20 апреля 2024

Протоколы и интерфейсы БС LTE. Лекция 7.

Интерфейс S1AP. TS 36.413

ВЛАД РЫЖОВ

Fast Track в Телеком, 2024

НТР
новые телеком решения

PHOENIX
EDUCATION

МФТИ

Что сегодня будет происходить? Адженда

Список процедур S1AP	Разбор типов процедур	Сообщения	Пример
5 минут	**25 минут**	**5 минут**	**10 минут**

Какие части сети соединяет интерфейс S1AP? Каковы его функции?

Список процедур S1AP

5 минут

Разбор типов процедур

25 минут

Сообщения

5 минут

Пример

10 минут

Список процедур

Все процедуры S1AP делятся на 2 класса:

- Класс-1 – элементарные процедуры с ответом
- Класс-2 – элементарные процедуры без ответа

Список процедур. Класс-1.

Table 1: Class 1 procedures

Elementary Procedure	Initiating Message	Successful Outcome Response message	Unsuccessful Outcome 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 Modification Indication	E-RAB MODIFICATION INDICATION	E-RAB MODIFICATION CONFIRM	
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 CONFIGURATION UPDATE 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	
Kill	KILL REQUEST	KILL RESPONSE	
UE Radio Capability Match	UE RADIO CAPABILITY MATCH REQUEST	UE RADIO CAPABILITY MATCH RESPONSE	
UE Context Modification Indication	UE CONTEXT MODIFICATION INDICATION	UE CONTEXT MODIFICATION CONFIRM	
UE Context Suspend	UE CONTEXT SUSPEND REQUEST	UE CONTEXT SUSPEND RESPONSE	
UE Context Resume	UE CONTEXT RESUME REQUEST	UE CONTEXT RESUME RESPONSE	UE CONTEXT RESUME FAILURE

Список процедур. Класс-2.

Table 2: Class 2 procedures

Elementary Procedure	Message
Handover Notification	HANDOVER NOTIFY
E-RAB Release Indication	E-RAB RELEASE INDICATION
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 Tunnelling	DOWNLINK S1 CDMA2000 TUNNELLING
Uplink S1 CDMA2000 Tunnelling	UPLINK S1 CDMA2000 TUNNELLING
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
eNB Configuration Transfer	eNB CONFIGURATION TRANSFER
MME Configuration Transfer	MME CONFIGURATION TRANSFER
Cell Traffic Trace	CELL TRAFFIC TRACE
Downlink UE Associated LPPa Transport	DOWNLINK UE ASSOCIATED LPPA TRANSPORT
Uplink UE Associated LPPa Transport	UPLINK UE ASSOCIATED LPPA TRANSPORT
Downlink Non UE Associated LPPa Transport	DOWNLINK NON UE ASSOCIATED LPPA TRANSPORT
Uplink Non UE Associated LPPa Transport	UPLINK NON UE ASSOCIATED LPPA TRANSPORT
PWS Restart Indication	PWS RESTART INDICATION
Reroute NAS Request	REROUTE NAS REQUEST
PWS Failure Indication	PWS FAILURE INDICATION
Connection Establishment Indication	CONNECTION ESTABLISHMENT INDICATION
NAS Delivery Indication	NAS DELIVERY INDICATION
Retrieve UE Information	RETRIEVE UE INFORMATION
UE Information Transfer	UE INFORMATION TRANSFER
eNB CP Relocation Indication	eNB CP RELOCATION INDICATION
MME CP Relocation Indication	MME CP RELOCATION INDICATION
Secondary RAT Data Usage Report	SECONDARY RAT DATA USAGE REPORT

| Список процедур S1AP | Разбор типов процедур | Сообщения | Пример |

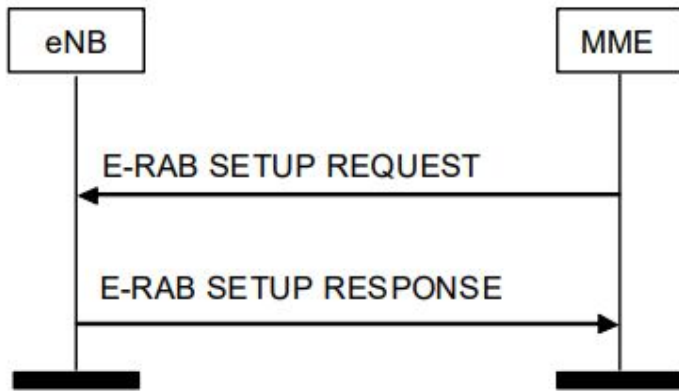**Список процедур S1AP**

Разбор типов процедур

Сообщения

Пример

5 минут

25 минут

5 минут

10 минут
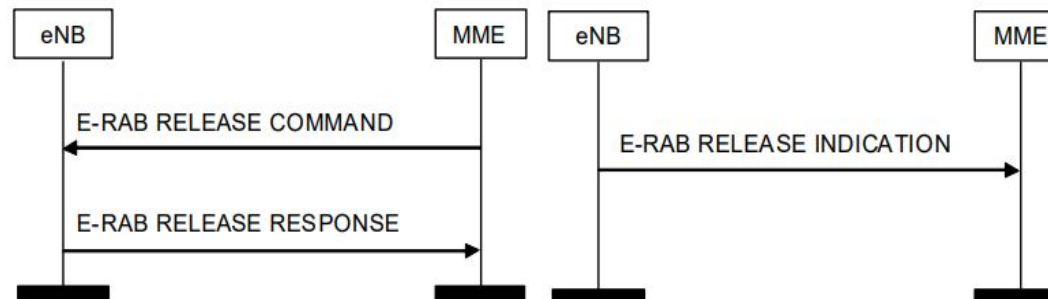
E-RAB – это…

E-RAB Management procedures

E-RAB Setup

eNB → MME

E-RAB SETUP REQUEST

E-RAB SETUP RESPONSE

E-RAB Modify

eNB → MME

E-RAB MODIFY REQUEST

E-RAB MODIFY RESPONSE

E-RAB Modification Indication

eNB → MME

E-RAB MODIFICATION INDICATION

E-RAB MODIFICATION CONFIRM

E-RAB Release

eNB → MME

E-RAB RELEASE COMMAND

E-RAB RELEASE RESPONSE

eNB → MME
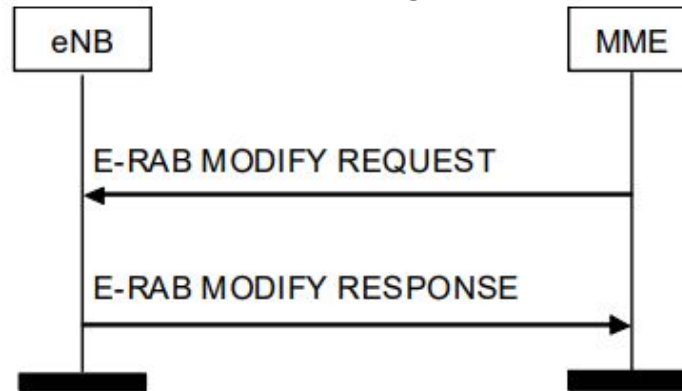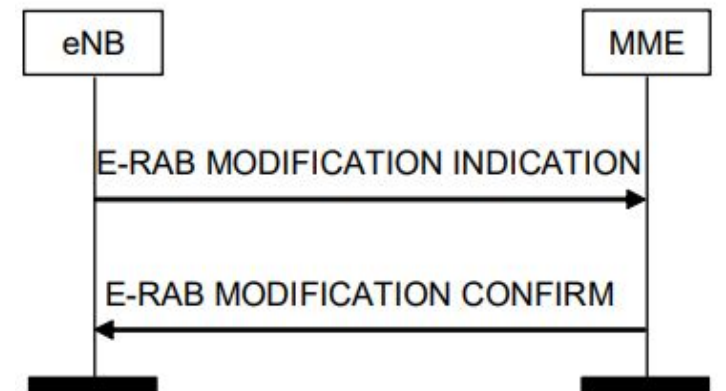
E-RAB RELEASE INDICATION

Context Management procedures

Initial Context Setup
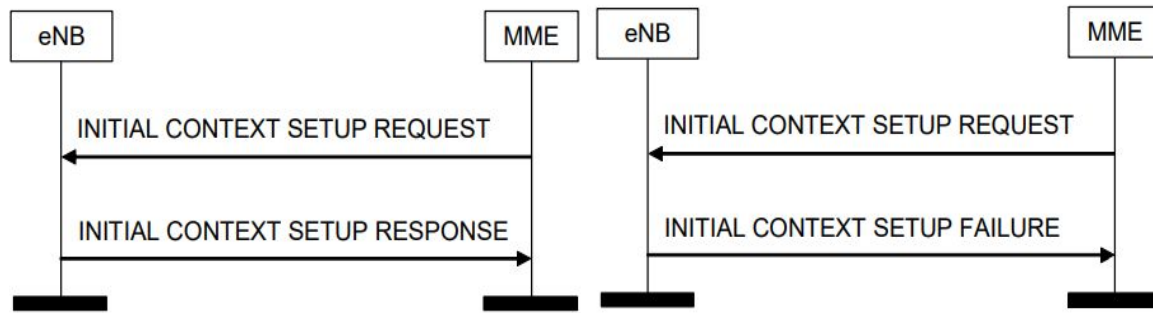
UE Context Release
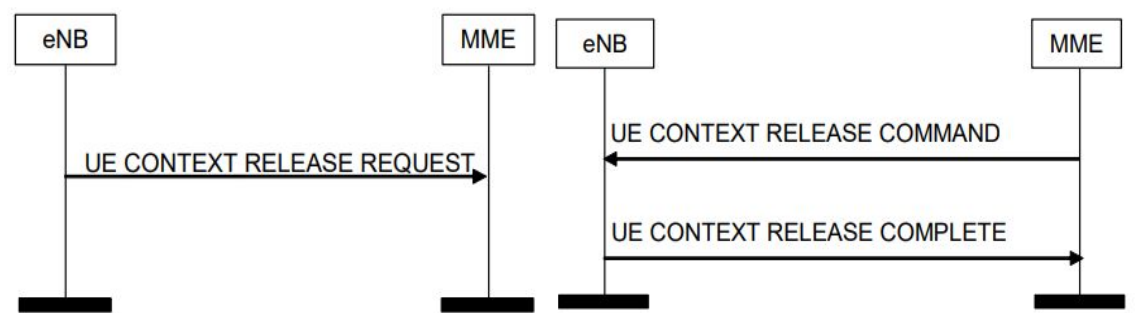
UE Context Modification

UE Radio Capability Match

11
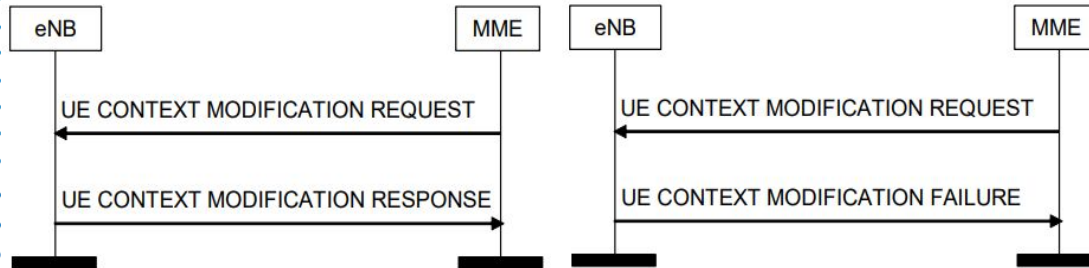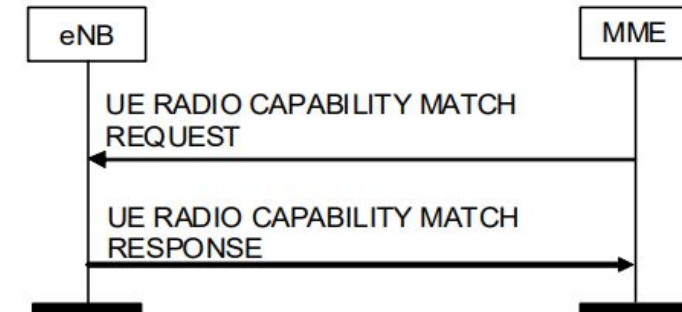
Context Management procedures

UE Context Modification Indication

eNB → MME: UE CONTEXT MODIFICATION INDICATION

MME → eNB: UE CONTEXT MODIFICATION CONFIRM

UE Context Suspend

eNB → MME: UE CONTEXT SUSPEND REQUEST

MME → eNB: UE CONTEXT SUSPEND RESPONSE

UE Context Resume

eNB → MME: UE CONTEXT RESUME REQUEST

MME → eNB: UE CONTEXT RESUME RESPONSE

eNB → MME: UE CONTEXT RESUME REQUEST

MME → eNB: UE CONTEXT RESUME FAILURE
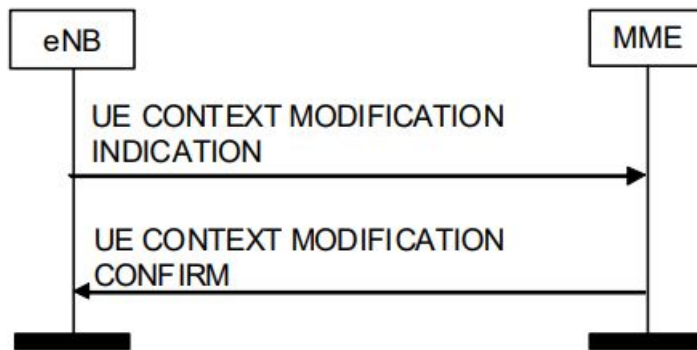
Connection Establishment Indication
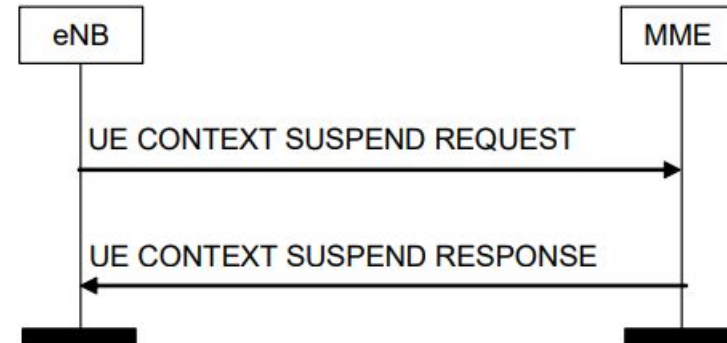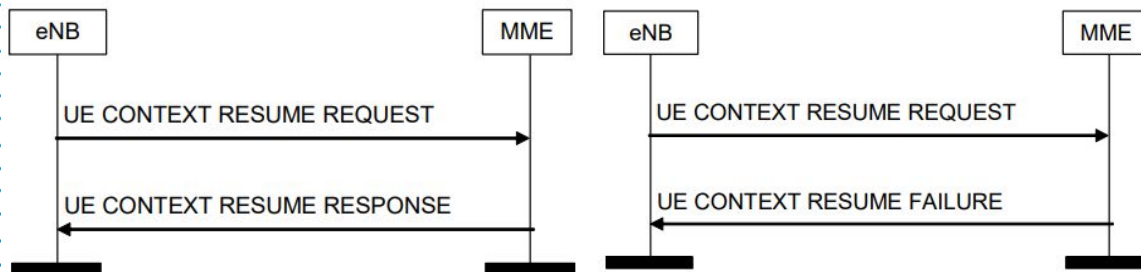
MME → eNB: CONNECTION ESTABLISHMENT INDICATION
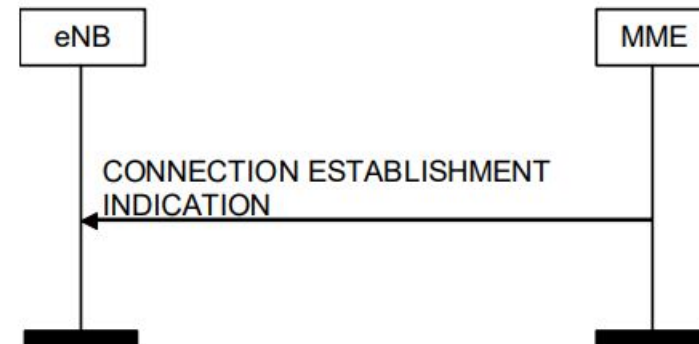
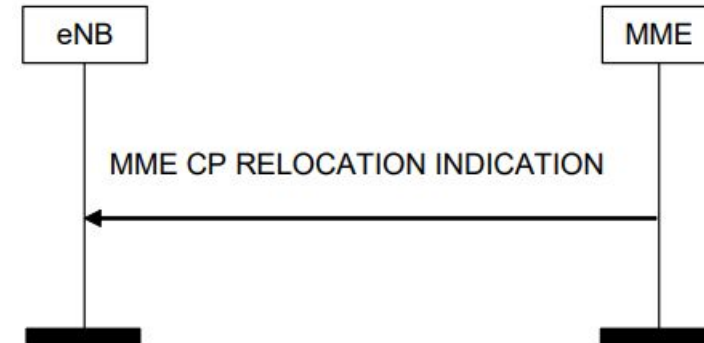# Context Management procedures

Retrieve UE Information
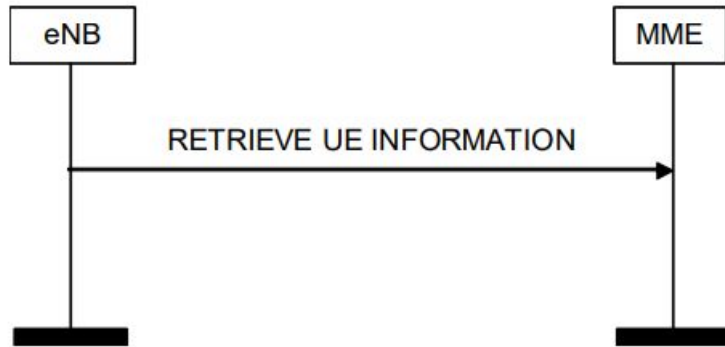
UE Information Transfer
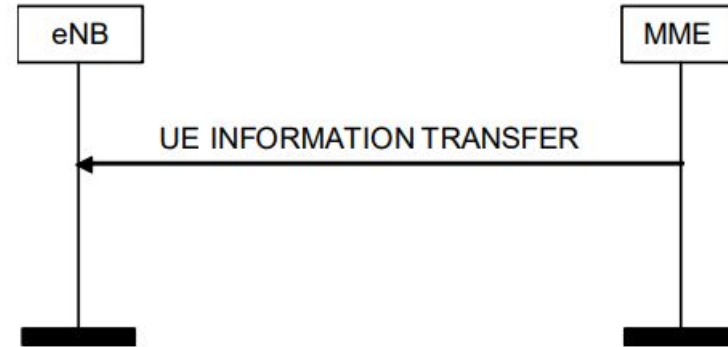
eNB CP Relocation Indication
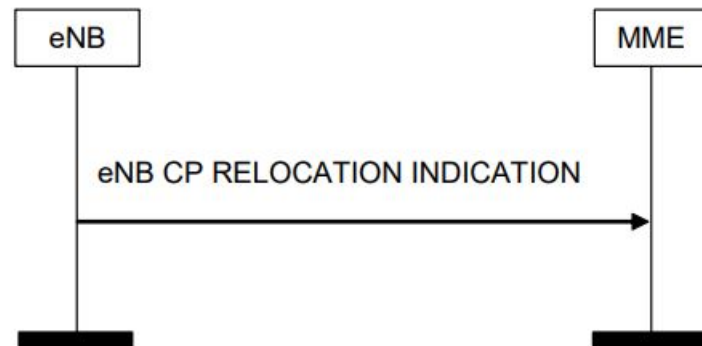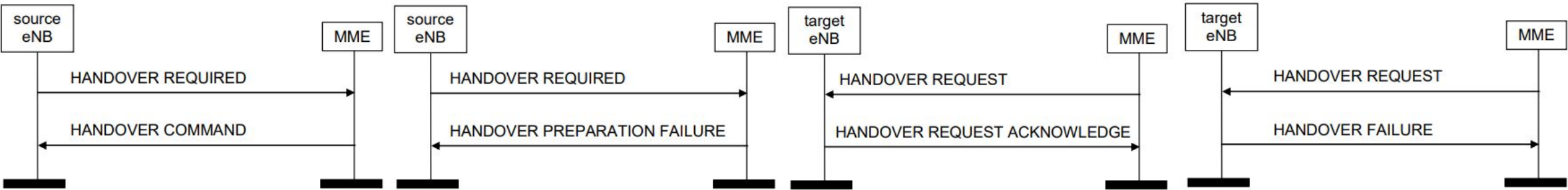
MME CP Relocation Indication

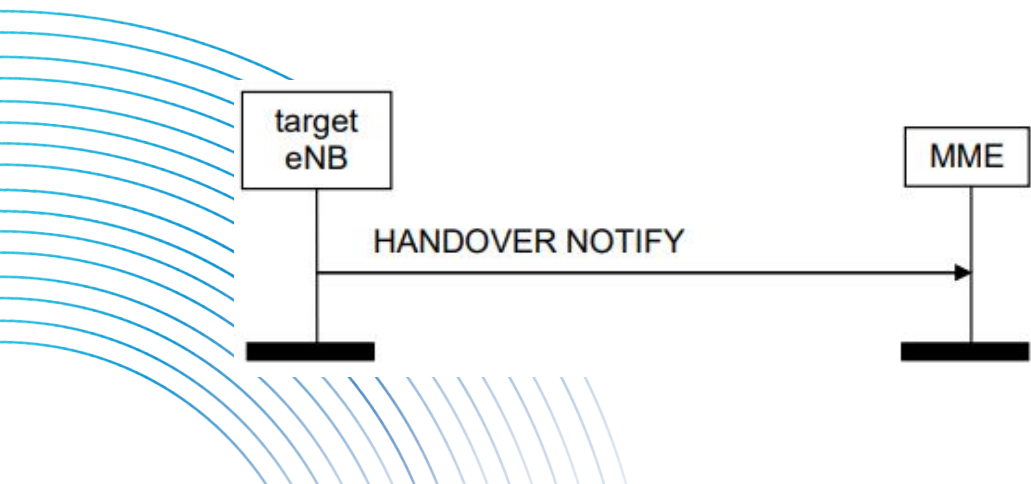**В каких процедурах управления контекстами по S1 интерфейсу определен формат ответа о неуспешной процедуре?**

Какую классификацию handover процедур вы можете назвать? inter-/intra- frequency/eNB? soft/hard?
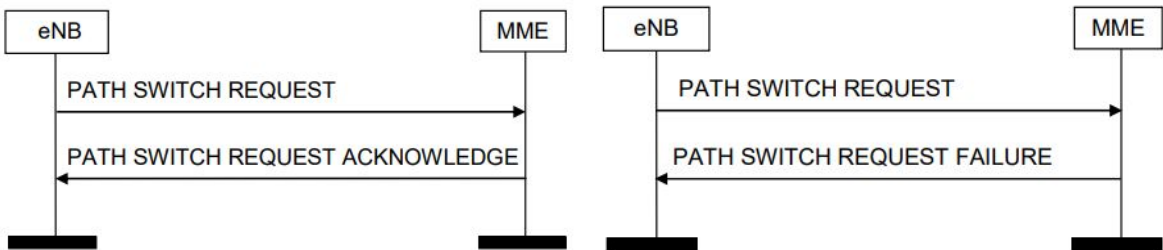
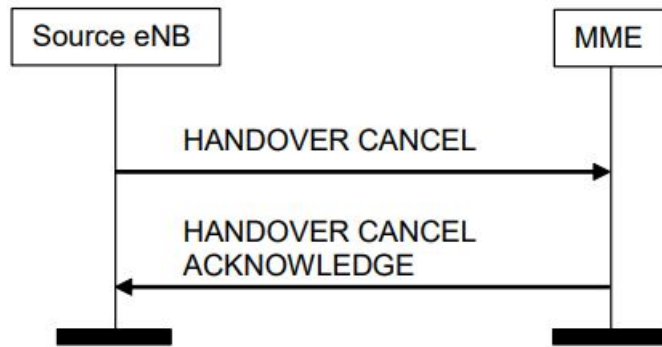# Handover Signalling

Handover Preparation

Handover Resource Allocation

Handover Notification
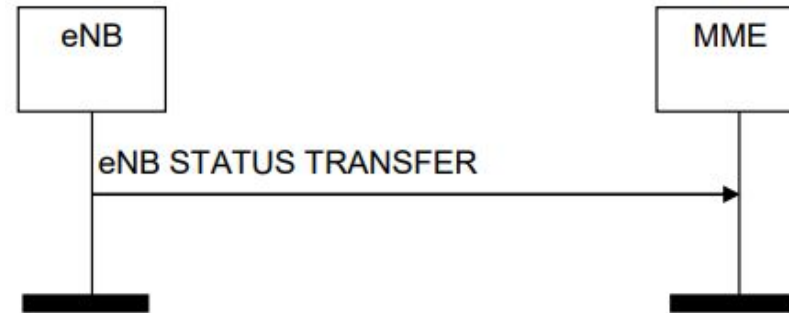
Path Switch Request

Handover Signalling

Handover Cancellation

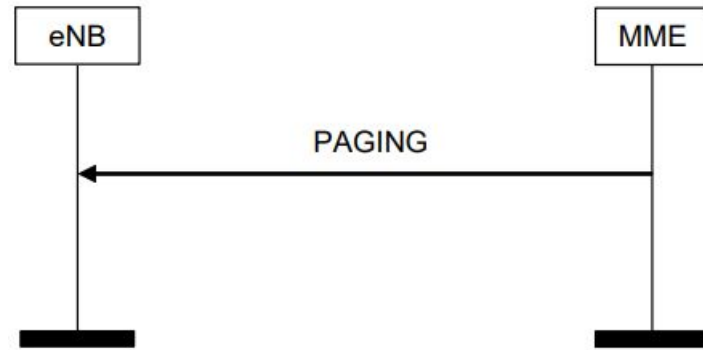

eNB Status Transfer

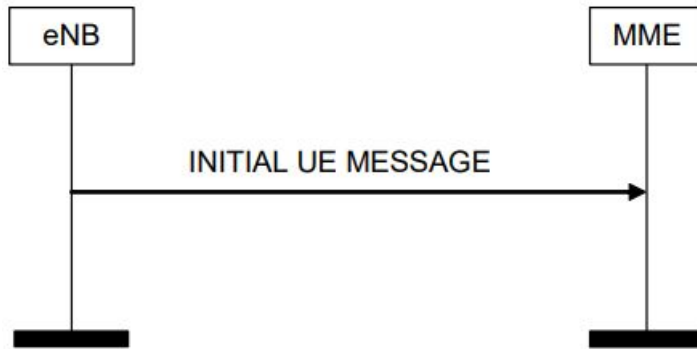## MME Status Transfer

Что такое paging?

Paging

NAS Transport

Initial UE Message
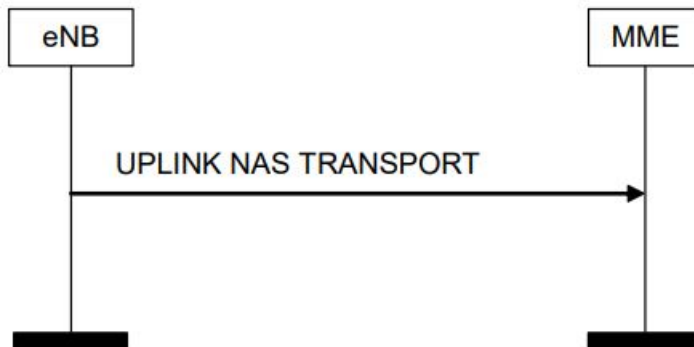

DOWNLINK NAS TRANSPORT

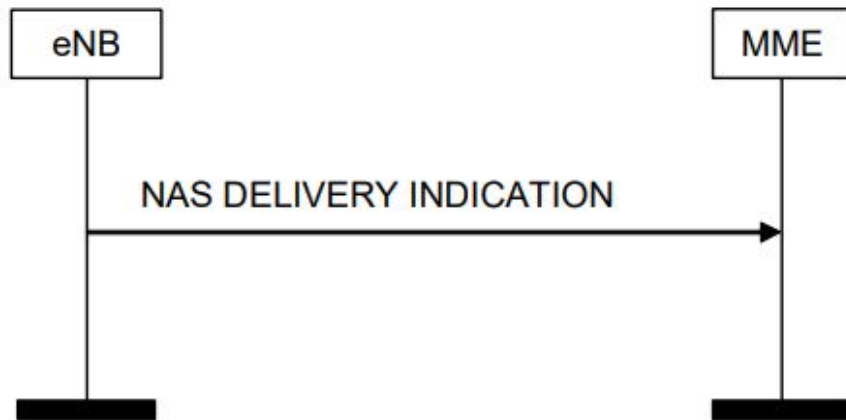### UPLINK NAS TRANSPORT

NAS NON DELIVERY INDICATION

NAS Transport

NAS DELIVERY INDICATION

Reroute NAS Request
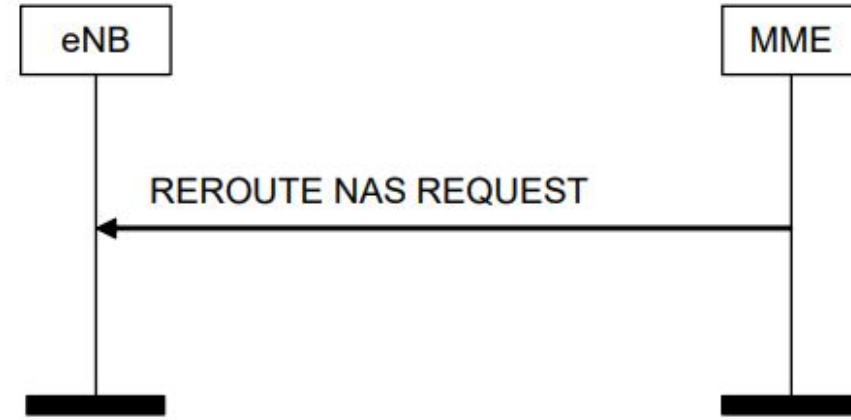
Management procedures

Reset Procedure
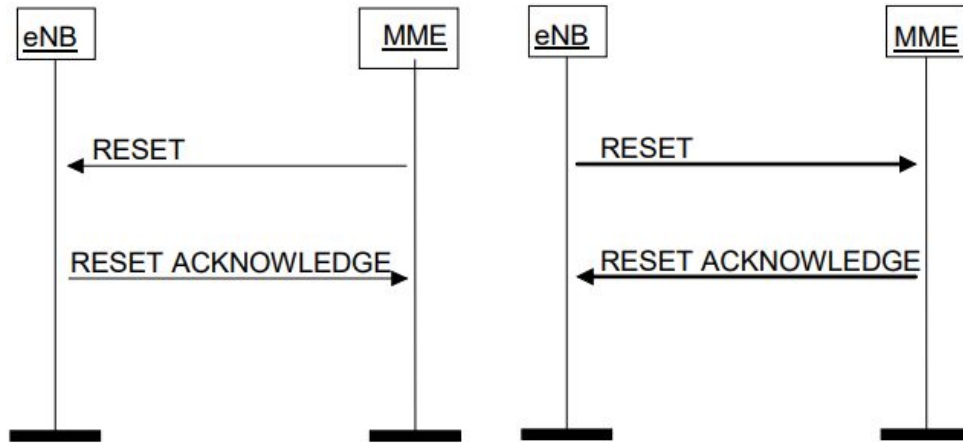
Error Indication
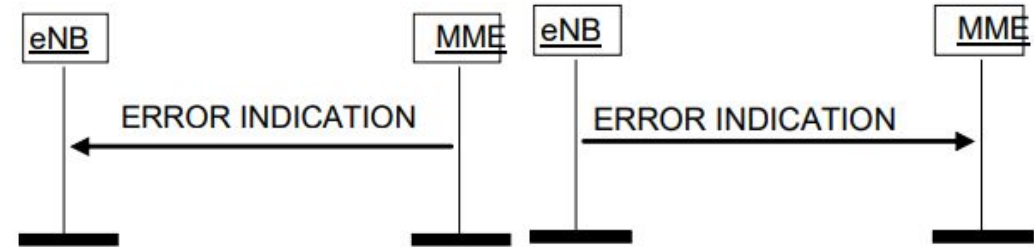
S1 Setup
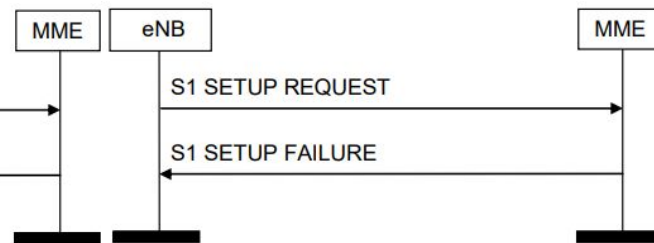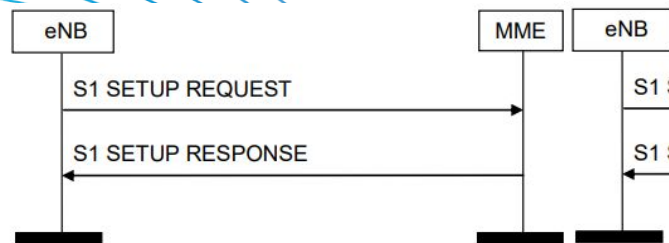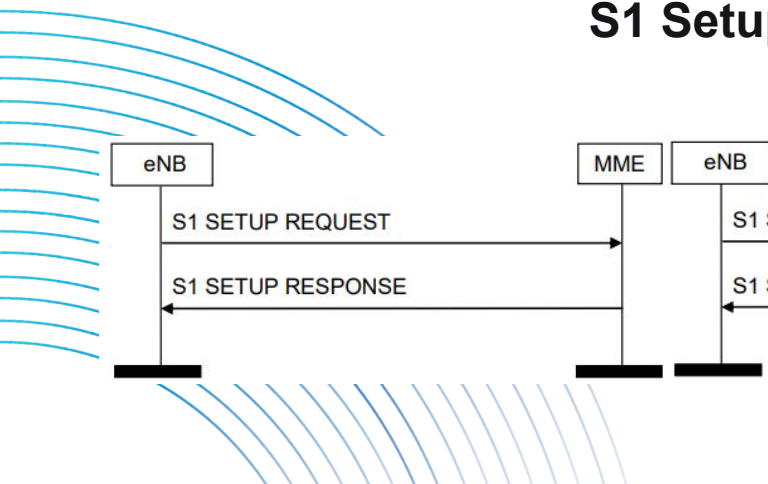
eNB Configuration Update
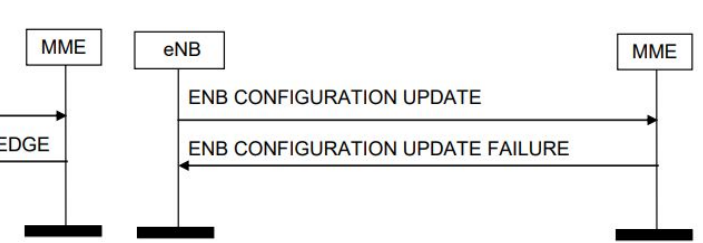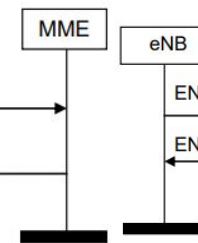
Management procedures

MME Configuration Update
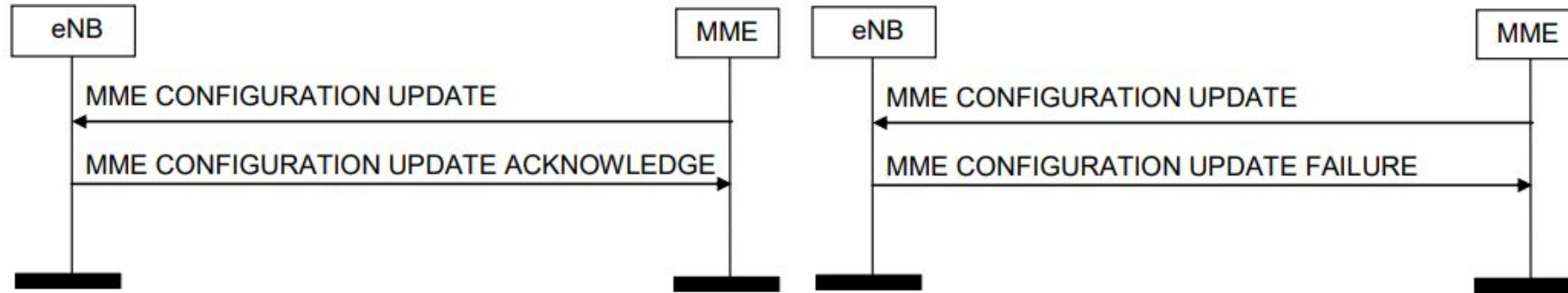
Overload Start
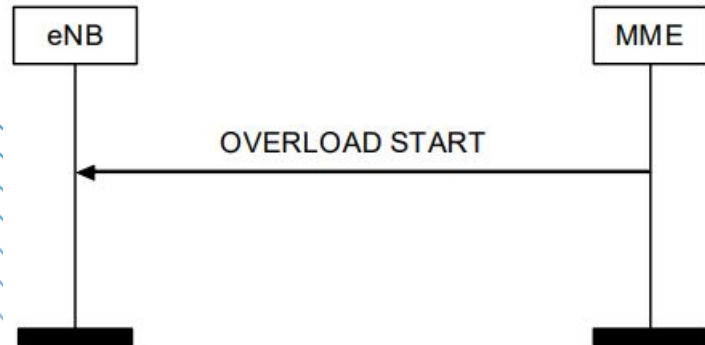
Overload Stop
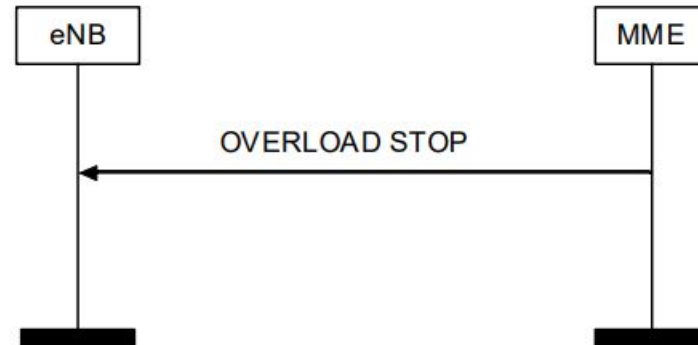
UE Capability Info Indication
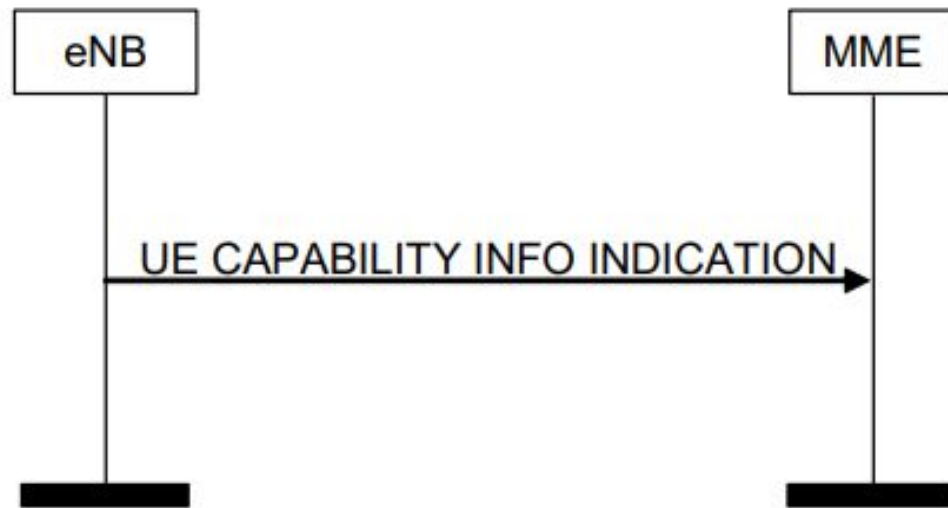
eNB Direct Information Transfer
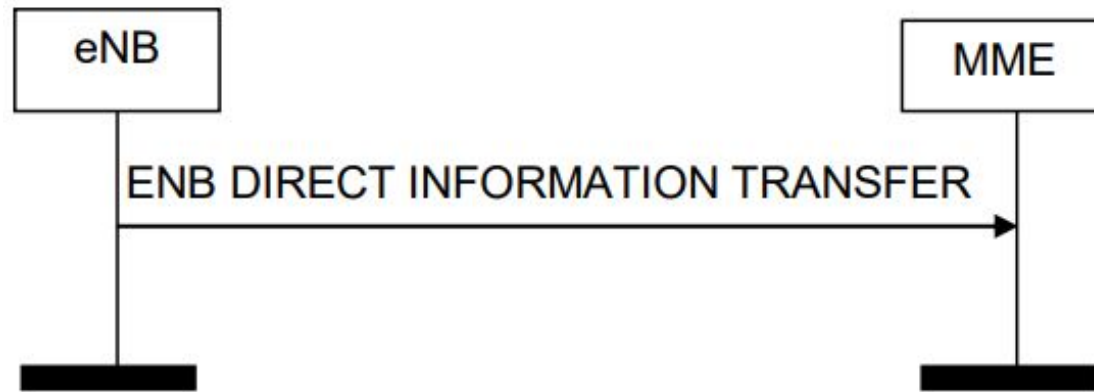
MME Direct Information Transfer
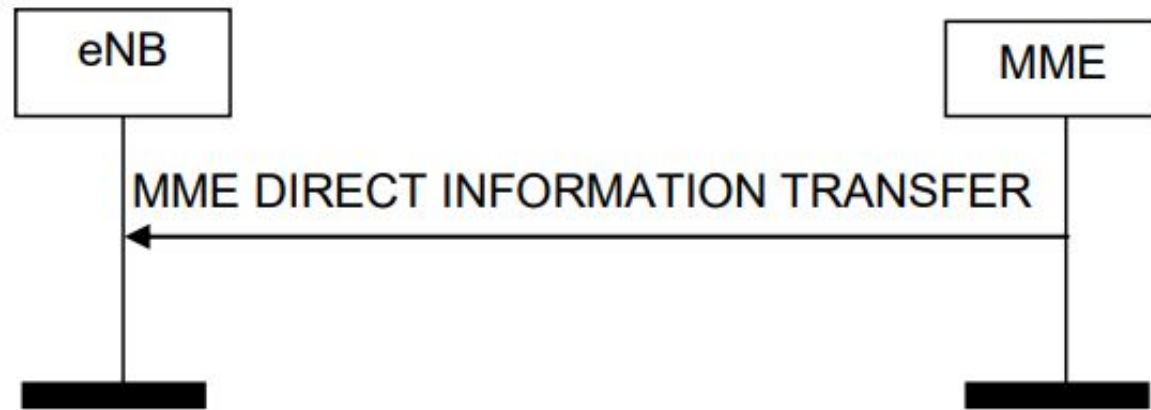
eNB Configuration Transfer

MME Configuration Transfer

Какие типы процедур из раздела 8 TS 36.413 v15 не были описаны?

Список процедур S1AP	Разбор типов процедур	Сообщения	Пример
5 минут	**25 минут**	**5 минут**	**10 минут**

Содержание сообщения

Presence

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.

Criticality

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.

Range

Assigned Criticality

- Reject IE.

- Ignore IE and Notify Sender.

- Ignore IE.

Список процедур S1AP	Разбор типов процедур	Сообщения	Пример
5 минут	25 минут	5 минут	10 минут

Пример сообщения S1 Setup Request. ASN1

S1 Setup Request – сообщение eNB → MME для трансфера информации для транспортного уровня сети.

```
-- *********************************************************
--
-- 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 optional}|
    { ID id-SupportedTAs             CRITICALITY reject  TYPE SupportedTAs              PRESENCE mandatory}|
    { ID id-DefaultPagingDRX         CRITICALITY ignore  TYPE PagingDRX                 PRESENCE mandatory}|
    { ID id-CSG-IdList               CRITICALITY reject  TYPE CSG-IdList                PRESENCE optional}|
    { ID id-UE-RetentionInformation  CRITICALITY ignore  TYPE UE-RetentionInformation   PRESENCE optional}|
    { ID id-NB-IoT-DefaultPagingDRX  CRITICALITY ignore  TYPE NB-IoT-DefaultPagingDRX   PRESENCE optional},
    ...
}
```

Пример сообщения S1 Setup Request

S1 Setup Request – сообщение eNB → MME для трансфера информации для транспортного уровня сети.

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	O		PrintableString(SIZE(1..150,…))		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			
>RAT-Type	O		9.2.1.117	RAT-Type associated with the TAC of the indicated PLMN(s).	YES	reject
Default Paging DRX	M		9.2.1.16		YES	ignore
CSG Id List		0..1			GLOBAL	reject
>CSG Id		1 ..<maxnoofCSGIds>	9.2.1.62			
UE Retention Information	O		9.2.1.112		YES	ignore
NB-IoT Default Paging DRX	O		9.2.1.114		YES	ignore

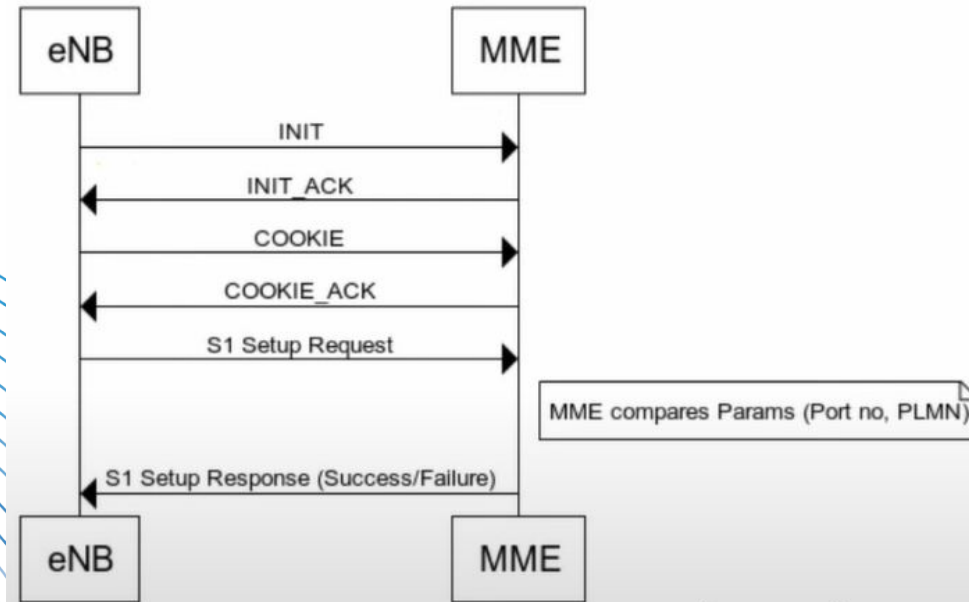| Range bound	Explanation
maxnoofTACs	Maximum no. of TACs. Value is 256.
maxnoofBPLMNs	Maximum no. of Broadcast PLMNs. Value is 6.
maxnoofCSGIds	Maximum no. of CSG Ids within the CSG Id List. Value is 256.

Пример S1 Setup Request

No.	Time	Source	Destination	Protocol	Length	App name	Info
20…	6.445316269	10.18.10.187	10.18.10.221	SCTP	84		INIT
20…	6.450406239	10.18.10.221	10.18.10.187	SCTP	308		INIT_ACK
20…	6.450446803	10.18.10.187	10.18.10.221	SCTP	280		COOKIE_ECHO
20…	6.455936882	10.18.10.221	10.18.10.187	SCTP	52		COOKIE_ACK
20…	6.456073979	10.18.10.187	10.18.10.221	S1AP	124		S1SetupRequest
20…	6.461231524	10.18.10.221	10.18.10.187	SCTP	64		SACK (Ack=0, Arwnd=106437)
20…	6.462556004	10.18.10.221	10.18.10.187	S1AP	108		S1SetupResponse
20…	6.462569448	10.18.10.187	10.18.10.221	SCTP	64		SACK (Ack=0, Arwnd=106455)
42…	10.480256997	10.18.10.187	10.18.10.221	S1AP…	160		InitialUEMessage, Attach request, PDN connectivity request

eNB

MME

S1 Setup

eNB — MME

INIT

INIT_ACK

COOKIE

COOKIE_ACK

S1 Setup Request

MME compares Params (Port no, PLMN)

S1 Setup Response (Success/Failure)

eNB — MME

proxy.rar

Пример S1 Setup Request


```
▼ S1 Application Protocol
  ▼ S1AP-PDU: initiatingMessage (0)
    ▼ initiatingMessage
        procedureCode: id-S1Setup (17)
        criticality: reject (0)
      ▼ value
        ▼ S1SetupRequest
          ▼ protocolIEs: 4 items
            ▼ Item 0: id-Global-ENB-ID
              ▼ ProtocolIE-Field
                  id: id-Global-ENB-ID (59)
                  criticality: reject (0)
                ▸ value
            ▼ Item 1: id-eNBname
              ▼ ProtocolIE-Field
                  id: id-eNBname (60)
                  criticality: ignore (1)
                ▼ value
                    ENBname: eNB-Eurecom-LTEBox
```

```
▼ S1 Application Protocol
  ▼ S1AP-PDU: initiatingMessage (0)
    ▼ initiatingMessage
        procedureCode: id-S1Setup (17)
        criticality: reject (0)
      ▼ value
        ▼ S1SetupRequest
          ▼ protocolIEs: 4 items
            ▸ Item 0: id-Global-ENB-ID
            ▸ Item 1: id-eNBname
            ▼ Item 2: id-SupportedTAs
              ▼ ProtocolIE-Field
                  id: id-SupportedTAs (64)
                  criticality: reject (0)
                ▼ value
                  ▼ SupportedTAs: 1 item
                    ▼ Item 0
                      ▼ SupportedTAs-Item
                          tAC: 5 (0x0005)
                        ▼ broadcastPLMNs: 1 item
                          ▼ Item 0
                              PLMNidentity: 232003
                              Mobile Country Code (MCC): Unassigned (320)
                              Mobile Network Code (MNC): Unknown (230)
            ▼ Item 3: id-DefaultPagingDRX
              ▼ ProtocolIE-Field
                  id: id-DefaultPagingDRX (137)
                  criticality: ignore (1)
                ▼ value
                    PagingDRX: v128 (2)
```

Разбор примера

СПАСИБО