**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) |
| Title | **D4 Comment resolution instructions** |
| Date Submitted | 20 July 2021 |
| Source | Bober, Kai LennertFraunhofer HHI | Voice: -Fax: -E-mail: bober@ieee.org |
| Re: | Comment resolution on D4 |
| Abstract | This document contains proposed resolutions for CIDs on D4.0 |
| Purpose | Aid comment resolution |
| Notice | This document has been prepared to assist the IEEE P802.15. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein. |
| Release | The contributor acknowledges and accepts that this contribution becomes the property of IEEE and may be made publicly available by P802.15. |

**Legend:**

* Arial size 13 indicates subsections for individual comments
* Red underlined text needs to be adapted during the comment implementation (e.g. because it is a reference).
* Bold italic text is an instruction to the editor to implement the text

CID A-19

***Remove the definition of HCM on page 20***

***Remove the following text from P27L28-31:***

, M-ary pulse amplitude modulation (PAM) with Hadamard-coded modulation (HCM) without the all-ones code

***Change P28L17-19 as follows:***

Binary pulse-amplitude modulation (2-PAM) with 8B10B line coding, as defined in 9.3.5 is supported. It is combined with Reed-Solomon (RS) forward error correction (FEC) to correct errors due to the noise.

***Remove HCM Allocation element from Table 4 Control frame subtypes.***

***Remove 6.6.17 HCM Allocation element and renumber the subsequent clauses.***

***Change 6.6.20 as follows:***

**6.6.20 PM-PHY MCS element**

The *PM-PHY MCS* element, shown in 0, holds a subset of supported MCS for the PM-PHY.

|  |
| --- |
| **1 Octet** |
| ClockRates |

**PM-PHY MCS element**

**Clock Rates:** A bitmap indicating the set of supported clock rates. Reserved bits shall be set to zero. A one in the bitmap indicates that the given clock rate is supported. A zero indicates that the clock rate is not supported. 0 shows the bitmap structure.

|  |  |  |
| --- | --- | --- |
|  | processedfirst | processed last  |
| 1. **Bit in the bitmap:**
 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1. **Clock rate:**
 | 12.5 MHz | 25 MHz | 50 MHz | 100 MHz | 200 MHz | reserved | reserved | reserved |

**Clock rate bitmap**

***Remove entry 13 HCM Allocation from table 12***

***Remove capHcm from table 37***

***Replace the sentence “PM-PHY enables moderate data rates from 1 Mb/s to some 100 Mb/s.” with:***

PM-PHY enables moderate data rates up to around 100 Mb/s.

***Change the sentences on P103L7-11 as follows:***

2-PAM with 8B10B line coding and RS FEC is used. The PM-PHY includes means to adapt the data rate of the link to varying channel conditions by varying the clock rate on a per PPDU basis.

***Change table 39 as follows:***

* ***Modulation: 2-PAM***
* ***Line Coding: 8B10B***
* ***Replace “Data rates with 2-PAM and 8b10b” with “Data rates”***
* ***Remove the “Min” column”***

***Replace the text on P103L15-16 with***

The base MCS for the PM-PHY use a 12.5 MHz clock rate.

***Change the sentence in P104L12 as follows:***

PPDU header fields that contain numbers shall be transmitted starting with the LSB of the number first to the MSB of the number last.

***Remove “independent of the clock rate” in P104L16.***

***Change P104L19 as follows:***

The second section is intended for channel estimation and synchronization. It enables cross- and autocorrelation with an appropriate window size.

NOTE – The general approach has been described by Schmidl and Cox [B12], Minn et al. [B3], Schellmann et al. [B10] and Goroshko et al. [B9].

For the preamble, the base sequence A8, a specific pseudo-noise sequence of length eight is used, as defined in B.2. A8 is repeated six times yielding a total sequence length of $N=48$ Each base sequence of length eight is multiplied with positive or negative sign as given below which is known to create a sharper peak after autocorrelation, compared to a double sequence of the same total length as described by Goroshko [B9]. The total preamble reads [A8 A8 A8 A8 A8 A8] where $x = 1 - x$ for elements of the sequence. The preamble is finally passed through the 2-PAM Modulator.

***Remove table 41.***

***Delete “data stream /” in P106L7***

***Remove “The MCS ID is composed as depicted in Figure 75.” in P107L12-13***

***Remove figure 75***

***Change text in P107L15-L20 as follows:***

MCSs are defined by the applied clock rate. The Clock Rate ID describes the used clock rate as defined in Table 43. The data rate for each MCS can be derived based on the corresponding clock rate and cyclic prefix duration. For instance, using RS(256,248) with 2-PAM, 8B10B and clock rate 12.5 MHz yields 9.6 Mb/s.

Table X ***(TE: adapt number)*** defines the relationship between MCS ID and clock rate.

***Insert a new table X at the end of subclause 9.2.5 as follows:***

***Create two columns MCS ID, Clock rate***

***Insert a row: MCS ID 0, Clock rate 12.5 MHz***

***Insert a row: MCS ID 1, Clock rate 25 MHz***

***Insert a row: MCS ID 2, Clock rate 50 MHz***

***Insert a row: MCS ID 3, Clock rate 100 MHz***

***Insert a row: MCS ID 4, Clock rate 200 MHz***

***Change “Channel estimation sequence, defined in B.2” to “Payload Channel estimation sequence, defined in B.2” in table 43.***

***Remove “For specific MCS, only a subset of the blocks may be used.” in P107L25.***

***Replace figure 76 with the following figure:***

***Change the text in P108L3-14 as follows:***

Header or payload data enters the transmitter and is scrambled in order to randomize uncoordinated interference. 8B10B line coding is applied as the second step. For FEC, the payload uses RS(256, 248) and the header uses RS(36, 24).

NOTE - According to Ivry [B4] and Boada [B5], a particular order of line and channel coding shown in Figure 76 achieves lowest error rates. After FEC, only the systematic part of the binary output code word (248 bits) is well balanced.

For maintaining a constant average light output, also the redundant part of the binary code word (360 – 240 = 120 bits in case of header data and 2560-2480 = 80 bits in case of payload data) passes through 8B10B line encoder. Both parts are concatenated again in a multiplexer. Subsequently, 2-PAM bit-to-symbol mapping is applied for the header.

***Remove the column Clock Rate ID in table 43***

***Remove P109L17-19.***

***Change text in P109L21-P110L2 as follows:***

The bit-to-symbol mapper is using PAM with two levels. For two levels, each input bit is mapped in one symbol. The symbols are mapped to levels as {0, 1} to {0, 1}, respectively.

***Remove table 44***

***Remove 9.3.7.***

***Remove Annex B.4***

***Remove Annex C.1***

CID I-13 / I-191 / I-9 / A-20

Replace figure 85 with the following graphic:

CID I-32 (PICS)

Insert the following new Annex and insert the correct references.

Annex D

(normative)

Protocol implementation conformance statement (PICS) proforma

D.1 Introduction

This annex contains the PICS for IEEE Std 802.15.13. Its purpose is to provide a statement about the implemented capabilities and options in a given entity. Vendors shall complete the following PICS based on their entity claimed to comply with IEEE Std 802.15.13.

D.2 Format and completion of the PICS

The PICS consists of multiple tables that list the available capabilities and options of the standard. Each Table describes a functional module of the standard and the individual features thereof.

For each feature, an item number, item description and reference to the relevant clause in the standard document is given. The status column indicates whether a feature is mandatory or optional.

The support column is for the convenience of completion and allows to indicate the presence of a feature in a tested entity.

O Optional

O.n Optional, but support of at least one of the group of options labeled O.n is required.

N/A Not applicable

“item” Conditional, status dependent upon the support marked for the “item.”

For example, “FD1: M” indicates that the status is mandatory if the protocol feature item FD1 is implemented.

D.3 Capabilities and options

Table D+1 Device types

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| DT1 | The entity is device-capable. |  | M |  |  |  |
| DT2 | The entity is coordinator-capable. |  | O |  |  |  |

Table D+2 General device functions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| GDF1 | The entity is able to transmit an MPDU. |  | M |  |  |  |
| GDF2 | The entity is able to receive an MPDU. |  | M |  |  |  |
| GDF3 | The entity is able to handle generation and parsing of MPDU format version zero. |  | M |  |  |  |
| GDF4 | The entity is able to perform an association request, parse an association response and retry the request when required. |  | M |  |  |  |
| GDF5 | The entity is able to scan for active OWPANs. |  | M |  |  |  |
| GDF6 | The entity is able to disassociate from an OWPAN. |  | M |  |  |  |

Table D+3 Beacon-enabled channel access

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| BECA1 | The entity is able to generate and transmit beacon frames when a new superframe starts. |  | O |  |  |  |
| BECA1.1 | The entity is able to generate Superframe Descriptor elements. |  |  |  |  |  |
| BECA2 | The entity is able to generate superframe schedules and transmit CAP and GTS allocations to devices. |  | O |  |  |  |
| BECA2.1 | The entity is able to regard for guard intervals in the generation of a superframe schedule. |  | O |  |  |  |
| BECA2.2 | The entity is able to generate GTS Descriptor List elements. |  | O |  |  |  |
| BECA2.3 | The entity is able to generate GTS Descriptor elements. |  | O |  |  |  |
| BECA3 | The entity is able to parse Beacon frames and handle the included information. |  | M |  |  |  |
| BECA4 | The entity is able to synchronize the local clock based on a received beacon frame. |  | M |  |  |  |
| BECA5 | The entity is able to perform channel access in the CAP, including backoff upon failure detection. |  | M |  |  |  |
| BECA6 | The entity is able to issue GTS requests. |  | M |  |  |  |
| BECA7 | The entity is able to parse GTS allocations received from the OWPAN coordinator. |  | M |  |  |  |
| BECA7.1 | The entity is able to parse GTS Descriptor List elements. |  | M |  |  |  |
| BECA7.2 | The entity is able to parse GTS Descriptor elements. |  | M |  |  |  |
| BECA8 | The entity is able to perform timed medium access in the CFP in eligible superframe slots. |  | M |  |  |  |
| BECA8.1 | The entity is able to regard for the TAIFS when operating in half duplex mode. |  | M |  |  |  |

Table D+4 Non-beacon-enabled channel access

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| NBECA1 | The entity is able to transmit Random Access frames in order to advertise a maintained OWPAN and initiate the polling cycle. |  | O |  |  |  |
| NBECA2 | The entity is able to transmit Poll Frames in order to initiate channel access of an associated device. |  | O |  |  |  |
| NBECA3 | The entity is able to parse Poll frames, handle the included information, and perform transmissions in accordance with the polling-based medium access specification. |  | O |  |  |  |

Table D+5 Coordinator device functions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| CDF1 | The entity is able to start an OWPAN after receiving the relevant MLME primitive. |  | O |  |  |  |
| CDF2 | The entity is able to handle a request for association from an unassociated device. |  | O |  |  |  |
| CDF2.1 | The entity is able to parse an Association Request element for the purpose of the parent item. |  | O |  |  |  |
| CDF2.2 | The entity is able to parse a Capability List element for the purpose of the parent item. |  | O |  |  |  |
| CDF2.3 | The entity is able to parse a Supported MCS element for the purpose of the parent item. |  | O |  |  |  |
| CDF3 | The entity is able to allow or deny association and negotiate the necessary parameters. |  | O |  |  |  |
| CDF3.1 | The entity is able to generate an Association Response element for the purpose of the parent item. |  | O |  |  |  |
| CDF3.2 | The entity is able to generate a Capability List element for the purpose of the parent item. |  | O |  |  |  |
| CDF3.3 | The entity is able to generate a Supported MCS element for the purpose of the parent item. |  | O |  |  |  |

Table D+5.1 Non-Coordinator device functions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| NCDF1 | The entity is able to request association from a coordinator. |  | M |  |  |  |
| NCDF1.1 | The entity is able to generate an Association Request element for the purpose of the parent item. |  | M |  |  |  |
| NCDF1.2 | The entity is able to generate a Capability List element for the purpose of the parent item. |  | M |  |  |  |
| NCDF1.3 | The entity is able to generate a Supported MCS element for the purpose of the parent item. |  | M |  |  |  |
| NCDF2 | The entity is able to handle a coordinator’s response to an association request. |  | M |  |  |  |
| NCDF2.1 | The entity is able to parse an Association Response element for the purpose of the parent item. |  | M |  |  |  |
| NCDF2.2 | The entity is able to parse a Capability List element for the purpose of the parent item. |  | M |  |  |  |
| NCDF2.3 | The entity is able to parse a Supported MCS element for the purpose of the parent item. |  | M |  |  |  |

| Table D+6 MPDU fragmentation and reassembly |
| --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| MPDUFR1 | The entity is able to fragment outgoing MSDUs according to the specification. |  | O |  |  |  |
| MPDUFR1 | The entity is able to reassemble received fragmented MSDUs |  | O |  |  |  |

Table D+7 MSDU aggregation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| MSDUA1 | The entity is able to aggregate multiple MSDUs in the payload of an outgoing data MPDU.  |  | O |  |  |  |
| MSDUA1.1 | The entity is able to generate a MSDU Aggregation element for the purpose of the parent item. |  | O |  |  |  |
| MSDUA2 | The entity is able to disaggregate an A-MSDU from the payload of a received data MPDU. |  | O |  |  |  |
| MSDUA2.1 | The entity is able to parse an MSDU Aggregation element for the purpose of the parent item. |  | O |  |  |  |

Table D+8 Attribute change procedure

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| ACP1 | The entity is able to initiate the setting of an attribute in an associated device. |  | M |  |  |  |
| ACP1.1 | The entity is able to generate an Attribute Change Request element. |  | M |  |  |  |
| ACP2 | The entity is able to process the request to change an attribute according to the specification. |  | M |  |  |  |
| ACP2.1 | The entity is able to generate an Attribute Change Response element. |  | M |  |  |  |

Table D+9 Multi-rate transmission

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| AT1 | The entity transmits essential frames and elements with the PHYs base MCS. |  | M |  |  |  |
| AT2 | The entity is able to transmit an MCS request to a device, requesting use of an MCS that is expected to be decodable. |  | M |  |  |  |
| AT2.1 | The entity is able to generate an MCS Request element for the purpose of the parent item. |  | M |  |  |  |
| AT2.2 | The entity is able to generate a PM-PHY MCS element for the purpose of the parent item. |  | O |  |  |  |
| AT2.3 | The entity is able to generate a LB-PHY MCS element for the purpose of the parent item. |  | O |  |  |  |
| AT2.4 | The entity is able to generate a HB-PHY MCS element for the purpose of the parent item. |  | O |  |  |  |
| AT3 | The entity is able to process an MCS request for the PHY it supports and aim to use the requested MCS for further transmissions to the requesting device. |  | O |  |  |  |
| AT3.1 | The entity is able to parse an MCS Request element for the purpose of the parent item. |  | O |  |  |  |
| AT3.2 | The entity is able to parse a PM-PHY MCS element for the purpose of the parent item. |  | O |  |  |  |
| AT3.3 | The entity is able to parse a LB-PHY MCS element for the purpose of the parent item. |  | O |  |  |  |
| AT3.4 | The entity is able to parse a HB-PHY MCS element for the purpose of the parent item. |  | O |  |  |  |
| AT4 | The entity is able to request usage of a BAT for future transmissions from a device. |  | O |  |  |  |
| AT4.1 | The entity is able to generate a BAT Request element for the purpose of the parent item. |  | O |  |  |  |
| AT5 | The entity is able to handle a request for usage of a BAT for future transmissions to the originating device.  |  | O |  |  |  |
| AT5.1 | The entity is able to parse a BAT request for the purpose of the parent item. |  | O |  |  |  |

Table D+10 Interference detection

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| MID1 | The entity is able to detect interfering, non-decodable signals above an energy threshold. |  | O |  |  |  |
| MID2 | The entity is able to detect interfering transmissions by being able to parse MPDUs in case a supported PHY and MPDU version is used. |  | O |  |  |  |
| MID3 | The entity is able to notify the coordinator about observed interference based on an implementation-specific trigger. |  | O |  |  |  |
| MID3.1 | The entity is able to generate an Alien Signal element for the purpose of the parent item. |  | O |  |  |  |

Table D+11 Adaptive MIMO transmission

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| MID1 | The entity is able to transmit a single PPDU over different connected OFEs. |  | O |  |  |  |
| MID2 | The entity is able to delay the transmission of a single PPDU on a per-OFE basis. |  | O |  |  |  |
| MID3 | The entity is able to transmit multiple different PPDUs over different connected OFEs. |  | O |  |  |  |
| MID4 | The entity is able to handle explicit MIMO channel feedback and adapt the transmission over different connected OFEs accordingly. |  | O |  |  |  |
| MID4.1 | The entity is able to parse the Explicit MIMO Feedback element for the purpose of the parent item. |  | O |  |  |  |
| MID5 | The entity is able to handle CSI feedback obtained at the PHY and feed it back to another device. |  | O |  |  |  |
| MID5.1 | The entity is able to generate the Explicit MIMO Feedback element for the purpose of the parent item |  | O |  |  |  |

| **Table D+12 Protected transmission** |
| --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| MPT1 | The entity is able to assign sequence numbers to outgoing MPDUs. |  | M |  |  |  |
| MPT2 | The entity is able to retransmit an outgoing MPDU if an ACK was not received after a specified timeout. |  | M |  |  |  |
| MPT3 | The entity is able to handle sequence numbers of incoming MPDUs. |  | M |  |  |  |
| MPT3.1 | The entity is able to identify duplicate received MPDUs and not hand them to the higher layers. |  | M |  |  |  |
| MPT4 | The entity is able to transmit a single ACK to acknowledge the successful reception of an MPDU with ACK request set. |  | M |  |  |  |
| MPT5 | The entity is able to transmit a block ACK to acknowledge the reception of more than one successfully received MPDUs. |  | M |  |  |  |
|  | ACK Element |  |  |  |  |  |
|  | Block ACK Request Element |  |  |  |  |  |
|  | Block ACK Element |  |  |  |  |  |

Table D+13 MAC frames

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| MF1 | The entity is able to generate and parse non-optional fields of the general MPDU format. |  | M |  |  |  |

Table D+14 MAC data frame type

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| MDFT1 | The entity is able to parse MDPUs with type data and subtype single MSDU. |  | M |  |  |  |
| MDFT2 | The entity is able parse MPDUs with type data and subtype Aggregated MSDU. |  | O |  |  |  |
| MDFT3 | The entity is able to parse MPDUs with type data and subtype Null Data. |  | O |  |  |  |

| **Table D+15 MAC management frame type** |
| --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| MMFT1 | The entity is able to parse MDPUs with type management and subtype Association Request. |  | O |  |  |  |
| MMFT2 | The entity is able to parse MDPUs with type management and subtype Association Response. |  | O |  |  |  |
| MMFT3 | The entity is able to parse MDPUs with type management and subtype Disassociation Notification. |  | O |  |  |  |
| MMFT4 | The entity is able to parse MDPUs with type management and subtype Poll |  | O |  |  |  |
| MMFT5 | The entity is able to parse MDPUs with type management and subtype Poll request |  | O |  |  |  |
| MMFT6 | The entity is able to parse MDPUs with type management and subtype Poll response |  | O |  |  |  |
| MMFT7 | The entity is able to parse MDPUs with type management and subtype Variable Element Container |  | O |  |  |  |

| Table D+16 MAC control frame type |
| --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| MCFT1 | The entity is able to parse MDPUs with type control and subtype ACK. |  | M |  |  |  |
| MCFT2 | The entity is able to parse MDPUs with type control and subtype Block ACK. |  | M |  |  |  |
| MCFT3 | The entity is able to parse MDPUs with type control and subtype Block ACK Request. |  | O |  |  |  |
| MCFT4 | The entity is able to parse MDPUs with type control and subtype MCS Request. |  | M |  |  |  |
| MCFT5 | The entity is able to parse MDPUs with type control and subtype GTS Request. |  | M |  |  |  |
| MCFT6 | The entity is able to parse MDPUs with type control and subtype GTS Allocation. |  | M |  |  |  |
| MCFT7 | The entity is able to parse MDPUs with type control and subtype GTS Allocation List. |  | O |  |  |  |
| MCFT8 | The entity is able to parse MDPUs with type control and subtype Variable Element Container. |  | M |  |  |  |
| MCFT9 | The entity is able to parse MDPUs with type control and subtype Beacon. |  | M |  |  |  |
| MCFT10 | The entity is able to parse MDPUs with type control and subtype Random Access. |  | O |  |  |  |
| MCFT11 | The entity is able to parse MDPUs with type control and subtype BAT Request. |  | O |  |  |  |
| MCFT12 | The entity is able to parse MDPUs with type control and subtype Explicit MIMO Feedback. |  | O |  |  |  |
| MCFT13 | The entity is able to parse MDPUs with type control and subtype HCM Allocation. |  | O |  |  |  |
| MCFT14 | The entity is able to parse MDPUs with type control and subtype Vendor Specific. |  | O |  |  |  |

| Table D+17 MCPS primitives |
| --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| MCPSP1 | The entity provides an MCPS interface supporting the MCPS-DATA.request primitive. |  | M |  |  |  |
| MCPSP2 | The entity provides an MCPS interface supporting the MCPS-DATA.indication primitive. |  | M |  |  |  |

| Table D+18 MLME primitives |
| --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| MLMEP1 | The entity is able to handle MLME-ASSOCIATE.request and issue a corresponding MLME-ASSOCIATE.response primitive. |  | M |  |  |  |
| MLMEP2 | The entity is able to issue an MLME-ASSOCIATE.indication and handle a corresponding MLME-ASSOCIATE.confirm primitive. |  | O |  |  |  |
| MLMEP3 | The entity is able to handle MLME-DISASSOCIATE.request primitive. |  | M |  |  |  |
| MLMEP4 | The entity is able to issue an MLME- DISASSOCIATE.indication and handle a corresponding MLME- DISASSOCIATE.confirm primitive. |  | O |  |  |  |
| MLMEP5 | The entity is able to handle MLME-GET.request and issue a corresponding MLME- GET.response primitive. |  | M |  |  |  |
| MLMEP6 | The entity is able to handle MLME-SET.request and issue a corresponding MLME- SET.response primitive. |  | M |  |  |  |
| MLMEP7 | The entity is able to handle MLME-SCAN.request and issue a corresponding MLME- SCAN.response primitive. |  | M |  |  |  |
| MLMEP8 | The entity is able to handle MLME-START.request and issue a corresponding MLME- START.response primitive. |  | O |  |  |  |
| MLMEP9 | The entity is able to handle MLME-STOP.request and issue a corresponding MLME- STOP.response primitive. |  | O |  |  |  |

| Table D+18 MAC-PIB |
| --- |
| Item number | Item description | Reference | Status | Support |
| N/A | Yes | No |
| MPIB1 | The entity is able to set MAC and PHY PIB attributes. |  | M |  |  |  |
| MPIB2 | The entity is able to get MAC and PHY PIB attributes. |  | M |  |  |  |

CID I-306

Change the contents of 4.5.1 as follows:

The IEEE Std 802.15.13 architecture is defined in terms of layers. The standard includes a specification of the PHY and MAC sublayer and their exposed interfaces. Each layer is responsible for one part of the standard and offers its services to the next higher layer. Layers make use of service access points (SAPs) based on primitives, as described in the subclause 5.8 "Concept of primitives" in IEEE Std 802.15.4-2020. Figure 5X depicts the architecture of a single device. The MAC sublayer and the PHY are described in more detail in 5.5.3 and 5.5.2.

Figure 5X OWPAN device architecture

The IEEE Std 802.15.13 MAC sublayer controls access to the medium for all types of transfers. It provides the MCPS-SAP and MLME-SAP to the higher layers. Its MCPS-SAP allows the next higher protocol layer to transmit MSDUs between peer IEEE Std 802.15.13 devices. The higher layers are a network layer, which provides network configuration, manipulation, and message routing, and an application layer, which provides the intended function of the device. The definition of these higher layers is outside the scope of this standard.

Each device involves a device management entity (DME), responsible for managing the device and OWPAN. The DME invokes MAC layer management entity (MLME) functionality through the MLME service access point (MLME-SAP). The MLME-SAP defines a set of essential primitives for network operation. Further functionality may be provided by the MAC sublayer to the DME in an implementation-specific manner.

The PHY contains the optical wireless transceiver, which is responsible for turning a PSDU into a PPDU for transmission. Thus, a series of data bits from the MAC sublayer, is transformed into an analog signal through signal processing. PSDUs, i.e., MPDUs from the MAC sublayer, are transferred through the PD-SAP of the PHY. Management functions of the PHY are invoked through the PLME-SAP.

The relationship between data units of the different layers is depicted in Figure 6X.

Figure 6X Relationship between data units of the different layers

Ensure that acronyms in the aforementioned change are correctly expanded.

CID I-243

Replace figure 90 with the following graphic:

Replace figure 91 with the following graphic:

Replace figure 92 with the following graphic:

CID I-52

Change P37L13 as follows:

[0, 𝐶𝑊],

Replace figure 9 with the following graphic:

CID I-58

Change 5.5.5 as follows:

To stop a running OWPAN, the DME of a coordinator issues the MLME-STOP.request through the MLME-SAP. Upon reception of the primitive, the coordinator should disassociate all associated devices with an appropriate reason code. It shall then stop transmitting Beacon or Random Access frames as well as handling new association requests. Furthermore, it shall reset all state that was introduced while the OWPAN was active.

The MAC shall respond to the MLME-STOP.request with a MLME-STOP.confirm. It shall set the Status parameter to SUCCESS upon successful stopping of the OWPAN. It shall set the Status parameter to TIMEOUT if the OWPAN could not be stopped after all associated devices were successfully disassociated within the time indicated through the Timeout parameter of the preceding MLME-STOP.request.

Change the description of the Timeout parameter in Table 33 as follows:

The time after which all devices must be successfully disassociated.

In Table 34, rename FORCED to TIMEOUT

CID I-59

Change 5.5.2 as follows

A scan procedure is performed by a device to detect OWPANs that are operating in its vicinity. In this standard, only a single frequency range in the baseband is utilized for all transmissions. Hence, scanning for existing OWPANs is reduced to the scanning of a single frequency channel. Devices shall support passive scanning for OWPANs during which the device listens for signals without performing any transmissions itself. If a device makes use of multiple OFEs, it shall listen on all frontends.

A device performing a passive scan for OWPANs shall decode all received *Beacon* frame or *Random Access* frames and store their contents until the end of the scan. Furthermore, it shall consider received signals whose power exceeds an implementation-specific threshold while the signal is not decodable. Distinction of these signals shall be implementation-specific.

The scan may be initialized by the MAC itself or based on a request from the DME through the MLME-SCAN.request primitive. If the scan was initiated through the MLME-SCAN.request primitive, the results of the scan shall be returned via the MLME-SCAN.confirm primitive as follows.

For every successfully decoded *Beacon* frame or *Random Access* frame in the scan period, the device shall add the corresponding OWPAN ID to the scan result list. It shall furthermore add the received electrical signal-to-noise ratio (SNR) to the result list. The returned list shall not contain duplicate entries. If a device detects at least one non-decodable signal during the scan time, the device shall add an entry with OWPAN ID = ff-ff-ff-ff-ff-ff with the received power level of the strongest received signal to the scan result list.

Change 5.5.3 as follows:

A coordinator-capable device shall start a new OWPAN upon receipt of the MLME-START.request primitive through the MLME-SAP. If the device maintained an OWPAN before, it shall stop the OWPAN, according to X prior to starting a new OWPAN in order to reset all MAC and PHY state and disassociated potentially associated devices.

The parameters for starting and maintaining the OWPAN shall be obtained from the device’s PIB attribute database. Thus, the DME of the coordinator-capable device should set the intended parameters prior to issuing the MLME-START.request.

The DME of the prospective coordinator selects a 48-bit MAC address for the coordinator through setting *macMac48Address* to the given value. Upon reception of the MLME-START.request primitive, the MAC shall set *macOwpanId* to its MAC address and use it as the OWPAN ID.

If the PIB attributes contain an invalid configuration, the device shall issue a MLME-START.confirm primitive with the Status parameter set to FAIL\_INVALID\_CONFIGURATION.

The device shall issue a scan immediately before attempting to start a new OWPAN as described in 5.5.2. The device shall only proceed to start an OWPAN if the scan found no other networks or no-decodable optical signals. Otherwise, the device shall issue a MLME-START.confirm primitive with the Status parameter set to FAIL\_OTHER\_NETWORK\_FOUND.

If the device is not able to start acting as a coordinator for another reason, it shall issue an MLME-START.confirm primitive with the Status parameter set to FAIL\_OTHER.

When all preconditions are met, the prospective coordinator shall start to transmit Beacon or Random Access frames in accordance with the implemented channel access mechanism. It shall furthermore begin to handle requests for association and other coordinator functionality as described in Clause 5. Finally the new coordinator shall issue an MLME-START.confirm primitive with the Status parameter set to SUCCESS.

Change clause 8.3.7.3 as follows:

**8.3.7.3 MLME-START.confirm**

The MLME-START.confirm primitive is issued by the coordinator MLME to report the result of the preceding request to start a new OWPAN.

The semantics of the primitive are as follows:

 **MLME-START.confirm (
Status
)**

The parameters of the primitive are listed in 0.

**Parameters of the MLME-START.confirm primitive**

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid range | Description |
| Status | enumeration | SUCCESS,FAIL\_INVALID\_CONFIGURATION,FAIL\_OTHER\_NETWORK\_FOUND,FAIL\_OTHER | Whether the preceding MLME-START.request primitive was successful or failed. |

CID I-169

Replace “AttributeId” with “Attribute” in P92L11.

Replace “AttributeId” with “Attribute” in Table 25

Replace the valid range in table 25 with

Valid attributes as listed in table 35.

Replace the description in table 25 with

The attribute to get.

Replace “AttributeId” with “Attribute” in P92L20.

Replace “AttributeId” with “Attribute” in Table 26 column 2

Replace the valid range in table 26 column 2 with

Valid attributes as listed in table 35.

Replace the description in table 26 column 2 with

The attribute that was requested.

Replace the description in table 26 column 3 with

The value of the attribute that was requested.

Replace “AttributeId” with “Attribute” in P93L11.

Replace “AttributeId” with “Attribute” in Table 27 column 2

Replace the valid range in table 27 column 2 with

Valid attributes as listed in table 35.

Replace the description in table 27 column 2 with

The attribute to set.

Replace “AttributeId” with “Attribute” in P94L3.

Replace “AttributeId” with “Attribute” in Table 28 column 2

Replace the valid range in table 28 column 2 with

Valid attributes as listed in table 35.

Replace the description in table 28 column 2 with

The attribute that was requested to be set.

Replace the description in table 28 column 3 with

The value of the attribute that was requested to be set.

CID I-337

Replace figure 12 with the following graphic:

Replace figure 13 with the following graphic:

Replace figure 14 with the following graphic:

Replace figure 15 with the following graphic:

Replace figure 16 with the following graphic:

Replace figure 17 with the following graphic:

Replace figure 18 with the following graphic:

CID I-357 / I-10

Replace line P58L33 to P59L6 with the following text and figures:

In the repetition coding, the same information is transmitted from all OFEs as shown in Figure 25. Solid lines indicate wires to the transmitter and dashed lines indicate light communication. Figure 25 depicts two light emitters at the left and two light receivers, i.e. photo diodes, at the right.



**Figure 25 Repetition coding for adaptive MIMO communication**

In the spatial multiplexing case, every OFE sends independent information as shown in Figure 26. The MCS of each OFE is provided separately. Solid lines indicate wires to the transmitter and dashed lines indicate light communication. Figure 26 depicts two light emitters at the left and two light receivers, i.e. photo diodes, at the right.



**Figure 26 Spatial multiplexing for adaptive MIMO communication**