3GPP TSG-RAN Working Group 1 Meeting No. 7
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Agenda Item:

Source: Siemens AG

Title: Common Channel Terminology in TDD Mode

Document for: Decision

Scope

In UTRA it is foreseen that every cell will have several Common Control Physical Channels (CCPCHs). Some of them have to support measurements and will have a predetermined position in TDD frame, others don't. In order to easily distinguish between both types of CCPCH this contribution proposes to introduce the term *Primary Common Control Physical Channel* (PCCPCH) for UTRA TDD mode.

Justification

In current TDD specification document TS25.221, the transport channels BCH, PCH and FACH can be mapped arbitrarily onto one or more common control physical channels (CCPCHs). But there are some reasons to distinguish between 'Primary'-CCPCHs and other CCPCHs:

- When initiating a network connection, a UE should know where to find the basic network information, i.e. where to find the BCH. Thus spreading code, timeslot and burst type of at least one CCPCH carrying the BCH have to be known.
- For a number of measurements an omnidirectional physical channel with constant power is required, i.e. some beacon functionality has to be provided. This is not supported by current CCPCH definition, as the FACH inside the CCPCH may use power control and beamforming.

For FDD mode, the former PCCPCH was recently redefined to support the usage of Common Pilot Channel (CPICH). As in TDD the purpose of a PCCPCH is different from a common pilot, we do not propose to use 'CPICH' in TDD case, but to stay with the term 'PCCPCH' in specification documents.

From the reasons shown above, we propose to adopt the term PCCPCH for a CCPCH which is

- designed to carry the BCH at a fixed, configurable position in frame and
- to be transmitted omnidirectionally and with reference power.

Additionally and as a clarification we propose not to use TFCIs in TDD CCPCHs and to use burst type 1. This will ease the network access for the user equipment.

Text proposal

In the text as given below the changes are elaborated for definition and usage of a PCCPCH. The changes apply to specification documents TS25.221 and TS25.224.

Conclusion

We propose to adopt the text from beyond to the according specification documents.

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5.3.1.2 Burst Types

The bursts type 1 as described in section 5.2.2 are is used for the downlink CCPCH. No TFCI is applied for CCPCHs.

5.3.1.3 Training sequences for spread bursts

The training sequences, i.e. midambles, as described in section 5.2.3are used for the downlink CCPCH.

5.3.1.4 Primary Common Control Physical Channels (PCCPCH)

A CCPCH is referred to as Primary Common Control Physical Channel (PCCPCH) if it is characterised by:

- Transmitted with reference power
- No beamforming
- Known position (timeslot, burst format and code) in frame. The position is known from the Synchronisation Channel (SCH), see section 5.4.
- Carrying BCH

If another physical channel is allocated to the same code and same timeslot as a PCCPCH, i.e. the same resource unit is used in a multiframe pattern, then this channel has also to use reference power and no beamforming can be applied.

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5.4 The physical synchronisation channel (PSCH)

The PSCH is similar to the FDD SCH, where the code group of a cell can be derived when decoding the FDD synchronisation channel. In TDD mode additional information, received from higher layers on SCH transport channel, is transmitted to the UE in PSCH in case 3 from below. In order not to limit the uplink/downlink asymmetry the PSCH is mapped on one or two downlink slots per frame only.

There are three cases of PSCH and PCCPCH allocation as follows:

Case 1) PSCH and PCCPCH allocated in TS#k, k=0….14

Case 2) PSCH in two TS k und k+8 and PCCPCH in the same two TS: TS#k and TS#k+8, k=0…6

Case 3) PSCH in two TS, TS#k and TS#k+8, k=0…6, and the Pprimary CCPCH in TS#i, i=0…14, pointed by PSCH. Pointing is determined via the SCH from the higher layers.

These three cases are addressed by higher layers using the SCCH in TDD Mode. The position of PSCH (value of k) in frame can change on a long term basis in any case.

Due to this PSCH scheme, the position of PCCPCH is known from the PSCH. The PCCPCH are using burst type 1, spreading code $a_{Q=16}^{(k=1)}$ and midamble $m_1^{(1)}$. To simplify measurements of PCCPCH power, this midamble shall not be used by other physical channels in the same timeslot.

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6.2.1 The Broadcast Channel (BCH)

The BCH is mapped on one or several CCPCHRU per frame. The secondary SCH indicates in which timeslot and code group a mobile can find the PCCPCH containing BCH. If the BCH uses more resources than PCCPCH, the BCH in PCCPCH comprises a pointer to additional CCPCH resources for BCH. than one RU, the secondary SCH comprises a pointer to the whole BCH mapping scheme or only to the primary BCH RU and this comprises a pointer to secondary BCH RU. The BCH has a reference power level. The RU allocated by BCH can be shared with other common control channels, e.g. PCH or FACH, according to a multi-frame structure.

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4.3.3.1 Common Physical Channel

The transmitter power of UE shall be calculated by the following equation:

$$P_{PRACH} = L_{PCCPCH} + I_{BTS} + \text{Constant value}$$

where, P_{PRACH} : transmitter power level in dBm,

L_{PCCPCH}: measured path loss in dB (transmit power is broadcasted on BCH),

I_{BTS}: interference signal power level at cell's receiver in dBm, which is broadcasted on BCH

Constant value: This value shall be set via Layer 3 message (operator matter).

4.3.3.2 Dedicated Physical Channel

The initial transmission power is decided in a similar manner as PRACH. After the synchronisation between nodeB and UE is established, the UE transits into open-loop or closed-loop transmitter power control (TPC).

UL Open Loop Power Control:

The transmitter power of UE shall be calculated by the following equation:

$$P_{UE} = \alpha L_{PCCPCH} + (1-\alpha) L_0 + I_{BTS} + SIR_{TARGET} + \text{Constant value}$$

Where, P_{UE} : transmitter power level in dBm,

L_{PCCPCH}: measure representing path loss in dB (reference transmit power is broadcast on BCH).

L_0: Long term average of path loss in dB

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4.3.4.1 Common Physical Channel

The pPrimary CCPCH transmit power can be changed based on network determination on a slow basis. The exact power of PCCPCH is signaled on the BCH on a periodic basis.

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4.5 Synchronisation and Cell Search Procedures

4.5.1 Cell Search

During the initial cell search, the UE searches for a cell. It then determines the midamble, the downlink scrambling code and frame synchronisation of that cell. The initial cell search uses the Physical Synchronisation Channel (PSCH) described in S1.21. The generation of synchronisation codes is described in S1.23

This initial cell search is carried out in three steps:

Step 1: Slot synchronisation

During the first step of the initial cell search procedure the UE uses the primary synchronisation code c_p to acquire slot synchronisation to the strongest cell. Furthermore, frame synchronisation with the uncertainty of 1 out of 2 is obtained in this step. A single matched filter (or any similar device) is used for this purpose, that is matched to the primary synchronisation code which is common to all cells. The procedure is according to the description for the FDD mode in S1.14.

Step 2: Frame synchronisation and code-group identification

The Step 2 is described for the case where PSCH and PCCPCH are in timeslot k and k+8 with k=0…6.

During the second step of the initial cell search procedure, the UE uses the sequence of Secondary Synchronisation Codes to find frame synchronisation and identify one of 32 code groups. Each code group is linked to a specific t_{Offset}, thus to a specific frame timing, and is containing 4 specific scrambling codes. Each scrambling code is associated with a specific short and long basic midamble code.

The detection of secondary synchronisation sequence is done by correlating the received signal at the positions of the Secondary Synchronisation Code with all possible sequences of Secondary Synchronisation Codes, similar to FDD Mode. After four frames a sequence of eight codes is available providing all necessary information described above. Nevertheless, it should be noted that due to the special coding already three codes show the sequence unambiguously, i.e. a UE can determine the whole sequence when three codes have been received.

Step 3: Scrambling code identification

During the third and last step of the initial cell-search procedure, the UE determines the exact basic midamble code and the accompanying scrambling code used by the found cell. They are identified through correlation over the PCCPCH with all four midambles of the code group identified in the second step . Thus the third step is a one out of four decision.

This step is taking into account that the PCCPCH containing the BCH is transmitted using the first spreading code ($a_{Q=16}^{(k=1)}$ in figure 2 of S1.23 section ‘6.2 Spreading Codes’) and using the first midamble $\mathbf{m}^{(1)}$ (derived from basic midamble code $\mathbf{m}_P$, cf. S1.21 section ‘7.2.3 Training sequences for spread bursts’). Thus CCPCH code and midamble can be immediately derived when knowing scrambling code and basic midamble code.

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