TSG-RAN Working Group 1 ***TSG R1#7(99)B95***

Hannover, Germany, 30 August – 03 September 1999

Agenda Item:

Source: CCL/ITRI

Title: Support of MAC Procedures for CPCH in the Physical Layer

Document for: Discussion and Decision/Information

Abstract: This contribution describes physical layer support for the MAC procedures for random packet data access over CPCH. The MAC scheme is described in TSG R1#7(99)B03.

1. Introduction

This document describes the physical layer support for MAC procedures for CPCH. Transmission of padding and AICH mapping for code assignment bitmap are specified in detail.

2. RACH Transmission

The MAC procedures involves transmission of :

1. preamble,

2. 16-bit padding,

3. code-assignment bitmap, and

4. message part.

The timing diagram of the random-access transmission is shown in Figure 1.

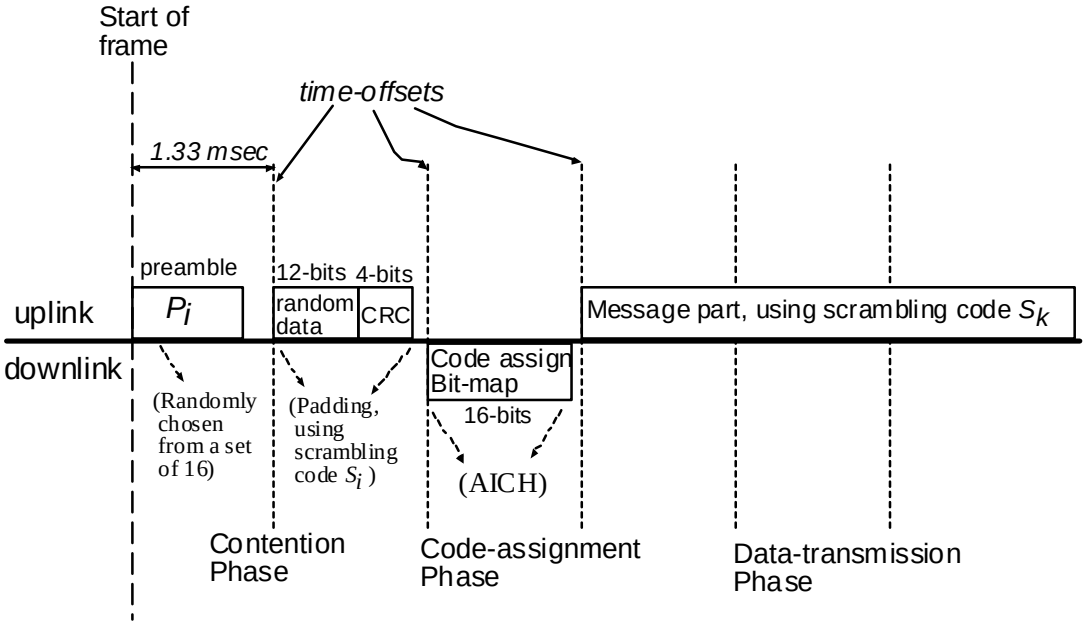

Figure 1. The timing diagram of the MAC protocol.

2.1 Preamble

An UE choose a time-offset and transmit its preamble code in the contention phase. The preamble consists of 256 repetitions of a signature, which is comprised of 16 complex symbols ±1(+j). The preamble is the same with the preamble part of the random-access burst. See TS 25.211 for more details.

2.2 16-bit padding

Figure 2 shows the structure of the 16-bit padding. Each padding consists of two parts, a data part that carries padding information and a control part that carries pilot bits. The data and control parts are transmitted in parallel.

The data part consists of 16 bits. The spreading factor of the data part is 256. This corresponds to a total length of 16*256 = 4096 chips.

The control part consists of 16 known pilot bits to support channel estimation for coherent detection. The spreading factor of the control part is 256. This corresponds to the same total length of 4096 chips. The 16 pilot bits are block repetition of two identical 8-bit pilot used in uplink DPCCH (see TS 25.211 for more detail).

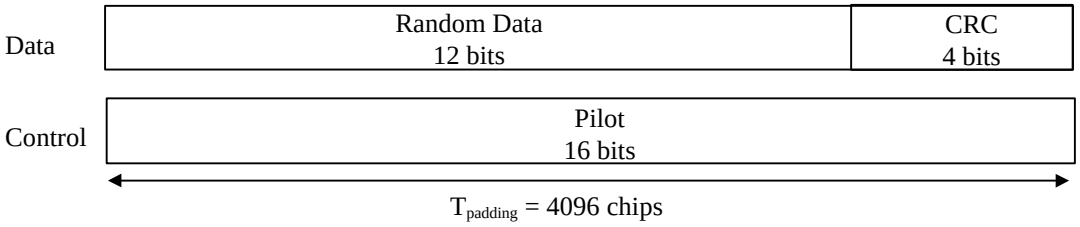

Figure 2: Structure of the 16-bit padding.

The signature in the preamble specifies one of the 16 nodes in the code-tree that corresponds to channelization codes of length 16, as shown in Figure 3. The sub-tree below the specified node is used for spreading of the message part. The control (Q-branch) is spread with the channelization code of spreading factor 256 in the lowest branch of the sub-tree. The data part (I-branch) is spread with the channelization code of spreading factor 256 in the upper-most branch of the sub-tree.

In addition to spreading, the padding is also subject to scrambling with a 4096 chip complex code. The scrambling code for the padding is cell-specific and has a one-to-one correspondence to the spreading code used for the preamble. This corresponds to sixteen scrambling codes for each cell. The scrambling codes used are the same set of codes as is used for the other dedicated uplink channels when the long scrambling codes are used for these channels. The first 256 of the long scrambling codes are used for the random access channel. The phases 4096..8191 of the codes are used for the padding (phases 0..4095 of c_1 are used in preamble spreading) with the chip rate of 3.84 Mchips/s (See TS 25.213 for detail description of these codes).

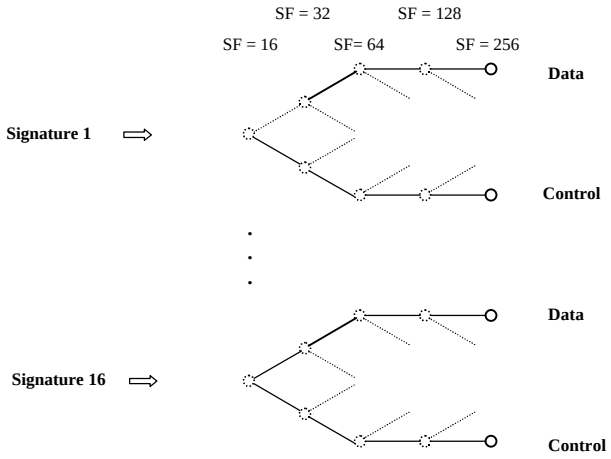

Figure 3: Channelization codes for the 16-bit padding

2.3 Code-assignment bitmap

A code-assignment bitmap is used for advertising the successful attempts in the contention phase of the MAC procedures. Sixteen Acquisition Indicators (AI_i, i = 1..16) in the the Acquisition Indicator channel (AICH) corresponds to notification of up to sixteen random access attempts in an access slot. Each AI_i represents one of three statuses: AI_i = +1 for successful attempt, AI_i = -1 for failure attempt and AI_i = 0 for no attempt. Sixteen AI_i can be transmitted simultaneously by 16 orthogonal code words w_1-w_{16}. See TS 25.211, Section 5.3.3.7 for detail description of the structure of AICH.

2.4 Message part

The structure and channelization code selection of the random-access message part is identical to those described in TS25.211 and TS25.213. The scrambling codes used are the same set of codes as is used for the other dedicated uplink channels when the long scrambling codes are used for these channels. The first 256 of the long scrambling codes are used for the random access channel. The phases 8192..46591 of the codes are used for the message part (phases 0..4095 of c_1 are used in preamble spreading and phases 4096..8191 are used in 16-bit padding scrambling) with the chip rate of 3.84 Mchips/s (See TS 25.213 for detail description of these codes).

3 Summary of the Proposal

The following items are physical layer modification for support of the MAC procedures:

1. 16-bit padding transmission:

   (a) padding information is transmitted in the data part (I-branch) and 16-bit pilot is transmitted in the control part (Q-branch).

(b) spreading factor is 256 for both data part and control part. Spreading and scrambling mechanisms are the same as those in the random access message part.

(c) the scrambling codes used are from the same set of the first 256 long scrambling codes for the random access channel, with code phases (4096..8191)

2. Code-assign bitmap transmission: AICH is used for code-assign bitmap transmission.

3. Message part transmission: the scrambling codes used are from the same set of the first 256 long scrambling codes for the random access channel, with different code phases (8192..46591) from those described in TS 25.213 V2.1.2 (where code phases 4096..42496 are used).

The proposal involves only minor modification in the physical layer in order to support the elegant MAC procedures with graceful implementation complexity.