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*Technical Specification*

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

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

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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# Contents

# Foreword

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# 1 Scope

The present document contains the description and definition of the measurements done at the UE and network in TDD mode in order to support operation in idle mode and connected mode.

# 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 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)". |
| [2] | 3GPP TS 25.212: "Multiplexing and channel coding (FDD)". |
| [3] | 3GPP TS 25.213: "Spreading and modulation (FDD)". |
| [4] | 3GPP TS 25.214: "Physical layer procedures (FDD)". |
| [5] | 3GPP TS 25.215: "Physical layer measurements (FDD)". |
| [6] | 3GPP TS 25.221: "Physical channels and mapping of transport channels onto physical channels (TDD)". |
| [7] | 3GPP TS 25.222: "Multiplexing and channel coding (TDD)". |
| [8] | 3GPP TS 25.223: "Spreading and modulation (TDD)". |
| [9] | 3GPP TS 25.224: "Physical layer procedures (TDD)". |
| [10] | 3GPP TS 25.301: "Radio Interface Protocol Architecture". |
| [11] | 3GPP TS 25.302: "Services provided by the Physical layer". |
| [12] | 3GPP TS 25.303: "UE functions and interlayer procedures in connected mode". |
| [13] | 3GPP TS 25.304: "UE procedures in idle mode". |
| [14] | 3GPP TS 25.331: "RRC Protocol Specification". |
| [15] | 3GPP TR 25.922: "Radio Resource Management Strategies". |
| [16] | 3GPP TR 25.923: "Report on Location Services (LCS)". |
| [17] | 3G TS 25.102: "UTRA (UE) TDD; Radio transmission and Reception" |
| [18] | 3G TS 25.105: "UTRA (BS) TDD; Radio transmission and Reception" |
| [19] | 3G TS 25.123: "Requirements for Support of Radio Resources Management (TDD)" |

# 3 Abbreviations

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

| | |
|---|---|
| BCH | Broadcast Channel |
| BCCH | Broadcast Control Channel (GSM) |
| BER | Bit Error Rate |
| BLER | Block Error Rate |
| CFN | Connection Frame Number |
| CPICH | Common Pilot Channel (FDD) |
| CRC | Cyclic Redundancy Check |
| DCA | Dynamic Channel Allocation |
| DCH | Dedicated Channel |
| DPCH | Dedicated Physical Channel |
| Ec/No | Received energy per chip divided by the power density in the band |
| FACH | Forward Access Channel |
| FCCH | Frequency Correction Channel (GSM) |
| FDD | Frequency Division Duplex |
| GSM | Global System for Mobile Communication |
| GPS | Global Positioning System |
| ISCP | Interference Signal Code Power |
| P-CCPCH | Primary Common Control Physical Channel |
| PCH | Paging Channel |
| PLMN | Public Land Mobile Network |
| PRACH | Physical Random Access Channel |
| PDSCH | Physical Downlink Shared Channel |
| PUSCH | Physical Uplink Shared Channel |
| RACH | Random Access Channel |
| RSCP | Received Signal Code Power |
| RSSI | Received Signal Strength Indicator |
| S-CCPCH | Secondary Common Control Physical Channel |
| SCH | Synchronisation Channel |
| SCTD | Space Code Transmit Diversity |
| SF | Spreading Factor |
| SFN | System Frame Number |
| SIR | Signal-to-Interference Ratio |
| TDD | Time Division Duplex |
| TDMA | Time Division Multiple Access |
| TrCH | Transport Channel |
| TTI | Transmission Time Interval |
| UE | User Equipment |
| UMTS | Universal Mobile Telecommunications System |
| USCH | Uplink Shared Channel |
| UTRA | UMTS Terrestrial Radio Access |
| UTRAN | UMTS Terrestrial Radio Access Network |

# 4 Control of UE/UTRAN measurements

In this clause the general measurement control concept of the higher layers is briefly described to provide an understanding on how L1 measurements are initiated and controlled by higher layers.

## 4.1 General measurement concept

L1 provides with the measurement specifications a toolbox of measurement abilities for the UE and the UTRAN. These measurements can be differentiated in different measurement types: intra-frequency, inter-frequency, inter-system, traffic volume, quality and internal measurements (see [14]).
In the L1 measurement specifications the measurements are distinguished between measurements in the UE (the

messages will be described in the RRC Protocol) and measurements in the UTRAN (the messages will be described in the NBAP and the Frame Protocol).

To initiate a specific measurement the UTRAN transmits a 'measurement control message' to the UE including a measurement ID and type, a command (setup, modify, release), the measurement objects and quantity, the reporting quantities, criteria (periodical/event-triggered) and mode (acknowledged/unacknowledged), see [14].
When the reporting criteria is fulfilled the UE shall answer with a 'measurement report message' to the UTRAN including the measurement ID and the results.
In idle mode the measurement control message is broadcast in a System Information.

Intra-frequency reporting events, traffic volume reporting events and UE internal measurement reporting events described in [14] define events which trigger the UE to send a report to the UTRAN. This defines a toolbox from which the UTRAN can choose the needed reporting events.

# 4.2 Measurements for cell selection/reselection

Whenever a PLMN has been selected the UE shall start to find a suitable cell to camp on, this is 'cell selection'. When camped on cell the UE regularly searches for a better cell depending on the cell reselection criteria, this is called 'cell reselection'. The procedures for cell selection and reselection are described in [13] and the measurements carried out by the UE are explained in this specification.

# 4.3 Measurements for Handover

For the handover preparation the UE receives from the UTRAN a list of cells (e.g. TDD, FDD or GSM).which the UE shall monitor (see 'monitored set' in [14]) in its idle timeslots.

At the beginning of the measurement process the UE shall find synchronization to the cell to measure using the synchronization channel. This is described under 'cell search' in [9] if the monitored cell is a TDD cell and in [4] if it is an FDD cell.

For a TDD cell to monitor after this procedure the exact timing of the midamble of the P-CCPCH is known and the measurements can be performed. Depending on the UE implementation and if timing information about the cell to monitor is available, the UE may perform the measurements on the P-CCPCH directly without prior SCH synchronisation.

# 4.4 Measurements for DCA

DCA is used to optimise the resource allocation by means of a channel quality criteria or traffic parameters. The DCA measurements are configured by the UTRAN. The UE reports the measurements to the UTRAN.

For DCA no measurements are performed in idle mode in the serving TDD cell.

When connecting with the initial access the UE immediately starts measuring the ISCP of time slots which are communicated on the BCH. The measurements and the preprocessing are done while the UTRAN assigns an UL channel for the UE for signalling and measurement reporting.

In connected mode the UE performs measurements according to a measurement control message from the UTRAN.

# 4.5 Measurements for timing advance

To update timing advance of a moving UE the UTRAN measures 'Received Timing Deviation', i.e. the time difference of the received UL transmission (PRACH, DPCH, PUSCH) in relation to its timeslot structure that means in relation to the ideal case where an UL transmission would have zero propagation delay. The measurements are reported to higher layers, where timing advance values are calculated and signalled to the UE.

# 5      Measurement abilities for UTRA TDD

In this clause the physical layer measurements reported to higher layers. (this may also include UE internal measurements not reported over the air-interface) are defined.

## 5.1      UE measurement abilities

The structure of the table defining a UE measurement quantity is shown below.

| Column field | Comment |
|---|---|
| Definition | Contains the definition of the measurement. |
| Applicable for | States in which RRC state according to [14] a measurement shall be possible to be performed. For RRC connected mode states information is also given on the possibility to perform the measurement on intra-frequency and/or inter-frequency.<br><br>The following terms are used in the tables:<br>    Idle = Shall be possible to perform in idle mode;<br>    URA_PCH = Shall be possible to perform in URA_PCH;<br>    CELL_PCH = Shall be possible to perform in CELL_PCH;<br>    CELL_FACH = Shall be possible to perform in CELL_FACH;<br>    CELL_DCH = Shall be possible to perform in CELL_DCH;<br><br>For all RRC connected mode states i.e. URA_PCH, CELL_PCH, CELL_FACH and CELL_DCH<br>Intra appended to the RRC state = Shall be possible to perform in the corresponding RRC state on an intra-frequency cell;<br>Inter appended to the RRC state = Shall be possible to perform in the corresponding RRC state on an inter-frequency cell.<br>Inter-RAT appended to the RRC state = Shall be possible to perform in the corresponding RRC state on an inter-RAT cell. |

NOTE 1:   Measurements for TDD which are specified on the Primary CCPCH (P-CCPCH) are carried out on the P-CCPCH or on any other beacon channel, see [6].

NOTE 2:   For the beacon channels [6], the received power measurements shall be based on the received power for midamble m[(1)] if no Space Code Transmit Diversity (SCTD) is applied to the P-CCPCH and on the sum of the received powers for midambles m[(1)] and m[(2)] if SCTD is applied to the P-CCPCH.

NOTE 3:   The UTRAN has to take into account the UE capabilities when specifying the timeslots to be measured in the measurement control message.

NOTE 4:   The line 'applicable for' indicates whether the measurement is applicable for inter-frequency and/or intra-frequency and furthermore for idle and/or connected mode.

NOTE 5:   The Interference part of the SIR measurement will be dependent on the receiver implementation, and will normally be different from the Timeslot ISCP measurement.

NOTE 6:   The measurement 'Timeslot ISCP' is only a measure of the intercell interference.

NOTE 7:   The term "antenna connector of the UE" used in this sub-clause to define the reference point for the UE measurements is defined in [17].

NOTE 8:   Performance and reporting requirements for the UE measurements are defined in [19].

### 5.1.1      P-CCPCH RSCP

| Definition | Received Signal Code Power, the received power on P-CCPCH of own or neighbour cell. The reference point for the RSCP shall be the antenna connector of the UE. |
|---|---|
| Applicable for | Idle,<br>URA_PCH intra, URA_PCH inter,<br>CELL_PCH intra, CELL_PCH inter,<br>CELL_FACH intra, CELL_FACH inter,<br>CELL_DCH intra, CELL_DCH inter |

## 5.1.2 CPICH RSCP

| Definition | Received Signal Code Power, the received power on one code measured on the Primary CPICH. The reference point for the RSCP shall be the antenna connector of the UE. (This measurement is used in TDD for monitoring FDD cells while camping on a TDD cell).<br>If Tx diversity is applied on the Primary CPICH the received code power from each antenna shall be separately measured and summed together in [W] to a total received code power on the Primary CPICH. |
|---|---|
| Applicable for | Idle,<br>URA_PCH inter,<br>CELL_PCH inter,<br>CELL_FACH inter,<br>CELL_DCH inter |

## 5.1.3 Timeslot ISCP

| Definition | Interference Signal Code Power, the interference on the received signal in a specified timeslot measured on the midamble. The reference point for the ISCP shall be the antenna connector of the UE. |
|---|---|
| Applicable for | CELL_FACH intra,<br>CELL_DCH intra |

## 5.1.4 UTRA carrier RSSI

| Definition | The received wide band power, including thermal noise and noise generated in the receiver, within the bandwidth defined by the receiver pulse shaping filter, for TDD within a specified timeslot. The reference point for the measurement shall be the antenna connector of the UE. |
|---|---|
| Applicable for | CELL_DCH intra, CELL_DCH inter |

## 5.1.5 GSM carrier RSSI

| Definition | Received Signal Strength Indicator, the wide-band received power within the relevant channel bandwidth Measurement shall be performed on a GSM BCCH carrier. The reference point for the RSSI shall be the antenna connector of the UE. |
|---|---|
| Applicable for | Idle,<br>URA_PCH inter-RAT,<br>CELL_PCH inter-RAT,<br>CELL_FACH inter-RAT,<br>CELL_DCH inter-RAT |

## 5.1.6 SIR

| Definition | Signal to Interference Ratio, defined as: (RSCP/Interference)xSF.<br>Where:<br>RSCP =     Received Signal Code Power, the received power on the code of a specified DPCH or PDSCH.<br>Interference =     The interference on the received signal in the same timeslot which can't be eliminated by the receiver.<br>SF =     The used spreading factor.<br><br>The reference point for the SIR shall be the antenna connector of the UE. |
|---|---|
| Applicable for | CELL_FACH intra,<br>CELL_DCH intra |

## 5.1.7 CPICH Ec/No

| Definition | The received energy per chip divided by the power density in the band. The CPICH Ec/No is identical to CPICH RSCP/UTRA Carrier RSSI. The measurement shall be performed on the Primary CPICH. The reference point for the CPICH Ec/No shall be the antenna connector of the UE. (This measurement is used in TDD for monitoring FDD cells while camping on a TDD cell) If Tx diversity is applied on the Primary CPICH the received energy per chip (Ec) from each antenna shall be separately measured and summed together in [Ws] to a total received chip energy per chip on the Primary CPICH, before calculating the Ec/No. |
|---|---|
| Applicable for | Idle, URA_PCH inter, CELL_PCH inter, CELL_FACH inter, CELL_DCH inter |

## 5.1.8 Transport channel BLER

| Definition | Estimation of the transport channel block error rate (BLER). The BLER estimation shall be based on evaluating the CRC on each transport block. |
|---|---|
| Applicable for | CELL_DCH intra |

## 5.1.9 UE transmitted power

| Definition | The total UE transmitted power on one carrier in a specified timeslot. The reference point for the UE transmitted power shall be the antenna connector of the UE. |
|---|---|
| Applicable for | CELL_FACH intra, CELL_DCH intra |

## 5.1.10    SFN-SFN observed time difference

| Definition | SFN-SFN observed time difference is the time difference of the reception times of frames from two cells (serving and target) measured in the UE and expressed in chips. It is distinguished by two types. Type 2 applies if the serving and the target cell have the same frame timing. |
|---|---|
| | The reference point for the SFN-SFN observed time difference type 1 and 2 shall be the antenna connector of the UE. |
| | **<u>Type 1:</u>** |
| | SFN-SFN observed time difference = $\begin{cases} \text{OFF} \times 12800 + T_m \ in\ chips & for\ 1.28\ Mcps\ TDD \\ \text{OFF} \times 38400 + T_m \ in\ chips & for\ 3.84\ Mcps\ TDD \end{cases}$ |
| | where: |
| | $T_m =$   $T_{RxSFNi}$ - $T_{RxSFNk}$, given in chip units |
| | with the range $\begin{cases} [0,1,\ldots,12799]\ \text{chips} & for\ 1.28\ Mcps\ TDD \\ [0,1,\ldots,38399]\text{chips} & for\ 3.84\ Mcps\ TDD \end{cases}$ |
| | $T_{RxSFNi} =$   time of start (defined by the first detected path in time) of the received frame $SFN_i$ of the serving TDD cell i. |
| | $T_{RxSFNk} =$   time of start (defined by the first detected path in time) of the received frame $SFN_k$ of the target UTRA cell k received most recently in time before the time instant $T_{RxSFNi}$ in the UE. If this frame $SFN_k$ of the target UTRA cell is received exactly at $T_{RxSFNi}$ then $T_{RxSFNk} = T_{RxSFNi}$ (which leads to $T_m=0$). |
| | $OFF =$   ($SFN_i$- $SFN_k$) mod 256, given in number of frames with the range [0, 1, ..., 255] frames |
| | $SFNi =$   system frame number for downlink frame from serving TDD cell i in the UE at the time $T_{RxSFNi}$. |
| | $SFNk =$   system frame number for downlink frame from target UTRA cell k received in the UE at the time $T_{RxSFNk}$.(for FDD: the P-CCPCH frame) |
| | The reference point for the SFN-SFN observed time difference type 1 shall be the antenna connector of the UE. |
| | **<u>Type 2:</u>** |
| | SFN-SFN observed time difference = $T_{Rx\_Frame\_cell\ k}$ - $T_{Rx\_Frame\_cell\ i}$, in chips, where |
| | $T_{Rx\_Frame\_cell\ i}$: time of start (defined by the first detected path in time) of the frame boundary from the serving TDD cell i. |
| | $T_{Rx\_Frame\_cell\ k}$: time of start (defined by the first detected path in time) of the frame boundary from the target UTRA cell k that is closest in time to the frame boundary of the serving TDD cell i. |
| | The reference point for the SFN-SFN observed time difference type 2 shall be the antenna connector of the UE. |
| **Applicable for** | **<u>Type 1:</u>** CELL_FACH intra |
| | **<u>Type 2:</u>** |
| | Idle, |
| | URA_PCH intra, URA_PCH inter, |
| | CELL_PCH intra, CELL_PCH inter, |
| | CELL_FACH intra, CELL_FACH inter, |
| | CELL_DCH intra, CELL_DCH inter |

## 5.1.11 SFN-CFN observed time difference

| Definition | The SFN-CFN observed time difference is defined as:<br>$T_m$     for an FDD neighbour cell (i.e. the value is reported in chips),<br>OFF    for a TDD neighbour cell (i.e the value is reported in frames),<br>where:<br><br>$T_m =$         $T_{UETx} - T_{RxSFN}$, given in chip units with the range [0, 1, ..., 38399] chips.<br><br>$T_{UETx} =$     the time at the beginning of the frame with the connection frame number $CFN_{TX}$ considering the transmission from the UE in the serving TDD cell.<br><br>$T_{RxSFN} =$    the time (defined by the first detected path in time) at the beginning of the frame with the system frame number SFN (for FDD neighbour cells: P-CCPCH frame is considered) received at the UE from a neighbour cell. $T_{RxSFN}$ is the time instant most recent in time before the time instant $T_{UETx}$<br><br>OFF =       $(SFN-CFN_{TX})$ mod 256, given in number of frames with the range [0, 1, ..., 255] frames.<br><br>$CFN_{Tx} =$    the connection frame number for the UE transmission.<br><br>SFN =       is the system frame number for the neighbouring cell frame (for FDD neighbour cells: P-CCPCH frame) received in the UE at the time instant $T_{RxSFN}$.<br><br>The reference point for the SFN-CFN observed time difference shall be the antenna connector of the UE. |
|---|---|
| Applicable for | CELL_DCH intra, CELL_DCH inter |

## 5.1.12 Observed time difference to GSM cell

| Definition | Observed time difference to GSM cell is reported as the time difference $T_m$ in ms, where<br>$T_m= T_{RxGSMk} - T_{RxSFN0i}$<br>$T_{RxSFN0i}$:     time of start (defined by the first detected path in time) of the received frame SFN=0 of the serving TDD cell i<br>$T_{RxGSMk}$:     time of start of the GSM BCCH 51-multiframe of the considered target GSM frequency k received closest in time after the time $T_{RxSFN0i}$. If the next GSM BCCH 51-multiframe is received exactly at $T_{RxSFN0i}$ then $T_{RxGSMk} = T_{RxSFN0i}$ (which leads to $T_m$=0). The beginning of the GSM BCCH 51-multiframe is defined as the beginning of the first tail bit of the frequency correction burst in the first TDMA-frame of the GSM BCCH 51-multiframe, i.e. the TDMA-frame following the IDLE-frame.<br><br>The reference point for the Observed time difference to GSM cell shall be the antenna connector of the UE.<br><br>The reported time difference is calculated from the actual measurement in the UE. The actual measurement shall be based on:<br><br>$T_{MeasGSM,j}$: The start of the first tail bit of the most recently received GSM SCH on frequency j<br>$T_{MeasSFN,i}$: The start of the last frame received in TDD cell i before receiving the GSM SCH on frequency j<br><br>For calculating the reported time difference, the frame lengths are always assumed to be 10 ms for UTRA and (60/13) ms for GSM. |
|---|---|
| Applicable for | Idle, URA PCH inter-RAT, CELL PCH inter-RAT, CELL_DCH Inter-RAT |

## 5.1.13 UE GPS Timing of Cell Frames for UE positioning

| Definition | $T_{UE-GPSj}$ is defined as the time of occurrence of a specified UTRAN event according to GPS Time Of Week. The specified UTRAN event is the beginning of a particular frame (identified through its SFN) in the first detected path (in time) of the cell j P-CCPCH. The reference point for $T_{UE-GPSj}$ shall be the antenna connector of the UE. |
|---|---|
| Applicable for | CELL_FACH intra, CELL_DCH intra |

## 5.1.14 Timing Advance ($T_{ADV}$) for 1.28 Mcps TDD

| Definition | The 'timing advance ($T_{ADV}$)' is the time difference |
|---|---|
| | $$T_{ADV} = T_{RX} - T_{TX}$$ |
| | Where |
| | $T_{RX}$: calculated beginning time of the first uplink time slot in the first subframe used by the UE with the UE timing according to the reception of a certain downlink time slot (for the timing it is assumed that the time slots within a sub-frame are scheduled like given in the frame structure described in 25.221 chapter 6.1) |
| | $T_{TX}$: time of the beginning of the same uplink time slot by the UE (for the timing it is assumed that the time slots within a sub-frame are scheduled like given in the frame structure described in 25.221 chapter 6.1) |
| Applicable for | CELL FACH intra, CELL DCH intra |

## 5.1.15 UE GPS code phase

| Definition | The whole and fractional phase of the spreading code of the ith GPS satellite signal. The reference point for the GPS code phase shall be the antenna connector of the UE. |
|---|---|
| Applicable for | Void (this measurement is not related to UTRAN/GSM signals; its applicability is therefore independent of the UE RRC state.) |

# 5.2 UTRAN measurement abilities

NOTE 1: If the UTRAN supports multiple frequency bands then the measurements apply for each frequency band individually.

NOTE 2: The Interference part of the SIR measurement will be dependent on the receiver implementation, and will normally be different from the Timeslot ISCP measurement

NOTE 3: The term "antenna connector" used in this sub-clause to define the reference point for the UTRAN measurements refers to the "BS antenna connector" test port A and test port B as described in [18]. The term "antenna connector" refers to Rx or Tx antenna connector as described in the respective measurement definitions.

## 5.2.1 RSCP

| Definition | Received Signal Code Power, the received power on one DPCH, PRACH or PUSCH code. The reference point for the RSCP shall be the Rx antenna connector. |
|---|---|

## 5.2.2 Timeslot ISCP

| Definition | Interference Signal Code Power, the interference on the received signal in a specified timeslot measured on the midamble. The reference point for the ISCP shall be the Rx antenna connector. |
|---|---|

## 5.2.3 Received total wide band power

| Definition | The received wide band power in a specified timeslot including the noise generated in the receiver, within the bandwidth defined by the pulse shaping filter. In case of receiver diversity the reported value shall be the linear average of the power in the diversity branches. The reference point for the Received total wideband power measurement shall be the output of the pulse shaping filter in the receiver. |
|---|---|

## 5.2.4 SIR

| Definition | Signal to Interference Ratio, defined as: (RSCP/Interference)xSF.<br>Where:<br>RSCP = Received Signal Code Power, the received power on the code of a specified DPCH, PRACH or PUSCH.<br>Interference = The interference on the received signal in the same timeslot which can't be eliminated by the receiver.<br>SF = The used spreading factor.<br><br>The reference point for the SIR shall be the Rx antenna connector. |
|---|---|

## 5.2.5 Transport channel BER

| Definition | The transport channel BER is an estimation of the average bit error rate (BER) of DCH or USCH data. The transport channel (TrCH) BER is measured from the data considering only non-punctured bits at the input of the channel decoder in Node B.<br>It shall be possible to report an estimate of the transport channel BER for a TrCH after the end of each TTI of the TrCH. The reported TrCH BER shall be an estimate of the BER during the latest TTI for that TrCH. Transport channel BER is only required to be reported for TrCHs that are channel coded. |
|---|---|

## 5.2.6 Transmitted carrier power

| Definition | Transmitted carrier power, is the ratio between the total transmitted power and the maximum transmission power.<br>Total transmission power is the power [W] transmitted on one DL carrier in a specific timeslot from one UTRAN access point.<br>Maximum transmission power is the power [W] on the same carrier when transmitting at the configured maximum transmission power for the cell.<br>The measurement shall be possible on any carrier transmitted from the UTRAN access point.<br>The reference point for the transmitted carrier power measurement shall be the Tx antenna connector.<br>In case of Tx diversity the transmitted carrier power for each branch shall be measured and the maximum of the two values shall be reported to higher layers, i.e. only one value will be reported to higher layers. |
|---|---|

## 5.2.7 Transmitted code power

| Definition | Transmitted Code Power, is the transmitted power on one carrier and one channelisation code in one timeslot. The reference point for the transmitted code power measurement shall be the Tx antenna connector. |
|---|---|

## 5.2.8 RX Timing Deviation

| Definition | 'RX Timing Deviation' is the time difference $TRXdev = TTS – TRXpath$ in chips, with<br>TRXpath: time of the reception in the Node B of the first detected uplink path (in time) to be used in the detection process. The reference point for TRXpath shall be the Rx antenna connector. For 1.28 Mcps TDD only the first UL timeslot in the first subframe used by the UE is used for the calculation of $T_{RXpath}$.<br>TTS: time of the beginning of the respective slot according to the Node B internal timing |
|---|---|

NOTE: This measurement can be used for timing advance calculation or location services.

## 5.2.9    UTRAN GPS Timing of Cell Frames for UE positioning

| Definition | $T_{UTRAN-GPS}$ is defined as the time of occurrence of a specified UTRAN event according to GPS Time Of Week. The specified UTRAN event is the beginning of the transmission of a particular frame (identified through its SFN) transmitted in the cell. The reference point for $T_{UTRAN-GPSj}$ shall be the Tx antenna connector. |
|---|---|

## 5.2.10    SFN-SFN observed time difference

| Definition | SFN-SFN observed time difference = $T_{Rx\_Frame\_cell\ k}$ - $T_{Rx\_Frame\_cell\ i}$, in chips, where |
|---|---|
| | $T_{Rx\_Frame\_cell\ i}$: time of start (defined by the first detected path in time) of the frame boundary from the TDD cell i. |
| | $T_{Rx\_Frame\_cell\ k}$: time of start (defined by the first detected path in time) of the frame boundary from the cell k that is closest in time to the frame boundary of the TDD cell i. |

## 5.2.11    Cell Sync Burst Timing

| Definition | Cell sync burst timing is the time of start (defined by the first detected path in time) of the cell sync burst of a neighbouring cell. For 1.28 Mcps TDD the DwPCH represents the cell sync burst. Type 1 is used for the initial phase of Node B synchronization. Type 2 is used for the steady-state phase of Node B synchronization. Both have different range. |
|---|---|
| | The reference point for the cell sync burst timing measurement shall be the Rx antenna connector. |
| | **Type 1:**<br>Cell sync burst timing = $T_{Rx}$ - $T_{slot}$ in chips, where |
| | $T_{slot}$: time of start of the cell sync timeslot in the frame, where the cell sync burst was received. |
| | $T_{RX}$: time of start (defined by the first detected path in time) of a cell sync burst received from the target UTRA cell. |
| | **Type 2:**<br>Cell sync burst timing = $T_{Rx}$ - $T_{slot}$, in chips, where |
| | $T_{slot}$: time of start of the cell sync timeslot in the frame, where the cell sync burst was received. |
| | $T_{RX}$: time of start (defined by the first detected path in time) of a cell sync burst received from the target UTRA cell. |

## 5.2.12    Cell Sync Burst SIR

| Definition | Signal to Interference Ratio for the cell sync burst, defined as: RSCP/Interference, where: |
|---|---|
| | RSCP = Received Signal Code Power, the received power on the code and code offset of a cell sync burst.<br>Interference = The interference on the received signal in the same timeslot which can't be eliminated by the receiver |
| | The reference point for the cell sync burst SIR shall be the Rx antenna connector. For 1.28 Mcps TDD the DwPCH represents the cell sync burst. |

## 5.2.13 Received SYNC-UL Timing Deviation for 1.28 Mcps TDD

| Definition | 'Received SYNC-UL Timing Deviation' is the time difference<br><br>$$UpPCH_{POS} = UpPTS_{Rxpath} - UpPTS_{TS}$$<br><br>Where<br><br>$UpPTS_{Rxpath}$: time of the reception in the Node B of the SYNC-UL to be used in the uplink synchronization process<br>$UpPTS_{TS}$:    time instance two symbols prior to the end of the DwPCH according to the Node B internal timing<br><br>UE can calculate Round Trip Time (RTT) towards the UTRAN after the reception of the FPACH containing $UpPCH_{POS}$ transmitted from the UTRAN.<br><br>Round Trip Time RTT is defined by<br><br>$$RTT = UpPCH_{AVD} + UpPCH_{POS} - 8*16\ T_C$$<br><br>Where<br>$UpPCH_{ADV}$:   the amount of time by which the transmission of UpPCH is advanced in time relative to the end of the guard period according to the UE Rx timing. |
|---|---|

## 5.2.14 Angle of Arrival (AOA) for 1.28 Mcps TDD

| Definition | AOA defines the estimated angle of a user with respect to a reference direction. The reference direction for this measurement shall be the North, positive in a counter-clockwise direction. The AOA is determined at the BS antenna for an UL channel corresponding to this UE. |
|---|---|

# Annex A (informative): Monitoring GSM from TDD: Calculation Results

## A.1 Low data rate traffic using 1 uplink and 1 downlink slot (for the 3.84 Mcps option)

NOTE: The section evaluates the time to acquire the FCCH if all idle slots are devoted to the tracking of a FCCH burst, meaning that no power measurements is done concurrently. The derived figures are better than those for GSM. The section does not derive though any conclusion. A conclusion may be that the use of the idle slots is a valid option. An alternative conclusion may be that this is the only mode to be used, removing hence the use of the slotted frames for low data traffic or the need for a dual receiver, if we were to considering the monitoring of GSM cells only, rather than GSM, TDD and FDD.

If a single synthesiser UE uses only one uplink and one downlink slot, e.g. for speech communication, the UE is not in transmit or receive state during 13 slots in each frame. According to the timeslot numbers allocated to the traffic, this period can be split into two continuous idle intervals A and B as shown in the figure below.
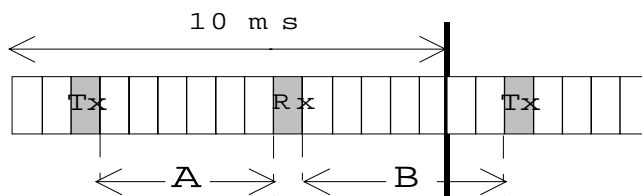


**Figure A.1: Possible idle periods in a frame with two occupied timeslots**

A is defined as the number of idle slots between the Tx and Rx slots and B the number of idle slots between the Rx and Tx slots. It is clear that A+B=13 time slots.

In the scope of low cost terminals, a [0.8] ms period is supposed to be required to perform a frequency jump from UMTS to GSM. This lets possibly two free periods of A*Ts-1.6 ms and B*Ts-1.6 ms during which the mobile station can monitor GSM, Ts being the slot period.

Following table evaluates the average synchronisation time and maximum synchronisation time, where the announced synchronisation time corresponds to the time needed to find the FCCH. The FCCH is supposed to be perfectly detected meaning that the FCCH is found if it is entirely present in the monitoring window. The FCCH being found the SCH location is unambiguously known from that point. All the 13 idle slots are assumed to be devoted to FCCH tracking and the UL traffic is supposed to occupy the time slot 0.

**Table A.1: example- of average and maximum synchronisation time with two busy timeslots per frame and with 0.8 ms switching time (\*)**

| Downlink time slot number | Number of free TS in A | Number of free TS in B | Average synchronisation time (ms) | Maximum synchronisation time (ms) |
|---|---|---|---|---|
| 1 | 0 | 13 | 44 | 140 |
| 2 | 1 | 12 | 50 | 187 |
| 3 | 2 | 11 | 58 | 188 |
| 4 | 3 | 10 | 66 | 189 |
| 5 | 4 | 9 | 70 | 233 |
| 6 | 5 | 8 | 77 | 234 |
| 7 | 6 | 7 | 75 | 189 |
| 8 | 7 | 6 | 75 | 189 |
| 9 | 8 | 5 | 75 | 235 |
| 10 | 9 | 4 | 67 | 235 |
| 11 | 10 | 3 | 63 | 186 |
| 12 | 11 | 2 | 56 | 186 |
| 13 | 12 | 1 | 49 | 186 |
| 14 | 13 | 0 | 43 | 132 |

(\*) All simulations have been performed with a random initial delay between GSM frames and UMTS frames.

Each configuration of TS allocation described above allows a monitoring period sufficient to acquire synchronisation.

## A.1.1 Higher data rate traffic using more than 1 uplink and/or 1 downlink TDD timeslot

The minimum idle time to detect a complete FCCH burst for all possible alignments between the GSM and the TDD frame structure (called 'guaranteed FCCH detection'), assuming that monitoring happens every TDD frame, can be calculated as follows ($t_{FCCH}$ = one GSM slot):

$$t_{\min, \; guaranteed} = 2 \times t_{synth} + t_{FCCH} + \frac{10\text{ms}}{13} = 2 \times t_{synth} + \frac{35\text{ms}}{26}$$

- (e.g for $t_{synth}$ =0ms: 3 TDD **consecutive** idle timeslots needed, for $t_{synth}$ =0,3ms: 3 slots, for $t_{synth}$ =0,5ms: 4 slots, for $t_{synth}$ =0,8ms: 5 slots). Under this conditions the FCCH detection time can never exceed the time of 660ms.

- (For a more general consideration $t_{synth}$ may be considered as a sum of all delays before starting monitoring is possible).

- For detecting SCH instead of FCCH (for a parallel search) the same equation applies.

- In the equation before the dual synthesiser UE is included if the synthesiser switching time is 0ms.

**Table A.2: FCCH detection time for a dual synthesizer UE monitoring GSM from TDD every TDD frame**

| occupied slots= 15-idle slots | cases | FCCH detection time in ms | |
|---|---|---|---|
| | | Average | maximum |
| 2 | 105 | 37 | 189 |
| 3 | 455 | 46 | 327 |
| 4 | 1365 | 58 | 419 |
| 5 | 3003 | 72 | 501 |
| 6 | 5005 | 90 | 646 |
| 7 | 6435 | 114 | 660 |
| 8 | 6435 | 144 | 660 |
| 9 | 5005 | 175 | 660 |
| 10 | 3003 | 203 | 660 |
| 11 | 1365 | 228 | 660 |
| 12 | 455 | 254 | 660 |
| 13 | 105 | - | - |
| 14 | 15 | - | - |
| | | | |

In the table above for a given number of occupied slots in the TDD mode all possible cases of distributions of these occupied TDD slots are considered (see 'cases'). For every case arbitrary alignments of the TDD and the GSM frame structure are taken into account for calculating the average FCCH detection time (only these cases are used which guarantee FCCH detection for all alignments; only the non-parallel FCCH search is reflected by the detection times in the table 2).

The term 'occupied slots' means that the UE is not able to monitor in these TDD slots.

For a synthesiser switching time of one or one half TDD timeslot the number of needed consecutive idle TDD timeslots is summarized in the table below:

**Table A.3: Link between the synthesiser performance and the number of free consecutive TSs for guaranteed FCCH detection, needed for GSM monitoring**

| One-way switching time for the synthesiser | Number of free consecutive TDD timeslots needed in the frame for a guaranteed FCCH detection |
|---|---|
| 1 TS (=2560 chips) | 5 |
| 0.5 TS (=1280 chips) | 4 |
| 0 (dual synthesiser) | 3 |

# A.2 Low data rate traffic using 1 uplink and 1 downlink slot (for the 1.28 Mcps option)

NOTE: The section evaluates the time to acquire the FCCH if all idle slots are devoted to the tracking of a FCCH burst, meaning that no power measurements is done concurrently. The derived figures are better than those for GSM. The section does not derive though any conclusion. A conclusion may be that the use of the idle slots is a valid option. An alternative conclusion may be that this is the only mode to be used, removing hence the use of the slotted frames for low data traffic or the need for a dual receiver, if we were to considering the monitoring of GSM cells only, rather than GSM, TDD and FDD.

If a single synthesiser UE uses only one uplink and one downlink slot, e.g. for speech communication, the UE is not in transmit or receive state during 5 slots in each frame. According to the timeslot numbers allocated to the traffic, this period can be split into two continuous idle intervals A and B as shown in the figure below.
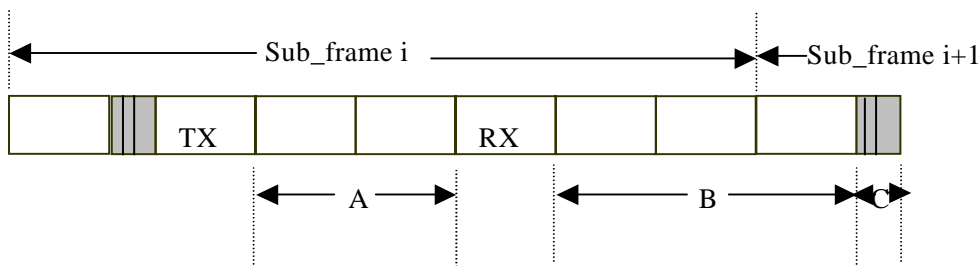
**Figure A.2: Possible idle periods in a subframe with two occupied timeslots**

A is defined as the number of idle slots between the Tx and Rx slots and B the number of idle slots between the Rx and Tx slots. It is clear that A+B=5 time slots and C is equal to the DwPTS+GP+UpPTS.

In the scope of low cost terminals, a [0.5] ms period is supposed to be required to perform a frequency jump from 1.28Mcps TDD to GSM and vice versa. This lets possibly two free periods of A*Timeslots-1 ms and B*Timeslots+C-1 ms during which the mobile station can monitor GSM, Timeslots being the slot period.

Following table evaluates the average synchronisation time and maximum synchronisation time, where the announced synchronisation time corresponds to the time needed to find the FCCH. The FCCH is supposed to be perfectly detected which means that it is entirely present in the monitoring window. The FCCH being found the SCH location is unambiguously known from that point. All the 5 idle slots and the DwPTS+GP+UpPTS are assumed to be devoted to FCCH tracking and the UL traffic is supposed to occupy the time slot 1.

**Table A.4: example- of average and maximum synchronisation time with two busy timeslots per sub-frame and with 0.5 ms switching time**

| Downlink time slot number | Number of free Timeslots in A | Number of free Timeslots in B | Average synchronisation time (ms) | Maximum synchronisation time (ms) |
|---|---|---|---|---|
| 0 | 5 | 0 | 83 | 231 |
| 2 | 0 | 5 | 75 | 186 |
| 3 | 1 | 4 | 98 | 232 |
| 4 | 2 | 3 | 185 | 558 |
| 5 | 3 | 2 | 288 | 656 |
| 6 | 4 | 1 | 110 | 371 |

(*) All simulations have been performed with a random initial delay between GSM frames and 1.28Mcps TDD sub-frames.

Each configuration of Timeslots allocation described above allows a monitoring period sufficient to acquire synchronisation.

NOTE:     Considering about the frame structure of 1.28Mcps TDD, there are total 7 timeslots in each sub-frame that can be used as data traffic. If more than 1 uplink and/or 1 downlink TDD timeslot are used for data traffic, that means it will occupy at least 3 time slots, equal to 0.675*3=2.205ms. And more time slots for traffic data means more switching point are needed to switch between the GSM and the 1.28Mcps TDD. As it was mentioned above, each switching will take 0.5ms. As a result, the idle time left for monitoring the GSM will be very little. So monitoring GSM from 1.28Mcps TDD under this situation will be considered in the future. It will need more carefully calculation and simulation.

## A.2.1     Higher data rate traffic using more than 1 uplink and/or 1 downlink TDD timeslot (for 1.28Mcps TDD)

The minimum idle time to detect a complete FCCH burst for all possible alignments between the GSM and the 1.28Mcps TDD frame structure (called 'guaranteed FCCH detection'), assuming that monitoring happens every sub-frame, can be calculated as follows ($t_{FCCH}$ = one GSM slot):

$$t_{\min , guarante \ ed} = 2 \times t_{synth} + t_{FCCH} + \frac{5 \, \text{ms}}{13} = 2 \times t_{synth} + \frac{25 \, \text{ms}}{26}$$

- (e.g for $t_{synth}$ =0ms: 2 1.28Mcps TDD **consecutive** idle timeslots needed, for $t_{synth}$ =0.3ms: 3 slots (or 2 slots and the DwPTS+GP+UpPTS), for $t_{synth}$ =0.5ms: 3 slots, for $t_{synth}$ =0.8ms: 4 slots). Under this conditions the FCCH detection time can never exceed the time of 660ms.

- (For a more general consideration $t_{synth}$ may be considered as a sum of all delays before starting monitoring is possible).

- For detecting SCH instead of FCCH (for a parallel search) the same equation applies.

- In the equation before the dual synthesiser UE is included if the synthesiser switching time is 0ms.

**Table A.5 : FCCH detection time for a single synthesizer UE monitoring GSM from 1.28Mcps TDD every sub-frame**

| Occupied Slots | Cases | AVERAGE FCCH detection time in ms | MAXIMUM FCCH detection time in ms |
|---|---|---|---|
| 2 | 21 | 136.625 | 660.785 |
| 3 | 35 | 188.451 | 660.785 |
| 4 | 35 | 231.115 | 660.785 |
| 5 | 21 | - | - |
| 6 | 7 | - | - |
| 7 | 1 | - | - |

The result in the above table is based on the following assumption:

- A single synthesizer is used.

- A [0.5] ms period is supposed to be required to perform a frequency jump from 1.28Mcps TDD to GSM and vice versa.

- For a given number of occupied slots in the TDD mode all possible cases of distributions of these occupied TDD slots are considered (see 'cases'). For every case arbitrary alignments of the TDD and the GSM frame structure are taken into account for calculating the average FCCH detection time (only these cases are used which guarantee FCCH detection for all alignments; only the non-parallel FCCH search is reflected by the detection times in the above table).

The term 'occupied slots' means that the UE is not able to monitor in these TDD slots.

For a synthesiser switching time of one or one half TDD timeslot the number of needed consecutive idle TDD timeslots is summarized in the table below:

**Table A.6 : Link between the synthesiser performance and the number of free consecutive Timeslots for guaranteed FCCH detection, needed for GSM monitoring**

| One-way switching time for the synthesiser | Number of free consecutive 1.28Mcps TDD timeslots needed in the sub-frame for a guaranteed FCCH detection |
|---|---|
| 1 Timeslot (=864 chips) | 4 |
| 0.5 Timeslot (=432 chips) | 3 |
| 0 (dual synthesiser) | 2 |

# Annex B (informative): Change history

| Change history | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Date** | **TSG #** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| 14/01/00 | RAN_05 | RP-99595 | - | | Approved at TSG RAN #5 and placed under Change Control | - | 3.0.0 |
| 14/01/00 | RAN_06 | RP-99700 | 001 | 1 | Primary and Secondary CCPCH in TDD | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99701 | 002 | 1 | Block STTD capability for P-CCPCH, TDD component | 3.0.0 | 3.1.0 |
| 14/01/00 | RAN_06 | RP-99700 | 003 | 1 | Update concerning measurement definitions, ranges and mappings | 3.0.0 | 3.1.0 |
| 14/01/00 | - | - | - | | Change history was added by the editor | 3.1.0 | 3.1.1 |
| 31/03/00 | RAN_07 | RP-000071 | 004 | 1 | Correction of CPICH measurements and 'RX Timing Deviation' range | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000071 | 005 | 2 | Editorial modifications to 25.225 | 3.1.1 | 3.2.0 |
| 31/03/00 | RAN_07 | RP-000071 | 006 | 1 | Corrections to 25.225 Measurements for TDD | 3.1.1 | 3.2.0 |
| 26/06/00 | RAN_08 | RP-000275 | 009 | - | Clarifications on TxDiversity for UTRA TDD | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000275 | 010 | - | Removal of Range/mapping | 3.2.0 | 3.3.0 |
| 26/06/00 | RAN_08 | RP-000275 | 011 | - | Removal of transport channel BLER | 3.2.0 | 3.3.0 |
| 23/09/00 | RAN_09 | RP-000348 | 012 | 1 | Alignment of TDD measurements with FDD : GPS related measurements | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000348 | 013 | 1 | Alignment of TDD measurements with FDD :SFN-CFN observed time difference | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000348 | 014 | - | Clarification of the Timeslot ISCP measurements | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000348 | 015 | - | Terminology regarding the beacon function | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000348 | 016 | - | Removal of Physical Channel BER | 3.3.0 | 3.4.0 |
| 23/09/00 | RAN_09 | RP-000348 | 017 | - | Update of TS25.225 due to recent change for FDD: Reporting of UTRAN TX carrier power | 3.3.0 | 3.4.0 |
| 15/12/00 | RAN_10 | RP-000545 | 018 | 2 | Corrections and Clarifications to 25.225 | 3.4.0 | 3.5.0 |
| 15/12/00 | RAN_10 | RP-000545 | 019 | 1 | Corrections and Clarifications to 25.225 | 3.4.0 | 3.5.0 |
| 15/12/00 | RAN_10 | RP-000545 | 020 | 1 | Clarification of measurement reference points | 3.4.0 | 3.5.0 |
| 15/12/00 | RAN_10 | RP-000545 | 021 | - | Removal of incorrect note relating to RSCP measurements | 3.4.0 | 3.5.0 |
| 16/03/01 | RAN_11 | - | - | - | Approved as Release 4 specification (v4.0.0) at TSG RAN #11 | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010066 | 023 | - | Correction of the observed time difference to GSM measurement | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010073 | 022 | - | Measurements for Node B synchronisation | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010071 | 024 | 1 | Inclusion of 1.28Mcps TDD in TS 25.225 | 3.5.0 | 4.0.0 |
| 16/03/01 | RAN_11 | RP-010072 | 025 | - | RTD measurement in UTRAN for UP-TDD | 3.5.0 | 4.0.0 |
| 15/06/01 | RAN_12 | RP-010339 | 029 | - | Renaming of LCS measurements | 4.0.0 | 4.1.0 |
| 15/06/01 | RAN_12 | RP-010339 | 030 | - | Addition to the abbreviation list | 4.0.0 | 4.1.0 |
| 21/09/01 | RAN_13 | RP-010526 | 034 | - | Clarification of the Beacon Measurement in TS25.225 | 4.1.0 | 4.2.0 |
| 21/09/01 | RAN_13 | RP-010707 | 031 | 1 | RxTiming Deviation for 1.28 Mcps TDD | 4.1.0 | 4.2.0 |
| 21/09/01 | RAN_13 | RP-010532 | 032 | - | SFN-SFN type 1 for 1.28 Mcps TDD | 4.1.0 | 4.2.0 |
| 14/12/01 | RAN_14 | RP-010743 | 036 | 1 | Removal of references to Block STTD | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010743 | 040 | - | Correction of measurement definition for UTRA Carrier RSSI and CPICH_Ec/No | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010750 | 038 | 1 | Introduction of new "UE GPS code phase" measurement | 4.2.0 | 4.3.0 |
| 14/12/01 | RAN_14 | RP-010750 | 042 | - | Corrections in annex A.2 in TS 25.225 | 4.2.0 | 4.3.0 |
| 08/03/02 | RAN_15 | RP-020055 | 041 | 1 | Introduction of "Node B synchronization for 1.28 Mcps TDD" | 4.3.0 | 5.0.0 |
| 08/03/02 | RAN_15 | RP-020057 | 043 | - | Introduction of "UE Positioning Enhancements for 1.28 Mcps TDD" | 4.3.0 | 5.0.0 |
| 07/06/02 | RAN_16 | RP-020312 | 050 | 2 | Clarification of UE measurements Applicability | 5.0.0 | 5.1.0 |
| 20/09/02 | RAN_17 | RP-020578 | 053 | - | Correction to SFN-SFN Type 2 measurement | 5.1.0 | 5.2.0 |
| 20/09/02 | RAN_17 | RP-020558 | 061 | - | Correction of UE SFN-SFN type 1 measurement for TDD | 5.1.0 | 5.2.0 |
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# History

| Document history | | |
|---|---|---|
| V5.0.0 | March 2002 | Publication |
| V5.1.0 | June 2002 | Publication |
| V5.2.0 | September 2002 | Publication |
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