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Agenda Item: AH21

Source: Siemens AG

To: TSG RAN WG1

Title: Description of the FPACH

Document for: Decision

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1. Summary

The 1.28 Mcps TDD option has different a random access procedure as in 3.84 Mcps TDD. The FPACH is used in 1.28 Mcps TDD option only by the Node B to answer the SYNC-UL to the UE. This paper is an update of R1-01-0091 with the information regarding the random access procedure being removed.

2. Introduction

The SYNC-UL sequence in UpPCH is used for the initial uplink synchronisation and power control as well as indicating the UEs wish to have a random access. The UE randomly selects one of the 8 possible SYNC-UL signatures of the cell it wants to access to and sends it on the UpPCH physical channel.

Then the UE determines the timing and the Tx power level (open loop procedure) for the UpPCH and transmits the selected signature on the UpPCH.

Once the Node B detects the UpPCH transmission from an UE, the arrival time and the received interference power on the PRACH are known. The Node B determines the transmit power command and received timing position and sends them to the UE within the next four frames through the FPACH (in a single burst/sub-frame message) to acknowledge the UpPCH signature. Note that the FPACH also contains the signature reference (the used UpPCH signature) and the relative sub-frame number (number of sub-frames passed after the reception of the acknowledged signature) in order to allow the UEs to identify that the FPACH message is the response to their UpPCH.

Once the UE receives the above mentioned physical signalling from the chosen FPACH (i.e. the FPACH which is associated to the selected signature), its UpPCH sequence has been accepted by the Node B. Then the UE will readjust its timing and power level and send the RACH on the PRACH channel corresponding to the FPACH exactly two frames later. In this step, the RACH sent to Node B by UE will have high synchronisation precision.

3. Proposal

We propose to add following paragraphs in the working CR for TS25.221 as the description and content of FPACH in the 1.28Mcps TDD option.

---------- Beginning of text proposal for working CR for 25.221 ----------

6.3.3 Forward Physical Access CHannel (FPACH)

The Forward Physical Access CHannel (FPACH) is used by the Node B to carry, in a single burst, the acknowledgement of a detected signature with timing and power level adjustment indication to a user equipment.

FPACH makes use of one resource unit only at spreading factor 16, so that its burst is composed by 44 symbols. The spreading code, training sequence and time slot position are configured by the network and signalled on the BCH.

6.3.3.1 FPACH burst

The FPACH burst contains 32 information bits.

Table X reports the content description of the FPACH information bits and their priority order.

Table X: FPACH information bits description

Information field	**Length (in bits)**
Signature Reference Number	3 (MSB)
Relative Sub-Frame Number	2
Received starting position of the UpPCH ($UpPCH_{POS}$)	11
Transmit Power Level Command for RACH message	7
Reserved bits (default value: 0)	9 (LSB)

In the use and ~~gereation~~generation of the ~~infotmation~~information fields is explained in TS25.224 sub-clause 5.6.2.1~~xxx~~

6.3.3.1.1 Signature Reference Number

~~The *Signature Reference Number* field contains the number of the acknowledged signature.~~

The reported number corresponds to the numbering principle for the cell signatures as described in sub-clause 9.3.

~~The user equipment shall use this information to verify whether it is the recipient of the FPACH message.~~

The Signature Reference Number value range is 0 – 7 coded in 3 bits such that:

bit sequence(0 0 0) corresponds to the first signature of the cell; …; bit sequence (1 1 1) corresponds to the 8^{th} signature of the cell.

6.3.3.1.2 Relative Sub-Frame Number

The *Relative Sub-Frame Number* field indicates the current sub-frame number with respect to the sub-frame at which the acknowledged signature has been detected.

The user equipment shall use this information to verify whether it is the recipient of the FPACH message.

The Relative Sub-Frame Number value range is 0 – 3 coded such that:

bit sequence (0 0) indicates one sub-frame difference; …; bit sequence (1 1) indicates 4 sub-frame difference.

6.3.3.1.3 Received starting position of the UpPCH (UpPCH$_{POS}$)

The received starting position of the UpPCH value range is 0 – 2047 coded such that:

bit sequence (0 0 … 0 0 0) indicates the received starting position zero chip; …; bit sequence (1 1 … 1 1 1) indicates the received starting position 2047*1/8 chip.

The *received starting position of the UpPCH (UpPCH$_{POS}$)* field indirectly indicates to the user equipment the timing adjustment it has to implement for the following transmission to the network. The network computes the proper value for this parameter, based on the correlation instant to the acknowledged signature from the UpPCH according to the following rules:

$$UpPCH_{POS} = UpPTS_{Rxpath} - UpPTS_{TS}$$

where

$UpPTS_{Rxpath}$: time of the reception in the Node B of the SYNC_UL to be used in the uplink synchronization process

$UpPTS_{TS}$: time instance two symbols prior to the end of the DwPCH according to the Node B internal timing

This information shall be used by the UE to adjust its timing when accessing the network.

The UE can use the *received starting position of the UpPCH (UpPCH$_{POS}$)* to estimate the propagation delay ($T_{propagation\ delay}$) according to the following law:

$$T_{propagation\ delay} = (UpPCH_{adv} + UpPCH_{POS} - 8*16\ T_c)/2$$

where:

- $UpPCH_{adv}$ is the difference between the RX timing (received DL at UE) and initial TX timing (transmitted UL at UE) of a UE for UpPCH transmission (timing advance of the UpPCH);
- T_c is the Time chip duration.

The timing advance for the RACH $RACH_{ADV}$ is $2* T_{propagation\ delay}$.

6.3.3.1.4 Transmit Power Level Command for the RACH message

The transmit power level command value range is –120 (0000000), …, -80 (1010000) dBm in 0.5 dB steps. The transmit power level command is transmitted in 7 bits.

~~This field indicates to the user equipment the power level to use for the RACH message transmission on the FPACH associated P-RACH.~~

~~The network sets this value based on the measured interference level (I) (in dBm) on the specific PRACH and on the desired signal to interference ratio (SIR) (in dB) on this channel as follows:~~

~~*Transmit Power Level Command for the PRACH = SIR + I - Z*~~

~~where Z is a corrective constant taking into account some receiver parameters like for example the antenna gain.~~

~~The UE shall add to this value the estimated path loss to compute the power level to transmit for the PRACH.~~

6.3.3.2 FPACH Spreading

The FPACH uses only spreading factor SF=16 as described in subclause 6.2.1.1. The set of admissible spreading codes for use on the FPACH are broadcast on the BCH (within the FPACH configuration parameters on the BCH).

6.3.3.2 FPACH Burst Format

The burst format as described in section 6.2.2 is used for the FPACH.

6.3.3.3 FPACH Training sequences

The training sequences, i.e. midambles, of different users active in the same time slot are time shifted versions of a single periodic basic code. The basic midamble codes as described in the subclause about midamble generation are used for FPACH.

6.3.3.4 FPACH timeslot formats

The FPACH uses slot format #0 of the DL time slot formats given in subclause 6.2.2.4.1.1.

6.3.~~3~~4 The physical random access channel (PRACH)

---------- End of text proposal for working CR for 25.221 ----------