**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) | |
| Title | **Text for CID resolutions on D1** | |
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| Source | Bober, Kai Lennert Fraunhofer HHI | Voice: [ ] Fax: [ ] E-mail: [ ] |
| Re: |  | |
| Abstract | This document contains text updates for the resolution of CIDs on draft 1.0 | |
| Purpose | Aid comment resolution | |
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The following clauses contain resolutions for some CIDs.

Text in red is an instruction to the technical editor, how to implement the resolution.

# CID 53

Change the sentence in P49L8-9 as follows:

The transmission of multi-OFE pilots of a single PPDU transmitted over multiple OFEs shall be synchronized with an accuracy of *aPhyOfeSyncAccuracy* at each OFE.

Add a new PHY constant *aPhyOfeSyncAccuracy* to the PM-PHY as follows:

**Description:** The required synchronization-accuracy of the OFEs if the coordinator has multiple OFEs.

**Value:** 640

**Unit:** ns

Add a new PHY constant *aPhyOfeSyncAccuracy* to the HB-PHY as follows:

**Description:** The required synchronization-accuracy of the OFEs if the coordinator has multiple OFEs.

**Value:** 640

**Unit:** ns

# CID 477

Change figure 46 as follows:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| bits 0-7 | bits 8-10 | bit 11 | bits 12-19 | bits 20-23 | octets 3-4 | octet 5-6 | variable | | |
| Number of  OFEs (N) | Tap  Format | reserved | Integer Noise Floor | Fractional Noise Floor | Superframe Number | Slot Number | OFE feedback  descriptor  element 1 | … | OFE feedback  descriptor  element N |

Replace the text in P64L4-L6 by:

**Tap Format:** This field describes the format for taps included in the child *Tap Descriptor* elements. The values for *Tap Format* are listed in Table 47. For each tap format, the interpretation of the *Strength* and *Delay* fields of the child *OFE Feedback Descriptor* elements is specified.

For Strength, the value 0 corresponds to the given lowest signal over noise value with respect to the noise floor value, contained in the *Integer Noise Floor* and *Fractional Noise Floor* fields. Each bit of the strength value, the indicated value of Step is added to the Lowest signal over noise value.

For the delay, the value 0 corresponds to the first tap. For each bit of the Delay value, the delay value is incremented by the Step value.

Table 47 Tap formats in the Multi-OFE Feedback element

|  |  |  |
| --- | --- | --- |
| Value | Strength | Delay |
| 0000 | |  |  | | --- | --- | | Bits: | 10 | | Lowest signal over noise: | -20 dB | | Step: | 0.1 dB | | |  |  | | --- | --- | | Bits: | 14 | | First tap: | 0 ps | | Step: | 100 ps | |
| 0001-1111 | reserved | reserved |

**Integer Noise Floor:** The integer part of the measured noise floor in dBm. The values are signed integers, ranging from -128 dBm to 127 dBm.

**Fractional Noise Floor:** The fractional part of the measured noise floor in dBm. Only the values 0 to 9 shall be used.

**Superframe Number:** This field contains the beacon number of the superframe, in which the channel for multiple OFEs was estimated.

**Slot Number:** This field contains the superframe slot number in which the channel for multiple OFEs was estimated. The slot number shall be the one in which the first sample of the PPDU was received.

# CID 175

Change figure 71 as follows:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Preamble** | **Header Channel Estimation** | **PHY header** | **HCS** | **MIMO PS** | **Payload Channel Estimation** | **PSDU** |
| **SHR** | | **PHR** | | | |

**Figure 71 PPDU format for PM-PHY**

Replace the text in subclause 10.3.1.2 Channel estimation with the following text:

**Header Channel Estimation**

Channel estimation is needed for equalization and subsequent detection of header information and data. Although defined in the time domain, the header channel estimation sequence allows frequency-domain equalization and hence consists of a base sequence and a cyclic prefix.

As channel estimation sequence, a specific pseudo-noise sequence **A64**, given in B.2 is used. The channel estimation sequence is transmitted with an OCR of 12.5 MHz. The channel estimation part of the SHR shall have a long cyclic prefix.

Replace P92L14-P93L5 with the following:

The PHY header consists of the fields given in Figure 48.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **2 octets** | **1 bit** | **1 bit** | **3 bits** | **4 bits** | **1 octet** |
| PSDU  Length | Short  CP | SI | MIMO PS Num | reserved | MCS ID |

**Figure 48 Fields in the PHY header**

The **PSDU Length** scales from 0 up to *aPhyMaxPsduSize* and contains the length of the PSDU in octets.

**Short CP** indicates whether a short cyclic prefix applies to the payload and payload channel estimation. If Short CP = 0, the subsequent payload and payload channel estimation field shall have a long cyclic prefix. If Short CP = 1, the subsequent payload and payload channel estimation field shall have a short cyclic prefix.

If OCR ID > 0 is used, repeat the PS Nseq / 64 times, where Nseq is obtained from Table 50 for the given OCR ID.

**SI** contains the initialization data for the payload scrambler as defined in 11.4.1.2.

**MIMO PS Num** specifies the number of MIMO PS trailing the PHY header. The sequence index for the specific PS to be used is incremented from 1 to NPS in steps of 1.

The **MCS ID** specifies the MCS used for the payload and is constructed as described in 9.3.3.

Replace P93L9-22 with the following:

**10.3.2.3 MIMO PS**

MIMO PS are pilot symbols for MIMO channel estimation. For MIMO PS, repetitions, FEC, line coding and HCS do not apply. The number of sent MIMO PS depends on the *MIMO PS Num* field of the PHR.

MIMO PSs are orthogonal in the time domain and constructed as follows. For the ith data stream/OFE, respectively, PS use the *i*th row of the NxN Hadamard matrix **H**K where N = 2K = 64 and K = 6.

The value of *i* is used to identify the specific OFE and defined by the MAC via the PHY SAP. Matrix **H**K is obtained iteratively by incrementing k from k=1…K as



The elements of the resulting sequence are mapped from (-1, +1) to (0, 1). Next, the sequence is scrambled symbol-wise by logical XOR operation with the base sequence **AN**.

Depending on the OCR, the resulting sequence is repeated by Nseq / 64 where Nseq can be obtained from Table 50 for each OCR. A long cyclic prefix is finally inserted, with length NCP from Table 50.[[1]](#footnote-1)

**10.3.2.4 Payload Channel Estimation**

The Payload Channel Estimation field contains reference data for the payload equalizer. It is required if the payload of the PPDU is transmitted with a different OCR than the PHR. The Payload Channel Estimation field shall be transmitted with the same OCR as the payload.

Measured in time units, the time durations the base sequence Tseq and the duration of the cyclic prefix TCP are maintained independent of the OCR. By increasing OCR, the number of clock cycles for the sequence and for the cyclic prefix, i.e., Nseq and NCP, respectively, increase proportionally, as defined in Table 49.

As channel estimation sequence, a specific pseudo-noise sequence **A**N given in B.2 is used having variable length N=2k (k=5 … 11), depending on the OCR so that N=Nseq as defined in Table 49. The channel estimation sequence is finally passed through a 2-PAM modulator.

1. All sequences in **H**K are mutually orthogonal. The XOR operation with **A**N does not change the orthogonality of sequences but improves cross-correlation properties which is beneficial in case of multi-path as described by Jungnickel [B1], [B10]. Note that the sequence for the first stream or transmitter just contains **A**N [↑](#footnote-ref-1)