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*Technical Specification*

**LTE;  
Evolved Universal Terrestrial Radio Access (E-UTRA);  
User Equipment (UE) procedures in idle mode  
(3GPP TS 36.304 version 9.3.0 Release 9)**

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650 Route des Lucioles  
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C  
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# 1 Scope

The present document specifies the Access Stratum (AS) part of the Idle Mode procedures applicable to a UE. The non-access stratum (NAS) part of Idle mode procedures and processes is specified in [5].

The present document specifies the model for the functional division between the NAS and AS in a UE.

The present document applies to all UEs that support at least E-UTRA, including multi-RAT UEs as described in 3GPP specifications, in the following cases:

- When the UE is camped on an E-UTRA cell;
- When the UE is searching for a cell to camp on;

NOTE: When the UE is camped on or searching for a cell to camp on belonging to other RATs, the UE behaviour is described in the specifications of the other RAT.

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# 2 References

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- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 25.990: "Vocabulary for UTRAN".
- [2] 3GPP TS 36.300: "E-UTRA and E-UTRAN Overall Description; Stage 2".
- [3] 3GPP TS 36.331: "E-UTRA; Radio Resource Control (RRC) - Protocol Specification".
- [4] 3GPP TS 22.011: "Service accessibility".
- [5] 3GPP TS 23.122: "NAS functions related to Mobile Station (MS) in idle mode".
- [6] 3GPP TS 36.213: "E-UTRA; Physical layer procedures".
- [7] 3GPP TS 36.214: "E-UTRA; Physical layer; Measurements".
- [8] 3GPP TS 25.304: "User Equipment (UE) procedures in idle mode and procedures for cell reselection in connected mode"
- [9] 3GPP TS 43.022: "Functions related to Mobile Station in idle mode and group receive mode".
- [10] 3GPP TS 36.133: "Requirements for Support of Radio Resource Management".
- [11] void
- [12] void
- [13] void
- [14] void
- [15] void

- [16] 3GPP TS 24.301: "Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3"
- [17] 3GPP2 C.S0024-A: "cdma2000 High Rate Packet Data Air Interface Specification".
- [18] 3GPP2 C.S0005-A: "Upper Layer (Layer 3) Signalling Standard for cdma2000 Spread Spectrum Systems".
- [19] 3GPP TS 25.304: "User Equipment (UE) procedures in idle mode and procedures for cell reselection in connected mode".
- [20] 3GPP TS 24.008: "Mobile Radio Interface Layer 3 specification; Core Network Protocols; Stage 3"

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## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

**Acceptable Cell:** A cell that satisfies certain conditions as specified in 4.3. A UE can always attempt emergency calls on an acceptable cell, but restriction as in 5.3.3 apply.

**CSG Whitelist:** A list provided by NAS containing all the CSG identities of the CSGs to which the subscriber belongs.

NOTE: This list is known as Allowed CSG List in Rel-8 Access Stratum specifications.

**Available PLMN(s):** One or more PLMN(s) for which the UE has found at least one cell and read its PLMN identity(ies).

**Barred Cell:** A cell a UE is not allowed to camp on.

**Camped on a cell:** UE has completed the cell selection/reselection process and has chosen a cell. The UE monitors system information and (in most cases) paging information.

**Camped on any cell:** UE is in idle mode and has completed the cell selection/reselection process and has chosen a cell irrespective of PLMN identity.

**Closed Subscriber Group (CSG):** A Closed Subscriber Group identifies subscribers of an operator who are permitted to access one or more cells of the PLMN but which have restricted access (CSG cells).

**Commercial Mobile Alert System:** Public Warning System that delivers *Warning Notifications* provided by *Warning Notification Providers* to CMAS capable UEs.

**CSG cell:** A cell, part of the PLMN, broadcasting a CSG indication that is set to TRUE and a specific CSG identity. A CSG cell is accessible by the members of the closed subscriber group for that CSG identity.

**CSG identity:** An identifier broadcast by a CSG or hybrid cell/cells and used by the UE to facilitate access for authorised members of the associated Closed Subscriber Group.

**DRX cycle:** Individual time interval between monitoring Paging Occasion for a specific UE.

**EHPLMN:** Any of the PLMN entries contained in the Equivalent HPLMN list [5].

**Equivalent PLMN list:** List of PLMNs considered as equivalent by the UE for cell selection, cell reselection, handover and manual CSG ID selection according to the information provided by the NAS.

**Home PLMN:** A PLMN where the Mobile Country Code (MCC) and Mobile Network Code (MNC) of the PLMN identity are the same as the MCC and MNC of the IMSI.

**HNB Name:** The Home eNodeB Name is a broadcast string in free text format that provides a human readable name for the Home eNodeB CSG identity.



**Hybrid cell:** A cell, part of the PLMN, broadcasting a CSG Indicator that is set to FALSE and a specific CSG identity.

**Location Registration (LR):** UE registers its presence in a registration area, for instance regularly or when entering a new tracking area.

**Process:** A local action in the UE invoked by a RRC procedure or an Idle Mode procedure.

**Radio Access Technology:** Type of technology used for radio access, for instance E-UTRA, UTRA, GSM, CDMA2000 1xEV-DO (HRPD) or CDMA2000 1x (1xRTT).

**Registered PLMN:** This is the PLMN on which certain Location Registration outcomes have occurred [5].

**Registration Area:** (NAS) registration area is an area in which the UE may roam without a need to perform location registration, which is a NAS procedure.

**Reserved Cell:** A cell on which camping is not allowed, except for particular UEs, if so indicated in the system information.

**Restricted Cell:** A cell on which camping is allowed, but access attempts are disallowed for UEs whose access classes are indicated as barred.

**Selected PLMN:** This is the PLMN that has been selected by the NAS, either manually or automatically.

**Serving cell:** The cell on which the UE is camped.

**Strongest cell:** The cell on a particular carrier that is considered strongest according to the layer 1 cell search procedure [6], [7].

**Suitable Cell:** This is a cell on which an UE may camp. For a E-UTRA cell, the criteria are defined in subclause 4.3, for a UTRA cell in [8], and for a GSM cell the criteria are defined in [9].

## 3.2 Symbols

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

<symbol>      <Explanation>

## 3.3 Abbreviations

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

1xRTT	CDMA2000 1x Radio Transmission Technology
AS	Access Stratum
AC	Access Class (of the USIM)
BCCH	Broadcast Control Channel
CMAS	Commercial Mobile Alert System
CSG	Closed Subscriber Group
DRX	Discontinuous Reception
DL-SCH	Downlink Shared Channel
EHPLMN	Equivalent Home PLMN
EPC	Evolved Packet Core
EPS	Evolved Packet System
ETWS	Earthquake and Tsunami Warning System
E-UTRA	Evolved UMTS Terrestrial Radio Access
E-UTRAN	Evolved UMTS Terrestrial Radio Access Network
FDD	Frequency Division Duplex
GERAN	GSM/EDGE Radio Access Network
HPLMN	Home PLMN
HRPD	High Rate Packet Data
IMSI	International Mobile Subscriber Identity
MBMS	Multimedia Broadcast-Multicast Service
MBSFN	Multimedia Broadcast multicast service Single Frequency Network
MCC	Mobile Country Code

MCCH	Multicast Control Channel
MM	Mobility Management
MNC	Mobile Network Code
MTCH	Multicast Traffic Channel
NAS	Non-Access Stratum
PLMN	Public Land Mobile Network
PWS	Public Warning System
RAT	Radio Access Technology
RRC	Radio Resource Control
SAP	Service Access Point
SIBX	SystemInformationBlockTypeX
TDD	Time Division Duplex
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
USIM	Universal Subscriber Identity Module
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network

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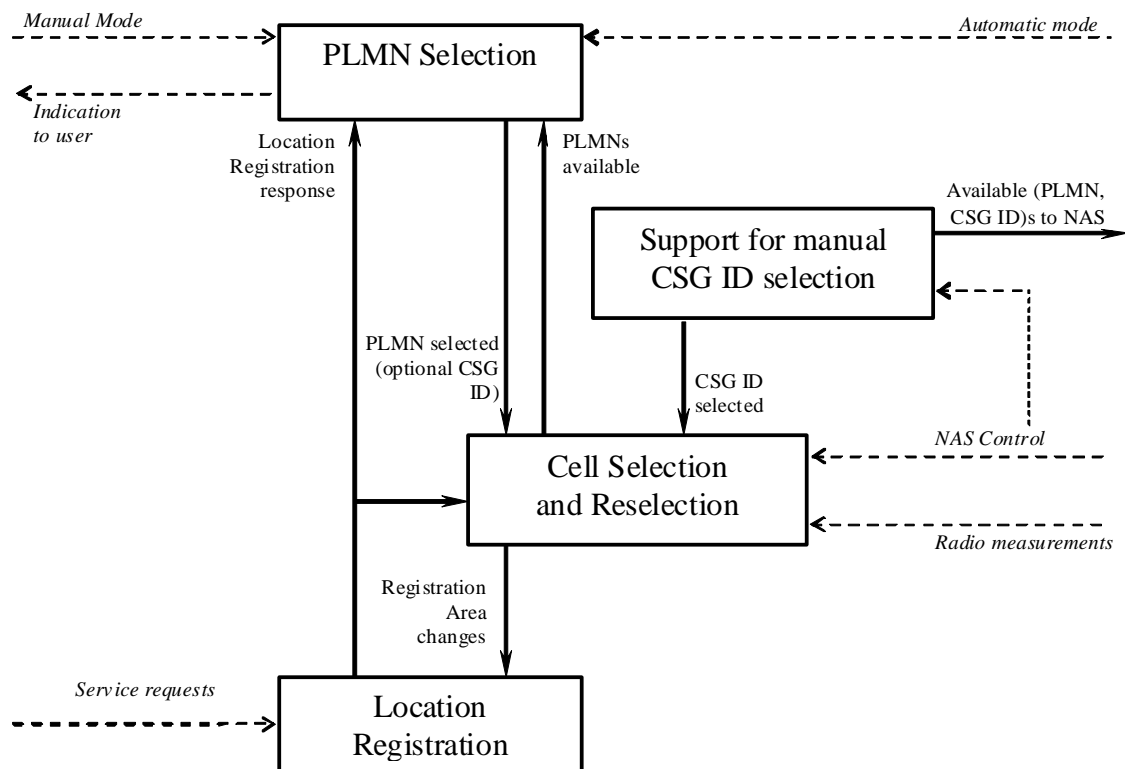
## 4 General description of Idle mode

### 4.1 Overview

The idle mode tasks can be subdivided into four processes:

- PLMN selection;
- Cell selection and reselection;
- Location registration;
- Support for manual CSG ID selection.

The relationship between these processes is illustrated in Figure 1.



**Figure 4.1-1: Overall Idle Mode process**

When a UE is switched on, a public land mobile network (PLMN) is selected by NAS. For the selected PLMN, associated RAT(s) may be set [5]. The NAS shall provide a list of equivalent PLMNs, if available, that the AS shall use for cell selection and cell reselection.

With the cell selection, the UE searches for a suitable cell of the selected PLMN and chooses that cell to provide available services, further the UE shall tune to its control channel. This choosing is known as "camping on the cell".

The UE shall, if necessary, then register its presence, by means of a NAS registration procedure, in the tracking area of the chosen cell and as outcome of a successful Location Registration the selected PLMN becomes the registered PLMN [5].

If the UE finds a more suitable cell, according to the cell reselection criteria, it reselects onto that cell and camps on it. If the new cell does not belong to at least one tracking area to which the UE is registered, location registration is performed.

If necessary, the UE shall search for higher priority PLMNs at regular time intervals as described in [4] and search for a suitable cell if another PLMN has been selected by NAS.

Search of available CSG IDs may be triggered by NAS to support manual CSG ID selection.

If the UE loses coverage of the registered PLMN, either a new PLMN is selected automatically (automatic mode), or an indication of which PLMNs are available is given to the user, so that a manual selection can be made (manual mode).

Registration is not performed by UEs only capable of services that need no registration.

The purpose of camping on a cell in idle mode is fourfold:

- It enables the UE to receive system information from the PLMN.
- When registered and if the UE wishes to establish an RRC connection, it can do this by initially accessing the network on the control channel of the cell on which it is camped.
- If the PLMN receives a call for the registered UE, it knows (in most cases) the set of tracking areas in which the UE is camped. It can then send a "paging" message for the UE on the control channels of all the cells in this set

of tracking areas. The UE will then receive the paging message because it is tuned to the control channel of a cell in one of the registered tracking areas and the UE can respond on that control channel.

d) It enables the UE to receive ETWS and CMAS notifications.

If the UE is unable to find a suitable cell to camp on or if the location registration failed (except for LR rejected with cause #12, cause #14, cause #15 or cause #25, see [5] and [16]), it attempts to camp on a cell irrespective of the PLMN identity, and enters a "limited service" state.

## 4.2 Functional division between AS and NAS in Idle mode

Table 1 presents the functional division between UE non-access stratum (NAS) and UE access stratum (AS) in idle mode. The NAS part is specified in [5] and the AS part in the present document.

Idle Mode Process	UE Non-Access Stratum	UE Access Stratum
PLMN Selection	<p>Maintain a list of PLMNs in priority order according to [5]. Select a PLMN using automatic or manual mode as specified in [5] and request AS to select a cell belonging to this PLMN. For each PLMN, associated RAT(s) may be set.</p> <p>Evaluate reports of available PLMNs from AS for PLMN selection.</p> <p>Maintain a list of equivalent PLMN identities.</p>	<p>Search for available PLMNs.</p> <p>If associated RAT(s) is (are) set for the PLMN, search in this (these) RAT(s) and other RAT(s) for that PLMN as specified in [5].</p> <p>Perform measurements to support PLMN selection.</p> <p>Synchronise to a broadcast channel to identify found PLMNs.</p> <p>Report available PLMNs with associated RAT(s) to NAS on request from NAS or autonomously.</p>
Cell Selection	<p>Control cell selection for example by indicating RAT(s) associated with the selected PLMN to be used initially in the search of a cell in the cell selection. NAS is also maintaining lists of forbidden registration areas and CSG IDs on which the UE is allowed (CSG whitelist) and provide these lists to AS.</p>	<p>Perform measurements needed to support cell selection.</p> <p>Detect and synchronise to a broadcast channel. Receive and handle broadcast information. Forward NAS system information to NAS.</p> <p>Search for a suitable cell. The cells broadcast one or more 'PLMN identity' in the system information. Respond to NAS whether such cell is found or not.</p> <p>If associated RATs is (are) set for the PLMN, perform the search in this (these) RAT(s) and other RATs for that PLMN as specified in [5].</p> <p>For a CSG cell, check the broadcast CSG ID against the CSG whitelist provided by NAS to check whether a CSG cell is suitable for the UE.</p> <p>If such a cell is found, the cell is selected to camp on.</p>
Cell Reselection	<p>Control cell reselection by for example, maintaining lists of forbidden registration areas.</p> <p>Maintain a list of equivalent PLMN identities and provide the list to AS.</p> <p>Maintain a list of forbidden registration areas and provide the list to AS.</p> <p>Maintain a list of CSG IDs on which the UE is allowed (CSG whitelist) to camp and provide the list to AS.</p>	<p>Perform measurements needed to support cell reselection.</p> <p>Detect and synchronise to a broadcast channel. Receive and handle broadcast information. Forward NAS system information to NAS.</p> <p>Change cell if a more suitable cell is found.</p> <p>For a CSG cell, check broadcast CSG ID against the CSG whitelist provided by NAS to check whether a CSG cell is suitable for the UE.</p>
Location registration	<p>Register the UE as active after power on.</p> <p>Register the UE's presence in a registration area, for instance regularly or when entering a new tracking area.</p> <p>Maintain lists of forbidden registration areas.</p> <p>Deregister UE when shutting down.</p>	<p>Report registration area information to NAS.</p>

Idle Mode Process	UE Non-Access Stratum	UE Access Stratum
Support for manual CSG ID selection	Provide request to search for available CSG IDs.  Evaluate reports of available CSG IDs from AS for CSG ID selection.  Select a CSG ID and request AS to select a cell belonging to this CSG ID.	Search for cells with a CSG ID.  Read the HNB name from BCCH on SIB9 if a cell with a CSG ID is found.  Report CSG ID of the found cell broadcasting a CSG ID together with the HNB name and PLMN(s) to NAS. On selection of a CSG ID by NAS, select any cell belonging to the selected CSG ID fulfilling the cell selection criteria and not barred or reserved for operator use for UEs not belonging to AC 11 or 15 and give an indication to NAS that access is possible (for the registration procedure).

**Table 4.2-1: Functional division between AS and NAS in idle mode**

## 4.3 Service types in Idle Mode

This clause defines the level of service that may be provided by the network to a UE in Idle mode.

The action of camping on a cell is necessary to get access to some services. Three levels of services are defined for UE:

- Limited service (emergency calls, ETWS and CMAS on an acceptable cell)
- Normal service (for public use on a suitable cell)
- Operator service (for operators only on a reserved cell)

Furthermore, the cells are categorised according to which services they offer:

### **acceptable cell:**

An "acceptable cell" is a cell on which the UE may camp to obtain limited service (originate emergency calls and receive ETWS and CMAS notifications). Such a cell shall fulfil the following requirements, which is the minimum set of requirements to initiate an emergency call and to receive ETWS and CMAS notification in a E-UTRAN network:

- The cell is not barred, see subclause 5.3.1;
- The cell selection criteria are fulfilled, see subclause 5.2.3.2;

### **suitable cell:**

A "suitable cell" is a cell on which the UE may camp on to obtain normal service. The UE shall have a valid USIM and such a cell shall fulfil all the following requirements.

- The cell is part of either:
  - the selected PLMN, or:
  - the registered PLMN, or:
  - a PLMN of the Equivalent PLMN list
 according to the latest information provided by NAS:
- The cell is not barred, see subclause 5.3.1;
- The cell is part of at least one TA that is not part of the list of "forbidden tracking areas for roaming" [4], which belongs to a PLMN that fulfils the first bullet above;
- The cell selection criteria are fulfilled, see subclause 5.2.3.2;
- For a CSG cell, the CSG ID is part of the CSG whitelist of the UE.

If more than one PLMN identity is broadcast in the cell, the cell is considered to be part of all TAs with TAIs constructed from the PLMN identities and the TAC broadcast in the cell.

**barred cell:**

A cell is barred if it is so indicated in the system information [3].

**reserved cell:**

A cell is reserved if it is so indicated in system information [3].

Following exceptions to these definitions are applicable for UEs:

- camped on a cell that belongs to a registration area that is forbidden for regional provision of service; a cell that belongs to a registration area that is forbidden for regional provision service ([5], [16]) is suitable but provides only limited service.
- as an outcome of the manual CSG ID selection procedure the UE is allowed to access an acceptable cell which fulfils the cell selection criteria and is not barred or reserved for operator use for UEs not belonging to AC 11 or 15 and inform NAS that access is possible (for location registration procedure).

NOTE: UE is not required to support manual search and selection of PLMN or CSG IDs while in RRC CONNECTED state. The UE may use local release of RRC connection to perform manual search if it is not possible to perform the search while RRC connected.

- if a UE has an ongoing emergency call, all acceptable cells of that PLMN are treated as suitable for the duration of the emergency call.

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## 5 Process and procedure descriptions

### 5.1 PLMN selection

In the UE, the AS shall report available PLMNs to the NAS on request from the NAS or autonomously.

During PLMN selection, based on the list of PLMN identities in priority order, the particular PLMN may be selected either automatically or manually. Each PLMN in the list of PLMN identities is identified by a 'PLMN identity'. In the system information on the broadcast channel, the UE can receive one or multiple 'PLMN identity' in a given cell. The result of the PLMN selection performed by NAS (see 3GPP TS 23.122 [5]) is an identifier of the selected PLMN.

#### 5.1.1 Void

#### 5.1.2 Support for PLMN selection

##### 5.1.2.1 General

On request of the NAS the AS shall perform a search for available PLMNs and report them to NAS.

##### 5.1.2.2 E-UTRA case

The UE shall scan all RF channels in the E-UTRA bands according to its capabilities to find available PLMNs. On each carrier, the UE shall search for the strongest cell and read its system information, in order to find out which PLMN(s) the cell belongs to. If the UE can read one or several PLMN identities in the strongest cell, each found PLMN (see the PLMN reading in [3]) shall be reported to the NAS as a high quality PLMN (but without the RSRP value), provided that the following high quality criterion is fulfilled:

1. For an E-UTRAN cell, the measured RSRP value shall be greater than or equal to -110 dBm.

Found PLMNs that do not satisfy the high quality criterion, but for which the UE has been able to read the PLMN identities are reported to the NAS together with the RSRP value. The quality measure reported by the UE to NAS shall be the same for each PLMN found in one cell.

The search for PLMNs may be stopped on request of the NAS. The UE may optimise PLMN search by using stored information e.g. carrier frequencies and optionally also information on cell parameters from previously received measurement control information elements.

Once the UE has selected a PLMN, the cell selection procedure shall be performed in order to select a suitable cell of that PLMN to camp on.

If a CSG ID is provided by NAS as part of PLMN selection, the UE shall search for an acceptable or suitable cell belonging to the provided CSG ID to camp on. When the UE is no longer camped on a cell with the provided CSG ID, AS shall inform NAS.

### 5.1.2.3 UTRA case

Support for PLMN selection in UTRA is described in [8].

### 5.1.2.4 GSM case

Support for PLMN selection in GERAN is described in [9].

### 5.1.2.5 CDMA2000 case

For CDMA2000 the network determination for HRPD and 1xRTT is described in [17] and [18] respectively.

## 5.2 Cell selection and reselection

### 5.2.1 Introduction

UE shall perform measurements for cell selection and reselection purposes as specified in [10].

The NAS can control the RAT(s) in which the cell selection should be performed, for instance by indicating RAT(s) associated with the selected PLMN, and by maintaining a list of forbidden registration area(s) and a list of equivalent PLMNs. The UE shall select a suitable cell based on idle mode measurements and cell selection criteria.

In order to speed up the cell selection process, stored information for several RATs may be available in the UE.

When camped on a cell, the UE shall regularly search for a better cell according to the cell reselection criteria. If a better cell is found, that cell is selected. The change of cell may imply a change of RAT. Details on performance requirements for cell reselection can be found in [10].

The NAS is informed if the cell selection and reselection results in changes in the received system information relevant for NAS.

For normal service, the UE shall camp on a suitable cell, tune to that cell's control channel(s) so that the UE can:

- Receive system information from the PLMN; and
  - receive registration area information from the PLMN, e.g., tracking area information; and
  - receive other AS and NAS Information; and
- if registered:
  - receive paging and notification messages from the PLMN; and
  - initiate transfer to connected mode.



### 5.2.2 States and state transitions in Idle Mode

Figure 2 shows the states and state transitions and procedures in RRC\_IDLE. Whenever a new PLMN selection is performed, it causes an exit to number 1.

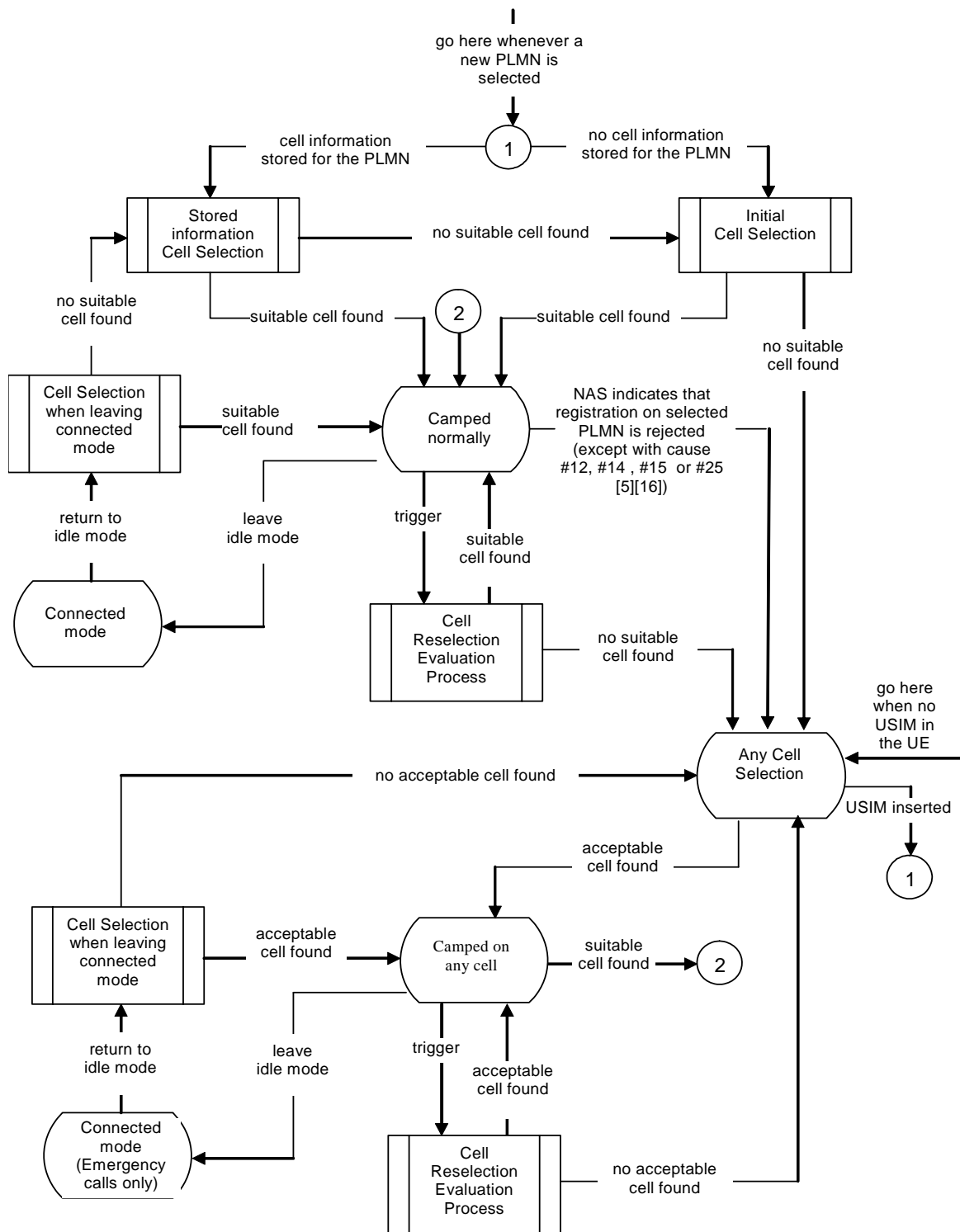


Figure 5.2.2-1: RRC\_IDLE Cell Selection and Reselection

## 5.2.3 Cell Selection process

### 5.2.3.1 Description

The UE shall use one of the following two cell selection procedures:

#### a) Initial Cell Selection

This procedure requires no prior knowledge of which RF channels are E-UTRA carriers. The UE shall scan all RF channels in the E-UTRA bands according to its capabilities to find a suitable cell. On each carrier frequency, the UE need only search for the strongest cell. Once a suitable cell is found this cell shall be selected.

#### b) Stored Information Cell Selection

This procedure requires stored information of carrier frequencies and optionally also information on cell parameters, from previously received measurement control information elements or from previously detected cells. Once the UE has found a suitable cell the UE shall select it. If no suitable cell is found the Initial Cell Selection procedure shall be started.

NOTE: Priorities between different frequencies or RATs provided to the UE by system information or dedicated signalling are not used in the cell selection process.

### 5.2.3.2 Cell Selection Criterion

The cell selection criterion  $S$  is fulfilled when:

$$S_{rxlev} > 0 \text{ AND } S_{qual} > 0$$

where:

$$S_{rxlev} = Q_{rxlevmeas} - (Q_{rxlevmin} + Q_{rxlevminoffset}) - P_{compensation}$$

$$S_{qual} = Q_{qualmeas} - (Q_{qualmin} + Q_{qualminoffset})$$

where:

$S_{rxlev}$	Cell selection RX level value (dB)
$S_{qual}$	Cell selection quality value (dB)
$Q_{rxlevmeas}$	Measured cell RX level value (RSRP)
$Q_{qualmeas}$	Measured cell quality value (RSRQ)
$Q_{rxlevmin}$	Minimum required RX level in the cell (dBm)
$Q_{qualmin}$	Minimum required quality level in the cell (dB)
$Q_{rxlevminoffset}$	Offset to the signalled $Q_{rxlevmin}$ taken into account in the $S_{rxlev}$ evaluation as a result of a periodic search for a higher priority PLMN while camped normally in a VPLMN [5]
$Q_{qualminoffset}$	Offset to the signalled $Q_{qualmin}$ taken into account in the $S_{qual}$ evaluation as a result of a periodic search for a higher priority PLMN while camped normally in a VPLMN [5]
$P_{compensation}$	$\max(P_{EMAX\_H} - P_{PowerClass}, 0)$ (dB)
$P_{EMAX\_H}$	Maximum TX power level an UE may use when transmitting on the uplink in the cell (dBm) defined as $P_{EMAX\_H}$ in [TS 36.101]
$P_{PowerClass}$	Maximum RF output power of the UE (dBm) according to the UE power class as defined in [TS 36.101]

The signalled values  $Q_{rxlevminoffset}$  and  $Q_{qualminoffset}$  are only applied when a cell is evaluated for cell selection as a result of a periodic search for a higher priority PLMN while camped normally in a VPLMN [5]. During this periodic search for higher priority PLMN the UE may check the  $S$  criteria of a cell using parameter values stored from a different cell of this higher priority PLMN.

### 5.2.3.3 CSG cells and Hybrid cells in Cell Selection

In addition to normal cell selection rules a manual selection of CSG IDs shall be supported by the UE upon request from higher layers as defined in subclause 5.5.

### 5.2.3.4 GSM case in Cell Selection

The cell selection criteria and procedures in GSM are specified in [9].

### 5.2.3.5 UTRAN case in Cell Selection

The cell selection criteria and procedures in UTRAN are specified in [8].

## 5.2.4 Cell Reselection evaluation process

### 5.2.4.1 Reselection priorities handling

Absolute priorities of different E-UTRAN frequencies or inter-RAT frequencies may be provided to the UE in the system information, in the *RRCConnectionRelease* message, or by inheriting from another RAT at inter-RAT cell (re)selection. In the case of system information, an E-UTRAN frequency or inter-RAT frequency may be listed without providing a priority (i.e. the field *cellReselectionPriority* is absent for that frequency). If priorities are provided in dedicated signalling, the UE shall ignore all the priorities provided in system information. If UE is in *camped on any cell* state, UE shall only apply the priorities provided by system information from current cell, and the UE preserves priorities provided by dedicated signalling unless specified otherwise. When the UE in *camped normally* state, has only dedicated priorities other than for the current frequency, the UE shall consider the current frequency to be the lowest priority frequency (i.e. lower than the eight network configured values). While the UE is camped on a suitable CSG cell, the UE shall always consider the current frequency to be the highest priority frequency (i.e. higher than the eight network configured values), irrespective of any other priority value allocated to this frequency. The UE shall delete priorities provided by dedicated signalling when:

- the UE enters RRC\_CONNECTED state; or
- the optional validity time of dedicated priorities (T320) expires; or
- a PLMN selection is performed on request by NAS [5].

NOTE: Equal priorities between RATs are not supported.

The UE shall only perform cell reselection evaluation for E-UTRAN frequencies and inter-RAT frequencies that are given in system information and for which the UE has a priority provided.

The UE shall not consider any black listed cells as candidate for cell reselection.

The UE shall inherit the priorities provided by dedicated signalling and the remaining validity time (i.e., T320 in E-UTRA, T322 in UTRA and T3230 in GERAN), if configured, at inter-RAT cell (re)selection.

NOTE: The network may assign dedicated cell reselection priorities for frequencies not configured by system information.

### 5.2.4.2 Measurement rules for cell re-selection

When evaluating  $S_{rxlev}$  and  $S_{qual}$  of non-serving cells for reselection purposes, the UE shall use parameters provided by the serving cell.

Following rules are used by the UE to limit needed measurements:

- If the serving cell fulfils  $S_{rxlev} > S_{IntraSearchP}$  and  $S_{qual} > S_{IntraSearchQ}$ , the UE may choose not to perform intra-frequency measurements.
- Otherwise, the UE shall perform intra-frequency measurements.

- The UE shall apply the following rules for E-UTRAN inter-frequencies and inter-RAT frequencies which are indicated in system information and for which the UE has priority provided as defined in 5.2.4.1:
  - For an E-UTRAN inter-frequency or inter-RAT frequency with a reselection priority higher than the reselection priority of the current E-UTRA frequency the UE shall perform measurements of higher priority E-UTRAN inter-frequency or inter-RAT frequencies according to [10].
  - For an E-UTRAN inter-frequency with an equal or lower reselection priority than the reselection priority of the current E-UTRA frequency and for inter-RAT frequency with lower reselection priority than the reselection priority of the current E-UTRAN frequency:
    - If the serving cell fulfils  $S_{rxlev} > S_{nonIntraSearchP}$  and  $S_{qual} > S_{nonIntraSearchQ}$ , the UE may choose not to perform measurements of E-UTRAN inter-frequencies or inter-RAT frequency cells of equal or lower priority.
    - Otherwise, the UE shall perform measurements of E-UTRAN inter-frequencies or inter-RAT frequency cells of equal or lower priority according to [10].

### 5.2.4.3 Mobility states of a UE

Besides Normal-mobility state a High-mobility and a Medium-mobility state are applicable if the parameters ( $T_{CRmax}$ ,  $N_{CR_H}$ ,  $N_{CR_M}$  and  $T_{CRmaxHyst}$ ) are sent in the system information broadcast of the serving cell.

#### State detection criteria:

Medium-mobility state criteria:

- If number of cell reselections during time period  $T_{CRmax}$  exceeds  $N_{CR_M}$  and not exceeds  $N_{CR_H}$

High-mobility state criteria:

- If number of cell reselections during time period  $T_{CRmax}$  exceeds  $N_{CR_H}$

The UE shall not count consecutive reselections between same two cells into mobility state detection criteria if same cell is reselected just after one other reselection.

#### State transitions:

The UE shall:

- if the criteria for High-mobility state is detected:
  - enter High-mobility state.
- else if the criteria for Medium-mobility state is detected:
  - enter Medium-mobility state.
- else if criteria for either Medium- or High-mobility state is not detected during time period  $T_{CRmaxHyst}$ :
  - enter Normal-mobility state.

If the UE is in High- or Medium-mobility state, the UE shall apply the speed dependent scaling rules as defined in subclause 5.2.4.3.1.

#### 5.2.4.3.1 Scaling rules

UE shall apply the following scaling rules:

- If neither Medium- nor Highmobility state is detected:
  - no scaling is applied.
- If High-mobility state is detected:

- Add the *sf-High* of "Speed dependent ScalingFactor for  $Q_{\text{hyst}}$ ' to  $Q_{\text{hyst}}$  if sent on system information
- For E-UTRAN cells multiply  $\text{Treselection}_{\text{EUTRA}}$  by the *sf-High* of "Speed dependent ScalingFactor for  $\text{Treselection}_{\text{EUTRA}}$ ' if sent on system information
- For UTRAN cells multiply  $\text{Treselection}_{\text{UTRA}}$  by the *sf-High* of "Speed dependent ScalingFactor for  $\text{Treselection}_{\text{UTRA}}$ ' if sent on system information
- For GERAN cells multiply  $\text{Treselection}_{\text{GERA}}$  by the *sf-High* of "Speed dependent ScalingFactor for  $\text{Treselection}_{\text{GERA}}$  state' if sent on system information
- For CDMA2000 HRPD cells Multiply  $\text{Treselection}_{\text{CDMA\_HRPD}}$  by the *sf-High* of "Speed dependent ScalingFactor for  $\text{Treselection}_{\text{CDMA\_HRPD}}$ ' if sent on system information
- For CDMA2000 1xRTT cells Multiply  $\text{Treselection}_{\text{CDMA\_1xRTT}}$  by the *sf-High* of "Speed dependent ScalingFactor for  $\text{Treselection}_{\text{CDMA\_1xRTT}}$ ' if sent on system information
- If Medium-mobility state is detected:
  - Add the *sf-Medium* of "Speed dependent ScalingFactor for  $Q_{\text{hyst}}$  for medium mobility state" to  $Q_{\text{hyst}}$  if sent on system information
  - For E-UTRAN cells multiply  $\text{Treselection}_{\text{EUTRA}}$  by the *sf-Medium* of "Speed dependent ScalingFactor for  $\text{Treselection}_{\text{EUTRA}}$ " if sent on system information
  - For UTRAN cells multiply  $\text{Treselection}_{\text{UTRA}}$  by the *sf-Medium* of "Speed dependent ScalingFactor for  $\text{Treselection}_{\text{UTRA}}$ " if sent on system information
  - For GERAN cells multiply  $\text{Treselection}_{\text{GERA}}$  by the *sf-Medium* of "Speed dependent ScalingFactor for  $\text{Treselection}_{\text{GERA}}$ " if sent on system information
  - For CDMA2000 HRPD cells Multiply  $\text{Treselection}_{\text{CDMA\_HRPD}}$  by the *sf-Medium* of "Speed dependent ScalingFactor for  $\text{Treselection}_{\text{CDMA\_HRPD}}$ " if sent on system information
  - For CDMA2000 1xRTT cells Multiply  $\text{Treselection}_{\text{CDMA\_1xRTT}}$  by the *sf-Medium* of "Speed dependent ScalingFactor for  $\text{Treselection}_{\text{CDMA\_1xRTT}}$ " if sent on system information

In case scaling is applied to any  $\text{Treselection}_{\text{RAT}}$  parameter the UE shall round up the result after all scalings to the nearest second.

#### 5.2.4.4 Cells with cell reservations, access restrictions or unsuitable for normal camping

For the highest ranked cell (including serving cell) according to cell reselection criteria specified in subclause 5.2.4.6, for the best cell according to absolute priority reselection criteria specified in subclause 5.2.4.5, the UE shall check if the access is restricted according to the rules in subclause 5.3.1.

If that cell and other cells have to be excluded from the candidate list, as stated in subclause 5.3.1, the UE shall not consider these as candidates for cell reselection. This limitation shall be removed when the highest ranked cell changes.

If the highest ranked cell or best cell according to absolute priority reselection rules is an intra-frequency or inter-frequency cell which is not suitable due to being part of the "list of forbidden TAs for roaming" or belonging to a PLMN which is not indicated as being equivalent to the registered PLMN, the UE shall not consider this cell and other cells on the same frequency, as candidates for reselection for a maximum of 300s. If the UE enters into state *any cell selection*, any limitation shall be removed. If the UE is redirected under E-UTRAN control to a frequency for which the timer is running, any limitation on that frequency shall be removed.

If the highest ranked cell or best cell according to absolute priority reselection rules is an inter-RAT cell which is not suitable due to being part of the "list of forbidden TAs for roaming" or belonging to a PLMN which is not indicated as being equivalent to the registered PLMN, the UE shall not consider this cell as a candidate for reselection for a maximum of 300s. In case of UTRA further requirements are defined in the [8]. If the UE enters into state *any cell selection*, any limitation shall be removed. If the UE is redirected under E-UTRAN control to a frequency for which the timer is running, any limitation on that frequency shall be removed.

If the highest ranked cell or best cell according to absolute priority reselection rules is a CSG cell which is not suitable due to the CSG ID not being present in the CSG whitelist of the UE, the UE shall not consider this cell as candidate for cell reselection but shall continue considering other cells on the same frequency for cell reselection.

#### 5.2.4.5 E-UTRAN Inter-frequency and inter-RAT Cell Reselection criteria

If  $ThreshX-Q$  is provided, cell reselection to a cell on a higher priority E-UTRAN frequency or inter-RAT frequency than the serving frequency shall be performed if:

- A cell of a higher priority RAT/ frequency fulfils  $S_{qual} > Thresh_{X, HighQ}$  during a time interval  $T_{reselection_{RAT}}$ ; and
- More than 1 second has elapsed since the UE camped on the current serving cell.

Otherwise, cell reselection to a cell on a higher priority E-UTRAN frequency or inter-RAT frequency than the serving frequency shall be performed if:

- A cell of a higher priority RAT/ frequency fulfils  $S_{rxlev} > Thresh_{X, HighP}$  during a time interval  $T_{reselection_{RAT}}$ ; and
- More than 1 second has elapsed since the UE camped on the current serving cell.

Cell reselection to a cell on an equal priority E-UTRAN frequency shall be based on ranking for Intra-frequency cell reselection as defined in sub-clause 5.2.4.6.

If  $ThreshX-Q$  is provided, cell reselection to a cell on a lower priority E-UTRAN frequency or inter-RAT frequency than the serving frequency shall be performed if:

- The serving cell fulfils  $S_{qual} < Thresh_{Serving, LowQ}$  and a cell of a lower priority RAT/ frequency fulfils  $S_{qual} > Thresh_{X, LowQ}$  during a time interval  $T_{reselection_{RAT}}$ ; and
- More than 1 second has elapsed since the UE camped on the current serving cell.

Otherwise, cell reselection to a cell on a lower priority E-UTRAN frequency or inter-RAT frequency than the serving frequency shall be performed if:

- The serving cell fulfils  $S_{rxlev} < Thresh_{Serving, LowP}$  and a cell of a lower priority RAT/ frequency fulfils  $S_{rxlev} > Thresh_{X, LowP}$  during a time interval  $T_{reselection_{RAT}}$ ; and
- More than 1 second has elapsed since the UE camped on the current serving cell.

Cell reselection to a higher priority RAT/ frequency shall take precedence over a lower priority RAT/ frequency, if multiple cells of different priorities fulfil the cell reselection criteria.

For cdma2000 RATs,  $S_{rxlev}$  is equal to  $-FLOOR(-2 \times 10 \times \log_{10} E_c/I_o)$  in units of 0.5 dB, as defined in [18], with  $E_c/I_o$  referring to the value measured from the evaluated cell.

For cdma2000 RATs,  $Thresh_{X, HighP}$  and  $Thresh_{X, LowP}$  are equal to -1 times the values signalled for the corresponding parameters in the system information.

In all the above criteria the value of  $T_{reselection_{RAT}}$  is scaled when the UE is in the medium or high mobility state as defined in subclause 5.2.4.3.1. If more than one cell meets the above criteria, the UE shall reselect a cell as follows:

- If the highest-priority frequency is an E-UTRAN frequency, a cell ranked as the best cell among the cells on the highest priority frequency(ies) meeting the criteria according to section 5.2.4.6;
- If the highest-priority frequency is from another RAT, a cell ranked as the best cell among the cells on the highest priority frequency(ies) meeting the criteria of that RAT.

#### 5.2.4.6 Intra-frequency and equal priority inter-frequency Cell Reselection criteria

The cell-ranking criterion  $R_s$  for serving cell and  $R_n$  for neighbouring cells is defined by:

$$R_s = Q_{\text{meas},s} + Q_{\text{Hyst}}$$

$$R_n = Q_{\text{meas},n} - Q_{\text{offset}}$$

where:

$Q_{\text{meas}}$	RSRP measurement quantity used in cell reselections.
$Q_{\text{offset}}$	For intra-frequency: Equals to $Q_{\text{offset},s,n}$ , if $Q_{\text{offset},s,n}$ is valid, otherwise this equals to zero. For inter-frequency: Equals to $Q_{\text{offset},s,n}$ plus $Q_{\text{offset},\text{frequency}}$ , if $Q_{\text{offset},s,n}$ is valid, otherwise this equals to $Q_{\text{offset},\text{frequency}}$ .

The UE shall perform ranking of all cells that fulfil the cell selection criterion S, which is defined in 5.2.3.2, but may exclude all CSG cells that are known by the UE to be not allowed.

The cells shall be ranked according to the R criteria specified above, deriving  $Q_{\text{meas},n}$  and  $Q_{\text{meas},s}$  and calculating the R values using averaged RSRP results.

If a cell is ranked as the best cell the UE shall perform cell reselection to that cell. If this cell is found to be not-suitable, the UE shall behave according to subclause 5.2.4.4.

In all cases, the UE shall reselect the new cell, only if the following conditions are met:

- the new cell is better ranked than the serving cell during a time interval  $T_{\text{reselection,RAT}}$ ;
- more than 1 second has elapsed since the UE camped on the current serving cell.

#### 5.2.4.7 Cell reselection parameters in system information broadcasts

Cell reselection parameters are broadcast in system information and are read from the serving cell as follows:

##### **cellReselectionPriority**

This specifies the absolute priority for E-UTRAN frequency or UTRAN frequency or group of GERAN frequencies or band class of CDMA2000 HRPD or band class of CDMA2000 1xRTT.

##### **$Q_{\text{offset},s,n}$**

This specifies the offset between the two cells.

##### **$Q_{\text{offset},\text{frequency}}$**

Frequency specific offset for equal priority E-UTRAN frequencies.

##### **$Q_{\text{hyst}}$**

This specifies the hysteresis value for ranking criteria.

##### **$Q_{\text{qualmin}}$**

This specifies the minimum required quality level in the cell in dB.

##### **$Q_{\text{rxlevmin}}$**

This specifies the minimum required Rx level in the cell in dBm.

##### **$T_{\text{reselection,RAT}}$**

This specifies the cell reselection timer value. For each target E-UTRA frequency and for each RAT (other than E-UTRA) a specific value for the cell reselection timer is defined, which is applicable when evaluating reselection within E-UTRAN or towards other RAT (i.e.  $T_{\text{reselection,RAT}}$  for E-UTRAN is  $T_{\text{reselection,EUTRA}}$ , for UTRAN  $T_{\text{reselection,UTRA}}$  for GERAN  $T_{\text{reselection,GERA}}$ , for  $T_{\text{reselection,CDMA\_HRPD}}$ , and for  $T_{\text{reselection,CDMA\_1xRTT}}$ ).

Note:  $T_{\text{reselection,RAT}}$  is not sent on system information, but used in reselection rules by the UE for each RAT.

**Treselection<sub>EUTRA</sub>**

This specifies the cell reselection timer value  $Treselection_{RAT}$  for E-UTRAN. The parameter can be set per E-UTRAN frequency [3].

**Treselection<sub>UTRA</sub>**

This specifies the cell reselection timer value  $Treselection_{RAT}$  for UTRAN.

**Treselection<sub>GERA</sub>**

This specifies the cell reselection timer value  $Treselection_{RAT}$  for GERAN.

**Treselection<sub>CDMA\_HRPD</sub>**

This specifies the cell reselection timer value  $Treselection_{RAT}$  for CDMA HRPD.

**Treselection<sub>CDMA\_1xRTT</sub>**

This specifies the cell reselection timer value  $Treselection_{RAT}$  for CDMA 1xRTT.

**Thresh<sub>X, HighP</sub>**

This specifies the  $S_{rxlev}$  threshold (in dB) used by the UE when reselecting towards a higher priority RAT/ frequency than the current serving frequency. Each frequency of E-UTRAN and UTRAN, each group of GERAN frequencies, each band class of CDMA2000 HRPD and CDMA2000 1xRTT might have a specific threshold.

**Thresh<sub>X, HighQ</sub>**

This specifies the Squal threshold (in dB) used by the UE when reselecting towards a higher priority RAT/ frequency than the current serving frequency. Each frequency of E-UTRAN and UTRAN FDD might have a specific threshold.

**Thresh<sub>X, LowP</sub>**

This specifies the  $S_{rxlev}$  threshold (in dB) used by the UE when reselecting towards a lower priority RAT/ frequency than the current serving frequency. Each frequency of E-UTRAN and UTRAN, each group of GERAN frequencies, each band class of CDMA2000 HRPD and CDMA2000 1xRTT might have a specific threshold.

**Thresh<sub>X, LowQ</sub>**

This specifies the Squal threshold (in dB) used by the UE when reselecting towards a lower priority RAT/ frequency than the current serving frequency. Each frequency of E-UTRAN and UTRAN FDD might have a specific threshold.

**Thresh<sub>Serving, LowP</sub>**

This specifies the  $S_{rxlev}$  threshold (in dB) used by the UE on the serving cell when reselecting towards a lower priority RAT/ frequency.

**Thresh<sub>Serving, LowQ</sub>**

This specifies the Squal threshold (in dB) used by the UE on the serving cell when reselecting towards a lower priority RAT/ frequency.

**S<sub>IntraSearchP</sub>**

This specifies the  $S_{rxlev}$  threshold (in dB) for intra-frequency measurements.

**S<sub>IntraSearchQ</sub>**

This specifies the Squal threshold (in dB) for intra-frequency measurements.

**S<sub>nonIntraSearchP</sub>**

This specifies the  $S_{rxlev}$  threshold (in dB) for E-UTRAN inter-frequency and inter-RAT measurements.

**S<sub>nonIntraSearchQ</sub>**

This specifies the Squal threshold (in dB) for E-UTRAN inter-frequency and inter-RAT measurements.



### 5.2.4.7.1 Speed dependant reselection parameters

#### $T_{CRmax}$

This specifies the duration for evaluating allowed amount of cell reselection(s).

#### $N_{CR_M}$

This specifies the maximum number of cell reselections to enter Medium-mobility state.

#### $N_{CR_H}$

This specifies the maximum number of cell reselections to enter High-mobility state.

#### $T_{CRmaxHyst}$

This specifies the additional time period before the UE can enter Normal-mobility state.

#### Speed dependent ScalingFactor for Qhyst

This specifies scaling factor for Qhyst in *sf-High* for High-mobility state and *sf-Medium* for Medium-mobility state

#### Speed dependent ScalingFactor for Treselection<sub>EUTRA</sub>

This specifies scaling factor for Treselection<sub>EUTRA</sub> in *sf-High* for High-mobility state and *sf-Medium* for Medium-mobility state

#### Speed dependent ScalingFactor for Treselection<sub>UTRA</sub>

This specifies scaling factor for Treselection<sub>UTRA</sub> in *sf-High* for High-mobility state and *sf-Medium* for Medium-mobility state

#### Speed dependent ScalingFactor for Treselection<sub>GERA</sub>

This specifies scaling factor for Treselection<sub>GERA</sub> in H *sf-High* for High-mobility state and *sf-Medium* for Medium-mobility state

#### Speed dependent ScalingFactor for Treselection<sub>CDMA\_HRPD</sub>

This specifies scaling factor for Treselection<sub>CDMA\_HRPD</sub> in *sf-High* for High mobility state and *sf-Medium* for Medium-mobility state

#### Speed dependent ScalingFactor for Treselection<sub>CDMA\_1xRTT</sub>

This specifies scaling factor for Treselection<sub>CDMA\_1xRTT</sub> in *sf-High* for High mobility state and *sf-Medium* for Medium-mobility state

## 5.2.4.8 Cell reselection with CSG cells

### 5.2.4.8.1 Cell reselection from a non-CSG cell to a CSG cell

In addition to normal cell reselection, the UE shall use an autonomous search function to detect allowed CSG cells on non-serving frequencies, including inter-RAT frequencies, when at least one CSG ID is included in the UE's CSG whitelist. The UE may also use autonomous search on the serving frequency. The UE shall disable the autonomous search function for CSG cells if the UE's CSG whitelist is empty.

NOTE: The UE autonomous search function, per UE implementation, determines when and/or where to search for allowed CSG cells. The UE autonomous search function should find previously visited allowed CSG cells.

If the UE detects one or more suitable CSG cells on different frequencies, then the UE shall reselect to one of the detected cells irrespective of the frequency priority of the cell the UE is currently camped on, if the concerned CSG cell is the highest ranked cell on that frequency.

If the UE detects a suitable CSG cell on the same frequency, it shall reselect to this cell as per normal reselection rules (5.2.4.6.).

If the UE detects one or more suitable CSG cells on another RAT, the UE shall reselect to one of them according to [19].

#### 5.2.4.8.2 Cell reselection from a CSG cell

While camped on a suitable CSG cell, the UE shall apply the normal cell reselection rules as defined in subclause 5.2.4.

To search for suitable CSG cells on non-serving frequencies, the UE may use an autonomous search function. If the UE detects a CSG cell on a non-serving frequency, the UE may reselect to the detected CSG cell if it is the highest ranked cell on its frequency.

If the UE detects one or more suitable CSG cells on another RAT, the UE may reselect to one of them if allowed according to [19].

#### 5.2.4.9 Cell reselection with Hybrid cells

In addition to normal cell reselection rules, UE shall use an autonomous search function to detect hybrid cells whose CSG IDs are in the UE's CSG whitelist. The UE shall treat detected hybrid cells as CSG cells if the CSG ID of the hybrid cell is in the UE's CSG whitelist and as normal cells otherwise.

### 5.2.5 Void

### 5.2.6 Camped Normally state

When camped normally, the UE shall perform the following tasks:

- select and monitor the indicated Paging Channels of the cell as specified in clause 7 according to information sent in system information;
- monitor relevant System Information as specified in [3];
- perform necessary measurements for the cell reselection evaluation procedure;
- execute the cell reselection evaluation process on the following occasions/triggers:
  - 1) UE internal triggers, so as to meet performance as specified in [10];
  - 2) When information on the BCCH used for the cell reselection evaluation procedure has been modified.

### 5.2.7 Cell Selection when leaving RRC\_CONNECTED state

On transition from RRC\_CONNECTED to RRC\_IDLE, UE shall select a suitable cell to camp on according to *redirectedCarrierInfo*, if included in the *RRCConnectionRelease* message. Otherwise UE shall select a suitable cell on an EUTRA carrier. If no suitable cell is found, the UE shall perform a cell selection starting with Stored Information Cell Selection procedure in order to find a suitable cell to camp on.

When returning to RRC\_IDLE after UE moved to RRC\_CONNECTED state from *camped on any cell* state, UE shall select an acceptable cell to camp on according to *redirectedCarrierInfo*, if included in the *RRCConnectionRelease* message. Otherwise UE shall select an acceptable cell on an EUTRA carrier. If no acceptable cell is found, the UE shall continue to search for an acceptable cell of any PLMN in state *any cell selection*.

### 5.2.8 Any Cell Selection state

In this state, the UE shall attempt to find an acceptable cell of any PLMN to camp on, trying all RATs that are supported by the UE and searching first for a high quality cell, as defined in subclause 5.1.2.2.

The UE, which is not camped on any cell, shall stay in this state until an acceptable cell is found.

### 5.2.9 Camped on Any Cell state

In this state, the UE shall perform the following tasks:

- select and monitor the indicated paging channels of the cell as specified in clause 7;
- monitor relevant System Information as specified in [3];
- perform necessary measurements for the cell reselection evaluation procedure;
- execute the cell reselection evaluation process on the following occasions/triggers:
  - 1) UE internal triggers, so as to meet performance as specified in [10];
  - 2) When information on the BCCH used for the cell reselection evaluation procedure has been modified;
- regularly attempt to find a suitable cell trying all frequencies of all RATs that are supported by the UE. If a suitable cell is found, UE shall move to *camped normally* state;
- if the UE supports voice services and the current cell does not support emergency call as indicated in System information specified in [3], the UE should perform cell selection/ reselection to an acceptable cell of any supported RAT regardless of priorities provided in system information from current cell, if no suitable cell is found.

NOTE1: The UE is allowed to not perform reselection to an inter-frequency E-UTRAN cell in order to prevent camping on a cell on which it cannot initiate an IMS emergency call.

## 5.3 Cell Reservations and Access Restrictions

There are two mechanisms which allow an operator to impose cell reservations or access restrictions. The first mechanism uses indication of cell status and special reservations for control of cell selection and reselection procedures. The second mechanism, referred to as Access Control, shall allow preventing selected classes of users from sending initial access messages for load control reasons. At subscription, one or more Access Classes are allocated to the subscriber and stored in the USIM [4], which are employed for this purpose.

### 5.3.1 Cell status and cell reservations

Cell status and cell reservations are indicated in the *SystemInformationBlockType1* message [3] by means of two fields:

- *cellBarred* (IE type: "barred" or "not barred")  
In case of multiple PLMNs indicated in SIB1, this field is common for all PLMNs
- *cellReservedForOperatorUse* (IE type: "reserved" or "not reserved")  
In case of multiple PLMNs indicated in SIB1, this field is specified per PLMN.

When cell status is indicated as "not barred" and "not reserved" for operator use,

- All UEs shall treat this cell as candidate during the cell selection and cell reselection procedures.

When cell status is indicated as "not barred" and "reserved" for operator use for any PLMN,

- UEs assigned to Access Class 11 or 15 operating in their HPLMN/EHPLMN shall treat this cell as candidate during the cell selection and reselection procedures if the field *cellReservedForOperatorUse* for that PLMN set to 'reserved'.
- UEs assigned to an Access Class in the range of 0 to 9, 12 to 14 shall behave as if the cell status is "barred" in case the cell is "reserved for operator use" for the registered PLMN or the selected PLMN.

NOTE 1: ACs 11, 15 are only valid for use in the HPLMN/ EHPLMN; ACs 12, 13, 14 are only valid for use in the home country [4].

When cell status "barred" is indicated or to be treated as if the cell status is "barred",

- The UE is not permitted to select/reselect this cell, not even for emergency calls.
- The UE shall select another cell according to the following rule:
  - If the cell is a CSG cell:

- the UE may select another cell on the same frequency if the selection/reselection criteria are fulfilled.
- else
  - If the field *intraFreqReselection* in field *cellAccessRelatedInfo* in *SystemInformationBlockType1* message is set to "allowed", the UE may select another cell on the same frequency if re-selection criteria are fulfilled.
    - The UE shall exclude the barred cell as a candidate for cell selection/reselection for 300 seconds.
  - If the field *intraFreqReselection* in field *cellAccessRelatedInfo* in *SystemInformationBlockType1* message is set to "not allowed" the UE shall not re-select a cell on the same frequency as the barred cell;
    - The UE shall exclude the barred cell and the cells on the same frequency as a candidate for cell selection/reselection for 300 seconds.

The cell selection of another cell may also include a change of RAT.

## 5.3.2 Access control

Information on cell access restrictions associated with the Access Classes is broadcast as system information, [3].

The UE shall ignore Access Class related cell access restrictions when selecting a cell to camp on, i.e. it shall not reject a cell for camping on because access on that cell is not allowed for any of the Access Classes of the UE. A change of the indicated access restriction shall not trigger cell reselection by the UE.

Access Class related cell access restrictions shall be checked by the UE when starting RRC connection establishment procedure as specified in [3].

## 5.3.3 Emergency call

A restriction on emergency calls, if needed, is indicated by the field *ac-BarringForEmergency* [3]. If access class 10 is indicated as barred in a cell, UEs with access class 0 to 9 or without an IMSI are not allowed to initiate emergency calls in this cell. For UEs with access classes 11 to 15, emergency calls are not allowed if both access class 10 and the relevant access class (11 to 15) are barred. Otherwise, emergency calls are allowed for those UEs.

Full details of operation under "Access class barred list" are described in [4].

## 5.4 Tracking Area registration

In the UE, the AS shall report tracking area information to the NAS.

If the UE reads more than one PLMN identity in the current cell, the UE shall report the found PLMN identities that make the cell suitable in the tracking area information to NAS.

The NAS part of the location registration process is specified in [5].

Actions for the UE AS upon reception of Location Registration reject are specified in [4] and [16].

## 5.5 Support for manual CSG ID selection

### 5.5.1 E-UTRA case

In the UE on request of NAS, the AS shall scan all RF channels in the E-UTRA bands according to its capabilities to find available CSG IDs. On each carrier, the UE shall at least search for the strongest cell, read its system information and report available CSG ID(s) together with their 'HNB name' (if broadcast) and PLMN(s) to the NAS. The search for available CSG IDs may be stopped on request of the NAS.

If NAS has selected a CSG ID and provided this selection to AS, the UE shall search for an acceptable or suitable cell belonging to the selected CSG ID to camp on.

## 5.5.2 UTRA case

Support for manual CSG ID selection in UTRA is described in [8].

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# 6 Reception of broadcast information

## 6.1 Reception of system information

The NAS is informed if the cell selection and reselection results in changes in the received NAS system information.

UE shall monitor PCH as described in chapter 7.1 to receive System Information change notifications in RRC\_IDLE. Changes in the system information are indicated by the network using a *Paging* message. When the *Paging* message indicates system information changes then UE shall re-acquire all system information as specified in [3].

## 6.2 Reception of MBMS

A UE interested to receive MBMS services shall apply the MCCH information acquisition procedure as specified in [3] to receive the MCCH information upon entering the corresponding MBSFN area and upon receiving a notification that the MCCH information has changed. A UE interested to receive MBMS services identifies if a service that it is interested to receive is started or ongoing by receiving the MCCH information, and then receives a MTCH corresponding to the identified service.

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# 7 Paging

## 7.1 Discontinuous Reception for paging

The UE may use Discontinuous Reception (DRX) in idle mode in order to reduce power consumption. One Paging Occasion (PO) is a subframe where there may be P-RNTI transmitted on PDCCH addressing the paging message. One Paging Frame (PF) is one Radio Frame, which may contain one or multiple Paging Occasion(s). When DRX is used the UE needs only to monitor one PO per DRX cycle.

PF and PO is determined by following formulae using the DRX parameters provided in System Information:

PF is given by following equation:

$$\text{SFN mod } T = (T \text{ div } N) * (\text{UE\_ID mod } N)$$

Index  $i_s$  pointing to PO from subframe pattern defined in 7.2 will be derived from following calculation:

$$i_s = \text{floor}(\text{UE\_ID}/N) \text{ mod } N_s$$

System Information DRX parameters stored in the UE shall be updated locally in the UE whenever the DRX parameter values are changed in SI. If the UE has no IMSI, for instance when making an emergency call without USIM, the UE shall use as default identity  $\text{UE\_ID} = 0$  in the PF and  $i_s$  formulas above.

The following Parameters are used for the calculation of the PF and  $i_s$ :

- T: DRX cycle of the UE. T is determined by the shortest of the UE specific DRX value, if allocated by upper layers, and a default DRX value broadcast in system information. If UE specific DRX is not configured by upper layers, the default value is applied.
- nB: 4T, 2T, T, T/2, T/4, T/8, T/16, T/32.
- N:  $\min(T, nB)$

- $N_s$ :  $\max(1, nB/T)$
- UE\_ID: IMSI mod 1024.

IMSI is given as sequence of digits of type Integer (0..9), IMSI shall in the formulae above be interpreted as a decimal integer number, where the first digit given in the sequence represents the highest order digit.

For example:

$$\text{IMSI} = 12 \text{ (digit1=1, digit2=2)}$$

In the calculations, this shall be interpreted as the decimal integer "12", not " $1 \times 16 + 2 = 18$ ".

## 7.2 Subframe Patterns

FDD:

<b>Ns</b>	<b>PO when i_s=0</b>	<b>PO when i_s=1</b>	<b>PO when i_s=2</b>	<b>PO when i_s=3</b>
1	9	N/A	N/A	N/A
2	4	9	N/A	N/A
4	0	4	5	9

TDD (all UL/DL configurations):

<b>Ns</b>	<b>PO when i_s=0</b>	<b>PO when i_s=1</b>	<b>PO when i_s=2</b>	<b>PO when i_s=3</b>
1	0	N/A	N/A	N/A
2	0	5	N/A	N/A
4	0	1	5	6

Annex A (informative):  
Void

## Annex B (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
2007-06					Agreed text proposals from TSG RAN2#58bis meeting	0.0.0	0.0.1
2007-09	RP-37	RP-070687			Presented for information at TSG RAN-37	0.1.0	1.0.0
2007-11	RP-38	RP-070915			Presented for approval at TSG RAN-38	1.2.0	2.0.0
	RP-38	-			Approved at TSG RAN-38 and placed under change control	2.0.0	8.0.0
2008-03	RP-39	RP-080193	0001	1	CR to 36.304 on Miscellaneous corrections	8.0.0	8.1.0
2008-05	RP-40	RP-080408	0002	-	Add RAT specific Treselection parameters for CDMA HRPD and 1xRTT	8.1.0	8.2.0
	RP-40	RP-080408	0003	1	Paging Subframe Patterns for FDD and TDD and paging parameters clarification	8.1.0	8.2.0
	RP-40	RP-080408	0004	1	Editorial corrections to 36.304	8.1.0	8.2.0
	RP-40	RP-080408	0005	-	PLMN selection ping-pong control	8.1.0	8.2.0
2008-09	RP-41	RP-080689	0006	1	CR on Considerations on various open items in 36.304	8.2.0	8.3.0
	RP-41	RP-080689	0007	1	CSG related correction to 36.304	8.2.0	8.3.0
	RP-41	RP-080689	0008	1	Clarification of the medium mobility state criteria	8.2.0	8.3.0
	RP-41	RP-080689	0009	-	Support for Manual CSG ID Selection	8.2.0	8.3.0
	RP-41	RP-080689	0010	-	USIM less paging occasion calculation	8.2.0	8.3.0
	RP-41	RP-080689	0013	1	Definition of Qoffset in cell reselection criteria	8.2.0	8.3.0
	RP-41	RP-080689	0017	-	Correction to Discontinuous Reception for paging	8.2.0	8.3.0
	RP-41	RP-080689	0018	-	Lifetime of dedicated cell reselection priorities	8.2.0	8.3.0
	RP-41	RP-080689	0019	-	Clarification on cell reselection parameters	8.2.0	8.3.0
2008-12	RP-42	RP-081017	0020	1	Correcting the UE behaviour when Sintrasearch and Snointrasearch are not provided	8.3.0	8.4.0
	RP-42	RP-081017	0021	-	Proposed CR to 36.304 [Rel-8] on Definition of	8.3.0	8.4.0
	RP-42	RP-081017	0022	1	Proposed CR to 36.304 [Rel-8] on Intra-frequency reselection allowed/not-allowed concept	8.3.0	8.4.0
	RP-42	RP-081017	0023	-	Proposed CR to 36.304 [Rel-8] on Introduction of Pcompensation	8.3.0	8.4.0
	RP-42	RP-081017	0024	-	Proposed CR to 36.304 [Rel-8] on Support of UE autonomous search for E-UTRAN CSG cells when camped on other RAT than E-UTRAN	8.3.0	8.4.0
	RP-42	RP-081017	0025	-	Correction to range of nB in TS 36.304	8.3.0	8.4.0
	RP-42	RP-081017	0026	2	Miscellaneous corrections to 36.304	8.3.0	8.4.0
	RP-42	RP-081017	0027	1	Proposed CR to 36.304 [Rel-8] on Support of registration procedures as outcome of a manual CSG ID selection	8.3.0	8.4.0
	RP-42	RP-081017	0029	2	Implicit priority for CSG cells	8.3.0	8.4.0
	RP-42	RP-081017	0032	-	Correction of the reselection formula for offset used for PLMN selection	8.3.0	8.4.0
	RP-42	RP-081017	0036	-	Clarification of definition of SnonServingCell,x for cdma2000 RATs in TS 36.304	8.3.0	8.4.0
	RP-42	RP-081017	0038	1	Support of emergency calls in LTE Rel-8	8.3.0	8.4.0
	RP-42	RP-081017	0042	-	CR to 36.304 on Removal of cellReservationExtension	8.3.0	8.4.0
	RP-42	RP-081017	0044	1	Idle mode agreements related to 36.304	8.3.0	8.4.0
2009-03	RP-43	RP-090125	0045	-	CR to 36.304 on correction of definition of Pmax	8.4.0	8.5.0
	RP-43	RP-090125	0046	1	Emergency call in camped on any cell state in LTE Rel8	8.4.0	8.5.0
	RP-43	RP-090125	0047	-	Handling of Priority of Camping Frequency	8.4.0	8.5.0
	RP-43	RP-090125	0048	2	Correction to implementation of CR0009 to 36.304	8.4.0	8.5.0
	RP-43	RP-090125	0049	-	UE Behaviour on Registration Failure to CSG	8.4.0	8.5.0
	RP-43	RP-090125	0050	2	CR to 36.304 to capture several editorial corrections	8.4.0	8.5.0
	RP-43	RP-090125	0051	1	CR to 36.304 on Update of Figure 4.1-1 Overall Idle Mode Process	8.4.0	8.5.0
	RP-43	RP-090125	0053	2	Correction to priority based reselection handling	8.4.0	8.5.0
	RP-43	RP-090125	0057	3	CR on UE behaviour in absence of reselection priorities in system information	8.4.0	8.5.0
	RP-43	RP-090125	0058	3	Cell reselection for CSG	8.4.0	8.5.0
	RP-43	RP-090125	0060	-	Corrections to Inter-RAT Cell Reselection Criteria	8.4.0	8.5.0
	RP-43	RP-090125	0062	-	Manual selection	8.4.0	8.5.0
	RP-43	RP-090145	0063	1	Reception of ETWS notification without verifying digital signature	8.4.0	8.5.0
	RP-43	RP-090125	0066	-	Draft CR to 36.304 on Inheriting of dedicated priorities at inter-RAT reselection	8.4.0	8.5.0
	RP-43	RP-090125	0067	-	Proposed CR to 36.304 Clarification on applying DRX value	8.4.0	8.5.0



	RP-43	RP-090125	0070	-	Draft CR to 36.304 on Correction to UE behaviour if dedicated cell reselection priority is assigned but frequency is not configured by system information	8.4.0	8.5.0
	RP-43	RP-090125	0071	-	Clarification to the best non-allowed CSG cell	8.4.0	8.5.0
2009-06	RP-44	RP-090510	0072	2	CR on correction of sign in SnonServingCell,x for CDMA2000 RATs	8.5.0	8.6.0
	RP-44	RP-090510	0073	-	Correction to UE behaviour while 300s frequency barring timer is running	8.5.0	8.6.0
	RP-44	RP-090510	0074	1	Correction to any cell selection procedure	8.5.0	8.6.0
	RP-44	RP-090510	0075	1	Correction to reselection in case IFRI is not allowed	8.5.0	8.6.0
	RP-44	RP-090510	0076	1	Clarification when no candidate cells on serving frequency	8.5.0	8.6.0
	RP-44	RP-090510	0077	1	Clarification of the Priority Handling in CSG Cell	8.5.0	8.6.0
	RP-44	RP-090510	0079	-	Correction to cell selection when leaving RRC connected mode	8.5.0	8.6.0
	RP-44	RP-090510	0080	-	CR for Removing FFS for T3230	8.5.0	8.6.0
	RP-44	RP-090510	0082	-	Correction on the Lower Priority Cell Reselection Rule	8.5.0	8.6.0
	RP-44	RP-090510	0084	-	Clarification on disabling E-UTRA capabilities with a USIM	8.5.0	8.6.0
2009-09	RP-45	RP-090906	0085	-	Clarification on cell status and cell reservations	8.6.0	8.7.0
	RP-45	RP-090906	0089	-	Correction on Cell reserved for operators use	8.6.0	8.7.0
	RP-45	RP-090906	0094	-	clarifications for manual CSG ID selection	8.6.0	8.7.0
2009-09	RP-45	RP-090934	0086	1	Some clarifications on TS 36.304	8.7.0	9.0.0
	RP-45	RP-090926	0091	1	IMS emergency call when UE camps on acceptable cell	8.7.0	9.0.0
	RP-45	RP-090933	0096	-	Reception of CMAS notifications in limited service state	8.7.0	9.0.0
2009-12	RP-46	RP-091314	0098	-	Clarification on Parameters for Cell Selection	9.0.0	9.1.0
	RP-46	RP-091346	0099	-	Clarifications on autonomous search function for CSG	9.0.0	9.1.0
	RP-46	RP-091346	0100	1	Correction of Treselection inconsistency regarding frequency groups	9.0.0	9.1.0
	RP-46	RP-091346	0102	-	CR to 36.304 - Handling of barring in case of priority based reselection	9.0.0	9.1.0
	RP-46	RP-091346	0103	-	Functions supported for the UE "limited service state"	9.0.0	9.1.0
	RP-46	RP-091334	0104	3	UE's behaviour when camping on cell supporting emergency call	9.0.0	9.1.0
	RP-46	RP-091343	0106	2	Stage3 CR for LTE hybrid cell Idle Mode Mobility	9.0.0	9.1.0
	RP-46	RP-091314	0109	-	Correction related to Location Registration in manual CSG ID selection procedure.	9.0.0	9.1.0
	RP-46	RP-091343	0114	-	Access Stratum support for manual CSG selection across PLMN (CR 36.304 Rel-9)	9.0.0	9.1.0
	RP-46	RP-091343	0117	-	Renaming Allowed CSG List (36.304 Rel-9)	9.0.0	9.1.0
	RP-46	RP-091341	0119	-	Proposed CR to 36.304 on Introduction of MBMS	9.0.0	9.1.0
2010-03	RP-47	RP-100296	0122	-	Clarification on RRC connection re-establishment for emergency calls	9.1.0	9.2.0
	RP-47	RP-100308	0123	1	Correction on reselection from non-CSG cell to CSG inter-RAT cell	9.1.0	9.2.0
	RP-47	RP-100308	0124	1	Miscellaneous correction on 36.304	9.1.0	9.2.0
	RP-47	RP-100305	0125	-	Proposed CR to 36.304 on Addition of missing abbreviations related with MBMS	9.1.0	9.2.0
	RP-47	RP-100308	0129	-	Cell reselection enhancements CR for 36.304	9.1.0	9.2.0
2010-06	RP-48	RP-100556	0133	-	Clarification to cell reselection to E-UTRA enhancement	9.2.0	9.3.0

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## History

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V9.0.0	October 2009	Publication
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