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Title: Modifications for Receiver Characteristics

Document for: Discussion & Decision

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1. INTRODUCTION

Open item list (Annex E) in TS 25101 V3.0.0 states that all tables in Section 7 (Receiver Characteristics) need changes due to harmonization and changes to the downlink physical channels that are transmitted during measurements [1]. This document provides needed changes to these tables. Proposed modifications will not change actual requirements specified in Section 7 as requested in open item list in [1].

2. BACKGROUND

It has been decided that physical channels shown in Table 1 are transmitted during a connection in measurements. Table 1 is taken from Annex C of [1].

Table 1. Downlink Physical Channels transmitted during a connection.

Physical Channel	Power
CPICH	CPICH_Ec/Ior = -10 dB
PCCPCH	PCCPCH_Ec/Ior = -12 dB
SCH	PCCPCH_Ec/Ior = -12 dB
PICH	PICH_Ec/Ior = -15 dB
DPCH	The power needed to meet the BER/BLER target
OCNS	Necessary power so that total transmit power spectral density of BS (Ior) adds to one

However, there are at the moment only two physical channels (PCCPCH and DPCH) in measurements for receiver characteristics (Section 7 in [1]). Thus, it is obvious that tables in Section 7 need modifications. It is important to remember that these modifications shall not have any impact on original requirements that are defined for a receiver.

This document shows simulation results using physical channels shown in Table 1 and based on these results necessary modifications for Section 7 are proposed. It is also shown that original requirements are unchanged.

3. SIMULATIONS RESULTS AND ASSUMPTIONS

Figure 1 shows DPCH_Ec/Ior curve as a function of BER. Assumptions that were used in simulations are shown in Annex A.

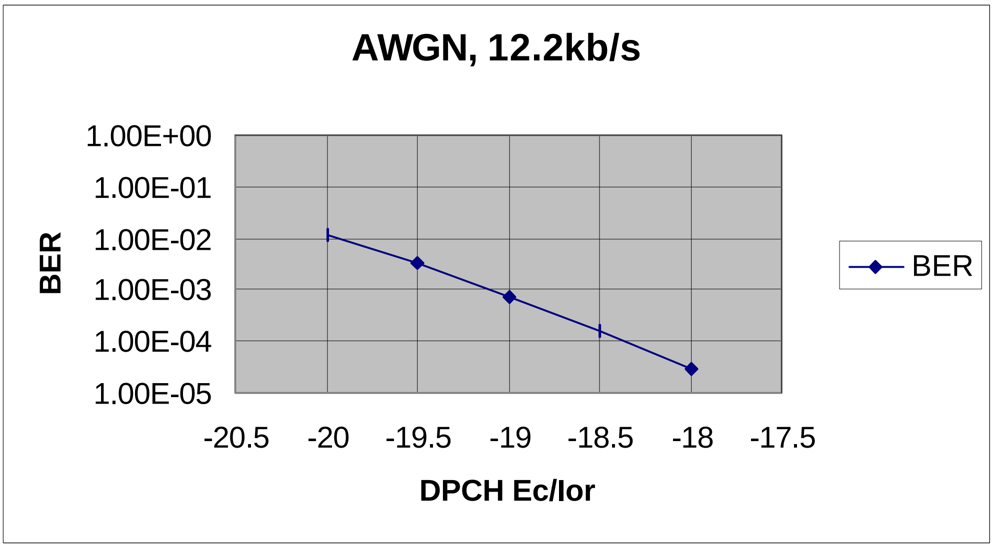

Figure 1. DPCH transmission power.

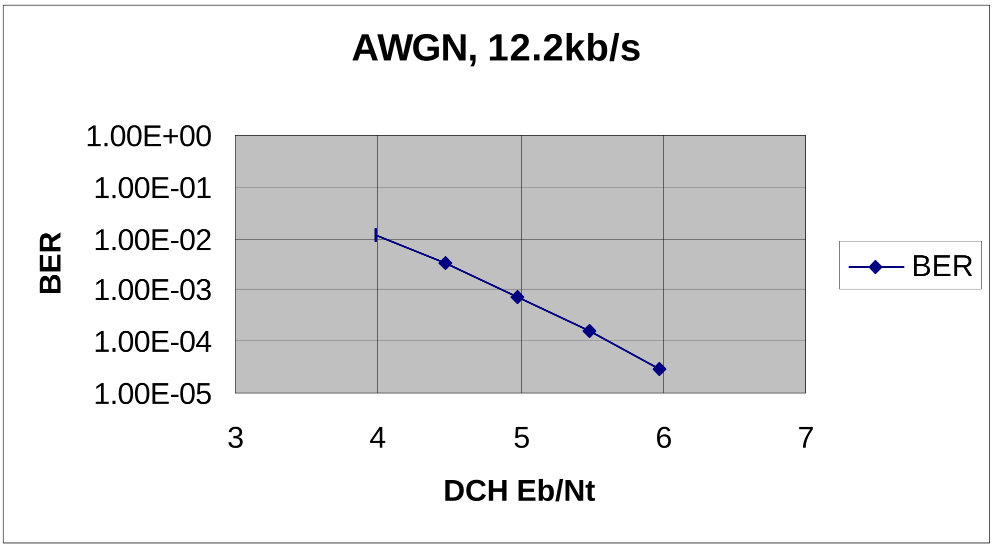

Figure 2. Signal-to-Noise ratio Eb/Nt at the UE antenna connector.

It can be concluded from Figure 1 that DPCH_Ec/Ior = -19 dB is enough to fulfill BER requirement when other parameters are as assumed in Annex A. When taking into account an implementation margin of 2 dB DPCH_Ec/Ior needs to be –17 dB in order to get Eb/Nt to 7 dB, which is exactly the same value that has been used to derive the current receiver characteristic requirements specified in [1].

4. TEXT PROPOSALS

All text proposals assume that PCCPCH_Ec/Ior value can be deleted from tables as being redundant information since PCCPCH_Ec/Ior, together with other downlink physical channels, can be found in Annex C of [1]. This assumption is in line with procedure, which has been applied to Section 8 in [1].

Basic principle has been to keep the wanted signal (DPCH) level as well as the interfering signal level the same in all tests. This implicitly means that requirements are unchanged.

4.1 Proposal 1 (Receiver Sensitivity)

~~**Table 12: Test parameters for reference sensitivity**~~

~~Parameter~~	~~Unit~~	~~Level~~
~~$\frac{PCCPCH\_Ec}{I_{or}}$~~	~~dB~~	~~-1~~
~~$\frac{DPCH\_Ec}{I_{or}}$~~	~~dB~~	~~-7~~
~~$\hat{I}_{or}$~~	~~dBm/3.84 MHz~~	~~-110~~

Table 12: Test parameters for reference sensitivity

Parameter	Unit	Level
$\frac{DPCH\_Ec}{I_{or}}$	dB	-17
$\hat{I}_{or}$	dBm/3.84 MHz	-100

4.1.1 Justification

Now it can been seen from modified Table 12 that Reference Sensitivity level for DPCH has remained as same i.e. -117 dB. In addition to that Signal-to-Noise Ratio can be calculated by using the following equation.

$$DCH\ \frac{E_b}{N_t} = \frac{\frac{DPCH\_E_c}{I_{or}} \times \frac{\text{Chip Rate}}{\text{Information Data Rate}}}{\frac{I_{oc}}{\hat{I}_{or}}}$$ Equation 1

Now Ioc[1] equals to –99 dBm, which is the effective Noise Floor at the UE (Noise floor + Noise Figure = -108 dBm + 9 dB). Since the DPCH level and interference level is the as previously it implicitly means that requirements have been kept the same.

On the other hand in simulation it was assumed that $\hat{I}_{or} / I_{oc}$ = -1 dB which is true since $\hat{I}_{or}$ equals to –100 dBm. Using these values together with values listed in Table 12 using Chip Rate = 3.84 Mchps and Information Data Rate = 12.2 kbps we get that Eb/Nt = 7 dB, which is required to get Eb/Nt to 5 dB when implementation margin is subtracted.

[1] Note that it is important to remember that tests in Section 7 do not include Ioc signal as defined in [1] (= The power of spectral density of a band limited white noise source, simulating interference from other cells, as measured at the UE antenna connector). In this contribution Ioc equals to effective Noise floor + interference from other bands in a receiver band.

4.2 Proposal 2 (Maximum Input Level)

~~Table 13: Maximum input level~~

~~Parameter~~	~~Unit~~	~~Level~~
~~$\frac{PCCPCH\_Ec}{I_{or}}$~~	~~dB~~	~~-10~~
~~$\frac{DPCH\_Ec}{I_{or}}$~~	~~dB~~	~~-19~~
~~$\frac{OCNS\_Ec}{I_{or}}$~~	~~dB~~	~~-0.52~~
~~$\hat{I}_{or}$~~	~~dBm/3.84 MHz~~	~~-25~~

~~Note~~

~~(a)Since the spreading factor is large (10log(SF)=21dB), the majority of the total input signal consists of the OCNS interference. <Change OCNS definition>~~

Table 13: Maximum input level

Parameter	Unit	Level
$\frac{DPCH\_Ec}{I_{or}}$	dB	-19
$\hat{I}_{or}$	dBm/3.84 MHz	-25

4.2.1 Justification

Maximum input level is remained (-25 dBm). This happen very close to BS and in this situation geometry factor $\hat{I}_{or} / I_{oc}$ is very high being >> 10 dB. This means that receiver has very good Eb/Nt unless receiver can not cope with such high input level.

4.3 Proposal 3 (Adjacent Channel Selectivity)

~~Table 14b: Test parameters for Adjacent Channel Selectivity~~

~~Parameter~~	~~Unit~~	~~Level~~
~~$\frac{PCCPCH\_Ec}{I_{or}}$~~	~~dB~~	~~-0.46~~
~~$\frac{DPCH\_Ec}{I_{or}}$~~	~~dB~~	~~-10~~
~~$\hat{I}_{or}$~~	~~dBm/3.84 MHz~~	~~-93~~
~~I_{oac}~~	~~dBm/3.84 MHz~~	~~-52~~
~~F_{uw} (modulated)~~	~~MHz~~	~~+5 or -5~~

Table 14b: Test parameters for Adjacent Channel Selectivity

Parameter	Unit	Level
$\frac{DPCH\_Ec}{I_{or}}$	dB	-17
$\hat{I}_{or}$	dBm/3.84 MHz	-86
I_{oac}	dBm/3.84 MHz	-52
F_{uw} (modulated)	MHz	+5 or -5

4.3.1 Justification

Assuming that ACS requirement remains same (33 dB) Ioc at the receiver is –52 dBm – 33 dB = -85 dBm. DPCH signal level remains also the same (-103 dBm). By using the Equation 1 we get that Eb/Nt = 7 dB, which is enough when taking into account the implementation margin. Again $\hat{I}_{or} / I_{oc}$ equals to –1 dB meaning that geometry parameter which was used in simulation is valid for this ACS scenario too.

4.4 Text proposal 4 (Blocking characteristics)

~~**Table 15: In-band blocking**~~

Parameter	Unit	Offset	Offset
$\frac{PCCPCH\_Ec}{I_{or}}$	dB	-1	-1
$\frac{DPCH\_Ec}{I_{or}}$	dB	-7	-7
$\hat{I}_{or}$	dBm/3.84 MHz	-107	-107
$I_{blocking}$ (modulated)	dBm/3.84 MHz	-56	-44
Blocking offset	MHz	10<|f-fo|<15	|f-fo| ≥15

~~**Table 16: Out of band blocking**~~

Parameter	Unit	Band 1	Band 2	Band 3
$\frac{PCCPCH\_Ec}{I_{or}}$	dB	-1	-1	-1
$\frac{DPCH\_Ec}{I_{or}}$	dB	-7	-7	-7
$\hat{I}_{or}$	dBm/3.84 MHz	-107	-107	-107
$I_{blocking}$ (CW)	dBm	-44	-30	-15
Blocking offset	MHz	2050<f <2095 2185<f <2230	2025 <f <2050 2230 <f <2255	1< f <2025 2255<f<12750

~~Note: On frequency regions 2095 <f< 2110 MHz and 2170<f< 2185 MHz, the appropriate in-band blocking or adjacent channel selectivity in section 7.5.1 shall be applied.~~

Table 15: In-band blocking

Parameter	Unit	Offset	Offset
$\frac{DPCH\_Ec}{I_{or}}$	dB	-17	-17
$\hat{I}_{or}$	dBm/3.84 MHz	-97	-97
$I_{blocking}$ (modulated)	dBm/3.84 MHz	-56	-44
Blocking offset	MHz	10<|f-fo|<15	|f-fo| ≥15

Table 16: Out of band blocking

Parameter	Unit	Band 1	Band 2	Band 3
$\frac{DPCH\_Ec}{I_{or}}$	dB	-17	-17	-17
$\hat{I}_{or}$	dBm/3.84 MHz	-97	-97	-97
$I_{blocking}$ (CW)	dBm	-44	-30	-15
Blocking offset	MHz	2050<f <2095 2185<f <2230	2025 <f <2050 2230 <f <2255	1< f <2025 2255<f<12750

Note: On frequency regions 2095 <f< 2110 MHz and 2170<f< 2185 MHz, the appropriate in-band blocking or adjacent channel selectivity in section 7.5.1 shall be applied.

4.4.1 Justifications

Now the DPCH signal level is 3 dB above the reference sensitivity level as it was also before. Blocking Signal levels need not to be raised since the receiver must suppress these blocking signals to the level of -99 dBm or below. Together with effective noise floor Ioc is now –96 dBm, so again $\hat{I}_{or} / I_{oc}$ equals to –1 dB meaning that geometry parameter which was used in simulation is valid for this test too.

4.5 Proposal 5 (Spurious response)

~~**Table 17: Spurious Response**~~

~~Parameter~~	~~Unit~~	~~Level~~
$\frac{PCCPCH\_Ec}{I_{or}}$	~~dB~~	~~-1~~
$\frac{DPCH\_Ec}{I_{or}}$	~~dB~~	~~-7~~
~~$\hat{I}_{or}$~~	~~dBm/3.84 MHz~~	~~-107~~
~~$I_{blocking}$ (CW)~~	~~dBm~~	~~-44~~
~~fcw~~	~~MHz~~	~~Spurious response frequencies~~

Table 17: Spurious Response

Parameter	Unit	Level
$\frac{DPCH\_Ec}{I_{or}}$	dB	-17
$\hat{I}_{or}$	dBm/3.84 MHz	-97
$I_{blocking}$ (CW)	dBm	-44
fcw	MHz	Spurious response frequencies

4.5.1 Justifications

Now the DPCH signal level is 3 dB above the reference sensitivity level as it was also before. The receiver must suppress these blocking signals to the level of -99 dBm or below. Together with effective noise floor Ioc is now –96 dBm, so again $\hat{I}_{or} / I_{oc}$ equals to –1 dB meaning that geometry parameter which was used in simulation is valid for this test too.

4.6 Proposal 6 (Intermodulation characteristics)

~~**Table 18: Receive intermodulation characteristics**~~

~~Parameter~~	~~Unit~~	~~Level~~
$\frac{PCCPCH\_Ec}{I_{or}}$	~~dB~~	~~-1~~
$\frac{DPCH\_Ec}{I_{or}}$	~~dB~~	~~-7~~
~~$\hat{I}_{or}$~~	~~dBm/3.84 MHz~~	~~-107~~
~~I_{ouw1}~~	~~dBm~~	~~-46~~
~~I_{ouw2}~~	~~dBm/3.84 MHz~~	~~-46~~
~~Fuw1 (CW)~~	~~MHz~~	~~10~~
~~Fuw2 (Modulated)~~	~~MHz~~	~~20~~

Table 18: Receive intermodulation characteristics

Parameter	Unit	Level
$\frac{DPCH\_Ec}{I_{or}}$	dB	-17
$\hat{I}_{or}$	dBm/3.84 MHz	-97
I_{ouw1}	dBm	-46
I_{ouw2}	dBm/3.84 MHz	-46
Fuw1 (CW)	MHz	10
Fuw2 (Modulated)	MHz	20

4.6.1 Justifications

Now the DPCH signal level is 3 dB above the reference sensitivity level as it was also before. Now Ioc is used to represent the sum of noise floor and suppressed intermodulation signal, together -96 dBm. Ior/Ioc = -1 dB. Only the Ior level is changed.

5. CONCLUSIONS

In this document several modifications for Section 7 in TS 25.101 are proposed. These modification are needed as indicated in open item list in Annex E of TS25.101 Modifications presented in this document are based on simulations using the latest assumptions for physical channels. Modifications presented in this document do not change current requirements specified in Section 7. This is shown for each modification.

REFERENCES

[1] TS 25.101 v.3.0.0 (1999-10) UE Radio transmission and reception (FDD)

ANNEX A   SIMULATION ASSUMPTIONS

Table 1 shows assumptions used for simulations.

Table 1. Simulation Assumptions

Parameter	Explanation/Assumption
Chip Rate	3.84 Mcps
Closed loop Power Control	OFF
AGC	OFF
Channel Estimation	Ideal
Number of samples per chip	1
Propagation Conditions	Additive White Gaussian Noise (AWGN) environment. No fading and multi-paths exist.
Number of bits in AD converter	Floating point simulations
Number of Rake Fingers	1
Downlink Physical Channels and Power Levels	CPICHP_Ec/Ior = -10 dB PCCPCH_Ec/Ior = -12 dB SCH_Ec/Ior = -12 dB (Combined energy of Primary and Secondary SCH) PICH_Ec/Ior = -15 dB OCNS_Ec/Ior = power needed to get total power spectral density (Ior) to 1. DPCH_Ec/Ior = power needed to get meet the required BER target
BER target	BER target is 10-3.
PCCPCH model	Random symbols transmitted, ignored in a receiver
PICH model	Random symbols transmitted, ignored in a receiver
DCCH model	Random symbols transmitted, ignored in a receiver
TFCI model	Random symbols, ignored in a receiver but it is assumed that receiver gets error free reception of TFCI information.
Used OVSF and scrambling codes	Codes are chosen from the allowed set
$\hat{I}_{or} / I_{oc}$ value	-1
SCH position	Offset between SCH and DPCH is zero chips meaning that SCH is overlapping with the first symbols in DPCH in the beginning of DPCH slot structure
Measurement Channels	12.2 kbps channel as specified in Annex A of TS 25.101 v2.2.0
Other L1 parameters	As specified in latest L1 specifications (July/August 1999 versions)