TSG-RAN Working Group 1 (Radio layer 1) ***TSGR1#7(99)c05***
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Title: Simulation results for outer-loop power control in compressed mode

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Introduction

In contribution [1], we showed a need for a faster algorithm than the classical outer-loop power control algorithm in compressed mode to avoid a severe degradation of the performances. The proposed solution is simple and only consists in increasing the target SIR for compressed and recovery frames, the target SIR increases being signaled with other compressed mode parameters.

The need for such scheme was already recognized in WG1 and liaised to WG2 in [2]. The proposed scheme was agreed in the last WG2 meeting in Sophia-Antipolis (see liaison statement [3]).

This paper provides simulation results to give background on the specific requirements at various speeds. It shows a need for signaling the required target Eb/N0 increases during compressed and recovery frames, since they vary with many parameters as the UE speed, the environment, the transmission gap length, …

Simulation results

In the following table, we give the required target E_b/N_0 increase for compressed frames and recovery frames to have an average BER of 10^{-3} in normal, compressed and recovery frames. These results were obtained with link level simulations in following conditions:

- Speech service (8 kbps),
- Pedestrian A environment,
- Downlink,
- Transmission gap period of 64 slots,
- Transmission gap length of 8 slots (the transmission gap being at the end of the frame),
- Fixed recovery period of 8 slots after each transmission gap.

Detailed simulation parameters are given in annex.

Mobile speed (km/h)	δ_{SIR} (dB) compressed frames	δ_{SIR} (dB) recovery frames
3	0.2	0.1
10	1.1	0.55
20	1.5	0.65
40	0.7	0.35
100	0.25	0.1

Table 1: Required target E_b/N_0 increase (δ_{SIR}) for compressed and recovery frames (compared to the target E_b/N_0 for normal frames) for speech service, in pedestrian environment.

These results enable to highlight that there is a real need to increase the target SIR for compressed and recovery frames and that this increase is highly dependent on the UE speed. It is also dependent on many other parameters like the environment or the transmission gap length.

Therefore, the increase of target SIR for compressed and recovery frames cannot have a fix value but needs to adapted to the environment, the UE speed, the transmission gap length, … Thus, the target SIR increases for compressed and recovery frames need to be signal. As already mentioned, it was agreed in WG2 to signal them with other compressed mode parameters, only once at the beginning of compressed mode, in order to have a low signaling overhead (see [3]).

References

[1] UMTS RAN WG1 TSGR1#6(99)956, "Improvement of outer-loop power control in compressed mode" (Alcatel), *July, 99.*

[2] UMTS RAN WG1 TSGR1#6(99)A53, "Liaison statement to WG2, WG3 and WG4 on power control issues" (RAN WG1), *July, 99.*

[3] UMTS RAN WG2 TSGR2#6(99)989, "Reply to LS from WG1 on power control issues" (RAN WG2), *July, 99.*

Annex

Below are described the detailed parameters used in the simulations previously presented in this document.

Parameters	Values, assumptions, …
Service	**Speech**
Carrier frequency	2 GHz
Chip period	4.096 Mcps
Number of slots per frame	16
Channel	Indoor to Outdoor and Pedestrian A channel where the delays of the different paths are multiple of the chip period.
Link direction	Downlink
Power control	- Fix step of 2 dB during recovery periods, 1 dB otherwise. - 1 slot delay (=0.625 ms) - Infinite dynamic range - Error rate on TPC commands: 7% in recovery period, 4% elsewhere. The SIR estimation is ideal (the channel energy is used), or performed with pilot bits.
Eb/N0 scaling	Eb is computed as the received power for each information bit including all overhead (coding, tail, pilot, TPC, TFCI, rate matching, 16-bit CRC)
Rake receiver	2 fingers An ideal path searcher with fixed delays is used. The oversampling rate is the chip rate.
Channel estimation method	Channel estimation is based on the present pilot group and pilot groups before and after the present slot. The different pilot groups are multiplied by a weighting factor. The different weights only depend on speed and are : - 3 km/h : (1, 1, 1, 1, **1**, 1, 1) - 10 km/h : (1, 1, 1,1, **1**, 1, 1) - 20 km/h : (0.9, 1, 1, 1, **1**, 1, 1) - 40 km/h : (0.7, 0.8, 0.9, 1, **1**, 1, 0.9) - 100 km/h: (0.2, 0.6, 0.9, **1**, 0.9, 0.6) where the current slot has the weight in bold font.
Compressed mode	- Transmission gap period (TGP) = 64 slots. - Transmission gap length (TGL) = 8 slots. - Fix recovery period of 8 slots. - Power control step of 2 dB during recovery periods and error rate on TPC commands of 7% during the recovery periods. - Transmission gap at the end of the frame.
Information bit rate	8 kbps
Physical channel rate	32 kbps (sf=128)
Number of info bits per frame	80

CRC	16 bits
Coding	Convolutional coding Constraint length 9, rate 1/3, 8 tail bits
Rate matching	Repetition: 8 bits
Interleaving	10 ms
Pilot/TPC/TFCI bits per slot	8/2/0
Number of bits in first and second data fields (per slot)	6/14
Number of reception antennas	1
DPCCH/DPDCH power	0 dB
Inter-users interference	Modeled as AWGN noise. It is assumed constant and known in the simulations.

Table 2. Simulation parameters