TSG-RAN Working Group 1 meeting #16 *TSGR1-00-1207*
Pusan, Korea

August 10 – 13, 2000

Agenda Item: Ad Hoc 99

Source: **Siemens AG, Alcatel**

Title: **Uplink power control in compressed mode**

Document for: **Discussion and Approval**

---

1. Abstract

This paper provides a correction of the description of the target SIR in the case of compressed mode. Therefore the term "? SIR_compression" was removed.

2. Introduction

Chapter 5.1.2.3 of the current specification 25.214 V3.4.0 describes the target SIR in the case of compressed mode. If the SF/2 method is used for achieving compressed mode, the target SIR would be increased due to the SF/2 method. This causes an increase of the power of the DPDCH and DPCCH. Additionally the power of the DPDCH will be increased again due to the gain factor readjustment (please refer to section 5.1.2.5.4 of TS 25.214). This means, corresponding to the current specification 25.214 V3.4.0, in the case of compressed mode by engaging the SF/2 method the power of the DPCCH would be increased once and the power of the DPDCH would be increased twice (first time by the term "? SIR_compression" and second time due to the gain factor readjustments).
But if we use the SF/2 method in the uplink, then the DPCCH will still maintain the basic SF of 256 and only the DPDCH for its own envisages the spreading factor reduction. As a matter of fact only the DPDCH should apply the power increase and the DPCCH should maintain its power. The power increase of the DPDCH is already provided by the gain factor readjustments.
So we propose to remove the term "? SIR_compression" which has been a part of the SIR_{cm_target} since the last meeting in Berlin.

3GPP TSG RAN WG1 Meeting #16
Pusan, Korea, 10-13 October 2000

Document R1-00-1207
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**	**132**	Current Version:	3.4.0

GSM (AA.BB) or 3G (AA.BBB) specification number ? *? CR number as allocated by MCC support team*

For submission to:		for approval	X	strategic	(for SMG
list expected approval meeting # here ?		for information		non-strategic	use only)

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		UTRAN / Radio	X	Core Network	

Source: Siemens AG, Alcatel **Date:** 2000-10-04

Subject: Uplink power control in compressed mode

Work item: AH 99

Category:				**Release:**	
	F	Correction	X	Phase 2	
	A	Corresponds to a correction in an earlier release		Release 96	
(only one category	B	Addition of feature		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: Tdoc 1159 (containing 25.214 CR 127r2) was approved at the last meeting TSG RAN WG 1#15 in Berlin. Tdoc 1159 intends to clarify the use of the SIR target in case of compressed mode. Unfortunately there is a mistake in the introduced formula. This CR provides a correction of this formula.

Clauses affected: 5.1.2.3

Other specs affected:				
	Other 3G core specifications		?	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:

<--------- double-click here for help and instructions on how to create a CR.

- Otherwise, TPC_cmd = 0 in the 5th slot.

5.1.2.2.3.2 Combining of TPC commands from radio links of the same radio link set

When a UE is in soft handover, multiple TPC commands may be received in each slot from different cells in the active set. In some cases, the UE has the knowledge that some of the transmitted TPC commands in a slot are the same. This is the case when the radio links are in the same radio link set. For these cases, the TPC commands from radio links of the same radio link set shall be combined into one TPC command, to be processed and further combined with any other TPC commands as described in subclause 5.1.2.2.3.3.

5.1.2.2.3.3 Combining of TPC commands from radio links of different radio link sets

This subclause describes the general scheme for combination of the TPC commands from radio links of different radio link sets.

The UE shall make a hard decision on the value of each TPC_i, where i = 1, 2, …, N and N is the number of TPC commands from radio links of different radio link sets, that may be the result of a first phase of combination according to subclause 5.1.2.2.3.2.

The UE shall follow this procedure for 3 consecutive slots, resulting in N hard decisions for each of the 3 slots.

The sets of 3 slots shall be aligned to the frame boundaries and there shall be no overlap between each set of 3 slots.

The value of TPC_cmd is zero for the first 2 slots. After 3 slots have elapsed, the UE shall determine the value of TPC_cmd for the third slot in the following way:

The UE first determines one temporary TPC command, TPC_temp_i, for each of the N sets of 3 TPC commands as follows:

- If all 3 hard decisions within a set are "1", $TPC\_temp_i = 1$.
- If all 3 hard decisions within a set are "0", $TPC\_temp_i = -1$.
- Otherwise, $TPC\_temp_i = 0$.

Finally, the UE derives a combined TPC command for the third slot, TPC_cmd, as a function γ of all the N temporary power control commands TPC_temp_i:

TPC_cmd(3rd slot) = γ (TPC_temp_1, TPC_temp_2, …, TPC_temp_N), where TPC_cmd(3rd slot) can take the values 1, 0 or –1, and γ is given by the following definition:

- TPC_cmd is set to 1 if $\frac{1}{N}\sum_{i=1}^{N} TPC\_temp_i \geq 0.5$.
- TPC_cmd is set to -1 if $\frac{1}{N}\sum_{i=1}^{N} TPC\_temp_i \leq -0.5$.

Otherwise, TPC_cmd is set to 0.

5.1.2.3 Transmit power control in compressed mode

In compressed mode, some frames are compressed and contain transmission gaps. The uplink power control procedure is as specified in clause 5.1.2.2, using the same UTRAN supplied parameters for Power Control Algorithm and step size (Δ_{TPC}), but with additional features which aim to recover as rapidly as possible a signal-to-interference ratio (SIR) close to the target SIR after each transmission gap.

The serving cells (cells in the active set) should estimate signal-to-interference ratio SIR_{est} of the received uplink DPCH. The serving cells should then generate TPC commands and transmit the commands once per slot, except during downlink transmission gaps, according to the following rule: if $SIR_{est} > SIR_{cm\_target}$ then the TPC command to transmit is "0", while if $SIR_{est} < SIR_{cm\_target}$ then the TPC command to transmit is "1".

SIR_{cm_target} is the target SIR during compressed mode and fulfils

$SIR_{cm\_target} = SIR_{target}$ + ~~? SIR_compression +~~ ? SIR1_coding + ? SIR2_coding,

where ? SIR1_coding and ? SIR2_coding are computed from uplink parameters DeltaSIR1, DeltaSIR2, DeltaSIRafter1, DeltaSIRafter2 signaled by higher layers as:

- ? SIR1_coding = DeltaSIR1 if the start of the first transmission gap in the transmission gap pattern is within the current uplink frame.
- ? SIR1_coding = DeltaSIRafter1 if the current uplink frame just follows a frame containing the start of the first transmission gap in the transmission gap pattern.
- ? SIR2_coding = DeltaSIR2 if the start of the second transmission gap in the transmission gap pattern is within the current uplink frame.
- ? SIR2_coding = DeltaSIRafter2 if the current uplink frame just follows a frame containing the start of the second transmission gap in the transmission gap pattern.
- ? SIR1_coding = 0 dB and ? SIR2_coding = 0 dB in all other cases.

~~and ? SIR_compression is defined by :~~

- ~~? SIR_compression = 10 log (15 / (15 - TGL)) dB if there is a transmission gap within the current uplink frame created by compressed mode by reducing the spreading factor by 2, where TGL is the gap length in the current uplink frame in number of slots.~~
- ~~? SIR_compression = 0 dB in all other cases.~~

In case several compressed mode patterns are used simultaneously, ? SIR1_coding and ? SIR2_coding offsets are computed for each compressed mode pattern and all ? SIR1_coding and ? SIR2_coding offsets are summed together.

In compressed mode, compressed frames may occur in either the uplink or the downlink or both. In uplink compressed frames, the transmission of uplink DPDCH(s) and DPCCH shall both be stopped during transmission gaps.

Due to the transmission gaps in compressed frames, there may be missing TPC commands in the downlink. If no downlink TPC command is transmitted, the corresponding TPC_cmd derived by the UE shall be set to zero.

Compressed and non-compressed frames in the uplink DPCCH may have a different number of pilot bits per slot. A change in the transmit power of the uplink DPCCH would be needed in order to compensate for the change in the total pilot energy. Therefore at the start of each slot the UE shall derive the value of a power offset $?_{PILOT}$. If the number of pilot bits per slot in the uplink DPCCH is different from its value in the most recently transmitted slot, $?_{PILOT}$ (in dB) shall be given by:

$$?_{PILOT} = 10\text{Log}_{10} (N_{pilot,prev}/N_{pilot,curr});$$

where $N_{pilot,prev}$ is the number of pilot bits in the most recently transmitted slot , and $N_{pilot,curr}$ is the number of pilot bits in the current slot. Otherwise, including during transmission gaps in the downlink, $?_{PILOT}$ shall be zero.

Unless otherwise specified, in every slot during compressed mode the UE shall adjust the transmit power of the uplink DPCCH with a step of $?_{DPCCH}$ (in dB) which is given by:

?

$$?_{DPCCH} = ?_{TPC} ? \; TPC\_cmd + ?_{PILOT}.$$

At the start of the first slot after an uplink or downlink transmission gap the UE shall apply a change in the transmit power of the uplink DPCCH by an amount $?_{DPCCH}$ (in dB), with respect to the uplink DPCCH power in the most recently transmitted uplink slot, where:

?

$$?_{DPCCH} = ?_{RESUME} + ?_{PILOT}.$$

The value of $?_{RESUME}$ (in dB) shall be determined by the UE according to the Initial Transmit Power mode (ITP). The ITP is a UE specific parameter, which is signalled by the network with the other compressed mode parameters (see [4]). The different modes are summarised in table 1.

Table 1: Initial Transmit Power modes during compressed mode

Initial Transmit Power mode	Description
0	$?_{RESUME} = ?_{TPC} ? TPC\_cmd_{gap}$
1	$?_{RESUME} = ?_{last}$

In the case of a transmission gap in the uplink, TPC_cmd_{gap} shall be the value of TPC_cmd derived in the first slot of the uplink transmission gap, if a downlink TPC_command is transmitted in that slot. Otherwise TPC_cmd_{gap} shall be zero.

$?_{last}$ shall be equal to the most recently computed value of $?_i$. $?_i$ shall be updated according to the following recursive relations, which shall be executed in all slots in which both the uplink DPCCH and a downlink TPC command are transmitted, and in the first slot of an uplink transmission gap if a downlink TPC command is transmitted in that slot:

$$?_i ? 0.9375 ?_{i?1} ? 0.96875 TPC\_cmd_i ?_{TPC} k_{sc}$$
$$?_{i?1} ? ?_i$$

where: TPC_cmd_i is the power control command derived by the UE in that slot;

k_{sc} = 0 if additional scaling is applied in the current slot and the previous slot as described in sub-clause 5.1.2.6, and k_{sc} = 1 otherwise.

$?_{i-1}$ is the value of $?_i$ computed for the previous slot. The value of $?_{i-1}$ shall be initialised to zero when the uplink DPCCH is activated, and also at the end of the first slot after each uplink transmission gap, and also at the end of the first slot after each downlink transmission gap. The value of $?_i$ shall be set to zero at the end of the first slot after each uplink transmission gap.

After a transmission gap in either the uplink or the downlink, the period following resumption of simultaneous uplink and downlink DPCCH transmission is called a recovery period. RPL is the recovery period length and is expressed as a number of slots. RPL is equal to the minimum value out of the transmission gap length and 7 slots. If a transmission gap is scheduled to start before RPL slots have elapsed, then the recovery period shall end at the start of the gap, and the value of RPL shall be reduced accordingly.

During the recovery period, 2 modes are possible for the power control algorithm. The Recovery Period Power control mode (RPP) is signalled with the other compressed mode parameters (see [4]). The different modes are summarised in the table 2:

Table 2: Recovery Period Power control modes during compressed mode

Recovery Period power control mode	Description
0	Transmit power control is applied using the algorithm determined by the value of PCA, as in subclause 5.1.2.2 with step size $?_{TPC.}$
1	Transmit power control is applied using algorithm 1 (see subclause 5.1.2.2.2) with step size $?_{RP-TPC}$ during RPL slots after each transmission gap.

For RPP mode 0, the step size is not changed during the recovery period and ordinary transmit power control is applied (see subclause 5.1.2.2), using the algorithm for processing TPC commands determined by the value of PCA (see sub clauses 5.1.2.2.2 and 5.1.2.2.3).

For RPP mode 1, during RPL slots after each transmission gap, power control algorithm 1 is applied with a step size $?_{RP-TPC}$ instead of $?_{TPC}$, regardless of the value of PCA. Therefore, the change in uplink DPCCH transmit power at the start of each of the RPL+1 slots immediately following the transmission gap (except for the first slot after the transmission gap) is given by:

? $$?_{DPCCH} = ?_{RP-TPC} ? TPC\_cmd + ?_{PILOT}$$

?$_{RP-TPC}$ is called the recovery power control step size and is expressed in dB. If PCA has the value 1, ?$_{RP-TPC}$ is equal to the minimum value of 3 dB and 2?$_{TPC}$. If PCA has the value 2 , ?$_{RP-TPC}$ is equal to 1 dB.