

**Agenda Item:** 8.2  
**Source:** Ericsson  
**Title:** Closed loop power control  
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## 1. Introduction

The inner loop power control for the UE is specified in [1], UE Radio transmission and Reception (FDD). In RAN-WG1 meeting #6 some progress of the power control scheme was achieved, this is described in the liaison statement [2]. There are now three sizes of the transmit power control steps, 1, 2 and 3 dB steps. The algorithms, which determine the steps, will be specified as well. These changes must be reflected in [1].

The power control is currently specified in the transmitter characteristics. In this power control requirements e.g. SIR estimation for downlink power control is specified. This requirement does not really fit in this part of the specification.

## 2. Closed loop power control in RAN WG1

In the text proposal for the changes of the power control in RAN WG1, [4], which were accepted to be included in [3], Physical Layer Procedures,

“The step size  $\Delta_{\text{TPC}}$  is a UE specific parameter that can have the values 1 dB or 2 dB.

*Note : the maximum power control step to be support by the UE shall be 3 dB, 3 dB being allowed for the compressed mode. It is FFS whether the 3 dB should also be allowed in normal mode. “*

The power steps between slots are now actually 0, 1, 2 or 3 dB.

The power control shall now support two algorithms, one is the previous one where the TPC commands directly determines the power control step, and one where the TPC commands are filtered before a decision on what steps should be used. This filtering function is not yet finally specified.

## 3. Proposal for specification

The closed loop power control in the UE is today a part of the transmitter characteristics section 8. The downlink power control is however more related to the receiver characteristics. Therefore it is proposed that the downlink power control paragraphs in [1] are moved from the Transmitter Characteristics paragraph, 6.4.2 to the Receiver characteristics section 7.10.

It is also proposed to include the three possible stepsizes 1, 2 and 3 dB. The 0 dB step size which is used in algorithm 2 does not need to be specified in [1] because this is just constant power and is covered by the EVM requirements.

We also propose that the closed loop power control in the future is called inner loop power control, in comparison to the outer loop power control. Both are closed loops.

## 4. Conclusions

The specification of the closed loop power control should be changed according the progress in RAN-WG1. It is also proposed to move it to Section 7 in [1] and to change the name to inner loop power control.

## References

- [1] 25.101 "UE Radio transmission and Reception (FDD), V2.0.0"
- [2] Liason Statement R1-(99)A45 to WG4, (R4-(99) 377)
- [3] 25.214 "Physical layer procedures (FDD), V1.1.0"
- [4] R1-(99)A39, "Text proposal on power control"

## 5. Text proposal

The following changes are proposed to TS 25.101:

### Section 6 Transmitter Characteristics

#### 6.4.2 ~~Closed~~Inner-loop power control in uplink

Closed loop power control in the Uplink is the ability of the UE transmitter to adjust its output power in accordance with the TPC symbols received in the downlink.

~~Closed loop power control in the downlink is the ability of the UE receiver to estimate the received SIR, compare it with the SIR target and transmit the TPC symbols in accordance to the results of this comparison.~~

#### ~~6.4.2.1~~ ~~Closed loop power control in the downlink~~

##### ~~6.4.2.1.1~~ ~~Minimum requirements~~

- ~~(a)The downlink tolerance for the SIR measurements shall be within the range shown in Table 4~~
- ~~(b)The dynamic range of the SIR measurement of the received signal in the downlink shall be better than shown in Table 4~~
- ~~(c)The transmitted TPC symbols must respond to a change in the received SIR within the time period specified in Table 4~~

**~~Table 4: Downlink closed loop power control~~**

<del>SIR measured tolerance</del>	<del>[ ] dB</del>
<del>SIR dynamic range</del>	<del>[ ] dB</del>
<del>Time constant for SIR<sub>target</sub></del>	<del>0.625 ms</del>

#### 6.4.2.1 Power control steps

The power control step is the minimum step change in the UL- transmitter output power in response to a ~~TPC message~~power control command.

##### 6.4.2.1.1 Minimum requirement

The UE transmitter shall have the capability of setting the ~~closed- inner~~ loop output power with a step size of 1, 2 and 3 dB

- (a) The tolerance of the transmitter output power step due to closed loop power control shall be within the range shown in Table 5.
- (b) The tolerance of the transmitter average output power step due to inner loop power control shall be within the range shown in Table 6.
- ~~(b)The greatest average rate of change in mean power shall be greater than 8.0 dB per 10 slots and less than 12.0 dB per 10 slots~~

**Table 5: Transmitter power control tolerance**

TPC Symbol in the forward link	Transmitter power control tolerance	
	Lower	Upper
11	+0.5dB	+1.5 dB
00	-0.5dB	-1.5 dB

Power control commands in the forward links	Transmitter power control tolerance					
	1 dB step size		2 dB step size		3 dB step size	
	Lower	Upper	Lower	Upper	Lower	Upper
Up	+0.5	+1.5	+1	+2	+1.5	+4.5
Down	-0.5	-1.5	-1	-2	-1.5	-4.5

**Table 6: Transmitter average power control tolerance**

Power control commands in the forward links	Transmitter power control tolerance after 10 equal commands (up or down)					
	1 dB step size		2 dB step size		3 dB step size	
	Lower	Upper	Lower	Upper	Lower	Upper
Up	+8	+12	+16	+24	+24	+36
Down	-8	-12	-16	-24	-24	-36

**Section 7: Receiver Characteristics:****6.4.2.7.10 Closed-Inner loop power control in downlink**

Closed loop power control in the downlink is the ability of the UE receiver to estimate the received SIR, compare it with the SIR target and transmit the TPC symbols in accordance to the results of this comparison.

**6.4.2.17.10.1 ClosedInner -loop power control in the downlink****6.4.2.1.17.10.1.1 Minimum requirements**

- (a) The downlink tolerance for the SIR measurements shall be within the range shown in Table 4
- (b) The dynamic range of the SIR measurement of the received signal in the downlink shall be better than shown in Table 4
- (c) The transmitted TPC symbols must respond to a change in the received SIR within the time period specified in Table 4

**Table 4: Downlink closed loop power control**

SIR measured tolerance	[ ] dB
SIR dynamic range	[ ] dB
Time constant for $SIR_{t_{sig}}$	0.625 ms/2560 chipperiods