ericsson.com

User Description, GSM-UMTS-LTE Cell Reselection and Handover

USER DESCRIPTION

293/1553-HSC 103 12/15 Uen D

ERICSSON

Disclaimer

The contents of this document are subject to revision without notice due to continued progress in methodology, design and manufacturing.

Ericsson shall have no liability for any error or damages of any kind resulting from the use of this document.

Trademark List

Ericsson	is a trademark owned by Telefonaktiebolaget LM Ericsson.

All other product or service names mentioned in this User Description are trademarks of their respective companies.

Contents

1 Introduction

1.1 General

This user description describes a number of BSS features related to mobility between GSM, UMTS and LTE. The features described are GSM-UMTS Cell Reselection and Handover, Smooth GSM to WCDMA Unloading, Handover with Usage of Service Indicator, Combined Cell Reselection Triggering GSM to WCDMA, Combined Handover Triggering GSM to WCDMA, Optimized throughput at GSM to WCDMA Cell Change (based on NC2), Queuing of WCDMA Calls in BSS, Fast Return to WCDMA after Call Release and GSM-LTE Cell Reselection.

The feature GSM-UMTS Cell Reselection and Handover allows end-users with Multi-RAT (Radio Access Technology) GSM/WCDMA Mobile Stations to roam between UTRAN (UMTS Terrestrial Radio Access Network) and GSM radio access network without loss of service (provided the service is supported in both networks). It gives support for mobility in idle mode (GSM to UTRAN), for handover of circuit switched connections (GSM to UTRAN), and for cell reselection for packed switched service (GPRS/EGPRS to UTRAN).

The feature Smooth GSM to WCDMA Unloading helps assuring resource availability in GSM cells and limits handover load at high load situations.

The feature Handover with Usage of Service Indicator gives support for service based handovers, which means the MSC can give preference to which radio access network to use for a connection, GSM or WCDMA. The Service Indicator is used by the BSC when deciding on CS handover from GSM to WCDMA

The feature Combined Cell Reselection Triggering GSM to WCDMA provides the possibility to define a threshold for CPICH RSCP measurements to be used at cell reselection. The threshold for CPICH RSCP measurements assures a sufficient downlink signal strength, which in turn increases the possibility for the mobile to reach the network in the uplink.

The feature Combined Handover Triggering GSM to WCDMA provides the possibility to define a CPICH RSCP threshold used to control the measurement reporting of UTRAN cells for MSs being in connected mode or for MSs being in NC2 mode. No UTRAN cells will be included in the measurement reports from the MS unless the non reporting radio entity (CPICH RSCP) have a value above the defined CPICH RSCP threshold.

The feature Optimized throughput at GSM to WCDMA Cell Change improves end-user performance by preventing a cell reselection from a GSM cell to a WCDMA cell which in some instances can have outage times of 10–20 seconds on the end-user application level.

The feature Fast Return to WCDMA after Call Release is introduced to decrease the Paging Outage Time. With the feature multi-RAT mobiles can be requested to select a WCDMA cell directly after the call release and hence preventing the mobile to first select a GSM cell and then re-select a WCDMA cell.

The feature Queuing of WCDMA Calls in BSS makes it possible to provide enhanced network accessibility in GSM to prioritized subscribers coming from the WCDMA network via the directed retry procedure.

The feature GSM-LTE Cell Reselection gives support for cell reselection in idle and packet transfer mode from GSM to LTE.

This document only describes the BSS functionality, not UTRAN parts, of circuit and packet switched inter system cell reselection and handover. Only WCDMA FDD (Frequency Division Duplex) is supported.

1.2 Readers Guide

This document describes the GSM and UMTS inter working from a BSS perspective. UMTS details can be found in the documentation describing the WCDMA Radio Access Network product.

1.3 Main Changes in Ericsson BSS 08B

No changes.

1.4 Main Changes in Ericsson BSS 09A

The feature Queuing of WCDMA Calls in BSS has been introduced.
The feature Fast Return to WCDMA after Call Release has been introduced.

1.5 Main Changes in Ericsson BSS G10A

The feature GSM-LTE Cell Reselection has been introduced.
The feature GSM-UMTS Cell Reselection and Handover has been updated to also support priority based cell reselection.

2 Capabilities

With the feature GSM-UMTS Cell Reselection and Handover, an operator (or two operators) of both a GSM and a UTRAN system in an area can use these networks to complement each other. For example, the already built out coverage of GSM can be used, so that end-users with Multi-RAT MSs will experience good coverage also in areas where there is no UTRAN coverage using the UMTS to GSM cell reselection and handover functionality. This will increase the service perceived by end-users as well as the combined network capacity.

For Cell reselection to UMTS, the operator has the choice to use cell ranking or/and priority based cell reselection.

With the feature Handover with Usage of Service Indicator, the feature GSM-UMTS Cell Reselection and Handover is extended with a mechanism that enables the MSC to affect which radio access network, GSM or WCDMA, preferably shall serve a CS connection.

With the feature Smooth GSM to WCDMA Unloading, the feature GSM-UMTS Cell Reselection and Handover is extended with the possibility to limit the maximum number of handovers to perform per second to UTRAN. Only the number of handovers that are triggered because of high traffic load in the GSM cell are limited. Furthermore, incoming handovers from UTRAN, will be rejected in case of high traffic load in the GSM cell. These mechanisms helps to assure the resource availability in the GSM network.

With the feature Combined Cell Reselection Triggering GSM to WCDMA, cell reselection is improved to decrease the number of ping-pong cell reselections. That is achieved by adding a threshold for CPICH RSCP measurements to assure a sufficient downlink signal strength, which in turn increases the possiblity for the mobile to reach the network in the uplink.

With the feature Combined Handover Triggering GSM to WCDMA, the IRAT handover behaviour is improved by avoiding handover attempts to weak UTRAN cells. That is achieved by adding a reporting threshold for non reporting radio entity of the UTRAN cells. Since CPICH Ec/No is the reporting radio entity the non reporting radio entity is CPICH RSCP. An MS will only include a UTRAN cell in the measurement reports in case the CPICH RSCP value of the UTRAN cell is above the defined threshold value. This assures that UTRAN handover candidates have a sufficient downlink signal strength, which in turn increases the possiblity for the mobile to reach the network in the uplink.

With the feature Optimized throughput at GSM to WCDMA Cell Change, end-user performance is improved for GPRS/EDGE/WCDMA subscribers. In particular, this feature reduces the impact on download times by prohibiting a cell reselection from a GSM cell to a WCDMA cell, and thus avoiding the long outage times, when an MS is in packet transfer mode.

With the feature Fast Return to WCDMA after Call Release, the Paging outage time can be decreased since the multi-RAT mobiles can be requested to select a WCDMA cell directly at the call release which prevents the mobile to first select a GSM cell and then re-select a WCDMA cell.

The feature Queuing of WCDMA Calls in BSS makes it possible to provide enhanced network accessibility in GSM to prioritized subscribers coming from the WCDMA network via the directed retry procedure.

With the feature GSM-LTE Cell Reselection priority based cell reselection to LTE is supported. When the feature is active, priority based cell reselection must also be used towards UMTS. The system information is sent in SI2quater on BCCH only, which mean that this feature does not work when MPDCH is used.

3 Technical Description

3.1 General

The feature GSM-UMTS Cell Reselection and Handover provides the basic mechanisms for handover and cell reselection from GSM to UMTS. Parameters can be set to control when a multi-RAT MS in idle or connected mode shall start measuring on UTRAN cells, see Section 3.2 on page 6. A UTRAN cell will only be considered as a candidate for cell reselection or a handover if the signal quality in the target cell is good enough. . Two different cell reselection algorithms are supported, cell ranking and priority based. Cell reselection based on cell ranking is described in Section 3.3.2.2 on page 11, Cell reselection based on priority is described in Section 3.3.2.5 Cell Reselection to UMTS and LTE based on priority on page 14 and the optional feature Combined Cell Reselection Triggering GSM to WCDMA is described in Section 3.3.4.5 on page 23. For handover, the traffic load of the GSM cell can in addition to the radio criteria be used as a criterion for handovers towards UMTS, see Section 3.3.4 on page 16.

With the optional feature Combined Handover Triggering GSM to WCDMA it is further possible to control if the MS shall include UTRAN cells in the measurement reports sent to the network. Only UTRAN cells with CPICH RSCP values above a given CPICH RSCP threshold will be included in the measurement reports.

In case the urgency criteria in the GSM cell are fulfilled, see Reference [4], handover to UTRAN may be triggered regardless of the traffic load in the GSM cell.

With the feature Handover with Usage of Service Indicator, the feature GSM-UMTS Cell Reselection and Handover is extended with a mechanism for the MSC to control in which system (GSM or UMTS) a connection preferably shall be served. If the MSC indicates that a connection shall not be handed over to UTRAN, BSS never triggers a handover to UTRAN. If the MSC indicates that a connection should not be handed over to UTRAN, BSS only triggers a handover to UTRAN in case any urgency criterion is fulfilled in the GSM cell and when the signal quality in the target cell is good enough. In case the MSC indicates that a handover should be performed, BSS triggers a handover to UTRAN when the signal quality in the target cell is good enough.

With the feature Smooth GSM to WCDMA Unloading, the feature GSM-UMTS Cell Reselection and Handover is extended with the possibility to limit the maximum number of handovers to perform per second to UTRAN. Only the number of handovers that is triggered because of high traffic load in the GSM cell is limited. Furthermore, incoming handovers from UTRAN, will be rejected in case of high traffic load in the GSM cell.

With the feature Optimized throughput at GSM to WCDMA Cell Change, end-user performance is improved for GPRS/EDGE/WCDMA subscribers. In particular, this feature reduces the impact on download times by prohibiting a cell reselection from a GSM cell to a WCDMA cell, and thus avoiding the long outage times, when an MS is in packet transfer mode. This feature is based on NC2, see Reference [3].

The feature Fast Return to WCDMA after Call Release is introduced to decrease the Paging outage time. With the feature multi-RAT mobiles can be requested to select a WCDMA cell directly the call release and hence preventing the mobile to first select a GSM cell and then re-select a WCDMA cell.

The feature Queuing of WCDMA Calls in BSS makes it possible to provide enhanced network accessibility in GSM to prioritized subscribers coming from the WCDMA network via the directed retry procedure.

The feature GSM-LTE Cell Reselection provides the mechanisms to distribute system information for cell reselection to LTE. Towards LTE only priority based cell reselection algorithm is possible. The network must be configured with LTE frequencies and priorities for GSM and LTE frequencies in order to be able to activate this feature. If measurements have been defined for UMTS cell reselection , priorities must be given for the UMTS frequencies as well and no RAT may have the same priority. It is also possible to define E_UTRAN cells that are not allowed to select during cell reselection. All the system information is sent in SI2quater on BCCH. This feature is further described in Section 3.3.2.5 Cell Reselection to UMTS and LTE based on priority on page 14

3.2 Measurements

3.2.1 Measurements for mobiles on dedicated channels and for cell reselection to UMTS based on cell ranking

Besides measurements on surrounding GSM/GPRS/EGPRS cells a Multi-RAT MS also performs measurements on UTRAN neighbouring cells. These measurements are performed in a different way than for GSM cells and may be less frequently than measurements on GSM. In general UTRAN measurements are done during spare time, that is, GSM measurements have priority and UTRAN measurements are done if there is time left.

In order to reduce unnecessary measurements and to optimize Multi-RAT MS battery consumption, the GSM network controls when the measurements on UTRAN cells shall be performed with the parameters **QSI** and **QSC**. The parameters **QSI** and **QSC** define thresholds and also indicate whether these measurements shall be performed when the signal strength (SS) of the serving cell is below or above the threshold. It can be used to avoid unnecessary measurements on UTRAN cells and does not control the behaviour of Multi-RAT MSs in terms of making decisions for cell reselection and handover. **QSI** is used for idle and packet switched modes and broadcast on BCCH and PBCCH (if enabled), while **QSC** is used for active mode, sent on SACCH.

After changing from idle to active mode, **QSC** is not immediately known, as it is sent on SACCH. For that period the measurement control is defined, with the cell parameter **QSCI** , broadcast on BCCH. It is possible to choose whether UTRAN measurements will be performed according to the known **QSI** value (**QSCI** =0) or always (**QSCI** =1), until the first **QSC** value is read.

There are four different scenarios to choose from. Parameters **QSI** and **QSC** are set per GSM cell and define both the scenario and the necessary threshold, at the same time:

1. UTRAN neighbouring cells are measured only when the signal strength of the GSM serving cell is *above* the threshold set by **QSI** and **QSC**.
2. UTRAN neighbour cells are measured only when the signal strength of the GSM serving cell is *below* the threshold set by **QSI** and **QSC**.
3. UTRAN neighbour cells are always measured.
4. UTRAN neighbour cells are never measured. This can be used to turn off the cell reselection/handover to UMTS, per cell, even if **COEXUMTS** is ON for the BSC.

In order to understand the purpose of **QSI** and **QSC** , two examples are shown in Figure 1 and Figure 2.

When **QSI** /**QSC** =5, UTRAN cell measurements are performed when the SS of the serving GSM cell is below the threshold of -78dBm, see Figure 1.

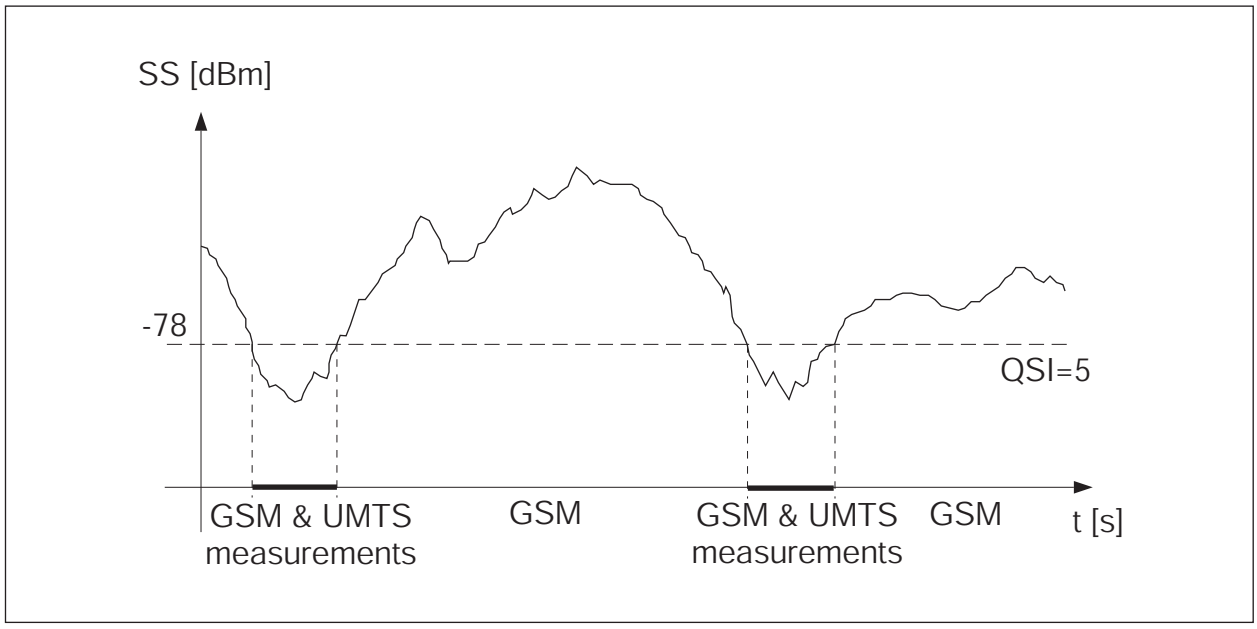

Figure 1 Example QSI/QSC=5, UTRAN Measurements Are Performed when the Signal Strength in the Serving Cell Is below -78 dBm.

When **QSI** /**QSC** =11, the measurements are performed when the same SS is above the threshold of -66dBm, see Figure 2.

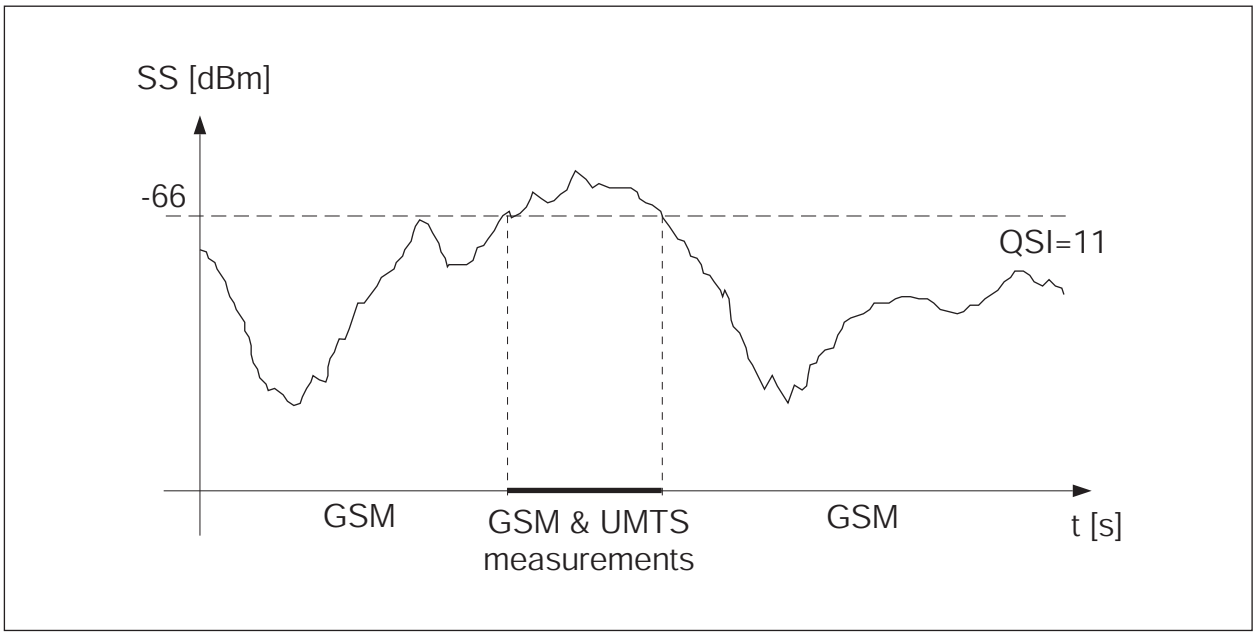

Figure 2 Example QSI/QSC=11, UTRAN Measurements Are Performed When the Signal Strength in the Serving Cell Is above -68 dBm.

Example 1: If an UTRAN cell should serve purely to extend the coverage for Multi-RAT MSs in GSM, it is logical to set **QSI** /**QSC** values from 0-6, since it's only needed to make cell reselection and handovers to UMTS when the GSM coverage falls low.

Example 2: If an UTRAN cell is co-sited with a GSM cell, there is a certain correlation between signal strengths of the two systems. If the GSM is for example using 900MHz band it is very probable that the GSM signal strength will always be higher than the UTRAN signal, for a number of dBs. Therefore, there is no point in measuring UTRAN cells in low GSM signal conditions and values 8-14 can be selected accordingly.

When in CS active or packet transfer mode a GSM/GPRS/EGPRS MS continuously measures the signal strength of the serving cell and all neighbouring cells (BCCH carriers) as indicated in the BA list. Besides, the GSM/GPRS/EGPRS MS shall attempt to decode the BSIC of as many neighbouring cells belonging to the BA list as possible, and as a minimum at least once every 10 seconds during the so called search frames. The MS is typically quite busy with performing GSM/GPRS/EGPRS measurement and there is not much time left for UTRAN measurements. In this case, the MS may perform the measurements, on cells belonging to the 3G neighbouring cell list, during search frames that are not required for BSIC decoding. If indicated by the parameter **SPRIO**, a Multi-RAT MS may use up to 25 search frames per 13 seconds even without considering the need for BSIC decoding in these frames. This implies more time for UTRAN measurements, but in the same way less time for BSIC decoding.

3.2.2 Measurements for cell reselection to UMTS and LTE based on priority

Measurements on UTRAN and E-UTRAN frequencies are triggered differently depending on if the frequencies have lower or higher priority than GSM.

The MS shall perform measurement of higher priority frequencies once every 60* (number of inter-RAT frequencies of higher priority) seconds.

The MS shall perform measurements of lower priority frequencies when RLA_C (see Reference [3]) of the serving GSM cell is below the threshold set by **MEASTHR** . If a UTRAN or E-UTRAN frequency is used to extend the GSM coverage, that frequency could be set to lower priority frequency and **MEASTHR** to a suitable value to prevent the MS to measure on E-UTRAN all the time.

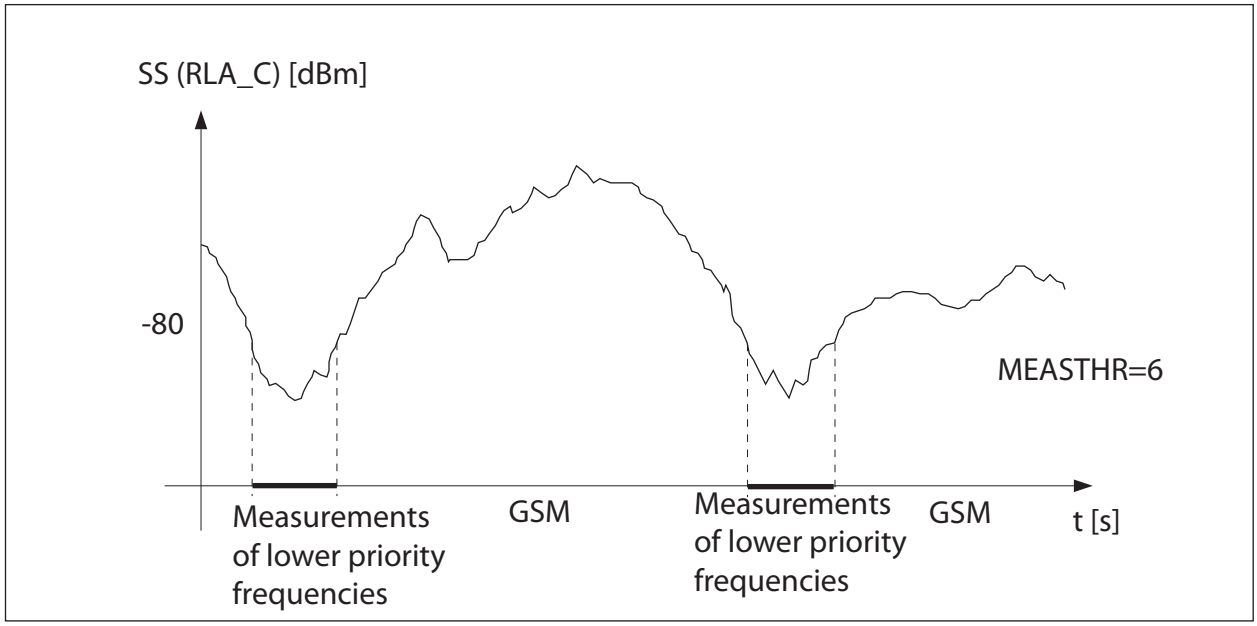

Figure 3 Example MEASTHR=6, Measurements on lower priority inter-RAT frequencies are performed when the RLA_C in the Serving Cell Is below -80 dBm. Measurements of higher priority inter-RAT frequencies are done periodically.

3.3 Inter-RAT functions

3.3.1 PLMN Selection

When a Multi-RAT MS is powered on or upon recovery from lack of coverage, it immediately attempts to make contact with a Public Land Mobile Network (PLMN). The PLMN may be selected either automatically or manually similar to a GSM only MS (see Reference [2]) . The PLMN selection procedure is somewhat different for a Multi-RAT MS since a PLMN could support more than one access technology. It will first try to select and register to the last registered PLMN if one exists. A Multi-RAT MS starts its search using the last used RAT.

If information about the last used RAT is not available, the Multi-RAT MS starts its search using GSM access technology. If there is no last registered PLMN, or if it is unavailable, the Multi-RAT MS will try to select another PLMN either automatically or manually depending on its operating mode, see Reference [10]. The automatic mode uses a list of PLMNs and RATs in an order of priority whereas the manual mode leaves the decision to the end-user and only shows the available PLMNs using all supported RATs.

If a PLMN is selected using GSM access technology the following cell selection and cell reselection procedures are described in Reference [2]. Multi-RAT procedures in UTRAN are not described in this document.

3.3.1.1 Automatic Mode

In automatic mode, if no last registered PLMN exists or is available the MS will select a PLMN, if it is available and allowed, in the following order:

1 Home PLMN. The Multi-RAT MS shall search for the Home PLMN using all access technologies it is capable of and start its search using the ‘‘access technologies priority list’’ stored in the Subscriber Identity Module (SIM). If no access technology information is available in the SIM the mobile shall start its search using GSM access technology.

2 Each PLMN in the ‘‘user controlled PLMN list’’ stored in the SIM in priority order. The Multi-RAT MS shall try find each PLMN using the ‘‘access technologies priority list’’stored for each PLMN in the SIM. If no access technology information is available on the SIM the mobile shall start its search using GSM access technology.

3 Each PLMN in the ‘‘operator controlled PLMN list’’ stored in the SIM in priority order. The Multi-RAT MS shall try find each PLMN using the‘‘access technologies priority list’’ stored for each PLMN in the SIM. If no access technology information is available on the SIM the mobile shall start its search using GSM access technology.

4 Other PLMN/access technology combinations with received high quality signal in random order. For GSM cells high quality cells are cells with signal level above -85 dBm. For WCDMA cells high quality cells are cells with CPICH RSCP level above -95 dBm. The Multi-RAT MS shall search using all access technologies it is capable of before selecting PLMN.

5 All other PLMN/access technology combinations in order of decreasing signal strength. The Multi-RAT MS shall search using all access technologies it is capable of before selecting PLMN.

3.3.1.2 Manual Mode

In manual mode, the Multi-RAT MS will first try to select the registered PLMN or home PLMN if no last registered PLMN exists. If this registration fails or if the user has initiated a PLMN reselection the Multi-RAT MS will indicate to the user all available PLMNs using all supported access technologies. The user can then select a desired PLMN which causes the MS to initiate a registration

on this PLMN. If the selected PLMN is not allowed, an indication to the user to select another PLMN will be given.

Note: An Multi-RAT MS may indicate access technology to the user (manufacturer dependent). If the access technology is not displayed the highest access technology according to the access technology information priority list in the SIM is used.

3.3.2 Inter System Cell Reselection

3.3.2.1 Cell Reselection to GSM

There is no significant impact of cell reselection from UMTS to GSM on the Base Station System. In general, cell reselection from UMTS to GSM/GPRS/EGPRS is introduced with as little change as possible to the GSM standard.

The cell reselection is initiated in UTRAN and not described here. In short, for an inter system cell reselection to occur the estimated quality of the currently used UTRAN frequency must be below a certain threshold and the estimated quality of the target GSM cell must be above a certain threshold. See Reference [15] for a description of UMTS to GSM/GPRS/EGPRS cell reselection in Ericsson WCDMA RAN.

When a Multi-RAT MS moves into a cell belonging to another LA/RA at cell reselection from UMTS to GSM/GPRS/EGPRS it performs LA/RA Update Request, when accessing the GSM network using existing signaling procedures to indicate its presence according to Section 3.3.5 on page 23 and Section 3.3.6 on page 24. The target BSC will not distinguish if the mobile came from a GSM or UTRAN cell before the cell reselection.

3.3.2.2 Cell Reselection to UMTS based on cell ranking

This algorithm is valid for MSs in NC0 or NC1 mode. For MSs in NC2 mode, refer to Reference [3].

To be able to perform inter system cell reselection from GSM to UMTS, a Multi-RAT MS listens to a defined list of UMTS neighbours. This list is broadcast on BCCH (and PBCCH if enabled). A similar algorithm to the one for GSM cell reselection is used for GSM to UTRAN cell reselection. Nevertheless, there is a difference when it comes to the evaluation of signal strength and quality for GSM and UMTS measurements. The reason for this is the completely different modulation technique used. Therefore, a mapping of UMTS signal strength is performed, in such a way that it can be compared to GSM signal strength values. The same algorithm and behaviour applies for inter system cell reselection in GPRS/EGPRS Ready state, GPRS/EGPRS Standby state and CS idle mode.

The algorithm for inter system cell reselection to UMTS is controlled by the network with the parameters **FDDQMIN** and **FDDQOFF**.

FDDQMIN is the minimum quality of a UTRAN cell for cell reselection. This parameter should not be used to control the cell reselection, but provide a sufficient quality of the candidate UTRAN cell.

FDDQOFF is the key parameter to control the behaviour of inter system cell reselection. It defines an offset between signal quality of UTRAN and GSM cells.

Lower values of the parameter **FDDQOFF** can be used to off-load the GSM system. This means that both potential traffic (Multi-RAT MSs in CS idle mode and GPRS/EGPRS packet idle mode) and resource occupying traffic (Multi-RAT MSs in GPRS/EGPRS packet transfer mode) will select a UTRAN cell that fulfills the inter system cell reselection criteria.

Higher values of the parameter **FDDQOFF** can be used to keep Multi-RAT MSs in the GSM system, for example if an UMTS to GSM off-load priority setting is applied in the UMTS system.

The values of the GSM signal strength and the UTRAN CPICH RSCP are not of the same kind and therefore not easily comparable. The balance between these two should be set with the offset **FDDQOFF**.

The BSS parameters **FDDQMIN** and **FDDQOFF** must be set in correlation to the corresponding UTRAN parameters to avoid unwanted behaviour, such as “ping-pong” effect.

Note that the setting of the parameter **QSI** indirectly restricts the control of cell reselection, since no cell reselection will be made without UTRAN measurements.

If the following criteria are fulfilled a Multi-RAT capable MS will reselect a suitable UTRAN cell (see Reference [11]):

$$CPICH\ E_c/N_o > \textbf{FDDQMIN} \quad (1)$$

and

$$CPICH\ RSCP > RLA_{(s+n)} + \textbf{FDDQOFF} \quad (2)$$

for a period of 5 seconds. (s+n = serving and neighbouring GSM cells)

CPICH E_c/N_o is the received energy per chip on the Common Pilot Channel (CPICH) divided by the power density in the band. This quantity measures the quality of the neighbouring UTRAN cells (roughly comparable to a signal to noise ratio measure). To fulfill the first criterion, it must exceed the threshold parameter **FDDQMIN** set in the BSC and broadcast to Multi-RAT MSs on the BCCH and PBCCH (if enabled).

CPICH RSCP is a measure of the signal strength for a UTRAN cell. To fulfill the second criterion, it must exceed the *RLA* (measured signal strength) for both the

serving cell and the 6 strongest non-serving GSM/GPRS/EGPRS cells with an offset defined by the parameter **FDDQOFF**. If more than one UTRAN cell fulfills these criteria, the Multi-RAT MS selects the one with highest *CPICH RSCP*.

RLA (Received Level Average) is the average of the received signal levels measured in dBm for all monitored GSM frequencies in the BA list. The averaging is based on at least five measurement samples per RF carrier spread over 3 to 5 seconds, the measurement samples from the different RF carriers being spread evenly during this period (see Reference [8]). *RLA=RLA_C* for GSM attached Multi-RAT MSs and *RLA=RLA_P* for GPRS/EGPRS attached Multi-RAT MSs.

Cell reselection back to UTRAN shall not occur within 5 seconds after a previous cell reselection from UTRAN. If a cell reselection occurred within the previous 15 seconds, an additional offset to **FDDQOFF** is increased by 5 dB by the multi RAT MS.

Note that if the criteria for inter system cell reselection to UMTS are fulfilled, the Multi-RAT capable MS reselects a UTRAN cell even if the criteria for selecting a GSM/GPRS/EGPRS cell is fulfilled. A GPRS/EGPRS Multi-RAT MS uses the same cell reselection algorithm in packet idle mode (no ongoing packet transfer) and in packet transfer mode.

3.3.2.3 Combined Cell Reselection Triggering GSM to WCDMA

With the feature Combined Cell Reselection Triggering GSM to WCDMA, a multi-RAT mobile will reselect a UTRAN suitable cell if cell reselection criteria (2), along with (3) and (4) below are fulfilled :

CPICH E_o/N_o > **FDDQMIN - FDDQMINOFF** (3)

and

CPICH RSCP > **FDDRSCPMIN - min((P_MAX-21 dBm),3dB)** (4)

With criterion (3), the requirement of signal quality can be made less restrictive for multi-RAT mobiles that supports signal strength criterion (4). **P_MAX** is the maximum RF output power of the MS (dBm) in UTRAN FDD.

In 3GPP a default value of -102 dBm is defined for FDDRSCPMIN which means that an MS will use the value -102 dBm if the feature Combined Cell Reselection Triggering GSM to WCDMA is not used.

3.3.2.4 Optimized throughput at GSM to WCDMA Cell Change

This feature is activated by setting the parameter **NCPROF** a value of 1.

This feature only affects MSs in packet transfer mode having DL/UL TBF with payload data. This feature will not affect an MS in DTM mode, i.e. when the MS is both in packet transfer mode and circuit switched dedicated mode.

This feature will engage when the floowing criteria are fulfilled:

1 There is at least one WCDMA neighbouring cell to the serving cell.

2 A downlink TBF with payload data has been established.

3 The TBF session (UL, DL or both) is longer than 2 seconds.

4 The current RP load permits another MS in NC2 mode.

5 The MS is not in DTM mode

From the time at establishment of the downlink TBF with payload data, a delay time of 2 seconds is applied before affecting the MS as stated in criteria (3) above. The reason to have a delay is to filter out the short TBF sessions and to minimize the load on the signalling channel.

Once the criteria above are fulfilled, the MS is ordered to NC2 mode and the network cell reselection algorithm is initiated. The network cell reselection algorithm is similar to the cell reselection algorithm in the MS as described in Reference [8] and Section 3.3.2.2 on page 11 and is described more in detail in Reference [3].

After an MS is instructed to perform a cell reselection to a new cell, it is then ordered to leave NC2 as described in Reference [14]. After the MS has entered the new cell, it will not be able to change to another cell during the first 5 seconds. During this period of time the MS may be ordered to NC2 again in the new cell before it can make any decision regarding cell change, for example, to a WCDMA cell.

3.3.2.5 Cell Reselection to UMTS and LTE based on priority

This algorithm is valid for MSs in NC0 or NC1 mode. For MSs in NC2 mode, refer to Reference [3].

When the criteria to start measuring on other RATs are fulfilled, see Section 3.2.2 Measurements for cell reselection to UMTS and LTE based on priority on page 9, the MS shall:
- measure RSCP for UTRAN and per frequency create S_non-serving_FDD = “measured RSCP value” - **QRXLEVMINU**
- measure RSRP for E-UTRAN and per frequency create S_non-serving_E-UTRAN = “measured RSRP value” – **QRXLEVMINE**
- create S_GSM = C1 for GERAN cells (C1 is described in Reference [2])

Cell reselection to a cell of another inter-RAT frequency of higher priority shall be performed if S_non-serving_FDD of one or more cells of a higher priority UTRAN frequency is greater than **HPRIOTHR** during a time interval **TRES** or if the S_non-serving_E-UTRAN of one or more cells of a higher priority E-UTRAN

frequency is greater than **HPRIOTHR** during a time interval **TRES**. In that case, the mobile station shall consider the cells for reselection in decreasing order of priority and for cells of the same inter-RAT frequency, in decreasing order of S_non-serving_FDD or S_non-serving_E-UTRAN and reselect the first cell that satisfies the conditions above.

Cell reselection to a cell of another inter-RAT frequency of lower priority may be performed if the value of S_GSM is lower than **PRIOTHR** for the serving cell and all measured GSM cells. In this case the mobile station shall evaluate the UTRAN and E-UTRAN cells in the following order and reselect the first one that satisfies the following criteria
- cells of a lower priority UTRAN frequency whose S_non-serving_FDD value is greater than **LPRIOTHR** a time interval **TRES** or cells of a lower priority E-UTRAN frequency whose S_non-serving_E-UTRAN value is greater than **LPRIOTHR** a time interval **TRES**. These cells shall be considered in decreasing order of priority and, for cells of the same RAT and priority, in decreasing order of S_non-serving_FDD or S_non-serving_E-UTRAN.
- if no cells satisfy the criterion above, inter-RAT cells for which, during a time interval **TRES**, the S_non-serving_FDD or S_non-serving_E-UTRAN is higher than S_GSM by at least a specific hysteresis **HPRIO**. These cells shall be considered in decreasing order of S_non-serving_FDD and S_non-serving_E-UTRAN.

Reselection to a UTRAN FDD cell is only done if, in addition to the criteria above, its measured Ec/No value is equal to or greater than **FDDQMIN - FDDQMINOFF**.

3.3.3 Inter system cell selection after call release

When the feature Fast Return to WCDMA after Call Release is activated, the BSC might request the MS to select a WCDMA cell directly after the release without first selecting the serving GSM cell. That is done by including the IE "Cell selection indicator after release of all TCH and SDCCH" in the CHANNEL RELEASE message. The BSC does not indicate any individual WCDMA cell but only indicates the frequency number(s), the UARFCN(s).

If the GSM cell has been configured with an Active UTRAN Measurement Frequency List, the BSC will direct a mobile to UTRAN when the following criteria are fulfilled:
1. The feature is activated
2. The mobile shall not become a VGCS listener
3. The parameter QSC has not been set to “never”
4. MS has reported measurements on a UTRAN cell while in dedicated mode (there is UTRAN coverage)

The BSC will only request the mobile to select a frequency reported by the mobile in the measurement report.

If the GSM cell has only been configured with an Idle UTRAN Measurement Frequency List or QSC is set to “never”, the mobile will not report any

measurements on UTRAN cells and the BSC will direct the mobile to UTRAN when following criteria are fulfilled:
1. The feature is activated.
2. The mobile shall not become a VGCS listener.
3. The MS is a multi-RAT mobile

Since the mobile does not include any WCDMA cells in any measurement when no Active UTRAN Measurement Frequency List has been defined or the QSC parameter is set to 15 (=never), the BSC will in this case request the mobile to select a frequency included from the Idle UTRAN Measurement Frequency List.

In the latter scenario, when there is no Active UTRAN Measurement Frequency List or the QSC is set to 15 (=never), there is a risk that the mobile will be re-directed to WCDMA even though there is no WCDMA coverage. The mobile will then unsuccessfully search for WCDMA cells and after a while select a GSM cell. In such a case, the Paging outage time will instead increase. Therefore it is recommended to turn off the feature in GSM cells where the UTRAN coverage is poor and when no Active UTRAN Measurement Frequency List has been configured.

If the parameter **QSI** is set to 15 (=never), meaning that mobile should not measure on WCDMA cells while in idle mode, the feature could be turned off in order to not request the mobile to select a WCDMA cell.

The mobile will be requested to select a WCDMA cell also if the CS connection of a DTM call is released. The interrupt of the packet data transfer will be shorter if the mobile instead is requested to enter NC2 in GSM. With the parameter **FASTRET3GNC2** it is possible to change the behavior so that the mobile is not requested to select a WCDMA cell if the feature Optimized throughput at GSM to WCDMA Cell Change is active and the CS connection of a DTM call is released.

3.3.4 Inter System Handover

3.3.4.1 Handover to GSM

The basis for UMTS to GSM handover decisions is implemented in the Radio Network Controller (RNC) in the UTRAN system. The algorithm for UMTS to GSM handover initiation in Ericsson WCDMA RAN is described in Reference [16]. In short, the handover criterion is based on the following event: estimated quality of the currently used UTRAN frequency is below a certain threshold and the estimated quality of the target GSM cell is above a certain threshold.

During handover execution the BSC is informed via the MSC that an inter system handover is required. The target BSC allocates resources and orders the Multi-RAT MS to access the target GSM cell via the serving RNC. The BSC will not distinguish between incoming intra- or inter system handovers.

With the feature Smooth GSM to UMTS Unloading, incoming inter system handovers will be treated differently, see Section 3.3.4.4 on page 22.

3.3.4.2 Handover to UMTS

This chapter describes the basic handover mechanism provided by the feature GSM-WCDMA Cell Reselection and Handover. These basic mechanism is modified/complemented by other features, described in Section 3.3.4.3 on page 21, Section 3.3.4.4 on page 22 and Section 3.3.4.5 on page 23.

In circuit switched active mode (speech and data), a Multi-RAT MS is measuring neighbouring UTRAN cells and reporting to the BSS through measurement reports. To be able to perform inter system measurements a list of UTRAN neighbours is sent to the Multi-RAT MS on the SACCH. These lists can be the same as the list broadcast on BCCH to Multi-RAT MSs in idle mode, but it is also possible to set them separately in order to have different UMTS neighbours in idle and active mode. After changing from idle to active mode, the last list received over BCCH is used (that is, Idle 3G-BA), until a new one is received over SACCH (that is, active 3G-BA). The Multi-RAT mobile is informed on how many UMTS cells (0-3) that shall be reported in the measurement report. This is set by parameter **FDDMRR**. BSS informs the mobile which measurement report to use, Measurement Report or Enhanced Measurement Report. Below follows a brief description of how the mobiles compose the different measurement reports.

Measurement report type is “Measurement Report”

When the Measurement Report is used, the multi-RAT MS will compose the list as follows:

1. Add MIN(FDDMRR, number of valid UTRAN cells) UTRAN cells to the top of the list.

2. Add MIN((6 - number of added UTRAN cells), number of valid GSM cells) GSM cells to the list.

3. If there is more space in the measurement report, add remaining valid UTRAN cells.

Note that if multiple GSM-bands are used, there will be few positions in the measurement report for cells from those bands, since only six cells can be reported in the measurement report. For more information on Multiband operation, see Reference [6].

Also note that if FDDMRR is set to 0 and if the number of valid GSM cells are not enough to fill the list, UTRAN cells may be reported.

UTRAN neighbouring cells are reported reusing the fields defined for GSM neighbouring cells measurements.

For GSM neighbour cells, the RXLEV field is as usual coded as the binary representation of the received signal strength on the neighbouring cell. For UTRAN neighbour cells, the RXLEV field is instead coded as the binary representation of CPICH Ec/No (defined in Reference [8]).

For GSM neighbour cells, the BCCH-FREQ field is as usual coded as the binary representation of the measured cell's position in the BA list. For UTRAN neighbour cells, the BCCH-FREQ field is always coded as 31 (binary). This means that the maximum number of GSM neighbouring cells is reduced from 32 to 31 in cells having UTRAN neighbouring cells defined.

A UTRAN cell is uniquely identified with its frequency and scrambling code combination so there is no equivalent to BSIC for GSM cells. In the field where BSIC is usually reported for GSM cells, the binary representation of the measured UTRAN cell's position in the active 3G-BA list is coded.

Measurement report type is "Enhanced Measurement Report"

When the Enhanced Measurement Report is used the multi-RAT MS will compose the list in the following priorty order:

1. From serving band, add MIN(3, number of valid GSM cells) GSM cells to the list.

2. From each non-serving band, add MIN(MBCR, number of valid GSM cells) GSM cells to the list.

3. Add MIN(FDDMRR, number of valid UTRAN cells) UTRAN cells to the list.

4. If possible add remaining GSM cells and UTRAN cells. The cells to include are selected by the MS. The cells are ranked by comparing RXLEV for GSM cells with CPICH RSCP for UTRAN cells.

Note that there is a risk that the mobile will not report the number of UTRAN cells as indicated by FDDMRR. However when UTRAN cells are reported, the BSC will always evaluate MIN(FDDMRR, number of valid UTRAN cells) number of UTRAN cells when producing the final handover candidate list.

Upon receiving the measurements from a Multi-RAT MS, the BSC is performing the locating algorithm in order to create a candidate list for handovers. Measured UTRAN and GSM cells are processed separately. This is done by filtering out the UTRAN cell measurements before applying the GSM locating algorithm.

The GSM locating algorithm is modified in order to process both UTRAN and GSM neighbouring cells, as shown on the Figure 4.

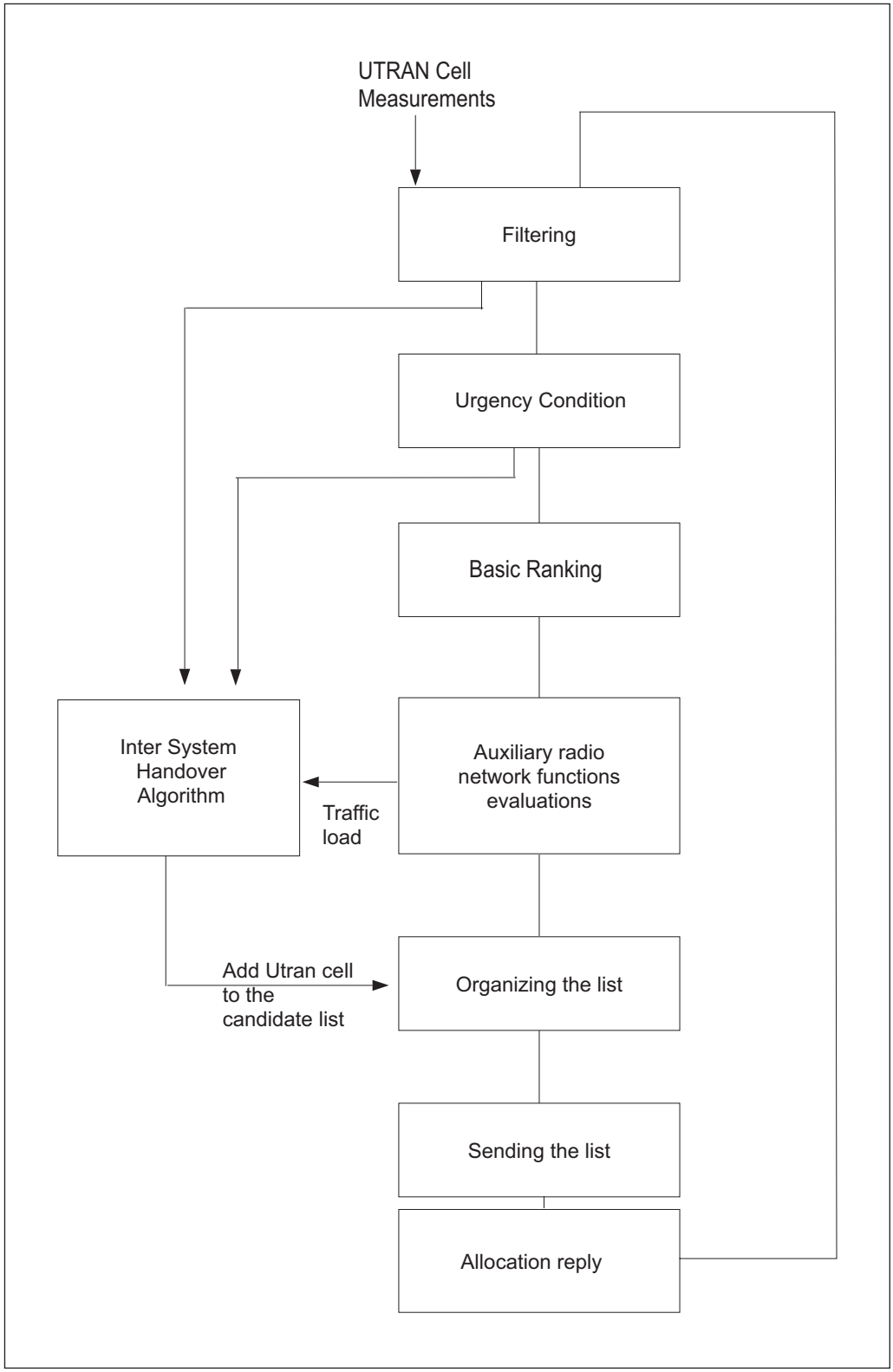

Figure 4 Modified Locating Algorithm. Measurement from UMTS and GSM Cells Are Processed Separately and UTRAN Cells Are Added to the GSM List

The existing GSM-GSM locating algorithm is kept intact. Parallel to that, a GSM-UMTS algorithm ranks UTRAN neighbour cells and adds possible candidates to the complete candidate list. For filtering GSM measurements, different filters can be used, see Reference [4]. For UTRAN cell measurements, a straight average filter can only be used with a fixed set of parameter.

The key parameters that control handovers from GSM to UMTS are **QSC** and **MRSL**. The first parameter controls when the Multi-RAT MS should measure on UMTS-frequencies, the second is the UTRAN quality criterion which is validated in BSS.

All UTRAN cells to be added to the candidate list must fulfill the quality criterion:

CPICH Ec/No >= **MRSL** (5)

where the threshold parameter **MRSL** is set in the BSC.

Other criteria that must be fulfilled are related to either load or urgency. A UTRAN cell will be a handover candidate only if any or both of the urgency or load criteria are fulfilled in addition to the quality criterion (5). The urgency criteria may be due to large timing advance, bad downlink quality or bad uplink quality. The urgency criteria are described in more detail in Reference [4]. The load criterion is described below.

Percentage of idle TCH in the serving cell <= **ISHOLEV** (6)

where **ISHOLEV**is a load related threshold set in the BSC per cell. The UTRAN cell will be a candidate if the percentage of idle TCHs from the total number of TCHs is lower or equal than a threshold. In other words, the remaining free traffic resources have to be below a threshold, in order to initiate evaluation of UTRAN cells for handover. Dedicated PDCHs are regarded as busy traffic channels when evaluating the parameter **ISHOLEV**. On-demand PDCHs are regarded as either idle or busy depending on the setting of the cell parameter **GPRSPRIO** (see Reference [7]). Traffic load in the serving cell is checked periodically. This period is set with per BSC with the exchange property **COEXUMTSTINT**.

Regardless of used handover criterion, all valid neighbouring UTRAN cells are sorted in order of decreasing CPICH Ec/No. A final candidate list is created by possibly adding UTRAN cells to the GSM candidate cells according to the table below.

Table 1 Cell order in the final handover candidate list. "Load" and "No load" is in relation to parameter ISHOLEV.

Non-urgency HO		Urgency HO	
No load	Load	No load	Load
G	UG	GU	UG

Legend: G-only GSM cells in the candidate list, UG-UTRAN cells are added on the top of the candidate list, GU-UTRAN cells are added at the bottom of the candidate list. “Load” indicates that the load criterion (6) is fulfilled. “Urgency” indicates that any of the urgency criteria is fulfilled.

If an inter system handover fails, the parameter **TALLOC** is used to prevent that a new candidate list will be immediately sent with the same UTRAN cell(s), see Reference [4].

The value of **MRSL** should depend on the corresponding settings in the UTRAN cell, in order to avoid unwanted ping-pong effects, for example. Also, **MRSL** should be set according to **FDDQMIN**. For example, in order to balance the behaviour in active and idle mode, **MRSL** can have the same value as **FDDQMIN**.

ISHOLEV defines the main behaviour of GSM-UMTS handovers. With **ISHOLEV** =99 (max. value), UMTS will be always prioritized. With different values of **ISHOLEV** handovers to UMTS will be triggered only in case of high traffic in the serving GSM cell. Therefore, a traffic off-load is achieved. Other parameters need to be carefully set, depending on the wanted strategy.

Example 1: It is wanted to off-load GSM traffic, and in the same time extend UMTS coverage. In this case **ISHOLEV** should be set to the wanted traffic threshold, **QSC** should be set to 7 (always), or to values 8-14 if the cells are co-sited. This is because no GSM signal level criterion is needed.

Example 2: It is only wanted to extend UMTS coverage with GSM. **ISHOLEV** should be than set to 99 in order to prioritize UMTS all the time. Both **QSC** and **QSI** should be set to 7, or 8-14 if the cells are co-sited. **FDDQOFF** can be -inf since all MSs are to be thrown back to UMTS in idle mode as well.

If the GSM is to be extended with the UMTS coverage, **QSC** has to be used as a threshold below which UTRAN measurements can start. In that case **ISHOLEV** should be set to 99.

3.3.4.3 Handover with Usage of Service Indicator

With the feature Handover with Usage of Service Indicator, the handover criteria provided with GSM-UMTS Cell Reselection and Handover are modified depending on the value of the Service Indicator. The Service Indicator is a BSS internal parameter that indicates whether the MSC has any preference on in which system, GSM or WCDMA, a CS connection shall be served. It will have the value as received in the Information Element “Service Handover” in the BBSMAP messages Handover Request and Assignment Request or the value “no preference” if the MSC has omitted the Information Element “Service Handover”. The “Service Handover” Information Element may have the values “Handover to UTRAN should be performed”, “Handover to UTRAN should not be performed” or “Handover to UTRAN shall not be performed”.

If the MSC indicates that the connection shall not be handed over to UTRAN, BSS never triggers a handover to UTRAN. If the MSC indicates that a

connection should not be handed over to UTRAN, BSS only triggers a handover to UTRAN in case any urgency criterion is fulfilled in the GSM cell. In case the MSC indicates that a handover should be performed, BSS triggers a handover to UTRAN when the signal quality in the target cell is good enough, regardless of the traffic load.

The Service Indicator is valid per CS connection but may be changed during a call. Regardless of used handover criteria, all valid neighbouring UTRAN cells are sorted in order of decreasing CPICH Ec/No. A final candidate list is created by possibly adding UTRAN cells to the GSM candidate cells according to the table below.

Table 2 Cell order in the final handover candidate list when Service Indicator is used. "Load" and "No load" is in relation to parameter ISHOLEV.

	Non-urgency HO		Urgency HO	
	No load	Load	No load	Load
No preference	G	UG	GU	UG
Should	UG	UG	UG	UG
should not	G	G	GU	GU
shall not	G	G	G	G

Legend: G-only GSM cells in the candidate list, UG-UTRAN cells are added on the top of the candidate list, GU-UTRAN cells are added at the bottom of the candidate list. “Load” indicates that the load criterion (6) is fulfilled. “Urgency” indicates that any of the urgency criteria is fulfilled.

Example 1. If the Service Indicator has the value “Handover to UTRAN shall not be performed”, the urgency criterion for Timing Advance is fulfilled, and the load criterion (6) is fulfilled no handover to UTRAN will take place since the final handover candidate list will not contain any UTRAN cells.

Example 2. If the Service Indicator has the value “Handover to UTRAN should be performed” and the load criterion (6) is NOT fulfilled, handover to UTRAN will be triggered if there are any UTRAN cells that fulfill the quality criterion (5).

3.3.4.4 Smooth GSM to WCDMA Unloading

With the feature Smooth GSM to WCDMA Unloading, the maximum number of handovers to perform per second to UTRAN is set with the parameter **MAXISHO**, defined per GSM cell. When the number of handovers have reached the value set by **MAXISHO**, UTRAN cells are not included in the candidate list produced by Locating. Only the number of handovers that are triggered because of high traffic load in the GSM cell (load criterion (6) fulfilled), are excluded and counted. Handovers for connections with the Service Indicator with a value other than “No preference”, are not counted nor excluded. Neither are handovers due to urgency excluded or counted.

Incoming handovers from UTRAN without Service Indicator and which has cause values "Directed Retry" or " Reduce load in serving cell' will be rejected in case of high traffic load in the GSM cell, that is when load criterion (6) is fulfilled.

3.3.4.5 Combined Handover Triggering GSM to WCDMA

With the feature Combined Handover Triggering GSM to WCDMA it is possible to control the measurement reporting of UTRAN neighbouring cells. The parameter **FDDREPTHR2** defines a threshold for the non reporting radio entity of the UTRAN cells. No UTRAN cells will be included in the measurement reports from the MS unless the non reporting UTRAN radio entity is above the defined threshold. Since UTRAN cells are reported using the radio entity CPICH Ec/No, the parameter **FDDREPTHR2** is related to the UTRAN radio entity CPICH RSCP.

The threshold parameter **FDDREPTHR2** assures a sufficient downlink signal strength of the UTRAN cell, which in turn increases the possibility for the mobile to reach the UTRAN cell in the uplink.

The threshold parameter **FDDREPTHR2** is used by MSs being in connected mode as well as MSs being in NC2 mode.

3.3.4.6 Queuing of WCDMA Calls in BSS

The feature Queuing of WCDMA Calls in BSS makes it possible to provide enhanced network accessibility in GSM to prioritized subscribers coming from the WCDMA network via the directed retry procedure. Directed retry is used during call set up in WCDMA to send the call to GSM during congestion in the WCDMA network. Priority and queuing information is sent from the core network to BSS as part of the directed retry procedure. In case of congestion in the target GSM cell, the high priority subscriber is then queued in BSS, together with other high priority subscribers, according to their priority and time of arrival in BSS until there are free resources in the GSM cell or until a time-out (after 10 seconds) in BSS.

This feature works as described even if the feature Smooth GSM to WCDMA Unloading is enabled.

For more details about this feature, see Reference [1]

3.3.5 Location Area Update Procedure

To make it possible for the end-user to receive a call, the network must know where the MS is located. To keep the network updated on the location of the MS, the system is informed by the MS. This is called Location Updating (see Reference [2]).

An operator can configure GSM and UMTS cells to be members of the same registration area (that is, same LAI) and the Multi-RAT MS does not need to perform location update just because the mobile has changed from a UMTS to

a GSM cell. A Multi-RAT MS initiates normal location updating when it detects that it has entered a new location area. When the Multi-RAT MS is listening to the system information transmitted on the serving cell, it will compare the broadcast Location Area Identity (LAI) with the one stored in the Multi-RAT MS. If the broadcast LAI differs from the one stored, a location updating type normal will be initiated and the new LAI will be stored in the Multi-RAT MS.

If a GSM-UMTS handover has occurred to a new LA during a call, Location Updating is performed after the call has finished.

3.3.6 Routing Area Update Procedure

An operator can configure GSM and UMTS cells to be members of the same registration area (that is, same RAI). During an inter system cell reselection from GPRS/EGPRS to UMTS or UMTS to GPRS/EGPRS, different procedures are followed depending on the mobility management state (that is, Standby or Ready state) and the Network Operation Mode.

Generally the same procedures are used at inter system cell reselection between GPRS/EGPRS and UMTS as for GPRS/EGPRS cell reselection (see Reference [3]). A Multi-RAT MS initiates a routing area update when it detects that it has entered a new routing area.

In short, the following relations between GPRS/EGPRS and UMTS mobility management states applies:

UMTS PS-Connected State corresponds to GPRS/EGPRS Ready State.

UMTS PS-Idle State corresponds to GPRS/EGPRS Standby State.

When a Multi-RAT MS in UMTS PS-Connected State changes to the GSM radio access, or in GPRS/EGPRS Ready State changes to the UMTS radio access, the Multi-RAT MS initiates “RA update” procedure independent of whether the RA has changed or not.

When a Multi-RAT MS in UMTS PS-Idle State changes to the GSM radio access, or in GPRS/EGPRS Standby State changes to UMTS radio access, the Multi-RAT MS initiates “RA update” procedure only if the RA changes.

If the RA does not change when a Multi-RAT MS in UMTS PS-Idle State changes to GPRS/EGPRS Standby State (or vise versa), the Multi-RAT MS shall initiate “Selective RA update” procedure. This means that the Multi-RAT MS only performs a RA Update when uplink data or signalling is required or when it gets paged (see Reference [9]).

The GPRS/EGPRS Multi-RAT MS performs a “Combined LA/RA Update” if the network operates in Network Operation Mode I and if the Multi-RAT MS is both PS and CS attached (Reference [9]).

3.4 Related Statistics

3.4.1 Impact on Legacy Counters

None.

3.4.2 Statistics for Performance Management

There are a number of counters per UTRAN cell relation in the object NUCELLRELCNT.

Counters related to handover performance on the air interface

The number of handover commands sent to mobile station, with the neighbouring UTRAN cell as target cell (HOVERCNTUTRAN).

The number of successful handovers to the neighbouring UTRAN cell (HOVERSUCUTRAN).

The number of handover attempts to the neighbouring UTRAN cell when the MS returned to the old channel (HORTTOCHUTRAN).

The number of handover commands sent to mobile station due to urgency in the GSM cell, with the neighbouring UTRAN cell as target cell (URGHOVERUTRAN).

The number of successful handover attempts, due to urgency in the GSM cell, to the neighbouring UTRAN cell (SUCURGHOUTRAN).

Counters related to handover procedures on the A-interface

The number of handover required sent to the neighbouring UTRAN cell (HOREQCNTUTRAN).

Counters related to the feature Handover with Usage of Service Indicator

Number of handover attempts to a neighbouring UTRAN cell because the Service Handover value is set to “Handover to UTRAN should be performed” (HOATTSHOULDUTRAN).

Counters related to the feature Optimized throughput at GSM to WCDMA Cell Change

The number of TBFs per cell where cell reselection to UTRAN was avoided at least once while in NC2 (IRATPREV).

Counters related to the feature Fast Return to WCDMA after Call Release

The number of times when the message CHANNEL RELEASE is sent with the IE "Cell selection indicator after release of all TCH and SDCCH"

4 Engineering Guidelines

4.1 Multi-RAT MS Capabilities

It is important to use the Early Classmark sending to assure that the system knows about the UTRAN FDD capabilities. With Early classmark sending (setting of parameter **ECSC** =YES), the Multi-RAT MS will then send Classmark Change as soon as possible after call setup. In this message, MS Classmark 3 is included, in which the Multi-RAT capabilities of the mobile are described.

4.2 System Information

The UTRAN cells to be monitored for inter system cell reselection, both cell ranking and priority based cell reselection, are defined in the 3G neighbouring cell list broadcast on BCCH (System Information Type 2quater). If also a PBCCH exists, the 3G neighbouring cell list is broadcast on PBCCH (Packet System Information Type 3quater). The 3G neighbouring cell list may contain up to 64 UTRAN neighbours.

The information to be monitored for priority based cell reselection to both UMTS and LTE is sent in System Information Type 2quater on BCCH only (not on PBCCH). This information contains different thresholds, priorities for the UTRAN frequencies in the 3G neighbouring list, LTE frequencies and their priorities, priority for GSM and information about not allowed LTE cells.

The PSI 3quater message only broadcasts UTRAN information for cell reselection if any UTRAN neighbouring cells exist and the exchange property **COEXUMTS** is set to ON. The SI 2quater message broadcasts UTRAN information for cell reselection if any UTRAN neighbouring cells exist and the exchange property **COEXUMTS** is set to ON. The SI 2quater message broadcasts UTRAN and/or E-UTRAN information if the information needed for priority based cell reselection has been configured and activated by command.

SI 2quater may be sent on either BCCH normal or BCCH extended (see Reference [12]). If not all information fits into one SI 2quater message, the remaining information will be sent in other instances of this message.

When SI 2quater is sent, **AGBLK** is recommended to be set to 1 in the following cases:

- SI 2bis and SI 2ter are sent.
- GPRS/EGPRS is active and SI 2bis is sent.
- GPRS/EGPRS is active and SI 2ter is sent.

This is because System Information 2quater will share the same resources as System Information 13 and/or System Information 2ter on BCCH normal implying longer cycle for these System Information to be broadcast. This

could impact cell selection/reselection performance. When **AGBLK** = 1, either SI2quater or System Information 13 are placed on BCCH extended in the above cases. However, use of BCCH extended implies reduction of the paging capacity since BCCH extended shares the resource with PCH and AGCH, see further Reference [2].

4.3 Cell Selection

It is the initial process of the PLMN selection that decides what PLMN will be chosen initially. This process will depend on the MS type, as well as both operator controllable and user controllable data stored on the SIM card, such as preferred PLMN and RAT (see Section 3.3.1 on page 9and Reference [10]). That type of data can not be controlled by the cell reselection parameters, as sent by the GSM network in system information messages.

4.4 Cell Reselection to UMTS based on cell ranking

4.4.1 Camping Strategy for a Combined WCDMA/GSM Network

The choice of system for idle mode camping is important. The Multi-RAT MS should camp on the system where it is expected to set up its services and where it will be paged. In order for the Multi-RAT MS to be able to access UTRAN specific services it need to camp on UTRAN. The recommended strategy is therefore:

— camp on UTRAN whenever there is UTRAN coverage.

Outside UTRAN coverage the Multi-RAT MS will camp on GSM, to get access to standard GSM services. Once a UTRAN cell is selected/reselected the parameter setting in UTRAN should try to keep the UE in UTRAN as long as the quality and received signal strength of the UTRAN cell is good enough.

The GSM parameter settings recommended in this engineering guideline enable the camping strategy described above.

4.4.2 Cell Reselection to UMTS

It is important to coordinate the parameters in GSM and UTRAN to achieve the wanted inter RAT cell reselection behaviour and thus a smooth co-existence. For extensive information on the cell reselection algorithm from UTRAN to GSM and corresponding parameters, parameter ranges and default values, see Reference [15].

The recommended cell reselection parameter setting in the following sub chapters are coordinated with the corresponding parameter recommendations for UTRAN to GSM cell reselection found in Reference [15].

4.4.2.1 Measurements on UTRAN Neighbouring Cells

The parameter **QSI** controls when the multi-RAT MS shall perform measurements on UTRAN neighbouring cells.

To enable cell reselection to UTRAN in areas with good GSM coverage it is necessary to measure on UTRAN also when GSM coverage is good. The recommendation is that GSM cells that have UTRAN neighbour cells should have the QSI value set to always.

4.4.2.2 Cell Reselection Algorithm

When an MS is in NC0 or NC1 mode, the algorithm for cell reselection from GSM to WCDMA is controlled with the parameters **FDDQMIN** and **FDDQOFF**. **FDDQMIN** defines the minimum quality of the a WCDMA cell for cell reselection, measured in CPICH Ec/No. This parameter is used to assure a sufficient quality of the candidate WCDMA cell. **FDDQOFF** sets an offset, positive or negative, between signal quality of GSM cells and the defined WCDMA neighbours. The cell reselection criteria are:

$$CPICH\ E_c/N_o > \textbf{FDDQMIN} \quad (1)$$

and

$$CPICH\ RSCP > RLA_{(s+n)} + \textbf{FDDQOFF} \quad (2)$$

Where $RLA_{(s+n)}$ is the averaged received signal level [dBm] for both the serving GSM cell and its strongest GSM neighbours.

For a multi-RAT MS just entered GSM a ping-pong back to UTRAN is prohibited by a timer. The multi-RAT MS must fulfil the two cell reselection criteria above for a period of 5 seconds after the cell reselection to GSM and an additional offset of 5 dB will be added to **FDDQOFF** during 15 seconds.

To achieve the preferred camping behaviour the Multi-RAT MS should camp on UTRAN when there is UTRAN coverage. This means that a negative value must be set for **FDDQOFF** if cell reselection shall be possible when GSM coverage is good. A drawback would be that cell reselection to a weak UTRAN cell could be made when GSM coverage is good. Using a higher setting of **FDDQMIN** prevents such effect. A setting of **FDDQMIN** as below,

FDDQMIN > **qQualMin** + **sRatSearch** + a hysteresis,

prevents the multi-RAT MS from making cell reselection to a weak UTRAN cell. This **FDDQMIN** parameter setting will also make sure that the multi-RAT MS will not start to measure on the GSM cells immediately in case the MS has made a cell reselection to UTRAN. **qQualMin** and **sRatSearch** are the UTRAN parameters that define the minimum quality level that is required for a UTRAN cell and at which point the measurement on GSM cells shall start, see Reference [15]. It shall be noted that the qQualMin and sRatSearch

parameters are related to the idle mode, Cell_Fach state and URA_PCH state in WCDMA. Another case is if a packet transfer is ongoing and if the packet transfer is going to continue using a dedicated channel on the WCDMA side. A setting of FDDQMIN as below,

FDDQMIN > **usedFreqThresh2dEcno** + a hysteresis

prevents the multi-RAT MS from starting measurements on GSM cells immediately in case the MS has made a cell reselection to WCDMA and ended up on a dedicated channel in WCDMA.

The recommended parameter setting of **FDDQMIN** and **FDDQOFF** are the following:

FDDQMIN = -10dB

FDDQOFF = -inf

This parameter setting will give a cell reselection algorithm that basis the cell reselection on the quality of the UTRAN cell only, this since the cell reselection criteria 2 above will be fulfilled for all UTRAN neighbours.

4.4.2.3 Combined Cell Reselection Triggering GSM to WCDMA

Multi-RAT mobiles that support RSCP evaluation before triggering a cell reselection to WCDMA, will evaluate UTRAN cells according to cell reslection criteria (2), (3) and (4) below:

CPICH RSCP > $RLA_{(s+n)}$ + **FDDQOFF** (2)

CPICH E_o/N_o > **FDDQMIN - FDDQMINOFF** (3)

and

CPICH RSCP > **FDDRSCPMIN-min((P_MAX-21), 3dB)** (4)

The recommended settings of **FDDQOFF** and **FDDQMIN** are as described in Section 4.4.2.2 on page 29.

The parameter **FDDQMINOFF** has a positive value and will decrease the minimal downlink quality CPICH Ec/N0 required for a cell reselection to the UTRAN cell and with the same arguments as in Section 4.4.2.2 on page 29, the following setting is recommended for **FDDQMINOFF** in combination with**FDDQMIN**:

FDDQMIN - FDDQMINOFF > **qQualMin** + **sRatSearch** +a hysteresis

Due to the recommended setting of **qQualMIn** and **sRATSearch**, **FDDQMINOFF** can either take the vale 0 or 2 dB and the recommended setting of **FDDQMINOFF** is:

FDDQMINOFF = 0 dB.

The absolute minimum CPICH RSCP value to reselect a UTRAN cell is given by the selection parameter **qRxLevMin** in UTRAN. A setting of **FDDRSCPMIN** as below,

FDDRSCPMIN > **qRxLevMin** + **sHcsRat** + a hysteresis

prevents the multi-RAT mobile to trigger a reselection to a weak UTRAN cell. This FDDRSCPMIN parameter setting will also make sure that the multi-RAT MS will not start to measure on the GSM cells immediately in case the MS has made a cell reselection to UTRAN. qRxLevMin and sHcsRat are the UTRAN parameters that define the minimum “signal strength” (CPICH RSCP) that is required for a UTRAN cell and at which point the measurement on GSM cells shall start, see Reference [15].

It shall be noted that the qRxLevMin and SHcsRat parametes are related to the idle mode and the Cell Fach state in WCDMA. Another case is if a packet transfer is ongoing and if the packet transfer is going to continue using a dedicated channel on the WCDMA side. A setting of **FDDRSCPMIN** as below,

FDDRSCPMIN > **usedFreqThresh2dRscp** + a hysteresis

The recommended setting of FDDRSCPmin is:

FDDRSCPMIN = – 102 dBm

Note that for a mobile with the maximum output power of 21 dBm, the cell reselection will be performed at this level but for a mobile with the maximum power output of 24 dBm, the cell reselection will be performed at –105 dBm.

4.4.2.4 Optimized throughput at GSM to WCDMA Cell Change

Since this feature is based on NC2, it is important that the parameters for NC2 are configured properly to the network, see Reference [3].

4.4.3 Cell Reselection from UMTS to GSM

For information on cell reselection from UTRAN to GSM and corresponding parameters, ranges, and default values, see Reference [15].

4.5 Cell Reselection to UMTS and LTE based on priority

4.5.1 Measurements of other RATs

When priority based cell reselection is used, the priority settings in the different RATs must be co-ordinated to avoid a ping-pong behavior between the systems. For example if the systems are prioritized in the order UMTS, GSM and LTE in GSM, the same priority order should be configured in UMTS and LTE.

The mobile continuously searches for higher priority RATs but lower priority RATs are searched when

RLA_C < **MEASTHR**

Within GSM one cell reselection criterion is (see Reference [2] for information about **ACCMIN** and **CCHPWR**):

RLA_C - **ACCMIN** - max(**CCHPWR** -
P,0) < 0

To ensure that the mobile remain in GSM and not moves to a lower priority RAT, these two criteria should be co-ordinated.

MEASTHR < **ACCMIN** + max
(**CCHPWR**-P, 0)

The value of max(**CCHPWR**-P, 0) is mobile dependent and the following setting is therefore recommended:

MEASTHR <**ACCMIN**

4.5.2 Priority Based Cell Reselection algorithm

4.5.2.1 Priority Based Cell Reselection algorithm to UMTS

Cell Reselection to a higher priority UMTS frequency occurs when

RSCP > **QRXLEVMINU** + **HPRIOTHR**

It is recommended to use the same requirements on RSCP as used for cell reselection based on cell ranking, that is RSCP should be greater than -102 dBm, seeSection 4.4.2.3 on page 30. Furthermore it is suggested to set **QRXLEVMINU** to the same value as the 3GPP default value which leads to the following recommendation for UMTS frequencies:

QRXLEVMINU = -119 dBm

HPRIOTHR = 18 dB

Cell reselection to a lower priority frequency may be performed when

S_GSM < **PRIOTHR**

Cell reselection within GSM is performed when C1 < 0. Therefore it is only necessary to search for lower priority frequencies when also S_GSM < 0, that is when

PRIOTHR = 0

Cell reselection to a lower priority UMTS frequency occurs when the following criterion is fulfilled and when no frequency with higher priority is found:

RSCP > **QRXLEVMINU** + **LPRIOTHR**

It is recommended to have the same requirements on RSCP for lower priority UMTS frequencies as for the higher priority UMTS frequencies, that is

QRXLEVMINU = -119 dBm

LPRIOTHR = 18 dB

If none of the criteria above are fulfilled the MS may perform cell reselection to a UMTS frequency with lower or higher priority if

S_GSM < **PRIOTHR**

and

RCSP - **QRXLEVMINU** > S_GSM + **HPRIO**

This criterion is only fulfilled when the signal strength is low in GSM and UMTS frequencies, both high and low priority frequencies. The value of S_GSM is unknown which means that it is not possible to know if the measured RSCP value is good enough. Therefore it is suggested to disable this rule:

HPRIO = 0

A UMTS cell is only selected if the quality measurement CPICH Ec/No is above the threshold **FDDQMIN**. See Section 4.4.2.2 on page 29 for recommended setting of the minimum quality of the a UMTS cell.

4.5.2.2 Priority Based Cell Reselection algorithm to LTE

Cell Reselection to a higher priority LTE frequency occurs when

RSRP > **QRXLEVMINE** + **HPRIOTHR**

It is recommended to only allow cell reselection to LTE if RSRP > -95 dBm. . Furthermore it is suggested to set **QRXLEVMINE** to the same value as the 3GPP default value which leads to the following recommendation for LTE frequencies:

QRXLEVMINE = -140 dBm

HPRIOTHR = 44 dB

Cell reselection to a lower priority frequency may be performed when

S_GSM < **PRIOTHR**

Cell reselection within GSM is performed when C1 < 0. Therefore it is only necessary to search for lower priority frequencies when also S_GSM < 0, that is when

PRIOTHR = 0

Cell reselection to a lower priority LTE frequency occurs when the following criterion is fulfilled and when no frequency with higher priority is found:

RSRP > **QRXLEVMINE** + **LPRIOTHR**

It is recommended to have the same requirements on RSRP for lower priority LTE frequencies as for the higher priority LTE frequencies, that is

QRXLEVMINE = -140 dBm

LPRIOTHR = 44 dB

If none of the criteria above are fulfilled the MS may perform cell reselection to a LTE frequency with lower or higher priority if

S_GSM < **PRIOTHR**

and

RSRP - **QRXLEVMINE** > S_GSM + **HPRIO**

This criterion is only fulfilled when the signal strength is low in GSM and UTRAN frequencies, both high and low priority frequencies. The value of S_GSM is unknown which means that it is not possible to know if the measured RSRP value is good enough. Therefore it is suggested to disable this rule:

HPRIO = 0

4.6 Inter system cell selection after call release

When there is no Active UTRAN Measurement Frequency List defined, there is a risk that the mobile will be re-directed to WCDMA even though there is no WCDMA coverage. The mobile will then unsuccessfully search for WCDMA cells and after a while select a GSM cell. In such a case, the Paging outage time will instead increase. Therefore it is recommended to use command RLRWE to turn off the feature in GSM cells where the UTRAN coverage is poor and when no Active UTRAN Measurement Frequency List has been configured.

If the parameter **QSI** is set to 15 (=never), meaning that mobile should not measure on WCDMA cells while in idle mode, it is recommended to turn off the feature (command RLRWE) in the GSM cell in order to not request the mobile to select a WCDMA cell after call release.

If a shorter packet data transfer time has higher priority than a shorter Paging outage time, the parameter **FASTRET3GNC2** should be set to 1 (=no-redirect) so that the mobile is not requested to select a WCDMA cell when the feature Optimized throughput at GSM to WCDMA Cell Change is active and a CS connection of a DTM call is released.

4.7 Inter System Handover

4.7.1 General

It is important to coordinate the parameters in GSM and UTRAN to achieve the wanted inter system handover behaviour and thus a smooth co-existence. The recommended handover parameter setting in the following sub chapter is coordinated with the corresponding UTRAN handover parameter setting found in Reference [16].

4.7.2 Handover to UTRAN

The following handover parameter setting is recommended:

1. **SPRIO** = Yes, motivation: secure that Multi-RAT mobiles have enough time for 3G measurements also for the case then the Multi-RAT mobile is busy with measurement on GMS neighbours.

2. **FDDMRR** = 1 in case the GSM cell has GSM neighbours in different GSM bands (that is, GSM 900 and 1800 band), motivation: minimize the impact on the measurement of GSM neighbours.

FDDMRR = 2 in case the GSM cell has neighbours within one GSM band. Motivation: minimize impact on GSM measurements but allow more 3G neighbours to be reported compared to the case above.

3. **QSC**/**ISHOLEV** (alternative 1, GSM used to extend UTRAN coverage and off-load GSM system at certain traffic load threshold):

Set **QSC** = 7(always) or **QSC** = 8(above -78dBm) for UTRAN cell co-sited with GSM cell. Set **ISHOLEV** = wanted traffic load at which the handover UTRAN shall start.

4. **QSC**/**ISHOLEV** (alternative 2, GSM used to extend UTRAN coverage):

Set **QSC** = 7(always) or **QSC** = 8(above -78dBm) for UTRAN cell co-sited with GSM cell. Set **ISHOLEV** = 99.

5. **QSC**/**ISHOLEV** (alternative 3, GSM to be extended with UTRAN coverage):

Set **QSC** = 1(below -94dBm) Set **ISHOLEV** = 99.

6. **QSCI** = 1 (always).

7. **MRSL** = 30 (-9dB) Motivation: the value of the **MRSL** parameter shall be set so that a handover to UTRAN is not immediately followed by a “ping-pong" handover back to GSM and to avoid starting GSM measurements directly when entering UTRAN. This is achieved if the **MRSL** parameter has the following relation to the UTRAN parameter **usedFreqThresh2dEcno**:

MRSL > **usedFreqThresh2dEcno** + a hysteresis.

The setting to -9dB fulfills the relations above using the default setting of the UTRAN parameter **usedFreqThresh2dEcno**.

The UTRAN parameter **usedFreqThresh2decno** defines the Ec/No threshold when starting to measure on GSM cells.

UTRAN may also start measurements if measured CPICH RSCP, which is a measure of the downlink signal strength, is below **UsedFreqThresh2dRscp**. Since it may accur that the measured signal quality CPICH ECN0 is good but the signal strength weak, the recommended **MRSL** setting above may have to be adjusted to a higher value to prevent ping-pong handovers.

The event 3a is used in UTRAN to trigger the execution of a handover from UTRAN to GSM, for further information see Reference [16]. The measurement event 3a is defined as follows: the estimated quality of the currently used UTRAN frequency is below a certain threshold and the estimated quality of the GSM system is above a certain threshold in the same time interval.

4.7.3 Combined Handover Triggering GSM to WCDMA

In addition to the recommended parameter setting in Section 4.7.2 on page 35 the following parameter settings are recommended:

1. **FDDREPTHR2** = 16 (-100dBm). Motivation: the value of the **FDDREPTRH2** parameter shall be set so that a handover to UTRAN is not immediately

followed by a “ping-pong” handover back to GSM and to avoid starting GSM measurements directly when entering UTRAN. This is achieved if the **FDDREPTHR2** parameter has the following relation to the UTRAN parameter **usedFreqThresh2dRscp**:

FDDREPTHR2 > **usedFreqThresh2dRscp** + a hysteresis.

The recommended setting to -100dBm fulfills the relations above using the default setting of the UTRAN parameter **usedFreqThresh2dRscp**.

The UTRAN parameter **usedFreqThresh2dRscp** defines the CPICH RSCP threshold when starting to measure on GSM cells.

4.7.4 Handover to GSM

For further information regarding the handover algorithm from UTRAN to GSM, see Reference [16].

4.7.5 Smooth GSM to WCDMA Unloading

The following parameter settings are recommended:

MAXISHO=2, Motivation: the rate at which load varies in a cell per second is normally related to the cell size. Assuming a cell with 20 channels and a mean holding time of 90 seconds, calls are in average set up with a rate of 20calls/90s, that is, less than one call per second. Therefore, to keep the load level close to **ISHOLEV**, a limitation of 2 handovers per second should be sufficient. Note that as long as there are multi-RAT MSs in the cell, the load will vary around the value set by **ISHOLEV**.

5 Parameters

5.1 General

The feature GSM-UMTS Cell Reselection and Handover is activated per BSC with the exchange property **COEXUMTS**. In addition the features Combined Cell Reselection Triggering GSM to WCDMA and Combined Handover Triggering GSM to WCDMA can be activated with this exchange property.

The feature Handover with Usage of Service Indicator is activated per BSC with the exchange property **SBHOACTIVE**.

The feature Smooth GSM to WCDMA Unloading is activated per BSC with the exchange property **COEXUMTSLSH**.

UTRAN FDD neighbouring cells are identified with a frequency and scrambling code combination. In idle mode, the measurement frequency (**MFDDARFCN**) and scrambling code **MSCRCODE** for the neighbouring UTRAN cells are defined within the parameter **UMFI**. This parameter is also used to define if diversity is applied or not for an UTRAN cell. Up to 64 UTRAN neighbouring cells may be defined per GSM cell. In active mode, within the definition of neighbouring cell relations, several parameters are defining one neighbouring UTRAN cell: Radio Frequency Channel Number (**FDDARFCN**), Scrambling Code (**SCRCODE**), Cell Identity (**UTRANID**) and the Minimum Reported Signal Level for CPICH Ec/No (**MRSL**). **UTRANID** consists of the RNC Identity (**RNCID**), Cell Identity within the RNC (**CI**), **MCC**, **MNC** and **LAC**.

The feature NC2 is activated per cell using the command RLNMI. The NC2 profile is selected via the parameter **NCPROF**.

Priority based cell reselection to both UMTS and LTE is activated per GSM cell with the command RLSRI. Before activation **RATPRIO** must be set for GSM, for each UMTS frequency **FDDARFCN** corresponding to **MFDDARFCN** in **UMFI** and for each LTE frequency **EARFCN**.

5.2 Main Controlling Parameters

5.2.1 Feature Controlling Parameters

COEXUMTS is used to enable the features GSM-UMTS Cell Reselection and Handover, Combined Cell Reselection Triggering and Combined Handover Triggering GSM to WCDMA. The parameter is a BSC exchange property.

0 OFF ; GSM-UMTS Cell Reselection and Handover and Combined Cell Reselection Triggering GSM to WCDMA are not activated.

1 ON; GSM-UMTS Cell Reselection and Handover is activated

2 ONADDINFO; GSM-UMTS Cell Reselection and Handover and Combined Cell Reselection Triggering GSM to WCDMA are activated

3 ONADDINFO; GSM-UMTS Cell Reselection and Handover and Combined Handover Triggering GSM to WCDMA are activated

4 ONADDINFO; GSM-UMTS Cell Reselection and Handover, Combined Cell Reselection Triggering GSM to WCDMA and Combined Handover Triggering GSM to WCDMA are activated

COEXUMTSLSH is used to determine if rejection of incoming handovers from UTRAN and limitation of the number of outgoing handovers to UTRAN due to load in GSM is allowed (=ON) or not (=OFF) in the BSC. The parameter is a BSC exchange property.

0 OFF

1 ON

FASTRET3G shows the activation status of the feature Fast Return to WCDMA after Call Release (activated/deactivated/printed with the commands RLRWI/RLRWE/RLRWP).

Active

Inactive

FASTRET3GNC2 controls whether to redirect DTM calls after call release when the feature Optimized throughput at GSM to WCDMA Cell Change is active. The parameter is a BSC exchange property.

0 re-direct

1 do not re-direct

NCPROF indicates which NC2 profile is to be activated in a cell when an MS is in NC2 mode. The default value is 1 which activates the feature Optimized throughput at

GSM to WCDMA Cell Change. The value range is 1–255, where 2–255 are undefined.

PRIOCR shows the activation status of priority based inter-RAT cell reselection (activated/changed/deactivated/printed with the commands RLSRI/RLSRC/RLSRE/RLSRP).

0 OFF

1 ON

SBHOACTIVE is used to determine if handover with usage of Service Indicator is allowed (=ON) or not (=OFF) in the BSC. The parameter is a BSC exchange property.

0 OFF

1 ON

5.2.2 Parameters for Cell Reselection to UMTS based on cell ranking

FDDQMIN defines the minimum threshold for the “quality” measure Ec/No for cell reselection to UTRAN. This parameter is defined per GSM cell and applies for all its UTRAN neighbours.

FDDQMINOFF defines an offset to the threshold **FDDQMIN**. This parameter is defined per GSM cell and applies for all its UTRAN neighbours.

FDDQOFF defines the minimum threshold for the “quality” measure Ec/No for cell reselection to UTRAN. This parameter is defined per GSM cell and applies for all its UTRAN neighbours.

FDDRSCPMIN defines the minimum threshold for the “signal strength” measure CPICH RSCP for cell reselection to UTRAN. This parameter is defined per GSM cell and applies for all its UTRAN neighbours.

QSI defines if the monitoring of UMTS cells will be performed if the signal level is below (0-6) or above the threshold (8-14), always (7) or never (15). This parameter is defined per GSM cell.

UMFI (MFDDARFCN-MSCRCODE-DIVERSITY) defines the frequency, scrambling code and diversity information for a UTRAN neighbouring cell.

MFDDARFCN indicates the absolute RF channel number of the neighbouring UTRAN cell to be measured on by Multi-RAT MSs. Several frequency bands exist

and the absolute RF channel number represents the center frequency within the frequency band. Allowed frequency bands and absolute RF channel numbers are described in detail in Reference [13].

MSCRCODE is the scrambling code for the neighbouring cell. The scrambling code has 512 values.

DIVERSITY indicates if diversity is applied for the UTRAN cell, or not.

This parameter is defined per GSM cell.

5.2.3 Parameters for Cell Reselection to UMTS and LTE based on priority

EARFCN defines the E-UTRAN Absolute Radio Frequency Channel Number to which cell reselection shall be performed. This parameter is defined per GSM cell.

FDDARFCN defines the UTRAN FDD Absolute Radio Frequency Channel Number to which priority based cell reselection shall be performed. The value shall correspond to MFDDARFCN in **UMFI**. This parameter is defined per GSM cell.

HPRIO defines an offset to apply at a relative comparison between GSM and inter-RAT frequencies when cell reselection to an inter-RAT frequency of lower priority than GSM is allowed. In 3GPP this parameter is called H_PRIO. This parameter is set per GSM cell.

HPRIOTHR defines the minimum threshold for reselection to LTE and UMTS frequencies of higher priority than GSM. The value "measured RSCP value" - **QRXLEVMINU** for UMTS and “measured RSRP value” – **QRXLEVMINE** for LTE must be above the threshold. The parameter is defined per **FDDARFCN** for UMTS frequencies and per **EARFCN** for LTE frequencies. In 3GPP, this parameter is called THRESH_FDD_high for UMTS and THRESH_E-UTRAN_high for LTE.

LPRIOTHR defines the minimum threshold for reselection to LTE and UMTS frequencies of lower priority than GSM. The value "measured RSCP value" - **QRXLEVMINU** for UMTS and “measured RSRP value” – **QRXLEVMINE** for LTE must be above the threshold. The parameter is defined per **FDDARFCN** for UMTS frequencies and per **EARFCN** for LTE frequencies. In 3GPP, this parameter is called THRESH_FDD_low for UMTS and THRESH_E-UTRAN_low for LTE.

MEASTHR defines a threshold for the serving cell below which measurements of inter-RAT frequencies with lower priority should be done. This parameter is defined per GSM cell. In 3GPP this parameter is called THRESH_priority_search.

MINCHBW defines the minimum value of the channel bandwidth of all valid E-UTRAN cells on the specified **EARFCN**. This parameter is defined per **EARFCN**.

PCID defines a E-UTRAN cell to which it is forbidden to perform cell reselection. This parameter is defined per **EARFCN**.

PCIDG indicates a group of not allowed E-UTRAN cells. If bit number n, where n can take the value from 1 to 6, in this field is set to '1', then cells with PCID values in the range (n-1) * 84 to (n*84)-1 inclusive are not allowed to reselect. This parameter is defined per **EARFCN**.

PCIDP is a pattern of the PCID which together with **PCIDPS** indicates which E-UTRAN cells are forbidden to select. This is a bitmap with variable length which refers to the pattern of the leftmost (most significant) PCID bits. For example 0 and 00 shall be seen as two different patterns. This parameter is defined per **EARFCN**

PCIDPS indicates if the PCID indicated by **PCIDP** are the not allowed cells or if all other PCID are not allowed cells.

PRIOTHR defines a threshold, for the serving cell and all neighbouring GSM cells, below which cell reselection is allowed to inter-RAT frequencies with lower priority than GSM. In 3GPP this parameter is called THRESH_GSM_low. This parameter is defined per GSM cell.

QRXLEVMINE defines the minimum required RX level (RSRP)) for cells on the target E-UTRAN frequency. In 3GPP this parameter is called E-UTRAN_QRXLEVMIN. This parameter is defined per **EARFCN**.

QRXLEVMINU defines the minimum required RX level (RSCP) for cells on the target UTRAN frequency. In 3GPP this parameter is called UTRAN_QRXLEVMIN.This parameter is defined per **FDDARFCN**.

RATPRIO defines the priority of GSM,, LTE frequencies and UMTS frequencies. The priority may not be the same for different RATs but may be the same within a RAT. The GSM priority is defined per GSM cell, the LTE

priority is defined per **EARFCN** and the UMTS priority is defined per **FDDARFCN**.

TRES defines the time during which the conditions for cell reselection to another RAT must be fulfilled. In 3GPP this parameter is called T_reselection. This parameter is defined per GSM cell.

5.2.4 Parameters for Inter System Handover to UMTS

COEXUMTSTINT is used to control the time interval between traffic load checking. This parameter is a BSC exchange property.

FDDARFCN indicates the absolute RF channel number of the neighbouring UTRAN cell in GSM active mode. Several frequency bands exist and the absolute RF channel number represents the center frequency within the frequency band. Allowed frequency bands and absolute RF channel numbers are described in detail in Reference [13]. This parameter is defined per UTRAN cell.

FDDMRR defines the number of UTRAN cells that the mobile should include in measurement reports. For a detailed description see Section 3.3.4.2 on page 17. This parameter is defined per GSM cell.

ISHOLEV defines the traffic load threshold of the serving GSM cell that needs to be exceeded in order to evaluate UMTS measurements for handovers. This parameter is defined per GSM cell.

MAXISHO defines the maximum number of allowed handovers to trigger to UTRAN per second. Only handovers that are triggered because of traffic load in the GSM cell are counted or limited. This parameter is defined per GSM cell.

MRSL defines a minimum threshold for the "quality" measure Ec/No for handovers to UTRAN. This parameter is defined per UTRAN cell.

FDDREPTHR2 defines a threshold for the non reported “signal strength” measure CPICH RSCP of UTRAN cells. The MS includes a UTRAN cell in the measurement reports only if the non reporting threshold is exceeded. It shall be noted that the reporting entity in the measurement reports is CPIC Ec/No. This parameter is defined per GSM cell.

SCRCODE is the scrambling code for the neighbouring UTRAN cell in active mode. The scrambling code has 512

combinations. This parameter is defined per UTRAN cell.

SPRIO indicates if 3G cells may be searched when BSIC decoding is required. This parameter is defined per GSM cell.

UTRANID UTRANID present the Identity of the neighbouring UTRAN cell in active mode. It consists of the RNC Identity (RNCID), Cell Identity within the RNC (CI), MCC, MNC and LAC. This parameter is defined per UTRAN cell.

QSC defines if the monitoring of UMTS cells will be performed if the signal level is below (0-6) or above the threshold (8-14). always (7) or never (15). This parameter is defined per GSM cell.

QSCI defines the control of UTRAN measurement after entering active mode, before reading the first QSC. In that period UTRAN measurements can always be performed (=1) or according to QSI value (=0). This parameter is defined per GSM cell.

GPRSPRIO GPRSPRIO is a BSC cell parameter that controls whether on-demand PDCHs shall be regarded as idle or busy when traffic load (percentage of idle channels) is calculated in the cell (see parameter description in Reference [7]).

5.3 Value Ranges and Defaults Values

Table 3 Feature Controlling Parameters

Parameter name	Default value	Recommended value	Value range	Unit
COEXUMTS	0 (OFF)	-	0 (OFF), 1 (ON), 2 (ONADDINFO), 3 (ONADDINFO), 4 (ONADDINFO)	
COEXUMTSLSH	0 (OFF)	-	0 (OFF), 1 (ON)	
FASTRET3GNC2	0 (re-direct)	0	0 (re-direct) 1 (do not re-direct)	

Parameter name	Default value	Recommended value	Value range	Unit
SBHOACTIVE	0 (OFF)	-	0 (OFF), 1 (ON)	
NCPROF	1	1	1 (Optimized throughput at GSM to WCDMA Cell Change) Values 2 — 255 are undefined.	-

Table 4 Parameters for Inter System Cell Reselection to UMTS based on cell ranking

Parameter name	Default value	Recommended value	Value range	Unit
UMFI (MFDDARFCN- MSCRCODE-DIVERSITY)	-	-	MFDDARFCN: 0 to 16383 MSCRCODE: 0 to 511 DIVERSITY: DIV, NODIV	
FDDQMIN	0 (-20dB)	5 (-10dB)	0 to 7 (-20dB, -6dB, -18dB, -8dB, -16dB, -10dB, -14dB, -12dB)	dB
FDDQMINOFF	0 (0dB)	0 (0dB)	0 to 7 (0 to 14 dB in steps of 2dB)	dB
FDDQOFF	8 (0dB)	0 (-inf)	0 to 15 (-inf, -28dB to +28dB in steps of 4dB)	dB
FDDRSCPMIN	6 (-102 dBm)	6 (-102 dBm)	0 to 15 (-114 dBm to – 84 dBm in steps of 2 dBm)	dBm
QSI	15 (never)	7 (always)	0 to 6 (below -98dBm to -74dBm in steps of 4dBm) 7 (always) 8 to 14 (above -78dBm to -54dBm in steps of 4dBm) 15 (never)	dBm

Table 5 Parameters for Inter System Cell Reselection to UMTS and LTE based on priority

Parameter name	Default value	Recommended value	Value range	Unit
EARFCN	-	-	0 to 65535	
FDDARFCN	-	-	0 to 16383	
HPRIO	0	0	0 to 3 (inf (rule disabled), 5 dB, 4 dB, 3 dB)	dB
HPRIOTHR	UMTS: 9 (18 dB) LTE: 22 (44 dB)	See Section 4.5.2.1 on page 32 and Section 4.5.2.2 on page 33	0 to 31 (0 dB to 62 dB in steps of 2 dB)	dB

Parameter name	Default value	Recommended value	Value range	Unit
LPRIOTHR	UMTS: 9 (18 dB) LTE: 22 (44 dB)	See Section 4.5.2.1 on page 32 and Section 4.5.2.2 on page 33	0 to 31 (0 dB to 62 dB in steps of 2 dB)	
MEASTHR	15 (inf)	See Section 4.5.1 on page 32	0 to 15 (-98 dBm to -56 in steps of 3 dBm, inf (always))	dBm
MINCHBW	0 (6 Nrb)	0	0 to 5 (6, 15, 25, 50, 75, 100)	Nrb, Number of Resorce Blocks
PCID	-	-	0-503	
PCIDG	0	-	0-63	
PCIDP	-	-	1 to 8 bits with values 0 or 1 per bit.	
PCIDPS	-	-	0,1	
PRIOTHR	0 (0 dB)	See Section 4.5.2.1 on page 32 and Section 4.5.2.2 on page 33	0 to 15 (0 to 28 in steps of 2 dB, inf (always))	dB
QRXLEVMINE	0 (-140 dBm)	0 (-140 dBm)	0 to 31 (-140 dBm to -78 dBm in steps of 2 dBm)	dBm
QRXLEVMINU	0 (-119 dBm)	0 (-119 dBm)	0 to 31 (-119 dBm to -57 dBm in steps of 2 dBm)	dBm
RATPRIO	-	-	0 to 7 (0 lowest priority, 7 highest priority)	
TRES	0 (5s)	0 (5s)	0 to 3 (5, 10,15,20 s)	seconds

Table 6 Parameters for Inter System Handover to UMTS

Parameter name	Default value	Recommended value	Value range	Unit
COEXUMTSTINT	1000	1000	100 to 1000	ms
FDDARCN	-	-	0 to 16383	
SCRCODE	-	-	0 to 511	
UTRANID (RNCID-CI-MCC-MNC-LAC)	-	-	RNCID:0 to 4095 CI: 0 to 65535 MCC MNC LAC	

Parameter name	Default value	Recommended value	Value range	Unit
MRSL	-	30 (-9dB)	0 to 49 (0: MRSL<-24dB 1: -24dB <= MRSL < -23.5dB 2: -23.5dB <= MRSL < -23dB ..... 48: -0.5dB <= MRSL < 0dB 49: 0 dB <= MRSL)	
ISHOLEV	20	See Section 4.7.2 on page 35	0 to 99	%
FDDREPTHR2	0 (disabled)	16 (-100dBm)	0 to 63 0 disabled 1 -115dBm 2 -114dBm . . 62 - 54dBm 63 - 53dBm	
FDDMRR	0	1 or 2 (for further details see Section 4.7.2 on page 35)	0 to 3	
QSC	15(never)	See Section 4.7.2 on page 35	0 to 6 (below -98dBm to -74dBm in steps of 4dBm) 7 (always) 8 to 14 (above -78dBm to -54dBm in steps of 4dBm) 15 (never)	
QSCI	0	1 (always)	0 (QSI), 1 (always)	
MAXISHO	2	2	1 to 100	
SPRIO	-	YES	YES, NO	

6 Concepts

Access Technology	GSM or UMTS
Active Mode	In active mode, the mobile station is allocateddedicated channels. It listens to the SACCH.
CPICH Ec/No	CPICH Ec/No is the received energy per chipon the Common Pilot Channel (CPICH) divided by the power density in the band.This quantity measures the quality of the neighbouring UTRAN cells (roughlycomparable to a signal to noise ratio measure).
GSM Candidate List	A list of candidates for handover,as a result of the GSM part of the locating algorithm. By adding the UMTSneighbours on the top, a final list is created.
CPICH RSCP	A Multi-RAT MS measures Received Signal CodePower on neighbouring UTRAN cells in order to evaluate inter system cell reselection candidates. RSCP is the average power of the received signal after despreading and combining.
Home PLMN	The PLMN where the MCC and MNC of the PLMN identitymatch the MCC and MNC of the IMSI.
Idle Mode	In this mode, the mobile station is not allocated any dedicated channel. It listens to the CCCH and the BCCH.
Inter System Cell Reselection	Cell reselection betweennetworks using different radio access, for example GSM and UMTS.
Multi-RAT MS	User equipment that can obtain service fromGSM and one or more different RATs such as UMTS.
On-demand PDCH	A PDCH which is set up and released dynamicallydepending on the need for packet data traffic in the cell. AN on-demand PDCHmay be PDCH pre-empted.
Paging outage time	The Paging Outage Time is referred to as the time when an MS cannot be reached by a paging message
PSI 3quater	System information message on PBCCH used byMulti-RAT MSs in GPRS/EGPRS Ready and Standby states.

Packet Idle Mode	In this mode (only applicable for mobilestations supporting GPRS/EGPRS), mobile station is not allocated any radioresource on a packet data physical channel. It listens to the PBCCH and PCCCHor, if the network does not provide those, to the BCCH and the CCCH.
Packet Transfer Mode	In this mode (only applicable formobile stations supporting GPRS/EGPRS), the mobile station is allocated radioresource on one or more packet data physical channels.
PDCH	A full rate TCH or dual rate TCH in the CS domainthat is allocated by the PS domain to carry GPRS/EGPRS traffic.
Registered PLMN	The PLMN to which Location Registrationhas been performed.
Service Indicator	The Service Indicator is a BSS internalparameter that indicates whether the MSC has any preference on in which system,GSM or WCDMA, a CS connection shall be served. It will have the value as receivedin the Information Element “Service Handover” in the BBSMAP messagesHandover Request and Assignment Request or the value “no preference”if the MSC has omitted the Information Element “Service Handover”.The “Service Handover” Information Element may have the values“Handover to UTRAN should be performed”, “Handover to UTRANshould not be performed” or “Handover to UTRAN shall not be performed”
SI 2quater	System Information message on BCCH used byMulti-RAT MSs in idle mode and GPRS/EGPRS Ready and Standby mode.
Urgency Handover	Urgency handover is a handover triggeredbecause an urgency criteria is fulfilled in the serving GSM cell. The urgencycriteria may be due to large timing advance, bad downlink quality or bad uplinkquality.
UTRAN FDD	UTRAN has two modes, FDD and TDD, for operatingwith paired or unpaired bands respectively. FDD is a duplex method wherebyuplink and downlink transmissions use two separated radio frequencies.

Glossary

BA
BCCH Allocation

BCCH
Broadcast Control Channel

BSC
Base Station Controller

CPICH
Common Pilot Channel

CS
Circuit Switched

EGPRS
Enhanced GPRS

E-UTRAN
Evolved UTRAN

FDD
Frequency Division Duplex

GPRS
General Packet Radio Service

GSM
Global System for Mobile communication

IMSI
International Mobile Subscriber Identity

LA
Location Area

LAC
Location Area Code

LAI
Location Area Identity

LTE
Long Term Evolution

MCC
Mobile Country Code

MNC
Mobile Network Code

MPDCH
Master Packet Data Channel

MS
Mobile Station

NCC
Network Color Code

PBCCH
Packet Broadcast Control Channel

PCID
Physical Layer Cell Identity

PDCH
Packet Data Channel

PLMN
Public Land Mobile Network

PS
Packet Switched

RA
Routing Area

RAT
Radio Access Technology

RLA_C
Received Level Average (circuit switched)

RLA_P
Received Level Average (packet switched)

RNC
Radio Network Controller

RSCP
Received Signal Code Power

RSRP
Reference Signal Received Power

SACCH
Slow Associated Control Channel

SIM
Subscriber Identity Module

UMTS
Universal Mobile Telecommunications System

UTRAN
UMTS Radio Access Network

WCDMA
Wideband Code Division Multiple Access

Reference List

Ericsson Documents

[1] *User Description, Enhanced Multi-Level Precedence and Pre-emption Service*, (User Description)

[2] *User Description, Idle Mode Behaviour*, (User Description)

[3] *User Description, GPRS/EGPRS Cell Reselection*, (User Description)

[4] *User Description, Locating*, (User Description)

[5] *User Description, Double BA Lists*, (User Description)

[6] *User Description, Multiband Operation*, (User Description)

[7] *User Description, Channel Administration*, (User Description)

Standards

[8] *3GPP TS 45.008*, (GSM Specification)

[9] *3GPP TS 23.060*, (GSM Specification)

[10] *3GPP TS 23.122*, (GSM Specification)

[11] *3GPP TS 25.304*, (GSM Specification)

[12] *3GPP TS 45.002*, (GSM Specification)

[13] *3GPP TS 25.101*, (GSM Specification)

[14] *3GPP TS 44.060*, (GSM Specification)

WCDMA User Descriptions

[15] *User Description, Idle Mode and Common Channel Behavior*, (User Description)

[16] *User Description, WCDMA RAN Handover*, (User Description)