### IEEE P802.11Wireless LANs

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| **11ax SA1 sounding comments** |
| Date: 11 July 2020 |
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Abstract

This document contains proposed resolutions for sounding related comments on 802.11ax SA ballot 1 (16 CIDs), on 11ax draft 6.0.

1. 24009 24042 24221 24262 24473 24474 24495 24496 24503 24504
2. 24505 24511 24010 24011 24012 24013

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| **CID****Clause****P.L****Commenter** | **Comment** | **Proposed Change** | **Resolution** |
| 2400926.7.2379.15Bims, Harry | The unqualified term "sounding sequences" is not defined. | Change the title to "HE TB and HE non-TB sounding sequences and support" | RevisedChange the heading to"HE sounding protocol" |
| 2404226.7.5387.58Seok, Yongho | The TXVECTOR parameters for an HE sounding NDP can have the INACTIVE\_SUBCHANNELS parameter.Please specify how to set the INACTIVE\_SUBCHANNELS parameter of an HE sounding NDP. | As in the comment. | RevisedAt 388.10, insert the following bullet item:— INACTIVE\_SUBCHANNELS is set to the value of the Disallowed Subchannel Bitmap subfield of the STA Info field with the AID11 subfield set to 2047 in the preceding HE NDP Announcement frame |
| 242219.4.1.66155.30Wilhelmsson, Leif | What does the word "typically" refer to? If Ng is signalled is this not then always used? The text reads as one don't have to. Or is there another intention with this wording? | If the sub-carriers are always spaced Ng apart, remove the word typically. If the sentence is formally correct, consider explaining why the word "typically" is used. | RevisedThe related text is at 155.30:"The HE MU Exclusive Beamforming Report information consists of Delta SNR subfields for each of the space-time streams, 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."For example, for the 20 MHz feedback subcarrier indices as shown in Table 9-93e (Subcarrier indices for compressed beamforming feedback matrix), the subcarrier spacing at the edge (between -122 and -120 and between 120 and 122) is 2, and the subcarrier spacing around DC (between -4 and -2 and between 2 and 4) is also 2. For all the other tones in this example, the subcarrier spacing is 4.At 155.36, add a NOTE as follows:"NOTE--Most feedback subcarrier spacings are equal to Ng, but there are a few exceptions, generally around the RU edge and the DC tone, where extra feedback carriers are added to improve the channel interpolation/extrapolation quality."(Editor please italicize Ng.) |
| 2426227.2.2479.10Seok, Yongho | The TXVECTOR parameter EXPANSION\_MAT is not used in anywhere of TGax Draft 6.0.Please remove this parameter or define how it is utilized in the PHY. | As in the comment. | RevisedAt 548.10, after 'columns.' add"When beamforming or DL MU-MIMO is applied, *Q(iseg)k*is a beamforming or DL MU-MIMO steering matrix that is derived from the TXVECTOR parameter EXPANSION\_MAT. The beamforming steering matrices and DL MU-MIMO steering matrices are implementation specific."(Editor please format Q(iseg)k to have (iseg) superscript and k subscript and all of Q(iseg)k in italics.) |
| 244739.3.1.19117.52RISON, Mark | "In an individually addressed HE NDP Announcement frame that has only one STA Info field with a value other than 2047 in the AID11 subfield, the Nc subfield is reserved." suffers from the ambiguity identified in CID 22289 (and CID 22290) and fixed in a different location in CID 22289 (and CID 22290) | Change to "In an individually addressed HE NDP Announcement frame with a single STA Info field, the STA Info field having a value in the AID11 field other than 2047, the Nc subfield is reserved." | Accepted |
| 2447426.7.3382.15RISON, Mark | "the HE NDP Announcement frame with a single STA Info field that has a value in the AID11 field other than 2047" suffers from the ambiguity identified in CID 22289 (and CID 22290) and fixed in a different location in CID 22289 (and CID 22290) | Change to "the HE NDP Announcement frame with a single STA Info field, the STA Info field having a value in the AID11 field other than 2047" | Accepted |
| 24495.RISON, Mark | CID 22373, 20675. The resolution to the latter says "The HE equivalent does not provide more detail either.". The proposed change referred to VHT, and the VHT equivalent does provide more detail: "In a VHT Compressed Beamforming frame not carrying all or part of a VHT Compressed Beamforming report (see 10.36.5 (VHT sounding protocol) for a description of such a case)" in 9.4.1.48 VHT MIMO Control field | Give an explanation or xref (as in the VHT equivalent) | RevisedMake changes as specified in <this document> at CID 24496, which resolves the CID in the direction suggested by the comment. |
| 24496.RISON, Mark | CID 22373, 20675. The resolution to the latter says "The HE equivalent does not provide more detail either.". The proposed change referred to VHT, and the VHT equivalent does provide more detail: "In a VHT Compressed Beamforming frame not carrying all or part of a VHT Compressed Beamforming report (see 10.36.5 (VHT sounding protocol) for a description of such a case)" in 9.4.1.48 VHT MIMO Control field | Give an explanation or xref (as in the VHT equivalent). I think the VHT equivalent is referring to "A VHT beamformee that transmits VHT compressed beamforming feedback(#1367) shall include neither the VHT Compressed Beamforming Report information and nor the MU Exclusive Beamforming Report information if the transmission duration of the PPDU carrying the VHT Compressed Beamforming Report information and any MU Exclusive Beamforming Report information would exceed the maximum PPDU duration."but there may be other conditions in 10.36.5 | RevisedImplement changes specified in <this document> at CID 24496, which resolves the CID in the direction suggested by the comment.At 140.56, modify as shown"In an HE Compressed Beamforming/CQI frame not carrying all or part of an HE compressed beamforming/CQI report (see 26.7 (HE sounding protocol) for a description of such a case), the Nc Index, Nr Index, BW, Grouping, Codebook Information, Feedback Type and Sounding Dialog Token Number subfields are reserved, the First Feedback Segment subfield is set to 0 and the Remaining Feedback Segments subfield is set to 7."At 386.54, insert"An HE beamformee that transmits HE compressed beamforming feedback shall include neither the HE Compressed Beamforming Report information nor the HE MU Exclusive Beamforming Report information if the transmission duration of the PPDU carrying the HE Compressed Beamforming Report information and any HE MU Exclusive Beamforming Report information would exceed the maximum PPDU duration."The equivalent text for VHT is as follows:**9.4.1.48 VHT MIMO Control field**"In a VHT Compressed Beamforming frame not carrying all or part of a VHT Compressed Beamforming report (see 10.36.5 (VHT sounding protocol) for a description of such a case), the Nc Index, Nr Index, Channel Width, Grouping, Codebook Information, Feedback Type and Sounding Dialog Token Number subfields are reserved, the First Feedback Segment subfield is set to 0 and the Remaining Feedback Segments subfield is set to 7."Same resolution as CID 24495. |

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| 24503.RISON, Mark | CID 22388, 20571. There are still far too many locations where the requirement for an AP that supports >= 4SS to support DL MU-MIMO is stated (search for "4 or more"): 4.3.15a High efficiency (HE) STA,Table 9-321b--Subfields of the HE PHY Capabilities Information field, 26.7.2 Sounding sequences and support,27.1.1 Introduction to the HE PHY,27.3.3.1.2 Maximum number of spatial streams in an HE MU PPDU,dot11HESUBeamformerOptionImplemented (but ironically not dot11HEMUBeamformerOptionImplemented!). I would hope that by now we all agree that duplication is a Bad Idea | Delete most of the duplicate statements; add a statement in the description of dot11HEMUBeamformerOptionImplemented | Revised.At 761.14, after "as an SU beamformee is supported;", add"for an AP implementation, operation as an SU beamformer is mandatory when the AP supports 4 or more spatial streams."At 760.61 Change"This attribute, when true, indicates that for a non-AP STA implementation, the operation as an SU beamformer is supported; for an AP implementation, the operation as an SU beamformer is supported when the AP is equipped with 4 or more spatial streams. When false, this attribute indicates that for the non-AP STA implementation, the operation as an SU beamformer is not supported."to"This attribute, when true, indicates that operation as an SU beamformer is supported; for an AP implementation, operation as an SU beamformer is mandatory when the AP supports 4 or more spatial streams. When false, this attribute indicates that operation as an SU beamformer is not supported ."This addition aligns dot11HESUBeamformeeOptionImplemented with dot11HESUBeamformerOptionImplemented, as requested by the comment.4.3.15a is an overview of the HE features, so "4 or more" can not be omitted here. The duplication is due to the structure of 4.3.15a.In Table 9-321b, the notes recite the normative requirement when this field is set to 1. These notes are informative to the reader.In 26.7.2 and 27.3.3.1.2, the "4 or more" is part of a normative requirement for the MAC and the PHY respectively. The duplication is useful in this case, so that PHY and MAC are both aware of it.27.1.1 is an overview of normative requirements on an HE AP, so "4 or more" can not be omitted here. The duplication is due to the structure of 27.1.1. |
| 2450426.7.2.RISON, Mark | The MU Beamformer field is not used anywhere. There was some vague suggestion during letter ballot that it might somehow be used by a STA to decide which AP to associate with, which is pretty weak, but hey | After the third para of 26.7.2 Sounding sequences and support add a "NOTE---A STA might use the setting of the MU Beamformer subfield to determine which AP to associate with." | Accepted |
| 245059.4.2.247.3.RISON, Mark | The MU Beamformer field is not used anywhere. A field that has no behaviour associated with it on reception has no purpose | In Figure 9-787c--HE PHY Capabilities Information field format change "MU Beamformer" to "Reserved" | Revised After the third para of 26.7.2 Sounding sequences and support add a "NOTE---A STA might use the setting of the MU Beamformer subfield to determine which AP to associate with."Note to the editor: this is the same resolution as CID 24504. |

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| 2451126.7.3385.62RISON, Mark | "An HE beamformer soliciting SU or CQI feedback in an HE non-TB sounding sequence shall set the Feedback Type And Ng, Codebook Size and Nc subfields in the HE NDP Announcement frame to 0."Fields should not be needlessly forced to 0. If they are not needed, they should be reserved, so that thay can be used in the future for new signalling | In the referenced subclause change "An HE beamformer soliciting SU or CQI feedback in an HE non-TB sounding sequence shall set the Feedback Type And Ng, Codebook Size and Nc subfields in the HE NDP Announcement frame to 0." to "The Feedback Type And Ng, Codebook Size and Nc subfields in the HE NDP Announcement frame are reserved in an HE non-TB sounding sequence." | RevisedImplement changes as shown in <this document> at CID 24511, which implements changes in the direction suggested by the commenter. |

***117.11 change as shown***

**Table 9-31a—Feedback Type And Ng subfield and Codebook Size subfield encoding for HE TB sounding**

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| **Feedback Type And Ng** | **Codebook Size** | **Description** |
| **B25** | **B26** | **B27** |
| 0 | 0 | 0 | SU, Ng = 4, quantization resolution (ϕ, ψ) = {4, 2} |
| 0 | 0 | 1 | SU, Ng = 4, quantization resolution (ϕ, ψ) = {6, 4} |
| 0 | 1 | 0 | SU, Ng = 16, quantization resolution (ϕ, ψ) = {4, 2} |
| 0 | 1 | 1 | SU, Ng = 16, quantization resolution (ϕ, ψ) = {6, 4} |
| 1 | 0 | 0 | MU, Ng = 4, quantization resolution (ϕ, ψ) = {7, 5} |
| 1 | 0 | 1 | MU, Ng = 4, quantization resolution (ϕ, ψ) = {9, 7} |
| 1 | 1 | 0 | CQI |
| 1 | 1 | 1 | MU, Ng = 16, quantization resolution (ϕ, ψ) = {9, 7} |

***117.35 insert a new table***

**Table 9-31a1—Feedback Type And Ng subfield and Codebook Size subfield encoding for HE non-TB sounding**

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| **Feedback Type And Ng** | **Codebook Size** | **Description** |
| **B25** | **B26** | **B27** |
| 0 | Reserved | Reserved | SU |
| 1 | 1 | 0 | CQI |

***117.7 change as shown***

The Feedback Type And Ng and Codebook Size subfields are defined in Table 9-31a (Feedback Type And Ng subfield and Codebook Size subfield encoding for HE TB sounding) and Table 9-31a1 (Feedback Type And Ng subfield and Codebook Size subfield encoding for HE non-TB sounding).

***379.41 change as shown***

The type of feedback (SU, MU or CQI) solicited by an HE beamformer from an HE beamformee is indicated in the Feedback Type And Ng and Codebook subfields in the STA Info field identifying the HE beamformee in the HE NDP Announcement frame as defined in Table 9-31a (Feedback Type And Ng subfield and Codebook Size subfield encoding for HE TB sounding) and Table 9-31a1 (Feedback Type And Ng subfield and Codebook Size subfield encoding for HE non-TB sounding).

***380.50 change as shown***

An HE beamformer shall not send an HE NDP Announcement frame that initiates an HE TB sounding sequence with a STA Info field identifying an HE beamformee if the STA Info field and the PHY Capabilities Information field in the HE Capabilities element most recently received from the HE beamformee meet any of the following conditions (see Table 9-31a (Feedback Type And Ng subfield and Codebook Size subfield encoding for HE TB sounding)):

***385.62 change as shown***

B26, the Codebook Size subfield, and the Nc subfield in the STA Info field of the HE NDP Announcement frame are reserved in an HE non-TB sounding sequence soliciting SU feedback.

The Nc subfield in an HE NDP Announcement frame is reserved in an HE non-TB sounding sequence soliciting CQI feedback.

***End of changes for CID 24511***

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| 2401026.7.3381.62Bims, Harry | The unqualified term "sounding sequence" is not defined.Further, this paragraph is largely repeated in the next paragraph. | Replace"An HE non-TB sounding sequence is a sounding sequence initiated by an HE beamformer with a burst of two frames comprising an individually addressed HE NDP Announcement frame with a single STA Info field, the STA Info field having a value in the AID11 field other than 2047, followed after a SIFS by an HE sounding NDP."with"An HE non-TB sounding sequence is a frame exchange sequence initiated by an HE beamformer. The sequence is initiated by a burst of two consecutive frames transmitted by the HE beamformer, followed by a response frame transmitted by the HE beamformee.The two initial frames are an individually addressed HE NDP Announcement frame with a single STA Info field having a value in the AID11 field other than 2047, and an HE sounding NDP frame, with the frames separated by a SIFS. The AID11 field in the STA Info field is set to the AID of the STA identified by the RA field, or to 0 if the STA identified by the RA field is a mesh STA, AP or IBSS member STA." | Revised.Change as shown in <this document> under CID 24010, which makes changes in the direction requested by the commenter.Note: Same resolution as for CID 24011. |

***381.62, 382.15, replace***

**26.7.3 Rules for HE sounding protocol sequences**

381.62

An HE non-TB sounding sequence is a sounding sequence initiated by an HE beamformer with a burst of two frames comprising an individually addressed HE NDP Announcement frame with a single STA Info field, the STA Info field having a value in the AID11 field other than 2047, followed after a SIFS by an HE sounding NDP. An example of an HE non-TB sounding protocol with a single HE beamformee is shown in Figure 26-7 (An example of the sounding protocol with a single HE beamformee).

382.15

An HE beamformer that initiates the HE non-TB sounding sequence shall transmit the HE NDP Announcement frame with a single STA Info field that has a value in the AID11 field other than 2047 and with the AID11 field in that STA Info field set to the AID of the STA identified by the RA field or to 0 if the STA identified by the RA field is a mesh STA, AP or IBSS member STA.

***with***

**26.7.3 Rules for HE sounding protocol sequences**

381.62

An HE non-TB sounding sequence is initiated by an HE beamformer with an individually addressed HE NDP Announcement frame comprising exactly one STA Info field, followed after SIFS by an HE sounding NDP. The HE beamformee responds after SIFS with an HE Compressed Beamforming/CQI frame.

The AID11 subfield of the STA Info field shall be set to the AID of the STA identified by the RA field of the HE NDP Announcement frame, or to 0 if the STA identified by the RA field is a mesh STA, AP or IBSS STA.

An example of an HE non-TB sounding sequence with a single HE beamformee is shown in Figure 26-7 (An example of HE non-TB sounding).

***382.13 change as shown***

**Figure 26-7—An example of HE non-TB sounding**

***383.27 change as shown (including inserting 3 line breaks)***

An HE beamformer that transmits an HE NDP Announcement frame to an HE beamformee that is an AP, TDLS peer STA, mesh STA or IBSS STA, shall include one STA Info field in the HE NDP Announcement frame and shall set the AID11 field in the STA Info field of the frame to 0.

An HE beamformer that is an AP and that transmits an HE NDP Announcement frame to one or more HE beamformees shall set the AID11 field in the STA Info field identifying a non-AP STA to the 11 LSBs of the AID of the non-AP STA.

An HE NDP Announcement frame shall not include multiple STA Info fields that have the same value in the AID11 subfield.

An HE beamformer that transmits an HE NDP Announcement frame initiating an HE TB sounding sequence may include a STA Info field with an AID11 subfield value of 2047 to indicate disallowed subchannels during punctured channel operation. When present, the STA Info field with AID11 value of 2047 shall be the first STA Info field in the frame. An HE beamformer that transmits an HE NDP Announcement frame shall not include more than one STA Info field with an AID11 subfield value of 2047. An HE beamformer that transmits an HE NDP Announcement frame initiating a HE non-TB sounding sequence shall not include a STA Info field with an AID11 subfield value of 2047.

***End of changes for CID 24010***

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| 2401126.7.3382.15Bims, Harry | This paragraph is largely a duplicate of the previous paragraph. Delete if comment about the previous paragraph is accepted. | Delete paragraph. | Revised.Change as shown in <this document> under CID 24010, which makes changes in the direction requested by the commenter.Note: Same resolution as for CID 24010. |

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| 2401226.7.3382.31Bims, Harry | The unqualified term "sounding sequence" is not defined.Further, the paragraph should be re-written for clarity. | Replace"An HE TB sounding sequence is a sounding sequence initiated by an HE beamformer with a burst of three frames comprising a broadcast HE NDP Announcement frame with two or more STA Info fields followed after a SIFS by an HE sounding NDP followed afer a SIFS by a BFRP Trigger frame."with"An HE TB sounding sequence is a frame exchange sequence initiated by an HE beamformer. The sequence is initiated by a burst of three consecutive frames transmitted by the HE beamformer, followed by a response frame transmitted by more than one HE beamformee.The three initial frames are a broadcast HE NDP Announcement frame with two or more STA Info fields, an HE sounding NDP frame, and a BFRP Trigger frame, with the frames separated by a SIFS. An example of an HE TB sounding sequence with more than one HE beamformee is shown in Figure a 26-8 (An example of the HE TB sounding sequence with more than one HE beamformee." | Revised.Change as shown in <this document> under CID 24012, which makes changes in the direction suggested by the commenter. |

***383.32 change as shown***

An HE TB sounding sequence is initiated by an HE beamformer with a broadcast HE NDP Announcement frame with two or more STA Info fields, followed after SIFS by an HE sounding NDP, followed after SIFS by a BFRP Trigger frame. Each HE beamformee responds after SIFS with an HE Compressed Beamforming/CQI frame.

An example of an HE TB sounding sequence with more than one HE beamformee is shown in Figure 26-8 (An example of HE TB sounding).

***383.58 change as shown***

**Figure 26-8—An example of HE TB sounding**

***End of changes for CID 24012***

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| 2401326.7.3383.7Bims, Harry | The sentence is redundant (given the opening paragraph is this subclause) and has a grammar error. | Delete the paragraph | Accepted(Note to editor: The deleted sentence is"An HE beamformer that initiates an HE non-TB sounding sequence or an HE TB sounding sequence shall transmit an HE sounding NDP a SIFS after the HE NDP Announcement frame.") |