TSG-RAN Working Group 1 meeting #15
Berlin, Germany

TSGR1-00-1055

August 22nd – 25th, 2000

Agenda Item: Ad Hoc 99

Source: **Siemens AG**

Title: **Correction of δ formula in the case of transmission at power limits**

Document for: **Discussion and Approval**

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1. Introduction

At the last meeting in Oulu Philips presented a CR [1] clarifying the power control issue at maximum and minimum power limits. Thus chapter 5.1.2.6 was introduced. Moreover the δ formula, which describes the first power control immediately after the transmission gap, was refined by adding the factor *k*. So during the scaling procedure, corresponding to the introduced chapter 5.1.2.6, *k* is set to zero and so the TPC commands are set to zero, too.

The current CR [1] implies for example reaching the maximum power limit applies setting *k* to zero but leaving the maximum power limit does not apply setting *k* to zero. Looking at a UE operating at a power limit, upper or lower bound, an unbalancing of the δ formula will occur, if the UE oversteps the limit frequently.

Therefore we propose a minor change to the already existing CR [1] yielding a remarkable improvement of the δ formula in the case of operating at maximum and minimum power level.

2. Features of current and proposed method

Assuming a UE operating at the maximum power level the following figure 1 demonstrates possible transmit power behaviours. Cases 1a and 2a depict two abstracted examples at the power limit, whereas case 1b and 2b shows exactly the same behaviour but at any arbitrary power level within the allowed transmit power range. Case one, mainly a theoretical process, consists of an alternating power up and down command. Case two shows a less frequent alternation (one up and down period lasts about 8 slots).

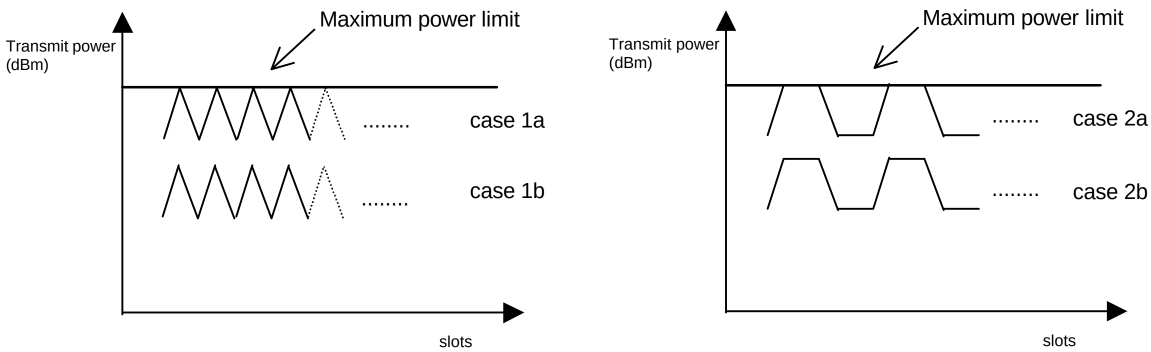

Figure 1: *Two possible UE transmit power behaviours*

Figure 2 demonstrates the δ function for the corresponding cases of figure 1 assuming an arbitrary start value of 5 dB. Line 1a and 2a represent the current δ function for the cases 1a and 2a (figure 1), i. e. a UE operating at the maximum power limit.
But in general if the transmit power behaves like demonstrated in case 1a and 2a no tendency of the power commands is recognisable, so the δ formula should merge to zero. Or in other words the resulting δ function in the cases 1a and 2a should act in the same way as in the cases 1b and 2b. Line 1b and 2b of figure 2 demonstrate the δ function for the cases 1b and 2b. These two lines are also desired for the cases 1a and 2a. Figure 2 shows clearly that the current malfunction could cause a differing value of up to 15 dB. The more frequent the alternation of transmit power is, the greater is the current malfunction.
The minor change we conducted in the CR avoids this described problem. If our proposed CR is applied, the δ function will act in the cases 1a and 2a as demonstrated in line 1b and 2b.
This described example is also applicable to the minimum transmit power limit.

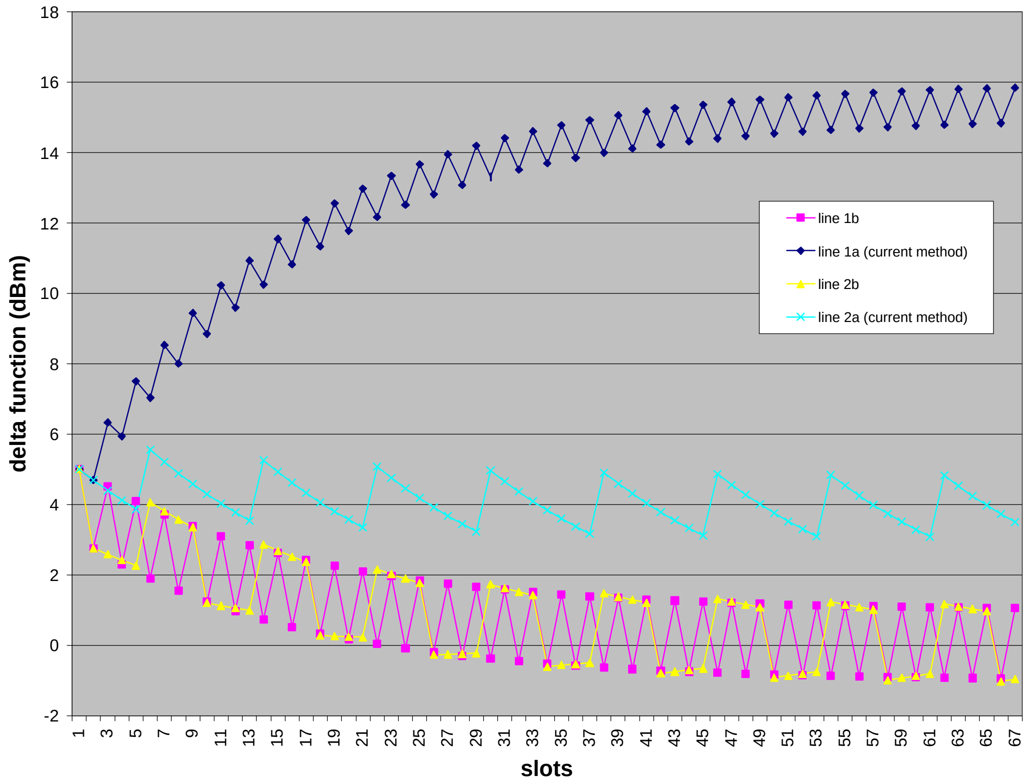

Figure 2: *d-function for current and proposed method*

3. Conclusions

We propose the following minor change of the δ formula in the following way: The introduced factor *k* should be zero, if additional scaling is applied in the current and the previous slot.

4. References

[1] TSGR1#14(00)0973; Oulu, Finland;7-2000; Philips; CR 25.214-118r2: Clarification of power control at maximum and minimum power

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Berlin, Germany, 22-25 August 2000

Document R1-00-1055
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**	**125**	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:	RAN #9	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		Core Network	

Source: Siemens AG   **Date:** 2000-08-16

Subject: Clarification and correction of δ formula

Work item:

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: At the last meeting Philips conducted a correction of the δ formula by presenting CR 118r2 (Tdoc 000973). Unfortunately a minor additional extension for the introduced definition of *k* would be necessary.

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: This CR supersedes the changes in section 5.1.2.3 performed by CR 118r2 (Tdoc 000973).

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

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:

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

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	$\Delta_{RESUME} = \Delta_{TPC} \times \mathrm{TPC\_cmd}_{gap}$
1	$\Delta_{RESUME} = \delta_{last}$

In the case of a transmission gap in the uplink, $\mathrm{TPC\_cmd}_{gap}$ 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 $\mathrm{TPC\_cmd}_{gap}$ 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:

$$\delta_i = 0.9375\delta_{i-1} - 0.96875\,TPC\_cmd_i\,\Delta_{TPC} \qquad \delta_i = 0.9375\delta_{i-1} - 0.96875\,TPC\_cmd_i\,\Delta_{TPC}\,k_{sc}$$
$$\delta_{i-1} = \delta_i \qquad \delta_{i-1} = \delta_i$$

where: $\mathrm{TPC\_cmd}_i$ is the power control command derived by the UE in that slot;

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

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.

5.1.2.4 Transmit power control in DPCCH power control preamble

A power control preamble may be used for initialisation of a DCH. Both the UL and DL DPCCHs shall be transmitted during the uplink power control preamble. The UL DPDCH shall not commence before the end of the power control preamble.

The length of the power control preamble is a UE-specific parameter signalled by the network, and can take the values 0 slots or 15 slots.

If the length of the power control preamble is greater than zero, the details of power control used during the power control preamble differ from the ordinary power control which is used afterwards. After the first slot of the power control preamble the change in uplink DPCCH transmit power shall initially be given by:

$$\Delta_{DPCCH} = \Delta_{TPC-init} \times TPC\_cmd.$$

For PCA equal to 1 and 2, the value of $\Delta_{TPC-init}$ is set to Δ_{TPC}.

TPC_cmd is derived according to algorithm 1 as described in sub clause 5.1.2.2.1, regardless of the value of PCA.

Ordinary power control (see subclause 5.1.2.2), with the power control algorithm determined by the value of PCA and step size $\Delta_{TPC,}$ shall be used as soon as the sign of TPC_cmd reverses for the first time, or at the end of the power control preamble if the power control preamble ends first.

5.1.2.5 Setting of the uplink DPCCH/DPDCH power difference

5.1.2.5.1 General

The uplink DPCCH and DPDCH(s) are transmitted on different codes as defined in subclause 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