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Text proposal for specifications 25.214 and 25.231 on power control in compressed mode

Introduction

In referenced contributions, different algorithms were proposed to improve uplink (resp. downlink) power control performances in downlink (resp. uplink) compressed mode. The aim of the proposed algorithms are to recover as fast as possible a SIR close to the target SIR after each transmission gap. All these algorithms are very simple and are complementary. Simulation results showed that the proposed algorithms lead to a significant improvement compared to the standard power control algorithm in compressed mode with nearly no additional complexity.

The main idea is to apply a larger power control step size for a certain duration (called *recovery period*) after each transmission gap (i.e. after UE restarts receiving TPC commands). To enable flexibility and optimization of performances, it is proposed to have four different modes, the mode being set up with the other parameters of compressed mode (transmission gap period, transmission gap length, …). The signaling overhead is low, since the compressed mode needs to be signaled anyway. Moreover, there is no significant additional complexity to implement these 4 modes, since they are all very close to the ordinary power control algorithm are remain very simple.

In the following, we give the text proposals for 25.214 and 25.231. The proposed scheme is identical for uplink power control in downlink compressed mode and downlink power control in uplink compressed mode.

Text proposal for 25.214 version 1.1.0

We propose to add two new sections 5.1.2.3 (uplink power control in compressed mode) and 5.2.3.3 (downlink power control in compressed mode) for power control in compressed mode. Other sections have not been modified, and only their title is reminded here.

5 Power control

5.1 Uplink power control

5.1.1 PRACH

5.1.2 DPCCH/DPDCH

5.1.2.1 General

5.1.2.2 Ordinary transmit power control

5.1.2.3 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. It is illustrated in Figure 1 below.

In downlink only 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. <Note: the initial transmit power of each uplink DPDCH or DPCCH after the transmission gap is FFS and is defined by the outer-loop power control algorithm>.

After each transmission gap, 4 modes are possible for the power control algorithm. The power control mode (PCM) is fixed and signaled with the other parameters of the downlink compressed mode (see TS 25.231). The different modes are summarized in the following table :

Mode	**Description**
0	Ordinary power control is applied with step size Δ_{TPC}
1	Ordinary power control is applied with step size Δ_{RP-TPC} during RL=$\lfloor TGL/2 \rfloor$ slots
2	Ordinary power control is applied with step size Δ_{RP-TPC} during RL=TGL slots
3	An adaptive power control scheme is applied during a maximum of RL=TGL slots. [The adaptive scheme is still FFS and is to be chosen between two proposals].

Table 1. Power control modes during compressed mode

For mode 0, the step size is not changed during compressed mode and the ordinary power control is still applied during compressed mode (see section 5.1.2.2).

For modes 1 and 2, during RL slots after each transmission gap, the ordinary power control algorithm is applied but with a step size Δ_{RP-TPC} instead of Δ_{TPC}, where

- RL is called recovery length and is an integer number of slots. RL is expressed in function of TGL, where TGL is the transmission gap length (see TS 25.231).
- Δ_{RP-TPC} is called recovery power control step size and is expressed in dB. Δ_{RP-TPC} is equal to $2\Delta_{TPC}$ when $\Delta_{TPC} <$ 2dB or Δ_{TPC} + 1 when $\Delta_{TPC} \geq$ 2dB.

Then, the ordinary power control algorithm with step Δ_{TPC} is performed.

For mode 4, during a maximum of RL= TGL slots, an adaptive power control scheme is applied. This scheme is still FFS and is to be chosen amongst the two following schemes:

- The ordinary power control algorithm is applied with a step size Δ_{RP-TPC} until the current and previous received power control commands are opposite. Then, the ordinary power control algorithm is applied with step size Δ_{TPC}.
- The ordinary power control algorithm is applied with step size Δ_{RP-TPC} for the first slot following the transmission gap. For the following slots, the ordinary power control algorithm is applied with step size Δ_{TPC} if the current and previous received power control commands are equal or with step size Δ_{RP-TPC} otherwise. After RL=TGL slots, the ordinary power control algorithm with step size Δ_{TPC} is applied.

Δ_{RP-TPC} is defined in function of Δ_{TPC} as for modes 1 and 2.

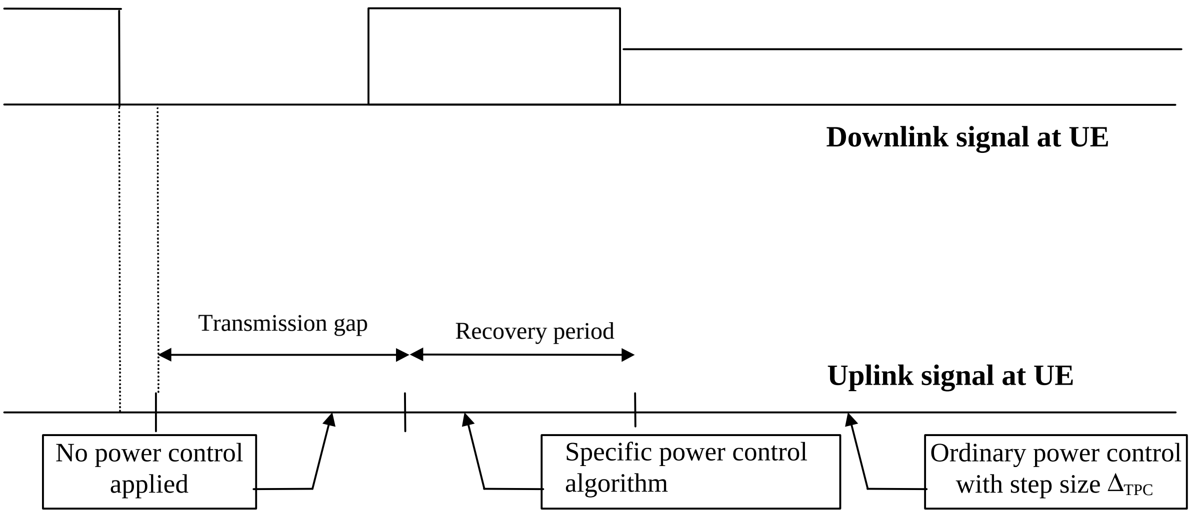

Figure 1. Uplink power control in downlink compressed mode

5.2 Downlink power control

5.2.1 Primary CCPCH

5.2.2 Secondary CCPCH

5.2.3 DPCCH/DPDCH

5.2.3.1 General

5.2.3.2 Ordinary transmit power control

5.2.3.3 Power control in compressed mode

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

As an example, It can be similar to uplink power control in downlink compressed mode illustrated in Figure 1 above and described below.

In downlink only compressed mode or in simultaneous downlink and uplink compressed mode, the transmission of downlink DCH is stopped. <Note: the initial transmit power of each downlink DPDCH or DPCCH after the transmission gap is FFS and may be defined by the outer-loop power control algorithm>.

After each transmission gap, 4 modes are possible for the power control algorithm. The different power control modes are the same that for the uplink power control in compressed mode, see section 5.1.2.3. The power control mode is not signaled to the UE. Thus, the UE does not know which mode is used by the node B for downlink power control in compressed mode.

5.2.3.4 Slow transmit power control

5.2.3.5 Site selection diversity transmit power control

Text proposal for 25.231 version 0.3.0

We propose to add the definition of the power control mode (PCM) that enables to define the power control algorithm in compressed mode in section 7.1.3.3.2. The new text appears in revision marks

7.1.3.3.2 Parametrisation of the compressed mode

In response to a request from upper layers, the UTRAN shall signal to the UE the compressed mode parameters.

The following parameters characterize a transmission gap :

- TGL : Transmission Gap Length is the duration of no transmission, expressed in number of slots (e.g. used for switching frequency, monitoring).
- SFN : The system frame number when the transmission gap starts
- SN : The slot number when the transmission gap starts

With this definition, it is possible to have a flexible position of the transmission gap in the frame, as defined in [2].

The following parameters characterize a compressed mode pattern :

- TGP : Transmission Gap Period is the period of repetition of a set of consecutive frames containing up to 2 transmission gaps (*).
- TGL : As defined above
- TGD : Transmission Gap Distance is the duration of transmission between two consecutive transmission gaps within a transmission gap period, expressed in number of frames. In case there is only one transmission gap in the transmission gap period, this parameter shall be set to zero.
- PD: Pattern duration is the total time of all TGPs expressed in number of frames.
- SFN : The system frame number when the first transmission gap starts
- PCM: Power Control Mode specifies the uplink power control algorithm applied during a few slots after each transmission gap in compressed mode. PCM can take 4 values. The different power control modes are described in TS 25.214.

In a compressed mode pattern, the first transmission gap starts in the first frame of the pattern. The gaps have a fixed position in the frames, and start in the slot position defined in [2].

(*) : Optionally, the set of parameters may contain 2 values TGP1 and TGP2, where TGP1 is used for the 1st and the consecutive odd gap periods and TGP2 is used for the even ones. Note if TGP1=TGP2 this is equivalent to using only one TGP value.

In all cases, upper layers has control of individual UE parameters. The repetition of any pattern can be stopped on upper layers command.

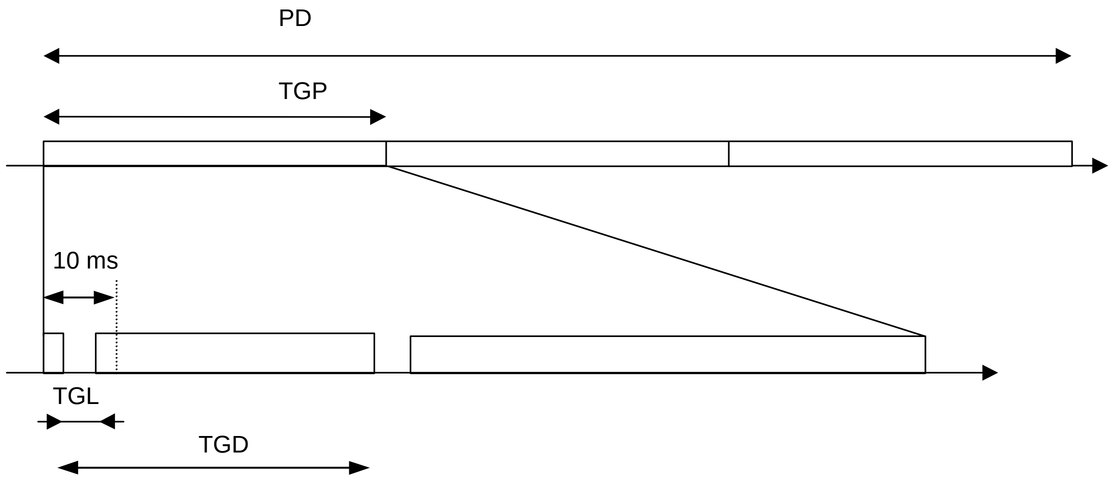

Figure 1 : illustration of compressed mode pattern parameterss

References

[1] TSGR1#4(99)342. Improved closed loop power control in compressed mode. Alcatel. (04/1999).

[2] TSGR1#5(99)542. Additional results for fixed-step closed loop power control algorithm in slotted mode. Alcatel. (05/1999).

[3] TSGR1#5(99)544. Parameters setting for fixed-step closed loop power control in compressed mode. Alcatel. (05/1999).

[4] TSGR1#5(99)715. Delta modulation for fast power control in compressed mode. Nortel. (05/1999).

[5] TSGR1#6(99)822. Optimum Recovery Period Power Control Algorithms for Slotted Mode. Philips. (07/1999).