IEEE P802.11
Wireless LANs

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| Comment Resolutions on Clause 9.4.1 Part 1 |
| Date: 2016-06-29 |
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Abstract

This submission proposes resolutions for multiple comments related to TGax D0.1 as follows:

* 112, 380, 381, 456, 539, 689, 690, 1154, 1316, 1862

Revisions:

* Rev 0: Initial version of the document.
* Rev1: corrected typo in CQI-only report information

Interpretation of a Motion to Adopt

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGax Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGax Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

***TGax Editor: Editing instructions preceded by “TGax Editor” are instructions to the TGax editor to modify existing material in the TGax draft. As a result of adopting the changes, the TGax editor will execute the instructions rather than copy them to the TGax Draft.***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause Number** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 112 | 9.4.1.62 | 43.52 | Not a happy way of defining the HE Compressed Beamforming field. Perhaps you want to specify which fields apply to HE STAs and VHT STAs, and which fields apply to HE STAs only. Same for the HE MU Exclusive Beamforming Report field. And please add any missing modifications (if any) so that we don’t have orphan TBDs in this and the next subclause. | As in comment (valid also for 9.4.1.63). | Revised.Proposed resolution accounts for the suggested change. TGax Editor to make the changes shown in IEEE 802.11-16/0836r1 under all headings that include CID 112. |
| 380 | 9.4.1.62 | 25.55 | This language "..is based on.." is suitable for a note. Note adequate to defined a field | "is the same as the VHT CBR field except with the following modifications:" is better. Complete copy/paste/modify would be better still. Ditto 9.4.1.63 | Revised.Proposed resolution accounts for the suggested change. TGax Editor to make the changes shown in IEEE 802.11-16/0836r1 under all headings that include CID 380. |
| 381 | 9.4.1.62 | 25.62 | PPDU | PSDU | Revised.Proposed resolution accounts for the suggested change. TGax Editor to make the changes shown in IEEE 802.11-16/0836r1 under all headings that include CID 381. |
| 456 | 9.4.1.62 | 25.55 | CSI report format is said to be based on VHT Compressed beamforming format field with the following exceptions. However, the descriptions for the exceptions are missing. It is stated "other modifications TBD". | Either remove the exceptions or finalize the details of the field format.When finalizing the field format, instead listing the exceptions, it is suggested to simply describe and draw the field format. This would be more simple to describe all the potential changes due to radical change in OFDM numerology in 11ax. Otherwise, this section would need to describe the tone index changes as exceptions, changes in Ng value as exception, etc. The list might be very long to be a list of exceptions. | Revised.Proposed resolution accounts for the suggested change. TGax Editor to make the changes shown in IEEE 802.11-16/0836r1 under all headings that include CID 456. |
| 539 | 9.4.1.62 | 25.63 | We agreed the tones for channel feedback but no corresponding text is present in the draft. | Define the tones for channel feedback based on PHY Motion 145 [11-16/0235r7]. | Revised.Proposed resolution accounts for the suggested change. TGax Editor to make the changes shown in IEEE 802.11-16/0836r1 under all headings that include CID 539. |
| 689 | 9.4.1.62 | 25.65 | Remove TBD. | Remove TBD. | Revised.Proposed resolution accounts for the suggested change. TGax Editor to make the changes shown in IEEE 802.11-16/0836r1 under all headings that include CID 689. |
| 690 | 9.4.1.63 | 26.13 | Remove TBD. | Remove TBD. | Revised.Proposed resolution accounts for the suggested change. TGax Editor to make the changes shown in IEEE 802.11-16/0836r1 under all headings that include CID 690. |
| 1154 | 9.4.1.63 | 26.10 | There is no delta SNR subfield. | Change "delta SNR subfields" to "Delta SNR subfields". | Revised.Proposed resolution accounts for the suggested change. TGax Editor to make the changes shown in IEEE 802.11-16/0836r1 under all headings that include CID 1154. |
| 1316 | 9.4.1.62 | 25.60 | Why does OFDMA matter here? | Delete "and OFDMA" | Revised.Proposed resolution accounts for the suggested change. TGax Editor to make the changes shown in IEEE 802.11-16/0836r1 under all headings that include CID 1316. |
| 1862 | 26.3.12.3.2 | 155 | PHY Motions 38, 101, 102 and MU Motion 46, and several related PHY motions in March 2016 were approved but no corresponding spec text is present in the draft | as comment | Revised.Proposed resolution accounts for the suggested change. TGax Editor to make the changes shown in IEEE 802.11-16/0836r1 under all headings that include CID 1862. |

*Changes to D0.2 related to CID 112, CID 380, CID 381, CID 456, CID 539, CID 689, CID 690, CID 1154, CID 1316, and CID 1862*

***Change the subsections below as follows (#112, #380, #381, #456, #539, #689, #690, #1154, #1316, #1862):***

**9.4.1.62 HE Compressed Beamforming Report field**

~~The format of the HE Compressed Beamforming Report field is based on the VHT Compressed Beamforming Report field in 9.4.1.68 (VHT Compressed Beamforming Report field) except for the following modifications.~~

~~The supported values for the tone grouping factor Ng shall be Ng = 4 and Ng = 16 for SU-MIMO, MU-MIMO, and OFDMA. Here, tone grouping factor Ng is defined with respect to data tones of the HE PPDU.~~

~~Other modifications are TBD.~~

The HE Compressed Beamforming Report field is used by the HE Compressed Beamforming and CQI feedback (see 9.5.1.1) to carry average SNR of each space-time stream and compressed beamforming feedback matrices V for use by a transmit beamformer to determine steering matrices Q, as described in 9.29.3 and 20.3.12.3.

The size of the HE Compressed Beamforming Report field depends on the values in the HE MIMO Control field. The HE Compressed Beamforming Report field contains HE Compressed Beamforming Report information or successive (possibly zero-length) portions thereof in the case of segmented HE Compressed Beamforming and CQI feedback (see 25.6). HE Compressed Beamforming Report information is included in the HE Compressed Beamforming and CQI feedback if an SU feedback type or an MU feedback type is indicated in the Feedback Type field in the HE MIMO Control field.

The HE Compressed Beamforming Report information contains the channel matrix elements indexed, first, by matrix angles in order shown in Table 8-53d, and second, by data and pilot subcarrier index from lowest frequency to highest frequency. The explanation on how these angles are generated from the beamforming feedback matrix V is given in 20.3.12.3.6 In Table 8-53d (Order of angles in the Compressed Beamforming Feedback Matrix subfield),

*Nc* is the number of columns in a compressed beamforming feedback matrix determined by the Nc Index field of the HE MIMO Control field,

*Nr* is the number of rows in a compressed beamforming feedback matrix determined by the Nr Index field of the HE MIMO Control field.

The beamforming feedback matrix V is formed by the beamformee as follows. The beamformer transmits an NDP with $N\_{STS,NDP}$ space-time streams, where $N\_{STS,NDP}$ may take a value between 2 and 8. Based on this NDP, the beamformee estimates the $N\_{RX,BFEE}×N\_{STS,NDP}$ channel, and based on that channel it determines a $Nr×Nc$ orthogonal matrix *V*, where *Nr* and *Nc* satisfy Equation (8-1).

Further restrictions on *Nc* are described in 26.2. The angles are quantized as defined in Table 8-53e (Quantization of angles).

The HE Compressed Beamforming Report information has the same structure and order as the VHT Compressed Beamforming Report information as defined in Table 8-53f (VHT Compressed Beamforming Report Information).

In Table 8-53f, *Ns* is the number of subcarriers for which the Compressed Beamforming Feedback Matrix subfield is sent back to the beamformer. A beamformee may choose to reduce *Ns* by using a method referred to as grouping, in which only a single Compressed Beamforming Feedback Matrix is reported for each group of *Ng* adjacent subcarriers. For HE Compressed Beamforming Report, *Ns* is a function of the RU Start Index, RU End Index, and Grouping subfields in the HE MIMO Control field (see 9.4.1.6x). Subcarriers *scidx(0)* and s*cidx(Ns-1)* represent the S (Start)-tone corresponding to the RU Start Index and E (End)-tone corresponding to the RU End Index, respectively. For 40 MHz and 80 MHz, subcarrier *scidx(i) = scidx(i-1) + Ng,* where $1\leq i\leq Ns-2$. The S-tone and E-tone corresponding to the possible RU indices are listed in Table YY-1 for Ng = 4 and YY-2 for Ng = 16. For 160 MHz, to determine the S-tone and E-tone, RUs 37 – 73 occupying the higher 80 MHz use the same entries in Table YY-1 and Table YY-2 as RUs 0 – 36 occupying the lower 80 MHz. For 20 MHz, $scidx(i)$, where $1\leq i\leq Ns-2,$ includes all subcarrier indices between the S-tone and the E-tone subcarrier indices described in Table YY-3 for Ng = 4 and Ng = 16.

Table YY-1: Feedback subcarrier indices indicating Start 26-tone RU index and end 26-tone RU index for *Ng* = 4.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 80 MHz26 RU Index | 80 MHz(S,E) FB tone | 40 MHz26 RU Index | 40 MHz(S,E) FB tone | 20 MHz26 RU Index | 20 MHz(S,E) FB tone |
| 0 | -500,-472 | 0 | = (S,E) for 80 MHz+256 |  |  |
| 1 | -476,-448 | 1 |  |  |
| 2 | -448,-420 | 2 |  |  |
| 3 | -420,-392 | 3 |  |  |
| 4 | -392,-364 | 4 |  |  |
| 5 | -368,-340 | 5 |  |  |
| 6 | -340,-312 | 6 |  |  |
| 7 | -312,-284 | 7 |  |  |
| 8 | -288,-260 | 8 |  |  |
| 9 | -260,-232 |  |  |  |  |
| 10 | -232,-204 |  |  |  |  |
| 11 | -204,-176 |  |  |  |  |
| 12 | -180,-152 |  |  |  |  |
| 13 | -152,-124 |  |  |  |  |
| 14 | -124,-96 |  |  | 0 | -122,-96 |
| 15 | -100,-72 |  |  | 1 | = (S,E) for 80 MHz +4 |
| 16 | -72,-44 |  |  | 2 |
| 17 | -44,-16 |  |  | 3 | = (S,E) for 80 MHz |
| 18 | -16,16 |  |  | 4 |
| 19 | 16,44 |  |  | 5 |
| 20 | 44,72 |  |  | 6 | = (S,E) for 80 MHz ‒4 |
| 21 | 72,100 |  |  | 7 |
| 22 | 96,124 |  |  | 8 | 96,122 |
| 23 | 124,152 |  |  |  |  |
| 24 | 152,180 |  |  |  |  |
| 25 | 176,204 |  |  |  |  |
| 26 | 204,232 |  |  |  |  |
| 27 | 232,260 |  |  |  |  |
| 28 | 260,288 | 9 | = (S,E) for 80 MHz‒256 |  |  |
| 29 | 284,312 | 10 |  |  |
| 30 | 312,340 | 11 |  |  |
| 31 | 340,368 | 12 |  |  |
| 32 | 364,392 | 13 |  |  |
| 33 | 392,420 | 14 |  |  |
| 34 | 420,448 | 15 |  |  |
| 35 | 448,476 | 16 |  |  |
| 36 | 472,500 | 17 |  |  |

Table YY-2: Feedback subcarrier indices indicating Start 26-tone RU index and end 26-tone RU index for *Ng* = 16.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 80 MHz26 RU Index | 80 MHz(S,E) FB tone | 40 MHz26 RU Index | 40 MHz(S,E) FB tone | 20 MHz26 RU Index | 20 MHz(S,E) FB tone |
| 0 | -500,-468 | 0 | = (S,E) for 80 MHz+256 |  |  |
| 1 | -484,-436 | 1 |  |  |
| 2 | -452,-420 | 2 |  |  |
| 3 | -420,-388 | 3 |  |  |
| 4 | -404,-356 | 4 |  |  |
| 5 | -372,-340 | 5 |  |  |
| 6 | -340,-308 | 6 |  |  |
| 7 | -324,-276 | 7 |  |  |
| 8 | -292,-260 | 8 |  |  |
| 9 | -260,-228 |  |  |  |  |
| 10 | -244,-196 |  |  |  |  |
| 11 | -212,-164 |  |  |  |  |
| 12 | -180,-148 |  |  |  |  |
| 13 | -164,-116 |  |  |  |  |
| 14 | -132,-84 |  |  | 0 | -122,-84 |
| 15 | -100,-68 |  |  | 1 | = (S,E) for 80 MHz |
| 16 | -84,-36 |  |  | 2 | -68,-36 |
| 17 | -52,-4 |  |  | 3 | = (S,E) for 80 MHz |
| 18 | -20,20 |  |  | 4 |
| 19 | 4,52 |  |  | 5 |
| 20 | 36,84 |  |  | 6 | 36,68 |
| 21 | 68,100 |  |  | 7 | = (S,E) for 80 MHz |
| 22 | 84,132 |  |  | 8 | 84,122 |
| 23 | 116,164 |  |  |  |  |
| 24 | 148,180 |  |  |  |  |
| 25 | 164,212 |  |  |  |  |
| 26 | 196,244 |  |  |  |  |
| 27 | 228,260 |  |  |  |  |
| 28 | 260,292 | 9 | = (S,E) for 80 MHz‒256 |  |  |
| 29 | 276,324 | 10 |  |  |
| 30 | 308,340 | 11 |  |  |
| 31 | 340,372 | 12 |  |  |
| 32 | 356,404 | 13 |  |  |
| 33 | 388,420 | 14 |  |  |
| 34 | 420,452 | 15 |  |  |
| 35 | 436,484 | 16 |  |  |
| 36 | 468,500 | 17 |  |  |

Table YY-3: Feedback subcarrier indices for 20 MHz bandwidth for Ng = 4 and Ng = 16.

|  |  |  |
| --- | --- | --- |
| Channel Width | Ng  | Subcarriers indices |
| 20 MHz | 4 | -122, -120, -116, -112, -108, -104, -100, -96, -92, -88, -84, -80, -76, -72, -68, -64, -60, -56, -52, -48, -44, -40, -36, -32, -28, -24, -20, -16, -12, -8, -4, -2, 2, 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 52, 56, 60, 64, 68, 72, 76, 80, 84, 88, 92, 96, 100, 104, 108, 112, 116, 120, 122 |
| 16 | -122, -116, -100, -84, -68, -52, -36, -20, -4, -2, 2, 4, 20, 36, 52, 68, 84, 100, 116, 122 |

The Average SNR of space-time stream $i$ subfield in the Table 8-53f is an 8-bit twos complement integer whose definition is shown in Table 8-53h (Average SNR of Space-Time Stream $i$ subfield).

The $AvgSNR\_{i}$ in Table 8-53h is found by computing the SNR per subcarrier in decibels for the subcarriers identified in Table YY-2 for *Ng* = 4 and Table YY-3 for *Ng* = 16, and then computing the arithmetic mean of those values. Each SNR value per subcarrier in stream $i$ (before being averaged) corresponds to the SNR associated with the column $i$ of the beamforming feedback matrix *V* determined at the beamformee. Each SNR corresponds to the predicted SNR at the beamformee when the beamformer applies all columns of the matrix *V.*

**9.4.1.63 HE MU Exclusive Beamforming Report field**

~~The HE MU Exclusive Beamforming Report field is based on the VHT Exclusive Beamforming Report field in 9.4.1.50, except for the following modications.~~

~~The MU Exclusive Beamforming Report information consists of Delta SNR subfields for each space-time stream (1 to Nc) of a subset of the subcarriers spaced Ng apart (where Ng is the tone grouping factor). Specifically, the locations of the feedback tones for delta SNR subfield shall be identical to the tone locations of the compressed V matrices feedback.~~

~~Other modifications are TBD.~~

The MU Exclusive Beamforming Report field is used by the HE Compressed Beamforming and CQI Feedback (see 9.5.1.1) to carry explicit feedback in the form of delta SNRs. The information in the HE Compressed Beamforming Report field and the HE MU Exclusive Beamforming Report field can be used by the transmit MU beamformer to determine the steering matrices Q, as described in 26.3.13.3.

The size of the HE MU Exclusive Beamforming Report field depends on the values in the HE MIMO Control field. The HE MU Exclusive Beamforming Report field contains HE MU Exclusive Beamforming Report information or successive (possibly zero-length) portions thereof in the case of segmented HE Compressed Beamforming and CQI feedback (see 25.6). HE Compressed Beamforming Report information and HE MU Exclusive Beamforming Report information are included in the HE Compressed Beamforming and CQI feedback if the MU feedback type is indicated in the Feedback Type field in the HE MIMO Control field.

The HE MU Exclusive Beamforming Report information consists of Delta SNR subfields for each of the space-time stream (1 to *Nc)* of a subset of subcarriers typically spaced *Ng* apart, where *Ng* is signaled in the Grouping subfield of the HE MIMO Control field. Starting from the lowest frequency subcarrier and continuing to the highest frequency subcarrier. Specifically, the locations of the feedback subcarriers for delta SNR subfield shall be identical to the subcarrier locations of the compressed V matrices feedback.

 No padding is present between $∆SNR\_{k,i}$, in the HE MU Exclusive Beamforming Report field, even if they correspond to different subcarriers. The subset of subcarriers included is determined by the values of the RU Start Index, RU End Index, and Grouping subfield of the HE MIMO Control field. For each subcarrier included, the deviation in dB of the SNR of that subcarrier for each column of V relative to the average SNR of the corresponding space-time stream is computed using Equation (8-2).

The HE MU Exclusive Beamforming Report information has the same structure and order as the VHT MU Exclusive Beamforming Report information as defined in Table 8-53i (MU Exclusive Beamforming Report information).

In Table 8-53i, *Ns’* is the number of subcarriers for which the Delta SNR subfield is sent back to the beamformer. Subcarriers *sscidx(0)* and s*scidx(Ns’-1)* represent the S-tone corresponding to the RU Start Index and E-tone corresponding to the RU End Index, respectively. For 40 MHz and 80 MHz, subcarrier *sscidx(i) = sscidx(i-1) + Ng,* where $1\leq i\leq Ns'-2$. The S-tone and E-tone corresponding to the possible RU indices are listed in Table YY-1 for Ng = 4 and YY-2 for Ng = 16. For 160 MHz, to determine the S-tone and E-tone, RUs 37 – 73 occupying the higher 80 MHz use the same entries in Table YY-1 and Table YY-2 as RUs 0 – 36 occupying the lower 80 MHz. For 20 MHz, $sscidx(i)$, where $1\leq i\leq Ns'-2,$ includes all subcarrier indices between the S-tone and the E-tone subcarrier indices described in Table YY-3 for Ng = 4 and Ng = 16.

**9.4.1.64 HE CQI-only Report field**

The HE CQI-only Report field is used by the HE Compressed Beamforming and CQI feedback (see 9.5.1.1) to carry the per-RU average SNRs of each space-time stream, where each per-RU average SNR is the arithmetic mean of the SNR in decibels over a 26-tone RU for which the feedback is being requested.

The size of the HE Compressed Beamforming Report field depends on the values in the HE MIMO Control field. The HE Compressed Beamforming Report field contains HE CQI-only Report information or successive (possibly zero-length) portions thereof in the case of segmented HE Compressed Beamforming and CQI feedback (see 25.6). HE CQI-only Report information is included in the HE Compressed Beamforming and CQI feedback if the CQI-only feedback type is indicated in the Feedback Type field of the HE MIMO Control field. The structure of the HE CQI-only Report field is shown in Table XX-3.

Table XX-3 HE CQI-only Report information

|  |  |  |
| --- | --- | --- |
| **Field** | **Size (Bits)** | **Meaning** |
| Average SNR for space-time stream 1 for RU index *k = ruidx(0)* | 6 | SNR at the beamformee for space-time stream 1 averaged over 26-tone RU. See Table xx-4. |
| … | … | … |
| Average SNR for space-time stream *Nc* for RU index *k = ruidx(0)* | 6 | SNR at the beamformee for space-time stream *Nc* averaged over 26-tone RU. See Table xx-4. |
| Average SNR for space-time stream 1 for RU index *k = ruidx(1)* | 6 | SNR at the beamformee for space-time stream 1 averaged over 26-tone RU. See Table xx-4. |
| … | … | … |
| Average SNR for space-time stream *Nc* for RU index *k = ruidx(1)* | 6 | SNR at the beamformee for space-time stream *Nc* averaged over 26-tone RU. See Table xx-4. |
| … | … |  |
| Average SNR for space-time stream 1 for RU index *k = ruidx(Ncqi-1)* | 6 | SNR at the beamformee for space-time stream 1 averaged over 26-tone RU. See Table xx-4. |
| … | … | … |
| Average SNR for space-time stream *Nc* for RU index *k = ruidx(Ncqi-1)* | 6 | SNR at the beamformee for space-time stream *Nc* averaged over 26-tone RU. See Table xx-4. |

*Ncqi* is the number of RU indices for which the CQI-only Report is sent back to the beamformer. *Ncqi* is a function of the RU Start Index and RU End Index subfields in the HE MIMO Control field. The RU indices *ruidx(0)* and *ruidx(Ncqi-1)* correspond to the RU Start Index and RU End Index, respectively. The RU index rui*dx(i) = ruidx(i-1) + 1,* where $1\leq i\leq Ncqi-2$.

The Average SNR of space-time stream $i$ for the RU index k subfield in the Table XX-3 is an 6-bit twos complement integer whose definition is shown in Table XX-4.

Table XX-4 – Average SNR of RU index $k$ for space-time stream $i$ subfield

|  |  |
| --- | --- |
| **Average SNR of RU Index** $k$ **for space-time stream** $i$ | $AvgSNR\_{i}^{k}$ **(dB)** |
| -32 | $$\leq -10$$ |
| -31 | -9 |
| -30 | -8 |
| … | … |
| 30 | 52 |
| 31 | $$\geq 53$$ |

The $AvgSNR\_{i}^{k}$ in Table XX-4 is found by computing the arithmetic mean of the SNR per subcarrier in decibels for space-time stream $i$ over the subcarriers in RU index $k$ for which the feedback is being requested.

**9.5 Action frames format details**

**9.5.1 HE Action frame details**

A HE Action field, in the octet immediately after the Category field, differentiates the HE Action frame formats. The HE Action field values associated with each frame format within the HE category are defined in Table AA-1.

Table AA-1 HE Action field values

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | HE Compressed Beamforming and CQI  |
| 1-255 | Reserved |

**9.5.1.1 HE Compressed Beamforming and CQI frame format**

The HE Compressed Beamforming and CQI frame is an Action No Ack frame of category HE. The Action field of a HE Compressed Beamforming and CQI frame contains the information shown in Table AA-2.

Table AA-2 HE Compressed Beamforming and CQI frame action field format

|  |  |
| --- | --- |
| Order | Information |
| 1 | Category |
| 2 | HE Action |
| 3 | HE MIMO Control  |
| 4 | HE Compressed Beamforming Report (see 9.4.1.62) |
| 5 | HE MU Exclusive Beamforming Report (see 9.4.1.63) |
| 6 | HE CQI-only Report (see 9.4.1.64) |

Category and HE Action field TBD.

The HE MIMO Control field is always present in the frame. The presence and contents of the HE Compressed Beamforming Report field, HE MU Exclusive Beamforming Report field, and HE CQI-only Report field are dependent on the values of Feedback Type subfield of HE MIMO Control field.

No vendor-specific elements are present in HE Compressed Beamforming and CQI frame.

**8.4.1.11 Action field**

***TGax Editor : Add following value to Table 8-46 (Category Values)***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Code | Meaning | See subclause | Robust | Group Addressed Privacy |
| TBD | HE | 9.5.1 HE Action Frame details | No | No |

**References:**

1. **IEEE P802.11axTM/D0.2, June 2016.**