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Foreword

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Contents

Foreword

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

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1 Scope

The present document specifies requirements for support of Radio Resource Management for the FDD and TDD modes of [Evolved UTRA]. These requirements include requirements on measurements in UTRAN and the UE as well as requirements on node dynamical behaviour and interaction, in terms of delay and response characteristics.

2 References

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

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

[1] 3GPP TS 36.304: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode"

[2] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) protocol specification".

[3] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures"

[4] 3GPP TS 36.214: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer; Measurements"

[5] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception"

[6] 3GPP TS 25.302: "Services provided by the Physical Layer".

[7] 3GPP TS 25.331: "RRC Protocol Specification".

[8] 3GPP TS 45.008: "Radio subsystem link control".

[9] 3GPP TS 45.005: "Radio transmission and reception".

[10] 3GPP TS 45.010: "Radio subsystem synchronization".

[11] 3GPP2 C.S0024-A: 'cdma2000 High Rate Packet Data Air Interface Specification'.

[12] 3GPP2 C.S0002-A: 'Physical Layer Standard for cdma2000 Spread Spectrum Systems – Release A'.

[13] 3GPP2 C.S0024-A: 'Recommended Minimum Performance Standards for cdma2000 High Rate Packet Data Access Terminal'.

[14] 3GPP2 C.S0011-A: 'Recommended Minimum Performance Standards for cdma2000 Spread Spectrum Mobile Stations'.

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [x] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [x].

3.2 Symbols

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

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [x] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [x].

1x RTT	CDMA2000 1x Radio Transmission Technology
AWGN	Additive White Gaussian Noise
BCCH	Broadcast Control Channel
BCH	Broadcast Channel
CPICH	Common Pilot Channel
CPICH Ec/No	CPICH Received energy per chip divided by the power density in the band
DCCH	Dedicated Control Channel
DL	Downlink
DRX	Discontinuous Reception
DTCH	Dedicated Traffic Channel
eNB	E-UTRAN NodeB
E-UTRA	Evolved UTRA
E-UTRAN	Evolved UTRAN
FDD	Frequency Division Duplex
GERAN	GSM EDGE Radio Access Network
GSM	Global System for Mobile communication
HO	Handover
HRPD	High Rate Packet Data
OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency Division Multiple Access
PBCH	Physical Broadcast Channel
P-CCPCH	Primary Common Control Physical Channel
PCFICH	Physical Control Format Indicator CHannel
PDCCH	Physical Downlink Control CHannel
PDSCH	Physical Downlink Shared CHannel
PLMN	Public Land Mobile Network
PRACH	Physical Random Access CHannel
PUCCH	Physical Uplink Control CHannel
PUSCH	Physical Uplink Shared Channel
RSCP	Received Signal Code Power
RSRP	Reference Signal Received Power
RSRQ	Reference Signal Received Quality
RSSI	Received Signal Strength Indicator
QAM	Quadrature Amplitude Modulation
RACH	Random Access Channel
RAT	Radio Access Technology
RNC	Radio Network Controller
RRC	Radio Resource Control
RRM	Radio Resource Management
SCH	Synchronization Channel
SFN	System Frame Number

TDD	Time Division Duplex
TTI	Transmission Time Interval
UE	User Equipment
UL	Uplink
UMTS	Universal Mobile Telecommunication System
UTRA	Universal Terrestrial Radio Access
UTRAN	Universal Terrestrial Radio Access Network

3.4 Test tolerances

4 E-UTRAN RRC_IDLE state mobility

4.1 Cell Selection

After a UE has switched on and a PLMN has been selected, the Cell selection process takes place, as described in TS36.304. This process allows the UE to select a suitable cell where to camp on in order to access available services. In this process the UE can use stored information (*Stored information cell selection*) or not (*Initial cell selection*).

4.2 Cell Re-selection

4.2.1 Introduction

The cell reselection procedure allows the UE to select a more suitable cell and camp on it.

When the UE is in either *Camped Normally* state or *Camped on Any Cell* state on a FDD cell, the UE shall attempt to detect, synchronise, and monitor intra-frequency, inter-frequency and inter-RAT cells indicated by the serving cell. For intra-frequency and inter-frequency cells the serving cell may not provide explicit neighbour list but carrier frequency information and bandwidth information only. UE measurement activity is also controlled by measurement rules defined in TS36.304, allowing the UE to limit its measurement activity.

4.2.2 Requirements

[Editor"s Note: Requirements for multiple Tx antennas are still FFS. So far only 1Tx antenna case has been considered.The number of Tx antennas and possibly CP length may need to be provided per frequency layer. Details are FFS. Low mobility and high mobility requirements are still FFS]

The UE shall search every layer of higher priority at least every $T_{higher\_proirty\_search}$ = (60 * N_{layers}) seconds, where N_{layers} is the total number of configured higher priority E-UTRA, UTRA FDD, UTRA TDD, CDMA2000 1x and HRPD carrier frequencies and is additionally increased by one if GSM is configured as a higher priority.

Editors note: The measurement of cells that are detected in this search is still to be described.

4.2.2.1 Measurement and evaluation of serving cell

The UE shall measure the RSRP level of the serving cell and evaluate the cell selection criterion S defined in [36.304] for the serving cell at least every DRX cycle. The UE shall also evaluate 'out of service area' criteria defined in [TBD] at least every DRX cycle. *Note: the 'out of service' criteria are still FFS.*

The UE shall filter the RSRP measurements of the serving cell using at least [2] measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by, at least [DRX cycle/2].

If the UE has evaluated in N_{serv} consecutive DRX cycles that the serving cell does not fulfil the cell selection criterion S, the UE shall initiate the measurements of all neighbour cells indicated by the serving cell, regardless of the measurement rules currently limiting UE measurement activities.

Table 4.2.2.1-1: N_{serv}

DRX cycle length [s]	N_{serv} [number of DRX cycles]
0.32	4
0.64	4
1.28	2
2.56	2

4.2.2.3 Measurements of intra-frequency E-UTRAN cells

The UE shall be able to identify new intra-frequency cells and perform RSRP measurements of identified intra-frequency cells without an explicit intra-frequency neighbour list containing physical layer cell identities.

The UE shall be able to evaluate the need for reselection to a newly detectable intra-frequency cell within $T_{detect,EUTRAN\_Intra}$ assuming that $T_{reselection} = 0$. It shall be possible to evaluate the need for reselection to cells which have:

- RSRP $\geq$ -TBD dBm and Ior/($\hat{I}_{interfering\ cells}$+Ioc) $\geq$ [-3] dB,

- SCH $\hat{I}$or $\geq$ -TBD dBm and SCH $\hat{I}$or/($\hat{I}_{interfering\ cells}$+Ioc) > [-3] dB.. The UE shall measure RSRP at least every $T_{measure,EUTRAN\_Intra}$ (see table 4.2.2.3-1) for intra-frequency cells that are identified and measured according to the measurement rules.

The UE shall filter RSRP measurements of each measured intra-frequency cell using at least [2] measurements. Within the set of measurements used for the filtering, [at least two measurements] shall be spaced by at least $T_{measure\_EUTRAN,Intra}/2$

The filtering shall be such that the UE shall be capable of evaluating that the intra-frequency cell has met reselection criterion defined TS 36.304 within $T_{evaluateFDD,intra}$ as specified in table 4.2.2.3-1.

Table 4.2.2.3-1 : $T_{detect,EUTRAN\_Intra}$, $T_{detect,EUTRAN\_Intra}$ and $T_{evaluateFDD\_intra}$

DRX cycle length [s]	$T_{detect,EUTRAN\_Intra}$ [s] (number of DRX cycles)	$T_{measure,EUTRAN\_Intra}$ [s] (number of DRX cycles)	$T_{evaluateFDD,intra}$ [s] (number of DRX cycles)
0.32	[11.52 (36)]	[1.28 (4)]	[5.12 (16)]
0.64	[17.92 (28)]	[1.28 (2)]	[5.12 (8)]
1.28	[32(25)]	[1.28 (1)]	[6.4 (5)]
2.56	[55.88 (23)]	[2.56 (1)]	[7.68 (3)]

4.2.2.4 Measurements of inter-frequency E-UTRAN cells

[Editor"s note: The RAN2 measurement rules for inter frequency are still to be clarified . It is assumed that the following parameter is defined : $Thresh_{serving\_high}$: Threshold for the LTE serving cell when the UE initiates measurements, or increases the measurement rate (in the case of high to low priority reselection) on a different E-UTRA frequency layer. This section should be reviewed and updated once more detailed measurement rules are defined by RAN2.]

The UE shall be able to identify new inter-frequency cells and perform RSRP measurements of identified inter-frequency cells if carrier frequency information is provided by the serving cell, even if no explicit neighbour list with physical layer cell identities is provided.

If the RSRP of the E-UTRA serving cell (or other cells on the same frequency layer) is greater than $Thresh_{serving\_high}$ then

- the UE may not search for, or measure inter-frequency or inter-RAT layers of equal or lower priority.

- the UE shall search for inter-frequency layers of higher priority at least every $T_{higher\_priority\_search}$ where $T_{higher\_priority\_search}$ is described in section 4.2.2. *Editors note: The measurement of cells that are detected in this search is still to be described.*

If the RSRP of the E-UTRA serving cell is less than or equal to $Thresh_{serving\_high,x}$ then the UE shall search for and measure inter-frequency layers of higher, equal or lower priority in preparation for possible reselection. In this scenario, the minimum rate at which the UE is required to search for and measure such layers is not reduced.

The UE shall be able to evaluate the need for reselection to a newly detectable inter-frequency cell within $K_{carrier}$ * $T_{detect,EUTRAN\_Inter}$ if at least carrier frequency information is provided for inter-frequency neighbour cells by the serving cells assuming that $T_{reselection}$ = 0. The parameter $K_{carrier}$ is the number of E-UTRA inter-frequency carriers indicated by the serving cell. It shall be possible to evaluate the need for reselection to cells which have:

- RSRP $\geq$ -TBD dBm and Ior/($\hat{I}_{interfering\ cells}$+Ioc) $\geq$ [-3] dB,

- SCH $\hat{I}$or > -TBD dBm and SCH $\hat{I}$or/($\hat{I}$interfering cells+Ioc) > [-3] dB..The UE shall measure RSRP at least every $K_{carrier}$ * $T_{measure,EUTRAN\_Inter}$ DRX cycle (see table 4.2.2.3-1) for identified inter-frequency cells. If the UE detects on a E-UTRA carrier a cell whose physical identity is indicated as not allowed for that carrier in the measurement control system information of the serving cell, the UE is not required to perform measurements on that cell.

The UE shall filter RSRP measurements of each measured inter-frequency cell using at least [2] measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least least [$T_{measure,EUTRAN\_Inter}$/2].

The UE shall not consider a E-UTRA neighbour cell in cell reselection, if it is indicated as not allowed in the measurement control system information of the serving cell.

The filtering shall be such that the UE shall be capable of evaluating that the inter-frequency cell has met reselection criterion defined TS 36.304 within $T_{evaluateFDD,Inter}$ as specified in table 4.2.2.4-1.

Table 4.2.2.4-1 : $T_{detect,EUTRAN\_Inter}$, $T_{detect,EUTRAN\_Inter}$ and $T_{evaluateFDD,Inter}$

DRX cycle length [s]	$T_{detect,EUTRAN\_Inter}$ [s] (number of DRX cycles)	$T_{measure,EUTRAN\_Inter}$ [s] (number of DRX cycles)	$T_{evaluateFDD,Inter}$ [s] (number of DRX cycles)
0.32	[11.52 (36)]	[1.28 (4)]	[5.12 (16)]
0.64	[17.92 (28)]	[1.28 (2)]	[5.12 (8)]
1.28	[32(25)]	[1.28 (1)]	[6.4 (5)]
2.56	[55.88 (23)]	[2.56 (1)]	[7.68 (3)]

4.2.2.5 Measurements of inter-RAT cells

[Editor"s note: The RAN2 measurement rules for when inter frequency or inter RAT measurements are still to be clarified . It is assumed that the following parameter is defined : $Thresh_{serving\_high}$: Threshold for the LTE serving cell when the UE initiates measurements, or increases the measurement rate (in the case of high to low priority reselection) on a different E-UTRA frequency layer, or RAT. This section should be reviewed and updated once more detailed measurement rules are defined by RAN2.]

If the RSRP of the E-UTRA serving cell (or other cells on the same frequency layer) is greater than $Thresh_{serving\_high}$ then

- the UE may not search for, or measure inter-RAT layers of equal or lower priority.

- the UE shall search for inter-RAT layers of higher priority at least every $T_{higher\_priority\_search}$ where $T_{higher\_priority\_search}$ is described in section 4.2.2. *Editors note: The measurement of cells that are detected in this search is still to be described.*

If the RSRP of the E-UTRA serving cell is less than or equal to $Thresh_{serving\_high,x}$ then the UE shall search for and measure inter-RAT layers of higher, equal or lower priority in preparation for possible reselection. In this scenario, the minimum rate at which the UE is required to search for and measure such layers is not reduced.

4.2.2.5.1 Measurements of UTRAN FDD cells

When the measurement rules indicate that UTRA FDD cells are to be measured, the UE shall measure CPICH Ec/Io and CPICH RSCP of detected UTRA FDD cells in the neighbour cell list at the minimum measurement rate specified in this section. The parameter $N_{UTRA\_carrier}$ is the number of carriers used for all UTRA FDD cells in the neighbour cell list. The UE shall filter CPICH Ec/Io and CPICH RSCP measurements of each measured UTRA FDD cell using at least [2] measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least half the minimum specified measurement period.

The UE shall evaluate the need for reselection to newly detectable cells within time ($N_{UTRA\_carrier}$) * $T_{detectUTRA\_FDD}$ except when UTRA FDD is of higher priority than the currently selected E-UTRAN frequency layer and the RSRP of the E-UTRA serving cell (or other cells on the same frequency layer) is greater than $Thresh_{serving\_high}$ assuming that $T_{reselection}$ = 0. *Note:The applicable propagation conditions and signal levels for which a newly detectable cell is required to be identified within $N_{utra\_carrier}$ *$T_{detectUTRA\_FDD}$ is still to be defined*

Cells which have been detected shall be measured at least every ($N_{UTRA\_carrier}$) * $T_{measureUTRA\_FDD}$ except when UTRA FDD is of or higher priority than the currently selected E-UTRAN frequency layer and the RSRP of the E-UTRA serving cell (or other cells on the same frequency layer) is greater than $Thresh_{serving\_high,UTRAN\_FDD}$. In this case, the minimum measurement rate is FFS.

The filtering shall be such that the UE shall be capable of evaluating that the inter-frequency cell has met reselection criterion defined TS 36.304 within $T_{evaluateUTRA\_FDD}$ as speficied in table 4.2.2.5-1.

Table 4.2.2.5.1-1 gives values of $T_{detectUTRA\_FDD}$, $T_{measureUTRA\_FDD}$ and and $T_{evaluateUTRA\_FDD}$

Table 4.2.2.5.1-1: $T_{detectUTRA\_FDD}$, $T_{measureUTRA\_FDD}$, and $T_{evaluateUTRA\_FDD}$

DRX cycle length [s]	$T_{detectUTRA\_FDD}$ [s] (number of DRX cycles)	$T_{measureUTRA\_FDD}$ [s] (number of DRX cycles)	$T_{evaluateUTRA\_FDD}$ [s] (number of DRX cycles)
0.32	[TBD]	[5.12 (16)]	[TBD]
0.64	[TBD]	[5.12 (8)]	[TBD]
1.28	[TBD]	[6.4(5)]	[TBD]
2.56	[TBD]	[7.68 (3)]	[TBD]

4.2.2.5.2 Measurements of UTRAN TDD cells

[Editor"s note: The text in this section is applicable when the UE is given a UTRA neighbour cell list which contains cell specific scrambling codes and tx diversity status. The appropriate requirements when only a UTRA carrier frequency is given are still to be added in this section.]

When the measurement rules indicate that UTRA TDD cells are to be measured, the UE shall measure P-CCPCH RSCP of detected UTRA TDD cells in the neighbour cell list at the minimum measurement rate specified in this section. The parameter $N_{UTRA\_carrier\_TDD}$ is the number of carriers used for all UTRA TDD cells in the neighbour cell list. The UE shall filter P-CCPCH RSCP measurements of each measured UTRA TDD cell using at least [2] measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least half the minimum specified measurement period. . P-CCPCH RSCP of UTRAN TDD cells shall not be filtered over a longer period than that specified in table 4.2.2.5.2-1.

The UE shall start to measure newly detectable cells within time ($N_{UTRA\_carrier\_TDD}$) * $T_{detectUTRA\_TDD}$ except when UTRA TDD is of equal to, or higher priority than the currently selected E-UTRAN frequency layer and the RSRP of the E-UTRA serving cell (or other cells on the same frequency layer) is greater than $Thresh_{serving\_high}$. . *Note:The applicable propagation conditions and signal levels for which a newly detectable cell is required to be identified within $N_{utra\_carrie\_TDDr}$ *$T_{detectUTRA\_TDD}$ is still to be defined.* Cells which have been detected shall be measured at least every ($N_{UTRA\_carrier\_TDD}$) * $T_{measureUTRA\_TDD}$ except when UTRA TDD is of equal to, or higher priority than the currently selected E-UTRAN frequency layer and the RSRP of the E-UTRA serving cell (or other cells on the same frequency layer) is greater than $Thresh_{serving\_high,UTRAN\_TDD}$. In this case, the minimum measurement rate is FFS.

The filtering shall be such that the UE shall be capable of evaluating that the UTRA TDD cell has met reselection criterion defined TS 36.304 within $T_{evaluateUTRA\_TDD}$ as specified in table 4.2.2.5.2-1.

Table 4.2.2.5.2-1 gives values of $T_{detectUTRA\_TDD}$, $T_{measureUTRA\_TDD}$ and $T_{evaluateUTRA\_TDD}$

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Table 4.2.2.5.2-1: $T_{detectUTRA\_TDD}$, $T_{measureUTRA\_TDD}$ and $T_{evaluateUTRA\_TDD}$

DRX cycle length [s]	$T_{detectUTRA\_TDD}$ [s] (number of DRX cycles)	$T_{measureUTRA\_TDD}$ [s] (number of DRX cycles)	$T_{evaluateUTRA\_TDD}$
0.32	[TBD]	[TBD]	TBD
0.64	[TBD]	[TBD]	TBD
1.28	[TBD]	[TBD]	TBD
2.56	[TBD]	[TBD}	TBD

4.2.2.5.3 Measurements of GSM cells

If the RSRP of the E-UTRA serving cell is greater than $Thresh_{serving\_high,GSM}$ then

- the UE may not search for, or measure GSM cells if the priority of GSM is lower than the serving cell.
- the UE shall search for and measure GSM cells if the priority of GSM is higher than the serving cell. The minimum rate at which the UE is required to search for and measure such layers may be reduced in this scenario to maintain UE battery life. Details are still FFS.

If the RSRP of the E-UTRA serving cell is less than or equal to $Thresh_{serving\_high,x}$ then the UE shall measure, according to the measurement rules defined in [1], at least every $T_{measure,GSM}$ (see table 4.2.2.5.3-1):

- if a detailed neighbour cell list is provided, the signal level of the GSM BCCH carrier of each GSM neighbour cell indicated in the measurement control system information of the serving cell; or
- if only BCCH carriers are provided, the signal level of the GSM BCCH carriers indicated in the measurement control system information of the serving cell.

Note : If it is concluded that only blacklist, or only whitelist can be used for reselection to GSM then one of these bullets can be deleted.

The UE shall maintain a running average of 4 measurements for each GSM BCCH carrier. The measurement samples for each cell shall be as far as possible uniformly distributed over the averaging period.

If GSM measurements are required by the measurement rules in [1], the UE shall attempt to verify the BSIC at least every 30 seconds for each of the 4 strongest GSM BCCH carriers. If a change of BSIC is detected for one GSM cell then that GSM BCCH carrier shall be treated as a new GSM neighbour cell. If the UE detects on a BCCH carrier a BSIC which is indicated as not allowed for that carrier in the measurement control system information of the serving cell, the UE is not required to perform BSIC re-confirmation for that cell.

The UE shall not consider the GSM BCCH carrier in cell reselection, if the UE cannot demodulate the BSIC of that GSM BCCH carrier. Additionally, the UE shall not consider a GSM neighbour cell in cell reselection, if it is indicated as not allowed in the measurement control system information of the serving cell.

Table 4.2.2.5.3-1: $T_{detect,GSM}$, $T_{measure,GSM}$,

DRX cycle length [s]	$T_{detect,GSM}$ [s] (number of DRX cycles)	$T_{measure,GSM}$ [s] (number of DRX cycles)
0.32	[TBD]	[5.12 (16)]
0.64	[TBD]	[5.12 (8)]
1.28	[TBD]	[6.4(5)]
2.56	[TBD]	[7.68 (3)]

4.2.2.5.4 Measurements of HRPD cells

In order to perform measurement and cell reselection to HRPD cell, the UE shall acquire the timing of HRPD cells.

When the measurement rules indicate that HRPD cells are to be measured, the UE shall measure CDMA2000 HRPD Pilot Strength of HRPD cells in the neighbour cell list at the minimum measurement rate specified in this section.

The parameter "Number of HRPD Neighbor Frequency", which is transmitted on E-UTRAN BCCH, is the number of carriers used for all HRPD cells in the neighbour cell list.

When the RSRP of the E-UTRA serving cell (or other cells on the same frequency layer) is lower than "HRPD Start Measuring E-UTRAN Rx Power Strength Threshold" and HRPD is of lower priority than the currently selected E-UTRAN frequency layer, the UE shall measure CDMA2000 HRPD Pilot Strength of the HRPD cells at least every (Number of HRPD Neighbor Frequency)*$T_{measureHRPD}$. In case HRPD is of higher priority than the currently selected E-UTRAN frequency layer the UE shall measure HRPD cells at least every (Number of HRPD Neighbor Frequency)*$T_{higher\_priority\_measure}$. The parameter $T_{higher\_priority\_measure}$ is FFS.

The UE shall be capable of evaluating that the HRPD cell has met cell reselection criterion defined in TS 36.304 within $T_{evaluateHRPD}$.

Table 4.2.2.5.4-1 gives values of $T_{measureHRPD}$ and $T_{evaluateHRPD.}$

Table 4.2.2.5.4-1: $T_{measureHRPD}$ and $T_{evaluateHRPD}$

DRX cycle length [s]	$T_{measureHRPD}$ [s] (number of DRX cycles)	$T_{evaluateHRPD}$ [s] (number of DRX cycles)
0.32	[TBD]	[TBD]
0.64	[TBD]	[TBD]
1.28	[TBD]	[TBD]
2.56	[TBD]	[TBD]

4.2.2.5.5 Measurements of cdma2000 1X

In order to perform measurement and cell reselection to cdma2000 1X cell, the UE shall acquire the timing of cdma2000 1X cells.

When the measurement rules indicate that cdma2000 1X cells are to be measured, the UE shall measure cdma2000 1x RTT Pilot Strength of cdma2000 1X cells in the neighbour cell list at the minimum measurement rate specified in this section.

The parameter "Number of CDMA2000 1X Neighbor Frequency", which is transmitted on E-UTRAN BCCH, is the number of carriers used for all cdma2000 1X cells in the neighbour cell list.

When the RSRP of the E-UTRA serving cell (or other cells on the same frequency layer) is lower than "CDMA2000 1X Start Measuring E-UTRAN Rx Power Strength Threshold" and cdma2000 1X is of lower priority than the currently selected E-UTRAN frequency layer, the UE shall measure Pilot Ec/Io of the CDMA2000 1X cells at least every (Number of CDMA2000 1X Neighbor Frequency)*$T_{measureCDMA2000\ 1X}$. In case cdma2000 1X is of higher priority than the currently selected E-UTRAN frequency layer, the UE shall measure cdma2000 1X cells at least every (Number of CDMA2000 1X Neighbor Frequency)*$T_{higher\_priority\_measure}$. The parameter $T_{higher\_priority\_measure}$ is FFS.

The UE shall be capable of evaluating that the cdma2000 1X cell has met cell reselection criterion defined in TS 36.304 within $T_{evaluateCDMA2000\ 1X}$.

Table 4.2.2.5.5-1 gives values of $T_{measureCDMA2000\ 1X}$ and $T_{evaluateCDMA2000\ 1X.}$

Table 4.2.2.5.5-1: $T_{measureCDMA2000\ 1X}$ and $T_{evaluateCDMA2000\ 1X}$

DRX cycle length [s]	$T_{measureCDMA2000\ 1X}$ [s] (number of DRX cycles)	$T_{evaluateCDMA2000\ 1X}$ [s] (number of DRX cycles)
0.32	[TBD]	[TBD]
0.64	[TBD]	[TBD]
1.28	[TBD]	[TBD]
2.56	[TBD]	[TBD]

4.2.2.6 Evaluation of cell re-selection criteria

The UE shall evaluate the intra-frequency, inter-frequency, UTRA and GERAN cell reselection criteria defined in [TS36.304] at least every DRX cycle.

4.2.2.7 Maximum interruption in paging reception

UE shall perform the cell re-selection with minimum interruption in monitoring downlink channels for paging reception.

At intra-frequency and inter-frequency cell re-selection, the UE shall monitor the downlink of serving cell for paging reception until the UE is capable to start monitoring downlink channels of the target intra-frequency cell for paging reception. The interruption time shall not exceed $T_{SI\text{-}EUTRA}$ + 50 ms.

At inter-RAT cell re-selection, the UE shall monitor the downlink of serving cell for paging reception until the UE is capable to start monitoring downlink channels for paging reception of the target inter-frequency cell. For E-UTRAN to UTRA cell re-selection the interruption time must not exceed $T_{SI\text{-}EUTRA}$ + 50 ms. For E-UTRAN to GSM cell re-selection the interruption time must not exceed T_{BCCH} + 50 ms.

T_{SI} is the time required for receiving all the relevant system information data according to the reception procedure and the RRC procedure delay of system information blocks defined in 3GPP TS 36.331 E-UTRAN cell and in 3GPP TS 25.331 for a UTRAN cell.

T_{BCCH} is the maximum time allowed to read BCCH data from a GSM cell defined in 3GPP TS 45.008.

These requirements assume sufficient radio conditions, so that decoding of system information can be made without errors and does not take into account cell re-selection failure.

At cell re-selection to HRPD, the UE shall monitor the downlink of serving cell for paging reception until the UE is capable of starting to monitor downlink channels for paging reception of the target HRPD cell. For HRPD cell re-selection the interruption time must not exceed $T_{SI\text{-}HRPD}$ + [50] ms.

$T_{SI\text{-}HRPD}$ is the time required for receiving all the relevant system information data according to the reception procedure and the upper layer (Layer 3) procedure delay of system information blocks defined in 3GPP2 C.S0005-A in section [xxx] for HRPD cell.

At cell re-selection to cdma2000 1X, the UE shall monitor the downlink of serving cell for paging reception until the UE is capable of starting to monitor downlink channels for paging reception of the target cdma2000 1X cell. For cdma2000 1X cell re-selection the interruption time must not exceed $T_{SI\text{-}cdma2000\ 1X}$ + [50] ms.

$T_{SI\text{-}cdma2000\ 1X}$ is the time required for receiving all the relevant system information data according to the reception procedure and the upper layer (Layer 3) procedure delay of system information blocks defined in 3GPP2 C.S0005-A in section [xxx] for cdma2000 1X cell.

4.2.2.8 void

5 E-UTRAN RRC_CONNECTED state mobility

5.1 E-UTRAN Handover

5.1.1 Introduction

5.1.2 Requirements

5.1.2.1 E-UTRAN FDD – FDD

The requirements in this section are applicable to both intra-frequency and inter-frequency handovers.

5.1.2.1.1 Handover delay

Procedure delays for all procedures that can command a handover are specified in TS36.331.

When the UE receives a RRC message implying handover with the activation time "now" or earlier than RRC procedure delay seconds from the end of the last TTI containing the RRC command, the UE shall be ready to start the transmission of the new uplink TBD channel within $D_{handover}$ seconds from the end of the last TTI containing the RRC command.

If the access is delayed to an indicated activation time later than RRC procedure delay seconds from the end of the last TTI containing the RRC command, the UE shall be ready to start the transmission of the new uplink TBD channel at the designated activation time + interruption time.

where:

$D_{handover}$ equals the RRC procedure delay to be defined in [TS36.331] plus the interruption time stated in section 5.1.2.1.2.

[Editor"s note : UL Channel used in handover execution is likely to have implications on handover delay]

5.1.2.1.2 Interruption time

The interruption time is the time between end of the last TTI in which the UE has received the handover command within DL PDCCH and the time the UE shall be ready to start a PRACH transmission of the new uplink. T

When intra-frequency or inter-frequency handover is commanded, the interruption time shall be less than $T_{interrupt1}$

$$T_{interrupt} = T_{search} + T_{IU} + T_{SI} + T_{sync} + 20 \text{ ms}$$

where

T_{search} is the time required to search the target cell when the target cell is not already known when the handover command is received by the UE. If the target cell is known, then T_{search} = 0 ms. Regardless of whether DRX is in use by the UE, T_{search} shall still be based on non-DRX target cell search times.

[Editor"s note: If blind handover is not needed then T_{search} shall be removed.]

T_{IU} is the interruption uncertainty when changing the timing from the old to the new cell. T_{IU} can be up to TBD.

T_{SI} is the time required for receiving all the relevant system information data needed for handover execution according to the reception procedure and the RRC procedure delay of system information blocks defined in

[TS36.331] for an E-UTRAN cell. This includes both MIB/PBCH and system information scheduled on the PDSCH.

[Editor"s note: It is expected that T_{SI} = 0. When this is confirmed then T_{SI} shall be removed.]

T_{sync} is TBD, relates to synchronisation procedure in TS 36.213.

[Editor"s note: The synchronisation procedures are not yet defined in TS 36.213 and possibly in TS 36.101.*When that is defined* T_{sync} *will be defined]*

[Editor"s note: [TBD] is an allowance for UE processing time.]

In the interruption requirement a cell is known if any of the conditions below has been met:

- the cell has been meeting the relevant cell identification requirement during the last [5] seconds. Relevant cell identification requirements are described in Section 8.1.2.2.1 for intra-frequency handover and Section 8.1.2.3.1 for inter-frequency handover.

5.2.2.2 E-UTRAN FDD – TDD

5.2.2.2.1 Handover delay

5.2.2.2.2 Interruption time

5.2.2.3 E-UTRAN TDD – FDD

5.2.2.3.1 Handover delay

5.2.2.3.2 Interruption time

5.2.2.4 E-UTRAN TDD – TDD

The requirements in this section are applicable to both intra-frequency and inter-frequency handovers.

5.2.2.4.1 Handover delay

Procedure delays for all procedures that can command a handover are specified in TS36.331.

When the UE receives a RRC message implying handover with the activation time "now" or earlier than RRC procedure delay seconds from the end of the last TTI containing the RRC command, the UE shall be ready to start the transmission of the new uplink TBD channel within $D_{handover}$ seconds from the end of the last TTI containing the RRC command.

If the access is delayed to an indicated activation time later than RRC procedure delay seconds from the end of the last TTI containing the RRC command, the UE shall be ready to start the transmission of the new uplink TBD channel at the designated activation time + interruption time.

where:

$D_{handover}$ equals the RRC procedure delay to be defined in [TS36.331] plus the interruption time stated in section 5.1.2.4.2.

[Editor"s note: UL Channel used in handover execution is likely to have implications on handover delay]

5.2.2.4.2 Interruption time

The interruption time is the time between end of the last TTI in which the UE has received the handover command within DL PDCCH and the time the UE shall be ready to start a PRACH transmission of the new uplink.

When intra-frequency or inter-frequency handover is commanded, the interruption time shall be less than $T_{interrupt1}$

$$T_{interrupt} = T_{search} + T_{IU} + T_{SI} + T_{sync} + [TBD] \text{ ms}$$

where

T_{search} is the time required to search the target cell when the target cell is not already known when the handover command is received by the UE. If the target cell is known, then T_{search} = 0 ms.

[Editor"s note: If blind handover is not needed then T_{search} shall be removed.]

T_{IU} is the interruption uncertainty when changing the timing from the old to the new cell. T_{IU} can be up to TBD.

T_{SI} is the time required for receiving all the relevant system information data needed for handover execution according to the reception procedure and the RRC procedure delay of system information blocks defined in [TS36.331] for an E-UTRAN cell. This includes both MIB/PBCH and system information scheduled on the PDSCH.

[Editor"s note: It is expected that T_{SI} = 0. When this is confirmed then T_{SI} shall be removed.]

T_{sync} is TBD, relates to synchronisation procedure in TS 36.213.

[Editor"s note: [TBD] is an allowance for UE processing time.]

In the interruption requirement a cell is known if any of the conditions below has been met:

- the cell has been meeting the relevant cell identification requirement during the last [5] seconds. Relevant cell identification requirements are described in Section 8.1.2.2.2 for intra-frequency handover and Section 8.1.2.3.4 for inter-frequency handover.

5.3 Handover to other RATs

5.3.1 E-UTRAN - UTRAN FDD Handover

5.3.1.1 Introduction

Editor"s note: The hard handover procedure is assumed to be initiated by E-UTRAN by sending a MOBILITY FROM E-UTRA RRC command.

5.3.1.1.1 Handover delay

Procedure delay is specified in [TS36.331], section [TBD].

When the UE receives a RRC message implying handover to UTRAN with the activation time "now" or earlier than RRC procedure delay seconds from the end of the last E-UTRAN TTI containing the RRC command, the UE shall be ready to start the transmission of the new UTRA uplink DPCCH within $D_{handover}$ seconds from the end of the last E-UTRAN TTI containing the RRC MOBILITY FROM E-UTRA command.

[Editor"s note: An accurate definition for the concept of "activation time" is still needed]

If the access is delayed to an indicated activation time later than E-UTRAN RRC procedure delay seconds from the end of the last TTI containing the E-UTRAN RRC command, the UE shall be ready to start the transmission of the new uplink DPCCH at the designated activation time + interruption time.

where:

- $D_{handover}$ equals the RRC procedure delay defined in TS36.331 Section [TBD] plus the interruption time stated in section 5.3.1.1.2.

5.3.1.1.2 Interruption time

The interruption time, i.e. the time between the last TTI containing a transport block on the E-UTRAN PDSCCH and the time the UE starts transmission of the new uplink DPCCH depends on whether the target cell is known for the UE or not. The UE shall always perform a UTRA synchronisation procedure as part of the handover procedure.

If the target cell has been measured by the UE during the last 5 seconds the interruption time shall be less than $T_{interrupt1}$

$$T_{interrupt1} = T_{IU}+T_{sync}+[50]+ 10*F_{max} \text{ ms}$$

If the target cell has not been measured by the UE during the last 5 seconds, the interruption time shall be less than $T_{interrupt2}$

$$T_{interrupt2} = T_{IU}+T_{sync}+[150] + 10*F_{max} \text{ ms}$$

This requirement shall be met, provided that there is one target cell in the MOBILITY FROM E-UTRA command. Performance requirements for E-UTRA to UTRA soft handover are not specified. When UE is connected to an E-UTRA cell, UTRA SFN timing measurements are not reported. This implies that the timing of the DPCH of the UTRA target cells in the active set cannot be configured by UTRAN to guarantee that all target cells fall within the UE reception window of T_0 +/- 148 chip.

where

T_{IU} is the interruption uncertainty when changing the timing from the E-UTRAN to the new UTRAN cell. T_{IU} can be up to one UTRA frame (10 ms).

F_{max} denotes the maximum number of radio frames within the transmission time intervals of all transport channels that are multiplexed into the same CCTrCH on the UTRA target cell.

T_{sync} is the time required for measuring the downlink DPCCH channel as stated in TS 25.214 section 4.3.1.2. In case higher layers indicate the usage of a post-verification period T_{sync}=0 ms. Otherwise T_{sync}=40 ms.

The phase reference is the primary CPICH.

The requirements in this section assume that N312 has the smallest possible value i.e. only one insync is required.

5.3.2 E-UTRAN - UTRAN TDD Handover

5.3.2.1 Introduction

The purpose of inter-RAT handover from E-UTRAN to UTRAN TDD is to change the radio access mode from E-UTRAN to UTRAN TDD. The handover procedure is initiated from E-UTRAN with a RRC message that implies a hard handover as described in [TS 36.331].

5.3.2.2 Requirements

The requirements in this section shall apply to UE supporting E-UTRAN and UTRAN TDD.

5.3.2.2.1 Handover delay

RRC procedure performance values for all RRC procedures that can command a hard handover are specified in [TS 36.331].

When the UE receives a RRC message implying E-UTRAN/UTRAN TDD handover with the activation time "now" or earlier than RRC procedure delay seconds from the end of the last TTI containing the RRC command, the UE shall be

ready to start the transmission of the new uplink DPCH or the SYNC-UL within $D_{handover}$ seconds from the end of the last TTI containing the RRC command.

If the access is delayed to an indicated activation time later than RRC procedure delay seconds from the end of the last TTI containing the RRC command, the UE shall be ready to start the transmission of the new uplink DPCH at the designated activation time + interruption time.

Where:

- $D_{handover}$ equals the RRC procedure performance value as defined in [TS 36.331] plus the interruption time stated in section 5.3.2.2.

5.3.2.2.2 Interruption time

The interruption time, i.e. the time between the end of the last TTI containing a transport block on the old DPDCH and the time the UE starts transmission of the new uplink DPCH or the SYNC-UL, is dependent on whether the target cell is known for the UE or not.

If E-UTRAN/UTRAN TDD handover is commanded, the interruption time shall be less than,

$$T_{interrupt} = T_{offset} + T_{UL} + 30*F_{SFN} + 20*KC + 180*UC + 10*F_{max} \text{ ms}$$

Where:

T_{offset}	Equal to 10 ms, the frame timing uncertainty between the old cell and the target cell and the time that can elapse until the appearance of a Beacon channel
T_{UL}	Equal to 10 ms, the time that can elapse until the appearance of the UL timeslot in the target cell
F_{SFN}	Equal to 1 if SFN decoding is required and equal to 0 otherwise
KC	Equal to 1 if a known target cell is indicated in the RRC message implying E-UTRAN/UTRAN TDD handover and equal to 0 otherwise
UC	Equal to 1 if an unknown target cell is indicated in the RRC message implying E-UTRAN/UTRAN TDD handover and equal to 0 otherwise
F_{max}	denotes the maximum number of radio frames within the transmission time intervals of all transport channels that are multiplexed into the same CCTrCH.

An UTRAN TDD target cell shall be considered known by the UE, if the target cell has been measured by the UE during the last 5 seconds.

The interruption time requirements for an unknown target cell shall apply only if the signal quality of the unknown target cell is sufficient for successful synchronisation with one attempt.

5.3.3 E-UTRAN - GSM Handover

5.3.3.1 Introduction

The purpose of inter-RAT handover from E-UTRAN to GSM is to transfer a connection between the UE and E-UTRAN to GSM. The handover procedure is initiated from E-UTRAN with a RRC message (MOBILITY FROM E-UTRA). The procedure is described in 3GPP TS 36.331.

5.3.3.2 Requirements

The requirements in this section shall apply to UE supporting E-UTRAN and GSM.

The requirements given below in Tables 5.3.3.2.1-1 and 5.3.3.2.2-1 for the case where the UE has not synchronised to the GSM cell before receiving the RRC MOBILITY FROM E-UTRA command are valid when the signal quality of the GSM cell is sufficient for successful synchronisation with one attempt. If the UE is unable to synchronise to the GSM cell on the first attempt, it shall continue to search for synchronisation information for up to 800 ms duration. If after

800 ms the UE has not synchronised to the GSM cell it shall follow the handover failure procedure specified in 3GPP TS 36.331.

5.3.3.2.1 Handover delay

When the UE receives a RRC MOBILITY FROM E-UTRA command with the activation time "now" or earlier than RRC procedure delay (see below) from the end of the last TTI containing the RRC command, the UE shall be ready to transmit (as specified in 3GPP TS 45.010) on the channel of the new RAT within the value in table 5.3.3.2.1-1 from the end of the last TTI containing the RRC command.

If the access is delayed to an indicated activation time later than RRC procedure delay from the end of the last TTI containing the RRC command, the UE shall be ready to transmit (as specified in 3GPP TS 45.010) on the channel of the new RAT at the designated activation time + interruption time.

The UE shall process the RRC procedures for the MOBILITY FROM E-UTRA command within 50 ms, which is noted as RRC procedure delay. If the activation time is used, it corresponds to the CFN of the E-UTRAN channel.

Table 5.3.3.2.1-1: E-UTRAN/GSM handover - handover delay

UE synchronisation status	handover delay [ms]
The UE has synchronised to the GSM cell before the TBD COMMAND is received	90
The UE has not synchronised to the GSM cell before the TBD COMMAND is received	190

5.3.3.2.2 Interruption time

The interruption time, i.e. the time between the end of the last TTI containing a transport block on the old channel and the time the UE is ready to transmit on the new channel, shall be less than the value in table 5.3.3.2.2-1.

Table 5.3.3.2.2-1: E-UTRAN/GSM handover - interruption time

Synchronisation status	Interruption time [ms]
The UE has synchronised to the GSM cell before the TBD COMMAND is received	40
The UE has not synchronised to the GSM cell before the TBD COMMAND is received	140

5.4 Handover to Non-3GPP RATs

5.4.1 E-UTRAN – HRPD Handover

5.4.1.1 Introduction

The handover procedure from E-UTRAN to HRPD is initiated when E-UTRAN sends handover command to the UE through dedicated RRC signalling.

5.4.1.1.1 Handover delay

The handover delay ($D_{handover}$) is defined as the sum of the RRC procedure delay, which is defined in TS 36.331 in section [TBD] and the interruption time specified in section 5.4.1.1.2.

When the UE receives a RRC message implying handover to HRPD, the UE shall be ready to start the transmission of the new reverse control channel in HRPD within $D_{handover}$ from the end of the last E-UTRAN TTI containing the RRC command.

5.4.1.1.2 Interruption time

The interruption time, i.e. the time between the last TTI containing a transport block on the E-UTRAN PDSCH and the time the UE starts transmission of the reverse control channel in HRPD depends on whether the target cell is known to the UE or not.

An HRPD cell is known if it has been measured by the UE during the last [5] seconds otherwise it is unknown. The interruption time shall be less than $T_{interrupt}$

$$T_{interrupt} = T_{IU} + [TBD]*KC+[TBD]*OC \text{ ms}$$

Where:

T_{IU} It is the interruption uncertainty when changing the timing from the E-UTRAN to the new HRPD cell. T_{IU} can be up to one HRPD frame (26.66 ms).

KC It is the number of known target HRPD cells in the message, and

OC It is the number of unknown target HRPD cells in the message.

Note: An additional delay in the interruption time may occur due to the silence time, which is specific to HRPD.

5.4.2 E-UTRAN – cdma2000 1X Handover

5.4.2.1 Introduction

The handover procedure from E-UTRAN to cdma2000 1X is initiated when E-UTRAN sends handover command to the UE through dedicated RRC signalling.

5.4.2.1.1 Handover delay

The handover delay ($D_{handover}$) is defined as the sum of the RRC procedure delay, which is defined in TS 36.331 in section [TBD] and the interruption time specified in section 5.4.2.1.2.

When the UE receives a RRC message implying handover to cdma2000 1X, the UE shall be ready to start the transmission of the new reverse control channel in cdma2000 1X within $D_{handover}$ from the end of the last E-UTRAN TTI containing the RRC command.

5.4.2.1.2 Interruption time

The interruption time, i.e. the time between the last TTI containing a transport block on the E-UTRAN PDSCH and the time the UE starts transmission of the reverse control channel in cdma2000 1X depends on whether the target cell is known to the UE or not.

A cdma2000 1X cell is known if it has been measured by the UE during the last [5] seconds otherwise it is unknown. In this case the interruption time shall be less than $T_{interrupt}$:

$$T_{interrupt} = T_{IU} + [TBD]*KC+[TBD]*OC \text{ ms}$$

Where:

T_{IU} It is the interruption uncertainty when changing the timing from the E-UTRAN to the new cdma2000 1X cell. T_{IU} can be up to one cdma2000 1X frame (20 ms).

KC It is the number of known target cdma2000 1X cells in the message, and

OC It is the number of unknown target cdma2000 1X cells in the message.

6 RRC Connection Mobility Control

6.1 RRC Re-establishment

6.2 Random Access

7 Timing and signalling characteristics

7.1 UE transmit timing

7.1.1 Introduction

The UE shall have capability to follow the frame timing change of the connected eNode B. The uplink frame transmission takes place approximately $N_{TA}*T_S$ seconds before the reception of [the first detected path (in time)]of the corresponding downlink frame from the reference cell as specified in [36.211]. N_{TA} is signalled by higher layers. UE initial transmit timing accuracy, maximum amount of timing change in one adjustment, minimum and maximum adjustment rate are defined in the following requirements.

7.1.2 Requirements

The UE initial transmission timing error shall be less than or equal to [$\pm 12*T_S$] seconds. This requirement applies at the first transmission on the uplink. The reference point for the UE initial transmit timing control requirement shall be the time when [the first detected path (in time)] of the corresponding downlink frame is received from the reference cell minus $N_{TA}*T$s seconds. N_{TA} is signalled by higher layers.

The UE shall be capable of changing the transmission timing according to the received downlink frame. When the transmission timing error between the UE and the reference cell exceeds [$\pm 12*T_S$] seconds the UE is required to adjust its timing to within [$\pm 12*T_S$] seconds.

All adjustments made to the UE timing shall follow these rules:

1) The maximum amount of the timing change in one adjustment shall be [$2*T_S$] seconds.

2) The minimum adjustment rate shall be [$7*T_S$] seconds per second.

3) The maximum adjustment rate shall be [$2*T_S$] seconds per [200ms].

Taking into account the timing change in one adjustment can be less than [2*Ts] seconds and considering [800*d] ms period, the UE transmit timing shall not change in excess of [$\pm 8*d*T_S$] seconds from the timing at the beginning of this [800*d] ms period, where [$0 \leq d \leq 1/4$].

7.2 UE timer accuracy

7.2.1 Introduction

UE timers are used in different protocol entities to control the UE behaviour.

7.2.2 Requirements

For UE timers T3xx, [TBD], UE shall comply with the timer accuracies according to Table 7.1.

The requirements are only related to the actual timing measurements internally in the UE. They do not include the following:

- Inaccuracy in the start and stop conditions of a timer (e.g. UE reaction time to detect that start and stop conditions of a timer is fulfilled), or
- Inaccuracies due to restrictions in observability of start and stop conditions of a UE timer (e.g. TTI alignment when UE sends messages at timer expiry).

Table 7.1

Timer value [s]	Accuracy
timer value < [4]	± [0.1s]
timer value ≥ [4]	± [2.5%]

8 UE Measurements Procedures in RRC_CONNECTED State

8.1 General Measurement Requirements

8.1.1 Introduction

This section contains requirements on the UE regarding measurement reporting in RRC_CONNECTED state. The requirements are split in E-UTRA intra frequency, E-UTRA inter frequency, Inter-RAT UTRA FDD, UTRA TDD and GSM measurements. These measurements may be used by the E-UTRAN, e.g. for handover decisions. The measurement quantities are defined in TS 36.214, the measurement model is defined in TBD and measurement accuracies are specified in section 9. Control of measurement reporting is specified in TS 36.331.

8.1.2 Requirements

8.1.2.1 UE measurement capability

If the UE requires transmission gaps to identify and measure inter-frequency and/or inter-RAT cells, in order for the requirements in the following subsections to apply the E-UTRAN must provide a single transmission gap pattern with constant gap duration for concurrent monitoring of all frequency layers and RATs.

During the monitoring gaps the UE:

- shall not transmit any data
- is not expected to tune its receiver on the E-UTRAN serving carrier frequency.

Inter-frequency and inter-RAT mesurement requirements within this section rely on the UE being configured with one monitoring gap pattern. UEs shall only support those measurement gap patterns listed in Table 8.1.2.1-1 that are relevant to its measurement capabilities.

Table 8.1.2.1-1: Gap Pattern Configurations supported by the UE

Gap Pattern Id	Transmission Gap Length (TGL, ms)	Transmission Gap **Repetition** Period (TGRP, ms)	Measurement Purpose
0	6	40	Inter-Frequency E-UTRAN FDD and TDD, UTRAN FDD, GERAN, LCR TDD, HRPD, CDMA2000 1x
1	6	120	Inter-Frequency E-UTRAN FDD and TDD, UTRAN FDD, GERAN, LCR TDD, HRPD, CDMA2000 1x
TBD	TBD	TBD	TBD

[Editor"s note: Further patterns still need to be defined in order to fulfil all required Inter-RAT monitoring purposes.]

The requirements in section 9 are applicable for a UE performing measurements according to this section.

8.1.2.2 E-UTRAN intra frequency measurements

The UE shall be able to identify new intra-frequency cells and perform RSRP measurements of identified intra-frequency cells without an explicit intra-frequency neighbour cell list containing physical layer cell identities. During the RRC_CONNECTED state the UE shall continuously measure identified intra frequency cells and additionally search for and identify new intra frequency cells.

8.1.2.2.1 E-UTRAN FDD intra frequency measurements

8.1.2.2.1.1 E-UTRAN intra frequency measurements when no DRX is used

When no DRX is in use the UE shall be able to identify a new detectable FDD intra frequency cell within

$$T_{identify\ intra} = Max\left\{[800], T_{basic\ identify\ E-UTRA\_FDD,\ intra} \cdot \frac{T_{Measurement\ Period,\ Intra}}{T_{Intra}}\right\} ms$$

where

$T_{basic\_identify\_E\text{-}UTRA\_FDD,\ intra}$ is [800] ms

A cell shall be considered detectable when

- RSRP $\geq$ -TBD dBm and Ior/($\hat{I}_{interfering\ cells}$+Ioc) $\geq$ TBD,
- SCH $\hat{I}$or $\geq$ -TBD dBm and SCH $\hat{I}$or/($\hat{I}_{interfering\ cells}$+Ioc) > [- 6] dB.

$T_{Measurement\_Period\ Intra}$ = [200] ms. The measurement period for Intra frequency RSRP measurements.

T_{Intra} : This is the minimum time that is available for intra frequency measurements, during the measurement period with an arbitrarily chosen timing. Time is assumed to be available for performing intra frequency measurements whenever the receiver is guaranteed to be active on the intra frequency carrier.

Identification of a cell shall include detection of the cell and additionally performing a single measurement with measurement period of $T_{Measurement\_Period\ Intra}$. If higher layer filtering is used, an additional cell identification delay can be expected.

In the RRC_CONNECTED state the measurement period for intra frequency measurements is [200] ms. When no measurement gaps are activated, the UE shall be capable of performing RSRP measurements for [8] identified-intra-frequency cells, and the UE physical layer shall be capable of reporting measurements to higher layers with the measurement period of [200] ms. When measurement gaps are activated the UE shall be capable of performing measurements for at least $Y_{measurement\ intra}$ cells , where $Y_{measurement\ intra}$ is defined in the following equation. If the UE has identified more than $Y_{measurement\ intra}$ cells, the UE shall perform measurements of all identified cells but the reporting rate of RSRP measurements of cells from UE physical layer to higher layers may be decreased.

$$Y_{measurement\ intra} = Floor\left\{ X_{basic\ measurement\ FDD} \cdot \frac{T_{Intra}}{T_{Measurement\ Period,\ Intra}} \right\} \text{ cells}$$

where

$X_{basic\ measurement\ FDD}$ = [8] (cells)

$T_{Measurement\_Period\ Intra}$ = [200] ms. The measurement period for Intra frequency RSRP measurements.

T_{Intra} : This is the time that is available for intra frequency measurements, during the measurement period with an arbitrarily chosen timing. Time is assumed to be available for performing intra frequency measurements whenever the receiver is guaranteed to be active on the intra frequency carrier.

$T_{basic\_identify\_FDD,\ intra}$ = [800] ms. This is the time period used in the intra frequency equation where the maximum allowed time for the UE to identify a new FDD cell is defined.

The measurement accuracy for all measured cells shall be as specified in the sub-clause 9.1.

8.1.2.2.1.2 E-UTRAN intra frequency measurements when DRX is used

When DRX is in use the UE shall be able to identify a new detectable FDD intra frequency cell within $T_{identify\_intra}$ as shown in table 8.1.2.2.1.2-1

Table 8.1.2.2.1.2-1: Requirement to identify a newly detectable FDD intrafrequency cell

DRX cycle length (s)	$T_{identify\_intra}$ (s) (DRX cycles)
≤40	0.8 (Note)
[0.08]	[3.2 (40)]
[0.16]	[3.2(20)]
[0.32]	[6.4(20)]
[0.64]	[12.8(20)]
[1.28]	[25.6 (20)]
[2.56]	[51.2 (20)]
Note: number of DRX cycle depends upon the DRX cycle in use	

A cell shall be considered detectable when

- RSRP $\geq$ -TBD dBm and Ior/($\hat{I}_{interfering\ cells}$+Ioc) $\geq$ TBD,
- SCH $\hat{I}$or $\geq$ -TBD dBm and SCH $\hat{I}$or/($\hat{I}_{interfering\ cells}$+Ioc) > [- 6] dB.

In the RRC_CONNECTED state with DRX cycles of 80ms or greater the measurement period for intra frequency measurements is $T_{measure\_intra}$ as shown in table 8.1.2.2.1.2-2. The UE shall be capable of performing RSRP measurements for [8] identified-intra-frequency cells, and the UE physical layer shall be capable of reporting measurements to higher layers with the measurement period of $T_{measure\_intra}$.

Table 8.1.2.2.1.2-2: Requirement to measure FDD intrafrequency cells

DRX cycle length (s)	$T_{measure\_intra}$ (s) (DRX cycles)
≤40	0.2 (Note)
[0.08]	0.4 (5)
[0.16]	0.8 (5)
[0.32]	1.6 (5)
[0.64]	3.2 (5)
[1.28]	6.4 (5)
[2.56]	12.8 (5)
Note: number of DRX cycle depends upon the DRX cycle in use	

The measurement accuracy for all measured cells shall be as specified in the sub-clause 9.1.

8.1.2.2.2 E-UTRAN TDD intra frequency measurements

8.1.2.2.2.1 E-UTRAN intra frequency measurements when no DRX is used

When no DRX is in use the UE shall be able to identify a new detectable TDD intra frequency cell within

$$T_{identify\ intra} = Max\left\{[800], T_{basic\ identify\ E-UTRA\_TDD,\ intra} \cdot \frac{T_{Measurement\ Period,\ Intra}}{T_{Intra}}\right\} ms$$

where

$T_{basic\_identify\_E\text{-}UTRA\_TDD,\ intra}$ is [800] ms

A cell shall be considered detectable when

- RSRP $\geq$ -TBD dBm and Ior/($\hat{I}_{interfering\ cells}$+Ioc) $\geq$ TBD,
- SCH $\hat{I}$or $\geq$ -TBD dBm and SCH $\hat{I}$or/($\hat{I}_{interfering\ cells}$+Ioc) > TBD dB.

$T_{Measurement\_Period\ Intra}$ = [200] ms. The measurement period for Intra frequency RSRP measurements.

T_{Intra} : This is the minimum time that is available for intra frequency measurements, during the measurement period with an arbitrarily chosen timing.

If higher layer filtering is used, an additional cell identification delay can be expected.

In the RRC_CONNECTED state the measurement period for intra frequency measurements is [200] ms. When no measurement gaps are activated, the UE shall be capable of performing RSRP measurements for [8] identified-intra-frequency cells, and the UE physical layer shall be capable of reporting measurements to higher layers with the measurement period of [200] ms. When measurement gaps are activated the UE shall be capable of performing measurements for at least $Y_{measurement\ intra}$ cells , where $Y_{measurement\ intra}$ is defined in the following equation. If the UE has identified more than $Y_{measurement\ intra}$ cells, the UE shall perform measurements of all identified cells but the reporting rate of RSRP measurements of cells from UE physical layer to higher layers may be decreased.

$$Y_{measurement\ intra} = Floor\left\{X_{basic\ measurement\ TDD} \cdot \frac{T_{Intra}}{T_{Measurement\ Period,\ Intra}}\right\} \text{ cells}$$

where

$X_{basic\ measurement\ TDD}$ = [8] (cells)

$T_{Measurement\_Period\ Intra}$ = [200] ms. The measurement period for Intra frequency RSRP measurements.

T_{Intra} : This is the minimum time that is available for intra frequency measurements, during the measurement period with an arbitrarily chosen timing.

$T_{basic\_identify\_TDD,\ intra}$ = [800] ms. This is the time period used in the intra frequency equation where the maximum allowed time for the UE to identify a new TDD cell is defined.

The measurement accuracy for all measured cells shall be as specified in the sub-clause 9.1.

8.1.2.2.2.2 E-UTRAN intra frequency measurements when DRX is used

8.1.2.3 E-UTRAN inter frequency measurements

The UE shall be able to identify new inter-frequency cells and perform RSRP measurements of identified inter-frequency cells if carrier frequency information is provided by the serving cell, even if no explicit neighbour list with physical layer cell identities is provided.

8.1.2.3.1 E-UTRAN FDD – FDD inter frequency measurements

When transmission gaps are scheduled the UE shall be able to identify a new FDD inter-frequency within $T_{Identify\_Inter}$ according to the following expression:

$$T_{Identify\_Inter} = T_{Basic\_Identify\_Inter} \cdot \frac{T_{Measurement\_Period\_Inter\_FDD}}{T_{Inter}} \quad \text{ms}$$

Where:

T_{Inter}: This is the minimum time that is available for inter frequency measurements during the measurement period $T_{Measurement\_Period\_Inter\_FDD}$ with an arbitrarily chosen timing. The minimum time per transmission gap is calculated by assuming 2*0.5 ms for implementation margin.

$T_{Basic\_Identify\_Inter}$ = TBD

A cell shall be considered detectable provided following conditions are fulfilled:

- RSRP $\geq$ -TBD dBm and Ior/($\hat{I}_{interfering\ cells}$+Ioc) $\geq$ TBD,
- SCH_RP $\geq$ -TBD dBm and SCH $\hat{I}$or/($\hat{I}_{interfering\ cells}$+Ioc) > TBD dB.

When transmission gaps are scheduled for FDD inter frequency measurements the UE physical layer shall be capable of reporting measurements to higher layers with measurement accuracy as specified in sub-clause 9.1.3 with measurement period given by table 8.1.2.3.1-1.

Table 8.1.2.3.1-1: RSRP measurement period and measurement bandwidth

Configuration	Physical Layer Measurement period: $T_{Measurement\_Period\_FDD\_Inter}$ [ms]	Measurement bandwidth [RB]
0	480 x N_{Freq}	6
1 (Note)	240 x N_{Freq}	50
TBD	TBD	TBD
Note: This configuration is optional		

Where:

N_{Freq}: This is the number of FDD frequencies indicated in the inter frequency measurement control information.

The UE shall be capable of performing RSRP measurements of at least 4 inter-frequency cells per FDD inter-frequency for up to 3 FDD inter-frequencies and the UE physical layer shall be capable of reporting RSRP measurements to higher layers with the measurement period defined in table 8.1.2.3.1-1.

8.1.2.3.2 E-UTRAN FDD – TDD inter frequency measurements

8.1.2.3.3 E-UTRAN TDD – FDD inter frequency measurements

8.1.2.3.4 E-UTRAN TDD – TDD inter frequency measurements

[Editor"s note :UTRA TDD neighbour cell list requirement should be added]

8.1.2.4 Inter RAT measurements

8.1.2.4.1 E-UTRAN FDD – UTRAN FDD measurements

8.1.2.4.1.1 Identification of a new UTRA FDD cell

When explicit neighbour list is provided and no DRX is used the UE shall be able to identify a new detectable cell belonging to the monitored set within

$$T_{identify,\ UTRAN\_FDD} = T_{basic\ identify\ UTRAN\_FDD} \cdot \frac{T_{measurement\_period\ UTRAN\_FDD}}{T_{UTRAN\_FDD}} \cdot N_{Freq} \quad ms$$

A cell shall be considered detectable when

- CPICH Ec/Io $\geq$ -20 dB,
- SCH_Ec/Io $\geq$ -17 dB for at least one channel tap and SCH_Ec/Ior is equally divided between primary synchronisation code and secondary synchronisation code. When L3 filtering is used an additional delay can be expected.

8.1.2.4.1.2 UE UTRA FDD CPICH measurement capability

When transmission gaps are scheduled for UTRA FDD inter RAT measurements the UE physical layer shall be capable of reporting measurements to higher layers with measurement accuracy as specified in Section 9.2 with measurement period given by

$$T_{measurement\ UTRAN\_FDD} = Max\left\{T_{Measurement\_Period\ UTRAN\_FDD}, T_{basic\ measurement\ UTRAN\_FDD} \cdot \frac{T_{Measurement\_Period\ UTRAN\_FDD}}{T_{UTRAN\_FDD}} \cdot N_{Freq}\right\} m$$

If the UE does not need measurement gaps to perform UTRA FDD measurements, the measurement period for UTRA FDD measurements is 480 ms.

The UE shall be capable of performing UTRA FDD CPICH measurements for $X_{basic\ measurementUTRA\_FDD}$ inter-frequency cells per FDD frequency of the monitored set, and the UE physical layer shall be capable of reporting measurements to higher layers with the measurement period of $T_{Measurement\_UTRA\_FDD}$.

$X_{basic\ measurement\ FDDinter} = 6$

$T_{Measurement\_Period\ UTRA\_FDD}$ = 480 ms. The period used for calculating the measurement period $T_{measurement\_UTRA\_FDD}$ for UTRA FDD CPICH measurements.

$T_{UTRA\_FDD::}$ This is the minimum time that is available for UTRA FDD measurements , during the period $T_{Measurement\_Period\ UTRA\_FDD}$ with an arbitrarily chosen timing. The minimum time per transmission gap is calculated by using the measurement gap length of 6ms and assuming 2*0.5 ms for implementation margin.

$T_{basic\_identify\_UTRA\_FDD}$ = 300 ms. This is the time period used in the inter RAT equation where the maximum allowed time for the UE to identify a new UTRA FDD cell is defined.

$T_{basic\_measurement\_UTRA\_FDD}$ = 50 ms. This is the time period used in the equation for defining the measurement period for inter RAT CPICH measurements.

N_{Freq}: Number of FDD frequencies indicated in the inter RAT measurement control information.

8.1.2.4.2 E-UTRAN TDD – UTRAN FDD measurements

8.1.2.4.3 E-UTRAN FDD – UTRAN TDD measurements

8.1.2.4.4 E-UTRAN TDD – UTRAN TDD measurements

8.1.2.4.5 E-UTRAN FDD – GSM measurements

[Editor"s note: GERAN neighbour cell list requirement should be added]

The requirements in this section apply only to UE supporting E-UTRAN FDD and GSM.

Measurements on GSM cells can be requested with BSIC verified or BSIC non-verified.

In RRC_CONNECTED state when a supported transmission gap pattern sequence according to table 8.1.2.1-1 is configured by E-UTRAN the UE shall continuously measure GSM cells, search for new GSM cells given in the monitored set and re-confirm the BSIC for already detected cells. During DRX periods the UE may use other periods of time outside the specified measurement gap patterns.

8.1.2.4.5.1 GSM carrier RSSI

This measurement shall be based on measurement gaps allocated for GSM carrier RSSI measurement as described in section 8.1.2.1. A UE supporting GSM measurements shall measure minimum number of 10 GSM carrier RSSI measurement samples ($N_{GSM\ carrier\ RSSI}$) per measurement gap. In RRC_CONNECTED state the measurement period, $T_{Measurement\ Period,\ GSM}$, for the GSM carrier RSSI measurement is 480 ms.

The UE shall meet the measurement accuracy requirements stated for RXLEV in 3GPP TS 45.008, when the given measurement time allows the UE to take at least 3 GSM carrier RSSI samples per GSM carrier in the monitored set during the measurement period.

In case the UE is not able to acquire the required number of samples per GSM carrier during one measurement period, when at least 25% of the monitoring gaps available for GSM monitoring purposes are used for GSM RSSI purposes the UE shall measure as many GSM carriers as possible during that measurement period using at least 3 samples per GSM carrier. The GSM carriers that were not measured during that measurement period shall be measured in the following measurement periods.

8.1.2.4.5.2 BSIC verification

Measurements on a GSM cell can be requested with BSIC verified or BSIC non-verified. If GSM measurements are requested with BSIC verified the UE shall be able to report the GSM cells with BSIC verified for those cells where the verification of BSIC has been successful.

If no BSIC verification is required then 100% of the measurement gaps available for GSM monitoring shall be used for GSM RSSI purposes.

The procedure for BSIC verification on a GSM cell can be divided into the following two tasks:

- **Initial BSIC identification:** Includes searching for the BSIC and decoding the BSIC for the first time when there is no knowledge about the relative timing between the E-UTRAN FDD and GSM cells. The UE shall trigger the initial BSIC identification within the available transmission gap pattern sequence. The requirements for BSIC re-confirmation can be found in section 8.1.2.4.5.2.1.

- **BSIC re-confirmation:** Tracking and decoding the BSIC of a GSM cell after initial BSIC identification is performed. The UE shall trigger the BSIC re-confirmation within the available transmission gap pattern. The requirements for BSIC re-confirmation can be found in section 8.1.2.4.5.2.2.

If the network requests measurements on a GSM cell with BSIC verified, the UE shall behave as follows:

- The UE shall perform GSM carrier RSSI measurements according to section 8.1.2.4.5.1 when a transmission gap pattern sequence is activated.
- The UE shall perform measurement reporting as defined in 3GPP TS 36.331.
- The UE shall perform BSIC identification if BSIC verified measurements are activated by RRC. The UE shall use the most recently available GSM carrier RSSI measurement results for arranging GSM cells in signal strength order for performing BSIC identification.
- The UE shall perform BSIC re-confirmation on all the GSM cells that have been successfully identified.
- The UE shall perform all configured event evaluation for event-triggered reporting after the BSIC has been verified for a GSM cell. The UE shall use the most recently available GSM carrier RSSI measurement results in event evaluation and event-triggered reporting.
- Event-triggered and periodic reports shall be triggered according to 3GPP TS 36.331.

The BSIC of a GSM cell is considered to be 'verified' if the UE has decoded the SCH of the BCCH carrier and identified the BSIC at least one time (initial BSIC identification). Once a GSM cell has been identified the BSIC shall be re-confirmed at least once every $8*T_{re\text{-}confirm,GSM}$ seconds. Otherwise the BSIC of the GSM cell is considered as "non-verified". If a transmission gap pattern sequence is deactivated by the network after BSIC has been identified or verified, the UE shall consider the BSIC as non-verified.

$T_{identify,GSM}$ indicates the maximum time allowed for the UE to decode the unknown BSIC of the GSM cell in one GSM BCCH carrier in the initial BSIC identification procedure.

$T_{re\text{-}confirm,GSM}$ indicates the maximum time allowed for the re-confirmation of the BSIC of one GSM cell in the BSIC re-confirmation procedure.

The UE shall be able to decode a BSIC within a transmission gap when the time difference between the middle of the received GSM synchronisation burst at the UE and the middle of the effective transmission gap is within the limits specified in table 8.1.2.4.5.2-1.

Table 8.1.2.4.5.2-1: The gap length and maximum time difference for BSIC verification

Gap length [ms]	Maximum time difference [µs]
6	± 2350 µs
[TBD]	[TBD]

The UE shall be able to perform BSIC verification at levels down to the reference sensitivity level or reference interference levels as specified in 3GPP TS 45.005.

8.1.2.4.5.2.1 Initial BSIC identification

This measurement shall be made on GSM cells that are requested with BSIC verified. The measurement shall be based on the measurement gaps used for Initial BSIC identification as described in section 8.1.2.4.5.2

The UE shall continuously attempt to decode the BSIC of SCH on the BCCH carrier of the 8 strongest BCCH carriers of the GSM cells indicated in the Inter-RAT cell info list. The UE shall give priority for BSIC decoding attempts in decreasing signal strength order to BCCH carriers with unknown BSIC. The strongest BCCH carrier is defined as the BCCH carrier having the highest measured GSM carrier RSSI value.

If the BSIC of the GSM BCCH carrier has been successfully decoded the UE shall immediately continue BSIC identification with the next GSM BCCH carrier, in signal strength order, with unknown BSIC. The GSM cell for which the BSIC has been successfully identified shall be moved to the BSIC re-confirmation procedure.

If the UE has not successfully decoded the BSIC of the GSM BCCH carrier within $T_{identify,GSM}$ ms, the UE shall abort the BSIC identification attempts for that GSM BCCH carrier. The UE shall continue to try to perform BSIC identification of the next GSM BCCH carrier in signal strength order. The GSM BCCH carrier for which the BSIC identification failed shall not be re-considered for BSIC identification until BSIC identification attempts have been made for all the rest of the 8 strongest GSM BCCH carriers in the monitored set with unknown BSIC.

$T_{identify,GSM}$ values are given for a set of reference gap patterns in table 8.1.2.4.5.2.1-1. The requirements in the table represent the time required to guarantee at least two attempts to decode the BSIC for one GSM BCCH carrier.

Table 8.1.2.4.5.2.1-1

Gap Pattern Id	$T_{identify,GSM}$ (ms)	$T_{re\text{-}confirm,GSM}$ (ms)
0	2160	1920
1	5040	4800
[TBD]	[TBD]	[TBD]

8.1.2.4.5.2.2 BSIC re-confirmation

The UE shall maintain the timing information of up to 8 identified GSM cells. Initial timing information is obtained from the initial BSIC identification. The timing information shall be updated every time the BSIC is decoded.

For each measurement gap used for GSM BSIC reconfirmation as described in section 8.1.2.4.5.2, the UE shall attempt to decode the BSIC falling within the measurement gap according to table 8.1.2.4.5.2.1-1. If more than one BSIC can be decoded within the same measurement gap, priority shall be given to the least recently decoded BSIC.

If the UE fails to decode the BSIC after two successive attempts or if the UE has not been able to re-confirm the BSIC for a GSM cell within $T_{re\text{-}confirm,GSM}$ seconds, the UE shall abort the BSIC re-confirmation attempts for that GSM cell. The GSM cell shall be treated as a new GSM cell with unidentified BSIC and the GSM cell shall be moved to the initial BSIC identification procedure, see section 8.1.2.4.5.2.1.

8.1.2.4.5.3 Periodic Reporting

Reported measurements in periodically triggered measurement reports shall meet the requirements in section 3GPP TS 36.331.

8.1.2.4.5.4 Event Triggered Reporting

Reported measurements in event triggered measurement reports shall meet the requirements in section 3GPP TS 36.331.

The UE shall not send any event triggered measurement reports, as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that that the measurement report is not delayed by other RRC signalling on the DCCH.

The event triggered reporting delay requirement is valid when the UE for each GSM carrier in the monitored set can take the required number of samples during the measurement period $T_{Measurement\ Period,\ GSM}$ (see section 8.1.2.4.5.1).

When no BSIC verification is required, the event triggered measurement reporting delay for a GSM carrier measured without L3 filtering shall be less than $2*T_{Measurement\ Period,\ GSM}$, where $T_{Measurement\ Period,\ GSM}$ is defined in section 8.1.2.4.5.1. When L3 filtering is used an additional delay can be expected.

When BSIC verification is required, the event triggered measurement reporting delay for a GSM cell with verified BSIC , measured without L3 filtering shall be less than $2*T_{Measurement\ Period,\ GSM}$, where $T_{Measurement\ Period,\ GSM}$ is defined in section 8.1.2.4.5.1. When L3 filtering is used an additional delay can be expected. For a GSM cell with non-verified BSIC an additional delay according to section 8.1.2.4.5.2.1 (Initial BSIC identification) can be expected.

8.1.2.4.6 E-UTRAN TDD – GSM measurements

[Editor"s note: GERAN neighbour cell list requirement should be added]

The requirements in section 8.1.2.4.5 also apply for this section.

9 Measurements performance requirements for UE

One of the key services provided by the physical layer is the measurements used to trigger or perform a multitude of functions. Both the UE and the E-UTRAN are required to perform measurements. The physical layer measurement model and a complete list of measurements is specified in TBD. The physical layer measurements for are described and defined in TS36.214. In this clause for each measurement the relevant requirements on the measurement period, reporting range, granularity and performance in terms of accuracy are specified.

Since the UE reference sensitivity requirements are different depending on supported band, this is noted in each case with definition of the range Io for each frequency band. Definitions of each frequency bands can be found in TS 36.101.

The accuracy requirements in this clause are applicable for AWGN radio propagation conditions.

[Editor"s Note: Requirements for multiple Tx antennas are still FFS. So far only 1Tx antenna case has been considered]

9.1 E-UTRAN measurements

The requirements in this clause are applicable for a UE:

- in state RRC_CONNECTED
- performing measurements with appropriate measurement gaps as defined in Section 8.1.2.1.
- that is synchronised to the cell that is measured.

The reported measurement result after layer 1 filtering shall be an estimate of the average value of the measured quantity over the measurement period. The reference point for the measurement result after layer 1 filtering is referred to as point B in the measurement model described in TBD.

The accuracy requirements in this clause are valid for the reported measurement result after layer 1 filtering. The accuracy requirements are verified from the measurement report at point D in the measurement model having the higher layer filtering disabled.

9.1.2 Intra-frequency RSRP Accuracy Requirements

9.1.2.1 Absolute RSRP Accuracy

The absolute accuracy of RSRP is defined as the RSRP measured from a cell on the same frequency as that of the serving cell.

The accuracy requirements in table 9.1.2.1-1 are valid under the following conditions:

Cell specific reference signals are transmitted either from one, two or four antenna ports.
$RSRP|_{dBm} \geq$ [-127] dBm for Bands [1]

Table 9.1.2.1-1: RSRP Intra frequency absolute accuracy

Parameter	Unit	Accuracy [dB]		Conditions[1]	
		Normal condition	Extreme condition	Bands 1 Io	Bands Io
RSRP for Ês/Iot ≥ -6 dB	dBm	±[6]	±[9]	[-121dBm/15kHz … -70dBm]	TBD
RSRP for Ês/Iot ≥ -6 dB	dBm	±[8]	±[11]	[-70dBm … -50dBm]	TBD
Note 1. Io is assumed to have constant EPRE across the bandwidth.					

[Editor"s note: Definition of RSRP signal-to-interference-and-noise-ratio and Io definition should clarified]

9.1.2.2 Relative Accuracy of RSRP

The relative accuracy of RSRP is defined as the RSRP measured from one cell compared to the RSRP measured from another cell on the same frequency.

The accuracy requirements in table 9.1.2.2-1 are valid under the following conditions:

Cell specific reference signals are transmitted either from one, two or four antenna ports.

$RSRP1,2|_{dBm} \geq$ [-127] dBm for Bands [1]

Table 9.1.2.2-1: RSRP Intra frequency relative accuracy

Parameter	Unit	Accuracy [dB]		Conditions[1]	
		Normal condition	Extreme condition	Bands 1,.. Io	Bands Io
RSRP for Ês/Iot > -3 dB	dBm	± [2]	± [3]	[-121dBm/15kHz … -50dBm]	TBD
RSRP for Ês/Iot ≥ -6 dB	dBm	± [3]	± [3]	[-121dBm/15kHz … -50dBm]	TBD
Note 1. Io is assumed to have constant EPRE across the bandwidth.					

[Editor"s note: Definition of RSRP signal-to-interference-and-noise-ratio and Io definition should clarified]

9.1.3 Inter-frequency RSRP Accuracy Requirements

9.1.3.1 Absolute RSRP Accuracy

The absolute accuracy of RSRP is defined as the RSRP measured from a cell that has different carrier frequency from the serving cell.

The accuracy requirements in table 9.1.3.1-1 are valid under the following conditions:

Cell specific reference signals are transmitted either from one, two or four antenna ports.
$RSRP|_{dBm} \geq$ [-127] dBm for Bands [1]

Table 9.1.3.1-1: RSRP Inter frequency absolute accuracy

Parameter	Unit	Accuracy [dB]		Conditions[1]	
		Normal condition	Extreme condition	Band 1, … Io	Bands Io
RSRP for Ês/Iot ≥ -6 dB	dBm	± [6]	± [9]	[-121dBm/15kHz … -70dBm]	TBD
RSRP for Ês/Iot ≥ -6 dB	dBm	± [8]	± [11]	[-70dBm … -50dBm]	TBD
Note 1. Io is assumed to have constant EPRE across the bandwidth.					

[Editor"s note: Definition of RSRP signal-to-interference-and-noise-ratio and Io definition should clarified]

9.1.3.2 Relative Accuracy of RSRP

The relative accuracy of RSRP in inter frequency case is defined as the RSRP measured from one cell compared to the RSRP measured from another cell on a different frequency.

The accuracy requirements in table 9.1.2.2-1 are valid under the following conditions:

Cell specific reference signals are transmitted either from one, two or four antenna ports.

$RSRP1|_{dBm} \geq$ [-127] dBm if RSRP1 is on Bands [1],

…

$RSRP2|_{dBm} \geq$ [-127] dBm if RSRP2 is on Bands [1],

| Channel 1_Io -Channel 2_Io | ≤ [20] dB

Table 9.1.2.2-1: RSRP Inter frequency relative accuracy

Parameter	Unit	Accuracy [dB]		Conditions[1]	
		Normal condition	Extreme condition	Bands Io	Bands Io
RSRP for Ês/Iot > -6dB	dBm	±[6]	±[6]	[-121dBm/15kHz … -50dBm]	TBD
Note 1. Io is assumed to have constant EPRE across the bandwidth.					

[Editor"s note: Definition of RSRP signal-to-interference-and-noise-ratio and Io definition should clarified]

9.1.4 RSRP Measurement Report Mapping

The reporting range of RSRP is defined from -140 dBm to -44 dBm with 1 dB resolution.

The mapping of measured quantity is defined in table 9.1.4-1. The range in the signalling may be larger than the guaranteed accuracy range.

Table 9.1.4-1: RSRP measurement report mapping

Reported value	Measured quantity value	Unit
RSRP_00	RSRP < -140	dBm
RSRP_01	-140 ≤ RSRP < -139	dBm
RSRP_02	-139 ≤ RSRP < -138	dBm
…	…	…
RSRP_95	-46 ≤ RSRP < -45	dBm
RSRP_96	-45 ≤ RSRP < -44	dBm
RSRP_97	-44 ≤ RSRP	dBm

9.1.5 Intra-frequency RSRQ Accuracy Requirements

9.1.5.1 Absolute RSRQ Accuracy

The absolute accuracy of RSRQ is defined as the RSRQ measured from a cell on the same frequency as that of the serving cell.

The accuracy requirements in table 9.1.5.1-1 are valid under the following conditions:

Cell specific reference signals are transmitted either from one, two or four antenna ports.
$RSRP|_{dBm} \geq$ [-127] dBm for Bands [I]

Table 9.1.5.1-1: RSRQ Intra frequency absolute accuracy

Parameter	Unit	Accuracy [dB]		Conditions[1]	
		Normal condition	Extreme condition	Bands I,.. Io	Bands Io
RSRQ when RSRP Ês/Iot > -3 dB	dBm	± [2.5]	± [4]	[-121dBm/15kHz … -50dBm]	TBD
RSRQ when RSRP Ês/Iot ≥ -6 dB	dBm	± [3.5]	± [4]	[-121dBm/15kHz … -50dBm]	TBD
Note 1. Io is assumed to have constant EPRE across the bandwidth.					

[Editor"s note: Definition of $\hat{E}_s$ and I_{ot} should be added to Symbols]

9.1.6 Inter-frequency RSRQ Accuracy Requirements

9.1.6.1 Absolute RSRQ Accuracy

The absolute accuracy of RSRQ is defined as the RSRQ measured from a cell that has different carrier frequency from the serving cell.

The accuracy requirements in table 9.1.6.1-1 are valid under the following conditions:

Cell specific reference signals are transmitted either from one, two or four antenna ports.
$RSRP|_{dBm} \geq$ [-127] dBm for Bands [I]

Table 9.1.6.1-1: RSRQ Inter frequency absolute accuracy

Parameter	Unit	Accuracy [dB]		Conditions[1]	
		Normal condition	Extreme condition	Bands I,.. Io	Bands Io
RSRQ when RSRP Ês/Iot > -3 dB	dBm	± [2.5]	± [4]	[-121dBm/15kHz … -50dBm]	TBD
RSRQ when RSRP Ês/Iot ≥ -6 dB	dBm	± [3.5]	± [4]	[-121dBm/15kHz … -50dBm]	TBD
Note 1. Io is assumed to have constant EPRE across the bandwidth.					

[Editor"s note: Definition of $\hat{E}_s$ and I_{ot} should be added to Symbols]

9.1.6.2 Relative Accuracy of RSRQ

The relative accuracy of RSRQ in inter frequency case is defined as the RSRQ measured from one cell compared to the RSRQ measured from another cell on a different frequency.

The accuracy requirements in table 9.1.6.2-1 are valid under the following conditions:

Cell specific reference signals are transmitted either from one, two or four antenna ports.

$RSRP1|_{dBm} \geq$ [-127] dBm if RSRP1 is on Band [I],

…

$RSRP2|_{dBm} \geq$ [-127] dBm if RSRP2 is on Bands [I],

$$\left| RSRP1|_{dBm} - RSRP2|_{dBm} \right| \leq [27] dB$$

| Channel 1_Io -Channel 2_Io | ≤ [20] dB

Table 9.1.6.2-1: RSRQ Inter frequency relative accuracy

Parameter	Unit	Accuracy [dB]		Conditions[1]	
		Normal condition	Extreme condition	Bands I,.. Io	Bands Io
RSRQ when RSRP Ês/Iot > -3 dB	dBm	± [3]	± [4]	[-121dBm/15kHz … -50dBm]	TBD
RSRQ when RSRP Ês/Iot ≥ -6 dB	dBm	± [4]	± [4]	[-121dBm/15kHz … -50dBm]	TBD
Note 1. Io is assumed to have constant EPRE across the bandwidth.					

[Editor"s note: Definition of $\hat{E}_s$ and I_{ot} should be added to Symbols]

9.2 UTRAN FDD Measurements

The requirements in this clause are applicable for a UE:

- in state RRC_CONNECTED
- performing measurements according to section 8.1.2.4.1.2 with appropriate measurement gaps
- that is synchronised to the cell that is measured.

The reported measurement result after layer 1 filtering shall be an estimate of the average value of the measured quantity over the measurement period. The reference point for the measurement result after layer 1 filtering is referred to as point B in the measurement model described in TS25.302.

The accuracy requirements in this clause are valid for the reported measurement result after layer 1 filtering. The accuracy requirements are verified from the measurement report at point D in the measurement model having the layer 3 filtering disabled.

9.2.1 UTRAN FDD CPICH RSCP

Editors note: When connected to an E-UTRA cell in RRC_Connected state, the measurement accuracy for UTRA CPICH RSCP shall be based on UTRA Inter frequency measurement accuracy, which is given in 25.133 section 9.1.1.2.

[Requirements to be added]

9.2.2 UTRAN FDD carrier RSSI

When connected to an E-UTRA cell in RRC_Connected state, the measurement accuracy for UTRA CPICH RSSI shall be based on UTRA Inter frequency measurement accuracy, which is given in 25.133 section 9.1.3.2.

[Requirements to be added]

9.2.3 UTRAN FDD CPICH Ec/No

When connected to an E-UTRA cell in RRC_Connected state, the measurement accuracy for UTRA CPICH Ec/Io shall be based on UTRA Inter frequency measurement accuracy, which is given in 25.133 section 9.1.2.2.

[Requirements to be added]

9.3 UTRAN TDD Measurements

9.3.1 UTRAN TDD P-CCPCH RSCP

9.3.2 UTRAN TDD carrier RSSI

9.3.3 UTRAN TDD P-CCPCH RSCP

9.4 GSM Measurements

9.4.1 GSM carrier RSSI

10 Measurements Performance Requirements for E-UTRAN

10.1 DL RS TX power

Annex A (normative): Test Cases

A.1 Purpose of annex

A.2 Requirement classification for statistical testing

A.2.1 Types of requirements in TS 36.133

A.3 RRM test configurations

A.4 E-UTRAN RRC_IDLE state

A.4.2 Cell Re-Selection

A.4.2.1 E-UTRAN FDD – FDD Intra frequency case

A.4.2.2 E-UTRAN TDD – TDD Intra frequency case

A.4.2.3 E-UTRAN FDD – FDD Inter frequency case

A.4.2.4 E-UTRAN FDD – TDD Inter frequency case

A.4.2.5 E-UTRAN TDD – FDD Inter frequency case

A.4.2.6 E-UTRAN TDD – TDD: Inter frequency case

A.4.3 E-UTRAN to UTRAN Cell Re-Selection

A.4.3.1 E-UTRAN FDD – UTRAN FDD:

A.4.3.2 E-UTRAN FDD – UTRAN TDD:

A.4.3.3 E-UTRAN TDD – UTRAN FDD:

A.4.3.4 E-UTRAN TDD – UTRAN TDD:

A.4.4 E-UTRAN to GSM Cell Re-Selection

A.4.5.1 E-UTRAN FDD – GSM:

A.4.5.2 E-UTRAN TDD – GSM:

A.5 E-UTRAN RRC CONNECTED Mode Mobility

A.6 RRC Connection Control

A.7 Timing and Signalling Characteristics

A.7.1 UE Transmit Timing

A.8 UE Measurements Procedures

A.9 Measurement Performance Requirements

Annex B (informative): Change history:

Table B.1: Change History

Date	TSG#	TSG Doc.	CR	Rev	Subject	Old	New
2007-12	RP#38	RP-071037			Approved version in TSG RAN#38	-	8.0.0
2008-03	RP#39	RP-080123	2		Updates of TS36.133	8.0.0	8.1.0
2008-05	RP#40	RP-080325	3		Updates of TS36.133	8.1.0	8.2.0

History

Document history		
V8.2.0	November 2008	Publication