3GPP TSG-RAN Working Group 1, Meeting #7 **TDoc TSG RAN WG1 (99)B70**
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Agenda Item: AdHoc 1
Source: Siemens AG
Title: Definition of TPC bits in TDD mode
Document for: Approval

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1 Introduction

In TDD fast closed loop power control can be used to increase system performance for slow moving mobiles. Fast closed loop power control is based on TPC commands sent by the receiving side to the transmitting side to adjust the Tx power. The procedure is described in [1] already, however, currently it is not specified how TPC is transmitted.

This contribution proposes a particular transmission scheme for TPC bits in TDD uplink to enable fast closed loop power control in the downlink. For uplink Tx power it is assumed that only open loop power control is used. Simulation results are provided that evaluate the performance of this scheme. A detailed text proposal is given that should be included in the specification text to fill the above mentioned gap.

2 TPC Command Transmission

For closed loop power control TPC information is sent from the receiving to the transmitting side, indicating whether Tx power has to be increased or decreased. Thus, the TPC command requires one information bit. In TDD mode, bits lying directly adjacent to the midamble, are detected most reliable, since the channel estimation is suited best for those bits. In contrast to this, bits at the slot border are potentially endangered in case of timing inaccuracies. Moreover, bits adjacent to the midamble offer the possibility to detect them first within a joint detection algorithm, so that the TPC command is available as fast as possible. In order to allow a reliable indication the TPC bit is repeated once to form a TPC symbol. For the TPC bits the same spreading factor is used as for the data bits.

Figure 1 shows the position of the TPC symbol in the traffic burst that was used in the simulation. As an alternative the position before the midamble had been simulated as well, however, the performance for both positions was almost the same.

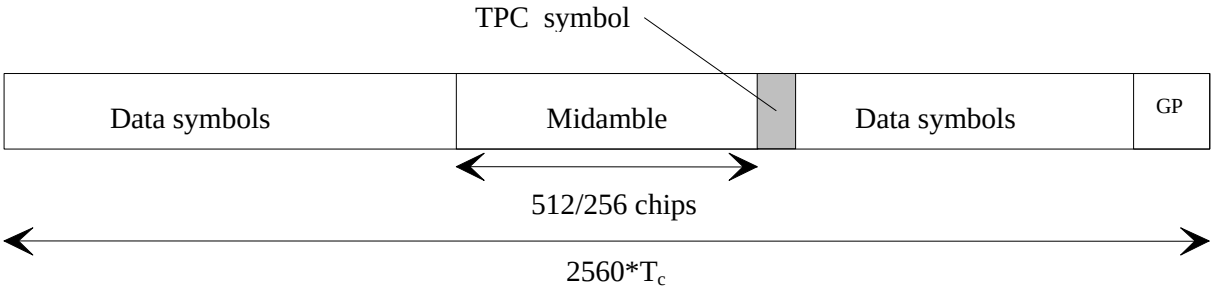

Figure 1 Position of TPC Bits in the Traffic Burst

3 Simulation Results

All simulations were carried out for the uplink only, since we propose the introduction of TPC bits only for the uplink transmission.

3.1 Speech Service

The speech service was simulated with 8 users in an Indoor environment (3km/h) with an effective code rate R=0.34. In figure 2 the raw BER, the user BER and the block error rate (BLER) are shown for the speech service. At a target user BER of 10^{-3} the TPC error rate (TPC BER am) is about 0.7%.

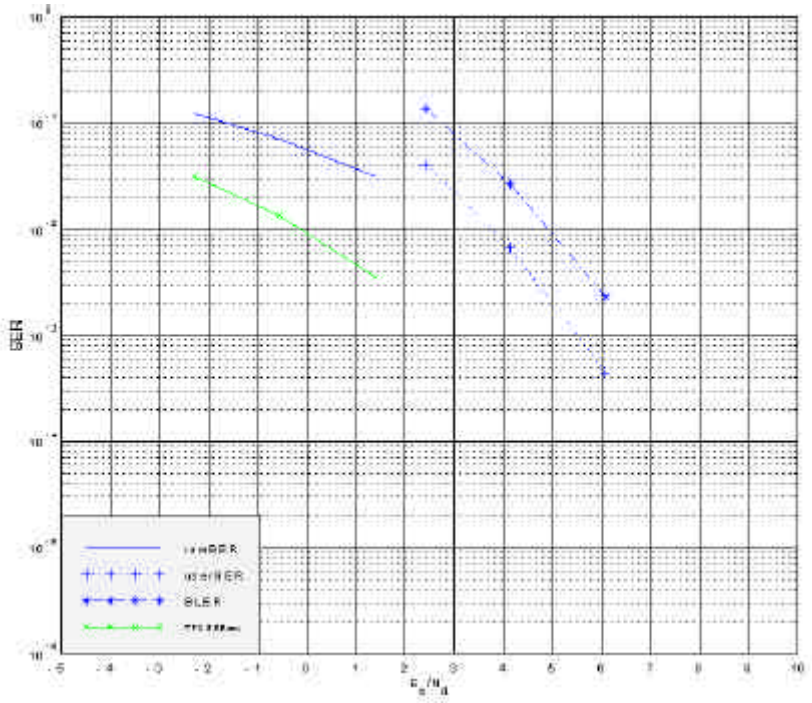

Figure 2 TPC performance for a simulated speech service (Indoor A (3km/h), 8 users, R=0.34)

3.2 LCD Service, Indoor

The LCD service with 144kbps was simulated with 1 user in an Indoor environment (3km/h) with an effective code rate R=0.59. In figure 3 the raw BER, the user BER and the block error rate (BLER) are shown for the LCD service. At a user BER of 10^{-3} the TPC error rate (TPC BER am) is about 0.07%. The target BER for this service will be much lower than this, thus, the TPC performance will be even better.

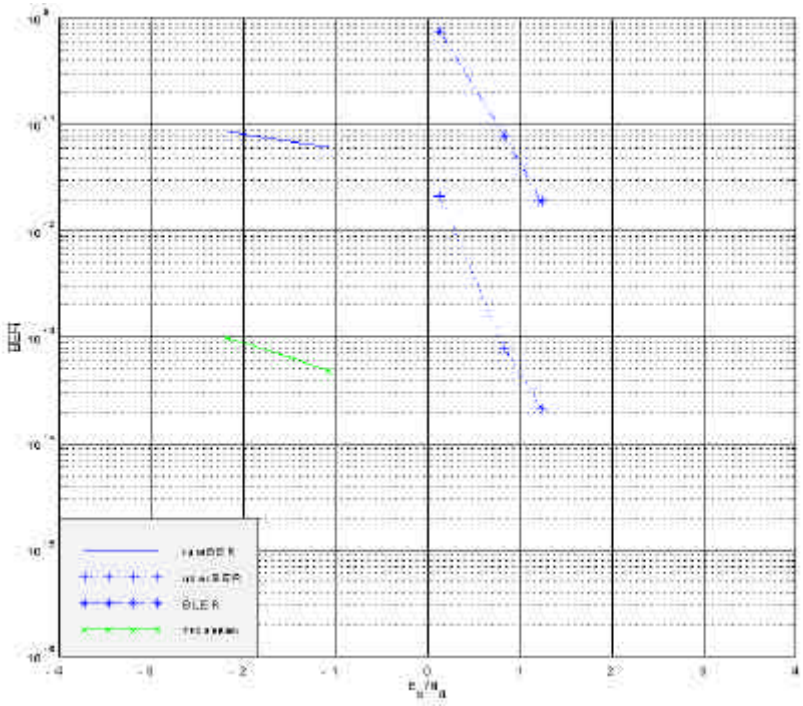

Figure 3 TPC performance for a simulated LCD 144 (Indoor A (3km/h), 1 user, R=0.59)

In order to allow a faster decoding of the TPC bits the output of the matched filter can be used for this instead of performing the complete joint detection. In figure 4 the TPC error rate at the matched filter output is compared to the error rate achieved by joint detection. It can be seen that the performance degradation is very small.

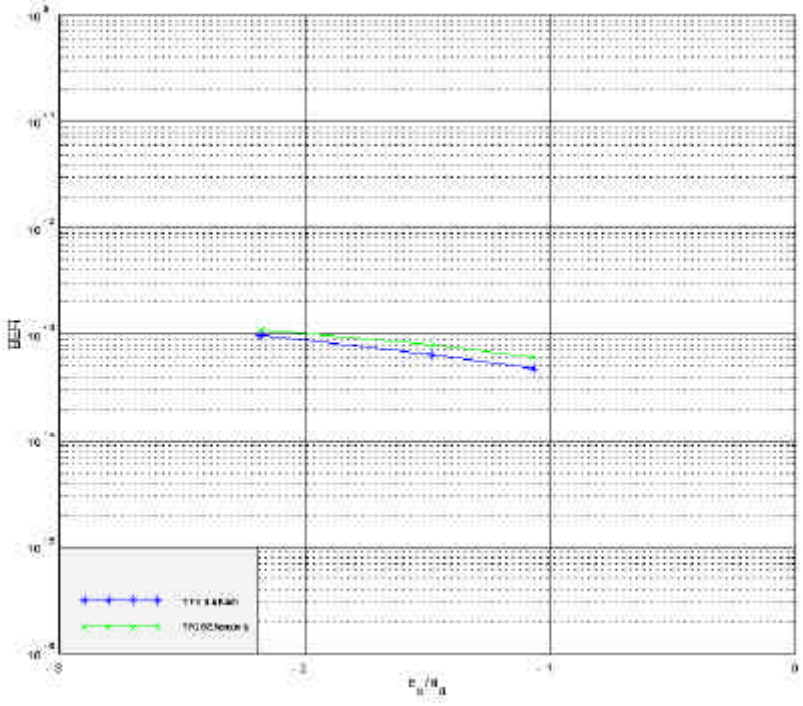

Figure 4 TPC performance at the output of the matched filter and after joint detection for the LCD 144, Indoor A

3.3 LCD Service, Outdoor to Indoor and Pedestrian

The LCD service with 144kbps was simulated with 1 user in an Outdoor to Indoor and Pedestrian environment (3km/h) with an effective code rate R=0.59. In figure 4 the raw BER, the user BER and the block error rate (BLER) are shown for the LCD service. At a user BER of 10^{-3} the TPC error rate (TPC BER am) is about 0.07%. The target BER for this service will be much lower than this, thus, the TPC performance will be even better.

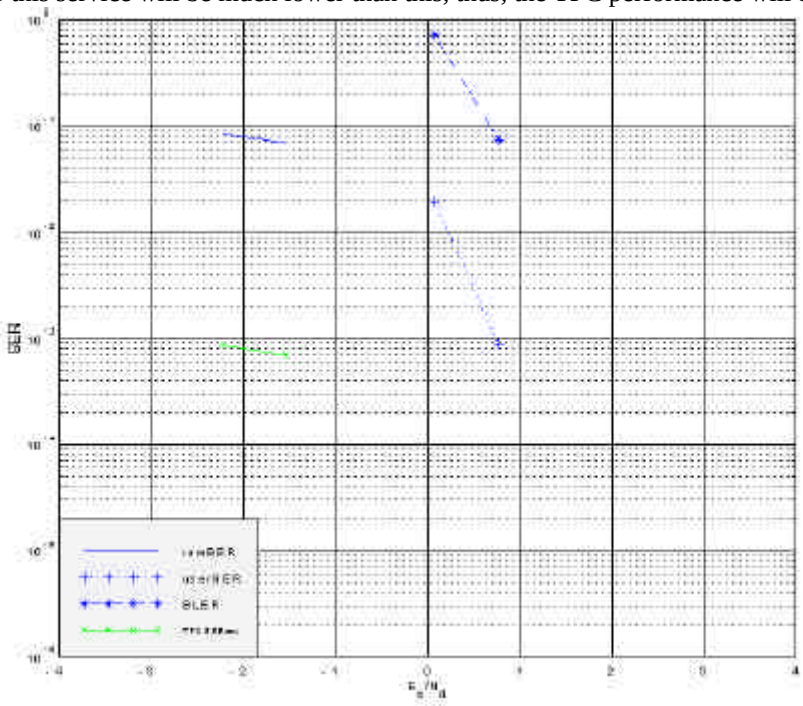

Figure 5 TPC performance for a simulated LCD 144 (Outdoor to Indoor and Pedestrian A (3km/h), 1 user, R=0.59)

Figure 6 again compares the TPC error rates at the output of the matched filter and the joint detector.

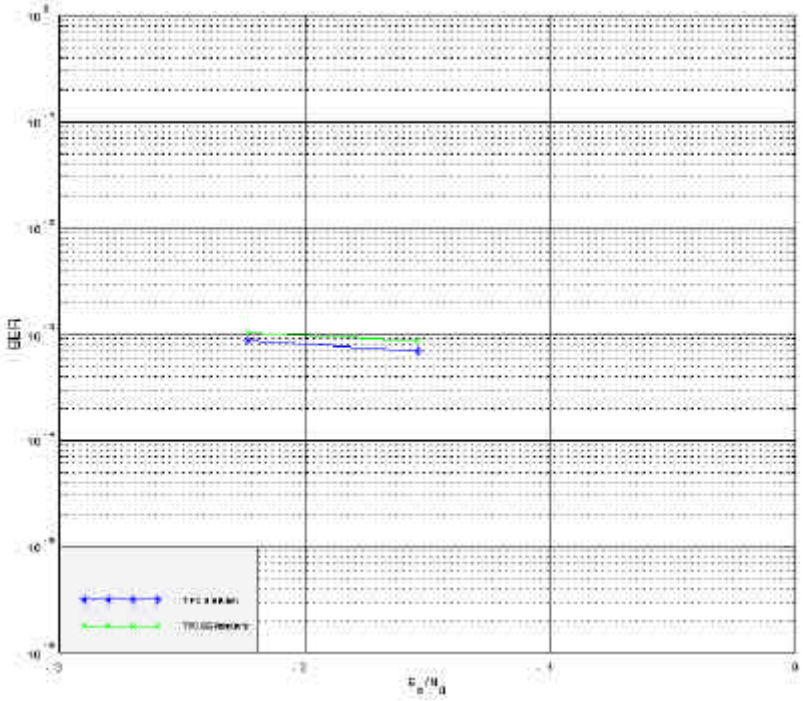

Figure 6 TPC performance at the output of the matched filter and after joint detection for the LCD 144, Outdoor to Indoor and Pedestrian A

4 Conclusions

In this contribution a detailed proposal for transmission of TPC bits in the uplink is made. It is proposed to transmit a single TPC symbol directly after the midamble and before the TFCI bits. Simulation results for different services and different environments were shown demonstrating that the TPC error rate is sufficiently low. To allow faster decoding of the TPC bits, the output of the matched filter can be used instead of performing the complete joint detection algorithm. Simulations were shown indicating that this leads only to a small performance degradation.

We propose to include the textproposal as given in section 6 of this document into the specification text of TS25.221 and TS25.222.

5 References

[1] 3GPP TSG RAN WG1 TDoc 99-A68, TS25.224 - Physical Layer Procedures (TDD)

6 Textproposal

We propose to change subsection 5.2.2.1 ‘Transmission of TFCI’ and to include the new subsection 5.2.2.2 into TS25.221 in section 5.2.2 ‘Burst Types’

---------- Begin of text proposal ----------

5.2.2.1 Transmission of TFCI

Both burst types 1 and 2 for dedicated channels provide the possibility for transmission of TFCI both in up- and downlink.

The transmission of TFCI is negotiated at call setup and can be re-negotiated during the call. This means, it is indicated whether the TFCI is applied or not and how many bits are to be allocated for this purpose. If applied, transmission of TFCI is done in the data parts of the traffic burst. Hence the midamble structure and length is not changed. The TFCI information is to be transmitted directly adjacent to the midamble, possibly after the TPC. Figure 7 shows the position of the TFCI in a traffic burst, if no TPC is transmitted. Figure 8 shows the position of the TFCI in a traffic burst, if TPC is transmitted.

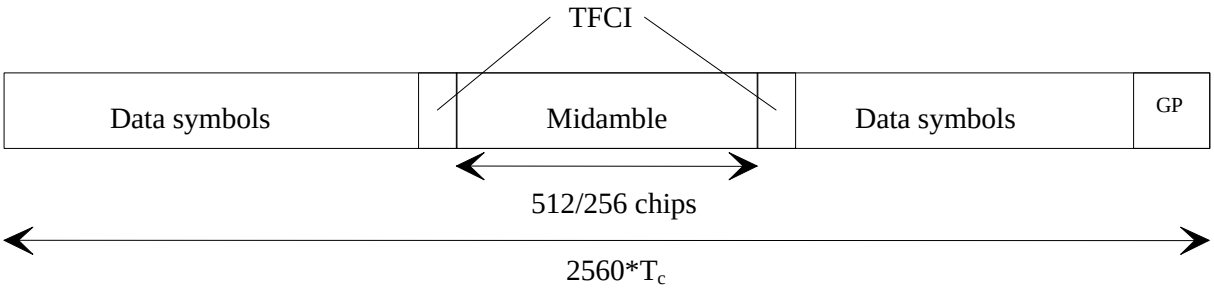

Figure 7 Position of TFCI information in the traffic burst in case of no TPC

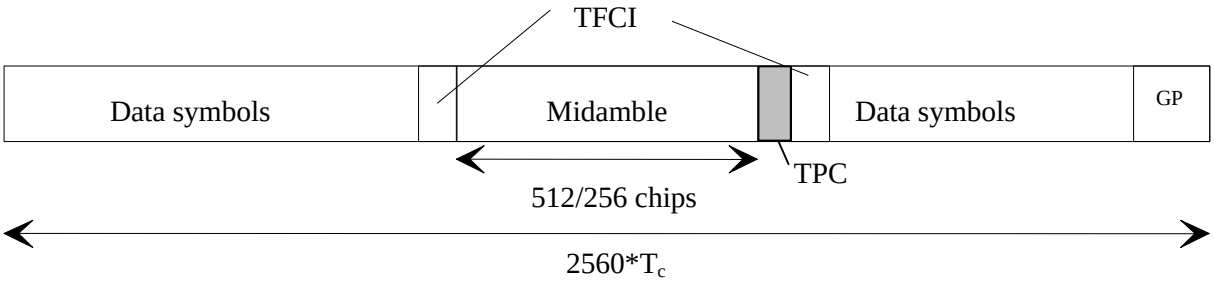

Figure 8 Position of TFCI information in the traffic burst in case of TPC

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5.2.2.2 Transmission of TPC

Both burst types 1 and 2 for dedicated channels provide the possibility for transmission of TPC in uplink.

The transmission of TPC is negotiated at call setup and can be re-negotiated during the call. If applied, transmission of TPC is done in the data parts of the traffic burst. Hence the midamble structure and length is not changed. The TPC information is to be transmitted directly after the midamble. Figure 9 shows the position of the TPC in a traffic burst.

For every user the TPC information is to be transmitted once per frame. The TPC is spread with the same spreading factor (SF) as the data parts. TPC and TFCI are always transmitted in the same physical channel.

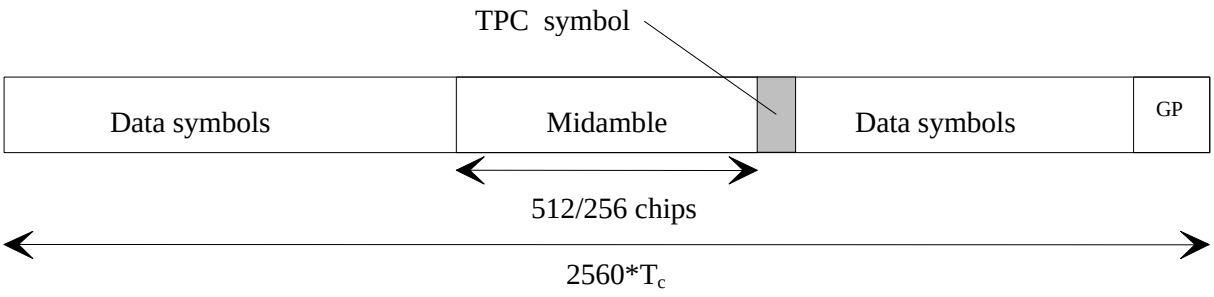

Figure 9 Position of TPC information in the traffic burst

---------- End of text proposal ----------

We propose to include the following new subsection into TS25.222 in section 6.3 “Coding for Layer 1 Control”

---------- Begin of text proposal ----------

6.3.3 Coding of Transmit Power Control (TPC)

The TPC command is an identifier sent in uplink transmission only, to instruct the NodeB whether Tx power has to be increased or decreased. The length of the TPC command is one symbol. The coding of the TPC command is shown in table 6.3.3-1.

Table 6.3.3-1 Coding of the TPC

TPC	TPC Bits	Meaning
‘Down’	00	Decrease Tx Power
‘Up’	11	Increase Tx Power

--- End of text proposal --