Agenda Item : **adhoc 16 (Measurements)**

Source : Siemens

Title : Update of TS 25.225 concerning measurement definitions, ranges and mappings

Document for : approval

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1. Introduction

This Tdoc proposes changes to the current TDD specification TS 25.225 [1] concerning measurement definitions, ranges and mappings of the measurements.

A CR proposal introducing these changes into the specification is attached.

2. Measurement definitions

This section has the intention to clarify the details of the measurements in a TDD cell.

2.1 UE: SFN-SFN observed time difference

Comparable to the FDD specification 25.215 [8] it is the proposal for the TDD specification 25.225 [1] to distinguish also 2 types of the measurement ‚SFN-SFN observed time difference' (the exact definition can be found in the CR proposal):

- Type 1 (when serving and target cell do not have the same frame timing or the SFN numbering is not synchronous):
  Difference between the start of the received frame SFN(serving) of the serving TDD cell and the start of the received frame SFN(target) in the target UTRA cell which is following next after the frame start of the serving cell. Time difference in chips.
  Analogous to FDD this time difference is defined modulo 256 frames (the 8 least significant bit of the SFN, which means up to 2.56sec –1 chip).
- Type 2 (when serving and target cell have the same frame timing and SFN numbering):
  Difference between the start of the received frame of the serving TDD cell and the start of the received frame in the target UTRA cell which is following next after the frame start of the serving cell. Time difference in chips.
  It allows the determination of propagation delays from the UE to different UTRA cells.

2.2 UE: Observed time difference to GSM cell

For the TDD specification 25.225 [1] the following definition is proposed:
‚Observed time difference to GSM cell' is the time difference in ms between the start of the received frame SFN=0 of the serving TDD cell and the start of the received 51-GSM-multiframe of the considered target GSM frequency which is following next after the start of frame SFN=0 of the serving cell. (The exact definition can be found in the CR proposal).
The purpose of this measurement is to ease the monitoring and handover to the GSM cell from the TDD cell by some knowledge about the relative timing.

2.3 UTRAN: RX Timing Deviation

This measurement (TDD only) may be used for timing advance calculations and location services.

For the TDD specification 25.225 [1] the following definition is proposed (the exact definition can be found in the CR proposal):
‘RX Timing Deviation’ is the time difference in chips between the reception of the first significant uplink path to be used in the detection process and the beginning of the respective slot according to the Node B internal timing.

2.4 UTRAN and UE: RSCP, ISCP and SIR

Following the discussions on the RAN WG1 email reflector on dependence of RSCP and ISCP and SIR on the spreading factor SF we thought some clarifications are necessary:

- The received signal code power (RSCP) and the interference on signal code power (ISCP) can only be determined *after* despreading. This was intended to be expressed in the definition.
- The ‘reference point antenna connector’ is mentioned to enable a testing of power measurement accuracies since a UE or base station internal reference point would make it difficult/impossible to interpret the measurement result. The relating to this reference point can be considered as a normalization of the measurement.
- Considering the RSCP of a code with spreading factor SF the energy per chip Ec divided by the chip duration Tc before despreading (at the antenna connector) will be equal to the energy collected for one bit SF*Ec divided by the duration of one bit SF*Tc after despreading. Therefore both power values remain the same and independent of SF.
- Nevertheless, since the transmit power is controlled in that way that it is proportional to 1/SF. This means that both values of RSCP before and after despreading are increasing in the same way when the spreading factor is reduced.
  This was the reason why in RAN WG1 Tdoc (99) i72 it is proposed to multiply the SIR with SF (or SF/2).
  It is just to get a more uniform exploitation of the measurement range for all the different SF.
  However this is more critical for FDD (SFmax=256) than for TDD (SFmax=16).
- The multiplication of SIR with SF (or SF/2) assumes that ISCP is independent of SF!
  If it is assumed that all codes (with SFmax) after despreading experience the same non-orthogonal interference ISCP, it is questionable whether ISCP is independent of SF. It is more likely that a code with SF=8 is interfered by two times of the interference for a code with SF=16 (i.e. ISCP after despreading ~ 1/SF).

Our proposal is therefore to leave the RSCP and ISCP definition untouched (we can add a note to differentiate between the measurement point and the reference point to which the measurement is normalized if this is really necessary).
Furthermore, since in the current SIR definition RSCP/ISCP is independent of SF (see explanations above) the proposal of a multiplication of RSCP/ISCP with SF is not proposed because it is based on the wrong assumptions ‘ISCP independent of SF’ and would therefore lead to the opposite of what was intended.

3. Measurement Ranges and Mappings

This section is divided into 4 sections: RX power measurements (including SIR and Ec/No), TX power measurements, time measurements and error rate measurements.

3.1 RX Power Measurements

3.1.1 UE: GSM carrier RSSI

Instead of citing the GSM 05.08 specification [5] it is proposed to include the detailed mapping:
GSM_carrier_RSSI_LEV 0: less than -110dBm
GSM_carrier_RSSI_LEV 1: -110dBm to –109dBm
GSM_carrier_RSSI_LEV 2: -109dBm to –108dBm
...
GSM_carrier_RSSI_LEV 62: -49dBm to –48dBm
GSM_carrier_RSSI_LEV 63: greater than -48dBm
That means GSM_carrier_RSSI_LEV is mapped on 6 bits.

3.1.2 UE: UTRA carrier RSSI

The noise floor level at the antenna connector reference point is –174.4dBm + 10*Log10(B/Hz) = -108.55dBm for the minimum UE operating temperature T=-10°C [25.102, see 2] and a signal bandwidth: B=3.84MHz.
The maximum input level, respectively received power, at the UE is specified with –25dBm for this bandwidth [25.102, see 2].

This would lead to a range –109dBm to –25dBm. However, in pratice neither the upper limit (high interference/load situation) nor the lower limit (no signal apart from thermic noise) will be reached.
The currently discussed range for FDD is –95dBm to –30dBm in 0.5dB.
According to [6] an implementation with an accuracy down to ±2.5dB seems to be feasible for the whole range. The accuracies proposed by RAN WG4 in [7] consider the values ±4dB below –70dBm and ±6dB over the full range (as they are also applied for GSM [5]). We therefore assume that a 1dB resolution is sufficient.

So for TDD we propose:
UTRA_carrier_RSSI_LEV 0: less than -95dBm
UTRA_carrier_RSSI_LEV 1: -95dBm to –94dBm
UTRA_carrier_RSSI_LEV 2: -94dBm to –93dBm
...
UTRA_carrier_RSSI_LEV 62: -34dBm to –33dBm
UTRA_carrier_RSSI_LEV 63: greater than -33dBm
since this allows to map UTRA_carrier_RSSI_LEV on 6 bits.

3.1.3 UTRAN: RSSI

The noise floor level at the antenna connector reference point is about –109dBm (compare 3.1.2) and the dynamic range of the receiver input power at the antenna connector is specified to 30dB [25.105, see 3].
Therefore the maximum received power at the antenna connector of the base station would be –79dBm.
Taking also into account that the thermic noise level will not be reached it seems to be useful to take a lower limit of more than –109dBm, e.g. –105dBm.
For FDD the currently discussed range is –105dBm to –70dBm in 0.1dB steps which would result in 351 steps or a 9 bit resolution. However, according to [25.104, see 10] the receiver's dynamic range is also 30dB for FDD.
According to [6] an implementation with an accuracy down to ±1.5dB seems to be feasible for the whole range. The accuracy proposed by RAN WG4 in [7] considers ±4dB over that range.
So due to the smaller dynamic range in the UTRAN compared to the UE we would propose a finer resolution of 0.5dB which would allow to save 3 bits (see FDD proposal) but is a good compromise considering the accuracy.

For TDD we propose:
RSSI_LEV 0:less than -105dBm
RSSI_LEV 1:-105dBm to –104.5dBm
RSSI_LEV 2:-104.5dBm to –103dBm
...
RSSI_LEV 62: -74.5dBm to –74dBm
RSSI_LEV 63: greater than -74dBm
which means RSSI_LEV is mapped on 6 bits.

3.1.4 UE: RSCP and Primary CCPCH RSCP

A maximum received power at the UE antenna port of –25dBm is specified in 25.102 [2] for TDD (same value for FDD see 25.104 [9]).

Considering the noise floor of –108.55dBm in 3.1.2 and taking a maximum spreading gain of 12dB (TDD: SFmax=16) into account we don't expect values below –120.55dBm for RSCP.
The TDD UE reference sensitivity level is specified in 25.102 [2] to -105dBm (for 12.2kbps & BER<=0.001, signal bandwidth B=243kHz and noise figure NF(UE)=9dB, see also [13]). (For FDD the reference sensitivity of the UE receiver is calculated to –117dBm, see [14]).
These values consider an AWGN channel and a UE noise figure NF=9dB (note: this value is not standardized) to read a dedicated channnel with a BER of 0.1%.

For FDD a range of –115dBm ... –40dBm with steps of 0.5dB (that means 151 steps and 8bit resolution) is discussed.
The lower limit was estimated using the reference sensitivity level –117dBm and taking +5dB for a fading channel and further –3dB (to allow measuring the channel before reading is possible) into account. For TDD the same consideration would lead to a lower limit of –103dBm.
For the reason of compatibility with FDD and also as a further margin (future services, perhaps a little lower NF etc.) we would also use –115dBm as the lower limit of the range.

Concerning the upper limit we agree that for cell selection/reselection or handover decisions it might not be necessary to distinguish between high levels of –40dBm ... –25dBm at the UE. However since a measurement on the P-CCPCH (or another channel with reference TX power) can be used for pathloss calculations and power control it would be useful to resolve also the measurement results above –40dBm. This seems applicable since only 151 of 256 steps of the 8bit resolution are used in the FDD proposal.

The accuracy currently discussed in RAN WG4 [7] for these RSCP measurements is ±6dB over the full range.
Due to the minimum power control step size tolerance of ±0.5dB for the 1dB power step size specified in 25.102 [2] for the UE in TDD we would also accept a 0.5dB resolution (or smaller).

For an efficient exploitation of the 8bit resolution we therefore propose a range and mapping for the RSCP and the P-CCPCH RSCP measurement of TDD:

RSCP_000:	less than -115dBm		
RSCP_N:	(-115 + (N-1)*1/3)dBm	to (–115 + N* 1/3)dBm	for N=1, 2, 3, ... , 223, 224
RSCP_225:	(-40 – 1/3)dBm	to –40dBm	
RSCP_K :	(-40 + (K-226)*1/2)dBm	to (-40 + (K-225)*1/2)dBm	for K=226, 227, ... , 252, 253
RSCP_254:	-26.0dBm	to –25.5dBm	
RSCP_255:	greater than –25.5dBm		

This mapping uses 1/3dB steps below –40dBm and a greater step size of 0.5dB above since this is not the range where the measurement values are usually expected. This mapping can also be applied for FDD.

3.1.5 UE: CPICH RSCP

For TDD this measurement is used for monitoring FDD cells in preparation of cell selection/reselection or handover.
For FDD a range of -115dBm ... -40dBm in steps of 0.5dB (151 steps or 8bit) is discussed.
For TDD we propose the same range as proposed for RSCP and P-CCPCH RSCP in 3.1.4.

3.1.6 UE: Timeslot ISCP

This measurement may be used for DCA, HO evaluation and for SIR calculations.

The considerations are similar to the RSCP of 3.1.4.

The accuracy currently discussed in RAN WG4 [7] for this ISCP measurement is ±6dB over the full range.

Since the RSCP range was a little bit extended concerning the lower limit for the benefit of an optimum exploitation of the 8bit resolution and to cover also the FDD range, we propose to use the RSCP range and mapping of 3.1.4 also for the TDD UE measurement Timeslot ISCP.

3.1.7 UE: SIR

For FDD the currently discussed range is –10dB ... 20dB in steps of 0.2dB (151 steps or 8bit) or 0.5dB (60steps or 6bit).
Since in our opinion the definition RSCP/ISCP is already independent of SF (see 2.4) we propose for TDD:

UE_SIR_00:	less than -11dB	
UE_SIR_01:	-11.0dB	to –10.5dB
UE_SIR_02:	-10.5dB	to –10.0dB
....		
UE_SIR_61:	19.0dB	to 19.5dB
UE_SIR_62:	19.5dB	to 20.0dB
UE_SIR_63:	more than 20dB	

3.1.8 UE: CPICH Ec/No

For TDD this measurement is used for monitoring FDD cells in preparation of cell selection/reselection or handover.

For FDD a range of -20dB ... 0dB (‘as it is used for IS-95’) in steps of 0.2dB (101 steps or 7 bit) or 0.5dB (41 steps or 6bit) depending on the accuracy requirement is discussed.

For TDD we would prefer the larger step size. For a more efficient mapping on just 5 bits we propose to have a step of (2/3)dB:

CPICH_Ec/No_00: less than -20dB
CPICH_Ec/No_N: (-20 + (N-1)*2/3)dB to (-20 + N*2/3)dB for N= 1, 2, 3,..., 28, 29, 30
CPICH_Ec/No_31: more than 0dB

(This proposal will only be included in the final CR for the TDD specification if it is also accepted for the FDD specification.)

3.1.9 UTRAN: RSCP

Considering the noise floor of about -109dBm in 3.1.3 and taking a maximum spreading gain of 12dB (TDD: SFmax=16) into account we don’t expect values below –121dBm for RSCP measured in the UTRAN.
The TDD base station reference sensitivity level is specified in 25.105 [3]: -110dBm (for 12.2kbps & BER<=0.001, signal bandwidth B=243kHz and NF(BS)=5dB, see also [13]). (For FDD a sensitivity level of –122dBm is specified in 25.104 [10], see also[15]).

The Dynamic range for the base station receiver input is 30dB, specified for TDD in 25.105 [3] and for FDD in 25.104 [10]. This results in a maximum received power at the base station of 80dB for TDD (and –92dBm for FDD).
For the base station’s RSCP measurement we would use the same step size as for the RSCP measurement in the UE below –40dBm: 1/3dB:

UTRAN_RSCP_000: less than -120dBm
UTRAN_RSCP_N: (-120 + (N-1)*1/3)dBm to (–120 + N* 1/3)dBm for N=1, 2, 3, ... , 125, 126
UTRAN_RSCP_127: greater than –78dBm

3.1.10 UTRAN: Timeslot ISCP

This measurement may be used for DCA, HO evaluation and for SIR calculations.

The considerations are similar to the RSCP of 3.1.9. Considering the theoretical minimum of –121dBm (see 3.1.9) plus the base station’s noise figure of NF=5dB (not standardized but usual assumption) the lower limit can be assumed to
–116dBm.
The accuracy currently discussed in RAN WG4 [7] for this ISCP measurement is ±6dB over the full range.

Since the RSCP range was a little bit extended in 3.1.9 concerning the lower limit for the benefit of an optimum exploitation of the 7bit resolution and to cover also the FDD range, we propose to use the RSCP range and mapping of 3.1.10 also for the TDD UTRAN measurement ‘Timeslot ISCP’.

3.1.11 UTRAN: SIR

For FDD the currently discussed range is –10dB ... 20dB in steps of 0.2dB (151 steps or 8bit) with a working point between –3dB and +3dB.

For TDD we propose the same range and mapping as for the TDD SIR measurement in the UE, see 3.1.7.

3.2 TX Power Measurements

3.2.1 UE: UE transmitted power

In 25.102 [2] the minimum transmit power –44dBm for the UE is specified.
A maximum UE ouput power of 30dBm is also specified there for TDD power class 1.

(For FDD a maximum UE output power of 33dBm for power class 1 and also a minimum UE transmit power of –44dBm is specified in 25.101 [9]. For FDD a range of –44dBm ... 33dBm is discussed with steps of 0.2dB which leads to 386 steps or 9 bit resolution.)

So for the UE transmitted power a measurement range of –44dBm to 33dBm (to harmonise the range with FDD) seems to be reasonable. However, there are also discussions to reduce the lower limit –44dB (e.g. to –50dB) which may be useful if the UE is very close to the base station.

According to [6] an implementation limit for the absolute measurement of ±4dB over the whole range and ±2dB over the range from 15dBm to 30dBm is assumed. On the other hand a minimum power control step size tolerance of ±0.5dB for the 1dB power step size is specified for TDD in 25.102 [2] which reflects the relative accuracy.

So a resolution of 0.5 dB may be a good compromise. This would lead to 156 steps for the range –44...33dBm and would require 8 bits. With the same 8 bits and 0.5dB steps it would be allow to extend the lower limit to –95dBm what is really not required.

So our proposal is to use an 8bit resolution with steps of 0.4dB below 0dBm and 0.3dB steps above 0dBm with the advantages of an optimum exploitation of the bits and finer steps close to the UE TX power maximum.

UE_TX_POWER_000: less than –57.6dBm
UE_TX_POWER_001: -57.6dBm to -57.2dBm
UE_TX_POWER_002: -57.2dBm to -56.8dBm
UE_TX_POWER_003: -56.8dBm to -56.4dBm

UE_TX_POWER_144: -0.8dBm to -0.4dBm
UE_TX_POWER_145: ..-0.4dBm to 0.0dBm
UE_TX_POWER_146: 0.0dBm to 0.3dBm
UE_TX_POWER_147: 0.3dBm to 0.6dBm
...
UE_TX_POWER_252: 31.8dBm to 32.1dBm
UE_TX_POWER_253: 32.1dBm to 32.4dBm
UE_TX_POWER_254: 32.4dBm to 32.7dBm
UE_TX_POWER_255: greater than 32.7dBm

3.2.2 UTRAN: Transmitted carrier power

As specified in 25.105 [3] for TDD and 25.104 [10] for FDD the maximum base station power has to be declared by the manufacturer but no limit is specified. Nevertheless, the maximum base station transmit power values used in RF system scenario simulations in 25.924 [12] are 43dBm (=20W) for macro cells and 33 dBm (2W) for micro cells.

Although 20W (=43dBm) are a realistic assumption now, a higher upper limit should be chosen to take care of possible future extensions, e.g. 50dBm. Also a margin for the lower limit should be taken into account (e.g. for pico cells).

In 25.105 [3] for TDD a downlink total power dynamic range of 30dB is specified (for FDD in 25.104 [10] '18dB or greater') which would imply 3dBm for the micro base station based on the simulation assumption.

In 25.105 [3] also the minimum power control step size tolerance of ±0.5dB for a 1dB power step is specified for TDD.
In RAN WG4 values for the accuracy of this measurement between ±6dB or ±3dB are discussed for TDD (see [7]). For FDD a proposal for a range 10dBm to 50dBm with steps of 0.1dB (which means 401 steps or 9 bit resolution) was made.

For TDD we propose a stepsize of 0.5dB which would require a resolution of 7bit to cover at least the range from 3dBm (=2mW) to 43dBm (=20W). This resolution allows to have some further margin in both directions (covering a range from 0.05mW to 100W):

UTRAN_TX_POWER_000: less than –13.0dBm
UTRAN_TX_POWER_001: -13.0dBm to -12.5dBm
UTRAN_TX_POWER_002: -12.5dBm to -12.0dBm
....
UTRAN_TX_POWER_125: 49.0dBm to 49.5dBm
UTRAN_TX_POWER_126: 49.5dBm to 50.0dBm
UTRAN_TX_POWER_127: more than 50.0dBm

3.2.3 UTRAN: Transmitted code power

The upper limit of this measurement must be lower than or equal to (if only one code is used) the upper limit of the ‘Transmitted carrier power’ also measured in the UTRAN. The lower limit should be the same.

For FDD currently a range from 0dBm to 46dBm with steps of 0.1dB is discussed (this leads to 461 steps and a 9 bit resolution).
For TDD we propose to take the same range and mapping for the UTRAN transmitted code power as for the UTRAN transmitted carrier power.

3.3 Time Measurements

3.3.1 UE: SFN-SFN observed time difference

This measurement may be used for cell reselection, handover and location services.
The range for type 1 of this measurement described in 2.1 is the same as for this measurement type 1 of FDD [25.215, see8] that means 0 chips ... (255 * 38400 + 38399 = 9830399 chips) in steps of 1 chip which requires 24 bits.
(Annotation to 25.215 definition of type 1: There seems to a writing error in the definition of Tm since as it is defined now Tm would always be negative contradicting to the mentioned range.)
For measurements between synchronized cells the type 2 of 2.1 applies. The range of this measurement is 0 chips ... 38399 chips in steps of 1 chip which requires 16 bits.
For both types of this measurement an accuracy of ±0.5 chips was proposed in [7].

3.3.2 UE: Observed time difference to GSM cell

This measurement may be used for handover to GSM.
With the duration of a 51GSM-multiframe of 51* 60ms/13 = 3060ms/13 = about 235.3846ms the range of this measurement can be 0ms ... 3060ms/13 * (1-1/2^N) with N bits resolution.
With 10 bits the resolution would be 3060ms/(13*1024)=229.87µs which is about 0.4 GSM slot.
With 12 bits the resolution would be 3060ms/(13*4096)=57.47µs which is about 0.1 GSM slot.
The latter resolution is also proposed for FDD and is therefore also accepted for TDD.
For this measurement an accuracy of ±0.5 chips was proposed in [7].

3.3.3 UTRAN: RX Timing Deviation

Since according to [25.224, see 11] the ‚timing advance will be represented as an 8 bit number (0-255) being the multiple of 4 chips‘ we propose a range of 0 chips ... 255*4chips = 1020 chips.
Since this measurement may also be used for location services we propose a resolution of 1 chip (propagation distance for one chip: 78.125m) which results in a 10 bit resolution.
For this measurement an accuracy of ±0.5 chips was proposed in [7].

3.4 Error Rate Measurements

3.4.1 UE and UTRAN: Physical channel BER

For GSM in [05.08, see 5] 3 bits are specified for a bit error rate before channel decoding:

RXQUAL_0:		BER <	0.2%
RXQUAL_1:	0.2%	< BER <	0.4%
RXQUAL_2:	0.4%	< BER <	0.8%
RXQUAL_3:	0.8%	< BER <	1.6%
RXQUAL_4:	1.6%	< BER <	3.2%
RXQUAL_5:	3.2%	< BER <	6.4%
RXQUAL_6:	6.4%	< BER <	12.8%
RXQUAL_7:	12.8%	< BER	

that means the main range considers rates of 0.002 to 0.128.

For FDD it is discussed to consider a raw BER range from –5.08 < Log10(raw BER) < 0 in 0.02 steps and a further value raw BER=0 (that means an 8 bit resolution). On the other hand there is a proposal to delete this measurement due to the ‚flat behaviour in some environments‘.

From our point of view: On the one hand, as mentioned in the definition the raw BER measurement is just an estimation. Due to the different coding possibilities it also may be complex to estimate from the raw BER the consequences for the user BER (<<raw BER). On the other hand the BER measurement may be a means for first quick and dirty guess for the signal quality which may be improved by averaging.

Therefore it is our proposal to relax the resolution to 4 bit (in contrast to FDD proposal of 8 bit).
From simulations it can be noticed that the raw BER usually has values in the range from 1% to 20%.
Proposal for TDD:

Raw_BER_00:		BER < 0.1 %
Raw_BER_01:	0.1 %	< BER < 0.3 %
Raw_BER_02:	0.3 %	< BER < 0.5 %
Raw_BER_03:	0.5 %	< BER < 1 %
Raw_BER_04:	1 %	< BER < 2 %
Raw_BER_05:	2 %	< BER < 4 %
Raw_BER_06:	4 %	< BER < 6 %
Raw_BER_07:	6 %	< BER < 8 %
Raw_BER_08:	8 %	< BER < 10 %
Raw_BER_09:	10 %	< BER < 12 %
Raw_BER_10:	12 %	< BER < 14 %
Raw_BER_11:	14 %	< BER < 16 %
Raw_BER_12:	16 %	< BER < 18 %
Raw_BER_13:	18 %	< BER < 20 %
Raw_BER_14:	20 %	< BER < 30 %
Raw_BER_15:	30 %	< BER

with quantisation steps of 0.2%, 0.5%, 1%, 2%, 10%

3.4.2 UE and UTRAN: Transport channel BLER

For the ‚Transport channel block error rate' there is a proposal to use the same range and mapping as proposed for the raw BER: –5.08 < Log10(BLER) < 0 in 0.02 steps and a further value BLER=0 (that means an 8 bit resolution).

Since the BLER of a transport channel is considered after channel decoding it gives a more realistic impression of the signal quality than the raw BER. Furthermore, it requires a larger time period to evaluate the BLER.
Therefore we propose for TDD to use also the FDD proposal in a modified way:

- Since the case BLER=0 is not realistic we propose to define BLER_000 as described below:
- We do not really expect BLER above 75% (log10(BER)=-0.125) therefore we used the unnecessary cases to extend the range to lower values.

BLER_000:		Log10(BLER) <	-5.20	(this means BLER < about 6.31E-6)
BLER_001:	-5.20	< Log10(BLER) <	-5.18	
BLER_002:	-5.18	< Log10(BLER) <	-5.16	
BLER_003:	-5.16	< Log10(BLER) <	-5.14	
...				
BLER_253:	-0.16	< Log10(BLER) <	-0.18	
BLER_254:	-0.14	< Log10(BLER) <	-0.12	
BLER_255:	-0.12	< Log10(BLER)		

4. References

[1] RAN WG1 TS 25.225 v.3.0.0 (1999-10) Physical Layer – Measurements (TDD), source: RAN #5

[2] RAN WG4 TS 25.102 v.3.0.0 (1999-10) UTRA (UE) TDD; Radio Transmission and Reception, source: RAN #5

[3] RAN WG4 TS 25.105 v.3.0.0 (1999-10) UTRA (BS) TDD; Radio Transmission and Reception, source: RAN #5

[4] GSM 05.05 (Phase 2+), Radio Transmission and Reception, source: ETSI

[5] GSM 05.08 (Phase 2+), Radio Subsystem Link Control, source: ETSI

[6] RAN WG4 AH02 Tdoc (99)R4rrm05, RRM Measurements performance requirements for TDD, source: Siemens

[7] RAN WG4 Tdoc (99)785 Annex B Measurement Requirements, Report of AH02: TS 25.123 and TS 25.133 drafting session (Helsinki, Nov. 18-19, 1999), source: RAN WG4 AH02

[8] RAN WG1 TS 25.215 v.3.0.0 (1999-10) Physical Layer – Measurements (FDD), source: RAN #5

[9] RAN WG4 TS 25.101 v.3.0.0 (1999-10) UTRA (UE) FDD; Radio Transmission and Reception, source: RAN #5

[10] RAN WG4 TS 25.104 v.3.0.0 (1999-10) UTRA (BS) FDD; Radio Transmission and Reception, source: RAN #5

[11] RAN WG1 TS 25.224 v.3.0.0 (1999-10) Physical Layer Procedures (TDD), source: RAN #5

[12] RAN WG4 TR 25.924 v2.0.0 (1999-10) RF System Scenarios, source: RAN #5

[13] RAN WG4 Tdoc (99)549 Proposal for UE and BS reference sensitivity in the TDD mode (Makuhari, Japan), source: Siemens

[14] RAN WG4 Tdoc (99)012 MS receiver sensitivity in UTRA FDD mode (Espoo, Finland), source: Nokia

[15] RAN WG4 Tdoc (99)373 Required Eb/No for Voice channel (12.2kbps, BS for FDD), source: NEC, NTT DoCoMo, Panasonic, Fujitsu

3GPP/SMG Meeting #?
Location, Country, DD-DD MMM YYYY

Document ???99???
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.

25.225 CR | Current Version: 3.0.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ | *↑ CR number as allocated by MCC support team*

For submission to:	RAN #6	for approval	X	strategic	*(for SMG use only)*
list expected approval meeting # here ↑		for information		non-strategic	

Form: CR cover sheet, version 2 for 3GPP and SMG The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: Siemens AG **Date:** 22.11.1999

Subject: Update concerning measurement definitions, ranges and mappings

Work item:

Category:
(only one category shall be marked with an X)

F	Correction	X	
A	Corresponds to a correction in an earlier release		
B	Addition of feature		
C	Functional modification of feature		
D	Editorial modification		

Release:

Phase 2	
Release 96	
Release 97	
Release 98	
Release 99	X
Release 00	

Reason for change: Time measurement definitions were updated to be more precise and range & mapping values for the measurements were added.

Clauses affected: Chapter 5

Other specs affected:

Other 3G core specifications		→ List of CRs:
Other GSM core specifications		→ List of CRs:
MS test specifications		→ List of CRs:
BSS test specifications		→ List of CRs:
O&M specifications		→ List of CRs:

Other comments: Draft CR proposed in RAN WG1 #9 Tdoc (99) i82

help.doc

<--------- double-click here for help and instructions on how to create a CR.

monitor is available, the UE may perform the measurements on the PCCPCH directly without prior SCH synchronisation.

4.1 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.

4.2 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.

4.3 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.

4.3.1 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	P-CCPCH_RSCP_000: less than -115dBm P-CCPCH_RSCP_N: (-115 + (N-1)*1/3)dBm to (–115 + N* 1/3)dBm for N=1, 2, 3, ... , 224 P-CCPCH_RSCP_225: (-40 – 1/3)dBm to –40dBm P-CCPCH_RSCP_K: (-40 + (K-226)*1/2)dBm to (-40 + (K-225)*1/2)dBm for K=226, ... , 253 P-CCPCH_RSCP_254: -26.0dBm to –25.5dBm P-CCPCH_RSCP_255: greater than –25.5dBm

4.3.2 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	CPICH_RSCP_000: less than -115dBm CPICH_RSCP_N: (-115 + (N-1)*1/3)dBm to (–115 + N* 1/3)dBm for N=1, 2, 3, ... , 224 CPICH_RSCP_225: (-40 – 1/3)dBm to –40dBm CPICH_RSCP_K: (-40 + (K-226)*1/2)dBm to (-40 + (K-225)*1/2)dBm for K=226, ... , 253 CPICH_RSCP_254: -26.0dBm to –25.5dBm CPICH_RSCP_255: greater than –25.5dBm

4.3.3 5.1.3 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	RSCP_000: less than -115dBm RSCP_N: (-115 + (N-1)*1/3)dBm to (–115 + N* 1/3)dBm for N=1, 2, 3, ... , 224 RSCP_225: (-40 – 1/3)dBm to –40dBm RSCP_K: (-40 + (K-226)*1/2)dBm to (-40 + (K-225)*1/2)dBm for K=226, ... , 253 RSCP_254: -26.0dBm to –25.5dBm RSCP_255: greater than –25.5dBm

4.3.4 5.1.4 Timeslot 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	ISCP_000: less than -115dBm ISCP_N: (-115 + (N-1)*1/3)dBm to (–115 + N* 1/3)dBm for N=1, 2, 3, ... , 224 ISCP_225: (-40 – 1/3)dBm to –40dBm ISCP_K: (-40 + (K-226)*1/2)dBm to (-40 + (K-225)*1/2)dBm for K=226, ... , 253 ISCP_254: -26.0dBm to –25.5dBm ISCP_255: greater than –25.5dBm

4.3.5 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, connected mode (intra- & inter-frequency)
Range/mapping	UTRA_carrier_RSSI_LEV 0: less than -95dBm UTRA_carrier_RSSI_LEV 1: -95dBm to –94dBm UTRA_carrier_RSSI_LEV 2: -94dBm to –93dBm ... UTRA_carrier_RSSI_LEV 62: -34dBm to –33dBm UTRA_carrier_RSSI_LEV 63: greater than -33dBm

4.3.6 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, connected mode (inter-frequency)
Range/mapping	GSM_carrier_RSSI_LEV 0: less than -110dBm GSM_carrier_RSSI_LEV 1: -110dBm to –109dBm GSM_carrier_RSSI_LEV 2: -109dBm to –108dBm ... GSM_carrier_RSSI_LEV 62: -49dBm to –48dBm GSM_carrier_RSSI_LEV 63: greater than -48dBm ~~For GSM: according to the definition of RXLEV in GSM 05.08.~~

4.3.7 5.1.7 SIR

Definition	Signal to Interference Ratio, defined as the RSCP of a DPCH or PDSCH 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	UE_SIR_00: less than 11dB UE_SIR_01: -11.0dB to –10.5dB UE_SIR_02: -10.5dB to –10.0dB .... UE_SIR_61: 19.0dB to 19.5dB UE_SIR_62: 19.5dB to 20.0dB UE_SIR_63: more than 20dB

4.3.8 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	CPICH_Ec/No_00: less than -20dB CPICH_Ec/No_0N: (-20 + (N-1)*2/3)dB to (-20 + N*2/3)dB for N= 1, 2, 3,..., 28, 29, 30 CPICH_Ec/No_31: more than 0dB

4.3.9 5.1.9 Physical channel 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	Raw_BER_00: BER < 0.1 % Raw_BER_01: 0.1 % < BER < 0.3 % Raw_BER_02: 0.3 % < BER < 0.5 % Raw_BER_03: 0.5 % < BER < 1 % Raw_BER_04: 1 % < BER < 2 % Raw_BER_05: 2 % < BER < 4 % Raw_BER_06: 4 % < BER < 6 % Raw_BER_07: 6 % < BER < 8 % Raw_BER_08: 8 % < BER < 10 % Raw_BER_09: 10 % < BER < 12 % Raw_BER_10: 12 % < BER < 14 % Raw_BER_11: 14 % < BER < 16 % Raw_BER_12: 16 % < BER < 18 % Raw_BER_13: 18 % < BER < 20 % Raw_BER_14: 20 % < BER < 30 % Raw_BER_15: 30 % < BER

4.3.10 5.1.10 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)
Range/mapping	BLER_000: Log10(BLER) < -5.20 BLER_001: -5.20 < Log10(BLER) < -5.18 BLER_002: -5.18 < Log10(BLER) < -5.16 BLER_003: -5.16 < Log10(BLER) < -5.14 ... BLER_253: -0.16 < Log10(BLER) < -0.18 BLER_254: -0.14 < Log10(BLER) < -0.12 BLER_255: -0.12 < Log10(BLER)

4.3.11 5.1.11 UE transmitted power

Definition	The total UE transmitted power on one carrier measured in a timeslot. The reference point for the UE transmitted power shall be the UE antenna connector.
Applicable for	connected mode (intra-frequency).
Range/mapping	- UE_TX_POWER_000: less than –57.6dBm UE_TX_POWER_001: -57.6dBm to -57.2dBm UE_TX_POWER_002: -57.2dBm to -56.8dBm UE_TX_POWER_003: -56.8dBm to -56.4dBm UE_TX_POWER_144: -0.8dBm to -0.4dBm UE_TX_POWER_145: ..-0.4dBm to 0.0dBm UE_TX_POWER_146: 0.0dBm to 0.3dBm UE_TX_POWER_147: 0.3dBm to 0.6dBm ... UE_TX_POWER_252: 31.8dBm to 32.1dBm UE_TX_POWER_253: 32.1dBm to 32.4dBm UE_TX_POWER_254: 32.4dBm to 32.7dBm UE_TX_POWER_255: greater than 32.7dBm

4.3.12 5.1.12 SFN-SFN observed time difference

Definition	~~Time difference in the frame timing between the serving TDD cell and the frame timing of the target UTRA cell measured by means of PCCPCH for a TDD cell and by means of CPICH for an FDD cell.~~ 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 in two types: Type 2 applies if the serving and the target cell have the same frame timing and SFN numbering. Type 1 applies in all other cases. **Type 1:** SFN-SFN observed time difference = OFF×38400+ T_m in chips, where: T_m= T_{RxSFNk} - T_{RxSFNi}, given in chip units with the range [0, 1, …, 38399] chips T_{RxSFNi} : time of start of the received frame SFN_i of the serving TDD cell i. T_{RxSFNk} : time of start of the received frame SFN_k of the target UTRA cell k after the time instant T_{RxSFNi} in the UE. If the next frame of the target UTRA cell is received exactly at T_{RxSFNi} then T_{RxSFNk}= T_{RxSFNi} (which leads to T_m=0). OFF=(SFN_k- SFN_i) 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) **Type 2:** SFN-SFN observed time difference = T_m with T_m see type 1 and SFNi = SFNk
Applicable for	idle mode, connected mode (intra-frequency)
Range/mapping	**Type 1:** 0 chips ... 9830399 chips with a resolution of 1 chip (24 bit) **Type 2:** 0 chips ... 38399 chips with a resolution of 1 chip (16 bit)

4.3.13 5.1.13 Observed time difference to GSM cell

Definition	~~Time difference between the Primary CCPCH of the current cell and the timing of the GSM cell~~ Observed time difference to GSM cell is the time difference T_m in ms, where T_m= T_{RxGSMk} - $T_{RxSFN0i}$ $T_{RxSFN0i}$: time of start of the received frame SFN=0 of the serving TDD cell i T_{RxGSMk} : time of start of the received 51-GSM-multiframe of the considered target GSM beacon frequency k which is following next after the start of frame SFN=0 of the serving TDD cell.
Applicable for	Idle mode, connected mode (inter-frequency)
Range/mapping	0ms ... 3060ms/13 – 3060ms/(13*4096) in steps of 3060ms/(13*4096) (12 bit)

4.4 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.

4.4.1 5.2.1 RSCP

Definition	Received Signal Code Power, the received power on one DPCH, PRACH or PUSCH code after despreading. The reference point for the RSCP shall be the antenna connector.
Range/mapping	UTRAN_RSCP_000: less than -120dBm UTRAN_RSCP_N: (-120 + (N-1)*1/3)dBm to (–120 + N* 1/3)dBm for N=1, 2, 3, ... , 125, 126 UTRAN_RSCP_127: greater than –78dBm

4.4.2 5.2.2 Timeslot 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	UTRAN_ISCP_000: less than -120dBm UTRAN_ISCP_N: (-120 + (N-1)*1/3)dBm to (–120 + N* 1/3)dBm for N=1, 2, 3, ... , 125, 126 UTRAN_ISCP_127: greater than –78dBm

4.4.3 5.2.3 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	RSSI_LEV 0: less than -105dBm RSSI_LEV 1: -105dBm to –104.5dBm RSSI_LEV 2: -104.5dBm to –103dBm ... RSSI_LEV 62: -74.5dBm to –74dBm RSSI_LEV 63: greater than –74dBm

4.4.4 5.2.4 SIR

Definition	Signal to Interference Ratio, defined as the RSCP of the DPCH or PUSCH divided by ISCP of the same timeslot. The reference point for the SIR shall be the antenna connector.
Range/mapping	UTRAN_SIR_00: less than 11dB UTRAN_SIR_01: -11.0dB to –10.5dB UTRAN_SIR_02: -10.5dB to –10.0dB .... UTRAN_SIR_61: 19.0dB to 19.5dB UTRAN_SIR_62: 19.5dB to 20.0dB UTRAN_SIR_63: more than 20dB

4.4.5 5.2.5 Physical channel BER

Definition	The physical channel BER is an estimation of the average bit error rate (BER) of a DPCH or PUSCH before channel decoding of the data.
Range/mapping	Raw_BER_00: BER < 0.1 % Raw_BER_01: 0.1 % < BER < 0.3 % Raw_BER_02: 0.3 % < BER < 0.5 % Raw_BER_03: 0.5 % < BER < 1 % Raw_BER_04: 1 % < BER < 2 % Raw_BER_05: 2 % < BER < 4 % Raw_BER_06: 4 % < BER < 6 % Raw_BER_07: 6 % < BER < 8 % Raw_BER_08: 8 % < BER < 10 % Raw_BER_09: 10 % < BER < 12 % Raw_BER_10: 12 % < BER < 14 % Raw_BER_11: 14 % < BER < 16 % Raw_BER_12: 16 % < BER < 18 % Raw_BER_13: 18 % < BER < 20 % Raw_BER_14: 20 % < BER < 30 % Raw_BER_15: 30 % < BER

4.4.6 5.2.6 Transport channel BLER

Definition	Estimation of the transport channel block error rate (BLER) of a DCH or USCH. The BLER estimation shall be based on evaluating the CRC on each transport block.
Range/mapping	BLER_000: Log10(BLER) < -5.20 BLER_001: -5.20 < Log10(BLER) < -5.18 BLER_002: -5.18 < Log10(BLER) < -5.16 BLER_003: -5.16 < Log10(BLER) < -5.14 ... BLER_253: -0.16 < Log10(BLER) < -0.18 BLER_254: -0.14 < Log10(BLER) < -0.12 BLER_255: -0.12 < Log10(BLER)

4.4.7 5.2.7 Transmitted carrier power

Definition	Transmitted carrier 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	UTRAN_TX_POWER_000: less than –13.0dBm UTRAN_TX_POWER_001: -13.0dBm to -12.5dBm UTRAN_TX_POWER_002: -12.5dBm to -12.0dBm .... UTRAN_TX_POWER_125: 49.0dBm to 49.5dBm UTRAN_TX_POWER_126: 49.5dBm to 50.0dBm UTRAN_TX_POWER_127: more than 50.0dBm

4.4.8 5.2.8 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	UTRAN_TX_CODE_POWER_000: less than –13.0dBm UTRAN_TX_CODE_POWER_001: -13.0dBm to -12.5dBm UTRAN_TX_CODE_POWER_002: -12.5dBm to -12.0dBm .... UTRAN_TX_CODE_POWER_125: 49.0dBm to 49.5dBm UTRAN_TX_CODE_POWER_126: 49.5dBm to 50.0dBm UTRAN_TX_CODE_POWER_127: more than 50.0dBm

4.4.9 5.2.9 RX 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.~~ '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 significant uplink path to be used in the detection process T_{TS} : time of the beginning of the respective slot according to the Node B internal timing
Range/mapping	0 chips ... 1023 chips in steps of 1 chip (10 bit)

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