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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 8.2.0 Release 8)**



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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.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 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 24.008: "Mobile radio interface layer 3 specification, Core Network Protocols - Stage 3".
Note: This reference does not yet have E-UTRAN specification that corresponds to UTRAN one.
- [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".

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.

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.

CSG: A closed subscriber group identifies subscribers which are allowed to use a number of E-UTRAN cells belonging to the PLMN of an operator but having restricted access ('CSG cells').

CSG cell: A cell which indicates being a CSG cell and provides a CSG identity. A CSG cell is only suitable for a UE if its CSG ID is in the UE's 'CSG whitelist'.

CSG identity: The identity of a CSG cell or a group of CSG cells.

CSG whitelist: A UE/USIM [FFS] maintained list of CSG IDs for CSG cells where a particular UE is allowed to camp.

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

Equivalent PLMN list: List of PLMNs considered as equivalent by the UE for cell selection, cell reselection and handover 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 or the defined equivalent HPLMN (EHPLMN).

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).

Radio Access Technology: Type of technology used for radio access, for instance E-UTRA, UTRA or GSM.

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
CSG	Closed Subscriber Group
DRX	Discontinuous Reception
DL-SCH	Downlink Shared Channel
EHPLMN	Equivalent Home PLMN
EPC	Evolved Packet Core
EPS	Evolved Packet 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
MCC	Mobile Country Code
MM	Mobility Management
MNC	Mobile Network Code
NAS	Non-Access Stratum
PLMN	Public Land Mobile Network
RAT	Radio Access Technology
RRC	Radio Resource Control
SAP	Service Access Point
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

4 General description of Idle mode

4.1 Overview

The idle mode tasks can be subdivided into three processes:

- PLMN selection;
- Cell selection and reselection;
- Location registration.

The relationship between these processes is illustrated in Figure 1.

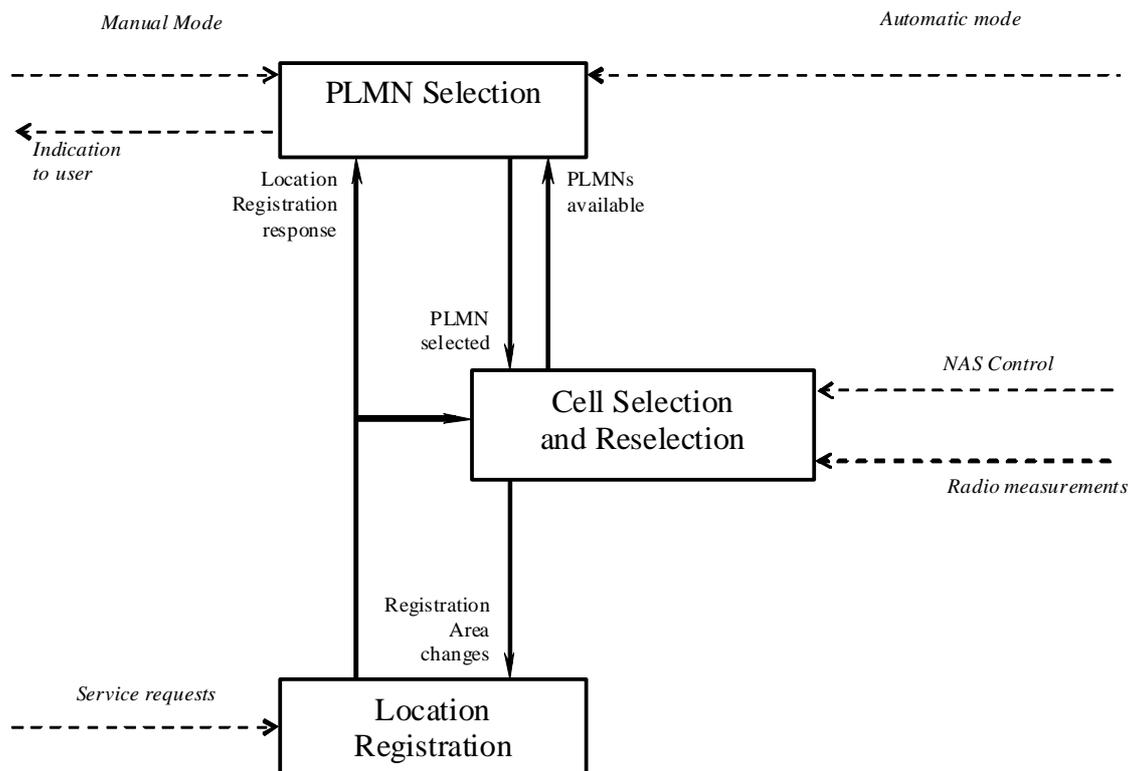


Figure 4.1-1: Overall Idle Mode process

When a UE is switched on, a public land mobile network (PLMN) is selected. 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, and tunes to its control channel. This choosing is known as "camping on the cell".

The UE will, 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 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.

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 threefold:

- a) It enables the UE to receive system information from the PLMN.
- b) 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.
- c) 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 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.

If the UE is unable to find a suitable cell to camp on, or the USIM is not inserted, or if the location registration failed (except for LR rejected with cause #12, cause #14 or cause #15, see [5] and [16]), it attempts to camp on a cell irrespective of the PLMN identity, and enters a "limited service" state in which it can only attempt to make emergency calls.

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).</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>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>Check broadcasted 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>

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 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). Such a cell shall fulfil the following requirements, which is the minimum set of requirements to initiate an emergency call 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. 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 listaccording to the latest information provided by the 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 LAs 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 cell identified as CSG cell by system information, the CSG ID is part of the CSG whitelist.

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.

Note: TA, TAI and TAC are used as synonyms for LA, LAI and LAC – updates needed if NAS specs are updated.

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].

An exception to these definitions is 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.

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 quality measure TBD), provided that the following high quality criterion is fulfilled:

[include definition of a 'high quality' E-UTRAN cell here]

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 quality measure TBD. 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.

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

Different types of measurements are used in different RATs and modes [FFS] for the cell selection and reselection. The performance requirements for the measurements are 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.

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 and procedures in RRC_IDLE

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.

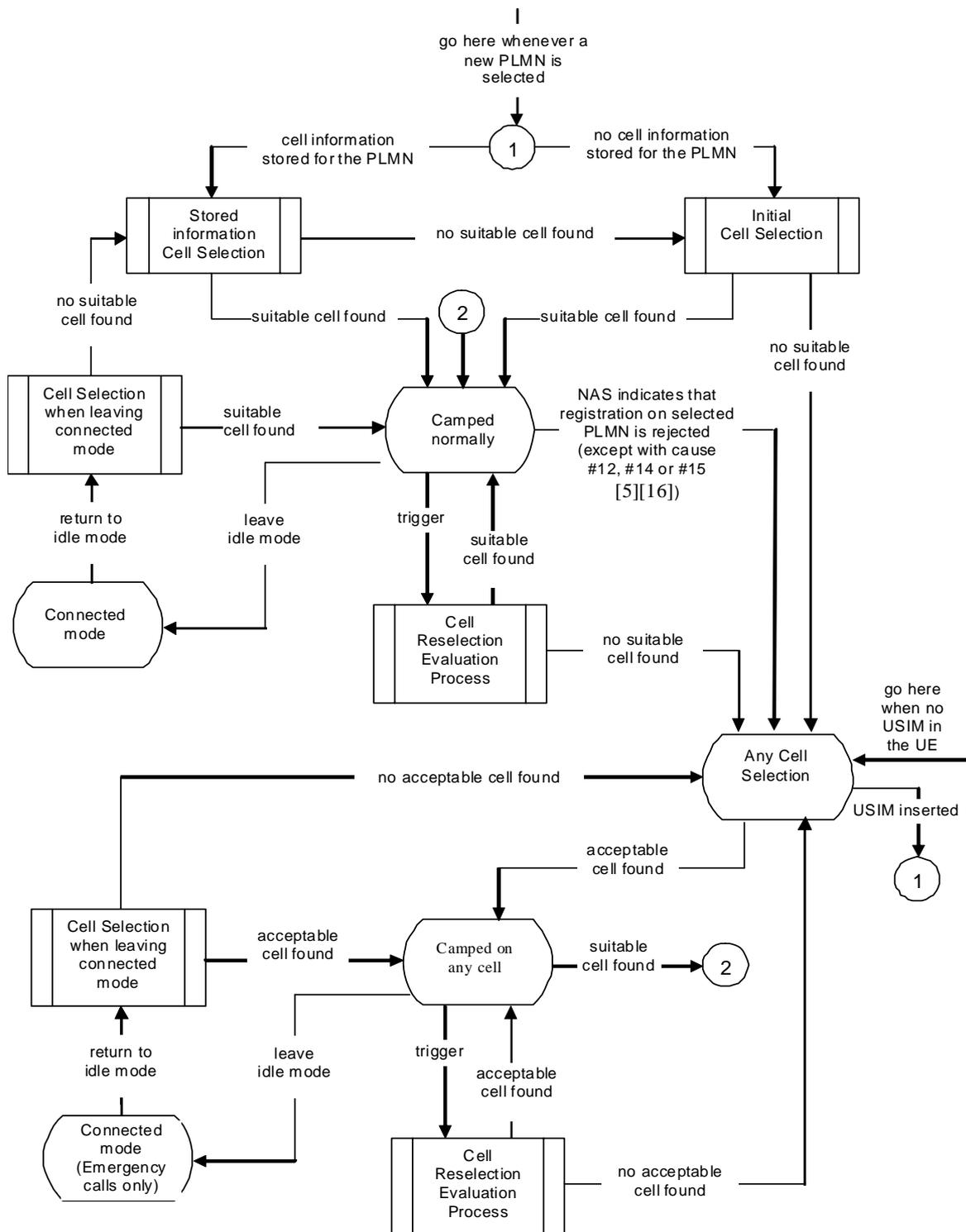


Figure 5.2.2-1: RRC_IDLE Cell Selection and Reselection

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 (Details of this is FFS), 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 RAT or frequencies provided to the UE by system information or dedicated signalling are not used in the cell selection process.

5.2.3.2 Cell Selection Criteria

The cell selection criterion S is fulfilled when:

$$S_{rxlev} > 0$$

Where:

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

Where:

the signalled value $Q_{rxlevminOffset}$ is 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.

S_{rxlev}	Cell Selection RX level value (dB)
$Q_{rxlevmeas}$	Measured cell RX level value (RSRP).
$Q_{rxlevmin}$	Minimum required RX level in the cell (dBm)
$Q_{rxlevminoffset}$	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]
$P_{compensation}$	[FFS]

Note: There may need to have additional measurement quantities in criterion S

5.2.3.3 CSG 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.

Note: It is FFS if more actions in the AS level for supporting manual selection is needed

Note: It is FFS if a UE not having CSG IDs in the whitelist shall consider any CSG cell for cell selection

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 and optionally in the RRC message releasing the RRC connection by the RPLMN. If priorities are assigned via dedicated signalling, the UE shall ignore all the priorities provided in system information. The UE shall delete priorities provided by dedicated signalling when:

- the UE leaves the PLMN which gave dedicated priorities; or
- the UE enters RRC_CONNECTED state; or

Note: Details FFS (e.g. if priorities deleted at entering the state or at leaving the state).

- the optional validity time of dedicated priorities expires.

Equal priorities between RATs are not supported.

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

Note: It is FFS what is priority life time in case of ePLMN and network sharing.

5.2.4.2 Measurement rules for cell re-selection

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

- If $S_{\text{ServingCell}} > S_{\text{intra search}}$, UE may choose to not perform intra-frequency measurements.
- If $S_{\text{ServingCell}} \leq S_{\text{intra search}}$, 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 as defined in 5.2.4.1:
 - o 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-frequencies or inter-RAT frequencies according to [10].
 - o For an E-UTRAN inter-frequency with a 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 $S_{\text{ServingCell}} > S_{\text{nonintra search}}$ UE may choose not to perform measurements of E-UTRAN inter-frequencies or inter-RAT frequencies of equal or lower priority.
 - If $S_{\text{ServingCell}} \leq S_{\text{nonintra search}}$ the UE shall perform measurements of E-UTRAN inter-frequencies or inter-RAT frequencies cells of equal or lower priority according to [10].

Where $S_{\text{ServingCell}}$ is the S_{rxlev} -value of the serving cell.

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} , $N_{\text{CR_H}}$, $N_{\text{CR_M}}$ and $T_{\text{CRmaxHyst}}$) 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 $N_{\text{CR_M}}$

High mobility state criteria:

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

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

State transitions:

- 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 5.2.4.6.

Note: It is FFS whether we have some additional speed detection methods

5.2.4.4 Highest ranked 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 5.2.3.4, 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 is removed when the highest ranked cell changes.

If the highest ranked cell 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 has to perform an *any cell selection* procedure any limitation shall be removed.

If the highest ranked cell 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. If the UE has to perform an *any cell selection* procedure any limitation shall be removed.

Note: Update may be needed for CSG (once agreed how to handle the 300s requirements when it comes to CSG).

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

Criteria 1: the $S_{\text{nonServingCell},x}$ of a cell on evaluated frequency is greater than $\text{Thresh}_{x, \text{high}}$ during a time interval $T_{\text{reselection}_{\text{RAT}}}$;

Cell reselection to a cell on a higher priority E-UTRAN frequency or RAT than camped frequency shall be performed if:

- A cell of a higher priority E-UTRAN frequency or RAT fulfills criteria 1; and
- more than 1 second has elapsed since the UE camped on the current serving cell.

Cell reselection to a cell on a lower priority E-UTRAN frequency or RAT than camped frequency shall be performed if:

- No cell on camped frequency or on a higher priority E-UTRAN frequency or RAT than camped frequency fulfills the criteria 1; and
- $S_{\text{ServingCell}} < \text{Thresh}_{\text{ServingCell}, \text{low}}$ and the $S_{\text{nonServingCell},x}$ of a cell of a lower priority E-UTRAN frequency or RAT is greater than $\text{Thresh}_{x, \text{low}}$ during a time interval $T_{\text{reselection}_{\text{RAT}}}$; 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.

$S_{\text{nonServingCell},x}$ is the S_{rxlev} -value of a evaluated cell. In all the above criteria the value of $T_{\text{reselection,RAT}}$ is scaled when the UE is in the medium or high mobility state as defined in subclause 5.2.4.6. If more than one cell meets the above criteria, the UE shall reselect a cell ranked as the best cell among the cells meeting the criteria on the highest priority RAT or the highest priority frequency if the highest priority RAT is E-UTRA.

Note: It is FFS what the definition is for $S_{\text{nonServingCell},x}$ for cdma2000 RATs.

5.2.4.6 Intra-frequency Cell Reselection criteria

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

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

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

where:

Q_{meas}	RSRP measurement quantity used in cell reselections.
Q_{offset}	Equals to $Q_{\text{offsets},n}$ if it is valid otherwise this equals to $Q_{\text{offsetfrequency}}$

The UE shall perform ranking of all cells that fulfill the cell selection criterion S , which is defined in 5.2.1.2

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 re-selection to that cell. If this cell is found to be non-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 $T_{\text{reselection},s}$
- if the mobile is in high mobility state multiply $T_{\text{reselection},s}$ by the IE "Speed dependent ScalingFactor for $T_{\text{reselection},s}$ for high mobility state' and Q_{hyst} by the IE "Speed dependent ScalingFactor for Q_{hyst} for high mobility state' if sent on system information
- more than 1 second has elapsed since the UE camped on the current serving cell.

Note: There may need to have additional measurement quantities in criterion R .

Note: Scaling of measurement rule parameters need to be specified when parameters are finalized.

Note: Exact scaling parameters for different mobility states are FFS.

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:

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

This specifies the offset between the two cells.

$Q_{\text{offsetfrequency}}$

Frequency specific offset for equal priority E-UTRAN frequencies.

Q_{hyst}

This specifies the hysteresis value for ranking criteria.

Qrxlevmin

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

Treselection_{RAT}

This specifies the cell reselection timer value. For each target RAT 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. Treselection_{RAT} for E-UTRAN is Treselection_{EUTRAN}, for UTRAN Treselection_{UTRAN} for GERAN Treselection_{GERAN}, for Treselection_{CDMA_HRPD}, and for Treselection_{CDMA_1XRTT}).

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

Treselection_{EUTRAN}

This specifies the cell reselection timer value Treselection_{RAT} for E-UTRAN

Treselection_{UTRAN}

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

Treselection_{GERAN}

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

Treselection_{CDMA_HRPD}

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

Treselection_{CDMA_1XRTT}

This specifies the cell reselection timer value Treselection_{RAT} for CDMA 1XRTT

Thresh_{x, high}

This specifies the threshold used by the UE when reselecting towards the higher priority frequency X than currently camped frequency. Each frequency of each RAT(excluding GERAN) and band of GERAN will have frequency specific threshold.

Thresh_{x, low}

This specifies the threshold used in reselection towards frequency X priority from a higher priority frequency. Each frequency of each RAT (excluding GERAN) and band of GERAN will have frequency specific threshold.

Thresh_{servicing, low}

This specifies the low threshold for serving frequency used in reselection evaluation.

S_{intrasearch}

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

S_{nonintrasearch}

This specifies the threshold (in dB) for inter-RAT and inter-frequency 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.

Speed dependent scaling parameters

Note: It is FFS how scaling of mobility parameters is done.

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

UE shall use an autonomous search function for CSG cells when at least one CSG ID is included in the UE's 'CSG whitelist'.

Note: It is FFS if details of autonomous search functions are defined and what kind of requirements will be defined.

The UE shall disable the autonomous search function for CSG cells if the UE's 'CSG whitelist' is empty.

Note: The need for a user selection of a CSG priority mode is FFS.

5.2.4.8.2 Cell reselection from a CSG cell

A UE leaving a CSG cell shall use normal cell reselection rules.

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. This is 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

If the UE supports MBMS and MBMS is active in the cell and the UE is permitted to receive MBMS services in the cell, the UE shall perform MBMS tasks as specified in subclause 6.2.

5.2.7 Cell Selection when leaving RRC_CONNECTED state

On transition from RRC_CONNECTED to RRC_IDLE, a UE shall attempt to camp on the last cell for which it was in RRC_CONNECTED or a cell/any cell of set of cells or any cell of frequency assigned by RRC in the state transition message. 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 idle mode after UE moved to RRC_CONNECTED state from camped on any cell state, UE shall attempt to camp on the last cell for which it was in RRC_CONNECTED state or a cell/any cell of set of cells or any cell of frequency assigned by RRC in the state transition message. 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.

Note: It is FFS if UE shall only attempt to camp on an acceptable CSG cell (a CSG for which the CSG ID is not in the UE's CSG whitelist) in case no other suitable or acceptable cell of any PLMN can be 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; This is 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 RATs that are supported by the UE. If a suitable cell is found, UE moves to camped normally state.

In this state UE is not permitted to receive any MBMS services.

Note: It is FFS if the UE shall regularly attempt to find an acceptable non CSG cell.

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 re-selection procedures. The second mechanism, referred to as Access Control, shall allow to prevent 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* [3] by means of three Information Elements:

- *cellBarred* (IE type: "barred" or "not barred")
In case of NW sharing, this IE is common for all PLMNs
- *cellReservedForOperatorUse* (IE type: "reserved" or "not reserved")
In case of NW sharing, this IE is specified per PLMN
- *cellReservationExtension* (IE type: "reserved" or "not reserved")
In case of NW sharing, this IE is common for all PLMNs.

When cell status is indicated as "not barred", "not reserved" for operator use and "not reserved" for future extension (Cell Reservation Extension),

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

When cell status is indicated as "not barred", "not reserved" for operator use and "reserved" for future extension (Cell Reservation Extension),

- UEs shall behave as if cell status "barred" is indicated.

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 IE *cellReservedForOperatorUse* for that PLMN set to 'reserved'.
- UEs assigned to an Access Class in the range of 0 to 9, 12 to 14 and UEs with AC 11 or 15 not operating in their HPLMN/EHPLMN shall behave as if the cell status is 'barred' in case the cell is 'reserved for operator use' for the PLMN the UE is currently registered with.

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,

- The UE is not permitted to select/re-select this cell, not even for emergency calls.
- The UE shall ignore the "Cell Reserved for future extension (Cell Reservation Extension) use" IE.
- The UE shall select another cell

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

Editor's note: Cell barring with 'intra-frequency cell reselection indicator' is FFS.

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 re-selection by the UE.

Access Class related cell access restrictions shall be checked by the UE when starting RRC connection establishment procedure.

5.3.3 Emergency call

A restriction on emergency calls, if needed, shall be indicated in the "Access class barred list" IE [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 non-access 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].

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 will monitor PCH as described in chapter 7.1 to received System Information change notifications in RRC_IDLE. Changes in the system information will be indicated by the PAGING MESSAGE. When the PAGING MESSAGE indicates changes then UE needs reacquire all system information..

6.2 Void

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 P-RNTI 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:

$$i_s = (\text{UE_ID}/N) \text{ mod } N_s$$

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 (e.g. 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: Range of DRX values 32, 64, 128, 256 radioframes. The UE specific DRX parameter, if allocated and having shorter DRX than T, shall override T.
- nB: 4T, 2T, T, 1/2T, 1/4T, 1/8T, 1/16T, 1/32T.
- N: min(T, nB)
- Ns: max(1, nB/T)
- UE_ID: IMSI mod 4096.

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 "1x16+2 = 18".

7.2 Subframe Patterns

FDD:

Ns	PO when $i_s=0$	PO when $i_s=1$	PO when $i_s=2$	PO when $i_s=3$
1	49	N/A	N/A	N/A
2	4	9	N/A	N/A
3	0,	4	8	N/A
4	0,	4	5	9

TDD (all UL/DL patterns):

Ns	PO when $i_s=0$	PO when $i_s=1$	PO when $i_s=2$	PO when $i_s=3$
1	0	N/A	N/A	N/A
2	0	5	N/A	N/A
4	0	1	5	6

TDD UL/DL pattern 1:

Annex A (informative):
Void

Annex B (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
06/2007					Agreed text proposals form TSG RAN2#58bis meeting	0.0.0	0.0.1
09/2007	RAN #37				Presented for information at TSG RAN-37	0.1.0	1.0.0
11/2007	RAN #38				Presented for approval at TSG RAN-38	1.2.0	2.0.0
	RAN #38	-			Approved at TSG RAN-38 and placed under change control	2.0.0	8.0.0
03/2008	RAN #39	RP-080193	0001	1	CR to 36.304 on Miscellaneous corrections	8.0.0	8.1.0
05/2008	RAN #40	RP-080408	0002	-	Add RAT specific Treselection parameters for CDMA HRPD and 1xRTT	8.1.0	8.2.0
	RAN #40	RP-080408	0003	1	Paging Subframe Patterns for FDD and TDD and paging parameters clarification	8.1.0	8.2.0
	RAN #40	RP-080408	0004	1	Editorial corrections to 36.304	8.1.0	8.2.0
	RAN #40	RP-080408	0005	-	PLMN selection ping-pong control	8.1.0	8.2.0

History

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