**IEEE P802.15**

**Wireless Personal Area Networks**

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| Re: | [If this is a proposed revision, cite the original document.][If this is a response to a Call for Contributions, cite the name and date of the Call for Contributions to which this document responds, as well as the relevant item number in the Call for Contributions.][Note: Contributions that are not responsive to this section of the template, and contributions which do not address the topic under which they are submitted, may be refused or consigned to the “General Contributions” area.] |
| Abstract | [Further 802.15.4z HRP UWB comment resolutions] |
| Purpose | [Resolve 802.15.4z HRP UWB comments] |
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**This document provides resolutions to comments i-0075, i-0119, i-0233, i-0309, i-0310, i-0311, i-0319, i-0410, i-0512, i-0513, i-1147, i-1148, i-1149, i-1150, i-1151, i-1152, i-1153, i-1154, i-1155, i-1156, i-1784, i-1785, i-1786, i-1787, i-1788, i-1789, i-1790, i-1791, i-1792, i-1793, i-2343, i-2850, i-2851, i-2852, i-2853, i-2854, i-2855, i-2856, i-2857, i-2858, i-2859, and rg-0012.**

**The following resolution applies to i-0075, i-0119, i-0233, i-0309, i-0310, i-0311, i-0512, i-0513, i-1147, i-1148, i-1149, i-1150, i-1151, i-1152, i-1153, i-1154, i-1155, i-1156, i-1784, i-1785, i-1786, i-1787, i-1788, i-1789, i-1790, i-1791, i-1792, i-1793, i-2850, i-2851, i-2852, i-2853, i-2854, i-2855, i-2856, i-2857, i-2858, i-2859.**

***Add 8.2.26 as follows:***

**8.2.26 Primitives for specifying STS parameters**

These primitives are used by a device to define the STS parameters. STS is only supported by HRP-ERDEVs using the HRP UWB PHY.

**8.2.26.1 MLME-STS.request**

The MLME-STS.request primitive allows the next higher layer to request that the PHY utilize a given set of STS parameters.

The semantics of this primitive are:

MLME-STS.request (

TxSTSPPDUMode

TxSTSSegLen

TxSTSSegNum

RxSTSPPDUMode

RxSTSSegLen

RxSTSSegNum

)

The primitive parameters are defined in Table 40.

**Table 40 — MLME-STS.request parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** |
| TxSTSPPDUMode | Integer | 0–3 | Indicates the STS PPDU mode, as defined in Table 13. |
| TxSTSSegLen | Integer | 0–3 | Indicates the STS active segment length, as defined in Table 16-AD2. |
| TxSTSSegNum | Integer | 0–3 | Indicates the number of STS segments, as defined in Table 16-AD3. |
| RxSTSPPDUMode | Integer | 0–3 | Indicates the STS PPDU mode, as defined in Table 13. |
| RxSTSSegLen | Integer | 0–3 | Indicates the STS active segment length, as defined in Table 16-AD2. |
| RxSTSSegNum | Integer | 0–3 | Indicates the number of STS segments, as defined in Table 16-AD3. |

This primitive may also be generated to cancel a previously generated request to configure STS parameters.

**8.2.26.2 MLME-STS.confirm**

The MLME-STS.confirm primitive reports the results of the attempt to configure STS parameters.

The semantics of this primitive are:

MLME-STS.confirm (

status

)

The primitive parameter is defined in Table 41.

**Table 41 — MLME-STS.confirm parameter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** |
| status | Enumeration | SUCCESS,STS\_CFG\_NOT\_SUPPORTED | The result of the request to configure STS parameters. |

The MLME-STS.confirm primitive is generated by the MLME and issued to its next higher layer in response

to an MLME-STS.request primitive.

If any parameter in the MLME-STS.request primitive is not supported or is out of range, the status of

STS\_CFG\_NOT\_SUPPORTED is returned. If the request to configure the STS parameters was successful, the MLME

issues the MLME-STS.confirm primitive with a status of SUCCESS.

**8.3.3 MCPS-DATA.indication**

***Change Lines 10-39 on Page 85 as follows:***

MCPS-DATA.indication (

SrcAddrMode,

SrcPanId,

SrcAddr,

DstAddrMode,

DstPanId

DstAddr,

Msdu,

HeaderIeList,

PayloadIeList,

MpduLinkQuality,

Dsn,

Timestamp,

SecurityLevel,

KeyIdMode,

KeySource,

KeyIndex,

RangingReceived,

~~RangingCounterStart~~TxRangingCounter

~~RangingCounterStop~~RxRangingCounter

RangingTrackingInterval,

RangingOffset,

RangingFom,

RxS0RangingCounter,

RxS1RangingCounter,

RxS2RangingCounter,

RxS3RangingCounter,

RxS4RangingCounter,

TxS0RangingCounter,

TxS1RangingCounter,

TxS2RangingCounter,

TxS3RangingCounter,

TxS4RangingCounter,

RangingS1StsFom,

RangingS2StsFom,

RangingS3StsFom,

RangingS4StsFom,

RangingStsAoAFomAzi,

RangingStsAoAFomEle,

AngleOfArrivalAzimuth,

AngleOfArrivalElevation,

AngleOfArrivalSupported,

DataRate,

Rssi

)

***Add the following (or equivalent) regarding the new marker definitions:***

For STS-based ranging, Figure AD1, shows how markers relate to the locations of the fields in the packet. Specifically, the SRMARKER{1,2,3,4} shall be the location on the peak of the hypothetical pulse in the first chip of the gap following STS segment #{1,2,3,4}, respectively. The SRMARKER0 shall be the location on the peak of the hypothetical pulse in the first chip of the 512-chip long gap transmitted before STS segment #1. In case the PHR and PSDU are transmitted after the STS (phyHrpUwbStsPacketConfiguration = 1) or not at all (phyHrpUwbStsPacketConfiguration = 3), SRMARKER0 and RMARKER are at the same location.

Figure AD1: Locations of RMARKER and SRMARKER{0,1,2} for packets containing 2 STS segments.

Note that the the markers for phyHrpUwbStsPacketConfiguration=3 are the same as for phyHrpUwbStsPacketConfiguration=1. In case of {1,3,4} STS segments, marker assignment (up to SRMARKER4 in case of 4 segments) follows the same scheme as shown in the diagram.

SRMARKER{0,1,2,3,4} allow the higher layers to estimate the relative clock offset between the transmitter and the local reference clock at the receiver based on one or more STS segments. For example, to determine the relative clock offset via a single STS segment numbered i, the following calculation can be used:

***Modify rows in Table 8-77 shown:***

**Table 8-77 — MCPS-DATA.indication parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** |
| RxS0RangingCounter | Unsigned Integer | 0x00000000-0xffffffff | A count of the time units corresponding to an SRMARKER0 at the antenna with respect to the reception of the frame being delivered by this MCPS-DATA.indication. The value here is meaningless if ranging is not supported or not enabled. The units of time are specified in 6.9.1.1. |
| RxS1RangingCounter | Unsigned Integer | 0x00000000-0xffffffff | A count of the time units corresponding to an SRMARKER1 at the antenna with respect to the reception of the frame being delivered by this MCPS-DATA.indication. The value here is meaningless if ranging is not supported or not enabled. The units of time are specified in 6.9.1.1. |
| RxS2RangingCounter | Unsigned Integer | 0x00000000-0xffffffff | A count of the time units corresponding to an SRMARKER2 at the antenna with respect to the reception of the frame being delivered by this MCPS-DATA.indication. The value here is meaningless if ranging is not supported or not enabled. The units of time are specified in 6.9.1.1. |
| RxS3RangingCounter | Unsigned Integer | 0x00000000-0xffffffff | A count of the time units corresponding to an SRMARKER3 at the antenna with respect to the reception of the frame being delivered by this MCPS-DATA.indication. The value here is meaningless if ranging is not supported or not enabled. The units of time are specified in 6.9.1.1. |
| RxS4RangingCounter | Unsigned Integer | 0x00000000-0xffffffff | A count of the time units corresponding to an SRMARKER4 at the antenna with respect to the reception of the frame being delivered by this MCPS-DATA.indication. The value here is meaningless if ranging is not supported or not enabled. The units of time are specified in 6.9.1.1. |
| TxS0RangingCounter | Unsigned Integer | 0x00000000-0xffffffff | A count of the time units corresponding to an SRMARKER0 at the antenna with respect to the transmission of the Ack frame (if solicited) by the frame being delivered by this MCPS-DATA.indication. The value here is meaningless if ranging is not supported, not enabled, or if an Ack frame was not solicited by the received frame. The units of time are specified in 6.9.1.1. |
| TxS1RangingCounter | Unsigned Integer | 0x00000000-0xffffffff | A count of the time units corresponding to an SRMARKER1 at the antenna with respect to the transmission of the Ack frame (if solicited) by the frame being delivered by this MCPS-DATA.indication. The value here is meaningless if ranging is not supported, not enabled, or if an Ack frame was not solicited by the received frame. The units of time are specified in 6.9.1.1. |
| TxS2RangingCounter | Unsigned Integer | 0x00000000-0xffffffff | A count of the time units corresponding to an SRMARKER2 at the antenna with respect to the transmission of the Ack frame (if solicited) by the frame being delivered by this MCPS-DATA.indication. The value here is meaningless if ranging is not supported, not enabled, or if an Ack frame was not solicited by the received frame. The units of time are specified in 6.9.1.1. |
| TxS3RangingCounter | Unsigned Integer | 0x00000000-0xffffffff | A count of the time units corresponding to an SRMARKER3 at the antenna with respect to the transmission of the Ack frame (if solicited) by the frame being delivered by this MCPS-DATA.indication. The value here is meaningless if ranging is not supported, not enabled, or if an Ack frame was not solicited by the received frame. The units of time are specified in 6.9.1.1. |
| TxS4RangingCounter | Unsigned Integer | 0x00000000-0xffffffff | A count of the time units corresponding to an SRMARKER4 at the antenna with respect to the transmission of the Ack frame (if solicited) by the frame being delivered by this MCPS-DATA.indication. The value here is meaningless if ranging is not supported, not enabled, or if an Ack frame was not solicited by the received frame. The units of time are specified in 6.9.1.1. |
| RangingS1StsFom | Unsigned Integer | 0x00-0xff | For the HRP-ERDEV, this parameter reports a percentage measurement of the correlation strength between the received first STS segment and the expected internally generated reference first STS segment, where a value of 255 means 100%. This parameter is meaningless if ranging is not supported, enabled or the receiver is not configured to expect an STS. The value of 0x00 is special and means “no FoM.” |
| RangingS2StsFom | Unsigned Integer | 0x00-0xff | For the HRP-ERDEV, this parameter reports a percentage measurement of the correlation strength between the received second STS segment and the expected internally generated reference second STS segment, where a value of 255 means 100%. This parameter is meaningless if ranging is not supported, enabled or the receiver is not configured to expect two or more STS segments. The value of 0x00 is special and means “no FoM.” |
| RangingS3StsFom | Unsigned Integer | 0x00-0xff | For the HRP-ERDEV, this parameter reports a percentage measurement of the correlation strength between the received third STS segment and the expected internally generated reference third STS segment, where a value of 255 means 100%. This parameter is meaningless if ranging is not supported, enabled or the receiver is not configured to expect three or more STS segments. The value of 0x00 is special and means “no FoM.” |
| RangingS4StsFom | Unsigned Integer | 0x00-0xff | For the HRP-ERDEV, this parameter reports a percentage measurement of the correlation strength between the received fourth STS segment and the expected internally generated reference fourth STS segment, where a value of 255 means 100%. This parameter is meaningless if ranging is not supported, enabled or the receiver is not configured to expect four STS segments. The value of 0x00 is special and means “no FoM.” |
| RangingStsAoAFomAzi | Unsigned Integer | 0x00-0xff | For the HRP-ERDEV, this parameter reports the accuracy of the Angle-of-Arrival measurement in azimuth performed on the received STS, where a value of 255 corresponds to a combination of maximum implementation accuracy as well as maximally favorable signal quality of the received STS. This parameter is valid only when AngleOfArrivalSupported is either set to AZIMUTH, or BOTH. The value of 0x00 is special and means “no FoM.” |
| RangingStsAoAFomEle | Unsigned Integer | 0x00-0xff | For the HRP-ERDEV, this parameter reports the accuracy of the Angle-of-Arrival measurement in elevation performed on the received STS, where a value of 255 corresponds to a combination of maximum implementation accuracy as well as maximally favorable signal quality of the received STS. This parameter is valid only when AngleOfArrivalSupported is either set to ELEVATION, or BOTH. The value of 0x00 is special and means “no FoM. |

***Insert the following paragraphs at the end of 8.3.3:***

In the case of an HRP-ERDEV configured to use SP3 format packets, the reception of a packet shall be treated like the receipt of a broadcast RFRAME. The RangingStsFom, RxRangingCounter, RangingS{1,2}StsFom, and RxS{0,1,2}RangingCounter parameters shall be provided, while all other ranging related parameters are dependent on the capability of the RDEV to support them, and parameters associated with the absent PHR and MAC Frame shall set appropriately empty (the higher layer in any case should not be expecting these when it has configured the use of SP3 packets).

**11.3 PHY PIB attributes**

***Modify rows in Table 11-2 shown:***

**Table 11-2 “PHY PIB attributes”**

|  |  |  |  |
| --- | --- | --- | --- |
| **Attribute** | **Type** | **Range** | **Description** |
| *phyHrpUwbTxStsSegLen* | Integer | 0 to 3 | For HRP-ERDEV, this attribute specifies the length of active STS segment(s) present in the transmitted PPDU as specified in Table 16-AD2. |
| *phyHrpUwbTxStsSegNum* | Integer | 0 to 3 | For HRP-ERDEV, this attribute specifies the number of STS segments present in the transmitted PPDU as specified in Table 16-AD3. |
| *phyHrpUwbRxStsSegLen* | Integer | 0 to 3 | For HRP-ERDEV, this attribute specifies the length of active STS segment(s) in the PPDU to be expected by the receiver, as specified in Table 16-AD2. |
| *phyHrpUwbRxStsSegNum* | Integer | 0 to 3 | For HRP-ERDEV, this attribute specifies the number of STS segments present in the PPDU to be expected by the receiver, as specified in Table 16-AD3. |

***Tables with HPRF HRP-ERDEV STS parameters, to be inserted & referenced in 16.2.8.2:***

**Table 16-AD2 — STS segment lengths**

|  |  |
| --- | --- |
| **Value of the *phyHrpUwbStsSegLen* attribute** | **Length of active STS segment in units of 512 chips (~1 µs)** |
| 0 | 32 |
| 1 | 64 |
| 2 | 128 |
| 3 | 256 |

**Table 16-AD3 — STS number of segments**

|  |  |
| --- | --- |
| **Value of the *phyHrpUwbStsSegNum* attribute** | **Number of STS segments transmitted** |
| 0 | 1 |
| 1 | 2 |
| 2 | 3 |
| 3 | 4 |

**The following resolution applies to i-0319.**

**11.3 PHY PIB attributes**

***Add row in Table 11-2 shown:***

**Table 11-2 “PHY PIB attributes”**

|  |  |  |  |
| --- | --- | --- | --- |
| **Attribute** | **Type** | **Range** | **Description** |
| *phyHrpUwbCcConstraintLength* | Enumeration | CL3 and CL7 | For HRP-ERDEV in the HPRF mode, this attribute specifies the constraint length of the convolutional code in use by the transmitter and receiver, applying to the PHR and PSDU fields, see 16.3.3.2. For HRP UWB PHY in any other mode than HPRF, this attribute shall be ignored, and the constraint length is always 3. |

***Modify the first paragraph of 16.3.3.2 as follows:***

**16.3.3.2 ~~Systematic c~~Convolutional encoding**

The HRP-ERDEV in its HPRF mode may optionally employ the K=7 (advanced) convolutional encoder, associated with the PHY PIB attribute *phyHrpUwbCcConstraintLength* being set to CL7. The advanced convolutional encoder uses generator polynomials (133,171), as shown in Figure 77. Before transmission of each PPDU, this encoder shall be initialized to the all zero state. Additionally, this encoder shall be returned to the all zero state by separately appending six zero bits to both the PHR and the PSDU. When employing this convolutional encoder, the Reed-Solomon coding specified in 16.3.3.1 shall not be applied to the PSDU.

**The following resolution applies to i-0410.**

**6.9.7.5 Ranging procedure for SS-TWR with fixed reply time**

***Change Figure 7 by replacing all instances of “MLME-SET.request” to “MLME-STS.request”.***

***Change Page 15, Lines 9-13 as follows:***

The next higher layer is responsible for properly configuring the operation at both ends, which involves use of the MLME-STS.request primitive parameters TxStsPacketStructure and RxStsPacketStructure to set *phyHrpUwbStsPacketConfiguration* = 3, as well as setting the PIB attributes *phyHrpUwbStsKey*, *phyHrpUwbStsVCounter* and *phyHrpUwbStsVUpper96* to the correct values.

***Change Page 15, Lines 14-15 as follows:***

The MCPS-DATA.request primitive is used to initiate the ranging exchange, even though in this mode the PPDU does not convey MAC data.

***Change Page 16, Lines 1-4 as follows:***

The ranging exchanges are repeated as many times as the higher layers have mutually agreed. To resume PHY and MAC data interactions, the next higher layer uses the MLME-STS.request primitive to restore *phyHrpUwbStsPacketConfiguration* to a value that allows such data interactions. This is shown in the final dashed box in Figure 7.

**The following resolution applies to i-2343.**

Resolution detail as follows:

The counter is a numeric value. The DRBG counter format does not follow Annex B, nor should it, as random number generators are outside the scope of Annex B. The DRBG counter format follows NIST SP 800-90A Rev. 1 convention. For information, Annex H describes how the bit order of the associated IE (following 4.3, i.e., LSB-first) maps to the DRBG output.**The following resolution applies to rg-0012.**

**11.3 PHY PIB attributes**

***Modify rows in Table 11-1 shown:***

**Table 11-2 “PHY PIB attributes”**

|  |  |  |
| --- | --- | --- |
| **Attribute** | **Description** | **Description** |
| *aMaxPhyPacketSize* | The maximum PSDU size (in octets) the PHY shall be able to receive. | 2047 for SUN, TVWS, RCC, and LECIM FSK PHYs. For LECIM DSSS PHY, this is not a constant; refer to *phyLecimDsssPsduSize*. For HRP UWB PHY, this is not a constant; refer to *phyHrpUwbPsduSize*. 127 for all other PHYs. |

***Add rows in Table 11-2 shown:***

**Table 11-2 “PHY PIB attributes”**

|  |  |  |  |
| --- | --- | --- | --- |
| **Attribute** | **Type** | **Range** | **Description** |
| *phyHrpUwbPsduSize* | Integer | 0 to 2 | For HRP-ERDEVs in HPRF mode, this attribute specifies the use of the A0 and A1 bits (as set by *phyHrpUwbPhrA0* and *phyHrpUwbPhrA1*, respectively) to increase *aMaxPhyPacketSize* and extend the length of the “PHR payload length” field. 0 corresponds to *aMaxPhyPacketSize* = 1023, 1 corresponds to *aMaxPhyPacketSize* = 2047, and 2 corresponds to *aMaxPhyPacketSize* = 4095. For HRP UWB PHY in any other mode than HPRF, this attribute shall be ignored and *aMaxPhyPacketSize* = 127. |

**16.2.6 PHR field**

***Append the following text to “16.2.6 PHR field”:***

The application specific bits A1 and A0 may be optionally used to extend the “PHY payload length” field. Where this feature is being employed, the receiver shall interpret either only A0 or both A0 and A1 as MSBs of the extended “PHY payload length” field. Where this feature is not being employed, e.g., the application wishes to use A1 and A0 for some other signaling purpose, it may be disabled by setting the *phyHrpUwbPsduSize* PIB attribute to zero. It is the responsibility of the higher layers to ensure that A1 and A0 are correctly set in the PHR, using the *phyHrpUwbPhrA0* and *phyHrpUwbPhrA1* attributes. There are two options to extend the “PHY payload length” field. The first option, by setting *phyHrpUwbPsduSize* to 1, increases *aMaxPhyPacketSize* to 2047, with the PSDU length being encoded as A0\*2^10 + L9\*2^9 + L8\*2^8 + L7\*2^7 + L6\*2^6 + L5\*2^5 + L4\*2^4 + L3\*2^3 + L2\*2^2 + L1\*2^1 + L0\*2^0. The second option, by setting *phyHrpUwbPsduSize* to 2, increases *aMaxPhyPacketSize* to 4095, with the PSDU length being encoded as A1\*2^11 + A0\*2^10 + L9\*2^9 + L8\*2^8 + L7\*2^7 + L6\*2^6 + L5\*2^5 + L4\*2^4 + L3\*2^3 + L2\*2^2 + L1\*2^1 + L0\*2^0. Otherwise, *aMaxPhyPacketSize* = 1023, with the PSDU length being encoded as L9\*2^9 + L8\*2^8 + L7\*2^7 + L6\*2^6 + L5\*2^5 + L4\*2^4 + L3\*2^3 + L2\*2^2 + L1\*2^1 + L0\*2^0.