TSG-RAN Meeting #12 *RP-010305*
Stockholm, Sweden, 12 - 15 June 2001

Title: **Agreed CRs (Release '99 and Rel-4 category A) to TS 25.304**

Source: **TSG-RAN WG2**

Agenda item: **8.2.3**

Doc-1st-	Status-	Spec	CR	Rev	Phase	Subject	Cat	Version	Versio
R2-011397	agreed	25.304	071	2	R99	Corrections to 25.304	F	3.6.0	3.7.0
R2-011398	agreed	25.304	072		Rel-4	Corrections to 25.304	A	4.0.0	4.1.0
R2-011401	agreed	25.304	073	1	R99	Emergency calls in barred cells	F	3.6.0	3.7.0
R2-011402	agreed	25.304	074		Rel-4	Emergency calls in barred cells	A	4.0.0	4.1.0
R2-011417	agreed	25.304	077	1	R99	Clarification to usage of measurement thresholds	F	3.6.0	3.7.0
R2-011418	agreed	25.304	078		Rel-4	Clarification to usage of measurement thresholds	A	4.0.0	4.1.0

3GPP TSG-RAN WG2 Meeting #21 ***R2-011397***
Busan, Korea, May 21st – May 25th 2001

CR-Form-v4

CHANGE REQUEST

⌘ **25.304** **CR** **071** ⌘ ev **r2** ⌘ Current version: **3.6.0** ⌘

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

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

Title:	⌘	Corrections to 25.304
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	***Date:*** ⌘ 24/05/2001
Category:	⌘ **F**	***Release:*** ⌘ R99

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

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

Reason for change: ⌘

- During last RAN2 meeting # 20 in Hayama a number of operators identified open issues and inconsitencies in TS 25.304 v 3.6.0, which could lead to erroneous behaviour of UE in idle mode operation.
- The following reasons apply for the removal of the mapping function:
  - The quantization of the measurement quantity used in the cell reselection criteria of TS25.304 causes unnecessary performance degradation in cell reselection process as discussed in the agreed Tdoc R4-010286.
  - There is a misalignment between TS25.133 and TS25.304 in the GSM measurement quantity used for cell reselection purposes.
  - The mapping function causes an additional inaccuracy. The amount of this inaccuracy varies depending on the defined mapping function. This issue is also discussed and agreed in R4-010286. Originally the mapping function was introduced to cope with the comparison of different types of measurement quantities in inter-RAT and inter-mode cell reselections. However, now TS25.304 clearly defines that CPICH RSCP is always used as measurement quantity when UTRA FDD cells are compared with GSM or TDD cells. The use mapping function in a network is therefore questioned.

BC:

Changes in R2-011372 are BC, except:

Regarding the removal of the mapping function, proposed modifications are backwards compatible, except for UE and network implementations using FDD/TDD to GSM re-selection. For such implementations, settings of parameter Qoffset will have a different understanding for FDD/TDD to GSM cell re-selection evaluation after introduction of this CR.

Changes on R2-011111 are BC.

Changes on R2-011297 are BC

Summary of change:	⌘	• Ambiguous description in the text may lead to erroneous behaviour of the UE • SoLSA is not supported in this release of spec – but kept due to BC • Prioritization concept of NAS defined service areas is not specified and therefore not applicable for this release • Split between AS and NAS needs to be defined in a more appropriate and consistent way • Definition how to report available PLMNs was missing in support for network selection • Cell selection criteria for FDD and TDD cells is defined in a more appropriate way • Various minor corrections necessary to improve quality of specification • The 'quantity' used in cell re-selection H and R criteria is changed to be the actual measured quantity and not quantized measurement quantity. • GSM measurement quantity is corrected to be the averaged received signal level according to Section 4.2.2.5 of TS25.133 instead of RXLEV. It is also clarified that the averaging of CPICH Ec/No, CPICH RSCP and P-CCPCH RSCP measurement quantities is performed according to TS25.133. • The mapping function is removed. • "List of equivalent PLMN codes" changed in "List of equivalent PLMN identities" according to LS received from SA1. • NAS defined Service Area removed in figure 12 and 13 • Chapter 5.2.2 restructured (new overview sections included and text describing details moved to sections on processes and states in later chapters ...) • Definition of cell selection criteria (also applied for cell reselection) copied to section on cell reselection and reference regarding GSM included • 2 new AS tasks in table 1 for PLMN selection and reselection introduced: • Minor editorial corrections • Agreed CRs R2-011111 (CR 069) and R2-011297 (CR 075) were merged into this version. • References to SoLSA are removed.
Consequences if not approved:	⌘	• Essential corrections needed – if not applied the correct UE behaviour in idle mode can not be ensured.

Clauses affected:	⌘	1, 2, 3.1, 3.2, 4.1, 4.2, 4.3, 5.1.1, 5.1.2, 5.1.2.1, 5.1.2.2, 5.2.1, 5.2.2, 5.2.2.1 (new), 5.2.2.2 (new), 5.2.2.3 (new), 5.2.2.4 (new), 5.2.2.5 (new), 5.2.3.1.1, 5.2.3.1.2, 5.2.3.2, 5.2.6.1.3, 5.2.6.1.4, 5.2.6.1.5, 5.2.8, 5.2.9.1, 5.3.1.1, 5.4.1, 5.4.1.1, 5.4.3, 5.5, 7, 7.1, 8.1, 8.3, 9, 9.1, 9.1.1, 9.1.2, 9.1.3, 9.1.4, 10.1, 10.2, 10.4, 10.5, 10.6, 10.7, 10.8.1, 10.8.2
Other specs Affected:	⌘	☐ Other core specifications ⌘ ☐ Test specifications ☐ O&M Specifications
Other comments:	⌘	

How to create CRs using this form:

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

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

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

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

3GPP TS 25.304 V3.6.0 (2001-03)

Technical Specification

3rd Generation Partnership Project; Technical Specification Group Radio Access Network; UE Procedures in Idle Mode and Procedures for Cell Reselection in Connected Mode (Release 1999)

The present document has been developed within the 3rd Generation Partnership Project (3GPP ™) and may be further elaborated for the purposes of 3GPP.

The present document has not been subject to any approval process by the 3GPP Organisational Partners and shall not be implemented.
This Specification is provided for future development work within 3GPP only. The Organisational Partners accept no liability for any use of this Specification.
Specifications and reports for implementation of the 3GPP ™ system should be obtained via the 3GPP Organisational Partners' Publications Offices.

Keywords
UMTS, radio

3GPP

Postal address

3GPP support office address
650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet
http://www.3gpp.org

Copyright Notification

No part may be reproduced except as authorized by written permission.
The copyright and the foregoing restriction extend to reproduction in all media.

© 2001, 3GPP Organizational Partners (ARIB, CWTS, ETSI, T1, TTA, TTC).
All rights reserved.

Contents

Foreword 8
1 Scope 9
2 References 9
3 Definitions and abbreviations 10
3.1 Definitions 10
3.2 Abbreviations 11
4 General description of Idle mode 13
4.1 Overview 13
4.2 Functional division between AS and NAS in Idle mode 15
4.3 Service type in Idle mode 17
5 Process and procedure descriptions 18
5.1 PLMN selection and reselection 18
5.1.1 General 18
5.1.2 Support for Network Selection 18
5.1.2.1 General 18
5.1.2.2 UTRA case 18
5.1.2.3 GSM case 19
5.2 Cell selection and reselection in idle mode 19
5.2.1 Introduction 19
5.2.2 States and state transitions in Idle Mode 20
5.2.3 Cell Selection Process 23
5.2.3.1 UTRA case 23
5.2.3.1.1 Description 23
5.2.3.1.2 Criteria 24
5.2.3.2 GSM case 24
5.2.4 Void 25
5.2.5 Camped Normally State 25
5.2.5.1 UTRA case 25
5.2.5.2 GSM case 25
5.2.6 Cell Reselection Evaluation Process 25
5.2.6.1 UTRA case 25
5.2.6.1.1 Measurement rules for cell re-selection when HCS is not used 25
5.2.6.1.2 Measurement rules for cell re-selection when HCS is used 25
5.2.6.1.3 Non-suitable cells (Squal > 0 or Srxlev > 0) 27
5.2.6.1.4 Cell Reselection Criteria 27
5.2.6.1.5 Cell reselection parameters in system information broadcasts 31
5.2.6.2 GSM case 32
5.2.7 Cell Selection when leaving connected mode 32
5.2.7.1 UTRA case 32
5.2.7.2 GSM case 32
5.2.8 Any Cell Selection state 33
5.2.9 Camped on Any Cell State 33
5.2.9.1 UTRA case 33
5.2.9.2 GSM case 33
5.3 Cell Access Restrictions 33
5.3.1 UTRA cells 33
5.3.1.1 Cell status and cell reservations 33
5.3.1.2 Access Control 34
5.3.1.3 Emergency Call 34
5.3.2 GSM cells 35
5.4 Cell Reselection Processes in RRC Connected Mode 35
5.4.1 Initial Cell Reselection Process 35
5.4.1.1 Criteria 35
5.4.2 Void 35

5.4.3 Cell Reselection Process....35
5.5 Location Registration....35

6 Broadcast information receiving....36
6.1 Reception of System Information....36
6.2 Cell Broadcast in Idle Mode....36

7 Measurements for cell selection / reselection....36
7.1 Use of Mapping Functions....36

8 Paging and SCCPCH selection in Idle mode....37
8.1 Paging Channel selection....37
8.2 SCCPCH selection when entering Connected mode....38
8.3 Discontinuous Reception....38

9 Multicast services....39
9.1 State diagram between the multicast service and DSCH....39
9.1.1 MT_Null State....40
9.1.2 MT_Monitor State....40
9.1.3 MT_Saving State....40
9.1.4 MT_Active State....41

10 Examples of Procedures....41
10.1 NAS initiated change of system information....42
10.2 System Information Update to NAS....43
10.3 CN originated paging in idle mode....44
10.4 PLMN Selection, automatic mode, normal case....45
10.5 PLMN Reselection, automatic mode....46
10.6 PLMN Reselection, manual mode....47
10.7 PLMN Selection, automatic mode, selected PLMN not found....48
10.8 NAS Controlled Cell Selection....49
10.8.1 Execution in Access Stratum....49
10.8.2 Execution in Non-Access Stratum....50

Annex A (informative): Change history....51

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

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 also specifies cell reselection processes applicable to UEs in connected mode. Invocation of these processes is described in [4].

The present document specifies the model for the functional division between the ~~non-access stratum~~NAS and ~~access stratum~~AS in a UE.

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

- When the UE is camped on a UTRA cell;
- When the UE is searching for a cell to camp on;
- ~~When the UE is camped on another RAT than UTRA.~~

NOTE: The details for those cases are described in the specifications of the other RAT.

The present document presents also examples of inter-layer procedures related to the idle mode processes and describes idle mode functionality of a dual RAT UTRA/GSM UE.

~~Following items are considered for future releases:~~

~~1) State diagram between the multicast service and DSCH (subclause 9.1).~~

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 TS 03.22: "Functions related to Mobile Station in idle mode and group receive mode".

[2] 3GPP TS 25.301: "Radio Interface Protocol Architecture".

[3] 3GPP TS 25.303: "Interlayer Procedures in Connected Mode".

[4] 3GPP TS 25.331: "RRC Protocol Specification".

[5] 3GPP TS 23.122: "NAS functions related to Mobile Station (MS) in idle mode ".

[6] 3GPP TR 25.922: "Radio Resource Management Strategies".

[7] 3GPP TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)".

[8] 3GPP TS 25.221: "Physical channels and mapping of transport channels onto physical channels (TDD)".

[9] 3GPP TS 22.011: "Service accessibility".

[10] 3GPP TS 25.133: "Requirements for Support of Radio Resource Management (FDD)".

[11] 3GPP TS 25.123: "Requirements for Support of Radio Resource Management (TDD)".

[12] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[13] 3GPP TS 05.08: "Radio subsystem link control".

[14] 3GPP TS 25.214: "Physical layer procedures (FDD)".

[15] 3GPP TS 25.224: "Physical Layer Procedures (TDD)".

[16] 3GPP TS 24.008: "3rd Generation Partnership Project;Universal Mobile Telecommunications System; Mobile radio interface layer 3 specification, Core Network Protocols - Stage 3".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following definitions and the definitions in [12] 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.

~~**Allowable PLMN:** a PLMN, which is not in the list of forbidden PLMNs in the UE.~~

Available PLMN: a PLMN for which the UE has found at least one acceptable cell.

Barred Cell: A cell is barred if it is so indicated in the system information.

Camped on a cell: UE is in idle mode and 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.

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

Equivalent PLMN: a PLMN considered as equivalent to the selected PLMN by the UE for PLMN selection, 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.

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

~~**LSA:** Localised Service Area. A LSA is an operator-defined group of cells for which specific access conditions applies. This may correspond to an area in which the Core Network offers specific services. A LSA may be defined within a PLMN or globally. Therefore, a LSA may offer non-contiguous radio coverage.~~

~~**LSA exclusive access cell:** UE may only camp on this cell if the cell belongs to the LSAs to which the user has subscribed. Nevertheless, if no other cells are available, the UE of non-LSA users may originate emergency calls from this cell.~~

~~**LSA ID:** Localised Service Area Identity.~~

~~**LSA only access:** when LSA only access applies to the user, the UE can only access cells that belong to the LSAs to which the user has subscribed. Outside the coverage area of the subscribed LSAs, the UE may camp on other cells and limited services apply.~~

~~**LSA preferential access cell:** LSA preferential access cell is a cell, which is part of the LSA. UEs of users that have subscribed to a LSA of an LSA-preferential-access cell have higher priority to resources than non-LSA users in the same cell. The availability of LSA preferential access cells impacts the radio resource allocation (controlled by UTRAN-Access Stratum). This function is out of the scope of the standards.~~

Maximum DRX cycle: time interval for the longest possible DRX cycle in a cell.

Paging Block Periodicity (PBP): period of the occurrence of Paging Blocks. (For FDD, PBP = 1).

Paging Message Receiving Occasion (TDD only)**:** the frame where the UE receives actual paging message.

Paging occasion:
(FDD) The SFN of the PICH frame where the UE monitors its paging indicator (i.e. the SFN of the PCCPCH frame in which the PICH frame begins).
(TDD) The paging block, which consists of several frames. The value of Paging Occasion is equal to the first frame of the Paging Block.

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

Radio Access Mode: radio access mode of the cell, FDD or TDD.

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

~~**Registered PLMN (RPLMN):** this is the PLMN on which the UE has performed a location registration successfully.~~

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.

Selected PLMN: this is the PLMN that has been selected by the ~~non-access stratum~~NAS, either manually or automatically.

Serving cell: the cell on which the UE is camped

Suitable Cell: This is a cell on which an UE may camp. It must satisfy criteria which is defined for A/Gb mode in 3GPP TS 03.22 and for Iu mode in section 4.3.~~a cell on which an UE may camp. It shall satisfy certain conditions, see subclause 4.3.~~ [5]

~~**Visited PLMN of home country:** a PLMN, different from the home PLMN, where the MCC part of the PLMN identity is the same as the MCC of the IMSI.~~

3.2 Abbreviations

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

AS	Access Stratum
BCCH	Broadcast Control Channel
CM	Connection Management
CN	Core Network
DRX	Discontinuous Reception
DSCH	Downlink Shared Channel
FDD	Frequency Division Duplex
GC	General Control (SAP)
GPRS	General Packet Radio ~~System~~Service
GSM	Global System for Mobile Communications
HCS	Hierarchical Cell Structure
IMSI	International Mobile Subscriber Identity
MCC	Mobile Country Code
MM	Mobility Management
MNC	Mobile Network Code
NAS	Non-Access Stratum
PCH	Paging Channel
PI	Page Indicator
PICH	Page Indication Channel
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
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network

4 General description of Idle mode

4.1 Overview

When a UE is switched on, a public land mobile network (PLMN) is selected and the UE searches for a suitable cell of this PLMN to camp on. Criteria for cell selection and cell re-selection between radio access technologies (RATs) described in this document only consider radio criteria. In addition to ~~radio access technology~~RAT, the PLMN type may differ as well. In this specification, the term PLMN is used as a generic term covering both GSM MAP and ANSI-41 type of PLMNs. According to the type of PLMN, the way to identify it can be different. If the PLMN type is GSM, the PLMN is identified by 'PLMN identity' and if the PLMN type is ANSI-41, the PLMN is identified by 'SID'

The NAS shall provide a list of equivalent PLMNs, if available, that the AS shall use for PLMN selection, cell selection, cell reselection and handover.

The UE searches for a suitable cell of the chosen 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 registration area of the chosen cell~~, if necessary~~.

If the UE finds a more suitable cell, it reselects onto that cell and camps on it. If the new cell is in a different registration area, location registration is performed.

If necessary, the UE will look for more suitable cells on other PLMNs at regular time intervals, which is referred to as PLMN-reselection. This is described in [9].

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:

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 registration area of the cell in which the UE is camped. It can then send a "paging" message for the UE on control channels of all the cells in the registration area. The UE will then receive the paging message because it is tuned to the control channel of a cell in that registration area and the UE can respond on that control channel.

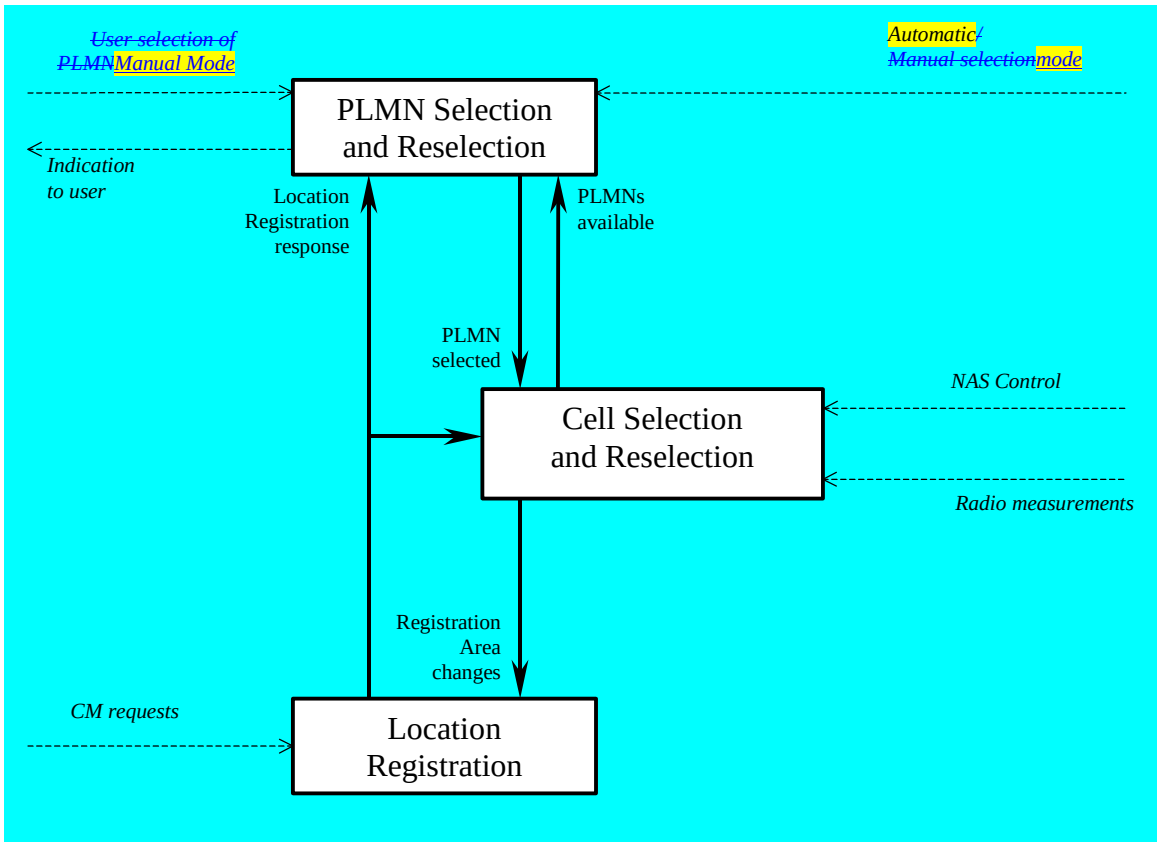
d) It enables the UE to receive cell broadcast services.

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 #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.

The idle mode tasks can be subdivided into three processes:

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

The relationship between these processes is illustrated in Figure 1.



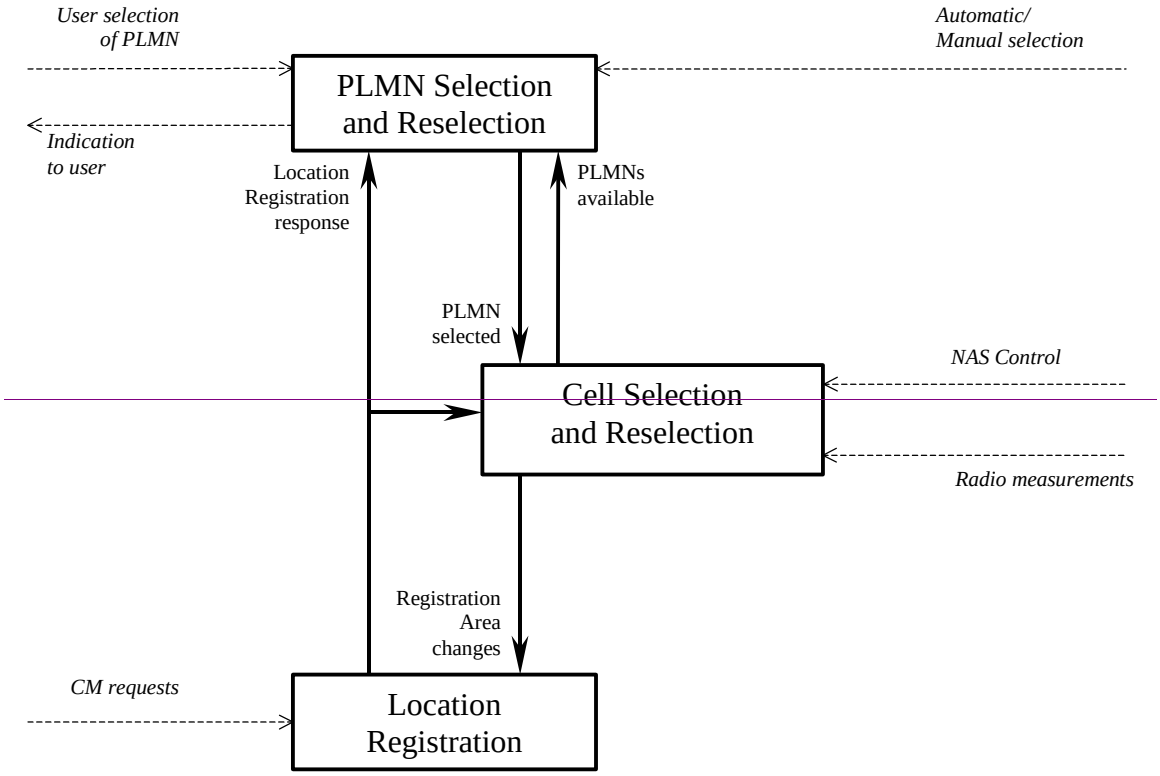


Figure 1: Overall Idle Mode process

~~NOTE: The impact of NAS defined service areas is FFS.~~

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 ~~non-access stratum~~NAS part is specified in [5] and the ~~access stratum~~AS part in the present document. Examples of different idle mode procedures are presented in Clause 10.

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

Idle Mode Process	UE Non-Access Stratum	UE Access Stratum
PLMN Selection and Reselection	Maintain the list of allowed PLMN types. It can be GSM-MAP only, ANSI-41 only or both. 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 ~~radio access technology(ies)~~RAT(s) may be set. Evaluate reports of available PLMNs from AS for PLMN selection. Maintain a list of equivalent PLMN ~~codes~~identities.	~~Search for a suitable cell belonging to the PLMN requested by NAS. Perform cell selection process as described below.~~ Search for available PLMNs. If associated ~~radio access technology(ies)~~RAT(s) is (are) set for the PLMN, search in this (these) ~~radio access technology(ies)~~RAT(s) and other ~~radio access technologies~~RATs for that PLMN as specified in [5]. Perform measurements to support PLMN selection. Synchronise to a broadcast channel to identify found PLMNs. Report available PLMNs with associated PLMN type and ~~radio access technology~~RAT to NAS on request from NAS or autonomously. It ~~must~~ shall respect allowed PLMN types indications from NAS.
Cell Selection	Control cell selection for example by indicating ~~radio access technology(ies)~~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 a list of NAS defined service areas in priority order~~.	Perform measurements needed to support cell selection. Detect and synchronise to a broadcast channel. Receive and handle broadcast information. Forward NAS system information to NAS. Search for a suitable cell belonging to the PLMN requested by NAS. The cells broadcast their 'PLMN identity' (GSM-MAP) or 'SID' in the system information. Respond to NAS whether such cell is found or not. If associated ~~radio access technology(ies)~~RATs is (are) set for the PLMN, perform the search in this (these) ~~radio access technology(ies)~~RAT(s) and other ~~radio access technologies~~RATs for that PLMN as specified in [5]. If such a cell is found, the cell is selected to camp on.
Cell Reselection	Control cell reselection by for example, maintaining lists of forbidden registration areas ~~and a list of NAS defined service areas in priority order~~. Maintain a list of equivalent PLMN ~~codes~~ identities and provide the list to AS.	Perform measurements needed to support cell reselection. Detect and synchronise to a broadcast channel. Receive and handle broadcast information. Forward NAS system information to NAS. Change cell if a more suitable cell is found.

Location registration	Register the UE as active after power on. Register the UE's presence in a registration area, for instance regularly or when entering a new registration area. Maintain lists of forbidden LAs. Deregister UE when shutting down.	Report registration area information to NAS.

4.3 Service type 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 in idle mode:

- 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 UTRAN network:

- The cell is not barred, see subclause 5.3.4.1
- The cell selection criteria are fulfilled, see subclause 5.2.3.1.2;

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 the selected PLMN or, ~~for cell reselection only ,~~ of a PLMN considered as equivalent by the UE according to the information provided by the NAS.
- The cell is not barred, see subclause 5.3.4.1.
- ~~The cell is not part of the list of "forbidden LAs for regional provision of service" [9].~~
- The cell is not part of the list of "forbidden LAs for roaming" [9]
- The cell selection criteria are fulfilled, see subclause 5.2.3.1.2.
- ~~The SoLSA criteria are fulfilled [SoLSA support is not in the current release].~~

barred cell:

A cell is barred if it is so indicated in the system information [4].

5 Process and procedure descriptions

5.1 PLMN selection and reselection

5.1.1 General

In the UE, the ~~access stratum~~AS shall report available PLMNs to the ~~non-access stratum~~NAS on request from the ~~non-access stratum~~NAS or autonomously.

UE shall maintain a list of allowed PLMN types. The allowed PLMN type can be GSM-MAP only, ANSI-41 only or both. During PLMN selection and reselection, based on the list of allowed PLMN types and a 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 can be identified by either 'PLMN identity' (GSM-MAP) or 'SID'. In the system information on the broadcast channel, the UE can receive ~~identities of multiple PLMNs of either or both types, i.e.~~ a 'PLMN identity' (GSM-MAP) or a 'SID' or a 'PLMN identity' (GSM-MAP) and a 'SID', in a given cell. The result of the PLMN selection is an identifier of the chosen PLMN, the choice being based on the allowed PLMN types, UE capability or other factors. This identifier is one of either 'PLMN identity' for GSM-MAP type of PLMNs or 'SID' for ANSI-41 type of PLMNs.

In case that the list of allowed PLMN types includes GSM-MAP, the non-access part of the PLMN selection and reselection process is specified in [5]. In the case that list of allowed PLMN types includes ANSI-41, the non-access stratum part of the PLMN selection and reselection is specified in TIA/EIA/IS-2000.5 and TIA/EIA/IS-707.

5.1.2 Support for ~~Network~~ PLMN Selection

5.1.2.1 General

~~PLMN selection for GSM-MAP is described in [5].~~

~~PLMN Selection for ANSI-41 is described in TIA/EIA/IS-2000.5 and TIA/EIA/IS-707.~~

On request of the ~~non-access stratum~~NAS the ~~access stratum~~AS should perform a search for available PLMNs and report them to ~~the non-access stratum~~NAS.

5.1.2.2 UTRA case

The UE shall scan all RF channels in the UTRA band according to its capabilities to find available PLMNs. On each carrier, the UE shall search for ~~the "strongest"~~ the strongest cell ~~(~~according to the cell search procedures (for FDD, see [14], and TDD, see [15]) and read its system information, in order to find out which PLMN the cell belongs to. If the UE can read the PLMN identity, the found PLMN ~~is~~ shall be reported to the ~~non-access stratum~~NAS as a high quality PLMN (but without the RSCP value), provided that the following high quality criterion is fulfilled:

1. For an FDD cell, the measured primary CPICH RSCP value shall be greater than or equal to -95 dBm.
2. For a TDD cell, the measured P-CCPCH RSCP shall be greater than or equal to -84 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 CPICH RSCP value for UTRA FDD cells and P-CCPCH RSCP for UTRA TDD cells.

~~The found PLMNs, which do not fulfil the high quality criterion but the UE has been able to read their PLMN identities, are reported to the non-access stratum as other PLMNs in decreasing CPICH RSCP order for UTRA FDD cells and in decreasing P-CCPCH RSCP order for UTRA TDD cell.~~

The search for PLMNs on the rest of the carriers may be stopped on request of the ~~non-access stratum~~NAS. The UE may optimise this search by using stored information of carrier frequencies and optionally also information on cell parameters, e.g. scrambling codes, from previously received measurement control information elements.

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

5.1.2.3 GSM case

Support for network selection in GSM is described in [1].

5.2 Cell selection and reselection in idle mode

5.2.1 Introduction

As stated in clause 1, the present document applies to UEs that support at least UTRA.

Different types of measurements are used in different ~~radio access technologies~~RATs and modes for the cell selection and reselection. Whenever a direct comparison of these measurements is required, mapping functions will be applied that are defined in [4]. ~~The use of the mapping functions is defined in subclause 7.1. Measured values are marked with the index 'meas', whereas the index 'map' is used whenever mapping functions have been applied onto a measured value.~~ The performance requirements for the measurements are specified in [10] and [11].

The ~~non-access stratum~~NAS can control the ~~radio access technology(ies)~~RAT(s) in which the cell selection should be performed, for instance by indicating ~~radio access technology(ies)~~RAT(s) associated with the selected PLMN, and by maintaining a list of forbidden registration area(s) ~~and a list of NAS defined service area(s) in priority order~~ and a list of equivalent PLMNs. The UE shall select a suitable cell and the radio access mode 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] and [11].

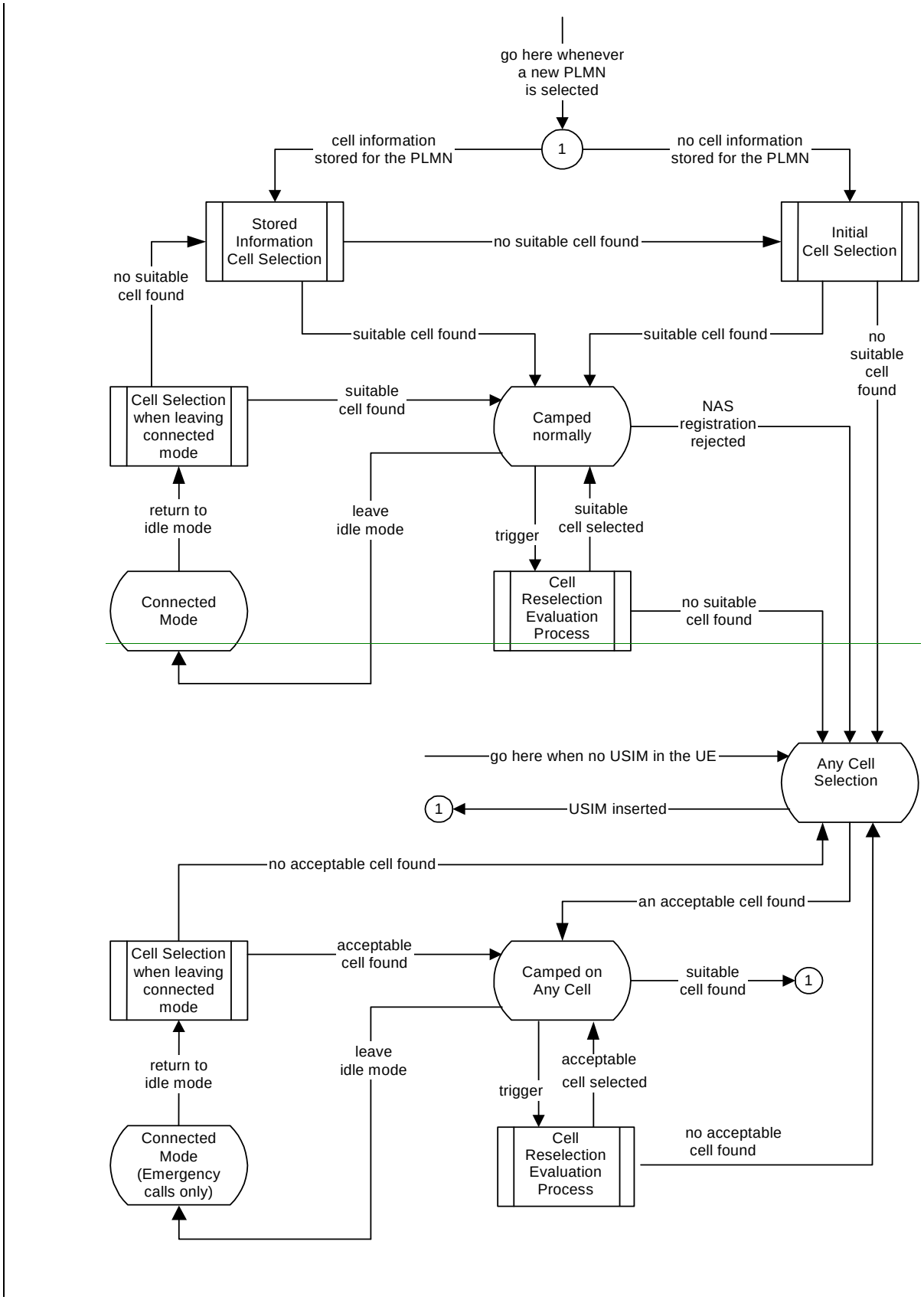
The ~~non-access stratum~~NAS is informed if the cell selection and reselection results in changes in the received system information~~.~~

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

- Receive system information from the PLMN;
  - Receive registration area information from the PLMN, e.g., location area and routing area; and
  - ~~Identify the NAS defined service area(s) to which the serving cell belongs;~~
  - Receive other AS and NAS Information;
- If registered:
  - receive paging and notification messages from the PLMN; and
  - initiate call setup for outgoing calls or other actions from the UE.

5.2.2 States and state transitions in Idle Mode

Figure 2 shows the states and procedures in Idle Mode.



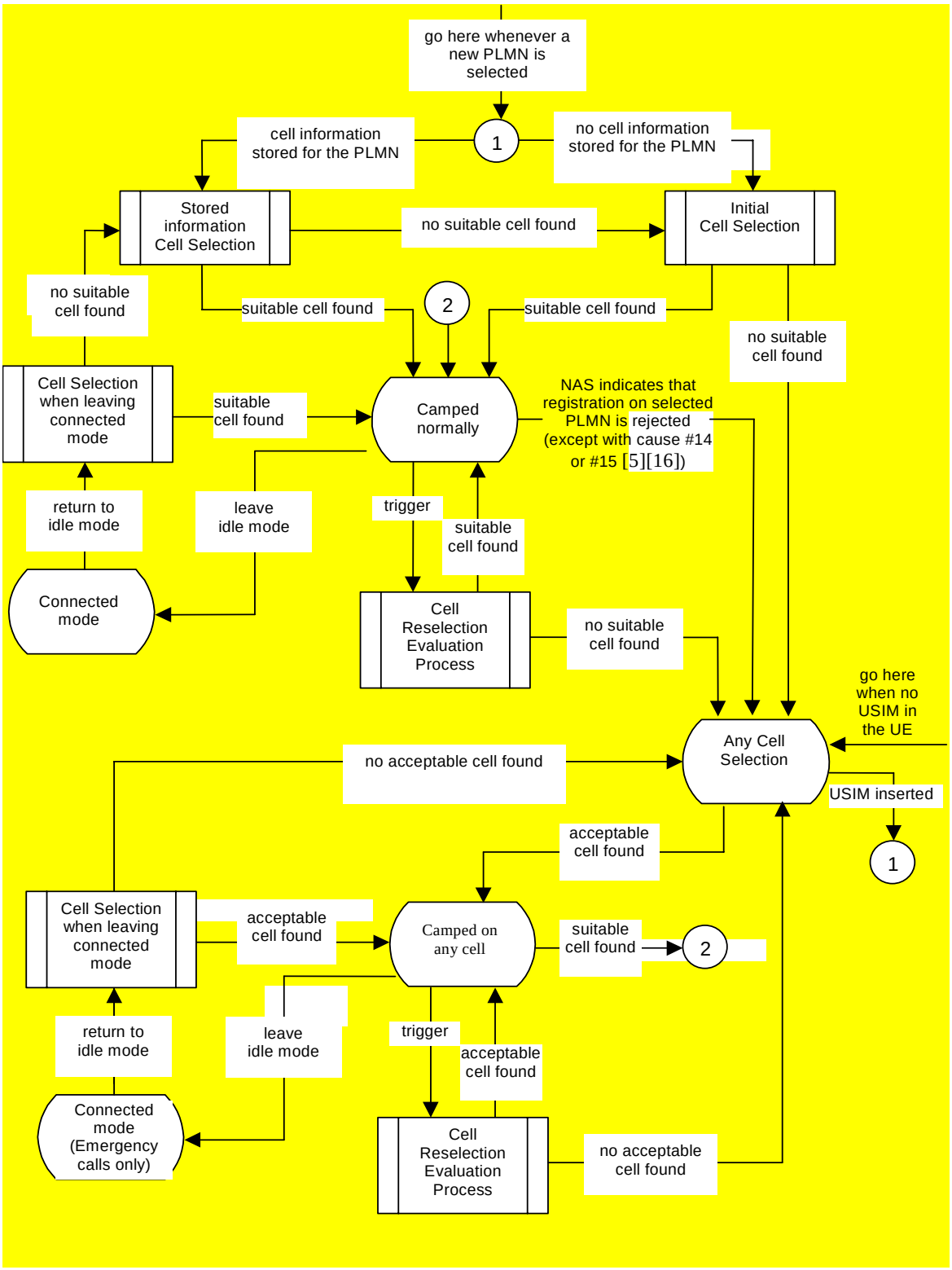


Figure 2: Idle Mode Cell Selection and Reselection
In any state, a new PLMN selection causes an exit to number 1

5.2.2.1 Cell Selection process overview

Whenever a PLMN has been selected by NAS, the UE shall attempt to find a suitable cell to camp on. ~~using one of the two procedures, *Initial cell selection* or *Stored information cell selection*. The *Initial cell selection* procedure requires no knowledge about the selected PLMN, but the *Stored information cell selection* procedure requires information to have been stored about the selected PLMN during a previous selection of~~camping in ~~that PLMN. This stored~~

~~information makes the search for a suitable cell faster. The information may contain information about several radio access technologies.~~

The ~~non-access stratum~~NAS may control the cell selection by:

- providing information on ~~radio access technology(ies)~~RAT(s) associated with the selected PLMN;
- maintaining lists of forbidden registration areas;
- providing a list of equivalent PLMNs;
- ~~a list of NAS defined service areas in priority order.~~

One or several ~~radio access technologies~~RATs may be associated with the selected PLMN. In [5]~~,~~ it is specified which ~~radio access technology~~RAT a UE shall select to search for a suitable cell of the selected PLMN.

The AS shall attempt to find a suitable cell to camp on as specifed in clause 5.2.3.

~~When~~ If a suitable cell ~~has been~~is found, the UE ~~shall~~ shall select~~s~~ this cell to camp on, and report~~s~~ this event to NAS so that the ~~perform~~ necessary NAS registration procedures can be performed. When the ~~UE has registered~~registration is successful~~ly~~, the ~~UE~~ UE enters ~~shall camp on the~~ in ~~cell,~~ state *Camped normally* in order to obtain normal service.

If the UE is unable to find any suitable cell of selected PLMN the UE shall enter the *Any cell selection* state.

5.2.2.2 Camped normally state overview

In this state,the UE ~~obtains normal service and performs the tasks specified in 5.2.5. shall monitor paging information, monitor system information and perform radio measurements. The measurements shall be used in evaluation of the and cell reselection criteria. The network controls what the UE shall measure by sending measurement control information in the system information. The measurement control information may contain intra-frequency, inter-frequency and inter-radio-access- technology measurements.~~

~~The UE shall evaluate the cell reselection criteria based on radio measurements, and if a better cell is found that cell is selected, procedure *Cell reselection*. The change of cell may imply a change of radio access technology.~~

If after a *Cell reselection evaluation process* a better cell is found, the *Cell reselection procedure* is performed. If no suitable cell is found, the UE shall enter the state *Any cell selection*.

If a necessary NAS registration is rejected, the UE shall enter the *Any cell selection* state, except if the LR is rejected with cause #14 or cause #15. In this case the UE shall behave as specified in [5] and [16].

When UE leaves idle mode~~, state *Camped normally*,~~ in order to enter ~~connected mode,~~ the state *Connected mode*, the UE shall attempt to access the current serving cell. If the access attempt to the serving cell fails, the UE shall use the *Cell reselection evaluation* procedure.

5.2.2.3 Connected mode State overview

The procedures in *Connected mode* state are specified in [4]

When returning to idle mode, the UE shall use the procedure *Cell selection when leaving connected mode* in order to find a suitable cell to camp on and enter~~,~~ state *Camped normally*. If a suitable cell is found, then the AS reports this event to NAS to be capable to perform necessary NAS registration procedures. If no suitable cell is found, the *Stored information cell selection* procedure shall be used.

If no suitable cell is found~~, in *Ccell reselection evaluation* procedure~~process, the UE ~~shall attempt to find an acceptable cell of any PLMN,~~ enter the state *Any cell selection*.

5.2.2.4 Any cell selection State overview

In this state the UE performs the tasks specified in subclause 5.2.8

~~This~~ The state *Any cell selection* is also entered if ~~a~~ the ~~non-access stratum~~NAS ~~registration procedure~~indicates that a location registration is rejected except if the LR is rejected with cause #14 or cause #15, see [5], or if there is no USIM in the UE.

If the UE received an LR reject with cause #14 or cause #15 the UE shall behave as specified in [5] and [16].

If an acceptable cell is found, the UE shall inform the NAS and camp on this cell and obtain limited service, state *Camped on any cell*. The subsequent actions of the NAS regarding the PLMN selection are specified in [5].

5.2.2.5 Camped on any cell State overview

In ~~thisthis~~ state~~,~~ the UE obtains limited service and shall behave as specified ~~for state *Camped normally*~~in subclause 5.2.9.
~~, but typically with a different PLMN. Additionally, t~~The UE shall regularly attempt to find a suitable cell of the selected PLMN ~~using stored information~~, trying ~~all radio access technologies~~RATs that are supported by the UE. If a suitable cell is found, ~~the PLMN is reselected which~~this causes an exit to number 2 in figure 2.

~~When a cell reselection is triggered, the UE shall evaluate the cell reselection criteria based on radio measurements, and if a better cell is found that cell is selected. The change of cell may imply a change of radio access technology.~~

~~If no acceptable cell is found, the UE shall continue to search for an acceptable cell of any PLMN in state *Any cell selection* trying all radio access technologies that are supported by the UE.~~

NOTE: The 'PLMN selection and reselection' process may select a new PLMN at any time in idle mode, which in Figure 2 causes an exit to number 1.

5.2.3 Cell Selection Process

5.2.3.1 UTRA case

5.2.3.1.1 Description

~~Whenever a PLMN is selected [5], the UE shall attempt to find a suitable cell of that PLMN to camp on according to the following steps.~~

~~1)~~ The UE shall use one of the following two search procedures:

a) Initial Cell Selection

This procedure requires no prior knowledge of which RF channels are UTRA carriers. The UE shall scan all RF channels in the UTRA band to find a suitable cell of the selected PLMN. ~~On each carrier, the UE searches first for the strongest cell and reads its system information, in order to find out which PLMN the cell belongs to. If the selected PLMN is found, the search of the rest of carriers may be stopped. Once the UE has found a suitable cell for the selected PLMN, the UE shall select it.~~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, e.g. scrambling codes, from previously received measurement control information elements. Once the UE has found a suitable cell for the selected PLMN the UE shall select it. If no suitable cell of the selected PLMN is found the Initial cell selection procedure shall be started.

~~2) Move to state *camped normally*~~

~~If no suitable cell of selected PLMN is found and the stored information cell selection procedure was used in step 1, the Initial cell selection procedure shall be started.~~

~~If the UE is unable to find any suitable cell of selected PLMN using the Initial cell selection procedure, it shall attempt to camp on the strongest an acceptable cell and enter the Camped on any cell state, where it can only obtain limited service. This result that cell selection on selected PLMN was not successful, shall be reported to the NAS. The subsequent actions of the NAS regarding the PLMN selection are specified in [5]. In PLMN selection, automatic mode, this would normally result in a new PLMN selection [5].~~

5.2.3.1.2 Criteria

~~The cell selection criteria S are defined as follows.~~

$Squal = Q_{qualmeas} – Qqualmin$
$Srxlev = Q_{rxlevmeas} - Qrxlevmin - Pcompensation$

The cell selection criterion S is fulfilled when:

for FDD cells:	Srxlev > 0 AND Squal > 0
for TDD cells:	Srxlev > 0

Where:

$Squal = Q_{qualmeas} – Qqualmin$
$Srxlev = Q_{rxlevmeas} - Qrxlevmin - Pcompensation$

Squal > 0
Srxlev > 0

~~Squal has to be evaluated for FDD cells only.~~

Squal	Cell Selection quality value~~,~~ (dB) Applicable only for FDD cells.~~Not applicable for TDD cells or GSM cells.~~
Srxlev	Cell Selection RX level value (dB)
$Q_{qualmeas}$	Measured cell quality value. The quality of the received signal expressed in CPICH E_c/N_0 (dB) for FDD cells. CPICH Ec/N0 shall be averaged as specified in [10]. Applicable only for FDD cells.~~Not applicable for TDD cells, or GSM cells.~~
$Q_{rxlevmeas}$	Measured cell RX level value. This is received signal, CPICH RSCP for FDD cells (dBm) and~~,~~ P-CCPCH RSCP for TDD cells (dBm) ~~and RXLEV for GSM cells (dBm).~~
Qqualmin	Minimum required quality level in the cell (dB)~~.~~ Applicable only for FDD cells.~~Not applicable for TDD cells. or GSM cells.~~
Qrxlevmin	Minimum required RX level in the cell~~.~~ (dBm)
Pcompensation	max(UE_TXPWR_MAX_RACH – P_MAX, 0) (dB)
UE_TXPWR_MAX_RACH	Maximum TX power level an UE may use when accessing the cell on RACH (read in system information)~~,~~ (dBm)
P_MAX	Maximum RF output power of the UE~~,~~ (dBm)

5.2.3.2 GSM case

The cell selection criteria and procedures in GSM are specified in [1].

5.2.4 Void

5.2.5 Camped Normally State

5.2.5.1 UTRA case

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

- select and monitor the indicated PICH and PCH of the cell as specified in clause 8 according to information sent in system information;
- monitor relevant System Information. This is specified in [4];
- 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] and [11];
  2) When information on the BCCH used for the cell reselection evaluation procedure has been modified

5.2.5.2 GSM case

The Camped Normally State is specified in [1].

5.2.6 Cell Reselection Evaluation Process

5.2.6.1 UTRA case

The cell reselection process is specified in the following sub-clauses:

5.2.6.1.1 Measurement rules for cell re-selection when HCS is not used

If the system information broadcast in the serving cell indicates that HCS is not used, then for intra-frequency and inter-frequency measurements and inter-RAT measurements, the UE shall:

- use Squal for FDD cells and Srxlev for TDD for Sx and apply the following rules.

1. If Sx > $S_{intrasearch}$, UE need not perform intra-frequency measurements.
   If Sx <= $S_{intrasearch,}$ perform intra-frequency measurements.
   If $S_{intrasearch,}$ is not sent for serving cell, perform intra-frequency measurements.
2. If Sx > $S_{intersearch}$, UE need not perform inter-frequency measurements
   If Sx <= $S_{intersearch}$, perform inter-frequency measurements.
   If $S_{intersearch}$, is not sent for serving cell, perform inter-frequency measurements.
3. If Sx > $Ssearch_{RAT\ m}$, UE need not perform measurements on cells of RAT "m".
   If Sx <= $Ssearch_{RAT\ m}$, perform measurements on cells of RAT "m".
   If $Ssearch_{RAT\ m}$, is not sent for serving cell, perform measurements on cells of RAT "m".

5.2.6.1.2 Measurement rules for cell re-selection when HCS is used

If the system information broadcast in the serving cell indicates that HCS is used, then for intra-frequency and inter-frequency measurements, the UE shall:

1. For intra-frequency and inter-frequency threshold-based measurement rules

   use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

   IF ($Srxlev_s$ <= $Ssearch_{HCS}$) or (if FDD and S_x <= $S_{intersearch}$) THEN

measure on all intra-frequency and inter-frequency cells

ELSE

IF (S_x > $S_{intrasearch}$) THEN

measure on all intra-frequency and inter-frequency cells, which have higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ELSE

measure on all intra-frequency and inter-frequency cells, which have equal or higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ENDIF

ENDIF

2. For intra-frequency and inter-frequency measurement rules for fast-moving UEs:

   If the number of cell reselections during time period T_{CRmax} exceeds N_{CR}, high-mobility has been detected. In this high-mobility state, UE shall

   - measure intra-frequency and inter-frequency neighbouring cells, which have equal or lower HCS priority than serving cell.
   - prioritise re-selection of intra-frequency and inter-frequency neighbouring cells on lower HCS priority level before neighbouring cells on same HCS priority level.

   When the number of cell reselections during time period T_{CRmax} no longer exceeds N_{CR}, UE shall

   - continue these measurements during time period $T_{CrmaxHyst}$, and
   - revert to measurements according to the threshold based measurement rules.

When serving cell belongs to a hierarchical cell structure, the UE shall follow these rules for Inter-RAT measurements:

1. Inter-RAT threshold-based measurement rules

   use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

   IF ($Srxlev_s$ <= $S_{HCS,RATm}$) or (if FDD and S_{qual} <= $S_{SearchRATm}$) THEN

   UE shall measure on all inter-RATm cells

   ELSE

   IF (S_x > $S_{limit,SearchRATm}$) THEN

   UE need not measure neighbouring cells in RAT "m"

   ELSE

   UE shall measure on all neighbouring cells in RAT "m", which have equal or higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

   ENDIF

   ENDIF

2. Inter-RAT measurement rules for fast-moving UEs

   - If the number of cell reselections during time period T_{CRmax} exceeds N_{CR}, high-mobility has been detected. In this high-mobility state, UE shall
     - measure the neighbouring cells in RAT "m", which have an equal or lower HCS priority than the serving cell

- prioritise re-selection of neighbouring cells in RAT "m" on lower HCS priority level before neighbouring cells in RAT "m" on same HCS priority level.

When the number of cell reselections during time interval T_{CRmax} no longer exceeds N_{CR}, UE shall

- continue these measurements during time period $T_{CrmaxHyst}$, and
- revert to measure according to the threshold-based measurement rules.

5.2.6.1.3 ~~Non-suitable cells (Squal > 0 or Srxlev > 0)~~ Highest ranked cells with access restrictions

For the highest ranked cell (including serving cell) according to cell reselection criteria specified in subclause 5.2.6.1.4, the UE shall check if the access is restricted according to the rules in subclause 5.3.1.1.

If that cell and other cells have to be excluded from the candidate list, as stated in subclause 5.3.1.1, the UE shall not consider these as candidates for cell reselection. This limitation is removed when the highest ranked cell changes.

~~If the best cell according to cell reselection criteria specified in subclause 5.2.6.1.4, does not fulfil all requirements for a suitable cell, that cell, together with all cells on that frequency shall be removed as candidate for cell re-selection (see also subclause 5.3).~~

5.2.6.1.4 Cell Reselection Criteria

The following cell re-selection criteria are used for intra-frequency cells, inter-frequency cells and inter-RAT cells:

The quality level threshold criterion H for hierarchical cell structures is used to determine whether prioritised ranking according to hierarchical cell re-selection rules shall apply, and is defined by:

$$H_s = Q_{meas,s} - Qhcs_s$$

$$H_n = Q_{meas,n} - Qhcs_n - TO_n * L_n$$

$$H_s = Q_{meas_LEV,s} - Qhcs_s$$

$$H_n = Q_{meas_LEV,n} - Qhcs_n - TO_n * L_n$$

If it is indicated in system information that HCS is not used, the quality level threshold criterion H is not applied.

The cell-ranking criterion R is defined by:

$$R_s = Q_{meas,s} + Qhyst_s$$

$$R_n = Q_{meas,n} - Qoffset_{s,n} - TO_n * (1 - L_n)$$

$$R_s = Q_{map,s} + Qhyst_s$$

$$R_n = Q_{map,n} - Qoffset_{s,n} - TO_n * (1 - L_n)$$

where:

$$TO_n = TEMP_OFFSET_n * W(PENALTY_TIME_n - T_n)$$

$L_n = 0$ if $HCS_PRIO_n = HCS_PRIO_s$
$L_n = 1$ if $HCS_PRIO_n <> HCS_PRIO_s$

$W(x) = 0$ for $x < 0$
$W(x) = 1$ for $x >= 0$

$TEMP_OFFSET_n$ applies an offset to the H and R criteria for the duration of $PENALTY_TIME_n$ after a timer T_n has started for that neighbouring cell.

$TEMP_OFFSET_n$ and $PENALTY_TIME_n$ are only applicable if the usage of HCS is indicated in system information.

The timer T_n is implemented for each neighbouring cell. T_n shall be started from zero when one of the following conditions becomes true:

- if $HCS_PRIO_n <> HCS_PRIO_s$ and

$$Q_{meas_LEV,n} > Qhcs_n$$

Or

- if $HCS_PRIO_n = HCS_PRIO_s$ and
  - for serving FDD and neighbour FDD cells if the quality measure for cell selection and reselection is set to CPICH RSCP in the serving cell, and:

$$Q_{mapmeas,n} > Q_{mapmeas,s} + Qoffset1_{s,n}$$

  - for serving FDD and neighbour FDD cells if the quality measure for cell selection and reselection is set to CPICH Ec/No in the serving cell, and:

$$Q_{meas_LEV,n} > Q_{meas_LEV,s} + Qoffset2_{s,n}$$

  - for all other serving and neighbour cells:

$$Q_{mapmeas,n} > Q_{mapmeas,s} + Qoffset1_{s,n}$$

T_n for the associated neighbour cell shall be stopped as soon as any of the above conditions are no longer fulfilled. Any value calculated for TO_n is valid only if the associated timer T_n is still running else TO_n shall be set to zero.

At cell-reselection, a timer T_n is stopped only if the corresponding cell is not a neighbour cell of the new serving cell, or if the criteria given above for starting timer T_n for the corresponding cell is no longer fulfilled with the parameters of the new serving cell. On cell re-selection, timer T_n shall be continued to be run for the corresponding cells but the

criteria given above shall be evaluated with parameters broadcast in the new serving cell if the corresponding cells are neighbours of the new serving cell.

S_n	Cell Selection value of the neighbouring cell, (dB)
~~$Q_{map,n}$~~	~~Quality of the neighbouring cell, after mapping function is applied, derived from CPICH E_c/N_0 or CPICH RSCP for FDD cells, from P-CCPCH RSCP for TDD cells and from RXLEV for GSM cells. For FDD cells, the measurement that is used to derive the quality value is set by the Cell_selection_and_reselection_quality_measure information element.~~
~~$Q_{map,s}$~~	~~Quality of the serving cell, after mapping function is applied, derived from CPICH E_c/N_0 or CPICH RSCP for FDD cells and from P-CCPCH RSCP for TDD cells. For FDD cells, the measurement that is used to derive the quality value is set by the Cell_selection_and_reselection_quality_measure information element.~~
Q_{meas}~~_LEV~~	Quality value. The quality value of the received signal derived from the averaged CPICH Ec/No or CPICH RSCP for FDD cells, from the averaged P-CCPCH RSCP for TDD cells and from the averaged received signal level for GSM cells. The averaging of these measurement quantities are performed as specified in [10] and [11]. For FDD cells, the measurement that is used to derive the quality value is set by the Cell_selection_and_reselection_quality_measure information element.~~expressed in CPICH_Ec/No or CPICH_RSCP_LEV for FDD cells as set by the Cell_selection_and_reselection_quality_measure information element, P-CCPCH_RSCP_LEV for TDD cells and RXLEV for GSM cells.~~

Cell reselection parameters broadcast in system information are listed in subclause 5.2.6.1.5.

~~The quality values $Q_{map,n}$ and $Q_{map,s}$ are determined by mapping functions. The parameters for these mapping functions are broadcast in system information. The mapping function maps a certain range of measurement values to a representing quality value. $Q_{map,n}$ and $Q_{map,s}$ can have values between 0 and 99 (step size 1).~~

The cell reselection criterion S is fulfilled when:

for FDD cells:	Srxlev > 0 AND Squal > 0
for TDD cells:	Srxlev > 0
for GSM cells:	Srxlev > 0

Where :

$$Squal = Q_{qualmeas} - Qqualmin$$

$$Srxlev = Q_{rxlevmeas} - Qrxlevmin - Pcompensation$$

Squal	Cell Selection quality value~~,~~ (dB) Applicable only for FDD cells.
Srxlev	Cell Selection RX level value (dB)
$Q_{qualmeas}$	Measured cell quality value. The quality of the received signal expressed in CPICH E_C/N_0 (dB) for FDD cells. CPICH Ec/N0 shall be averaged as specified in [10]. Applicable only for FDD cells.
$Q_{rxlevmeas}$	Measured cell RX level value. This is received signal, CPICH RSCP for FDD cells (dBm), P-CCPCH RSCP for TDD cells (dBm) and the averaged received signal level as specified in [10] for GSM cells (dBm). CPICH RSCP, P-CCPCH RSCP and the received signal level for GSM cells shall be averaged as specified in [10] and [11].
Qqualmin	Minimum required quality level in the cell (dB). Applicable only for FDD cells.
Qrxlevmin	Minimum required RX level in the cell~~.~~ (dBm)
Pcompensation	max(UE_TXPWR_MAX_RACH – P_MAX, 0) (dB)
UE_TXPWR_MAX_RACH	Maximum TX power level an UE may use when accessing the cell on RACH (read in system information)~~,~~ (dBm)
P_MAX	Maximum RF output power of the UE~~,~~ (dBm)

The UE shall perform ranking of all cells that fulfil the S criterion~~ (see subclause 5.2.3.1.2)~~ among

- all cells that have the highest HCS_PRIO among those cells that fulfil the criterion H >= 0**.** Note that this rule is not valid when UE high-mobility is detected (see subclause 5.2.6.1.2).
- all cells, not considering HCS priority levels, if no cell fulfil the criterion H >= 0. This case is also valid when it is indicated in system information that HCS is not used, that is when serving cell does not belong to a hierarchical cell structure.

The cells shall be ranked according to the R criteria specified above, deriving $Q_{\sout{map}meas,n}$ and $Q_{\sout{map}meas,s}$ and calculating the R values using CPICH RSCP, P-CCPCH RSCP and the averaged received signal level as specified in [10] and [11]~~RXLEV~~ for FDD, TDD and GSM cells, respectively.

The offset $Qoffset1_{s,n}$ is used for $Qoffset_{s,n}$ to calculate R_n, the hysteresis $Qhyst1_s$ is used for $Qhyst_s$ to calculate R_s.

If the usage of HCS is indicated in system information, $TEMP_OFFSET1_n$ is used for $TEMP_OFFSET_n$ to calculate TO_n. If it is indicated in system information that HCS is not used, $TEMP_OFFSET_n$ is not applied when calculating R_n. The best ranked cell is the cell with the highest R value.

If a TDD or GSM cell is ranked as the best cell, then the UE shall perform cell re-selection to that TDD or GSM cell.

If an FDD cell is ranked as the best cell and the quality measure for cell selection and re-selection is set to CPICH RSCP, the UE shall perform cell re-selection to that FDD cell.

If an FDD cell is ranked as the best cell and the quality measure for cell selection and re-selection is set to CPICH Ec/No, the UE shall perform a second ranking of the FDD cells according to the R criteria specified above, but using the measurement quantity CPICH Ec/No for deriving the $Q_{\sout{map}meas,n}$ and $Q_{\sout{map}meas,s}$ and calculating the R values of the FDD cells. ~~In this case, the mapping function $Q_{map} = Q_{meas_LEV}$ is used and t~~The offset $Qoffset2_{s,n}$ is used for $Qoffset_{s,n}$ to calculate R_n, the hysteresis $Qhyst2_s$ is used for $Qhyst_s$ to calculate R_s. If the usage of HCS is indicated in system information, $TEMP_OFFSET2_n$ is used to calculate TO_n. If it is indicated in system information that HCS is not used, $TEMP_OFFSET_n$ is not applied when calculating R_n. Following this second ranking, the UE shall perform cell re-selection to the best ranked FDD cell.

In all cases, the UE shall reselect the new cell, only if the cell reselection criteria are fulfilled during a time interval Treselection.

5.2.6.1.5 Cell reselection parameters in system information broadcasts

The selection of values for network controlled parameters can be optimised by means of different methods. Examples of methods are described in [6]. Cell reselection parameters are broadcast in system information and are read in the serving cell as follows:

$Qoffset1_{s,n}$

This specifies the offset between the two cells. It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP.

$Qoffset2_{s,n}$

This specifies the offset between the two cells. It is used for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH Ec/No.

$Qhyst1_s$

This specifies the hysteresis value (Qhyst). It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP.

$Qhyst2_s$

This specifies the hysteresis value (Qhyst). It is used for FDD cells if the quality measure for cell selection and re-selection is set to CPICH Ec/No.

HCS_PRIO_s, HCS_PRIO_n

This specifies the HCS priority level (0-7) for serving cell and neighbouring cells.

$Qhcs_s$, $Qhcs_n$

This specifies the quality threshold levels for applying prioritised hierarchical cell re-selection.

Qqualmin

This specifies the minimum required quality level in the cell in dB. It is not applicable for TDD cells or GSM cells.

Qrxlevmin

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

$PENALTY_TIME_n$

This specifies the time duration for which the $TEMPORARY_OFFSET_n$ is applied for a neighbouring cell.

$TEMPORARY_OFFSET1_n$

This specifies the offset applied to the H and R criteria for a neighbouring cell for the duration of $PENALTY_TIME_n$. It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP.

$TEMPORARY_OFFSET2_n$

This specifies the offset applied to the H and R criteria for a neighbouring cell for the duration of $PENALTY_TIME_n$. It is used for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH Ec/No.

T_{CRmax}

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

N_{CR}

This specifies the maximum number of cell reselections.

$T_{CRmaxHyst}$

This specifies the additional time period before the UE can revert to low-mobility measurements.

$Treselection_s$

This specifies the cell reselection timer value.

$Ssearch_{HCS}$

This threshold is used in the measurement rules for cell re-selection when HCS is used. It specifies the limit for Srxlev in the serving cell below which the UE shall initiate measurements of all neighbouring cells of the serving cell.

$Ssearch_{RAT\ 1}$ - $Ssearch_{RAT\ k}$

This specifies the RAT specific threshold in the serving cell used in the inter-RAT measurement rules.

$S_{HCS,RATm}$

This threshold is used in the measurement rules for cell re-selection when HCS is used. It specifies the RAT specific threshold in the serving cell used in the inter-RAT measurement rules.

$S_{intrasearch}$

This specifies the threshold (in dB) for intra frequency measurements and for the HCS measurement rules.

$S_{intersearch}$

This specifies the threshold (in dB) for ~~intra~~ inter frequency measurements and for the HCS measurement rules.

$S_{limit,SearchRATm}$

This threshold is used in the measurement rules for cell re-selection when HCS is used. It specifies the RAT specific threshold (in dB) in the serving UTRA cell above which the UE need not perform any inter-RAT measurements in RAT "m".

~~**Mapping Info**~~

~~This specifies the information necessary to define the mapping function used for mapping a certain range of measurement values to a representing quality value (0..99, step size 1).~~

5.2.6.2 GSM case

The cell reselection procedure in GSM, including reselection from GSM to UTRA, is specified in [1].

5.2.7 Cell Selection when leaving connected mode

5.2.7.1 UTRA case

When returning to idle mode from connected mode, the UE shall select a suitable cell to camp on. Candidate cells for this selection are the cell(s) used immediately before leaving connected mode. If no suitable cell is found, the UE shall use the Stored information cell selection procedure in order to find a suitable cell to camp on.

When returning to idle mode after an emergency call on any PLMN, the UE shall select an acceptable cell to camp on. Candidate cells for this selection are the cell(s) used immediately before leaving connected mode. If no acceptable cell is found, the UE shall continue to search for an acceptable cell of any PLMN in state Any cell selection.

5.2.7.2 GSM case

Cell selection when leaving connected mode in GSM is specified in [1].

5.2.8 Any Cell Selection state

In this state, the UE shall attempt to find an acceptable cell of an any PLMN to camp on, trying all ~~radio access technologies~~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

5.2.9.1 UTRA case

~~If an acceptable cell is found, the UE shall camp on this cell and obtain limited service, state Camped on any cell.~~

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

- select and monitor the indicated PICH and PCH of the cell as specified in clause 8
- monitor relevant System Information; This is specified in [4];
- 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] and [11];
  2) When information on the BCCH used for the cell reselection evaluation procedure has been modified;
- regularly attempt to find a suitable cell of the selected PLMN trying all ~~radio access technologies~~RATs that are supported by the UE. If a suitable cell is found, this causes an exit to number ~~1~~ 2 in Figure 2.

5.2.9.2 GSM case

The camped on any cell state in GSM is specified in [1].

5.3 Cell Access Restrictions

5.3.1 UTRA cells

There are two mechanisms which allow an operator to impose cell 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 [9], which are employed for this purpose.

5.3.1.1 Cell status and cell reservations

Cell status and cell reservations are indicated with the *Cell Access Restriction* Information Element in the System Information Message [4] by means of three Information Elements:

- Cell barred (IE type: "barred" or "not barred"),
- Cell Reserved for operator use (IE type: "reserved" or "not reserved"),
- ~~Cell Reserved for SoLSA exclusive use (IE type: "reserved" or "not reserved").~~

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

- the UE may select/re-select this cell during the cell selection and cell re-selection procedures in Idle mode and in Connected mode.

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

- UEs ~~not supporting SoLSA~~ shall behave as if cell status "barred" is indicated using the value "not allowed" in the IE "Intra-frequency cell re-selection indicator" and the maximum value for T_{barred}, see [4] (see also below).

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

- UEs assigned to an Access Class in the range 11 to 15 may select/re-select this cell if in the home PLMN.

- UEs assigned to an Access Class in the range 0 to 9 shall behave as if cell status "barred" is indicated using the value "not allowed" in the IE "Intra-frequency cell re-selection indicator" and the maximum value for T_{barred}, see [4] (see also below).

When cell status "barred" is indicated,

- the UE is not permitted to select/re-select this cell, except for emergency call, when no other acceptable cell can be found, and the cell is not barred for emergency call by means of the "Access Class 10 bit", see clause 5.3.1.3.

- The UE shall ignore the "Cell Reserved for ~~SoLSA exclusive~~ future extension (Cell Reservation Extension) use" IE.

- The UE shall select another cell according to the following rule:

  - If the "Intra-frequency cell re-selection indicator" IE in Cell Access Restriction IE is set to value "allowed", the UE may select another cell on the same frequency if selection/re-selection criteria are fulfilled.

    - If the UE is camping on another cell, the UE shall exclude the barred cell from the neighbouring cell list until the expiry of a time interval T_{barred}. The time interval T_{barred} is sent via system information in a barred cell together with Cell status information in the Cell Access Restriction IE.

    - If the UE does not select another cell, and the barred cell remains to be the "best" one, the UE shall after expiry of the time interval T_{barred} again check whether the status of the barred cell has changed.

  - If the "Intra-frequency cell re-selection indicator" IE is set to "not allowed" the UE shall not re-select a cell on the same frequency as the barred cell. For emergency call, the Intra-frequency cell re-selection indicator IE" shall be ignored, i.e. even if it is set to "not allowed" the UE may select another intra-frequency cell.

    - If the barred cell remains to be the "best" one, the UE shall after expiry of the time interval T_{barred} again check whether the status of the barred cell has changed.

5.3.1.2 Access Control

Information on cell access restrictions associated with the Access Classes is broadcast as system information, [4].

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 before sending an RRC CONNECTION REQUEST message when entering Connected Mode from UTRAN Idle mode. Cell access restrictions associated with the Access Classes shall not apply when the initial access for entering Connected Mode is triggered by an Inter-RAT cell re-selection to UTRAN, and for a UE which already is in Connected Mode.

5.3.1.3 Emergency Call

Generally, emergency calls shall be allowed in all cells whose barred status is not barred, independent of restrictions due to cell reservations.

A restriction on emergency calls, if needed, shall be indicated in the "Access class barred list" IE [4]. Full details of operation under "Access class barred list" are described in [9].

5.3.2 GSM cells

The cell access restrictions applicable to GSM are specified in [1].

5.4 Cell Reselection Processes in RRC Connected Mode

5.4.1 Initial Cell Reselection Process

Triggers for the Initial cell re-selection process are specified in [4].

The UE shall attempt to find a suitable cell belonging to the selected PLMN and select it. ~~according to the following steps:~~

~~1) The UE shall scan all RF channels of the UTRA band to find a suitable cell. The UE may optimise this search by using stored information of carrier frequencies and optionally also information on cell parameters, e.g. scrambling codes, from previously received measurement control information elements.~~

~~2) After the UE has found one suitable cell for the selected PLMN, the UE shall create a candidate list consisting of this cell and its neighbouring UTRA cells, as received in measurement control information via the selected cell.~~

~~3) Rank the cells according to the cell reselection criteria (see 5.2.6.1.4), without considering the parameters Qhyst and Treselection.~~

~~4) Check if the highest ranked cell fulfils all requirements for a suitable cell. If so, select this cell. If this cell does not fulfil all requirements for a suitable cell, this cell and all cells on the same frequency shall be removed as candidates for cell selection (see also 5.3.1), and step 3 shall be repeated for the remaining cells.~~

~~The use of mapping functions is indicated in system information. For each radio access mode and radio access technology, such a mapping function is defined and its parameters are broadcast in system information. The mapping function maps a certain range of measurement values to a representing quality value Q_{map} that can have values between 0 and 99 (step size 1). These quality values Q_{map} are then used to evaluate the cell reselection criteria in subclause 5.2.6.1.4.~~

If the UE is unable to find any suitable cell, the UE shall release the RRC connection and enter idle mode.

5.4.1.1 Criteria

The criteria for initial cell reselection are specified in subclause ~~5.2.2.1.2~~5.2.6.1.4.

5.4.2 Void

5.4.3 Cell Reselection Process

The *cell reselection* process in Connected Mode is the same as *cell reselection evaluation process* used for idle mode, described in subclause 5.2.6.

5.5 Location Registration

In the UE, the ~~access stratum~~AS shall report registration area information to the ~~non-access stratum~~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 specifed in [9] and [16].

6 Broadcast information receiving

6.1 Reception of System Information

Requirements are specified in [4].

6.2 Cell Broadcast in Idle Mode

A UE supporting Cell Broadcast Service (CBS) shall be capable to receive BMC messages in the Idle mode. When several PCHs exist in the cell, the FACH which carries the CTCH may be mapped to a different SCCPCH than the PCH selected by the UE for paging in Idle mode (as specified in Sec. 8.1). In this case, UEs with basic service capabilities shall be capable to change from the SCCPCH that carries the PCH selected for paging to another SCCPCH which carries Cell Broadcast messages (i.e. the CTCH mapped to an FACH) and receive BMC messages during time intervals which do not conflict with the UE specific paging occasions.

7 ~~Measurements for cell selection / reselection~~Void

~~7.1 Use of Mapping Functions~~

~~Different types of measurements are used in different radio access technologies~~RATs ~~and modes for the cell selection and reselection (CPICH Ec/N0 or CPICH RSCP in UTRA FDD, P-CCPCH RSCP in UTRA TDD, RXLEV in GSM). The use of mapping functions is indicated in system information.~~

~~Mapping functions are used for mapping a certain range of measurement values Q_{meas_LEV} (CPICH_EC/N0, CPICH_RSCP_LEV, P-CCPCH_RSCP_LEV, RXLEV) to a representing quality value Q_{map} (0..99, step size 1).~~

~~For each radio access technology~~RAT ~~and mode, one mapping function is defined. It may be defined over one or several consecutive intervals of the measurement values Q_{meas_LEV}.~~

~~The size of the consecutive intervals is sufficiently defined by their upper limit (given by parameter Upper_limit). In case of only one interval specified, the parameter Upper_limit is not needed and the interval is equivalent to the measurement range defined for that radio access technology~~RAT~~. In case of more than one interval specified, the upper limit of the last interval defined is equivalent to the upper limit of the defined measurement range. The lower limit of an interval is equivalent to the upper limit of the interval before that interval. For the first interval, the lower limit is equivalent to the lower limit of the defined measurement range.~~

~~Within each interval, one function type (given by parameter Function_type) is defined by two parameters Map_parameter_1 and Map_parameter_2. The function type "linear" is specified: $Q_{map} = a * Q_{meas_LEV} + b$, if Q_{meas_LEV} is the measured value and Q_{map} is the representing quality value.~~

~~Map_parameter_1 and Map_parameter_2 for an interval define the Q_{map} values that the Q_{meas_LEV} values at the upper and the lower limit of this interval are mapped to, respectively. In other words, the linear function within one interval is defined by two tuples (Q_{meas_LEV}, Q_{map}) at the interval limits, so that the parameters a and b can be derived from this.~~

~~Accordingly, if the mapping function is steady between two consecutive intervals, Map_parameter_2 for the first interval has the same value as Map_parameter_1 for the following interval. This is illustrated in the following Figure 3:~~

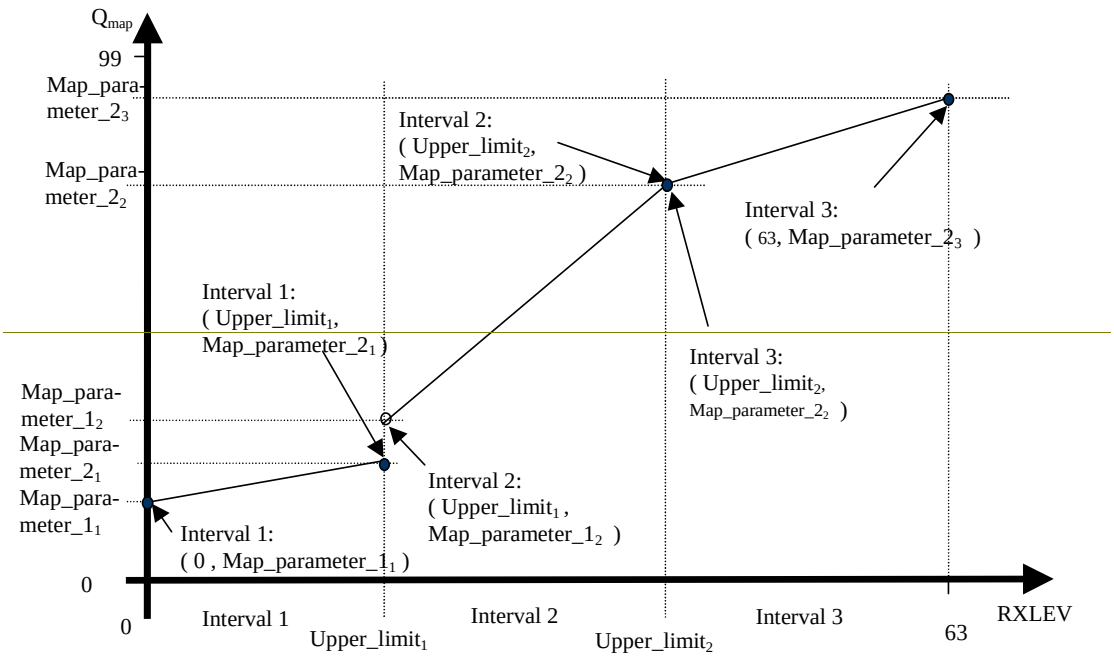


Figure 3: Illustration of mapping of RXLEV using multiple linear models

If no mapping functionality is needed (e.g. in FDD- or TDD-only networks), an implicit mapping is used: $Q_{map} = Q_{meas_LEV}$. This is specified as default case.

The parameters defined for each interval (Function_type, Map_parameter_1, Map_parameter_2 and Upper_limit)are broadcast in system information.

8 Paging and SCCPCH selection in Idle mode

8.1 Paging Channel selection

System information block type 5 (SIB 5) defines common channels to be employed in Idle mode [4]. In a cell, a single or several PCHs may be established. Each Secondary Common Control Physical Channel (SCCPCH) indicated to the UE in system information may carry up to one PCH. Thus, for each defined PCH there is one uniquely associated PICH also indicated.

In case that more than a single PCH and associated PICH are defined in SIB 5, the UE shall perform a selection according to the following rule:

- The UE shall select a SCCPCH from the ones listed in SIB 5 based on IMSI as follows:

"Index of selected SCCPCH" = IMSI mod K,

where K is equal to the number of listed SCCPCHs which carry a PCH (i.e. SCCPCHs carrying FACH only shall not be counted). These SCCPCHs shall be indexed in the order of their occurrence in SIB 5 from 0 to K-1.

"Index of selected SCCPCH" identifies the selected SCCPCH with the PCH and the uniquely associated PICH to be used by the UE.

If the UE has no IMSI, for instance when making an emergency call without USIM, the UE shall use as default number IMSI = 0.

8.2 SCCPCH selection when entering Connected mode

When entering Connected mode from Idle mode by sending an RRC CONNECTION REQUEST message, the UE shall select the S-CCPCH which carries an FACH to be used for reception of the RRC CONNECTION SETUP message according to the following rule:

- the UE shall select an SCCPCH from the SCCPCHs listed in System Information Block type 5 (SIB 5) based on "Initial UE Identity" as follows:

  "Index of selected SCCPCH" = "Initial UE Identity" mod K,

  where K is equal to the number of listed SCCPCHs which carry a FACH (i.e. SCCPCHs carrying PCH only shall not be counted). These SCCPCHs shall be indexed from 0 to K-1 in the order of their occurrence in SIB 5, and "Index of selected SCCPCH" identifies the selected SCCPCH. "Initial UE Identity" refers to the Information Element included by the UE into the RRC CONNECTION REQUEST message. In the above formula, the parameter "Initial UE Identity" shall be interpreted as follows, depending on the choice of UE-Id type of the respective IE:

  For UE-Id type "IMSI (GSM-MAP)", i.e. the IE is given as sequence of digits of type Integer(0..9), "Initial UE Identity" shall be interpreted as an integer number, where the first digit given in the sequence represents the highest order digit.

  For UE-Id types "TMSI and LAI (GSM-MAP)" or "P-TMSI and RAI (GSM-MAP)", only the TMSI or P-TMSI parts given as Bitstring(32) shall be used, and "Initial UE Identity" shall be interpreted as a binary representation of an integer number, where the first bit in the Bitstring represents the highest order bit.

  For UE-Id type "IMEI", i.e. the IE is given as sequence of hexadecimal digits of type Integer(0..15), "Initial UE Identity" shall be interpreted as a hexadecimal representation of an integer number, where the first digit given in the sequence represents the highest order digit.

  For UE-Id type "IMSI (DS-41)", i.e. the IE is given as octet string, "Initial UE Identity" shall correspond to the decoded decimal representation of the IMSI-S part included in the octet string (see TIA/EIA/IS-2000-5).

  For UE-Id types "ESN (DS-41)" or "TMSI (DS-41)", i.e. the IE is given as Bitstring(32), "Initial UE Identity" shall be interpreted as a binary representation of an integer number, where the first bit in the Bitstring represents the highest order bit.

  For UE-Id type "IMSI and ESN (DS-41)" only the ESN part shall be used as "Initial UE Identity", as defined above.

8.3 Discontinuous Reception

The UE may use Discontinuous Reception (DRX) in idle mode in order to reduce power consumption. When DRX is used the UE needs only to monitor one Page Indicator, PI, (see definition in [7] and [8]) in one Paging Occasion per DRX cycle.

The DRX cycle length shall be MAX(2^k, PBP) frames, where k is an integer and PBP is the Paging Block Periodicity. PBP is only applicable for TDD and is equal to the PICH repetition period that is broadcast in system information. For FDD, PBP=1.

The UE may be attached to different CN domains with different CN domain specific DRX cycle lengths. The UE shall store each CN domain specific DRX cycle length for each CN domain the UE is attached to and use the shortest of those DRX cycle lengths. The CS CN specific DRX cycle length coefficient shall be updated locally in the UE using information given in system information. On the other hand, the PS CN specific DRX cycle length coefficient shall be updated after the negotiation between the UE and PS CN by NAS procedure. If no specific value "k" is negotiated in NAS procedure, the UE and PS CN shall use the DRX cycle length given for PS CN domain in system information.

The DRX cycle lengths to use for UTRAN connected mode is the shortest of the following:

- UTRAN DRX cycle length;

- any of the stored CN domain specific DRX cycle length for the CN domains the UE is only attached to with no signalling connection established.

The UE shall use the IMSI, the number of available SCCPCH which carry a PCH (K) as derived according to subclause 8.1,the Cell System Frame Number (SFN), Np (for FDD, Np is the number of page indicators within a frame; for TDD, Np is the number of page indicators within a paging block), Frame offset (For FDD, Frame offset = 0; for TDD, PICH frame offset values are given in system information), PBP and the DRX cycle length to determine the Paging Occasions.

In FDD the UE shall monitor its paging indicator in the PICH frame with SFN given by the Paging Occasion

In TDD the UE shall monitor its paging indicator in the paging block given by the Paging Occasion. The Paging Occasion gives the SFN of the first frame of the paging block.

The value of the Paging Occasion is determined as follows:

Paging Occasion= {(IMSI div K) mod (DRX cycle length div PBP)} * PBP + n * DRX cycle length + Frame Offset

Where n = 0,1,2… as long as SFN is below its maximum value.

The actual Page Indicator within a Paging Occasion that the UE shall read is similarly determined based on IMSI.

The Page Indicator to use is calculated by using the following formula:

PI = DRX Index mod Np

where DRX Index = IMSI div 8192

In FDD mode, Np = (18,36,72,144) is the number of Page Indicators per frame, and is given in IE "Number of PI per frame", part of system information in FDD mode. In TDD mode, Np is the number of Page Indicators per paging block and is calculated by the Paging Indicator Length $L_{PI,}$ the Burst Type (long or short midamble) and the PICH repetition length, which are given in system information.

If the UE has no IMSI, for instance when making an emergency call without USIM, the UE shall use as default numbers, IMSI = 0 and DRX cycle length = 256 (2.56 s), in the formulas above.

For FDD, see [7] for details about the timing between a PICH frame and when the paging message is transmitted on the PCH in the associated S-CCPCH frame.

In TDD mode, the Paging Message Receiving Occasion is calculated using the following formula:

Paging Message Receiving Occasion =Paging Occasion + N_{PICH} + N_{GAP} + {(DRX Index div Np) mod N_{PCH} } *2

The value N_{PICH} is the number of frames for PICH transmission and is equal to the PICH repetition length given in system information. The value N_{GAP} is the number of frames between the last frame carrying PICH for this Paging Occasion and the first frame carrying paging messages for this Paging Occasion. The value N_{PCH} is the number of Paging Groups. N_{PCH} and N_{GAP} are given in system information.

9 Multicast services

9.1 State diagram between the multicast service and DSCH

NOTE: DSCH for multicast services is not supported in the current release.

The multicast service relative to the DSCH consists of the following states:

- MT_Null State;
- MT_Monitor State;
- MT_Saving State;
- MT_Active State.

Figure 4 shows the multicast state diagram relative to the DSCH. The MT_Monitor State is a state for decoding the DSCH in order to monitor its multicast control data and the MT_Saving State is a state in which the UE savings for the supporting power saving feature.

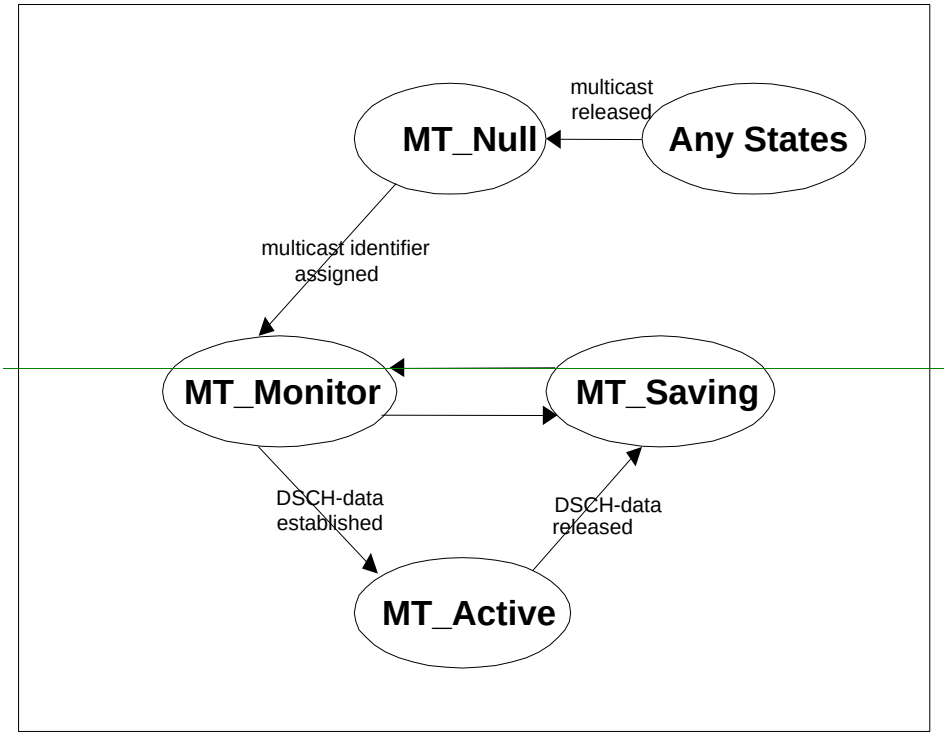


Figure 4: Multicast State Diagram relative to the DSCH, MT=MulTicast service

9.1.1 MT_Null State

a) Attributes

- Multicast service has not been activated.
- DSCH is not established.

b) Behaviour

- Waits for activation of multicast service.

9.1.2 MT_Monitor State

a) Attributes

- DSCH is monitored in order to decode the multicast control data that contains the assigned multicast identifier.

b) Behaviour

- Receives the DSCH control data on DSCH and confirms the assigned multicast identifier.

9.1.3 MT_Saving State

a) Attributes

- DSCH is not monitored for the control or the user data.

b) Behaviour

- FFS

9.1.4 MT_Active State

a) Attributes

- DSCH is not monitored for the control data.
- DSCH is monitored for the user data.

b) Behaviour

- Receives the multicast user data on the established DSCH.

---

9 Void

10 Examples of Procedures

10.1 NAS initiated change of system information

The sequence in Figure 5 shows the change of broadcast system information initiated from the ~~non-access stratum (~~NAS~~)~~.

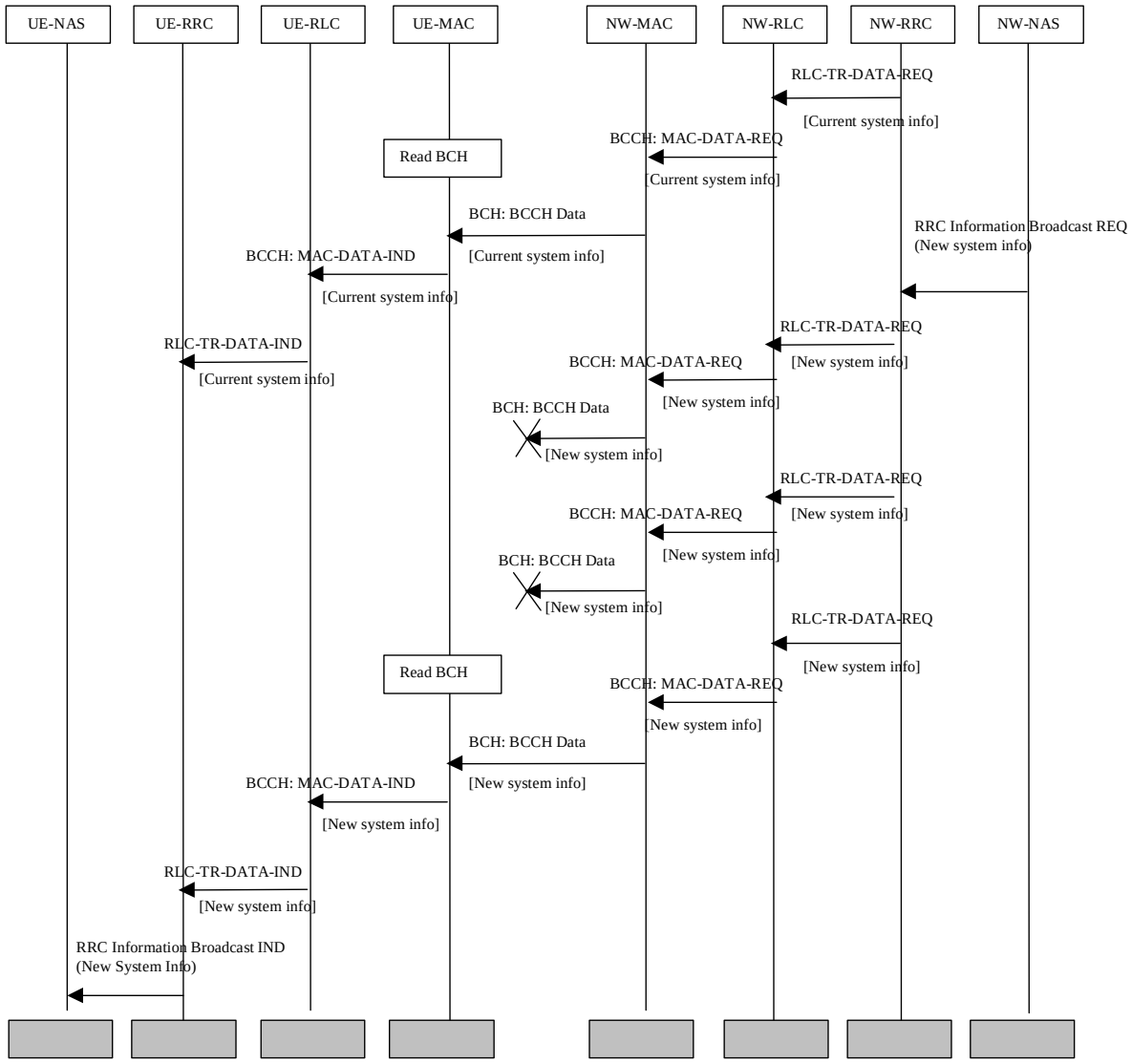


Figure 5: Example sequence, ~~non-access stratum~~NAS initiated change of broadcast system info

A ~~non-access stratum~~NAS entity in the network issues a request for change of the broadcast system information, by issuing a RRC Information Broadcast REQ primitive over the General Control (GC) SAP.

The change in system information in this example is such that it is not necessary for the UEs to be forced to receive BCCH immediately after the change. All UEs will eventually read the new system information either at e.g. cell reselection or at UE state change.

When the UE reads system information on BCCH and the RRC layer finds out that the non-access part of the information has been changed, an RRC Information Broadcast IND primitive is issued to the ~~non-access stratum~~NAS entity in the UE over the General Control (GC) SAP.

NOTE: The network may force the UEs in a paging group to read system information by sending a page request message, but this is not shown in the example above.

10.2 System Information Update to NAS

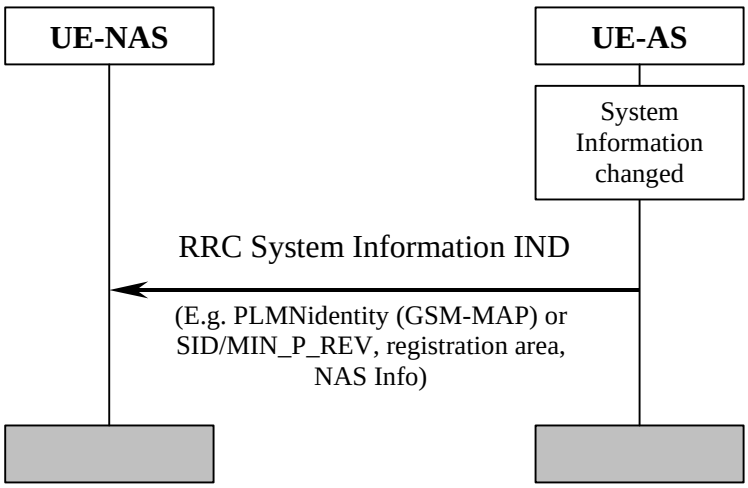


Figure 6: System Information Update to NAS

AS sends system information to NAS when a change of system information is detected in the cell currently camped on. This happens for instance when a new cell is selected due to cell reselection. The information sent can include PLMN identity (GSM-MAP or SID, registration area and NAS information. ~~The NAS information includes the identity of the NAS defined service area.~~

10.3 CN originated paging in idle mode

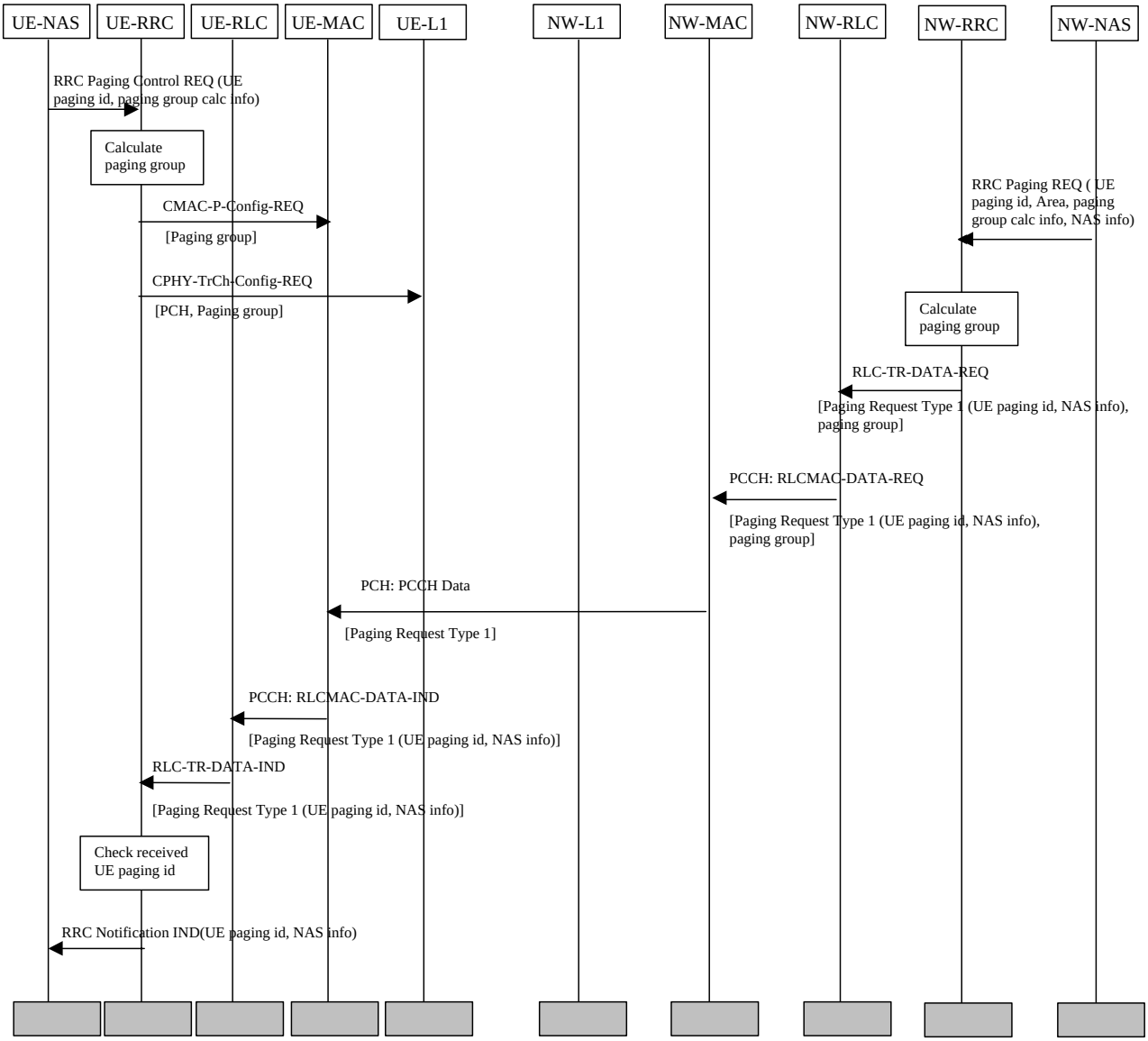


Figure 7: Example sequence of CN initiated paging request in idle mode

Figure 7 illustrates a CN originated paging request when the UE is in idle mode.

In the UE, a NAS entity issues the primitive RRC Paging Control REQ, which tells RRC to listen to paging and notifications addressed to a given UE paging identity and on a paging group which can be calculated using information given from NAS.

NOTE: The paging group calculation info can e.g. be the IMSI of the UE.

A NAS entity on the network side requests paging of an UE using the RRC Paging REQ primitive over the Nt-SAP. The primitive contains a UE paging identity, an area where the page request is to be broadcast, information for calculation of the paging group and NAS information to be transparently transmitted to the UE by the paging request.

The RRC layer calculates the paging group, and formats a Paging Request Type 1 message containing the UE paging identity and the NAS information The RRC layer then requests MAC to transmit the message on a specific PCH on the selected paging group. The PCH to be used for transmission of the paging message is selected based on the IMSI of the UE.

In the UE, the RRC layer continuously monitors the paging group compares the UE paging identities in received paging request messages with its own identities. A match occurs, and in this case the UE paging identity and the NAS information is forwarded to the NAS entity of the UE.

10.4 PLMN Selection, automatic mode, normal case

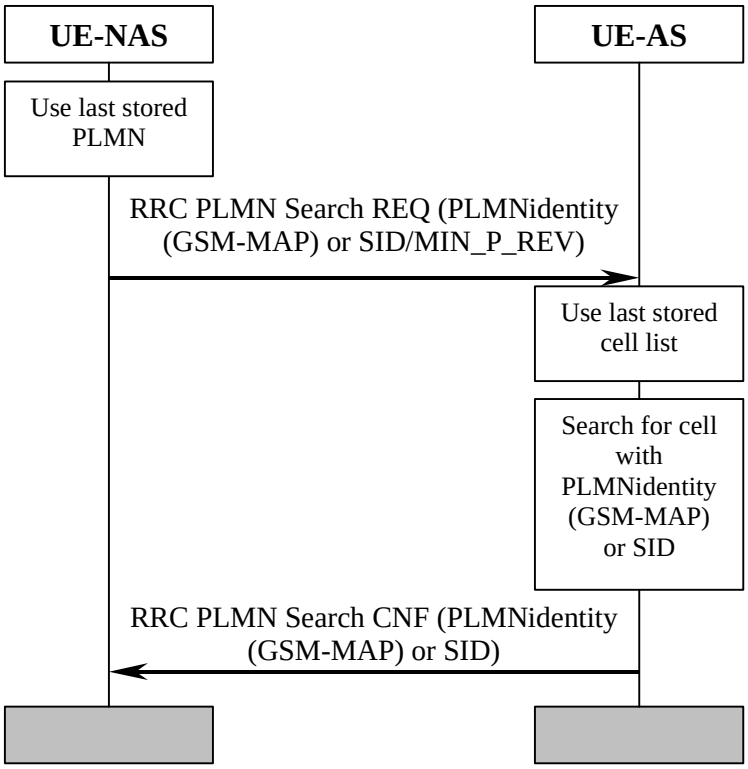


Figure 8: PLMN Selection, automatic mode, normal case

At power-on, ~~the non-access stratum (~~NAS~~)~~ selects the PLMN ~~with highest~~according to the priority defined in [5]~~,~~ ~~possibly the last PLMN stored prior to previous power off~~. The ~~access stratum (~~AS~~)~~ is requested to find a cell belonging to that PLMN. When searching for the requested PLMN and in order to speed up the search, AS may use a list of cell information stored prior to previous power-off. When a suitable cell belonging to the requested PLMN is found, that cell is selected and NAS is notified that the PLMN was found.

10.5 PLMN Reselection, automatic mode

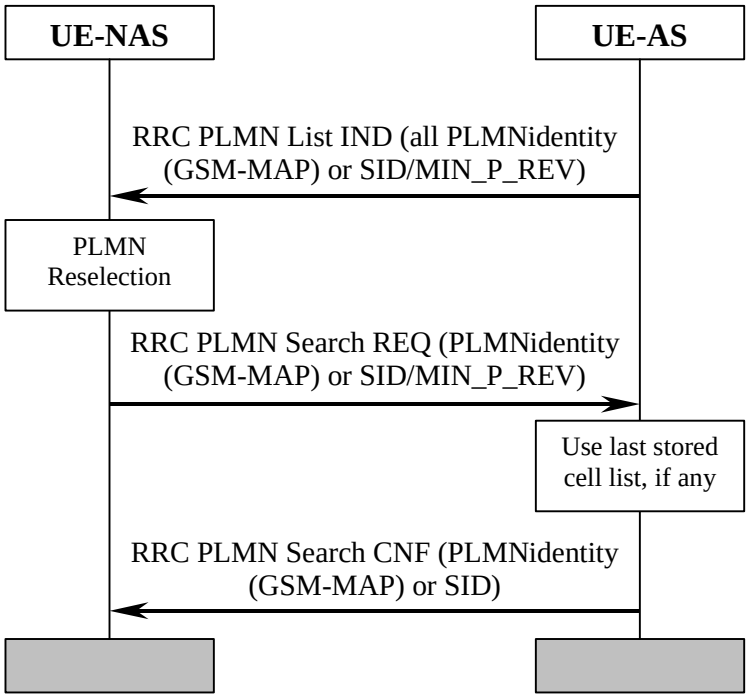


Figure 9: PLMN Reselection, automatic mode

Triggered by, for instance, a timer in NAS, AS is requested to send~~s~~ a list to NAS with all PLMNs currently available. The list includes the identities of available PLMNs and ~~possibly information about their NAS defined service area(s)~~. Assuming that a PLMN with higher priority is found, NAS requests AS to select a suitable cell belonging to the PLMN with highest priority. When searching for the requested PLMN and in order to speed up the search, AS may use a list of cell information previously stored~~, if any~~. When a suitable cell belonging to the requested PLMN is found, that cell is selected and NAS is notified that the PLMN was found.

10.6 PLMN Reselection, manual mode

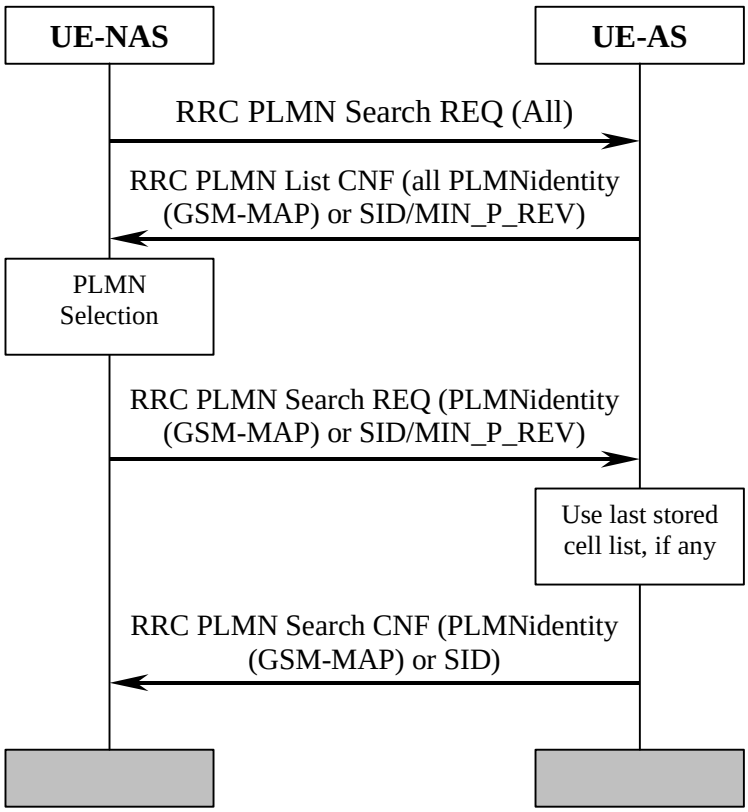


Figure 10: PLMN Reselection, manual mode

NAS requests AS to report all PLMNs currently available, for instance as a response to a user request. AS sends a list to NAS with all PLMNs currently available. The list includes the identities of available PLMNs ~~and possibly information about their NAS defined service area(s)~~. Assuming that a PLMN with higher priority is selected by for instance the user, NAS requests AS to select a suitable cell belonging to the PLMN with highest priority. When searching for the requested PLMN and in order to speed up the search, AS may use a list of cell information previously stored~~, if any~~. When a suitable cell belonging to the requested PLMN is found, that cell is selected and NAS is notified that the PLMN was found.

10.7 PLMN Selection, automatic mode, selected PLMN not found

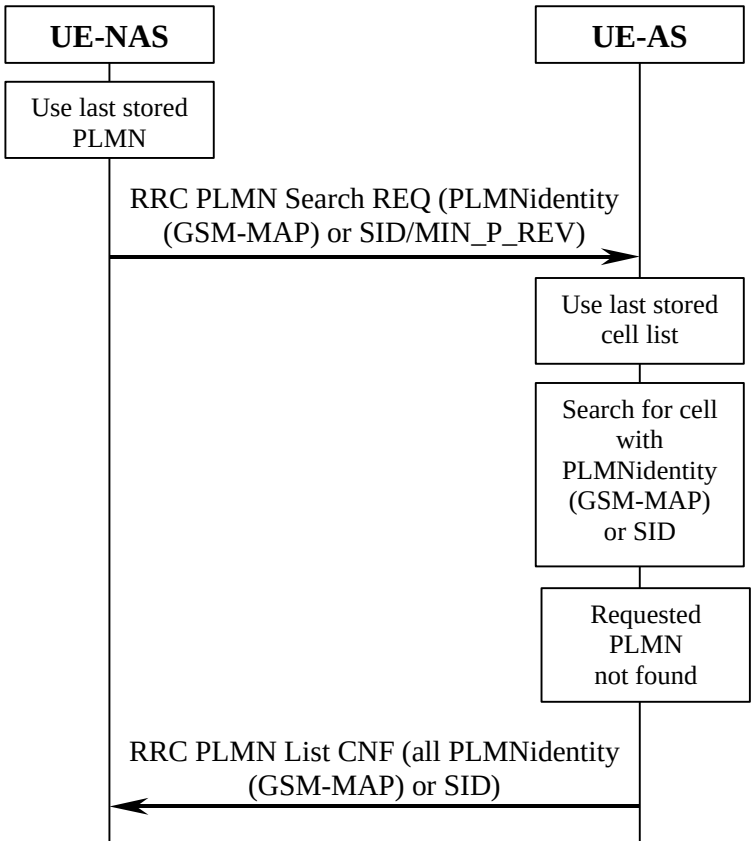


Figure 11: PLMN Selection, automatic mode, selected PLMN not found

At power-on, ~~the non-access stratum~~NAS selects the PLMN according to the~~with highest~~ priority defined in [5],~~ possibly from the list of PLMNs stored prior to previous power off.~~ The ~~access stratum~~ AS is requested to find a suitable cell belonging to that PLMN. When searching for the requested PLMN and in order to speed up the search, AS may use a list of cell information stored prior to previous power-off. If no suitable cell is found belonging to the requested PLMN, a list of available PLMNs is sent to NAS~~, indicating which PLMN has been temporarily chosen by AS~~.

10.8 NAS Controlled Cell Selection

10.8.1 Execution in ~~Access Stratum~~AS

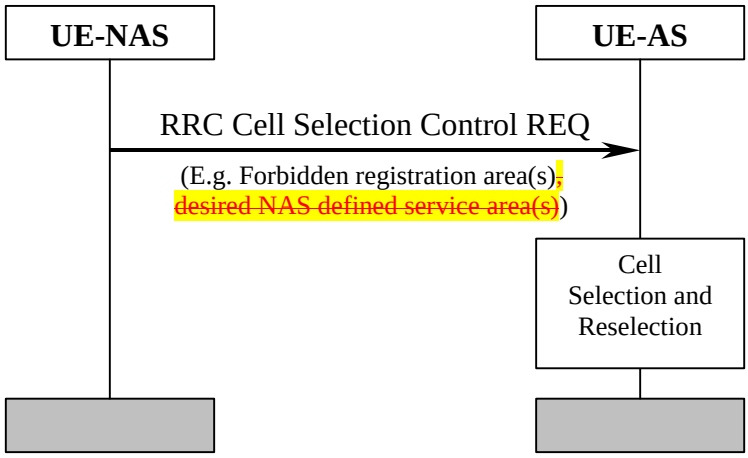


Figure 12: NAS Controlled Cell Selection, execution in AS

NAS may influence the cell selection and reselection by sending control information to AS. This information can include, for example, lists of forbidden registration areas ~~and a list of NAS defined service areas in priority order~~. The control information is used by AS in cell selection and reselection:

- Cells belonging to a forbidden registration area will only be selected if no better cell is found. At this point, the services provided the UE might be limited.

~~- Cells belonging to a NAS defined service area with higher priority than current service area will be considered better than the cell currently camped on. Depending on radio access mode, the most suitable cell in idle mode may not be the most suitable cell in connected mode.~~

10.8.2 Execution in ~~Non-Access Stratum~~NAS

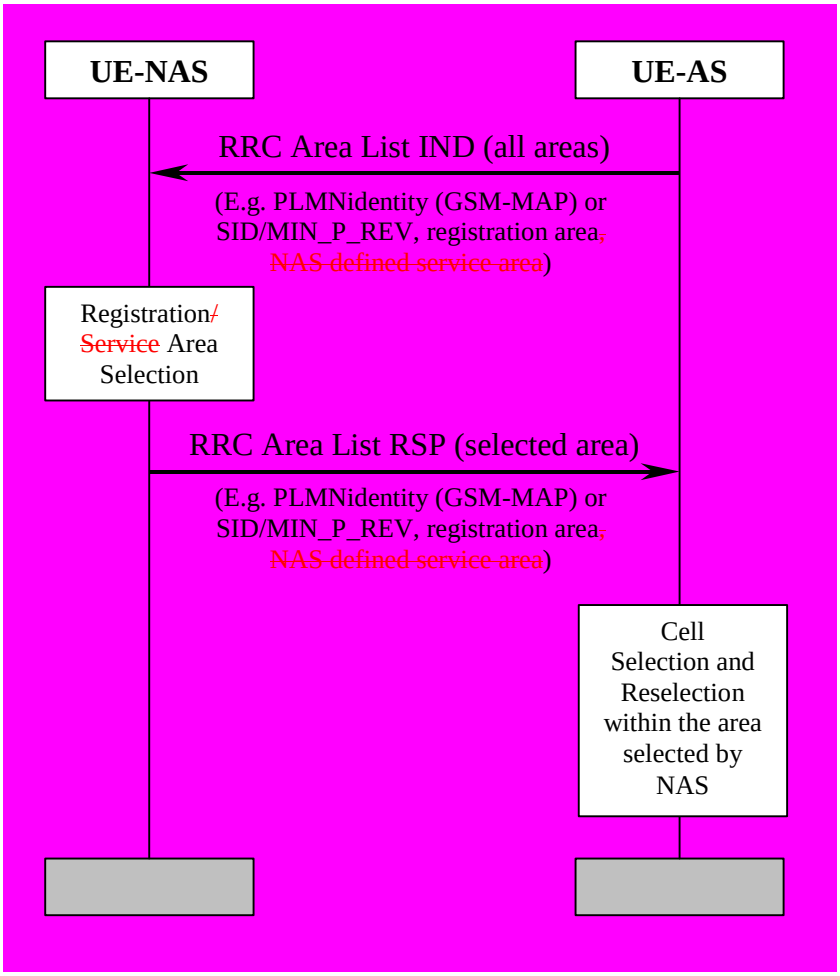


Figure 13: NAS Controlled Cell Selection, execution in NAS

As an alternative to the example in subclause ~~11~~10.8.1, AS sends cell selection information to NAS. This information can include PLMN identity (GSM-MAP) or SID and~~,~~ registration area~~ and NAS defined service area~~. The information contains the full set of available registration areas~~ and NAS defined service areas~~. The information is typically sent when there is a change of available areas, for instance when a neighbour cell belonging to a new registration area/ ~~NAS defined service area is found. Correspondingly, a new list of available areas is sent from AS to NAS when for instance coverage is lost from the cell currently camped on and that is the only cell belonging to the current NAS defined service area.~~

AS performs cell selection and reselection for the selected registration area~~/NAS defined service area~~ without interaction with NAS. However, before reselecting a cell in another registration area~~/NAS defined service area~~, AS ~~must~~ shall check with NAS.

Annex A (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
10/1999	RP-05	RP-99464	-	-	Approved at TSG-RAN #5 and placed under Change Control	-	3.0.0
12/1999	RP-06	RP-99632	001	2	Modification and editorial changes	3.0.0	3.1.0
	RP-06	RP-99633	002	3	Specification of Cell reselection procedures in	3.0.0	3.1.0
	RP-06	RP-99633	003	2	Integration of Cell Broadcast Service (CBS)	3.0.0	3.1.0
	RP-06	RP-99633	004	2	Measurement used as a quality estimate for cell	3.0.0	3.1.0
	RP-06	RP-99632	006		Discontinuous reception	3.0.0	3.1.0
	RP-06	RP-99633	008	3	Barred Cells and Access Control	3.0.0	3.1.0
	RP-06	RP-99633	009		Introduction of network control of UE measurement	3.0.0	3.1.0
	RP-06	RP-99631	011		Editorial issues	3.0.0	3.1.0
03/2000	RP-07	RP-000037	007	2	Cell Selection for DS-41 mode	3.1.0	3.2.0
	RP-07	RP-000037	014		Modified description of cell search procedure	3.1.0	3.2.0
	RP-07	RP-000037	018	1	UE individual DRX cycles in CELL_PCH and URA_PCH states	3.1.0	3.2.0
	RP-07	RP-000037	019	1	Cell re-selection criteria including HCS	3.1.0	3.2.0
	RP-07	RP-000037	021		Modified description of DRX	3.1.0	3.2.0
06/2000	RP-08	RP-000217	025		Triggering of inter-system measurements for cell re-selection when HCS is used	3.2.0	3.3.0
	RP-08	RP-000217	026	5	Cell re-selection	3.2.0	3.3.0
	RP-08	RP-000217	027	4	Access Control	3.2.0	3.3.0
	RP-08	RP-000217	028		Downlink signalling failure	3.2.0	3.3.0
	RP-08	RP-000217	029		Cell-reselection parameter signalling	3.2.0	3.3.0
	RP-08	RP-000217	030		Cell Selection and Reselection	3.2.0	3.3.0
	RP-08	RP-000217	031	1	CN DRX cycle coefficient	3.2.0	3.3.0
09/2000	RP-09	RP-000355	035	2	Paging channel selection	3.3.0	3.4.0
	RP-09	RP-000355	037	1	Editorial corrections	3.3.0	3.4.0
	RP-09	RP-000355	039		HCS measurement rules	3.3.0	3.4.0
	RP-09	RP-000355	042	2	Usage of Ec/N0 measurement quantity for cell ranking	3.3.0	3.4.0
	RP-09	RP-000355	044		Correction and restructuring	3.3.0	3.4.0
12/2000	RP-10	RP-000565	046	1	Support for PLMN selection	3.4.0	3.5.0
	RP-10	RP-000565	049	1	Correction of algorithm for paging channel selection	3.4.0	3.5.0
	RP-10	RP-000565	050		Alignment of use of TEMP_OFFSET parameters with TS 25.331	3.4.0	3.5.0
	RP-10	RP-000565	051	2	Clarifications and Editorial Corrections	3.4.0	3.5.0
	RP-10	RP-000565	052	1	Clarifications to cell selection and reselection procedures	3.4.0	3.5.0
	RP-10	RP-000565	053		Removal of immediate cell evaluation	3.4.0	3.5.0
	RP-10	RP-000565	054		One step cell selection	3.4.0	3.5.0
03/2001	RP-11	RP-010022	055	1	Usage of HCS Parameters in Cell Reselection	3.5.0	3.6.0
	RP-11	RP-010022	056		Clarification of usage of "Initial UE-Id" for SCCPCH selection	3.5.0	3.6.0
	RP-11	RP-010022	058		Clarification of paging occasion	3.5.0	3.6.0
	RP-11	RP-010022	059	1	Correction in Any Cell Selection State	3.5.0	3.6.0
	RP-11	RP-010022	061		Correction to the definition of a suitable cell	3.5.0	3.6.0
	RP-11	RP-010022	062		Correction to discontinuous reception in TDD	3.5.0	3.6.0
	RP-11	RP-010022	063	1	Correction of PI calculation for Paging DRX	3.5.0	3.6.0
	RP-11	RP-010200	064	3	Equivalent PLMN codes	3.5.0	3.6.0
	RP-11	RP-010022	065		High quality cell in PLMN selection	3.5.0	3.6.0
	RP-11	RP-010022	066		Clean-up	3.5.0	3.6.0

3GPP TSG-RAN WG2 Meeting #21
Busan, Korea, May 21st – May 25th 2001

R2-011398

CR-Form-v4

CHANGE REQUEST

⌘ **25.304** **CR** **072** ⌘ ev **-** ⌘ Current version: **4.0.0** ⌘

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

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

Title:	⌘	Corrections to 25.304
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	***Date:*** ⌘ 25/05/2001
Category:	⌘ **A**	***Release:*** ⌘ Rel-4

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

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

Reason for change: ⌘ History for proposed changes to 25.304 v 3.6.0 (R2-011397):

- During last RAN2 meeting # 20 in Hayama a number of operators identified open issues and inconsitencies in TS 25.304 v 3.6.0 which occur also in Rel-4 version of TS and which could lead to erroneous behaviour of UE in idle mode operation.
- The following reasons apply for the removal of the mapping function:
- The quantization of the measurement quantity used in the cell reselection criteria of TS25.304 causes unnecessary performance degradation in cell reselection process as discussed in the agreed Tdoc R4-010286.
- There is a misalignment between TS25.133 and TS25.304 in the GSM measurement quantity used for cell reselection purposes.
- The mapping function causes an additional inaccuracy. The amount of this inaccuracy varies depending on the defined mapping function. This issue is also discussed and agreed in R4-010286. Originally the mapping function was introduced to cope with the comparison of different types of measurement quantities in inter-RAT and inter-mode cell reselections. However, now TS25.304 clearly defines that CPICH RSCP is always used as measurement quantity when UTRA FDD cells are compared with GSM or TDD cells. The use mapping function in a network is therefore questioned.

Summary of change: ⌘

- Ambiguous description in the text may lead to erroneous behaviour of the UE
- SoLSA is not supported in this release of spec – but kept due to BC
- Prioritization concept of NAS defined service areas is not specified and therefore not applicable for this release
- Split between AS and NAS needs to be defined in a more appropriate and consistent way
- Definition how to report available PLMNs was missing in support for network selection

		• Cell selection criteria for FDD and TDD cells is defined in a more appropriate way • Various minor corrections necessary to improve quality of specification • The 'quantity' used in cell re-selection H and R criteria is changed to be the actual measured quantity and not quantized measurement quantity. • GSM measurement quantity is corrected to be the averaged received signal level according to Section 4.2.2.5 of TS25.133 instead of RXLEV. It is also clarified that the averaging of CPICH Ec/No, CPICH RSCP and P-CCPCH RSCP measurement quantities is performed according to TS25.133. • The mapping function is removed. • "List of equivalent PLMN codes" changed in "List of equivalent PLMN identities" according to LS received from SA1. • NAS defined Service Area removed in figure 12 and 13 • Chapter 5.2.2 restructured (new overview sections included and text describing details moved to sections on processes and states in later chapters ...) • Definition of cell selection criteria (also applied for cell reselection) copied to section on cell reselection and reference regarding GSM included • 2 new AS tasks in table 1 for PLMN selection and reselection introduced: • Minor editorial corrections • Agreed CRs R2-011111 (CR 069) and R2-011297 (CR 075) were merged into this appropriate version on R'99. • References to SoLSA are removed.
Consequences if not approved:	⌘	• Essential corrections needed – if not applied the correct UE behaviour in idle mode can not be ensured.

Clauses affected:	⌘	1, 2, 3.1, 3.2, 4.1, 4.2, 4.3, 5.1.1, 5.1.2, 5.1.2.1, 5.1.2.2, 5.2.1, 5.2.2, 5.2.2.1 (new), 5.2.2.2 (new), 5.2.2.3 (new), 5.2.2.4 (new), 5.2.2.5 (new), 5.2.3.1.1, 5.2.3.1.2, 5.2.3.2, 5.2.6.1.3, 5.2.6.1.4, 5.2.6.1.5, 5.2.8, 5.2.9.1, 5.3.1.1, 5.4.1, 5.4.1.1, 5.4.3, 5.5, 7, 7.1, 8.1, 8.3, 9, 9.1, 9.1.1, 9.1.2, 9.1.3, 9.1.4, 10.1, 10.2, 10.4, 10.5, 10.6, 10.7, 10.8.1, 10.8.2
Other specs Affected:	⌘	☐ Other core specifications ⌘ ☐ Test specifications ☐ O&M Specifications
Other comments:	⌘	

How to create CRs using this form:

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

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

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

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

3GPP TS 25.304 V4.0.0 (2001-03)

Technical Specification

3rd Generation Partnership Project; Technical Specification Group Radio Access Network; UE Procedures in Idle Mode and Procedures for Cell Reselection in Connected Mode (Release 4)

The present document has been developed within the 3rd Generation Partnership Project (3GPP ™) and may be further elaborated for the purposes of 3GPP.

The present document has not been subject to any approval process by the 3GPP Organisational Partners and shall not be implemented.
This Specification is provided for future development work within 3GPP only. The Organisational Partners accept no liability for any use of this Specification.
Specifications and reports for implementation of the 3GPP ™ system should be obtained via the 3GPP Organisational Partners' Publications Offices.

Keywords
UMTS, radio

3GPP

Postal address

3GPP support office address
650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet
http://www.3gpp.org

Copyright Notification

No part may be reproduced except as authorized by written permission.
The copyright and the foregoing restriction extend to reproduction in all media.

© 2001, 3GPP Organizational Partners (ARIB, CWTS, ETSI, T1, TTA, TTC).
All rights reserved.

Contents

Foreword 87
1 Scope 98
2 References 98
3 Definitions and abbreviations 109
3.1 Definitions 109
3.2 Abbreviations 1110
4 General description of Idle mode 1312
4.1 Overview 1312
4.2 Functional division between AS and NAS in Idle mode 1514
4.3 Service type in Idle mode 1716
5 Process and procedure descriptions 1817
5.1 PLMN selection and reselection 1817
5.1.1 General 1817
5.1.2 Support for Network Selection 1817
5.1.2.1 General 1817
5.1.2.2 UTRA case 1817
5.1.2.3 GSM case 1918
5.2 Cell selection and reselection in idle mode 1918
5.2.1 Introduction 1918
5.2.2 States and state transitions in Idle Mode 2019
5.2.3 Cell Selection Process 2322
5.2.3.1 UTRA case 2322
5.2.3.1.1 Description 2322
5.2.3.1.2 Criteria 2423
5.2.3.2 GSM case 2423
5.2.4 Void 2524
5.2.5 Camped Normally State 2524
5.2.5.1 UTRA case 2524
5.2.5.2 GSM case 2524
5.2.6 Cell Reselection Evaluation Process 2524
5.2.6.1 UTRA case 2524
5.2.6.1.1 Measurement rules for cell re-selection when HCS is not used 2524
5.2.6.1.2 Measurement rules for cell re-selection when HCS is used 2524
5.2.6.1.3 Non-suitable cells (Squal > 0 or Srxlev > 0) 2726
5.2.6.1.4 Cell Reselection Criteria 2726
5.2.6.1.5 Cell reselection parameters in system information broadcasts 3130
5.2.6.2 GSM case 3231
5.2.7 Cell Selection when leaving connected mode 3231
5.2.7.1 UTRA case 3231
5.2.7.2 GSM case 3231
5.2.8 Any Cell Selection state 3332
5.2.9 Camped on Any Cell State 3332
5.2.9.1 UTRA case 3332
5.2.9.2 GSM case 3332
5.3 Cell Access Restrictions 3332
5.3.1 UTRA cells 3332
5.3.1.1 Cell status and cell reservations 3332
5.3.1.2 Access Control 3433
5.3.1.3 Emergency Call 3433
5.3.2 GSM cells 3534
5.4 Cell Reselection Processes in RRC Connected Mode 3534
5.4.1 Initial Cell Reselection Process 3534
5.4.1.1 Criteria 3534
5.4.2 Void 3534

5.4.3 Cell Reselection Process 3534
5.5 Location Registration 3534

6 Broadcast information receiving 3635
6.1 Reception of System Information 3635
6.2 Cell Broadcast in Idle Mode 3635

7 Measurements for cell selection / reselection 3635
7.1 Use of Mapping Functions 3635

8 Paging and SCCPCH selection in Idle mode 3736
8.1 Paging Channel selection 3736
8.2 SCCPCH selection when entering Connected mode 3837
8.3 Discontinuous Reception 3837

9 Multicast services 3938
9.1 State diagram between the multicast service and DSCH 3938
9.1.1 MT_Null State 4039
9.1.2 MT_Monitor State 4039
9.1.3 MT_Saving State 4039
9.1.4 MT_Active State 4140

10 Examples of Procedures 41
10.1 NAS initiated change of system information 4241
10.2 System Information Update to NAS 4342
10.3 CN originated paging in idle mode 4443
10.4 PLMN Selection, automatic mode, normal case 4544
10.5 PLMN Reselection, automatic mode 4645
10.6 PLMN Reselection, manual mode 4746
10.7 PLMN Selection, automatic mode, selected PLMN not found 4847
10.8 NAS Controlled Cell Selection 4948
10.8.1 Execution in Access Stratum 4948
10.8.2 Execution in Non-Access Stratum 5049

Annex A (informative): Change history 5150

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

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 also specifies cell reselection processes applicable to UEs in connected mode. Invocation of these processes is described in [4].

The present document specifies the model for the functional division between the ~~non-access stratum~~NAS and ~~access stratum~~AS in a UE.

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

- When the UE is camped on a UTRA cell;
- When the UE is searching for a cell to camp on;
- ~~When the UE is camped on another RAT than UTRA.~~

NOTE: The details for those cases are described in the specifications of the other RAT.

The present document presents also examples of inter-layer procedures related to the idle mode processes and describes idle mode functionality of a dual RAT UTRA/GSM UE.

~~Following items are considered for future releases:~~

~~1) State diagram between the multicast service and DSCH (subclause 9.1).~~

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 TS 03.22: "Functions related to Mobile Station in idle mode and group receive mode".

[2] 3GPP TS 25.301: "Radio Interface Protocol Architecture".

[3] 3GPP TS 25.303: "Interlayer Procedures in Connected Mode".

[4] 3GPP TS 25.331: "RRC Protocol Specification".

[5] 3GPP TS 23.122: "NAS functions related to Mobile Station (MS) in idle mode ".

[6] 3GPP TR 25.922: "Radio Resource Management Strategies".

[7] 3GPP TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)".

[8] 3GPP TS 25.221: "Physical channels and mapping of transport channels onto physical channels (TDD)".

[9] 3GPP TS 22.011: "Service accessibility".

[10] 3GPP TS 25.133: "Requirements for Support of Radio Resource Management (FDD)".

[11] 3GPP TS 25.123: "Requirements for Support of Radio Resource Management (TDD)".

[12] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[13] 3GPP TS 05.08: "Radio subsystem link control".

[14] 3GPP TS 25.214: "Physical layer procedures (FDD)".

[15] 3GPP TS 25.224: "Physical Layer Procedures (TDD)".

[16] 3GPP TS 24.008: "3rd Generation Partnership Project;Universal Mobile Telecommunications System; Mobile radio interface layer 3 specification, Core Network Protocols - Stage 3".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following definitions and the definitions in [12] 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.

~~**Allowable PLMN:** a PLMN, which is not in the list of forbidden PLMNs in the UE.~~

Available PLMN: a PLMN for which the UE has found at least one acceptable cell.

Barred Cell: A cell is barred if it is so indicated in the system information.

Camped on a cell: UE is in idle mode and 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.

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

Equivalent PLMN: a PLMN considered as equivalent to the selected PLMN by the UE for PLMN selection, 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.

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

~~**LSA:** Localised Service Area. A LSA is an operator-defined group of cells for which specific access conditions applies. This may correspond to an area in which the Core Network offers specific services. A LSA may be defined within a PLMN or globally. Therefore, a LSA may offer non-contiguous radio coverage.~~

~~**LSA exclusive access cell:** UE may only camp on this cell if the cell belongs to the LSAs to which the user has subscribed. Nevertheless, if no other cells are available, the UE of non-LSA users may originate emergency calls from this cell.~~

~~**LSA ID:** Localised Service Area Identity.~~

~~**LSA only access:** when LSA only access applies to the user, the UE can only access cells that belong to the LSAs to which the user has subscribed. Outside the coverage area of the subscribed LSAs, the UE may camp on other cells and limited services apply.~~

~~**LSA preferential access cell:** LSA preferential access cell is a cell, which is part of the LSA. UEs of users that have subscribed to a LSA of an LSA-preferential-access cell have higher priority to resources than non-LSA users in the same cell. The availability of LSA preferential access cells impacts the radio resource allocation (controlled by UTRAN-Access Stratum). This function is out of the scope of the standards.~~

Maximum DRX cycle: time interval for the longest possible DRX cycle in a cell.

Paging Block Periodicity (PBP): period of the occurrence of Paging Blocks. (For FDD, PBP = 1).

Paging Message Receiving Occasion (TDD only)**:** the frame where the UE receives actual paging message.

Paging occasion:
(FDD) The SFN of the PICH frame where the UE monitors its paging indicator (i.e. the SFN of the PCCPCH frame in which the PICH frame begins).
(TDD) The paging block, which consists of several frames. The value of Paging Occasion is equal to the first frame of the Paging Block.

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

Radio Access Mode: radio access mode of the cell, FDD or TDD.

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

~~**Registered PLMN (RPLMN):** this is the PLMN on which the UE has performed a location registration successfully.~~

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.

Selected PLMN: this is the PLMN that has been selected by the ~~non-access stratum~~NAS, either manually or automatically.

Serving cell: the cell on which the UE is camped

Suitable Cell: This is a cell on which an UE may camp. It must satisfy criteria which is defined for A/Gb mode in 3GPP TS 03.22 and for Iu mode in section 4.3.~~a cell on which an UE may camp. It shall satisfy certain conditions, see subclause 4.3.~~ [5]

~~**Visited PLMN of home country:** a PLMN, different from the home PLMN, where the MCC part of the PLMN identity is the same as the MCC of the IMSI.~~

3.2 Abbreviations

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

AS	Access Stratum
BCCH	Broadcast Control Channel
CM	Connection Management
CN	Core Network
DRX	Discontinuous Reception
DSCH	Downlink Shared Channel
FDD	Frequency Division Duplex
GC	General Control (SAP)
GPRS	General Packet Radio ~~System~~Service
GSM	Global System for Mobile Communications
HCS	Hierarchical Cell Structure
IMSI	International Mobile Subscriber Identity
MCC	Mobile Country Code
MM	Mobility Management
MNC	Mobile Network Code
NAS	Non-Access Stratum
PCH	Paging Channel
PI	Page Indicator
PICH	Page Indication Channel
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
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network

4 General description of Idle mode

4.1 Overview

When a UE is switched on, a public land mobile network (PLMN) is selected and the UE searches for a suitable cell of this PLMN to camp on. Criteria for cell selection and cell re-selection between radio access technologies (RATs) described in this document only consider radio criteria. In addition to ~~radio access technology~~RAT, the PLMN type may differ as well. In this specification, the term PLMN is used as a generic term covering both GSM MAP and ANSI-41 type of PLMNs. According to the type of PLMN, the way to identify it can be different. If the PLMN type is GSM, the PLMN is identified by 'PLMN identity' and if the PLMN type is ANSI-41, the PLMN is identified by 'SID'

The NAS shall provide a list of equivalent PLMNs, if available, that the AS shall use for PLMN selection, cell selection, cell reselection and handover.

The UE searches for a suitable cell of the chosen 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 registration area of the chosen cell~~, if necessary~~.

If the UE finds a more suitable cell, it reselects onto that cell and camps on it. If the new cell is in a different registration area, location registration is performed.

If necessary, the UE will look for more suitable cells on other PLMNs at regular time intervals, which is referred to as PLMN-reselection. This is described in [9].

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:

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 registration area of the cell in which the UE is camped. It can then send a "paging" message for the UE on control channels of all the cells in the registration area. The UE will then receive the paging message because it is tuned to the control channel of a cell in that registration area and the UE can respond on that control channel.

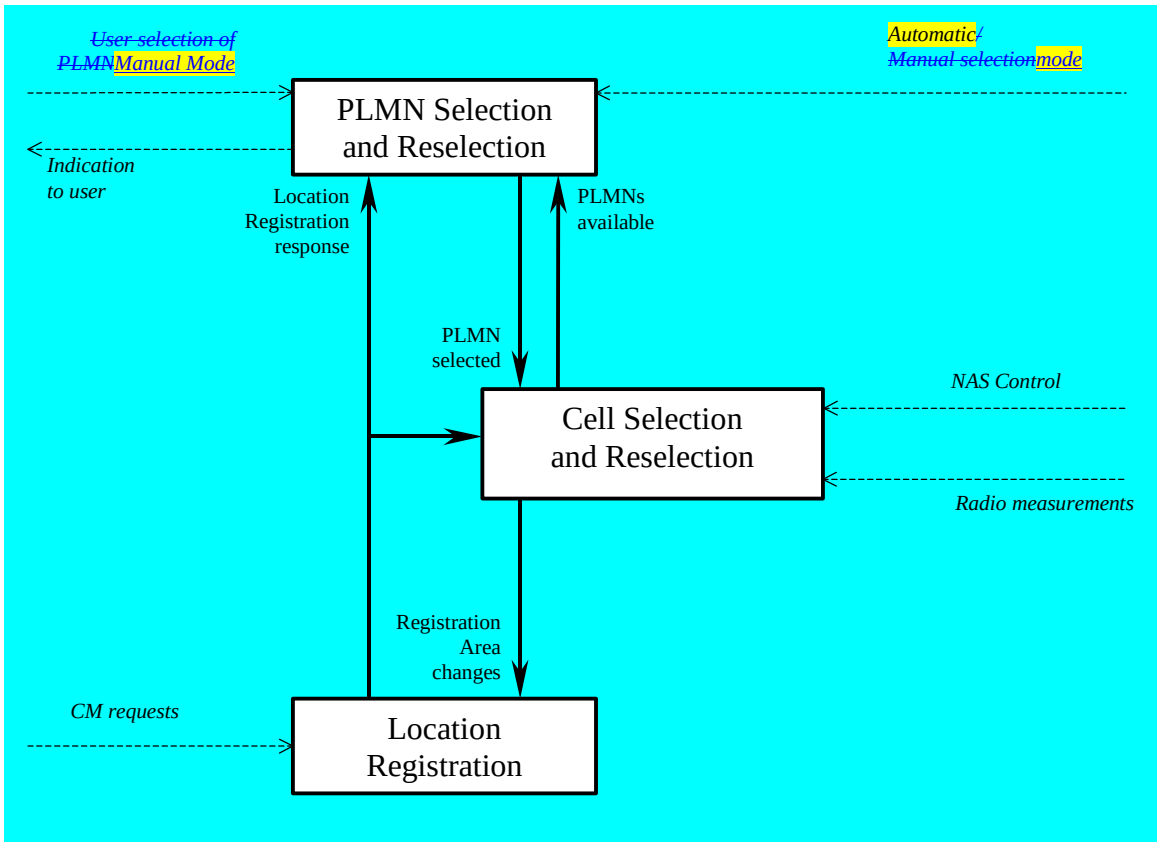
d) It enables the UE to receive cell broadcast services.

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 #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.

The idle mode tasks can be subdivided into three processes:

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

The relationship between these processes is illustrated in Figure 1.



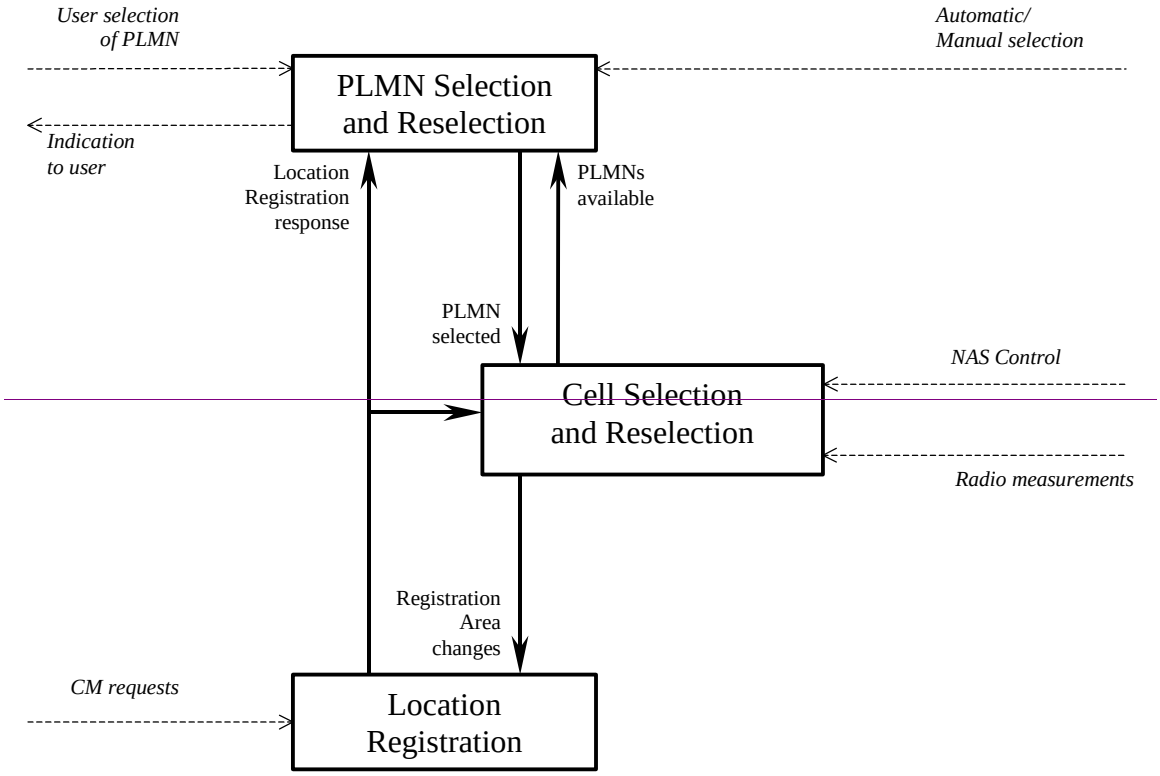


Figure 1: Overall Idle Mode process

~~NOTE: The impact of NAS defined service areas is FFS.~~

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 ~~non-access stratum~~NAS part is specified in [5] and the ~~access stratum~~AS part in the present document. Examples of different idle mode procedures are presented in Clause 10.

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

Idle Mode Process	UE Non-Access Stratum	UE Access Stratum
PLMN Selection and Reselection	Maintain the list of allowed PLMN types. It can be GSM-MAP only, ANSI-41 only or both. 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 ~~radio access technology(ies)~~RAT(s) may be set. Evaluate reports of available PLMNs from AS for PLMN selection. Maintain a list of equivalent PLMN ~~codes~~identities.	~~Search for a suitable cell belonging to the PLMN requested by NAS. Perform cell selection process as described below.~~ Search for available PLMNs. If associated ~~radio access technology(ies)~~RAT(s) is (are) set for the PLMN, search in this (these) ~~radio access technology(ies)~~RAT(s) and other ~~radio access technologies~~RATs for that PLMN as specified in [5]. Perform measurements to support PLMN selection. Synchronise to a broadcast channel to identify found PLMNs. Report available PLMNs with associated PLMN type and ~~radio access technology~~RAT to NAS on request from NAS or autonomously. It ~~must~~ shall respect allowed PLMN types indications from NAS.
Cell Selection	Control cell selection for example by indicating ~~radio access technology(ies)~~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 a list of NAS defined service areas in priority order~~.	Perform measurements needed to support cell selection. Detect and synchronise to a broadcast channel. Receive and handle broadcast information. Forward NAS system information to NAS. Search for a suitable cell belonging to the PLMN requested by NAS. The cells broadcast their 'PLMN identity' (GSM-MAP) or 'SID' in the system information. Respond to NAS whether such cell is found or not. If associated ~~radio access technology(ies)~~RATs is (are) set for the PLMN, perform the search in this (these) ~~radio access technology(ies)~~RAT(s) and other ~~radio access technologies~~RATs for that PLMN as specified in [5]. If such a cell is found, the cell is selected to camp on.
Cell Reselection	Control cell reselection by for example, maintaining lists of forbidden registration areas ~~and a list of NAS defined service areas in priority order~~. Maintain a list of equivalent PLMN ~~codes~~ identities and provide the list to AS.	Perform measurements needed to support cell reselection. Detect and synchronise to a broadcast channel. Receive and handle broadcast information. Forward NAS system information to NAS. Change cell if a more suitable cell is found.

Location registration	Register the UE as active after power on. Register the UE's presence in a registration area, for instance regularly or when entering a new registration area. Maintain lists of forbidden LAs. Deregister UE when shutting down.	Report registration area information to NAS.

4.3 Service type 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 in idle mode:

- 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 UTRAN network:

- The cell is not barred, see subclause 5.3.4.1
- The cell selection criteria are fulfilled, see subclause 5.2.3.1.2;

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 the selected PLMN or, ~~for cell reselection only ,~~ of a PLMN considered as equivalent by the UE according to the information provided by the NAS.
- The cell is not barred, see subclause 5.3.4.1.
- ~~The cell is not part of the list of "forbidden LAs for regional provision of service" [9].~~
- The cell is not part of the list of "forbidden LAs for roaming" [9]
- The cell selection criteria are fulfilled, see subclause 5.2.3.1.2.
- ~~The SoLSA criteria are fulfilled [SoLSA support is not in the current release].~~

barred cell:

A cell is barred if it is so indicated in the system information [4].

5 Process and procedure descriptions

5.1 PLMN selection and reselection

5.1.1 General

In the UE, the ~~access stratum~~AS shall report available PLMNs to the ~~non-access stratum~~NAS on request from the ~~non-access stratum~~NAS or autonomously.

UE shall maintain a list of allowed PLMN types. The allowed PLMN type can be GSM-MAP only, ANSI-41 only or both. During PLMN selection and reselection, based on the list of allowed PLMN types and a 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 can be identified by either 'PLMN identity' (GSM-MAP) or 'SID'. In the system information on the broadcast channel, the UE can receive ~~identities of multiple PLMNs of either or both types, i.e.~~ a 'PLMN identity' (GSM-MAP) or a 'SID' or a 'PLMN identity' (GSM-MAP) and a 'SID', in a given cell. The result of the PLMN selection is an identifier of the chosen PLMN, the choice being based on the allowed PLMN types, UE capability or other factors. This identifier is one of either 'PLMN identity' for GSM-MAP type of PLMNs or 'SID' for ANSI-41 type of PLMNs.

In case that the list of allowed PLMN types includes GSM-MAP, the non-access part of the PLMN selection and reselection process is specified in [5]. In the case that list of allowed PLMN types includes ANSI-41, the non-access stratum part of the PLMN selection and reselection is specified in TIA/EIA/IS-2000.5 and TIA/EIA/IS-707.

5.1.2 Support for ~~Network~~ PLMN Selection

5.1.2.1 General

~~PLMN selection for GSM-MAP is described in [5].~~

~~PLMN Selection for ANSI-41 is described in TIA/EIA/IS-2000.5 and TIA/EIA/IS-707.~~

On request of the ~~non-access stratum~~NAS the ~~access stratum~~AS should perform a search for available PLMNs and report them to ~~the non-access stratum~~NAS.

5.1.2.2 UTRA case

The UE shall scan all RF channels in the UTRA band according to its capabilities to find available PLMNs. On each carrier, the UE shall search for ~~the "strongest"~~ the strongest cell ~~(~~according to the cell search procedures (for FDD, see [14], and TDD, see [15]) and read its system information, in order to find out which PLMN the cell belongs to. If the UE can read the PLMN identity, the found PLMN ~~is~~ shall be reported to the ~~non-access stratum~~NAS as a high quality PLMN (but without the RSCP value), provided that the following high quality criterion is fulfilled:

1. For an FDD cell, the measured primary CPICH RSCP value shall be greater than or equal to -95 dBm.
2. For a TDD cell, the measured P-CCPCH RSCP shall be greater than or equal to -84 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 CPICH RSCP value for UTRA FDD cells and P-CCPCH RSCP for UTRA TDD cells.

~~The found PLMNs, which do not fulfil the high quality criterion but the UE has been able to read their PLMN identities, are reported to the non-access stratum as other PLMNs in decreasing CPICH RSCP order for UTRA FDD cells and in decreasing P-CCPCH RSCP order for UTRA TDD cell.~~

The search for PLMNs on the rest of the carriers may be stopped on request of the ~~non-access stratum~~NAS. The UE may optimise this search by using stored information of carrier frequencies and optionally also information on cell parameters, e.g. scrambling codes, from previously received measurement control information elements.

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

5.1.2.3 GSM case

Support for network selection in GSM is described in [1].

5.2 Cell selection and reselection in idle mode

5.2.1 Introduction

As stated in clause 1, the present document applies to UEs that support at least UTRA.

Different types of measurements are used in different ~~radio access technologies~~RATs and modes for the cell selection and reselection. Whenever a direct comparison of these measurements is required, mapping functions will be applied that are defined in [4]. ~~The use of the mapping functions is defined in subclause 7.1. Measured values are marked with the index 'meas', whereas the index 'map' is used whenever mapping functions have been applied onto a measured value.~~ The performance requirements for the measurements are specified in [10] and [11].

The ~~non-access stratum~~NAS can control the ~~radio access technology(ies)~~RAT(s) in which the cell selection should be performed, for instance by indicating ~~radio access technology(ies)~~RAT(s) associated with the selected PLMN, and by maintaining a list of forbidden registration area(s) ~~and a list of NAS defined service area(s) in priority order~~ and a list of equivalent PLMNs. The UE shall select a suitable cell and the radio access mode 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] and [11].

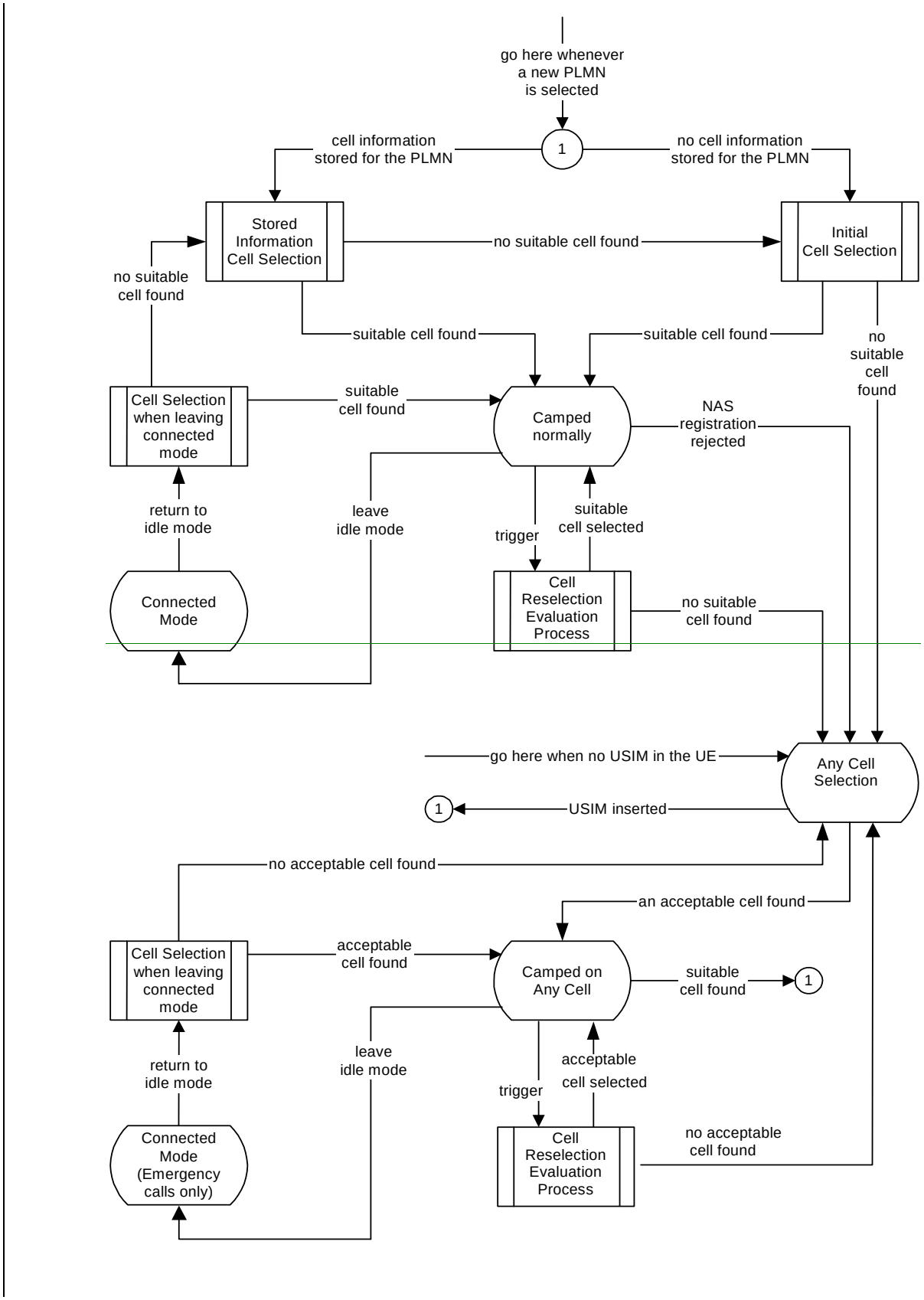
The ~~non-access stratum~~NAS is informed if the cell selection and reselection results in changes in the received system information~~.~~

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

- Receive system information from the PLMN;
  - Receive registration area information from the PLMN, e.g., location area and routing area; and
  - ~~Identify the NAS defined service area(s) to which the serving cell belongs;~~
  - Receive other AS and NAS Information;
- If registered:
  - receive paging and notification messages from the PLMN; and
  - initiate call setup for outgoing calls or other actions from the UE.

5.2.2 States and state transitions in Idle Mode

Figure 2 shows the states and procedures in Idle Mode.



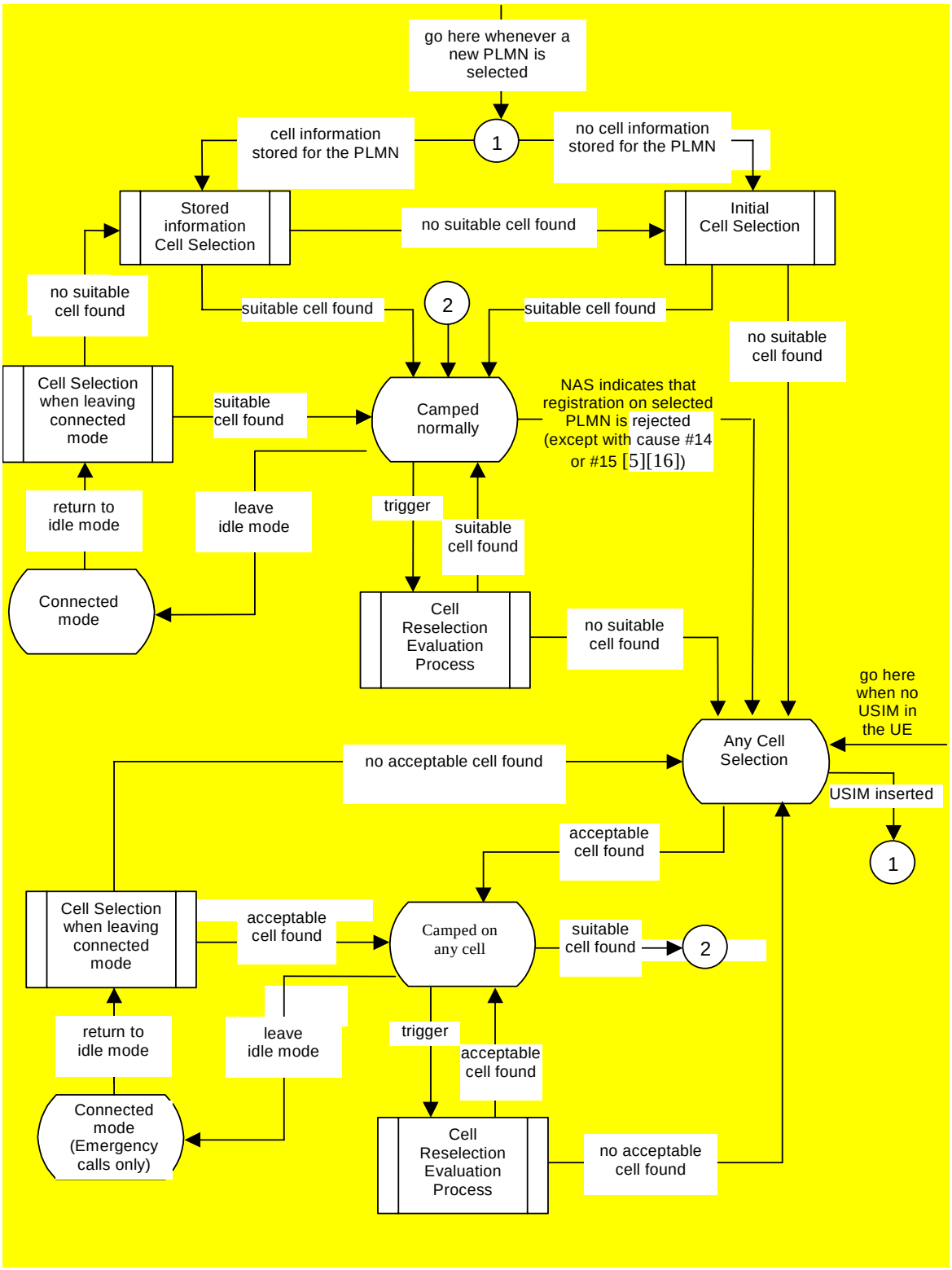


Figure 2: Idle Mode Cell Selection and Reselection
In any state, a new PLMN selection causes an exit to number 1

5.2.2.1 Cell Selection process overview

Whenever a PLMN has been selected by NAS, the UE shall attempt to find a suitable cell to camp on. ~~using one of the two procedures, *Initial cell selection* or *Stored information cell selection*. The *Initial cell selection* procedure requires no knowledge about the selected PLMN, but the *Stored information cell selection* procedure requires information to have been stored about the selected PLMN during a previous selection of~~camping in ~~that PLMN. This stored~~

~~information makes the search for a suitable cell faster. The information may contain information about several radio access technologies.~~

The ~~non-access stratum~~NAS may control the cell selection by:

- providing information on ~~radio access technology(ies)~~RAT(s) associated with the selected PLMN;
- maintaining lists of forbidden registration areas;
- providing a list of equivalent PLMNs;
- ~~a list of NAS defined service areas in priority order.~~

One or several ~~radio access technologies~~RATs may be associated with the selected PLMN. In [5]~~,~~ it is specified which ~~radio access technology~~RAT a UE shall select to search for a suitable cell of the selected PLMN.

The AS shall attempt to find a suitable cell to camp on as specifed in clause 5.2.3.

~~When~~ If a suitable cell ~~has been~~is found, the UE ~~shall~~ shall select~~s~~ this cell to camp on, and report~~s~~ this event to NAS so that the ~~perform~~ necessary NAS registration procedures can be performed. When the ~~UE has registered~~registration is successful~~ly~~, the ~~UE~~ UE enters ~~shall camp on the~~ in ~~cell,~~ state *Camped normally* in order to obtain normal service.

If the UE is unable to find any suitable cell of selected PLMN the UE shall enter the *Any cell selection* state.

5.2.2.2 Camped normally state overview

In this state,the UE ~~obtains~~ normal service and performs the tasks specified in 5.2.5. ~~shall monitor paging information, monitor system information and perform radio measurements. The measurements shall be used in evaluation of the and cell reselection criteria. The network controls what the UE shall measure by sending measurement control information in the system information. The measurement control information may contain intra-frequency, inter-frequency and inter-radio-access- technology measurements.~~

~~The UE shall evaluate the cell reselection criteria based on radio measurements, and if a better cell is found that cell is selected, procedure *Cell reselection*. The change of cell may imply a change of radio access technology.~~

If after a *Cell reselection evaluation process* a better cell is found, the *Cell reselection procedure* is performed. If no suitable cell is found, the UE shall enter the state *Any cell selection*.

If a necessary NAS registration is rejected, the UE shall enter the *Any cell selection* state, except if the LR is rejected with cause #14 or cause #15. In this case the UE shall behave as specified in [5] and [16].

When UE leaves idle mode~~, state *Camped normally*,~~ in order to enter ~~connected mode,~~ the state *Connected mode*, the UE shall attempt to access the current serving cell. If the access attempt to the serving cell fails, the UE shall use the *Cell reselection evaluation* procedure.

5.2.2.3 Connected mode State overview

The procedures in *Connected mode* state are specified in [4]

When returning to idle mode, the UE shall use the procedure *Cell selection when leaving connected mode* in order to find a suitable cell to camp on and enter~~,~~ state *Camped normally*. If a suitable cell is found, then the AS reports this event to NAS to be capable to perform necessary NAS registration procedures. If no suitable cell is found, the *Stored information cell selection* procedure shall be used.

If no suitable cell is found~~, in *Ccell reselection evaluation* procedure~~process, the UE ~~shall attempt to find an acceptable cell of any PLMN,~~ enter the state *Any cell selection*.

5.2.2.4 Any cell selection State overview

In this state the UE performs the tasks specified in subclause 5.2.8

~~This~~ The state *Any cell selection* is also entered if ~~a~~ the ~~non-access stratum~~NAS ~~registration procedure~~indicates that a location registration is rejected except if the LR is rejected with cause #14 or cause #15, see [5], or if there is no USIM in the UE.

If the UE received an LR reject with cause #14 or cause #15 the UE shall behave as specified in [5] and [16].

If an acceptable cell is found, the UE shall inform the NAS and camp on this cell and obtain limited service, state *Camped on any cell*. The subsequent actions of the NAS regarding the PLMN selection are specified in [5].

5.2.2.5 Camped on any cell State overview

In ~~thisthis~~ state~~,~~ the UE obtains limited service and shall behave as specified ~~for state *Camped normally*~~in subclause 5.2.9.
~~, but typically with a different PLMN. Additionally, t~~The UE shall regularly attempt to find a suitable cell of the selected PLMN ~~using stored information~~, trying ~~all radio access technologies~~RATs that are supported by the UE. If a suitable cell is found, ~~the PLMN is reselected which~~this causes an exit to number 2 in figure 2.

~~When a cell reselection is triggered, the UE shall evaluate the cell reselection criteria based on radio measurements, and if a better cell is found that cell is selected. The change of cell may imply a change of radio access technology.~~

~~If no acceptable cell is found, the UE shall continue to search for an acceptable cell of any PLMN in state *Any cell selection* trying all radio access technologies that are supported by the UE.~~

NOTE: The 'PLMN selection and reselection' process may select a new PLMN at any time in idle mode, which in Figure 2 causes an exit to number 1.

5.2.3 Cell Selection Process

5.2.3.1 UTRA case

5.2.3.1.1 Description

~~Whenever a PLMN is selected [5], the UE shall attempt to find a suitable cell of that PLMN to camp on according to the following steps.~~

~~1)~~ The UE shall use one of the following two search procedures:

a) Initial Cell Selection

This procedure requires no prior knowledge of which RF channels are UTRA carriers. The UE shall scan all RF channels in the UTRA band to find a suitable cell of the selected PLMN. ~~On each carrier, the UE searches first for the strongest cell and reads its system information, in order to find out which PLMN the cell belongs to. If the selected PLMN is found, the search of the rest of carriers may be stopped. Once the UE has found a suitable cell for the selected PLMN, the UE shall select it.~~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, e.g. scrambling codes, from previously received measurement control information elements. Once the UE has found a suitable cell for the selected PLMN the UE shall select it. If no suitable cell of the selected PLMN is found the Initial cell selection procedure shall be started.

~~2) Move to state *camped normally*~~

~~If no suitable cell of selected PLMN is found and the stored information cell selection procedure was used in step 1, the Initial cell selection procedure shall be started.~~

~~If the UE is unable to find any suitable cell of selected PLMN using the Initial cell selection procedure, it shall attempt to camp on the strongest an acceptable cell and enter the Camped on any cell state, where it can only obtain limited service. This result that cell selection on selected PLMN was not successful, shall be reported to the NAS. The subsequent actions of the NAS regarding the PLMN selection are specified in [5]. In PLMN selection, automatic mode, this would normally result in a new PLMN selection [5].~~

5.2.3.1.2 Criteria

~~The cell selection criteria S are defined as follows.~~

$Squal = Q_{qualmeas} – Qqualmin$
$Srxlev = Q_{rxlevmeas} - Qrxlevmin - Pcompensation$

The cell selection criterion S is fulfilled when:

for FDD cells:	Srxlev > 0 AND Squal > 0
for TDD cells:	Srxlev > 0

Where:

$Squal = Q_{qualmeas} – Qqualmin$
$Srxlev = Q_{rxlevmeas} - Qrxlevmin - Pcompensation$

Squal > 0
Srxlev > 0

~~Squal has to be evaluated for FDD cells only.~~

Squal	Cell Selection quality value~~,~~ (dB) Applicable only for FDD cells.~~Not applicable for TDD cells or GSM cells.~~
Srxlev	Cell Selection RX level value (dB)
$Q_{qualmeas}$	Measured cell quality value. The quality of the received signal expressed in CPICH E_c/N_0 (dB) for FDD cells. CPICH Ec/N0 shall be averaged as specified in [10]. Applicable only for FDD cells.~~Not applicable for TDD cells, or GSM cells.~~
$Q_{rxlevmeas}$	Measured cell RX level value. This is received signal, CPICH RSCP for FDD cells (dBm) and,~~ P~~-CCPCH RSCP for TDD cells (dBm) ~~and RXLEV for GSM cells (dBm).~~
Qqualmin	Minimum required quality level in the cell (dB)~~.~~ Applicable only for FDD cells.~~Not applicable for TDD cells. or GSM cells.~~
Qrxlevmin	Minimum required RX level in the cell~~.~~ (dBm)
Pcompensation	max(UE_TXPWR_MAX_RACH – P_MAX, 0) (dB)
UE_TXPWR_MAX_RACH	Maximum TX power level an UE may use when accessing the cell on RACH (read in system information)~~,~~ (dBm)
P_MAX	Maximum RF output power of the UE~~,~~ (dBm)

5.2.3.2 GSM case

The cell selection criteria and procedures in GSM are specified in [1].

5.2.4 Void

5.2.5 Camped Normally State

5.2.5.1 UTRA case

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

- select and monitor the indicated PICH and PCH of the cell as specified in clause 8 according to information sent in system information;
- monitor relevant System Information. This is specified in [4];
- 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] and [11];
  2) When information on the BCCH used for the cell reselection evaluation procedure has been modified

5.2.5.2 GSM case

The Camped Normally State is specified in [1].

5.2.6 Cell Reselection Evaluation Process

5.2.6.1 UTRA case

The cell reselection process is specified in the following sub-clauses:

5.2.6.1.1 Measurement rules for cell re-selection when HCS is not used

If the system information broadcast in the serving cell indicates that HCS is not used, then for intra-frequency and inter-frequency measurements and inter-RAT measurements, the UE shall:

- use Squal for FDD cells and Srxlev for TDD for Sx and apply the following rules.

1. If Sx > $S_{intrasearch}$, UE need not perform intra-frequency measurements.
   If Sx <= $S_{intrasearch,}$ perform intra-frequency measurements.
   If $S_{intrasearch,}$ is not sent for serving cell, perform intra-frequency measurements.
2. If Sx > $S_{intersearch}$, UE need not perform inter-frequency measurements
   If Sx <= $S_{intersearch}$, perform inter-frequency measurements.
   If $S_{intersearch}$, is not sent for serving cell, perform inter-frequency measurements.
3. If Sx > $Ssearch_{RAT\ m}$, UE need not perform measurements on cells of RAT "m".
   If Sx <= $Ssearch_{RAT\ m}$, perform measurements on cells of RAT "m".
   If $Ssearch_{RAT\ m}$, is not sent for serving cell, perform measurements on cells of RAT "m".

5.2.6.1.2 Measurement rules for cell re-selection when HCS is used

If the system information broadcast in the serving cell indicates that HCS is used, then for intra-frequency and inter-frequency measurements, the UE shall:

1. For intra-frequency and inter-frequency threshold-based measurement rules

   use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

   IF ($Srxlev_s$ <= $Ssearch_{HCS}$) or (if FDD and S_x <= $S_{intersearch}$) THEN

measure on all intra-frequency and inter-frequency cells

ELSE

IF (S_x > $S_{intrasearch}$) THEN

measure on all intra-frequency and inter-frequency cells, which have higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ELSE

measure on all intra-frequency and inter-frequency cells, which have equal or higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ENDIF

ENDIF

2. For intra-frequency and inter-frequency measurement rules for fast-moving UEs:

If the number of cell reselections during time period T_{CRmax} exceeds N_{CR}, high-mobility has been detected. In this high-mobility state, UE shall

- measure intra-frequency and inter-frequency neighbouring cells, which have equal or lower HCS priority than serving cell.
- prioritise re-selection of intra-frequency and inter-frequency neighbouring cells on lower HCS priority level before neighbouring cells on same HCS priority level.

When the number of cell reselections during time period T_{CRmax} no longer exceeds N_{CR}, UE shall

- continue these measurements during time period $T_{CrmaxHyst}$, and
- revert to measurements according to the threshold based measurement rules.

When serving cell belongs to a hierarchical cell structure, the UE shall follow these rules for Inter-RAT measurements:

1. Inter-RAT threshold-based measurement rules

use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

IF ($Srxlev_s$ <= $S_{HCS,RATm}$) or (if FDD and S_{qual} <= $S_{SearchRATm}$) THEN

UE shall measure on all inter-RATm cells

ELSE

IF (S_x > $S_{limit,SearchRATm}$) THEN

UE need not measure neighbouring cells in RAT "m"

ELSE

UE shall measure on all neighbouring cells in RAT "m", which have equal or higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ENDIF

ENDIF

2. Inter-RAT measurement rules for fast-moving UEs

- If the number of cell reselections during time period T_{CRmax} exceeds N_{CR}, high-mobility has been detected. In this high-mobility state, UE shall
  - measure the neighbouring cells in RAT "m", which have an equal or lower HCS priority than the serving cell

- prioritise re-selection of neighbouring cells in RAT "m" on lower HCS priority level before neighbouring cells in RAT "m" on same HCS priority level.

When the number of cell reselections during time interval T_{CRmax} no longer exceeds N_{CR}, UE shall

- continue these measurements during time period $T_{CrmaxHyst}$, and
- revert to measure according to the threshold-based measurement rules.

5.2.6.1.3 ~~Non-suitable cells (Squal > 0 or Srxlev > 0)~~ Highest ranked cells with access restrictions

For the highest ranked cell (including serving cell) according to cell reselection criteria specified in subclause 5.2.6.1.4, the UE shall check if the access is restricted according to the rules in subclause 5.3.1.1.

If that cell and other cells have to be excluded from the candidate list, as stated in subclause 5.3.1.1, the UE shall not consider these as candidates for cell reselection. This limitation is removed when the highest ranked cell changes.

~~If the best cell according to cell reselection criteria specified in subclause 5.2.6.1.4, does not fulfil all requirements for a suitable cell, that cell, together with all cells on that frequency shall be removed as candidate for cell re-selection (see also subclause 5.3).~~

5.2.6.1.4 Cell Reselection Criteria

The following cell re-selection criteria are used for intra-frequency cells, inter-frequency cells and inter-RAT cells:

The quality level threshold criterion H for hierarchical cell structures is used to determine whether prioritised ranking according to hierarchical cell re-selection rules shall apply, and is defined by:

$$H_s = Q_{meas,s} - Qhcs_s$$

$$H_n = Q_{meas,n} - Qhcs_n - TO_n * L_n$$

$$H_s = Q_{meas_LEV,s} - Qhcs_s$$

$$H_n = Q_{meas_LEV,n} - Qhcs_n - TO_n * L_n$$

If it is indicated in system information that HCS is not used, the quality level threshold criterion H is not applied.

The cell-ranking criterion R is defined by:

$$R_s = Q_{meas,s} + Qhyst_s$$

$$R_n = Q_{meas,n} - Qoffset_{s,n} - TO_n * (1 - L_n)$$

$$R_s = Q_{map,s} + Qhyst_s$$

$$R_n = Q_{map,n} - Qoffset_{s,n} - TO_n * (1 - L_n)$$

where:

$$TO_n = TEMP_OFFSET_n * W(PENALTY_TIME_n - T_n)$$

$L_n = 0$ if $HCS_PRIO_n = HCS_PRIO_s$
$L_n = 1$ if $HCS_PRIO_n <> HCS_PRIO_s$

$W(x) = 0$ for $x < 0$
$W(x) = 1$ for $x >= 0$

$TEMP_OFFSET_n$ applies an offset to the H and R criteria for the duration of $PENALTY_TIME_n$ after a timer T_n has started for that neighbouring cell.

$TEMP_OFFSET_n$ and $PENALTY_TIME_n$ are only applicable if the usage of HCS is indicated in system information.

The timer T_n is implemented for each neighbouring cell. T_n shall be started from zero when one of the following conditions becomes true:

- if $HCS_PRIO_n <> HCS_PRIO_s$ and

$$Q_{meas_LEV,n} > Qhcs_n$$

Or

- if $HCS_PRIO_n = HCS_PRIO_s$ and
  - for serving FDD and neighbour FDD cells if the quality measure for cell selection and reselection is set to CPICH RSCP in the serving cell, and:

$$Q_{mapmeas,n} > Q_{mapmeas,s} + Qoffset1_{s,n}$$

  - for serving FDD and neighbour FDD cells if the quality measure for cell selection and reselection is set to CPICH Ec/No in the serving cell, and:

$$Q_{meas_LEV,n} > Q_{meas_LEV,s} + Qoffset2_{s,n}$$

  - for all other serving and neighbour cells:

$$Q_{mapmeas,n} > Q_{mapmeas,s} + Qoffset1_{s,n}$$

T_n for the associated neighbour cell shall be stopped as soon as any of the above conditions are no longer fulfilled. Any value calculated for TO_n is valid only if the associated timer T_n is still running else TO_n shall be set to zero.

At cell-reselection, a timer T_n is stopped only if the corresponding cell is not a neighbour cell of the new serving cell, or if the criteria given above for starting timer T_n for the corresponding cell is no longer fulfilled with the parameters of the new serving cell. On cell re-selection, timer T_n shall be continued to be run for the corresponding cells but the

criteria given above shall be evaluated with parameters broadcast in the new serving cell if the corresponding cells are neighbours of the new serving cell.

S_n	Cell Selection value of the neighbouring cell, (dB)
~~$Q_{map,n}$~~	~~Quality of the neighbouring cell, after mapping function is applied, derived from CPICH E_c/N_0 or CPICH RSCP for FDD cells, from P-CCPCH RSCP for TDD cells and from RXLEV for GSM cells. For FDD cells, the measurement that is used to derive the quality value is set by the Cell_selection_and_reselection_quality_measure information element.~~
~~$Q_{map,s}$~~	~~Quality of the serving cell, after mapping function is applied, derived from CPICH E_c/N_0 or CPICH RSCP for FDD cells and from P-CCPCH RSCP for TDD cells. For FDD cells, the measurement that is used to derive the quality value is set by the Cell_selection_and_reselection_quality_measure information element.~~
Q_{meas}~~_LEV~~	Quality value. The quality value of the received signal derived from the averaged CPICH Ec/No or CPICH RSCP for FDD cells, from the averaged P-CCPCH RSCP for TDD cells and from the averaged received signal level for GSM cells. The averaging of these measurement quantities are performed as specified in [10] and [11]. For FDD cells, the measurement that is used to derive the quality value is set by the Cell_selection_and_reselection_quality_measure information element.~~expressed in CPICH_Ec/No or CPICH_RSCP_LEV for FDD cells as set by the Cell_selection_and_reselection_quality_measure information element, P-CCPCH_RSCP_LEV for TDD cells and RXLEV for GSM cells.~~

Cell reselection parameters broadcast in system information are listed in subclause 5.2.6.1.5.

~~The quality values $Q_{map,n}$ and $Q_{map,s}$ are determined by mapping functions. The parameters for these mapping functions are broadcast in system information. The mapping function maps a certain range of measurement values to a representing quality value. $Q_{map,n}$ and $Q_{map,s}$ can have values between 0 and 99 (step size 1).~~

The cell reselection criterion S is fulfilled when:

for FDD cells:	Srxlev > 0 AND Squal > 0
for TDD cells:	Srxlev > 0
for GSM cells:	Srxlev > 0

Where :

$$Squal = Q_{qualmeas} - Qqualmin$$

$$Srxlev = Q_{rxlevmeas} - Qrxlevmin - Pcompensation$$

Squal	Cell Selection quality value~~,~~ (dB) Applicable only for FDD cells.
Srxlev	Cell Selection RX level value (dB)
$Q_{qualmeas}$	Measured cell quality value. The quality of the received signal expressed in CPICH E_C/N_0 (dB) for FDD cells. CPICH Ec/N0 shall be averaged as specified in [10]. Applicable only for FDD cells.
$Q_{rxlevmeas}$	Measured cell RX level value. This is received signal, CPICH RSCP for FDD cells (dBm), P-CCPCH RSCP for TDD cells (dBm) and the averaged received signal level as specified in [10] for GSM cells (dBm). CPICH RSCP, P-CCPCH RSCP and the received signal level for GSM cells shall be averaged as specified in [10] and [11].
Qqualmin	Minimum required quality level in the cell (dB). Applicable only for FDD cells.
Qrxlevmin	Minimum required RX level in the cell~~.~~ (dBm)
Pcompensation	max(UE_TXPWR_MAX_RACH – P_MAX, 0) (dB)
UE_TXPWR_MAX_RACH	Maximum TX power level an UE may use when accessing the cell on RACH (read in system information)~~,~~ (dBm)
P_MAX	Maximum RF output power of the UE~~,~~ (dBm)

The UE shall perform ranking of all cells that fulfil the S criterion~~ (see subclause 5.2.3.1.2)~~ among

- all cells that have the highest HCS_PRIO among those cells that fulfil the criterion H >= 0**.** Note that this rule is not valid when UE high-mobility is detected (see subclause 5.2.6.1.2).
- all cells, not considering HCS priority levels, if no cell fulfil the criterion H >= 0. This case is also valid when it is indicated in system information that HCS is not used, that is when serving cell does not belong to a hierarchical cell structure.

The cells shall be ranked according to the R criteria specified above, deriving $Q_{\text{~~map~~meas},n}$ and $Q_{\text{~~map~~meas},s}$ and calculating the R values using CPICH RSCP, P-CCPCH RSCP and the averaged received signal level as specified in [10] and [11]~~RXLEV~~ for FDD, TDD and GSM cells, respectively.

The offset $Qoffset1_{s,n}$ is used for $Qoffset_{s,n}$ to calculate R_n, the hysteresis $Qhyst1_s$ is used for $Qhyst_s$ to calculate R_s.

If the usage of HCS is indicated in system information, $TEMP_OFFSET1_n$ is used for $TEMP_OFFSET_n$ to calculate TO_n. If it is indicated in system information that HCS is not used, $TEMP_OFFSET_n$ is not applied when calculating R_n. The best ranked cell is the cell with the highest R value.

If a TDD or GSM cell is ranked as the best cell, then the UE shall perform cell re-selection to that TDD or GSM cell.

If an FDD cell is ranked as the best cell and the quality measure for cell selection and re-selection is set to CPICH RSCP, the UE shall perform cell re-selection to that FDD cell.

If an FDD cell is ranked as the best cell and the quality measure for cell selection and re-selection is set to CPICH Ec/No, the UE shall perform a second ranking of the FDD cells according to the R criteria specified above, but using the measurement quantity CPICH Ec/No for deriving the $Q_{\text{~~map~~meas},n}$ and $Q_{\text{~~map~~meas},s}$ and calculating the R values of the FDD cells. ~~In this case, the mapping function $Q_{map} = Q_{meas_LEV}$ is used and t~~The offset $Qoffset2_{s,n}$ is used for $Qoffset_{s,n}$ to calculate R_n, the hysteresis $Qhyst2_s$ is used for $Qhyst_s$ to calculate R_s. If the usage of HCS is indicated in system information, $TEMP_OFFSET2_n$ is used to calculate TO_n. If it is indicated in system information that HCS is not used, $TEMP_OFFSET_n$ is not applied when calculating R_n. Following this second ranking, the UE shall perform cell re-selection to the best ranked FDD cell.

In all cases, the UE shall reselect the new cell, only if the cell reselection criteria are fulfilled during a time interval Treselection.

5.2.6.1.5 Cell reselection parameters in system information broadcasts

The selection of values for network controlled parameters can be optimised by means of different methods. Examples of methods are described in [6]. Cell reselection parameters are broadcast in system information and are read in the serving cell as follows:

$Qoffset1_{s,n}$

This specifies the offset between the two cells. It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP.

$Qoffset2_{s,n}$

This specifies the offset between the two cells. It is used for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH Ec/No.

$Qhyst1_s$

This specifies the hysteresis value (Qhyst). It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP.

$Qhyst2_s$

This specifies the hysteresis value (Qhyst). It is used for FDD cells if the quality measure for cell selection and re-selection is set to CPICH Ec/No.

HCS_PRIO_s, HCS_PRIO_n

This specifies the HCS priority level (0-7) for serving cell and neighbouring cells.

$Qhcs_s$, $Qhcs_n$

This specifies the quality threshold levels for applying prioritised hierarchical cell re-selection.

Qqualmin

This specifies the minimum required quality level in the cell in dB. It is not applicable for TDD cells or GSM cells.

Qrxlevmin

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

$PENALTY_TIME_n$

This specifies the time duration for which the $TEMPORARY_OFFSET_n$ is applied for a neighbouring cell.

$TEMPORARY_OFFSET1_n$

This specifies the offset applied to the H and R criteria for a neighbouring cell for the duration of $PENALTY_TIME_n$. It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP.

$TEMPORARY_OFFSET2_n$

This specifies the offset applied to the H and R criteria for a neighbouring cell for the duration of $PENALTY_TIME_n$. It is used for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH Ec/No.

T_{CRmax}

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

N_{CR}

This specifies the maximum number of cell reselections.

$T_{CRmaxHyst}$

This specifies the additional time period before the UE can revert to low-mobility measurements.

$Treselection_s$

This specifies the cell reselection timer value.

$Ssearch_{HCS}$

This threshold is used in the measurement rules for cell re-selection when HCS is used. It specifies the limit for Srxlev in the serving cell below which the UE shall initiate measurements of all neighbouring cells of the serving cell.

$Ssearch_{RAT\ 1}$ - $Ssearch_{RAT\ k}$

This specifies the RAT specific threshold in the serving cell used in the inter-RAT measurement rules.

$S_{HCS,RATm}$

This threshold is used in the measurement rules for cell re-selection when HCS is used. It specifies the RAT specific threshold in the serving cell used in the inter-RAT measurement rules.

$S_{intrasearch}$

This specifies the threshold (in dB) for intra frequency measurements and for the HCS measurement rules.

$S_{intersearch}$

This specifies the threshold (in dB) for ~~intra~~ inter frequency measurements and for the HCS measurement rules.

$S_{limit,SearchRATm}$

This threshold is used in the measurement rules for cell re-selection when HCS is used. It specifies the RAT specific threshold (in dB) in the serving UTRA cell above which the UE need not perform any inter-RAT measurements in RAT "m".

~~**Mapping Info**~~

~~This specifies the information necessary to define the mapping function used for mapping a certain range of measurement values to a representing quality value (0..99, step size 1).~~

5.2.6.2 GSM case

The cell reselection procedure in GSM, including reselection from GSM to UTRA, is specified in [1].

5.2.7 Cell Selection when leaving connected mode

5.2.7.1 UTRA case

When returning to idle mode from connected mode, the UE shall select a suitable cell to camp on. Candidate cells for this selection are the cell(s) used immediately before leaving connected mode. If no suitable cell is found, the UE shall use the Stored information cell selection procedure in order to find a suitable cell to camp on.

When returning to idle mode after an emergency call on any PLMN, the UE shall select an acceptable cell to camp on. Candidate cells for this selection are the cell(s) used immediately before leaving connected mode. If no acceptable cell is found, the UE shall continue to search for an acceptable cell of any PLMN in state Any cell selection.

5.2.7.2 GSM case

Cell selection when leaving connected mode in GSM is specified in [1].

5.2.8 Any Cell Selection state

In this state, the UE shall attempt to find an acceptable cell of an any PLMN to camp on, trying all ~~radio access technologies~~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

5.2.9.1 UTRA case

~~If an acceptable cell is found, the UE shall camp on this cell and obtain limited service, state Camped on any cell.~~

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

- select and monitor the indicated PICH and PCH of the cell as specified in clause 8
- monitor relevant System Information; This is specified in [4];
- 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] and [11];
  2) When information on the BCCH used for the cell reselection evaluation procedure has been modified;
- regularly attempt to find a suitable cell of the selected PLMN trying all ~~radio access technologies~~RATs that are supported by the UE. If a suitable cell is found, this causes an exit to number ~~1~~ 2 in Figure 2.

5.2.9.2 GSM case

The camped on any cell state in GSM is specified in [1].

5.3 Cell Access Restrictions

5.3.1 UTRA cells

There are two mechanisms which allow an operator to impose cell 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 [9], which are employed for this purpose.

5.3.1.1 Cell status and cell reservations

Cell status and cell reservations are indicated with the *Cell Access Restriction* Information Element in the System Information Message [4] by means of three Information Elements:

- Cell barred (IE type: "barred" or "not barred"),
- Cell Reserved for operator use (IE type: "reserved" or "not reserved"),
- ~~Cell Reserved for SoLSA exclusive use (IE type: "reserved" or "not reserved").~~

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

- the UE may select/re-select this cell during the cell selection and cell re-selection procedures in Idle mode and in Connected mode.

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

- UEs ~~not supporting SoLSA~~ shall behave as if cell status "barred" is indicated using the value "not allowed" in the IE "Intra-frequency cell re-selection indicator" and the maximum value for T_{barred}, see [4] (see also below).

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

- UEs assigned to an Access Class in the range 11 to 15 may select/re-select this cell if in the home PLMN.

- UEs assigned to an Access Class in the range 0 to 9 shall behave as if cell status "barred" is indicated using the value "not allowed" in the IE "Intra-frequency cell re-selection indicator" and the maximum value for T_{barred}, see [4] (see also below).

When cell status "barred" is indicated,

- the UE is not permitted to select/re-select this cell, except for emergency call, when no other acceptable cell can be found, and the cell is not barred for emergency call by means of the "Access Class 10 bit", see clause 5.3.1.3.

- The UE shall ignore the "Cell Reserved for ~~SoLSA exclusive~~ future extension (Cell Reservation Extension) use" IE.

- The UE shall select another cell according to the following rule:

  - If the "Intra-frequency cell re-selection indicator" IE in Cell Access Restriction IE is set to value "allowed", the UE may select another cell on the same frequency if selection/re-selection criteria are fulfilled.

    - If the UE is camping on another cell, the UE shall exclude the barred cell from the neighbouring cell list until the expiry of a time interval T_{barred}. The time interval T_{barred} is sent via system information in a barred cell together with Cell status information in the Cell Access Restriction IE.

    - If the UE does not select another cell, and the barred cell remains to be the "best" one, the UE shall after expiry of the time interval T_{barred} again check whether the status of the barred cell has changed.

  - If the "Intra-frequency cell re-selection indicator" IE is set to "not allowed" the UE shall not re-select a cell on the same frequency as the barred cell. For emergency call, the Intra-frequency cell re-selection indicator IE" shall be ignored, i.e. even if it is set to "not allowed" the UE may select another intra-frequency cell.

    - If the barred cell remains to be the "best" one, the UE shall after expiry of the time interval T_{barred} again check whether the status of the barred cell has changed.

5.3.1.2 Access Control

Information on cell access restrictions associated with the Access Classes is broadcast as system information, [4].

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 before sending an RRC CONNECTION REQUEST message when entering Connected Mode from UTRAN Idle mode. Cell access restrictions associated with the Access Classes shall not apply when the initial access for entering Connected Mode is triggered by an Inter-RAT cell re-selection to UTRAN, and for a UE which already is in Connected Mode.

5.3.1.3 Emergency Call

Generally, emergency calls shall be allowed in all cells whose barred status is not barred, independent of restrictions due to cell reservations.

A restriction on emergency calls, if needed, shall be indicated in the "Access class barred list" IE [4]. Full details of operation under "Access class barred list" are described in [9].

5.3.2 GSM cells

The cell access restrictions applicable to GSM are specified in [1].

5.4 Cell Reselection Processes in RRC Connected Mode

5.4.1 Initial Cell Reselection Process

Triggers for the Initial cell re-selection process are specified in [4].

The UE shall attempt to find a suitable cell belonging to the selected PLMN and select it. ~~according to the following steps:~~

~~1) The UE shall scan all RF channels of the UTRA band to find a suitable cell. The UE may optimise this search by using stored information of carrier frequencies and optionally also information on cell parameters, e.g. scrambling codes, from previously received measurement control information elements.~~

~~2) After the UE has found one suitable cell for the selected PLMN, the UE shall create a candidate list consisting of this cell and its neighbouring UTRA cells, as received in measurement control information via the selected cell.~~

~~3) Rank the cells according to the cell reselection criteria (see 5.2.6.1.4), without considering the parameters Qhyst and Treselection.~~

~~4) Check if the highest ranked cell fulfils all requirements for a suitable cell. If so, select this cell. If this cell does not fulfil all requirements for a suitable cell, this cell and all cells on the same frequency shall be removed as candidates for cell selection (see also 5.3.1), and step 3 shall be repeated for the remaining cells.~~

~~The use of mapping functions is indicated in system information. For each radio access mode and radio access technology, such a mapping function is defined and its parameters are broadcast in system information. The mapping function maps a certain range of measurement values to a representing quality value Q_{map} that can have values between 0 and 99 (step size 1). These quality values Q_{map} are then used to evaluate the cell reselection criteria in subclause 5.2.6.1.4.~~

If the UE is unable to find any suitable cell, the UE shall release the RRC connection and enter idle mode.

5.4.1.1 Criteria

The criteria for initial cell reselection are specified in subclause ~~5.2.2.1.2~~5.2.6.1.4.

5.4.2 Void

5.4.3 Cell Reselection Process

The *cell reselection* process in Connected Mode is the same as *cell reselection evaluation process* used for idle mode, described in subclause 5.2.6.

5.5 Location Registration

In the UE, the ~~access stratum~~AS shall report registration area information to the ~~non-access stratum~~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 specifed in [9] and [16].

6 Broadcast information receiving

6.1 Reception of System Information

Requirements are specified in [4].

6.2 Cell Broadcast in Idle Mode

A UE supporting Cell Broadcast Service (CBS) shall be capable to receive BMC messages in the Idle mode. When several PCHs exist in the cell, the FACH which carries the CTCH may be mapped to a different SCCPCH than the PCH selected by the UE for paging in Idle mode (as specified in Sec. 8.1). In this case, UEs with basic service capabilities shall be capable to change from the SCCPCH that carries the PCH selected for paging to another SCCPCH which carries Cell Broadcast messages (i.e. the CTCH mapped to an FACH) and receive BMC messages during time intervals which do not conflict with the UE specific paging occasions.

7 ~~Measurements for cell selection / reselection~~Void

~~7.1 Use of Mapping Functions~~

~~Different types of measurements are used in different radio access technologies~~RATs ~~and modes for the cell selection and reselection (CPICH Ec/N0 or CPICH RSCP in UTRA FDD, P-CCPCH RSCP in UTRA TDD, RXLEV in GSM). The use of mapping functions is indicated in system information.~~

~~Mapping functions are used for mapping a certain range of measurement values Q_{meas_LEV} (CPICH_EC/N0, CPICH_RSCP_LEV, P-CCPCH_RSCP_LEV, RXLEV) to a representing quality value Q_{map} (0..99, step size 1).~~

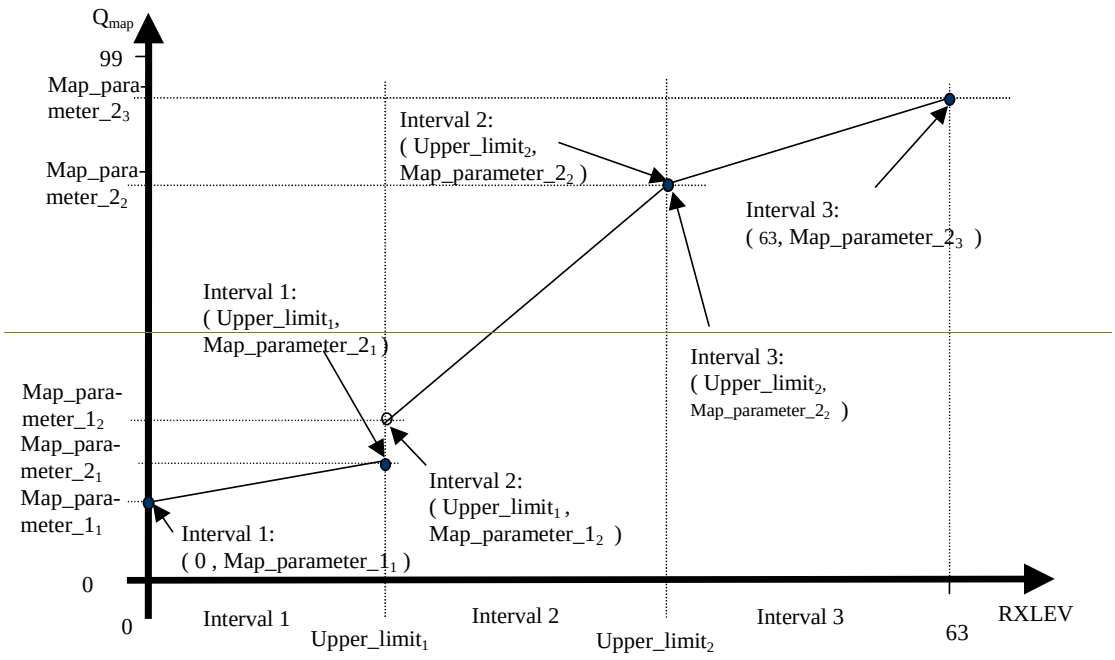
~~For each radio access technology~~RAT ~~and mode, one mapping function is defined. It may be defined over one or several consecutive intervals of the measurement values Q_{meas_LEV}.~~

~~The size of the consecutive intervals is sufficiently defined by their upper limit (given by parameter Upper_limit). In case of only one interval specified, the parameter Upper_limit is not needed and the interval is equivalent to the measurement range defined for that radio access technology~~RAT~~. In case of more than one interval specified, the upper limit of the last interval defined is equivalent to the upper limit of the defined measurement range. The lower limit of an interval is equivalent to the upper limit of the interval before that interval. For the first interval, the lower limit is equivalent to the lower limit of the defined measurement range.~~

~~Within each interval, one function type (given by parameter Function_type) is defined by two parameters Map_parameter_1 and Map_parameter_2. The function type "linear" is specified: $Q_{map} = a * Q_{meas_LEV} + b$, if Q_{meas_LEV} is the measured value and Q_{map} is the representing quality value.~~

~~Map_parameter_1 and Map_parameter_2 for an interval define the Q_{map} values that the Q_{meas_LEV} values at the upper and the lower limit of this interval are mapped to, respectively. In other words, the linear function within one interval is defined by two tuples (Q_{meas_LEV}, Q_{map}) at the interval limits, so that the parameters a and b can be derived from this.~~

~~Accordingly, if the mapping function is steady between two consecutive intervals, Map_parameter_2 for the first interval has the same value as Map_parameter_1 for the following interval. This is illustrated in the following Figure 3:~~



~~Figure 3: Illustration of mapping of RXLEV using multiple linear models~~

~~If no mapping functionality is needed (e.g. in FDD- or TDD-only networks), an implicit mapping is used: $Q_{map} = Q_{meas_LEV}$. This is specified as default case.~~

~~The parameters defined for each interval (Function_type, Map_parameter_1, Map_parameter_2 and Upper_limit)are broadcast in system information.~~

8 Paging and SCCPCH selection in Idle mode

8.1 Paging Channel selection

System information block type 5 (SIB 5) defines common channels to be employed in Idle mode [4]. In a cell, a single or several PCHs may be established. Each Secondary Common Control Physical Channel (SCCPCH) indicated to the UE in system information may carry up to one PCH. Thus, for each defined PCH there is one uniquely associated PICH also indicated.

In case that more than a single PCH and associated PICH are defined in SIB 5, the UE shall perform a selection according to the following rule:

- The UE shall select a SCCPCH from the ones listed in SIB 5 based on IMSI as follows:

  "Index of selected SCCPCH" = IMSI mod K,

  where K is equal to the number of listed SCCPCHs which carry a PCH (i.e. SCCPCHs carrying FACH only shall not be counted). These SCCPCHs shall be indexed in the order of their occurrence in SIB 5 from 0 to K-1.

"Index of selected SCCPCH" identifies the selected SCCPCH with the PCH and the uniquely associated PICH to be used by the UE.

If the UE has no IMSI, for instance when making an emergency call without USIM, the UE shall use as default number IMSI = 0.

8.2 SCCPCH selection when entering Connected mode

When entering Connected mode from Idle mode by sending an RRC CONNECTION REQUEST message, the UE shall select the S-CCPCH which carries an FACH to be used for reception of the RRC CONNECTION SETUP message according to the following rule:

- the UE shall select an SCCPCH from the SCCPCHs listed in System Information Block type 5 (SIB 5) based on "Initial UE Identity" as follows:

  "Index of selected SCCPCH" = "Initial UE Identity" mod K,

  where K is equal to the number of listed SCCPCHs which carry a FACH (i.e. SCCPCHs carrying PCH only shall not be counted). These SCCPCHs shall be indexed from 0 to K-1 in the order of their occurrence in SIB 5, and "Index of selected SCCPCH" identifies the selected SCCPCH. "Initial UE Identity" refers to the Information Element included by the UE into the RRC CONNECTION REQUEST message. In the above formula, the parameter "Initial UE Identity" shall be interpreted as follows, depending on the choice of UE-Id type of the respective IE:

  For UE-Id type "IMSI (GSM-MAP)", i.e. the IE is given as sequence of digits of type Integer(0..9), "Initial UE Identity" shall be interpreted as an integer number, where the first digit given in the sequence represents the highest order digit.

  For UE-Id types "TMSI and LAI (GSM-MAP)" or "P-TMSI and RAI (GSM-MAP)", only the TMSI or P-TMSI parts given as Bitstring(32) shall be used, and "Initial UE Identity" shall be interpreted as a binary representation of an integer number, where the first bit in the Bitstring represents the highest order bit.

  For UE-Id type "IMEI", i.e. the IE is given as sequence of hexadecimal digits of type Integer(0..15), "Initial UE Identity" shall be interpreted as a hexadecimal representation of an integer number, where the first digit given in the sequence represents the highest order digit.

  For UE-Id type "IMSI (DS-41)", i.e. the IE is given as octet string, "Initial UE Identity" shall correspond to the decoded decimal representation of the IMSI-S part included in the octet string (see TIA/EIA/IS-2000-5).

  For UE-Id types "ESN (DS-41)" or "TMSI (DS-41)", i.e. the IE is given as Bitstring(32), "Initial UE Identity" shall be interpreted as a binary representation of an integer number, where the first bit in the Bitstring represents the highest order bit.

  For UE-Id type "IMSI and ESN (DS-41)" only the ESN part shall be used as "Initial UE Identity", as defined above.

8.3 Discontinuous Reception

The UE may use Discontinuous Reception (DRX) in idle mode in order to reduce power consumption. When DRX is used the UE needs only to monitor one Page Indicator, PI, (see definition in [7] and [8]) in one Paging Occasion per DRX cycle.

The DRX cycle length shall be MAX(2^k, PBP) frames, where k is an integer and PBP is the Paging Block Periodicity. PBP is only applicable for TDD and is equal to the PICH repetition period that is broadcast in system information. For FDD, PBP=1.

The UE may be attached to different CN domains with different CN domain specific DRX cycle lengths. The UE shall store each CN domain specific DRX cycle length for each CN domain the UE is attached to and use the shortest of those DRX cycle lengths. The CS CN specific DRX cycle length coefficient shall be updated locally in the UE using information given in system information. On the other hand, the PS CN specific DRX cycle length coefficient shall be updated after the negotiation between the UE and PS CN by NAS procedure. If no specific value "k" is negotiated in NAS procedure, the UE and PS CN shall use the DRX cycle length given for PS CN domain in system information.

The DRX cycle lengths to use for UTRAN connected mode is the shortest of the following:

- UTRAN DRX cycle length;

- any of the stored CN domain specific DRX cycle length for the CN domains the UE is only attached to with no signalling connection established.

The UE shall use the IMSI, the number of available SCCPCH which carry a PCH (K) as derived according to subclause 8.1,the Cell System Frame Number (SFN), Np (for FDD, Np is the number of page indicators within a frame; for TDD, Np is the number of page indicators within a paging block), Frame offset (For FDD, Frame offset = 0; for TDD, PICH frame offset values are given in system information), PBP and the DRX cycle length to determine the Paging Occasions.

In FDD the UE shall monitor its paging indicator in the PICH frame with SFN given by the Paging Occasion

In TDD the UE shall monitor its paging indicator in the paging block given by the Paging Occasion. The Paging Occasion gives the SFN of the first frame of the paging block.

The value of the Paging Occasion is determined as follows:

Paging Occasion= {(IMSI div K) mod (DRX cycle length div PBP)} * PBP + n * DRX cycle length + Frame Offset

Where n = 0,1,2… as long as SFN is below its maximum value.

The actual Page Indicator within a Paging Occasion that the UE shall read is similarly determined based on IMSI.

The Page Indicator to use is calculated by using the following formula:

PI = DRX Index mod Np

where DRX Index = IMSI div 8192

In FDD mode, Np = (18,36,72,144) is the number of Page Indicators per frame, and is given in IE "Number of PI per frame", part of system information in FDD mode. In TDD mode, Np is the number of Page Indicators per paging block and is calculated by the Paging Indicator Length $L_{PI,}$ the Burst Type (long or short midamble for 3.84 ~~Mpcs~~ Mcps TDD) and the PICH repetition length, which are given in system information.

If the UE has no IMSI, for instance when making an emergency call without USIM, the UE shall use as default numbers, IMSI = 0 and DRX cycle length = 256 (2.56 s), in the formulas above.

For FDD, see [7] for details about the timing between a PICH frame and when the paging message is transmitted on the PCH in the associated S-CCPCH frame.

In TDD mode, the Paging Message Receiving Occasion is calculated using the following formula:

Paging Message Receiving Occasion =Paging Occasion + N_{PICH} + N_{GAP} + {(DRX Index div Np) mod N_{PCH} } *2

The value N_{PICH} is the number of frames for PICH transmission and is equal to the PICH repetition length given in system information. The value N_{GAP} is the number of frames between the last frame carrying PICH for this Paging Occasion and the first frame carrying paging messages for this Paging Occasion. The value N_{PCH} is the number of Paging Groups. N_{PCH} and N_{GAP} are given in system information.

~~9 Multicast services~~

~~9.1 State diagram between the multicast service and DSCH~~

~~NOTE: DSCH for multicast services is not supported in the current release.~~

~~The multicast service relative to the DSCH consists of the following states:~~

- ~~MT_Null State;~~
- ~~MT_Monitor State;~~
- ~~MT_Saving State;~~
- ~~MT_Active State.~~

Figure 4 shows the multicast state diagram relative to the DSCH. The MT_Monitor State is a state for decoding the DSCH in order to monitor its multicast control data and the MT_Saving State is a state in which the UE savings for the supporting power saving feature.

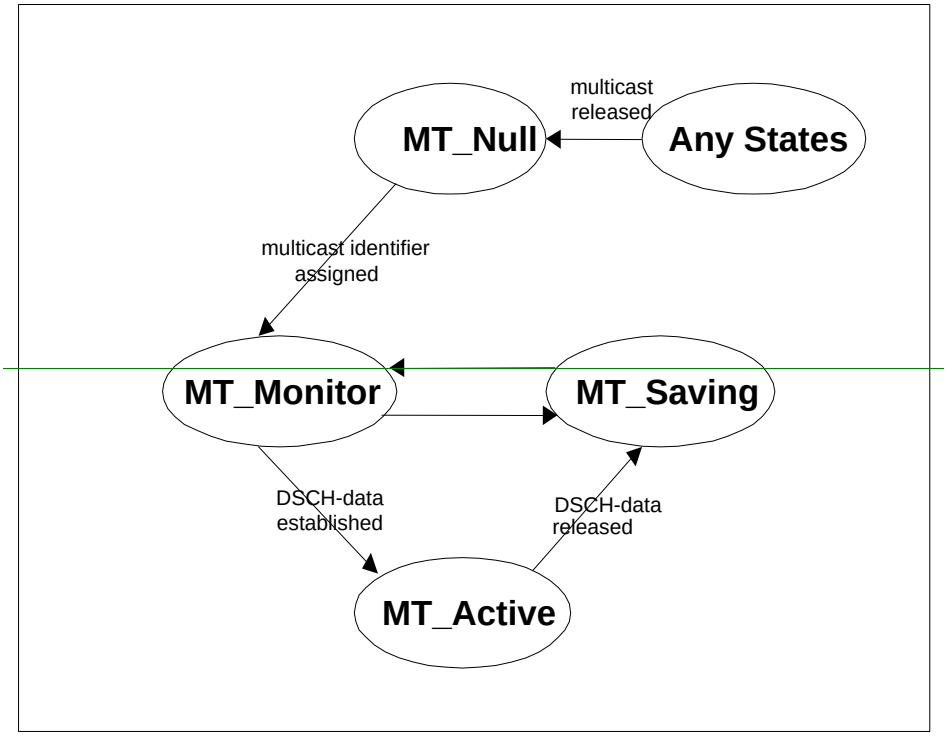


Figure 4: Multicast State Diagram relative to the DSCH, MT=MulTicast service

9.1.1 MT_Null State

a) Attributes

- Multicast service has not been activated.
- DSCH is not established.

b) Behaviour

- Waits for activation of multicast service.

9.1.2 MT_Monitor State

a) Attributes

- DSCH is monitored in order to decode the multicast control data that contains the assigned multicast identifier.

b) Behaviour

- Receives the DSCH control data on DSCH and confirms the assigned multicast identifier.

9.1.3 MT_Saving State

a) Attributes

- DSCH is not monitored for the control or the user data.

b) Behaviour

- FFS

9.1.4 MT_Active State

a) Attributes

- DSCH is not monitored for the control data.
- DSCH is monitored for the user data.

b) Behaviour

- Receives the multicast user data on the established DSCH.

---

9 Void

10 Examples of Procedures

10.1 NAS initiated change of system information

The sequence in Figure 5 shows the change of broadcast system information initiated from the ~~non-access stratum (~~NAS~~)~~.

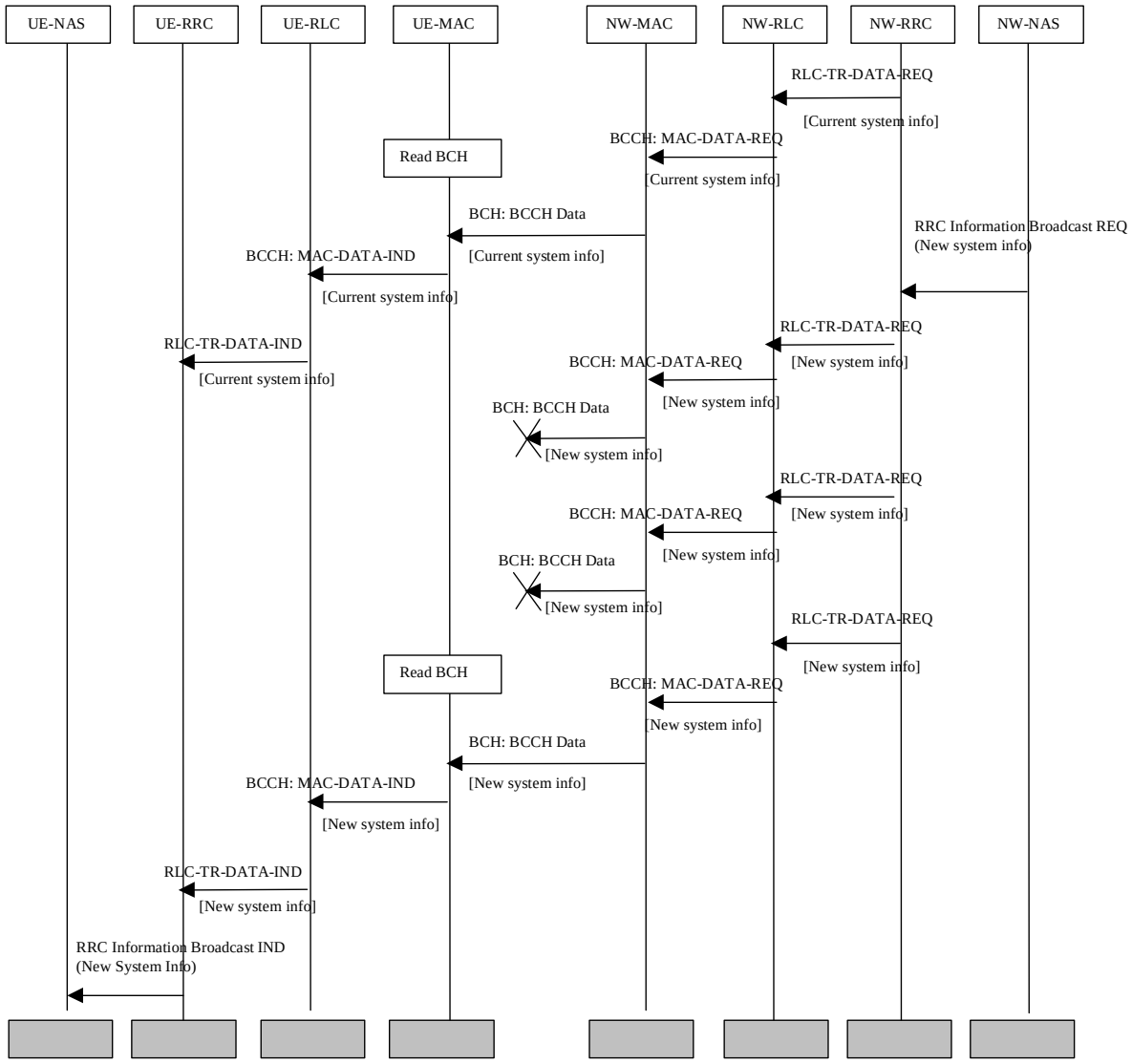


Figure 5: Example sequence, ~~non-access stratum~~NAS initiated change of broadcast system info

A ~~non-access stratum~~NAS entity in the network issues a request for change of the broadcast system information, by issuing a RRC Information Broadcast REQ primitive over the General Control (GC) SAP.

The change in system information in this example is such that it is not necessary for the UEs to be forced to receive BCCH immediately after the change. All UEs will eventually read the new system information either at e.g. cell reselection or at UE state change.

When the UE reads system information on BCCH and the RRC layer finds out that the non-access part of the information has been changed, an RRC Information Broadcast IND primitive is issued to the ~~non-access stratum~~NAS entity in the UE over the General Control (GC) SAP.

NOTE: The network may force the UEs in a paging group to read system information by sending a page request message, but this is not shown in the example above.

10.2 System Information Update to NAS

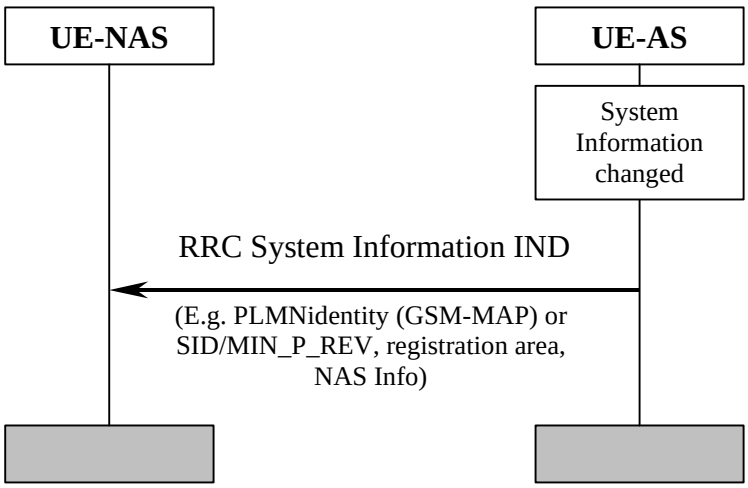


Figure 6: System Information Update to NAS

AS sends system information to NAS when a change of system information is detected in the cell currently camped on. This happens for instance when a new cell is selected due to cell reselection. The information sent can include PLMN identity (GSM-MAP or SID, registration area and NAS information. ~~The NAS information includes the identity of the NAS defined service area.~~

10.3 CN originated paging in idle mode

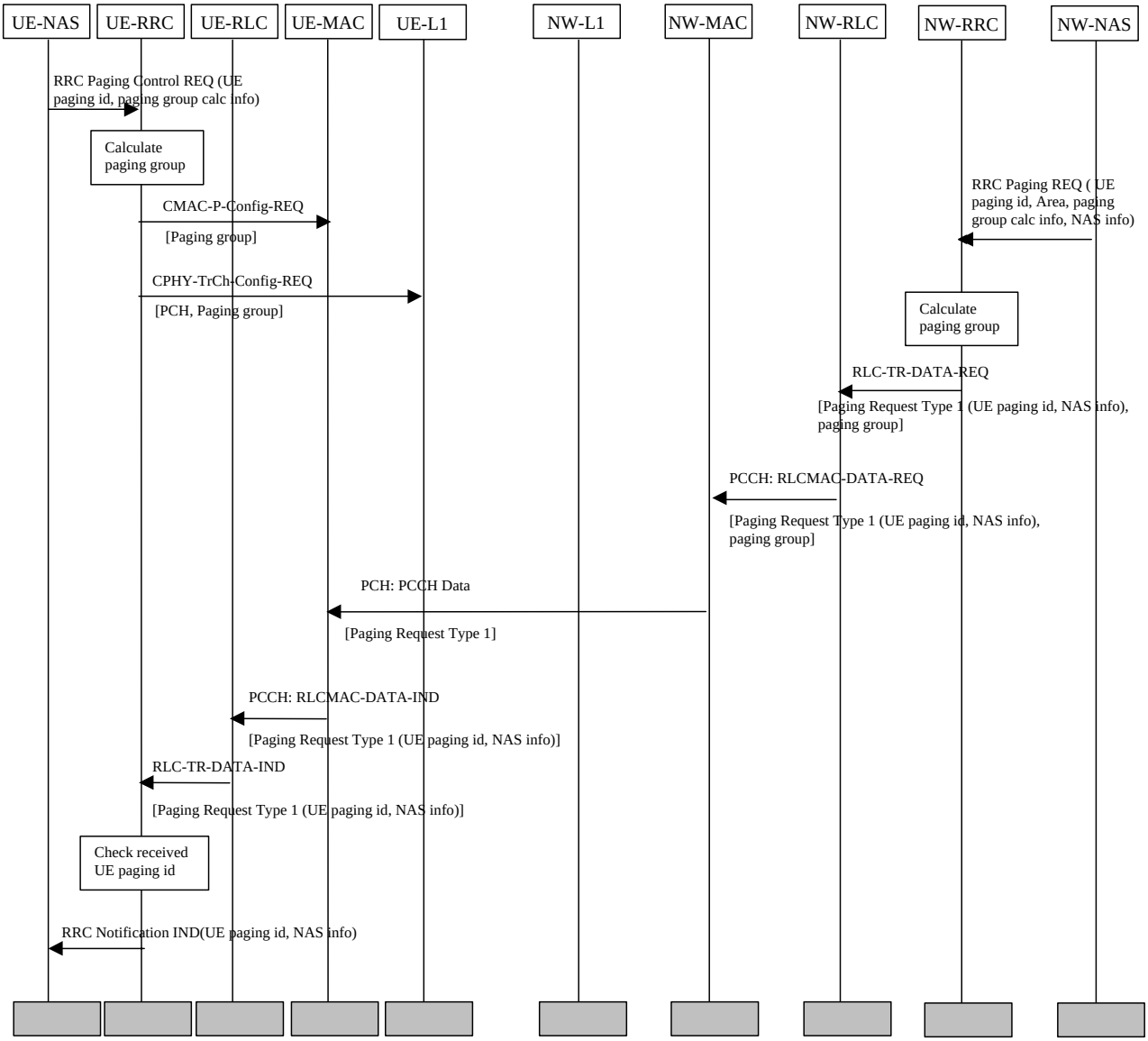


Figure 7: Example sequence of CN initiated paging request in idle mode

Figure 7 illustrates a CN originated paging request when the UE is in idle mode.

In the UE, a NAS entity issues the primitive RRC Paging Control REQ, which tells RRC to listen to paging and notifications addressed to a given UE paging identity and on a paging group which can be calculated using information given from NAS.

NOTE: The paging group calculation info can e.g. be the IMSI of the UE.

A NAS entity on the network side requests paging of an UE using the RRC Paging REQ primitive over the Nt-SAP. The primitive contains a UE paging identity, an area where the page request is to be broadcast, information for calculation of the paging group and NAS information to be transparently transmitted to the UE by the paging request.

The RRC layer calculates the paging group, and formats a Paging Request Type 1 message containing the UE paging identity and the NAS information The RRC layer then requests MAC to transmit the message on a specific PCH on the selected paging group. The PCH to be used for transmission of the paging message is selected based on the IMSI of the UE.

In the UE, the RRC layer continuously monitors the paging group compares the UE paging identities in received paging request messages with its own identities. A match occurs, and in this case the UE paging identity and the NAS information is forwarded to the NAS entity of the UE.

10.4 PLMN Selection, automatic mode, normal case

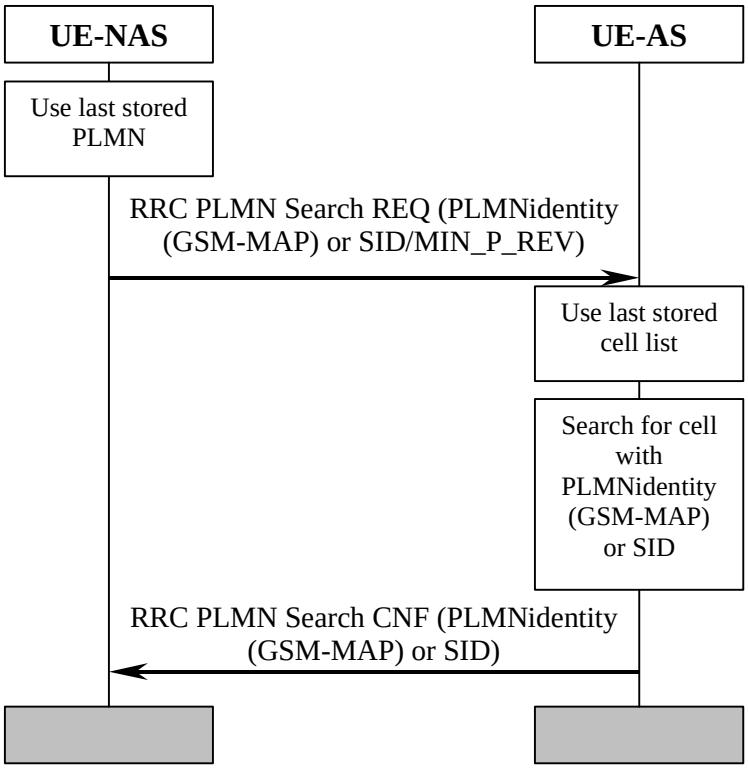


Figure 8: PLMN Selection, automatic mode, normal case

At power-on, ~~the non-access stratum (~~NAS~~)~~ selects the PLMN ~~with highest~~according to the priority defined in [5]~~,~~ ~~possibly the last PLMN stored prior to previous power off~~. The ~~access stratum (~~AS~~)~~ is requested to find a cell belonging to that PLMN. When searching for the requested PLMN and in order to speed up the search, AS may use a list of cell information stored prior to previous power-off. When a suitable cell belonging to the requested PLMN is found, that cell is selected and NAS is notified that the PLMN was found.

10.5 PLMN Reselection, automatic mode

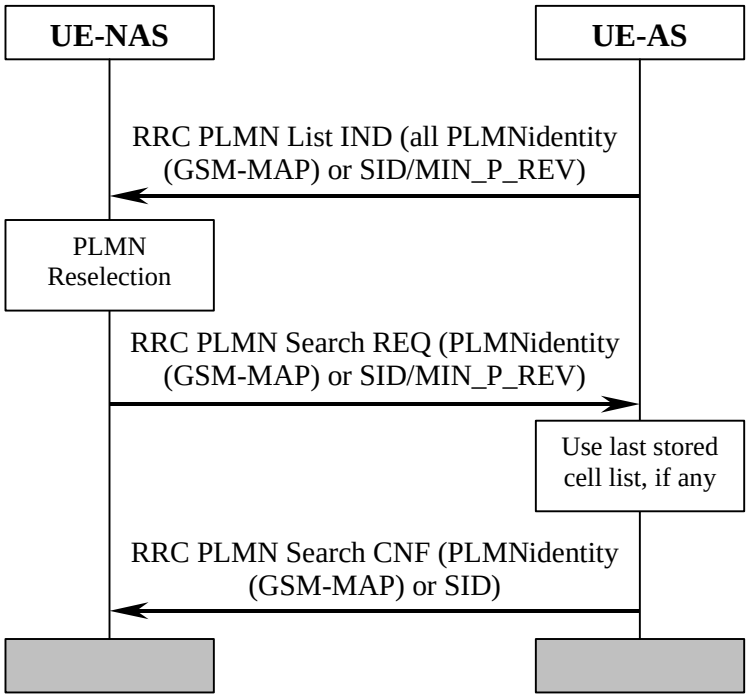


Figure 9: PLMN Reselection, automatic mode

Triggered by, for instance, a timer in NAS, AS is requested to send~~s~~ a list to NAS with all PLMNs currently available. The list includes the identities of available PLMNs and ~~possibly information about their NAS defined service area(s)~~. Assuming that a PLMN with higher priority is found, NAS requests AS to select a suitable cell belonging to the PLMN with highest priority. When searching for the requested PLMN and in order to speed up the search, AS may use a list of cell information previously stored~~, if any~~. When a suitable cell belonging to the requested PLMN is found, that cell is selected and NAS is notified that the PLMN was found.

10.6 PLMN Reselection, manual mode

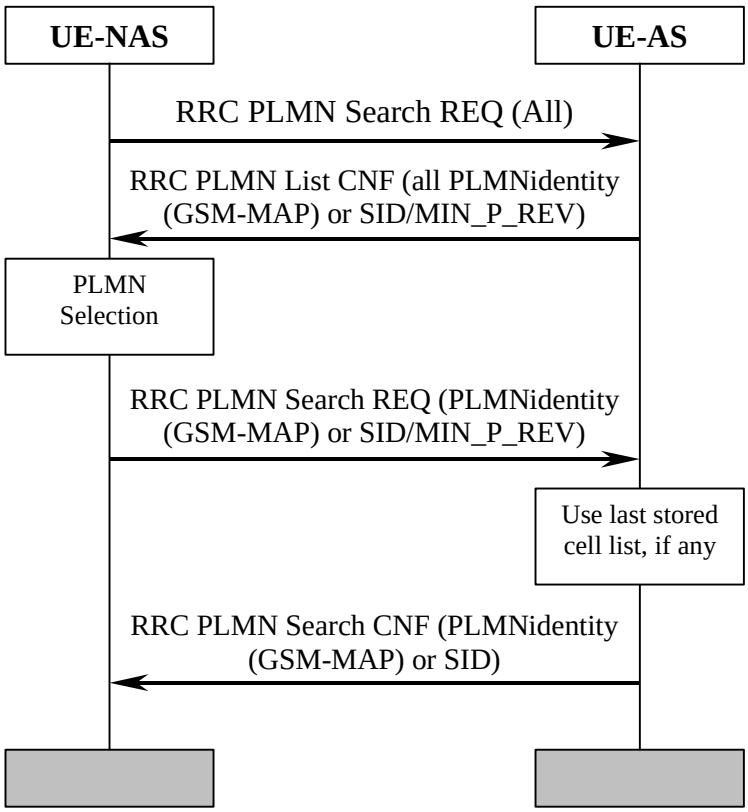


Figure 10: PLMN Reselection, manual mode

NAS requests AS to report all PLMNs currently available, for instance as a response to a user request. AS sends a list to NAS with all PLMNs currently available. The list includes the identities of available PLMNs ~~and possibly information about their NAS defined service area(s)~~. Assuming that a PLMN with higher priority is selected by for instance the user, NAS requests AS to select a suitable cell belonging to the PLMN with highest priority. When searching for the requested PLMN and in order to speed up the search, AS may use a list of cell information previously stored~~, if any~~. When a suitable cell belonging to the requested PLMN is found, that cell is selected and NAS is notified that the PLMN was found.

10.7 PLMN Selection, automatic mode, selected PLMN not found

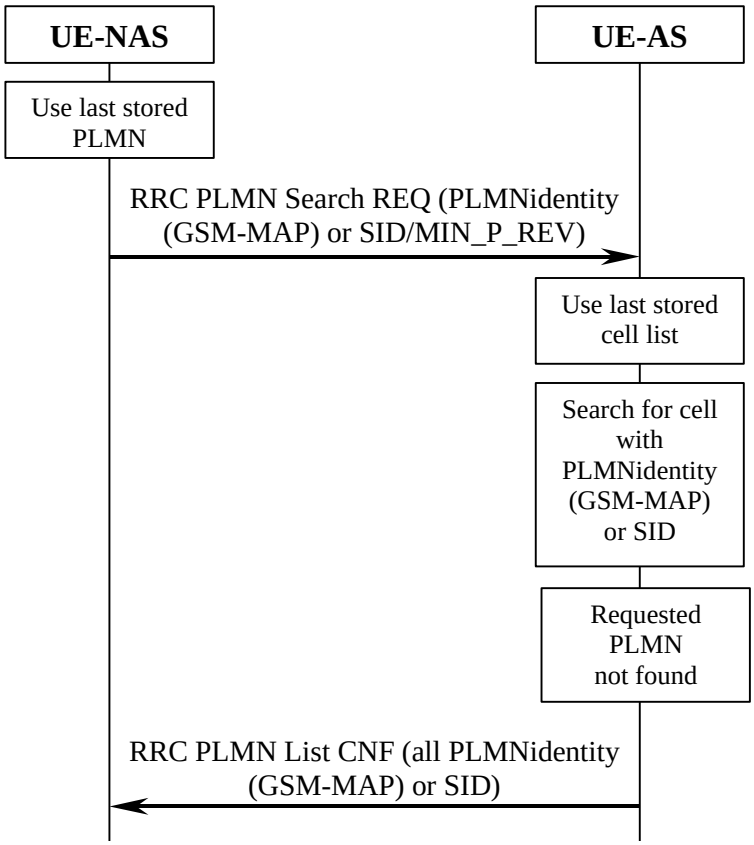


Figure 11: PLMN Selection, automatic mode, selected PLMN not found

At power-on, ~~the non-access stratum~~NAS selects the PLMN according to the~~with highest~~ priority defined in [5],~~ possibly from the list of PLMNs stored prior to previous power off.~~ The ~~access stratum~~ AS is requested to find a suitable cell belonging to that PLMN. When searching for the requested PLMN and in order to speed up the search, AS may use a list of cell information stored prior to previous power-off. If no suitable cell is found belonging to the requested PLMN, a list of available PLMNs is sent to NAS~~, indicating which PLMN has been temporarily chosen by AS~~.

10.8 NAS Controlled Cell Selection

10.8.1 Execution in ~~Access Stratum~~AS

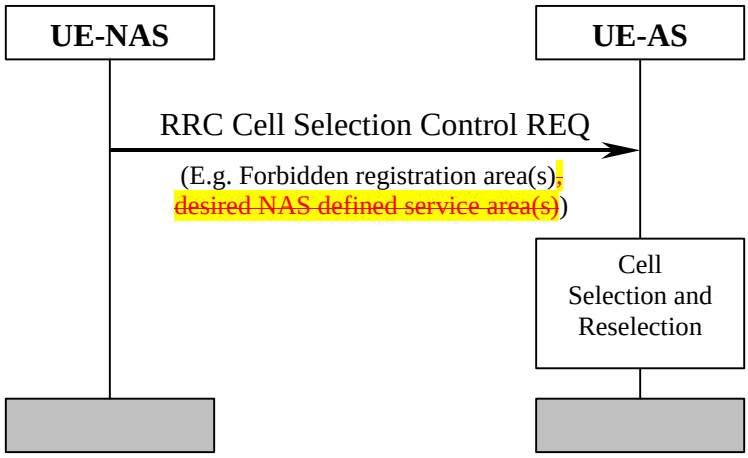


Figure 12: NAS Controlled Cell Selection, execution in AS

NAS may influence the cell selection and reselection by sending control information to AS. This information can include, for example, lists of forbidden registration areas ~~and a list of NAS defined service areas in priority order~~. The control information is used by AS in cell selection and reselection:

- Cells belonging to a forbidden registration area will only be selected if no better cell is found. At this point, the services provided the UE might be limited.

~~- Cells belonging to a NAS defined service area with higher priority than current service area will be considered better than the cell currently camped on. Depending on radio access mode, the most suitable cell in idle mode may not be the most suitable cell in connected mode.~~

10.8.2 Execution in ~~Non-Access Stratum~~NAS

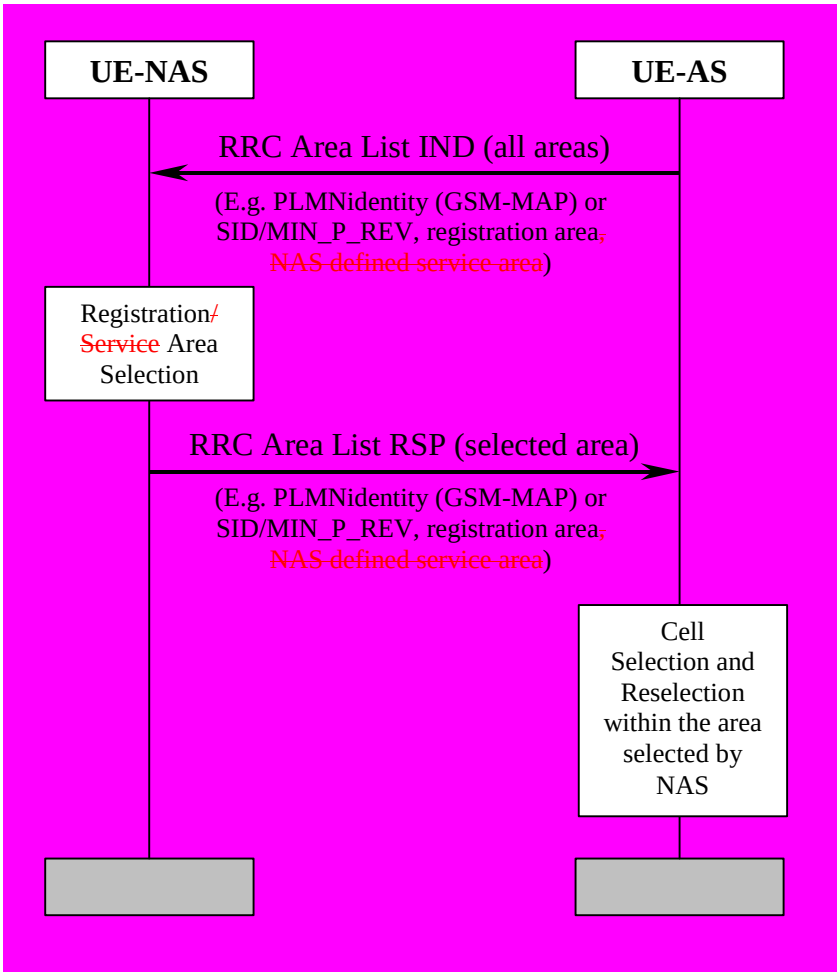


Figure 13: NAS Controlled Cell Selection, execution in NAS

As an alternative to the example in subclause ~~11~~10.8.1, AS sends cell selection information to NAS. This information can include PLMN identity (GSM-MAP) or SID and~~,~~ registration area~~ and NAS defined service area~~. The information contains the full set of available registration areas~~ and NAS defined service areas~~. The information is typically sent when there is a change of available areas, for instance when a neighbour cell belonging to a new registration area/ ~~NAS defined service area is found. Correspondingly, a new list of available areas is sent from AS to NAS when for instance coverage is lost from the cell currently camped on and that is the only cell belonging to the current NAS defined service area.~~

AS performs cell selection and reselection for the selected registration area~~/NAS defined service area~~ without interaction with NAS. However, before reselecting a cell in another registration area~~/NAS defined service area~~, AS ~~must~~ shall check with NAS.

Annex A (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
10/1999	RP-05	RP-99464	-	-	Approved at TSG-RAN #5 and placed under Change Control	-	3.0.0
12/1999	RP-06	RP-99632	001	2	Modification and editorial changes	3.0.0	3.1.0
	RP-06	RP-99633	002	3	Specification of Cell reselection procedures in	3.0.0	3.1.0
	RP-06	RP-99633	003	2	Integration of Cell Broadcast Service (CBS)	3.0.0	3.1.0
	RP-06	RP-99633	004	2	Measurement used as a quality estimate for cell	3.0.0	3.1.0
	RP-06	RP-99632	006		Discontinuous reception	3.0.0	3.1.0
	RP-06	RP-99633	008	3	Barred Cells and Access Control	3.0.0	3.1.0
	RP-06	RP-99633	009		Introduction of network control of UE measurement	3.0.0	3.1.0
	RP-06	RP-99631	011		Editorial issues	3.0.0	3.1.0
03/2000	RP-07	RP-000037	007	2	Cell Selection for DS-41 mode	3.1.0	3.2.0
	RP-07	RP-000037	014		Modified description of cell search procedure	3.1.0	3.2.0
	RP-07	RP-000037	018	1	UE individual DRX cycles in CELL_PCH and URA_PCH states	3.1.0	3.2.0
	RP-07	RP-000037	019	1	Cell re-selection criteria including HCS	3.1.0	3.2.0
	RP-07	RP-000037	021		Modified description of DRX	3.1.0	3.2.0
06/2000	RP-08	RP-000217	025		Triggering of inter-system measurements for cell re-selection when HCS is used	3.2.0	3.3.0
	RP-08	RP-000217	026	5	Cell re-selection	3.2.0	3.3.0
	RP-08	RP-000217	027	4	Access Control	3.2.0	3.3.0
	RP-08	RP-000217	028		Downlink signalling failure	3.2.0	3.3.0
	RP-08	RP-000217	029		Cell-reselection parameter signalling	3.2.0	3.3.0
	RP-08	RP-000217	030		Cell Selection and Reselection	3.2.0	3.3.0
	RP-08	RP-000217	031	1	CN DRX cycle coefficient	3.2.0	3.3.0
09/2000	RP-09	RP-000355	035	2	Paging channel selection	3.3.0	3.4.0
	RP-09	RP-000355	037	1	Editorial corrections	3.3.0	3.4.0
	RP-09	RP-000355	039		HCS measurement rules	3.3.0	3.4.0
	RP-09	RP-000355	042	2	Usage of Ec/N0 measurement quantity for cell ranking	3.3.0	3.4.0
	RP-09	RP-000355	044		Correction and restructuring	3.3.0	3.4.0
12/2000	RP-10	RP-000565	046	1	Support for PLMN selection	3.4.0	3.5.0
	RP-10	RP-000565	049	1	Correction of algorithm for paging channel selection	3.4.0	3.5.0
	RP-10	RP-000565	050		Alignment of use of TEMP_OFFSET parameters with TS 25.331	3.4.0	3.5.0
	RP-10	RP-000565	051	2	Clarifications and Editorial Corrections	3.4.0	3.5.0
	RP-10	RP-000565	052	1	Clarifications to cell selection and reselection procedures	3.4.0	3.5.0
	RP-10	RP-000565	053		Removal of immediate cell evaluation	3.4.0	3.5.0
	RP-10	RP-000565	054		One step cell selection	3.4.0	3.5.0
03/2001	RP-11	RP-010022	055	1	Usage of HCS Parameters in Cell Reselection	3.5.0	3.6.0
	RP-11	RP-010022	056		Clarification of usage of "Initial UE-Id" for SCCPCH selection	3.5.0	3.6.0
	RP-11	RP-010022	058		Clarification of paging occasion	3.5.0	3.6.0
	RP-11	RP-010022	059	1	Correction in Any Cell Selection State	3.5.0	3.6.0
	RP-11	RP-010022	061		Correction to the definition of a suitable cell	3.5.0	3.6.0
	RP-11	RP-010022	062		Correction to discontinuous reception in TDD	3.5.0	3.6.0
	RP-11	RP-010022	063	1	Correction of PI calculation for Paging DRX	3.5.0	3.6.0
	RP-11	RP-010200	064	3	Equivalent PLMN codes	3.5.0	3.6.0
	RP-11	RP-010022	065		High quality cell in PLMN selection	3.5.0	3.6.0
	RP-11	RP-010022	066		Clean-up	3.5.0	3.6.0
	RP-11	RP-010037	057	1	Support of 1.28Mcps TDD	3.6.0	4.0.0

3GPP TSG-RAN WG2 Meeting #21
Busan, Korea, 21-25 May 2001

R2-011401

CR-Form-v4

CHANGE REQUEST

⌘ **25.304** **CR** **073** ⌘ ev **r1** ⌘ Current version: **3.6.0** ⌘

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

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

Title:	⌘	Emergency calls in barred cells
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	2001-05-25
Category:	⌘	**F**
Release:	⌘	R99

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

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

Reason for change:	⌘	Different parts of 25.304 contradict each other concerning whether emergency calls are allowed on barred cells or not.
Summary of change:	⌘	Removal of text that incorrectly defines the minimum requirements for initiating an emergency call in UMTS. Clarifying text about when emergency calls are allowed is also introduced.
Consequences if not approved:	⌘	The current version of the specification may lead to inconsistent UE behavior.

Clauses affected:	⌘	4.3, 5.3.1.1, 5.3.1.3
Other specs affected:	⌘	☐ Other core specifications ⌘ ☐ Test specifications ☐ O&M Specifications
Other comments:	⌘	The use of the concept of barred cell in TS 25.331 will need to be aligned with the change proposed here.

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

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

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

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

4.3 Service type 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 in idle mode:

- 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 UTRAN network~~:

- The cell is not barred, see subclause 5.3.4.1
- The cell selection criteria are fulfilled, see subclause 5.2.3.1.2;

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 the selected PLMN or, for cell reselection only, of a PLMN considered as equivalent by the UE according to the information provided by the NAS.
- The cell is not barred, see subclause 5.3.4.1.
- The cell is not part of the list of "forbidden LAs for regional provision of service" [9].
- The cell selection criteria are fulfilled, see subclause 5.2.3.1.2.
- The SoLSA criteria are fulfilled [SoLSA support is not in the current release].

barred cell:
A cell is barred if it is so indicated in the system information [4].

---------- Next change ----------

5.3 Cell Access Restrictions

5.3.1 UTRA cells

There are two mechanisms which allow an operator to impose cell 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 [9], which are employed for this purpose.

5.3.1.1 Cell status and cell reservations

Cell status and cell reservations are indicated with the *Cell Access Restriction* Information Element in the System Information Message [4] by means of three Information Elements:

- Cell barred (IE type: "barred" or "not barred"),
- Cell Reserved for operator use (IE type: "reserved" or "not reserved"),

- Cell Reserved for SoLSA exclusive use (IE type: "reserved" or "not reserved").

When cell status is indicated as "not barred", "not reserved" for operator use, and "not reserved" for SoLSA,
- the UE may select/re-select this cell during the cell selection and cell re-selection procedures in Idle mode and in Connected mode.

When cell status is indicated as "not barred", "not reserved" for operator use, and "reserved" for SoLSA,
- UEs not supporting SoLSA shall behave as if cell status "barred" is indicated (see below).

When cell status is indicated as "not barred", "reserved" for operator use,
- UEs assigned to an Access Class in the range 11 to 15 may select/re-select this cell if in the home PLMN.

- UEs assigned to an Access Class in the range 0 to 9 shall behave as if cell status "barred" is indicated (see below).

When cell status "barred" is indicated,

- If the cell is not barred for emergency calls, see subclause 5.3.1.3, ~~and the UE is not camped on another cell,~~ the UE is allowed to select the cell to initiate an emergency call.

- The UE is not allowed to reselect this cell.

- ~~the UE is not permitted to select/re-select this cell, except for emergency call, when no other acceptable cell can be found, and the cell is not barred for emergency call by means of the "Access Class 10 bit", see clause 5.3.1.3.~~

- The UE shall ignore the "Cell Reserved for SoLSA exclusive use" IE.

- The UE shall select another cell according to the following rule:

  - If the "Intra-frequency cell re-selection indicator" IE in Cell Access Restriction IE is set to value "allowed", the UE may select another cell on the same frequency if selection/re-selection criteria are fulfilled.

    - If the UE is camping on another cell, the UE shall exclude the barred cell from the neighbouring cell list until the expiry of a time interval T_{barred}. The time interval T_{barred} is sent via system information in a barred cell together with Cell status information in the Cell Access Restriction IE.

    - If the UE does not select another cell, and the barred cell remains to be the "best" one, the UE shall after expiry of the time interval T_{barred} again check whether the status of the barred cell has changed.

  - If the "Intra-frequency cell re-selection indicator" IE is set to "not allowed" the UE shall not re-select a cell on the same frequency as the barred cell. For emergency call, the Intra-frequency cell re-selection indicator IE" shall be ignored, i.e. even if it is set to "not allowed" the UE may select another intra-frequency cell.

    - If the barred cell remains to be the "best" one, the UE shall after expiry of the time interval T_{barred} again check whether the status of the barred cell has changed.

5.3.1.2 Access Control

Information on cell access restrictions associated with the Access Classes is broadcast as system information, [4].
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 before sending an RRC CONNECTION REQUEST message when entering Connected Mode from UTRAN Idle mode. Cell access restrictions associated with the Access Classes shall not apply when the initial access for entering Connected Mode is triggered by an Inter-RAT cell re-selection to UTRAN, and for a UE which already is in Connected Mode.

5.3.1.3 Emergency Call

For UEs with access classes 0 to 9 or without an IMSI, emergency calls shall be allowed in all cells, including cells reserved for operator use and barred cells, expect when restrictions on emergency calls are indicated in the "Access class barred list" IE [4]. 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 . Full details of operation under "Access class barred list" are described in [9].

~~Generally, emergency calls shall be allowed in all cells whose barred status is not barred, independent of restrictions due to cell reservations.~~
~~A restriction on emergency calls, if needed, shall be indicated in the "Access class barred list" IE [4]. Full details of operation under "Access class barred list" are described in [9].~~

3GPP TSG-RAN WG2 Meeting #21
Busan, Korea, 21-25 May 2001

R2-011402

CR-Form-v4

CHANGE REQUEST

⌘ **25.304** **CR** **074** ⌘ ev **-** ⌘ Current version: **4.0.0** ⌘

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

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

Title:	⌘	Emergency calls in barred cells
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	2001-05-25
Category:	⌘	**A**
Release:	⌘	REL-4

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

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

Reason for change:	⌘	Different parts of 25.304 contradict each other concerning whether emergency calls are allowed on barred cells or not.
Summary of change:	⌘	Removal of text that incorrectly defines the minimum requirements for initiating an emergency call in UMTS. Clarifying text about when emergency calls are allowed is also introduced.
Consequences if not approved:	⌘	The current version of the specification may lead to inconsistent UE behavior.

Clauses affected:	⌘	4.3, 5.3.1.1, 5.3.1.3
Other specs affected:	⌘	☐ Other core specifications ⌘ ☐ Test specifications ☐ O&M Specifications
Other comments:	⌘	The use of the concept of barred cell in TS 25.331 will need to be aligned with the change proposed here.

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

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

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

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

4.3 Service type 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 in idle mode:

- 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 UTRAN network~~:

- The cell is not barred, see subclause 5.3.4.1
- The cell selection criteria are fulfilled, see subclause 5.2.3.1.2;

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 the selected PLMN or, for cell reselection only, of a PLMN considered as equivalent by the UE according to the information provided by the NAS.
- The cell is not barred, see subclause 5.3.4.1.
- The cell is not part of the list of "forbidden LAs for regional provision of service" [9].
- The cell selection criteria are fulfilled, see subclause 5.2.3.1.2.
- The SoLSA criteria are fulfilled [SoLSA support is not in the current release].

barred cell:
A cell is barred if it is so indicated in the system information [4].

---------- Next change ----------

5.3 Cell Access Restrictions

5.3.1 UTRA cells

There are two mechanisms which allow an operator to impose cell 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 [9], which are employed for this purpose.

5.3.1.1 Cell status and cell reservations

Cell status and cell reservations are indicated with the *Cell Access Restriction* Information Element in the System Information Message [4] by means of three Information Elements:

- Cell barred (IE type: "barred" or "not barred"),
- Cell Reserved for operator use (IE type: "reserved" or "not reserved"),

- Cell Reserved for SoLSA exclusive use (IE type: "reserved" or "not reserved").

When cell status is indicated as "not barred", "not reserved" for operator use, and "not reserved" for SoLSA,
- the UE may select/re-select this cell during the cell selection and cell re-selection procedures in Idle mode and in Connected mode.

When cell status is indicated as "not barred", "not reserved" for operator use, and "reserved" for SoLSA,
- UEs not supporting SoLSA shall behave as if cell status "barred" is indicated (see below).

When cell status is indicated as "not barred", "reserved" for operator use,
- UEs assigned to an Access Class in the range 11 to 15 may select/re-select this cell if in the home PLMN.

- UEs assigned to an Access Class in the range 0 to 9 shall behave as if cell status "barred" is indicated (see below).

When cell status "barred" is indicated,

- If the cell is not barred for emergency calls, see subclause 5.3.1.3, ~~and the UE is not camped on another cell,~~ the UE is allowed to select the cell to initiate an emergency call.

- The UE is not allowed to reselect this cell.

- ~~the UE is not permitted to select/re-select this cell, except for emergency call, when no other acceptable cell can be found, and the cell is not barred for emergency call by means of the "Access Class 10 bit", see clause 5.3.1.3.~~

- The UE shall ignore the "Cell Reserved for SoLSA exclusive use" IE.

- The UE shall select another cell according to the following rule:

  - If the "Intra-frequency cell re-selection indicator" IE in Cell Access Restriction IE is set to value "allowed", the UE may select another cell on the same frequency if selection/re-selection criteria are fulfilled.

    - If the UE is camping on another cell, the UE shall exclude the barred cell from the neighbouring cell list until the expiry of a time interval T_{barred}. The time interval T_{barred} is sent via system information in a barred cell together with Cell status information in the Cell Access Restriction IE.

    - If the UE does not select another cell, and the barred cell remains to be the "best" one, the UE shall after expiry of the time interval T_{barred} again check whether the status of the barred cell has changed.

  - If the "Intra-frequency cell re-selection indicator" IE is set to "not allowed" the UE shall not re-select a cell on the same frequency as the barred cell. For emergency call, the Intra-frequency cell re-selection indicator IE" shall be ignored, i.e. even if it is set to "not allowed" the UE may select another intra-frequency cell.

    - If the barred cell remains to be the "best" one, the UE shall after expiry of the time interval T_{barred} again check whether the status of the barred cell has changed.

5.3.1.2 Access Control

Information on cell access restrictions associated with the Access Classes is broadcast as system information, [4].
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 before sending an RRC CONNECTION REQUEST message when entering Connected Mode from UTRAN Idle mode. Cell access restrictions associated with the Access Classes shall not apply when the initial access for entering Connected Mode is triggered by an Inter-RAT cell re-selection to UTRAN, and for a UE which already is in Connected Mode.

5.3.1.3 Emergency Call

For UEs with access classes 0 to 9 or without an IMSI, emergency calls shall be allowed in all cells, including cells reserved for operator use and barred cells, expect when restrictions on emergency calls are indicated in the "Access class barred list" IE [4]. 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 . Full details of operation under "Access class barred list" are described in [9].

~~Generally, emergency calls shall be allowed in all cells whose barred status is not barred, independent of restrictions due to cell reservations.~~
~~A restriction on emergency calls, if needed, shall be indicated in the "Access class barred list" IE [4]. Full details of operation under "Access class barred list" are described in [9].~~

3GPP TSG-RAN WG2 Meeting #21
Busan, South Korea, 21st–25th May 2001

Tdoc R2-011417

CR-Form-v4

CHANGE REQUEST

⌘ **25.304** **CR** **077** ⌘ ev **r1** ⌘ Current version: **3.6.0** ⌘

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

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

Title:	⌘	Clarification to usage of measurement thresholds
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	24th May 2001
Category:	⌘	**F**
Release:	⌘	R99

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

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

Reason for change: ⌘ Currently, it is not specified how UE should behave if measurement thresholds expected for HCS are not sent.

In R2-011280, an inconsistency between ASN.1 and tabular in 25.331 has been identified with respect to parameter $S_{limit,SearchRATm}$. It is MP in the ASN.1, it should however be optional.

Summary of change: ⌘ Usage of parameters $S_{HCS,RATm}$, $S_{limit,SearchRATm}$, $S_{intersearch}$ and $S_{intrasearch}$ is clarified.

Backward Compatibility Analysis:

- $S_{limit,SearchRATm}$: Correction to a function where the specification was :
  - Containing some contradictions.

Would not affect implementations behaving like indicated in the CR, would affect implementations supporting the corrected functionality otherwise.

Affected function: Measurement rules for cell reselection.

It is proposed that UE ignores $S_{limit,SearchRATm}$ if it is sent in case HCS is not used.

- $S_{HCS,RATm}$, $S_{intrasearch}$ and $S_{intersearch}$: Correction to a function where the specification was :
  - ambiguous or not sufficiently explicit.

Would not affect implementations behaving like indicated in the CR, would affect implementations supporting the corrected functionality otherwise.

Affected function: Measurement rules for cell reselection in HCS.

The related change is necessary in order to clarify UE behaviour in case these parameters

		are not sent when HCS is used. It is proposed that UE shall measure on all affected cells and shall not apply any measurement rules in these cases. Since UTRAN is expected to send these values in case HCS is used, this scenario is assumed to be not very likely.
Consequences if not approved:	⌘	Ambiguous specification.

Clauses affected:	⌘	5.2.6.1.1, 5.2.6.1.2		
Other specs affected:	⌘	☐ Other core specifications ☐ Test specifications ☐ O&M Specifications	⌘	
Other comments:	⌘			

How to create CRs using this form:

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

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.
2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.
3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

5.2.6 Cell Reselection Evaluation Process

5.2.6.1 UTRA case

The cell reselection process is specified in the following sub-clauses:

5.2.6.1.1 Measurement rules for cell re-selection when HCS is not used

If the system information broadcast in the serving cell indicates that HCS is not used, then for intra-frequency and inter-frequency measurements and inter-RAT measurements, the UE shall:

- use Squal for FDD cells and Srxlev for TDD for Sx and apply the following rules.

1. If Sx > $S_{intrasearch}$, UE need not perform intra-frequency measurements.
   If Sx <= $S_{intrasearch,}$ perform intra-frequency measurements.
   If $S_{intrasearch,}$ is not sent for serving cell, perform intra-frequency measurements.

2. If Sx > $S_{intersearch}$, UE need not perform inter-frequency measurements
   If Sx <= $S_{intersearch}$, perform inter-frequency measurements.
   If $S_{intersearch}$, is not sent for serving cell, perform inter-frequency measurements.

3. If Sx > $Ssearch_{RAT\ m}$, UE need not perform measurements on cells of RAT "m".
   If Sx <= $Ssearch_{RAT\ m}$, perform measurements on cells of RAT "m".
   If $Ssearch_{RAT\ m}$, is not sent for serving cell, perform measurements on cells of RAT "m".

If HCS is not used and if $S_{limit,SearchRATm}$ is sent for serving cell, UE shall ignore it.

5.2.6.1.2 Measurement rules for cell re-selection when HCS is used

If the system information broadcast in the serving cell indicates that HCS is used, then for intra-frequency and inter-frequency measurements, the UE shall:

1. For intra-frequency and inter-frequency threshold-based measurement rules

   use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

   IF ($Srxlev_s$ <= $Ssearch_{HCS}$) or (if FDD and S_x <= $S_{intersearch}$) THEN

      measure on all intra-frequency and inter-frequency cells

   ELSE

      IF (S_x > $S_{intrasearch}$) THEN

         measure on all intra-frequency and inter-frequency cells, which have higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

      ELSE

         measure on all intra-frequency and inter-frequency cells, which have equal or higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

      ENDIF

   ENDIF

If HCS is used and if $S_{intersearch}$ is not sent for the serving cell, UE shall measure on all intra-frequency and inter-frequency cells.

If HCS is used and if $S_{intrasearch}$ is not sent for the serving cell, UE shall measure on all intra-frequency and inter-frequency cells.

2. For intra-frequency and inter-frequency measurement rules for fast-moving UEs:

   If the number of cell reselections during time period T_{CRmax} exceeds N_{CR}, high-mobility has been detected. In this high-mobility state, UE shall

   - measure intra-frequency and inter-frequency neighbouring cells, which have equal or lower HCS priority than serving cell.
   - prioritise re-selection of intra-frequency and inter-frequency neighbouring cells on lower HCS priority level before neighbouring cells on same HCS priority level.

   When the number of cell reselections during time period T_{CRmax} no longer exceeds N_{CR}, UE shall

   - continue these measurements during time period $T_{CrmaxHyst}$, and
   - revert to measurements according to the threshold based measurement rules.

When serving cell belongs to a hierarchical cell structure, the UE shall follow these rules for Inter-RAT measurements:

1. Inter-RAT threshold-based measurement rules

   use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

   IF ($Srxlev_s$ <= $S_{HCS,RATm}$) or (if FDD and S_{qual} <= $S_{SearchRATm}$) THEN

      UE shall measure on all inter-RATm cells

   ELSE

      IF (S_x > $S_{limit,SearchRATm}$) THEN

         UE need not measure neighbouring cells in RAT "m"

      ELSE

         UE shall measure on all neighbouring cells in RAT "m", which have equal or higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

      ENDIF

   ENDIF

   If HCS is used and if $S_{HCS,RATm}$ is not sent for the serving cell, UE shall measure on all inter-RATm cells.

2. Inter-RAT measurement rules for fast-moving UEs

   - If the number of cell reselections during time period T_{CRmax} exceeds N_{CR}, high-mobility has been detected. In this high-mobility state, UE shall
     - measure the neighbouring cells in RAT "m", which have an equal or lower HCS priority than the serving cell
     - prioritise re-selection of neighbouring cells in RAT "m" on lower HCS priority level before neighbouring cells in RAT "m" on same HCS priority level.

     When the number of cell reselections during time interval T_{CRmax} no longer exceeds N_{CR}, UE shall

     - continue these measurements during time period $T_{CrmaxHyst}$, and
     - revert to measure according to the threshold-based measurement rules.

3GPP TSG-RAN WG2 Meeting #21
Busan, South Korea, 21st–25th May 2001

Tdoc R2-011418

CR-Form-v4

CHANGE REQUEST

⌘ **25.304** **CR** **078** ⌘ ev **-** ⌘ Current version: **4.0.0** ⌘

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

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

Title:	⌘	Clarification to usage of measurement thresholds
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	25th May 2001
Category:	⌘	**A**
Release:	⌘	REL-4

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

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

Reason for change:	⌘	Currently, it is not specified how UE should behave if measurement thresholds expected for HCS are not sent. In R2-011280, an inconsistency between ASN.1 and tabular in 25.331 has been identified with respect to parameter $S_{limit,SearchRATm}$. It is MP in the ASN.1, it should however be optional.
Summary of change:	⌘	Usage of parameters $S_{HCS,RATm}$, $S_{limit,SearchRATm}$, $S_{intersearch}$ and $S_{intrasearch}$ is clarified. It is proposed that UE ignores $S_{limit,SearchRATm}$ if it is sent in case HCS is not used. $S_{HCS,RATm}$, $S_{intrasearch}$ and $S_{intersearch}$: The related change is necessary in order to clarify UE behaviour in case these parameters are not sent when HCS is used. It is proposed that UE shall measure on all affected cells and shall not apply any measurement rules in these cases. Since UTRAN is expected to send these values in case HCS is used, this scenario is assumed to be not very likely.
Consequences if not approved:	⌘	Ambiguous specification.

Clauses affected:	⌘	5.2.6.1.1, 5.2.6.1.2
Other specs affected:	⌘	☐ Other core specifications ⌘ ☐ Test specifications ☐ O&M Specifications
Other comments:	⌘	This CR is shadow CR to CR 77 to 25.304 v3.6.0 (R2-011417)

How to create CRs using this form:

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

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

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

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

5.2.6 Cell Reselection Evaluation Process

5.2.6.1 UTRA case

The cell reselection process is specified in the following sub-clauses:

5.2.6.1.1 Measurement rules for cell re-selection when HCS is not used

If the system information broadcast in the serving cell indicates that HCS is not used, then for intra-frequency and inter-frequency measurements and inter-RAT measurements, the UE shall:

- use Squal for FDD cells and Srxlev for TDD for Sx and apply the following rules.

1. If Sx > $S_{intrasearch}$, UE need not perform intra-frequency measurements.
   If Sx <= $S_{intrasearch,}$ perform intra-frequency measurements.
   If $S_{intrasearch,}$ is not sent for serving cell, perform intra-frequency measurements.

2. If Sx > $S_{intersearch}$, UE need not perform inter-frequency measurements
   If Sx <= $S_{intersearch}$, perform inter-frequency measurements.
   If $S_{intersearch}$, is not sent for serving cell, perform inter-frequency measurements.

3. If Sx > $Ssearch_{RAT\ m}$, UE need not perform measurements on cells of RAT "m".
   If Sx <= $Ssearch_{RAT\ m}$, perform measurements on cells of RAT "m".
   If $Ssearch_{RAT\ m}$, is not sent for serving cell, perform measurements on cells of RAT "m".

If HCS is not used and if $S_{limit,SearchRATm}$ is sent for serving cell, UE shall ignore it.

5.2.6.1.2 Measurement rules for cell re-selection when HCS is used

If the system information broadcast in the serving cell indicates that HCS is used, then for intra-frequency and inter-frequency measurements, the UE shall:

1. For intra-frequency and inter-frequency threshold-based measurement rules

   use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

   IF ($Srxlev_s$ <= $Ssearch_{HCS}$) or (if FDD and S_x <= $S_{intersearch}$) THEN

      measure on all intra-frequency and inter-frequency cells

   ELSE

      IF (S_x > $S_{intrasearch}$) THEN

         measure on all intra-frequency and inter-frequency cells, which have higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

      ELSE

         measure on all intra-frequency and inter-frequency cells, which have equal or higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

      ENDIF

   ENDIF

If HCS is used and if $S_{intersearch}$ is not sent for the serving cell, UE shall measure on all intra-frequency and inter-frequency cells.

If HCS is used and if $S_{intrasearch}$ is not sent for the serving cell, UE shall measure on all intra-frequency and inter-frequency cells.

2. For intra-frequency and inter-frequency measurement rules for fast-moving UEs:

   If the number of cell reselections during time period T_{CRmax} exceeds N_{CR}, high-mobility has been detected. In this high-mobility state, UE shall

   - measure intra-frequency and inter-frequency neighbouring cells, which have equal or lower HCS priority than serving cell.
   - prioritise re-selection of intra-frequency and inter-frequency neighbouring cells on lower HCS priority level before neighbouring cells on same HCS priority level.

   When the number of cell reselections during time period T_{CRmax} no longer exceeds N_{CR}, UE shall

   - continue these measurements during time period $T_{CrmaxHyst}$, and
   - revert to measurements according to the threshold based measurement rules.

When serving cell belongs to a hierarchical cell structure, the UE shall follow these rules for Inter-RAT measurements:

1. Inter-RAT threshold-based measurement rules

   use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

   IF ($Srxlev_s$ <= $S_{HCS,RATm}$) or (if FDD and S_{qual} <= $S_{SearchRATm}$) THEN

      UE shall measure on all inter-RATm cells

   ELSE

      IF (S_x > $S_{limit,SearchRATm}$) THEN

         UE need not measure neighbouring cells in RAT "m"

      ELSE

         UE shall measure on all neighbouring cells in RAT "m", which have equal or higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

      ENDIF

   ENDIF

   If HCS is used and if $S_{HCS,RATm}$ is not sent for the serving cell, UE shall measure on all inter-RATm cells.

2. Inter-RAT measurement rules for fast-moving UEs

   - If the number of cell reselections during time period T_{CRmax} exceeds N_{CR}, high-mobility has been detected. In this high-mobility state, UE shall
     - measure the neighbouring cells in RAT "m", which have an equal or lower HCS priority than the serving cell
     - prioritise re-selection of neighbouring cells in RAT "m" on lower HCS priority level before neighbouring cells in RAT "m" on same HCS priority level.

     When the number of cell reselections during time interval T_{CRmax} no longer exceeds N_{CR}, UE shall

     - continue these measurements during time period $T_{CrmaxHyst}$, and
     - revert to measure according to the threshold-based measurement rules.