**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) | |
| Title | **Proposed modifications on NBA-UWB MAC text proposal** | |
| Date Submitted | July 2023 | |
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| Re: | Contribution to IEEE 802.15.4ab | |
| Abstract |  | |
| Purpose | This submission proposes modifications on NBA-UWB MAC text proposal. | |
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***The baseline for this contribution is 15-22-0381-05-04ab-nba-uwb-ranging-text-proposal-for-15-4ab-tfd\_clean***

1. NBA-UWB MMS Ranging
   1. NBA-UWB MMS ranging cycle
      1. Overview
      2. NBA-UWB MMS control phase

***Modify the 3rd and 4th paragraph as follows:***

A poll message serves to enable carrier coherent transmissions from the initiator to the responder device. Additionally, a poll message may serve to transmit control information from the initiator to the responder. For example, a poll message with the MessageControl field set to 0x10 may indicate short-term operating parameters (i.e. NbaChannelMap, NB PHY configuration, NB MAC configuration, UWB PHY configuration and UWB MAC configuration) for the current ranging cycle and include a request for the responder to suggest short-term operating parameters for the next ranging cycle. The Presence Bitmap field of the poll message with the MessageControl field set to 0x10 indicates which of short-term operating parameters are indicated. The Request Bitmap field of the poll message with the MessageControl field set to 0x10 indicates which of short-term operating parameters are requested to suggest from the responder. The poll message is transmitted at long-term NB PHY configuration.

After receiving the poll message with the MessageControl field set to 0x10 which indicates short-term operating parameters, the responder shall update the short-term operating parameters accordingly.A response message serves to enable carrier coherent transmissions from the responder to the initiator device. Additionally, a response message may serve to transmit control information from the responder to the initiator. For example, if the responder receives the request from the initiator to suggest short-term operating parameters in the poll message with the MessageControl field set to 0x10, and does not transmit any measurement report in the current ranging cycle, then the response message with the MessageControl field set to 0x10 transmitted by the responder shall include the suggested short-term operating parameters. The Presence Bitmap field of the response message with the MessageControl field set to 0x10 indicates which of short-term operating parameters are suggested. 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 NB PHY configuration is indicated in the poll message, the response message is transmitted at the NB PHY configuration indicated in the poll message. Otherwise, the response message is transmitted at long-term NB PHY configuration.

* + 1. NBA-UWB MMS ranging phase
    2. NBA-UWB MMS report phase

***Modify the 7th paragraph as follows:***

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 the responder receives the request from the initiator to suggest short-term operating parameters in the poll message with the MessageControl field set to 0x10, then the report message with the MessageControl field set to 0x10 transmitted by the responder shall include the suggested short-term operating parameters. The Presence Bitmap field of the report message with the MessageControl field set to 0x10 indicates which of short-term operating parameters are suggested. 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 NB PHY configuration is indicated in the poll message, the report message is transmitted at the NB PHY configuration indicated in the poll message. Otherwise, the report message is transmitted at long-term NB PHY configuration.

* 1. NBA-UWB MMS initialization and setup
     1. Overview
     2. Ranging session initialization
        1. Overview
        2. Initialization setup handshake

***Modify this clause as follows:***

The initiator (controller) may indicate the supported message control commands for each of ADV-RSP, RESP and REPORT packets in ADV-POLL with the MessageControl field set to 0x10 or 0x30.

The responder (controlee) may request ranging session configuration in ADV-RESP. The responder (controlee) may indicate the supported message control commands for each of SOR, POLL and REPORT packets in ADV-RSP with the MessageControl field set to 0x10 or 0x20.

…

The ADV-RESP and SOR packets are defined in subsection 1.6.3. The ADV-RESP packet with the MessageControl field set to 0x00 or 0x20 may contain the fields NB\_Channel\_Select, UWB\_PHY\_Config, UWB\_MAC\_Config, NB\_PHY\_Config, and NB\_MAC\_Config. The Presence Bitmap field of the ADV-RESP packet indicates which of these fields are suggested. The SOR packet contain all of these fields. For these fields, the initiator may either use the same values received via ADV-RESP from the responder, or change the values of each field before transmitting the updated field values in the SOR packet.

If the initiator changes the value of NB\_Channel\_Select received from ADV-RESP, it shall change the value to a subset of the channels requested by the responder. For all other fields, the initiator may choose all field values independently from the values requested by the responder via ADV-RESP if the selected configuration is mandatorily supported. If the initiator chooses field values that correspond to optional support features, the initiator may take a-priori information about the supported optional features of the responder into account. The acquisition of a-priori information on optional features supported by the responder device may be provided by higher layer functionality, e.g., a pairing process, that is out of scope here.

…

Alternatively, the same procedure can be applied using public addresses (PUBLIC-ADV-POLL, PUBLIC-ADV-RESP, and PUBLIC- SOR).

***Insert a new subclause 1.2.2.3 after 1.2.2.2 as follows***

* + - 1. Contention based initialization setup handshake

Contention based initialization and setup may be used for one-to-one ranging or one-to-many ranging. In the contention based initialization and setup stage, the initiator sends an ADV-POLL packet with the MessageControl field set to 0x20 or 0x30 on the initialization channel to one or more intended responders opportunistically at times and intervals as deemed suitable for the higher layer functionality to be supported. The ADV-POLL packet with the MessageControl field set to 0x20 or 0x30 specifies the duration of a contention access based period (CAP) starting from the end of the ADV-POLL packet. The CAP consists of multiple Initialization slots and the initialization slot duration is specified in the ADV-POLL packet with the MessageControl field set to 0x20 or 0x30. After transmitting the ADV-POLL packet, the initiator shall listen for one or more incoming ADV-RESP packets in the subsequent CAP.

Upon the reception of the ADV-POLL packet with the MessageControl field set to 0x20 or 0x30 from the initiator, any intended responder randomly selects one of the initialization slots in the CAP and transmits an ADV-RESP packet at the beginning of the selected initialization slot. Once the CAP is timeout, each responder which has transmitted the ADV-RESP packet shall listen for an ADV-CONF packet or SOR packet.

Upon the reception of the one or more ADV-RESP packets in the CAP, if the initiator intends for one-to-one ranging, the initiator should select one of the responders from which the initiator has received the ADV-RESP packets in the CAP. If the initiator intends for one-to-many ranging, the initiator should select two or more of the responders from which the initiator has received the ADV-RESP packets in the CAP.

If only a single responder is selected and the coordination is inactive, the initiator shall send an SOR packet to the selected responder in the initialization slot following the CAP. The SOR packet indicates the corresponding ranging configurations and the time offset between the end of the SOR packet and the beginning of the first ranging block.

If only a single responder is selected and the coordination is active, the initiator should send an ADV-CONF packet with the MessageControl field set to 0x00 to the selected responder in the initialization slot following the CAP. The ADV-CONF packet with the MessageControl field set to 0x00 indicates the time offset between the end of the ADV-CONF packet and the beginning of a following SOR packet, during which the initiator may attempt to capture the acquisition packets transmitted by other initiators on the initialization channel in NB and/or the default channel in UWB. Then the initiator shall send the SOR packet to the selected responder at the time indicated in the preceding ADV-CONF packet. The SOR packet specifies the corresponding ranging configurations and the time offset between the end of the SOR packet and the beginning of the first ranging block.

If two or more responders are selected, the initiator shall send an ADV-CONF packet with the MessageControl field set to 0x20 in the initialization slot following the CAP. The ADV-CONF packet indicates the selected responders and the time offset between the end of the ADV-CONF packet and the beginning of an SOR packet for each of the selected responders. During the minimum of all the time offsets, the initiator may attempt to capture the acquisition packets transmitted by other initiators on the initialization channel in NB and/or the default channel in UWB. Then the initiator shall send SOR packets to the selected responders individually at the respective times indicated in the preceding ADV-CONF packet. Each SOR packet specifies the corresponding ranging configurations and the time offset between the end of the SOR packet and the beginning of the Poll packet addressed to the corresponding responder in the first ranging block.

Upon the reception of the ADV-CONF packet in the CAP, each of the selected responders shall listen for incoming SOR packet at the corresponding time specified in the ADV-CONF packet.

After transmitting the SOR packet, the initiator shall enter the control phase. After receiving the SOR packet, the responder shall enter the control phase. After the initiator has confirmed receipt of the RESP packet from the responder during the control phase, and unless initialization of further HRP-ARDEVs is required, the initiator shall discontinue ranging initialization and cease the transmission of ADV-POLL packets.

The contention based initialization and setup process for one-to-one ranging is exemplified in the following figure:



1. The coordination is inactive



1. The coordination is active

**Figure 1.2.2.3.1 - An example of contention based initialization and setup process for one-to-one ranging**

The contention based initialization and setup process for one-to-many ranging is exemplified in the following figure:



**Figure 1.2.2.3.2 - An example of contention based initialization and setup process for one-to-many ranging**

* + 1. Ranging session configuration

***Modify the 2nd paragraph as follows:***

An initiator and a responder shall use the parameters which are set or updated by the next higher layers or the parameters which are not set or updated by the next higher layers but are negotiated during the initialization setup handshake as the long-term operating parameters. If the parameters are not set or updated by the next higher layers and not negotiated during initialization setup handshake, an initiator and a responder shall use default parameters as the long-term operating parameters.

***Modify 4th paragraph as follows:***

A responder may request short-term operating parameters for the next ranging cycle during the control phase. The initiator may serve the responder’s request in the next ranging cycle or ignore the request.

* 1. Coordination
  2. NBA-UWB MMS bands and channels
  3. NBA-UWB MMS channel switching
  4. NBA-UWB MMS control channel messages
     1. Overview
     2. PSDU formats
     3. Compressed PSDU format
        1. Compressed PSDU messages

***Modify the clause as follows:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Phase** | **Message Name** | **Octet 0 (Msg ID)** | **Octets 1-N [Len]** | **Description** |
| ..Initialization | ADV-POLL | 0x01 | [RPA\_hash[3],  RPA\_prand[3], MessageControl[1], MessageContent[], CRC16] | MessageControl=0x10: MessageContent={  SMC TLVs[]}  Where SMC\_TLVs is the list of supported message control commands.  Message Control=0x20:  MessageContent={  CapDuration[1],  InitializationSlotDuration[1]}  Message Control=0x30:  MessageContent={  SMC TLVs[],  CapDuration[1],  InitializationSlotDuration[1]  } |
| ADV-RESP | 0x02 | [RPA\_hash[3],  MessageControl[1], MessageContent[],  CRC16] | MessageControl=0x00: MessageContent={ Presence Bitmap[1],  If Bit 0 of Presence Bitmap == 1 then {NB Channel Select[2]},  If Bit 1 of Presence Bitmap == 1 then {NB PHY Config[1]}, If Bit 2 of Presence Bitmap == 1 then {NB MAC Config[7]},  If Bit 3 of Presence Bitmap == 1 then {UWB PHY Config[3]}, If Bit 4 of Presence Bitmap == 1 then {UWB MAC Config[2]}}  MessageControl=0x10: MessageContent={  SMC TLVs[]}  MessageControl=0x20: MessageContent={  SMC TLVs[],  Presence Bitmap[1],  If Bit 0 of Presence Bitmap == 1 then {NB Channel Select[2]}, If Bit 1 of Presence Bitmap == 1 then {NB PHY Config[1]}, If Bit 2 of Presence Bitmap == 1 then {NB MAC Config[7]},  If Bit 3 of Presence Bitmap == 1 then {UWB PHY Config[3]}, If Bit 4 of Presence Bitmap == 1 then {UWB MAC Config[2]}} |
| … |  |  |  |
| ADV-CONF | 0x08 | [RPA\_hash[3],  MessageControl[1], MessageContent[], CRC16] | MessageControl=0x20:  MessageContent={  Number of Responders [1],  List of {Responder Address [3], SOR Time Offset [4]}} |
| … |  |  |  |
|  |  |  |  |  |
| Control | POLL | 0x04 | [RPA\_hash[3],  RPA\_prand[3],  MessageControl[1], MessageContent[], CRC16] | MessageControl=0x10:  MessageContent={Request Bitmap[1],  Presence Bitmap[1],  If Bit 0 of Presence Bitmap == 1 then {NB Channel Select[2]}, If Bit 1 of Presence Bitmap == 1 then {NB PHY Config[1]}, If Bit 2 of Presence Bitmap == 1 then {NB MAC Config[7]},  If Bit 3 of Presence Bitmap == 1 then {UWB PHY Config[3]}, If Bit 4 of Presence Bitmap == 1 then {UWB MAC Config[2]}} |
| RESP | 0x05 | [RPA\_hash[3],  MessageControl[1], MessageContent[], CRC16] | MessageControl=0x10:  MessageContent={Presence Bitmap[1],  If Bit 0 of Presence Bitmap == 1 then {NB Channel Select[2]}, If Bit 1 of Presence Bitmap == 1 then {NB PHY Config[1]}, If Bit 2 of Presence Bitmap == 1 then {NB MAC Config[7]},  If Bit 3 of Presence Bitmap == 1 then {UWB PHY Config[3]}, If Bit 4 of Presence Bitmap == 1 then {UWB MAC Config[2]},  zero, one, two or three times 0x00}  where the number of padding bytes are determined so that the MessageContent field has a minimum size of 5 bytes; and at least one of NbaChannelMap, NB PHY Config, NB MAC Config, UWB PHY Config and UWB MAC Config fields shall be present. |
|  |  |  |  |
|  |  |  |  |
| POLL (One-to-many) | 0x10 | [RPA\_hash[3], RPA\_prand[3], MessageControl[1], MessageContent[], CRC16] | MessageControl = 0x70:  MessageContent={  Number of Responders[1],  SlotsPerResponder[1],  Request Bitmap[1],  Presence Bitmap[1],  List of {Responder Address[3],  If Bit 0 of Presence Bitmap == 1 then {NB Channel Select[2]}, If Bit 1 of Presence Bitmap == 1 then {NB PHY Config[1]}, If Bit 2 of Presence Bitmap == 1 then {NB MAC Config[7]},  If Bit 3 of Presence Bitmap == 1 then {UWB PHY Config[3]}, If Bit 4 of Presence Bitmap == 1 then {UWB MAC Config[2]}}  }  MessageControl = 0x80:  MessageContent={  Number of Responders[1],  Request Bitmap[1],  Presence Bitmap[1],  List of {Responder Address[3],  If Bit 0 of Presence Bitmap == 1 then {NB Channel Select[2]}, If Bit 1 of Presence Bitmap == 1 then {NB PHY Config[1]}, If Bit 2 of Presence Bitmap == 1 then {NB MAC Config[7]},  If Bit 3 of Presence Bitmap == 1 then {UWB PHY Config[3]}, If Bit 4 of Presence Bitmap == 1 then {UWB MAC Config[2]},  If Bit 5 of Presence Bitmap == 1 then {StartSlotIndex[2], EndSlotIndex[2]}}  } |
| RESP (One-to-many) | 0x11 | [RPA\_hash[3],  MessageControl[1], MessageContent[], CRC16] | MessageControl=0x10:  MessageContent={Presence Bitmap[1],  If Bit 0 of Presence Bitmap == 1 then {NB Channel Select[2]}, If Bit 1 of Presence Bitmap == 1 then {NB PHY Config[1]}, If Bit 2 of Presence Bitmap == 1 then {NB MAC Config[7]},  If Bit 3 of Presence Bitmap == 1 then {UWB PHY Config[3]}, If Bit 4 of Presence Bitmap == 1 then {UWB MAC Config[2]},  zero, one, two or three times 0x00},  where the number of padding bytes is determined so that the MessageContent field has a minimum size of 5 bytes; and at least one of NbaChannelMap, NB PHY Config, NB MAC Config, UWB PHY Config and UWB MAC Config fields shall be present. |
| Report |  |  |  |  |
| REPORT (from responder) | 0x07 | [RPA\_hash[3], MessageControl[1], MessageContent[], CRC16] | MessageControl=0x10: MessageContent={  Presence Bitmap[1], ReplyTime[5], PTDataLength[1], PTData[PTDataLength],  If Bit 0 of Presence Bitmap == 1 then {NB Channel Select[2]}, If Bit 1 of Presence Bitmap == 1 then {NB PHY Config[1]}, If Bit 2 of Presence Bitmap == 1 then {NB MAC Config[7]},  If Bit 3 of Presence Bitmap == 1 then {UWB PHY Config[3]}, If Bit 4 of Presence Bitmap == 1 then {UWB MAC Config[2]}},  where PTDataLength and PTData fields are optionally present and represent pass through data to higher layers; and at least one of NbaChannelMap, NB PHY Config, NB MAC Config, UWB PHY Config and UWB MAC Config fields shall be present. |
| REPORT (from responder in one-to-many ranging) | 0x12 | [RPA\_hash[3], MessageControl[1], MessageContent[], CRC16] | MessageControl=0x10: MessageContent={  Presence Bitmap[1], ReplyTime[5], PTDataLength[1], PTData[PTDataLength],  If Bit 0 of Presence Bitmap == 1 then {NB Channel Select[2]}, If Bit 1 of Presence Bitmap == 1 then {NB PHY Config[1]}, If Bit 2 of Presence Bitmap == 1 then {NB MAC Config[7]},  If Bit 3 of Presence Bitmap == 1 then {UWB PHY Config[3]}, If Bit 4 of Presence Bitmap == 1 then {UWB MAC Config[2]}},  where at least one of NbaChannelMap, NB PHY Config, NB MAC Config, UWB PHY Config and UWB MAC Config fields shall be present. |
|  |  |  |  |
|  |  |  |  |  |

* + - 1. Compressed PSDU message fields

***Modify the clause as follows:***

|  |  |  |
| --- | --- | --- |
| **Field name** | **Length in bits** | **Description** |
| … |  |  |
| Request Bitmap | 8 | Bit 0: NbaChannelMap requested: 0: not requested, 1: requested  Bit 1: NB PHY Config requested: 0: not requested, 1: requested  Bit 2: NB MAC Config requested: 0: not requested, 1: requestedBit 3: UWB PHY Config requested: 0: not requested, 1: requested  Bit 4: UWB MAC Config requested: 0: not requested, 1: requested  Bits 5-7: reserved |
| Presence Bitmap | 8 | Bit 0: NB Channel Select or NbaChannelMap’s presence: 0 not present, 1: present  Bit 1: NB PHY Config’s presence: 0 not present, 1: present  Bit 2: NB MAC Config’s presence: 0 not present, 1: present  Bit 3: UWB PHY Config’s presence: 0 not present, 1: present  Bit 4: UWB MAC Config’s presence: 0 not present, 1: present  Bit 5: Scheduling Information's presence (i.e., StartSlotIndex[2] and EndSlotIndex[2]): 0 not present, 1: present  Bits 6-7: reserved |
| … |  |  |
|  |  |  |
|  |  |  |
| CapDuration | 8 | The number of initialization slots contained in the CAP minus one. |
| … |  |  |
| SMC\_TLVs | var | The list of supported message control commands, where SMC\_TLVs[] contains one or more SMC\_TLV items. |
| SMC\_TLV | var | SMC = {PSDU\_ID[1], LEN(SMC\_MessageControls)[1], SMC\_MessageControls[]}, where each octet in SMC\_MessageControls signals support for message PSDU\_ID. |
| SMC\_MessageControls[] | var | Array of supported MessageControl codes. |