### IEEE P802.11Wireless LANs

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| **11ax D4.0 sounding comments** |
| Date: 2019-5-26 |
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Abstract

This document contains proposed resolutions for sounding related comments on 802.11ax draft 4.0 (xx CIDs).

1. 20118 20163 20197 20198 20222 20223 20224 20225 20226 20490
2. 20510 20534 20465 20562 20563 20564 20567 20576 20585 20612
3. 20613 20614 20618 20656 20670 20673 20674 20675 20694 20752
4. 20782 20821 20823 20824 20830 20869 20878 20884 20949 20992
5. 21002 21009 21010 21013 21014 21015 21016 21017 21018 21019
6. 21320 21321 21322 21323 21325 21326 21400 21401 21482 21539
7. 21551 21608 21609 21614 21615

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| **CID** | **page.****line** | **clause** | **comment** | **proposed change** | **proposed resolution** |
| 20118 | 356.10 | 26.7 | The preamble punctured sounding changes are sparse and bring some confusion. Please place them in a separate subclause of the sounding subclause. | As in comment. | Rejected - the comment does not identify a technical issue, while the proposed reshuffling of the text would require a submission. |
| 20163 | 139.02 | 9.4.1.67 | In case of NDP puncturing, some RU26s are disallowed, should put the disallowed # of RU26 into caculation of Ncqi | "Ncqi = (RUEndIndex - RUStartIndex) + 1-Disallowed # of RU26," | Revised - at the cited location, add "- Disallowed # of RU26".Ask Matt for definition. |
| 20197 | 357.27 | 26.7.2 | The condition to determine if the solicited sounding feedback is full bandwidth as described in the four paragraphs can be simplified to avoid unnecessary complexity. | Use condition of "RU End Index subfield equal to 0x3F" to indicate full bandwidth explicitly. | Rejected - the curent text is not in error and there is not enough perceived benefit for the change. |
| 20198 | 358.01 | 26.7.3 | HE MU sounding feedback can be obtained using HE TB sounding sequence. When UL MU is disabled by the non-AP STA, AP's DL MU-MIMO transmission can not be performed due to this constraint and this limitation contraints 11ax performance/gain. | Extend the paragraph as follows:An MU beamformer may solicit full bandwidth MU or CQI feedback from an MU beamformee in an HE non-TB sounding sequence ... | Rejected - the current text reflects what was decided in the task group. The requested addition of a new sounding option is considered to add complexity without sufficient technical justification. (Copy of CID 15692, which was previously rejected. CID 16672 explicitly added that "An MU beamformer shall not solicit MU feedback in an HE non-TB sounding seqeunce.".) |
| 20222 | 357.48 | 26.7.2 | Allow SU beamformer soliciting partial BW SU feedback, just like allowing SU beamformer soliciting CQI-only feedback. This is to assist DL OFDMA operation. | Remove:"An SU beamformer shall not solicit partial bandwidth SU feedback in an HE non-TB sounding sequence " | Rejected - the current text reflects what was decided in the task group. The requested addition of a new sounding option is considered to add complexity without sufficient technical justification. (Copy of CID 15687, 15689, 15692, which were previously rejected.) |
| 20223 | 357.55 | 26.7.2 | allow non-TB sounding sequence to solicit MU feedback as well. | Change the paragraph as below:"An MU beamformer may solicit full bandwidth MU feedback from an MU beamformee in an HE TB or no-TB sounding sequence. An MU beamformer may solicit partial bandwidth MU feedback from an MU beamformee in an HE TB or non-TB sounding sequence if the MU beamformee indicates support by setting the Triggered MU Beamforming Partial BW Feedback subfield to 1." | Rejected - the current text reflects what was decided in the task group. The requested addition of a new sounding option is considered to add complexity without sufficient technical justification. (Copy of CID 15692, which was previously rejected. CID 16672 explicitly added that "An MU beamformer shall not solicit MU feedback in an HE non-TB sounding seqeunce.".) |
| 20224 | 359.57 | 26.7.3 | Should allow SU beamformer to solicit partial BW feedback | Remove the paragraph of:"An HE beamformer shall not initiate an HE non-TB sounding sequence with an HE NDP Announcementframe that has a Partial BW Info field that indicates less than full bandwidth (see Table 26-4 (Settings for BW, RU Start Index, and RU End Index fields in HE NDP Announcement frame))." | Rejected - the current text reflects what was decided in the task group. The requested addition of a new sounding option is considered to add complexity without sufficient technical justification. (Copy of CID 15687, 15689, 15692, which were previously rejected.) |
| 20225 | 361.12 | 26.7.3 | SU beamformee may take the Ng, codebook, and Nc parameters from the NDPA STA\_INFO field as well. | Add following statement:"The HE beamformee can optionally take the Ng, codebook size, and Nc parameters from the STA Info in NDP Announcement frame." | Rejected - the current text reflects what was decided in the task group. The requested addition of a new sounding option is considered to add complexity without sufficient technical justification. (Copy of CID 15690, 15693, which were previously rejected.) |
| 20226 | 363.45 | 26.7.3 | If allows SU beamformee optionally to take the SU feedback parameters from NDPA's STA\_INFO field, then these fields (feedback type & Ng, codebook size and Nc) are allowed to have non zero values. | Remove:"An HE beamformer soliciting SU 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." | Rejected - the current text reflects what was decided in the task group. The requested addition of a new sounding option is considered to add complexity without sufficient technical justification. (Copy of CID 15690, 15693, which were previously rejected.) |
| 20490 | 126.36 | 9.4.1.64 | "is included in" duplicates information and leads to spec rot | Delete the sentence with the cited text in 9.4.1.64, 9.4.2.254 | Revised -at 126.39 delete "The HE MIMO Control field is included in every HE Compressed Beamforming/ CQI frame (see 9.6.31.2 (HE Compressed Beamforming/CQI frame format))."at 202.2 delete "The Short SSID List element is included in Probe Request frames, as described in 9.3.3.10 (Probe Request frame format)." |
| 20510 | 129.31 | 9.4.1.65 | "The angles are quantized asdefined in Table 9-68 (Quantization of angles)." -- this is not true because that table is specifically about VHT (and the xref is stale anyway) | Copy Table 9-76 and change "VHT" to "HE" (2x) | Revised - At 129.12, 129.58, 129.63, 130.5, 130.12 change "Table 9-74 (Order of angles in the Compressed Beamforming Feedback Matrix subfield when used in a non-S1G band) to "Table 9-73 (Order of angles in the Compressed Beamforming Feedback Matrix subfield when used in a non-S1G band)".At 129.47, 129.54 change "Table 9-80 (Average SNR of Space-Time Stream i subfield)" to "Table 9-79 (Average SNR of Space-Time Stream i subfield)".At 136.28, 136.31 change "Table 9-71 (Average SNR of Space-Time Stream i subfield)" to "Table 9-79 (Average SNR of Space-Time Stream i subfield)".At 129.32, 610.52 change "Table 9-68 (Quantization of angles)" to "Table 9-76 (Quantization of angles), with b sub(psi) defined by the Codebook Information field of the HE MIMO Control field (see see 9.4.1.64 (HE MIMO Control field))". |
| 20534 | 362.43 | 26.7.3 | Per 18/2033: the current spec doesn't explicitly spell out whether a 20 MHz operating STA can be sounded together with other 80 MHz operating STAs in one PPDU. The only clue is Table 26-4, which implicitly suggests a 20 MHz operating STA can only be sounded with a 20 MHz NDPA | Spell it out | Rejected -- Table 26-4 specifies the permitted combinations of Operating channel width of the HE beamformee, Bandwidth of HE NDP Announcement frame and the sounded RUs (through the RU Start Index field and the RU End Index field). The permitted combinations can be inferred from it.Sounding a 20 MHz STA with an 80 MHz NDPA is not possible according to Table 26-4. |
| 20465 | 127.10 | 9.4.1.64 | "Indicates the number of columns, Nc, in the compressed beamforming feedback matrix minus 1:Set to 0 for Nc = 1Set to 1 for Nc = 2...Set to 7 for Nc = 8" -- people reading the spec can reasonably be assumed to be comfortable with the concept "minus 1" | Change the cited text at the referenced location to "Indicates the number of columns, Nc, in the compressed beamforming feedback matrix minus 1.". Similarly in the cell immediately below replace ":Set to 0 for Nr = 1Set to 1 for Nr = 2...Set to 7 for Nr = 8" with "." | Accepted |
| 20562 | 359.07 | 26.7.2 | "Beamformee > 80 MHz" -- no such field | Change to "Beamformee STS > 80 MHz" | Accepted |
| 20563 | 361.29 | 26.7.3 | "Rx HE-MCS Map > 80 MHz" -- no such field | Change to "Rx HE-MCS Map 160 MHz" | Revised -At 361.29 change "> 80 MHz" to "160 MHz ".At 422.29 delete "For" after "Map".At 427.30 delete "For" after "Map".At 427.33 delete "For" after "Map".At 423.1 delete "For" after "Map".At 430.12 delete the extra space between "Map" and "80 MHz".For page 429, implement changes in <this document> at CID 20563. |
| 20564 | 361.42 | 26.7.3 | "The HE beamformee indicates the maximum number of space-time streams it can receive in an HE NDP, N\_STS,max, as defined in 27.6.2 (Sounding sequences and support)." -- N\_STS,max does not appear in 27.6.2. Nor does it appear anywhere else, in fact | Delete the cited text at the referenced location | Accepted |
| 20567 |  |  | Triplication:10.37.6: "If an HE STA transmits a VHT NDP where at least one of the intended recipients of the VHT NDP is an HE STA, then the following conditions apply:--- If the bandwidth of an VHT NDP is less than or equal to 80 MHz, the number of space-time streams sounded as indicated by the TXVECTOR parameter NUM\_STS shall not exceed the value indicated in the Beamformee STS <= 80 MHz field in the HE Capabilities element of any intended HE STA recipient of the VHT NDP."[and similar for > 80M]26.7.2: "An HE beamformer shall not transmit a 20 MHz, 40 MHz or 80 MHz HE NDP with a TXVECTOR parameter NUM\_STS that is greater than the maximum number of HE-LTF symbols indicated in the Beamformee STS <= 80 MHz subfield of any STA addressed by a STA Info field in the preceding HE NDP Announcement frame."[and similar for > 80M]26.7.5: "If the HE NDP bandwidth is less than or equal to 80 MHz, the number of space-time streams sounded and as indicated by the NUM\_STS parameter shall not exceed the value indicated in the Beamformee STS <= 80 MHz field in the HE Capabilities element of any intended recipient of the HE NDP."[and similar for > 80M] | Detriplicate | Revised -The first citation is for a VHT NDP. The second two are indeed duplications for HE. Implement changes specified in <this document> under CID 20567. |
| 20576 | 358.00 | 26.7.2 | "HE NDP sounding sequence" -- no such sequence | Change each of the 2 instances of the cited text to "HE TB sounding sequence" | Accepted |
| 20585 | 101.63 | 9.3.1.19 | "The Disambiguation subfield is set to 1 to prevent a non-HE VHT STA from wrongly determining its AID in the NDP Announcement frame. The Disambiguation subfield coincides with the MSB of the AID12 subfield of an expected VHT NDP Announcement when the HE NDP Announcement field is parsed by a non-HE VHT STA." -- this is true for the two upper octets of each set of 4 octets, but what about the two lower ones? b0-b11 can end up looking like an AID12 for a VHT STA, if the lsb of the Partial BW Info field is 0 | Use a new Control subtype for HE NDP Announcement frames | Rejected - The AID11 will contain the AID of an HE STA and therefore will not accidentally map to the AID of a non-HE STA. |
| 20612 |  |  | RU Start Index and RU End Index in Partial BW Info in HE NDPA do not in fact correspond to any RUs (the subcarriers signalled by some indices overlap!) | Change "RU Start Index" to "Subcarrier Start Index" throughout and "RU End Index" to "Subcarrier End Index" throughout | Rejected - the definition of the SU Start Index field and the RU End Index field is clear that the field refers to the first and last 26-tone RU for which feedback is requested. |
| 20613 | 129.10 | 9.4.1.65 | The compressed beamforming feedback matrix for pilot subcarriers is useless | After "The HE Compressed Beamforming Report information contains the channel matrix elements indexed, first, by matrix angles in order shown in Table 9-74 (Order of angles in the Compressed Beamforming Feedback Matrix subfield when used in a non-S1G band), and second, by data and pilot subcarrier index from lowest frequency to highest frequency. " add "The beamformer ignores the compressed beamforming feedback matrices for pilot subcarriers." | Rejected - Since the sounding feedback uses Ng=4, the precoding matrix for non-feedbacks tones are computed based on interpolation of feedback on Ng=4 tones. So the compressed beamforming feedback on pilot tones are important for good interpolation to generate precoding matrix of neighboring tones. |
| 20614 | 129.10 | 9.4.1.65 | The compressed beamforming feedback matrix for pilot subcarriers is useless | Remove the pilot subcarriers from Table 9-93e (as was done for VHT) | Rejected - Since the sounding feedback uses Ng=4, the precoding matrix for non-feedbacks tones are computed based on interpolation of feedback on Ng=4 tones. So the compressed beamforming feedback on pilot tones are important for good interpolation to generate precoding matrix of neighboring tones. |
| 20618 | 128.55 | 9.4.1.65 | This subclause is missing some of the material in the subclause on the VHT CBR field, e.g. the "where Na is the number of angles used for the compressed beamforming feedback matrix subfield" (i.e. Na is not actually defined anywhere) and "No padding is present between angles in the VHT Compressed Beamforming Report information, even if they correspond to different subcarriers. If the size of the VHT Compressed Beamforming Report information is not an integer multiple of 8 bits, up to seven zeros are appended to the end of the field to make its size an integer multiple of 8 bits." (i.e. the padding is not defined - there are some SU cases where 4 zero bits need to be appended) | Insert the cited text (changing VHT to HE) in the locations that parallel their locations in the subclause on the HE CBR field |  |
| 20656 | 356.10 | 26.7 | 102.6 says Nc is chosen by BFee for non-TB sounding (but also talks of a matrix, which is N/A for CQI feedback; ditto Table 9-93a). 179.35 does not qualify "Max Nc" as being only about TB sounding (and maybe also about non-TB CQI sounding; 363.55 suggests the BFer chooses here?). Also spurious underline under "Nc" at 179.35. 361.24 makes the BFer look at Max Nc only for MU feedback, not for TB SU feedback or for non-TB CQI feedback. At 363.55, first Nc should be italic. 137.1 says "The HE MU Exclusive Beamforming Report information consists of Delta SNR subfields for each of the space-time streams, 1 to Nc" but there is no explanation of Nc in 9.4.1.67 HE CQI Report field | Address the issues in the comment. Really the rules for SU/MU/CQI v. TB/non-TB and which side determines what are such a huge mess that a table should be considered to capture it all clearly in one place | Revised - make changes as specified in <this document> under CID 20656. |
| 20670 | 361.24 | 26.7.3 | "An HE beamformer that transmits an HE NDP Announcement frame and sets the Feedback Type And Ng subfield of a STA Info field to indicate MU shall set the Nc subfield of the STA Info field to indicate a value less than or equal to the minimum of:" -- these restrictions also need to apply for SU and CQI feedback in a trigger-based sounding sequence (since the BFer picks Nc in those cases) | As it says in the comment | Revised - agree with the comment, modify as shown in <this document> under CID 20670. |
| 20673 | 127.24 | 9.4.1.64 | Nr for SU/MU can't be 1 | After the "Set to 7" line at 127.24 add "The value 0 is reserved." | Accepted |
| 20674 | 127.25 | 9.4.1.64 | "If the Feedback Type subfield indicates CQI, then the Nr Index subfield indicates the Nss of the HE sounding NDP minus 1." -- this makes no sense. It's not indicating Nr and the BFer doesn't need to be reminded what NSS it used for the HE sounding NDP! | Change the cited text at the referenced location to "If the Feedback Type subfield indicates CQI, then the Nr Index subfield is reserved." | Accepted |
| 20675 | 128.38 | 9.4.1.64 | "In an HE Compressed Beamforming/CQI frame not carrying an HE compressed beamforming/CQI report, " -- not clear how this would ever happen | Give an explanation or xref (see VHT equivalent) |   |
| 20694 |  |  | The following are not true for CQI feedback: 102.7 "the Nc field indicates the number of columns, Nc, in the compressed beamforming feedback matrix"; 127.11 "Indicates the number of columns, Nc, in the compressed beamforming feedback matrix ". Also 363.13 "An HE beamformee that receives an HE NDP Announcement frame soliciting CQI feedback shall generate an HE compressed beamforming/CQI report for CQI feedback with Nc indicated by the Nc subfield in the STA Info field." is circular | As it says in the comment | Revised - Similar to CID 20821: At 127.11 change "Indicates" to "If the Feedback Type subfield indicates SU or MU, the Nc Index subfield indicates".At 127.16, add "If the Feedback Type subfield indicates CQI, the Nc Index subfield indicates the number of space time streams, Nc, in the CQI Report minus 1."At 102.6, add "or CQI report" after "compressed beamforming matrix".The cited reference at 363.13 does not appear to be circular.  |
| 20752 | 356.61 | 26.7.2 | Re CID 16148, 16240: the stuff quoted in the resolution explains what an MU beamformer may do, but it does not justify the AP advertising that it is capable of doing these things. There needs to be something at the non-AP STA that relies on the setting of this bit, otherwise it's useless | In Figure 9-772c change "MU Beamformer" to "Reserved". In Table 9-321b delete the "MU Beamformer" row. In 27.6.2 delete all but the last sentence of the third para | Rejected - this information may be used by STAs for selecting an AP to associate with. |
| 20782 | 363.45 | 26.7.3 | Re CID 16338: err, yes, that's the point. Saying reserved rather than 0 leaves options open for future expansion (forward-compatibility). 102.10 already does this, in fact, for the Nc field ("In an individually addressed HE NDP Announcement frame that has only one STA Info field with a value other than 2047 in the AID11 field, the Nc field is reserved." | At the referenced location change "An HE beamformer soliciting SU 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." | Rejected - the comment does not identify a technical issue in sufficient detail. Sometimes it is better to avoid that specific fields can all of a certain have different values. |
| 20821 | 127.10 | 9.4.1.64 | "Indicates the number of columns, Nc, in the compressed beamforming feedback matrix minus 1" is not true for CQI | Change the cited text at the referenced location to "Indicates the number of columns, Nc, in the compressed beamforming feedback matrix (if the Feedback Type subfield indicates SU or MU) or CQI report (if the Feedback Type subfield indicates CQI), minus 1". At 102.6 change "In a broadcast HE NDP Announcement frame that has more than one STA Info field with a value other than 2047 in the AID11 field, the Nc field indicates the number of columns, Nc, in the compressed beamforming feedback matrix and is set to Nc - 1." to "In a broadcast HE NDP Announcement frame that has more than one STA Info field with a value other than 2047 in the AID11 field, the Nc field indicates the number of columns, Nc, in the compressed beamforming feedback matrix (if the Feedback Type And Ng subfield and Codebook Size subfield indicate SU or MU) or CQI report (if the Feedback Type And Ng subfield and Codebook Size subfield indicate CQI) and is set to Nc minus 1." | Revised -At 127.11 change "Indicates" to "If the Feedback Type subfield indicates SU or MU, the Nc Index subfield indicates".At 127.16, add "If the Feedback Type subfield indicates CQI, the Nc Index subfield indicates the number of space time streams, Nc, in the CQI Report minus 1."At 102.9, add "or CQI report" after "compressed beamforming matrix". |
| 20823 | 363.54 | 26.7.3 | Not clear who picks Nc for non-TB CQI feedback. 102.9 suggests BFee ("In an individually addressed HE NDP Announcement frame that has only one STA Info field with a value other than 2047 in the AID11 field, the Nc field is reserved."). 361.4 leaves this open ("In an HE TB sounding sequence, each STA Info field in the HE NDP Announcement frame that solicits SU or MU feedback indicates the subcarrier grouping, Ng, codebook size and the number of columns, Nc, to be used by the HE beamformee addressed by the STA Info field for the generation of HE compressed beam-forming/CQI report carrying the SU or MU feedback. In an HE non-TB sounding sequence where the STA Info field in the HE NDP Announcement frame solicits SU feedback, the subcarrier grouping, Ng, codebook size and the number of columns, Nc, used for the generation of the HE compressed beamforming/CQI report carrying the SU feedback are determined by the HE beamformee."). 363.54 says BFer ("An HE beamformee that receives an HE NDP Announcement frame soliciting CQI feedback shall generate an HE compressed beamforming/CQI report for CQI feedback with Nc indicated by the Nc subfield in the STA Info field.") | Change the last cited para to "An HE beamformee that receives an HE NDP Announcement frame soliciting CQI feedback shall generate an HE compressed beamforming/CQI report for CQI feedback with Nc Nc in the range 1 to 8." | Revised -Nc for CQI feedback is determined by the beamformer for TB sounding and by the beamformee for non-TB sounding.Make changes as specified in <this document> under CID 20823. |
| 20824 | 361.42 | 26.7.3 | "the maximum number of space-time streams that the STA can receive in an HE sounding NDP" needs to be tied more explicitly to Nr | At 361.42, after "The HE beamformee indicates the maximum number of space-time streams it can receive in an HE sounding NDP, NSTS,max, as defined in 26.7.2 (Sounding sequences and support)." add "This maximum is the maximum number it can support for Nr in a compresed beamforming feedback matrix." | Revised - At 361.42, after "The HE beamformee indicates the maximum number of space-time streams it can receive in an HE sounding NDP, NSTS,max, as defined in 26.7.2 (Sounding sequences and support)." add "This maximum is the maximum number it can support for Nr in a compressed beamforming feedback matrix." |
| 20830 | 359.03 | 26.7.2 | "An HE beamformee that support 160 MHz or 80+80 MHz channel widths shall set the Beamformee STS > 80 MHzsubfield to indicate a maximum number of HE-LTFs of 4 or greater. An HE beamformee that supports neither 80+80 MHz nor 160 MHz channel widths sets the Beamformee > 80 MHz subfield to 0." -- duplication of Clause 9 (cf. CID 16311) | Delete the cited text at the referenced location | Rejected - the cited text contains the normative requirements, which can not be deleted. |
| 20869 | 357.21 | 26.7.2 | Re CID 15966: the resolution is not clear (reference to just "<this document>") but in any case the issue of duplication has not been addressed | Change " one of the following conditions apply (see Table 26-4 (Settings for BW, RU Start Index, and RU End Index fields in HE NDP Announcement frame)):--- The RU End Index subfield in the Partial BW subfield is 8 and the bandwidth of the HE NDP Announcement frame is 20 MHz--- The RU End Index subfield in the Partial BW subfield is 17 and the bandwidth of the HE NDP Announcement frame is 40 MHz--- The RU End Index subfield in the Partial BW subfield is 36 and the bandwidth of the HE NDP Announcement frame is 80 MHz--- The RU End Index subfield in the Partial BW subfield is 73 and the bandwidth of the HE NDP Announcement frame is 80+80 MHz or 160 MHz"to"the RU End Index subfield in the Partial BW subfield is the value shown in Table 26-4 where partial bandwidth is not supported by the HE beamformer, for the bandwidth of the HE NDP Announcement frame." |  |
| 20878 | 365.43 | 26.7.5 | Re CID 15989: there is still a contradiction between"Otherwise, NUM\_STS is set to any value in the range 1 to 8."and"If the HE sounding NDP bandwidth is less than or equal to 80 MHz, the number of space-time streams sounded and as indicated by the NUM\_STS parameter shall not exceed the value indicated in the Beamformee STS ∩éú 80 MHz field in the HE Capabilities element of any intended recipient of the HE sounding NDP.If the HE sounding NDP bandwidth is greater than 80 MHz, the number of space-time streams sounded and as indicated by the NUM\_STS parameter shall not exceed the value indicated in the Beamformee STS > 80 MHz field in the HE Capabilities element of any intended recipient of the HE sounding NDP." | At the referenced location change"NUM\_STS indicates two or more space-time streams if the Feedback Type field in the HE MIMO Control field of the preceding HE NDP Announcement frame is set to either SU or MU. Otherwise, NUM\_STS is set to any value in the range 1 to 8."to"NUM\_STS indicates two or more space-time streams if the Feedback Type field in the HE MIMO Control field of the preceding HE NDP Announcement frame is set to either SU or MU. See below for additional constraints on NUM\_STS." | Accepted |
| 20884 | 365.20 | 26.7.4 | Re CID 16009: missed one | Add "HE " before "MU Exclusive Beamforming Report information " at the referenced location | Accepted |
| 20949 | 127.20 | 9.4.1.64 | Re CID 16174: "Nr should reflect the Nss of the sounding NDP" -- yes, and for CBR this necessarily has to be >1 | Change "Set to 0 for Nr = 1" to "0 is reserved", as proposed in CID 16174 | Accepted |
| 20992 | 138.06 | 9.4.1.67 | "The HE CQI Report field contains information about the quality of the link." -- this is vague, compared to the CBR fields ("for use by a transmit beamformer to determine steering matrices Q"; "can be used by the transmit MU beamformer to determine the steering matrices Q") | Change "The HE CQI Report field contains information about the quality of the link." to "The HE CQI Report field contains information about the quality of the channel. This information can be used by an AP to determine RUs to use for DL OFDMA transmissions." |  |
| 21002 | 356.10 | 26.7 | There are various issues with the description of HE sounding:- To avoid confusion between "addresses" in the context of the RA and in the context of a STA Info field's AID11, the latter should be referred to as "identifies" | As it says in the comment |  |
| 21009 | 356.10 | 26.7 | Re CID 16313: the resolution refers to the need for prudence but does not give any justification for this claim. Note that, as it says on page 1, "This document is an unapproved draft of a proposed IEEE Standard. As such, this document is subject to change. USE AT YOUR OWN RISK! Because this is an unapproved draft, this document must not be utilized for any conformance/ compliance purposes." | Make the choice between TB sounding and non-TB sounding dependent only on whether the NDPA is broadcast or unicast | Rejected - the choice between TB and non-TB sounding is based on the number of STA Info fields, and the comment does not identify a technical issue. The current text reflects what was decided in the task group. |
| 21010 | 356.10 | 26.7 | Re CID 16313: there at least needs to be a NOTE that certain combinations of RA and number of STA Info fields are not allowed | At the end of 27.6.3 add a "NOTE---An individually addressed HE NDP Announcement frame only has one STA Info field that has a value in the AID11 field other than 2047. A broadcast HE NDP Announcement frame only has more than one STA Info field that has a value in the AID11 field other than 2047." | Rejected - the proposed combinations are not necessarily disallowed, although they would not accomplish much either. The note would not clarify much to this effect. |
| 21013 | 356.10 | 26.7 | There are various issues with the description of HE sounding:- The wording for non-infrastructure BSSes is self-contradictory | Ensure the wording for non-infrastructure BSSes is not self-contradictory |  |
| 21014 | 356.10 | 26.7 | There are various issues with the description of HE sounding:- The requirement for each STA Info to identify a different STA should be taken out of Clause 9 (it's already in Clause 27) | Remove the material in Clause 9 that applies a requirement already stated in Clause 27 |  |
| 21015 | 356.10 | 26.7 | There are various issues with the description of HE sounding:- The Codebook Size subfield is ignored in non-TB sounding too, so should (like the Nc and Feedback Type And Ng subfields) be set to 0 | As it says in the comment | Rejected - this is already specified at 363.45 "An HE beamformer soliciting SU 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.". CID 20823 adds CQI. |
| 21016 | 356.10 | 26.7 | There are various issues with the description of HE sounding:- HE NDPAs can only be transmitted by HE STAs to HE STAs, so qualifiers like "to/from an HE beamformee" do not need to be constantly repeated (a single statement at the beginning suffices) | As it says in the comment |  |
| 21017 | 356.10 | 26.7 | There are various issues with the description of HE sounding:- TB sounding can be used for SU and CQI feedback, not just MU feedback | Modify the wording to allow for the possibility of TB-sounding for CQI feedback | Rejected - TB sounding for CQI this is already allowed per 357.62: "An MU beamformer may solicit full bandwidth or partial bandwidth CQI feedback from an MU beamformee in an HE TB sounding sequence if the MU beamformee indicates support by setting the Triggered CQI Beamforming Feedback subfield to 1." |
| 21018 | 356.10 | 26.7 | There are various issues with the description of HE sounding:- It is not clear which of the various fields are N/A or ignored in which contexts | Add a table to show which fields are N/A or ignored in various contexts (SU/MU/CQI, TB/non-TB) |  |
| 21019 | 356.10 | 26.7 | There are various issues with the description of HE sounding:- Some of the wording needs caveats to allow for the case where a STA Info field is a fake that does not actually identify an actual STA | As it says in the comment |  |
| 21320 | 358.06 | 26.7.2 | It is the MU beamformer and MU beamformee that use the HE TB sounding sequence, not the SU beamformer / beamformee so surely the requirements here apply to the MU beamformer / beamformee. The requirements require more karma in than that possessed by an SU beamformer/e. | Apply requirements to MU beamformer and MU beamformee, not the SU beamformer and SU beamformee. An MU beamforme{e,r} is an SU beamforme{e,r} so the requirements would still apply to the SU beamformee/r as long as it was also an MU beamformer/e | Revised - At 358.6, change"An SU beamformer may solicit punctured feedback from an SU beamformee in an HE TB sounding sequence if the SU beamformee indicates support for punctured sounding by setting the Punctured Sounding Support subfield to 1. An SU beamformer shall indicate punctured subchannels in the NDP frames ..."to"An HE beamformer may solicit punctured SU feedback from an HE beamformee in an HE TB sounding sequence if the HE beamformee indicates support for punctured sounding by setting the Punctured Sounding Support subfield to 1. An HE beamformer shall indicate punctured subchannels in the NDP frames ..." |
| 21321 | 358.08 | 26.7.2 | No such thing as NDP frames | HE sounding NDP | Revised -At 358.8 change "NDP frame" to "HE sounding NDPs".At 359.38, in Figure 26-6 (An example of the sounding protocol with a single HE beamformee), change "HE NDP" to "HE sounding NDP".At 359.38, in Figure 26-7 (An example of the sounding protocol with more than one HE beamformee), change "HE NDP" to "HE sounding NDP".At 359.47 change "The HE beamformer" to "An HE beamformer".At 360.26 change "The HE beamformer" to "An HE beamformer". |
| 21322 | 358.15 | 26.7.2 | The indication is done in the HE NDP Announcement frame and not the NDP frames, whatever they are. | change "in the NDP frames of an" to "in the HE NDP Announcement frame in the" | Accepted |
| 21323 | 358.16 | 26.7.2 | Set the TXVECTOR of what? | "shall set the TXVECTOR parameter INACTIVE\_SUBCHANNELS accordint to 27.11.7 of the non-HT duplicate PPDU carrying the HE NDP HE Announcement frame and the HE sounding NDP." | Revised - At 358.15, change"shall set the TXVECTOR parameter INACTIVE\_SUBCHANNELS"to"shall set the TXVECTOR parameter INACTIVE\_SUBCHANNELS of the non-HT duplicate PPDU carrying the HE NDP Announcement frame and the HE sounding NDP" |
| 21325 | 357.38 | 26.7.2 | There is no description or definition of punctured sounding. | Add a description that captures how and why it would be used. | TBD -- I asked Matt Fischer |
| 21326 | 357.38 | 26.7.2 | The punctured sounding mechansim no descernable use. A STA is always able to transmit at the BSS channel width without puncuturing so why is sounding so special that it needs puncturing? | Add descriptive text to explain the value of the mechanism (puctured sounding) or remove it from the spec and complete the design in EHT. | TBD -- I asked Matt Fischer |
| 21400 | 358.13 | 26.7.2 | "An SU beamformer that indicates punctured subchannels in the NDP frames of an HE NDP sounding sequence shall set the TXVECTOR parameter INACTIVE\_SUBCHANNELS according to 27.11.7 (INACTIVE\_SUBCHANNELS)."TXVECTOR does not define a parameter INACTIVE\_SUBCHANNELS. | Add parameter if needed. Is this parameter different from PREAMBLE\_PUNCTURING\_BITMAP? | Revised - at 455.10 change "PREAMBLE\_PUNCTURING\_BITMAP" to "INACTIVE\_SUBCHANNELS". |
| 21401 | 358.13 | 26.7.2 | "An SU beamformer that indicates punctured subchannels in the NDP frames of an HE NDP sounding sequence shall set the TXVECTOR parameter INACTIVE\_SUBCHANNELS according to 27.11.7 (INACTIVE\_SUBCHANNELS)."Wrong reference. Should be 26.11.7. | Correct reference | Revised - at 358.16 change "27.11.7" to "26.11.7", which implements what the comment requested for. |
| 21482 | 128.45 | 9.4.1.64 | why would "Disallowed Subchannel Bitmap Present" is set to 1 also indicate that a reserved field of 8 bits is present? If the Reserved field serves no puppose or has no specification, it should not be included. | make the bit "Disallowed Subchannel Bitmap Present" indicate only whether "Disallowed Subchannel Bitmap" is present or not. | Rejected - the reserved bits allow for possible extension of the field. |
| 21539 | 357.39 | 26.7.2 | "Punctured sounding is indicated by the inclusion of a non-zero Disallowed Subchannel Bitmap subfield in the NDP Announcement frame and in such a case, the disallowed subchannels are applied to the tone information to be included in the feedback after selecting tones for feedback based on the RU Start Index and RU End Index subfield values and HE NDP Announcement frame bandwidth as described above."For the partial BW feedback, please states that the RU Start Index subfield and the RU End Index subfield shall cover at least one tones that are outside of the disallowed subchannels. | As in comment. | Revised - at 357.45 add "The RU Start Index and RU End Index subfields shall cover at least one allowed subchannel." |
| 21551 | 358.65 | 26.7.2 | HE beamformee needs to support at least 4 HE -LTF symbols in an HE NDP. P359L5 specifies this only for 160/80+80 HE NDP. | Add at P358L65: "An HE beamformee shall set the Beamformee STS <= 80 MHz subfield to indicate a maximum number of HE-LTFs of 4 or greater." | Revised - agree with the comment. Make changes as shown in <this document> under CID CID 20567 (note to editor, this is a different CID). |
| 21608 | 357.27 | 26.7.2 | The condition to determine if the solicited sounding feedback is full bandwidth as described in the four paragraphs can be simplified to avoid unnecessary complexity. | Use condition of "RU End Index subfield equal to 0x3F" to indicate full bandwidth explicitly. | Rejected - the curent text is not in error, while the proposed change does not provide sufficient improvement. |
| 21609 | 358.01 | 26.7.3 | HE MU sounding feedback can be obtained using HE TB sounding sequence. When UL MU is disabled by the non-AP STA, AP's DL MU-MIMO transmission can not be performed due to this constraint and this limitation contraints 11ax performance/gain. | Extend the paragraph as follows:An MU beamformer may solicit full bandwidth MU or CQI feedback from an MU beamformee in an HE non-TB sounding sequence ... | Rejected - the current text reflects what was decided in the task group. The requested addition of a new mode is considered to add complexity without sufficient technical justidication. (Copy of CID 15692, which was previously rejected. CID 16672 explicitly added that "An MU beamformer shall not solicit MU feedback in an HE non-TB sounding seqeunce.".) |
| 21614 | 356.45 | 26.7.1 | "An HE beamformer shall support a maximum MPDU length for the HE compressed beamforming/CQI report that is the minimum of 11 454 octets...." isn't this 11454 octets rule applies to all the MPDUs, not limited to beamforming feedback? If it is true, remove this part of duplicated setence. | As stated in the comment. | Rejected - the 11 454 limitation for regular MPDUs is optional, because 3895 or 7991 are also possible. |
| 21615 | 356.50 | 26.7.2 | Please clarify when a 20MHz only STA is operating in the broadband OFDMA, can this STA use 80MHz NDP frame for sounding? If not, add spec support for it. | As stated in the comment. | Rejected - Table 26-4 specifies the permitted combinations of Operating channel width of the HE beamformee, Bandwidth of HE NDP Announcement frame and the sounded RUs (through the RU Start Index field and the RU End Index field). The permitted combinations can be inferred from it.  |

**CID 20823**

361.4 modify as shown

In an HE TB sounding sequence, each STA Info field in the HE NDP Announcement frame that solicits SU or MU feedback indicates the subcarrier grouping, Ng, codebook size and the number of columns, Nc, to be used by the HE beamformee addressed by the STA Info field for the generation of the SU or MU feedback.

In an HE non-TB sounding sequence where the STA Info field in the HE NDP Announcement frame solicits SU feedback, the subcarrier grouping, Ng, codebook size and the number of columns, Nc, used for the generation of the SU feedback are determined by the HE beamformee.

In an HE TB sounding sequence, each STA Info field in the HE NDP Announcement frame that solicits CQI feedback indicates the Nc to be used by the HE beamformee addressed by the STA Info field for the generation of the CQI feedback.

In an HE non-TB sounding sequence where the STA Info field in the HE NDP Announcement frame solicits CQI feedback, the Nc used for the generation of the CQI feedback is determined by the HE beamformee.

363.45 modify as shown

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.

An HE beamformee that receives an HE NDP Announcement frame soliciting SU feedback as part of an HE non-TB sounding sequence shall generate an HE compressed beamforming/CQI report for SU feedback with Nc in the range 1 to 8, Ng = 4 or Ng = 16, and codebook size (ϕ, ψ) = {4, 2} or (ϕ, ψ) = {6, 4}. The HE beamformee shall transmit the HE compressed beamforming/CQI report a SIFS after the HE sounding NDP.

363.55 modify as shown

An HE beamformee that receives an HE NDP Announcement frame soliciting CQI feedback as part of an HE non-TB sounding sequence shall generate an HE compressed beamforming/CQI report for CQI feedback with Nc determined by the HE beamformee.

An HE beamformee that receives an HE NDP Announcement frame soliciting CQI feedback as part of an HE TB sounding sequence shall generate an HE compressed beamforming/CQI report for CQI feedback with Nc determined by the HE beamformer.

363.60 modify as shown

An HE beamformee that receives an HE NDP Announcement frame from an HE beamformer with which it is associated and that contains the HE beamformee's MAC address in the RA field (indicating non-TB sounding) and also receives an HE sounding NDP a SIFS after the HE NDP Announcement frame

364.3 modify as shown

An HE beamformee that receives an HE NDP Announcement frame as part of an HE TB sounding sequence with a STA Info field addressed to it soliciting SU or MU feedback shall generate an HE compressed beamforming/ CQI report using the feedback type, Ng and codebook size and *Nc* indicated in the STA Info field.

**CID 20656**

102.6 modify as shown

In a broadcast HE NDP Announcement frame that has more than one STA Info field with a value other than 2047 in the AID11 field, if the Feedback Type subfield indicates SU or MU, the Nc field indicates the number of columns, Nc, in the compressed beamforming feedback matrix and is set to Nc – 1, and if the Feedback Type subfield indicates CQI, the Nc Index subfield indicates the number of space time streams, Nc, in the CQI Report minus 1. In an individually addressed HE NDP Announcement frame that has only one STA Info field with a value other than 2047 in the AID11 field, the Nc field is reserved.

361.24 remove underline under Nc.

363.55 make Nc italics

**CID 20670**

361.24 modify as shown

An HE beamformer that transmits an HE NDP Announcement frame as part of an HE TB sounding sequence shall set the Nc subfield of the STA Info field to indicate a value less than or equal to the minimum of:

**CID 20563**

429.18 modify as shown

A STA shall have the same value of maximum VHT NSS defined by its Rx HE-MCS Map ≤ 80 MHz field in the HE Capabilities element as the maximum NSS value indicated by its Rx VHT-MCS Map field in the VHT Capabilities element.

If a STA supports 160 MHz, the Maximum NSS defined by its Rx VHT MCS Map field and Extended NSS BW Support field in the VHT Capabilities element at 160 MHz shall not be more than the maximum NSS defined by its Rx HE-MCS Map 160 MHz field in the HE Capabilities element at 160 MHz.

If a STA supports 80+80 MHz, the maximum NSS defined by its Rx VHT-MCS Map field and Extended NSS BW Support field in the VHT Capabilities element at 80+80 MHz shall not be more than the maximum NSS defined by its Rx HE-MCS Map 80+80 MHz field in the HE Capabilities element at 80+80 MHz.

For every NSS in VHT Capabilities elements and HE Capabilities elements transmitted by a STA, if the maximum HE-MCS is 9 or more, the maximal VHT-MCS shall be 9. Otherwise the maximal VHT-MCS shall be the same as the HE-MCS.

An HE STA shall not transmit a VHT Capabilities element with the Supported Channel Width Set field equal to 1 and the Extended NSS BW Support field equal to 3 or with the Supported Channel Width Set field equal to 2 and the Extended NSS BW Support field equal to 3.

If an HE STA supports 160 MHz, the maximum NSS defined by its Rx HE-MCS Map 160 MHz field for an HE-MCS in the HE Capabilities element at 160 MHz shall not be more than the maximum NSS defined by its Rx HE-MCS Map 80 MHz field for the HE-MCS in the HE Capabilities element at 80 MHz.

If an HE STA supports 80+80 MHz, the maximum NSS defined by its Rx HE-MCS Map 80+80 MHz field for an HE-MCS in the HE Capabilities element at 80+80 MHz shall not be more than the maximum NSS defined by its Rx HE-MCS Map 80 MHz field for the HE-MCS in the HE Capabilities element at 80 MHz.

**CID 20567**

**26.7.2 Sounding sequences and support**

358.59 modify as shown (including inserting the line breaks):

An HE beamformee indicates the maximum number of HE-LTFs it can receive in a 20 MHz, 40 MHz or 80 MHz HE sounding NDP in the Beamformee STS ≤ 80 MHz subfield in the PHY Capabilities Information field in the HE Capabilities element it transmits.

An HE beamformee shall set the Beamformee STS <= 80 MHz subfield to indicate a maximum number of HE-LTFs of 4 or greater."

STS

An HE beamformee that supports 160 MHz or 80+80 MHz channel widths indicates the maximum number of HE-LTFs it can receive in a 160 MHz or 80+80 MHz HE sounding NDP in the Beamformee STS > 80 MHz subfield in the PHY Capabilities Information field in the HE Capabilities element it transmits.

An HE beamformee that supports 160 MHz or 80+80 MHz channel widths shall set the Beamformee STS > 80 MHz subfield to indicate a maximum number of HE-LTFs of 4 or greater.

An HE beamformer shall not transmit a 160 MHz or 80+80 MHz HE sounding NDP with a TXVECTOR parameter NUM\_STS that is greater than the maximum number of HE-LTF symbols indicated in the Beamformee STS > 80 MHz subfield of any STA addressed by a STA Info field in the preceding HE NDP Announcement frame.

An HE beamformer indicates the maximum number of HE-LTF symbols it might transmit in a 20 MHz, 40 MHz or 80 MHz HE sounding NDP in the Number Of Sounding Dimensions ≤ 80 MHz subfield.

An HE beamformer indicates the maximum number of HE-LTF symbols it might transmit in an 80+80 MHz or 160 MHz HE sounding NDP in the Number Of Sounding Dimensions > 80 MHz subfield.

An HE beamformer shall not transmit a 20 MHz, 40 MHz or 80 MHz HE sounding NDP where the number of HE-LTF symbols exceeds the value indicated in the Number Of Sounding Dimensions ≤ 80 MHz subfield.

An HE beamformer shall not transmit an 80+80 MHz or 160 MHz HE sounding NDP where the number of HE-LTF symbols exceeds the value indicated in the Number Of Sounding Dimensions > 80 MHz subfield.

**26.7.5 HE sounding NDP transmission**

366.6 delete the following requirements, which are duplicates from 26.7.2 (Sounding sequences and support):

"If the HE sounding NDP bandwidth is less than or equal to 80 MHz, the number of space-time streams sounded and as indicated by the NUM\_STS parameter shall not exceed the value indicated in the Beamformee STS ≤ 80 MHz field in the HE Capabilities element of any intended recipient of the HE sounding NDP. If the HE sounding NDP bandwidth is greater than 80 MHz, the number of space-time streams sounded and as indicated by the NUM\_STS parameter shall not exceed the value indicated in the Beamformee STS > 80 MHz field in the HE Capabilities element of any intended recipient of the HE sounding NDP."