TSG-RANWG1#8 **TSGR1#8(99)g44**
October 12^{th} – 15^{th}
New York(USA)

Agenda item: Ad hoc 9

Source : NEC

Title: On power control rate reduction

Document for: Discussion and Decision

1. Introduction

In TS 25.214, the introduction of the DPC_MODE parameter and its use are working assumptions. That technique is called power control rate reduction, and was proposed to alleviate power drifting of downlink transmit powers among cells during soft handover. In power control rate reduction, the UE repeats the same TPC command over 3 slots. With the technique, power drifting slows down due to the following reasons:

- Reception error rate of TPC commands is reduced.
- Downlink transmit power is updated only once in three slots.

On the other hand, it is concerned that the gain of inner-loop power control is reduced because the UE speed up to which inner-loop power control is beneficial, is reduced to 1/3.

In order to confirm the benefit, we need to compare the performance with and without power control rate reduction. However, it is shown in R1-99b15 that average transmission power is reduced with the combination of power control rate reduction and resynchronization compared with a case where neither of them is employed. And it has not been made clear whether average transmission power is reduced only with power control rate reduction. For fair comparison, the performance with and without power control rate reduction should be evaluated with an assumption that resynchronization is always employed. In addition, the paths loss difference between the two cells and the UE should not be limited only to 2dB since the gain of power control reduction seems to depend on the relation between the path loss difference and the TPC command gain (which is ideally 4.8dB).

Since we cannot confirm the benefit of power control rate reduction, it should not be part of TS 25.214 until TSG RAN1 confirms its benefit. The text proposal which does not include power control rate reduction is presented in the following section.

2. Text proposal

5.2 Downlink power control

5.2.3 DPCCH/DPDCH

5.2.3.2 Ordinary transmit power control

The downlink inner-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.

~~When the UE is not in soft handover t~~The TPC command generated is transmitted in the first available TPC field in the uplink DPCCH.

~~When the UE is in soft handover it should check the downlink power control mode (DPC_MODE) before generating the TPC command~~

- ~~if DPC_MODE = 0 : the UE sends a unique TPC command in each slot and the TPC command generated is transmitted in the first available TPC field in the uplink DPCCH~~
- ~~if DPC_MODE = 1 : the UE repeats the same TPC command over 3 slots and the new TPC command is transmitted such that there is a new command at the beginning of the frame.~~

~~The DPC_MODE parameter is a UE specific parameter controlled by the UTRAN.~~

~~*<Note : the introduction of the DPC_MODE parameter and its use are working assumptions>*~~

As a response to the received TPC commands, UTRAN may adjust the downlink DPCCH/DPDCH power. The transmitted DPCCH/DPDCH power may not exceed Maximum_DL_Power, nor may it be below Minimum_DL_Power.

< Note: It should be clarified with WG3 if Maximum_DL_Power and Minimum_DL_Power are given as absolute values or relative. >

< Note: It is not clear to what extent the UTRAN response to the received TPC commands should be specified. Until this has been clarified, the text in the paragraph below should be seen as an example of UTRAN behaviour. >

Changes of power shall be a multiple of the minimum step size $\Delta_{TPC,min}$ dB. It is mandatory for UTRAN to support $\Delta_{TPC,min}$ of 1 dB, while support of 0.5 dB is optional.

< Note: It needs to be clarified if an upper limit on the downlink power step should be specified. >

’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.

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. ~~Note that in soft handover, 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.