TSG RAN Working Group 1 (Radio layer 1) *TSGR1#15 (00) 1088*
Berlin (Germany), 21st August – 25th August 2000

Agenda Item: 4

Source: Alcatel

Title: CR 25.214-127 : uplink power control in compressed mode

Document for: Decision

Introduction

In the NBAP and RNSAP protocols [1, 2, 3, 4], four parameters are signalled from the SRNC to the Node B to compute the target SIR for uplink inner-loop power control:

- DeltaSIR1 and DeltaSIR2 are the delta in UL SIR target value to be set in the Node B during the compressed frames corresponding to the first and second transmission gap in the transmission gap pattern (without including the effect of the bit-rate increase).
- DeltaSIRafter1 and DeltaSIRafter2 are the delta in UL SIR target value to be set in the Node B one frame after the compressed frames corresponding to the first and second transmission gap in the transmission gap pattern.

However, the description of how these parameters should be used is still missing in the physical layer procedures specification [5]. Therefore, we propose to add this description as proposed in the attached CR.

References

[1] 3GPP TS 25.433 version 3.2.0, "UTRAN Iub Interface NBAP Signalling", June 2000

[2] 3GPP TS 25.423 version 3.2.0, "UTRAN Iur Interface RNSAP Signalling", June 2000

[3] 3GPP R3-00-1975, "CR 25.433-195r1: compressed mode", Nokia, June 2000

[4] 3GPP R3-00-1974, "CR 25.423-166r1: compressed mode", Nokia, June 2000

[5] 3GPP TS 25.214 version 3.3.0, "Physical layer procedures", June 2000

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***Document* R1-00-1088**
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**	**127**	Current Version:	3.3.0

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

For submission to:	TSG-RAN #9	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: (U)SIM [ ] ME [ ] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: Alcatel **Date:** 2000-08-21

Subject: Uplink power control in compressed mode

Work item: Uplink power control

Category: *(only one category Shall be marked With an X)*

F	Correction	X	**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature			Release 98	
D	Editorial modification			Release 99	X
				Release 00	

Reason for change: The usage of uplink DeltaSIR1, DeltaSIR2, DeltaSIRafter1 and DeltaSIRafter2 parameters in the Node B was not described in the specifications so far.

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:

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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

$$SIR_{cm\_target} = SIR_{target} + \Delta SIR\_compression + \Delta SIR\_coding,$$

where ΔSIR_coding is computed from parameters DeltaSIR1, DeltaSIR2, DeltaSIRafter1, DeltaSIRafter2 signaled by higher layers as:

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

and ΔSIR_compression is defined by :

- ΔSIR_compression = 3 dB for uplink frames compressed by reducing the spreading factor by 2.
- ΔSIR_compression = 0 dB in all other cases.

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 Δ_{PILOT}. If the number of pilot bits per slot in the uplink DPCCH is different from its value in the most recently transmitted slot, Δ_{PILOT} (in dB) shall be given by:

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

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, Δ_{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 Δ_{DPCCH} (in dB) which is given by:

$$\Delta_{DPCCH} = \Delta_{TPC} \times TPC\_cmd + \Delta_{PILOT}.$$

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 Δ_{DPCCH} (in dB), with respect to the uplink DPCCH power in the most recently transmitted uplink slot, where:

$$\Delta_{DPCCH} = \Delta_{RESUME} + \Delta_{PILOT}.$$

The value of Δ_{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 TS 25.215). The different modes are summarised in table 1.

Table 1: Initial Transmit Power modes during compressed mode

Initial Transmit Power mode	Description
0	$\Delta_{RESUME} = \Delta_{TPC} \times$ TPC_cmd$_{gap}$
1	$\Delta_{RESUME} = \delta_{last}$

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.

δ_{last} shall be equal to the most recently computed value of δ_i. δ_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:

$$\delta_i = 0.9375\delta_{i-1} - 0.96875 TPC\_cmd_i \Delta_{TPC}$$
$$\delta_{i-1} = \delta_i$$

TPC_cmd$_i$ is the power control command derived by the UE in that slot.

δ_{i-1} is the value of δ_i computed for the previous slot. The value of δ_{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 δ_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 TS 25.215). 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 $\Delta_{TPC.}$
1	Transmit power control is applied using algorithm 1 (see subclause 5.1.2.2.2) with step size Δ_{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 Δ_{RP-TPC} instead of Δ_{TPC}, regardless of the value of PCA. The change in uplink DPCCH transmit power (except for the first slot after the transmission gap) is given by:

$$\Delta_{DPCCH} = \Delta_{RP-TPC} \times TPC\_cmd + \Delta_{PILOT}$$

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

After the recovery period, ordinary transmit power control resumes using the algorithm specified by the value of PCA and with step size Δ_{TPC}.

If PCA has the value 2 , the sets of slots over which the TPC commands are processed shall remain aligned to the frame boundaries in the compressed frame. For both RPP mode 0 and RPP mode 1, if the transmission gap or the recovery period results in any incomplete sets of TPC commands, TPC_cmd shall be zero for those sets of slots which are incomplete.