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Contents

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Foreword

This Technical Specification has been produced by the 3GPP.

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of this TS, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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x the first digit:

1 presented to TSG for information;

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y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the specification;

1 Scope

This 3GPP Telecommunication Specification TS 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, subsequent revisions do apply.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] 3GPP RAN TS 25.211 Transport channels and physical channels (FDD)

[2] 3GPP RAN TS 25.212 Multiplexing and channel coding (FDD)

[3] 3GPP RAN TS 25.213 Spreading and modulation (FDD)

[4] 3GPP RAN TS 25.214 Physical layer procedures (FDD)

[5] 3GPP RAN TS 25.215 Physical layer measurements (FDD)

[6] 3GPP RAN TS 25.221 Transport channels and physical channels (TDD)

[7] 3GPP RAN TS 25.222 Multiplexing and channel coding (TDD)

[8] 3GPP RAN TS 25.223 Spreading and modulation (TDD)

[9] 3GPP RAN TS 25.224 Physical layer procedures (TDD)

[10] 3GPP RAN TS 25.301 Radio Interface Protocol Architecture

[11] 3GPP RAN TS 25.302 Services provided by the Physical layer

[12] 3GPP RAN TS 25.303 UE functions and interlayer procedures in connected mode

[13] 3GPP RAN TS 25.304 UE procedures in idle mode

[14] 3GPP RAN TS 25.331 RRC Protocol Specification

[15] 3GPP RAN TR 25.922 Radio Resource Management Strategies

[16] 3GPP RAN TR 25.923 Report on Location Services (LCS) [

3 Definitions, symbols and abbreviations

3.1 Definitions

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

<defined term>**:** <definition>.

3.2 Symbols

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

<symbol> <Explanation>

3.3 Abbreviations

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

BER	Bit Error Rate
BLER	Block Error Rate
CCPCH	Common Control Physical Channel
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
ISCP	Interference Signal Code Power
PCH	Paging Channel
PRACH	Physical Random Access Channel
RACH	Random Access Channel
RSCP	Received Signal Code Power
RSSI	Received Signal Strength Indicator
SCH	Synchronisation Channel
SIR	Signal-to-Interference Ratio
UE	User Equipment

4 Control of UE/UTRAN measurements

In this chapter 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 PCCPCH 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 PCCPCH 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 chapter 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 carried out on Primary CCPCH (PCCPCH) can also be carried out on another CCPCH if it has the same constant power level as the PCCPCH and no beamforming is used.

Note 2: The UTRAN has to take into account the UE capabilities when specifying the timeslots to be measured in the measurement control message.

Note 3: The RSCP can either be measured on the data part or the midamble of a burst, since there is no power offset between both. However, in order to have a common reference, the measurement on the midamble is assumed.

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.

5.1.1 PCCPCH RSCP

Definition	Received Signal Code Power, the received power on PCCPCH of own or neighbour cell after despreading. The reference point for the RSCP is the antenna connector at the UE.
Applicable for	idle mode, connected mode (intra-frequency & inter-frequency)
Range/mapping	

5.1.2 CPICH RSCP

Definition	Received Signal Code Power, the received power on the CPICH code after despreading. The reference point for the RSCP is the antenna connector at the UE.
Applicable for	idle mode, connected mode (inter-frequency)
Range/mapping	

5.1.3 DPCH / PDSCH RSCP

Definition	Received Signal Code Power, the received power on the code of a specified DPCH or PDSCH after despreading. The reference point for the RSCP is the antenna connector at the UE.
Applicable for	connected mode (intra-frequency)
Range/mapping	

5.1.4 ISCP

Definition	Interference Signal Code Power, the interference on the received signal in a specified timeslot after despreading. Only the non-orthogonal part of the interference is included in the measurement. The reference point for the ISCP is the antenna connector at the UE.
Applicable for	connected mode (intra-frequency)
Range/mapping	

5.1.5 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 is the antenna connector at the UE.
Applicable for	idle mode, connnected mode (intra- & inter-frequency)
Range/mapping	

5.1.6 GSM 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 GSM BCCH carrier. The reference point for the RSSI is the antenna connector at the UE.
Applicable for	idle mode, connnected mode (inter-frequency)
Range/mapping	For GSM: according to the definition of RXLEV in GSM 05.08.

5.1.7 DPCH / PDSCH SIR

Definition	Signal to Interference Ratio, defined as the RSCP divided by ISCP of the same timeslot. The reference point for the SIR is the antenna connector of the UE.
Applicable for	connected mode (intra-frequency)
Range/mapping	

5.1.8 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. The reference point for Ec/No is the antenna connector at the UE.
Applicable for	idle mode, connected mode (inter-frequency)
Range/mapping	

5.1.9 DPCH / PDSCH Physical CH BER

Definition	The physical channel BER is an estimation of the average bit error rate (BER) before channel decoding of the data.
Applicable for	connected mode (intra-frequency)
Range/mapping	

5.1.10 DCH / DSCH Transport CH 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)
Range/mapping	

5.1.11 UE TX Power

Definition	The total UE transmitted power on one carrier measured in a timeslot. The reference point for the UE TX Power shall be the UE antenna connector.
Applicable for	connected mode (intra-frequency).
Range/mapping	.

5.1.12 Observed time difference to target cell on same frequency

Definition	Time difference in the frame timing between the serving TDD cell and the frame timing of the target TDD cell measured by means of PCCPCH on the same frequency.
Applicable for	idle mode, connected mode (intra-frequency)
Range/mapping	

5.1.13 Observed time difference to target cell on different frequency

Definition	Time difference in the frame timing between the serving TDD cell and the frame timing of the target cell on a different frequency, measured on CPICH for FDD cell, PCCPCH for TDD cell, BCCH for GSM cell.
Applicable for	Idle mode, connected mode (inter-frequency)
Range/mapping	

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 RSCP can either be measured on the data part or the midamble of a burst, since there is no power offset between both. However, in order to have a common reference, the measurement on the midamble is assumed.

5.2.1 DPCH / PUSCH RSCP

Definition	Received Signal Code Power, the received power on one DPCH or PUSCH code after despreading. The reference point for the RSCP shall be the antenna connector.
Range/mapping	

5.2.2 PRACH RSCP

Definition	Received Signal Code Power, the received power on one PRACH code after despreading. The reference point for the RSCP shall be the antenna connector.
Range/mapping	

5.2.3 ISCP

Definition	Interference Signal Code Power, the interference on the received signal in a specified timeslot after despreading. Only the non-orthogonal part of the interference is included in the measurement. The reference point for the ISCP shall be the antenna connector.
Range/mapping	

5.2.4 RSSI

Definition	Received Signal Strength Indicator, the wide-band received power within the UTRAN UL channel bandwidth in a specified timeslot. The reference point for the RSSI shall be the antenna connector.
Range/mapping	

5.2.5 DPCH / PUSCH SIR

Definition	Signal to Interference Ratio, defined as the RSCP divided by ISCP of the same timeslot. The reference point for the SIR shall be the antenna connector.
Range/mapping	

5.2.6 DPCH / PUSCH Physical CH BER

Definition	The physical channel BER is an estimation of the average bit error rate (BER) before channel decoding of the data.
Range/mapping	

5.2.7 DCH / USCH Transport CH 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.
Range/mapping	

5.2.8 UTRAN Total Transmitted Power

Definition	UTRAN Total Transmitted Power, is the total transmitted power on one DL carrier from one UTRAN access point measured in a timeslot. The reference point for the UTRAN total transmitted power measurement shall be the antenna connector.
Range/mapping	

5.2.9 UTRAN 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 antenna connector at the UTRAN access point cabinet.
Range/mapping	

5.2.10 Received Timing Deviation

Definition	The difference of the time of arrival of the UL transmissions in relation to the arrival time of a signal with zero propagation delay.
Range/mapping	

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

6 Annex A (informative)

6.1 Monitoring GSM from TDD: Calculation Results

6.1.1 Low data rate traffic using 1 uplink and 1 downlink slot

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.

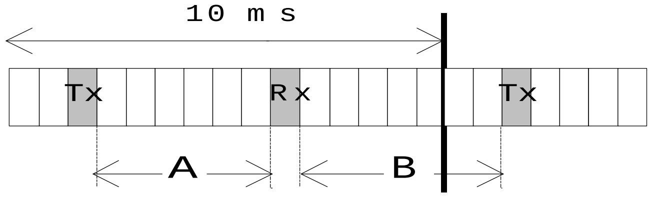

Figure: Possible idle periods in a frame with two occupied timeslots.

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.

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

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

(*) 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.

6.1.2 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.

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	-	-

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

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:

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

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

7 History

V.0.0.1	01.09.1999	First version of ‘TS 25.225 Physical Layer – Measurements (TDD)’ based on ‘TS 25.231 Physical Layer – Measurements’ V0.3.1 of 11.08.1999 approved in RAN WG1 meeting #6 including the agreed text proposals R1-99c22, R1-99a79 (with changes) and R1-99d62. (temporary editor)
V.0.1.0	03.09.1999	TS 25.225 Physical Layer – Measurements (TDD) V.0.0.1 approved in RAN WG1 meeting #7 agreeing the measurements in section 6 marked by # and therefore deleting the corresponding notes. Furthermore, adding a section ‘Measurements for Cell Selection/Reselection’ after section 7.1.2 and therefore updating the table in chapter 9. (temporary editor)
V.0.1.1	05.10.1999	R1-99f92 is a text proposal for the RAN WG1 #7bis plenary which is based on V.0.1.0 with the changes of R1-99d42 and corresponding inputs to 25.215 (FDD) agreed in a measurement drafting group. (temporary editor)
V.2.0.0	05.10.1999	R1-99g11 is the TS 25.225 V.0.1.1 as it was agreed in the RAN WG1 meeting #7bis and as it will be submitted to the RAN meeting #5.

The editor for TS 25.225 Physical Layer – Measurements (TDD is

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