3GPP TSG RAN WG1 ***TSGR1#9(99)k51***

November 30 – December 3, 1999, Dresden, Germany

Agenda item: **Ad hoc 14, Adhoc 9**

Source: **Philips**

Title: **Consolidation of Power Control Information for DCH Initialisation**

Document for: **Decision**

Introduction

This paper is a revision of R1-99i13, incorporating changes agreed in Adhoc 9 at WG1#9:

1. The reference to the outer power control loop in the power control preamble has been removed;
2. The reference to DSCHs has been removed, as the power control preamble relates to a DCH;
3. The existence of the DL DPCCH during the power control preamble on the UL DPCCH has been clarified.

This paper consolidates the uplink power control information for DCHs into one section.

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

***Document* R1-99k51**

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.

3G25.214 CR 015rev1 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
list expected approval meeting # here ↑

for approval	X	strategic		*(for SMG*
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	Core Network
	X	X	

Source: Philips **Date:** 1999-12-01

Subject: Consolidation of Power Control Information for DCH Initialisation

Work item:

Category:
(only one category shall be marked with an X)

F	Correction	
A	Corresponds to a correction in an earlier release	
B	Addition of feature	
C	Functional modification of feature	X
D	Editorial modification	

Release:

Phase 2	
Release 96	
Release 97	
Release 98	
Release 99	X
Release 00	

Reason for change: Power control information for DCH initialisation appears in a different part of the specification from the rest of the power control information for DCHs, and needs to be brought together.

Clauses affected: 5.1.2 DPCCH/DPDCH
7.1.1 Rapid initialisation of DCH for Packet Data Transfer using DSCH

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

5.1.2.3 Transmit power control in compressed mode

The aim of uplink power control in downlink or/and uplink compressed mode is to recover as fast as possible a signal-to-interference ratio (SIR) close to the target SIR after each transmission gap.

In downlink compressed mode, no power control is applied during transmission gaps, since no downlink TPC command is sent. Thus, the transmit powers of the uplink DPDCH(s) and DPCCH are not changed during the transmission gaps.

In simultaneous downlink and uplink compressed mode, the transmission of uplink DPDCH(s) and DPCCH is stopped during transmission gaps.

The initial transmit power of each uplink DPDCH and DPCCH after the transmission gap is equal to the power before the gap, but with an offset Δ_{RESUME}. The value of Δ_{RESUME} (in dB) is determined according to the Power Resume Mode (PRM). The PRM is a UE specific parameter, which is signalled by the network with the other parameters of the downlink compressed mode (see TS 25.215). The different modes are summarised in table 1.

Table 1: Power control resume modes during compressed mode

Power Resume Mode	Description
0	$\Delta_{RESUME} = 0$
1	$\Delta_{RESUME} = \text{Int}[d_{last} / \Delta_{TPCmin}]\ \Delta_{TPCmin}$

Here Int[ ] means round to the nearest integer and Δ_{TPCmin} is the minimum power control step size supported by the UE. δ_{last} is the power offset computed at the last slot before the transmission gap according to the following recursive relations, which are, executed every slot during uplink transmission:

$$d_{last} = 0.9375 d_{previous} - 0.96875 TPC\_cmd_{last} \Delta_{TPC}$$
$$d_{previous} = d_{last}$$

TPC_cmd is the power control command executed by the UE in the last slot before the transmission gap. $\delta_{previous}$ is the power offset computed for the previous slot. The value of $\delta_{previous}$ shall be initialised to zero when a DCH is activated, or during the first slot after a transmission gap.

After each transmission gap, 2 modes are possible for the power control algorithm. The power control mode (PCM) is fixed and signalled with the other parameters of the downlink compressed mode (see TS 25.215). The different modes are summarised in the table 2:

Table 2: Power control modes during compressed mode

Mode	Description
0	Ordinary transmit power control is applied with step size Δ_{TPC}
1	Ordinary transmit power control is applied with step size Δ_{RP-TPC} during RPL slots after each transmission gap.

For mode 0, the step size is not changed and the ordinary transmit power control is still applied during compressed mode (see subclause 5.1.2.2), using the same algorithm for processing TPC commands as in normal mode (see section 5.1.2.2.2 and 5.1.2.2.3).

For mode 1, during RPL slots after each transmission gap, called the recovery period, the same power control algorithm is applied but with a step size Δ_{RP-TPC} instead of Δ_{TPC}.

Δ_{RP-TPC} is called recovery power control step size and is expressed in dB. If algorithm 1 (section 5.1.2.2.2) is used in normal mode, Δ_{RP-TPC} is equal to the minimum value of 3 dB and $2\Delta_{TPC}$. If algorithm 2 (section 5.1.2.2.3) is used in normal mode, Δ_{RP-TPC} is equal to 1 dB.

RPL is called recovery period length and is expressed in number of slots. RPL is fixed and equal to the minimum value of TGL and 7 slots.

After the recovery period transmit power control resumes using the same algorithm and step size as used in normal mode before the transmission gap.

If algorithm 2 (section 5.1.2.2.3) is being used in normal mode, the sets of slots over which the TPC commands are processed (in section 5.1.2.2.2.3.1) shall remain aligned to the frame boundaries in the compressed frame. In both mode 0 or mode 1, if the transmission gap or the recovery period results in any incomplete sets of TPC commands, no TPC_temp_i command will be determined for those sets of slots which are incomplete, and there will be no change in transmit power level for those sets of slots.

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 8 slots.

The inner power control loop acts on the UL DPCCH during the preamble in the same way as described in section 5.1.2.2.1.

The initial power control step size used in the power control preamble differs from that used after the preamble in the following way. If algorithm 1 is to be used after the preamble to calculate the value of TPC_cmd, then the initial step size in the power control preamble is $\Delta_{TPC\text{-}init}$, where $\Delta_{TPC\text{-}init}$ is equal to the minimum value out of 3 dB and $2\Delta_{TPC}$. If algorithm 2 is to be used after the preamble to calculate the value of TPC_cmd, then initially in the power control preamble algorithm 1 is used with a step size of 2dB. In either case, the power control algorithm and step size revert to those used for the main part of the transmission 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~~4~~ Setting of the uplink DPCCH/DPDCH power difference

5.1.2.5~~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:

- 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.

5.1.2.5~~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).

5.1.2.5~~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.

7 Procedures in Packet Data Transfer

7.1 Rapid Initialization of DCH for Packet Data Transfer

A rapid initialization procedure for establishing a DCH is defined to support bursting packet data transfer. The rapid initialization may be invoked for downlink packet data transfer on the DSCH or uplink packet data transfer on the DCH. The procedure may also be invoked to resume a recently discontinued DCH connection.

7.1.1 Rapid Initialization of DCH for Packet Data Transfer using DSCH

The synchronization of the DSCH/DCH pair may be expedited so that data transmission using DSCH can commence in slightly over 10 ms following the FACH burst assigning the TFCI using DCH. Figure 3shows the timing diagram of RACH/FACH to DCH/DCH+DSCH state transition. The parameter T_A specifies the RACH/FACH response time. The parameters T_B, T_C and T_D are referenced relative to the FACH frame. T_B specifies the time period when the downlink DPCCH is started. The parameter T_C specifies the period at which the UE will start the uplink DPCCH. Finally, T_D specifies the period that the DCH will be stable and the first frame of data may arrive. The parameters T_B, T_C, and T_D have the following relationship:

$$T_B < T_C << T_D$$

$$T_D = T_B + N_{slots}*0.666$$

where N_{slots} is a positive integer.

In order to initialise fast uplink link power control loop, searcher and channel estimator at the Node B, the UE will adhere to the following:

- The transmission of uplink link DPCCH will start at N_{slots} slots (1 to 15 slots) prior to the scheduled downlink packet data transmission using DSCH.
- The DPCCH will be transmitted with an additional negative power offset P_{offset} from the computed open loop estimate.
- ~~The initial power control step size for transmitting the DPCCH will be set at P_{step} (typically: 2dB).~~
- ~~The UE will revert back to the normal power control (PC) step size upon the receipt of the first down power control command during the uplink DPCCH transmission phase,~~
- ~~The step size always goes back to its nominal setting in the beginning of DSCH transmission~~Power control until the time T_D is described in section 5.1.2.4.

The parameters T_B, T_C, T_D , N_{slots}~~,~~ *and* P_{offset} ~~and P_{step}~~ may be negotiated with each individual UE or broadcast by the system so that the transition from RACH/FACH to DCH/DCH+DSCH sub-state is optimised.

7.1.2 Rapid Initialization of DCH for Uplink Packet Data Transfer

The synchronization of the DCH may also be expedited for the transfer of uplink packet data.. Figure 4 shows the same parameters T_B, T_C, and T_D applied to an uplink packet data transfer. The UE, upon detecting data in its queue, transmits a RACH with measurement report. After the UTRAN assigns the DCH via the FACH message, the downlink DPCCH is started after a time period T_B. The UE then begins transmission of the uplink DPCCH for reasons as outlined in section 7.3.4 at time period T_C. T_C is measured relative to the FACH transmit timing. Finally, the UE begins transmitting the data on the DPDCH after the period. The procedure for starting the uplink DPCCH transmission will be similar to Section 7.3.4.1