**3GPP RAN** **RP-040138**
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**Agenda Item:**

**Source:** **Motorola**

**Title:** **PAR/Back-off Simulation/Analysis Assumptions**

**Document for:** **Discussion and approval**

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# 1.0 Summary

This contribution gives a set of simulation/analysis assumptions for studying HSDPA PAR/back-off issues concerning coverage.

# 2.0 Methodology and Assumptions

It is important to quantify the coverage impact for different TFCs when reducing the PA maximum power level to meet ACLR and other requirements while the HS-DPCCH is transmitted. The amount of PA maximum power reduction or PA back-off needed has been determined to be a function of, $\beta_c$ , $\beta_d$ the code channel gain factors determining code channel power for the DPCCH and DPDCH.

A methodology is given on computing a coverage area metric based on per TFC total Ec/Nt. Examples of the required information to perform each step in the methodology is then given.

**Methodology**

1) Choose a reference TFC for determining minimum uplink cell coverage of deployed WCDMA system
2) Choose TFCS including TFCs for speech and mix of data rates including reference TFC
3) Choose βc, βd such that DPCCH Ec/Nt is the same across all TFCs while achieving the required DPDCH Ec/Nt (for a channel model such as Pedestrian B 3km/h) to achieve a target BLER.
4) Choose a βhs/βc from [2] so that per TFC HS-DPCCH Ec/Nt achieves target Ec/Nt (e.g. -19.5dB)(note that the reference TFC has a zero βhs while the other TFCs have a βhs to achieve target Ec/Nt)
5) Compare total Ec/Nt computed for each TFC to the reference TFC total Ec/Nt to get delta Ec/Nt
6) Modify per TFC delta Ec/Nt with PA back-off value corresponding to βc and βd values obtained from PA back-off mapping table (see Table 4 for example)
7) If a TFC's Modified delta Ec/Nt is positive then coverage margin exists else there is coverage area reduction relative to reference TFC case.
8) If coverage area reduction is unacceptable adjust mapping table as needed (e.g. to include less PA back-off) and repeat procedure until per TFC coverage meets desired requirements of operator.

**Reference TFC**

Examples of possible Reference TFC determining minimum uplink cell coverage of Deployed System:

1) PS 64 kbps, TTI=10ms, 1.0%BLER
2) CS 64 kbps, TTI=20ms, 0.25%BLER
3) PS 64 kbps, TTI=10ms, 1.0%BLER + DCCH
4) CS 64 kbps, TTI=20ms, 0.25%BLER + DCCH

**TFCS information**

A example of a reference TFS for analysis and simulation is composed of Release 99/4/5 TFCs given in Table 1 below as discussed in [1].

**Table 1 -** TFCS information for the Rel99/Rel4/Rel5 reference case

| Parameter | Explanation/Assumption | Comments |
|---|---|---|
| User data rates in TFCS | 8, 16, 32, 64, 128, 256, 384 kbit/s with 10ms TTI | |
| Other TFCs in TFCS | 12.2Kbps AMR speech with 20ms TTI,<br>3.4kbps DCCH (40ms TTI),<br>1.95kbps SID (20ms TTI) | Note speech can occur as part of a data+speech call or a speech only call. |

To determine the corresponding long term Eb/Nt for each TFC link level assumptions are given below in Table 2..

**Table 2 -** General link level parameters

| Parameter | Explanation/Assumption | Comments |
|---|---|---|
| Channel coder | Turbo 1/3 | |
| Number of iterations for turbo decoder | 8 | |
| Turbo decoder | Max Log MAP | |
| Channel models/<br>UE speed for channel model | Pedestrian B / 3 km/h,<br>Vehicular A / 30 km/h | |
| CL power control | ON | |
| CL power control error rate | 4% | |
| | | |

An example of long term Eb/Nts for different channel conditions is given below for data TFCs:

| | 8 | 16 | 32 | 64 | 128 | 256 | 384 |
|---|---|---|---|---|---|---|---|
| AWGN | 4.28 | 3.22 | 2.87 | 2.61 | 2.44 | 2.54 | 2.90 |
| PA3 | 4.56 | 3.48 | 3.13 | 2.92 | 2.76 | 2.90 | 3.31 |
| PB3 | 5.69 | 4.38 | 4.07 | 3.90 | 3.76 | 4.02 | 4.61 |
| VA30 | 6.10 | 4.82 | 4.54 | 4.34 | 4.22 | 4.49 | 5.10 |
| VA120 | 6.47 | 5.19 | 4.91 | 4.68 | 4.53 | 4.80 | 5.43 |

Table 3. Required Long Term DPDCH Eb/Nt (combined across both rx antennas) for 1% BLER, 10ms TTI, non-ideal channel estimation, 2 RX antennas, inner-loop and outer-loop power control on, c = 15, 15, 11, 8, 6, 4, 3 for 8, 16, 32, 64, 128, 256, and 384 kbps, d = 15.

# 3.0 PA back-off mapping table

Example of PA back-off mapping table as shown in Table 4 for Ratio of $\beta_c$ to $\beta_d$ for all values of $\beta_{hs}$ .

| Ratio of $\beta_c$ to $\beta_d$ for all values of $\beta_{hs}$ | Nominal maximum Power delta (dB) |
|---|---|
| $1/15 \leq \beta_c/\beta_d < 13/15$ | 0 |
| $13/15 \leq \beta_c/\beta_d \leq 15/7$ | $-1 \leq$ delta $\leq 0$ |
| $15/7 < \beta_c/\beta_d < 15/0$ | $-2 \leq$ delta $\leq 0$ |

Table 4: UE maximum output power with HS-DPCCH

The mapping example in Table 4 should ensure that there is no impact to the UL cell radius for 64 kbps and higher data rate services since 0dB is the proposed change in nominal maximum output power for $\beta_c / \beta_d$ < [13]/15..

# 4.0 Back –off analysis

Based on using a REL99 64 kbps reference service we consider the impact for lower data rate services as well as higher data rate services. Table 5 below, shows the required Ec/Nt and betas for different packet data rates and for the packet data + speech case when only speech is being transmitted. Also shown is the impact of the maximum output power reduction as proposed in Table 4.

| | Speech .+DCCH 15/15 | Speech 13/15 | DCCH | SID | | | R99 REF | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| LT Ec/Nt_dpdch combined | -19.4 | -20.6 | -24.5 | -26.9 | -19.4 | -16.7 | -13.9 | -11.0 | -7.7 | -5.4 |
| LT Eb/Nt_dpdch combined | 4.5 | 4.4 | 6.0 | 6.0 | 4.4 | 4.1 | 3.9 | 3.8 | 4.0 | 4.6 |
| | 12.2 Kbps | 12.2 Kbps | 3.4 Kbps | 1.95 Kbps | 16 Kbps | 32 Kbps | 64 Kbps | 128 Kbps | 256 Kbps | 384 Kbps |
| beta_d | 15 | 13 | 9 | 7 | 15 | 15 | 15 | 15 | 15 | 15 |
| beta_c | 15 | 15 | 15 | 15 | 15 | 11 | 8 | 6 | 4 | 3 |
| beta_hs | 15 | 15 | 15 | 15 | 15 | 11 | 0.0 | 6 | 4 | 3 |
| Ec/Nt total | -14.7 | -15.1 | -15.8 | -16.0 | -14.7 | -13.6 | -12.9 | -10.3 | -7.4 | -5.2 |
| DPCCH Ec/Nt | -19.5 | -19.5 | -19.5 | -19.5 | -19.5 | -19.5 | -19.5 | -19.5 | -19.5 | -19.5 |
| DPDCH Ec/Nt | -19.5 | -20.7 | -23.9 | -26.1 | -19.5 | -16.8 | -14.0 | -11.5 | -8.0 | -5.5 |
| hs Ec/Nt | -19.5 | -19.5 | -19.5 | -19.5 | -19.5 | -19.5 | -117.5 | -19.5 | -19.5 | -19.5 |
| Back–off (dB) | [1] | [1] | [1] | [1] | [1] | [0] | [0] | [0] | [0] | [0] |
| Ec/Nt total margin | [0.8] | [1.2] | [1.9] | [2.1] | [0.8] | [0.7] | [0] | - | - | - |

Table 5 Example of Ec/Nt and Betas for different data and data + speech channel configurations

In Table 5 above we have selected $\beta_c$ and $\beta_d$ to achieve a constant DPCCH Ec/Nt level across all rates which is needed to ensure power control stability when switching between the different rates (TFCs) including 12.2Kb/s AMR speech.

Table 5 also shows that even with 1dB of back-off there is still significant Ec/Nt margin (see last row of table which includes back-off) relative to the 64 kbps reference case for speech, 16kbps, and 32kbps services. An Ec/Nt margin for a given services implies that its coverage is at least as good as the 64 kbps reference service.

# 5.0 Node B performance

In TS25.104 the reference measurement channel for 64 kbps is based on a $\beta_c/\beta_d = 8/15$. However, a larger break-point of $\beta_c/\beta_d < 13/15$ is given in Table 4 to account for differences in Node B receiver performance as observed by operators with different Node B implementations. One reason to increase the required $\beta_c$ is to compensate for Node-B receiver degradation from DLL, AFC, channel estimation, or finger management/searcher functions. In the future it may be advantageous to operators and network coverage to modify TS25.104 to limit allowed degradation from the above described receiver functions.

# 6.0 References


[1] R1-040392 Enhanced Uplink TR

[2] TS 25213-550