

ETSI TS 125 304 V3.4.0 (2000-09)

Technical Specification

Universal Mobile Telecommunications System (UMTS); UE Procedures in Idle Mode and Procedures for Cell Reselection in Connected Mode (3GPP TS 25.304 version 3.4.0 Release 1999)



Reference

RTS/TSGR-0225304UR3

Keywords

UMTS

ETSI

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

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

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

Individual copies of the present document can be downloaded from:

<http://www.etsi.org>

The present document may be made available in more than one electronic version or in print. In any case of existing or perceived difference in contents between such versions, the reference version is the Portable Document Format (PDF). In case of dispute, the reference shall be the printing on ETSI printers of the PDF version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at <http://www.etsi.org/tb/status/>

If you find errors in the present document, send your comment to:
editor@etsi.fr

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.

© European Telecommunications Standards Institute 2000.

All rights reserved.

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: "*Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards*", which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<http://www.etsi.org/ipr>).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

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

The present document may refer to technical specifications or reports using their 3GPP identities, UMTS identities or GSM identities. These should be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between GSM, UMTS, 3GPP and ETSI identities can be found under www.etsi.org/key .

Contents

Foreword.....	5
1 Scope.....	6
2 References.....	6
3 Definitions and abbreviations.....	7
3.1 Definitions.....	7
3.2 Abbreviations.....	8
4 General description of Idle mode.....	8
4.1 Overview.....	8
4.2 Functional division between AS and NAS in Idle mode.....	10
4.3 Service type in Idle mode.....	11
5 Process and procedure descriptions.....	12
5.1 PLMN selection and reselection.....	12
5.2 Cell selection and reselection in idle mode.....	12
5.2.1 Introduction.....	12
5.2.2 States and state transitions in Idle Mode.....	13
5.2.3 Cell Selection Process.....	15
5.2.3.1 UTRA.....	15
5.2.3.1.1 Description.....	15
5.2.3.1.2 Criteria.....	16
5.2.3.2 GSM.....	17
5.2.4 Immediate Cell Evaluation Process.....	17
5.2.4.1 UTRA.....	17
5.2.4.1.1 Description.....	17
5.2.4.1.2 Criteria.....	18
5.2.4.2 GSM.....	18
5.2.5 Camped Normally State.....	19
5.2.5.1 UTRA.....	19
5.2.5.2 GSM.....	19
5.2.6 Cell Reselection Evaluation Process.....	19
5.2.6.1 UTRA.....	19
5.2.6.1.1 Measurements for cell re-selection when HCS is not used.....	19
5.2.6.1.2 Measurements for cell re-selection when HCS is used.....	19
5.2.6.1.3 Non-suitable cells (Squal > 0 or Srxlev > 0).....	20
5.2.6.1.4 Cell Reselection Criteria.....	21
5.2.6.1.5 Cell reselection parameters in system information broadcasts.....	23
5.2.6.2 GSM.....	24
5.2.7 Cell Selection when leaving connected mode.....	24
5.2.7.1 UTRA.....	24
5.2.7.2 GSM.....	24
5.2.8 Any Cell Selection state.....	25
5.2.8.1 UTRA.....	25
5.2.8.2 GSM.....	25
5.2.9 Camped on Any Cell State.....	25
5.2.9.1 UTRA.....	25
5.2.9.2 GSM.....	25
5.3 Cell Access Restrictions.....	25
5.3.1 UTRA cells.....	25
5.3.1.1 Cell status and cell reservations.....	25
5.3.1.2 Access Control.....	26
5.3.1.3 Emergency Call.....	26
5.3.2 GSM cells.....	27
5.4 Cell Reselection Processes in RRC Connected Mode.....	27
5.4.1 Initial Cell Reselection Process.....	27
5.4.1.1 Criteria.....	27

5.4.2	Immediate Cell Evaluation Process	27
5.4.3	Cell Reselection Process	27
5.5	Location Registration	27
6	Broadcast information receiving	28
6.1	Reception of System Information.....	28
	Requirements are specified in [4].6.2 Cell Broadcast in Idle Mode	28
7	Measurements for cell selection / reselection.....	28
7.1	Use of Mapping Functions	28
8	Paging and SCCPCH selection in Idle mode	29
8.1	Paging Channel selection	29
8.2	SCCPCH selection when entering Connected mode	29
8.3	Discontinuous Reception.....	30
9	Multicast services	31
9.1	State diagram between the multicast service and DSCH.....	31
9.1.1	MT_Null State	31
9.1.2	MT_Monitor State	32
9.1.3	MT_Saving State	32
9.1.4	MT_Active State.....	32
10	Examples of Procedures	32
10.1	NAS initiated change of system information.....	32
10.2	System Information Update to NAS.....	34
10.3	CN originated paging in idle mode	35
10.4	PLMN Selection, automatic mode, normal case	36
10.5	PLMN Reselection, automatic mode.....	37
10.6	PLMN Reselection, manual mode.....	38
10.7	PLMN Selection, automatic mode, selected PLMN not found	39
10.8	NAS Controlled Cell Selection	40
10.8.1	Execution in Access Stratum	40
10.8.2	Execution in Non-Access Stratum	41
	Annex A (informative): Change history	42

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 part of the Idle Mode procedures applicable to a UE. The non-access stratum 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 and access stratum 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.

- [1] GSM 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)".

3 Definitions and abbreviations

3.1 Definitions

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

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.

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

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: frame where the UE receives actual paging message.

Paging occasion:

(FDD) The frame where the UE monitors the PICH.

(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, either manually or automatically.

Suitable Cell: a cell on which an UE may camp. It shall satisfy certain conditions, see subclause 4.3.

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
CN	Core Network
DRX	Discontinuous Reception
DSCH	Downlink Shared Channel
FDD	Frequency Division Duplex
GC	General Control (SAP)
GPRS	General Packet Radio System
GSM	Global System for Mobile
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, it searches and selects a public land mobile network (PLMN) using a certain radio access technology (RAT). Criteria for cell selection and cell re-selection between RATs described in this document only consider radio criteria. In addition to radio access technology, 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 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 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 of the selected PLMN, 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, 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.

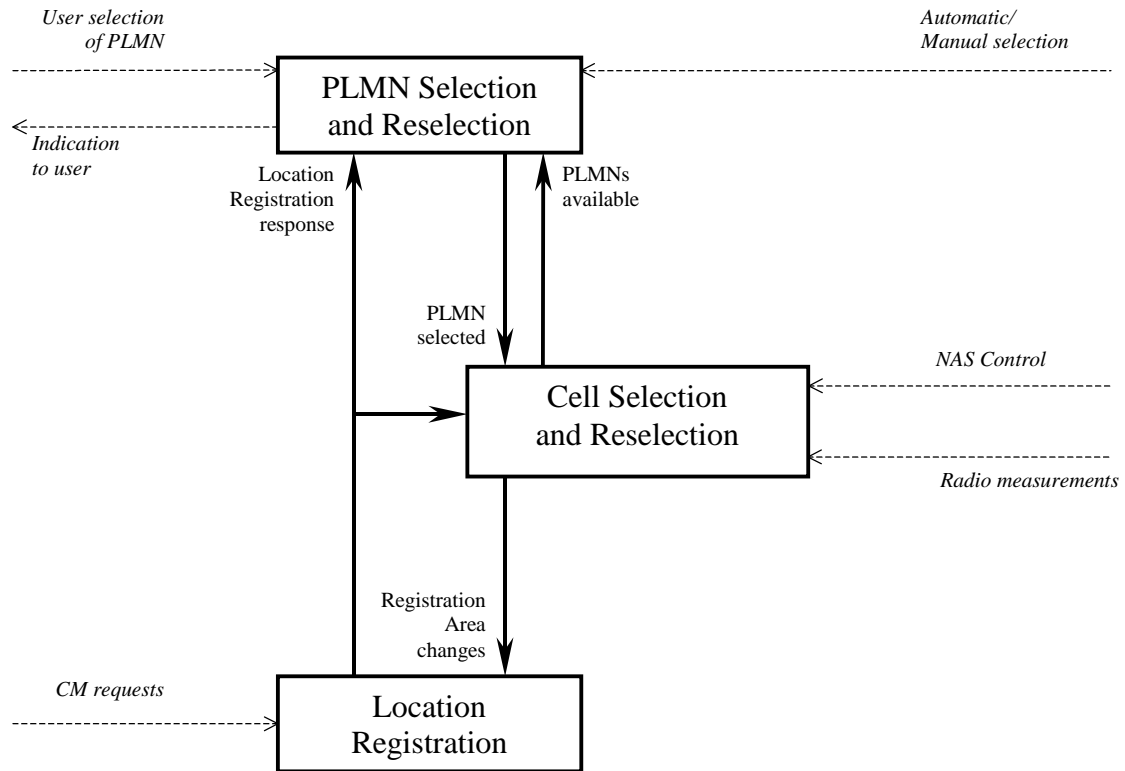


Figure 1: Overall Idle Mode process

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 part is specified in [5] and the access stratum 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	<p>Maintain the list of allowed PLMN types. It can be GSM-MAP only, ANSI-41 only or both.</p> <p>Maintain a list of PLMNs in priority order. Request AS to select a cell either belonging to the PLMN having the highest priority (in automatic mode) or belonging to the manually selected PLMN. For each PLMN, associated radio access technology(ies) may be set.</p> <p>In automatic mode, if a PLMN with higher priority is found, request AS to select a cell belonging to that PLMN.</p>	<p>If associated radio access technology(ies) is (are) available for the PLMN, search in that radio access technology for that PLMN in cell selection.</p> <p>Report available PLMNs with associated PLMN type and radio access technology to NAS on request from NAS or autonomously.</p> <p>It must respect allowed PLMN types indications from NAS.</p>
Cell Selection	<p>Control cell selection for example by indicating associated radio access technology(ies) 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.</p>	<p>Perform measurements needed to support cell selection.</p> <p>Detect and synchronise to a broadcast channel. Receive and handle broadcast information. Forward NAS system information to NAS.</p> <p>Search for a suitable cell in the associated radio access technology(ies) 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.</p> <p>If such a cell is found, the cell is selected to camp on.</p>
Cell Reselection	<p>Control cell reselection by for example, maintaining lists of forbidden registration areas and a list of NAS defined service areas in priority order.</p>	<p>Perform measurements needed to support cell reselection.</p> <p>Detect and synchronise to a broadcast channel. Receive and handle broadcast information. Forward NAS system information to NAS.</p> <p>Change cell if a more suitable cell is found.</p>
Location registration	<p>Register the UE as active after power on.</p> <p>Register the UE's presence in a registration area, for instance regularly or when entering a new registration area.</p> <p>Deregister UE when shutting down.</p>	<p>Report registration area information to NAS.</p>

4.3 Service type in Idle mode

This chapter 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.
- The cell is not barred, see subclause 5.3.4.1.
- The cell is not part of a forbidden registration area.
- 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 indicated in the system information [4].

5 Process and procedure descriptions

5.1 PLMN selection and reselection

In the UE, the access stratum shall report available PLMNs to the non-access stratum on request from the non-access stratum 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.

5.2 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 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][11].

The UE shall select a suitable cell and the radio access mode based on idle mode measurements and cell selection criteria. The non-access stratum can control the radio access technology(ies) in which the cell selection should be performed, for instance by indicating associated radio access technology(ies), and by maintaining a list of forbidden registration area(s) and a list of NAS defined service area(s) in priority order.

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 non-access stratum 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.

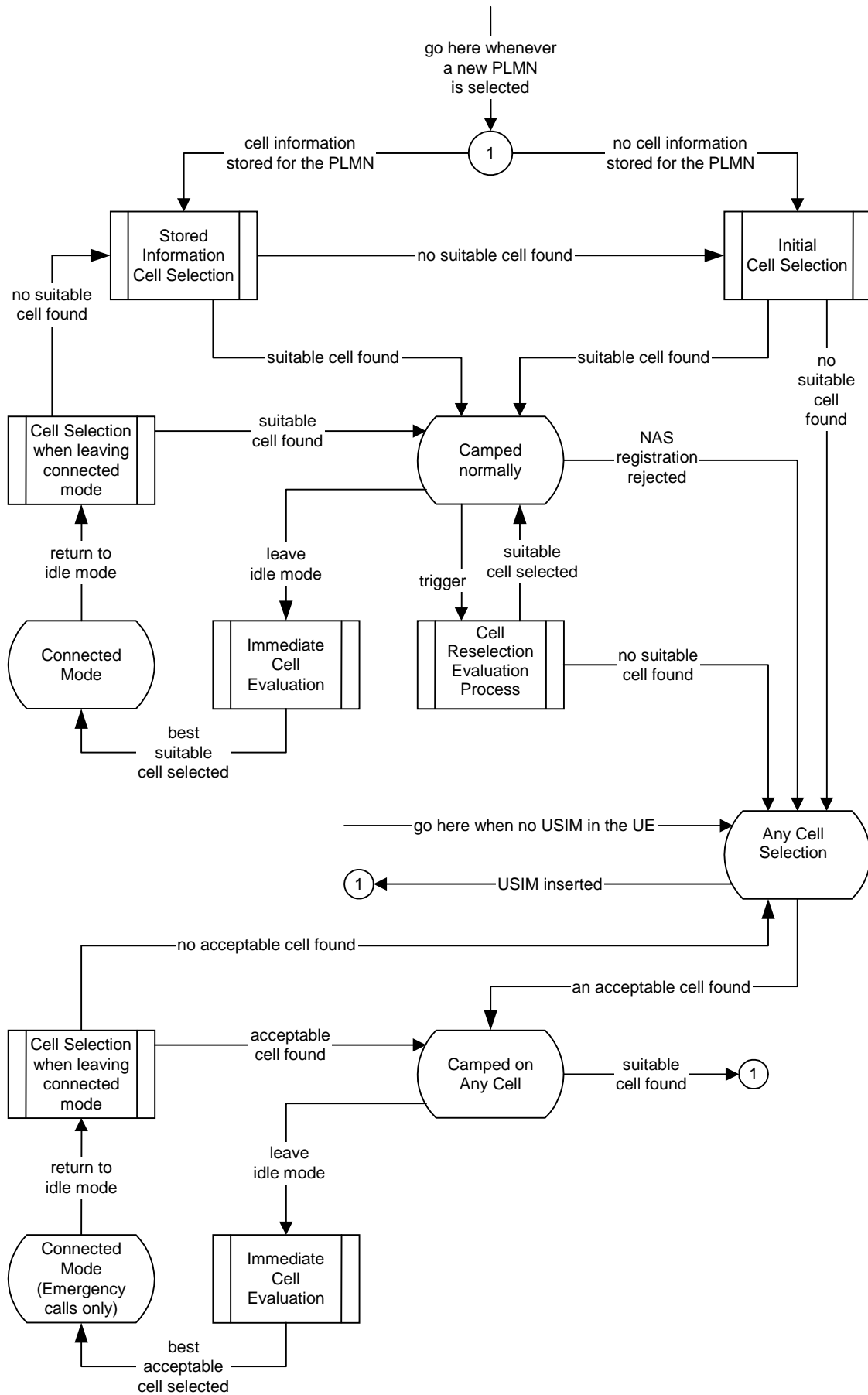


Figure 2: Idle Mode Cell Selection and Reselection
 In any state, a new PLMN selection causes an exit to number 1

Whenever a PLMN has been selected, 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 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 may control the cell selection by:

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

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

When a suitable cell has been found, the UE shall perform necessary NAS registration procedures. When the UE has registered successfully, the UE shall camp on the cell, state *Camped normally*. In this state, the UE shall monitor paging information, monitor system information and perform radio measurements. The measurements shall be used in evaluation of the cell selection, immediate cell evaluation (UTRA only) and 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.

When UE leaves idle mode, state *Camped normally*, in order to enter connected mode, state *Connected mode*, the UE shall use the *Immediate cell evaluation* procedure (UTRA only) in order to select the best cell on the current frequency for the access attempt. This procedure allows the UE to reduce power consumption spent on radio measurements, still enabling the UE to select the best cell for access, thus minimising the interference in the system. If no suitable cell is found, the UE shall use the *Cell reselection* procedure. 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, state *Camped normally*. If no suitable cell is found, the *Stored information cell selection* procedure shall be used.

If no suitable cell is found, the UE shall attempt to find an acceptable cell of any PLMN, state *Any cell search*. This state is also entered if a non-access stratum registration procedure is rejected, see [5], or if there is no USIM in the UE. 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 behave as specified for state *Camped normally*, but typically with a different PLMN. Additionally, the UE shall regularly attempt to find a suitable cell using stored information, trying all radio access technologies that are supported by the UE. If a suitable cell is found, the PLMN is reselected which causes an exit to number 1.

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, procedure *Any cell search*. 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

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) Create a candidate list of potential cells to camp on by using one of the 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. 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 create a candidate list consisting of this cell and its neighbouring cells, as received in measurement control information via the selected cell.

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. After the UE has found one suitable cell for a selected PLMN the UE shall create the candidate list consisting of this cell and its neighbouring cells, using information from the selected cells' measurement control information.

2) For each cell on the candidate list calculate the cell selection value S_{rxlev} and S_{qual} (S_{qual} is used for FDD cells only), defined in subclause 5.2.3.1.2. Cells which do not fulfil the criteria S are removed from the candidate list.

3) Evaluate the cells as follows;

- For FDD cells, select CPICH E_c/N_0 or RSCP used for evaluation of Q_{meas_LEV} defined in section 5.2.4.1.2 by the Cell_selection_and_reselection_quality measure in system information.
- If mapping information is provided in system information, the specified mapping function is used in the UE following the formula in clause 5.2.4.1.2 for cell ranking.
- If mapping information is not provided in system information, the UE shall use the default mapping function $Q_{map} = Q_{meas_LEV}$ in the formula in clause 5.2.4.1.2 and apply it for cell ranking.

4) Select the cell that fulfils the $Q_{map,n} > Q_{map,s} + Q_{offset_{s,n}}$ criterion in 5.2.4.1.2 best. If no cell fulfils the criteria, the UE should select the initial suitable cell. Check if the selected cell fulfils all requirements for a suitable cell. If so, choose this cell to camp on. 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 in case the barred cell does not accept intra-frequency cell selection and re-selection. On the other hand, in case the selected cell accepts intra-frequency cell selection and re-selection, only the barred cell shall be removed as candidate for cell selection (see also subclause 5.2.3), and step 3 shall be repeated for the remaining cells.

NOTE: $Q_{map,s}$ and $Q_{offset_{s,n}}$ in this case apply to the cell from which system information was read.

5) Move to state *camped normally*

If different radio access modes are involved in the procedure, specific mapping functions shall be applied. For each radio access mode, such a mapping function is defined and its parameters are broadcast in system information. The mapping function maps a certain range of measurement values Q_{meas_LEV} to a representative quality value Q_{map} that ranges between 0 and 99 with a granularity of 1. These quality values Q_{map} can then be compared with each other and the cell with the highest Q_{map} value is chosen (among those cells fulfilling 5.2.3.1.2).

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 and the steps are repeated. 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 highest ranked acceptable cell and enter the Camped on any cell state, where it can only obtain limited service. 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.

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

$$Srxlev = Q_{rxlevmeas} - Q_{rxlevmin} - P_{compensation}$$

Squal	Cell Selection quality value, (dB) Not applicable for TDD cells or GSM cells.
Srxlev	Cell Selection RX level value (dB)
Cell_selection_and_reselect on_quality_measure (FDD only)	Choice of measurement (CPICH E_c/N_0 or CPICH RSCP) to use as quality measure Q_{meas_LEV} (read in system information)
$Q_{qualmeas}$	Measured cell quality value. The quality of the received signal expressed in CPICH E_c/N_0 (dB) 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), P-CCPCH RSCP for TDD cells (dBm) and RXLEV for GSM cells (dBm).
Q_{meas_LEV}	Quality value. The quality value of the received signal expressed in CPICH E_c/N_0 or CPICH_RSCP_LEV for FDD cells, P-CCPCH_RSCP_LEV for TDD cells and RXLEV for GSM cells (dBm).
$Q_{qualmin}$	Minimum required quality level in the cell (dB). Not applicable for TDD cells or GSM cells.
$Q_{rxlevmin}$	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 cell selection criterion S is fulfilled when:

$$Squal > 0$$

$$Srxlev > 0$$

Squal has to be evaluated for FDD cells only.

5.2.3.2 GSM

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

5.2.4 Immediate Cell Evaluation Process

5.2.4.1 UTRA

5.2.4.1.1 Description

The Immediate Cell Evaluation procedure is used by the UE to perform a quick evaluation of the quality of the intra-frequency cells. Based on this information, the UE shall select the best cell among the cells on the same frequency, according to the criteria defined in the next subclause.

The following steps shall be carried out when an immediate cell evaluation has been triggered.

- 1) The candidate list of potential cells to camp on consists of the cells in the current registration area listed for intra-frequency measurements in system information of the serving cell.
- 2) For each cell on the candidate list calculate the cell selection values, Srxlev and Squal (for FDD cells only), defined in subclause 5.2.3.1.2. Cells, which do not fulfil criteria S, are removed from the candidate list.
- 3) Evaluate the cells as follows;

- For FDD cells, select CPICH E_c/N_0 or RSCP used for evaluation of Q_{meas_LEV} defined in section 5.2.6.1.4 based on `Cell_selection_and_reselection_quality_measure` in system information.
 - If mapping information is provided in system information, the specified mapping function is used in the UE and the formula in section 5.2.6.1.4 for cell ranking is applied.
 - If mapping information is not provided in system information, UE shall use default mapping function $Q_{map} = Q_{meas_LEV}$ in the formula in section 5.2.6.1.4 and use it for cell ranking.
- 4) Select the neighbouring cell that fulfils the $Q_{map,n} > Q_{map,s} + Q_{offset_{s,n}}$ criteria in 5.2.6.1.4 best. If the best cell does not fulfil all other requirements for a suitable cell, UE shall trigger cell re-selection. Otherwise select the serving cell if $Q_{map,s} > Q_{map,n} - Q_{offset_{s,n}}$.

NOTE: Whether the calculation of the Q_{map} value should require the immediate decoding (e.g. in case the UL load value is used for the calculation) of a set of neighbouring cell BCHs is FFS.

5.2.4.1.2 Criteria

The UE shall select a new cell if the following criteria are fulfilled.

$$\begin{aligned}
 &Squal_n > 0 \\
 &Srxlev_n > 0 \\
 &Q_{map,n} > Q_{map,s} + Q_{offset_{s,n}}
 \end{aligned}$$

$Squal_n$ has to be evaluated for FDD cells only.

$Squal_n$	Cell Selection quality value of the neighbouring cell, (dB) Not applicable for TDD cells or GSM cells.
$Srxlev_n$	Cell Selection RX level value of the neighbouring cell, (dB)
<code>Cell_selection_and_reselection_quality_measure</code> (FDD only)	Choice of measurement (CPICH E_c/N_0 or CPICH RSCP) that is used to derive $Q_{map,n}$ and $Q_{map,s}$, (read in system information).
Q_{meas_LEV}	Quality value. The quality value of the received signal expressed in CPICH E_c/N_0 or CPICH_RSCP_LEV for FDD cells and P-CCPCHRSCPLEV for TDD cells.
$Q_{map,n}$	Quality of the neighbouring cell, after mapping function is applied, derived from CPICH E_c/N_0 or CPICH RSCP for FDD cells 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 <code>Cell_selection_and_reselection_quality_measure</code> information element.
$Q_{map,s}$	Quality of the serving cell, after mapping function is applied. For FDD cells, the measurement that is used to derive the quality value is set by the <code>Cell_selection_and_reselection_quality_measure</code> information element.
$Q_{offset_{s,n}}$	Offset between the two cells considered in the evaluation (read in system information).

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).

If more than one neighbouring cell fulfils the criteria, the UE shall choose the cell where the difference between $Q_{map,n}$ and $(Q_{map,s} + Q_{offset})$ is highest. If no neighbouring cell fulfils the criteria, the UE shall keep the serving cell.

5.2.4.2 GSM

Immediate Cell Evaluation procedure is not applicable for GSM.

5.2.5 Camped Normally State

5.2.5.1 UTRA

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

The Camped Normally State is specified in [1].

5.2.6 Cell Reselection Evaluation Process

5.2.6.1 UTRA

The cell reselection process is described by the following sub-clauses:

5.2.6.1.1 Measurements for cell re-selection when HCS is not used

When serving cell does not belong to a hierarchical cell structure, UE shall follow these rules for intra- and inter-frequency measurements and inter-RAT measurements:

The UE shall use Squal for FDD cells and Srxlev for TDD and GSM cells as S_x in the following rules.

1. If $S_x > S_{\text{intrasearch}}$, UE need not perform intra-frequency measurements.
If $S_x \leq S_{\text{intrasearch}}$, UE shall perform intra-frequency measurements.
If $S_{\text{intrasearch}}$ is not sent for serving cell, UE shall perform intra-frequency measurements.
2. If $S_x > S_{\text{intersearch}}$, UE need not perform inter-frequency measurements
If $S_x \leq S_{\text{intersearch}}$, UE shall perform inter-frequency measurements.
If $S_{\text{intersearch}}$ is not sent for serving cell, UE shall perform intra-frequency measurements.
3. If $S_x > S_{\text{search}_{\text{RAT } n}}$, UE need not perform measurements on cells of RAT n
If $S_x \leq S_{\text{search}_{\text{RAT } n}}$, UE shall perform measurements on cells of RAT n.
If $S_{\text{search}_{\text{RAT } m}}$ is not sent for serving cell, UE shall perform measurements on cells of RAT m.

5.2.6.1.2 Measurements for cell re-selection when HCS is used

When serving cell belongs to a hierarchical cell structure, the UE shall follow these rules for intra- and inter-frequency measurements:

1. Intra- and inter-frequency threshold-based measurement rules

The UE shall use Squal for FDD cells and Srxlev for TDD cells as S_x in the following rules.

IF ($S_{\text{rxlev}_s} \leq S_{\text{search}_{\text{HCS}}}$) or ($S_x \leq S_{\text{intersearch}}$ (FDD only)) THEN

<UE shall measure on all intra- and inter-frequency cells>

ELSE

IF ($S_x > S_{\text{intra}}^{\text{search}}$) THEN

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

ELSE

<UE shall measure on all intra- 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. Intra- 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- and inter-frequency neighbouring cells, which have equal or lower HCS priority than serving cell. Furthermore, UE shall prioritise re-selection of intra- 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 $T_{\text{CRmaxHyst}}$. Then, UE shall revert to measure 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

The UE shall use S_{qual} for FDD cells and S_{rxlev} for TDD cells as S_x in the following rules.

IF ($S_{\text{rxlev}_s} \leq S_{\text{HCS,RATm}}$) OR ($S_{\text{qual}} \leq S_{\text{SearchRATm}}$ (FDD only)) THEN

<UE shall measure on all inter-RATm cells>

ELSE

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

< UE need not measure inter-RATm neighbouring cells >

ELSE

<UE shall measure on all inter-RATm 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. 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 RATm neighbouring cells, which have an equal or lower HCS priority than the serving cell. Furthermore, UE shall prioritise re-selection of RATm neighbouring cells on lower HCS priority level before RATm neighbouring cells 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 $T_{\text{CRmaxHyst}}$. Then, UE shall revert to measure according to the threshold-based measurement rules.

5.2.6.1.3 Non-suitable cells ($S_{\text{qual}} > 0$ or $S_{\text{rxlev}} > 0$)

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 5.2.6).

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:

$$H_s = Q_{\text{meas_LEV},s} - Q_{\text{hcs}_s}$$

$$H_n = Q_{\text{meas_LEV},n} - Q_{\text{hcs}_n} - TO_n * L_n$$

The cell-ranking criterion R is defined by:

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

$$R_n = Q_{\text{map},n} - Q_{\text{offset}_{s,n}} - TO_n * (1 - L_n)$$

where:

$$TO_n = \text{TEMP_OFFSET}_n * W(\text{PENALTY_TIME}_n - T_n)$$

$$L_n = 0 \quad \text{if } \text{HCS_PRIO}_n = \text{HCS_PRIO}_s$$

$$L_n = 1 \quad \text{if } \text{HCS_PRIO}_n \neq \text{HCS_PRIO}_s$$

$$W(x) = 0 \quad \text{for } x < 0$$

$$W(x) = 1 \quad \text{for } x \geq 0$$

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

$$Q_{\text{meas_LEV},n} > Q_{\text{hcs}_n} \quad \text{if } \text{HCS_PRIO}_n \neq \text{HCS_PRIO}_s$$

or

For TDD cells, GSM cells and FDD cells if the cell_selection_and_reselection-quality_measure IE sets the quality value to be CPICH RSCP:

$$Q_{\text{map},n} > Q_{\text{map},s} + Q_{\text{offset}_{1,s,n}} \quad \text{if } \text{HCS_PRIO}_n = \text{HCS_PRIO}_s$$

or

For FDD cells if the cell_selection_and_reselection-quality_measure IE sets the quality value to be CPICH Ec/No:

$$Q_{\text{meas_LEV},n} > Q_{\text{meas_LEV},s} + Q_{\text{offset}_{2,s,n}} \quad \text{if } \text{HCS_PRIO}_n = \text{HCS_PRIO}_s$$

T_n shall be stopped as soon as these conditions are no longer fulfilled.

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 criterion given above for starting timer T_n for the corresponding cell is no longer fulfilled with the parameters of the new serving cell.

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

S _n	Cell Selection value of the neighbouring cell, (dB)
Cell_selection_and_reselecti on_quality_measure (FDD only)	Choice of measurement (CPICH Ec/N0 or CPICH RSCP) that is used to derive quality measures Q _{map,n} and Q _{map,s} , (read in system information).
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 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 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 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.
Qoffset1 _{s,n}	Offset value 1 between the two cells considered in the evaluation (read in system information).
Qoffset2 _{s,n}	Offset value 2 between the two cells considered in the evaluation (read in system information).
Qhyst1 _s	Hysteresis value of the serving cell.
Qhyst2 _s	Hysteresis value of the serving cell.
HCS_PRIO _s , HCS_PRIO _n	HCS priority level (0-7) for serving cell and neighbouring cells
PENALTY_TIME _n	Duration for applying TEMP_OFFSET _n to H and R criteria (s)
Qhcs _s , Qhcs _n	Quality threshold level for applying prioritised hierarchical cell re-selection
TEMP_OFFSET1 _n	Offset to H and R criteria for the duration of PENALTY_TIME _n
TEMP_OFFSET2 _n	Offset to H and R criteria for the duration of PENALTY_TIME _n
T _{C_rmax}	Duration for evaluating allowed amount of cell reselections (s).
N _{CR}	Maximum number of cell reselections
T _{C_rmaxHyst}	Additional time period before UE reverts to low-mobility measurements (s)
T _{reselection_s}	Time-to-trigger for cell reselection, (s)

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 UE shall perform ranking of all cells that fulfil the S criterion (see subclause 5.2.6.1.4) among

- all cells that have the highest HCS_PRIO among those cells that fulfil the criterion $H \geq 0$. Note that this rule is not valid when UE high-mobility is detected (see subclause 5.2.6.1.4).
- all cells, not considering HCS priority levels, if no cell fulfil the criterion $H \geq 0$. This case is also valid when HCS is not applied, 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, using CPICH RSCP, P-CCPCH RSCP and RXLEV for deriving Q_{map,n} and Q_{map,s} and calculating the R values of the FDD, TDD and GSM cells, respectively. The offset Qoffset1_{s,n} is used to calculate R_n, the hysteresis Qhyst1_s is used to calculate R_s and TEMP_OFFSET1_n is used to calculate TO_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 a FDD cell is ranked as the best cell and IE cell_selection_and_reselection-quality_measure is set to CPICH RSCP, the UE shall perform cell re-selection to that FDD cell.

If a FDD cell is ranked as the best cell and IE cell_selection_and_reselection-quality_measure 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 as given in cell_selection_and_reselection-quality_measure for deriving the Q_{map,n} and Q_{map,s} and calculating the R values of the FDD cells. In this case, default mapping function Q_{map} = Q_{meas_LEV} is used

and the offset $Q_{\text{offset}2_{s,n}}$ is used to calculate R_n , the hysteresis $Q_{\text{hyst}2_s}$ is used to calculate R_s and $TEMP_OFFSET2_n$ is used to calculate TO_n . Then the UE shall perform cell re-selection to the best ranked FDD cell.

The UE shall reselect the new cell, if the cell reselection criteria are fulfilled during a time interval $T_{\text{reselection}}$.

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 as follows:

$Q_{\text{offset}1_{s,n}}$

The offset between the two cells is read in system information of the serving cell. It is used for TDD and GSM cells and for FDD cells in case IE `cell_selection_and_re-selection_quality_measure` is set to CPICH RSCP.

$Q_{\text{offset}2_{s,n}}$

The offset between the two cells is read in system information of the serving cell. It is used for FDD cells in case IE `cell_selection_and_re-selection_quality_measure` is set to CPICH Ec/No.

$Q_{\text{hyst}1_s}$

The hysteresis value (Q_{hyst}) is read in system information of the serving cell. It is used for TDD and GSM cells and for FDD cells in case IE `cell_selection_and_re-selection_quality_measure` is set to CPICH RSCP.

$Q_{\text{hyst}2_s}$

The hysteresis value (Q_{hyst}) is read in system information of the serving cell. It is used for FDD cells in case IE `cell_selection_and_re-selection_quality_measure` is set to CPICH Ec/No.

HCS_PRIO_s, HCS_PRIO_n

HCS priority level (0-7) for serving cell and neighbouring cells are read in system information of serving cell.

Q_{hcs_s} , Q_{hcs_n}

Quality threshold levels for applying prioritised hierarchical cell re-selection are read in system information of serving cell.

Q_{qualmin}

Minimum required quality level in the cell, (dB). Not applicable for TDD cells or GSM cells.

Q_{rxlevmin}

Minimum required RX level in the cell. (dBm)

PENALTY_TIME_n

Time duration for which the $TEMPORARY_OFFSET_n$ is applied for a neighbouring cell is read in system information of serving cell.

TEMPORARY_OFFSET1_n

Applies an offset to the H and R criteria for a neighbouring cell for the duration of $PENALTY_TIME_n$. The parameter is read in system information of serving cell. It is used for TDD and GSM cells and for FDD cells in case IE `cell_selection_and_re-selection_quality_measure` is set to CPICH RSCP.

TEMPORARY_OFFSET2_n

Applies an offset to the H and R criteria for a neighbouring cell for the duration of $PENALTY_TIME_n$. The parameter is read in system information of serving cell. It is used for FDD cells in case IE `cell_selection_and_re-selection_quality_measure` is set to CPICH Ec/No.

T_{CRmax}

Duration for evaluating allowed amount of cell reselection(s) is read in system information of serving cell.

N_{CR}

Maximum number of cell reselections is read in system information of serving cell.

 $T_{CRmaxHyst}$

Additional time period before UE reverts to low-mobility measurements is read in system information of serving cell.

 $T_{reselection_s}$

The cell reselection timer value is read in system information of the serving cell.

 $S_{search_{HCS}}$

Below this limit in the serving cell, the UE shall initiate measurements of all neighbouring cells of the serving cell. The value is read in system information of the serving cell.

 $S_{search_{RAT1}} - S_{search_{RATk}}$

This RAT specific threshold in the serving cell is used in the inter-RAT measurement rules. The values are read in system information of the serving cell.

 $S_{HCS,RATm}$

This RAT specific threshold in the serving cell is used in the inter-RAT measurement rules. The values are read in system information of the serving cell.

 $S_{intra_{search}}$

Threshold for intra frequency measurements (dB for FDD, dBm for TDD) and for the HCS measurement rules.

 $S_{inter_{search}}$

Threshold for intra frequency measurements (dB for FDD, dBm for TDD) and for the HCS measurement rules.

 $S_{limit,Search_{RATm}}$

Above this RAT specific threshold in the serving UTRA cell, the UE need not perform any inter-RAT_m measurements (dB for FDD, dBm for TDD)

Mapping Info

Mapping Info contains all the information that is necessary to define the mapping function that is used for mapping a certain range of measurement values to a representing quality value (0..99, step size 1).

5.2.6.2 GSM

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**

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

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

5.2.8 Any Cell Selection state

5.2.8.1 UTRA

In this state, the UE shall attempt to find an acceptable cell to camp on, trying all radio access technologies that are supported by the UE.

If no acceptable cell is found, the UE shall continue to search for an acceptable cell in this state.

5.2.8.2 GSM

The *any cell selection* state in GSM is specified in [1].

5.2.9 Camped on Any Cell State

5.2.9.1 UTRA

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:

- 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 trying all radio access technologies that are supported by the UE. If a suitable cell is found, this causes an exit to number 1 in Figure 2.

5.2.9.2 GSM

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,

- the UE may select/re-select this cell during the cell selection, immediate cell evaluation 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 (i.e. all UEs for Release '99) 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,

- 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

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" is 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 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 Q_{hyst} and T_{resel} .
- 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 5.2.3), and step 4 shall be repeated for the remaining cells.

If different radio access modes are involved in the procedure, then mapping functions shall be applied. For each radio access mode, 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} can then be compared with each other and the cell with the highest Q_{map} value is chosen (among those cells with S criterion is fulfilled).

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 is specified in subclause 5.2.2.1.2.

5.4.2 Immediate Cell Evaluation Process

The immediate cell evaluation procedure is the same as used for idle mode, described in subclause 5.2.4, with the following differences:

- 1) The potential cells for selection at immediate cell evaluation in Connected Mode consists of the cells for intra-frequency measurements in system information of the serving cell. However, if UE dedicated measurements control information has been assigned to the UE in the serving cell, the candidate list consists of the cells for intra-frequency measurements included in this UE dedicated measurement control information.

5.4.3 Cell Reselection Process

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

5.5 Location Registration

In the UE, the access stratum shall report registration area information to the non-access stratum.

The non-access part of the location registration process is specified in [5].

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

7.1 Use of Mapping Functions

Different types of measurements are used in different radio access technologies 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). Whenever a direct comparison of these measurements is required, mapping functions shall be applied.

Mapping functions are used for mapping a certain range of measurement values $Q_{\text{meas_LEV}}$ (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 and mode, one mapping function is defined. It may be defined over one or several consecutive intervals of the measurement values $Q_{\text{meas_LEV}}$.

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. 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*. For release 99, only linear functions are specified: $Q_{\text{map}} = a * Q_{\text{meas_LEV}} + b$, if $Q_{\text{meas_LEV}}$ 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 $Q_{\text{meas_LEV}}$ 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 ($Q_{\text{meas_LEV}}$, 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:

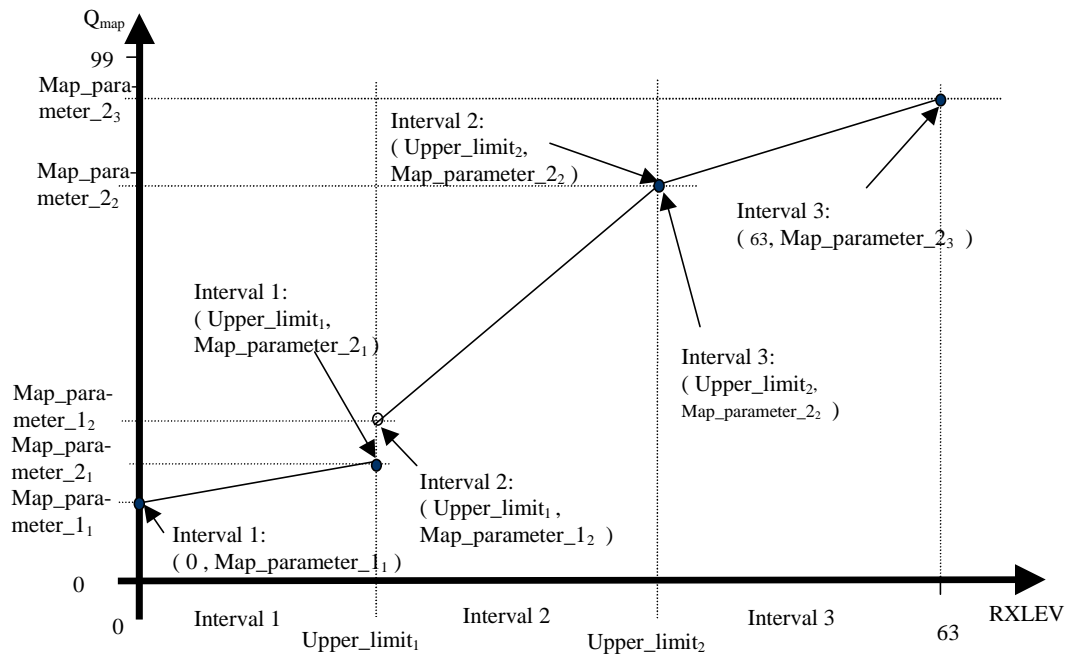


Figure 3: Illustration of mapping of RXLEV using multiple linear models

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 is 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:

$$\text{Index of selected SCCPCH} = (\text{IMSI} \div ((\text{"DRX cycle length"} \div \text{PBP}) * N_p * N_{\text{PICH}})) \bmod K,$$

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. "DRX cycle length", PBP, N_p and N_{PICH} shall be determined as specified Section 8.3.

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:

$$\text{"Index of selected SCCPCH"} = \text{"Initial UE Identity"} \bmod K,$$

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.

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 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 Cell System Frame Number (SFN), N_p (for FDD, N_p is the number of page indicators within a frame; for TDD, N_p 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.

The value of the Paging Occasion (i.e. the SFN of the first frame of the Paging Block) is determined as follows:

$$\text{Paging Occasion} = \{ \text{IMSI} \bmod (\text{DRX cycle length} \div \text{PBP}) \} * \text{PBP} + n * \text{DRX cycle length} + \text{Frame Offset}$$

Where $n = 0, 1, 2, \dots$ 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:

$$\text{PI} = \text{DRX Index} \bmod N_p$$

$$\text{where DRX Index} = \{ \text{IMSI} \div (\text{DRX cycle length} \div \text{PBP}) \}$$

In FDD mode, $N_p = (18, 36, 72, 144)$ 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, N_p 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 a default number, $\text{IMSI} = 0$, 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:

$$\text{Paging Message Receiving Occasion} = \text{Paging Occasion} + N_{\text{PICH}} + N_{\text{GAP}} + \{(\text{DRX Index div } N_p) \bmod N_{\text{PCH}}\} * 2$$

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.

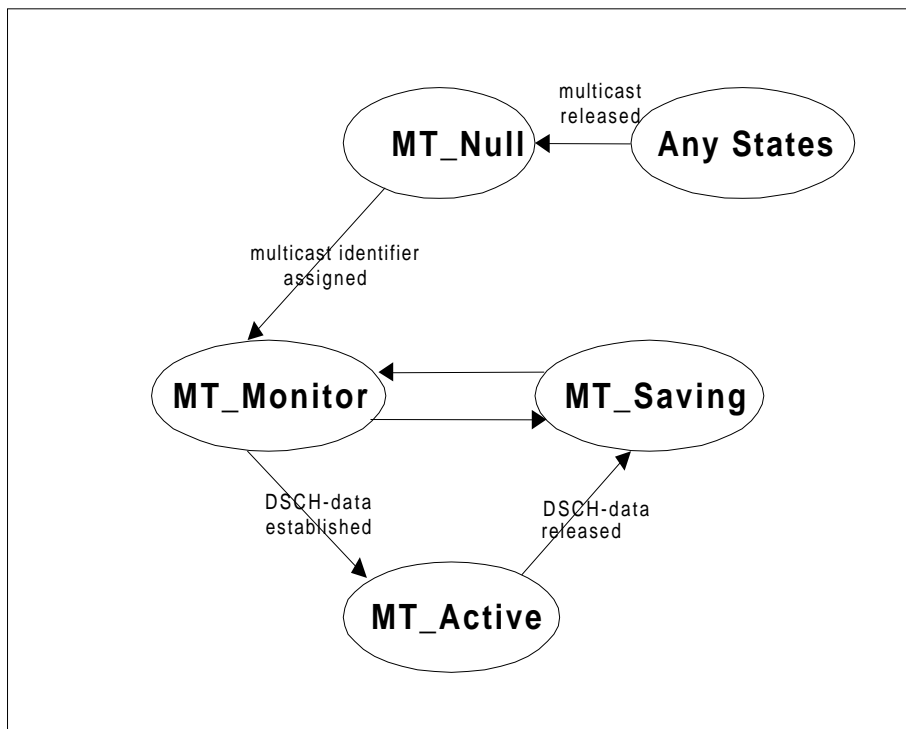


Figure 4: Multicast State Diagram relative to the DSCH, MT=MultiCast service

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.

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).

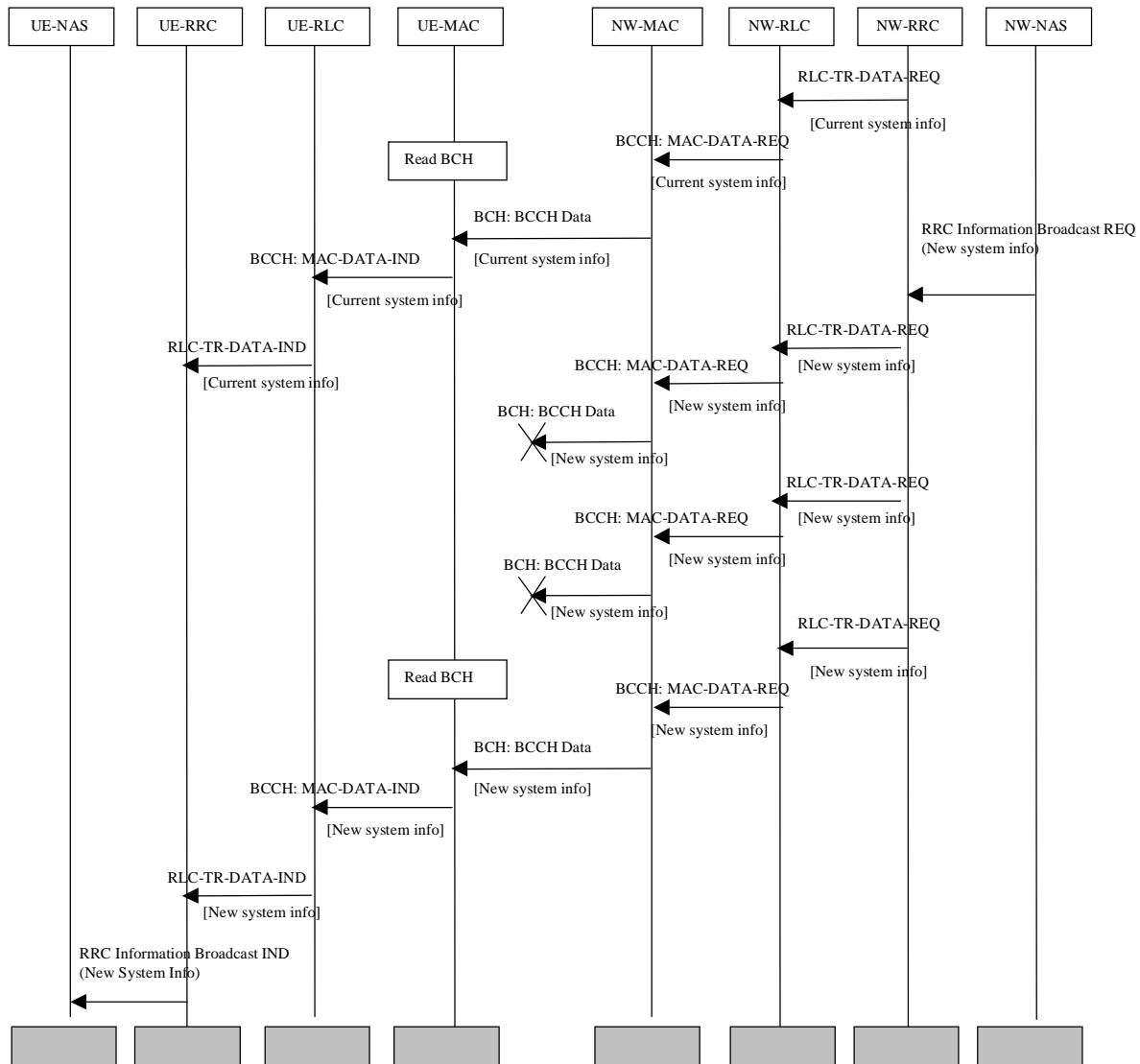


Figure 5: Example sequence, non-access stratum initiated change of broadcast system info

A non-access stratum 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 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

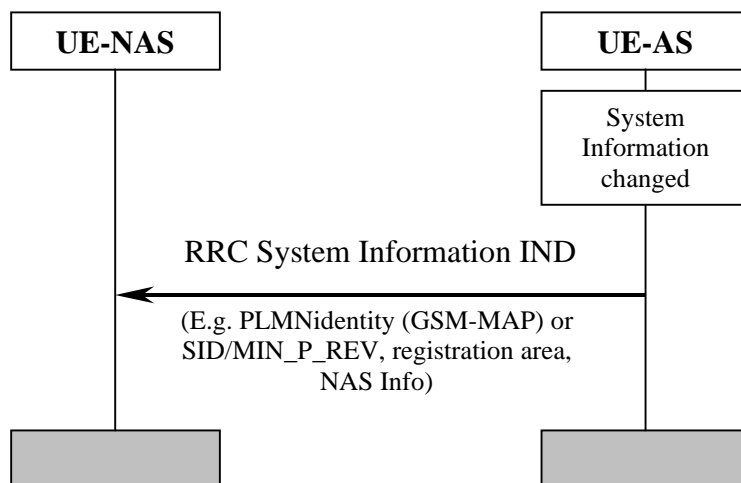


Figure 6: System Information Update to NAS

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

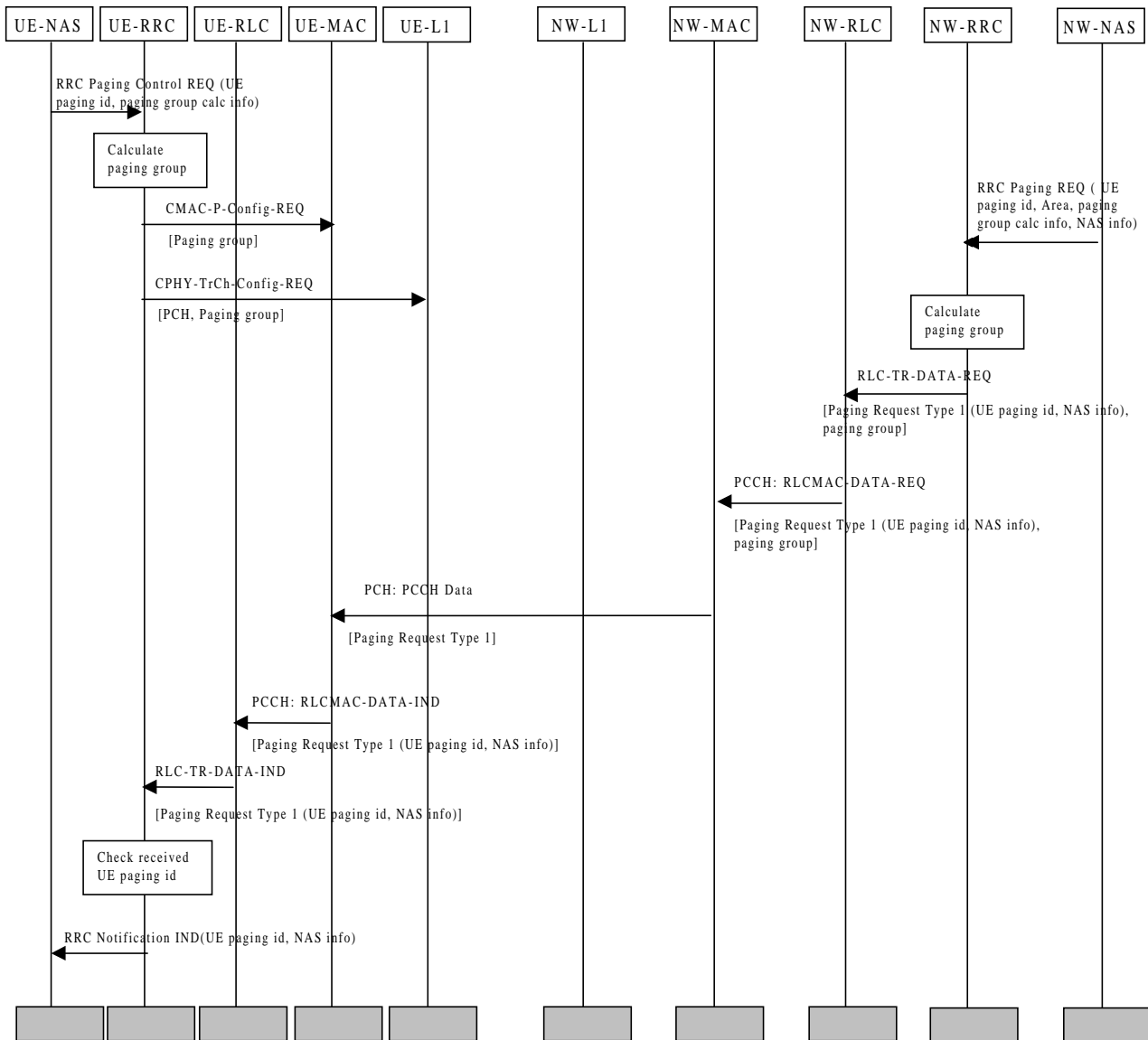


Figure 7: Example sequence of CN initiated paging request in idle mode

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 and 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

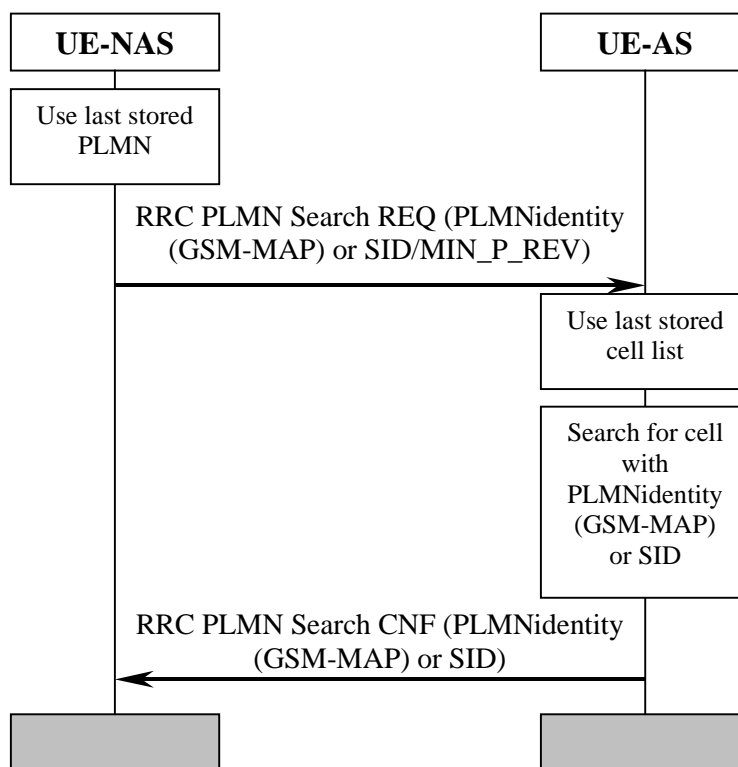


Figure 8: PLMN Selection, automatic mode, normal case

At power-on, the non-access stratum (NAS) selects the PLMN with highest priority, 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 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

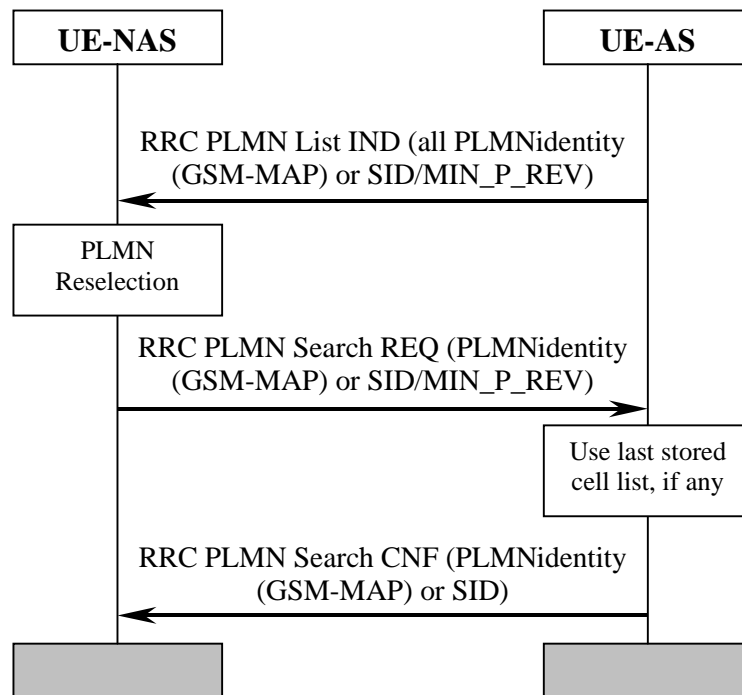


Figure 9: PLMN Reselection, automatic mode

Triggered by, for instance, a timer, 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 found, NAS requests AS to select a 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 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

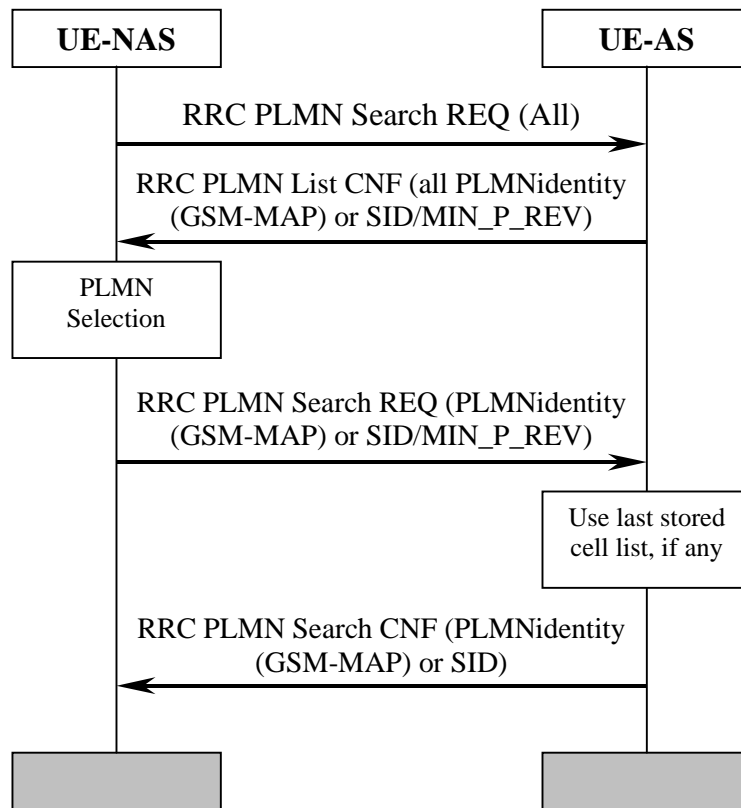


Figure 10: PLMN Reselection, manual mode

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 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 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

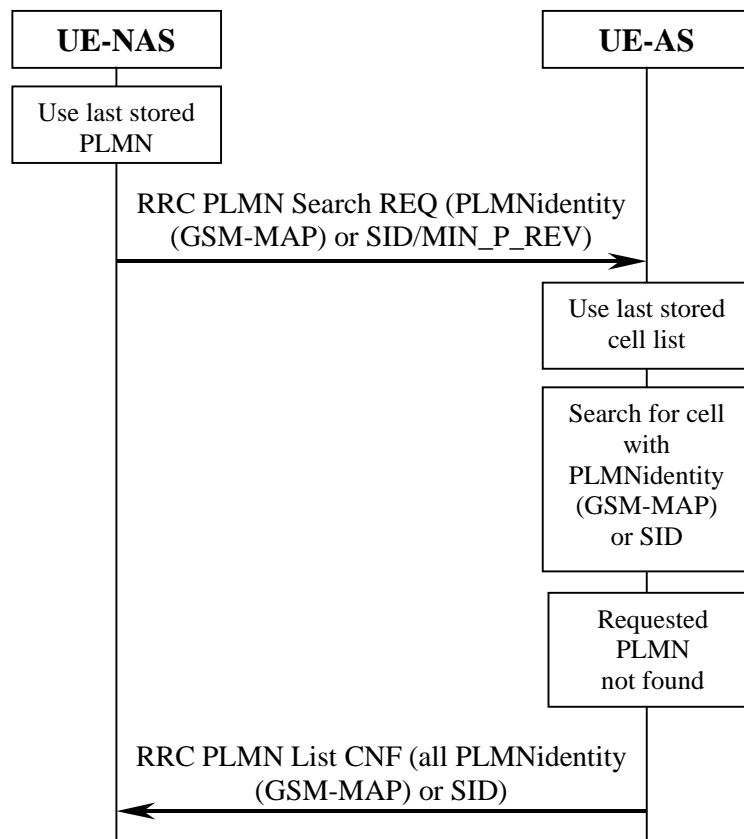


Figure 11: PLMN Selection, automatic mode, selected PLMN not found

At power-on, the non-access stratum selects the PLMN with highest priority, possibly from the list of PLMNs stored prior to previous power off. The access stratum 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. If no 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

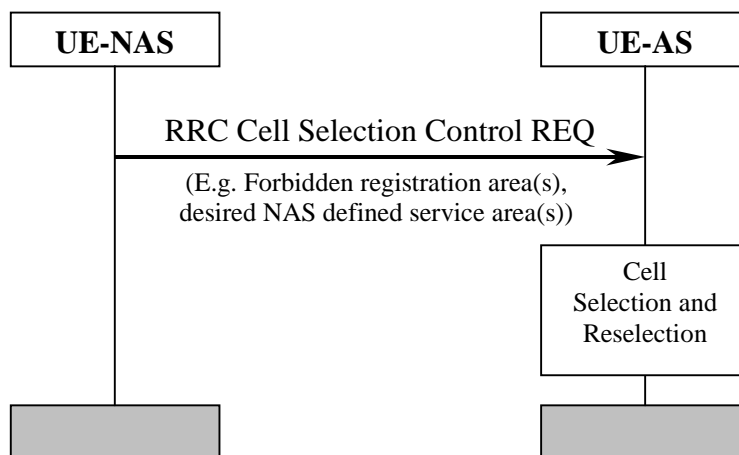


Figure 12: NAS Controlled Cell Selection, execution in AS

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

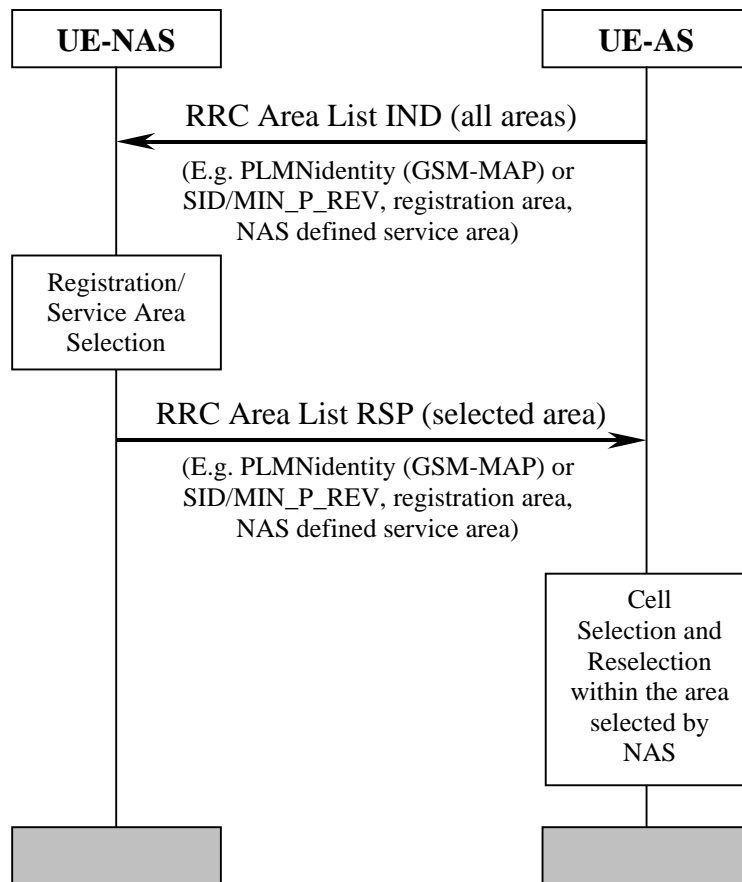


Figure 13: NAS Controlled Cell Selection, execution in NAS

As an alternative to the example in subclause 11.8.1, AS sends cell selection information to NAS. This information can include PLMN identity (GSM-MAP) or SID, 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 check with NAS.

Annex A (informative): Change history

Change history					
TSG-RAN#	Version	CR	Tdoc RAN	New Version	Subject/Comment
RAN_05	-	-	RP-99464	3.0.0	(10/99) Approved at TSG-RAN #5 and placed under Change Control
RAN_06	3.0.0	001	RP-99632	3.1.0	(12/99) Modification and editorial changes
RAN_06	3.0.0	002	RP-99633	3.1.0	Specification of Cell reselection procedures in
RAN_06	3.0.0	003	RP-99633	3.1.0	Integration of Cell Broadcast Service (CBS)
RAN_06	3.0.0	004	RP-99633	3.1.0	Measurement used as a quality estimate for cell
RAN_06	3.0.0	006	RP-99632	3.1.0	Discontinuous reception
RAN_06	3.0.0	008	RP-99633	3.1.0	Barred Cells and Access Control
RAN_06	3.0.0	009	RP-99633	3.1.0	Introduction of network control of UE measurement
RAN_06	3.0.0	011	RP-99631	3.1.0	Editorial issues
RAN_07	3.1.0	007	RP-000037	3.2.0	(03/00) Cell Selection for DS-41 mode
RAN_07	3.1.0	014	RP-000037	3.2.0	Modified description of cell search procedure
RAN_07	3.1.0	018	RP-000037	3.2.0	UE individual DRX cycles in CELL_PCH and URA_PCH states
RAN_07	3.1.0	019	RP-000037	3.2.0	Cell re-selection criteria including HCS
RAN_07	3.1.0	021	RP-000037	3.2.0	Modified description of DRX
RAN_08	3.2.0	025	RP-000217	3.3.0	(06/00) Triggering of inter-system measurements for cell re-selection when HCS is used
RAN_08	3.2.0	026	RP-000217	3.3.0	Cell re-selection
RAN_08	3.2.0	027	RP-000217	3.3.0	Access Control
RAN_08	3.2.0	028	RP-000217	3.3.0	Downlink signalling failure
RAN_08	3.2.0	029	RP-000217	3.3.0	Cell-reselection parameter signalling
RAN_08	3.2.0	030	RP-000217	3.3.0	Cell Selection and Reselection
RAN_08	3.2.0	031	RP-000217	3.3.0	CN DRX cycle coefficient
RAN_09	3.3.0	035	RP-000355	3.4.0	(09/00) Paging channel selection
RAN_09	3.3.0	037	RP-000355	3.4.0	Editorial corrections
RAN_09	3.3.0	039	RP-000355	3.4.0	HCS measurement rules
RAN_09	3.3.0	042	RP-000355	3.4.0	Usage of Ec/N0 measurement quantity for cell ranking
RAN_09	3.3.0	044	RP-000355	3.4.0	Correction and restructuring

History

Document history		
V3.1.0	January 2000	Publication
V3.2.0	March 2000	Publication
V3.3.0	June 2000	Publication
V3.4.0	September 2000	Publication