IEs/IE groups and continue with the procedure as if the not comprehended IEs/IE groups were not received using the understood IEs/IE groups.

When reporting not comprehended IEs/IE groups marked with "*Reject IE*" or "*Ignore IE and Notify Sender*" using a response message defined for the procedure, the *Information Element Criticality Diagnostics* IE shall be included in the *Criticality Diagnostics* IE for each reported IE/IE group.

When reporting not comprehended IEs/IE groups marked with "*Reject IE*" or "*Ignore IE and Notify Sender*" using the Error Indication procedure, the *Procedure Code* IE, the *Triggering Message* IE, *Procedure Criticality* IE, and the *Information Element Criticality Diagnostics* IE shall be included in the *Criticality Diagnostics* IE for each reported IE/IE group.

10.3.5 Missing IE or IE group

The receiving node shall treat the missing IE/IE group according to the criticality information for the missing IE/IE group in the received message specified in the version of this specification used by the receiver:

Reject IE:

- if a received message *initiating* a procedure is missing one or more IEs/IE groups with specified criticality "*Reject IE*"; none of the functional requests of the message shall be executed. The receiving node shall reject the procedure and report the missing IEs/IE groups using the message normally used to report unsuccessful outcome of the procedure. In case the information received in the initiating message was insufficient to determine a value for all IEs that are required to be present in the message used to report the unsuccessful outcome of the procedure, the receiving node shall instead terminate the procedure and initiate the Error Indication procedure.

- if a received message *initiating* a procedure that does not have a message to report unsuccessful outcome is missing one or more IEs/IE groups with specified criticality "*Reject IE*", the receiving node shall terminate the procedure and initiate the Error Indication procedure.

- if a received *response* message is missing one or more IEs/IE groups with specified criticality "*Reject IE*, the receiving node shall consider the procedure as unsuccessfully terminated and initiate local error handling.

Ignore IE and Notify Sender:

- if a received message *initiating* a procedure is missing one or more IEs/IE groups with specified criticality "*Ignore IE and Notify Sender*', the receiving node shall ignore that those IEs are missing and continue with the procedure based on the other IEs/IE groups present in the message and report in the response message of the procedure that one or more IEs/IE groups were missing. In case the information received in the initiating message was insufficient to determine a value for all IEs that are required to be present in the response message, the receiving node shall instead terminate the procedure and initiate the Error Indication procedure.

- if a received message *initiating* a procedure that does not have a message to report the outcome of the procedure is missing one or more IEs/IE groups with specified criticality "*Ignore IE and Notify Sender*', the receiving node shall ignore that those IEs are missing and continue with the procedure based on the other IEs/IE groups present in the message and initiate the Error Indication procedure to report that one or more IEs/IE groups were missing.

- if a received *response* message is missing one or more IEs/IE groups with specified criticality "*Ignore IE and Notify Sender*", the receiving node shall ignore that those IEs are missing and continue with the procedure based on the other IEs/IE groups present in the message and initiate the Error Indication procedure to report that one or more IEs/IE groups were missing.

Ignore IE:

- if a received message *initiating* a procedure is missing one or more IEs/IE groups with specified criticality '*Ignore IE*', the receiving node shall ignore that those IEs are missing and continue with the procedure based on the other IEs/IE groups present in the message.

- if a received *response* message is missing one or more IEs/IE groups with specified criticality '*Ignore IE*', the receiving node shall ignore that those IEs/IE groups are missing and continue with the procedure based on the other IEs/IE groups present in the message.

When reporting missing IEs/IE groups with specified criticality '*Reject IE*' or '*Ignore IE and Notify Sender*' using a response message defined for the procedure, the *Information Element Criticality Diagnostics* IE shall be included in the *Criticality Diagnostics* IE for each reported IE/IE group.

When reporting missing IEs/IE groups with specified criticality '*Reject IE*' or '*Ignore IE and Notify Sender*' using the Error Indication procedure, the *Procedure Code* IE, the *Triggering Message* IE, *Procedure Criticality* IE, and the *Information Element Criticality Diagnostics* IE shall be included in the *Criticality Diagnostics* IE for each reported IE/IE group.

10.3.6 IEs or IE groups received in wrong order or with too many occurrences or erroneously present

If a message with IEs or IE groups in wrong order or with too many occurrences is received or if IEs or IE groups with a conditional presence are present when the condition is not met (i.e. erroneously present), the receiving node shall behave according to the following:

- If a message *initiating* a procedure is received containing IEs or IE groups in wrong order or with too many occurrences or erroneously present, none of the functional requests of the message shall be executed. The receiving node shall reject the procedure and report the cause value "Abstract Syntax Error (Falsely Constructed

Message)" using the message normally used to report unsuccessful outcome of the procedure. In case the information received in the initiating message was insufficient to determine a value for all IEs that are required to be present in the message used to report the unsuccessful outcome of the procedure, the receiving node shall instead terminate the procedure and initiate the Error Indication procedure.

- If a message *initiating* a procedure that does not have a message to report unsuccessful outcome is received containing IEs or IE groups in wrong order or with too many occurrences or erroneously present, the receiving node shall terminate the procedure and initiate the Error Indication procedure, and use cause value "Abstract Syntax Error (Falsely Constructed Message)".

- If a *response* message is received containing IEs or IE groups in wrong order or with too many occurrences or erroneously present, the receiving node shall consider the procedure as unsuccessfully terminated and initiate local error handling.

When determining the correct order only the IEs specified in the specification version used by the receiver shall be considered.

10.4 Logical Error

Logical error situations occur when a message is comprehended correctly, but the information contained within the message is not valid (i.e. semantic error), or describes a procedure which is not compatible with the state of the receiver. In these conditions, the following behaviour shall be performed (unless otherwise specified) as defined by the class of the elementary procedure, irrespective of the criticality information of the IEs/IE groups containing the erroneous values.

Class 1:

Where the logical error occurs in a request message of a class 1 procedure, and the procedure has a message to report this unsuccessful outcome, this message shall be sent with an appropriate cause value. Typical cause values are:

- Semantic Error.

- Message not compatible with receiver state.

Where the logical error is contained in a request message of a class 1 procedure, and the procedure does not have a message to report this unsuccessful outcome, the procedure shall be terminated and the Error Indication procedure shall be initiated with an appropriate cause value. The *Procedure Code* IE and the *Triggering Message* IE within the *Criticality Diagnostics* IE shall then be included in order to identify the message containing the logical error.

Where the logical error exists in a response message of a class 1 procedure, the procedure shall be considered as unsuccessfully terminated and local error handling shall be initiated.

Class 2:

Where the logical error occurs in a message of a class 2 procedure, the procedure shall be terminated and the Error Indication procedure shall be initiated with an appropriate cause value. The *Procedure Code* IE and the *Triggering Message* IE within the *Criticality Diagnostics* IE shall then be included in order to identify the message containing the logical error.

10.5 Exceptions

The error handling for all the cases described hereafter shall take precedence over any other error handling described in the other subclauses of clause 10.

- If any type of error (Transfer Syntax Error, Abstract Syntax Error or Logical Error) is detected in the ERROR INDICATION message, it shall not trigger the Error Indication procedure in the receiving Node but local error handling.

- In case a response message or Error Indication message needs to be returned, but the information necessary to determine the receiver of that message is missing, the procedure shall be considered as unsuccessfully terminated and local error handling shall be initiated.

- If an error that terminates a procedure occurs, the returned cause value shall reflect the error that caused the termination of the procedure even if one or more abstract syntax errors with criticality 'ignore and notify' have earlier occurred within the same procedure.

- If an AP ID error is detected, the error handling as described in subclause 10.6 shall be applied.

10.6 Handling of AP ID

Note: The 'first message', the 'first returned message' and the 'last message'as used below correspond to messages for a UE-associated logical connection. The 'first message' has a new AP ID from the sending node and the 'first returned message' is the first response message, which has a new APID from the node sending the 'first returned message'. Thereafter the two APIDs are included in all messages over the UE-associated logical connection unless otherwise allowed by the specification. The 'last message' is a message sent by a node in order to complete the termination of a given UE-associated logical connection, such that no other messages for the same connection are expected in either direction.

If a node receives a first message that includes a remote AP ID which is erroneous e.g. an AP ID which has been stored previously for another UE-associated logical connection for the same peer node, the receiving node shall initiate an Error Indication procedure with inclusion of only the previously received AP ID from the peer node and an appropriate cause value. In this case, both nodes shall initiate a local release of any established UE-associated logical connection having the erroneous AP ID as local or remote identifier.

If a node receives a first returned message that includes a remote AP ID which has been stored previously for another UE-associated logical connection for the same peer node, or that includes an AP ID pair which is inconsistent (e.g. the local AP ID is unknown or already allocated to another UE-associated logical connection), the receiving node shall initiate an Error Indication procedure with inclusion of the received AP IDs from the peer node and an appropriate cause value. Both nodes shall initiate a local release of any established UE-associated logical connection (for the same S1 interface) having these AP IDs as local or remote identifier.

If a node receives a message (other than the first or first returned messages) that includes AP ID(s) identifying a logical connection which is unknown to the node (for the same S1 interface):

- if this message is not the last message for this UE-associated logical connection, the node shall initiate an Error Indication procedure with inclusion of the received AP ID(s) from the peer node and an appropriate cause value. Both nodes shall initiate a local release of any established UE-associated logical connection (for the same S1 interface) having the erroneous AP ID(s) as local or remote identifier.

- if this message is the last message for this UE-associated logical connection, the receiving node shall initiate a local release of any established UE-associated logical connection (for the same S1 interface) that have either the local or remote AP ID(s) as identifiers.

Annex A (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2007-01					Scope, Skeleton		0.0.0
2007-05					inclusion of post-RAN3#55bis-email agreed text proposals	0.0.0	0.0.1
2007-06					inclusion of post-RAN3#56-email agreed text-proposals	0.0.1	0.1.0
2007-08					Updates according to discussions in RAN3#57	0.1.0	0.2.0
2007-09	37				Presentation to TSG-RAN for information -version 1.0.0	0.2.0	1.0.0
2007-10					Updates according to agreements in RAN3#57bis for ASN.1 framework and error handling, MME UE S1AP ID, eNB UE S1AP ID within all messages	1.0.0	1.1.0
2007-10					Updates according to agreements on the RAN3 email reflector following the 'complementing' exercise. The incorporated documents are R3-072031, R3-072032, R3-072033, R3-072034 and R3-072035. The content is related to tabular message representation with tabular representation of Information Elements and ASN.1 code. V120 then served as a base for RAN3#58	1.1.0	1.2.0
2007-11					Updates according to agreements in R3-072320 and R3-072355 achieved in RAN3#58 and according to post RAN3#58 email check: R3-072417, R3-072348, R3-072435, R3-072420, R3-072422, R3-072437, R3-072436, R3-072422, R3-072423.	1.2.0	1.3.0
2007-11	38	RP-070851			Presentation to TSG-RAN for approval	1.3.0	2.0.0
2007-12	38				specification approved at TSG-RAN and placed under change control	2.0.0	8.0.0
2008-03	39	RP-080080	58		RAN3 agreed changes for TS 36.413	8.0.0	8.1.0
2008-06	40	RP-080304	59	1	RAN3 agreed changes for TS 36.413	8.1.0	8.2.0
2008-09	41	RP-080584	223		changes to TS36.413 agreed in RAN3#61	8.2.0	8.3.0
2008-12	42	RP-080846	325	1	changes to TS36.413 agreed in RAN3#62	8.3.0	8.4.0

History

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