**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 Comments Resolution on Sensing Comments Part 2** | |
| Date Submitted | Mar. 2024 | |
| Sources | Bin Qian, Lei Huang, Rojan Chitrakar, David Xun Yang (Huawei) |  |
| Re: |  | |
| Abstract |  | |
| Purpose | To propose comments resolution for “P802.15.4ab™/D (pre-ballot) C Draft Standard for Low-Rate Wireless Networks” | |
| 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. | |

***Comment Index #412 in 15-24-0010-10-04ab-cc-consolidated-comment***

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| **Index #** | **Commenter** | **Sub-Clause** | **Page** | **Line** | **Comment** | **Proposed Change** |
| 412 | Bin Qian | 10.39.4.5.2 | 109 | 22 | The strongest detected CIR tap is optional, which should be mentioned | As in the comment |

**Discussion:**

Regarding the reference point of the window-based CIR measurement report, the earliest detected CIR tap is mandatory, and the strongest detected CIR tap is optional.

**Resolution: Revised**

**Proposed text changes on P802.15.4ab™/D (pre-ballot) C:**

**10.39.4.5 Window-based CIR measurement report**

**10.39.4.5.1 General**

*Add the following text at the end of Line 21 on page 108*

The CIR is estimated from the received sensing PPDU packets. In this case, a window-based approach for the CIR sensing report is used to provide consistency for multiple CIR measurement reports across packets. A sensing report bitmap is used to signal the taps present in the CIR report. The bitmap offset, *BMoffset*, is the offset to the first tap from the reference tap, as shown in Figure 125. The HRP-SDEV shall support the earliest detect CIR tap as the reference tap. Support for the strongest detected CIR tap is optional.

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***Comment Index #658, #659 in 15-24-0010-10-04ab-cc-consolidated-comment***

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| **Index #** | **Commenter** | **Sub-Clause** | **Page** | **Line** | **Comment** | **Proposed Change** |
| 658 | Rojan Chitrakar | 10.39.4.5.2 | 109 | 26 | "The CIR measurement report shall be sampled at Over Sampling Ratio (OSR) of 2,"  What is OSR? | Explain OSR and its effect on the CIR measurement. |
| 659 | Rojan Chitrakar | 10.39.4.5.2 | 109 | 29 | "OSR is defined with respect to signal BW." The preceding sentence states OSR of 2 is used, here seems OSR can vary, which is correct? | Clarify the OSR value for frequency stitching case. |

**Discussion:**

The over sampling ratio is a ratio of the CIR sampling frequency to the signal bandwidth. For example, if the signal bandwidth is 499.2 MHz, the CIR measurement report shall be sampled at 998.4 MHz. The higher over sampling ratio, the more accurate CIR measurement, the higher complexity and report overhead.

For frequency stitching, when the CIR is obtained from an effective larger bandwidth, the OSR is also 2. And the CIR sampling frequency is the aggregated bandwidth times 2.

**Resolution: Revised**

**Proposed text changes on P802.15.4ab™/D (pre-ballot) C:**

**10.39.4.5.2 Mandatory bitmap configurations**

*Change Line 26-29 on page 109 as follows*

The CIR measurement report shall be sampled at Over Sampling Ratio (OSR) of 2, to balance reasonable accuracy, complexity, and report overhead. OSR is defined as the ratio of the CIR tap sampling rate to signal bandwidth.

For frequency stitching feature, when the CIR of an effective larger bandwidth is obtained by an SDEV, OSR is 2 and defined with respect to the aggregated bandwidth.

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***Comment Index #661, #662 in 15-24-0010-10-04ab-cc-consolidated-comment***

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| **Index #** | **Commenter** | **Sub-Clause** | **Page** | **Line** | **Comment** | **Proposed Change** |
| 661 | Rojan Chitrakar | 10.39.4.5.2 | 110 | 1 | "The CIR measurement report signed I/Q values for each RX chain shall be represented using 16 bits. An SDEV may optionally reduce the width of the CIR I/Q values to 10, 12 or 14 bits." The sentences contradict each other. | Rephrase and also explain the relationship with the CIR IQ number of bits field of the AC IE. |
| 662 | Rojan Chitrakar | 10.39.4.5.2 | 110 | 4 | real or imaginary components are same as I and Q? If so, consistent terms should be used. | as in comment |

**Discussion:**

Using 16 bits to represent real and imaginary components of each CIR tap is mandatorily supported. Using 10, 12 and 14 bits to represent real and imaginary components of each CIR tap is optionally supported.

The real component is same as I part, while the imaginary component is same as Q part. It is suggested to use real and imaginary components instead of I/Q values and keep consistency.

**Resolution: Revised**

**Proposed text changes on P802.15.4ab™/D (pre-ballot) C:**

**10.39.4.5.2 Mandatory bitmap configurations**

*Change Line 1-2 on page 110 as follows*

The CIR measurement report signed real and imaginary components for each RX chain shall be represented using 16 bits, and may be represented using 10, 12 or 14 bits optionally.

**10.39.7.1 Application Control IE (AC IE)**

*Change Figure 137 on page 119 as follows*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Bits: 0-1** | **2-3** | **4-13** | **14-15** | **16-17** | **18-24** | **25-31** | **Octets: 0/4/8/16/32** |
|  | Bitmap Mode | Bitmap Offset | Reference Tap | Length | Mode Dependent Parameter | Reserved | Bitmap |

**Figure 137—Report Parameters field format when the Report Type field value is zero**

*Change Figure 139 on page 120 as follows*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Bits: 0-1** | **2-3** | **4-13** | **14-15** | **16-17** | **18-24** | **25** | **26** | **27** | **28** | **29** | **30** | **31** | **32** | **32-39** | **Octets: 0/4/8/16/32** |
|  | Bitmap Mode | Bitmap Offset | Reference Tap | Length | Mode Dependent Parameters | Angle of Arrival (Azimuth) | Angle of Arrival (Elevation) | Delay | Velocity | RSSI | Span | Span Reference | Receiver Orientation | Reserved | Bitmap |

*Change Line 4-8 on page 120 as follows*

The field specifies as the number of bits for encoding signed real and imaginary components each, normalized per antenna receive chain and per segment. The field shall have one of the values specified in Table 23.

Table 23— field values

|  |  |
| --- | --- |
| Field Value | Meaning |
| 0 | 10 bits |
| 1 | 12 bits |
| 2 | 14 bits |
| 3 | 16 bits |

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***Comment Index #96 in 15-24-0010-10-04ab-cc-consolidated-comment***

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| **Index #** | **Commenter** | **Sub-Clause** | **Page** | **Line** | **Comment** | **Proposed Change** |
| 96 | Pooria Pakrooh | 10.39.7.1 | 111 | 4 | Slot/Round/block could apply to sensing too. | Rename "RBDP, RRDP, RSDP" to "BDP, RDP, SDP". |

**Discussion:**

This comment is same as CID 258 and CID 415, which have been resolved by the editor.

**Resolution: Revised, the disposition detail is same as that of CID 258 and CID 415.**

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***Comment Index #416, #417, #665, #257, #852 in 15-24-0010-10-04ab-cc-consolidated-comment***

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| **Index #** | **Commenter** | **Sub-Clause** | **Page** | **Line** | **Comment** | **Proposed Change** |
| 416 | Bin Qian | 10.39.7.1 | 112 | 4 | Remove the TCP field since there is no TDoA Control field any more | As in the comment |
| 417 | Bin Qian | 10.39.7.1 | 112 | 22 | Remove this line since there is no TDoA Control field any more | As in the comment |
| 665 | Rojan Chitrakar | 10.39.7.1 | 117 | 22 | Where is the TDoA Control field? | Delete the TCP field |
| 257 | Dag T. Wisland | 10.39.7.1 | 112 | 1 | The TDoA field corresponding to the TCP field in fig 128 is missing from Fig 127. | Add TDoA Control field to table 127 |
| 852 | Carl Murray | 10.39.7.1 | 112 | 1 | The TDoA field is missing from Figure 127 |  |

**Discussion:**

Since there is no TDoA Control field, the TDoA Control Present (TCP) field and its description are not needed.

**Resolution: Revised**

**Proposed text changes on P802.15.4ab™/D (pre-ballot) C:**

**10.39.7.1 Application Control IE (AC IE)**

*Change Figure 128 on page 112 as follows*

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Bits: 0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |  | **10-15** |
| SIP | RBDP | RRDP | RSDP | Scheduling Mode | Association Availability | CSIP | RCP | DCP | SCP |  | Reserved |

**Figure 128—Content Control field of the AC IE**

*Delete Line 22 on page 112 as follows*

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***Comment Index #857 in 15-24-0010-10-04ab-cc-consolidated-comment***

|  |  |  |  |  |  |  |
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| **Index #** | **Commenter** | **Sub-Clause** | **Page** | **Line** | **Comment** | **Proposed Change** |
| 857 | Carl Murray | 10.39.7.1 | 113 | 19 | Recommend switching the "Preamble Code Configuration" and "MMS Ranging Configuration" fields. This is more logical with respect to the presence bits. |  |

**Resolution: Revised**

**Proposed text changes on P802.15.4ab™/D (pre-ballot) C:**

**10.39.7.1 Application Control IE (AC IE)**

*Change Figure 130 on page 113 as follows*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Bits: 0** | **1** | **2** | **3-7** | **Octets: 0/1** | **4** | **4** |
| Common Ranging Control Present | MMS Ranging Configuration Present | Preamble Code Configuration  Present | Reserved | Common Ranging Control | MMS Ranging Configuration | Preamble Code Configuration |

**Figure 130—Ranging Control field of the AC IE**

*Reposition Line 20-21 on Page 114 after Line 8 on Page 116.*

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***Comment Index #422 in 15-24-0010-10-04ab-cc-consolidated-comment***

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| **Index #** | **Commenter** | **Sub-Clause** | **Page** | **Line** | **Comment** | **Proposed Change** |
| 422 | Bin Qian | 10.39.7.1 | 117 | 12 | Suggest to add the Number of Segment field in Common Sensing Control field | As in the comment |

**Discussion:**

Besides the sensing packet format, the initiator and the responder also need to negotiate the number of segments in the SENS field.

**Resolution: Revised**

**Proposed text changes on P802.15.4ab™/D (pre-ballot) C:**

**10.39.7.1 Application Control IE (AC IE)**

*Change Figure 135 on page 117 as follows*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bits: 0-1** | **2** | **3-4** | **5-6** | 7 |
| Sensing Mode | Responder Role | Sensing Packet Format | Number of Segments | Reserved |

**Figure 135—Common Sensing Control subfield of the Sensing Control field of the AC IE**

*Insert the following text after Line 8 on Page 118*

The Number of Segments field value plus one specifies the number of sensing segments in the SENS field of the sensing packet to be used in the sensing round(s) that follow the AC IE.

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***Comment Index #99 in 15-24-0010-10-04ab-cc-consolidated-comment***

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| **Index #** | **Commenter** | **Sub-Clause** | **Page** | **Line** | **Comment** | **Proposed Change** |
| 99 | Pooria Pakrooh | 10.39.7.1 | 119 | 3 | Compression refers to DEFLATE compression | change the paragraph to "The Compression field when one indicates that the DEFLATE compression is enabled. In this case, the fields to be compressed are specified in Table 22. The Compression field value of zero indicates that the DEFLATE compression is disabled. Support for the DEFLATE compression is optional for an SDEV." |

**Discussion:**

The details of DEFLATE compression could be found in DEFLATE Compressed Data Format Specification version 1.3 (<https://dl.acm.org/doi/pdf/10.17487/RFC1951>)

**Resolution: Revised**

**Proposed text changes on P802.15.4ab™/D (pre-ballot) C:**

**10.39.7.1 Application Control IE (AC IE)**

*Change Line 3-5 on page 119 as follows*

The Compression field when one indicates that the DEFLATE compression is enabled. In this case, the fields to be compressed are specified in Table 22. The Compression field value of zero indicates that the DEFLATE compression is disabled. Support for the DEFLATE compression is optional for an SDEV. The details of DEFLATE compression could be found in [B4].

*Change Table 22 on page 119 as follows*

**Table 22—Fields to be compressed**

|  |  |
| --- | --- |
| **Report Type Field Value** | **Fields to be compressed when Compression field value is one** |
| 0 | CIR Taps field of each receive report in the CIR Report IE |
| 1 | Full Target List field and Sparse Target List field in the Processed Target Feature IE |
| 2 | CIR Taps field of each receive report in the CIR Report IE, and Full Target List field and Sparse Target List field in the Processed Target Feature IE |

*Insert the following reference after [B3] on Page 192*

[B4] P. Deutsch, “DEFLATE Compressed Data Format Specification version 1.3”, May 1996.

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***Comment Index #441 in 15-24-0010-10-04ab-cc-consolidated-comment***

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| **Index #** | **Commenter** | **Sub-Clause** | **Page** | **Line** | **Comment** | **Proposed Change** |
| 441 | Bin Qian | 10.39.7.6 | 132 | 18 | It is suggested to have the Compress field to indicate if the Full Target Report List field and the Sparse Target Report List field are compressed or not | As in the comment |

**Discussion:**

The Full Target List field and the Sparse Target List field could be DEFLATE compressed. It is useful for the responder to report if these fields are compressed or not.

**Resolution: Revised**

**Proposed text changes on P802.15.4ab™/D (pre-ballot) C:**

**10.39.7.6 Processed Target Feature Report IE**

*Change Figure 153 on page 132 as follows*

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Bits: 0-5** | **6** | **7-12** | **13-16** | **19** | **20-23** | **Octets: 0/1** | **0/1** | **0/1** | **0/Variable** | **0/Variable** |
| Number of Targets | EOL | Number of Full Targets | Number of Sparse Targets | Compression | Reserved | Receiver Orientation (Azimuth) | Receiver Orientation (Elevation) | Receiver Orientation (Rotation) | Full Target Report List | Sparse Target Report List |

**Figure 153—Processed Target Feature Report IE Content field format**

*Insert the following paragraph after Line 26 on Page 132*

The Compression field value when one indicates that the Full Target Report List field and the Sparse Target Report List field are DEFLATE compressed, or when zero that compression is not enabled.

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***Comment Index #427 in 15-24-0010-10-04ab-cc-consolidated-comment***

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| **Index #** | **Commenter** | **Sub-Clause** | **Page** | **Line** | **Comment** | **Proposed Change** |
| 427 | Bin Qian | 10.39.7.1 | 124 | 7 | Change "Frequency Stitching Direction field is one" to "Frequency Stitching Direction field is zero" | As in the comment |

**Discussion:**

When the Frequency Stitching Direction field is one, the base channel has the lowest center frequency. When the Frequency stitching direction field value is zero, the base channel has the highest center frequency.

**Resolution: Revised**

**Proposed text changes on P802.15.4ab™/D (pre-ballot) C:**

**10.39.7.1 Application Control IE (AC IE)**

*Change Line 4-9 on page 124 as follows*

When the Channel Sequence Order field value is zero, if the Frequency Stitching Direction field is one, the channels used are selected in sequence starting at the channel defined by the Base Channel field value and increasing in frequency using the step size defined by the Carrier Frequency Grid field value. On the other hand, if the Frequency Stitching Direction field is zero, the channels used are selected in sequence starting at the channel defined by the Base Channel field value and decreasing in frequency using the step size defined by the Carrier Frequency Grid field value.

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***Comment Index #873, #668 in 15-24-0010-10-04ab-cc-consolidated-comment***

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| **Index #** | **Commenter** | **Sub-Clause** | **Page** | **Line** | **Comment** | **Proposed Change** |
| 873 | Carl Murray | 10.39.7.1 | 124 | 13 | This equation and the related text are really unclear and will lead to lots of errors.  Example - does the mod operator apply after multiplication by p and what is the value of the 'factor' OF 0.25 or 3)? | As in the comment |
| 668 | Rojan Chitrakar | 10.39.7.1 | 123 | 11 | When out-of-sequence channel ordering is used, it should also be mentioned that there should be at least 1 ms gap between any two overlapping transmissions. | as in comment |

**Discussion:**

The MOD operator is applied after multiplication by p. The DIV operator is applied after multiplication by p. The factor OF equals to the value of the Carrier Frequency Grid field, i.e., 0-3.

The out-of-sequence channel order could be applied when the Carrier Frequency Grid field value is 2 or 3. To comply with the power regulations, the gap between any two overlapping transmissions is at least 1 ms.

**Resolution: Revised**

**Proposed text changes on P802.15.4ab™/D (pre-ballot) C:**

**10.39.7.1 Application Control IE (AC IE)**

*Change Line 11-23 on page 124 as follows*

When the Channel Sequence Order field value is one, the channel used for the -th transmission is selected according to the formula:

where p iterates sequentially from 0 through to , OF is the value given in the Carrier Frequency Grid field, MOD denotes the modulo division operator, and DIV denotes integer division. are

The center frequency in MHz of CH(i) shall be computed according to

where is the center frequency in MHz of the base channel, and is the Frequency Stitching Direction field value.

When the Channel Sequence Order field value is one, the starting time interval of two transmissions with channel frequency overlap is at least 1 ms.

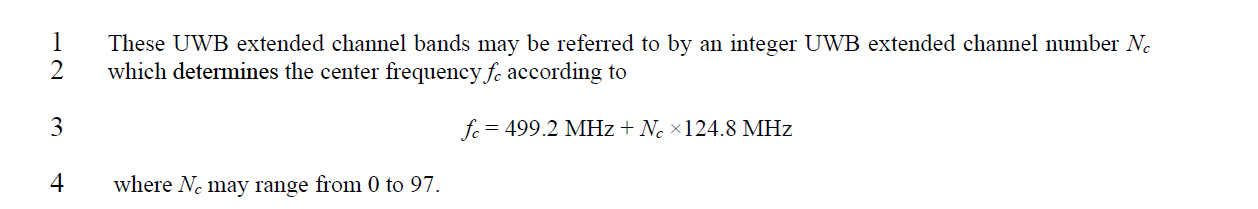
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***Comment Index #426, #667 in 15-24-0010-10-04ab-cc-consolidated-comment***

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| **Index #** | **Commenter** | **Sub-Clause** | **Page** | **Line** | **Comment** | **Proposed Change** |
| 426 | Bin Qian | 10.39.7.1 | 123 | 27 | Suggest to define the base channel as one of UWB channels per 11.1.3.5, otherwise 4 bits are not enough | As in the comment |
| 667 | Rojan Chitrakar | 10.39.7.1 | 124 | 27 | "The Base Channel field indicates the starting channel for performing UWB sensing …" I believe it indicates the index of the channel. | Rephrase as: "The Base Channel field indicates the starting index of the channel for performing UWB sensing…" Also, provide the reference where the index mapping is described. |

**Discussion:**

The Base Channel field occupies 4 bits, which is able to indicate 16 different UWB channels. However, for the frequency stitching, some extended channel bands could be used.



Obviously, the Base Channel field cannot be used to indicate these extended channels. It is suggested to make it clear that the Base Channel field is used to indicate one of channels per Table 16-27.

**Resolution: Revised**

**Proposed text changes on P802.15.4ab™/D (pre-ballot) C:**

**10.39.7.6 Processed Target Feature Report IE**

*Change Line 27-28 on page 123 as follows*

The Base Channel field indicates the index of the starting channel for performing UWB sensing when frequency stitching is enabled. The starting channel shall be one of HRP UWB channels per Table 16-27.

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***Comment Index #106, #227 in 15-24-0010-10-04ab-cc-consolidated-comment***

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| **Index #** | **Commenter** | **Sub-Clause** | **Page** | **Line** | **Comment** | **Proposed Change** |
| 106 | Pooria Pakrooh | 10.39.7.2 | 127 | 23 | Generation of fragments of report in the presence of compression should be clarified. | Generation of fragments of report in the presence of compression should be clarified. |
| 227 | Billy Verso | 10.39.7.2 | 128 | 11 | "could be zero padded" is strange terminology, does this not need to be "a shall" so that the receiver knows how to process the received report to decompress it? | Specify exactly what is done. |
| 670 | Rojan Chitrakar | 10.39.7.2 | 128 | 9 | "The Compression field value when one indicates that the Receive Report(s) field is DEFLATE compressed," From the sentence, it is not clear how the compression is done. | as in comment |

**Discussion:**

If the compression is enabled, it is suggested to compress the CIR Taps field of each receive report individually. Based on the compressed field size, the SDEV could decide whether the report is fragmented or not. The benefits are:

1. Each fragment could be filled to maximum size
2. If one fragment is not received correctly, the decompression of remaining fragments is not affected

The raw data of the DEFLATE compression is byte based. However, the CIR Taps field whose signed real and imaginary components for each CIR tap are represented using 10 bits or 14 bits may lead to a non-byte size. In this case, the zero padding is required to guarantee a byte based size.

**Resolution: Revised**

**Proposed text changes on P802.15.4ab™/D (pre-ballot) C:**

**10.39.7.2 CIR Report IE**

*Change Line 9-11 on page 128 as follows*

The Compression field value when one indicates that the CIR Taps field of each receive report in the Receive Report(s) field is DEFLATE compressed individually, or when zero that DEFLATE compression is not enabled. If the CIR Taps field of a receive report in the Receive Report(s) field is not an integer number of bytes, the receive report shall be zero padded prior to the DEFLATE compression to enable the byte-wise processing of the DEFLATE compression. If the size of the CIR Report IE containing the compressed CIR Taps field exceeds the available space of the corresponding Payload field, the Receive Report(s) field is fragmented as described in 10.39.4.5.3.

*Note to the editor*: 10.39.4.5.3 (CIR measurement report fragmentation) is a new subclause added by DCN 24-0114.

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***Comment Index #435 in 15-24-0010-10-04ab-cc-consolidated-comment***

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| --- | --- | --- | --- | --- | --- | --- |
| **Index #** | **Commenter** | **Sub-Clause** | **Page** | **Line** | **Comment** | **Proposed Change** |
| 435 | Bin Qian | 10.39.7.2 | 129 | 21 | The number of bits per I/Q could be 16 bits, 14 bits, 12 bits and 10 bits | As in the comment |

**Discussion:**

The CIR measurement report signed real and imaginary components for each RX chain shall be represented using 16 bits, and may be represented using 10, 12 or 14 bits optionally.

**Resolution: Revised**

**Proposed text changes on P802.15.4ab™/D (pre-ballot) C:**

**10.39.7.2 CIR Report IE**

*Change Line 20-22 on page 129 as follows*

The CIR Taps field contains the CIR tap values, with one CIR tap value for each bit in the CIR Bitmap that is set to a binary-one, where each CIR tap consists of a signed 16-bit real component and a signed 16-bit imaginary component, in that order. The support of 10, 12, 14 for each real and imaginary component is optional.