**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 UWB only MMS ranging** |
| Date Submitted | July 2023 |
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| Re: | Contribution to IEEE 802.15.4ab  |
| Abstract |  |
| Purpose | This submission proposes text to for the IEEE Std 802.15.4ab specification framework document.  |
| Notice | This document does not represent the agreed views of the IEEE 802.15 Working Group or IEEE 802.15.4ab Task Group. It represents only the views of the participants listed in the “Sources” field above.It is offered as a basis for discussion and is not binding on the contributing individuals. The material in this document is subject to change in form and content after further study. The contributors reserve the right to add, amend or withdraw material contained herein. |

**Rational for this proposal.**

To propose simple changes to “P802.15.4ab™/D (pre-ballot) B Draft Standard for Low-Rate Wireless Networks” to make the text inclusive of UWB driven MMS and the 3rd option where there is another PHY.

Note that some ambiguities and inconsistencies exist in the current draft text that impact the correct operation of the functionality being addressed here. A good example is the fact that the UWB MAC and PHY configs do not currently allow the optional SYNC+SFD in the MMS ranging packet to be configured. So, this is true before and after the changes being proposed here as it is considered that this and other ambiguities or inconsistencies are best addressed through comment resolution as they have wider implications than the core changes being proposed here.

**All the text after this page is from the draft with proposed changes and comments.**

**10.35 Multi-millisecond (MMS) UWB operation**

**10.35.1 Introduction**

For improved UWB sensitivity the multi-millisecond (MMS) technique operates to accumulate the channel impulse response (CIR) estimate from a sequence of fragments each sent in a separate millisecond to utilize the allowed per millisecond regulatory transmit power budget. The HRP UWB PHY includes an MMS packet mode to support this functionality, see 16.2.11.

This clause describes the MMS operation and the details of the MAC and PHY interactions involved in MMS based two-way ranging. There are three general methods to initiate the MMS exchange and accumulation, each of which is optional but at least one of which is required to support MMS mode:

 Narrowband assisted (NBA) MMS. Here the O-QPSK PHY described in clause 13 is employed for control and data transfer and to initiate the UWB MMS packet mode, and, where O-QPSK PHY shares a common clock source with the UWB PHY, to determine the clock offset to assist the MMS accumulation.

 UWB driven MMS. Here UWB itself, (i.e., HRP UWB PHY described in clause 16), is employed for control and data transfer, switching to the MMS packet mode at the appropriate times.

 Another PHY may be employed for control and data transfer, and to initiate the UWB MMS packet mode appropriately. This alternative is considered OOB and not described further below.

The NBA-MMS and the UWB driven MMS approaches share common methods and messages, albeit using different PHY layers for the control and initiation of the MMS ranging and the associated reporting phases. To allow common text cover both approaches, the term MMS Management (PHY) is used to mean either.

**10.35.2 MMS ranging overview**

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**10.35.3 Narrowband MMS initialization and setup**

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**10.35.4 MMS control phase**

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The poll message (10.35.9.7) serves to enable carrier coherent transmissions from the initiator to the responder device. Additionally, the poll message may indicate short-term operating parameters for the current ranging round and optionally request that the responder suggests short-term operating parameters for the next ranging round. The poll message is transmitted at long-term Management PHY configuration. After receiving the poll message including short-term operating parameters, the responder shall update the short-term operating parameters accordingly.

 The poll message is transmitted using the long-term Management PHY configuration.

The response message serves to enable carrier coherent transmissions from the responder to the initiator device. Additionally, a response message may serve to convey control information from the responder to the initiator, as follows: If the responder receives a poll message from the initiator with a request to suggest short-term operating parameters and is not intending to send any measurement report in the current ranging round, then the response message transmitted by the responder shall include suggested short-term operating parameters. The initiator may make use of the suggested short-term operating parameters to determine updated short-term operating parameters to be used in the next ranging round. If the Management PHY configuration is indicated in the poll message, the response message is transmitted using the Management PHY configuration indicated in the poll message. Otherwise, the response message is transmitted using the long-term Management NB PHY configuration.

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**10.35.5 MMS ranging phase**

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**10.35.6 MMS report phase**

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A report message primarily serves to provide ranging results obtained during the ranging phase. Additionally, report messages may be used to serve other purposes. For example, if poll message from the initiator includes a request to suggest short-term operating parameters, then the report message transmitted by the responder shall include suggested short-term operating parameters. The initiator may make use of these suggested short-term operating parameters to determine updated short-term operating parameters to be used in the next ranging round. If the Management PHY configuration is indicated in the poll message, the report message is transmitted using the Management PHY configuration indicated in the poll message. Otherwise, the report message is transmitted using the long-term Management PHY configuration.

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**10.35.9 Control messages for MMS operation**

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**10.35.9.1 Overview**

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**10.35.9.2 Address formats**

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**10.35.9.3 Common message fields**

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**10.35.9.3.7 The Ranging PHY Config field**

This is a three-octet field formatted as shown in Figure 37.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Bits: 0–5**  | **6–12**  | **13–15** | **16–17**  | **18–21**  | **21–23**  |
| Preamble Code Index | MMRS complementary set zeros | N\_MSR | STS Segment Length | UWB channel | Reserved |

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**10.35.9.3.8 The RangingMAC Config field**

This is a one-octet field formatted as shown in Figure 38.

|  |  |  |  |
| --- | --- | --- | --- |
| **Bits: 0–2**  | **3–5**  | **6** | **7** |
| X RSF | Y RIF | Z RSF-to-RIF gap | reserved |

…

**10.35.9.3.9 The Management MAC Config field**

This field is formatted as shown in Figure 38.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Bits: 0–2**  | **3–10**  | **11–18** | **19** | **20** | **21–23** | **24–27** | **28–31** | **32–43** | **44–47** | **48–51** | **52–55** |
| Ranging Slot Duration | Ranging Round Duration | Ranging Block Duration | NBA Channel Switching | Measurement Report Request | Reserved | RcpPollSlots | RcpResponseSlots | RpDuration | RpOffset | MrpFirstSlots | MrpSecondSlots |

**Figure 39—The Framework MAC Config field**

Ranging Slot Duration {300, 600, …, 2400} RSTUs

Ranging Round Duration 0-255 ranging slots

Ranging Block Duration 0-255 ranging rounds

NBA Channel Switching: 0=Disabled, 1=Blockwise (ignored if NB PHY is not being used)

Measurement Report Request: 0=No, 1=Yes

RcpPollSlots=0-15

RcpResponseSlots=0-15

RpDuration=0-4095

RpOffset=0-15

MrpFirstSlots=0-15

MrpSecondSlots=0-15

**10.35.9.3.10 The Request Bitmap field**

This is a one-octet field formatted as shown in Figure 40.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Bits: 0**  | **1**  | **2** | **3** | **4** | **5–7** |
| NbaChannelMap requested | Management PHY Config requested | Management MAC Config requested | Ranging PHY Config requested | Ranging MAC Config requested | reserved |

**Figure 40—The Request Bitmap field**

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**10.35.9.3.14 The Management PHY Config field**

This is a three-octet field formatted as shown in Figure 41.

|  |  |
| --- | --- |
| **Bits: 0–3**  | **4–7**  |
| Control Phase Config  | Report Phase Config |

**Figure 41—The Management PHY Config field**

The Control Phase Config field specifies NB PHY Config in the Control Phase. Valid values 1 to 9, as per Table 28.

The Report Phase Config field specifies NB PHY Config in the NB Report Phase. Valid values in Table 28.

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**10.35.9.7 POLL**

The poll message is sent by the initiator during the control message, this message serves to enable carrier coherent transmissions from the initiator to the responder device, and may also convey short term operating parameters. The POLL message shall be formatted as shown in Figure 48.

|  |  |  |  |
| --- | --- | --- | --- |
| **Octets: 3** |  | **1** | **variable** |
| RPA hash | RPA Prand | Message Control | Message Content |

**Figure 48—POLL Compact Message**

The RPA Hash and RPA Prand fields shall be set as specified in 10.35.9.2.1.

The Message Control field value shall be either zero or one. This value determines the formatting of the Message Content field.

When the Message Control field value is zero the Message Content field shall consist of two octets with the value of zero as shown in Figure 49.

|  |
| --- |
| **Octets: 2** |
| 0x0000 |

**Figure 49—Message Content field in POLL when message control is zero**

When the Message Control field value is one the Message Content field shall be formatted as shown in Figure 50.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Octets: 1** | **1** | **0/2** | **0/3** | **0/2** | **0/1** | **0/7** |
| Request Bitmap | Presence Bitmap | NB Channel Select | Ranging PHY Configuration | Ranging MAC Configuration | Management PHY Configuration | Management MAC Configuration |

**Figure 50—Message Content field in POLL when message control is one**

The Request Bitmap …. <needs some text to describe this field>

The Presence Bitmap field shall be formatted as shown in Figure 51.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Bits: 0** | **1** | **2** | **3** | **4** | **5–7** |
| NB Channel Select Present | Management PHY Configuration Present | Management MAC Configuration Present | Ranging MAC Configuration Present | Ranging PHY Configuration Present | Reserved |

**Figure 51—Presence Bitmap format**

< add text to describe/define the above fields >