ETSI TS 136 133 V8.3.0 (2008-11)

Technical Specification

LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
Requirements for support of radio resource management
(3GPP TS 36.133 version 8.3.0 Release 8)

Reference
RTS/TSGR-0436133v830

Keywords
LTE

ETSI

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Sous-Préfecture de Grasse (06) N° 7803/88

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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-B: 'cdma2000 High Rate Packet Data Air Interface Specification'.

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

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

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

[15] 3GPP2 C.S0005-D: Upper Layer (Layer 3) Signaling Specification for cdma2000 Spread Spectrum Systems

[16] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation'

[17] 3GPP TS 36.321: 'Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification'.

[18] 3GPP TS 25.133: "Requirements for Support of Radio Resource Management (FDD)".

[19] 3GPP TS 25.123: "Requirements for Support of Radio Resource Management (TDD)".

[20] 3GPP TS 25.214: "Physical layer procedures (FDD)".

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:

[…]	Values included in square bracket must be considered for further studies, because it means that a decision about that value was not taken.
$BW_{Channel}$	Channel bandwidth, defined in TS 36.101 subclause 3.2
CPICH_Ec	Average energy per PN chip for the CPICH
CPICH_Ec/Io	The ratio of the received energy per PN chip for the CPICH to the total received power spectral density at the UE antenna connector.
Ec	Average energy per PN chip.
Ês	Received energy per RE (power normalized to the subcarrier spacing) during the useful part of the symbol, i.e. excluding the cyclic prefix, at the UE antenna connector
Io	The total received power density, including signal and interference, as measured at the UE antenna connector.
Ioc	The power spectral density (integrated in a noise bandwidth equal to the chip rate and normalized to the chip rate) of a band limited noise source (simulating interference from cells, which are not defined in a test procedure) as measured at the UE antenna connector.
Iot	The received power spectral density of the total noise and interference for a certain RE (power integrated over the RE and normalized to the subcarrier spacing) as measured at the UE antenna connector
S	Defined in TS 36.304, subclause 5.2.3.2 for E-UTRAN
SCH_Ec/Ior	The ratio of the transmit energy per PN chip of the SCH to the total transmit power spectral density at the UTRA Node B antenna connector
SCH_RP	Received (linear) average power of the resource elements that carry E-UTRA synchronisation signal, measured at the UE antenna connector$S_{ServingCcell}$ Defined in TS 36.304
Sintersearch	Defined in TS 25.304, subclause 5.2.6.1.5
Sintrasearch	Defined in TS 25.304, subclause 5.2.6.1.5 for UTRAN and in TS 36.304 , subclause 5.2.4.7 for E-UTRAN
Snonintrasearch	Defined in TS 36.304 , subclause 5.2.4.7
SsearchRAT	Defined in TS 25.304, subclause 5.2.6.1.5
$Thresh_{x, high}$	Defined in TS 36.304 , subclause 5.2.4.7
$Thresh_{x, low}$	Defined in TS 36.304 , subclause 5.2.4.7
$Thresh_{serving, low}$	Defined in TS 36.304 , subclause 5.2.4.7
$T_{RE\text{-}ESTABLISH\text{-}REQ}$	The RRC Re-establishment delay requirement, the time between the moment when erroneous CRCs are applied, to when the UE starts to send preambles on the PRACH.
Treselection	Defined in TS 25.304, subclause 5.2.6.1.5
$Treselection_{RAT}$	Defined in TS 36.304 , subclause 5.2.4.7
$Treselection_{EUTRAN}$	Defined in TS 36.304 , subclause 5.2.4.7
$Treselection_{UTRAN}$	Defined in TS 36.304 , subclause 5.2.4.7

$Treselection_{GERAN}$ Defined in TS 36.304 , subclause 5.2.4.7

T_S Basic time unit, defined in TS 36.211, clause 4

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 $T_{higher\_priority\_search}$ = (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 [1] 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

4.2.2.2 Void

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 whether a newly detectable intra-frequency cell meets the reselection criteria defined in TS36.304 within $T_{detect,EUTRAN\_Intra}$ when that Treselection= 0 . An intra frequency cell is considered to be detectable if:

- RSRP $\geq$ -TBD dBm and Ês/Iot > [-3] dB,

- SCH Îor $\geq$ -TBD dBm and SCHÊs/Iot > [-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 $T_{measure,EUTRAN\_Intra}/2$

For an intra-frequency cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that the intra-frequency cell has met reselection criterion defined [1] within $T_{evaluateFDD,intra}$ when $T_{reselection} = 0$ 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

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 $S_{ServingCell}$of the E-UTRA serving cell (or other cells on the same frequency layer) is greater than $S_{nonintrasearch}$ 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.

If the $S_{ServingCell}$ of the E-UTRA serving cell is less than or equal to $S_{nonintrasearch}$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 higher priority layers is not reduced and shall be the same as that defined below for a lower or equal priority interfrequency layers.

The UE shall be able to evaluate whether a newly detectable lower or equal priority inter-frequency cell meets the reselection criteria defined in TS36.304 within $K_{carrier} * T_{detect,EUTRAN\_Inter}$ if at least carrier frequency information is provided for inter-frequency neighbour cells by the serving cells when $T_{reselection} = 0$. The parameter $K_{carrier}$ is the number of E-UTRA inter-frequency carriers indicated by the serving cell. An inter-frequency cell is considered to be detectable if:

- RSRP $\geq$ -TBD dBm and Ês/Iot > [-3] dB,
- SCH_RP > -TBD dBm and SCH Ês/Iot > [-3] dB.

When higher priority cells are found by the higher priority search, they shall be measured at least every $T_{measureFDD,Inter}$. If, after detecting a cell in a higher priority search, it is determined that reselection has not occurred then the UE is not required to continuously measure the detected cell to evaluate the ongoing possibility of reselection. However, the minimum measurement filtering requirements specified later in this section shall still be met by the UE before it makes any determination that it may stop measuring the cell. 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 measure RSRP at least every $K_{carrier} * T_{measure,EUTRAN\_Inter}$ (see table 4.2.2.3-1) for identified lower or equal priority 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 higher, lower and equal priority 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 $[T_{measure,EUTRAN\_Inter}/2]$.

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.

For an inter-frequency cell that has been already detected, but that has not been reselected to, 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 $K_{carrier} * T_{evaluateFDD,Inter}$ when $T_{reselection} = 0$ as specified in table 4.2.2.4-1.

Table 4.2.2.4-1 : $T_{detect,EUTRAN\_Inter}$, $T_{measure,EUTRAN\_Inter}$ 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

If the $S_{ServingCell}$ of the E-UTRA serving cell (or other cells on the same frequency layer) is greater than $S_{nonintrasearch}$ 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.

If the $S_{ServingCell}$ of the E-UTRA serving cell is less than or equal to $S_{nonintrasearch}$ 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 and shall be the same as that defined below for lower priority RATs.

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 whether newly detectable UTRA FDD cells have met the reselection criteria in TS 36.304 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 $S_{ServingCell}$ of the E-UTRA serving cell (or other cells on the same frequency layer) is greater than $S_{nonintrasearch}$ when $Treselection_{RAT} = 0$.

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 $S_{ServingCell}$ of the E-UTRA serving cell (or other cells on the same frequency layer) is greater than $S_{nonintrasearch}$.

When higher priority UTRA FDD cells are found by the higher priority search, they shall be measured at least every $T_{measure,UTRA\_FDD}$. If, after detecting a cell in a higher priority search, it is determined that reselection has not occurred then the UE is not required to continuously measure the detected cell to evaluate the ongoing possibility of reselection. However, the minimum measurement filtering requirements specified later in this section shall still be met by the UE before it makes any determination that it may stop measuring the cell.

For a cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that an already identified UTRA FDD cell has met reselection criterion defined in 3GPP TS 36.304 [1] within $(N_{UTRA\_carrier}) * T_{evaluateUTRA\_FDD}$ when $T_{reselection} = 0$ as speficied in table 4.2.2.5.1-1.

For non-identified UTRA FDD cells, the filtering shall be such that the UE shall be capable of evaluating that a non-identified a UTRA FDD cell has met reselection criterion defined in 3GPP TS 36.304 [1] within $T_{detectUTRA\_FDD} = [60]$ seconds from the moment the UTRA FDD cell has met the reselection criterion.

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

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

DRX cycle length [s]	$T_{measureUTRA\_FDD}$ [s] (number of DRX cycles)	$T_{evaluateUTRA\_FDD}$ [s] (number of DRX cycles)
0.32	[5.12 (16)]	[15.36 (48)]
0.64	[5.12 (8)]	[15.36 (24)]
1.28	[6.4(5)]	[19.2 (15)]
2.56	[7.68 (3)]	[23.04 (9)]

4.2.2.5.2 Measurements of UTRAN TDD cells

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 evaluate whether newly detectable UTRA FDD cells have met the reselection criteria in TS 36.304 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 $S_{ServingCell}$ of the E-UTRA serving cell (or other cells on the same frequency layer) is greater than $S_{nonintrasearch}$ when $T_{reselection} = 0$.

Cells which have been detected shall be measured at least every ($N_{UTRA\_carrier\_TDD}$) * $T_{measureUTRA\_TDD}$ except when UTRA TDD is of higher priority than the currently selected E-UTRAN frequency layer and the $S_{ServingCell}$ of the E-UTRA serving cell (or other cells on the same frequency layer) is greater than $S_{nonintrasearch}$.

When higher priority UTRA TDD cells are found by the higher priority search, they shall be measured at least every $T_{measure,UTRA\_TDD}$. If, after detecting a cell in a higher priority search, it is determined that reselection has not occurred then the UE is not required to continuously measure the detected cell to evaluate the ongoing possibility of reselection. However, the minimum measurement filtering requirements specified later in this section shall still be met by the UE before it makes any determination that it may stop measuring the cell.

For a cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that the UTRA TDD cell has met reselection criterion defined in [1] within $N_{UTRA\_carrier\_TDD}$ *$T_{evaluateUTRA\_TDD}$ when $T_{reselection}$ = 0 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 $T_{evaluateUTRA\_TDD}$

.

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 $S_{ServingCell}$ of the E-UTRA serving cell is greater than $S_{nonintrasearch}$ 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.

If the $S_{ServingCell}$ of the E-UTRA serving cell is less than or equal to $S_{nonintrasearch}$ 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.

If the RSRP of the E-UTRA serving cell is greater than $Thresh_{serving\_high,x}$ then the UE shall search for GSM BCCH carrier at least every $T_{higher\_priority\_search}$ where $T_{higher\_priority\_search}$ is described in section 4.2.2. When higher priority GSM BCCH carriers are found by the higher priority search, they shall be measured at least every $T_{measure,GSM,}$ and the UE shall decode the BSIC of the GSM BCCH carrier. If, after detecting a cell in a higher priority search, it is determined that reselection has not occurred then the UE is not required to continuously measure the detected cell to evaluate the ongoing possibility of reselection, or to continuously verify the BSIC of the GSM BCCH carrier every 30s. However, the minimum measurement filtering requirements specified later in this section shall still be met by the UE before it makes any determination that it may stop measuring the cell.

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 continuous 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]	$T_{measure,GSM}$ [s] (number of DRX cycles)
0.32	[5.12 (16)]
0.64	[5.12 (8)]
1.28	[6.4(5)]
2.56	[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)* $T_{higher\_proirty\_search}$. The parameter $T_{higher\_proirty\_search}$ is defined in section 4.2.2.

The UE shall be capable of evaluating that the HRPD cell has met cell reselection criterion defined in [1] 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	5.12 (16)	15.36 (48)
0.64	5.12 (8)	15.36 (24)
1.28	6.4 (5)	19.2 (15)
2.56	7.68 (3)	23.04 (9)

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)* $T_{higher\_proirty\_search}$. The parameter $T_{higher\_proirty\_search}$ is defined in section 4.2.2.

The UE shall be capable of evaluating that the cdma2000 1X cell has met cell reselection criterion defined in [1] 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	5.12 (16)	15.36 (48)
0.64	5.12 (8)	15.36 (24)
1.28	6.4 (5)	19.2 (15)
2.56	7.68 (3)	23.04 (9)

4.2.2.6 Evaluation of cell re-selection criteria

The UE shall evaluate the intra-frequency, inter-frequency and inter-RAT cell reselection criteria defined in [1] 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 $T_{SI\text{-}UTRA}$ + 50 ms. For E-UTRAN to GSM cell re-selection the interruption time must not exceed T_{BCCH} + 50 ms.

$T_{SI\text{-}EUTRA}$ 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 [2] for a E-UTRAN cell.

$T_{SI\text{-}UTRA}$ 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 [7] for a UTRAN cell.

T_{BCCH} is the maximum time allowed to read BCCH data from a GSM cell defined in [8].

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 [15] in 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 [15] 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 [2].

When the UE receives a RRC message implying handover the UE shall be ready to start the transmission of the new uplink PRACH channel within $D_{handover}$ seconds from the end of the last TTI containing the RRC command.

Where:

$D_{handover}$ equals the maximum RRC procedure delay to be defined in section 11.2 in 3GPP TS 36.331 [2] plus the interruption time stated in section 5.1.2.1.2.

5.1.2.1.2 Interruption time

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay. This requirement applies when UE is not required to perform any synchronisation procedure before transmitting on the new PRACH.

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

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

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.

T_{IU} is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. T_{IU} can be up to TBD.

In the interruption requirement a cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds otherwise it is unknown. 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

The requirements in this section are applicable to handover from FDD to TDD. The requirements in this section shall apply to UE supporting FDD and TDD.

The requirements in section 5.2.2.4 apply for this section.

5.2.2.2.1 (Void)

5.2.2.2.2 (Void)

5.2.2.3 E-UTRAN TDD – FDD

The requirements in this section are applicable to handover from TDD to FDD. The requirements in this section shall apply to UE supporting FDD and TDD.

The requirements in section 5.1.2.1 apply for this section.

5.2.2.3.1 (Void)

5.2.2.3.2 (Void)

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 3GPP TS 36.331 [2].

When the UE receives a RRC message implying handover, the UE shall be ready to start the transmission of the new uplink UpPTS or PRACH channel within $D_{handover}$ seconds from the end of the last TTI containing the RRC command.

Where:

$D_{handover}$ equals the maximum RRC procedure delay to be defined in section 11.2 in 3GPP TS36.331 [2] plus the interruption time stated in section 5.1.2.4.2.

5.2.2.4.2 Interruption time

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new UpPTS or PRACH, excluding the RRC procedure delay. This requirement applies when UE is not required to perform any synchronisation procedure before transmitting on the new UpPTS or PRACH.

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

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

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.

T_{IU} is the interruption uncertainty in acquiring the first available UpPTS or PRACH occasion in the new cell. T_{IU} can be up to TBD.

In the interruption requirement a cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds otherwise it is unknown. 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 section 11.2 in 3GPP TS36.331 [2].

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 section 11.2 in 3GPP TS 36.331 [2] 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 target cell is known if it has been measured by the UE during the last 5 seconds otherwise it is unknown. The UE shall always perform a UTRA synchronisation procedure as part of the handover procedure.

If the target cell is known 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 is unknown 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 chips.

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 3GPP TS 25.214 section 4.3.1.2 [20]. 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 [2].

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 [2].

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 MOBILITY FROM E-UTRA 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 [2] 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 E-UTRAN PDCCH 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. 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 $T_{interrupt1}$

$$T_{interrupt1} = T_{offset} + T_{UL} + 30 * F_{SFN} + [20] + 10 * F_{max} \text{ ms}$$

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

$$T_{interrupt2} = T_{offset} + T_{UL} + 30 * F_{SFN} + [180] + 10 * F_{max} \text{ ms}$$

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

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.

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 in 3GPP TS 36.331 [2].

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 [2].

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 [10]) 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 [10]) 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 RRC MOBILITY FROM E-UTRA COMMAND is received	90
The UE has not synchronised to the GSM cell before the RRC MOBILITY FROM E-UTRA 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 RRC MOBILITY FROM E-UTRA COMMAND is received	40
The UE has not synchronised to the GSM cell before the RRC MOBILITY FROM E-UTRA 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 [2] 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. Under the reference conditions specified in sub-clause 6.6 of [13], the interruption time shall be less than $T_{interrupt}$

$$T_{interrupt} = T_{IU} + [40] + [10]*KC*SW_K + [10]*OC*SW_O \text{ ms}$$

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).

SW_K is $SW_K = \left\lceil \frac{srch\_win\_k}{60} \right\rceil$ where srch_win_k is the number of HRPD chips indicated by the search window for known target HRPD cells in the message

SW_O is $SW_O = \left\lceil \frac{srch\_win\_o}{60} \right\rceil$ where srch_win_o is the number of HRPD chips indicated by the search window for unknown target HRPD cells in the message

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 reverse link silence interval [11], 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 [2] 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. Under the reference conditions specified in sub-clause 4.2.1 of [14], the interruption time shall be less than $T_{interrupt}$:

$$T_{interrupt} = T_{IU} + [40] + [10]*KC*SW_K + [10]*OC*SW_O \text{ ms}$$

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).

SW_K is $SW_K = \left\lceil \frac{srch\_win\_k}{60} \right\rceil$ where srch_win_k is the number of cdma2000 1x chips indicated by the search window for known target cdma2000 1x cells in the message

SW_O is $SW_O = \left\lceil \frac{srch\_win\_o}{60} \right\rceil$ where srch_win_o is the number of cdma2000 1x chips indicated by the search window for unknown target cdma2000 1x cells in the message

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

The requirements in this section are applicable to both E-UTRAN FDD and TDD.

6.1.1 Introduction

RRC connection re-establishment is initiated when a UE in RRC connected mode looses RRC connection due to any of these reasons: radio link failure, handover failure or radio link problem. The RRC es-tablishment procedure is specified in section 5.3.7 in TS 36.331 [2].

6.1.2 Requirements

In RRC connected mode the UE shall be capable of sending *RRCConnectionReestablishmentRequest* message within $T_{re\text{-}establish\_delay}$ seconds from the moment it detects a loss in RRC connection. The total RRC connection delay ($T_{re\text{-}establish\_delay}$) shall be less than:

$$T_{re\text{-}establish\_delay} = T_{RRC\_re\text{-}establish\_procedure\_delay} + T_{UL\_grant} + T_{UE\_re\text{-}establish\_delay}$$

$T_{RRC\_re\text{-}establish\_procedure\_delay}$: It is the RRC procedure delay as specified in TS 36.331 [2].

T_{UL_grant}: It is the time required to acquire and process uplink grant from the target cell. The uplink grant is required to transmit *RRCConnectionReestablishmentRequest* message.

The UE re-establishment delay ($T_{UE\_re\text{-}establish\_delay}$) is specified in section 6.1.2.1.

6.1.2.1 UE Re-establishment delay requirement

The UE re-establishment delay ($T_{UE\_re\text{-}establish\_delay}$) is the time between the moments when any of the conditions requiring RRC re-estbalishment as defined in section 5.3.7 in TS 36.331 [2] is detected by the UE to the time when the UE sends PRACH to the target cell. The UE re-establishment delay ($T_{UE\_re\text{-}establish\_delay}$) requirement shall be less than:

$$T_{UE\text{-}re\text{-}establish\_delay} = 50 \text{ ms} + N_{freq} * Tsearch + T_{SI} + T_{PRACH}$$

T_{search}: It is the time required by the UE to search the target cell.

T_{search} = It is [100] ms if the target cell is known by the UE; the target cell is known if it has been measured by the UE in the last 5 seconds.

T_{search} = It is 800 ms if the target cell is unknown by the UE; the target cell is unknown if it has not been measured by the UE in the last 5 seconds.

T_{SI} = 0 in the cases where UE doesn"t need to read system information. Otherwise, T_{SI} is the time required for receiving all the relevant system information according to the reception procedure and the RRC procedure delay of system information blocks defined in TS 36.331 [2] for E-UTRAN cell.

T_{PRACH} = The additional delay caused by the random access procedure; it will be at least 10 ms due to random access occasion and there might be additional delay due to ramping procedure.

N_{freq}: It is the total number of E-UTRA frequencies to be monitored for RRC re-establishment; N_{freq} = 1 if the target cell is known.

There is no requirement if the target cell does not contain the UE context.

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 3GPP TS 36.211 [16]. 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.

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 specified in section 7.3 in [2], UE shall comply with the timer accuracies according to Table 7.2.2-1.

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 7.2.2-1

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

7.3 Timing Advance

7.3.1 Introduction

The timing advance is initiated from E-UTRAN with MAC message that implies and adjustment of the timing advance, see 3GPP TS 36.321 [17] section 5.2.

7.3.2 Requirements

7.3.2.1 Timing Advance adjustment delay

UE shall adjust the timing of its uplink transmission timing at sub-frame *n*+6 for a timing advancement command received in sub-frame *n*.

7.3.2.2 Timing Advance adjustment accuracy

The UE shall adjust the timing of its transmissions with an accuracy better than or equal to [±4* T_S seconds] to the signalled timing advance value. The timing advance command is expressed in multiples of 16* T_S and is relative to the current uplink timing.

7.4 Cell phase synchronization accuracy (TDD)

7.4.1 Definition

Cell phase synchronization accuracy is defined as the maximum absolute deviation in frame start timing between any pair of cells on the same frequency that have overlapping coverage areas.

7.4.2 Minimum requirements

The cell phase synchronization accuracy measured at BS antenna connectors shall be better than the requirement specified in table 7.4.2-1.

Table 7.4.2-1

Cell Type	Cell Radius	Requirement
Small cell	≤ TBD km	< 3 μs
Large cell	> TBD km	< TBD μs

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 [4], the measurement model is defined in TBD and measurement accuracies are specified in section 9. Control of measurement reporting is specified in [2].

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 measurement 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	80	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.

8.1.2.1.1 Monitoring of multiple layers using gaps

When monitoring of multiple inter-frequency E-UTRAN FDD and inter-RAT (UTRAN, GSM) using gaps is configured, the UE shall be capable of performing one measurement of the configured measurement type (RSRP, RSRQ, UTRAN, UTRAN FDD CPICH measurements, GSM carrier RSSI, etc.) of detected cells on all the layers

The effective total number of frequencies being monitored is

$N_{freq} = N_{freq,\ E\text{-}UTRA} + N_{freq,UTRA} + M_{gsm}$

where

$N_{freq,\ E\text{-}UTRA}$ is the number of E-UTRA carriers being monitored (FDD and TDD)

$N_{freq,UTRA}$ is the number of E-UTRA carriers being monitored (FDD and TDD)

M_{GSM} is an integer which is a function of the number of GSM carriers on which measurements are being performed. M_{GSM} is equal to 0 if no GSM carrier is being monitored. For a TGRP of 40 ms, M_{GSM} is equal to 1 if cells on up to 32 GSM carriers are being measured. For a TGRP of 80 ms, M_{GSM} is equal to [ceil($N_{carriers,GSM}$ /20)] where $N_{carriers,GSM}$ is the number of GSM carriers on which cells are being measured. [Editor"s note: If additional gap patterns with periodicities other than 40 ms or 80 ms are added, M_{GSM} would need to be defined for them.]

Additionally, T_{Inter1} is defined as the minimum time in milliseconds that is available for inter frequency and inter RAT measurements during the measurement period a 480ms period with an arbitrarily chosen timing. The minimum time per transmission gap is calculated by assuming 2*0.5 ms for implementation margin.

[Editor"s note: Requirements for measurements on inter-frequency E-UTRA TDD and other RATs (UTRAN TDD, cdma2000 and HRPD) when multiple layers are being monitored will need to be included into this section when the individual requirements for those RATs are defined in Section 8.1.2.]

[Editor"s note: A mandatory behaviour on how the UE utilizes monitoring gaps for the different layers will not be specified in 36.133.]

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

$$T_{identify\ \ intra} = T_{basic\ identify\ E-UTRA\_FDD,\ intra} \cdot \frac{T_{Measurement\ Period,\ Intra}}{T_{Intra}} \quad ms$$

where

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

A cell shall be considered detectable when

- RSRP related side condition given in Section 9.1 are fulfilled for a corresponding Band,
- SCH_RP $\geq$ [-127] dBm for Bands [1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40] and SCH Ês/Iot > [- 6] dB.
- SCH_RP$|_{dBm}\geq$ [-126] dBm for Band [9] and SCH_RP/Iot > [- 6] dB,
- SCH_RP $|_{dBm}\geq$ [-125] dBm for Bands [2, 5, 7 and 11] and SCH_RP/Iot > [- 6] dB,
- SCH_RP $|_{dBm}\geq$ [-124] dBm for Bands [3, 8, 13 …] and SCH_RP/Iot > [- 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 RSRPand RSRQ 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 and RSRQ 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.

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

8.1.2.2.1.1.1 Measurement Reporting Requirements

8.1.2.2.1.1.1.1 Periodic Reporting

Reported measurements contained in periodically triggered measurement reports shall meet the requirements in section 9.

8.1.2.2.1.1.1.2 Event-triggered Periodic Reporting

Reported measurements contained in event triggered periodic measurement reports shall meet the requirements in section 9.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in section 8.1.2.2.1.1.1.3 Event Triggered Reporting.

8.1.2.2.1.1.1.3 Event Triggered Reporting

Reported measurements contained in event triggered measurement reports shall meet the requirements in section 9.

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. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: [2] x TTI_{DCCH}.This measurement reporting delay excludes a delay which caused by no UL resoureces for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than $T_{identify\ intra}$ defined in Section 8.1.2.2.1.1 When L3 filtering is used an additional delay can be expected.

If a cell has been detectable at least for the time period $T_{identify\_intra}$ and then enters or leaves the reporting range, the event triggered measurement reporting delay shall be less than $T_{Measurement\_Period\ Intra}$ provided the timing to that cell has not changed more than [FFS] while transmission gap has not been available and the L3 filter has not been used.

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)
≤0.04	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 ≥ -TBD dBm and Ês/Iot ≥ TBD,
- SCH_RP ≥ -TBD dBm and SCH Ês/Iot > [- 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)
≤0.04	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.

8.1.2.2.1.2.1 Measurement Reporting Requirements

8.1.2.2.1.1.2.1 Periodic Reporting

Reported measurements contained in periodically triggered measurement reports shall meet the requirements in section 9.

8.1.2.2.1.1.2.2 Event-triggered Periodic Reporting

Reported measurements contained in event triggered periodic measurement reports shall meet the requirements in section 9.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in section 8.1.2.2.1.1.2.3 Event Triggered Reporting.

8.1.2.2.1.1.2.3 Event Triggered Reporting

Reported measurements contained in event triggered measurement reports shall meet the requirements in section 9.

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. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: [2] x TTI_{DCCH}.This measurement reporting delay excludes a delay which caused by no UL resoureces for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than $T_{identify\_intra}$ defined in Section 8.1.2.2.1.1 When L3 filtering is used an additional delay can be expected.

If a cell has been detectable at least for the time period $T_{identify\_intra}$ and then enters or leaves the reporting range, the event triggered measurement reporting delay shall be less than $T_{measure\_intra}$ provided the timing to that cell has not changed more than [FFS] while transmission gap has not been available and the L3 filter has not been used.

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

$$T_{identify\ intra} = T_{basic\ identify\ E-UTRA\_TDD,\ intra} \cdot \frac{T_{Measurement\ Period,\ Intra}}{T_{Intra}} \quad ms$$

where

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

A cell shall be considered detectable when

- RSRP $\geq$ -TBD dBm and Ês/Iot $\geq$ TBD,
- SCH_RP $\geq$ -TBD dBm and SCH Ês/Iot > 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.

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

where

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

$T_{\text{Measurement\_Period Intra}}$ = [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.

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

When DRX is in use the UE shall be able to identify a new detectable TDD intra frequency cell within $T_{\text{identify\_intra}}$ as shown in table 8.1.2.2.2.2-1

Table 8.1.2.2.2.2-1: Requirement to identify a newly detectable TDD intrafrequency cell

DRX cycle length (s)	$T_{\text{identify\_intra}}$ (s) (DRX cycles)
≤0.04	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 ≥ -TBD dBm and Ês/Iot > TBD,
- SCH_RP ≥ -TBD dBm and SCH Ês/Iot > [-6] dB.

In the RRC_CONNECTED state with DRX cycles of 80ms or greater the measurement period for intra frequency measurements is $T_{\text{measure\_intra}}$ as shown in table 8.1.2.2.2.2-2. 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 $T_{\text{measure\_intra}}$.

Table 8.1.2.2.2.2-2: Requirement to measure TDD intra frequency cells

DRX cycle length (s)	$T_{\text{measure\_intra}}$ (s) (DRX cycles)
≤0.04	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.

8.1.2.3 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

8.1.2.3.1.1 E-UTRAN FDD – FDD inter frequency measurements when no DRX is used

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:

$$T_{Identify\_Inter} = T_{Basic\_Identify\_Inter} \cdot \frac{480}{T_{Inter1}} \cdot N_{freq} \quad ms$$

Where:

$T_{Basic\_Identify\_Inter}$ = 480 ms. It is the time period used in the inter frequency equation where the maximum allowed time for the UE to identify a new FDD inter-frequency cell is defined.

N_{freq} and T_{inter1} are defined in section 8.1.2.1.1

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

- RSRP related side condition given in Section 9.1 are fulfilled for a corresponding Band,
- $SCH\_RP|_{dBm} \geq$ -127 dBm for Bands 1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40 and SCH_RP/Iot > -4 dB,
- $SCH\_RP|_{dBm} \geq$ -126 dBm for Band 9 and SCH_RP/Iot > -4 dB,
- $SCH\_RP|_{dBm} \geq$ -125 dBm for Bands 2, 5, 7 and 11 and SCH_RP/Iot > -4 dB,
- $SCH\_RP|_{dBm} \geq$ -124 dBm for Bands 3, 8 and 13 and SCH_RP/Iot > -4 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 8.1.2.3.1.1-1.

Table 8.1.2.3.1.1-1: RSRP measurement period and measurement bandwidth

Configuration	Physical Layer Measurement period: $T_{Measurement\_Period\_Inter\_FDD}$ [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} and T_{inter1} are defined in section 8.1.2.1.1

The UE shall be capable of performing RSRP and RSRQ 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 and RSRQ measurements to higher layers with the measurement period defined in Table 8.1.2.3.1-1.

.1.2.3.1.1.1 Measurement Reporting Requirements

8.1.2.3.1.1.1.1 Periodic Reporting

Reported measurements contained in periodically triggered measurement reports shall meet the requirements in section 9.

8.1.2.3.1.1.1.2 Event-triggered Periodic Reporting

Reported measurements contained in event triggered periodic measurement reports shall meet the requirements in section 9.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in section 8.1.2.2.5 Event Triggered Reporting.

8.1.2.3.1.1.1.3 Event Triggered Reporting

Reported measurements contained in event triggered measurement reports shall meet the requirements in section 9.

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. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH . The delay uncertainty is: [2] x TTI_{DCCH}. This measurement reporting delay excludes a delay which caused by no UL resoureces for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than $T_{identify\ -inter}$ defined in Section 8.1.2.2.1.1 When L3 filtering is used an additional delay can be expected.

If a cell has been detectable at least for the time period $T_{identify\_inter}$ and then enters or leaves the reporting range, the event triggered measurement reporting delay shall be less than $T_{Measurement\_Period\_Inter\_FDD}$ provided the timing to that cell has not changed more than [FFS] while transmission gap has not been available and the L3 filter has not been used.

8.1.2.3.1.2 E-UTRAN FDD – FDD inter frequency measurements when DRX is used

When DRX is in use the UE shall be able to identify a new detectable E-UTRAN FDD inter frequency cell within $T_{identify\_inter}$ as shown in table 8.1.2.3.1.2-1

Table 8.1.2.3.1.2-1: Requirement to identify a newly detectable FDD interfrequency cell

DRX cycle length (s)	$T_{identify\_inter}$ (s) (DRX cycles)	
	Gap period = 40 ms	Gap period = 80 ms
≤0.04	Non DRX Requirements in section 8.1.2.3.1.1 are applicable	Non DRX Requirements in section 8.1.2.3.1.1 are applicable
0.08	TBD TBD	TBD TBD
0.16	TBD TBD	TBD TBD
0.32	TBD TBD	TBD TBD
0.64	TBD TBD	TBD TBD
1.28	TBD TBD	TBD TBD
2.56	TBD TBD	TBD TBD

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

- RSRP $\geq$ -TBD dBm and $\hat{E}_s/I_{ot} \geq$ TBD,

- SCH_RP $\geq$ -TBD dBm and SCH $\hat{E}_s/I_{ot}$ > TBD dB.

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 8.1.2.3.1.2-2.

Table 8.1.2.3.1.2-2: Requirement to measure FDD interfrequency cells

DRX cycle length (s)	$T_{measure\_inter}$ (s) (DRX cycles)
≤0.04	Non DRX Requirements in section 8.1.2.3.1.1 are applicable
0.08	$0.48*N_{freq}$ ($6*N_{freq}$)
0.16	$0.8*N_{freq}$ ($5*N_{freq}$)
0.32	$1.6*N_{freq}$ ($5*N_{freq}$)
0.64	$3.2*N_{freq}$ ($5*N_{freq}$)
1.28	$6.4*N_{freq}$ ($5*N_{freq}$)
2.56	$12.8*N_{freq}$ ($5*N_{freq}$)

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

8.1.2.3.1.2.1 Measurement Reporting Requirements

8.1.2.3.1.1.2.1 Periodic Reporting

Reported measurements contained in periodically triggered measurement reports shall meet the requirements in section 9.

8.1.2.3.1.1.2.2 Event-triggered Periodic Reporting

Reported measurements contained in event triggered periodic measurement reports shall meet the requirements in section 9.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in section 8.1.2.2.5 Event Triggered Reporting.

8.1.2.3.1.1.2.3 Event Triggered Reporting

Reported measurements contained in event triggered measurement reports shall meet the requirements in section 9.

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. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: [2] x TTI_{DCCH}. This measurement reporting delay excludes a delay which caused by no UL resoureces for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than $T_{identify\_inter}$ defined in Section 8.1.2.2.1.1 When L3 filtering is used an additional delay can be expected.

If a cell has been detectable at least for the time period $T_{identify\_inter}$ and then enters or leaves the reporting range, the event triggered measurement reporting delay shall be less than $T_{measure\_inter}$ provided the timing to that cell has not changed more than [FFS] while transmission gap has not been available and the L3 filter has not been used.

8.1.2.3.2 E-UTRAN TDD – TDD inter frequency measurements

8.1.2.3.2.1 E-UTRAN TDD – TDD inter frequency measurements when no DRX is used

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

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

Where:

T_{Inter}: This is the minimum time that is available for inter frequency measurements during the measurement period $T_{Measurement\_Period\_Inter\_TDD}$ with an arbitrarily chosen timing. The minimum time per transmission gap is calculated by assuming [2*0.5 ms] for implementation margin. The value of $T_{Measurement\_Period\_TDD\_Inter}$ is defined in table 8.1.2.3.4.1-1.

$T_{Basic\_Identify\_Inter}$ = 480 ms. It is the time period used in the inter frequency equation where the maximum allowed time for the UE to identify a new TDD inter-frequency cell is defined.

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

- RSRP related side condition given in Section 9.1 are fulfilled for a corresponding Band,
- $SCH\_RP|_{dBm} \geq$ -127 dBm for Bands 1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40 and SCH_RP/Iot > -4 dB,
- $SCH\_RP|_{dBm} \geq$ -126 dBm for Band 9 and SCH_RP/Iot > -4 dB,
- $SCH\_RP|_{dBm} \geq$ -125 dBm for Bands 2, 5, 7 and 11 and SCH_RP/Iot > -4 dB,
- $SCH\_RP|_{dBm} \geq$ -124 dBm for Bands 3, 8 and 13 and SCH_RP/Iot > -4 dB.

When transmission gaps are scheduled for TDD 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 ($T_{Measurement\_Period\_TDD\_Inter}$) given by table 8.1.2.3.2.1-1:

Table 8.1.2.3.2.1-1: $T_{Measurement\_Period\_TDD\_Inter}$ for different configurations

Configuration	Measurement bandwidth [RB]	Number of UL/DL sub-frames per half frame (5 ms)		DwPTS		$T_{Measurement\_Period\_TDD\_Inter}$ [ms]
		DL	UL	Normal CP	Extended CP	
0	6	2	2	$19760 \cdot T_s$	$20480 \cdot T_s$	480 x $N_{freq, EUTRA-TDD}$
1 (Note 1)	50	2	2	$19760 \cdot T_s$	$20480 \cdot T_s$	240 x $N_{freq, EUTRA-TDD}$
Note 1: This configuration is optional Note 2: T_s is defined in 3GPP TS 36.211 [16]						

Where:

$N_{freq, EUTRA-TDD}$: This is the number of TDD frequencies indicated in the inter frequency measurement control information.

The UE shall be capable of performing RSRP and RSRQ measurements of at least 4 inter-frequency cells per TDD inter-frequency for up to 3 TDD inter-frequencies and the UE physical layer shall be capable of reporting RSRP and RSRQ measurements to higher layers with the measurement period $T_{Measurement\_Period\_TDD\_Inter}$.

8.1.2.3.2.2 E-UTRAN TDD – TDD inter frequency measurements when DRX is used

When DRX is in use the UE shall be able to identify a new detectable E-UTRAN TDD inter frequency cell within $T_{identify\_inter}$ as shown in table 8.1.2.3.2.2-1

Table 8.1.2.3.2.2-1: Requirement to identify a newly detectable TDD interfrequency cell

DRX cycle length (s)	$T_{identify\_inter}$ (s) (DRX cycles)	
	Gap period = 40 ms	Gap period = 80 ms
≤0.04	Non DRX Requirements in section 8.1.2.3.1.1 are applicable	Non DRX Requirements in section 8.1.2.3.1.1 are applicable
[0.08]	TBD TBD	TBD TBD
[0.16]	TBD TBD	TBD TBD
[0.32]	TBD TBD	TBD TBD
[0.64]	TBD TBD	TBD TBD
[1.28]	TBD TBD	TBD TBD
[2.56]	TBD TBD	TBD TBD

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

- RSRP related side condition given in Section 9.1 are fulfilled for a corresponding Band,
- $SCH\_RP|_{dBm} \geq$ -127 dBm for Bands 1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40 and SCH_RP/Iot > -4 dB,
- $SCH\_RP|_{dBm} \geq$ -126 dBm for Band 9 and SCH_RP/Iot > -4 dB,
- $SCH\_RP|_{dBm} \geq$ -125 dBm for Bands 2, 5, 7 and 11 and SCH_RP/Iot > -4 dB,
- $SCH\_RP|_{dBm} \geq$ -124 dBm for Bands 3, 8 and 13 and SCH_RP/Iot > -4 dB.

The UE shall be capable of performing RSRP and RSRQ measurements of at least 4 inter-frequency cells per TDD inter-frequency for up to 3 TDD inter-frequencies and the UE physical layer shall be capable of reporting RSRP and RSRQ measurements to higher layers with the measurement period defined in Table 8.1.2.3.2.2-2.

Table 8.1.2.3.2.2-2: Requirement to measure TDD interfrequency cells

DRX cycle length (s)	$T_{measure\_inter}$ (s) (DRX cycles)
≤0.04	Non DRX Requirements in section 8.1.2.3.1.1 are applicable
[0.08]	$0.48*N_{freq}$ ($6*N_{freq}$)
[0.16]	$0.8*N_{freq}$ ($5*N_{freq}$)
[0.32]	$1.6*N_{freq}$ ($5*N_{freq}$)
[0.64]	$3.2*N_{freq}$ ($5*N_{freq}$)
[1.28]	$6.4*N_{freq}$ ($5*N_{freq}$)
[2.56]	$12.8*N_{freq}$ ($5*N_{freq}$)

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

8.1.2.3.3 E-UTRAN TDD – FDD inter frequency measurements

8.1.2.3.3.1 E-UTRAN TDD – FDD inter frequency measurements when no DRX is used

The requirements in this section shall apply to UE supporting FDD and TDD.

The requirements in section 8.1.2.3.1.1 also apply for this section.

8.1.2.3.3.2 E-UTRAN TDD – FDD inter frequency measurements when DRX is used

The requirements in this section shall apply to UE supporting FDD and TDD.

The requirements in section 8.1.2.3.1.2 also apply for this section.

8.1.2.3.3.2 (Void)

8.1.2.3.4 E-UTRAN FDD – TDD inter frequency measurements

8.1.2.3.4.1 E-UTRAN FDD – TDD inter frequency measurements when no DRX is used

The requirements in this section shall apply to UE supporting FDD and TDD.

The requirements in section 8.1.2.3.2.1 also apply for this section.

8.1.2.3.4.2 E-UTRAN FDD – TDD inter frequency measurements when DRX is used

The requirements in this section shall apply to UE supporting FDD and TDD.

The requirements in section 8.1.2.3.2.2 also apply for this section.

8.1.2.4 Inter RAT measurements

8.1.2.4.1 E-UTRAN FDD – UTRAN FDD measurements

8.1.2.4.1.1 E-UTRAN FDD – UTRAN FDD measurements when no DRX is used

8.1.2.4.1.1.1 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

$$T_{identify,\ UTRA\_FDD} = T_{basic\_identify\_UTRA\_FDD} \cdot \frac{480}{Tinter1} \cdot N_{Freq} \quad ms$$

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.

8.1.2.4.1.1.2 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

$$T_{measurement\_UTRA\_FDD} = Max\left\{T_{Measurement\_Period\ UTRA\_FDD}, T_{basic\_measurement\_UTRA\_FDD} \cdot \frac{T_{Measurement\_Period\ UTRA\_FDD}}{T_{UTRA\_FDD}} \cdot N_{Freq}\right\} ms$$

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 $T_{Measurement\_UTRA\_FDD}$.

$X_{basic\ measurement\ UTRA\_FDD} = 6$

$T_{Measurement\_Period\ UTRA\_FDD}$ = 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} and T_{inter1} are defined in section 8.1.2.1.1

8.1.2.4.1.2 E-UTRAN FDD – UTRAN FDD measurements when DRX is used

When explicit neighbour list is provided and DRX is used the UE shall be able to identify a new detectable cell belonging to the neighbour cell list within $T_{identify,UTRA\_FDD}$ as shown in table 8.1.2.4.1.2-1

Table 8.1.2.4.1.2-1: Requirement to identify a newly detectable UTRA FDD cell

DRX cycle length (s)	$T_{identify\_inter}$ (s) (DRX cycles)	
	Gap period = 40 ms	Gap period = 80 ms
≤0.04	Non DRX Requirements in section 8.1.2.3.1.1 are applicable	Non DRX Requirements in section 8.1.2.3.1.1 are applicable
0.08	3.2* N_{freq} (40* N_{freq})	7.2* N_{freq} (90* N_{freq})
0.16	3.2* N_{freq} (20* N_{freq})	7.2* N_{freq} (45* N_{freq})
0.32	6.4* N_{freq} (20* N_{freq})	7.36* N_{freq} (23* N_{freq})
0.64	12.8 * N_{freq} (20* N_{freq})	12.8 * N_{freq} (20* N_{freq})
1.28	25.6 * N_{freq} (20* N_{freq})	25.6* N_{freq} (20* N_{freq})
2.56	51.2* N_{freq} (20* N_{freq})	51.2* N_{freq} (20* N_{freq})

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

The UE shall be capable of performing RSCP and Ec/Io measurements of at least 6 UTRA cells per UTRA FDD carrier for up to 3 UTRA FDD carriers and the UE physical layer shall be capable of reporting RSCP and Ec/Io measurements to higher layers with the measurement period defined in table 8.1.2.3.1.2-2.

Table 8.1.2.4.1.2-2: Requirement to measure UTRA FDD cells

DRX cycle length (s)	$T_{measure\_inter}$ (s) (DRX cycles)
≤0.04	Non DRX Requirements in section 8.1.2.4.1.1 are applicable
0.08	$0.48*N_{freq}$ ($6*N_{freq}$)
0.16	$0.8*N_{freq}$ ($5*N_{freq}$)
0.32	$1.6*N_{freq}$ ($5*N_{freq}$)
0.64	$3.2*N_{freq}$ ($5*N_{freq}$)
1.28	$6.4*N_{freq}$ ($5*N_{freq}$)
2.56	$12.8*N_{freq}$ ($5*N_{freq}$)

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

8.1.2.4.2 E-UTRAN TDD – UTRAN FDD measurements

8.1.2.4.2.1 E-UTRAN TDD – UTRAN FDD measurements when no DRX is used

8.1.2.4.2.2 E-UTRAN TDD – UTRAN FDD measurements when DRX is used

8.1.2.4.3 E-UTRAN TDD – UTRAN TDD measurements

8.1.2.4.3.1 E-UTRAN TDD – UTRAN TDD measurements when no DRX is used

8.1.2.4.3.1.1 Identification of a new UTRA TDD 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

$$T_{identify,\ UTRA\_TDD} = Max\left\{5000, T_{basic\ identify\ UTRA\_TDD} \cdot \frac{480}{T_{inter1}} \cdot N_{Freq}\right\} ms$$

If the UE does not require transmit gap to perform inter-RAT UTRA TDD measurements, the UE shall be able to identify a new detectable inter-RAT UTRA TDD cell belonging to the monitored set within 5000 ms.

A cell shall be considered detectable when

- P-CCPCH Ec/Io $\geq$ -8 dB,

- DwPCH_Ec/Io $\geq$ -5 dB.

When L3 filtering is used an additional delay can be expected.

8.1.2.4.3.1.2 UE UTRA TDD P-CCPCH RSCP measurement capability

When transmission gaps are scheduled for UTRA TDD inter RAT measurements the UE physical layer shall be capable of reporting measurements to higher layers with measurement accuracy as specified in Section 9.3 with measurement period given by

$$T_{measurement\ UTRA\_TDD} = Max\left\{T_{Measurement\_Period\ UTRA\_TDD}, T_{basic\ measurement\ UTRA\_TDD} \cdot \frac{T_{Measurement\_Period\ UTRA\_TDD}}{T_{UTRA\_TDD}} \cdot N_{Freq}\right\} ms$$

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

The UE shall be capable of performing UTRA TDD P-CCPCH RSCP measurements for $X_{basic\ measurementUTRA\_TDD}$ inter-frequency cells per TDD frequency of the monitored set for up to 3 UTRA TDD carrier frequencies, and the UE physical layer shall be capable of reporting measurements to higher layers with the measurement period of $T_{Measurement\_UTRA\_TDD}$.

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

$T_{Measurement\_Period\ UTRA\_TDD}$ = 480 ms is the period used for calculating the measurement period $T_{measurement\_UTRA\_TDD}$ for UTRA TDD P-CCPCH RSCP measurements.

T_{UTRA_TDD}: This is the minimum time that is available for UTRA TDD measurements, during the period $T_{Measurement\_Period\ UTRA\_TDD}$ 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.

$T_{basic\_identify\_UTRA\_TDD}$ = 800 ms is the time period used in the inter RAT equation where the maximum allowed time for the UE to identify a new UTRA TDD cell is defined.

$T_{basic\_measurement\_UTRA\_TDD}$ = 50 ms is the time period used in the equation for defining the measurement period for inter RAT P-CCPCH RSCP measurements.

N_{freq} and T_{inter1} are defined in section 8.1.2.1.1

8.1.2.4.3.2 E-UTRAN TDD – UTRAN TDD measurements when DRX is used

8.1.2.4.4 E-UTRAN FDD – UTRAN TDD measurements

The requirements in section 8.1.2.4.3 also apply for this section.

8.1.2.4.5 E-UTRAN FDD – GSM measurements

8.1.2.4.5.1 E-UTRAN FDD – GSM measurements when no DRX is used

[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.

8.1.2.4.5.1.1 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 [8], 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.

8.1.2.4.5.1.2 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 [2].
- 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 [2].

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 [9].

8.1.2.4.5.1.2.1 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]

8.1.2.4.5.1.2.2 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.

8.1.2.4.1.5.3 Periodic Reporting

Reported measurements in periodically triggered measurement reports shall meet the requirements in section [2].

8.1.2.4.1.5.4 Event Triggered Reporting

Reported measurements in event triggered measurement reports shall meet the requirements in section [2].

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.

8.1.2.4.5.1 E-UTRAN FDD – GSM measurements when DRX is used

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.

8.2 Capabilities for Support of Event Triggering and Reporting Criteria

8.2.1 Introduction

This section contains requirements on UE capabilities for support of event triggering and reporting criteria. As long as the measurement configuration does not exceed the requirements stated in section 8.x.2, the UE shall meet the performance requirements defined in section 9.

The UE can be requested to make measurements under different measurement identities defined in 3GPP TS 36.331 [2]. Each measurement identity corresponds to either event based reporting, periodic reporting or no reporting. In case of event based reporting, each measurement identity is associated with one or more events, each identified with an event identity. In case of periodic reporting, a measurement identity is associated with one periodic reporting criterion. In case of no reporting, a measurement identity is associated with one no reporting criterion.

The purpose of this section is to set some limits on the number of different event, periodic and no reporting criteria the UE may be requested to track in parallel.

8.2.2 Requirements

In this section a reporting criterion corresponds to either one event (in the case of event based reporting), or one periodic reporting criterion (in case of periodic reporting), or one no reporting criterion (in case of no reporting). For event based reporting, each instance of event, with the same or different event identities, is counted as separate reporting criterion in table 8.x.2-1.

The UE shall be able to support in parallel per category up to E_{cat} reporting criteria according to table 8.x.2-1. For the measurement categories belonging to measurements on: E-UTRA intra-frequency cells, E-UTRA inter frequency cells, and inter-RAT per supported RAT, the UE need not support more than 21 reporting criteria in total.

Table 8.2.2-1: Requirements for reporting criteria per measurement category

Measurement category	E_{cat}	Note
Intra-frequency	9	E-UTRA intra-frequency cells
Inter-frequency	7	E-UTRA inter-frequency cells
Inter-RAT (E-UTRAN FDD or TDD, UTRAN FDD, UTRAN TDD, GSM, cdma2000 1 x RTT and HRPD)	5	Only applicable for UE with this (inter-RAT) capability. This requirement (E_{cat} = 5) is per supported RAT.

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 [4]. 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 [5].

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≥ [-127] dBm for Bands [1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40],

RSRP|dBm≥ [-126] dBm for Bands [9],

$RSRP|_{dBm}$≥ [-125] dBm for Bands [2, 5, 7 and 11],

$RSRP|_{dBm}$≥ [-124] dBm for Bands [3, 8, 13 …],

[*Editors note that the above mentioned RSRP side conditions apply in accordance on the conditions given for reference sensitivity in TS 36.101*]

Table 9.1.2.1-1: RSRP Intra frequency absolute accuracy

Parameter	Unit	Accuracy [dB]		Conditions[1]			
		Normal condition	Extreme condition	Bands 1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40	Bands 2, 5, 7 and 11	Bands 3, 8, 13 …	Band 9
				Io	Io	Io	Io
RSRP for Ês/Iot ≥ -6 dB	dBm	±[6]	±[9]	[-121dBm/15kHz … -70dBm/ $BW_{Channel}$]	[-119dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-118dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-120dBm/15kHz … -50dBm/ $BW_{Channel}$]
RSRP for Ês/Iot ≥ -6 dB	dBm	±[8]	±[11]	[-70dBm/ $BW_{Channel}$ … -50dBm/ $BW_{Channel}$]	[-119dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-118dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-120dBm/15kHz … -50dBm/ $BW_{Channel}$]
Note 1. Io is assumed to have constant EPRE across the bandwidth.							

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, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40],

$RSRP1,2|_{dBm} \geq$ [-126] dBm for Bands [9],

$RSRP1,2|_{dBm} \geq$ [-125] dBm for Bands [2, 5, 7 and 11],

$RSRP1,2|_{dBm} \geq$ [-124] dBm for Bands [3, 8, 13 …],

[*Editors note that the above mentioned RSRP side conditions apply in accordance on the conditions given for reference sensitivity in TS 36.101*]

Table 9.1.2.2-1: RSRP Intra frequency relative accuracy

Parameter	Unit	Accuracy [dB]		Conditions[1]			
		Normal condition	Extreme condition	Bands 1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40	Bands 2, 5, 7 and 11	Bands 3, 8, 13 …	Band 9
				Io	Io	Io	Io
RSRP for Ês/Iot > -3 dB	dBm	±[2]	±[3]	[-121dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-119dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-118dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-120dBm/15kHz … -50dBm/ $BW_{Channel}$]
RSRP for Ês/Iot ≥ -6 dB	dBm	±[3]	±[3]	[-121dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-119dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-118dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-120dBm/15kHz … -50dBm/ $BW_{Channel}$]
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≥ [-127] dBm for Bands [1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40],

RSRP|dBm≥ [-126] dBm for Bands [9],

RSRP|dBm≥ [-125] dBm for Bands [2, 5, 7 and 11],

RSRP|dBm≥ [-124] dBm for Bands [3, 8, 13 …],

[*Editors note that the above mentioned RSRP side conditions apply in accordance on the conditions given for reference sensitivity in TS 36.101*]

Table 9.1.3.1-1: RSRP Inter frequency absolute accuracy

Parameter	Unit	Accuracy [dB]		Conditions[1]			
		Normal condition	Extreme condition	Bands 1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40	Bands 2, 5, 7 and 11	Bands 3, 8, 13 …	Band 9
				Io	Io	Io	Io
RSRP for Ês/Iot ≥ -6 dB	dBm	±[6]	±[9]	[-121dBm/15kHz … -70dBm/ $BW_{Channel}$]	[-119dBm/15kHz … -70dBm/ $BW_{Channel}$]	[-118dBm/15kHz … -70dBm/ $BW_{Channel}$]	[-120dBm/15kHz … -70dBm/ $BW_{Channel}$]
RSRP for Ês/Iot ≥ -6 dB	dBm	±[8]	±[11]	[-70dBm/ $BW_{Channel}$ … -50dBm/ $BW_{Channel}$]	[-70dBm/ $BW_{Channel}$ … -50dBm/ $BW_{Channel}$]	[-70dBm/ $BW_{Channel}$ … -50dBm/ $BW_{Channel}$]	[-70dBm/ $BW_{Channel}$ … -50dBm/ $BW_{Channel}$]
Note 1. Io is assumed to have constant EPRE across the bandwidth.							

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 9.1.3.2-1 are valid under the following conditions:

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

$RSRP1|_{dBm}$ ≥ [-127] dBm if RSRP1 is on Bands [1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40],

$RSRP1|_{dBm}$ ≥ [-126] dBm if RSRP1 is on Band [9],

$RSRP1|_{dBm}$ ≥ [-125] dBm if RSRP1 is on Bands [2, 5, 7 and 11],

$RSRP1|_{dBm}$ ≥ [-124] dBm if RSRP1 is on Bands [3, 8, 13 …],

RSRP2$|_{dBm}$ ≥ [-127] dBm if RSRP2 is on Bands [1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40],

RSRP2$|_{dBm}$ ≥ [-126] dBm if RSRP2 is on Band [9],

RSRP2$|_{dBm}$ ≥ [-125] dBm if RSRP2 is on Bands [2, 5, 7 and 11],

RSRP2$|_{dBm}$ ≥ [-125] dBm if RSRP2 is on Bands [3, 8, 13 …]

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

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

[*Editors note that the above mentioned RSRP side conditions apply in accordance on the conditions given for reference sensitivity in TS 36.101*]

Table 9.1.3.2-1: RSRP Inter frequency relative accuracy

Parameter	Unit	Accuracy [dB]		Conditions[1]			
		Normal condition	Extreme condition	RSRP is on Bands 1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40	RSRP is on Bands 2, 5, 7 and 11	RSRP is on Bands 3, 8, 13 …	RSRP is on Band 9
				Io	Io	Io	Io
RSRP for Ês/Iot > -6dB	dBm	±[6]	±[6]	[-121dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-119dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-118dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-120dBm/15kHz … -50dBm/ $BW_{Channel}$]
Note 1. Io is assumed to have constant EPRE across the bandwidth.							

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≥ [-127] dBm for Bands [1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40] ,

RSRP|dBm≥ [-126] dBm for Bands [9],

$RSRP|_{dBm}$≥ [-125] dBm for Bands [2, 5, 7 and 11],

$RSRP|_{dBm}$≥ [-124] dBm for Bands [3, 8, 13 …],

[*Editors note that the above mentioned RSRP side conditions apply in accordance on the conditions given for reference sensitivity in TS 36.101*]

Table 9.1.5.1-1: RSRQ Intra frequency absolute accuracy

Parameter	Unit	Accuracy [dB]		Conditions[1]			
		Normal condition	Extreme condition	Bands 1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40	Bands 2, 5, 7 and 11	Bands 3, 8, 13 …	Band 9
				Io	Io	Io	Io
RSRQ when RSRP Ês/Iot > -3 dB	dBm	± [2.5]	± [4]	[-121dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-119dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-118dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-120dBm/15kHz … -50dBm/ $BW_{Channel}$]
RSRQ when RSRP Ês/Iot ≥ -6 dB	dBm	± [3.5]	± [4]	[-121dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-119dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-118dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-120dBm/15kHz … -50dBm/ $BW_{Channel}$]
Note 1. Io is assumed to have constant EPRE across the bandwidth.							

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≥ [-127] dBm for Bands [1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40],

RSRP|dBm≥ [-126] dBm for Bands [9],

$RSRP|_{dBm}$≥ [-125] dBm for Bands [2, 5, 7 and 11],

$RSRP|_{dBm}$≥ [-124] dBm for Bands [3, 8, 13 …],[*Editors note that the above mentioned RSRP side conditions apply in accordance on the conditions given for reference sensitivity in TS 36.101*]

Table 9.1.6.1-1: RSRQ Inter frequency absolute accuracy

Parameter	Unit	Accuracy [dB]		Conditions[1]			
		Normal condition	Extreme condition	Bands 1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40	Bands 2, 5, 7 and 11	Bands 3, 8, 13 …	Bands 9
				Io	Io	Io	Io
RSRQ when RSRP Ês/Iot > -3 dB	dBm	± [2.5]	± [4]	[-121dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-119dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-118dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-120dBm/15kHz … -50dBm/ $BW_{Channel}$]
RSRQ when RSRP Ês/Iot ≥ -6 dB	dBm	± [3.5]	± [4]	[-121dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-119dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-118dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-120dBm/15kHz … -50dBm/ $BW_{Channel}$]
Note 1. Io is assumed to have constant EPRE across the bandwidth.							

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 [1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40],

$RSRP1|_{dBm} \geq$ [-126] dBm if RSRP1 is on Band [9],

$RSRP1|_{dBm} \geq$ [-125] dBm if RSRP1 is on Bands [2, 5, 7 and 11],

$RSRP1|_{dBm} \geq$ [-124] dBm if RSRP1 is on Bands [3, 8, 13 …],

$RSRP2|_{dBm} \geq$ [-127] dBm if RSRP2 is on Bands [1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40],

$RSRP2|_{dBm} \geq$ [-126] dBm if RSRP2 is on Band [9],

$RSRP2|_{dBm} \geq$ [-125] dBm if RSRP2 is on Bands [2, 5, 7 and 11],

$RSRP2|_{dBm} \geq$ [-125] dBm if RSRP2 is on Bands [3, 8, 13 …]

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

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

[*Editors note that the above mentioned RSRP side conditions apply in accordance on the conditions given for reference sensitivity in TS 36.101*]

Table 9.1.6.2-1: RSRQ Inter frequency relative accuracy

Parameter	Unit	Accuracy [dB]		Conditions[1]			
		Normal condition	Extreme condition	RSRQ is on Bands 1, 4, 6, 10, 33, 34, 35, 36, 37, 38, 39 and 40	RSRQ is on Bands 2, 5, 7 and 11	RSRQ is on Bands 3, 8, 13 …	RSRQ is on Band 9
				Io	Io		
RSRQ when RSRP Ês/Iot > -3 dB	dBm	± [3]	± [4]	[-121dBm/15kHz … -50dBm]	[-119dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-118dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-120dBm/15kHz … -50dBm/ $BW_{Channel}$]
RSRQ when RSRP Ês/Iot ≥ -6 dB	dBm	± [4]	± [4]	[-121dBm/15kHz … -50dBm]	[-119dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-118dBm/15kHz … -50dBm/ $BW_{Channel}$]	[-120dBm/15kHz … -50dBm/ $BW_{Channel}$]
Note 1. Io is assumed to have constant EPRE across the bandwidth.							

9.1.7 RSRQ Measurement Report Mapping

The reporting range of RSRQ is defined from -19.5 dB to -3 with 0.5 dB resolution.

The mapping of measured quantity is defined in table 9.1.x-1. The range in the signalling may be larger than the guaranteed accuracy range.

Table 9.1.7-1: RSRQ measurement report mapping

Reported value	Measured quantity value	Unit
RSRQ_00	RSRQ < -19.5	dB
RSRQ_01	-19.5 ≤ RSRQ < -19	dB
RSRQ_02	-19 ≤ RSRQ < -18.5	dB
…	…	…
RSRQ_31	-4 ≤ RSRQ < -3.5	dB
RSRQ_32	-3.5 ≤ RSRQ < -3	dB
RSRQ_33	-3 ≤ RSRQ	dB

9.1.8 Power Headroom

The power headroom (PH), expressed in dB, is defined as the difference between the nominal UE maximum transmit power and the estimated power for PUSCH transmission according to section 5.1.1.1 in TS 36.213.

9.1.8.1 Period

The reported power headroom shall be estimated over 1 subframe. The power headroom shall be estimated only in a subframe where PUSCH is transmitted.

9.1.8.2 Reporting Delay

The power headroom reporting delay is defined as the time between the end of the power headroom estimation period and the time when the UE starts transmitting the power headroom over the radio interface. The reporting delay of the power headroom shall be [0 ms], which is applicable for all configured triggering mechanisms for power headroom reporting.

9.1.8.4 Report Mapping

The power headroom reporting range is from -23 ...+40 dB. Table 9.1.8.4-1 defines the report mapping.

Table 9.1.8.4-1: Power headroom report mapping

Reported value	Measured quantity value (dB)
POWER_HEADROOM_0	-23 ≤ PH < -22
POWER_HEADROOM_1	-22 ≤ PH < -21
POWER_HEADROOM_2	-21 ≤ PH < -20
POWER_HEADROOM_3	-20 ≤ PH < -19
POWER_HEADROOM_4	-19 ≤ PH < -18
POWER_HEADROOM_5	-18 ≤ PH < -17
…	…
POWER_HEADROOM_57	34 ≤ PH < 35
POWER_HEADROOM_58	35 ≤ PH < 36
POWER_HEADROOM_59	36 ≤ PH < 37
POWER_HEADROOM_60	37 ≤ PH < 38
POWER_HEADROOM_61	38 ≤ PH < 39
POWER_HEADROOM_62	39 ≤ PH < 40
POWER_HEADROOM_63	PH ≥ 40

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 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 3GPP TS 25.302 [6].

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

NOTE: This measurement is for handover between E-UTRAN and UTRAN FDD.

The requirements in this section are valid for terminals supporting this capability.

The measurement period for RRC_CONNECTED state is specified in section 8.1.2.4.1.

In RRC_CONNECTED state the accuracy requirements shall be the same as the inter-frequency measurement accuracy requirements for FDD CPICH RSCP in 3GPP TS 25.133 [cc].

If the UE, in RRC_CONNECTED state, needs measurement gaps to perform UTRAN FDD measurements, the UTRAN FDD measurement procedure and measurement gap pattern stated in section 8.1.2.4.1 shall apply.

The reporting range and mapping specified for FDD CPICH RSCP in 3GPP TS 25.133 [cc] shall apply.

9.2.2 UTRAN FDD carrier RSSI

NOTE: This measurement is for handover between E-UTRAN and UTRAN FDD.

The requirements in this section are valid for terminals supporting this capability.

The measurement period for RRC_CONNECTED state is equal to the measurement period for FDD CPICH measurements, whose measurement period is specified in section 8.1.2.4.1.

In RRC_CONNECTED state the accuracy requirements shall be the same as the inter-frequency measurement accuracy requirements for FDD carrier RSSI in 3GPP TS 25.133 [cc.

If the UE, in RRC_CONNECTED state, needs measurement gaps to perform UTRAN FDD measurements, the UTRAN FDD measurement procedure and measurement gap pattern stated in section 8.1.2.4.1 shall apply.

The reporting range and mapping specified for FDD carrier RSSI in 3GPP TS 25.133 [cc] shall apply.

9.2.3 UTRAN FDD CPICH Ec/No

NOTE: This measurement is for handover between E-UTRAN and UTRAN FDD.

The requirements in this section are valid for terminals supporting this capability.

The measurement period for RRC_CONNECTED state is specified in section 8.1.2.4.1.

In RRC_CONNECTED state the accuracy requirements shall be the same as the inter-frequency measurement accuracy requirements for FDD CPICH Ec/No in 3GPP TS 25.133 [cc].

If the UE, in RRC_CONNECTED state, needs measurement gaps to perform UTRAN FDD measurements, the UTRAN FDD measurement procedure and measurement gap pattern stated in section 8.1.2.4.1 shall apply.

The reporting range and mapping specified for FDD CPICH Ec/No in 3GPP TS 25.133 [cc] shall apply.

9.3 UTRAN TDD Measurements

The requirements in this clause are applicable for a UE:

- in state RRC_CONNECTED
- performing measurements according to section 8.1.2.4.3 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 3GPP TS 25.302 [6].

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.

9.3.1 UTRAN TDD P-CCPCH RSCP

NOTE: This measurement is for handover between E-UTRAN and UTRAN TDD.

The requirements in this section are valid for terminals supporting this capability.

The measurement period for RRC_CONNECTED state is specified in section 8.1.2.4.3.

In RRC_CONNECTED state the accuracy requirements shall be the same as the inter-frequency measurement accuracy requirements for TDD P-CCPCH in 3GPP TS 25.123 [19].

If the UE, in RRC_CONNECTED state, needs measurement gaps to perform UTRAN TDD measurements, the UTRAN TDD measurement procedure and measurement gap pattern stated in section 8.1.2.4.3 shall apply.

The reporting range and mapping specified for TDD P-CCPCH RSCP in 3GPP TS 25.123 [19] shall apply.

9.3.2 UTRAN TDD carrier RSSI

NOTE: This measurement is for handover between E-UTRAN and UTRAN TDD.

The requirements in this section are valid for terminals supporting this capability.

The measurement period for RRC_CONNECTED state is equal to the measurement period for TDD P-CCPCH RSCP measurement, whose measurement period is specified in section 8.1.2.4.3.

In RRC_CONNECTED state the accuracy requirements shall be the same as the inter-frequency measurement accuracy requirements for TDD carrier RSSI in 3GPP TS 25.123 [19].

If the UE, in RRC_CONNECTED state, needs measurement gaps to perform UTRAN TDD measurements, the UTRAN TDD measurement procedure and measurement gap pattern stated in section 8.1.2.4.3 shall apply.

The reporting range and mapping specified for TDD carrier RSSI in 3GPP TS 25.123 [19] shall apply.

9.3.3 Void

9.4 GSM Measurements

The requirements in this clause are applicable for a UE:

- in state RRC_CONNECTED
- performing measurements according to section 8.1.2.4.5 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 3GPP TS 25.302 [6].

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.

9.4.1 GSM carrier RSSI

NOTE: This measurement is for handover between E-UTRAN and GSM.

The requirements in this section are valid for terminals supporting this capability.

The measurement period for RRC_CONNECTED state is specified in section 8.1.2.4.5.

In RRC_CONNECTED state the measurement accuracy requirements for RXLEV in TS 45.008 [8] shall apply.

If the UE, in RRC_CONNECED state, needs measurement gaps to perform GSM measurements, the GSM measurement procedure and measurement gap pattern stated in section 8.1.2.4.5 shall apply.

The reporting range and mapping specified for RXLEV in TS 45.008 [8] shall apply.

10 Measurements Performance Requirements for E-UTRAN

10.1 Received Interference Power

The measurement period shall be 100 ms.

10.1.1 Absolute accuracy requirement

Table 10.2.1-1: Received Interference Power absolute accuracy

Parameter	Unit	Accuracy [dB]	Conditions
			Iob [dBm/180 kHz]
Iob	dBm/180 kHz	± 4	-117 ... -96

10.1.2 Relative accuracy requirement

The relative accuracy is defined as the Received Interference Power measured at one frequency compared to the Received Interference Power measured from the same frequency at a different time.

Table 10.2.2-1: Received Interference Power relative accuracy

Parameter	Unit	Accuracy [dB]	Conditions
			Iob [dBm/180 kHz]
Iob	dBm/180 kHz	± 0.5	-117 ... -96 AND for changes ≤ ±9.0 dB

10.1.3 Received Interference Power measurement report mapping

The reporting range for *Received Interference Power (RIP)* is from -126 ... -75 dBm.

In table 10.2.3-1 the mapping of measured quantity is defined. The range in the signalling may be larger than the guaranteed accuracy range.

Table 10.2.3-1: Received Interference Power measurement reporting range

Reported value	Measured quantity value	Unit
RTWP_LEV _000	RIP < -126.0	dBm
RTWP_LEV _001	-126.0 ≤ RIP < -125.9	dBm
RTWP_LEV _002	-125.9 ≤ RIP < -125.8	dBm
…	…	…
RTWP_LEV _509	-75.2 ≤ RIP < -75.1	dBm
RTWP_LEV _510	-75.1 ≤ RIP < -75.0	dBm
RTWP_LEV _511	-75.0 ≤ RIP	dBm

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
2008-09	RP#41	RP-080644	006	1	E-UTRAN TDD intra frequency measurements when DRX is used	8.2.0	8.3.0
2008-09	RP#41	RP-080644	008	1	E-UTRAN TDD - UTRAN TDD measurements	8.2.0	8.3.0
2008-09	RP#41	RP-080644	012		RSRQ reporting Range	8.2.0	8.3.0
2008-09	RP#41	RP-080644	018	1	Interfrequency and UTRA interRAT DRX peformance requirements	8.2.0	8.3.0
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2008-09	RP#41	RP-080644	043		Received interference power measurement performance requirement	8.2.0	8.3.0
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2008-09	RP#41	RP-080642	004		Correction of E-UTRAN to UTRAN TDD handover	8.2.0	8.3.0
2008-09	RP#41	RP-080642	016	1	Definition of Symbols	8.2.0	8.3.0
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2008-09	RP#41	RP-080642	021	1	General updates to 36.133	8.2.0	8.3.0
2008-09	RP#41	RP-080642	023	1	Handover requirements for E-UTRAN to cdma200 HRPD/1x	8.2.0	8.3.0
2008-09	RP#41	RP-080642	024		Inter-frequency and inter-RAT measurement requirements for multiple layer monitoring	8.2.0	8.3.0
2008-09	RP#41	RP-080642	025		Side conditions for UE measurement procedures and measurement performance requirements	8.2.0	8.3.0
2008-09	RP#41	RP-080642	026		Correction to cell reselection Requirement from E-UTRAN to HRPD/cdma200 1x	8.2.0	8.3.0
2008-09	RP#41	RP-080642	027		IRAT Measurement requirements in TS 36.133	8.2.0	8.3.0
2008-09	RP#41	RP-080713	022	1	Corrections to Handover requirements	8.2.0	8.3.0
2008-09	RP#41	RP-080713	028		Measurement reporting requirements	8.2.0	8.3.0
2008-09	RP#41	RP-080713	029	2	RRC re-establishment requirements	8.2.0	8.3.0
2008-09	RP#41	RP-080713	032		Correction to UE measurement requirements	8.2.0	8.3.0
2008-09	RP#41	RP-080713	033		Correction for the definition of interruption time	8.2.0	8.3.0
2008-09	RP#41	RP-080713	040	1	Correction to idle mode higher priority search requirements	8.2.0	8.3.0
2008-09	RP#41	RP-080713	045		E-UTRAN TDD inter frequency measurement requirements	8.2.0	8.3.0
2008-09	RP#41	RP-080713	046		Updates of the Measurement procedures in RRC_Connected state from RAN 4#47bis and RAN 4#48	8.2.0	8.3.0

History

Document history		
V8.2.0	November 2008	Publication
V8.3.0	November 2008	Publication