**IEEE P802.15**

**Wireless Personal Area Networks**

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| --- | --- |
| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) |
| Title | IEEE 802.15.4z MAC LRP - CRG |
| Date Submitted | 29th July 2019 |
| Source | Peter Sauer (Microchip), David Barras (3dB-technologies), Boris Danev (3dB-technologies), Patrik Leu (ETH Zurich) |
| Re: | Letter Ballot Comments with Figures and Tables – P802.15.4z-D1 |
| Abstract | This contribution proposes updated text for the baseline draft P802.15.4z-D1 |
| Purpose | Provision of the text to facilitate its incorporation into the draft text of the IEEE 802.15.4z standard currently under development in TG4z. |
| Notice | This document does not represent the agreed views of the IEEE 802.15 Working Group. It represents only the views of the participants listed in the “Source(s)” field above. 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 |  |
| Patent Policy | The contributor is familiar with the IEEE-SA Patent Policy and Procedures:  <http://standards.ieee.org/guides/bylaws/sect6-7.html#6> and  <http://standards.ieee.org/guides/opman/sect6.html#6.3>.  Further information is located at <http://standards.ieee.org/board/pat/pat-material.html> and  <http://standards.ieee.org/board/pat>. |

**Technical Comments**

* i-0143:

**Page 5 Line 18 to 19:**

*Reject comment; do not change text in draft as time unit is already defined in standard 15.4-2015 Table 8-40.*

* i-1132, i-1769, i-2812:

**Page 76 Line 15:**

*Reject comment; for LRP devices the fixedReplyTime is defined by phyFixedReplyTime with fixed values of 4, 8, 16, 32 µs; for HRP devices the max. fixedReplyTime is about 67 ms*

* i-0423, i-0424, i-0425, i-0426, i-0427, i-0428, i-2428, i-0713, i-1350, i-0429, i-0145, i-0430, i-0144, i-2819, i-2815, i-2816, i-2813, i-2814, i-2817, i-2817, i-2820, i-2818, i-0721, i-0723, i-1358, i-1360:

**Page 16 Line 9 to 23:**

*Revise comments for this section lines 9 to 23 and Figure 8 and replace with following text:*

For ranging with SS-TWR and DS-TWR and fixed reply times using one way authentication with and without tolerating bit errors refer to section 6.9.9.4.

*(The following figure is the revised Figure 8 moved to section 6.9.9.4 and an explaining comment which is updated by contribution in document 15-19-0259-xx-004z-lb-comment-resolution-6.9.9.docx)*

(For UWB LRP SS-TWR ranging with Verifier and Prover device the ranging procedure uses a fixed reply time defined by *phyFixedReplyTime*. The Prover device acting as a responder is first configured with MCPS-RANGING-REPLY.request to start as a receiver. The verifier device initiates the ranging using the MCPS-RANGING.request primitive. The Verifier MAC generate the Challenge data before transmission with the Ranging command and the Prover MAC the Response data before reply with the Ranging Reply command. Verifier switch into receive and Prover switch into transmit mode after the fixed reply time has expired. MCPS-RANGING-REPLY.indication and MCPS-RANGING.indication primitives provide the Challenge and Response data together with the ranging counter information to the upper layer. MCPS-RANGING-REPLY.confirm and MCPS-RANGING.confirm message are triggered by the indication messages or by the TimeOut to report the status to the upper layers and to disable the ranging.

The configuration of the Verifier and Prover node requires the setting for the *phyFixedReplyTime*, the TimeOut to abort the transfer and ranging, the RawMode to ignore FCS checks, set *macMaxFrameRetries*= 0 and setting the AddressMask to disable filtering of the addresses. The length of the Challenge and Response is defined with the SecurityLevel.



***Figure 8—Message sequence chart for SS-TWR with fixed reply time)***

* i-0237, i-0468, i-0469, i-0046, i-0147, i-2698, i-0847, i-1484, i-2696, i-0845, i-1482, i-2697, i-0846, i-1483, i-2694, i-0843, i-1480, i-2695, i-0844, i-1481, i-2693, i-0842, i-1479:

**Page 31 Line 10 to 19:**

*Revise comments for this section. This description (lines 10 to 19 and Figure 23) shall be moved and inserted after section 6.9.9.4.1 in the document 15-19-0259-xx-004z-lb-comment-resolution-6.9.9.docx and can be removed from page 31 in the draft P802.15.4z-D1.*

(6.9.9.4.2 SS-TWR with one-way authentication for multiple nodes

Figure 23 illustrates the ranging for multi-node SS-TWR with one-way authentication between one Verifier and N Prover with different *FixedReplyDelayTime(1…N)*, i.e., each Prover is configured with its own fixed reply time such that the response frames do not overlap. In case of variable PRP as defined in 19.2.5 the response frames may overlap each other. The *FixedReplyDelayTime* for each prover device is defined by *phyFixedReplyTime\*phyFixedDelayFactor.* In both cases the Verifier MAC captures each RangingCounterStop(1…N) and each Response(1...N). The Prover devices respond to the broadcast address and the Verifier use AddressMask defined with the MCPS-RANGING.request to accept a range of Prover addresses. The Verifier and Prover Timeout for the ranging frames shall be set accordingly to the N Prover *FixedReplyDelayTime(1…N)* at the Verifier and Prover higher layer.



**Figure 23—Message sequence chart for multi-node SS-TWR with fixed reply time)**

* i-0200, i-0072, i-0570, i-0509, i-0301, i-2112, i-1133, i-1770, i-0107, i-2109, i-0131, i-0136, i-0139, i-1849, i-0005, i-0154, i-0201, i-0073, i-0571, i-0510, i-0302, i-2198, i-1134, i-1771, i-0108, i-2195, i-0132, i-0137, i-0140, i-1850, i-0006, i-0155, i-0109, i-2196, i-0133, i-0138, i-0141, i-1851, i-0007, i-0202, i-0303, i-0074, i-0572, i-0511, i-2296, i-1135, i-1772, i-0156, i-0018:
* Remove this clause and the entry in Table 7-16

**7.4.4.59 Challenge IE**

* Remove this clause and the entry in Table 7-16

**7.4.4.59 Response IE**

* Remove this clause and the entry in Table 7-16

**7.4.4.61 ReplyTime IE**

* New additions:

***7.5.1 Command ID field***

*Add in table 7-49 new MAC commands*

ID1\_tbd\*) Ranging command

ID2\_tbd\*) Ranging Reply command

*\*) the command ID must be requested and is assigned by IEEE*

* Add new sections

**7.5.27 Ranging command**

This command shall only be sent by the Verifier ranging device in combination with the MCPS-RANGING.request primitive.

The Destination Addressing Mode field and Source Addressing Mode field shall be set to indicate no addressing or short addressing.

The Frame Pending field and the AR field shall be set to zero and the Frame Version field shall set to 0b10.

The Sequence Number Suppression field shall be set to one.

The Content field uses the following format.

|  |  |
| --- | --- |
| **Octets: 1** | **4/8/16** |
| Reserved | Challenge |

**Figure 1—Content field for Ranging command**

Reserved is used for future use and shall be set to zero.

Challenge field includes Challenge data created by the MAC and the length is defined by the SecurityLevel for MCPS-RANGING.request primitive.

**7.5.28 Ranging Reply command**

This command shall only be sent by the Prover ranging device in combination with the MCPS-RANGING-REPLY.request primitive.

The Destination Addressing Mode field and Source Addressing Mode field shall be set to indicate no addressing or short addressing.

The Frame Pending field and the AR field shall be set to zero and the Frame Version field shall set to 0b10.

The Sequence Number Suppression field shall be set to one.

The Content field uses the following format.

|  |  |
| --- | --- |
| **Octets: 1** | **4/8/16** |
| Reserved | Response |

**Figure 2—Content field for Ranging Reply command**

Reserved is used for future use and shall be set to zero.

Response field includes Response data created by the MAC and the length is defined by the SecurityLevel for MCPS-RANGING-REPLY.request primitive.

**8.3.6 MCPS-RANGING.request**

The MCPS-RANGING.request primitive configures and starts a ranging with fixed reply time as shown in clause 6.9.9. The Verifier device configures the MAC with *phyFixedReplyTime*, *macMaxFrameRetries*=0, enabling or disabling the FCS checking, enabling Ranging with setting of the TimeOut. If the TimeOut timer expires ranging will be aborted and automatically disabled. After configuration a Challenge is generated and the ranging is started using the Ranging command with the Challenge as payload. In multi-node ranging with broadcast address an AddressMask is configured to filter addresses from the Prover responses.

The semantics of this primitive are:

MCPS-RANGING.request (

TimeOut,

RawMode,

AddressMask,

SrcAddrMode,

DstAddrMode,

DstPanId,

DstAddr,

SecurityLevel,

KeyIdMode,

KeySource,

KeyIndex,

DistanceCommitmentLevel,

UwbPreambleSymbolRepetitions,

DataRate,

LocationEnhancingInformationPostamble,

LocationEnhancingInformationPostambleLength

)

The primitive parameters are defined in Table 1.

**Table 1—MCPS-RANGING.request**

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid Range | Description |
| TimeOut | Integer | 0x000000 – 0xFFFFFF | Max. time period for the activation of the ranging. When the timeout period expires or the MCPS-RANGING.confirm is received the current ranging transfer will be aborted and ranging disabled. The time out period is defined by TimeOut \* *phyFixedReplyTime* |
| RawMode | Boolean | TRUE, FALSE | If set to TRUE the FCS check is ignored and the received frame is returned to the higher layer. If set to FALSE FCS check is active. |
| AddressMask | Short address | -- | The address mask bits enable the corresponding address bit check when set to 1. When set to 0 the corresponding address bit is don’t care. |
| SrcAddrMode | Enumeration | NONE, SHORT | The source addressing mode. |
| DstAddrMode | Enumeration | NONE, SHORT | The destination addressing mode. |
| DstPanId | Integer | 0x0000–0xffff | The PAN ID of the entity to which the command is being transferred. |
| DstAddr | -- | As specified by the  DstAddrMode parameter. | The address of the entity to which the command is being transferred. |
| SecurityLevel | Integer | As defined in Table 9-6 | The security level to be used. |
| KeyIdMode |  | As defined in Table 9-7 | The mode used to identify the key to be used. This parameter is ignored if the SecurityLevel parameter is set to 0x00. |
| KeySource | Set of octets | As specified by the  KeyIdMode parameter | The originator of the key to be used, as described in 9.4.3.1. This parameter is ignored if the KeyIdMode parameter is ignored or set to 0x00 or 0x01. |
| KeyIndex | Integer | 0x01–0xff | The index of the key to be used, as described in 9.4.3.2. This parameter is ignored if the KeyIdMode parameter is  ignored or set to 0x00. |
| DistanceCommitmentLevel | Enumeration | DCL\_1\_4096, DCL\_2\_2048, DCL\_1\_1024, DCL\_1\_512, DCL\_1\_256, DCL\_1\_128, DCL\_1\_64,  DCL\_DISABLED | Specifies the aperture time Tint,RF in the fraction of one microsecond used to collect earliest path(s) by the receiver for symbol decoding in the PSDU in the LRP UWB PHY (see clause 19.6) |
| UwbPreambleSymbolRepetitions | Integer | 0, 16, 32, 64, 128, 256, 512, 1024, 4096, 8192 | The preamble symbol repetitions of the LRP UWB frame. A zero value is used for all other PHYs. |
| DataRate | Integer | -- | Indicates the data rate. For LRP UWB PHYs, valid values are defined in Table 19-1. For all other PHYs, the parameter is set to zero. |
| LocationEnhancingInformationPostamble | Enumeration | LEIP\_NONE, LEIP\_IMMEDIATE, LEIP\_DELAYED | For the LRP UWB PHY this parameter specifies whether the Location enhancing information postamble sequence is to be sent or not and, if present, whether it directly follows the CRC or is delayed by the *aLeipDelayTime*. A value of LEIP\_NONE is used for non-LRP UWB PHYs. |
| LocationEnhancingInformationPostambleLength | Enumeration | LEIP\_LEN\_16, LEIP\_LEN\_64,  LEIP\_LEN\_128, LEIP\_LEN\_192,  LEIP\_LEN\_256,  LEIP\_LEN\_512,  LEIP\_LEN\_1024 | LEIP\_LEN\_16, LEIP\_LEN\_64,  LEIP\_LEN\_128, LEIP\_LEN\_192,  LEIP\_LEN\_256, LEIP\_LEN\_512, LEIP\_LEN\_1024  For the LRP UWB PHY when the  LocationEnhancingInformationPostamble parameter has a value of either LEIP\_IMMEDIATE or  LEIP\_DELAYED, then this parameter specifies the length in pulses of the location enhancing information postamble to send. This parameter is ignored when the LocationEnhancingInformationPostamble parameter has a value of LEIP\_NONE. |

**8.3.7 MCPS-RANGING.indication**

The MCPS-RANGING.indication primitive indicates the reception of the Ranging Reply command from a Prover device.

The semantics of this primitive are:

MCPS-RANGING.indication (

SrcAddrMode,

SrcPanId,

SrcAddr,

DstAddrMode,

DstPanId,

DstAddr,

SecurityLevel,

KeyIdMode,

KeySource,

KeyIndex,

DistanceCommitmentLevel,

RangingStatus,

RangingCounterStart,

RangingCounterStop,

Rssi,

Challenge,

Response

)

The primitive parameter are defined in Table 2.

**Table 2—MCPS-RANGING.indication**

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid Range | Description |
| SrcAddrMode | Enumeration | NONE, SHORT | The source addressing mode of the received command. |
| SrcPanId | Integer | 0x0000–0xffff | The PAN ID of the entity from which the command was received. Valid only when a source PAN ID is included in the received frame. |
| DstAddrMode | Enumeration | NONE, SHORT | The destination addressing mode of the received command. |
| DstPanId | Integer | 0x0000–0xffff | The PAN ID of the entity to which the command is being transferred. Set to the receiver’s PAN ID if the PAN ID is not carried in the received frame. |
| DstAddr | -- | As specified by the  DstAddrMode parameter. | The address of the entity to which the command is being transferred. |
| SecurityLevel | Integer | 0x00-0x07 | The security level purportedly used by the received command, as defined in Table 9-6. |
| KeyIdMode | Integer | 0x00-0x03 | The mode used to identify the key purportedly used by the originator of the received frame, as defined in Table 9-7. This parameter is invalid if the SecurityLevel parameter is set to 0x00. |
| KeySource | Set of octets | As specified by the  KeyIdMode parameter | The originator of the key purportedly used by the originator of the received frame, as described in 9.4.3.1. This parameter is invalid if the KeyIdMode parameter is invalid or set to 0x00 or 0x01. |
| KeyIndex | Integer | 0x01–0xff | The index of the key purportedly used by the originator of the received frame, as described in 9.4.3.2. This parameter is invalid if the KeyIdMode parameter is invalid or set to 0x00. |
| DistanceCommitmentLevel | Enumeration | DCL\_1\_4096, DCL\_2\_2048, DCL\_1\_1024, DCL\_1\_512, DCL\_1\_256, DCL\_1\_128, DCL\_1\_64,  DCL\_DISABLED | The aperture time Tint,RF in the fraction of one microsecond used to collect earliest path(s) by the receiver for symbol decoding in the PSDU in the LRP UWB PHY (see clause 19.6) |
| RangingStatus | Enumeration | RANGING\_ACTIVE, RANGING\_ABORTED,  NO\_RANGING\_RECEIVED | A value of NO\_RANGING\_  RECEIVED indicates that the received frame was not a ranging frame. A value of RANGING\_ACTIVE denotes ranging operations is active and enabled. A value of RANGING\_ ABORTED denotes that ranging is disabled or timed out. |
| RangingCounterStart | Unsigned  Integer | 0x00000000–  0xffffffff | A count of the time units corresponding to an RMARKER at the antenna at the beginning of a ranging exchange.  The 36bit ranging counter operates with the time unit defined in clause 6.9.1.1. for the LRP UWB PHY. The RangingCounterStart are the 32bit MSB of this counter. |
| RangingCounterStop | Unsigned  Integer | 0x00000000–  0xffffffff | A count of the time units corresponding to an RMARKER at the antenna at the end of a ranging exchange. A value of 0x00000000 is used if ranging is not supported or not enabled.  The RangingCounterStop are the 32bit MSB of the 36bit ranging counter. |
| Rssi | Integer | 0x00-0xff | The Received Signal Strength Indicator is a measure of the RF power level at the input of the transceiver measured during the SFD. |
| Challenge | Set of octets | As defined in clause 7.5.27 | Payload send by the Verifier with Ranging command. |
| Response | Set of octets | As defined in clause 7.5.28 | Payload send by the Prover with Ranging Reply command. |

**8.3.8 MCPS-RANGING.confirm**

The MCPS-RANGING.confirm primitive reports the result of a ranging request to transfer a Ranging Reply command from a Prover device.

The semantics of this primitive are:

MCPS-RANGING.confirm (

Status

)

The primitive parameter is defined in Table 3.

**Table 3—MCPS-RANGING.confirm**

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid Range | Description |
| Status | Enumeration | SUCCESS, TIMEOUT,  INVALID\_PARAMETER,  RANGING\_NOT\_SUPPORTED | The result of the request for the ranging operation. |

**8.3.9 MCPS-RANGING-REPLY.request**

The MCPS-RANGING-REPLY.request primitive configures and starts the receiver for a ranging with fixed reply time as shown in clause 6.9.9. The Prover device configures the MAC with *phyFixedReplyTime*, enabling or disabling the FCS checking, enabling Ranging with setting of the TimeOut. If the TimeOut timer expires ranging will be aborted and automatically disabled. After configuration a Response is created when a Ranging command is received and the transfer of a Ranging Reply command using the Response as payload is started when the *phyFixedReplyTime* is expired. In multi-node ranging the Prover replies to the broadcast address using the *FixedReplyDelayTime* as described in clause 6.9.9.4.2.

The semantics of this primitive are:

MCPS-RANGING-REPLY.request (

TimeOut,

RawMode,

SrcAddrMode,

DstAddrMode,

DstPanId,

DstAddr,

SecurityLevel,

KeyIdMode,

KeySource,

KeyIndex,

DistanceCommitmentLevel,

UwbPreambleSymbolRepetitions,

DataRate,

LocationEnhancingInformationPostamble,

LocationEnhancingInformationPostambleLength

)

The primitive parameters are defined in Table 4.

**Table 4—MCPS-RANGING-REPLY.request**

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid Range | Description |
| TimeOut | Integer | 0x000000 – 0xFFFFFF | Max. time period for the activation of the ranging. When the timeout period expires or the MCPS-RANGING-REPLY.confirm is received the current ranging transfer will be aborted and ranging disabled. The time out period is defined by TimeOut \* *phyFixedReplyTime* |
| RawMode | Boolean | TRUE, FALSE | If set to TRUE the FCS check is ignored and the received frame is returned to the higher layer. If set to FALSE FCS check is active. |
| SrcAddrMode | Enumeration | NONE, SHORT | The source addressing mode. |
| DstAddrMode | Enumeration | NONE, SHORT | The destination addressing mode. |
| DstPanId | Integer | 0x0000–0xffff | The PAN ID of the entity to which the command is being transferred. |
| DstAddr | -- | As specified by the  DstAddrMode parameter. | The address of the entity to which the command is being transferred. |
| SecurityLevel | Integer | As defined in Table 9-6 | The security level to be used. |
| KeyIdMode |  | As defined in Table 9-7 | The mode used to identify the key to be used. This parameter is ignored if the SecurityLevel parameter is set to 0x00. |
| KeySource | Set of octets | As specified by the  KeyIdMode parameter | The originator of the key to be used, as described in 9.4.3.1. This parameter is ignored if the KeyIdMode parameter is ignored or set to 0x00 or 0x01. |
| KeyIndex | Integer | 0x01–0xff | The index of the key to be used, as described in 9.4.3.2. This parameter is ignored if the KeyIdMode parameter is  ignored or set to 0x00. |
| DistanceCommitmentLevel | Enumeration | DCL\_1\_4096, DCL\_2\_2048, DCL\_1\_1024, DCL\_1\_512, DCL\_1\_256, DCL\_1\_128, DCL\_1\_64,  DCL\_DISABLED | Specifies the aperture time Tint,RF in the fraction of one microsecond used to collect earliest path(s) by the receiver for symbol decoding in the PSDU in the LRP UWB PHY (see clause 19.6) |
| UwbPreambleSymbolRepetitions | Integer | 0, 16, 32, 64, 128, 256, 512, 1024, 4096, 8192 | The preamble symbol repetitions of the LRP UWB frame. A zero value is used for all other PHYs. |
| DataRate | Integer | -- | Indicates the data rate. For LRP UWB PHYs, valid values are defined in Table 19-1. For all other PHYs, the parameter is set to zero. |
| LocationEnhancingInformationPostamble | Enumeration | LEIP\_NONE, LEIP\_IMMEDIATE, LEIP\_DELAYED | For the LRP UWB PHY this parameter specifies whether the Location enhancing information postamble sequence is to be sent or not and, if present, whether it directly follows the CRC or is delayed by the *aLeipDelayTime*. A value of LEIP\_NONE is used for non-LRP UWB PHYs. |
| LocationEnhancingInformationPostambleLength | Enumeration | LEIP\_LEN\_16, LEIP\_LEN\_64,  LEIP\_LEN\_128, LEIP\_LEN\_192,  LEIP\_LEN\_256,  LEIP\_LEN\_512,  LEIP\_LEN\_1024 | LEIP\_LEN\_16, LEIP\_LEN\_64,  LEIP\_LEN\_128, LEIP\_LEN\_192,  LEIP\_LEN\_256, LEIP\_LEN\_512, LEIP\_LEN\_1024  For the LRP UWB PHY when the LocationEnhancingInformationPostamble parameter has a value of either LEIP\_IMMEDIATE or  LEIP\_DELAYED, then this parameter specifies the length in pulses of the location enhancing information postamble to send. This parameter is ignored when the LocationEnhancingInformationPostamble parameter has a value of LEIP\_NONE. |

**8.3.10 MCPS-RANGING-REPLY.indication**

The MCPS-RANGING-REPLY.indication primitive indicates the reception of the Ranging command from a Verifier device.

The semantics of this primitive are:

MCPS-RANGING-REPLY.indication (

SrcAddrMode,

SrcPanId,

SrcAddr,

DstAddrMode,

DstPanId,

DstAddr,

SecurityLevel,

KeyIdMode,

KeySource,

KeyIndex,

DistanceCommitmentLevel,

Rssi,

Challenge,

Response

)

The primitive parameter is defined in Table 5.

**Table 5—MCPS-RANGING-REPLY.indication**

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid Range | Description |
| SrcAddrMode | Enumeration | NONE, SHORT | The source addressing mode of the received command. |
| SrcPanId | Integer | 0x0000–0xffff | The PAN ID of the entity from which the command was received. Valid only when a source PAN ID is included in the received frame. |
| DstAddrMode | Enumeration | NONE, SHORT | The destination addressing mode of the received command. |
| DstPanId | Integer | 0x0000–0xffff | The PAN ID of the entity to which the command is being transferred. Set to the receiver’s PAN ID if the PAN ID is not carried in the received frame. |
| DstAddr | -- | As specified by the  DstAddrMode parameter. | The address of the entity to which the command is being transferred. |
| SecurityLevel | Integer | 0x00-0x07 | The security level purportedly used by the received command, as defined in Table 9-6. |
| KeyIdMode | Integer | 0x00-0x03 | The mode used to identify the key purportedly used by the originator of the received frame, as defined in Table 9-7. This parameter is invalid if the SecurityLevel parameter is set to 0x00. |
| KeySource | Set of octets | As specified by the  KeyIdMode parameter | The originator of the key purportedly used by the originator of the received frame, as described in 9.4.3.1. This parameter is invalid if the KeyIdMode parameter is invalid or set to 0x00 or 0x01. |
| KeyIndex | Integer | 0x01–0xff | The index of the key purportedly used by the originator of the received frame, as described in 9.4.3.2. This parameter is invalid if the KeyIdMode parameter is invalid or set to 0x00. |
| DistanceCommitmentLevel | Enumeration | DCL\_1\_4096, DCL\_2\_2048, DCL\_1\_1024, DCL\_1\_512, DCL\_1\_256, DCL\_1\_128, DCL\_1\_64,  DCL\_DISABLED | The aperture time Tint,RF in the fraction of one microsecond used to collect earliest path(s) by the receiver for symbol decoding in the PSDU in the LRP UWB PHY (see clause 19.6) |
| Rssi | Integer | 0x00-0xff | The Received Signal Strength Indicator is a measure of the RF power level at the input of the transceiver measured during the SFD. |
| Challenge | Set of octets | As defined in clause 7.5.27 | Payload send by the Verifier with Ranging command. |
| Response | Set of octets | As defined in clause 7.5.28 | Payload send by the Prover with Ranging Reply command. |

**8.3.11 MCPS-RANGING-REPLY.confirm**

The MCPS-RANGING-REPLY.confirm primitive reports the result of a ranging request to transfer a Ranging Reply command to a Verifier device.

The semantics of this primitive are:

MCPS-RANGING-REPLY.confirm (

Status

)

The primitive parameter is defined in Table 6.

**Table 6—MCPS-RANGING-REPLY.confirm**

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid Range | Description |
| Status | Enumeration | SUCCESS, TIMEOUT,  INVALID\_PARAMETER,  RANGING\_NOT\_SUPPORTED | The result of the request for the ranging operation. |

**11.3 PHY PIB attributes**

**Table 11-2–PHY PIB attributes**

*Insert the following new PHY PIB attributes into Table 11-2:*

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid Range | Description |
| *phyFixedDelayFactor* | Integer | 0 to 32767 | Define the reply delay factor for the reply time in multi-node ranging with *phyFixedReplyTime*. |