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Text proposal for Specifications 25.214 and 25.211on downlink power control

Introduction

In contributions R199-951 and R199-B15, an algorithm was proposed to improve the downlink power control algorithm during soft handover. The aim of the proposal is to reduce the error rate on the power control commands sent by the UE and to reduce the frequency at which the cells adjust their powers. Simulation results show considerable reduction in the variance of the cells transmitted powers and a reduction also in the cells average transmitted powers.

When the UE is in soft handover, it sends one power control command that the cells (in soft handover with the UE) have to follow. Due to an error on the command, one cell can adjust its power in the wrong direction. This can result in the cells transmitting at different power levels which waste the gain from soft handover. The proposed idea is to use a parameter called DPC_MODE (downlink power control mode). If DPC_MODE is 0, the UE sends a unique power control command every slot while it sends the same power control command over three slots if DPC_MODE is 1. By repeating the power control command over three slots, the error rate on the command is reduced. The cells will also adjust their powers each three slots (when DPC_MODE=1) and hence there will be less deviation in their transmitted powers since the power is adjusted less frequently. The DPC_MODE can be set to 1 during soft handoff or during any other process that benefits from a lower power control rate.

Text proposal for 25.214 version 1.1.0

We propose to change section 5.2.3.2

5.2.3.2 Ordinary transmit power control

The downlink closed-loop power control adjusts the network transmit power in order to keep the received downlink SIR at a given SIR target, SIR_{target}. An higher layer outer loop adjusts SIR_{target} independently for each connection.
The UE should estimate the received downlink DPCCH/DPDCH power of the connection to be power controlled. Simultaneously, the UE should estimate the received interference. The obtained SIR estimate SIR_{est} is then used by the UE to generate TPC commands according to the following rule: if $SIR_{est} > SIR_{target}$ then the TPC command to transmit is “0”, requesting a transmit power decrease, while if $SIR_{est} < SIR_{target}$ then the TPC command to transmit is “1”, requesting a transmit power increase.

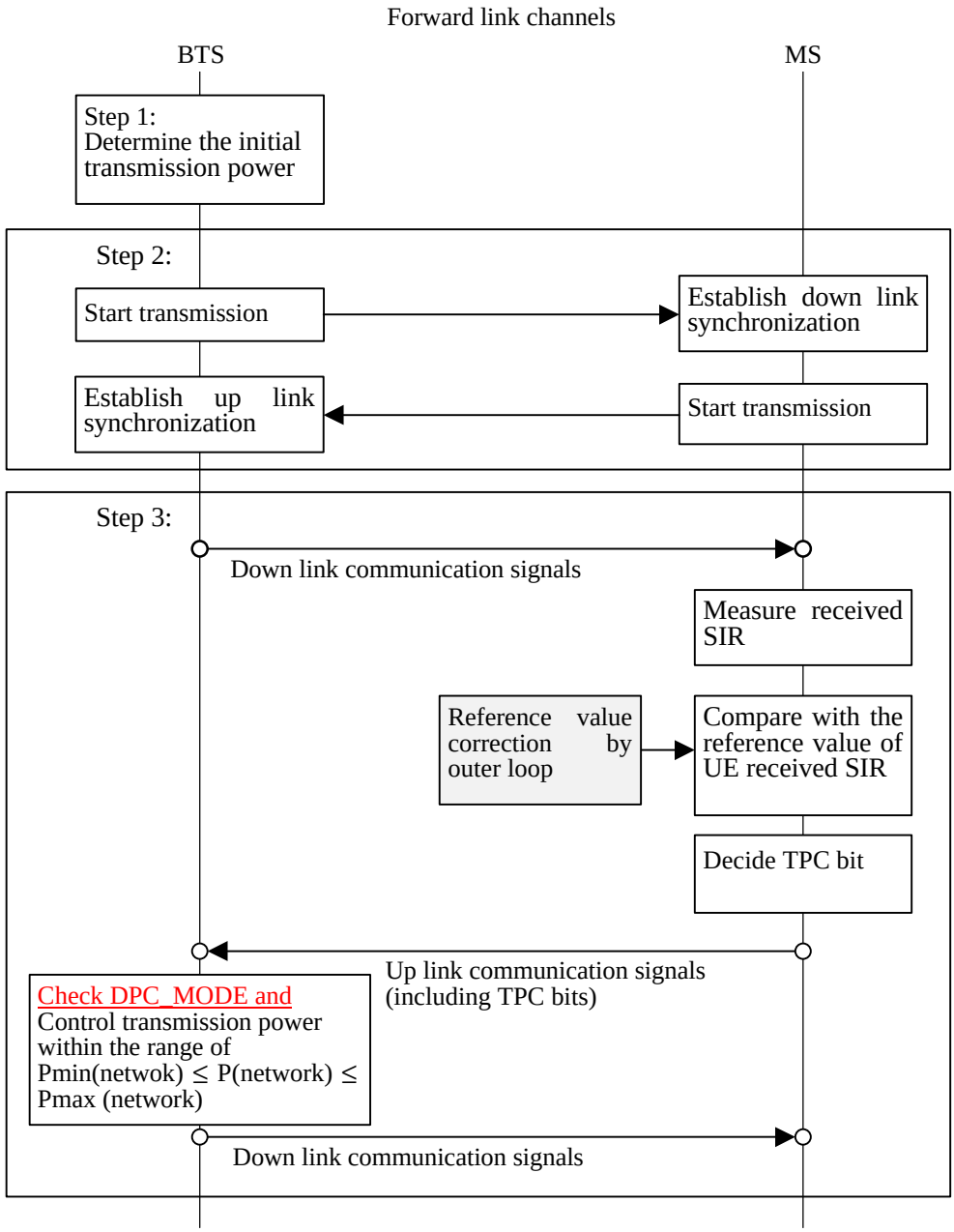
< Editor's note: How the SIR estimate should be derived is to be specified, in particular how it should be done for the case with power offsets on the DPCCH. >

~~The TPC command generated is transmitted in the first available TPC field in the uplink DPCCH.~~
The UE checks the downlink power control mode (DPC_MODE) before generating and sending the TPC bits.

If *DPC_MODE=0*
the UE sends a unique TPC command each slot and the TPC command generated is transmitted in the first available TPC field in the uplink DPCCH The cell adjusts its transmit power after receiving this TPC command..

If DPC_MODE=1,
the UE repeats the same TPC command over three slots and the TPC commands generated are transmitted such that there is a new command at the beginning of the frame. The cell adjusts its transmit power only after receiving the three TPC commands known to be the same.

< Editor's note: In Volume 3, the behaviour of the network is only given as examples. This leaves full freedom for the network to decide how to respond to the TPC commands received. However, in XX.07 more information about the networks behaviour is given: "Upon the reception of a TPC command, the network should adjust the transmit power in the given direction with a step of D_{TPC} dB. The step size D_{TPC} is a parameter that may differ between different cells, in the range 0,25 –1,5 dB."It is the view of the editor that the implementation of the network behaviour is not subject to standardisation. To be confirmed. >
'When SIR measurements cannot be performed due to downlink out-of-synchronisation, the TPC command transmitted shall be set as "1" during the period of out-of-synchronisation.
< Editor's note: In Volume 3 it is also described how the power should be controlled during link set-up. This should probably be described in the synchronisation clause, so that the information is not repeated in several places. >
The ordinary transmit power control of uplink dedicated physical channels is summarised in Figure 1 below. '



P(network): Down link transmission power
Pmax(network): Downlink maximum transmission power
Pmin(network): Downlink minimum transmission power

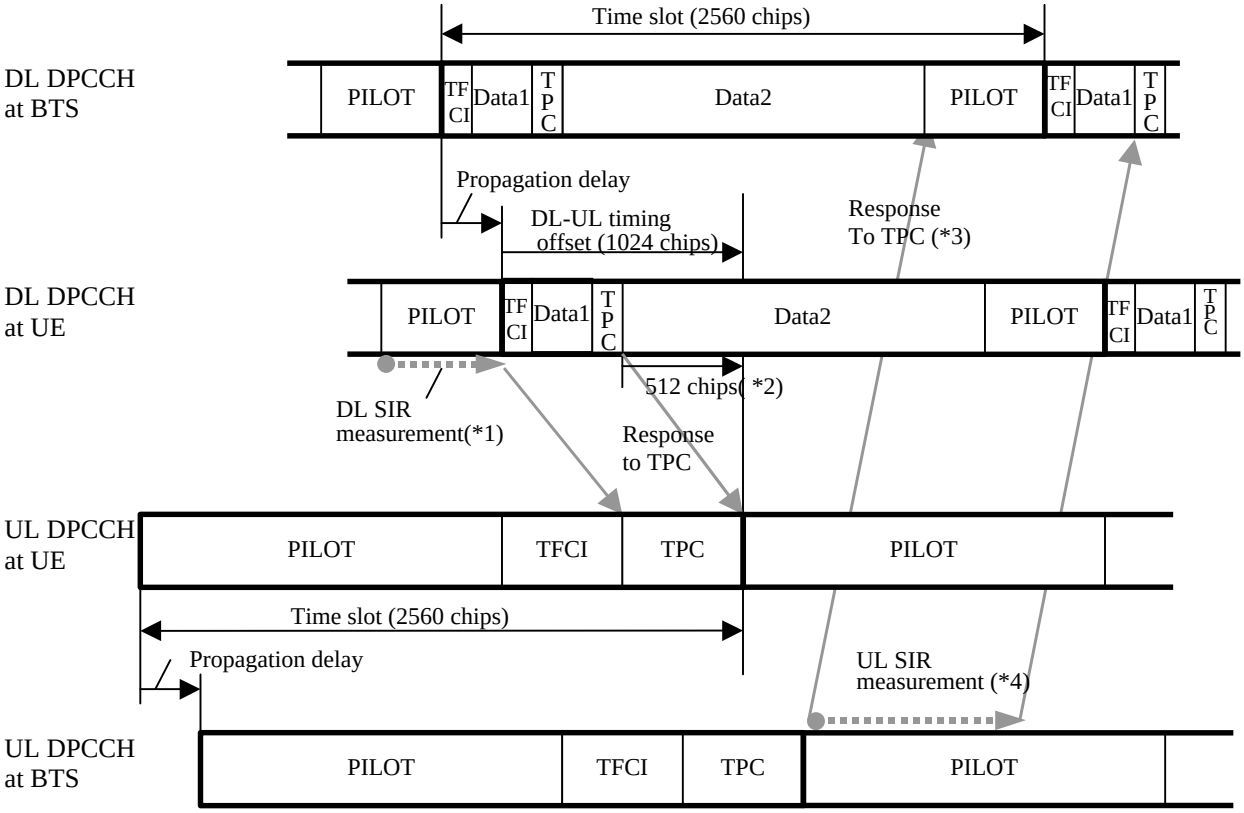
Figure 1: Forward link transmitter power control

Text proposal for 25.211 version 2.2.1

We propose to modify Appendix A to show that the BTS changes its DPCH power only after receiving all the TPC bits known to be the same. This means receiving the TPC over three slots when DPC_MODE is 1 and over one slot when DPC_MODE is 0..

Appendix A: Power Control Timing

<Editors note: The Power control timing described in this appendix should be seen as an example on how the control bits have to be placed in order to permit a short TPC delay. It seems appropriate to move this part later.>
In order to maximize the BTS-UE distance within which one-slot control delay is achieved, the frame timing of an uplink DPCH is delayed by 1024 chips from that of the corresponding downlink DPCH measured at the UE antenna.
Responding to a downlink TPC command, the UE shall change its uplink DPCH output power at the beginning of the first uplink pilot field after the TPC command reception. Responding to an uplink TPC command, BTS shall change its DPCH output power at the beginning of the next downlink pilot field after the reception of the whole TPC command ~~reception~~. Note that the TPC command is sent over one slot when DPC_MODE is 0 and over three slots when DPC_MODE is 1. Note also that the delay from the uplink TPC command reception to the power change timing is not specified for BTS. The UE shall decide and send TPC commands on the uplink based on the downlink SIR measurement. The TPC command field on the uplink starts, when measured at the UE antenna, 512 chips after the end of the downlink pilot field. BTS shall decide and send TPC commands based on the uplink SIR measurement. However, the SIR measurement periods are not specified either for UE nor BTS.
Fig. A-1 illustrates an example of transmitter power control timings.



*1,4 The SIR measurement periods illustrated here are examples. Other ways of measurement are allowed to achieve accurate SIR estimation.

*2 Except the case of DL symbol rate=7.5ksps.

*3 If there is not enough time for BTS to respond to the TPC, the action can be delayed until the next slot. The BTS changes its DPCH output power only after receiving all TPC bits known to be the same (1 TPC if DPC_MODE is 0 and 3 TPCs if DPC_MODE is 1).

Fig. A-1 Transmitter power control Timing