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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
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Foreword

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Contents

Foreword

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

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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”

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
SF	Spreading Factor
SFN	System Frame Number
SIR	Signal-to-Interference Ratio
STTD	Space Time Transmit Diversity
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

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 Block-STTD is applied to the P-CCPCH and on the sum of the received powers for midambles $m^{(1)}$ and $m^{(2)}$ if Block-STTD 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].

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 mode, connected mode (intra-frequency & inter-frequency)

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). 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 mode, connected mode (inter-frequency)

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	connected mode (intra-frequency).

5.1.4 UTRA carrier RSSI

Definition	Received Signal Strength Indicator, the wide-band received power within the relevant channel bandwidth in a specified timeslot. Measurement shall be performed on a UTRAN DL carrier. The reference point for the RSSI shall be the antenna connector of the UE.
Applicable for	idle mode, connected mode (intra- & inter-frequency)

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 mode, connected mode (inter-frequency)

5.1.6 SIR

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

5.1.7 CPICH Ec/No

Definition	The received energy per chip divided by the power density in the band. The Ec/No is identical to RSCP/RSSI. 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 mode, connected mode (inter-frequency)

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	connected mode (intra-frequency)

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	connected mode (intra-frequency).

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. **Type 1:** SFN-SFN observed time difference = $\begin{cases} \mathrm{OFF} \times 12800 + T_m \ \mathit{in\ chips} & \mathit{for}\ 1.28\ \mathit{Mcps\ TDD} \\ \mathrm{OFF} \times 38400 + T_m \ \mathit{in\ chips} & \mathit{for}\ 3.84\ \mathit{Mcps\ TDD} \end{cases}$ where: T_m = T_{RxSFNi} - T_{RxSFNk}, given in chip units with the range $\begin{cases} [0,1,\ldots,12799]\ \text{chips} & \mathit{for}\ 1.28\ \mathit{Mcps\ TDD} \\ [0,1,\ldots,38399]\text{chips} & \mathit{for}\ 3.84\ \mathit{Mcps\ TDD} \end{cases}$ 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. **Type 2:** SFN-SFN observed time difference = T_{RxTSk} - T_{RxTSi}, in chips, where T_{RxTSi} : time of start (defined by the first detected path in time) of a timeslot received from the serving TDD cell i. T_{RxTSk} : time of start (defined by the first detected path in time) of a timeslot received from the target UTRA cell k that is closest in time to the start of the timeslot 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	idle mode, connected mode (intra-frequency), connected mode (inter-frequency)

5.1.11 SFN-CFN observed time difference

Definition	The SFN-CFN observed time difference is defined as: T_m for an FDD neighbour cell (i.e. the value is reported in chips), OFF for a TDD neighbour cell (i.e the value is reported in frames), where: T_m = T_{UETx} - T_{RxSFN}, given in chip units with the range [0, 1, …, 38399] chips. 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. 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} OFF = $(SFN-CFN_{TX})$ mod 256, given in number of frames with the range [0, 1, …, 255] frames. CFN_{Tx} = the connection frame number for the UE transmission. 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}. The reference point for the SFN-CFN observed time difference shall be the antenna connector of the UE.
Applicable for	connected mode (inter-frequency), connected mode (intra-frequency)

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 $T_m = T_{RxGSMk} - T_{RxSFN0i}$ $T_{RxSFN0i}$: time of start (defined by the first detected path in time) of the received frame SFN=0 of the serving TDD cell i $T_{RxGSMk.}$: 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. The reference point for the Observed time difference to GSM cell shall be the antenna connector of the UE. The reported time difference is calculated from the actual measurement in the UE. The actual measurement shall be based on: $T_{MeasGSM,j}$: The start of the first tail bit of the most recently received GSM SCH on frequency j $T_{MeasSFN,i}$: The start of the last frame received in TDD cell i before receiving the GSM SCH on frequency j 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 mode, connected mode (inter-frequency)

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	connected mode (intra-frequency, inter-frequency)

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)

Note: This measurement can be used for UE positioning.

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. Where: RSCP = Received Signal Code Power, the received power on the code of a specified DPCH, PRACH or PUSCH. Interference = The interference on the received signal in the same timeslot which can't be eliminated by the receiver. SF = The used spreading factor. 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. 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. Total transmission power is the power [W] transmitted on one DL carrier in a specific timeslot from one UTRAN access point. Maximum transmission power is the power [W] on the same carrier when transmitting at the configured maximum transmission power for the cell. The measurement shall be possible on any carrier transmitted from the UTRAN access point. The reference point for the transmitted carrier power measurement shall be the Tx antenna connector. 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 $T_{RXdev} = T_{TS} – T_{RXpath}$ in chips, with T_{RXpath}: 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 T_{RXpath} 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}. T_{TS}: 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_{RxTSk} - T_{RxTSi}, in chips, where T_{RxTSi} : time of start (defined by the first detected path in time) of a timeslot received by the LMU from the TDD cell i. T_{RxTSk} : time of start (defined by the first detected path in time) of a timeslot received by the LMU from the cell k that is closest in time to the start of the received timeslot 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. 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:** 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:** 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. 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.

5.2.13 Received SYNC-UL Timing Deviation for 1.28 Mcps TDD

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

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.

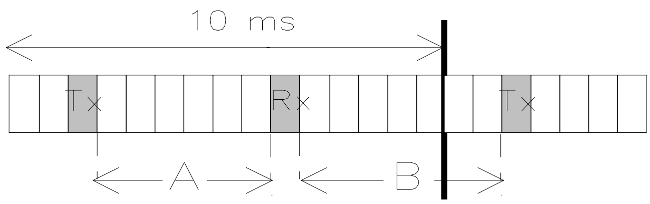

Figure A.1: Possible idle periods in a frame with two occupied timeslots

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.

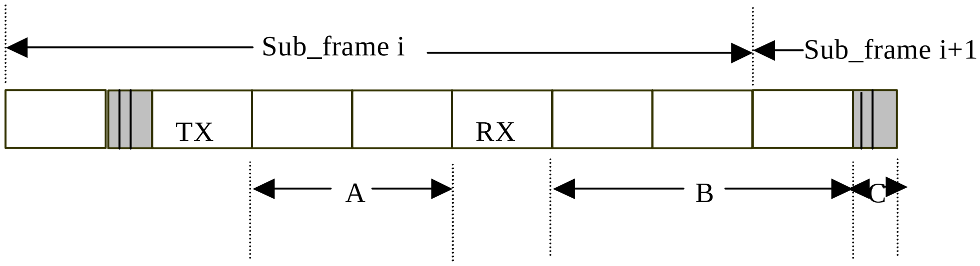

Figure A.2: Possible idle periods in a subframe with two occupied timeslots

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 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 timeslot 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 slot, 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):

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

- (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

History

Document history		
V4.0.0	March 2001	Publication
V4.1.0	June 2001	Publication
V4.2.0	September 2001	Publication