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Nokia Networks

Nokia Academy

LTE Optimization Principles [RL70]

Module 07

Call Drop Analysis

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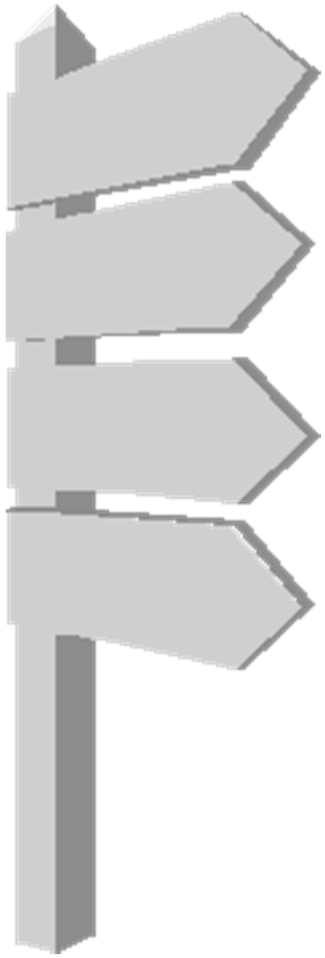
Document Change History

Date	Version	Name	Change comment

Module Objectives



- After completing this module, you will be able to:
  - Describe related network and field KPIs
  - Give an overview about call drop causes
  - Distinguish UE and eNB initiated drops
  - Summarize call drop counters and trigger points
  - Discuss call drops during handover procedures
  - Analyse drop examples via means of field mesurement and UE trace

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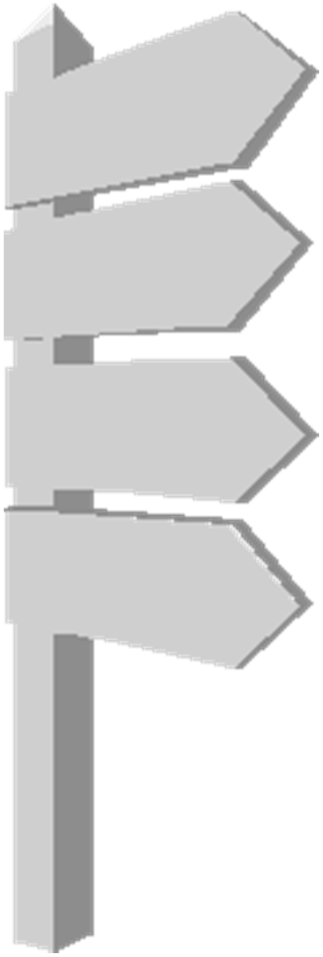


- Network + Field KPIs
- KPI Reference Values
- Drop Call Causes, Theory
  - UE initiated drop
  - eNB initiated drop
- Drop Call Counter Triggers
- Handover Signalling, Counter Triggers
- Relevant Features and Parameters Summary
- Project Example

This module discusses call drops and handover drops after call setup has already succeeded. See separate module for call setup problems.

3GPP KPI definitions

- 3GPP defines basic KPIs in TS 32.450 and TS 32.451 in a vendor-independent way

3GPP KPI definitions – retainability

- Accessibility KPI, TS 32.450 Sec 6.2
- A measurement that shows how often an end-user *abnormally* looses an E-RAB during the time the E-RAB is used.
- Number of E-RABs with data in a buffer that was abnormally released, normalized with number of data session time units.
- Defined per QCI
- Unit: drops per minute, or minutes per drop
- Only drops of active E-RABs are counted

$$R2 = \frac{\sum_{QCI} ERAB.RelActNbr.[QCI]}{ERAB.SessionTimeUE}$$

RL70 Top Level KPIs – Category: Retainability

- E-RAB Drop Ratio, RAN View (pre-emptions excluded): LTE_5025d
- E-RAB Retainability Rate, RAN View, RNL Failure with UE LostTotal: LTE_5581b

The Most Important Call Drop Counter-Based KPIs

• LTE_5025d E-UTRAN E-RAB Drop Ratio, RAN View

• **Formula:** (Logical)

E-RAB DR=(abnormal E-RAB releases from RAN point of view / all E-RAB releases)*100%

• **Formula:** (NE names)

100*sum([ENB_EPS_BEARER_REL_REQ_RNL]+ [ENB_EPS_BEARER_REL_REQ_TNL]+
[ENB_EPS_BEARER_REL_REQ_OTH])/sum([EPC_EPS_BEARER_REL_REQ_NORM]+
[EPC_EPS_BEARER_REL_REQ_DETACH]+[EPC_EPS_BEARER_REL_REQ_RNL]+
[EPC_EPS_BEARER_REL_REQ_OTH] +[ENB_EPS_BEAR_REL_REQ_RNL_REDIR]+
[ENB_EPS_BEARER_REL_REQ_NORM] +[ENB_EPS_BEARER_REL_REQ_RNL]+
[ENB_EPS_BEARER_REL_REQ_TNL]+[ENB_EPS_BEARER_REL_REQ_OTH]+
[PRE_EMPT_GBR_BEARER] +
[PRE_EMPT_NON_GBR_BEARER])

The Most Important Call Drop Counter-Based KPIs

• LTE_5581b E-RAB Retainability Rate, RAN View, RNL Failure with UE Lost

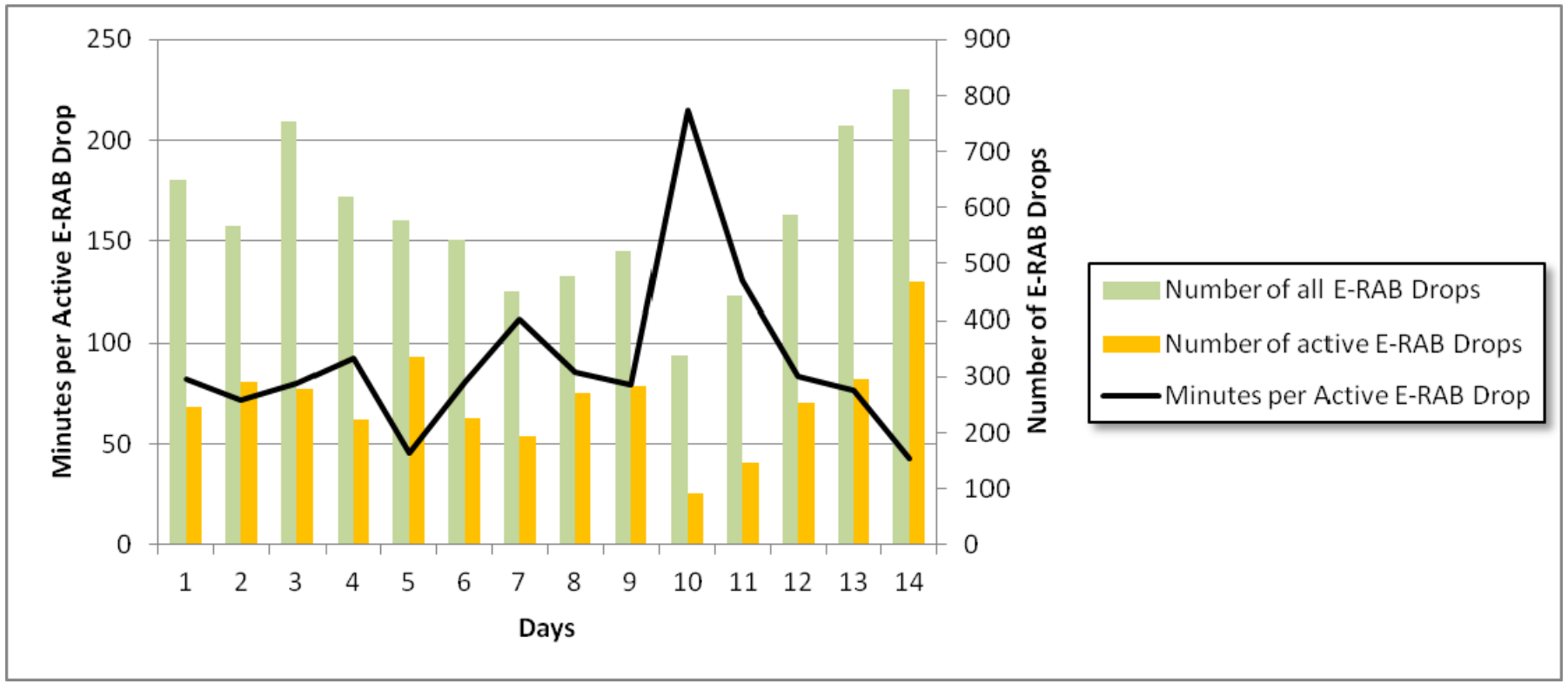
• **Formula:** (Logical)

E-RAB RetainR (RNL UE Los)= (Active ERAB Rel QCI1 + Active ERAB Rel QCI2 + Active ERAB Rel QCI3 + Active ERAB Rel QCI4 + Active ERAB Rel non GBR)/(ERAB Active Time QCI1 + ERAB Active Time QCI2 + ERAB Active Time QCI3 + ERAB Active Time QCI4 + ERAB Active Time nonGBR)

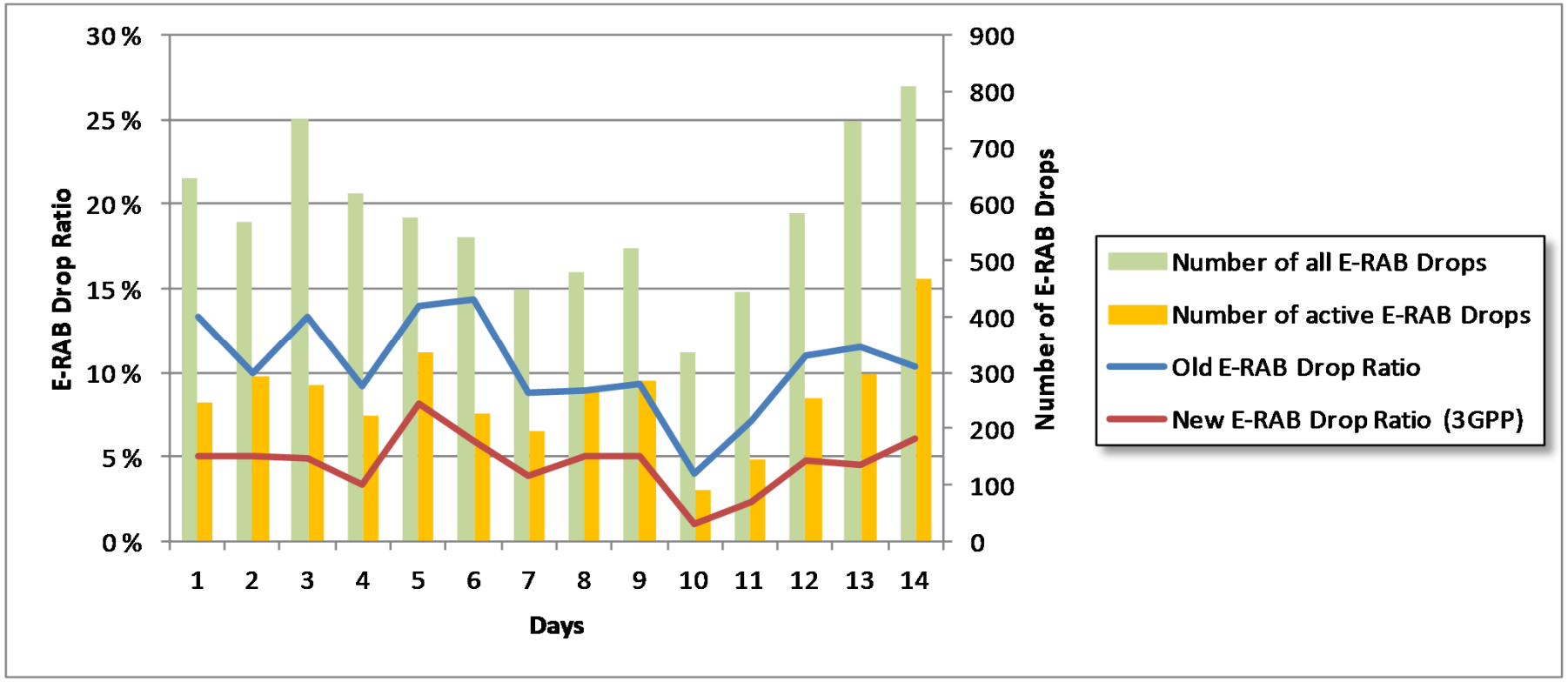
• **Formula:** (NE names)

sum([Released active ERABs QCI1] + [Released active ERABs QCI2] + [Released active ERABs QCI3] + [Released active ERABs QCI4] + [Released active non GBR ERABs (QCI5...9)])
/ (sum([In-session activity time for QCI1 ERABs] + [In-session activity time for QCI2 ERABs] + [In-session activity time for QCI3 ERABs] + [In-session activity time for QCI4 ERABs] + [In-session activity time for non-GBR ERABs (QCI5..9)])/(60 * 60))

Example of Minutes per E-RAB Drop



Example of E-RAB Drop Ratio based on active and inactive drops



Field KPIs
Service Drop Rate

- It is the ratio between abnormally released bearers and the overall number of established EPS bearers. An abnormal release is defined as any EPS bearer termination that was not triggered by the mobile user (from UE side).
- Dropping the bearer becomes visible to the end-user if an application service is actively using it. If the application automatically re-establishes the bearer, it remains unnoticed by the user.

- **Formula**:

$$\text{EPSBearerDR} = \frac{\text{number\_of (dropped\_calls)}}{\text{number\_of (successfull\_calls)}} \times 100\%$$

Field KPIs - drop analysis

Post processing challenges (with Actix or Nemo Analyzer):

•How to detect abnormal RRC Release by eNodeB (RRC release cause ‘other’ used for normal and abnormal releases)

•TAU, RACH SR or PDDCH Order could be misinterpreted as a drop.

Table1

Saunalahti S3_Ping RLK to Kara3 from LTE only 13Apr08_061150.1:samsung/GT-I9305

Time	LTE_RRCConnectionDrop	LTE_RRCConnectionEndRes...	LTE_RRCConnection_DroppedEvent	LTE_RRCConnection_ReestablishmentFailed	LTE_Uu_RRC_MsgType	GSM_Um_Msg_Type	LTE_U
06:35:26:102					BCCH-BCH MasterInformationBlock		
06:35:26:130					BCCH-DL_SCH SystemInformationBlockType1		
06:35:26:142					UL_CCCH RRCConnectionReestablishmentRequest		
06:35:26:300	1	RRC Drop		1	DL-CCCH RRCConnectionReestablishmentReject		
06:35:26:462					BCCH-BCH MasterInformationBlock		
06:35:26:491					BCCH-DL_SCH SystemInformationBlockType1		
06:35:26:502						EMM Tracking Area Update Request	
06:35:26:503					UL_CCCH RRCConnectionRequest		
06:35:26:542					DL-CCCH RRCConnectionSetup		
06:35:26:545	1	RRC Drop	1		UL-DCCH RRCConnectionSetupComplete	EMM Tracking Area Update Request	
06:35:31:087						EMM Tracking Area Update Request	
06:35:31:088					UL_CCCH RRCConnectionRequest		
06:35:31:437		RRC Setup Failure					
06:35:41:297						EMM Tracking Area Update Request	
06:35:41:302					UL_CCCH RRCConnectionRequest		
06:35:41:402					DL-CCCH RRCConnectionSetup		
06:35:41:406					UL-DCCH RRCConnectionSetupComplete	EMM Tracking Area Update Request	
06:35:41:481					DL-DCCH SecurityModeCommand		
06:35:41:482					UL-DCCH SecurityModeComplete		
06:35:41:482					DL-DCCH RRCConnectionReconfiguration		
06:35:41:488					UL-DCCH RRCConnectionReconfigurationComplete		

False drop

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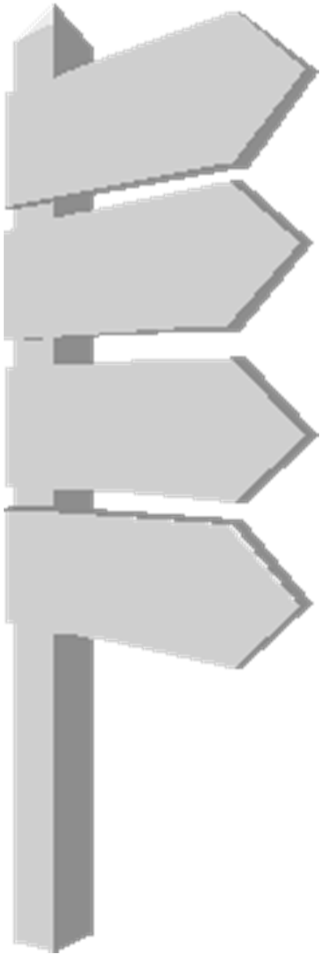

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KPI Reference Values

Example values only!!

Network average from different networks (A, B, C,…)

KPI	A	B	C	D	E
eRAB Drop Ratio [%] (LTE_5025d)	0.07	0.07	0.07	0.08	0.09
eRAB Drops per PDCP Vol. [#/GB] (LTE_5812a)	0.78	1.59	1.77	2.27	2.32

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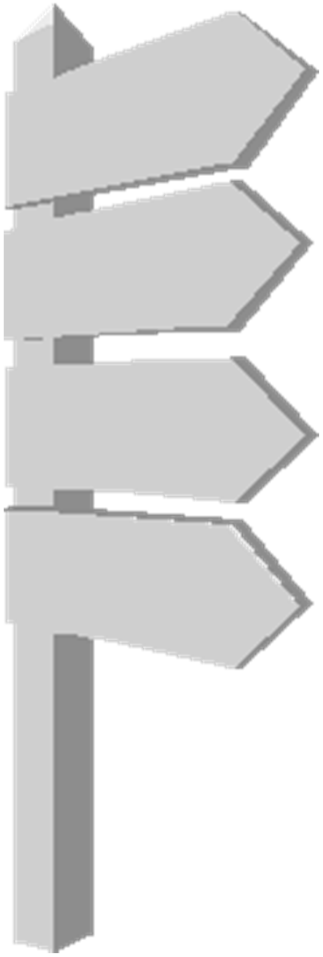

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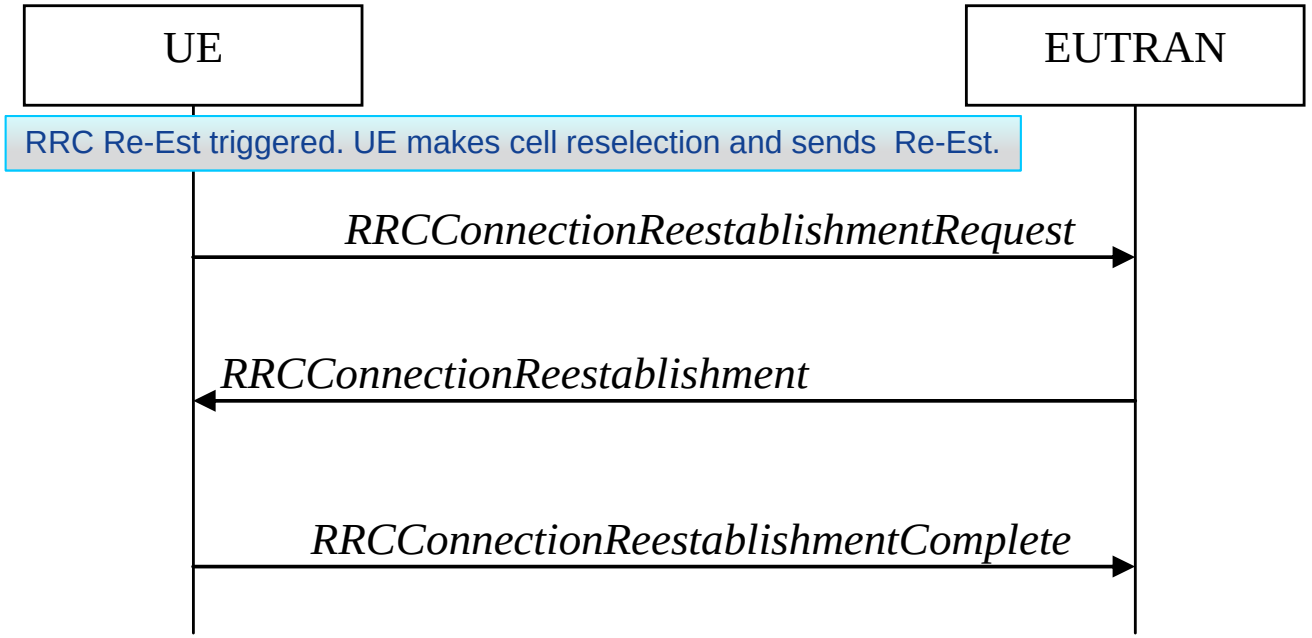
RRC Re-Establishment Procedure, Successful



- RRC Conn Re-Est can only succeed in a cell that has:
- short MAC-I of the source cell
- PCI of the source cell
- C-RNTI in the source cell

Example: RRC Connection Reestablishment Request

```
RRC SIGNALING MESSAGE

Time: 9:38:13.165

RRCConnectionReestablishmentRequest    (3GPP TS 36.331 ver 8.7.0 Rel 8)

UL-CCCH-Message
  message
    c1
      rrcConnectionReestablishmentRequest
        criticalExtensions
          rrcConnectionReestablishmentRequest-r8
            ue-Identity
              c-RNTI
                Bin  : 4C F0  (= 19696)
              physCellId  : 30
              shortMAC-I
                Bin  : AB 7D  (= 43901)
            reestablishmentCause    : otherFailure
            spare
              Bin    : 0 (2 bits)

Data (hex):
       09 9E 01 EA B7 D8
```

This is the PCI of the cell where UE was last succesfully connected to. In HO case it's the source cell.

RRC Re-Establishment Procedure, Successful

- RRC Re-Establishment message sets up SRB1 again

```
RRC SIGNALING MESSAGE
Time:          16:49:06.085
RRCConnectionReestablishment          (3GPP TS 36.331 ver 8.7.0 Rel 8)

DL-CCCH-Message
 message
  c1
   rrcConnectionReestablishment
    rrc-TransactionIdentifier                : 2
    criticalExtensions
     c1
      rrcConnectionReestablishment-r8
       radioResourceConfigDedicated
        srb-ToAddModList
         srb-ToAddModList value 1
          srb-Identity     : 1
        mac-MainConfig
         explicitValue
          ul-SCH-Config
           maxHARQ-Tx                : n5
           periodicBSR-Timer         : infinity
           retxBSR-Timer             : sf2560
           ttiBundling     : false
          drx-Config       : release
          ----------KLIP----------
```

SRB1 re-establishment in RRC Conn Re-establishment message.

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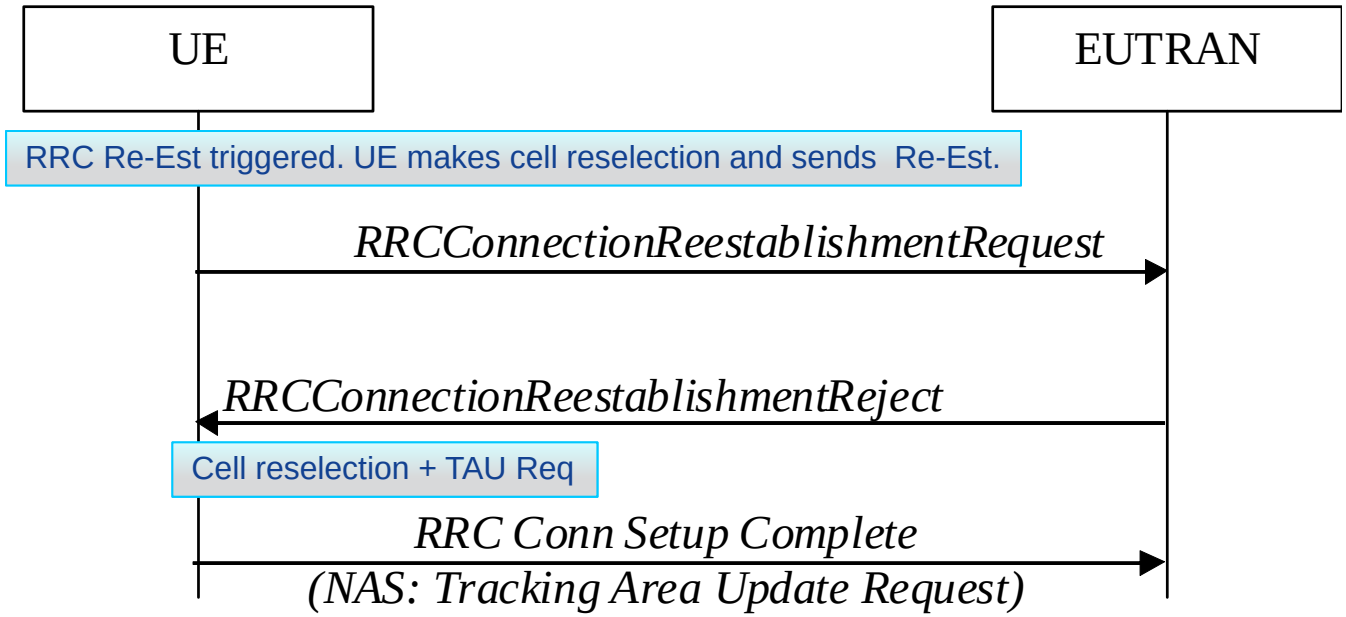
RRC Re-Establishment Procedure, Unsuccessful

- If re-establishment is not possible eNB responds with reject → UE performs cell reselection + TAU



RRC Re-Establishment Procedure, Unsuccessful

- Nemo log of reject case

EventId	Time	Subchannel	Direction	Message
RRCSM	09:38:13.165	CCCH	Uplink	RRCConnectionReestablishmentRequest
RRCSM	09:38:13.244	CCCH	Downlink	RRCConnectionReestablishmentReject
RRCSM	09:38:13.969	BCCH-BCH	Downlink	MasterInformationBlock
RRCSM	09:38:14.014	BCCH-SCH	Downlink	SystemInformationBlockType1
L3SM	09:38:14.014		Uplink	TRACKING_AREA_UPDATE_REQUEST

- RRC Conn Re-est Request

```
RRC SIGNALING MESSAGE
Time:              9:38:13.165
RRCConnectionReestablishmentRequest     (3GPP TS 36.331 ver 8.7.0 Rel 8)
UL-CCCH-Message
 message
  c1
   rrcConnectionReestablishmentRequest
    criticalExtensions
     rrcConnectionReestablishmentRequest-r8
      ue-Identity
       c-RNTI
        Bin   : 4C F0  (= 19696)
       physCellId              : 30
       shortMAC-I
        Bin   : AB 7D  (= 43901)
      reestablishmentCause: otherFailure
      spare
       Bin    : 0 (2 bits)
```

Re-establishment cause can be:
- Other Failure (UE radio link failure)
- Handover Failure (T304 HO timer expiry)
- Reconfiguration Failure

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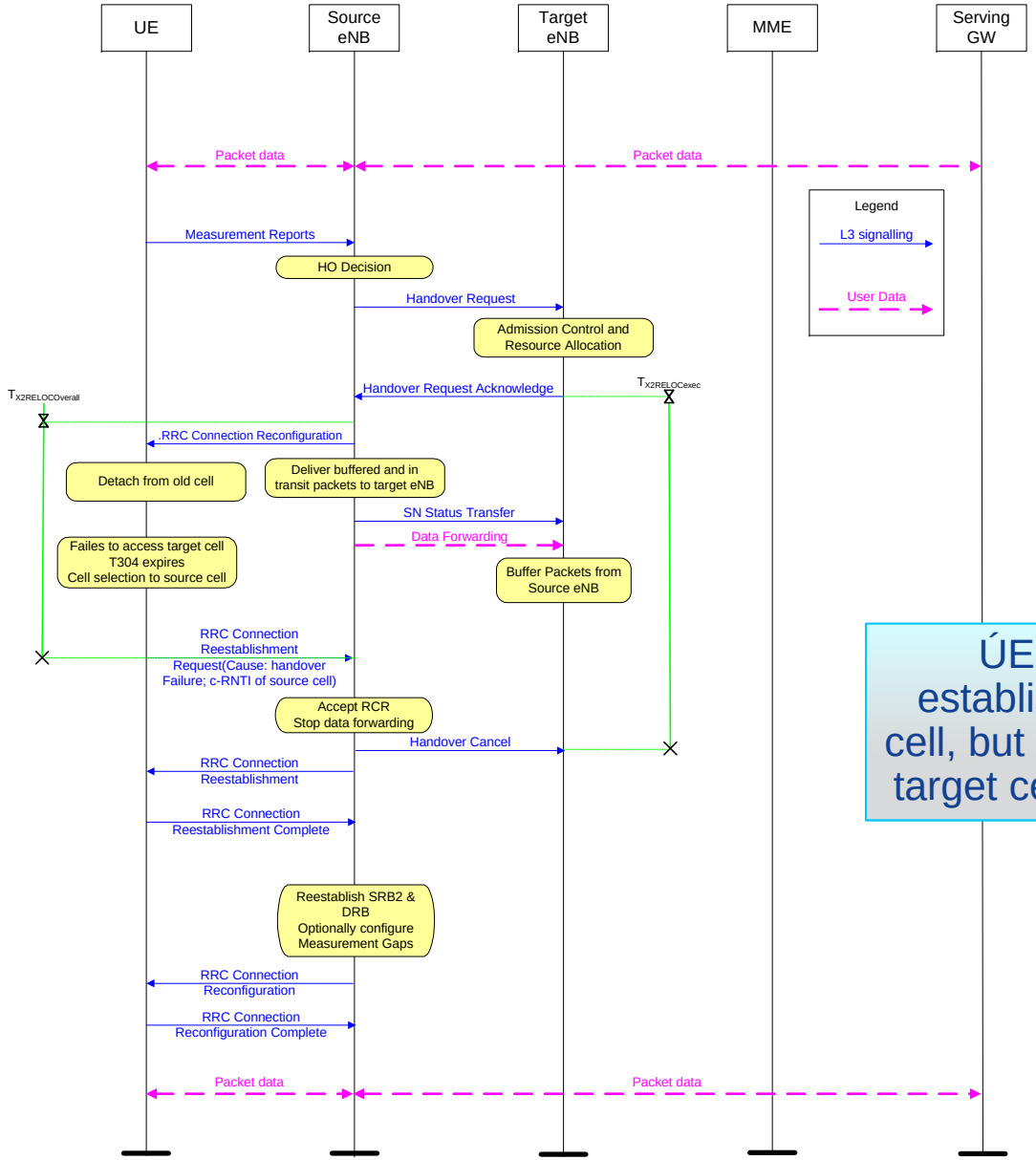
RRC Re-Establishment Signalling, HO Case



Source C-RNTI, MAC-I and PCI sent to target cell in X2AP HO Req

ÚE can try re-establishment to any cell, but only source and target cell are prepared

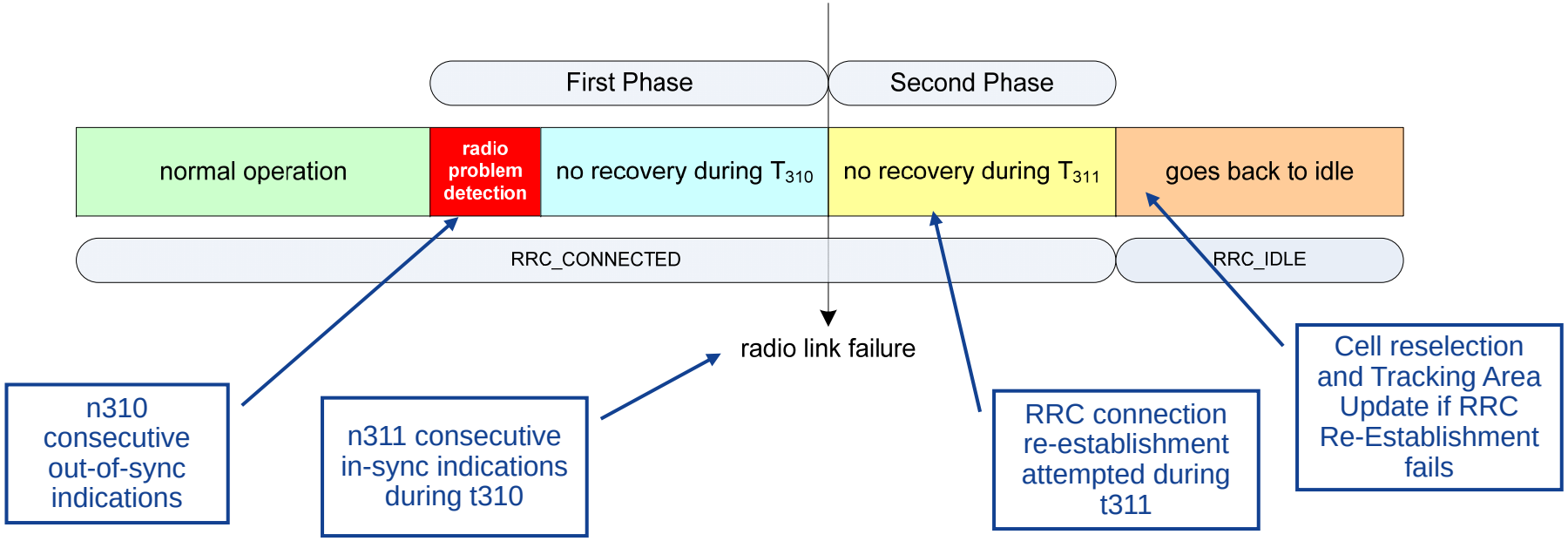
RRC Connection Re-Establishment Trigger Causes

- When UE is in RRC_CONNECTED and RRC security is active, it can trigger RRC Connection Re-establishment

1. upon T310 expiry
2. upon reaching the maximum number of UL RLC retransmissions
3. upon handover failure (T304 expiry)
4. upon non-HO related random access problem

- If successful, RRC Conn Re-Establishment
  - reconfigures SRB1 to resume data transfer of RRC msgs
  - re-activates RRC security without changing algorithms
  - NOTE: DRB should be re-configured after SRB1
- NOTE: if UE is in RRC_CONNECTED while RRC security is *not* active, UE goes to RRC_IDLE, performs cell reselection and TAU

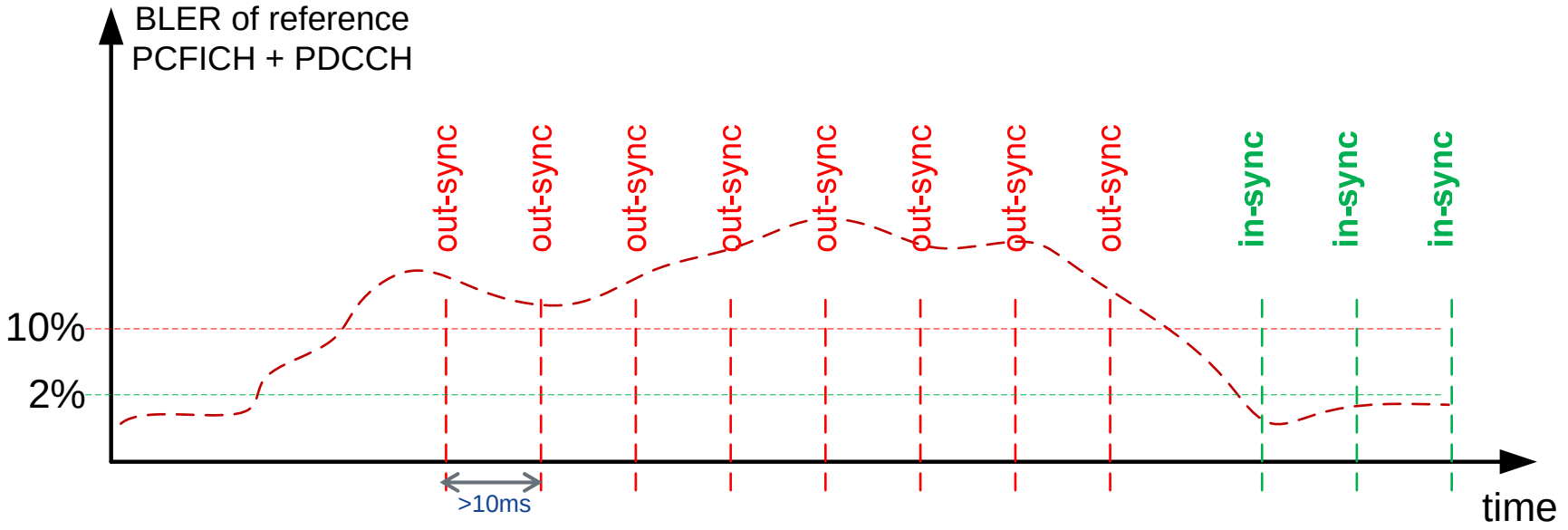
1. RLF due to T310 Expiry at UE



- For UE “normal operation” in the figure above means :
  - UE not waiting for RRC Connection Setup/Reject (T300 not running)
  - UE not waiting for RRC Re-establishment Establishment/Reject (T301 not running)
  - handover not ongoing (T304 not running)
  - No RLF recovery ongoing (T311 not running)
- NOTE: the terms in-sync and out-of-sync refer to L1 problems, *not* to timing alignment

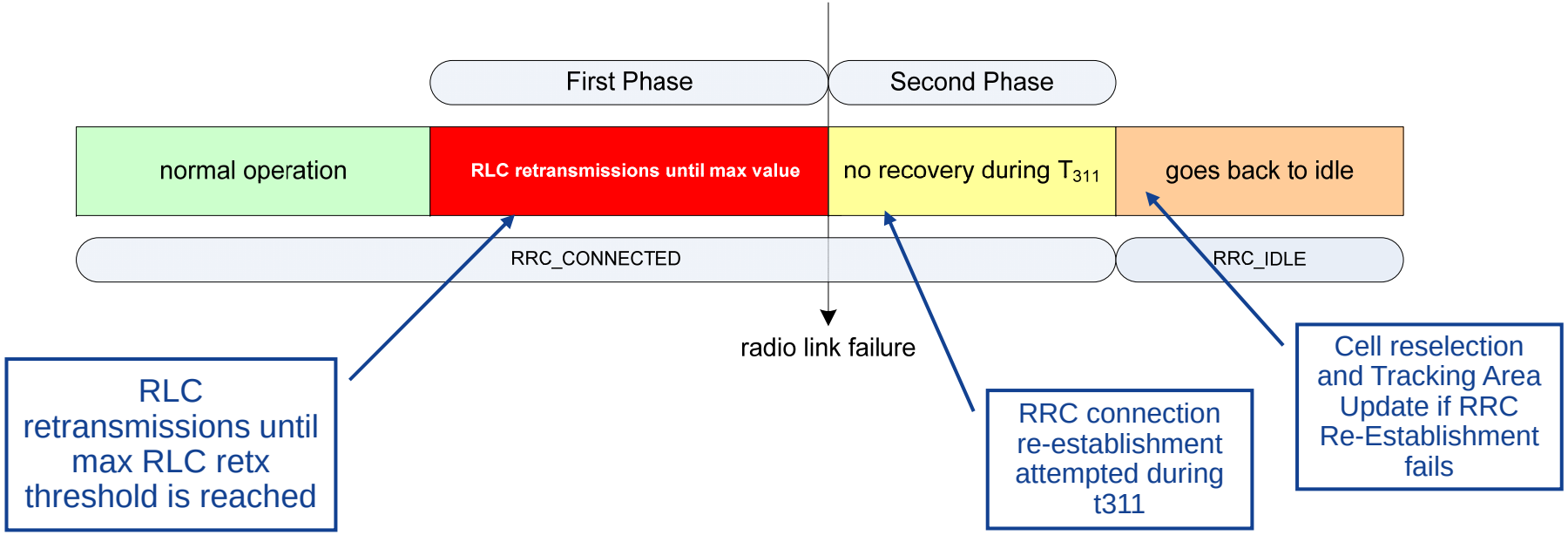
1. In-Sync and Out-Of-Sync Definition Without DRX

- Window to estimate if BLER > out-sync threshold is [200ms]
  - Hence: out of last 200 TTIs at least 20 PDCCH have been received in error
- Window to estimate if BLER < in-sync threshold is [100ms]
  - Hence: out of last 100 TTIs at most 2 PDCCH have been received in error



- NOTE: 3GPP notation [.] means that the final numerical values have not been agreed in the specification.
- Reference PDCCH and PCFICH configuration used in the BLER estimation is defined by 3GPP

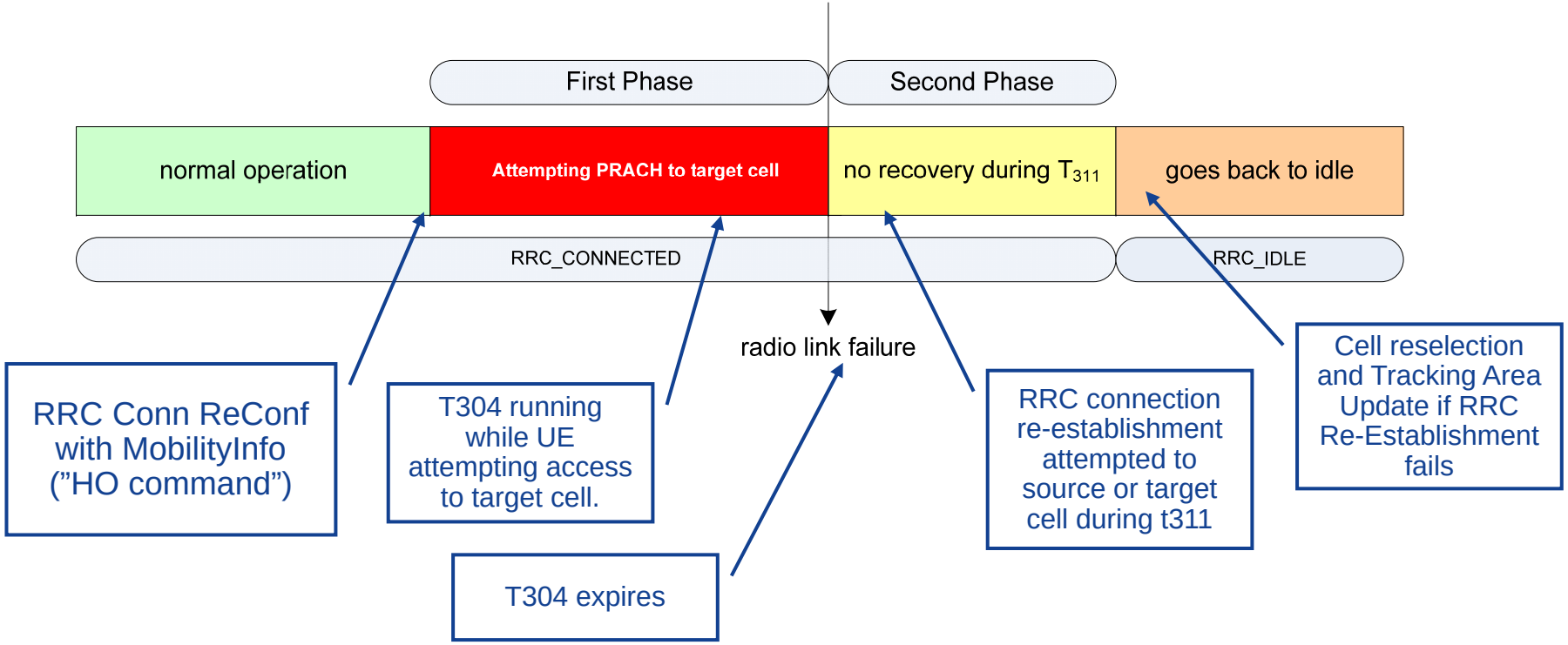
2. RLF due to Maximum UL RLC Re-Tx Reached



from RRC Connection Reconfiguration:

drb-ToAddModList
drb-ToAddModList value 1
drb-Identity : 1
rlc-Config
am
ul-AM-RLC
t-PollRetransmit : ms40
pollPDU : p32
pollByte : kB25
maxRetxThreshold : t8

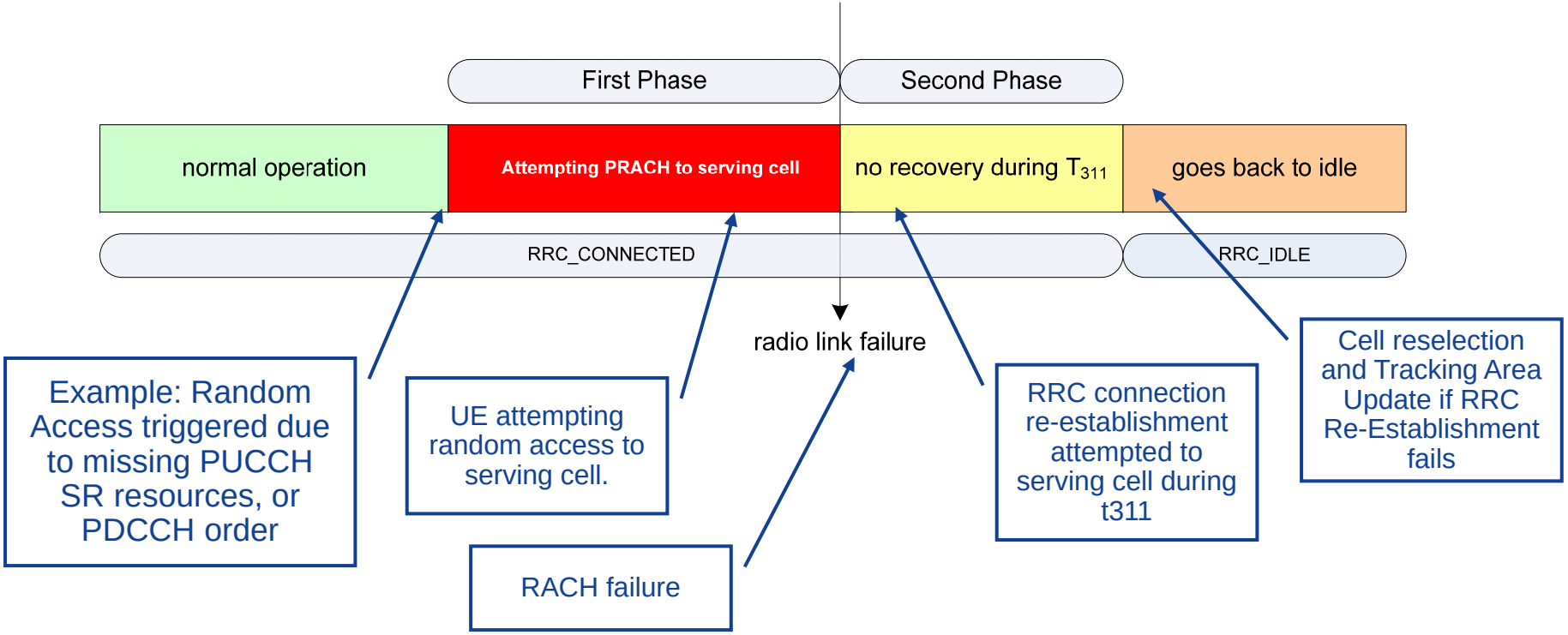
3. RLF due to HO Failure



from RRC Connection Reconfiguration:

mobilityControlInfo
 targetPhysCellId : 33
 t304 : ms1000
 newUE-Identity
  Bin : 14 EB (= 5355)

4. RLF Due to Non-HO Random Access Failure



- "Non-HO random access" means
  - PDCCH order -triggered RA
  - Random Access Scheduling Request

Re-Establishment Cause in RRC Conn Re-Est Msg

Source: 3GPP TS 36.331

- UE sets the *reestablishmentCause* as follows:
  - if the re-establishment procedure was initiated due to RRC reconfiguration failure (i.e., the UE is unable to comply with the reconfiguration), UE sets the *reestablishmentCause* to the value '*reconfigurationFailure*'
  - if the re-establishment procedure was initiated due to intra-LTE handover failure or inter-RAT mobility from EUTRA failure, UE sets the *reestablishmentCause* to the value '*handoverFailure*'
  - Otherwise UE sets the *reestablishmentCause* to the value '*otherFailure*'. NOTE: This includes T310 RLF failure.
- There are counters for re-est causes received
  - … but no counter for re-est due to RRC reconfiguration failure

Default Values for Timers/Constants

Source: 3GPP TS 36.331

- RLF timers signalled in BCCH SIB2
  - In 3GPP Rel9 optionally in RRC Conn Reconfig
  - If not signalled to UE, default values are assumed:

Name	Value
t310	ms2000
n310	6
t311	ms3000
n311	0

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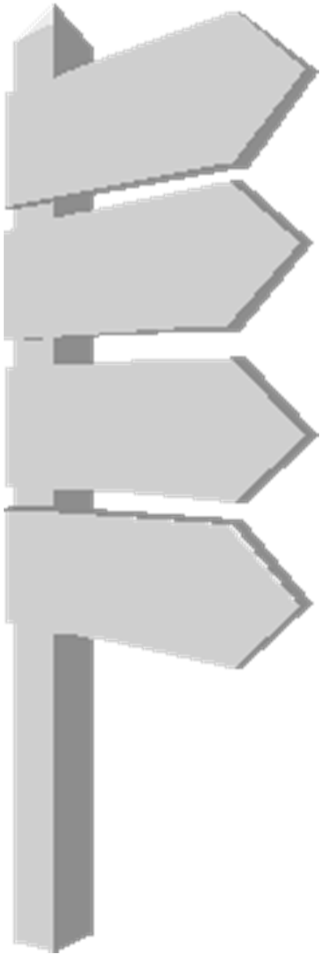

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eNB Initiated Call Drops: Overview

- eNB can drop the call due to following triggers
  - **eNB-detected radio link problems**
    - PUSCH RLF
    - CQI RLF
    - Ack/Nack RLF
    - PDCCH Order failure
    - SRS RLF
  - TA timer expiry
  - Maximum RLC retransmissions exceeded
  - GTP-U failure

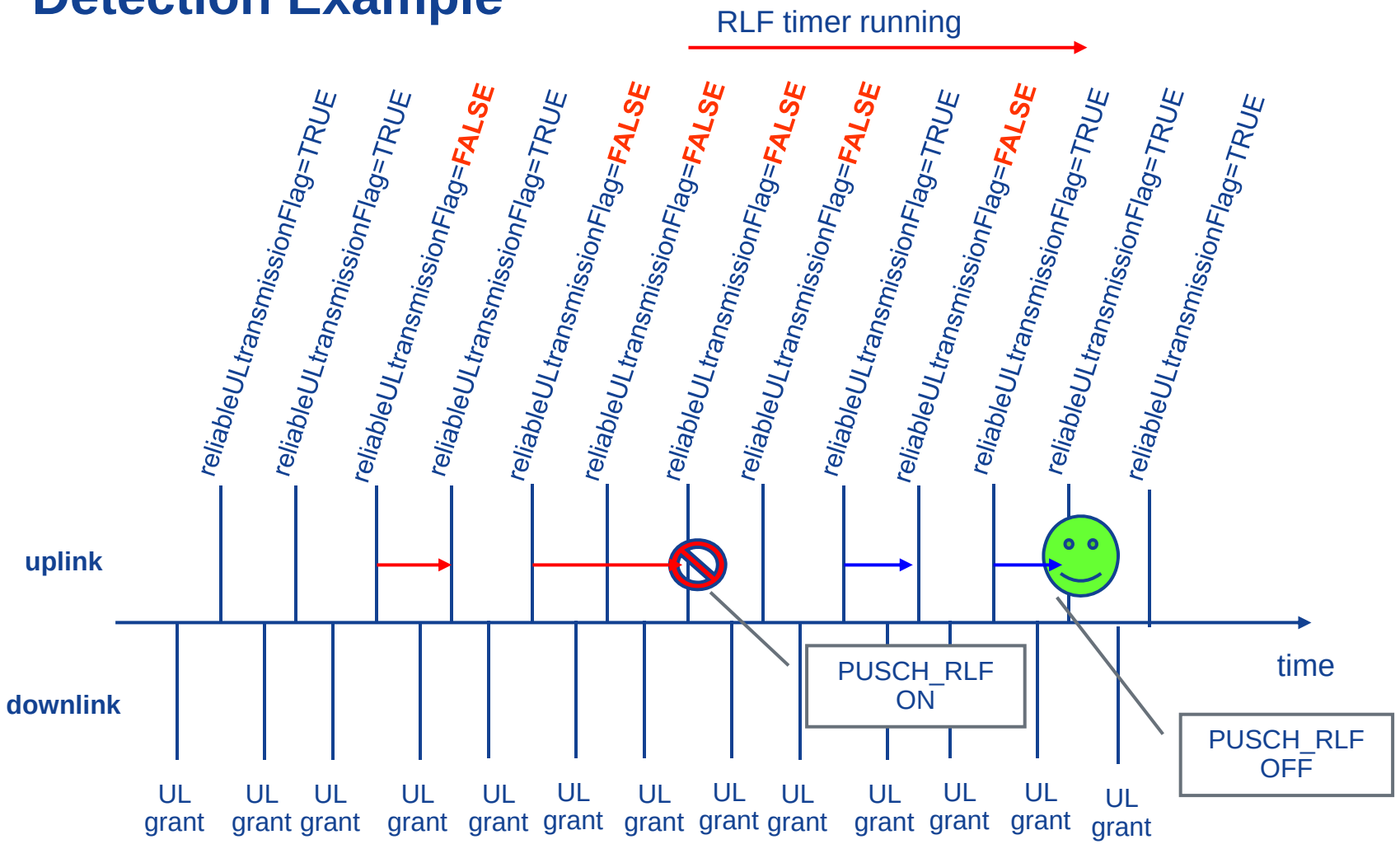
Radio Link Problem Detection at eNB

- eNB radio link problem detection mechanisms are NSN-internally specified
- Multiple methods (called “link monitors”) are defined to detect a radio link problem in the eNB.
- When one link monitor detects a problem, it is really a radio link problem even if other link monitors have not yet indicated anything.
- Each link monitor has its internal criteria to decide when radio link problem is flagged and de-flagged (radio link recovers).
- If the RLP persists longer than T_RLF, RRC+S1 release is triggered
  - T_RLF = t310 + t311 (eNB-internal timer)
- Link monitors:
  1. Uplink PUSCH DTX detection for scheduled uplink data
  2. CQI DTX detection for periodic CQI reports in PUCCH and PUSCH
  3. Uplink Ack/Nack DTX detection for transmitted downlink data
  4. PDCCH Order RLF
  5. SRS DTX detection (TD-LTE)

1. PUSCH RLF: RlsCause_PuschRlf_ON

- When UE is scheduled for PUSCH transmission, eNB expects to receive UL transmission on the scheduled PRBs
- If signal from UE cannot be detected at all, PUSCH DTX is declared
  - NOTE: The case where UL TBS is received but it fails CRC check is *not* DTX (it's a NACK)
- DTX PUSCH indication is provided by the UL physical layer.
- The result is received by LTE MAC in *reliableULtransmissionFlag* parameter.
- Both counter-based and timer-based RLF detection is supported
- Timer-based PUSCH RLF detection:
  - If "DTX" is received on the PUSCH for a configurable period of time (*rlpDetMaxTimeUl*), PUSCH RLF is set on
- Counter-based PUSCH RLF detection:
  - If "DTX" is received on the PUSCH for a consecutive number of times (*rlpDetMaxNoUl*), PUSCH RLF is set on
- The recovery of the radio link is indicated when for a configurable number of contiguous UL resource assignments data is detected on PUSCH (ACK or NACK received).
  - Defined by parameter *rlpDetEndNoUl*.

1. PUSCH RLF: RlsCause_PuschRlf, Counter-based RLF Detection Example



T_RLF = T310 + T311

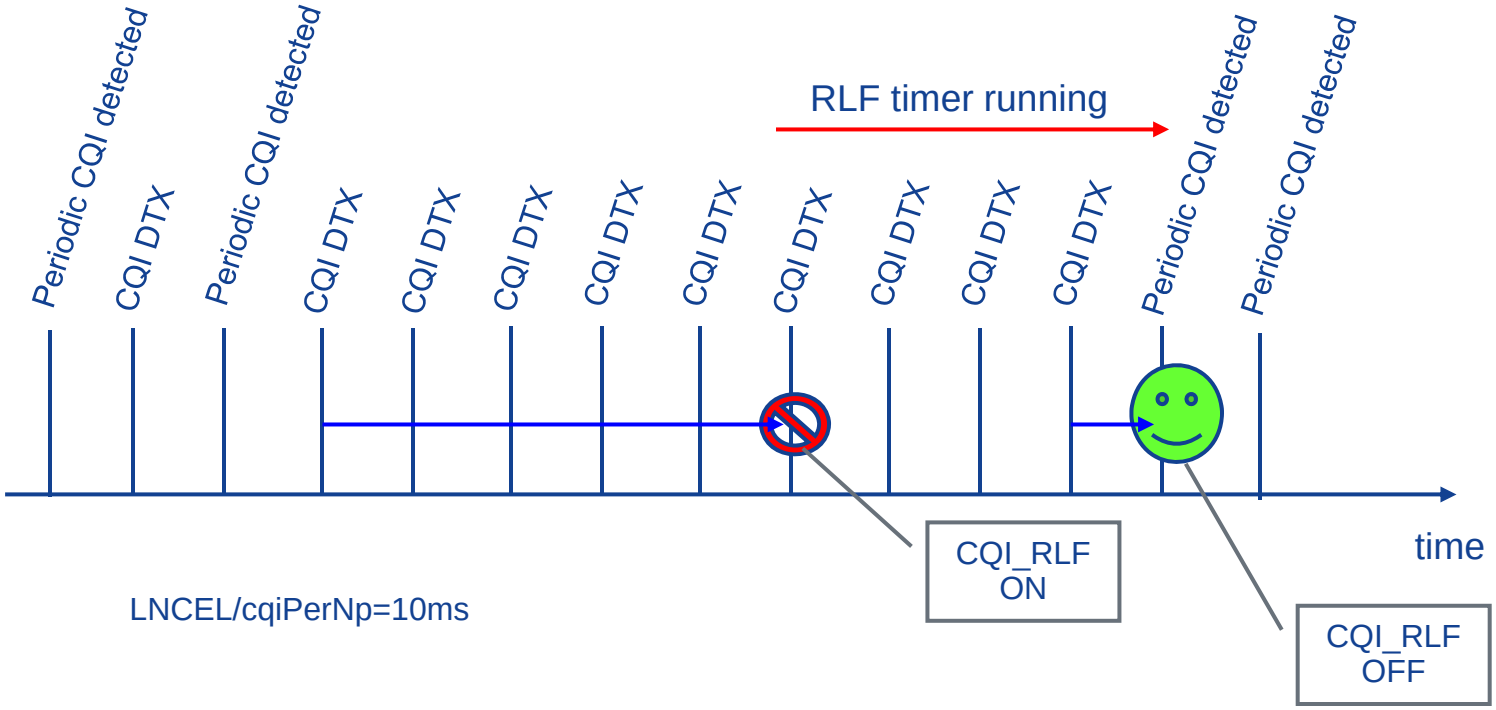
vendor-file parameters in this example:

3
2

2. Periodic CQI RLF: RlsCause_CqiRlf_ON

- The eNB supports CQI DTX detection for periodic CQI reports on PUCCH and PUSCH.
- If MAC layer receives *nCqiDtx* consecutive reports from UL PHY, the MAC declares CqiRLF_ON
- If the MAC has set CqiRLF_ON for a specific UE and *nCqiRec* consecutive CQI reports are again detected successfully for that UE, the MAC sets CqiRLF_OFF
- The parameters *nCqiDtx* and *nCqiRec* are in the vendor-specific parameter file
- For both PUSCH and PUCCH the periodic CQI is encoded using a Reed Muller block code and comes along without any CRC. Hence, the UL PHY indicates a DTX detection for periodic CQI reports on PUCCH or PUSCH whenever a report is configured but no reliable transmission from the UE could be detected. So the output of the detector shall be either the detected CQI report or a DTX indication.
- NOTE: CQI_RLF detection does not apply to aperiodic CQI report on PUSCH

2. Periodic CQI RLF: RlsCause_CqiRlf, Example



LNCEL/cqiPerNp=10ms

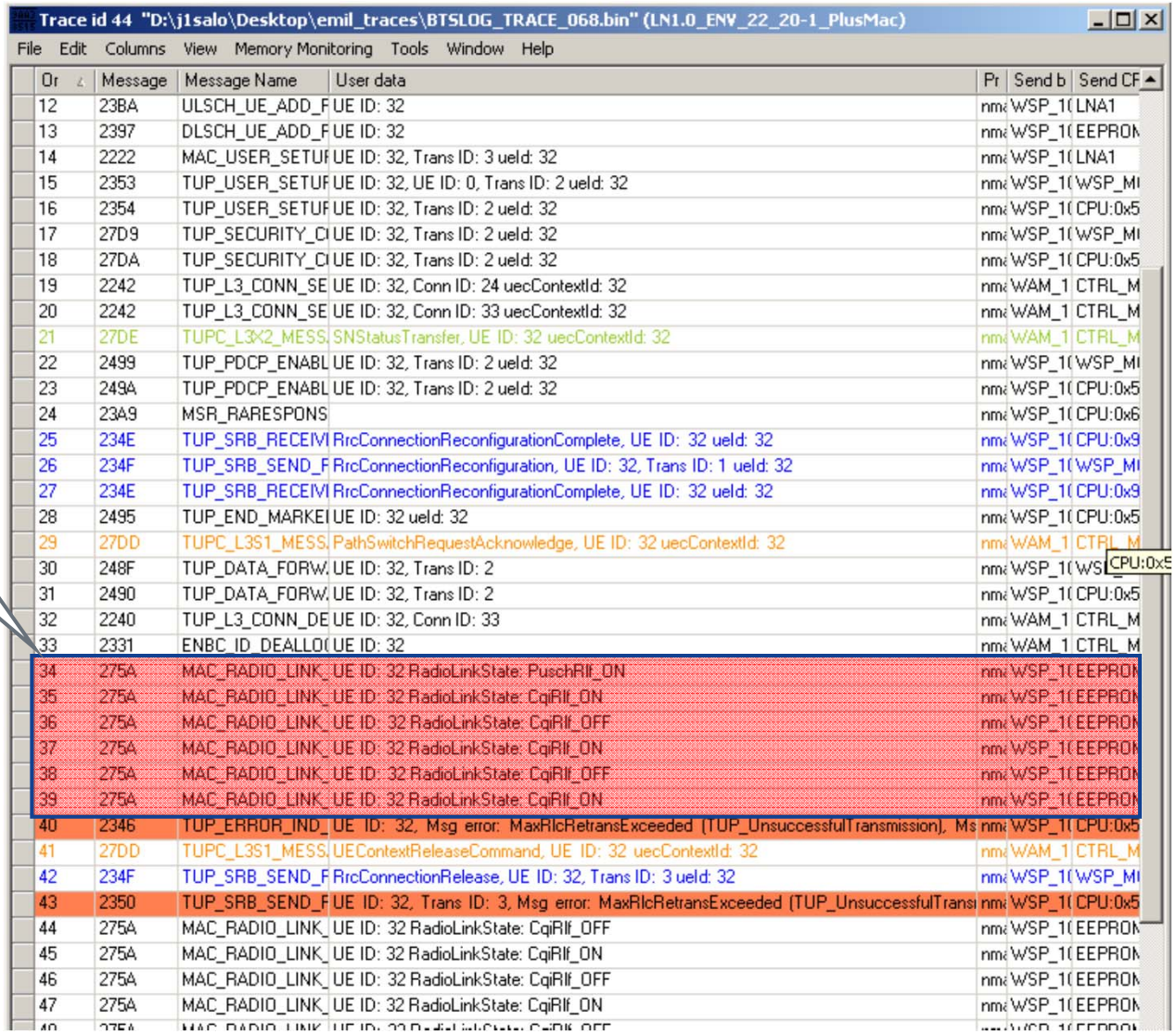
vendor-file parameters in this example:

6
1

T_RLF = T310 + T311

Emil Example

Example of UL problems



3. Ack/Nack RLF: RlsCause_AckNackRlf_ON

- After DL scheduled data, eNB expects HARQ ACK or NACK on PUCCH or PUSCH at known UL TTI
- Timer-based ACK/NACK RLF detection:
  - If ACK/NACK “DTX“ is received for a configurable period of time (*rlpDetMaxTimeDl*), ACK/NACK RLF is set on
- Counter-based ACK/NACK RLF detection:
  - If ACK/NACK “DTX“ is received for a consecutive number of times (*rlpDetMaxNoDl*), ACK/NACK RLF is set on
- The recovery of the RLF is indicated when for a configurable number of contiguous ACK/NACK opportunities ACK or NACK is detected on PUSCH or PUCCH (no DTX).
  - Defined by parameter *rlpDetEndNoDl*.
- .

4. PDCCH Order RLF

- If there DL data in eNB buffer and UE is out-of-sync, UE must be brought back to in-sync (time aligned) with a RA procedure before DL data can be sent

• Signalling of dedicated RA preamble via PDCCH (so-called PDCCH order) is done using DCI format 1A

• In case that PDCCH order fails for a UE (i.e., no transmission of assigned dedicated preamble detected by eNodeB, or no msg3 transmission) the PDCCH order shall be repeated *noRepPdcchOrder* times (R&D configurable parameter, range 0-3, default 1), again using the selected preamble and considering DRX status of the UE accordingly.

• Final failure of the PDCCH order process shall be indicated as radio link problem to higher layers with cause “PDCCH order failure”

• If inactivity timer for the UE has expired then there is no T_RLF timer involved → S1 and RRC released immediately

5. SRS RLF

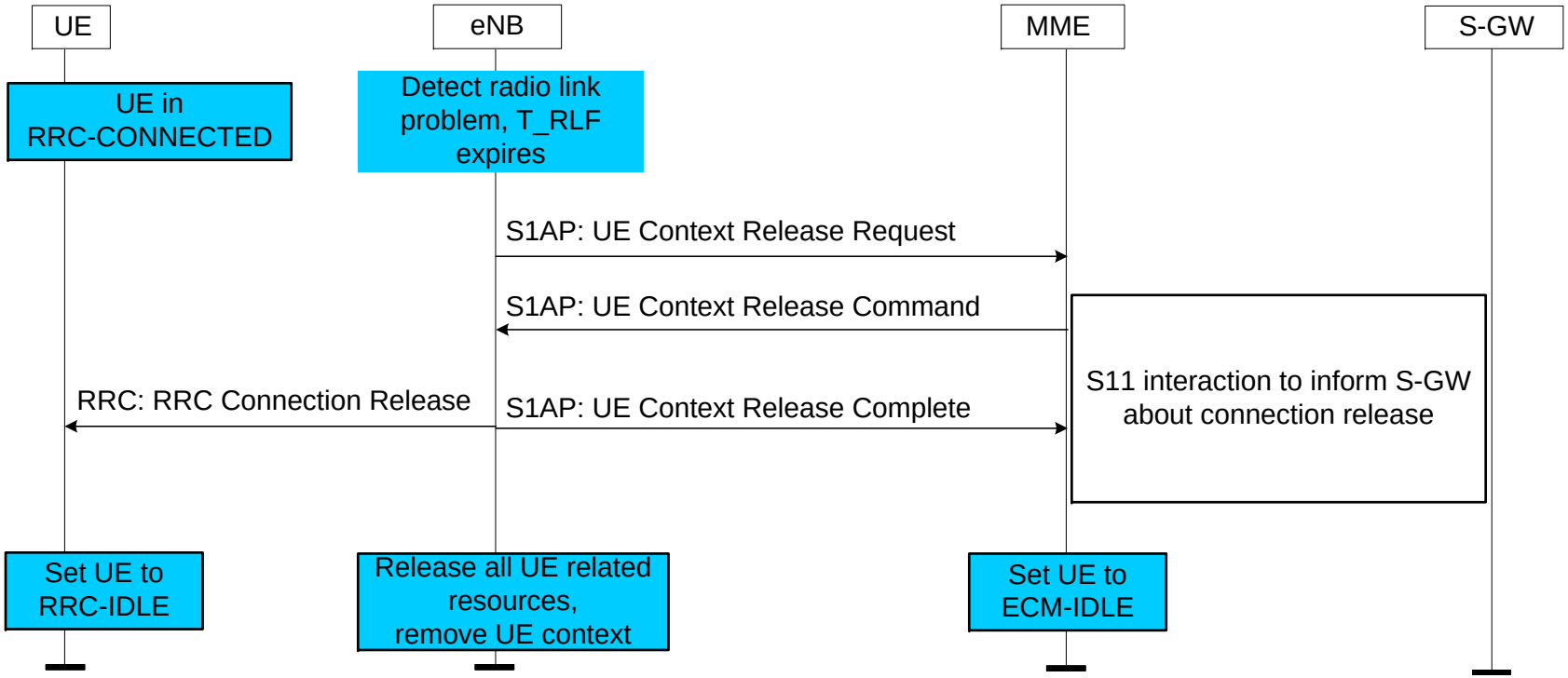
- The eNB supports SRS DTX detection for radio link problem detection
- If MAC layer receives *nSrsDtx* consecutive reports from UL PHY, the MAC declares SRS RLF
- If the MAC has set SRS RLF for a specific UE and *nSrsRec* consecutive SRS transmissions are succesfully detected the UE, the MAC sets SRS RLF OFF
  - Hence the SRS RLF has similar mechanism as CQI DTX RLF
- The parameters *nSrsDtx* and *nSrsRec* are operator-configurable

- nSrsDtx – default 50
- nSrsRec – default 2

When is Drop (= RRC + S1 release) Triggered by eNB?

- 3GPP does not specify eNB radio link failures, but NSN eNB mimics the behaviour of the UE RLF specified in 3GPP.
- When a radio link problem is detected, an eNB-internal timer (T_RLF) is started. The timer T_RLF is stopped when in case of radio link failure recovery.
- For a given UE, T_RLF is started when any of the PUSCH RLF, CQI RLF, SRS RLF or AckNack RLF is set to ON state
- For a given UE, T_RLF is stopped only if all RLFs are OFF
- When the timer T_RLF expires, the UE is released from the eNB using eNB initiated S1 release + RRC connection release –> call drop
- T_RLF = T310 + T311

RLF Triggering by eNB, Signalling



Only L2 Ack needed for successful RRC Conn Release. If L2 Ack not received after timer *tL2AckRrcRel* expires (def=800ms), RRC is released anyway.

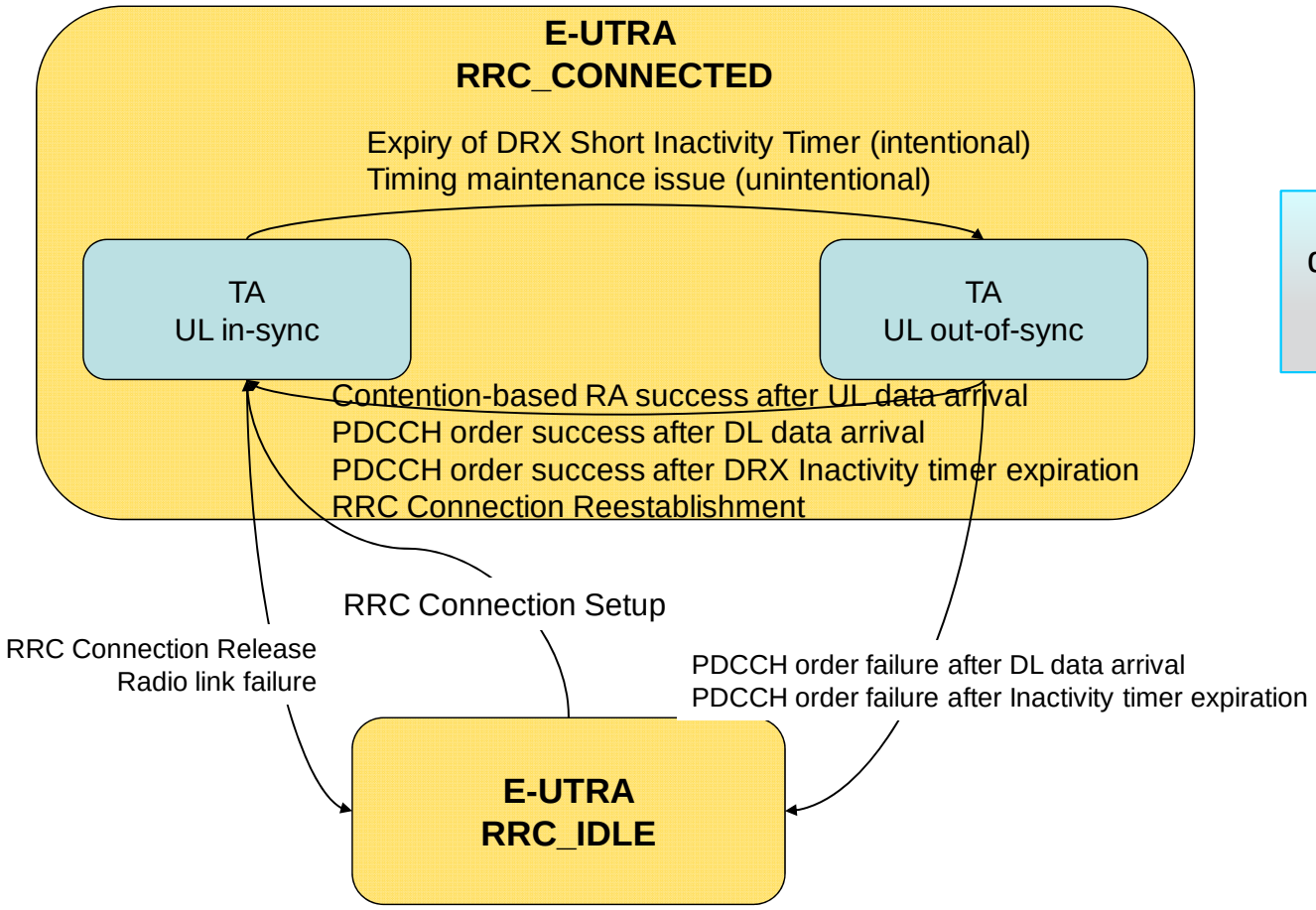
NOTE: No RLC Ack needed for RRC Connection Release. No reTx for RRC Connection Release

eNB Initiated Call Drops: Overview

- eNB can drop the call due to following triggers
  - eNB-detected radio link problems
    - PUSCH RLF
    - CQI RLF
    - Ack/Nack RLF
    - PDCCH Order failure
    - SRS RLF
  - **TA timer expiry**
  - Maximum RLC retransmissions exceeded
  - GTP-U failure

In-Sync and Out-Of-Sync States: Overview

- RRC connected substates: UL in-sync and UL out-of-sync



Uplink RA SR or downlink PDCCH order to bring UE back in-sync

TA Timer Expiry at UE

- As UE detects Out-of-Sync status using a Timing Alignment Timer, the timer shall be started or restarted whenever an initial TA or a TA update command is received (see [3GPP-36.321], section 5.2). If the timer expires, the UE detects out-of-sync status.
- 3GPP TS 36.321: When *timeAlignmentTimer* expires at UE, UE MAC layer shall:
  - flush all HARQ buffers;
  - notify RRC layer to release PUCCH/SRS;
  - clear any configured downlink assignments and uplink grants

- 3GPP TS 36.331: Upon receiving a PUCCH/ SRS release request from MAC layer, the UE RRC shall:
  - release periodic CQI reporting config, ie it stops CQI reporting on PUCCH
  - release Scheduling Request Config

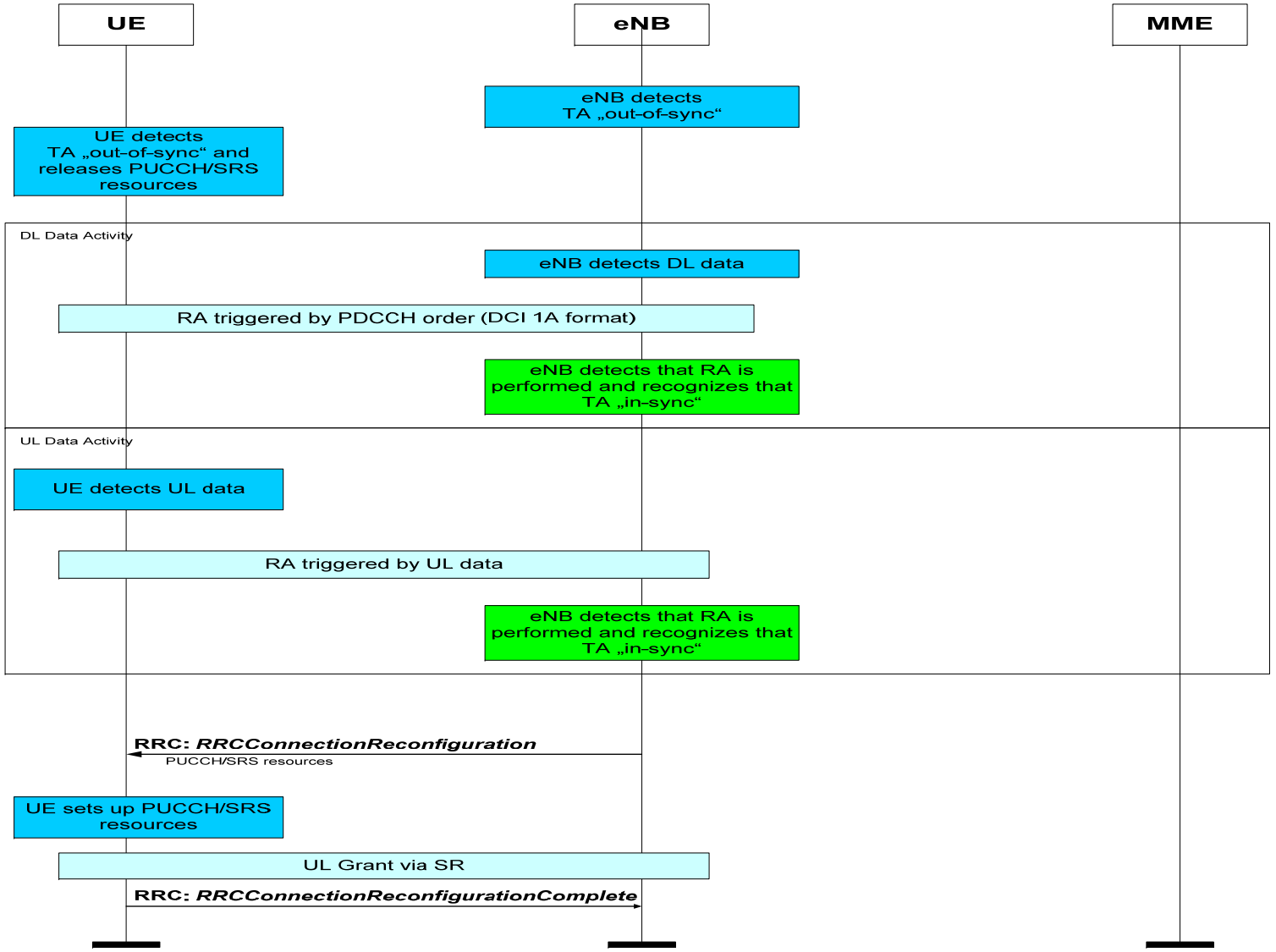
In-Sync, Out-Of-Sync Handling

•Parameter *LNCEL/applyOutOfSyncState* defines how eNB handles TA expiry

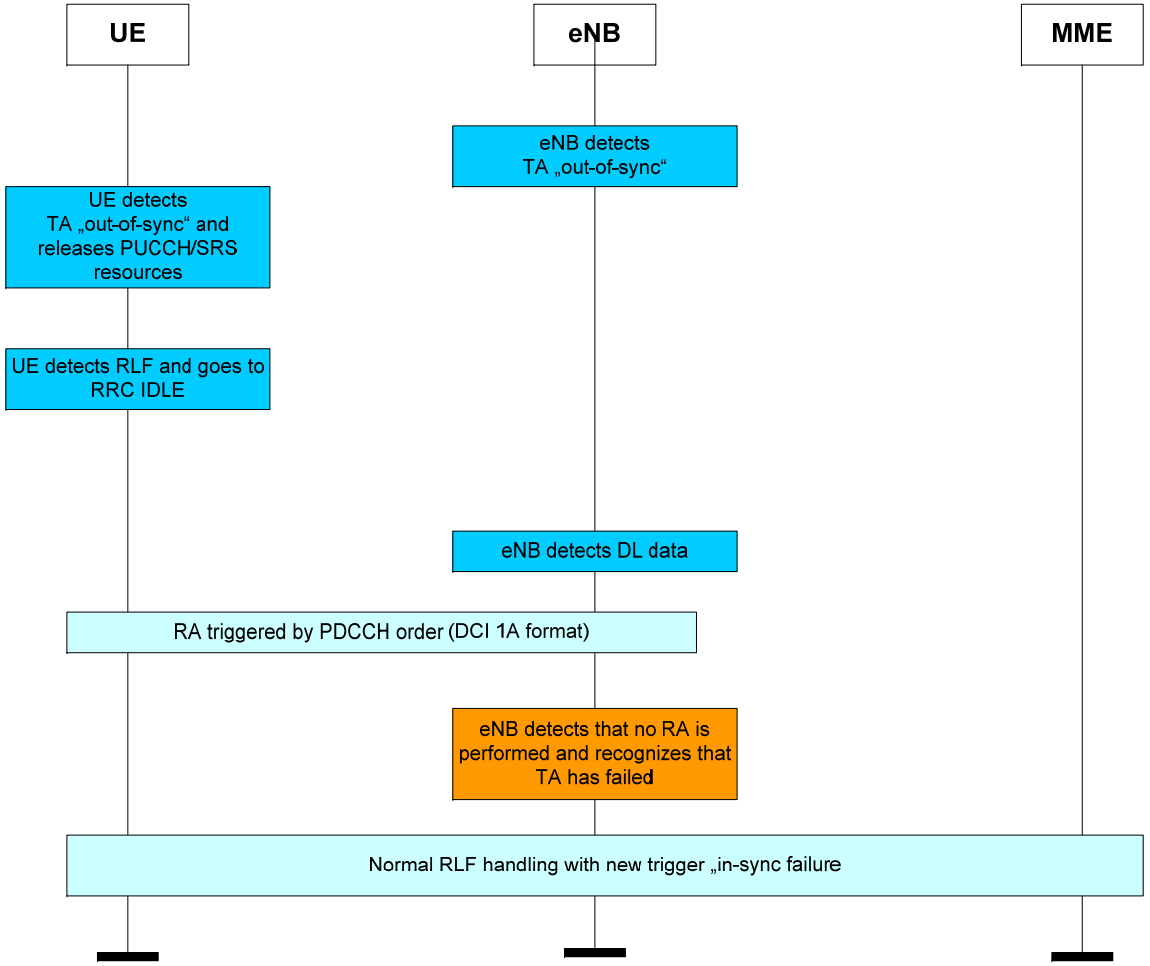
- extendedDrxOnly: only UEs being configured with extended settings for the long DRX cycle are *not* dropped if TA timer expires (default)
- allDrx: all UEs being configured for DRX provided that applied DRX profile allows are *not* dropped if TA timer expires
- allUEs: all UEs independently of DRX configuration provided that bearer combination allows are kept RRC Connected even if TA timer expires.

- If DRX is not used at all, then setting '*allUEs*' should be used to prevent eNB drops due to TA timer expiry

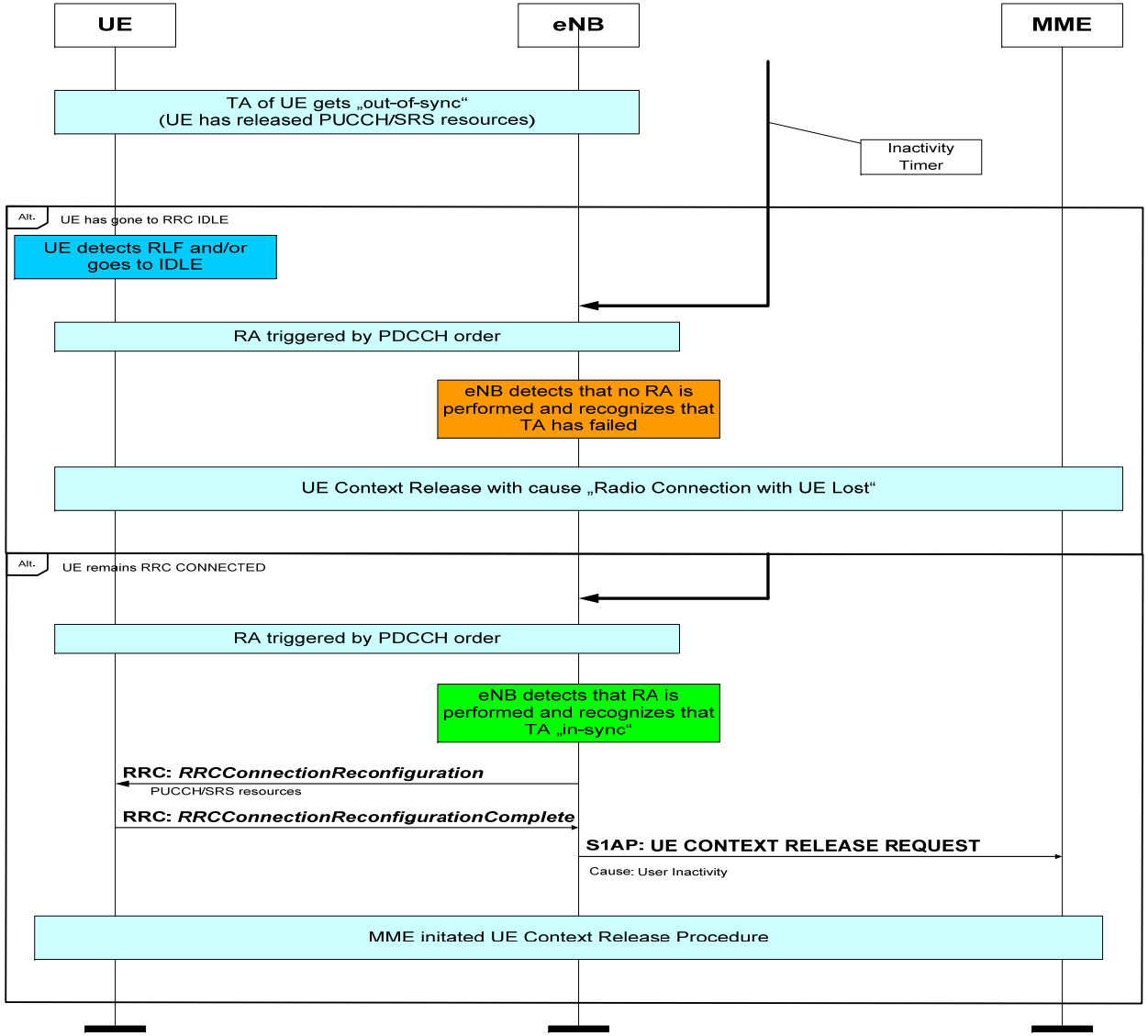
In-Sync Normal Case



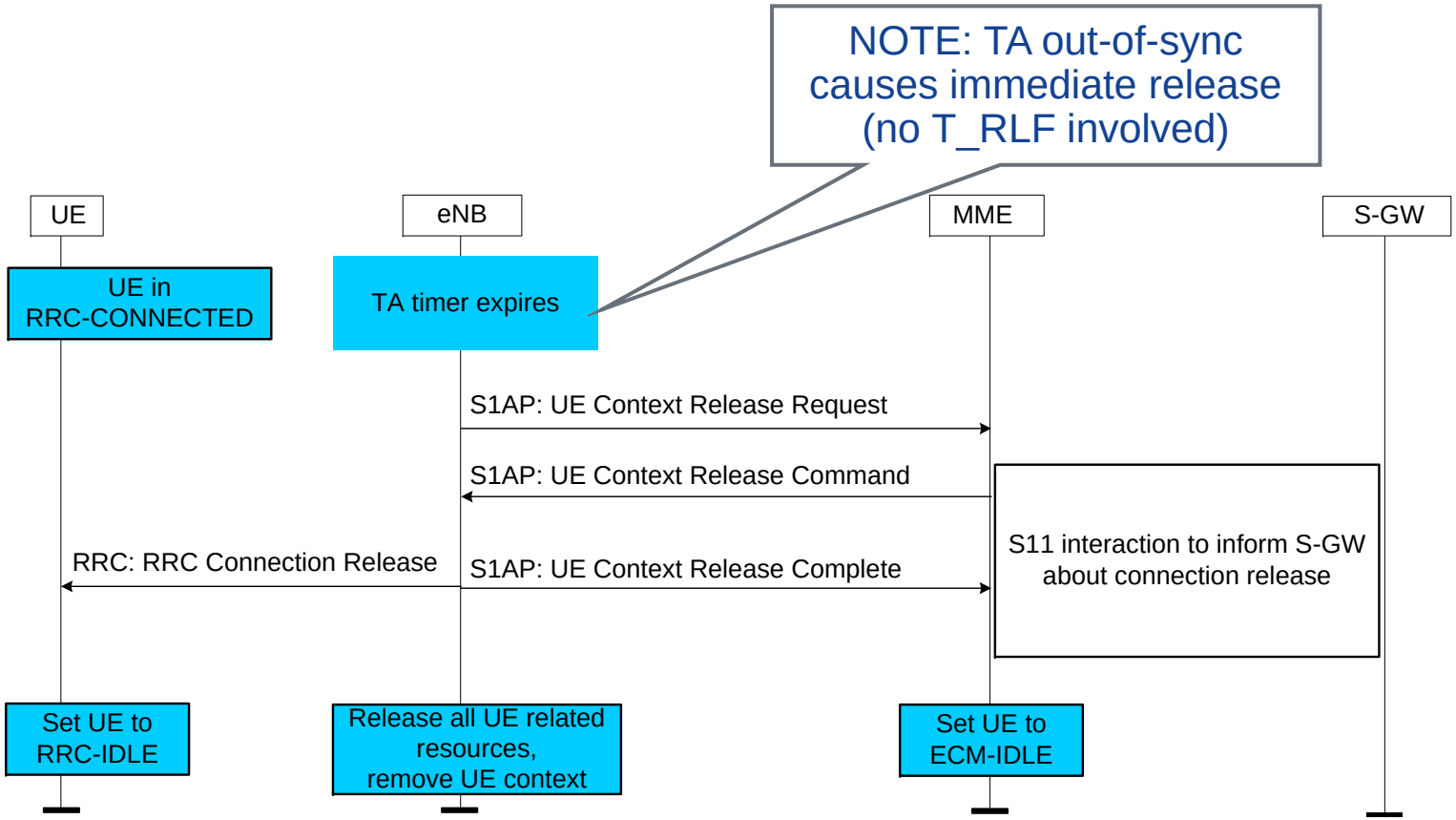
In-Sync Failure Case



User Inactivity Detection During Out-Of-Sync



RRC + S1 Release after TA Timer Expiry at eNB When Out-Of-Sync Handling Not Used for UE



TA Timer Expiry at eNB, User-Configurable Parameters

Parameter abbreviated Name	Description	Ac-cess	Parameter Type	Range/ Step-size	Default value	Para-meter Scope	Reference	Multi-plicity
taTimer	Determines the number of subframes after which a UE assumes being Out-of-Sync in UL if no Time Alignment Command was received.	RW BTS restart	O	{500, 750, 1280, 1920, 2560, 5120, 10240}	1280	cell	36.331 timeAlignmentTimer	1
taMaxOffset	Determines the maximum allowed time alignment offset. If value is exceeded the need for time alignment update is given.	RW	O	0..5/0.01 Unit: µs	0.52 (corresponds to $16*T_s$)	cell	TF_LTE_SFS_RL2_697	1

Always check the current values (defaults and the actual used) of the eNB sw version in use.

TA Timer Expiry at eNB, Vendor Parameters

Parameter abbreviated Name	Description	Access	Parameter Type	Range/ Step-size	Default value	Parameter Scope	Reference	Multi-plicity
taTimerMargin	Used to control the interval between periodic timing alignment commands being sent to the UE. The actual time interval between updates will be TimeAlignTimer – taTimerMargin The upper value is constrained by the value of TimeAlignTimer.	RW	O	0..2560/1 Unit: subframes	89	Cell	TF_LTE_SFS_RL2_697	1
taOffScheMarg	Used to determine when to no longer consider a UE that is drifting out of time alignment in uplink scheduling;	R	V	1.5…4/0.1 unit: µs	2	BTS	TF_LTE_SFS_RL2_697	1
taCmdMaxRetry	The number of times the TA command will be retried before MAC assumes the UE has gone out-of-sync.	R	V	0..10/1	10	BTS	TF_LTE_SFS_RL2_697	1

Always check the current values (defaults and the actual used) of the eNB sw version in use.

eNB Initiated Call Drops: Overview

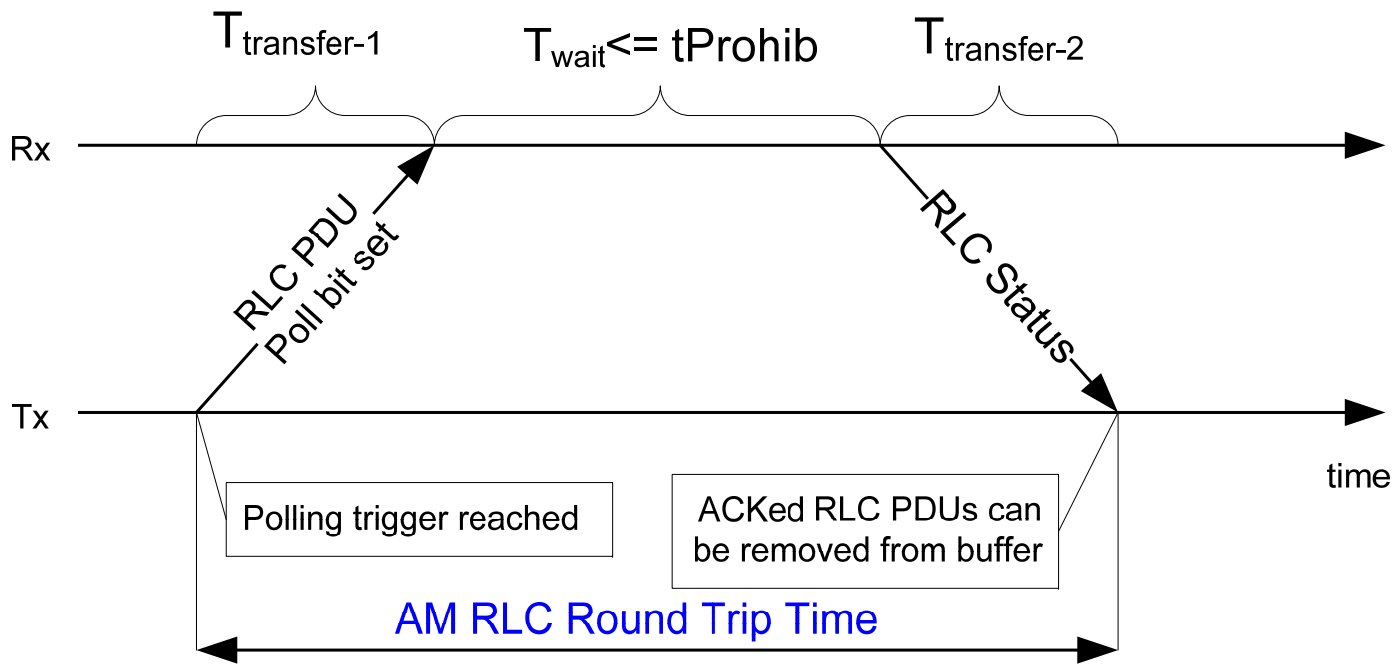
- eNB can drop the call due to following triggers
  - eNB-detected radio link problems
    - PUSCH RLF
    - CQI RLF
    - Ack/Nack RLF
    - PDCCH Order failure
    - SRS RLF
  - TA timer expiry
  - **Maximum RLC retransmissions exceeded**
  - GTP-U failure

RLC Layer STATUS Polling Mechanism

- RLC layer retransmissions only in RLC acknowledged mode
- RLC AM transmitter requests a STATUS PDU from RLC receiver (sets poll bit on in RLC header)
  - After the number of bytes transmitted since previous poll exceeds the value of *amRlcPBTab3ulPollByte* (uplink, ue cat3) or *amRlcPBTab3dlPollByte* (downlink, ue cat3), or
  - After *pollPdu* RLC PDUs have been transmitted since previous poll
  - in the last data PDU in the RLC transmit buffer
- The RLC AM receiver responds to polling request by transmitting a STATUS PDU which acknowledges successfully received PDUs and also selectively nacks unsuccessfully received PDUs.
  - RLC receiver also sends STATUS PDU if *tReord* timer expires.
  - RLC receiver will not send STATUS PDU more often than interval defined by parameter *tProhib*.
  - NOTE: default PDDB settings *tProhib*=50ms and *tReord*=50ms.
- If RLC transmitter receives no STATUS PDU within *tPollretr*, a new poll request along with unacknowledged data will be sent to RLC receiver
- RLC AM window size is fixed to 512 RLC PDUs (segments of an RLC PDU are counted as one PDU).

RLC Layer ARQ Mechanism

- RLC transmitter will retransmit all data that is nacked in the STATUS PDU
- Maximum number of UL and DL RLC retransmissions is defined by vendor parameter *drbAmMxRtxTh* (default=16)



Release due to Maximum Number of Downlink RLC Retransmissions (eNB-triggered)

- Vendor parameter drbAmMxRtxTh (default=16)

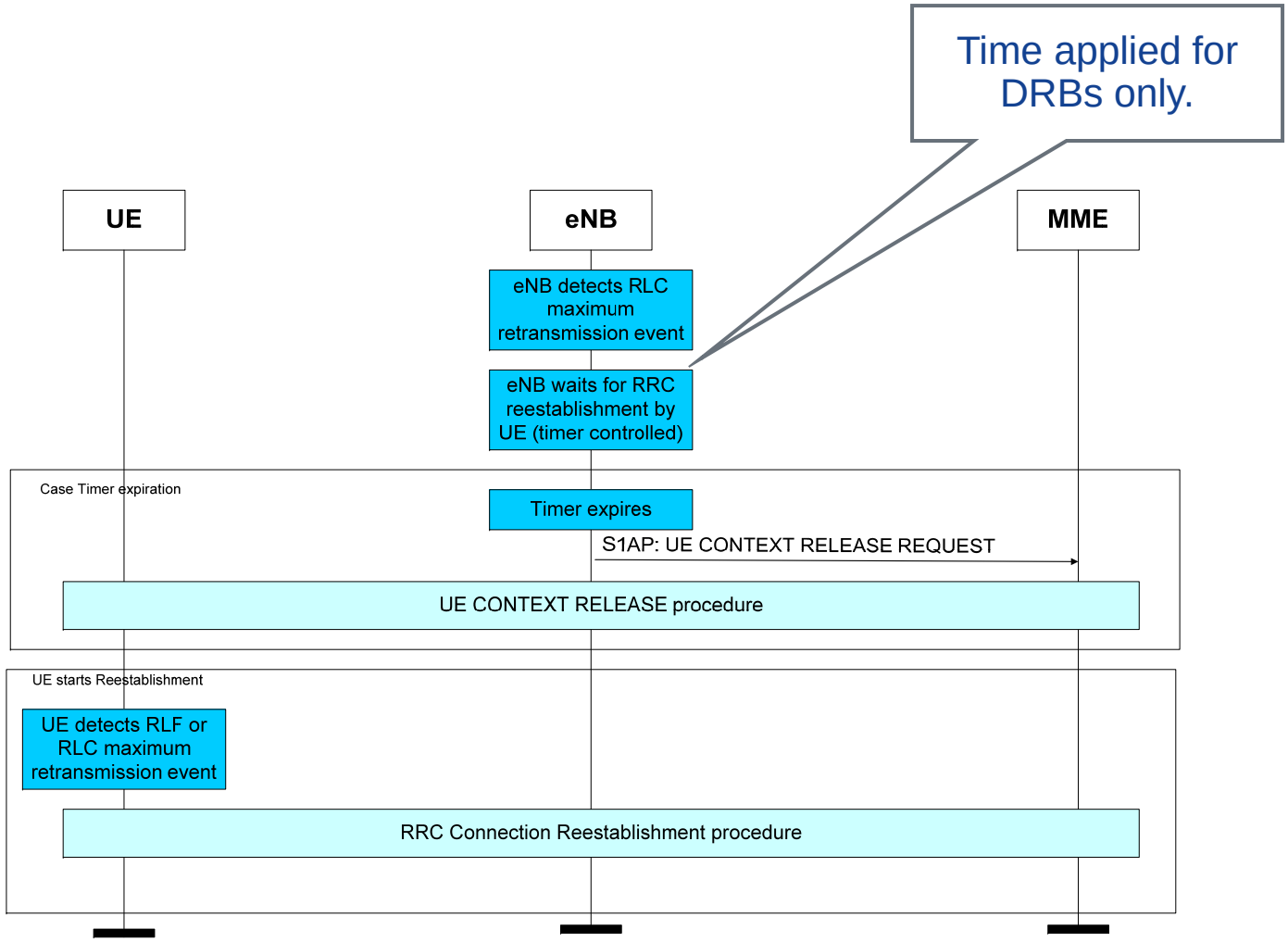
- SRB1 or SRB2: after max RLC retransmissions has been reached
  - eNB releases the UE immediately (S1 + RRC release).

- DRB: after max RLC retransmissions has been reached
  - eNB starts a timer T_RLC (T311+200ms) to wait for an UE triggered RRC Connection Reestablishment. If the timer expires: eNB releases the UE.
  - Otherwise: UE has triggered a RRC Connection Reestablishment procedure and eNB performs the RRC Connection Reestablishment procedure (as for a RLF).

```
message
  c1
    rrcConnectionSetup
      rrc-TransactionIdentifier      : 2
      criticalExtensions
        c1
          rrcConnectionSetup-r8
            radioResourceConfigDedicated
              srb-ToAddModList
                srb-ToAddModList value 1
                  srb-Identity            : 1
                  rlc-Config
                    explicitValue
                      am
                        ul-AM-RLC
                          t-PollRetransmit          : ms100
                          pollPDU          : pInfinity
                          pollByte         : kBinfinity
                          maxRetxThreshold          : t16
                        dl-AM-RLC
```

```
drb-Identity      : 4
                pdcp-Config
                  discardTimer        : ms750
                  rlc-AM
                    statusReportRequired          : true
                  headerCompression               : notUsed
                rlc-Config
                  am
                    ul-AM-RLC
                      t-PollRetransmit: ms120
                      pollPDU          : p64
                      pollByte         : kB500
                      maxRetxThreshold          : t16
```

Release due to Maximum Number of RLC Retransmissions (eNB-triggered)



eNB Initiated call Drops: Overview

- eNB can drop the call due to following triggers
  - eNB-detected radio link problems
    - PUSCH RLF
    - CQI RLF
    - Ack/Nack RLF
    - PDCCH Order failure
    - SRS RLF
  - TA timer expiry
  - Maximum RLC retransmissions exceeded
  - **GTP-U failure**

Release due to GTP-U Error Indication from S-GW (eNB-triggered)

- Handling of Event "GTP-U Error Indication"

- eNB may receive a “GTP-U Error Indication” on an active (single) S1 bearer (S-GW has rejected the reception of uplink data packets). In that case eNB shall send the S1AP message UE CONTEXT RELEASE REQUEST with cause “TNL Cause Transport Resource Unavailable” to MME

- Example: This failure cause happens S-GW relocation attempt is not successful in X2 handover. In RL40/50, there is no support for S-GW relocation (i.e. no support of new uplink transport layer address and uplink GTP-TEID in PATH SWITCH REQUEST ACKNOWLEDGE message).

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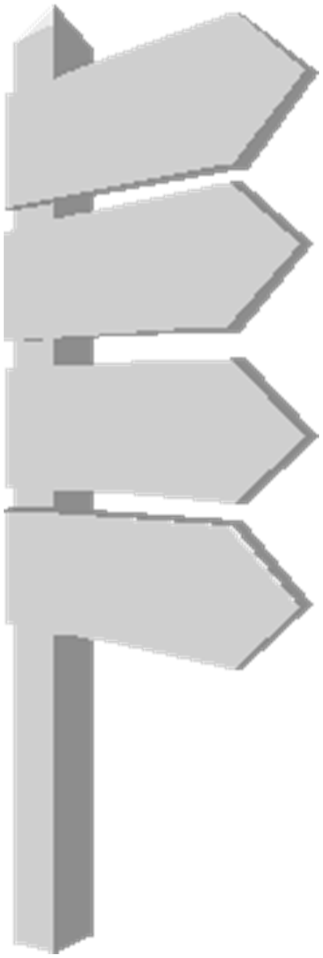
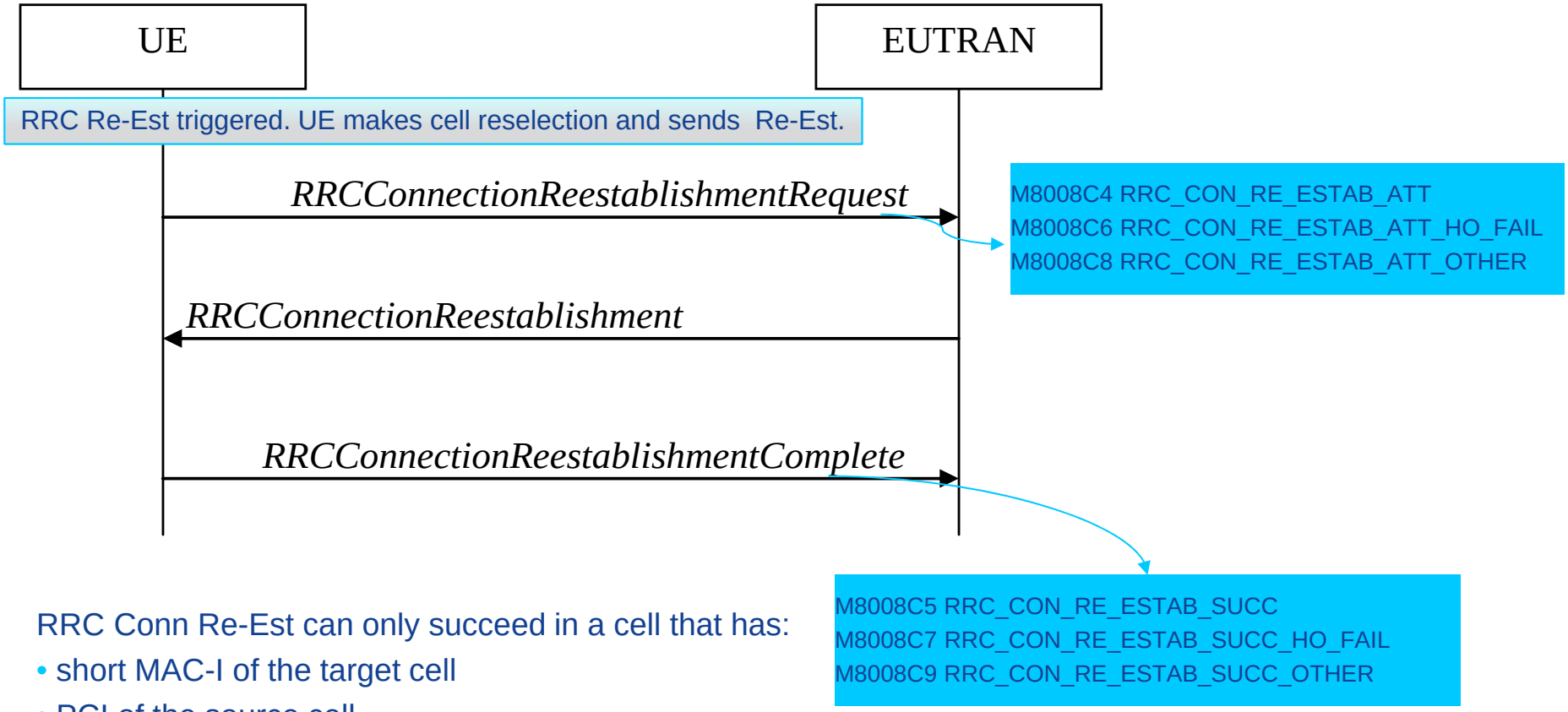


This module discusses call drops and handover drops after call setup has already succeeded. See separate module for call setup problems.

Who Initiates Drops, UE, MME or eNB?

- UE can ”initiate a drop” by starting RRC Connection Re-establishment
  - Note: besides RLF also other causes can trigger RRC Conn Re-Establishment
- eNB can initiate abnormal S1 + RRC release due to
  - Radio network layer problem (TA timer, RLF, PDCCH Order failure)
  - Transport network layer problem (GTP-U error, Treloc expiry, Path Switch problem)
  - Other abnormal cause
- MME can initiate abnormal S1 + RRC release due to
  - Radio network layer problem
  - Other abnormal cause

RRC Re-Establishment Procedure, Successful

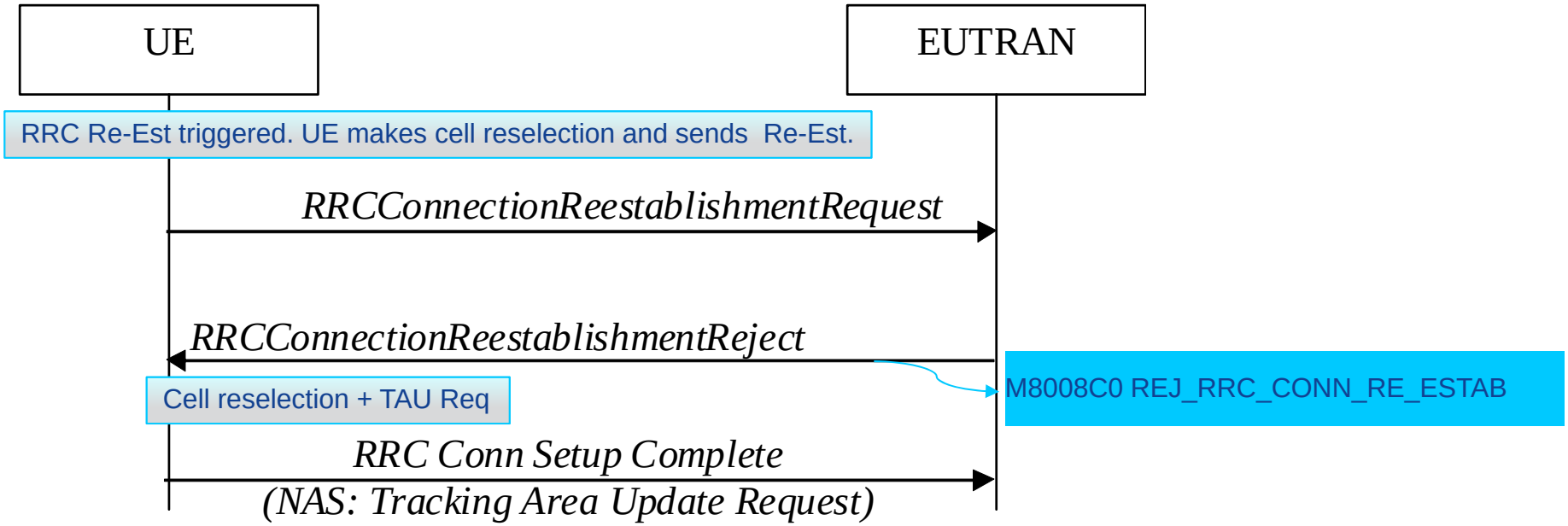


RRC Conn Re-Est can only succeed in a cell that has:

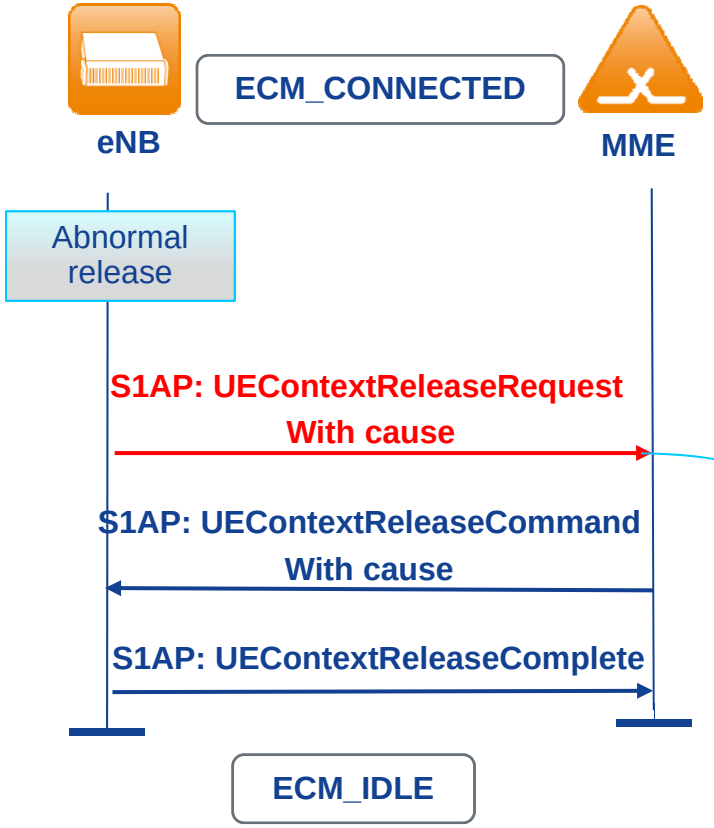
- short MAC-I of the target cell
- PCI of the source cell
- C-RNTI in the source cell

RRC Re-Establishment Procedure, Unsuccesful

- Re-establishment fails if target cell has not been prepared , eNB responds with reject
  → UE performs cell reselection + TAU



eNB Initiated Abnormal Release Counters



eNodeB initiated EPS bearer release (abnormal)

M8006C12 ENB_EPS_BEARER_REL_REQ_RNL

M8006C14 ENB_EPS_BEARER_REL_REQ_TNL

M8006C13 ENB_EPS_BEARER_REL_REQ_OTH

M8006C134 ENB_EPS_BEAR_REL_REQ_R_QCI1

M8006C143 ENB_EPS_BEAR_REL_REQ_O_QCI1

M8006C152 ENB_EPS_BEAR_REL_REQ_T_QCI1

eNodeB initiated UE Context Release (abnormal)

M8013C15 ENB_INIT_TO_IDLE_RNL

M8013C16 ENB_INIT_TO_IDLE_OTHER

Radio bearer release (abnormal)

M8007C5 RB_REL_REQ_RNL

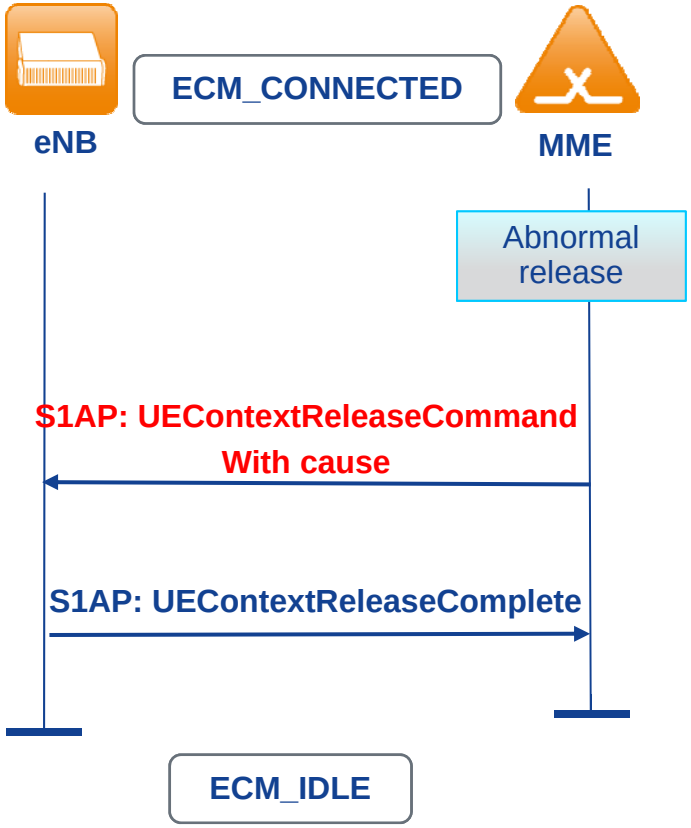
M8007C6 RB_REL_REQ_OTHER

M8006 EPS Bearer Measurements: cell level

M8007 Radio Bearer Measurements: cell level

M8013 UE State Measurements: cell level

MME Initiated Abnormal Release Counters



MME initiated EPS bearer release (abnormal)

M8006C8 EPC_EPS_BEARER_REL_REQ_RNL

M8006C9 EPC_EPS_BEARER_REL_REQ_OTH

MME initiated UE Context Release (abnormal)

M8013C11 EPC_INIT_TO_IDLE_RNL

M8013C12 EPC_INIT_TO_IDLE_OTHER

Cause value mapping should be checked from MME

M8006 EPS Bearer Measurements: cell level

M8007 Radio Bearer Measurements: cell level

M8013 UE State Measurements: cell level

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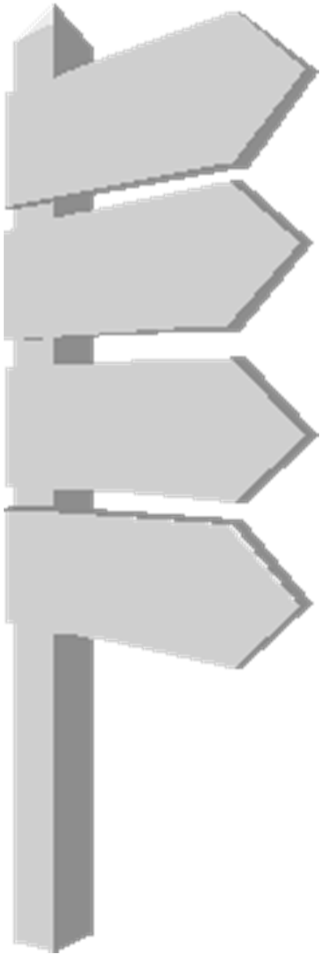


- Network + Field KPIs
- KPI Reference Values
- Drop Call Causes, Theory
  - UE initiated drop
  - eNB initiated drop
- Drop Call Counter Triggers
- Handover Signalling, Counter Triggers
- Relevant Features and Parameters Summary
- Project Example

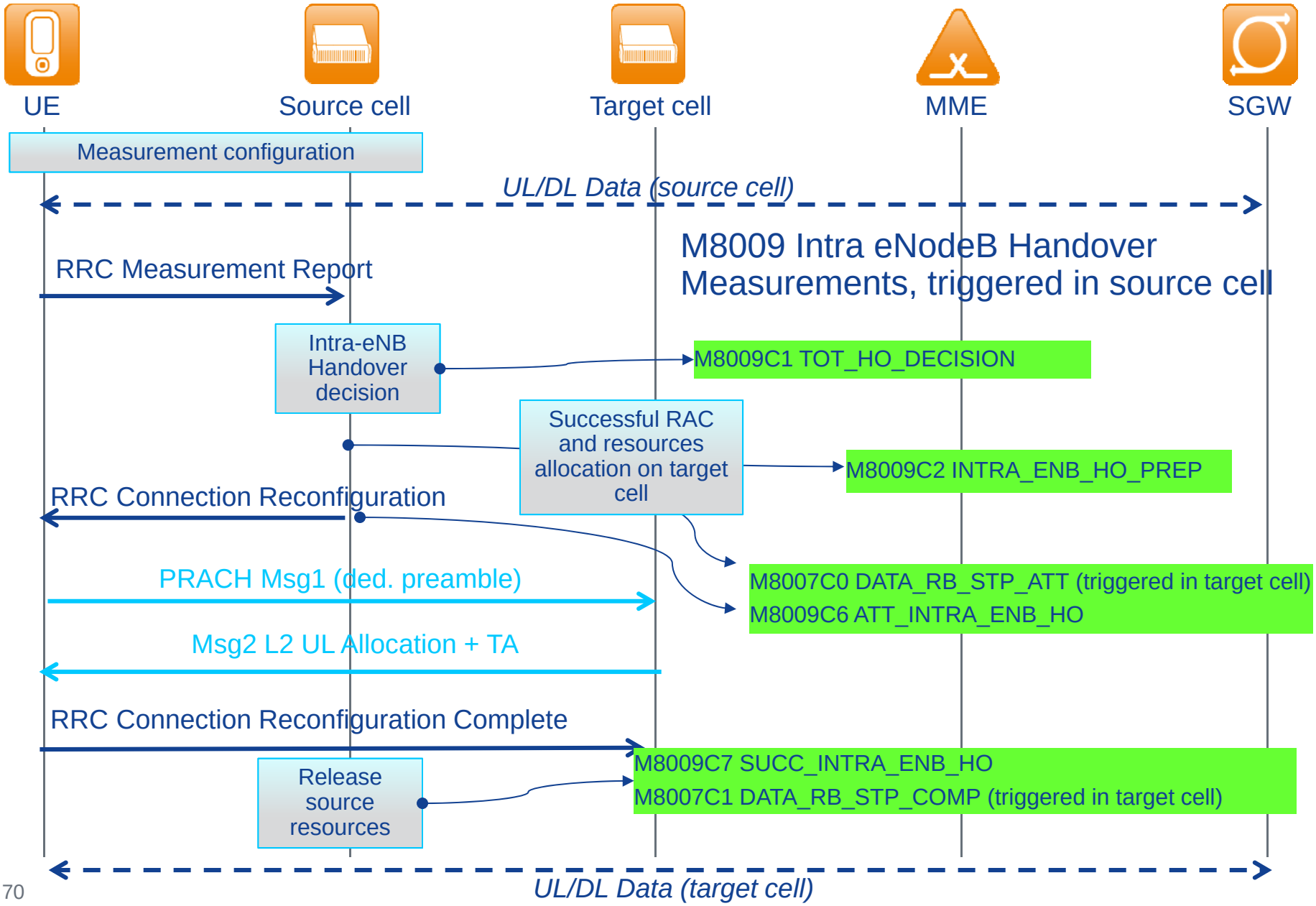
This module discusses call drops and handover drops after call setup has already succeeded. See separate module for call setup problems.

Handover measurements

- Counters of group M8009 Intra-eNB HO measurement give information per source cell only
- Counters of group M8014 Inter-eNB HO measurement give information per source cell only

- Counters of group M8015 give information per neighbor
  - M8015C0: Failed intra eNodeB HO preparations
  - M8015C1: Intra eNodeB HO attempts
  - M8015C2: Intra eNodeB HO successes
  - M8015C15: Intra eNodeB HO failures (any reason)
  - MRO events per cell

Intra eNodeB Handover (Positive)



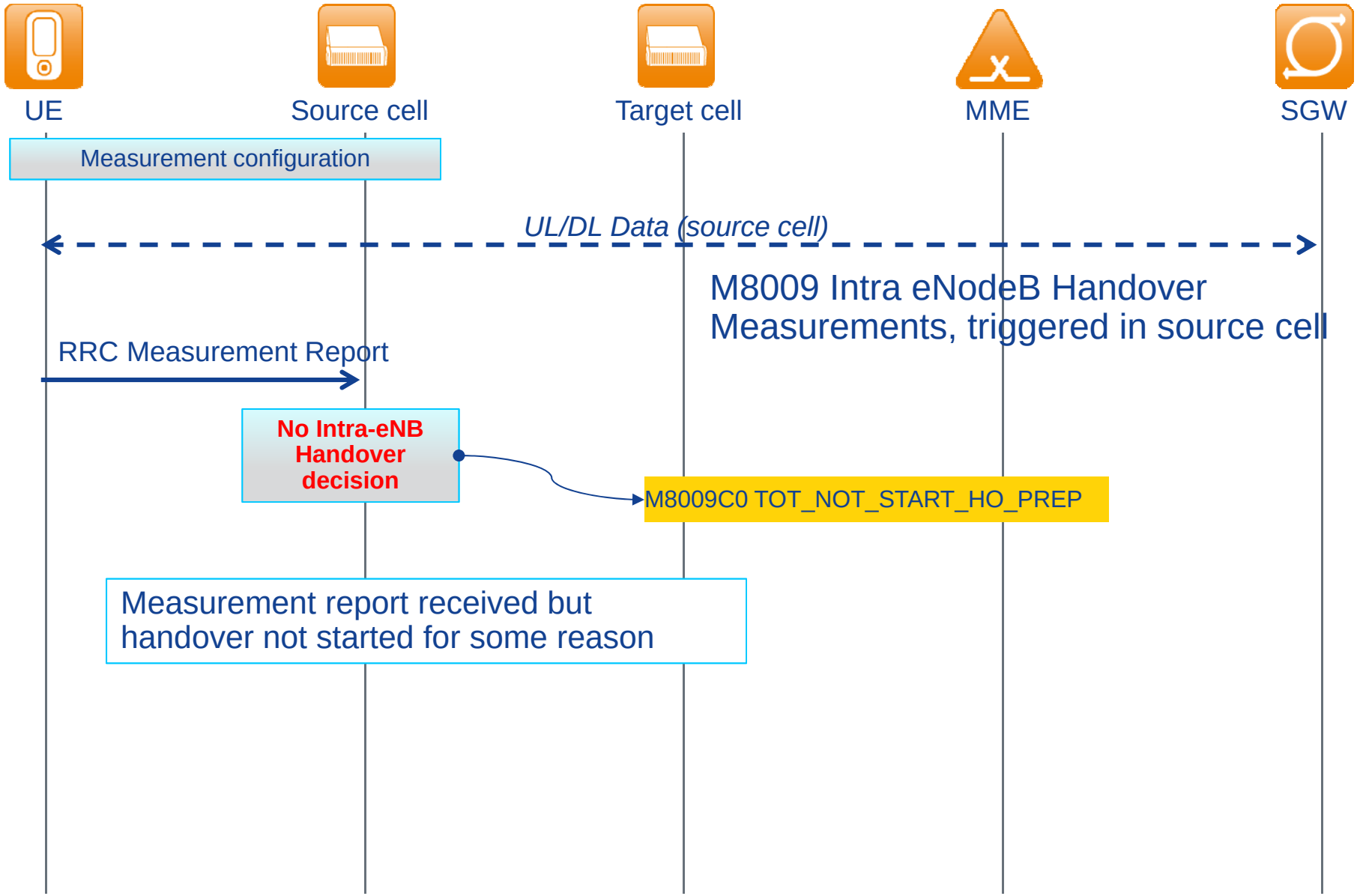
Intra eNodeB Handover KPI, Total Success Rate

- **Formula LTE_5043a:** (NetAct names)

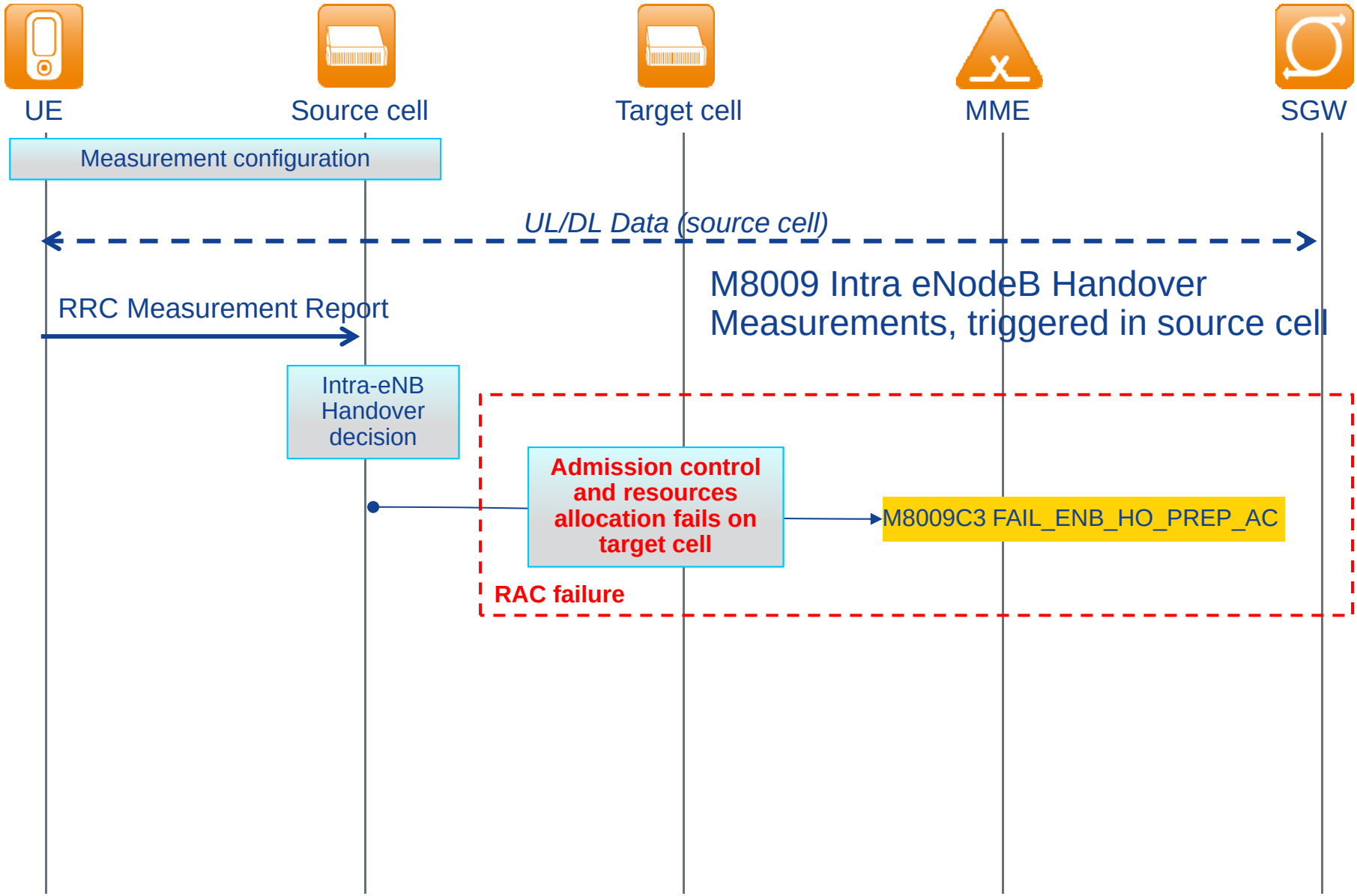
  100*sum(SUCC_INTRA_ENB_HO) / sum(INTRA_ENB_HO_PREP)

  - M8009C7 SUCC_INTRA_ENB_HO = The reception of an internal UE Context Release Request for the handover on the source side. Updated to the source cell.
  - M8009C2 INTRA_ENB_HO_PREP = An internal eNB trigger. The eNB MM receives a list with the target cells from RRM and decides on an Intra-eNB Handover. Updated to the source cell.

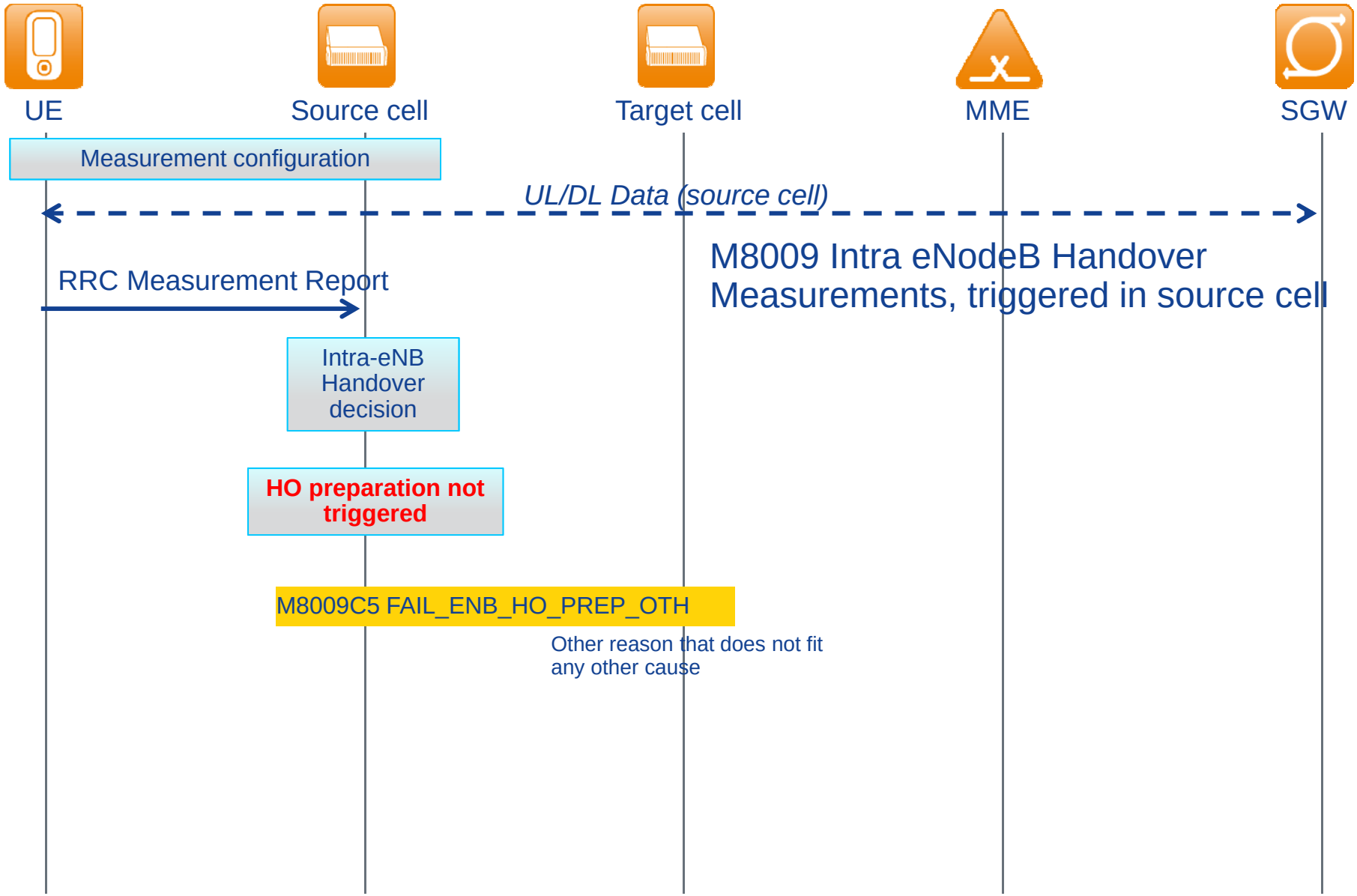
Intra eNodeB Handover (Negative 1)



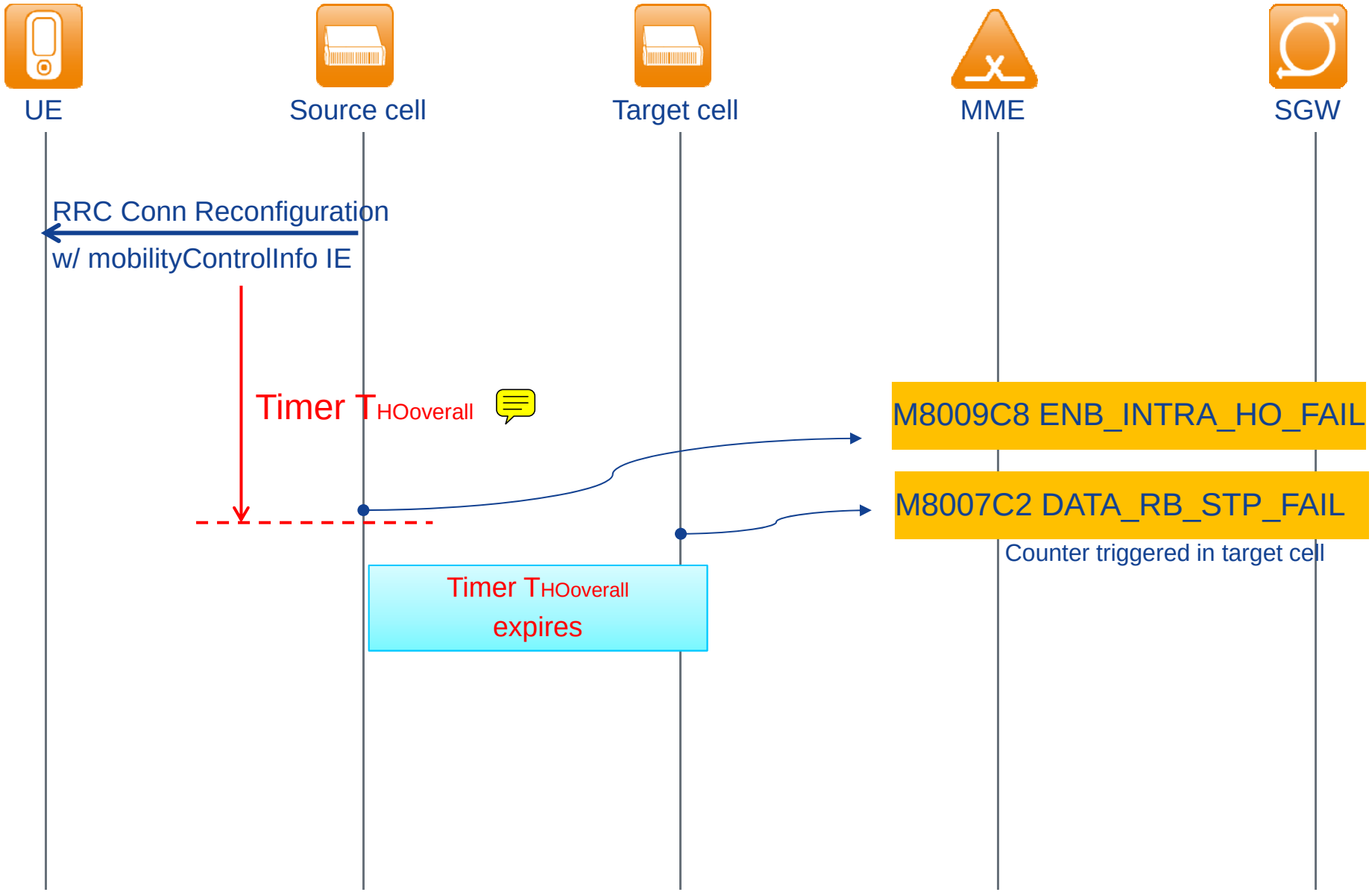
Intra eNodeB Handover (Negative 2)



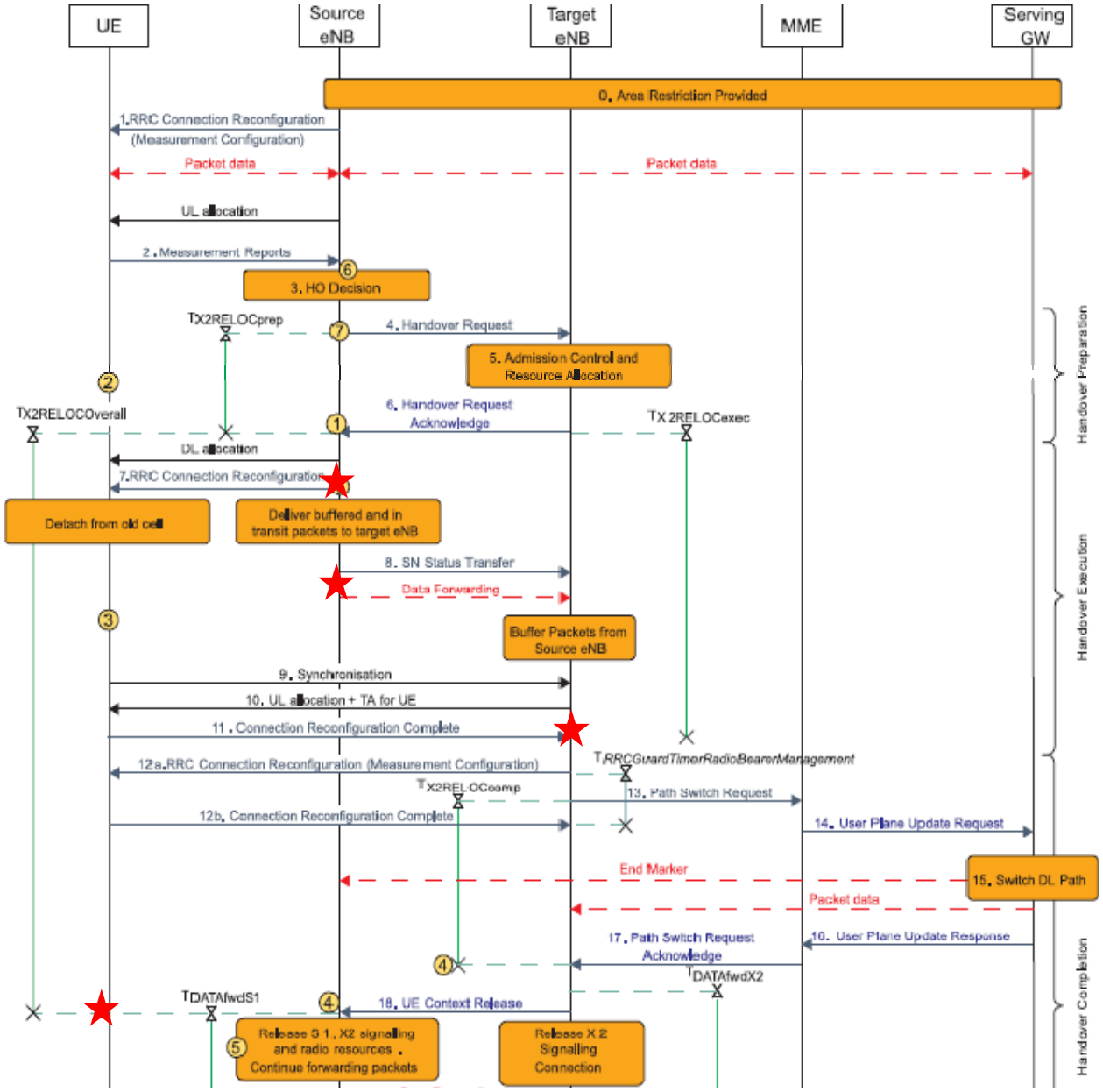
Intra eNodeB Handover (Negative 3)



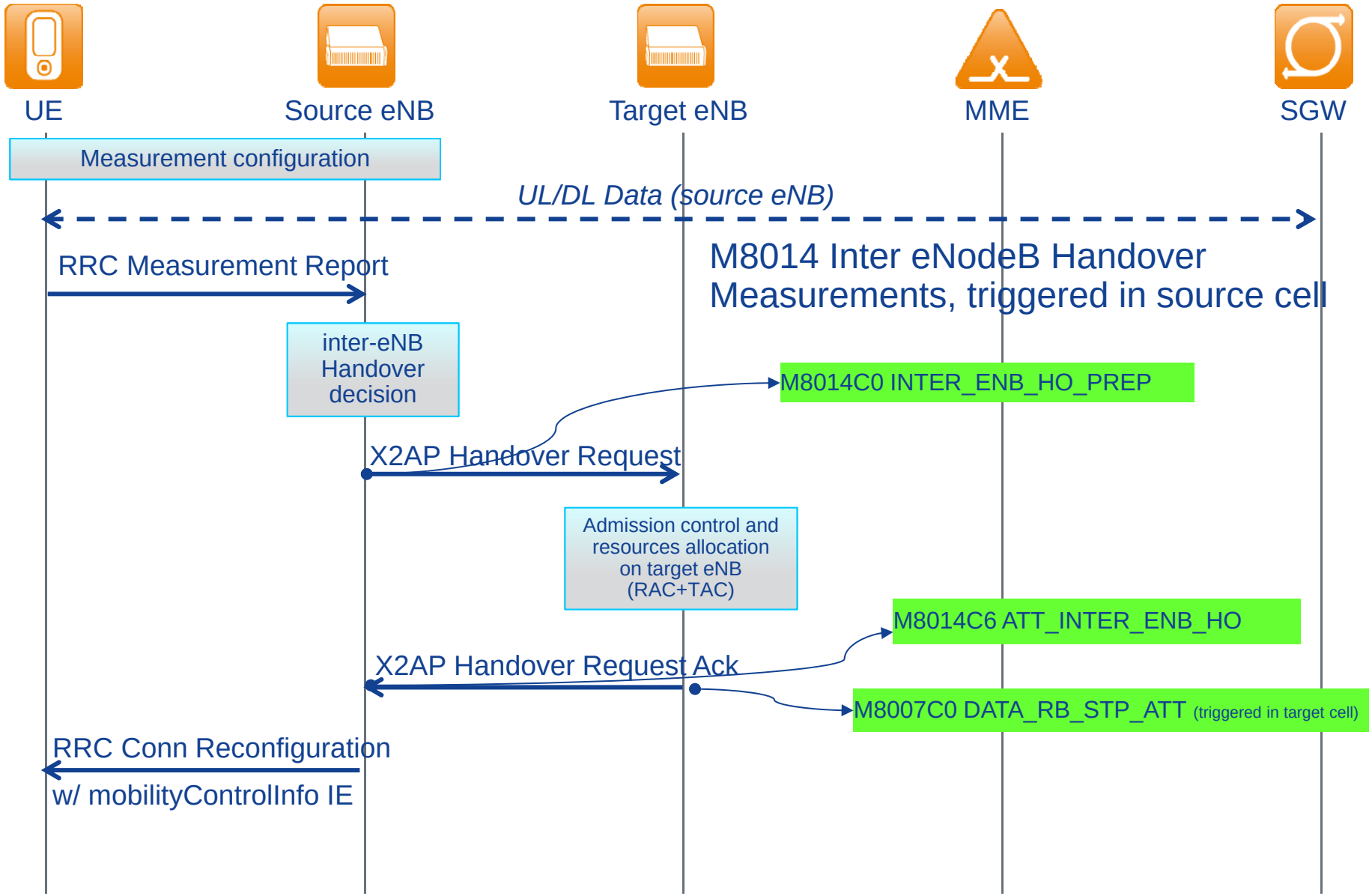
Intra eNodeB Handover (Negative 4)



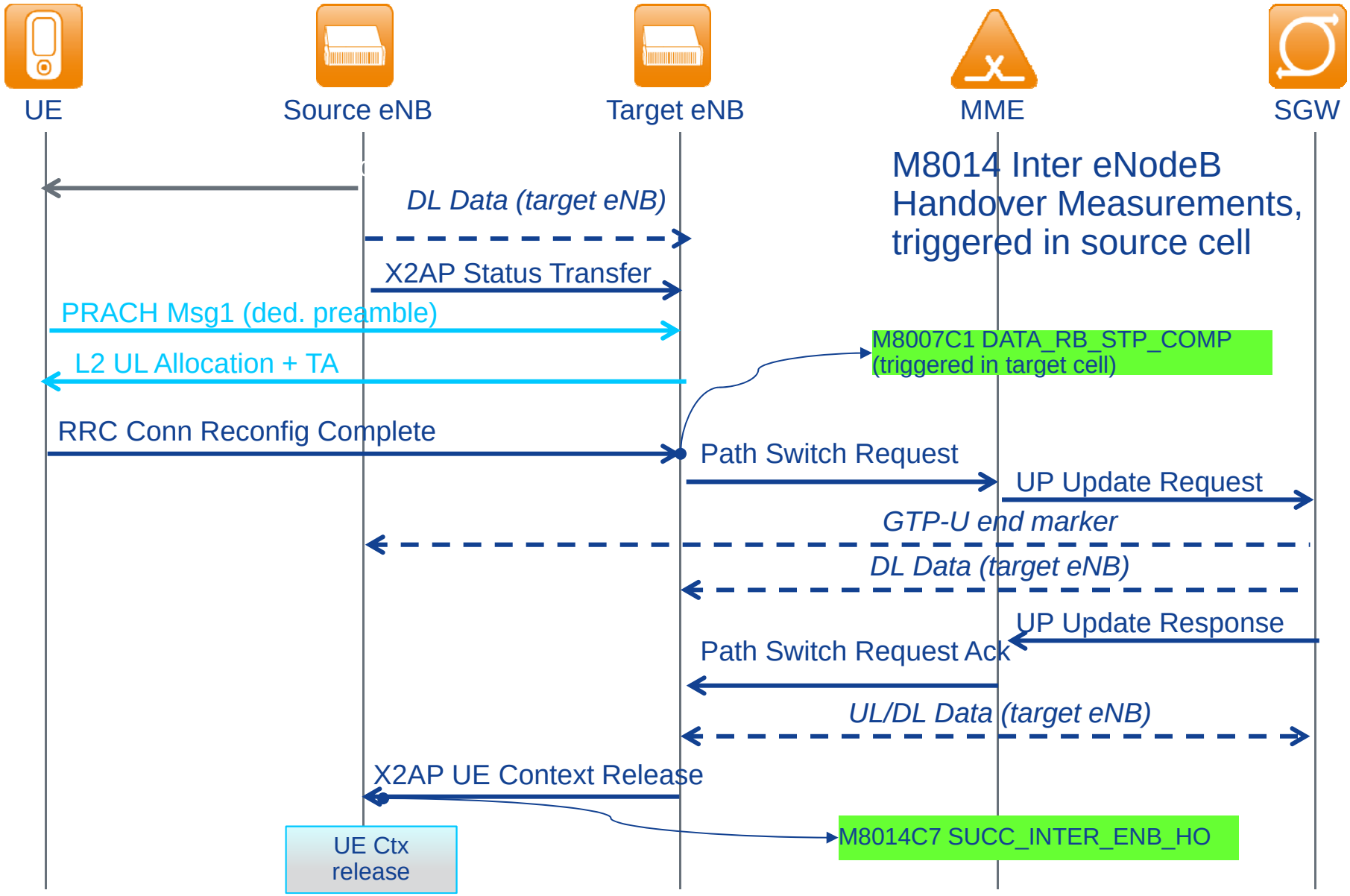
Inter-eNB X2 Handover – Message Flow



Inter eNodeB Handover (Positive, Preparation)



Inter eNodeB Handover (Positive, Execution)



Inter eNodeB Handover KPI, Total Success Rate

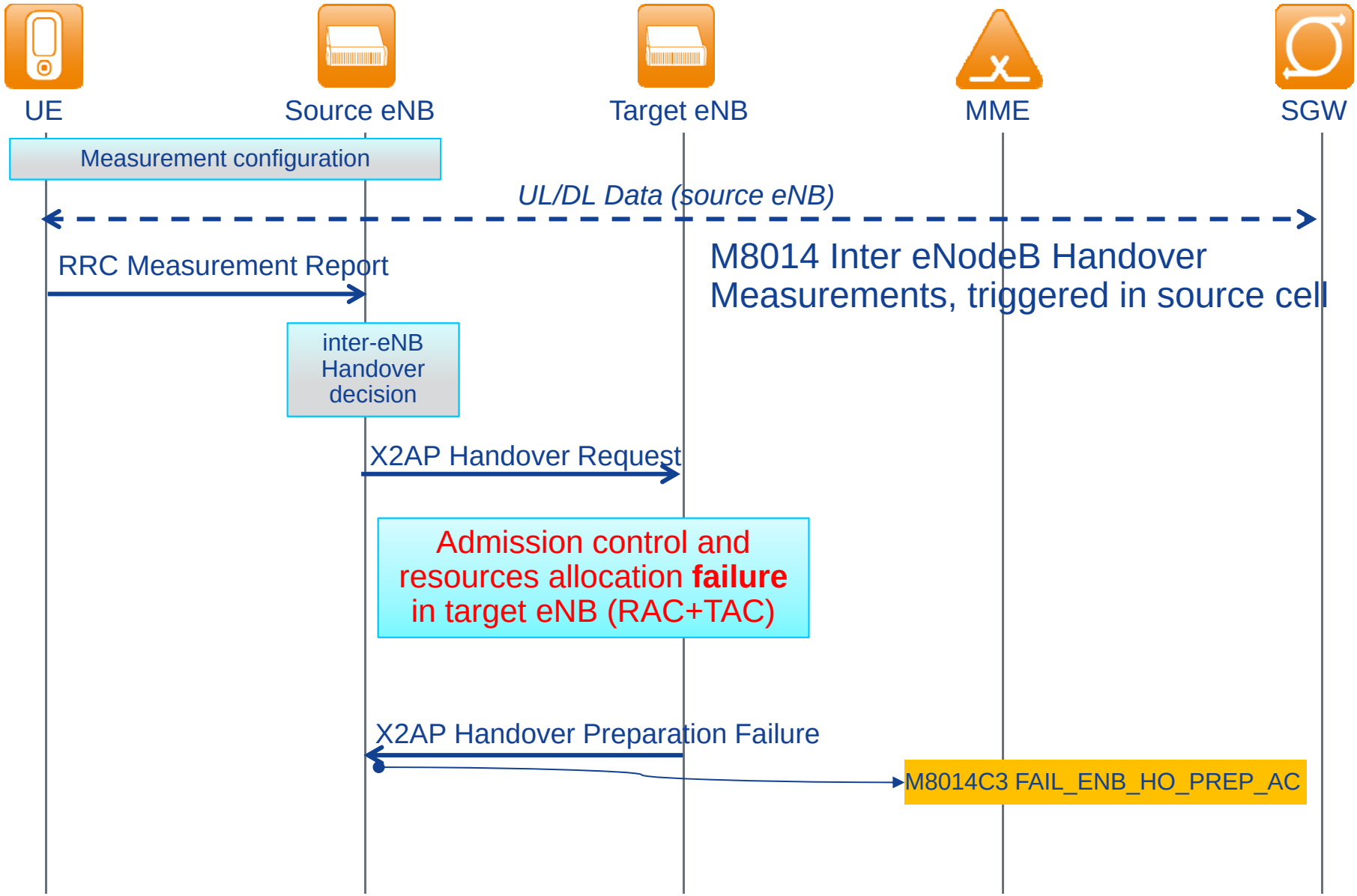
- **Formula LTE_5058b:** (NetAct names)

- LTE_5058b E-UTRAN Total HO Success Ratio, inter eNB X2 based

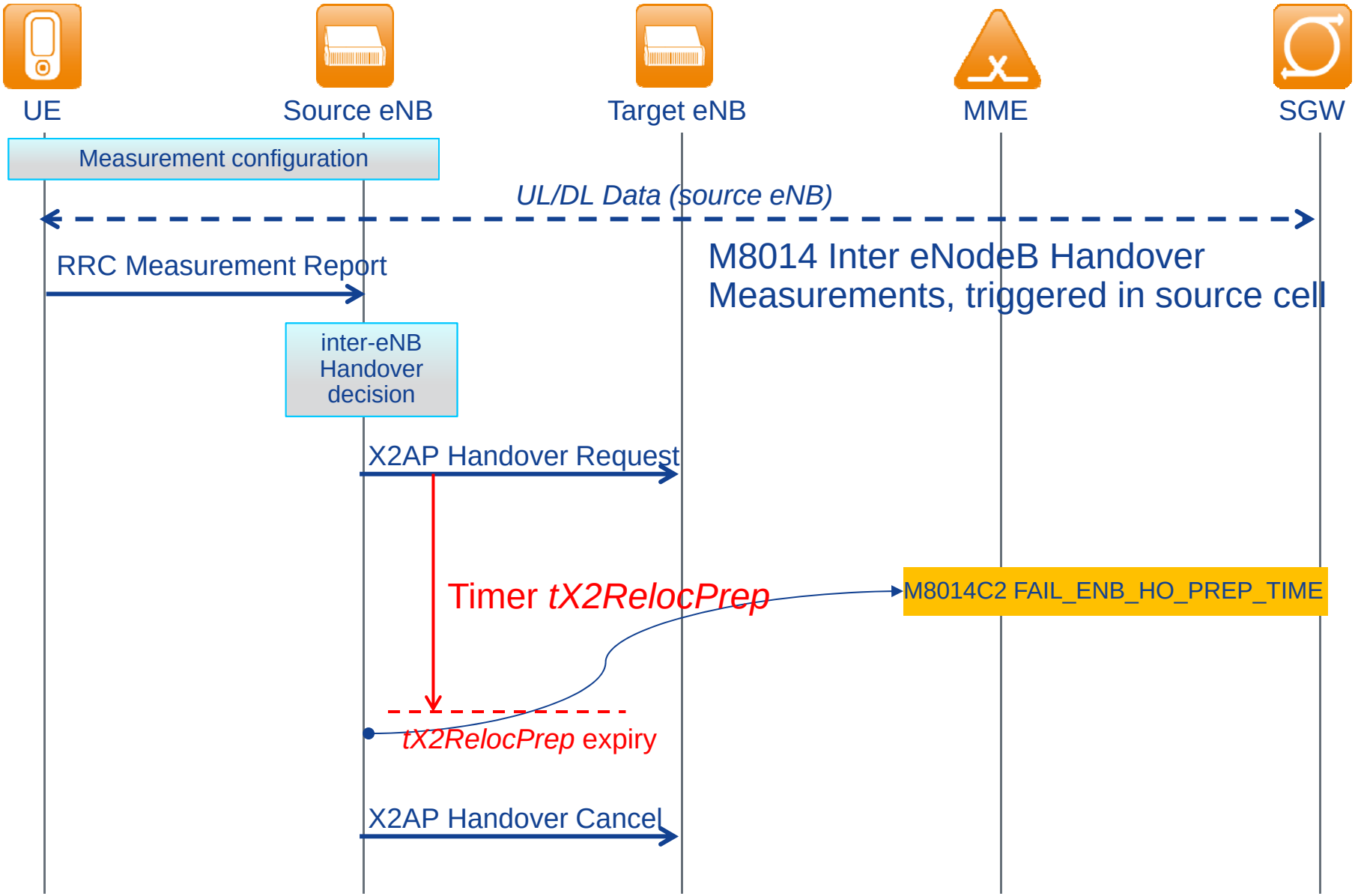
  - 100*sum(SUCC_INTER_ENB_HO) / sum(INTER_ENB_HO_PREP)

  - M8014C7 SUCC_INTER_ENB_HO = the reception of a X2AP: Release Resource message sent by the target eNB
  - M8014C0 INTER_ENB_HO_PREP = the transmission of an X2AP: Handover Request to the target eNB.

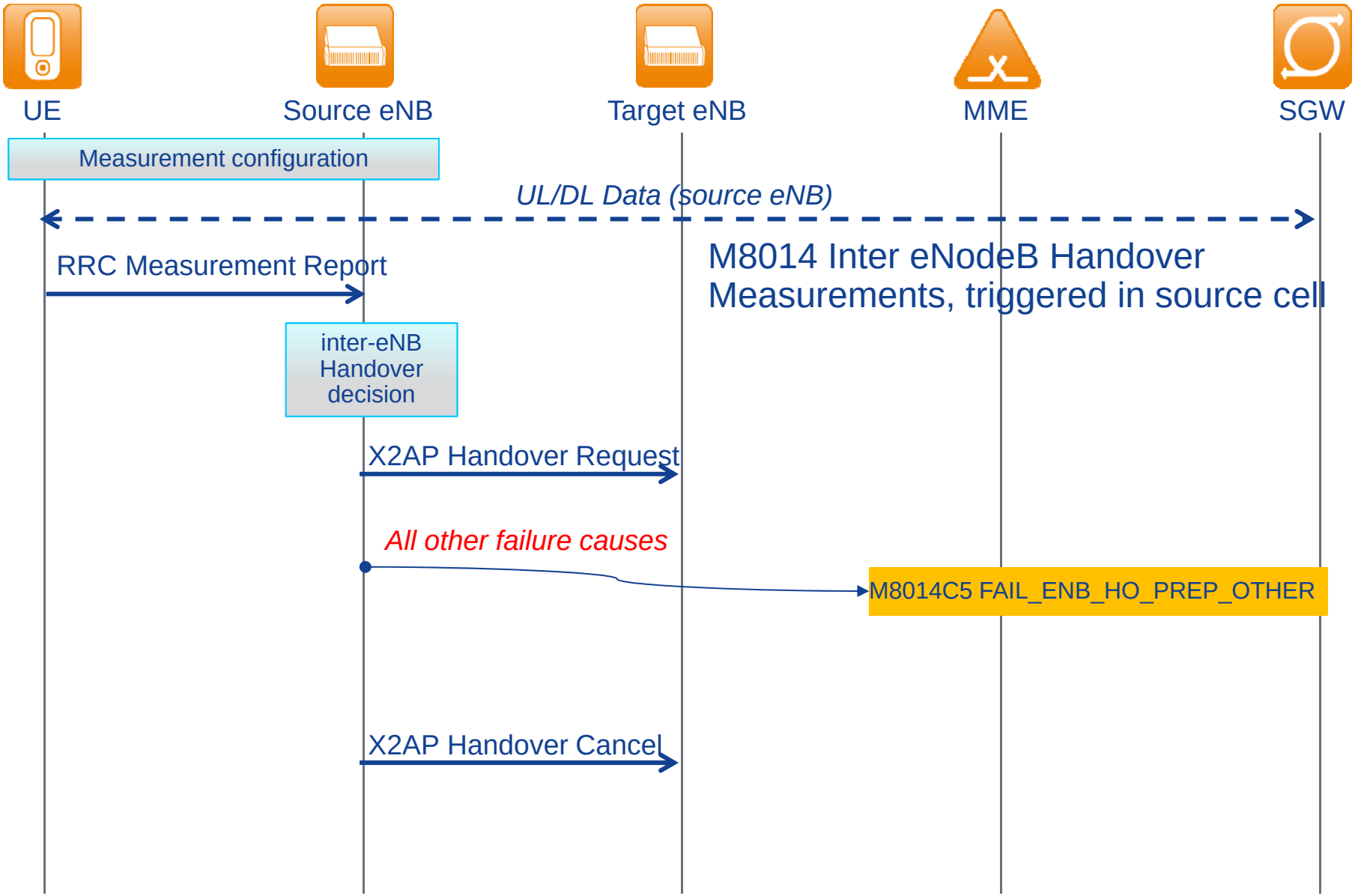
Inter eNodeB Handover (Negative 1, Preparation)



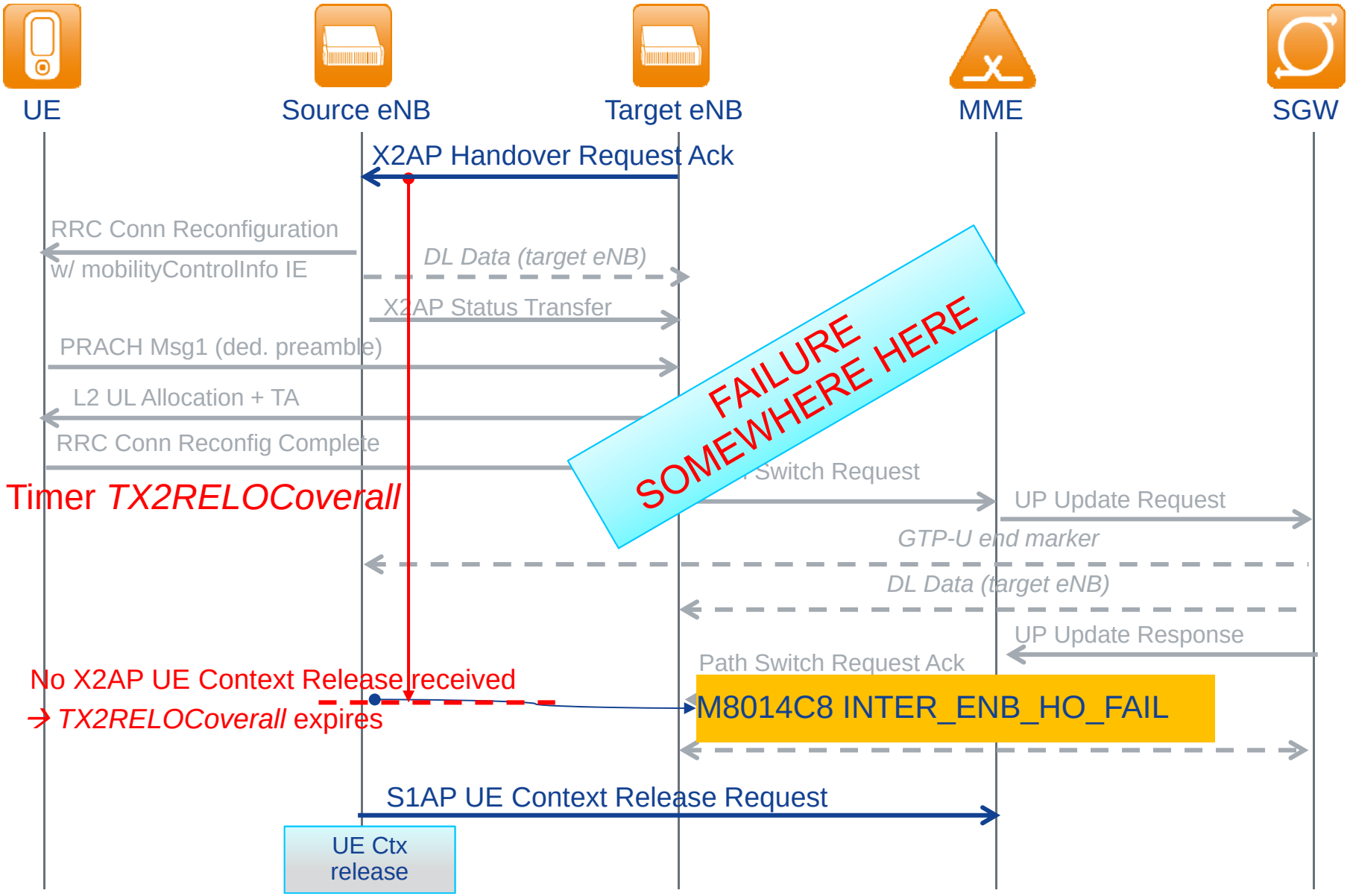
Inter eNodeB Handover (Negative 2, Preparation)



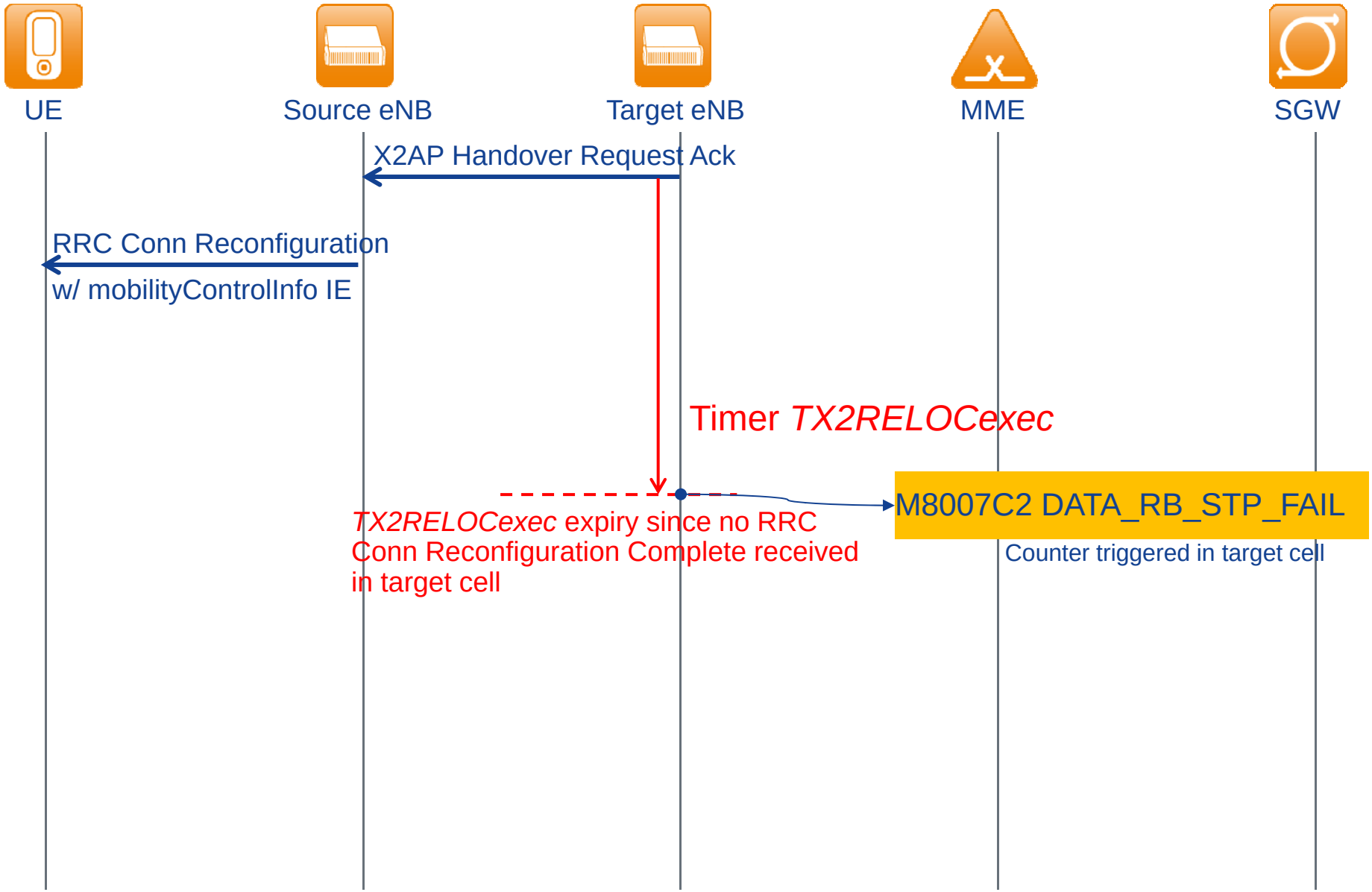
Inter eNodeB Handover (Negative 3, Preparation)



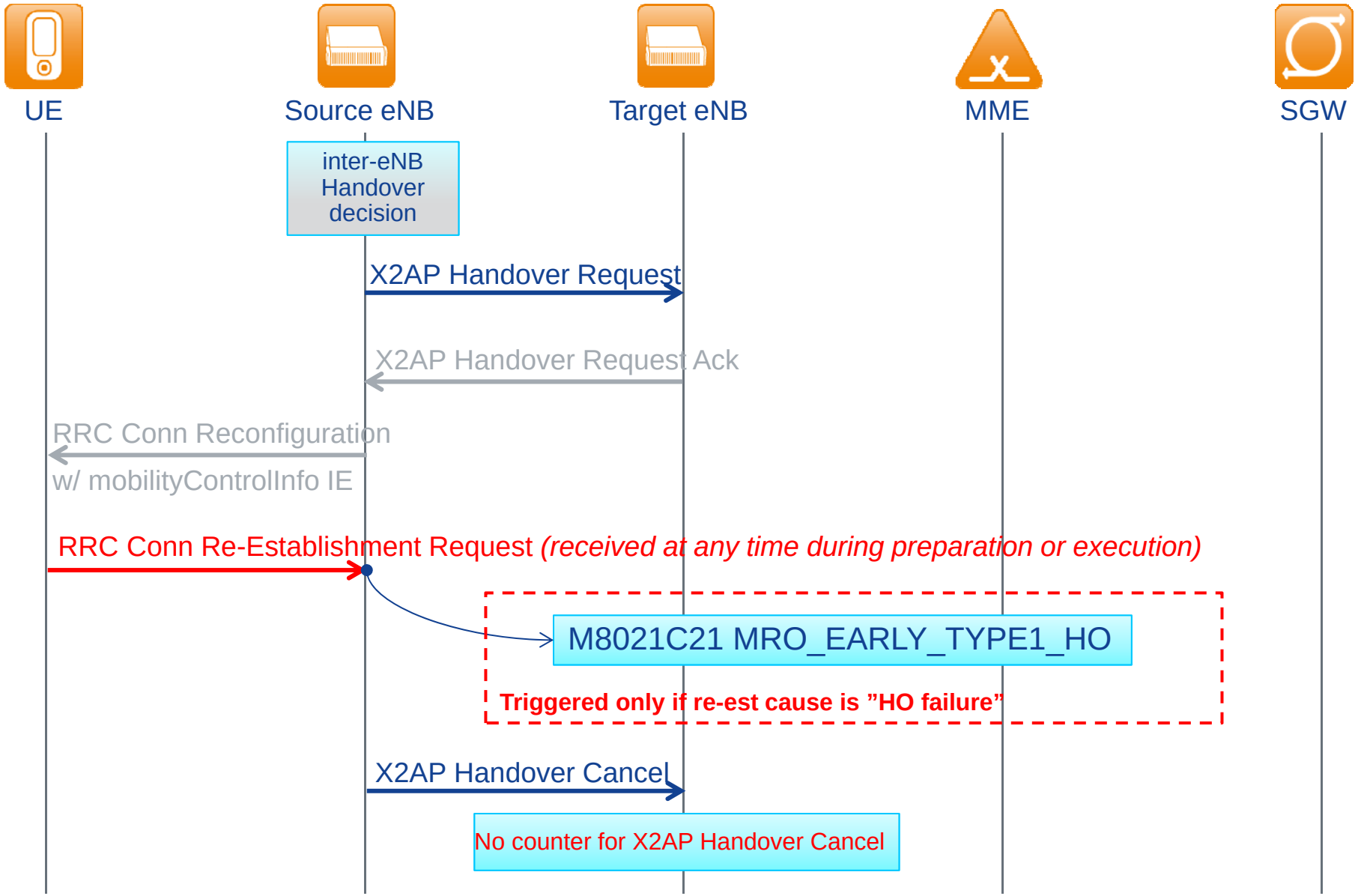
Inter eNodeB Handover (Negative 1, Execution)



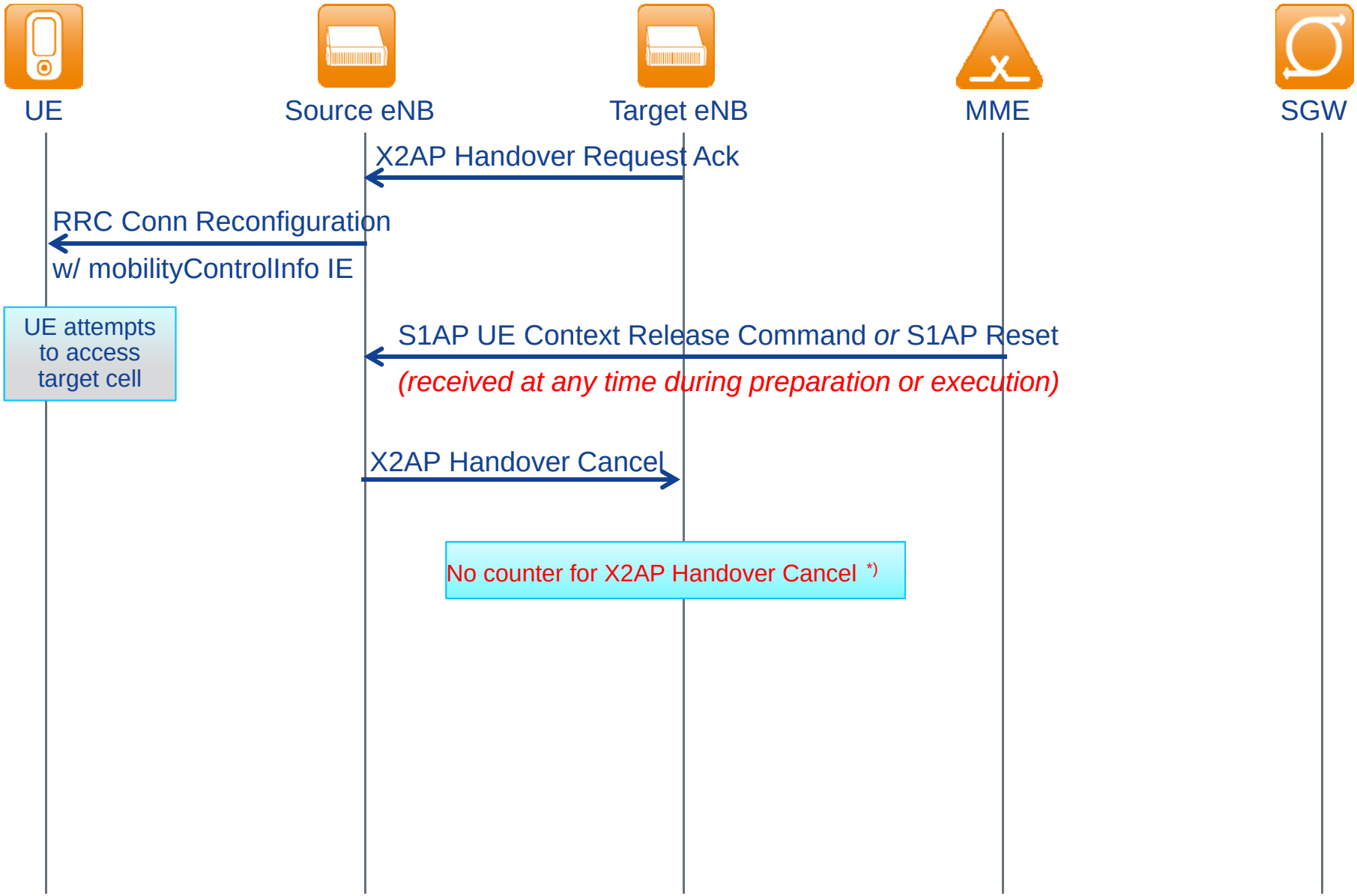
Inter eNodeB Handover (Negative 2, Execution)



Inter eNodeB Handover (Negative 1, Generic)



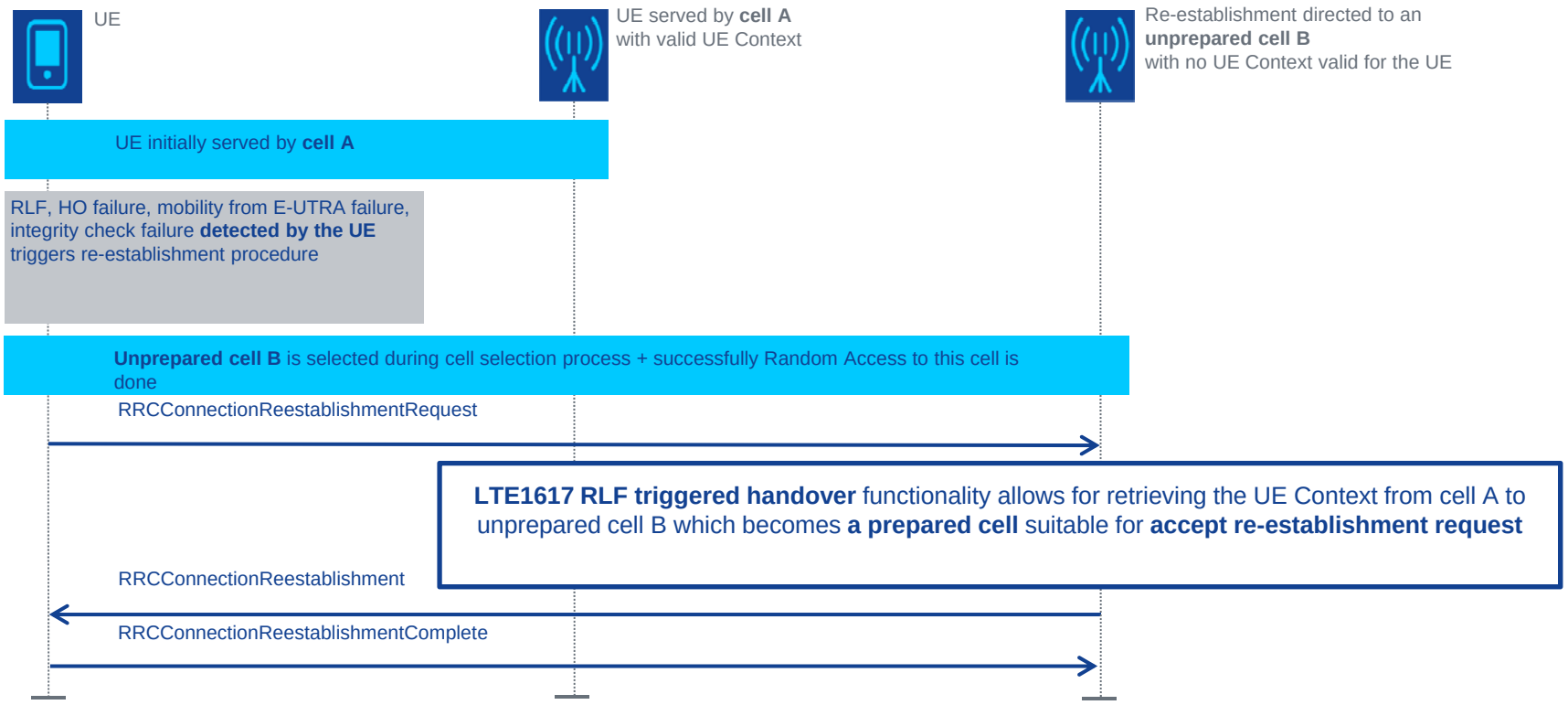
Inter eNodeB Handover (Negative 2, Generic)



RLF triggered Handover

RRC connection re-establishment procedure – Nokia implementation with LTE1617

- LTE1617 RLF triggered handover available from RL70/RL55TD onwards allows for re-establishment even towards the **unprepared cell**
- This is possible due to introduction of new mechanism **RLF triggered Handover**, which allows for retrieving of UE Context from eNB being prior RRC connection re-establishment procedure a serving eNB



RLF triggered Handover

RRC connection re-establishment procedure – Nokia implementation before LTE1617

- Till RL20/RL15TD any *RRC:RRCConnectionReestablishmentRequest* was rejected by the eNB
- From RL30/RL25TD onwards LTE735 RRC Connection re-establishment is implemented in Flexi Multiradio BTS; re-establishment may be successfully completed only in prepared cell (with valid UE context)
- Cases supported by LTE735:

Successful cases
- RRC connection re-establishment to the serving cell, without ongoing handover
- RRC connection re-establishment in source cell during ongoing Intra eNB HO, X2AP HO, S1HO, HO to UTRAN or eNACC to GSM
- RRC connection re-establishment in target cell during ongoing Intra eNB HO, X2AP HO, S1HO
- RRC connection re-establishment to the serving cell during ongoing RRC or S1AP procedures (selected number of procedures)

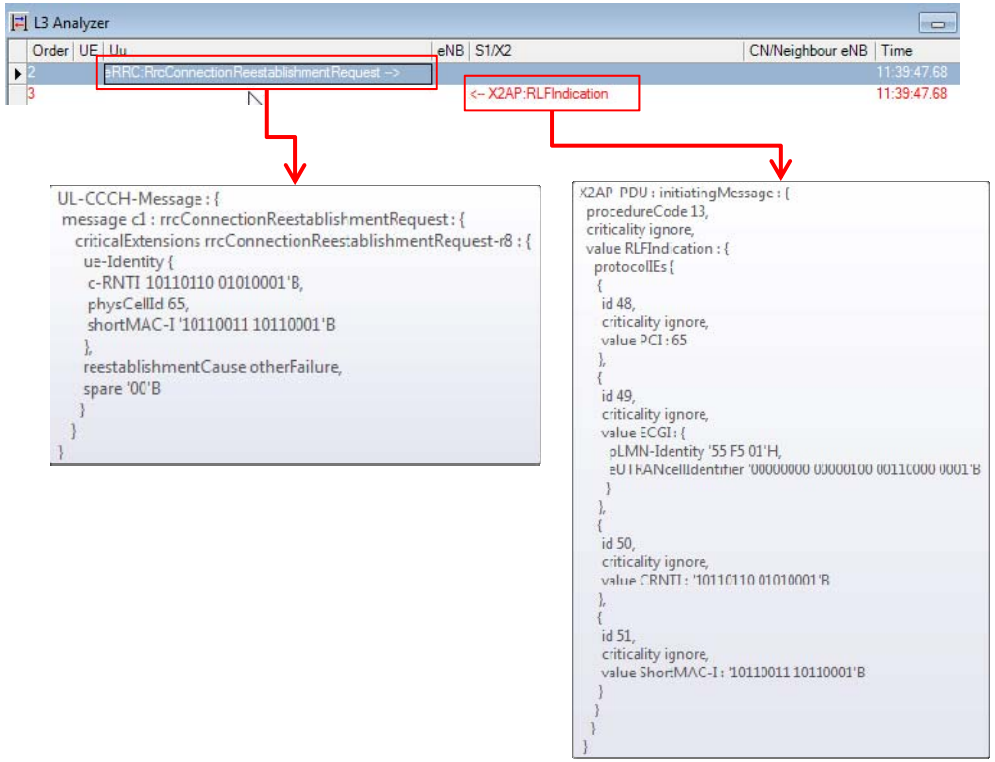
Unsuccessful cases
- Rejection of RRC connection re-establishment to the serving cell, without handover
- Rejection of RRC connection re-establishment in the serving cell, during Initial Context Setup procedure
- Rejection of RRC connection re-establishment in source cell during ongoing Intra eNB HO, X2AP HO, S1HO and HO to UTRAN
- Rejection of RRC connection re-establishment in target cell during ongoing Intra eNB HO, X2AP HO, S1HO

RLF triggered Handover

RRC connection re-establishment procedure

After UE detects RLF it issues an RRC Connection Reestablishment request in target cell. This will indicate PCI of source.

For inter eNB cases an X2 RLF Indication from target to source eNB.will be transmitted.

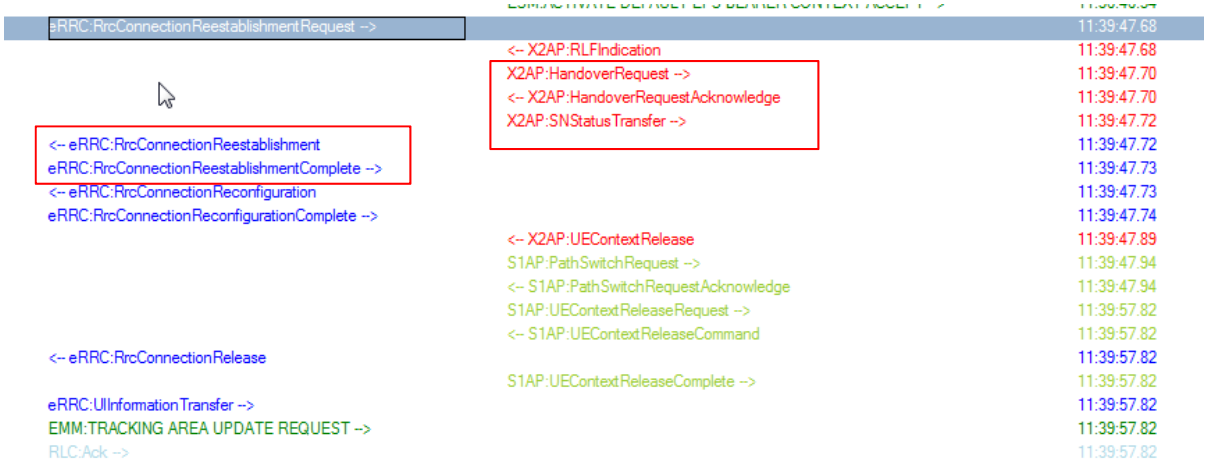


RLF triggered Handover

RRC connection re-establishment procedure

After RLF Indication is received by source eNB, X2 HO procedure is executed to exchange UE context.

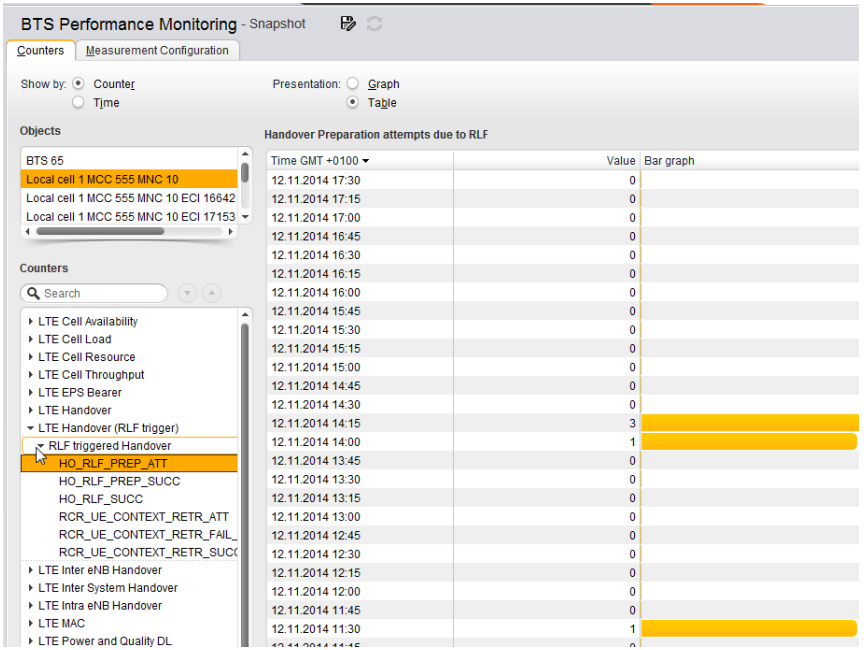
Instead of HO command, target eNB sends RRC Connection Reestablishment message.



RLF triggered Handover

Performance Monitoring

- For the monitoring of the LTE1617 RLF Triggered Handover procedure an own set of measurements is defined **M8027 - LTE Handover (RLF Trigger)**
  - HO_RLF_PREP_ATT (M8027C0)
  - HO_RLF_PREP_SUCC (M8027C1)
  - HO_RLF_SUCC (M8027C2)
  - RCR_UE_CONTEXT_RETR_ATT (M8027C3)
  - RCR_UE_CONTEXT_RETR_SUCC (M8027C4)
  - RCR_UE_CONTEXT_RETR_FAIL_TIM (M8027C5)



- Measurement granularity for counters from **M8027 - LTE Handover (RLF Trigger)** is controlled by **new parameter *mtHoRlf (PMRNL)***

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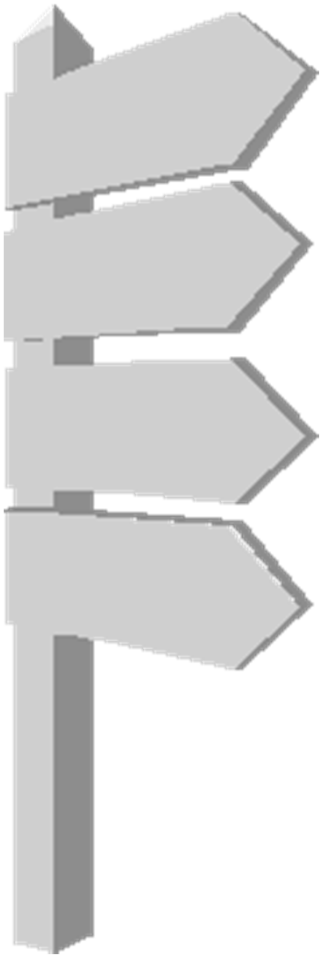

This module discusses call drops and handover drops after call setup has already succeeded. See separate module for call setup problems.

Features Relevant to Drops

Missing neighbours result in UL interference and user-perceived coverage gaps in the network → drops

- Mobility Robustness LTE533 RL30
- Optimization of Neighbor Relations LTE771 RL30
- InterRAT PS handover to WCDMA LTE56 RL30
- InterRAt Ho from UTRAN LTE57 RL60
- Inter RAT PS Ho to eHRPD/3GPP2 LTE60 RL60
- ANR Intra-LTE, Intra-frequency Fully UE based LTE782 RL30
- ANR Intra-LTE, Inter-frequency Fully UE based LTE556 RL60
- ANR InterRAT with O&M LTE783 & LTE784 & LTE510 RL30
- ANR Optimization of Intra-LTE neighbor relations LTE 771 RL30
- Inter RAT Neighbor Relation Optimization LTE507 RL50
- Cell specific neighbor relation / PCI handling LTE1283 RL50

Parameters Related to Drops

- Too many parameters to mention can increase drops if wrongly configured…
- For handover access related drops, the PRACH phase in target cell should be optimized. See call setup optimization material in this training.
- Prolonging UE and eNB initiated drop timers and constants may improve probability of recovery
- Inactivity timer and DRX settings can have major impact on drop rates.

- **The best way to improve retainability is to optimize basic physical RF: improve coverage and cell dominance!**

Parameters Related to Drops

MO	parameter full name	parameter short name	description	value range	PDDB default
LNCEL	Maximum number of HARQ transmission in UL	harqMaxTrUl	Indicates the maximum number of HARQ transmissions in UL that is configured for each UE at initial access to a specific cell. *NOTE: this parameter also defines number of transmissions in PRACH handover access.*	1...7, step 1	5
LNCEL	Maximum number of HARQ transmission in DL	harqMaxTrDl	Indicates the maximum number of HARQ transmissions in DL that is configured for each UE at initial access to a specific cell.	1...16, step 1	3
LNCEL	Maximum number of out-of-sync indications	n310	This is the maximum number of consecutive "out of sync" indications received from lower layers. n1 corresponds to 1 and so on.	n1 (0), n2 (1), n3 (2), n4 (3), n6 (4), n8 (5), n10 (6), n20 (7)	-
LNCEL	Maximum number of in-sync indications	n311	Maximum number of consecutive "in-sync" indications received from lower layers. n1 corresponds to 1 and so on.	n1 (0), n2 (1), n3 (2), n4 (3), n5 (4), n6 (5), n8 (6), n10 (7)	-
LNCEL	Timer T310	t310	Timer T310 supervises the recovery from physical layer problems.	0ms (0), 50ms (1), 100ms (2), 200ms (3), 500ms (4), 1000ms (5), 2000ms (6)	-
LNCEL	Timer T311	t311	Timer T311 supervises the RRC connection re-establishment.	1000ms (0), 3000ms (1), 5000ms (2), 10000ms (3), 15000ms (4), 20000ms (5), 30000ms (6)	-

Parameters Related to Drops

LNCEL	Timer T304 intra-LTE	t304IntraLte	Timer T304 supervises the successful completion of a handover or cell change.	50ms (0), 100ms (1), 150ms (2), 200ms (3), 500ms (4), 1000ms (5), 2000ms (6)	1000ms (5)
LNCEL	Time alignment timer	taTimer	Determines the number of subframes after which a UE assumes it is out-of-sync in UL if no Time Alignment command was received.	500 (0), 750 (1), 1280 (2), 1920 (3), 2560 (4), 5120 (5), 10240 (6)	10240 (6)
LNCEL	Time alignment timer margin	taTimerMargin	The parameter defines lead with respect to the taTimer expiration time for starting to send the periodic timing advance command.	0...2560 subframes, step 1 subframes	2000 subframes
LNBTS	Maximum number of time alignment command retries	taCmdMaxRetry	The number of times the timing advance command is retried before the LTE MAC assumes that the UE has gone out-of-synch. This parameter is vendor-specific.	1...10, step 1	10
LNCEL	Apply UL out-of-sync state	applyOutOfSyncState	Determines which UEs shall be actively sent to UL out-of-sync state provided that bearer combination and applied DRX profile allows for this. extendedDrxOnly: only UEs being configured with extended settings for the long DRX cycle allDrx: all UEs being configured for DRX provided that applied DRX profile allows allUEs: all UEs independently of DRX configuration provided that bearer combination allows.	extendedDrxOnly (0), allDrx (1), allUEs (2)	extendedDrxOnly (0)

Parameters Related to Drops

LNBTS	Radio problem indication based on CQI DTX	nCqiDtx	The parameter defines the number of consecutive CQI DTX detections causing radio link failure indication. Special value 0 means that the feature is disabled. The parameter is vendor-specific.	0...100, step 1	50
LNBTS	Radio problem recovery based on CQI DTX	nCqiRec	The parameter defines number of consecutive CQI non-DTX detections causing radio link failure recovery indication. The parameter is vendor-specific.	1...8, step 1	2
LNBTS	Number of PUSCH detections to end radio link problem	rlpDetEndNUl	Defines the number of consecutive uplink data receptions on PUSCH without DTX detection before the radio link problems are assumed to be over and an indication about radio link recovery is sent to higher layers. This parameter is vendor-specific.	1...20, step 1	3
LNBTS	Number of successful PDSCH transmissions	rlpDetEndNoDl	This parameter determines the number DL PDSCH transmission with correct HARQ feedback until detected radio link problems are assumed to be over. This parameter is vendor-specific.	1...20, step 1	3
LNBTS	Number of PUSCH DTX detections for radio link problem	rlpDetMaxNUl	Defines the number of uplink DTX detections on PUSCH before an indication about radio link problems is sent to higher layers. This parameter is vendor-specific.	1...1000, step 1	1000
LNBTS	Number of failed PDSCH transmissions	rlpDetMaxNoDl	This parameter determines the maximum number of failed DL PDSCH transmission attempts until radio link problems are detected. This parameter is vendor-specific.	1...1000, step 1	1000

Parameters Related to Drops

LNBTS	Number of failed PDSCH transmissions	rlpDetMaxNoDl	This parameter determines the maximum number of failed DL PDSCH transmission attempts until radio link problems are detected. This parameter is vendor-specific.	1...1000, step 1	1000
LNBTS	Time of PUSCH DTX detections for radio link problem	rlpDetMaxTUl	Defines the time frame for uplink DTX detections on PUSCH before an indication about radio link problems is sent to higher layers. This parameter is vendor-specific. IMPORTANT: The parameter cannot have a value other than 0.	20...5000 ms, step 1 ms	0 ms
LNBTS	Timeframe for failed PDSCH transmissions	rlpDetMaxTimeDl	Determines the timeframe for failed DL PDSCH transmission attempts until radio link problems are detected. This parameter is vendor-specific.	20...5000 ms, step 1 ms	5000 ms

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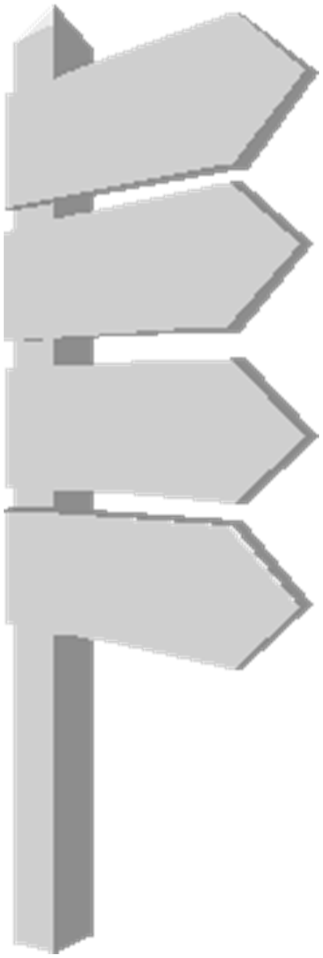


- Network + Field KPIs
- KPI Reference Values
- Drop Call Causes, Theory
  - UE initiated drop
  - eNB initiated drop
- Drop Call Counter Triggers
- Handover Signalling, Counter Triggers
- Relevant Features and Parameters Summary
- Project Example

This module discusses call drops and handover drops after call setup has already succeeded. See separate module for call setup problems.

Case Study: Call Drop due to Handover Failure – *Tx2RelocOverall* Timer Expiry

UE Log: Handover to Target Cell (PCI:29)

Time	Code	Message
2011-09-20 11:45:11.653	UL-DCCH [Lte]	measurementReport
2011-09-20 11:45:11.731	DL-DCCH [Lte]	rrcConnectionReconfiguration
2011-09-20 11:45:11.731	UL-DCCH [Lte]	rrcConnectionReconfigurationComplete
2011-09-20 11:45:11.746	RACH REQ Info	
2011-09-20 11:45:11.762	RACH RSP General Info	
2011-09-20 11:45:11.778	BCCH-BCH [Lte]	masterInformationBloc
2011-09-20 11:45:11.809	BCCH-DL-SCH [Lte]	systemInformationBloc
2011-09-20 11:45:11.949	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 11:45:11.981	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 11:45:11.996	Cell Information	
2011-09-20 11:45:20.996	PCCH [Lte]	Paging
2011-09-20 11:45:23.559	PCCH [Lte]	Paging
2011-09-20 11:45:47.356	RACH REQ Info	
2011-09-20 11:45:47.371	RACH RSP General Info	
2011-09-20 11:45:47.418	RACH REQ Info	
2011-09-20 11:45:47.434	RACH RSP General Info	
2011-09-20 11:45:47.465	RACH REQ Info	
2011-09-20 11:45:47.496	RACH RSP General Info	
2011-09-20 11:45:47.528	RACH REQ Info	
2011-09-20 11:45:47.559	RACH RSP General Info	
2011-09-20 11:45:47.590	RACH REQ Info	
2011-09-20 11:45:47.606	RACH RSP General Info	
2011-09-20 11:45:47.653	RACH REQ Info	
2011-09-20 11:45:47.668	RACH RSP General Info	
2011-09-20 11:45:47.715	RACH REQ Info	
2011-09-20 11:45:47.731	RACH RSP General Info	
2011-09-20 11:45:47.778	RACH REQ Info	
2011-09-20 11:45:47.793	RACH RSP General Info	
2011-09-20 11:45:47.840	RACH REQ Info	
2011-09-20 11:45:47.856	RACH RSP General Info	
2011-09-20 11:45:47.887	RACH REQ Info	
2011-09-20 11:45:47.918	RACH RSP General Info	
2011-09-20 11:45:47.949	RACH REQ Info	

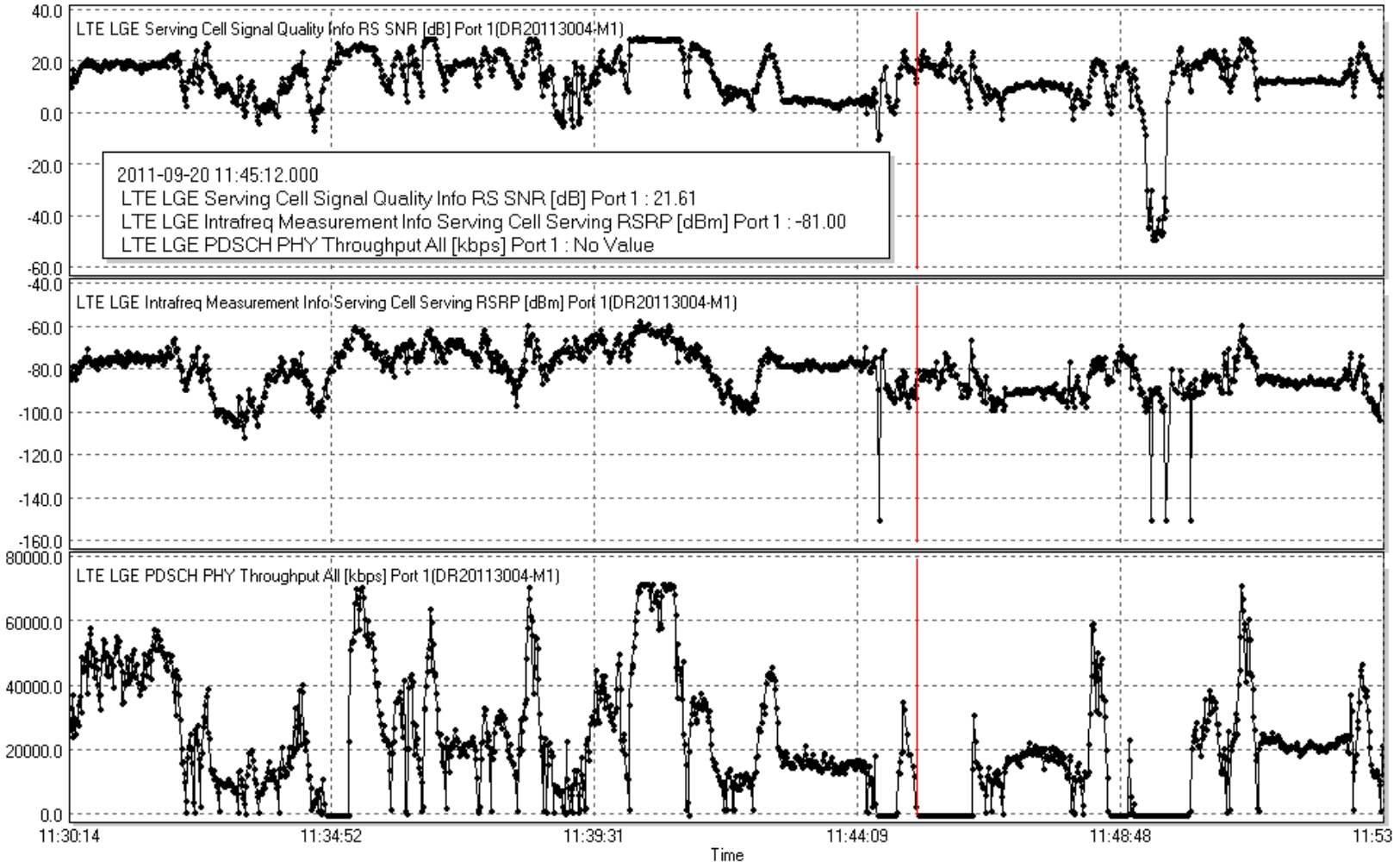
```
value DL-DCCH-Message ::=
  message c1 : rrcConnectionReconfiguration :
        rrc-TransactionIdentifier 1,
        criticalExtensions c1 : rrcConnectionReconfiguration-r8 :
              mobilityControlInfo
                targetPhysCellId 29,
```

```
TxTTI : 7551
RetNum : 0
RachType : HANDOVER
RA_RNTI : 2
PreambleID : 45
```

```
RxSTI : 7556
Result : ACK
dmHeaderInfo.RAPID : 45
dmHeaderInfo.BI : 0
TA : 4
T_CRNTI : 22729
dmUlGrantInfo.MCS : 5
dmUlGrantInfo.TPC : 3
dmUlGrantInfo.HF : 0
dmUlGrantInfo.UlDelay : 0
dmUlGrantInfo.CQIReq : 0
dmUlGrantInfo.RbAssign : 352
```

- UE received *RrcConnection-Reconfiguration* (handover command) for target cell: PCI 29.
- UE completed the contention-free random access to the target cell (preamble id = 45) by receiving Random Access Response (RACH RSP) from eNB and sent *RrcConnection ReconfigurationComplete* message to eNB.

UE Log: Radio Conditions



Cell trace: Source Cell (PCI=71)

User data	Target time
UE ID: 8, MME S1AP ID: 41374	11:47:52.556165
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 8, CRNTI: 31313, Cell ID: 135, Source RSRP: -90 dBm, PCI 29 RSRP: -82 dBm	11:48:13.194846
UE ID: 8, MME S1AP ID: 41374, Cell ID: 34606341	11:48:13.195663
UE ID: 8, MME S1AP ID: 41374, L3 Link ID: 0	11:48:13.197273
UE ID: 8, Conn ID: 16, L3 Link ID: 17	11:48:13.197041
UE ID: 8, Conn ID: 16, L3 Link ID: 17	11:48:13.198668
eNB X2AP: HandoverRequest, UE ID: 8, MME S1AP ID: 0, Conn ID: 0, L3 Link ID: 17	11:48:13.201008
Target eNB X2AP: HandoverRequestAcknowledge, eNB X2AP: HandoverRequestAcknowledge, UE ID: 8, MME S1AP ID: 0, L3 Link ID: 17	11:48:13.236851
UE ID: 8, UE ID: 0, CRNTI: 31313, Trans ID: 2, Cell ID: 135	11:48:13.236875
UE ID: 8	11:48:13.237545
UE ID: 8	11:48:13.237746
UE ID: 8, CRNTI: 31313, Trans ID: 2, Cell ID: 135	11:48:13.238923
eNB X2AP: SNStatusTransfer, UE ID: 8, MME S1AP ID: 0, Conn ID: 16, L3 Link ID: 17	11:48:13.239533
eNB PDSCH/DL-SCH/DCCH: RrcConnectionReconfiguration, UE ID: 8, CRNTI: 31313, Trans ID: 1, Cell ID: 135	11:48:13.240023
UE ID: 8, CRNTI: 31313, Trans ID: 1, Cell ID: 135, Msg error: MaxRlcRetransExceeded (TUP_UnsuccessfulTransmission)	11:48:15.910421
eNB S1AP: UEContextReleaseRequest, Cause : radioNetwork : tx2relocoverall-expiry, UE ID: 8, MME S1AP ID: 41374, Conn ID: 9, L3 Link ID	11:48:18.916603
EPC S1AP: UEContextReleaseCommand, Cause : nas : normal-release, UE ID: 8, MME S1AP ID: 41374, L3 Link ID: 1	11:48:18.942142
eNB PDSCH/DL-SCH/DCCH: RrcConnectionRelease, UE ID: 8, CRNTI: 31313, Trans ID: 3, Cell ID: 135	11:48:18.942018
eNB S1AP: UEContextReleaseComplete, UE ID: 8, MME S1AP ID: 41374, Conn ID: 9, L3 Link ID: 1	11:48:18.942671

tx2relocoverall timer= 5.35s

•RLC layer detected issue on DL data acknowledgements and triggered RLC retransmissions until maximum number of retransmissions (16) were reached.

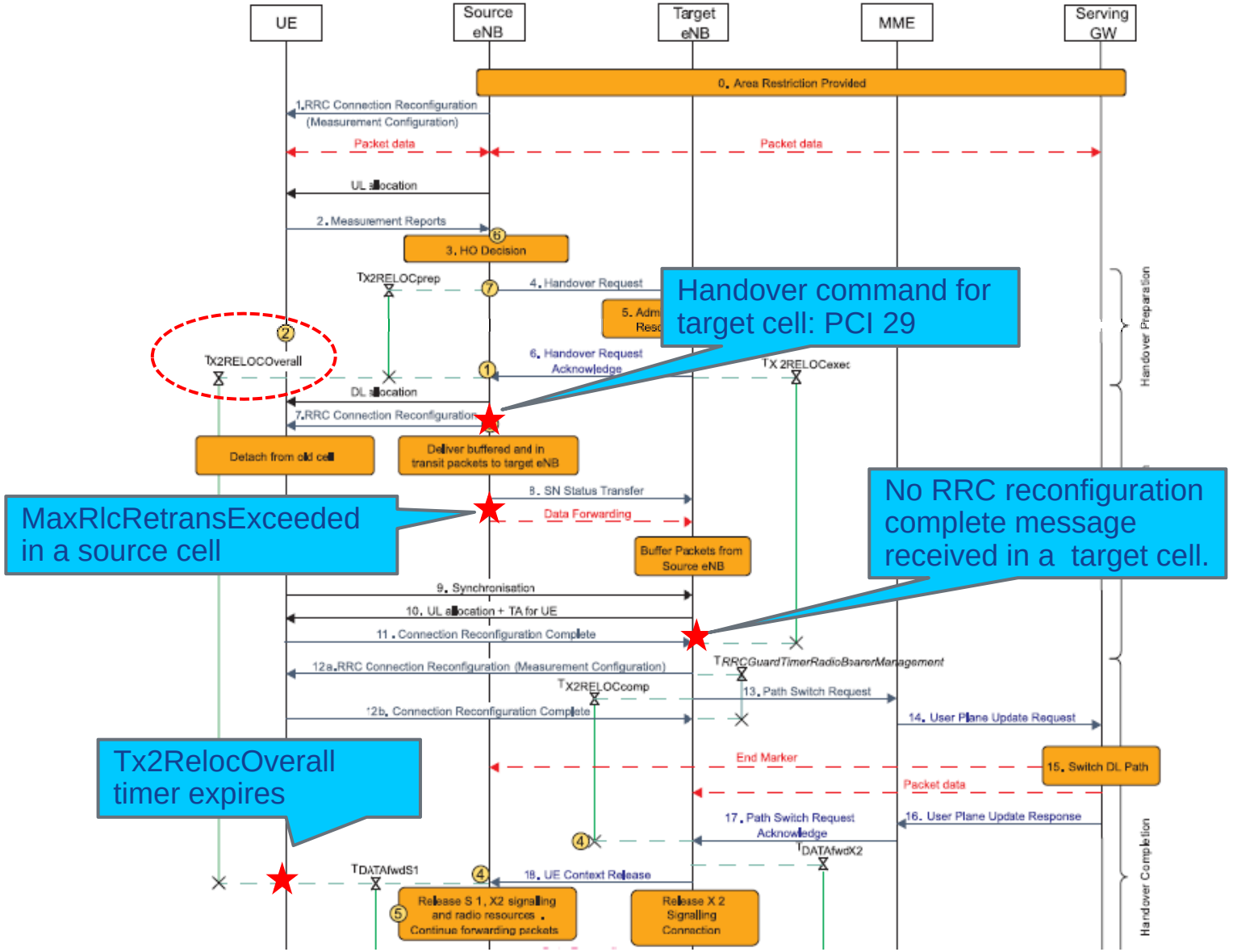
- The UE context release was initiated by eNB on a source cell with cause: *tx2relocoverall-expiry* (*tx2relocoverall=T304max+T311+T301+ tx2relocoverallDelta* = 5350ms).

Cell trace: Target Cell (PCI=29)

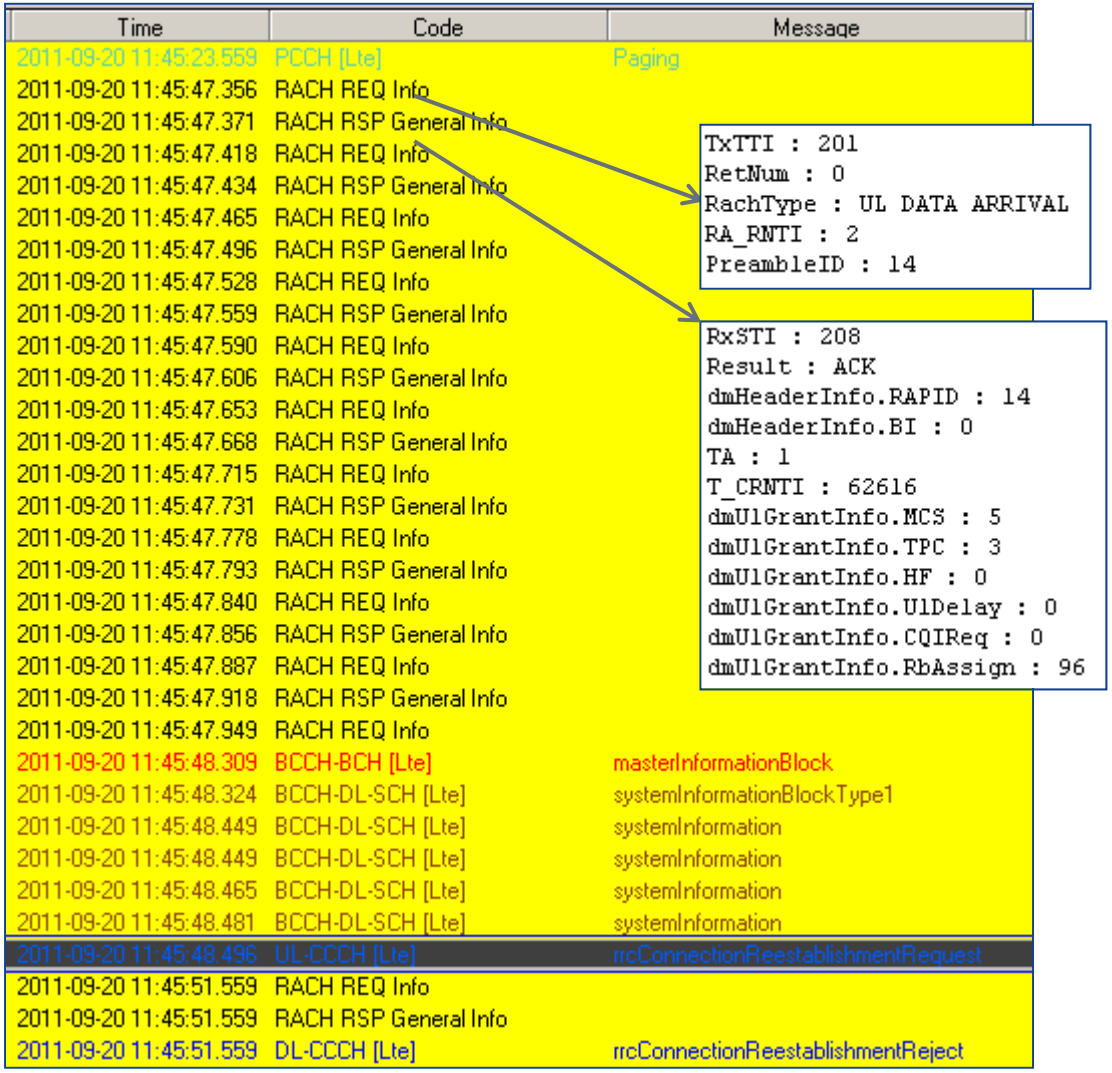
User data	Target time
UE ID: 14, CRNTI: 22729, CRNTI: 9128, Trans ID: 3, Cell ID: 5	11:44:56.801670
UE ID: 14, UE ID: 0, CRNTI: 22729, Trans ID: 2, Cell ID: 5	11:44:56.802105
UE ID: 14, CRNTI: 22729, Trans ID: 2, Cell ID: 5	11:44:56.802971
UE ID: 14, CRNTI: 22729, Trans ID: 2, Cell ID: 5	11:44:56.803327
UE ID: 14, CRNTI: 22729, Trans ID: 2, Cell ID: 5	11:44:56.803836
UE ID: 14, Conn ID: 24, L3 Link ID: 1	11:44:56.804200
UE ID: 14, Conn ID: 24, L3 Link ID: 1	11:44:56.805273
UE ID: 14, Conn ID: 41, L3 Link ID: 21	11:44:56.805841
UE ID: 14, Conn ID: 41, L3 Link ID: 21	11:44:56.806510
eNB X2AP: HandoverRequestAcknowledge, UE ID: 14, MME S1AP ID: 0, Conn ID: 41, L3 Link ID: 21	11:44:56.819107
Target eNB X2AP: SNStatusTransfer, eNB X2AP: SNStatusTransfer, UE ID: 14, MME S1AP ID: 0, L3 Link ID: 21	11:44:56.831628
UE ID: 14, CRNTI: 22729, Trans ID: 2, Cell ID: 5	11:44:56.832693
UE ID: 14, CRNTI: 22729, Trans ID: 2, Cell ID: 5	11:44:56.833608
eNB PDSCH/DL-SCH/CCCH: RandomAccessResponse, CRNTI: 22729, Cell ID: 5, TA: 2.1 us/624 m, FreqHop: No, Mod: QPSK, TPC: 0 dB,	11:44:56.864182
UE ID: 14, CRNTI: 22729, Trans ID: 2, Cell ID: 5	11:45:30.378245
UE ID: 14, CRNTI: 22729, Trans ID: 2, Cell ID: 5	11:45:30.379258

- The UE receives successfully random access response from a target cell (C-RNTI=22729) but *RrcConnectionReconfigurationComplete* message (Msg3) was never received for some reason (e.g. interference or poor uplink coverage) by a target cell and thus, the handover was not further proceeded.

Inter-eNB X2 Handover – Message Flow



UE Log: Random Access for UL Data Arrival



Time	Code	Message
2011-09-20 11:45:23.559	PCCH [Lte]	Paging
2011-09-20 11:45:47.356	RACH REQ Info	
2011-09-20 11:45:47.371	RACH RSP General Info	
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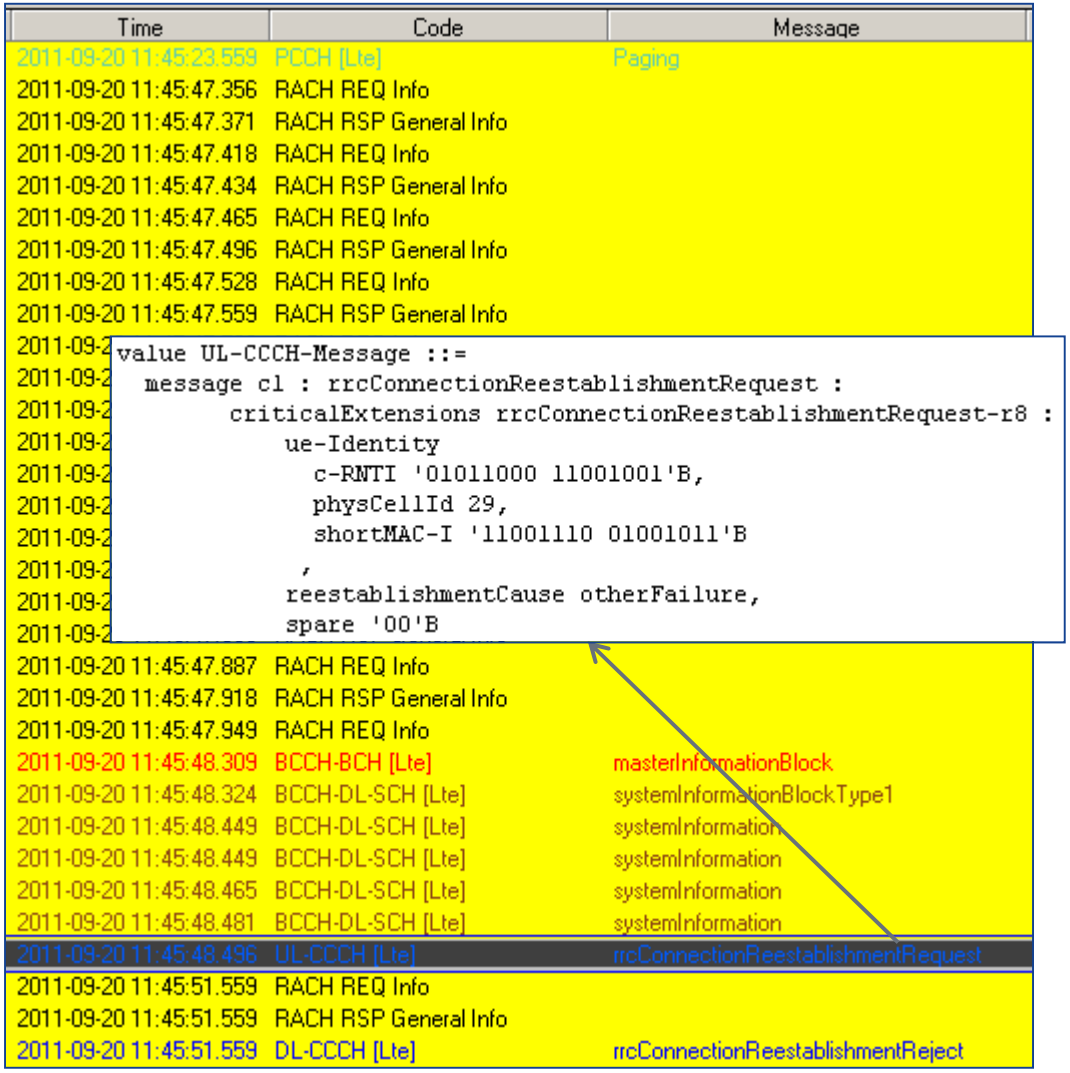
2011-09-20 11:45:47.465	RACH REQ Info	
2011-09-20 11:45:47.496	RACH RSP General Info	
2011-09-20 11:45:47.528	RACH REQ Info	
2011-09-20 11:45:47.559	RACH RSP General Info	
2011-09-20 11:45:47.590	RACH REQ Info	
2011-09-20 11:45:47.606	RACH RSP General Info	
2011-09-20 11:45:47.653	RACH REQ Info	
2011-09-20 11:45:47.668	RACH RSP General Info	
2011-09-20 11:45:47.715	RACH REQ Info	
2011-09-20 11:45:47.731	RACH RSP General Info	
2011-09-20 11:45:47.778	RACH REQ Info	
2011-09-20 11:45:47.793	RACH RSP General Info	
2011-09-20 11:45:47.840	RACH REQ Info	
2011-09-20 11:45:47.856	RACH RSP General Info	
2011-09-20 11:45:47.887	RACH REQ Info	
2011-09-20 11:45:47.918	RACH RSP General Info	
2011-09-20 11:45:47.949	RACH REQ Info	
2011-09-20 11:45:48.309	BCCH-BCH [Lte]	masterInformationBlock
2011-09-20 11:45:48.324	BCCH-DL-SCH [Lte]	systemInformationBlockType1
2011-09-20 11:45:48.449	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 11:45:48.449	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 11:45:48.465	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 11:45:48.481	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 11:45:48.496	UL-CCCH [Lte]	rrcConnectionReestablishmentRequest
2011-09-20 11:45:51.559	RACH REQ Info	
2011-09-20 11:45:51.559	RACH RSP General Info	
2011-09-20 11:45:51.559	DL-CCCH [Lte]	rrcConnectionReestablishmentReject

```
TxTTI : 201
RetNum : 0
RachType : UL DATA ARRIVAL
RA_RNTI : 2
PreambleID : 14
```

```
RxSTI : 208
Result : ACK
dmHeaderInfo.RAPID : 14
dmHeaderInfo.BI : 0
TA : 1
T_CRNTI : 62616
dmUlGrantInfo.MCS : 5
dmUlGrantInfo.TPC : 3
dmUlGrantInfo.HF : 0
dmUlGrantInfo.UlDelay : 0
dmUlGrantInfo.CQIReq : 0
dmUlGrantInfo.RbAssign : 96
```

- The eNB had already released RRC connection and stopped scheduling the UE.
- However, UE never received *RrcConnectionRelease* message and thus, the random access procedure was initiated due to UL data arrival.
- The UE keeps sending the requests until max. preamble retransmissions (10) reached.

UE Log: RRC Connection Re-establishment

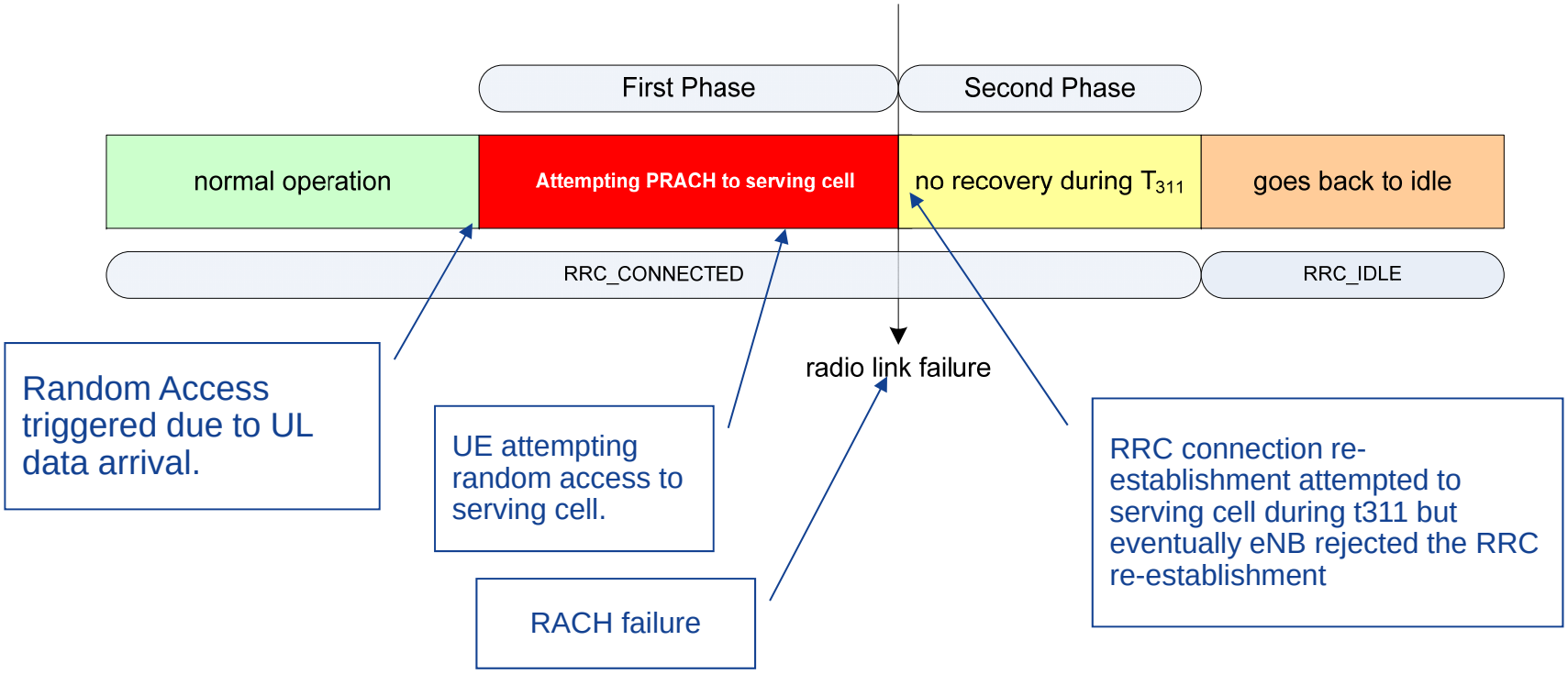


Time	Code	Message
2011-09-20 11:45:23.559	PCCH [Lte]	Paging
2011-09-20 11:45:47.356	RACH REQ Info	
2011-09-20 11:45:47.371	RACH RSP General Info	
2011-09-20 11:45:47.418	RACH REQ Info	
2011-09-20 11:45:47.434	RACH RSP General Info	
2011-09-20 11:45:47.465	RACH REQ Info	
2011-09-20 11:45:47.496	RACH RSP General Info	
2011-09-20 11:45:47.528	RACH REQ Info	
2011-09-20 11:45:47.559	RACH RSP General Info	
2011-09-20 11:45:47.887	RACH REQ Info	
2011-09-20 11:45:47.918	RACH RSP General Info	
2011-09-20 11:45:47.949	RACH REQ Info	
2011-09-20 11:45:48.309	BCCH-BCH [Lte]	masterInformationBlock
2011-09-20 11:45:48.324	BCCH-DL-SCH [Lte]	systemInformationBlockType1
2011-09-20 11:45:48.449	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 11:45:48.449	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 11:45:48.465	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 11:45:48.481	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 11:45:48.496	UL-CCCH [Lte]	rrcConnectionReestablishmentRequest
2011-09-20 11:45:51.559	RACH REQ Info	
2011-09-20 11:45:51.559	RACH RSP General Info	
2011-09-20 11:45:51.559	DL-CCCH [Lte]	rrcConnectionReestablishmentReject

```
value UL-CCCH-Message ::=
  message cl : rrcConnectionReestablishmentRequest :
        criticalExtensions rrcConnectionReestablishmentRequest-r8 :
            ue-Identity
              c-RNTI '01011000 11001001'B,
              physCellId 29,
              shortMAC-I '11001110 01001011'B
             ,
            reestablishmentCause otherFailure,
            spare '00'B
```

- After the failed random access procedure, RRC connection re-establishment was initiated by UE to the target cell.
- However, RRC connection re-establishment was rejected by the eNB because the UE context was earlier released due to incomplete handover.

Radio Link Failure



Case Study: Call Drop due to Handover Cancel – *Tx2RelocPrep* Timer Expiry

UE Log: Multiple Measurement Reports from UE

Time	Code	Message
2011-11-01 18:53:00.616	UL-DCCH [Lte]	measurementReport
2011-11-01 18:53:00.855	UL-DCCH [Lte]	measurementReport
2011-11-01 18:53:01.095	UL-DCCH [Lte]	measurementReport
2011-11-01 18:53:01.334	UL-DCCH [Lte]	measurementReport
2011-11-01 18:53:01.575	UL-DCCH [Lte]	measurementReport
2011-11-01 18:53:01.815	UL-DCCH [Lte]	measurementReport
2011-11-01 18:53:02.055	UL-DCCH [Lte]	measurementReport
2011-11-01 18:53:02.295	UL-DCCH [Lte]	measurementReport
2011-11-01 18:53:02.534	UL-DCCH [Lte]	measurementReport
2011-11-01 18:53:02.774	UL-DCCH [Lte]	measurementReport
2011-11-01 18:53:03.015	UL-DCCH [Lte]	measurementReport
2011-11-01 18:53:03.255	UL-DCCH [Lte]	measurementReport
2011-11-01 18:53:03.494	UL-DCCH [Lte]	measurementReport
2011-11-01 18:53:03.735	UL-DCCH [Lte]	measurementReport
2011-11-01 18:53:03.975	UL-DCCH [Lte]	measurementReport
2011-11-01 18:53:04.214	UL-DCCH [Lte]	measurementReport
2011-11-01 18:53:04.455	UL-DCCH [Lte]	measurementReport
2011-11-01 18:53:04.536	Radio Problem Cause	
2011-11-01 18:53:05.007	BCCH-BCH [Lte]	masterInformationBlock
2011-11-01 18:53:05.033	BCCH-DL-SCH [Lte]	systemInformationBlockType1
2011-11-01 18:53:05.048	BCCH-DL-SCH [Lte]	systemInformation
2011-11-01 18:53:05.057	BCCH-DL-SCH [Lte]	systemInformation
2011-11-01 18:53:05.071	BCCH-DL-SCH [Lte]	systemInformation
2011-11-01 18:53:05.082	UL-CCCH [Lte]	rrcConnectionReestablishmentRequest
2011-11-01 18:53:08.141	RACH REQ Info	
2011-11-01 18:53:08.141	RACH RSP General Info	
2011-11-01 18:53:08.141	DL-CCCH [Lte]	rrcConnectionReestablishmentReject
2011-11-01 18:53:08.141	BCCH-BCH [Lte]	masterInformationBlock

```
value UL-DCCH-Message ::=
  message c1 : measurementReport :
        criticalExtensions c1 : measurementReport-r8 :
              measResults
                measId 1,
                measResultServCell
                  rsrpResult 56,
                  rsrqResult 2
                 ,
                measResultNeighCells measResultListEUTRA :
                      physCellId 160,
                      measResult
                        rsrpResult 67
                     ,
                      physCellId 157,
                      measResult
                        rsrpResult 65
                     ,
                      physCellId 158,
                      measResult
                        rsrpResult 62
```

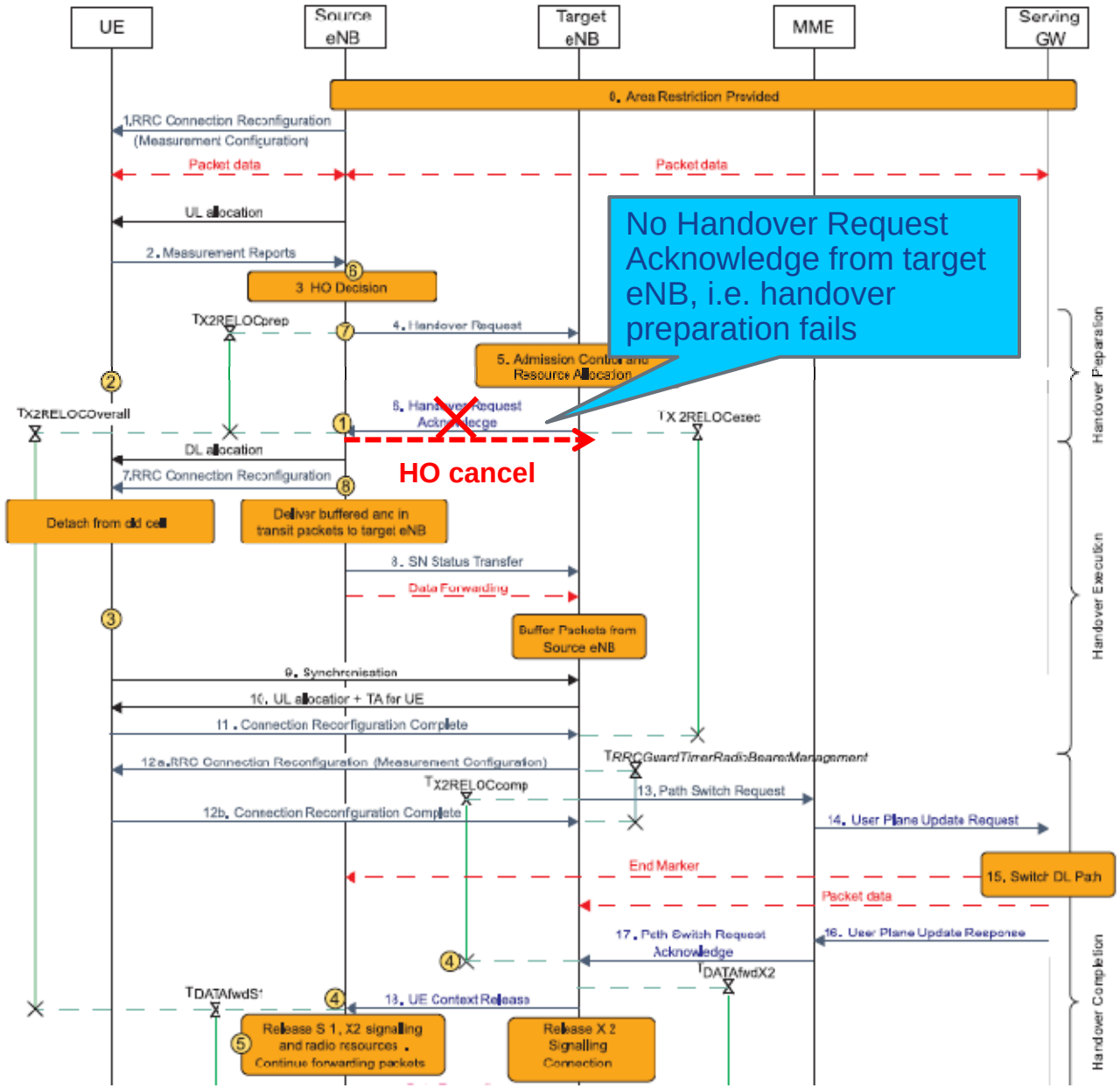
- UE triggers multiple measurements reports for handover (event A3) but no response from eNB.

Cell trace: Source Cell (PCI = 124)

User data	Target time
UE ID: 246, Conn ID: 996, L3 Link ID: 18	18:52:50.395868
UE ID: 246, Conn ID: 996, L3 Link ID: 18	18:52:50.396556
eNB X2AP: HandoverRequest, UE ID: 246, MME S1AP ID: 0, Conn ID: 0, L3 Link ID: 18	18:52:50.399549
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 246, CRNTI: 65074, Cell ID: 4014, Source RSRP: -83 dB	18:52:50.573791
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 246, CRNTI: 65074, Cell ID: 4014, Source RSRP: -84 dB	18:52:50.815925
eNB X2AP: HandoverCancel, UE ID: 246, MME S1AP ID: 0, Conn ID: 0, L3 Link ID: 18	18:52:50.908889
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 246, CRNTI: 65074, Cell ID: 4014, Source RSRP: -84 dB	18:52:51.053800
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 246, CRNTI: 65074, Cell ID: 4014, Source RSRP: -84 dB	18:52:51.292794
UE ID: 246, Conn ID: 996, L3 Link ID: 18	18:52:51.414784
UE ID: 246, Conn ID: 996, L3 Link ID: 18	18:52:51.415563
UE ID: 246, MME S1AP ID: 577700, L3 Link ID: 0	18:52:51.416103
UE ID: 246, MME S1AP ID: 577700	18:52:51.417163
UE ID: 246, MME S1AP ID: 577700, Cell ID: 34705668	18:52:51.417840
UE ID: 246, MME S1AP ID: 577700, L3 Link ID: 0	18:52:51.418517
UE ID: 246, Conn ID: 997, L3 Link ID: 18	18:52:51.419008
UE ID: 246, Conn ID: 997, L3 Link ID: 18	18:52:51.419675
eNB X2AP: HandoverRequest, UE ID: 246, MME S1AP ID: 0, Conn ID: 0, L3 Link ID: 18	18:52:51.422524
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 246, CRNTI: 65074, Cell ID: 4014, Source RSRP: -84 dB	18:52:51.539855
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 246, CRNTI: 65074, Cell ID: 4014, Source RSRP: -84 dB	18:52:51.773849
eNB X2AP: HandoverCancel, UE ID: 246, MME S1AP ID: 0, Conn ID: 0, L3 Link ID: 18	18:52:51.931799
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 246, CRNTI: 65074, Cell ID: 4014, Source RSRP: -84 dB	18:52:52.011910
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 246, CRNTI: 65074, Cell ID: 4014, Source RSRP: -83 dB	18:52:52.277704

•The source eNB sends multiple X2AP: HANDOVER REQUEST messages but target eNB does not respond with X2AP: HANDOVER ACKNOWLEDGE and thus, after the expiry of *tX2RelocPrep* timer (500ms) the X2AP: HANDOVER CANCEL procedure is started.

Inter-eNB X2 Handover – Message Flow



Case Study: Call Drop due to Handover Failure – No Path Switch Request ACK from MME

UE log: RRC Connection Release

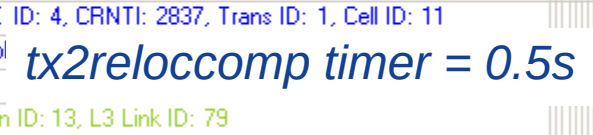
Time	Code	Message
2011-09-16 14:34:54.199	DL-DCCH [Lte]	rrcConnectionReconfiguration
2011-09-16 14:34:54.210	UL-DCCH [Lte]	rrcConnectionReconfigurationComplete
2011-09-16 14:34:54.212	RACH REQ Info	
2011-09-16 14:34:54.226	RACH RSP General Info	
2011-09-16 14:34:54.244	DL-DCCH [Lte]	rrcConnectionReconfiguration
2011-09-16 14:34:54.244	UL-DCCH [Lte]	rrcConnectionReconfigurationComplete
2011-09-16 14:34:54.251	BCCH-BCH [Lte]	
2011-09-16 14:34:54.277	BCCH-DL-SCH [Lte]	
2011-09-16 14:34:54.282	Cell Information	
2011-09-16 14:34:55.009	DL-DCCH [Lte]	
2011-09-16 14:34:58.030	BCCH-BCH [Lte]	
2011-09-16 14:34:58.030	BCCH-DL-SCH [Lte]	
2011-09-16 14:34:58.031	BCCH-DL-SCH [Lte]	systemInformation
2011-09-16 14:34:58.031	BCCH-DL-SCH [Lte]	systemInformation
2011-09-16 14:34:58.031	BCCH-DL-SCH [Lte]	systemInformation
2011-09-16 14:34:58.031	BCCH-DL-SCH [Lte]	systemInformation
2011-09-16 14:34:58.032	Cell Information	
2011-09-16 14:34:58.032	UL EPS MM	Service request
2011-09-16 14:34:58.032	UL-CCCH [Lte]	rrcConnectionRequest

```
value DL-DCCH-Message ::=
  message c1 : rrcConnectionRelease :
        rrc-TransactionIdentifier 3,
        criticalExtensions c1 : rrcConnectionRelease-r8 :
              releaseCause other
```

- The message: *rrcConnectionRelease* was sent by eNB to release the call after UE successfully handover from PCI:56 to PCI:4.

Cell trace: No PathSwitchRequestACK from MME

User data	Target time
UE ID: 4, Conn ID: 13, L3 Link ID: 79	14:34:06.133648
eNB X2AP: HandoverRequestAcknowledge, UE ID: 4, MME S1AP ID: 0, Conn ID: 13, L3 Link ID: 79	14:34:06.139250
Target eNB X2AP: SNStatusTransfer, eNB X2AP: SNStatusTransfer, UE ID: 4, MME S1AP ID: 0, L3 Link ID: 79	14:34:06.145219
UE ID: 4, CRNTI: 2837, Trans ID: 2, Cell ID: 11	14:34:06.146389
UE ID: 4, CRNTI: 2837, Trans ID: 2, Cell ID: 11	14:34:06.147148
eNB PDSCH/DL-SCH/CCCH: RandomAccessResponse, CRNTI: 2837, Cell ID: 11, TA: 2.6 us/779 m, FreqHop: No, Mo	14:34:06.178733
UE PUSCH/UL-SCH/DCCH: RrcConnectionReconfigurationComplete, UE ID: 4, CRNTI: 2837, Cell ID: 11	14:34:06.189835
eNB S1AP: PathSwitchRequest, UE ID: 4, MME S1AP ID: 623, Conn ID: 10, L3 Link ID: 1	14:34:06.190533
eNB PDSCH/DL-SCH/DCCH: RrcConnectionReconfiguration, UE ID: 4, CRNTI: 2837, Trans ID: 1, Cell ID: 11	14:34:06.192353
UE PUSCH/UL-SCH/DCCH: RrcConnectionReconfigurationCompl	14:34:06.211867
UE ID: 4, CRNTI: 2837, Cell ID: 11	14:34:06.275554
eNB X2AP: UEContextRelease, UE ID: 4, MME S1AP ID: 0, Conn ID: 13, L3 Link ID: 79	14:34:06.703102
eNB PDSCH/DL-SCH/DCCH: RrcConnectionRelease, UE ID: 4, CRNTI: 2837, Trans ID: 3, Cell ID: 11	14:34:06.957463
UE PUCCH/UCI: RlcAck, UE ID: 4, CRNTI: 2837, Trans ID: 3, Cell ID: 11	14:34:06.969936
UE ID: 4, CRNTI: 2837, Trans ID: 2, Cell ID: 11	14:34:06.970553
UE ID: 4, CRNTI: 2837, Trans ID: 2, Cell ID: 11	14:34:06.971692
UE ID: 4, CRNTI: 2837, Trans ID: 3, Cell ID: 11	14:34:06.972056
UE ID: 4, Conn ID: 10, L3 Link ID: 1	14:34:06.972580



• No *S1AP:PathSwitchRequestACK* message response from MME, so after expiration of timer *tx2relocccomp* (= 500ms) the target eNB initiated UE context release procedure to release the resource in both source eNB by sending *X2AP:UEContextRelease* and target eNB by sending *RrcConnectionRelease* to UE for release the call.

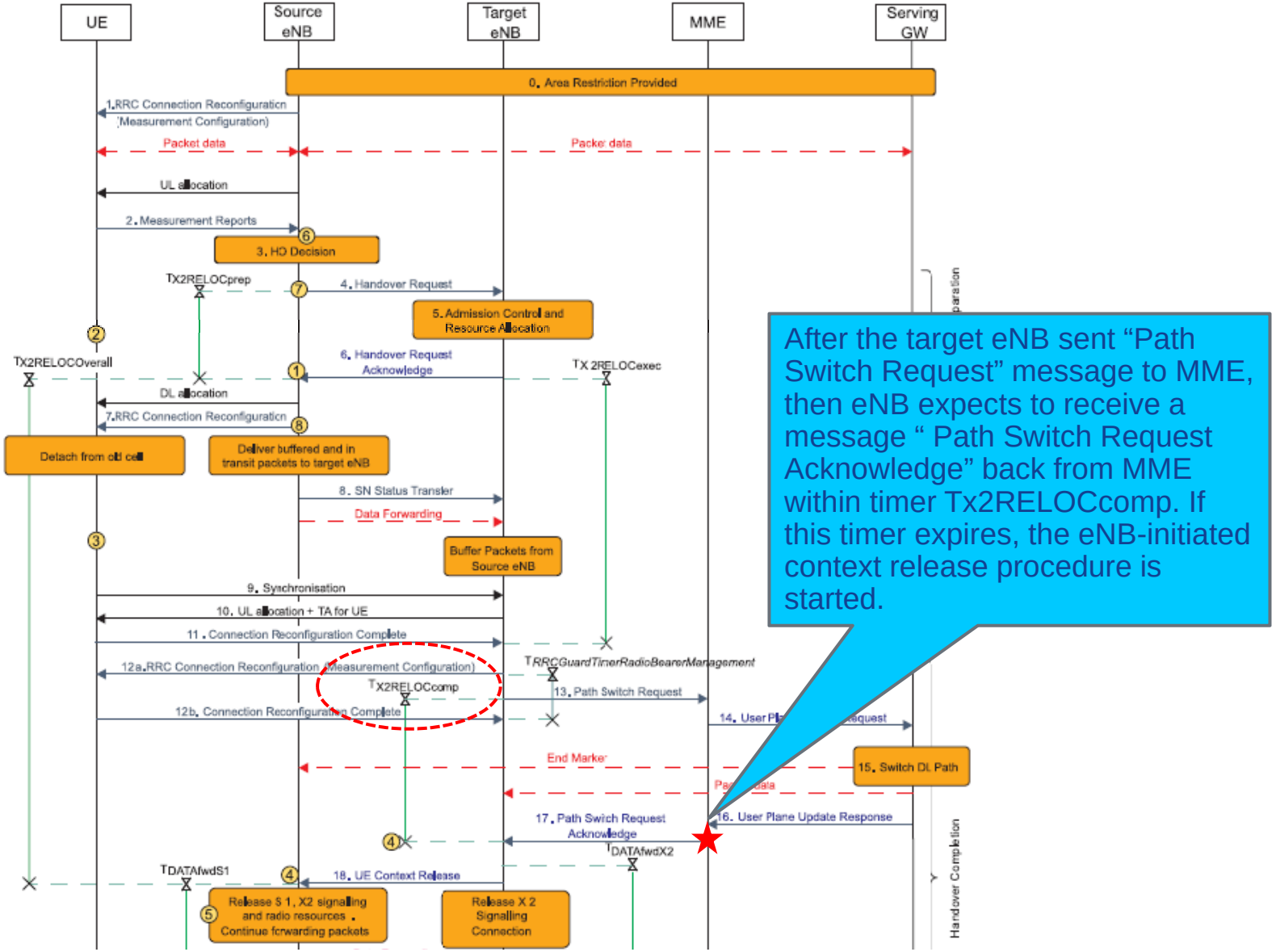
Cell trace: No PathSwitchRequestAck from MME

User data	Target time
UE ID: 101, CRNTI: 59171, Trans ID: 2, Cell ID: 110	11:37:43.852776
UE ID: 101, CRNTI: 59171, Trans ID: 2, Cell ID: 110	11:37:43.853290
UE ID: 101, Conn ID: 117, L3 Link ID: 1	11:37:43.853672
UE ID: 101, Conn ID: 117, L3 Link ID: 1	11:37:43.855077
UE ID: 101, Conn ID: 46, L3 Link ID: 77	11:37:43.854856
UE ID: 101, Conn ID: 46, L3 Link ID: 77	11:37:43.856201
eNB X2AP: HandoverRequestAcknowledge, UE ID: 101, MME S1AP ID: 0, Conn ID: 46, L3 Link ID: 77	11:37:43.861688
Target eNB X2AP: SNStatusTransfer, eNB X2AP: SNStatusTransfer, UE ID: 101, MME S1AP ID: 0, L3 Link ID: 77	11:37:43.877507
UE ID: 101, CRNTI: 59171, Trans ID: 2, Cell ID: 110	11:37:43.877959
UE ID: 101, CRNTI: 59171, Trans ID: 2, Cell ID: 110	11:37:43.879077
eNB PDSCH/DL-SCH/CCCH: RandomAccessResponse, CRNTI: 59171, Cell ID: 110, TA: 3.1 us/935 m, FreqHop: No, Mod: QPSK, TPC: 0 d	11:37:43.917743
UE PUSCH/UL-SCH/DCCH: RrcConnectionReconfigurationComplete, UE ID: 101, CRNTI: 59171, Cell ID: 110	11:37:43.936899
eNB S1AP: PathSwitchRequest, UE ID: 101, MME S1AP ID: 39965, Conn ID: 117, L3 Link ID: 1	11:37:43.937618
eNB PDSCH/DL-SCH/DCCH: RrcConnectionReconfiguration, UE ID: 101, CRNTI:	11:37:43.939541
UE PUSCH/UL-SCH/DCCH: RrcConnectionReconfigurationComplete, UE ID: 101,	11:37:43.961748
eNB X2AP: UEContextRelease, UE ID: 101, MME S1AP ID: 0, Conn ID: 46, L3 Link ID: 77	11:37:45.984523
eNB PDSCH/DL-SCH/DCCH: RrcConnectionRelease, UE ID: 101, CRNTI: 59171, Trans ID: 3, Cell ID: 110	11:37:46.238918
UE PUCCH/UCI: RlcAck, UE ID: 101, CRNTI: 59171, Trans ID: 3, Cell ID: 110	11:37:46.251965

tx2reloccomp timer = 2s

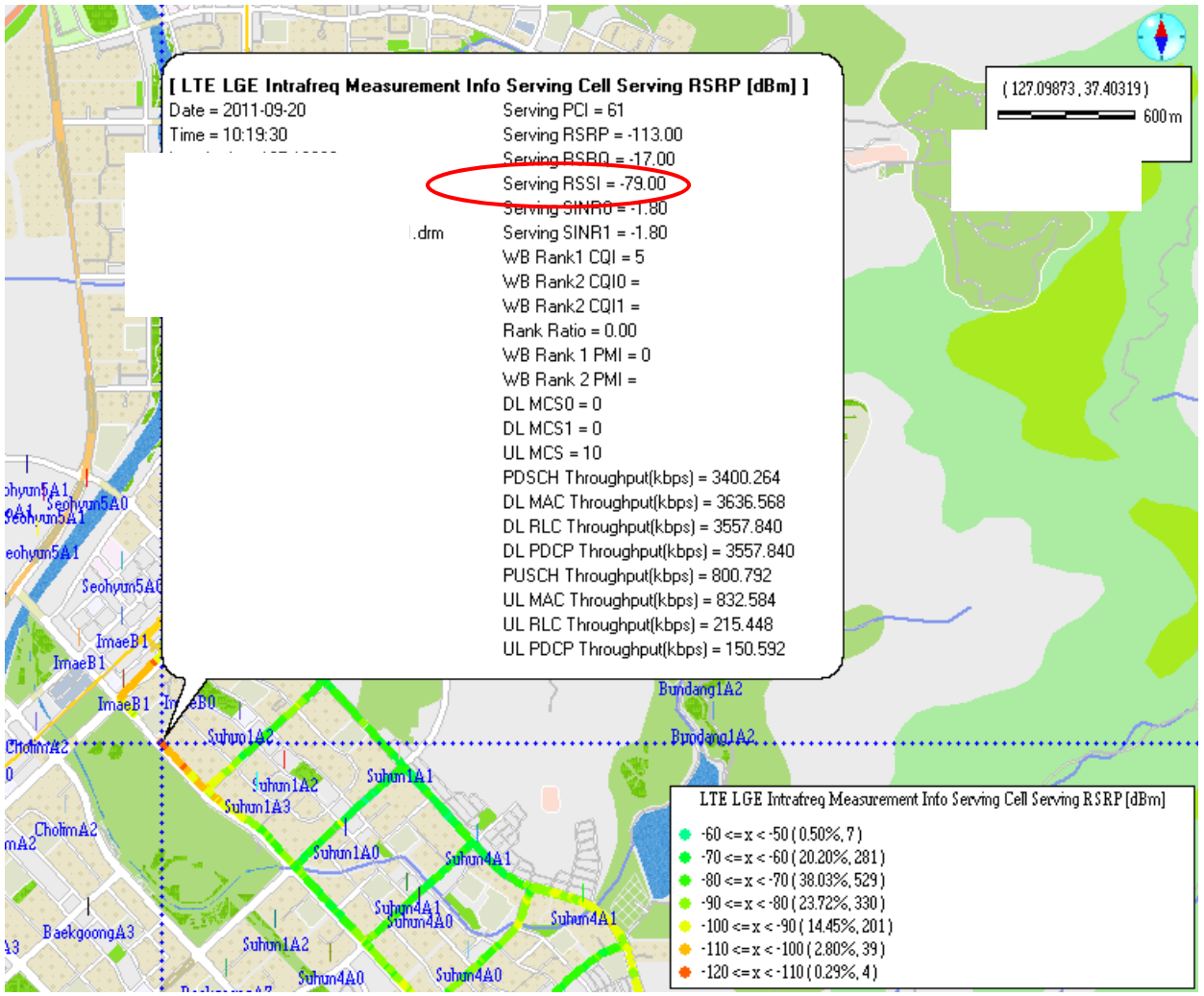
- The timer *tx2reloccomp* setting was changed to 2000ms (max. value) in order to allow more time for MME for path switch but it failed as well.

Inter-eNB X2 Handover – Message Flow



Case Study: Missing Neighbour – RRC Release with Redirect to eHRPD

UE Log: Low Serving Cell RSRP



UE Log: RRC Release with Redirect to eHRPD

Time	Code	Message
2011-09-20 10:19:25.599	BCCH-BCH [Lte]	masterInformationBlock
2011-09-20 10:19:25.630	BCCH-DL-SCH [Lte]	systemInformationBlockType1
2011-09-20 10:19:25.740	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 10:19:25.896	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 10:19:25.943	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 10:19:25.943	Cell Information	
2011-09-20 10:19:27.974	PCCH [Lte]	Paging
2011-09-20 10:19:28.786	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:28.786	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:29.021	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:29.036	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:29.271	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:29.271	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:29.505	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:29.521	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:29.630	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:29.755	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:29.755	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:29.990	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:29.990	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:30.099	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:30.240	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:30.349	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:30.474	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:30.536	UL-DCCH [Lte]	measurementReport
2011-09-20 10:19:30.552	DL-DCCH [Lte]	rrcConnectionRelease

```
value UL-DCCH-Message ::=
  message c1 : measurementReport :
        criticalExtensions c1 : measurementReport-r8 :
              measResults
                measId 4,
                measResultServCell
                  rsrpResult 27,
                  rsrqResult 4
```

```
value DL-DCCH-Message ::=
  message c1 : rrcConnectionRelease :
        rrc-TransactionIdentifier 3,
        criticalExtensions c1 : rrcConnectionRelease-r8 :
              releaseCause other,
              redirectedCarrierInfo cdma2000-HRPD :
                  bandClass bc4,
                  arfcn 500
```

- UE is sending consecutive measurement reports until *RrcConnectionRelease* is received from eNB.
- The event A2 is triggered: RSRP 27 (-113 dBm) < threshold4 (-110 dBm)

NOKIA

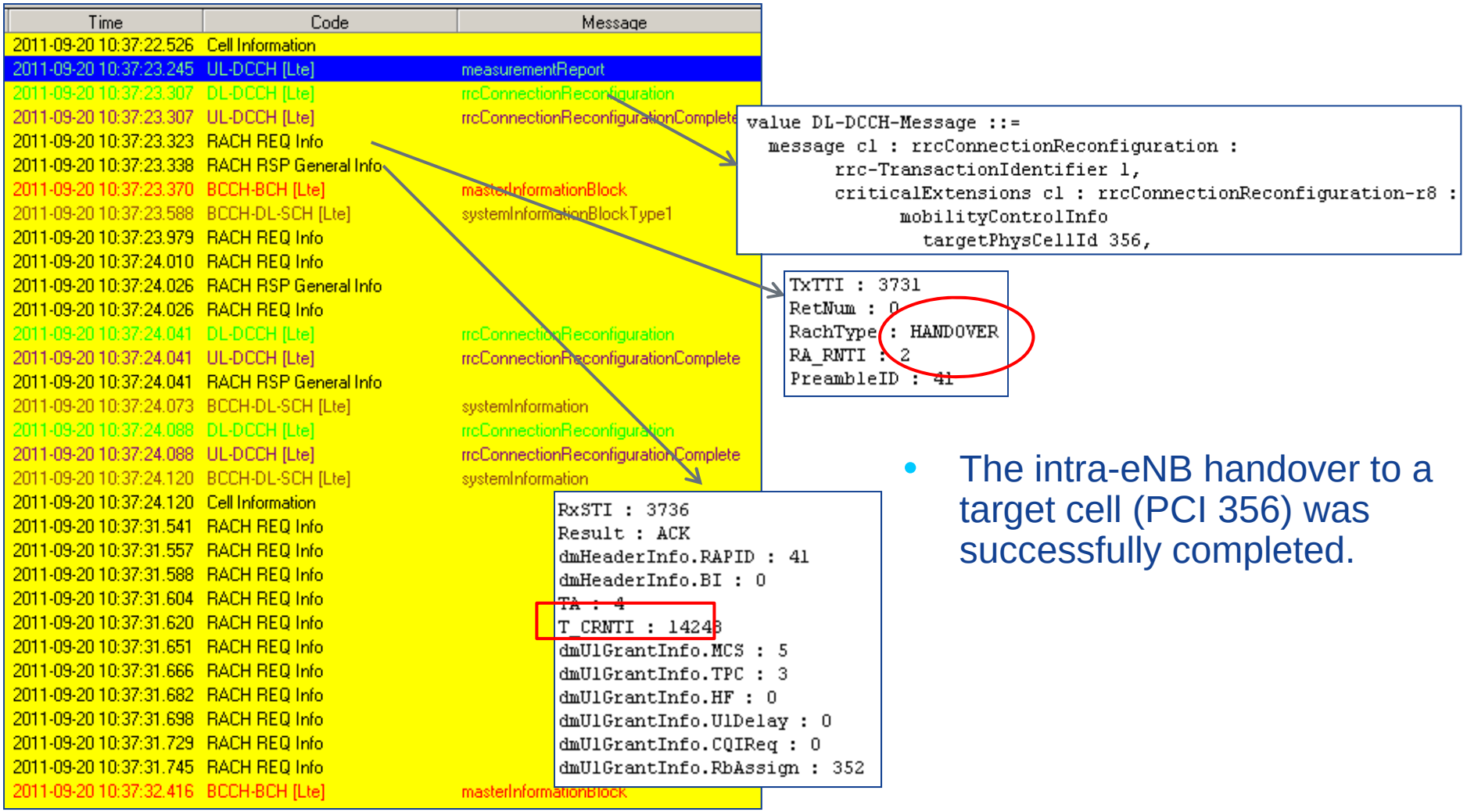
Cell trace: RRC Connection Release

User data	Target time
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 1, CRNTI: 14248, Cell ID: 121, Source RSRP: -109 dBm, PCI 168 RSRP: -105 dBm	10:22:30.013833
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 1, CRNTI: 14248, Cell ID: 121, Source RSRP: -110 dBm, PCI 168 RSRP: -104 dBm	10:22:30.249835
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 1, CRNTI: 14248, Cell ID: 121, Source RSRP: -110 dBm, PCI 168 RSRP: -104 dBm	10:22:30.260690
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 1, CRNTI: 14248, Cell ID: 121, Source RSRP: -110 dBm, PCI 168 RSRP: -104 dBm	10:22:30.491721
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 1, CRNTI: 14248, Cell ID: 121, Source RSRP: -110 dBm, PCI 168 RSRP: -104 dBm	10:22:30.492786
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 1, CRNTI: 14248, Cell ID: 121, Source RSRP: -110 dBm, PCI 168 RSRP: -105 dBm	10:22:30.735820
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 1, CRNTI: 14248, Cell ID: 121, Source RSRP: -110 dBm, PCI 168 RSRP: -105 dBm	10:22:30.743691
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 1, CRNTI: 14248, Cell ID: 121, Source RSRP: -110 dBm, PCI 168 RSRP: -105 dBm	10:22:30.851009
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 1, CRNTI: 14248, Cell ID: 121, Source RSRP: -111 dBm, PCI 193 RSRP: -106 dBm	10:22:30.970809
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 1, CRNTI: 14248, Cell ID: 121, Source RSRP: -111 dBm, PCI 193 RSRP: -106 dBm	10:22:30.972688
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 1, CRNTI: 14248, Cell ID: 121, Source RSRP: -112 dBm, PCI 193 RSRP: -106 dBm	10:22:31.210803
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 1, CRNTI: 14248, Cell ID: 121, Source RSRP: -112 dBm, PCI 193 RSRP: -106 dBm	10:22:31.220843
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 1, CRNTI: 14248, Cell ID: 121, Source RSRP: -112 dBm, PCI 168 RSRP: -106 dBm	10:22:31.329718
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 1, CRNTI: 14248, Cell ID: 121, Source RSRP: -113 dBm, PCI 168 RSRP: -106 dBm	10:22:31.460850
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 1, CRNTI: 14248, Cell ID: 121, Source RSRP: -113 dBm, PCI 168 RSRP: -106 dBm	10:22:31.578766
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 1, CRNTI: 14248, Cell ID: 121, Source RSRP: -113 dBm, PCI 168 RSRP: -106 dBm	10:22:31.700854
UE PUSCH/UL-SCH/DCCH: MeasurementReport, UE ID: 1, CRNTI: 14248, Cell ID: 121, Source RSRP: -113	10:22:31.761705
eNB PDSCH/DL-SCH/DCCH: RrcConnectionRelease, redirectedCarrierInfo cdma2000-HRPD : {, UE ID: 1, CRNTI: 14248, Trans ID: 3, Cell ID	10:22:31.762459
eNB S1AP: UEContextReleaseRequest, Cause : radioNetwork : interrat-redirection, UE ID: 1, MME S1AP ID: 37830, Conn ID: 117, L3 Link ID	10:22:31.763525
UE PUCCH/UCI: RlcAck, UE ID: 1, CRNTI: 14248, Trans ID: 3, Cell ID: 121	10:22:31.774452
EPC S1AP: UEContextReleaseCommand, Cause : nas : normal-release, UE ID: 1, MME S1AP ID: 37830, L3 Link ID: 1	10:22:31.799080
eNB S1AP: UEContextReleaseComplete, UE ID: 1, MME S1AP ID: 37830, Conn ID: 117, L3 Link ID: 1	10:22:31.799525

- The UE sends measurement reports but the eNodeB doesn't react to them (i.e. it doesn't start the HO preparation) because the PCI=168 in the measurement report is not configured as eNodeB neighbour.

Case Study: Call Drop due to Radio Link Failure – PuschRlf & CqiRlf

UE Log: Intra-eNB Handover



Time	Code	Message
2011-09-20 10:37:22.526	Cell Information	
2011-09-20 10:37:23.245	UL-DCCH [Lte]	measurementReport
2011-09-20 10:37:23.307	DL-DCCH [Lte]	rrcConnectionReconfiguration
2011-09-20 10:37:23.307	UL-DCCH [Lte]	rrcConnectionReconfigurationComplete
2011-09-20 10:37:23.323	RACH REQ Info	
2011-09-20 10:37:23.338	RACH RSP General Info	
2011-09-20 10:37:23.370	BCCH-BCH [Lte]	masterInformationBlock
2011-09-20 10:37:23.588	BCCH-DL-SCH [Lte]	systemInformationBlockType1
2011-09-20 10:37:23.979	RACH REQ Info	
2011-09-20 10:37:24.010	RACH REQ Info	
2011-09-20 10:37:24.026	RACH RSP General Info	
2011-09-20 10:37:24.026	RACH REQ Info	
2011-09-20 10:37:24.041	DL-DCCH [Lte]	rrcConnectionReconfiguration
2011-09-20 10:37:24.041	UL-DCCH [Lte]	rrcConnectionReconfigurationComplete
2011-09-20 10:37:24.041	RACH RSP General Info	
2011-09-20 10:37:24.073	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 10:37:24.088	DL-DCCH [Lte]	rrcConnectionReconfiguration
2011-09-20 10:37:24.088	UL-DCCH [Lte]	rrcConnectionReconfigurationComplete
2011-09-20 10:37:24.120	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 10:37:24.120	Cell Information	
2011-09-20 10:37:31.541	RACH REQ Info	
2011-09-20 10:37:31.557	RACH REQ Info	
2011-09-20 10:37:31.588	RACH REQ Info	
2011-09-20 10:37:31.604	RACH REQ Info	
2011-09-20 10:37:31.620	RACH REQ Info	
2011-09-20 10:37:31.651	RACH REQ Info	
2011-09-20 10:37:31.666	RACH REQ Info	
2011-09-20 10:37:31.682	RACH REQ Info	
2011-09-20 10:37:31.698	RACH REQ Info	
2011-09-20 10:37:31.729	RACH REQ Info	
2011-09-20 10:37:31.745	RACH REQ Info	
2011-09-20 10:37:32.416	BCCH-BCH [Lte]	masterInformationBlock

```
value DL-DCCH-Message ::=
  message c1 : rrcConnectionReconfiguration :
        rrc-TransactionIdentifier 1,
        criticalExtensions c1 : rrcConnectionReconfiguration-r8 :
              mobilityControlInfo
                targetPhysCellId 356,
```

```
TxTTI : 3731
RetNum : 0
RachType : HANDOVER
RA_RNTI : 2
PreambleID : 41
```

```
RxSTI : 3736
Result : ACK
dmHeaderInfo.RAPID : 41
dmHeaderInfo.BI : 0
TA : 4
T_CRNTI : 14248
dmUlGrantInfo.MCS : 5
dmUlGrantInfo.TPC : 3
dmUlGrantInfo.HF : 0
dmUlGrantInfo.UlDelay : 0
dmUlGrantInfo.CQIReq : 0
dmUlGrantInfo.RbAssign : 352
```

- The intra-eNB handover to a target cell (PCI 356) was successfully completed.

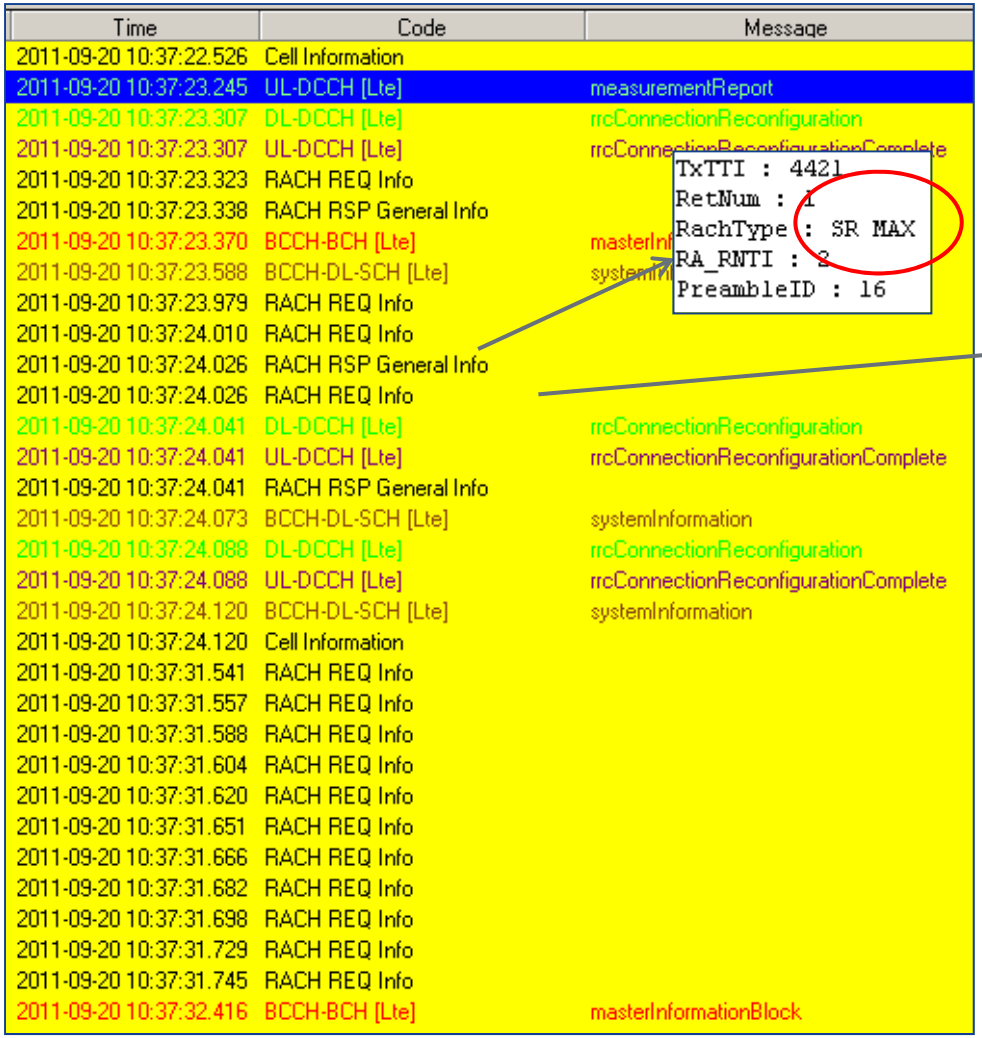
BTS Log: Target Cell (PCI:356)

User data	Target time
UE ID: 5, CRNTI: 14248, Trans ID: 2, Cell ID: 1042	10:37:08.297753
UE ID: 5, CRNTI: 14248, Trans ID: 2, Cell ID: 1042	10:37:08.298585
UE ID: 5, CRNTI: 14248, Trans ID: 2, Cell ID: 1042	10:37:08.299103
eNB PDSCH/DL-SCH/CCCH: RandomAccessResponse, CRNTI: 14248, Cell ID: 1042, TA: 2.1 us/624 m, FreqHop: No, Mod: QPSK, TPC: 0	10:37:08.349829
UE PUSCH/UL-SCH/DCCH: RrcConnectionReconfigurationComplete, UE ID: 5, CRNTI: 14248, Cell ID: 1042	10:37:09.050873
UE ID: 5, Conn ID: 6, L3 Link ID: 1	10:37:09.051572
UE ID: 5, Conn ID: 6, L3 Link ID: 1	10:37:09.052466
UE PRACH/RACH: RandomAccessSchedulingRequest, UE ID: 5, CRNTI: 14248, Cell ID: 1042 RadioLinkState: RA_SR	10:37:09.052575
eNB PDSCH/DL-SCH/DCCH: RrcConnectionReconfiguration, UE ID: 5, CRNTI: 14248, Trans ID: 1, Cell ID: 1042	10:37:09.054301
UE ID: 5, CRNTI: 14248, Trans ID: 0, Cell ID: 1042	10:37:09.057465
UE ID: 5, CRNTI: 14248, Trans ID: 0, Cell ID: 1042	10:37:09.057711
UE PRACH/RACH: RandomAccessSchedulingRequest, UE ID: 5, CRNTI: 14248, Cell ID: 1042 RadioLinkState: RA_SR	10:37:09.081201
UE PUSCH/UL-SCH/DCCH: RrcConnectionReconfigurationComplete, UE ID: 5, CRNTI: 14248, Cell ID: 1042	10:37:09.081843
eNB PDSCH/DL-SCH/DCCH: RrcConnectionReconfiguration, UE ID: 5, CRNTI: 14248, Trans ID: 1, Cell ID: 1042	10:37:09.084103
UE PUSCH/UL-SCH/DCCH: RrcConnectionReconfigurationComplete, UE ID: 5, CRNTI: 14248, Cell ID: 1042	10:37:09.117839
UE ID: 5, CRNTI: 14248, Cell ID: 1042 RadioLinkState: PuschRlf_ON	10:37:16.886560
UE ID: 5, CRNTI: 14248, Cell ID: 1042 RadioLinkState: CqiRlf_ON	10:37:17.760413
UE ID: 5, CRNTI: 14248, Cell ID: 1042 RadioLinkState: OutSync	10:37:20.652154
eNB S1AP: UEContextReleaseRequest, Cause : radioNetwork : radio-connection-with-ue-lost, UE ID: 5, MME S1AP ID: 38380, Conn ID: 6, L3	10:37:22.144034
EPC S1AP: UEContextReleaseCommand, Cause : nas : normal-release, UE ID: 5, MME S1AP ID: 38380, L3 Link ID: 1	10:37:22.167892
eNB PDSCH/DL-SCH/DCCH: RrcConnectionRelease, UE ID: 5, CRNTI: 14248, Trans ID: 3, Cell ID: 1042	10:37:22.168914
eNB S1AP: UEContextReleaseComplete, UE ID: 5, MME S1AP ID: 38380, Conn ID: 6, L3 Link ID: 1	10:37:22.169568

User data	Target time
eNB PDCCH/DCI: RandomAccess-RNTI, Preamble 17, CRNTI: 2837, Cell ID: 1042	10:37:09.069828
UE ID: -1, CRNTI: 2837, Cell ID: 1042	10:37:09.069952
eNB PDSCH/DL-SCH/CCCH: RandomAccessResponse, CRNTI: 2837, Cell ID: 1042, TA: 1.6 us/468 m, FreqHop: No, Mod: QPSK, TPC: 0 d	10:37:09.070020

- The handover was completed in a target cell (C-RNTI= 14248) by receiving RRC connection reconfiguration complete message from UE.
- However, UE initiates random access for scheduling requests.

UE Log: Random Access for Scheduling Request



Time	Code	Message
2011-09-20 10:37:22.526	Cell Information	
2011-09-20 10:37:23.245	UL-DCCH [Lte]	measurementReport
2011-09-20 10:37:23.307	DL-DCCH [Lte]	rrcConnectionReconfiguration
2011-09-20 10:37:23.307	UL-DCCH [Lte]	rrcConnectionReconfigurationComplete
2011-09-20 10:37:23.323	RACH REQ Info	
2011-09-20 10:37:23.338	RACH RSP General Info	
2011-09-20 10:37:23.370	BCCH-BCH [Lte]	masterInf
2011-09-20 10:37:23.588	BCCH-DL-SCH [Lte]	systemInfo
2011-09-20 10:37:23.979	RACH REQ Info	
2011-09-20 10:37:24.010	RACH REQ Info	
2011-09-20 10:37:24.026	RACH RSP General Info	
2011-09-20 10:37:24.026	RACH REQ Info	
2011-09-20 10:37:24.041	DL-DCCH [Lte]	rrcConnectionReconfiguration
2011-09-20 10:37:24.041	UL-DCCH [Lte]	rrcConnectionReconfigurationComplete
2011-09-20 10:37:24.041	RACH RSP General Info	
2011-09-20 10:37:24.073	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 10:37:24.088	DL-DCCH [Lte]	rrcConnectionReconfiguration
2011-09-20 10:37:24.088	UL-DCCH [Lte]	rrcConnectionReconfigurationComplete
2011-09-20 10:37:24.120	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 10:37:24.120	Cell Information	
2011-09-20 10:37:31.541	RACH REQ Info	
2011-09-20 10:37:31.557	RACH REQ Info	
2011-09-20 10:37:31.588	RACH REQ Info	
2011-09-20 10:37:31.604	RACH REQ Info	
2011-09-20 10:37:31.620	RACH REQ Info	
2011-09-20 10:37:31.651	RACH REQ Info	
2011-09-20 10:37:31.666	RACH REQ Info	
2011-09-20 10:37:31.682	RACH REQ Info	
2011-09-20 10:37:31.698	RACH REQ Info	
2011-09-20 10:37:31.729	RACH REQ Info	
2011-09-20 10:37:31.745	RACH REQ Info	
2011-09-20 10:37:32.416	BCCH-BCH [Lte]	masterInformationBlock

```
TxTTI : 4421
RetNum : 1
RachType : SR MAX
RA_RNTI : 2
PreambleID : 16
```

```
RxSTI : 4426
Result : ACK
dmHeaderInfo.RAPID : 16
dmHeaderInfo.BI : 0
TA : 3
T_CRNTI : 28486
dmUlGrantInfo.MCS : 5
dmUlGrantInfo.TPC : 3
dmUlGrantInfo.HF : 0
dmUlGrantInfo.UlDelay : 0
dmUlGrantInfo.CQIReq : 0
dmUlGrantInfo.RbAssign : 96
```

- The UE stops receiving UL grants (e.g. insufficient power for PUCCH-SR) and thus, after the time *dSrTransMax* * *cellSrPeriod* = 64*10 = 640 ms is reached, UE releases PUCCH resources and performs the scheduling request via random access (RA-SR).

UE Log: Random Access for Scheduling Request

Time	Code	Message
2011-09-20 10:37:22.526	Cell Information	
2011-09-20 10:37:23.245	UL-DCCH [Lte]	measurementReport
2011-09-20 10:37:23.307	DL-DCCH [Lte]	rrcConnectionReconfiguration
2011-09-20 10:37:23.307	UL-DCCH [Lte]	rrcConnectionReconfigurationComplete
2011-09-20 10:37:23.323	RACH REQ Info	
2011-09-20 10:37:23.338	RACH RSP General Info	
2011-09-20 10:37:23.370	BCCH-BCH [Lte]	masterInformationBlock
2011-09-20 10:37:23.588	BCCH-DL-SCH [Lte]	systemInformationBlockType1
2011-09-20 10:37:23.979	RACH REQ Info	
2011-09-20 10:37:24.010	RACH REQ Info	
2011-09-20 10:37:24.026	RACH RSP General Info	
2011-09-20 10:37:24.026	RACH REQ Info	
2011-09-20 10:37:24.041	DL-DCCH [Lte]	rrcConnectionReconfiguration
2011-09-20 10:37:24.041	UL-DCCH [Lte]	rrcConnectionReconfigurationComplete
2011-09-20 10:37:24.041	RACH RSP General Info	
2011-09-20 10:37:24.073	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 10:37:24.088	DL-DCCH [Lte]	rrcConnectionReconfiguration
2011-09-20 10:37:24.088	UL-DCCH [Lte]	rrcConnectionReconfigurationComplete
2011-09-20 10:37:24.120	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 10:37:24.120	Cell Information	
2011-09-20 10:37:31.541	RACH REQ Info	
2011-09-20 10:37:31.557	RACH REQ Info	
2011-09-20 10:37:31.588	RACH REQ Info	
2011-09-20 10:37:31.604	RACH REQ Info	
2011-09-20 10:37:31.620	RACH REQ Info	
2011-09-20 10:37:31.651	RACH REQ Info	
2011-09-20 10:37:31.666	RACH REQ Info	
2011-09-20 10:37:31.682	RACH REQ Info	
2011-09-20 10:37:31.698	RACH REQ Info	
2011-09-20 10:37:31.729	RACH REQ Info	
2011-09-20 10:37:31.745	RACH REQ Info	
2011-09-20 10:37:32.416	BCCH-BCH [Lte]	masterInformationBlock

```
TxTTI : 4451
RetNum : 0
RachType : NO_SR_CONFIG
RA_RNTI : 2
PreambleID : 17
```

```
value DL-DCCH-Message ::=
  message c1 : rrcConnectionReconfiguration :
        rrc-TransactionIdentifier 1,
        criticalExtensions c1 : rrcConnectionReconfiguration-r8 :
              radioResourceConfigDedicated
                physicalConfigDedicated
                  cqi-ReportConfig
                    cqi-ReportModeAperiodic rm30,
                    nomPDSCH-RS-EPRE-Offset 0,
                    cqi-ReportPeriodic setup :
                        cqi-PUCCH-ResourceIndex 0,
                        cqi-pmi-ConfigIndex 19,
                        cqi-FormatIndicatorPeriodic widebandCQI : NULL,
                        ri-ConfigIndex 161,
                        simultaneousAckNackAndCQI TRUE
                    ,
                  soundingRS-UL-ConfigDedicated release : NULL,
                  schedulingRequestConfig setup :
                      sr-PUCCH-ResourceIndex 4,
                      sr-ConfigIndex 6,
                      dsr-TransMax n64
```

- The eNB detects RA-SR from UE and sends the RRC message *RrcConnection-Reconfiguration* to inform the UE regarding SR and CQI reconfiguration on PUCCH.

BTS Log: eNB Detected RLF – PuschRlf

User data	Target time
UE ID: 5, CRNTI: 14248, Trans ID: 0, Cell ID: 1042	10:37:09.057465
UE ID: 5, CRNTI: 14248, Trans ID: 0, Cell ID: 1042	10:37:09.057711
UE PRACH/RACH: RandomAccessSchedulingRequest, UE ID: 5, CRNTI: 14248, Cell ID: 1042 RadioLinkState: RA_SR	10:37:09.081201
UE PUSCH/UL-SCH/DCCH: RrcConnectionReconfigurationComplete, UE ID: 5, CRNTI: 14248, Cell ID: 1042	10:37:09.081843
eNB PDSCH/DL-SCH/DCCH: RrcConnectionReconfiguration, UE ID: 5, CRNTI: 14248, Trans ID: 1, Cell ID: 1042	10:37:09.084103
UE PUSCH/UL-SCH/DCCH: RrcConnectionReconfigurationComplete, UE ID: 5, CRNTI: 14248, Cell ID: 1042	10:37:09.117839
UE ID: 5, CRNTI: 14248, Cell ID: 1042 RadioLinkState: PuschRlf_ON	10:37:16.886560
UE ID: 5, CRNTI: 14248, Cell ID: 1042 RadioLinkState: CqiRlf_ON	10:37:17.760413
UE ID: 5, CRNTI: 14248, Cell ID: 1042 RadioLinkState: OutSync	10:37:20.652154
eNB S1AP: UEContextReleaseRequest, Cause : radioNetwork : radio-connection-with-ue-lost, UE ID: 5, MME S1AP ID: 38380, Conn ID: 6, L3	10:37:22.144034
EPC S1AP: UEContextReleaseCommand, Cause : nas : normal-release, UE ID: 5, MME S1AP ID: 38380, L3 Link ID: 1	10:37:22.167892
eNB PDSCH/DL-SCH/DCCH: RrcConnectionRelease, UE ID: 5, CRNTI: 14248, Trans ID: 3, Cell ID: 1042	10:37:22.168914
eNB S1AP: UEContextReleaseComplete, UE ID: 5, MME S1AP ID: 38380, Conn ID: 6, L3 Link ID: 1	10:37:22.169568

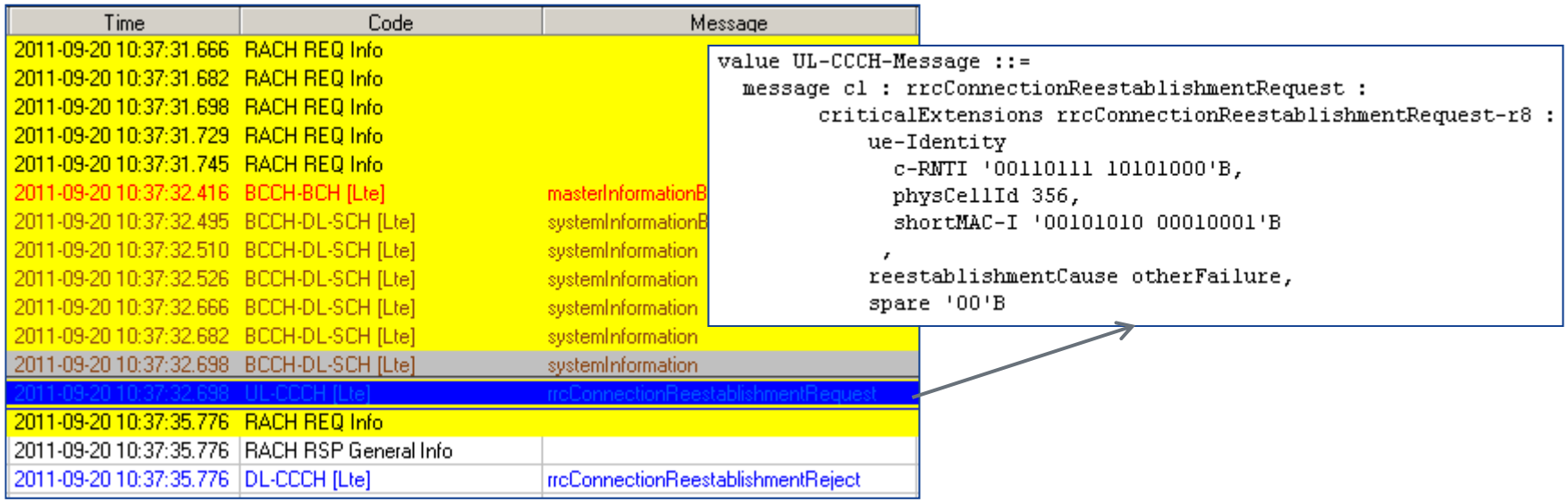
- The eNB detects uplink DTX on PUSCH and indicates radio link problems to higher layers, i.e. PuschRlf_ON.
- The detection of the radio link problem by the uplink scheduler is based on the comparison of grant assignment and the DTX detection on PUSCH for the assigned PRBs. The detection shall take into account the DTX PUSCH indication provided by the physical layer.
- This could occur due to insufficient UE Tx power for PUSCH. The uplink power control parameter for PUSCH may need to be adjusted.

BTS Log: eNB Detected RLF – CqiRlf

User data	Target time
UE ID: 5, CRNTI: 14248, Trans ID: 0, Cell ID: 1042	10:37:09.057465
UE ID: 5, CRNTI: 14248, Trans ID: 0, Cell ID: 1042	10:37:09.057711
UE PRACH/RACH: RandomAccessSchedulingRequest, UE ID: 5, CRNTI: 14248, Cell ID: 1042 RadioLinkState: RA_SR	10:37:09.081201
UE PUSCH/UL-SCH/DCCH: RrcConnectionReconfigurationComplete, UE ID: 5, CRNTI: 14248, Cell ID: 1042	10:37:09.081843
eNB PDSCH/DL-SCH/DCCH: RrcConnectionReconfiguration, UE ID: 5, CRNTI: 14248, Trans ID: 1, Cell ID: 1042	10:37:09.084103
UE PUSCH/UL-SCH/DCCH: RrcConnectionReconfigurationComplete, UE ID: 5, CRNTI: 14248, Cell ID: 1042	10:37:09.117839
UE ID: 5, CRNTI: 14248, Cell ID: 1042 RadioLinkState: PuschRlf_ON	10:37:16.886560
UE ID: 5, CRNTI: 14248, Cell ID: 1042 RadioLinkState: CqiRlf_ON	10:37:17.760413
UE ID: 5, CRNTI: 14248, Cell ID: 1042 RadioLinkState: OutSync	10:37:20.652154
eNB S1AP: UEContextReleaseRequest, Cause : radioNetwork : radio-connection-with-ue-lost, UE ID: 5, MME S1AP ID: 38380, Conn ID: 6, L3	10:37:22.144034
EPC S1AP: UEContextReleaseCommand, Cause : nas : normal-release, UE ID: 5, MME S1AP ID: 38380, L3 Link ID: 1	10:37:22.167892
eNB PDSCH/DL-SCH/DCCH: RrcConnectionRelease, UE ID: 5, CRNTI: 14248, Trans ID: 3, Cell ID: 1042	10:37:22.168914
eNB S1AP: UEContextReleaseComplete, UE ID: 5, MME S1AP ID: 38380, Conn ID: 6, L3 Link ID: 1	10:37:22.169568

- The eNB supports CQI DTX detection for periodic CQI reports on PUCCH and PUSCH .
- The CqiRlf_ON indicates the number of consecutive CQI DTX detections causing radio link failure.
- This could occur due to insufficient UE tx power for CQI reports on PUSCH. The parameter *puschCqiOffI* may need to be adjusted based on CQI misdetection on eNodeB or *dFpucchF2* for carrying CQI reports on PUCCH.

UE Log: RRC Connection Re-Establishment Reject



Time	Code	Message
2011-09-20 10:37:31.666	RACH REQ Info	
2011-09-20 10:37:31.682	RACH REQ Info	
2011-09-20 10:37:31.698	RACH REQ Info	
2011-09-20 10:37:31.729	RACH REQ Info	
2011-09-20 10:37:31.745	RACH REQ Info	
2011-09-20 10:37:32.416	BCCH-BCH [Lte]	masterInformationB
2011-09-20 10:37:32.495	BCCH-DL-SCH [Lte]	systemInformationB
2011-09-20 10:37:32.510	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 10:37:32.526	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 10:37:32.666	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 10:37:32.682	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 10:37:32.698	BCCH-DL-SCH [Lte]	systemInformation
2011-09-20 10:37:32.698	UL-CCCH [Lte]	rrcConnectionReestablishmentRequest
2011-09-20 10:37:35.776	RACH REQ Info	
2011-09-20 10:37:35.776	RACH RSP General Info	
2011-09-20 10:37:35.776	DL-CCCH [Lte]	rrcConnectionReestablishmentReject

```
value UL-CCCH-Message ::=
  message c1 : rrcConnectionReestablishmentRequest :
       criticalExtensions rrcConnectionReestablishmentRequest-r8 :
           ue-Identity
             c-RNTI '00110111 10101000'B,
             physCellId 356,
             shortMAC-I '00101010 00010001'B
           ,
           reestablishmentCause otherFailure,
           spare '00'B
```

- Eventually, the RRC connection re-establishment is triggered by UE due to radio link failure because UE never received *RrcConnectionRelease* from eNB.
- The UE context was earlier released by eNB with cause: *radio-connection-with-ue-lost* and thus, the request was rejected by eNB.

Exercises

Call drop analysis exercise

- Files:
  - KPI report: KPI_Report_LTE-2
  - Nemo log: Nemo log 7 drop call exercise.1.nmf

1. Check the KPI report:
   - What's the call drop rate in KPI stats?
   - What's the handover drop rate in KPI stats?
   - Is there difference between DRB Drop Ratio and E-RAB Drop Ratio?

2. Check the Nemo log:
   - Can you find any call drop or handover drops in the drive test log?
   - Are the drops caused by bad RF conditions or something else?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