

Agenda item: AH 16
Source: Ericsson
Title: CR 25.215-008: Range and resolution of BER/BLER measurements
Document for: Decision

1. Range and resolution for physical channel BER and Transport channel BLER

In TS 25.427 Iur/Iub User plane protocol for DCH data streams, section 8.2.4.5 the Quality Estimate (QE) is currently defined as:

QE = - Log10 (Physical channel BER)
Value range: {0-25.5}, granularity 0.1.
Field length: 8 bits.

The range proposed in 25.427 goes down to BER values as low as $3.2 \cdot 10^{-26}$ (QE=25.5). That seems to be somewhat low and the actual interesting area for the BER is somewhere between 0,1 to 10%. Representing values down to 10^{-26} will also imply that the resolution in the BER interval of interest will be worse than if a smaller range is chosen, using the same number of bits. In figure 1 below the mapping defined in 25.427 is shown together with a proposal for a new mapping (both using 8 bits = 256 values).

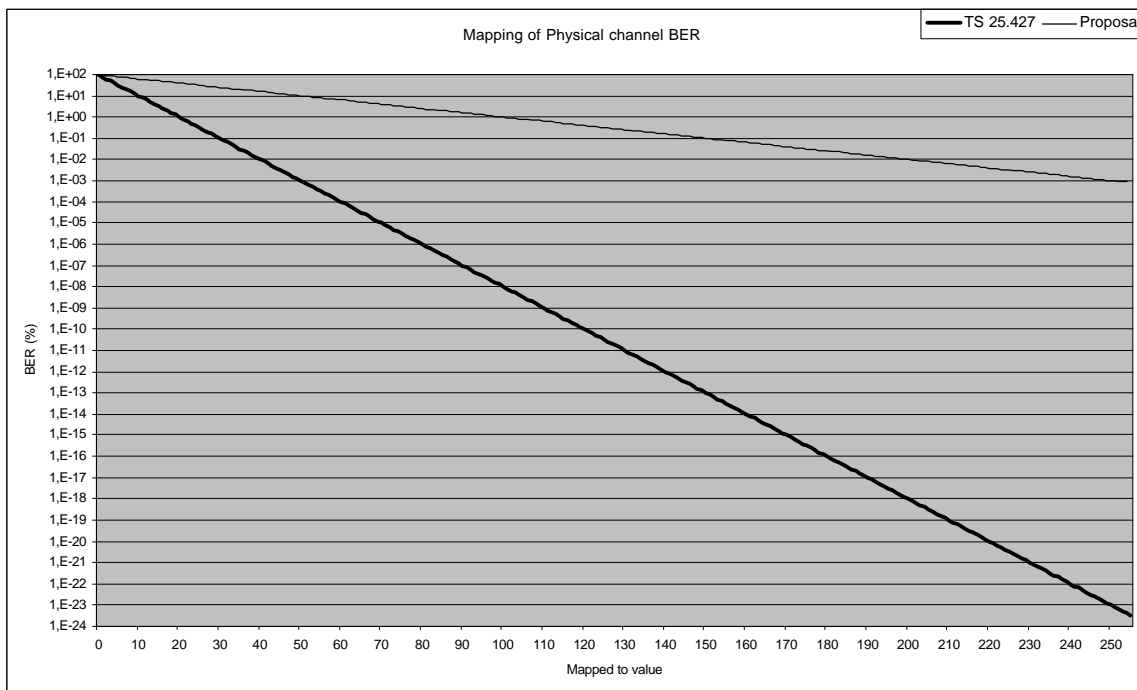


Figure 1 Mapping of physical channel BER

Mapping of the Physical channel BER in the proposal:

$BER_dB\% = -\text{Log}_{10}(\text{Physical channel BER})$, with value range [0 - 5.08] in step of 0.02 for Physical channel BER > 0
 $BER_dB\% = 5.10$ for Physical channel BER = 0.

This mapping makes it possible to represent BER down to approx. 10^{-5} . Consider a worst case where the uplink channel bit rate is 960kbps (SF=4). The maximum TTI is 80ms, which leads that the maximum number of bits received during 80ms will be $960\text{kbps} \times 80\text{ms} = 76800$. To resolve one erroneous bit a resolution of $1/76800 = 1.3 \times 10^{-5}$ is required. The lowest resolvable BER (except BER=0) in the proposal is $10^{-5.08} = 0.83 \times 10^{-5}$ which will be sufficient.

As BER=0 is included in the range it will be possible to resolve even smaller BER values if several BER measurements are accumulated.

It also proposed to use the same mapping for the Transport channel BLER. To resolve BLER values down to the proposed $BLER = 10^{-5.08}$ a minimum of $10^{5.08}$ transport blocks needs to be received. Consider a TrCh with TTI=10ms which will give a minimum averaging period of $10^{5.08} \times (10 \times 10^{-3}) = 1202 \text{ sec.} = 20 \text{ minutes}$, which should be sufficient.

In figure 2 and 3 below the quantisation step size for the current mapping in TS 25.427 and the proposed mapping of physical channel BER is shown.

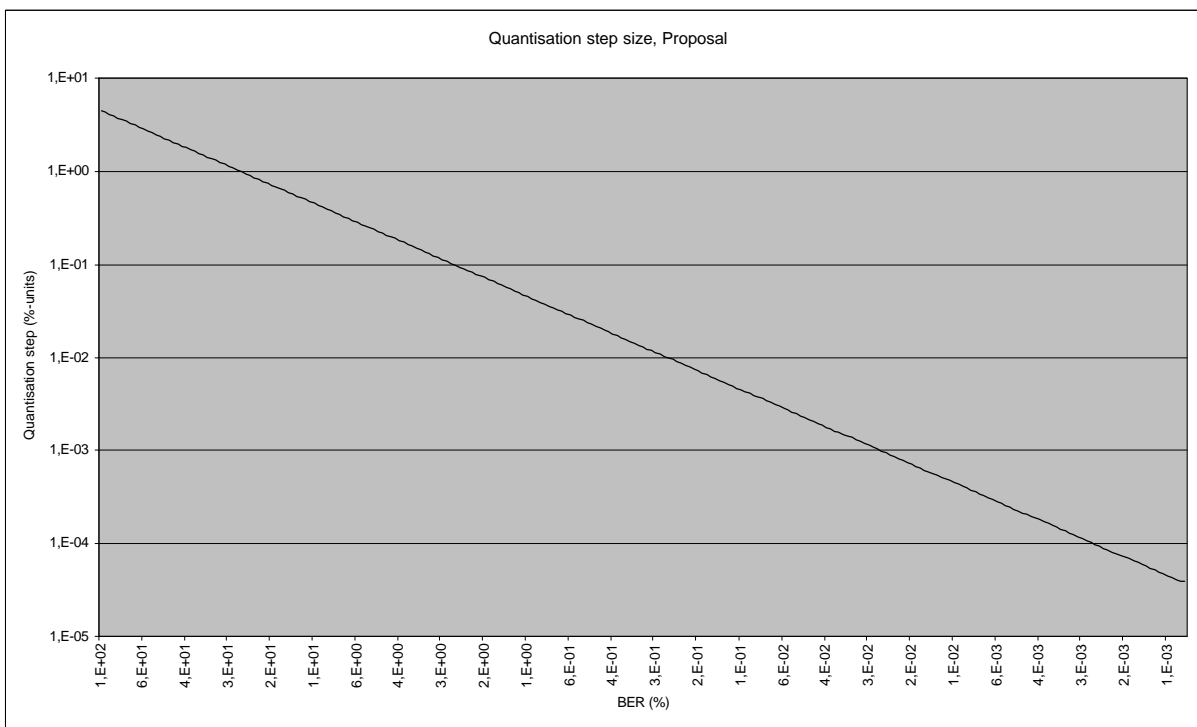


Figure 2 Quantisation step size for the mapping in TS 25.427

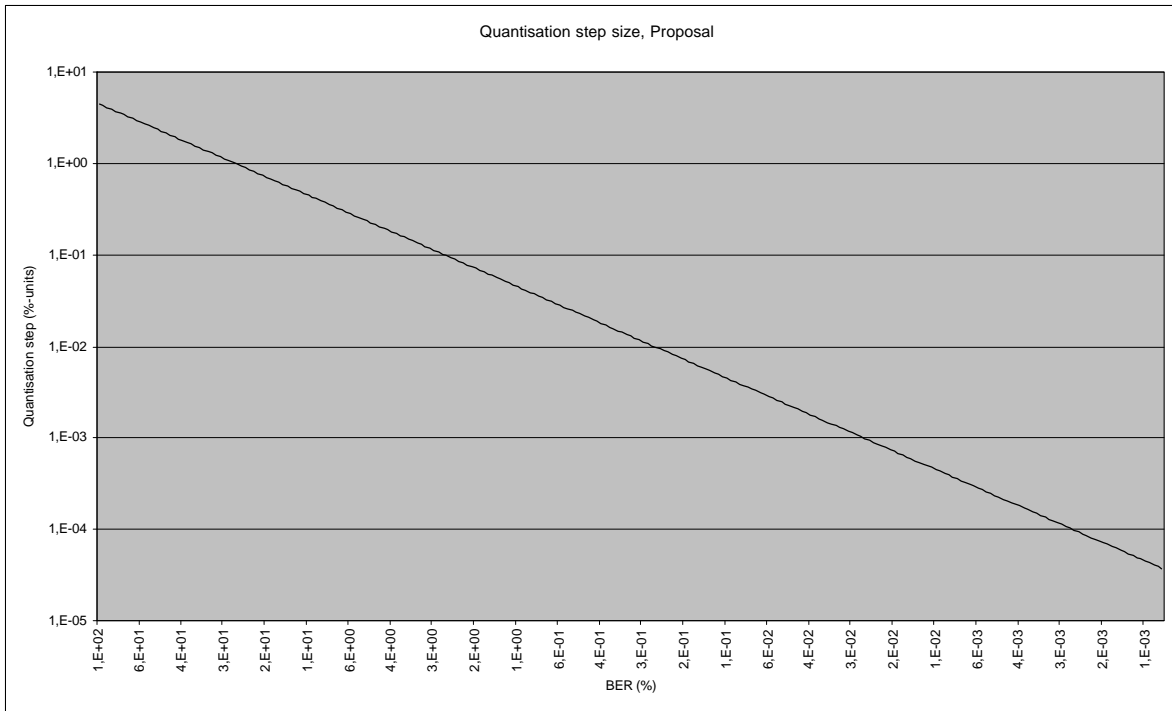


Figure 3 Quantisation step size for the proposed mapping

In the table below the quantisation step is shown around BER 0,1%, 1% and 10%

TS 25.427 BER (%)	Proposal BER (%)
12,5893	10,471
10,0000	10,000
7,9433	9,550
...	...
1,2589	1,047
1,0000	1,000
0,7943	0,955
...	...
0,1259	0,105
0,1000	0,100
0,0794	0,095

2. Proposal

It is proposed to use above proposed mapping of physical channel BER and BLER both for UTRAN and the UE.

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 after RL combination. BLER estimation is only required for transport channels containing CRC. In connected mode the BLER shall be possible to measure on any transport channel. If requested in idle mode it shall be possible to measure the BLER on transport channel PCH.
Applicable for	Idle, Connected Intra
Range/mapping	<u>The Transport channel BLER shall be reported in the unit BLER_dB% where:</u> <u>$BLER_dB\% = -\text{Log}_{10}(\text{Transport channel BLER})$, with value range [0 - 5.08] in step of 0.02 for Transport channel BLER >0</u> <u>$BLER_dB\% = 5.10$ for Transport channel BLER =0.</u>

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 DPDCH data after RL combination. At most it shall be possible to report a physical channel BER estimate at the end of each TTI for the transferred TrCh's, e.g. for TrCh's with a TTI of x ms a x ms averaged physical channel BER shall be possible to report every x ms.
Applicable for	Connected Intra
Range/mapping	<u>The Physical channel BER shall be reported in the unit BER_dB% where:</u> <u>$BER_dB\% = -\text{Log}_{10}(\text{Physical channel BER})$, with value range [0 - 5.08] in step of 0.02 for Physical channel BER >0</u> <u>$BER_dB\% = 5.10$ for Physical channel BER =0.</u>

5.1.10 UE transmitted power

Definition	The total UE transmitted power on one carrier. The reference point for the UE transmitted power shall be the UE antenna connector.
Applicable for	Connected Intra
Range/mapping	

5.1.11 CFN-SFN observed time difference

Definition	The CFN-SFN observed time difference to cell is defined as: $OFF \times 38400 + T_m$, where: $T_m = T_{RxSFN} - (T_{UETx} - T_0)$, given in chip units with the range [0, 1, ..., 38399] chips T_{UETx} is the time when the UE transmits an uplink DPCCCH/DPDCH frame. T_0 is defined in TS 25.211 section 7.1.3. T_{RxSFN} is time at the beginning of the next received neighbouring P-CCPCH frame after the time instant $T_{UETx} - T_0$ in the UE. If the next neighbouring P-CCPCH frame is received exactly at $T_{UETx} - T_0$ then $T_{RxSFN} = T_{UETx} - T_0$ (which leads to $T_m = 0$). and $OFF = (CFN_{Tx} - SFN) \bmod 256$, given in number of frames with the range [0, 1, ..., 255] frames CFN_{Tx} is the connection frame number for the UE transmission of an uplink DPCCCH/DPDCH frame at the time T_{UETx} . SFN = the system frame number for the neighbouring P-CCPCH frame received in the UE at the time T_{RxSFN} .
Applicable for	Connected Inter, Connected Intra
Range/mapping	Time difference is given with the resolution of one chip with the range [0, ..., 9830399] chips.

5.1.12 SFN-SFN observed time difference

Definition	<p>Type 1: The SFN-SFN observed time difference to cell is defined as: $OFF \times 38400 + T_m$, where: $T_m = T_{RxSFNj} - T_{RxSFNi}$, given in chip units with the range [0, 1, ..., 38399] chips T_{RxSFNj} is the time at the beginning of a received neighbouring P-CCPCH frame from cell j. T_{RxSFNi} is time at the beginning of the next received neighbouring P-CCPCH frame from cell i after the time instant T_{RxSFNj} in the UE. If the next neighbouring P-CCPCH frame is received exactly at T_{RxSFNj} then $T_{RxSFNj} = T_{RxSFNi}$ (which leads to $T_m=0$). and $OFF = (SFN_j - SFN_i) \bmod 256$, given in number of frames with the range [0, 1, ..., 255] frames SFN_j = the system frame number for downlink P-CCPCH frame from cell j in the UE at the time T_{RxSFNj}. SFN_i = the system frame number for the P-CCPCH frame from cell i received in the UE at the time T_{RxSFNi}.</p> <p>Type 2: The relative timing difference between cell j and cell i, defined as $T_{CPICHRj} - T_{CPICHRi}$, where: $T_{CPICHRj}$ is the time when the UE receives one CPICH slot from cell j $T_{CPICHRi}$ is the time when the UE receives the CPICH slot from cell i that is closest in time to the CPICH slot received from cell j</p>
Applicable for	<p>Type 1: Idle, Connected Intra Type 2: Idle, Connected Intra, Connected Inter</p>
Range/mapping	<p>Type 1: Time difference is given with a resolution of one chip with the range [0, ..., 9830399] chips. Type 2: Time difference is given with a resolution of 0.5 chip with the range [-1279, ..., 1280] chips.</p>

5.1.13 UE Rx-Tx time difference

Definition	<p>The difference in time between the UE uplink DPCCH/DPDCH frame transmission and the first significant path, of the downlink DPCH frame from the measured radio link. Measurement shall be made for each cell included in the active set. Note: The definition of "first significant path" needs further elaboration.</p>
Applicable for	Connected Intra
Range/mapping	Always positive.

5.2 UTRAN measurement abilities

The structure of the table defining a UTRAN measurement quantity is shown below:

Column field	Comment
Definition	Contains the definition of the measurement.
Range/mapping	Gives the range and mapping to bits for the measurements quantity.

5.2.1 RSSI

Definition	Received Signal Strength Indicator, the wide-band received power within the UTRAN uplink carrier channel bandwidth in an UTRAN access point. The reference point for the RSSI measurements shall be the antenna connector.
Range/mapping	

5.2.2 SIR

Definition	Signal to Interference Ratio, is defined as the RSCP divided by the ISCP. Measurement shall be performed on the DPCH after RL combination in Node B. The reference point for the SIR measurements shall be the antenna connector.
Range/mapping	

5.2.3 Transmitted carrier power

Definition	Transmitted carrier power, is the total transmitted power on one carrier from one UTRAN access point. Measurement shall be possible on any carrier transmitted from the UTRAN access point. The reference point for the total transmitted power measurement shall be the antenna connector. In case of Tx diversity the total transmitted power for each branch shall be measured.
Range/mapping	

5.2.4 Transmitted code power

Definition	Transmitted code power, is the transmitted power on one carrier, one scrambling code and one channelisation code. Measurement shall be possible on any channelisation code transmitted from the UTRAN access point. The reference point for the transmitted code power measurement shall be the antenna connector. In case of Tx diversity the transmitted code power for each branch shall be measured.
Range/mapping	

5.2.5 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. Measurement shall be possible to perform on any transport channel after RL combination in Node B. BLER estimation is only required for transport channels containing CRC.
Range/mapping	The Transport channel BLER shall be reported in the unit BLER_dB% where: BLER_dB%=-Log10(Transport channel BLER), with value range [0 - 5.08] in step of 0.02 for Transport channel BLER >0 BLER_dB%=5.10 for Transport channel BLER =0.

5.2.6 Physical channel BER

Definition	The physical channel BER is an estimation of the average bit error rate (BER) before channel decoding of the DPCH data after RL combination in Node B. It shall be possible to report a physical channel BER estimate at the end of each TTI for the transferred TrCh's, e.g. for TrCh's with a TTI of x ms a x ms averaged physical channel BER shall be possible to report every x ms.
Range/mapping	The Physical channel BER shall be reported in the unit BER_dB% where: BER_dB%=-Log10(Physical channel BER), with value range [0 - 5.08] in step of 0.02 for Physical channel BER >0 BER_dB%=5.10 for Physical channel BER =0.