TSG-RAN Working Group 4 meeting #6 **TSGR4#6(99) 399**

Queensferry, 26. – 29. July 1999

Agenda Item:

Source: SIEMENS

Title: **BS output power dynamics (TDD)**

Document for: Discussion and Decision

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1. Document scope

In this document the following parameters of TDD-BTS are discussed:

- Closed loop power control uplink
  - Power control steps
  - Power control steps per second
- Minimum transmit output power

A text proposal for TS 25.105 is attached at the end of this document

2. General assumptions

- Procedures to control the selection of the actual power control step size have to be defined by WG1

3. Closed loop power control

The intent of using power control is to limit the interference level at the receiver.

Closed loop power control is the capability of the BTS transmitter to adjust its output power in accordance with the TPC symbols received in the uplink. Closed loop power control is based on SIR measurements at the UE receiver and the corresponding TPC commands generated by the UE.

3.1 Power control steps

The power control step is the step change in the DL transmitter output power in response to a TPC command.

We propose to define fixed step sizes because received TPC commands are not very reliable due to transmission errors. TPC commands tell the BTS whether to decrease or to increase the transmission power by one step.

Three different step sizes take into account the different UL/DL-allocation scenarios conceivable in TDD mode. The time in between two UL timeslots is maximum 15 timeslots, in opposite to 1 timeslot (logical) delay in FDD. The maximum possible frequency of TPC commands varies compared to FDD because of channel allocation.

Tolerances:

GSM specification of BTS defines step sizes of 2dB with tolerances of ±1dB under normal conditions. However, the absolute power level tolerances have to be within ±3dB. Taking into account some improvement in technology we propose a tolerance of +/-0.75dB for step size 2dB and +/-1dB for step size 3dB. The tolerance of +/-0.5dB for step size 1dB appears to be the minimum reasonable range due to measurement accuracy and implementation aspects. It is the same tolerance value as defined for FDD and TDD UE step size 1dB.

The power steps shall form a monotonous sequence. This is reflected by the requirement: “the greatest average rate of change in mean power per 10 steps shall be within the range shown in table x”.

3.2 Power control cycles per second

The number of power control cycles per second is the rate of change of the DL transmitter power due to closed loop power control. The number of power control cycles of closed loop power control is:

- Minimum value: 100 cycles/sec. The minimum rate of 100 Hz is to ensure that every frame is power controlled. For instance that is 1 cycle per frame in case of 1 UL-TS and 1 DL-TS per frame (minimum resource scenario).
- Maximum value: 800 cycles/sec. That is the fastest scenario: successive slots are allocated alternating to UL and DL corresponding to 1 cycle each 2 TS (=2x 10ms/14 frames). Due to the new defined odd number of timeslots per frame (15) only 14 TS can form 7 closed cycles.

4. Minimum transmit output power

The minimum transmission power for TDD BTS is derived by the formula:

Minimum transmission power = Maximum output power – output power dynamics,

whereby the output power dynamics is 30dB.

5. Conclusions

One set of **power control step sizes** should be fixed. Three power control steps are proposed:

- 1dB±0.5dB
- 2dB±[0.75dB]
- 3dB±[1dB]

To guarantee that the power steps form a monotonous sequence the following is specified:

Range of average rate of change in mean power per 10 steps	
minimum	maximum
+/-8dB	+/-12dB
[+/-16dB]	[+/-24dB]
[+/-24dB]	[+/-36dB]

A minimum of 100 and a maximum of 800 **power control steps per second** is proposed. The number of power control steps per second depends on the frame configuration (UL/DL).

The **minimum transmit output power** is defined by: maximum output power – 30dB

6. References

[1] GSM 05.05 Version 5.2.0, July 1996; Digital cellular telecommunications system (Phase 2+); Radio transmission and reception

[2] TS 25.104v2.1.0 UTRA (BS) FDD; Radio Transmission and Reception

Text Proposal for 25.105

6.4 Output power dynamics

Power control is used to limit the interference level. The transmitter uses a quality-based power control on the downlink.

6.4.1 Closed loop power control

Closed loop power control is the ability of the BS transmitter to adjust its output power in response to the UL received signal.

For closed loop correction on the Downlink Channel (with respect to the open loop estimate), the base station adjust its mean output power level in response to each valid power control bit received from the UE on the Uplink Traffic Channel.

6.4.2 Power control steps

The power control step is the ~~minimum~~ step change in the DL transmitter output power in response to a TPC message from the UE.

6.4.2.1 Minimum Requirement

Down link (DL) ~~{~~1, 2, ~~—~~3 dB~~}~~

~~Tolerance ffs.~~

The tolerance of the transmitter output power and the greatest average rate of change in mean power due to the power control step shall be within the range shown in Table x.

Table x: power control step size tolerance

Step size	tolerance	Range of average rate of change in mean power per 10 steps	
		minimum	maximum
1dB	+/-0.5dB	+/-8dB	+/-12dB
2dB	[+/-0.75dB]	[+/-16dB]	[+/-24dB]
3dB	[+/-1dB]	[+/-24dB]	[+/-36dB]

<Need to define the transmitter power as “code domain power”. This is ffs.>

6.4.3 Power control dynamic range

The power control dynamic range is the difference between the maximum and the minimum transmit output power for a specified reference condition

6.4.3.1 Minimum Requirement

Down link (DL) power control dynamic range [~~x~~ 30 dB]

<Definition needs clarification.>

6.4.4 Minimum transmit power

The minimum controlled output power of the BS is when the power control setting is set to a minimum value. This is when the power control indicates a minimum transmit output power is required.

6.4.4.1 Minimum Requirement

Down link (DL) minimum transmit power is set to: [Maximum output power – 30dB]

<The maximum output power definition is ffs.>

6.4.5 Total power dynamic range

The power control dynamic range is difference between the maximum and the minimum transmit output power for a specified reference condition

6.4.5.1 Minimum Requirement

Down link (DL) total dynamic range [30 dB]

<This requirement is redundant, since 6.4.4 defines the same dynamic range by a minimum transmit power.>

6.4.6 Power control cycles per second

The rate of change for DL transmitter power control step.

6.4.6.1 Minimum Requirement

The rate of change for the DL transmitter power control step is a s follows: [100 – 800] Hz.

The minimum rate of [100] Hz is to ensure that every frame is power controlled. The maximum rate may differ for open and closed loop power control due to frame configuration.

6.4.7 Perch channel power

<The name and the use of the common control channel may need to be adapted , subject to WG1 definition.>