TSG-RAN Working Group1 meeting #3
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Agenda Item:

Source: **Panasonic, Siemens**

Title: **Text proposal for TDD power control**

Document for: **Decision**

Abstract

In the 3GPP S1.24 permanent document, two different descriptions of the TDD power control exist beside each other, originating from ARIB and ETSI. By adopting the main ideas of both descriptions, this document proposes a new uniform text, with respect to the characteristics of the TDD system, after the merge of ARIB and ETSI features.

Description of the text proposal

The proposed text is mainly based on the ARIB description. General parameters from ETSI with respect to the TDMA component of TDD are inserted in section 6.4.1. In the following downlink closed loop and for the uplink closed or open loop power control is described. Open loop power control is very fast and accurate in TDD, due to the reciprocity of the channel. The closed loop control enables a quality based power control, but has a longer control cycle than open loop control. The chapter about diversity handover (=soft handover) is deleted, since SHO is for further studies in TDD. The section about PC in packet mode is erased, since the power control uses the schemes described in 6.4.3 and 6.4.4 according the allocated channel, e.g. RACH, FACH or dedicated.
The stepsize is modified to 1-3dB, instead of 0.25-3 dB, in order to align with TSG RAN WG4.

Text proposal for 3GPP S1.24:

[6.4 Transmitter Power Control ~~(ETSI)~~

~~*<editor's note: the basic characteristics are the same for ETSI and ARIB. The description, however, is different and some section of ARIB TDD are for further study for ETSI TDD, like diversity handover.>*~~

6.4.1 General Parameters

Power control is applied for the TDD mode to limit the interference level within the system thus reducing the intercell interference level and to reduce the power consumption in the UE.

~~A slow C level based power control scheme (similar to GSM) is mandatory for both up and downlink. Open loop power control and the reference source for power measurements are under study. Power control is made, individually for each group of resource units (codes) in each slot which have a common TFCI, with the following characteristics:~~

Table -Error! Unknown switch argument.~~1~~**: TPC characteristics**

	Uplink	**Downlink**
Dynamic range	80 dB	30 dB

Power control rate	Variable: Closed Loop: 100-800 cycles / second Open Loop: 228,6 – 1600 cycles / second.	variable; Closed Loop: -100-800 cycles / second
Step size	[10.25 ... 3] dB	[10.25 ... 3] dB
Remarks	Closed Loop: worst case: 1 cycle=16 slots best case: 1 cycle=2 slots Open Loop: worst case: 1 cycle= 7 slots best case: 1 cycles= 1 slot All figures are without TPC decoding and received power measurements. ~~A cycle rate of 100 means that every frame the power level is controlled~~	within one timeslot the powers of all active codes may be balanced to within a range of [20] dB

- All codes within one timeslot allocated to the same bearer service use the same transmission power.
- ~~For RT services, in UL and DL a closed loop power control is used. UL open loop power control is under study~~
- ~~For NRT services, both open loop power control and closed loop power control are used according to the UE state and the operators' needs (similar to GPRS power control in GSM 03.64)~~
- ~~The initial power value is based on the pathloss estimate to the serving BS~~
- In case of one user with simultaneous RT and NRT bearer service, the closed loop power control is used both for RT and NRT bearer service. However, depending on the current services different power levels are used.

~~Optional enhancements concerning power control for further study:~~

- ~~Introduction of quality based power control~~

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6.4.1~~1~~2 ODMA Power Control

<for further study>

~~[6.4 Transmitter Power Control (ARIB 3.3.6.7)~~

~~*<The text in the ARIB FDD section, which is referred to, is based on the specific physical structure and timing. It might not be applicable for other channel structures. Also the figures in this chapter should be adapted in the future.>*~~

6.4.1~~1~~3 ~~Reverse link~~Uplink Control ~~(ARIB 3.3.6.7.1)~~

6.4.3~~1~~.1 Common Physical Channel

Transmission power of ~~perch channel~~ CCPCH ~~and reverse link interference power are~~ is transmitted using BC~~C~~H. Mobile station decides transmission power of RACH by open loop power control based on the information and the signal power level of the ~~Perch channel~~CCPCH.

6.4.1~~1~~3.2 Dedicated Physical Channel

The initial transmission power is decided in a similar manner as RACH. After the synchronisation between Node B~~BTS~~ and UE ~~MS~~ is established, ~~MS~~UE transits into ~~a combination scheme of~~ open-loop ~~and~~ or ~~fast~~ closed-loop transmitter power control (TPC).

UL Open Loop Power Control:

The UE measures the received signal power of the CCPCH, which is sent with a reference power. After this, the transmitter power is decided in order to compensate the measured pathloss.
This PC scheme provides very good compensation of fast fading, due to the short control cycle and the reciprocity of the TDD channel.

UL Closed Loop Power Control:
Fast closed-loop TPC is based on SIR, and the TPC processing procedures are the same as the FDD mode. During this power control process, the ~~BTS~~Node B periodically makes a comparison between the received SIR measurement value and the target SIR value. When the measured value is higher than the target SIR value, TPC bit = „0“. When this is lower than the target SIR value, TPC bit = „1“. ~~The TPC bits shall be transmitted continuously to the MS.~~ At the UE~~MS~~, soft decision on the TPC bits is performed, and when it is judged as „0“, the ~~target received~~mobile transmit power ~~at the BTS (P_{BTS})~~ shall be reduced by ~~P_{TPC2}dB~~the PC stepsize, whereas if it is judged as „1“, ~~P_{BTS}~~mobile transmit power shall be raised by ~~P_{TPC2}dB~~the PC stepsize.
~~The MS measures the received signal power of the perch channel, which is code multiplexed with the dedicated channel, at the previous forward link time slot. After this, the transmitter power is decided by the combination of open loop and closed loop transmitter power control based on the equation below:~~
An higher layer outer loop adjusts the target SIR. This scheme allowes quality based power control.

~~$T_{MS} = (P_{BTS} + P_{TPC2}) + (T_{BTS} - R_{MS})$~~
~~T_{MS}: Transmission power of MS~~
~~T_{BTS}: Transmitted signal power level of perch channel on BTS, which is broadcasted on BCH~~
~~P_{BTS}: Target received power on BTS~~
~~R_{MS}: Received power of Perch channel on MS~~

When the TPC bit cannot be received due to out-of-synchronisation, T_{MS} shall be kept at a constant value. When SIR measurement cannot be performed for being out-of-synchronisation, the TPC bit shall always be = „1“ during the period of being out-of-synchronisation.
~~Fig.3.3.6-3 shows reverse link transmitter power control timing. The combination power control of open loop with 1-slot control delay and closed loop with 2-slots control delay can be realised.~~

~~Fig.3.3.6-3 Reverse link transmitter power control timing~~

~~**6.4.1.2.1Outer Loop**~~
~~This is the same as FDD mode.~~

~~**6.4.1.2.2 Transmitter power control upon Inter-sector Diversity Handover**~~
~~This is the same as FDD mode.~~

~~6.4.1.3 Transmitter power control upon Inter-cell Diversity Handover~~

~~(a)BTS operations~~

~~This is the same as FDD mode.~~

~~(b)MS operations~~

~~Receives the TPC bits independently in BTS units(inter-sector handover is performed). At the same time, measures the reliability of the TPC bits(received SIR) for each BTS. If there is even one „0“ among the soft-decision majority result of TPC bits that satisfy the required reliability, the target received power on BTS(P_{BTS}) shall be reduced by P_{TPC}dB. If the TPC bits are all „1“, P_{BTS} shall be raised by P_{TPC}dB.~~

~~6.4.2~~4 ~~Forward link~~Downlink Control ~~(ARIB 3.3.6.7.2)~~

~~6.4.2.1 Perch Channel~~
~~This is the same as FDD mode.~~

6.4.~~2~~4.~~2~~1 Common Physical Channel

~~This is the same as FDD mode~~Common Physical Channels are not power controlled. The constant power is used as a reference for measurements.

6.4.~~2~~4.3 Dedicated Physical Channel

In principle, there is no restrictions on the initial transmission power of the ~~forward link~~Downlink Dedicated Physical Channel. After the initial transmission, the Node B~~BTS~~ transits into SIR-based ~~fast~~ closed-loop TPC as similar to the FDD mode.

The measurement of received SIR shall be carried out periodically at the ~~MS~~UE. When the measured value is higher than the target SIR value, TPC bit = „0“. When this is lower than the target SIR value, TPC bit = „1“. ~~2bits are transmitted continuously to the BTS.~~ At the BTS, soft decision on the TPC bits is performed, and when it is judged as „0“, the transmission power shall be reduced by PC stepsize~~P_{TPC1}dB~~, whereas if it is judged as „1“, the transmission power shall be raised by PC stepsize~~P_{TPC1}dB~~.

When the TPC bit cannot be received due to out-of-synchronisation, the transmission power value shall be kept at a constant value. When SIR measurement cannot be performed due to out-of-synchronisation, the TPC bit shall always be = „1“ during the period of being out-of-synchronisation.

An higher layer outer loop adjusts the target SIR.

~~Fig.3.3.6-4 shows forward link transmitter power control timing. The transmitter power control of closed loop with 2-slots control delay can be realised.~~

~~Fig.3.3.6-4 Forward link transmitter power control timing~~

~~6.4.3 Transmitter power control for Packet Data Transmission~~

~~Packet data transmission using the dedicated physical channels is always handled as a pair of reverse link and forward link as similar to the FDD mode.~~

~~Uplink common physical channel (RACH):~~

~~Open-loop transmitter power control is adopted.~~

~~Downlink common physical channel (FACH):~~

~~Transmission power is determined by the information transmitted on RACH, or fixed power.~~

~~Uplink dedicated physical channel (DCH):~~

~~Open-loop transmitter power control is applied basically. Fast closed-loop transmitter power control is combined with open-loop control. TPC bits in downlink dedicated physical channel are used for power control.~~

~~Downlink dedicated physical channel (DCH):~~

~~Fast closed-loop transmitter power control is adopted. TPC bits in the uplink dedicated physical channel are used.~~

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