TSG-RAN Meeting #7
Madrid, Spain, 13 – 15 March 2000

RP-000037

Title: **Agreed CRs to TS 25.304**

Source: **TSG-RAN WG2**

Agenda item: **6.3.3**

Doc-1st-	Spec	CR	Rev	Subject	Cat	Version	Versio
R2-000191	25.304	007	2	Cell Selection for DS-41 mode	B	3.1.0	3.2.0
R2-000118	25.304	014		Modified description of cell search	D	3.1.0	3.2.0
R2-000538	25.304	018	1	UE individual DRX cycles in CELL_PCH	F	3.1.0	3.2.0
R2-000546	25.304	019	1	Cell re-selection criteria including HCS	B	3.1.0	3.2.0
R2-000488	25.304	021		Modified description of DRX	F	3.1.0	3.2.0

3GPP TSG-RAN Meeting #7
Madrid, Spain, 13 - 15 March 2000

***Document* R2-000191**

0 e.g. for 3GPP use the format TP-99xxx or for SMG, use the format P-99-xxx

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25.304	**CR**	**007r2**	Current Version:	3.1.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to:	TSG-RAN #7	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑		for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from:* ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: *(at least one should be marked with an X)* (U)SIM [ ] ME [X] UTRAN / Radio [ ] Core Network [ ]

Source: TSG-RAN WG2 **Date:** 2000-1-19

Subject: Cell Selection for DS-41 mode

Work item:

Category: *(only one category shall be marked with an X)*

F	Correction		**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature	X		Release 97	
C	Functional modification of feature			Release 98	
D	Editorial modification			Release 99	X
				Release 00	

Reason for change: During cell selection and reselection procedure, the case of ANSI-41 should be also considered. In case of ANSI-41, UE should consider the SID instead of PLMN identity (GSM-MAP) to camp on. So, UE should be able to maintain the multiple kind of PLMN during PLMN selection procedure according to the allowed PLMN types for the UE.

Clauses affected: 4.1, 4.2, 5.1, 10.2, 10.4, 10.5, 10.6, 10.7, 10.8.2

Other specs affected:

Other 3G core specifications	[ ]	→ List of CRs:
Other GSM core specifications	[ ]	→ List of CRs:
MS test specifications	[ ]	→ List of CRs:
BSS test specifications	[ ]	→ List of CRs:
O&M specifications	[ ]	→ List of CRs:

Other comments:


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4 General description of Idle mode

4.1 Overview

When a multi-RAT UE is switched on, it attempts to make contact with a public land mobile network (PLMN) using a certain radio access technology. In addition to radio access technology, the core network 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 particular PLMN to be contacted may be selected either automatically or manually.~~

The UE looks 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, it reselects onto that alternative cell of the selected PLMN and camps on that cell. 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. Particularly, in the home country of the UE, the UE will try to get back to its Home PLMN.

If the UE loses coverage of a 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 UE's 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 initiate a call, 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 messages

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.

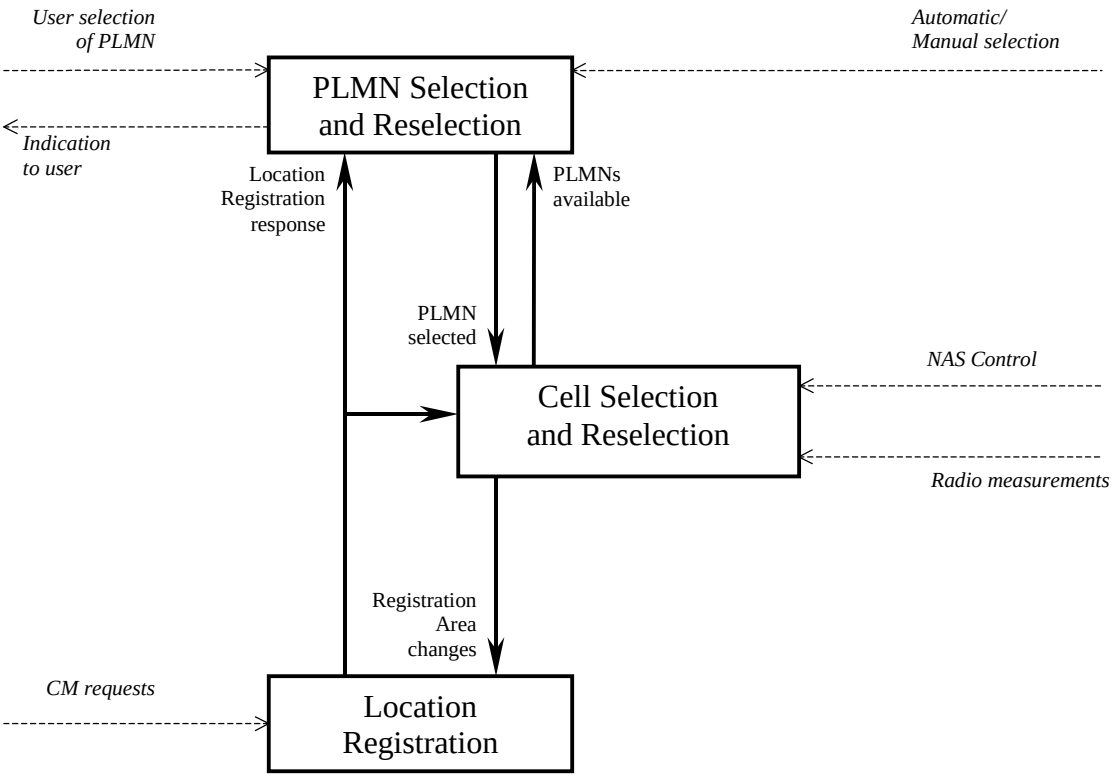

Figure 1: Overall Idle Mode process

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 this document. Examples of different idle mode procedures are presented in Section 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. 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. In automatic mode, if a PLMN with higher priority is found, request AS to select a cell belonging to that PLMN.	Report available PLMNs with associated PLMN type to NAS on request from NAS or autonomously. **It must respect allowed PLMN types indications from NAS**
Cell Selection	Control cell selection by for example, 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 are identified with 'PLMN identity' (GSM-MAP) or SID in the system information. Respond to NAS whether such cell is found or not. 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.	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. Perform ODMA probing in an ODMA Relay Node.
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. Deregister UE when shutting down.	Report registration area information to NAS.

5 Process 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~~ the non-access part of the PLMN selection and reselection process is specified in [5].

10.2 System Information Update to NAS

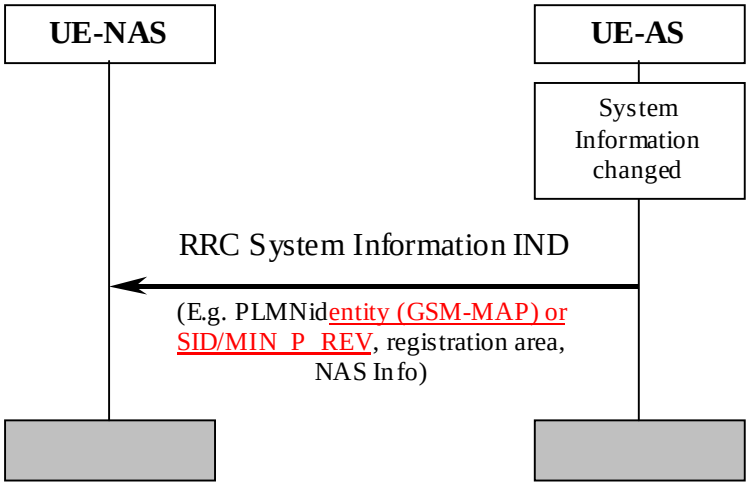

Figure 8: System Information Update to NAS

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.

10.4 PLMN Selection, automatic mode, normal case

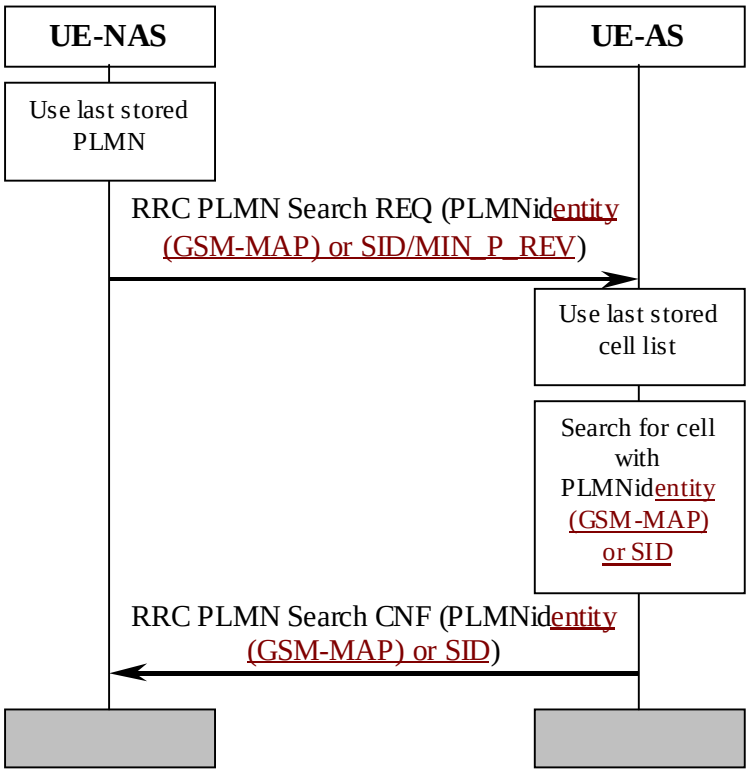

Figure 10: PLMN Selection, automatic mode, normal case

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

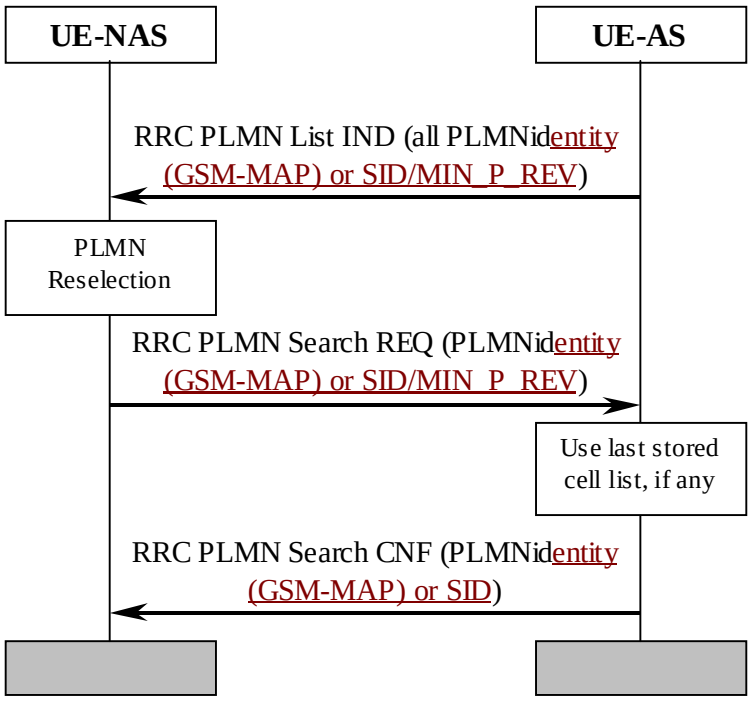

Figure 11: PLMN Reselection, automatic mode

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

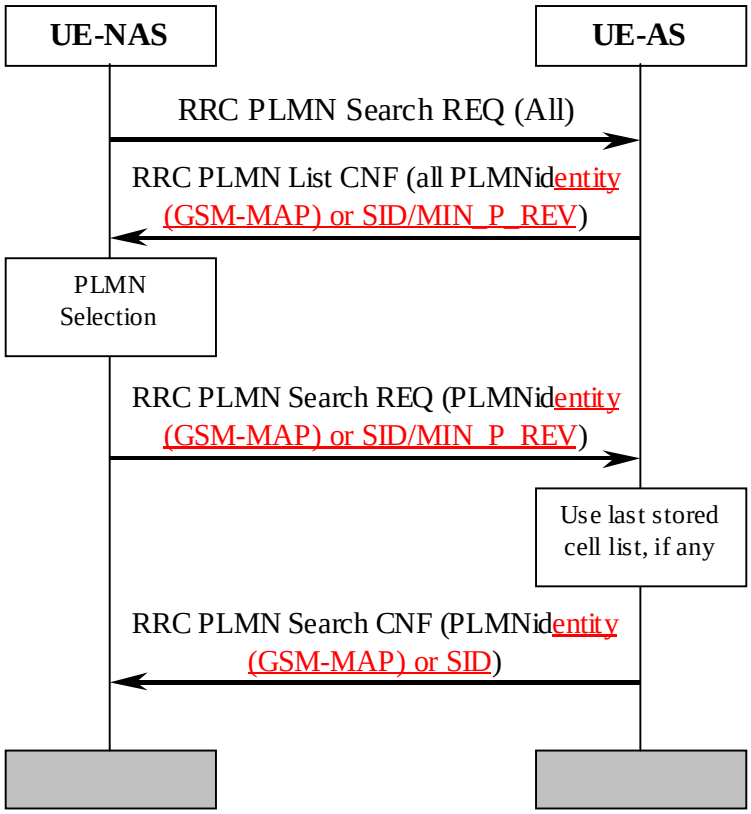

Figure 12: PLMN Reselection, manual mode

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

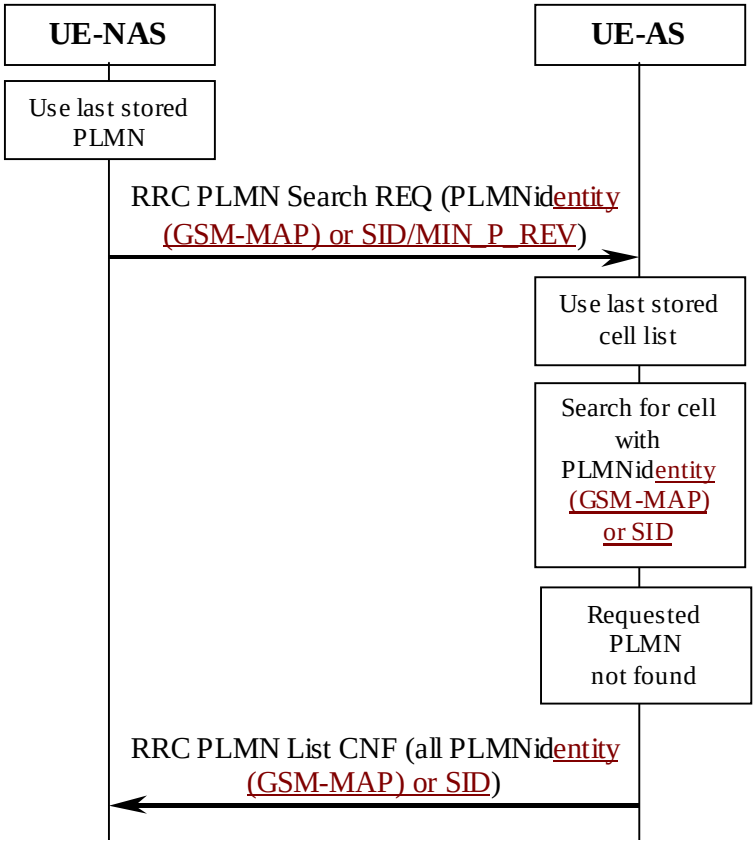

Figure 13: PLMN Selection, automatic mode, selected PLMN not found

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

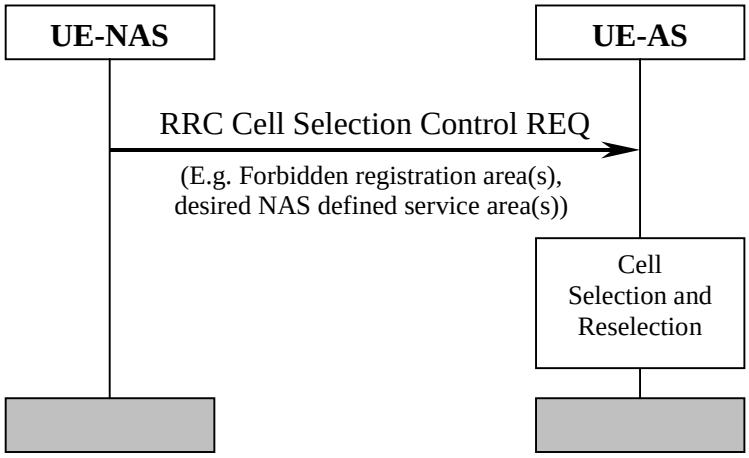

Figure 14: NAS Controlled Cell Selection, execution in AS

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

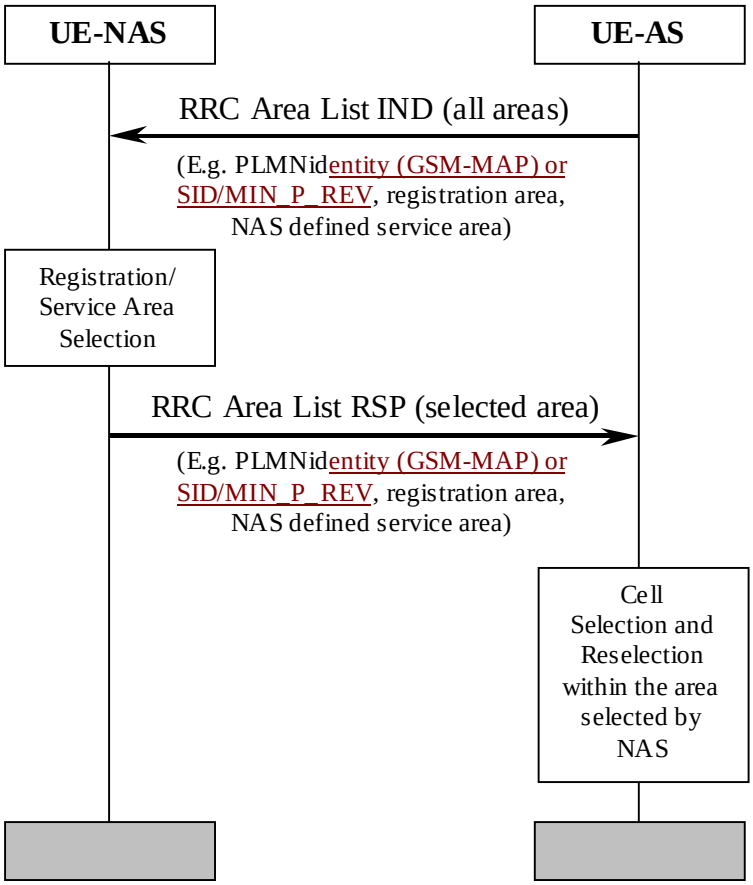

Figure 15: NAS Controlled Cell Selection, execution in NAS

As an alternative to the example in Section 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.

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GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

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Proposed change affects: (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: TSG-RAN WG2 **Date:** 05/01/00

Subject: Modified description of cell search procedure

Work item:

Category: *(only one category shall be marked with an X)*

F	Correction		**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature			Release 98	
D	Editorial modification	X		Release 99	X
				Release 00	

Reason for change: The description of the UTRA cell search procedure is specified in more detail.

Clauses affected: 5.2.2.1.1, 5.3.1.2.1

Other specs affected:

Other 3G core specifications		→ List of CRs:
Other GSM core specifications		→ List of CRs:
MS test specifications		→ List of CRs:
BSS test specifications		→ List of CRs:
O&M specifications		→ List of CRs:

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5.2.2 UTRA Radio access technology

5.2.2.1 Cell Selection Procedures

5.2.2.1.1 Description

Whenever a PLMN is selected, 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. Two searching procedures are possible.

   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 ~~scrambling code of the~~ strongest cell and reads its system information, in order to find out which PLMNs are available. If the selected PLMN is found, the search of the rest of carriers may be stopped. 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 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 ~~scrambling codes~~ 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, as received in measurement control information via the selected cell.

   NOTE: Setting the priorities of PLMN search and selection are FFS

2) For each cell on the candidate list fulfilling all criteria for a suitable cell, see 4.3, except the cell selection criteria,, calculate the cell selection value, S, and the quality value, Q, defined in Section 5.2.2.1.2.

3) Among the cells with S > 0 choose the cell with the highest Q value to camp on.

If no suitable cells are 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 using the Initial cell selection procedure, it shall attempt to camp on any acceptable cell and enter the Camped on any cell state, where it can only obtain limited service.

NOTE: In PLMN selection, automatic mode, this would normally result in a new PLMN selection.

5.3 Cell Reselection in Connected Mode

5.3.1 UTRA Radio Access Technology

5.3.1.1 General

This section specifies cell reselection procedures in UTRAN connected mode.
The UE shall select a suitable cell and radio access technology based on connected mode radio measurements and cell reselection criteria.
Figure 5 shows the states and procedures in the cell reselection process in connected mode.

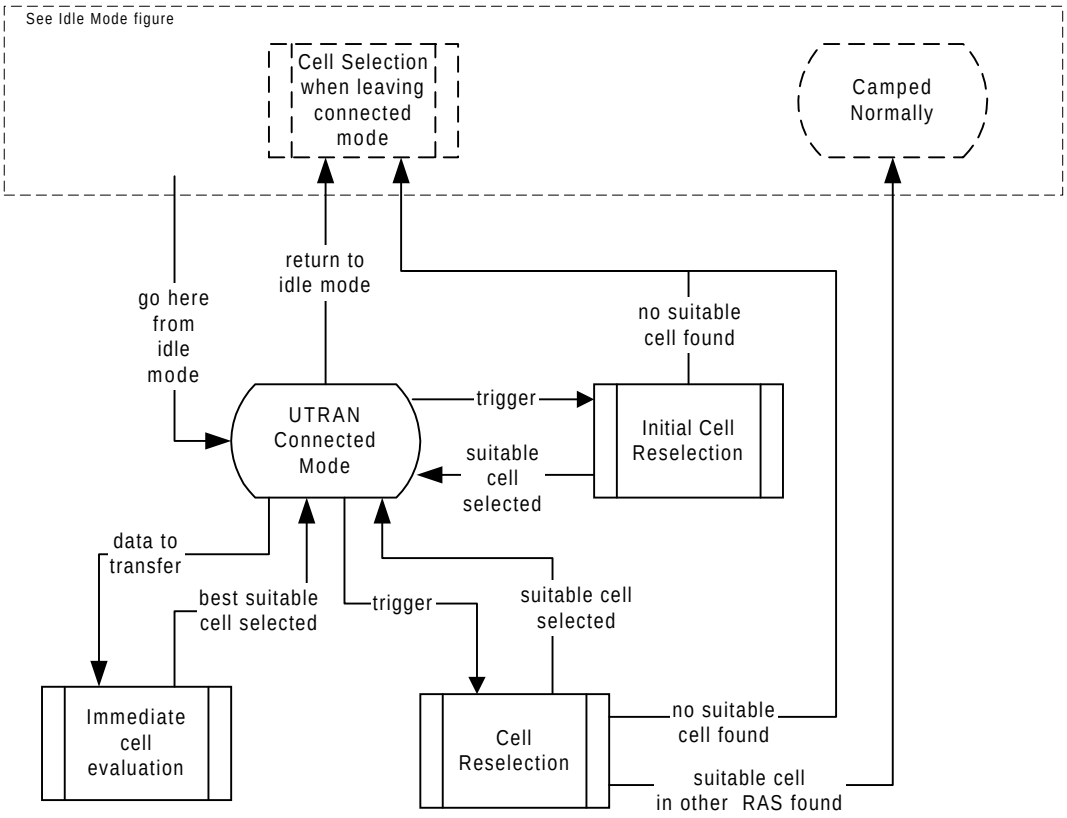

Figure 5: UTRAN Connected mode cell reselection

Transition from idle mode to connected mode is described in Section 5.2.
For UTRAN connected mode, RRC connection mobility tasks are specified in [25.331]. In some states the UE shall perform cell reselection procedures.
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 *Cell reselection* (see Section 5.3.1.4). If the change of cell implies a change of radio access technology, the RRC connection is released, and the UE enters idle mode. If no suitable cell is found in the cell reselection procedure, the RRC connection is released, and the UE enters idle mode.
When the UE has data to transmit, and there is no restriction for the UE to reselect cell (see [25.331]),.the UE shall use the *Immediate cell evaluation* procedure (see Section 5.3.1.3) to select the best suitable cell prior to the access attempt, according to the immediate cell evaluation criteria. Constraints on the use of this procedure are specified in [25.331].
When an immediate cell reselection is triggered, the UE shall use the Initial *cell reselection* procedure (see Section 5.3.1.2) to find a suitable cell. The cases where this may be triggered are specified in [25.331]. One example where this procedure is triggered is at radio link failure, where the UE may trigger an initial cell reselection in order to request re-establishment of the RRC connection. If the UE is unable to find a suitable cell, the UE shall release the RRC connection and enter idle mode.

5.3.1.2 Initial Cell Reselection Procedure

5.3.1.2.1 Description

Triggers for the Initial cell re-selection procedure are specified in [25.331].
When the Initial cell reselection procedure is triggered, 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 ~~scrambling code~~ 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. For each cell on the candidate list fulfilling all criteria for a suitable cell, see Section 5.2.2.1, except the cell selection criteria, calculate the cell selection value, S, and the quality value, Q, defined in Section 5.3.1.2.2.

4. Among the cells with S > 0 select the cell with the highest Q value.

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

3GPP RAN WG2#11
Turin, Italy, Feb 28-Mar 3, 2000

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GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

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Proposed change affects: *(at least one should be marked with an X)* (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]

Source: TSG-RAN WG2 **Date:** 2000-02-20

Subject: UE individual DRX cycles in CELL_PCH and URA_PCH states

Work item:

Category: *(only one category shall be marked with an X)*

F	Correction	X	**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature			Release 98	
D	Editorial modification			Release 99	X
				Release 00	

Reason for change:

It is proposed to remove the broadcast of the IE "UTRAN DRX cycle length" from SIB type 2 for UTRAN connected mode as response to item 1 in the LS (R3-000392, to TSG-RAN WG2) LS on Paging related parameters/DRX cycles, Tdoc R2-000316.

Also included are proposed changes to co-ordinate this CR with the contribution R2-000384 "Proposed CR162r1 to TS 25.331 on UE individual DRX cycles in CELL_PCH and URA_PCH states.

Clauses affected: 8

Other specs affected:

Other 3G core specifications	[ ]	→ List of CRs:
Other GSM core specifications	[ ]	→ List of CRs:
MS test specifications	[ ]	→ List of CRs:
BSS test specifications	[ ]	→ List of CRs:
O&M specifications	[ ]	→ List of CRs:

Other comments:

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8 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. For FDD, PBP=1.

The UE may be attached to different CN domains with different CN domain specific DRX cycle lengths. ~~In this case,~~ ~~t~~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 DRX cycle lengths to use for each CN domain are given in system information. ~~An UE may also be assigned an individual DRX cycle length to use in idle mode by a CN.~~

The DRX cycle lengths to use for UTRAN connected mode is ~~also given in~~ 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.~~system information~~.

~~An UE may also be assigned an individual DRX cycle length to use by UTRAN.~~

The UE shall use the IMSI, the Cell System Frame Number (SFN), Np (number of page indicators within a frame), Frame offset (For FDD, Frame offset = 0), PBP and the DRX cycle length to determine the Paging Occasions.

The Paging Occasions are the frames where:

Cell SFN = {IMSI 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 (DRX cycle length div PBP)}

The number of Page Indicators per frame, Np = (18, 36,72, 144), is given in IE "Number of PI per frame", part of system information in FDD mode. In TDD mode, Np is calculated by PICH repetition cycle and Burst Type (long or short midamble).

If the UE has no IMSI, for instance when making an emergency call without USIM, the UE shall use a default number, 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:

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. 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.

3GPP TSG RAN WG2#11
Turin, 28 Feb-03 Mar, 2000

Document R2-000546
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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25.304	CR	019	Current Version:	3.1.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to:	TSG-RAN #7	for approval	X	strategic		(for SMG use only)
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Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from:* ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: *(at least one should be marked with an X)* (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]

Source: TSG-RAN WG2 **Date:** 2000-02-21

Subject: Cell re-selection criteria including HCS

Work item:

Category: *(only one category shall be marked with an X)*

F	Correction		**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature	X		Release 97	
C	Functional modification of feature			Release 98	
D	Editorial modification			Release 99	X
				Release 00	

Reason for change: Introduction of support for hierarchical cell structures in idle mode and connected mode cell re-selection. The operator should be able to define cells in a hierarchical cell structure. The best cell to camp on for a UE is dependent on radio measurements and the priority given for a cell relative to its neighbouring cell.

Clauses affected:

Other specs affected:

Other 3G core specifications		→ List of CRs:
Other GSM core specifications		→ List of CRs:
MS test specifications		→ List of CRs:
BSS test specifications		→ List of CRs:
O&M specifications		→ List of CRs:

Other comments:
Rules for UE measurements related to HCS added.
When non-suitable cell with S>0 detected at cell re-selection, UE avoids selecting cell on that frequency.
Cell re-selection criteria same for intra/inter-frequency cells and inter-RAT cells.
Mapping function between measurement types of different RATs included.


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5.2 Cell selection and reselection in idle mode

5.2.1 General

As stated in Section 1, this document applies to UEs that support at least UTRA and possibly also other radio access technologies, for instance GSM. The following subsections specify the details for idle mode cell selection and reselection.

- The general part for all radio access technologies, currently UTRA and GSM, this subsection.
- UTRA radio access technologies, see subsection 5.2.2.
- GSM radio access technologies, see subsection 5.2.3.

As an example, consider a UE supporting both UTRA and GSM radio access technologies. It shall follow the specification in this subsection at all times, the specification in 5.2.2 while in UTRA and 5.2.3 while in GSM radio access technology (in addition to the GSM specifications).

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 section 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 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 cell selection, for instance in terms of 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.

Figure 2 shows the states and procedures in the cell selection and reselection process.

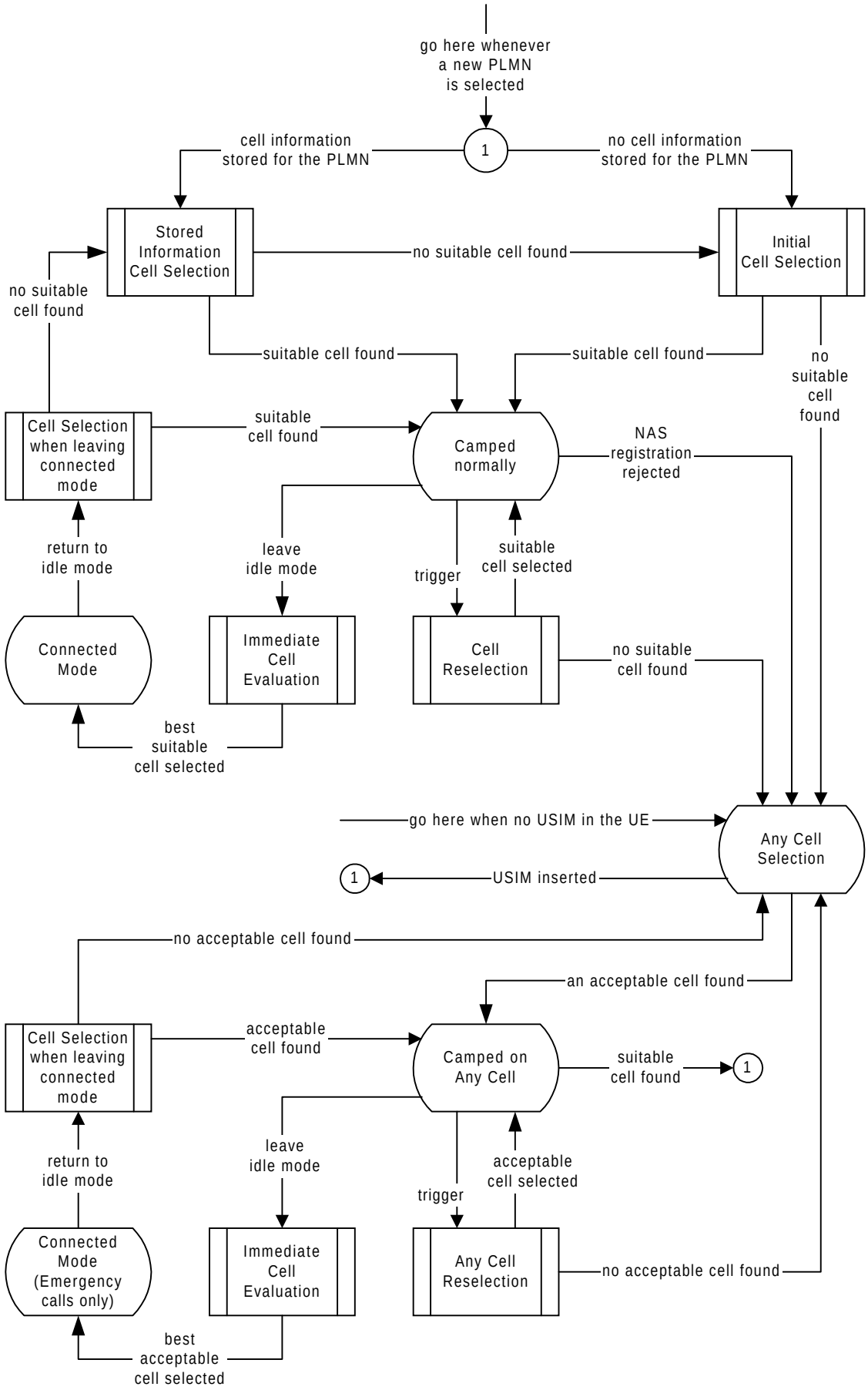

Figure 2: Idle Mode Cell Selection and Reselection
In any state, a new PLMN selection causes an exit to number 1.

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 about the selected PLMN previously stored. This information makes the search for a suitable cell faster. The non-access stratum may control the cell selection by for example, maintaining lists of forbidden registration areas and a list of NAS defined service areas in priority order.

In the *Initial cell selection* procedure), the UE shall select one radio access technology and search for a suitable cell. If no suitable cell is found, the UE shall select another radio access technology and search for a suitable cell, and so on. In the *Stored information cell selection* procedure, the UE may use stored information about the selected PLMN. The information may contain information from several radio access technologies.

When a suitable cell has been found, the UE shall perform necessary NAS registration procedures. When the UE has registered successfully (assuming a service that requires registration), 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.

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 *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 selection*. 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 reselection*. The change of cell may imply a change of radio access technology.

When UE leaves idle mode, state *Camped on any cell*, in order to make an emergency call in connected mode, state *Connected mode (emergency calls only)*, 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. If no suitable cell is found, the UE shall use the *Any 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 on any cell*.

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.

5.2.2 UTRA Radio access technology

5.2.2.1 Cell Selection Procedures

5.2.2.1.1 Description

Whenever a PLMN is selected, 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. Two searching procedures are possible.

   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 scrambling code of the strongest cell, in order to find out which PLMNs are available. If the selected PLMN is found, the search of the rest of carriers may be stopped. 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 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 scrambling codes information 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, as received in measurement control information via the selected cell.

NOTE: Setting the priorities of PLMN search and selection are FFS

2) ~~2)~~ For each cell on the candidate list ~~fulfilling all criteria for a suitable cell, see 4.3, except the cell selection criteria,,~~ calculate the cell selection value, S, and the quality value, Q_{meas}, defined in Section 5.2.2.1.2.

3) Rank the cells with S>0 from the highest Q_{meas} value

34) ~~3) Among the cells with S > 0~~Check if the cell ~~choose the cell~~ with the highest Q_{meas} value ~~to camp on.~~fulfil 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 (see also 5.2.4), and step 3 shall be repeated.

If different radio access modes are involved in the procedure, 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} to a representing quality value Q_{map} which 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>0).

If no suitable cells are 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 using the Initial cell selection procedure, it shall attempt to camp on any acceptable cell and enter the Camped on any cell state, where it can only obtain limited service.

NOTE: In PLMN selection, automatic mode, this would normally result in a new PLMN selection.

5.2.2.1.2 Criteria

The cell selection value, S, is defined as follows.

$$S = Q_{meas} - Qmin - Pcompensation$$

S	Cell Selection value, (dB)
Cell_selection_and_reselection_quality_measure (FDD only)	Choice of measurement (CPICH Rx Ec/N0 or CPICH Rx SIR) to use as quality measure Q_{meas} (read in system information). See NOTE 1.
Q_{meas}	Quality value. The quality of the received signal, CPICH Rx E_C/N_0 or CPICH Rx SIR, (dB) for FDD, P-CCPCH for TDD (dBm). In FDD, ~~.~~ ~~The~~ the measurement to use for the quality value is set by the Cell_selection_and_reselection_quality_measure information element.
Qmin	Minimum required quality level in the cell (read in system information and dependent on the quantity to measure), (FDD:dB, ~~or~~ TDD: dBm).
Pcompensation	max(UE_TXPWR_MAX_RACH – P_MAX, 0), (FDD: dB, TDD: dBm)
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)

NOTE 1: The work in order to support the CPICH Rx SIR measurement is in progress in TSG-RAN WG4 and may impact the use of that measurement in this document

The cell selection criterion is fulfilled if:

$$S > 0$$

5.2.2.2 Immediate Cell Evaluation Procedure

NOTE: Conditions on the use of the immediate cell evaluation procedure are FFS. Specifically, the time needed to perform the procedure is to be considered.

5.2.2.2.1 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 section.

The immediate cell evaluation shall be triggered prior to RACH transmission.

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) Calculate the Q_{map} value and the S value for each cell on the candidate list.

3) Select the neighbouring cell that fulfils the criteria in 5.2.2.2.2. best.
If the best cell does not fulfil all other requirements for a suitable cell, UE shall trigger cell re-selection (see also 5.2.4)

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.

5.2.2.2.2 Criteria

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

$$S_n > 0$$

$$Q_{map,n} > Q_{map,s} + Qoffset_{s,n}$$

S_n	Cell Selection value of the neighbouring cell, (dB)
Cell_selection_and_reselection_quality_measure (FDD only)	Choice of measurement (CPICH Rx Ec/N0 or CPICH Rx SIR) ~~to use as~~that is used to derive ~~quality measures~~ $Q_{map,n}$ and $Q_{map,s}$, (read in system information). See NOTE 1.
$Q_{~~n~~map,n}$	Quality of the neighbouring cell, derived from CPICH Rx E_C/N_0 or CPICH Rx SIR in FDD and from P-CCPCH RSCP in TDD ~~, (dB). T~~In FDD, the measurement ~~to use for~~that is used to derive the quality value is set by the Cell_selection_and_reselection_quality_measure information element.
$Q_{~~s~~map,s}$	Quality of the serving cell~~, (dB)~~. ~~T~~In FDD, the measurement ~~to use for~~ that is used to derive the quality value is set by the Cell_selection_and_reselection_quality_measure information element.
$Qoffset_{s,n}$	Offset between the two cells considered in the evaluation (read in system information), ~~(dB).~~

NOTE 1: The work in order to support the CPICH Rx SIR measurement is in progress in TSG-RAN WG4 and may impact the use of that measurement in this document

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 ($Q_{map,s}$ + Qoffset) is highest. If no neighbouring cell fulfils the criteria, the UE shall keep the serving cell.

5.2.2.3 Camped Normally

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

- Monitor PICH and PCH of the cell as specified in section 8 according to information sent in system information
- Monitor relevant System Information.
- Prior to RACH transmission, the UE shall perform an immediate cell evaluation, according to 5.2.2.2.

5.2.2.4 Cell Reselection Procedure

5.2.2.4.1 Triggers for cell re-selection~~Description~~

~~The purpose of the cell reselection is to look for a better cell for the UE to camp on. The serving cell is changed when a better cell is found. The criteria for a better cell are different for intra/inter-frequency and inter-radio access system cell reselections (see below).~~

The cell reselection procedure shall be triggered in the following cases.

1. Better cell is found
2. $S \leq 0$
3. Downlink signalling failure [details are FFS]

4. Cell has become barred or forbidden [~~details are FFS~~]

In case 2), 3) and 4) the parameters Qhyst and Treselection shall not be considered in the criteria.

~~The following steps are carried out when evaluating cells for cell reselection.~~

~~1) The candidate list of potential cells to camp on consists of the cells for intra- and inter-frequency measurements and intra-radio access technology measurements in system information of the serving cell.~~

~~2) Intra- and inter-frequency cells: Calculate the Q value and the S value for each cell on the candidate list. Inter-radio access technology cells: When Q_s ≤ Qsearch, calculate the Q value of each cell on the candidate list.~~

~~3) Depending on which type of cells is on the candidate list (intra-frequency, inter-frequency and inter-radio access technology), select the cell that fulfils the corresponding criteria best.~~

~~Better cells are prioritised in the following order when several cells fulfil their corresponding criteria:~~

~~1) Intra-frequency neighbouring cells, see 5.2.2.4.2.~~

~~2) Inter-frequency neighbouring cells, see 5.2.2.4.3.~~

~~3) Inter-radio access technology neighbouring cells, see 5.2.2.4.4.~~

5.2.2.4.2 ~~5.2.2.4.2 Intra-Frequency Cell Reselection Criteria~~Measurements for cell re-selection when HCS is not used

~~-~~If hierarchical cell structures are not used in the network, UE shall follow the rules for network control of UE measurement activities in section 7.1.

5.2.2.4.3 Measurements for cell re-selection when HCS is used

If hierarchical cell structures are used in the network, the following rules for intra- and inter-frequency measurements, depending on the quality of serving cell S_S, applies:

1. If $S_S > S_{intraserch}$ UE need not perform intra-frequency measurements.
2. If $S_S > S_{interserch}$, UE need not perform inter-frequency measurements
3. If $Ssearch_{HCS} < S_S <= S_{intraserch}$, UE shall measure on all intra-frequency neighbouring cells, which have equal or higher HCS priority level than the serving cell.
4. If $Ssearch_{HCS} < S_S <= S_{interserch}$, UE shall measure on all inter-frequency neighbouring cells, which have equal or higher HCS priority level than the serving cell.
5. If $S_S <= Ssearch_{HCS}$, UE shall measure on all intra- and inter-frequency neighbouring cells of the serving cell.
6. 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 $T_{CrmaxHyst}$. Then, UE shall revert to measure all intra- and inter-frequency neighbouring cells, which have equal or higher HCS priority level than the serving cell.

If hierarchical cell structures are used in the network, the following rules for inter-RAT measurements, depending on the quality of serving cell S_S, applies:

1. If $S_S > S_{SearchRATm}$, UE need not measure on RATm neighbouring cells.

2. If $S_{HCS,RATm} < S_S <= S_{Search,RATm}$, UE shall measure on RATm neighbouring cells according to the following rules:

   - If the number of cell reselections during time period T_{CRmax} does not exceed N_{CR}, the UE shall measure RATm neighbouring cells, which have an equal or higher HCS priority than the serving cell.

   - 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 $T_{CrmaxHyst}$. Then, UE shall revert to measure all intra- and inter-frequency neighbouring cells, which have equal or higher HCS priority level than the serving cell.

~~1.~~3. If $S_S <= S_{search,RATm}$, UE shall measure on all RATm neighbouring cells.

5.2.2.4.3 Non-suitable cells with S>0

If ~~UE during the cell re-selection procedure detects intra- or inter-frequency neighbouring cell i, that~~ the best cell according to cell reselection criteria specified in section 5.2.2.4.4, does not fulfil ~~the cell selection criteria S>0, but not~~ all ~~other~~ requirements for a suitable cell, that cell, together with all cells on that~~same~~ frequency ~~as cell i~~ shall be removed as candidates for cell re-selection (see also 5.2.4).

~~UE shall regard that the cell barred condition of cell i is valid during time interval T_{barred}. T_{barred} is sent via system information of cell i.~~

5.2.2.4.4 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 hierarchical cell re-selection shall apply, and is defined by:

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

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

The cell ranking criterion R is defined by

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

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

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 $x >= 0$

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

$Q_{map,n} > Qhcs_n$ if $HCS\_PRIO_n <> HCS\_PRIO_s$
$Q_{map,n} > Q_{map,s} + Qoffset_{s,n}$ if $HCS\_PRIO_n = HCS\_PRIO_s$

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. ~~The following exemption applies: if during T_{CRmax} the number of cell reselections has exceeded N_{CR} then, the UE shall apply $TEMP\_OFFSET_n = 0$ for neighbours of lower HCS priority. When the number of cell reselections in timeperiod T_{CRmax} no longer exceeds N_{CR}, UE shall continue to apply the zero value during time period $T_{CRmaxHyst}$.~~

~~The criteria for a better intra-frequency cell are:~~

$$S_n > 0$$

$$Q_n > Q_s + Qoffset_{s,n} + Qhyst$$

S_n	Cell Selection value of the neighbouring cell, (dB)
Cell_selection_and_reselection_quality_measure (FDD only)	Choice of measurement (CPICH Rx Ec/N0 or CPICH Rx SIR) ~~to use as~~ that is used to derive quality measures $Q_{map,n}$ and $Q_{map,s}$, (read in system information). See NOTE 1.
$Q_{map,n}$	Quality of the neighbouring cell, derived from CPICH Rx E_C/N_0 or CPICH Rx SIR in FDD, from P-CCPCH in TDD and from RXLEV in GSM~~, (dB)~~. ~~T~~In FDD, the measurement ~~to use for~~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, derived from CPICH Rx E_C/N_0 or CPICH Rx SIR ~~,~~in FDD, from P-CCPCH in TDD and from RXLEV in GSM. ~~(dB).~~ The measurement ~~to use for~~that is used to derinve the quality value is set by the Cell_selection_and_reselection_quality_measure information element.
$Qoffset_{s,n}$	Offset between the two cells considered in the evaluation (read in system information), ~~(dB)~~
$Qhyst_s$	Hysteresis value of the serving cell, (~~dB~~)
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 ~~(dB)~~
$TEMP\_OFFSET_n$	Offset to H and R criteria for the duration of $PENALTY\_TIME_n$ ~~(dB)~~
T_{maxCR}	Duration for evaluating allowed amount of cell reselections (s).
N_{CR}	Maximum number of cell reselections
$T_{CrmaxHyst}$	Additional time period before UE reverts to low-mobility measurements (s)
$Treselection_s$	Time-to-trigger for cell reselection, (s) ~~NOTE: Exact unit is FFS~~

NOTE 1: The work in order to support the CPICH Rx SIR measurement is in progress in RAN WG4 and may impact the use of that measurement in this document

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 a cell re-selection if a non-serving cell is evaluated to be better than the serving cell. The best cell is the cell with the highest R value and S>0 among

- those 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 section 5.2.2.4.3).
- all cells, not considering HCS priority levels, if no cell fulfil the criterion H >= 0 or HCS is not applied.

The UE shall reselect the new cell, if the cell reselection criteria are fulfilled during a time interval Treselection. ~~The value of Treselection is broadcast in system information.~~

~~5.2.2.4.3 Inter-Frequency Cell Reselection Criteria~~

~~The inter-frequency cell reselection evaluation uses the same criteria as intra-frequency cell reselections.~~

~~5.2.2.4.4 Inter-Radio Access Technology Cell Reselection Criteria~~

~~The criteria for a better inter-radio-access-technology cell are:~~

$Q_s < Qsearch_s$
$Q_n > Qaccept_{s,n}$

~~Q_s~~	~~Quality of the serving cell, (dB or dBm)~~ ~~NOTE: Exact unit is FFS~~
~~Q_n~~	~~Quality of the neighbouring cell, (dB or dBm)~~ ~~NOTE: Exact unit is FFS~~
~~$Qsearch_s$~~	~~Below this limit in the serving cell, the UE shall take measurements of inter-radio access technology cells if such entries exist in the measurement control information elements (dB or dBm).~~ ~~NOTE: Exact unit is FFS~~
~~$Qaccept_{s,n}$~~	~~Minimum quality required for a cell in another radio access technology. (dB or dBm)~~ ~~NOTE: Exact unit is FFS~~

~~Measurements on another radio access technology are not carried out unless the quality of the serving cell is lower than a threshold, Qsearch.~~

~~The UE shall select an inter-radio access technology cell that fulfils the criteria Q_n > $Qaccept_{s,n}$. If more than one cell fulfils the criteria, the UE shall select the cell with the highest quality Q.~~

~~Qaccept and Qsearch are included in the system information of the serving cell.~~

~~If no cells of the other radio access technologies fulfil the criteria, the UE shall stay on the current cell and continue to perform measurements as long as Q_s < $Qsearch_s$.~~

5.2.2.4.5 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:

$Qoffset_{s,n}$

The offset between the two cells considered in the evaluation ($Qoffset_{s,n}$ ~~(dB)~~) can be conveyed in two different ways:

Alternative 1. Offsets can be included for each neighbouring cell in the intra-frequency neighbouring cell list, which is read in system information of the serving cell.

Alternative 2. The offset can be broadcast in each cell, and the UE decodes it from system information broadcasts in the neighbouring cell. In the case, this offset is applied for all cell relations towards that neighbouring cell (i.e. for each value on the subscript s). Decoding is done only when the cell measurement exceeds the neighbour cell decoding range. The offset is broadcast together with an offset expiration timer, which indicates how long the offset value is valid.

NOTE: Whether both 1 and 2 could be used or if only one of these alternatives is used is FFS

$Qhyst_s$

The hysteresis value (Qhyst) is read in system information of the serving cell.

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

$Qhcs_s$, $Qhcs_n$

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

$PENALTY\_TIME_n$

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

TEMPORARY_OFFSET$_n$

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.

T_{CRmax}

Duration for evaluating allowed amount of cell reselections (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.

Treselection$_s$

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

Decoding range

The decoding range is read in system information of the serving cell.

NOTE: This parameter is only applicable for Alternative 2, see above.

OffsetExp

The offset expiration timer is read in system information of the neighbouring cell.

NOTE: This parameter is only applicable for Alternative 2, see above.

~~**Qaccept$_{s,n}$**~~

~~Minimum quality required for selecting a cell in other radio access technology. The value is read in system information of the serving cell.~~

Ssearch$_{HCS}$

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.

~~**Qsearch$_s$**~~

~~Below this limit in the serving UTRA cell, the UE shall take measurements of inter-radio access technology cells. The value is read in system information of the serving cell.~~

Ssearch$_{RAT\ 1}$ - Ssearch$_{RAT\ k}$

Below this RAT specific threshold in the serving UTRA cell, the UE shall initiate measurements of inter-radio access technology cells. The values are read in system information of the serving cell.

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).

***** Next modified section *****

5.2.3 GSM Radio access technology

5.2.3.1 Cell Selection Procedures

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

5.2.3.2 Immediate Cell Evaluation Procedure

Immediate Cell Evaluation procedure is not applicable for GSM.

5.2.3.3 Cell Reselection Procedure

5.2.3.3.1 Description

The cell reselection procedure in GSM is specified in [1].

5.2.3.3.2 Cell Reselection Criteria

The cell reselection criteria in GSM are specified in [1].

5.2.3.3.3 Inter-Radio Access Technology Cell Reselection Procedure

The criteria for a better UTRA cell are:

$$Q_s < Qsearch_s$$

$$Q_n > Qaccept_{s,n}$$

Q_s	Quality of the serving cell, (dB or dBm) NOTE: Exact unit is FFS
Q_n	Quality of the neighbouring cell, (dB or dBm) NOTE: Exact unit is FFS
$Qsearch_s$	Below this limit in the serving cell, the UE shall take measurements of UTRA cells if such entries exist in the measurement control information elements (dB or dBm). NOTE: Exact unit is FFS
$Qaccept_{s,n}$	Minimum quality required for a UTRA cell. (dB or dBm) NOTE: Exact unit is FFS

Measurements on UTRA cells are not carried out unless the quality of the serving cell is lower than a threshold, Qsearch.

The UE shall select a UTRA cell that fulfils the criteria $Q_n > Qaccept_{s,n}$. If more than one cell fulfils the criteria, the UE shall select the cell with the highest quality Q.

Qaccept and Qsearch are included in the system information of the serving cell.

If no cells of the other technologies fulfil the criteria, the UE shall stay on the current cell and continue to perform measurements as long as $Q_s < Qsearch_s$.

5.2.3.3.4 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]. Inter-radio access technology cell reselection parameters are broadcast in GSM system information as follows:

$Qsearch_s$

When the Q value of the serving GSM cell is below this value, the UE shall perform measurements of UTRA cells.

$Qaccept_{s,n}$

Minimum quality of the UTRA cell required for selecting the UTRA cell.

5.2.3.4 Cell Selection when leaving connected mode

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

5.2.3.5 Any Cell Selection

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

5.2.3.6 Camped on Any Cell

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

5.2.3.7 Any Cell Reselection

The any cell reselection procedure in GSM is specified in [1].

5.2.4 Barred Cells and Access Control

The barred case of cell status is used to bar completely a cell against access by all normal subscribers. This barred status is indicated in the information broadcast by the cell, in the Cell Access Restriction information element, which has 4 cases:

1. Cell not Barred,
2. Cell Barred for normal users - allows Operator access,
3. Cell Barred for normal users – allows Emergency access,
4. Cell Barred for normal users – allows SoLSA access.

Additionally, combinations of cases 2, 3, and 4 are allowed in one cell.

If UE, during the cell selection, immediate cell evaluation and cell re-selection procedures, detects UTRA cell i, that fulfil the cell selection criteria S>0, but not all other requirements for a suitable cell, all cells on same frequency as cell i shall be removed as candidates for cell selection. Specific actions performed by the UE are described for each procedure

UE shall regard that the cell barred condition of cell i is valid during time interval T_{barred}. T_{barred} is sent via system information of cell i.

NOTE: Access Control is FFS

FFS

5.2.5 Regional Provision of Service

FFS

5.3 Cell Reselection in Connected Mode

5.3.1 UTRA Radio Access Technology

5.3.1.1 General

This section specifies cell reselection procedures in UTRAN connected mode.

The UE shall select a suitable cell and radio access technology based on connected mode radio measurements and cell reselection criteria.

Figure 5 shows the states and procedures in the cell reselection process in connected mode.

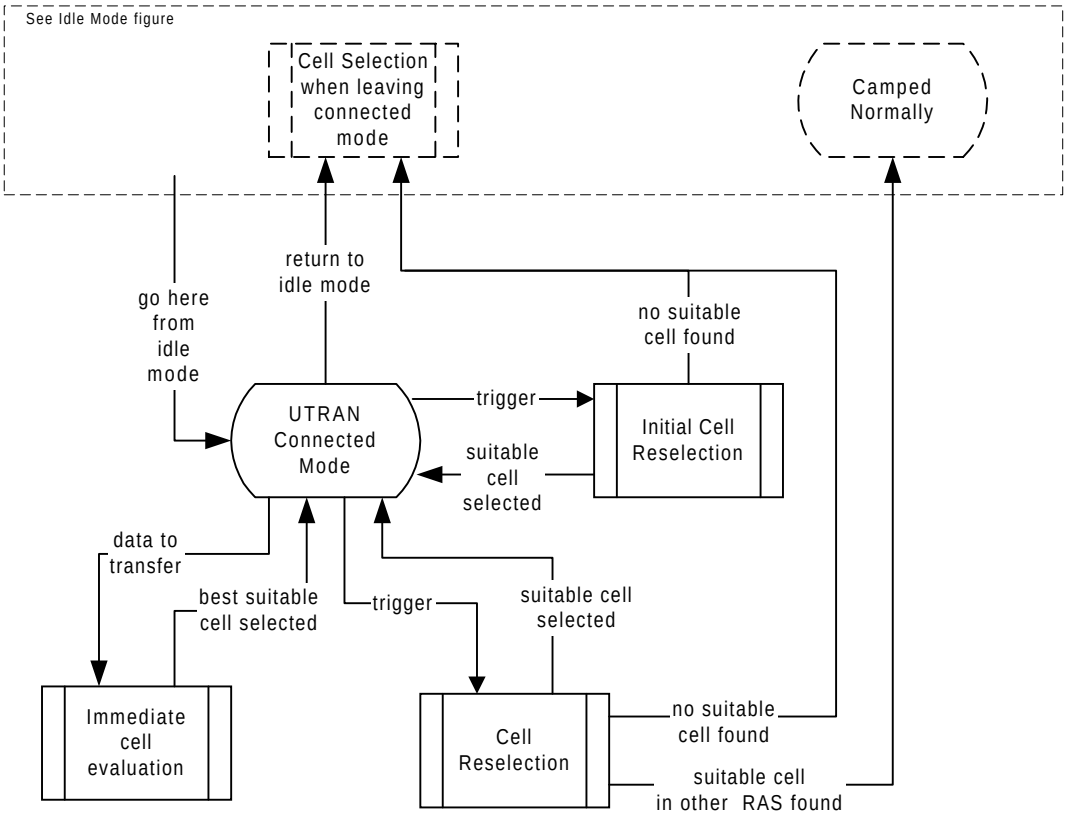

Figure 5: UTRAN Connected mode cell reselection

Transition from idle mode to connected mode is described in Section 5.2.

For UTRAN connected mode, RRC connection mobility tasks are specified in [25.331]. In some states the UE shall perform cell reselection procedures.

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 *Cell reselection* (see Section 5.3.1.4). If the change of cell implies a change of radio access technology, the RRC connection is released, and the UE enters idle mode. If no suitable cell is found in the cell reselection procedure, the RRC connection is released, and the UE enters idle mode.

When the UE has data to transmit, and there is no restriction for the UE to reselect cell (see [25.331]),.the UE shall use the *Immediate cell evaluation* procedure (see Section 5.3.1.3) to select the best suitable cell prior to the access attempt, according to the immediate cell evaluation criteria. Constraints on the use of this procedure are specified in [25.331].

When an immediate cell reselection is triggered, the UE shall use the Initial *cell reselection* procedure (see Section 5.3.1.2) to find a suitable cell. The cases where this may be triggered are specified in [25.331]. One example where this procedure is triggered is at radio link failure, where the UE may trigger an initial cell reselection in order to request re-establishment of the RRC connection. If the UE is unable to find a suitable cell, the UE shall release the RRC connection and enter idle mode.

5.3.1.2 Initial Cell Reselection Procedure

5.3.1.2.1 Description

Triggers for the Initial cell re-selection procedure are specified in [25.331].

When the Initial cell reselection procedure is triggered, 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 scrambling code information from previously received measurement control information elements. If UE, during the initial cell re-selection procedure, detects UTRA cell i, that fulfil the cell selection criteria S>0, but not all other requirements for a suitable cell, all cells on same frequency as cell i shall be removed as candidates for cell selection (see also 5.2.4).

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. For each cell on the candidate list fulfilling all criteria for a suitable cell, see Section 5.2.2.1, except the cell selection criteria, calculate the cell selection value, S, and the quality value, Q_{meas}, defined in Section 5.3.1.2.2.

4. Among the cells with S > 0 select the cell with the highest Q_{meas} value.

If different radio access modes are involved in the procedure, 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} which 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>0).

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

5.3.1.2.2 Criteria

The criteria for initial cell reselection is specified in 5.2.2.1.2. ~~The cell selection value, S, is defined as follows.~~

~~$$S = Q - Qmin - Pcompensation$$~~

~~S~~	~~Cell Selection value, (dB)~~
~~Cell_selection_and_reselection_quality_measure~~	~~Choice of measurement (CPICH Rx Ec/N0 or CPICH Rx SIR) to use as quality measures Q (read in system information). See NOTE 1.~~
~~Q~~	~~Quality value. The quality of the received signal, (CPICH Rx Ec/N0 or CPICH Rx SIR) (dB)~~
~~Q_{min}~~	~~Minimum required quality level in the cell (read in system information and dependent on the quantity to measure), (dB)~~
~~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)~~

~~NOTE 1: The work in order to support the CPICH Rx SIR measurement is in progress in TSG-RAN WG4 and may impact the use of that measurement in this document~~

~~The initial cell re-selection criterion is fulfilled if:~~

$$S > 0$$

5.3.1.3 Immediate Cell Evaluation Procedure

5.3.1.3.1 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 section.

The immediate cell evaluation procedure shall be triggered prior to RACH and CPCH (FFS) transmission, if not restrictions specified in [4] inhibits use of the procedure.

The immediate cell evaluation procedure in UTRA access technology Connnected Mode is the same as used for idle mode, described in section 5.2.2.2, 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.

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

~~1. The candidate list of potential cells 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.~~

~~2. Calculate the Q value and the S value for each cell on the candidate list.~~

~~3. Select the neighbouring cell that fulfils the criteria in Section 5.3.1.3.2 best.~~

~~5.3.1.3.2 Criteria~~

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

$$S_n > 0$$

$$Q_n > Q_s + Qoffset_{s,n}$$

S_n	Cell Selection value of the neighbouring cell, (dB)
Cell_selection_and_reselection_quality_measure	Choice of measurement (CPICH Rx Ec/N0 or CPICH Rx SIR) to use as quality measures Q_n and Q_s (read in system information). See NOTE 1.
Q_n	Quality of the neighbouring cell, (CPICH Rx Ec/N0 or CPICH Rx SIR), (dB)
Q_s	Quality of the serving cell, (CPICH Rx Ec/N0 or CPICH Rx SIR), (dB)
$Qoffset_{s,n}$	Offset between the two cells considered in the evaluation (read in system information), (dB).

NOTE 1: The work in order to support the CPICH Rx SIR measurement is in progress in RAN WG4 and may impact the use of that measurement in this document

If more than one neighbouring cell fulfils the criteria, the UE shall choose the cell where the difference between Q_n and (Q_s + Qoffset) is highest. If no neighbouring cell fulfils the criteria, the UE shall keep the serving cell.

5.3.1.4 Cell Reselection Procedure

The cell reselection procedure in UTRA access technology Connnected Mode is the same as used for idle mode, described in section 5.2.2.4.

5.3.1.4.1 Description

The purpose of the cell reselection is to look for a better cell for the UE to camp on. The serving cell is changed when a better cell is found.

The cell reselection procedure shall be triggered in the following cases.

1) Better cell is found

2) S ≤ 0

3) Downlink signalling failure [details are FFS]

4) Cell has become barred or forbidden [details are FFS]

In case 2), 3) and 4), the parameters Qhyst and Treselection shall not be considered in the criteria.

The following steps are carried out when evaluating cells for cell reselection.

1. The candidate list of potential cells consists of the cells for intra- and inter-frequency and inter radio access technology 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- and inter-frequency and inter-radio access technology measurements included in this UE dedicated measurement control information.

2. Intra- and inter frequency cells : Calculate the Q value and the S value for each cell on the candidate list. Inter-radio-access-technology cells: When Q_s ≤ Qsearch, calculate the Q value of each cell on the candidate list.

3. Depending on which types of cells are on the candidate list (intra-frequency, inter-frequency and inter-radio-access technology), select the cell that fulfils the corresponding criteria best.

Better cells are prioritised in the following order when several cells fulfil their corresponding criteria:

1) Intra-frequency neighbouring cells, see 5.3.1.4.2.

2) Inter-frequency neighbouring cells, see 5.3.1.4.3.

3) Inter-radio-access-technology neighbouring cells, see 5.3.1.4.4.

5.3.1.4.2 Intra-Frequency Cell Reselection Criteria

The criteria for a better intra-frequency cell are:

$$S_n > 0$$

$$Q_n > Q_s + Qoffset_{s,n} + Qhyst_s$$

S_n	Cell Selection value of the neighbouring cell, (dB)
Cell_selection_and_reselection_quality_measure	Choice of measurement (CPICH Rx Ec/N0 or CPICH Rx SIR) to use as quality measures Q_n and Q_s (read in system information). See NOTE 1.
Q_n	Quality of the neighbouring cell, (CPICH Rx Ec/N0 or CPICH Rx SIR), (dB)
Q_s	Quality of the serving cell, (CPICH Rx Ec/N0 or CPICH Rx SIR), (dB)
$Qoffset_{s,n}$	Offset between the two cells considered in the evaluation (read in system information), (dB)
$Qhyst_s$	Hysteresis value of the serving cell, (dB)
$Treselection_s$	Time-to-trigger criteria for cell reselection, (s) *[Note: Exact unit is FFS]*

NOTE 1: The work in order to support the CPICH Rx SIR measurement is in progress in RAN WG4 and may impact the use of that measurement in this document

The UE shall reselect the new cell, if the cell reselection criteria are fulfilled during a time interval Treselection. The value of Treselection is broadcast in system information.

5.3.1.4.3 Inter-Frequency Cell Reselection Criteria

The inter-frequency cell reselection evaluation uses the same criteria as intra-frequency cell reselections.

5.3.1.4.4 Inter Radio Access Technology Cell Reselection Criteria

The criteria for a better inter-radio-access-technology cell are:

$$Q_s < Qsearch_s$$

$$Q_n > Qaccept_{s,n}$$

Q_s	Quality of the serving cell, (dB or dBm) NOTE: Exact unit is FFS
Q_n	Quality of the neighbouring cell, (dB or dBm) NOTE: Exact unit is FFS
$Qsearch_{s,n}$	Below this limit in the serving cell, the UE shall take measurements of inter-radio-access-technology cells if such entries exist in the measurement control information elements. (dB or dBm) NOTE: Exact unit is FFS
$Qaccept_{s,n}$	Minimum quality required for a cell in another radio access technology. (dB or dBm) NOTE: Exact unit is FFS

Measurements on another radio access are not carried out unless the quality of the serving cell is lower than a threshold, Qsearch.

The UE shall select an inter-radio-access-technology cell that fulfils the criteria $Q_n > Qaccept_{s,n}$. If more than one cell fulfils the criteria, the UE shall select the cell with the highest quality Q.

~~Qaccept and Qsearch are included in the system information of the serving cell.~~

~~If no cells of the other systems fulfil the criteria, the UE shall stay on the current cell and continue to perform measurements as long as Q_s < $Qsearch_s$.~~

***** Next modified section *****

7 ~~Idle mode m~~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 SIR 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_{meas} 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_{meas}.

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 is defined (given by parameter Function_type) and the according function is defined by two parameters Map_parameter_1 and Map_parameter_2. If Q_{meas} is the measured value and Q_{map} is the representing quality value, the following relation is defined over a certain interval:

Function type:

- linear: Q_{map}=Map_parameter_1* Q_{meas} +Map_parameter_2.

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

7.2~~1~~ Network control of UE measurement activities

7.2~~1~~.1 Intra-frequency cell measurements

The optional parameter Sintrasearch provides means for the network to control the UE Intra-frequency measurement activities in idle mode. The parameter is included in the system information of the serving cell.

Depending on the presence of the parameter, and the quality of the serving cell, S_s, the following 2 cases are possible:

1. Parameter Sintrasearch is available for serving cell:

S_s > Sintrasearch	UE need not perform Intra-frequency measurements
S_s <= Sintrasearch	UE shall perform Intra-frequency measurements

2. Parameter Sintrasearch is not available for serving cell:
   UE shall perform Intra-frequency measurements.

7.21.2 Inter-frequency cell measurements

The optional parameters QSintersearch and QSintersearchsize provide means for the network to control the UE Inter-frequency measurement activities in idle mode. The parameters areis included in the system information of the serving cell.

Depending on the presence of the parameters, and the quality of the serving cell, QS_s, the following 3 cases are possible

1. Parameters QSintersearch and QSintersearchsize are available for serving cell:

QS_s > QSintersearch + QSintersearchsize	UE shall perform Inter-frequency measurements
QSintersearch < QS_s <= QSintersearch + QSintersearchsize	UE need not perform Inter-frequency measurements
QS_s <= QSintersearch	UE shall perform Inter-frequency measurements

21. Parameters QSintersearch is available for serving cell, QSintersearchadd is not available for serving cell:

QS_s > QSintersearch	UE need not perform Inter-frequency measurements
QS_s <= QSintersearch	UE shall perform Inter-frequency measurements

32. Parameters QSintersearch and QSintersearchsize areis not available for serving cell:
   UE shall perform Inter-frequency measurements.

7.21.3 Inter-Radio Access Technology measurements

The parameter QSsearch provides means for the network to control the UE Interra-Radio Access Technology measurement activities in idle mode. The parameter is included in the system information of the serving cell.

QS_s > QSsearch	UE need not perform Inter-RAT measurements
QS_s <= QSsearch	UE shall perform Inter-RAT measurements

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Torino, Italy, 28 February - 3 March 2000

***Document* R2-000488**
e.g. for 3GPP use the format TP-99xxx
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CHANGE REQUEST

Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.

25.304	CR	021	Current Version:	3.1.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to:	TSG-RAN #7	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑		for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: *(at least one should be marked with an X)* (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]

Source: TSG-RAN WG2 **Date:** 01/02/00

Subject: Modified description of DRX

Work item:

Category: *(only one category shall be marked with an X)*

F	Correction	X	**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature			Release 98	
D	Editorial modification			Release 99	X
				Release 00	

Reason for change: The definition of some parameters needed for DRX is corrected and some editorial modifications are made.

Clauses affected: 8

Other specs affected:

Other 3G core specifications		→ List of CRs:
Other GSM core specifications		→ List of CRs:
MS test specifications		→ List of CRs:
BSS test specifications		→ List of CRs:
O&M specifications		→ List of CRs:

Other comments:

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<--------- double-click here for help and instructions on how to create a CR.

8 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 which is broadcast in system information. For FDD, PBP=1.

The UE may be attached to different CN domains with different DRX cycle lengths. In this case, the UE shall use the shortest of those DRX cycle lengths. The DRX cycle lengths to use for each CN domain are given in system information. An UE may also be assigned an individual DRX cycle length to use in idle mode by a CN.

The DRX cycle lengths to use for UTRAN connected mode is also given in system information. An UE may also be assigned an individual DRX cycle length to use by UTRAN.

The UE shall use the IMSI, the Cell System Frame Number (SFN), Np (number of page indicators within a frame), 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 Occasions (i.e. the SFN of the first frame of the Paging Block) is determined as follows are the frames where:

Cell SFN Paging Occasion = {IMSI 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 (DRX cycle length div PBP)}

In FDD mode, TNp = (18,36,72,144) is the number of Page Indicators per frame, Np = (18, 36,72, 144), 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 PICH repetition cycle the Paging Indicator Length L_{PI}, and 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, 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:

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.