**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 LB213/D02 Comments Resolution for LE UWB PHY (Clause 33) CIDs 225, 658, 663** |
| Date Submitted | May 2025 |
| Sources | Larry Zakaib (Spark Microsystems)  larry.zakaib@sparkmicro.com |
| Re: |  |
| Abstract | Proposed comments resolution for CIDs 225, 658, 663 |
| Purpose | Proposed resolutions to Clause 33 comments for “P802.15.4ab™/D2.0 Draft Standard for Low-Rate Wireless Networks”. |
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# CID 187

# CID 225 (Accepted)

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| **Name** | **Index #** | **Page** | **Sub-clause** | **Line #** | **Comment** | **Proposed Change** | **Disposition Detail** | **Category** |
| NEIRYNCK, DRIES | 225 | 253 | 33.4 | 15 | The UWB LE PHY does not have any specification on the clock accuracy. There were none in the original proposal because it was assumed that the LE PHY would be integrated in chapter 16 (HRP PHY) which already has the +/- 20 ppm spec for the coherent radios. However, now that the LE PHY is in a separate chapter, that chapter should specify clock accuracy such that designers know the worst-case to expect at the receiver. | Add a new clause in the "33.4 RF requirements" section, "33.4.5 Symbol clock accuracy" stating "Symbol durations shall be within +/- 100 ppm of the specified symbol rate in 33.3.4 and 33.3.5." | Accepted | PHYLE |

# CID 663 (Revised)

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| **Name** | **Index #** | **Page** | **Sub-clause** | **Line #** | **Comment** | **Proposed Change** | **Disposition Detail** | **Category** |
| ZAKAIB, LARRY | 663 | 250 | 33.2.6.2 | 1 | Symbol Rates 27.30 MHz and 40.96 MHz are missing from the LE UWB PHY Table 91 | Add the 27.30 MHz and 40.96 MHz Symbol Rates and corresponding data rates for each config to Table 91.  Amend sections 33.3.4 and 33.3.5 to include the added symbol rates in the text and corresponding figures.  Add the phyLeUwbSymbolRate attribute to Table 12-14 | Amend Table 91 to include the additional symbol rates as shown below.  Amend sections 33.3.4 and 33.3.5 to include the added symbol rates as shown below.  Add the phyLeUwbSymbolRate attribute to Table 12-14 as shown below | PHYLE |

**Amend Table 91 as shown below**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Modulation selected by the *phyLeUwbModulation*** attribute | **Value of the**  ***phyLeUwbSymbolRate*** attribute | **Symbol Rate**  **(MHz)** | **Value of the *phyLeUwbFecRate*** attribute | **FEC Rate** | **Data Rate**  **(Mb/s)** |
| OOK | SYM\_20\_48 | 20.48 | RATE\_1\_1 | 1 | 20.480 |
| RATE\_4\_5 | 4/5 | 16.384 |
| RATE\_2\_3 | 2/3 | 13.653 |
| RATE\_4\_7 | 4/7 | 11.703 |
| RATE\_1\_2 | 1/2 | 10.240 |
| SYM\_27\_31 | 27.31 | RATE\_1\_1 | 1 | 27.310 |
| RATE\_4\_5 | 4/5 | 21.848 |
| RATE\_2\_3 | 2/3 | 18.207 |
| RATE\_4\_7 | 4/7 | 15.606 |
| RATE\_1\_2 | 1/2 | 13.655 |
| SYM\_40\_96 | 40.96 | RATE\_1\_1 | 1 | 40.960 |
| RATE\_4\_5 | 4/5 | 32.768 |
| RATE\_2\_3 | 2/3 | 27.307 |
| RATE\_4\_7 | 4/7 | 23.406 |
| RATE\_1\_2 | 1/2 | 20.480 |
| BPM | SYM\_10\_24 | 10.24 | RATE\_1\_1 | 1 | 10.240 |
| RATE\_4\_5 | 4/5 | 8.192 |
| RATE\_2\_3 | 2/3 | 6.827 |
| RATE\_4\_7 | 4/7 | 5.851 |
| RATE\_1\_2 | 1/2 | 5.120 |
| SYM\_13\_65 | 13.65 | RATE\_1\_1 | 1 | 13.650 |
| RATE\_4\_5 | 4/5 | 10.920 |
| RATE\_2\_3 | 2/3 | 9.100 |
| RATE\_4\_7 | 4/7 | 7.800 |
| RATE\_1\_2 | 1/2 | 6.825 |
| SYM\_20\_48 | 20.48 | RATE\_1\_1 | 1 | 20.480 |
| RATE\_4\_5 | 4/5 | 16.384 |
| RATE\_2\_3 | 2/3 | 13.653 |
| RATE\_4\_7 | 4/7 | 11.703 |
| RATE\_1\_2 | 1/2 | 10.240 |

**Replace section 33.3.4 with the following:**

**33.3.4 On-off keying (OOK) modulation**

The OOK symbol duration shall be either 12 chips duration (Nc) transmitted at a chip rate of 245.76 MHz corresponding to a 20.48 MHz symbol rate (*T*sym ~48.83 ns), or 9 chips duration (Nc) transmitted at a chip rate of 245.76 MHz corresponding to a 27.31 MHz symbol rate (*T*sym ~36.62 ns), or 6 chips duration (Nc), transmitted at a chip rate of 245.76 MHz corresponding to a 40.96 MHz symbol rate (*T*sym ~24.42 ns).

A symbol may have 1, 2 or 4 active chips. A binary ’0’ is encoded as a silent symbol, while a ’1’ is represented by an active chip sequence. The burst of active chips shall be transmitted at the beginning of the symbol, as shown in Figure 227.

*Tsym*

*Tc*

Guard Interval

*Tsym*

*Tc*

Guard Interval

*Tsym*

*Tc*

Guard

Interval

20.48 MHz Symbol Rate

27.31MHz Symbol Rate

40.96 MHz Symbol Rate

Burst,

1 to 4 chips

Burst,

1 to 4 chips

Burst,

1 to 4 chips

**Figure 227—LE-UWB symbol structure for OOK modulation**

**Replace section 33.3.5 with the following:**

**33.3.5 BPM**

The BPM symbol duration shall be either 24 chips duration (*N*c) transmitted at a chip rate of 245.76 MHz corresponding to a 10.24 MHz symbol rate (*T*sym ~97.66 ns), or 18 chips duration (*N*c) transmitted at a chip rate of 245.76 MHz corresponding to a 13.65 MHz symbol rate (*T*sym ~73.26 ns), or 12 chips duration (*N*c) transmitted at a chip rate of 245.76 MHz corresponding to a 20.48 MHz symbol rate (*T*sym ~48.83 ns). The burst of active chips is either located at the beginning of the first or second half of the symbol, as shown in Figure 228.

An active burst in the first position corresponds to a ‘0’ bit and in the second position to a ‘1’ bit.

10.24 MHz Symbol Rate

*Tsym*

*Tc*

Guard Interval

*Tsym*

*Tc*

Guard Interval

*Tsym*

*Tc*

Guard

Interval

13.65 MHz Symbol Rate

20.48 MHz Symbol Rate

Guard Interval

Burst,

1 to 4 chips

Burst,

1 to 4 chips

Burst,

1 to 4 chips

Burst,

1 to 4 chips

Guard Interval

Burst,

1 to 4 chips

Guard

Interval

Burst,

1 to 4 chips

**Figure 228—LE-UWB symbol structure for BPM modulation**

1. **Amend Table 12-14 to remove the LE PHY related PIB Attributes**
2. **Create new table (Table 12-15) for the LE PHY related PIB Attributes**
3. **Add the *phyLeUwbSymbolRate* attribute to Table 12-15**

**Table 12-15—LE UWB related PIB attributes**

|  |  |  |  |
| --- | --- | --- | --- |
| **Attribute** | **Type** | **Range** | **Description** |
| *phyLeUwbModulation* | Enumeration | OOK, BPM | This selects the modulation type for the LE UWB PHY as described in 33.2.6.2, either OOK or BPM as defined in 33.3.4 and 33.3.5 respectively. |
| *phyLeUwbNumPulse* | Enumeration | PULSE\_1, PULSE\_2, PULSE\_4 | This selects number of pulses *N*cpb within a symbol for the LE UWB PHY as described in 33.2.4. |
| *phyLeUwbCcConstraintLength* | Enumeration | CL5, CL7 | This selects the convolution code for the LE UWB PHY as in 33.3.3. |
| *phyLeUwbFecRate* | Enumeration | RATE\_1\_1, RATE\_4\_5, RATE\_2\_3, RATE\_4\_7, RATE\_1\_2 | This selects the FEC coding rate for the LE UWB PHY as per Table 91. |
| *phyLeUwbSymbolRate* | Enumeration | SYM\_10\_24  SYM\_13\_65  SYM\_20\_48  SYM\_27\_31  SYM\_40\_96 | This selects the symbol rate for the LE UWB PHY as per Table 91. |

# CID 658 (Revised)

|  |  |  |  |  |  |  |  |  |
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| **Name** | **Index #** | **Page** | **Sub-clause** | **Line #** | **Comment** | **Proposed Change** | **Disposition Detail** | **Category** |
| VERSO, BILLY | 658 | 249 | 33.2.6.2 | 14 | This does not make sense that the higher layer handles an option configurable definition. Actually control of the PHY does not make much send to me…. The NHL can set any of these phyLeUwbModulation, phyLeUwbNumPulse, phyLeUwbFecCC and phyLeUwbFecRate to configure what to send (and receive?) so what does the phy send into PHY Config Index field for each of these possible configurations. THis doesn't work, or make sense. | Remove the PHY Configuration field, or make it support all the configurable modes, fix this broken clause 33 or delete it. | Revised:   1. Change P249 Lines 14 - 17 of section 33.2.6.2 as shown below 2. Amend Table 90 as shown below | PHYLE |

**Change P249 Lines 14 - 17 of section 33.2.6.2 from:**

The support of the PHY Config Index field value of zero is mandatory and signals the configuration indicated in table 90. The optional configuration definition, of PHY Config Index field value of one, shall be handled by the higher layer and is not within the scope of this standard.

The configurable parameters are described in Table 91. For the number of pulses refer to 33.3.1.

**To:**

The PHY Config field allows dynamic changing between PHY configurations. It configures the attributes PhyLeUwbModulation and PhyLeUwbFecRate that determine the modulation and FEC rate of the remainder of the packet respectively. The PHY Config Index value of "0" is the mandatory configuration to allow interoperability. The PHY Config Index value of 1 through 6 are optional configurations which can be set by the higher layer to signal any valid selection of Modulation & FEC Rate. The packet shall be discarded if the PHY Config Index is a reserved value, or if PHY Config Index has not been configured. The reserved value enables future extensibility of the PHR.

**Change Table 90 from:**

|  |  |
| --- | --- |
| **PHY Config**  **Index field value** | **Configurations** |
| **0** | Modulation = OOK; FEC (K=5) Rate = 1/2; Number of Pulses = 1 (mandatory) |
| **1** | Optional configurable definition |
| **2 - 7** | Reserved |

**To:**

|  |  |
| --- | --- |
| **PHY Config**  **Index field value** | **Configurations** |
| **0** | Modulation = OOK; FEC (K=5) Rate = 1/2 (mandatory) |
| **1 - 6** | Optional configurable definition |
| **7** | Reserved |

**Explanation**

* The Modulation & FEC Rate can be set by the PHY Config Index field value
* The higher layer sets the Symbol Rate, FEC CC, and Number of pulses attributes according to Table 12-15