**3GPP TSG SA WG3 Security — S3#22** **S3-020178**
**14 - 17 May 2002**
**Victoria, Canada**

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# TSG-RAN Working Group 2 Meeting #28 *R2-020797*
# Kobe, Japan, 8 - 12 April 2002

**Title:** LS on Group release security solution
**Source:** RAN2
**To:** SA3
**Cc:**
**Response to:**
**Release:** Rel-5

**Contact Person:**
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**Attachments:** R2-020734 Actions at RNC reset

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**1. Overall Description:**

During the TSG RAN WG2 meeting #28, Rel-5 enhancements were discussed for scenarios when there is a reset of a RNC in UTRAN. The discussed solution included a group release of several UEs with a single RRC message. The group release solution also included a security solution preventing an intruder to be able to utilize this function to sabotage the service for a large number of UEs with a single message.

This security solution is presented in the attached document in section 2.2.2. It was felt in RAN WG2 that any security solution should be reviewed and acknowledged by SA WG3.

Please note that the proposal in the attachment has not yet been agreed by RAN WG2.

**2. Actions:**

**To S3 group.**

**ACTION:** SA WG3 is kindly requested to provide answers to the following question:

Is the security solution outlined in R2-020734 acceptable to SA WG3?

**3. Date of Next RAN2 Meetings:**

| | | |
|---|---|---|
| RAN2_29 | 13 – 17 May 2002 | Gyeongju, Korea. |
| RAN2_30 | 24 – 28 June 2002 | Torino, Italy. |

**3GPP TSG-RAN WG2 meeting#28** ***Tdoc R2-020734***
**Kobe, Japan, April 8-12, 2002**

**Agenda Item:** 10.6.1

**Source:** Ericsson

**Title:** Actions at RNC reset

**Document for:** Discussion and decision

# 1 Introduction

This contribution discusses some issues that may arise after reset of an RNC and possible solutions.

# 2 Discussion

## 2.1 What is the issue?

After serious failures involving parts of or a whole RNC, UE contexts may be lost due to RNC reset.

If an RNC that lost the UE context (for a UE for which it was the SRNC) receives a CN originated paging request, the RNC will use idle mode paging with the CN UE identity. However, if the UE is still in connected mode the UE only detects connected mode paging using the U-RNTI.

UEs in CELL_DCH state may expect a loss of sync and at the recovery they will go to CELL_FACH state after having selected a suitable cell, and eventually they will enter idle mode. However, UEs in CELL_FACH, CELL_PCH and URA_PCH state will not necessarily notice the loss of the RRC connection, at least not immediately.

Therefore, to ensure that the UEs which contexts are lost in the RNC are reachable by CN originated paging after the RNC reset, it is important to bring them to idle mode. Since there may be a lot of UE contexts lost in the worst situation, a “mass release” of UEs is needed.

NOTE: The CN UE identity (such as TMSI) cannot be used in connected mode, since the UE may camp in a cell which in idle mode belongs to a different location area than the location area in which the TMSI is valid (i.e. a location area controlled by a different MSC). The CN system information (including the location area identity) reported to upper layers is in connected mode always sent from the SRNC, and the UE does not use the CN system information used in SIB1 sent from the CRNC.

## 2.2 Requirements on a release mechanism

The mechanism to release the RRC connection in the UE after an RNC reset need to fulfil at least the following objectives:

1) The UEs should be brought to idle mode fast to minimize the period when the UEs are unreachable for paging.

2) The amount signalling needed should be moderate to enable a fast release without excessive network load.

3) The release should be possible to perform with a minimum of UE specific data: This means that as little UE specific data as possible is necessary to survive an RNC reset.

4) The amount of UEs brought to idle mode unnecessarily (e.g. those UEs that were not affected by the RNC reset) should be minimized.

5) The system's availability to receive new RRC connection requests should not be affected.

6) A new method is used for the new UEs should not negatively affect the possibilities to release the old UEs with the method they support.

7) The method should not compromise security, not even for denial of service attacks

## 2.3 Existing release mechanisms

Examples of existing mechanisms that can be used to release UEs after RNC reset are:

- **Release at the next periodical update**: If the periodical cell/URA update mechanism is activated, the SRNC and/or the DRNC will have to opportunity to release the RRC connection in the UE when the UE initiates the next periodical update. However, the delay before UEs are brought into idle mode may be considerable, depending on the interval for periodic update (5 to 720 minutes). Also, if the periodical update mechanism is not activated (timer set to infinity), the method can not be used at all.

- **Release UEs one by one**: The U-RNTIs for the UEs needing release have to be known for this mechanism to be used. An example is when the CRNC of the UE is a DRNC and the SRNC was reset. The DRNC detects the SRNC reset over Iur and initiates release on CCCH of all affected UEs one by one (preceeded by paging for UEs in CELL_PCH or URA_PCH state). Another case is when the CRNC for the UE is the same as the SRNC and this SRNC was reset but the U-RNTI is known. This solution is very time and signalling intensive, even if UE-specific information survives the RNC reset, such as the U-RNTI and the UE location. If no UE specific information survives the RNC reset, the method is not very useful (cycling through all S-RNTI values and releasing the UEs in all cells of the CRNC or the whole UTRAN is not very attractive).

The existing mechanisms can be used to release UEs works, but still, they do not satisfactorily fulfil the seven objectives above.

## 2.4 A proposed enhanced release mechanism

A possible new mechanism is discussed below for each UE state. A short discussion is also made on how anew mechanism and existing mechanisms could be combined, since many UEs will not support a new mechanism for a long period of time.

### 2.4.1 Release in CELL_DCH state

A UE in this state when the failure occurs will either

- experience a radio link failure and during the recovery it will enter idle mode either immediately (if T314 and T315 are both set to zero) or enter a recovery procedure where the network can release it when it sends the first CELL UPDATE message.

- loose one or several radio links but still have L1 sync and thus unaffected by the failure

### 2.4.2 Release in CELL_FACH state

The UE is in a normal case released by transmitting an RRC CONNECTION RELEASE message (either on the DCCH or the CCCH). Using the release procedure like this is very precise and does not have any side effects. However, the amount of signalling can be considerable since only one UE can be addressed in a signle message.

If there was a possibility to address a certain group of UEs using a single RRC CONNECTION RELEASE message on the CCCH, the amount of signalling would be significantly reduced.

Examples of groups of UEs that would be benefical to address in the RRC CONNECTION RELEASE message on CCCH are:

**All UEs belonging to a certain SRNC**: In case of SRNC reset, the message is typically sent by each DRNCs having affected UE contexts in the cells controlled by the DRNC. The message is also sent by the SRNC in the cells controlled by the SRNC. In that way, all UEs with a certain SRNC-identity as part of the U-RNTI are efficiently released. In

Release 5, an RNSAP Reset procedure has been added (see [1]), which enables the DRNC to release UE contexts upon an SRNC reset.

**All UEs in the cell**: In case of a DRNC reset the DRNC sends an RRC CONNECTION RELEASE message on the CCCH to all UEs in all cells, using group addressing of "all UEs".

This new method can be combined with existing methods according to the following:

- First, release is made using the group addressing. This will release all UEs supporting the new mechanism as fast as possible.
- Then, the old method is applied, such as releasing UEs one by one. In this way, old UEs will still be released, but it will take longer time to release those (that is, the same time as it would take without applying the new method at all).

### 2.4.3 Release in CELL_PCH or URA_PCH state

These UEs are in a normal case released by transmitting a PAGING TYPE 1 message to the UE, awaiting the CELL UPDATE message sent as paging response and then transmitting an RRC CONNECTION RELEASE as response to the received CELL UPDATE.

If there was a possibility to address a certain group of UEs using a single PAGING TYPE 1 message, the amount of paging messages would be significantly reduced. Further, if there was a possibility to release the UE(s) directly by the PAGING TYPE 1 message the reduction of signalling would be even more significant.

An enhanced PAGING TYPE 1 message could be used for CELL_PCH and URA_PCH state UEs, in a corresponding way as an enhanced RRC CONNECTION RELEASE message would be used to release CELL_FACH UEs.

This new method can be combined with existing methods according to the following:

- First, release is made using the group addressing in the PAGING TYPE 1 message with a release indicator. This will release all UEs supporting the new mechanism as fast as possible and without cause any uplink signalling.
- Then, the old method is applied, such as first paging the UEs one by one followed by individual release. Old UEs will still be released, but it will take longer time to release those (that is, the same time as it would take without applying the new method at all).

### 2.2.2 Security considerations

Introducing possibilities to release a group of UEs is a challenge from a security point of view. If the release message was sent without ciphering, integrity protection or authentication, a non-friendly intruder could efficiently release all radio connections in a cell.

An advantage would therefore if there was a more secure way of releasing a group of UEs. Ciphering and integrity protection is normally established per-UE basis with individual keys. Using "group keys" together with cipherin gor integrity protection might be possible, but there are much simpler ways to use a group key but still keeping a sufficient security level.

The proposal is to use an authentication mechanism, as outlined below.

The principles of the mechanism are fairly simple:

1) The SRNC selects an **authentication release key**, associated with a certain group of UEs, e.g. all UEs having this RNC as the Serving RNC. It stores the authentication release key in a way that survives a reset of the RNC.

2) For a given RRC connection the SRNC uses the authentication release key to derive an **authentication release indicia**. There are two alternative solutions how the derivation is done, please see below.

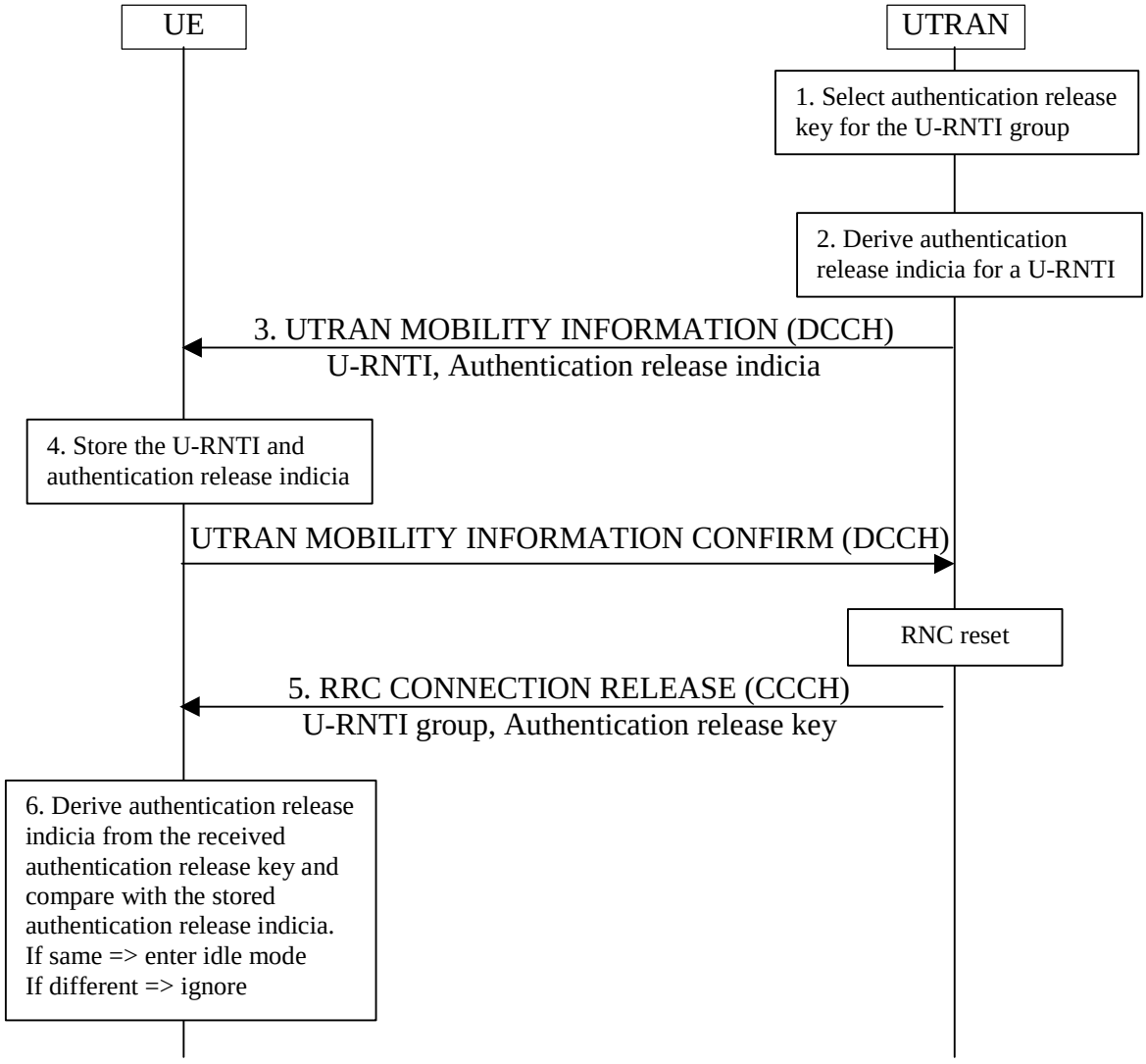
3) The RNC sends the authentication release indicia to the UE, typically shortly after the establishment of the RRC connection, that is when the U-RNTI is assigned the first time for this UE, and at all times the U-RNTI for a UE is changed, such as SRNC relocation. The authentication release indicia should be sent on an encrypted channel, the dedicated control channel (DCCH). If the channel is not encrypted, an integrity protection mechanism can be used to prevent that a man-in-the-middle acts as a false base station assigning false authentication release indicia (can

also be combined with encryption). In any case, there is a choice by the SRNC to use encryption or not when sending the authentication release indicia.

4) When the UE receives the authentication release indicia, it stores it during the lifetime of the RRC connection (or until it receives a new authentication release indicia).

5) When the RNC needs to release one or several UEs on the CCCH or the PCCH, e.g. after an RNC reset when UE contexts were lost it includes the authentication release key in the release message.

6) When the UE receives the release message, it uses the authentication release to derive an authentication release indicia. The UE will then compare the derived authentication release indicia with its stored UE individual authentication release indicia received previously. If there is a match, the UE considers the message as authenticated and proceeds with the release (i.e. enters idle mode). If there was no match, the release is not authenticated (possibly the message is sent by an intruder making a denial of service attack) and the UE simply ignores the message.




The necessary information in the RNC neccessary to release all UEs upon reset is the authentication release key, if all UEs belong to the same U_RNTI group. If several U-RNTI groups are implemented in an RNC, an authentication release key needs to be stored for each U-RNTI group. The U-RNTI group is the smallest unit of UEs handled from an RNC reset point of view.

To be able to release UEs from the DRNC, the authentication release key needs to be sent to the DRNC over Iur and stored as part of the DRNC UE context.

Regarding the relation between the authentication release key and the authentication release indicia, two alternatives are compared:

- In alternative 1, the authentication release key and the authentication release indicia are simply the same. This means that even if it is sent encrypted, once a UE receives the authentication release indicia, he immediately knows which authentication release key that it belongs to, not just for him, but also for all UEs in a certain group. A fake UE could therefore be used to get hands of an authentication release key in advance.

- In alternative 2, the authentication release indicia cannot be used to derive the authentication release key. Instead, the authentication release indicia is derived from the authentication release key using a **one-way function**, and use the U-RNTI of the UE as additional input. This is a far more secure method, especially if the key and indicia are large enough. Even if the authentication release key is sent in plain text during the time of release (if the CCCH or PCCH is used for the release), there is no problem, since then it is too late for the introduer to use it. As the one-way function, the proposal is to use the Kasumi function [2], which is an already mandatory feature to be used for ciphering and integrity protection:

  $C = \text{Kasumi}(M)_{KEY}$

  where in this context:

  M is the U-RNTI concatenated 2 times (resulting in 64 bits)
  KEY is the authentication release key (64 bits)
  C is the authentication release indicia (64 bits)

  64 bits should be seen as an example. The size of the authentication release key and the authentication release indicia is a trade-off between the security level and the radio interface overhead.

## 2.3 Conclusion

There is a need to efficiently bring down many UEs at once to idle mode after an RNC reset. In the current RRC protocol, there are mechanisms that may be used. However by listing the objectives such a mechanism should fulfil, we don't think the current mechanisms are good enough.

A new mechanism to release UEs at RNC reset can be designed to fulfil the general objectives. For UEs supporting the new methods, they will be released faster than existing methods. Still, an RNC implementation can make sure any UEs that do not support the new methods can be released with the same grade of efficiency as today.

# 3 Proposal

It is proposed to enhance the RRC connection release and paging features in the RRC protocol to facilitate a mass release of UEs. The following mechanisms are proposed:

- include an optional assignment of authentication release indicia in all messages that can assign an U-RNTI (e.g. RRC CONNECTION SETUP, UTRAN MOBILITY INFORMATION, CELL UPDATE CONFIRM, TRANSPORT CHANNEL RECONFIGURATION);

- include group addressing in the RRC CONNECTION RELEASE and PAGING TYPE 1 messages. The group is indicated using a variable length group address, which is masked out from the 1-31 most significant bits of the U-RNTI;

- include an RRC connection release possibility in the PAGING TYPE 1message;

- include an authentication release key in the RRC CONNECTION RELEASE and PAGING TYPE 1 messages;

- include an authentication procedure in the UE, activated by the reception of an authentication release indicia, and executed upon an attempt by UTRAN to release the RRC connection;

- base the relation between the authentication release key and the authentication release indicia on the Kasumi function, as outlined above.

We propose to include this in release 5 of the RRC specification. Please note that in release 5 of the RNSAP protocol, a Reset procedure to inform other RNCs about lost UE contexts has been agreed in RAN3 (see [1]).

A draft CR to 25.331 is attached (**the current CR is based on 4.3.0 instead of the Rel'5 version**).

# 4 References

[1] R3-020120, RNSAP Reset Procedure, source: Ericsson
[2] 3GPP TS 35.202, Specification of the 3GPP confidentiality and integrity algorithms, document 2, Kasumi specification

**3GPP TSG-RAN WG2 Meeting #28**
**Kobe, Japan, April 8-12, 2002**

***Tdoc R2-02xxxx***

*CR-Form-v5*

# CHANGE REQUEST

⌘ **25.331** **CR** **CRNum** ⌘ **rev** **-** ⌘ Current version: **4.3.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

***Proposed change affects:*** ⌘ (U)SIM ☐ ME/UE **X** Radio Access Network **X** Core Network ☐

| | | |
|---|---|---|
| ***Title:*** | ⌘ | Paging and release enhancements |
| ***Source:*** | ⌘ | Ericsson |
| ***Work item code:*** | ⌘ | TEI-5 |
| ***Date:*** | ⌘ | 2002-04-02 |
| ***Category:*** | ⌘ | **C** |
| ***Release:*** | ⌘ | REL-5 |

*Use one of the following categories:*
***F*** *(correction)*
***A*** *(corresponds to a correction in an earlier release)*
***B*** *(addition of feature),*
***C*** *(functional modification of feature)*
***D*** *(editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

*Use one of the following releases:*
*2* *(GSM Phase 2)*
*R96* *(Release 1996)*
*R97* *(Release 1997)*
*R98* *(Release 1998)*
*R99* *(Release 1999)*
*REL-4* *(Release 4)*
*REL-5* *(Release 5)*

***Reason for change:*** ⌘

After an RNC reset, there is a need to release the UEs for which the RNC context was lost.

In release 99 and release 4 there exists no optimal method for mass release of UEs.

A more efficient and at the same time secure mechanism for mass release of UEs at RNC reset is therefore necessary.

***Summary of change:*** ⌘

The following enhancements to the RRC connection release and paging features are added:

- inclusion of an optional assignment of the IE "Authentication release indicia" in all messages that can assign an U-RNTI (e.g. RRC CONNECTION SETUP, UTRAN MOBILITY INFORMATION, CELL UPDATE CONFIRM);
- inclusion of group addressing in the RRC CONNECTION RELEASE and PAGING TYPE 1 messages. The group is indicated using a variable length group address (*U-RNTI group*), which is compared to 1-31 most significant bits the UE's U-RNTI
- inclusion of RRC connection release possibility in the PAGING TYPE 1 message
- inclusion of the IE "Authentication release key" in RRC CONNECTION RELEASE and PAGING TYPE 1 (when using the message for release) and a procedure in the UE using the Kasumi function to derive an authentication release indicia and compare with the received authentication release indicia, of such an IE was previously received

NOTE: The present version of the CR is not complete with regards to the modifications in clauses 10 and 11.

***Consequences if not approved:*** ⌘

Mass release of UEs will still be possible, but will cause high signalling load and possibly side-effects.

| | | |
|---|---|---|
| ***Clauses affected:*** | ⌘ | 8.1.2.1, 8.1.2.3, 8.1.4.3, 8.6.3.13 (new), 10.2.37, 10.3.3.x (new), 10.3.3.y (new), 10.3.3.23, 10.3.3.32a (new), 10.3.3.47, 10.3.3.47a (new), 10.3.3.48, 11.2, 11.3, 13.4.a (new). |
| ***Other specs affected:*** | ⌘ | ☐ Other core specifications ⌘<br>☐ Test specifications<br>☐ O&M Specifications |
| ***Other comments:*** | ⌘ | |

**How to create CRs using this form:**
Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

## 8.1.2 Paging

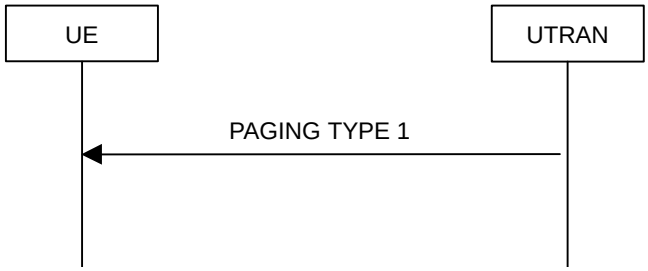



**Figure 8.1.2-1: Paging**

### 8.1.2.1 General

This procedure is used to transmit paging information to selected UEs in idle mode, CELL_PCH or URA_PCH state using the paging control channel (PCCH). Upper layers in the network may request paging, to e.g. establish a signalling connection. UTRAN may initiate paging for UEs in CELL_PCH or URA_PCH state to trigger a cell update procedure. In addition, UTRAN may initiate paging for UEs in idle mode, CELL_PCH and URA_PCH state to trigger reading of updated system information. UTRAN may also initiate paging for UEs in CELL_PCH and URA_PCH state to release the RRC connection.

### 8.1.2.2 Initiation

UTRAN initiates the paging procedure by transmitting a PAGING TYPE 1 message on an appropriate paging occasion on the PCCH.

UTRAN may repeat transmission of a PAGING TYPE 1 message to a UE in several paging occasions to increase the probability of proper reception of a page.

UTRAN may page several UEs in the same paging occasion by including one IE "Paging record" for each UE in the PAGING TYPE 1 message.

For CN originated paging, UTRAN should set the IE "Paging cause" to the cause for paging received from upper layers. If no cause for paging is received from upper layers, UTRAN should set the value "Terminating – cause unknown".

UTRAN may also indicate that system information has been updated, by including the value tag of the master information block in the IE "BCCH modification info" in the PAGING TYPE 1 message. In this case, UTRAN may omit the IEs "Paging record".

### 8.1.2.3 Reception of a PAGING TYPE 1 message by the UE

A UE in idle mode, CELL_PCH state or URA_PCH state shall receive the paging information for all its monitored paging occasions. For an UE in idle mode, the paging occasions are specified in [4] and depend on the IE "CN domain specific DRX cycle length coefficient", as specified in subclause 8.6.3.1a. For a UE in CELL_PCH state or URA_PCH state, the paging occasions depend also on the IE "UTRAN DRX cycle length coefficient" and the IE "RRC State Indicator", as specified in subclauses 8.6.3.2 and 8.6.3.3 respectively.

When the UE receives a PAGING TYPE 1 message, it shall perform the actions as specified below.

If the UE is in idle mode, for each occurrence of the IE "Paging record" included in the message the UE shall:

- if the IE "Used paging identity" is a CN identity:
  - compare the IE "UE identity" with all of its allocated CN UE identities:
  - if one match is found:
    - indicate reception of paging; and
    - forward the IE "CN domain identity", the IE "UE identity" and the IE "Paging cause" to the upper layers.

- otherwise:
  - ignore that paging record.

If the UE is in connected mode, for each occurrence of the IE "Paging record" included in the message the UE shall:

- if the IE "Used paging identity" is a UTRAN single UE identity and if this U-RNTI is the same as the U-RNTI ~~allocated to the Ue~~stored in the UE variable U_RNTI:
  - if the optional IE "CN originated page to connected mode UE" is included:
    - indicate reception of paging; and
    - forward the IE "CN domain identity", the IE "Paging cause" and the IE "Paging record type identifier" to the upper layers.
  - if the IE “Release indicator” in the IE “RRC connection release information” has the value “Release”:
    - if the authentication of the release was successful according to 8.6.3.y:
      - release all its radio resources;
      - indicate the release of the established signalling connections (as stored in the variable ESTABLISHED_SIGNALLING_CONNECTIONS) and established radio access bearers (as stored in the variable ESTABLISHED_RABS) to the upper layers;
      - clear the variable ESTABLISHED_SIGNALLING_CONNECTIONS;
      - clear the variable ESTABLISHED_RABS;
      - pass the value of the IE "Release cause" received in the IE “Release information” to upper layers;
      - enter idle mode;
      - perform the actions specified in subclause 8.5.2 when entering idle mode;
      - and the procedure ends.
  - otherwise:
    - perform a cell update procedure with cause "paging response" as specified in subclause 8.3.1.2.
  - ignore any other remaining IE "Paging record" that may be present in the message.
- if the IE "Used paging identity" is a UTRAN group identity and there is a group identity match according to subclause 8.6.3.13:
  - if the IE “Release indicator” in the IE “RRC connection release information” has the value “Release”:
    - release all its radio resources;
    - indicate the release of the established signalling connections (as stored in the variable ESTABLISHED_SIGNALLING_CONNECTIONS) and established radio access bearers (as stored in the variable ESTABLISHED_RABS) to the upper layers;
    - clear the variable ESTABLISHED_SIGNALLING_CONNECTIONS;
    - clear the variable ESTABLISHED_RABS;
    - pass the value of the IE "Release cause" received in the IE “Release information” to upper layers;
    - enter idle mode;
    - perform the actions specified in subclause 8.5.2 when entering idle mode;
    - and the procedure ends.
  - otherwise:

- perform a cell update procedure with cause "paging response" as specified in subclause 8.3.1.2.

- ignore any other remaining IE "Paging record" that may be present in the message.

- otherwise:
  - ignore that paging record.

If the IE "BCCH modification info" is included, any UE in idle mode, CELL_PCH or URA_PCH state shall perform the actions as specified in subclause 8.1.1 in addition to any actions caused by the IE "Paging record" occurrences in the message as specified above.

### 8.1.4.3 Reception of an RRC CONNECTION RELEASE message by the UE

The UE shall receive and act on an RRC CONNECTION RELEASE message in states CELL_DCH and CELL_FACH. Furthermore this procedure can interrupt any ongoing procedures with the UE in the above listed states.

When the UE receives the first RRC CONNECTION RELEASE message; and

- if the message is received on the CCCH, and IE "U-RNTI" is present and has the same value as the variable U_RNTI; or
- if the message is received on the CCCH, the IE "UTRAN group identity" is present and there is a group identity match according to 8.6.3.13; or
- if the message is received on DCCH:

the UE shall authenticate the release according to subclause 8.6.3.y. If the authentication was unsuccessful, the UE shall ignore the RRC CONNECTION RELEASE message and the procedure ends. If the authentication was successful the UE shall:

- in state CELL_DCH:
  - initialise the counter V308 to zero;
  - set the IE "RRC transaction identifier" in the RRC CONNECTION RELEASE COMPLETE message to the value of "RRC transaction identifier" in the entry for the RRC CONNECTION RELEASE message in the table "Accepted transactions" in the variable TRANSACTIONS;
  - submit an RRC CONNECTION RELEASE COMPLETE message to the lower layers for transmission using UM RLC on the DCCH to the UTRAN;
  - if the IE "Rplmn information" is present:
    - the UE may:
      - store the IE on the ME together with the PLMN id for which it applies;
    - the UE may then:
      - utilise this information, typically indicating where a number of BCCH frequency ranges of a RAT may be expected to be found, during subsequent Rplmn selections of the indicated PLMN.
  - start timer T308 when the RRC CONNECTION RELEASE COMPLETE message is sent on the radio interface.
- in state CELL_FACH:
  - if the RRC CONNECTION RELEASE message was received on the DCCH:
    - set the IE "RRC transaction identifier" in the RRC CONNECTION RELEASE COMPLETE message to the value of "RRC transaction identifier" in the entry for the RRC CONNECTION RELEASE message in the table "Accepted transactions" in the variable TRANSACTIONS;
    - submit an RRC CONNECTION RELEASE COMPLETE message to the lower layers for transmission using AM RLC on the DCCH to the UTRAN.
    - when the successful transmission of the RRC CONNECTION RELEASE COMPLETE message has been confirmed by the lower layers:
      - release all its radio resources; and
      - indicate the release of the established signalling connections (as stored in the variable ESTABLISHED_SIGNALLING_CONNECTIONS) and established radio access bearers (as stored in the variable ESTABLISHED_RABS) to upper layers; and
      - clear any entry for the RRC CONNECTION RELEASE message in the tables "Accepted transactions" and "Rejected transactions" in the variable TRANSACTIONS;

- clear the variable ESTABLISHED_SIGNALLING_CONNECTIONS;
- clear the variable ESTABLISHED_RABS;
- pass the value of the IE "Release cause" received in the RRC CONNECTION RELEASE message to upper layers;
- enter idle mode;
- perform the actions specified in subclause 8.5.2 when entering idle mode.

- and the procedure ends.

- if the RRC CONNECTION RELEASE message was received on the CCCH:
  - release all its radio resources;
  - indicate the release of the established signalling connections (as stored in the variable ESTABLISHED_SIGNALLING_CONNECTIONS) and established radio access bearers (as stored in the variable ESTABLISHED_RABS) to the upper layers;
  - clear any entry for the RRC CONNECTION RELEASE message in the tables "Accepted transactions" and "Rejected transactions" in the variable TRANSACTIONS;
  - clear the variable ESTABLISHED_SIGNALLING_CONNECTIONS;
  - clear the variable ESTABLISHED_RABS;
  - pass the value of the IE "Release cause" received in the RRC CONNECTION RELEASE message to upper layers;
  - enter idle mode;
  - perform the actions specified in subclause 8.5.2 when entering idle mode;
  - and the procedure ends.

### 8.6.3.x Authentication release indicia

If the IE "Authentication release indicia" is included, the UE shall store the value in the variable AUTHENTICATION_RELEASE_INDICIA.

### 8.6.3.y Authentication release key

If the IE "Authentication release key" is included, the UE shall use the following procedure to authenticate the release of RRC connection:

- If the variable AUTHENTICATION_RELEASE_INDICIA is empty:
  - consider the authentication of the RRC connection release as successful.
- If the variable AUTHENTICATION_RELEASE_INDICIA is non-empty:
  - derive an Authentication release indicia I, using the following formula:
    - $I = Kasumi(U2)_{KEY}$, where
      - Kasumi is in accordance with [40];
      - U2 is the value of the variable U_RNTI concatenated twice forming 64 bits;
      - KEY is the value of the received IE "Authentication release key"
    - if the Authentication release indicia I is equal to the value of the variable AUTHENTICATION_RELEASE_INDICIA:
      - consider the authentication of the RRC connection release as successful;
    - else:
      - consider the authentication of the RRC connection release as unsuccessful.

If the IE "Authentication release key" was not included, the UE shall use the following procedure to authenticate the release of RRC connection:

- If the variable AUTHENTICATION_RELEASE_INDICIA is empty:
  - consider the authentication of the RRC connection release as successful.
- If the variable AUTHENTICATION_RELEASE_INDICIA is non-empty:
  - consider the authentication of the RRC connection release as unsuccessful.

### 8.6.3.12 Capability Update Requirement

If the IE "Capability Update Requirement" is included, the UE shall:

- if the IE "UE radio access FDD capability update requirement" has the value TRUE:
  - if the UE supports FDD mode:
    - store its UTRA FDD capabilities and its UTRA capabilities common to FDD and TDD in the IE "UE radio access capability" and the IE "UE radio access capability extension" in variable UE_CAPABILITY_REQUESTED as specified below:
      - if the UE supports multiple UTRA FDD Frequency Bands; or
      - if the UE supports a single UTRA FDD Frequency Band different from 2100 MHz:
        - store the IE "UE radio access capability", excluding IEs "RF capability FDD" and "Measurement capability";
        - store the IE "UE radio access capability extension", including the IEs "RF capability FDD extension" and the "Measurement capability extension" associated with each supported UTRA FDD frequency band indicated in the IE "Frequency band".
      - else:
        - store the IE "UE radio access capability", including the IEs "RF capability FDD" and "Measurement capability" associated with the 2100 MHz UTRA FDD frequency band.
- if the IE "UE radio access TDD capability update requirement" has the value TRUE:
  - if the UE supports TDD mode:
    - store it's UTRA TDD capabilities and its UTRA capabilities common to FDD and TDD in the IE "UE radio access capability" in the variable UE_CAPABILITY_REQUESTED.
- if the IE "System specific capability update requirement list" is present:
  - for each of the RAT requested in the IE "UE system specific capability":
    - if the UE supports the listed RAT:
      - include its inter-RAT radio access capabilities for the listed RAT in the IE "UE system specific capability" from the variable UE_CAPABILITY_REQUESTED.

If the IE "Capability update requirement " is not present, the UE shall:

- assume the default values as specified in subclause 10.3.3.2 and act in accordance with the above.

### 8.6.3.13 U-RNTI group

The UE shall apply the following procedure to compare the IE "U-RNTI group" with the U-RNTI allocated to the UE stored in the variable U_RNTI.

If the IE "group discriminator" is equal to "All":

- consider this as a group identity match.

If the IE "group discriminator" is equal to "U-RNTI mask":

- let N be the value of the IE "U-RNTI bit mask index";
- if N is equal to b20, b21, … or b31:
  - compare pairs of bits, starting from bit b31 downto, and including, bit N of the "SRNC identity" of the IE "U-RNTI" with the corresponding bits stored in the variable U_RNTI;

- if all pairs of bits are equal:
  - consider this as a group identity match.

- if N is equal to b1, b2, … or b19:
  - compare pairs of bits, starting from bit b31 downto, and including, bit b20 of the "SRNC identity" in the IE "U-RNTI" with the corresponding bits of the "SRNC identity" stored in the variable U_RNTI;
  - if all pairs of bits are equal:
    - then compare pairs of bits, starting from bit b19 downto, and including, bit N of the "S-RNTI" in the IE "U-RNTI" with the corresponding bits of the "S-RNTI" stored in the variable U_RNTI;
    - if all pairs of bits are equal:
      - consider this as a group identity match.

## 8.6.4 Radio bearer information elements

## 10.2.37 RRC CONNECTION RELEASE

This message is sent by UTRAN to release the RRC connection. The message also releases the signalling connection and all radio bearers between the UE and UTRAN.

RLC-SAP: UM

Logical channel: CCCH or DCCH

Direction: UTRAN→UE

| Information Element/Group name | Need | Multi | Type and reference | Semantics description | Version |
|---|---|---|---|---|---|
| Message Type | MP | | Message Type | | |
| **UE information elements** | | | | | |
| CHOICE *identity type* | CV-*CCCH* | | | | REL-5 |
| >U-RNTI | ~~CV-*CCCH*~~ | | U-RNTI 10.3.3.47 | | |
| >U-RNTI group | | | U-RNTI group 10.3.3.47a | | REL-5 |
| Authentication release key | OP | | Authentication release key 10.3.3.y | | REL-5 |
| RRC transaction identifier | MP | | RRC transaction identifier 10.3.3.36 | | |
| Integrity check info | CV-*DCCH* | | Integrity check info 10.3.3.16 | Integrity check info is included if integrity protection is applied | |
| N308 | CH-*Cell_DCH* | | Integer(1..8) | | |
| Release cause | MP | | Release cause 10.3.3.32 | | |
| **Other information elements** | | | | | |
| Rplmn information | OP | | Rplmn information 10.3.8.15 | | |

| Condition | Explanation |
|---|---|
| *CCCH* | This IE is mandatory present when CCCH is used and not needed otherwise. |
| *DCCH* | This IE is mandatory present when DCCH is used and not needed otherwise. |
| *Cell_DCH* | This IE is mandatory present when UE is in CELL_DCH state and not needed otherwise. |

## 10.2.62 UTRAN MOBILITY INFORMATION

This message is used by UTRAN to allocate a new RNTI and to convey other UTRAN mobility related information to a UE.

RLC-SAP: AM or UM

Logical channel: DCCH

Direction: UTRAN→UE

| Information Element/Group name | Need | Multi | Type and reference | Semantics description | Version |
|---|---|---|---|---|---|
| Message Type | MP | | Message Type | | |
| **UE Information Elements** | | | | | |
| Integrity check info | CH | | Integrity check info 10.3.3.16 | | |
| RRC transaction identifier | MP | | RRC transaction identifier 10.3.3.36 | | |
| Integrity protection mode info | OP | | Integrity protection mode info 10.3.3.19 | | |
| Ciphering mode info | OP | | Ciphering mode info 10.3.3.5 | | |
| New U-RNTI | OP | | U-RNTI 10.3.3.47 | | |
| New C-RNTI | OP | | C-RNTI 10.3.3.8 | | |
| Authentication release indicia | OP | | Authentication release indicia 10.3.3.x | | REL-5 |
| UE Timers and constants in connected mode | OP | | UE Timers and constants in connected mode 10.3.3.43 | | |
| **CN Information Elements** | | | | | |
| CN Information info | OP | | CN Information info full 10.3.1.3a | | |
| **UTRAN Information Elements** | | | | | |
| URA identity | OP | | URA identity 10.3.2.6 | | |
| **RB Information elements** | | | | | |
| Downlink counter synchronisation info | OP | | | | |
| >RB with PDCP information list | OP | 1 to <maxRBallRABs> | | This IE is needed for each RB having PDCP in the case of lossless SRNS relocation | |
| >>RB with PDCP information | MP | | RB with PDCP information 10.3.4.22 | | |

### 10.3.3.x Authentication release indicia

| Information Element/Group name | Need | Multi | Type and reference | Semantics description | Version |
|---|---|---|---|---|---|
| Authentication release indicia | MP | | Bit string (64) | | REL-5 |

### 10.3.3.y Authentication release key

| Information Element/Group name | Need | Multi | Type and reference | Semantics description | Version |
|---|---|---|---|---|---|
| Authentication release key | MP | | Bit string (64) | | REL-5 |

## 10.3.3.23 Paging record

| Information Element/Group name | Need | Multi | Type and reference | Semantics description | Version |
|---|---|---|---|---|---|
| CHOICE *Used paging identity* | MP | | | | |
| >CN identity | | | | | |
| >>Paging cause | MP | | Paging cause 10.3.3.22 | | |
| >>CN domain identity | MP | | CN domain identity 10.3.1.1 | | |
| >>CHOICE *UE Identity* | MP | | | | |
| >>>IMSI (GSM-MAP) | | | IMSI (GSM-MAP) 10.3.1.5 | | |
| >>>TMSI (GSM-MAP) | | | TMSI (GSM-MAP) 10.3.1.17 | | |
| >>>P-TMSI (GSM-MAP) | | | P-TMSI (GSM-MAP) 10.3.1.13 | | |
| >>>IMSI (DS-41) | | | TIA/EIA/IS-2000-4 | | |
| >>>TMSI (DS-41) | | | TIA/EIA/IS-2000-4 | | |
| >UTRAN single UE identity | | | | | |
| >>U-RNTI | MP | | U-RNTI 10.3.3.47 | | |
| >>CN originated page to connected mode UE | OP | | | | |
| >>>Paging cause | MP | | Paging cause 10.3.3.22 | | |
| >>>CN domain identity | MP | | CN domain identity 10.3.1.1 | | |
| >>>Paging record type identifier | MP | | Paging record type identifier 10.3.1.10 | | |
| >>RRC connection release information | MP | | RRC connection release information 10.3.3.32a | | REL-5 |
| >UTRAN group identity | | | | | REL-5 |
| >> U-RNTI group | MP | | U-RNTI group 10.3.3.47a | | REL-5 |
| >> RRC connection release information | MP | | RRC connection release information 10.3.3.32a | | REL-5 |

| Condition | Explanation |
|---|---|
| **CHOICE *Used paging identity*** | **Condition under which the given *used paging identity* is chosen** |
| CN identity | For CN originating pages (for idle mode UEs) |
| UTRAN identity | For UTRAN originating pages (for connected mode UEs) |

### 10.3.3.32 Release cause

Cause for release of RRC connection.

| Information Element/Group name | Need | Multi | Type and reference | Semantics description |
|---|---|---|---|---|
| Release cause | MP | | Enumerated (normal event, unspecified, pre-emptive release, congestion, re-establishment reject, user inactivity), directed signalling connection re-establishment) | |

### 10.3.3.32a RRC connection release information

Indicates whether the UE shall perform a release.

| Information Element/Group name | Need | Multi | Type and reference | Semantics description | Version |
|---|---|---|---|---|---|
| CHOICE *Release indicator* | MD | | | Default value is "No release" | REL-5 |
| >No release | | | | | REL-5 |
| >Release | | | | | REL-5 |
| >>Release cause | MP | | Release cause 10.3.3.32 | | REL-5 |
| >>Authentication release key | OP | | Authentication release key 10.3.3.y | | REL-5 |

### 10.3.3.33 RF capability FDD

| Information Element/Group name | Need | Multi | Type and Reference | Semantics description | Version |
|---|---|---|---|---|---|
| UE power class | MP | | Enumerated( 1..4) | as defined in [21] | |
| Tx/Rx frequency separation | MP | | Enumerated( 190, 174.8-205.2, 134.8-245.2) | In MHz<br>as defined in [21].<br>NOTE: Not applicable if UE is not operating in frequency band a (as defined in [21]). | |

### 10.3.3.47 U-RNTI

The U-RNTI (UTRAN Radio Network Temporary Identity) is allocated to an UE having a RRC connection and identifies the UE within UTRAN.

| Information Element/Group name | Need | Multi | Type and reference | Semantics description |
|---|---|---|---|---|
| SRNC identity | MP | | bit string(12) | The SRNC identity bits are numbered b20 to b31, where b20 is the least significant bit. |
| S-RNTI | MP | | bit string(20) | The S-RNTI bits are numbered b0 to b19, where b0 is the least significant bit. |

### 10.3.3.47a U-RNTI group

The U-RNTI group is used to identify a group of UEs having an RRC connection.

| Information Element/Group name | Need | Multi | Type and reference | Semantics description | Version |
|---|---|---|---|---|---|
| CHOICE *group discrimimator* | MP | | | | REL-5 |
| >All | | | | (no data) | REL-5 |
| >U-RNTI mask | | | | | REL-5 |
| >> U-RNTI | MP | | U-RNTI 10.3.3.47 | The bits that are less significant than the bit position indicated by the U-RNTI bit mask index shall be ignored. | REL-5 |
| >> U-RNTI bit mask index | MP | | Enumerated( b1, b2,..b31) | Values b1 to b19 indicate bit positions in the S-RNTI. Values b20 to b31 indicate bit positions in the SRNC identity. | REL-5 |

### 10.3.3.48 U-RNTI Short

The U-RNTI (UTRAN Radio Network Temporary Identity) is allocated to an UE having a RRC connection and identifies the UE within UTRAN.

| Information Element/Group name | Need | Multi | Type and reference | Semantics description |
|---|---|---|---|---|
| SRNC identity | MP | | bit string(12) | The SRNC identity bits are numbered b20 to b31, where b20 is the least significant bit. |
| S-RNTI 2 | MP | | bit string(10) | The S-RNTI 2 bits are numbered b0 to b9, where b0 is the least significant bit. |

# 11.2 PDU definitions

```
PagingType1 ::= SEQUENCE {
    -- User equipment IEs
        pagingRecordList                PagingRecordList                    OPTIONAL,
    -- Other IEs
        bcch-ModificationInfo           BCCH-ModificationInfo               OPTIONAL,
    -- Extension mechanism for non- release99 information
        nonCriticalExtensions           SEQUENCE {}     OPTIONAL
}


PagingType1 ::= SEQUENCE {
    -- User equipment IEs
        pagingRecordList                PagingRecordList                    OPTIONAL,
    -- Other IEs
        bcch-ModificationInfo           BCCH-ModificationInfo               OPTIONAL,
    -- Extension mechanism for non- release99 information
        nonCriticalExtensions           SEQUENCE {
            pagingType1-r3-r5-ext       PagingType1-r3-r5-ext-IEs,
            nonCriticalExtensions           SEQUENCE {} OPTIONAL
        }       OPTIONAL
}

PagingType1-r3-r5-ext-IEs ::= SEQUENCE {
    -- User equipment IEs
        pagingRecordList-r5             PagingRecordList-r5                 OPTIONAL
}


-- **************************************************
--
-- RRC CONNECTION RELEASE
--
-- **************************************************

RRCConnectionRelease ::= CHOICE {
    r3                              SEQUENCE {
        rrcConnectionRelease-r3         RRCConnectionRelease-r3-IEs,
        nonCriticalExtensions           SEQUENCE {} OPTIONAL
    },
    later-than-r3                   SEQUENCE {
        rrc-TransactionIdentifier       RRC-TransactionIdentifier,
        criticalExtensions              SEQUENCE {}
    }
}

RRCConnectionRelease-r3-IEs ::= SEQUENCE {
    -- User equipment IEs
        rrc-TransactionIdentifier       RRC-TransactionIdentifier,
        n-308                           N-308                               OPTIONAL,
        -- The IE above is conditional on the UE state.
        releaseCause                    ReleaseCause,
        rplmn-information               Rplmn-Information                   OPTIONAL
}

-- **************************************************
--
-- RRC CONNECTION RELEASE for CCCH
--
-- **************************************************

RRCConnectionRelease-CCCH ::= CHOICE {
    r3                              SEQUENCE {
        rrcConnectionRelease-CCCH-r3    RRCConnectionRelease-CCCH-r3-IEs,
        nonCriticalExtensions           SEQUENCE {} OPTIONAL
    },
    later-than-r3                   SEQUENCE {
        rrc-TransactionIdentifier       RRC-TransactionIdentifier,
        criticalExtensions              SEQUENCE {}
    }
}

RRCConnectionRelease-CCCH ::= CHOICE {
```

```
    r3                              SEQUENCE {
        rrcConnectionRelease-CCCH-r3    RRCConnectionRelease-CCCH-r3-IEs,
        nonCriticalExtensions           SEQUENCE {} OPTIONAL
    },
    later-than-r3                   SEQUENCE {
        rrc-TransactionIdentifier       RRC-TransactionIdentifier,
        criticalExtensions              CHOICE {
            r5                              SEQUENCE {
                rrcConnectionRelease-CCCH-r5    RRCConnectionRelease-CCCH-r5-IEs  OPTIONAL,
                noncriticalExtensions               SEQUENCE {}  OPTIONAL
            }
            criticalExtensions              SEQUENCE {}
    }
}

RRCConnectionRelease-CCCH-r3-IEs ::= SEQUENCE {
    -- User equipment IEs
        u-RNTI                          U-RNTI,
    -- The rest of the message is identical to the one sent on DCCH.
        rrcConnectionRelease            RRCConnectionRelease-r3-IEs
}

RRCConnectionRelease-CCCH-r5-IEs ::= SEQUENCE {
    -- User equipment IEs
        identityType                    CHOICE {
            u-RNTI                          U-RNTI,
            u-RNTI-Group                    U-RNTI-Group
        }
    -- The rest of the message is identical to the one sent on DCCH.
        rrcConnectionRelease            RRCConnectionRelease-r3-IEs
}


-- ************************************************
--
-- UTRAN MOBILITY INFORMATION
--
-- ************************************************

UTRANMobilityInformation ::= CHOICE {
    r3                              SEQUENCE {
        utranMobilityInformation-r3     UTRANMobilityInformation-r3-IEs,
        nonCriticalExtensions           SEQUENCE {}     OPTIONAL
    },
    later-than-r3                   SEQUENCE {
        rrc-TransactionIdentifier       RRC-TransactionIdentifier,
        criticalExtensions              SEQUENCE {}
    }
}

UTRANMobilityInformation-r3-IEs ::= SEQUENCE {
    -- User equipment IEs
        rrc-TransactionIdentifier       RRC-TransactionIdentifier,
        integrityProtectionModeInfo     IntegrityProtectionModeInfo         OPTIONAL,
        cipheringModeInfo               CipheringModeInfo                   OPTIONAL,
        new-U-RNTI                      U-RNTI                              OPTIONAL,
        new-C-RNTI                      C-RNTI                              OPTIONAL,
        ue-ConnTimersAndConstants       UE-ConnTimersAndConstants           OPTIONAL,
    -- CN information elements
        cn-InformationInfo              CN-InformationInfoFull              OPTIONAL,
    -- UTRAN mobility IEs
        ura-Identity                    URA-Identity                        OPTIONAL,
    -- Radio bearer IEs
        dl-CounterSynchronisationInfo   DL-CounterSynchronisationInfo       OPTIONAL,
    -- Extension mechanism for non- release99 information
        nonCriticalExtensions           SEQUENCE {}     OPTIONAL
}
```

# 11.3 Information element definitions

```
-- **************************************************
--
--     USER EQUIPMENT INFORMATION ELEMENTS (10.3.3)
--
-- **************************************************

PagingRecord ::=                    CHOICE {
    cn-Identity                         SEQUENCE {
        pagingCause                         PagingCause,
        cn-DomainIdentity                   CN-DomainIdentity,
        cn-pagedUE-Identity                 CN-PagedUE-Identity
    },
    utran-Identity                      SEQUENCE {
        u-RNTI                              U-RNTI,
        cn-OriginatedPage-connectedMode-UE  SEQUENCE {
            pagingCause                         PagingCause,
            cn-DomainIdentity                   CN-DomainIdentity,
            pagingRecordTypeID                  PagingRecordTypeID
        }                                                               OPTIONAL
    }
}

PagingRecordList ::=                SEQUENCE (SIZE (1..maxPage1)) OF
                                        PagingRecord

PagingRecord-r5 ::=                 CHOICE {
    utran-SingleUE-Identity                 SEQUENCE {
        u-RNTI                              U-RNTI,
        cn-OriginatedPage-connectedMode-UE  SEQUENCE {
            pagingCause                         PagingCause,
            cn-DomainIdentity                   CN-DomainIdentity,
            pagingRecordTypeID                  PagingRecordTypeID
        }                                                               OPTIONAL,
        releaseInformation                  ReleaseInformation
    }
    utran-GroupIdentity                 SEQUENCE {
        u-RNTI-Group                        U-RNTI-Group,
        releaseInformation                  ReleaseInformation
    }
}

PagingRecordList-r5 ::=             SEQUENCE (SIZE (1..maxPage1)) OF
                                        PagingRecord-r5

ReleaseInformation ::=              CHOICE {
    noRelease                           NULL,
    release                             ReleaseCause
}


U-RNTI ::=                          SEQUENCE {
    srnc-Identity                       SRNC-Identity,
    s-RNTI                              S-RNTI
}

U-RNTI-Short ::=                    SEQUENCE {
    srnc-Identity                       SRNC-Identity,
    s-RNTI-2                            S-RNTI-2
}

U-RNTI-BitMaskIndex ::=             ENUMERATED (
                                        b1,
                                        b2,
                                        b3,
                                        b4,
                                        b5,
                                        b6,
                                        b7,
                                        b8,
                                        b9,
                                        b10,
                                        b11,
                                        b12,
                                        b13,
```

```
                                        b14,
                                        b15,
                                        b16,
                                        b17,
                                        b18,
                                        b19,
                                        b20,
                                        b21,
                                        b22,
                                        b23,
                                        b24,
                                        b25,
                                        b26,
                                        b27,
                                        b28,
                                        b29,
                                        b30,
                                        b31
)
```

```
-- TABULAR: not following the tabular strictly, but this will most likely save bits
U-RNTI-Group ::=                    CHOICE {
    all                                 NULL,
    u-RNTI-BitMaskIndex-b1              BIT STRING (SIZE (31)),
    u-RNTI-BitMaskIndex-b2              BIT STRING (SIZE (30)),
    u-RNTI-BitMaskIndex-b3              BIT STRING (SIZE (29)),
    u-RNTI-BitMaskIndex-b4              BIT STRING (SIZE (28)),
    u-RNTI-BitMaskIndex-b5              BIT STRING (SIZE (27)),
    u-RNTI-BitMaskIndex-b6              BIT STRING (SIZE (26)),
    u-RNTI-BitMaskIndex-b7              BIT STRING (SIZE (25)),
    u-RNTI-BitMaskIndex-b8              BIT STRING (SIZE (24)),
    u-RNTI-BitMaskIndex-b9              BIT STRING (SIZE (23)),
    u-RNTI-BitMaskIndex-b10             BIT STRING (SIZE (22)),
    u-RNTI-BitMaskIndex-b11             BIT STRING (SIZE (21)),
    u-RNTI-BitMaskIndex-b12             BIT STRING (SIZE (20)),
    u-RNTI-BitMaskIndex-b13             BIT STRING (SIZE (19)),
    u-RNTI-BitMaskIndex-b14             BIT STRING (SIZE (18)),
    u-RNTI-BitMaskIndex-b15             BIT STRING (SIZE (17)),
    u-RNTI-BitMaskIndex-b16             BIT STRING (SIZE (16)),
    u-RNTI-BitMaskIndex-b17             BIT STRING (SIZE (15)),
    u-RNTI-BitMaskIndex-b18             BIT STRING (SIZE (14)),
    u-RNTI-BitMaskIndex-b19             BIT STRING (SIZE (13)),
    u-RNTI-BitMaskIndex-b20             BIT STRING (SIZE (12)),
    u-RNTI-BitMaskIndex-b21             BIT STRING (SIZE (11)),
    u-RNTI-BitMaskIndex-b22             BIT STRING (SIZE (10)),
    u-RNTI-BitMaskIndex-b23             BIT STRING (SIZE (9)),
    u-RNTI-BitMaskIndex-b24             BIT STRING (SIZE (8)),
    u-RNTI-BitMaskIndex-b25             BIT STRING (SIZE (7)),
    u-RNTI-BitMaskIndex-b26             BIT STRING (SIZE (6)),
    u-RNTI-BitMaskIndex-b27             BIT STRING (SIZE (5)),
    u-RNTI-BitMaskIndex-b28             BIT STRING (SIZE (4)),
    u-RNTI-BitMaskIndex-b29             BIT STRING (SIZE (3)),
    u-RNTI-BitMaskIndex-b30             BIT STRING (SIZE (2)),
    u-RNTI-BitMaskIndex-b31             BIT STRING (SIZE (1))
}
```

# 13.4 UE variables

## 13.4.A AUTHENTICATION_RELEASE_INDICIA

| Information Element/Group name | Need | Multi | Type and reference | Semantics description | Version |
|---|---|---|---|---|---|
| Authentication release indicia | OP | | Authentication release indicia 10.3.3.x | | REL-5 |

NOTE: This IE shall be cleared when entering UTRA RRC connected mode, when leaving UTRA RRC connected mode, when switched off as well as at selection of a new PLMN.

## 13.4.0 CELL INFO LIST

This variable contains cell information on intra-frequency, inter-frequency and inter-RAT cells, as received in messages System Information Block Type 11, System Information Block Type 12, and MEASUREMENT CONTROL.

The first position in Intra-frequency cell info list corresponds to Intra-frequency cell id 0, the second to Intra-frequency cell id 1, etc.

The first position in Inter-frequency cell info list corresponds to Inter-frequency cell id 0, the second to Inter-frequency cell id 1, etc.

The first position in Inter-RAT cell info list corresponds to Intra-frequency cell id 0, the second to Inter-RAT cell id 1, etc.

| Information Element/Group name | Need | Multi | Type and reference | Semantics description |
|---|---|---|---|---|
| Intra-frequency cell info | OP | 1..<maxCellMeas> | | Note |
| >CHOICE *position status* | MP | | | |
| >>Occupied | | | | |
| >>>Cell info | MP | | Cell info 10.3.7.2 | |
| >>Vacant | | | | No data |
| Inter-frequency cell info | OP | 1..<maxCellMeas> | | Note |
| >CHOICE *position status* | MP | | | |
| >>Occupied | | | | |
| >>>Frequency info | MP | | Frequency info 10.3.6.36 | |
| >>>Cell info | MP | | Cell info 10.3.7.2 | |
| >>Vacant | | | | No data |
| Inter-RAT cell info | OP | 1..<maxCellMeas> | | Note |
| >CHOICE *position status* | MP | | | |
| >>Occupied | | | | |
| >>>CHOICE *Radio Access Technology* | | | | |

| Information Element/Group name | Need | Multi | Type and reference | Semantics description |
|---|---|---|---|---|
| >>>>GSM | | | | |
| >>>>>Cell selection and re-selection info | MP | | Cell selection and re-selection info for SIB11/12 10.3.2.4 | |
| >>>>>BSIC | MP | | BSIC 10.3.8.2 | |
| >>>>>BCCH ARFCN | MP | | Integer (0..1023) | [43] |
| >>>>IS-2000 | | | | |
| >>>>>System specific measurement info | | | enumerated (frequency, timeslot, colour code, output power, PN offset) | For IS-2000, use fields from TIA/EIA/IS-2000.5, subclause 3. 7.3.3.2.27, *Candidate Frequency Neighbour List Message* |
| >>Vacant | | | | No data |

NOTE: This IE shall be cleared when entering UTRA RRC connected mode, when leaving UTRA RRC connected mode, when switched off as well as at selection of a new PLMN.