TSG-RAN Working Group 1 meeting #9 **TSGR1#9(99)k78**
Dresden, Germany
November 30 – December 3, 1999

Agenda item:

Source: Ericsson

Title: Setting of power in uplink compressed mode, revised

Document for: Approval

---

1 Introduction

In compressed mode data is only transmitted in a part of the frame. In [1] a number of formats for uplink compression are given. With these formats between 3 and 7 slots are used as a gap. Thereby measurements on other frequencies and other systems can be made. Uplink compressed mode is used together with downlink compressed mode when measuring on other frequencies, on TDD and on GSM 1800.

In uplink the DPDCH and DPCCH signals are transmitted simultaneously on different codes. The gap of the DPDCH and DPCCH have the same length but the compression is not done in a similar way on the DPDCH as on the DPCCH code. In DPDCH the data is compressed either by puncturing, by using only half the spreading factor or by higher layer signalling transmitting fewer information bits in the compressed frame. In DPCCH there are four kinds of bits, pilot, TPC, FBI and TFCI. The number of TPC and FBI bits per slot is not changed. When there are TFCI bits the number of TFCI bits per slot is increased in order to transmit all 32 TFCI bits for the frame. Instead the number of pilot bits is decreased, see [1].

The power levels of the DPDCH and of the DPCCH codes respectively in compressed mode depends on the compression methods. The power offset between the codes during compressed mode can either be signalled or computed by the UE. In this contribution this power offset is computed in the UE, based on the offsets used during normal frames given the datarate in the actual frame and on the level of compression.

2 DPCCH power in compressed mode

The DPCCH formats when in compressed mode are listed in [1]. The formats that have TFCI bits contains fewer pilot bits than the formats when not in compressed mode. The reason for that the number of pilot bits is decreased compared to when in non compressed mode is that the number of TFCI bits shall be the same during a frame. Thereby a robust scheme with a good reliability of the transport format detection is used. In order to keep the same channel quality the energy of the pilot must be kept equal. Thereby the channel estimate and power control performance during the compressed slots is kept at approximately the same level as in normal mode. The power of the DPCCH shall therefore be increased by the factor

$$P_{DPCCH,C} \geq P_{DPCCH,N} \cdot \frac{N_{Pilot,N}}{N_{Pilot,C}}$$

where $P_{DPCCH,C}$ is the power of the DPCCH channel when in compressed mode and $P_{DPCCH,N}$ is the power of the DPCCH in normal mode (non-compressed mode). $N_{Pilot,N}$ and $N_{Pilot,C}$ is the number of pilot bits per slot in normal and compressed mode respectively.

3 DPDCH power in compressed mode

When a DPDCH frame is compressed, either the spreading factor is decreased by a factor 2, the coded data is punctured so that the number of transmitted bits is decreased or by higher signalling the number of transmitted information bits in the frame is decreased. Thereby a gap in the transmission is achieved so that measurements o other frequencies can be made.

In order to get a good quality the transmitted energy per information bit shall be the same independent of if the channel is in compressed mode or not. Therefore given the number of information bits the power of the DPDCH shall be changed so that the total frame is transmitted with the same total energy. The DPDCH is then transmitted with the power

$$P_{DPDCH,C} \geq P_{DPDCH,N} \cdot \frac{15}{N_{slots,C}}$$

where $P_{DPDCH,C}$ is the power of the DPDCH channel when in compressed mode and $P_{DPDCH,N}$ is the power the DPDCH channel should be transmitted with when in normal mode. $N_{slots,C}$ is the number of slots transmitted in a frame when in compressed mode as defined in [1].

This means that if higher layer scheduling is used to decrease the number of information bits the power of the compressed frame is not necessarily increased during a compressed frame, instead the total energy transmitted on the DPDCH during the frame and thereby $P_{DPDCH,N}$ is decreased due to lower information bit rate.

4 Beta setting in compressed mode

Based on the above reasoning, the beta setting in compressed mode is therefore given by the ratio of the square root of the power ratio between DPDCH and DPCCH as:

$$\frac{b_{d,c}}{b_{c,c}} \geq \frac{b_{d,N}}{b_{c,N}} \cdot \sqrt{\frac{15 \cdot N_{Pilot,C}}{N_{slots,C} \cdot N_{Pilot,N}}} .$$

5 Conclusions

A proposal of the beta setting while in compressed mode is given. With this proposal the loss of compressed mode should be minimized since the pilots are transmitted with the same energy per slot on the DPCCH. The transmitted information bit energy of the DPDCH channel is also kept constant.

References

[1]. TS 25.212 Coding and Multiplexing

Revision information

In revision 1 of the CR, the following things have been fixed:

- It was pointed out that the gain factors used in compressed frames should be derived from the gain factors used in normal frames, regardless of how those gain factors had been computed. This has now been fixed, so the method is general, i.e. first we associate gain factors with every TFC in normal mode, then we recalculate dthem for compressed mode.
- Changed terminology "TFC in j:th frame" to "j:th TFC".
- Changed to latest version of CR front page.
- Updated the heading of the CR.

In revision 2 of the CR, the following things have been fixed:

- It was clarified that the power step during the recovery period is $\pm\Delta_{RP-TPC}$ dB.

3GPP TSG RAN WG1 Meeting #9
Dresden, Germany, Nov 30 – Dec 3, 1999

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.

25.214	**CR**	**024r2**	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:	TSG-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: *(at least one should be marked with an X)*	(U)SIM		ME	X	UTRAN / Radio	X	Core Network

Source:	Ericsson	**Date:**	1999-11-28
Subject:	Setting of power in uplink compressed mode		
Work item:			

Category:	F	Correction		**Release:**	Phase 2	
	A	Corresponds to a correction in an earlier release			Release 96	
(only one category	B	Addition of feature	X		Release 97	
shall be marked	C	Functional modification of feature			Release 98	
with an X)	D	Editorial modification			Release 99	X
					Release 00	

Reason for change:	The power setting in the UE in uplink compressed mode is not yet specified. This CR adds that information.
Clauses affected:	5.1.2.4

Other specs affected:	Other 3G core specifications	X	→ 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:	

5.1.2.4 Setting of the uplink DPCCH/DPDCH power difference

5.1.2.4.1 General

The uplink DPCCH and DPDCH(s) are transmitted on different codes as defined in section 4.2.1 of TS 25.213. The gain factors β_c and β_d may vary for each TFC. There are two ways of controlling the gain factors of the DPCCH code and the DPDCH codes for different TFCs in normal (non-compressed) frames:

- b_c and b_d are signalled for the TFC, or
- b_c and b_d is computed for the TFC, based on the signalled settings for a reference TFC.

Combinations of the two above methods may be used to associate b_c and b_d values to all TFCs in the TFCS. The two methods are described in sections 5.1.2.4.2 and 5.1.2.4.3 respectively. Several reference TFCs may be signalled from higher layers.

The gain factors may vary on radio frame basis depending on the current TFC used. Further, the setting of gain factors is independent of the inner loop power control. This means that at the start of a frame, the gain factors are determined and the inner loop power control step is applied on top of that.

Appropriate scaling of the output power shall be performed by the UE, so that the output DPCCH power follows the inner loop power control with power steps of $\pm\Delta_{TPC}$ dB.

The gain factors during compressed frames are based on the gain factors defined in normal frames, as specified in 5.1.2.4.4.

5.1.2.4.2 Signalled gain factors

When the gain factors b_c and b_d are signalled by higher layers for a certain TFC, the signalled values are used directly for weighting of DPCCH and DPDCH(s).

5.1.2.4.3 Computed gain factors

The gain factors b_c and b_d may also be computed for certain TFCs, based on the signalled settings for a reference TFC.

Let $b_{c,ref}$ and $b_{d,ref}$ denote the signalled gain factors for the reference TFC. Further, let $b_{c,j}$ and $b_{d,j}$ denote the gain factors used for the TFC in the *j*:th radio frame.

Define the variable

$$K_{ref} = \sum_i RM_i \cdot N_i \ ,$$

where RM_i is the semi-static rate matching attribute for transport channel *i* (defined in TS 25.212 section 4.2.7), N_i is the number of bits output from the radio frame segmentation block for transport channel *i* (defined in TS 25.212 section 4.2.6.1), and the sum is taken over all the transport channels *i* in the reference TFC.

Similarly, define the variable

$$K_j = \sum_i RM_i \cdot N_i \ ,$$

where the sum is taken over all the transport channels *i* in the TFC used in the *j*:th frame.

The variable A_j is then computed as:

$$A_j = \frac{b_{d,ref}}{b_{c,ref}} \cdot \sqrt{\frac{K_j}{K_{ref}}} \ .$$

The gain factors for the TFC in the *j*:th radio frame are then computed as follows:

If $A_j > 1$, then $b_{d,j} = 1.0$ and $b_{c,j} = \lfloor 1/A_j \rfloor$, where $\lfloor \bullet \rfloor$ means rounding to closest lower quantized β–value.

If $A_j \le 1$, then $b_{d,j} = \lceil A_j \rceil$ and $b_{c,j} = 1.0$, where $\lceil \bullet \rceil$ means rounding to closest higher quantized β-value.

The quantized β-values is defined in TS 25.213 section 4.2.1, table 1.

5.1.2.4.4 Setting of the uplink DPCCH/DPDCH power difference in compressed mode

The gain factors used during a compressed frame for a certain TFC are calculated from the gain factors used in normal (non-compressed) frames for that TFC. Let $b_{c,j}$ and $b_{d,j}$ denote the gain factors for the *j*:th TFC in a normal frame. Further, let $b_{c,C,j}$ and $b_{d,C,j}$ denote the gain factors used for the *j*:th TFC when the frame is compressed. The variable $A_{C,j}$ is computed as:

$$A_{C,j} = \frac{b_{d,j}}{b_{c,j}} \cdot \sqrt{\frac{15 \cdot N_{pilot,C}}{N_{slots,C} \cdot N_{pilot,N}}} \ ,$$

where $N_{pilot,C}$ is the number of pilot bits per slot when in compressed mode, and $N_{pilot,N}$ is the number of pilot bits per slot in normal mode. $N_{slots,C}$ is the number of slots in the compressed frame used for transmitting the data.

The gain factors for the *j*:th TFC in a compressed frame are computed as follows:

If $A_{C,j} > 1$, then $b_{d,C,j} = 1.0$ and $b_{c,C,j} = \lfloor 1/A_{C,j} \rfloor$, where $\lfloor \bullet \rfloor$ means rounding to closest lower quantized β–value. Since $b_{c,j}$ may not be set to zero, if the above rounding results in a zero value, $b_{c,j}$ shall be set to the lowest quantized amplitude ratio of 0.0667 as specified in TS 25.213.

If $A_{C,j} \le 1$, then $b_{d,C,j} = \lceil A_{C,j} \rceil$ and $b_{c,C,j} = 1.0$, where $\lceil \bullet \rceil$ means rounding to closest higher quantized β-value.

The quantized β-values is defined in TS 25.213 section 4.2.1, table 1.

Appropriate scaling of the output power shall be performed by the UE, so that the output DPCCH power follows the inner loop power control with power steps of $\pm\Delta_{TPC}$ dB ($\pm\Delta_{RP\text{-}TPC}$ dB during the recovery period) with an additional power offset during a compressed frame of $N_{pilot,N} / N_{pilot,C}$.