IEEE P802.11
Wireless LANs

|  |
| --- |
| CR on 27.6.2 revisited |
| Date: 2018-03-02 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Robert Stacey | Intel |  | +1-503-724-0893 | robert.stacey@intel.com |
|  |  |  |  |  |

Abstract

Revisits resolutions to the following comments on 27.6.2:

12511, 12668, 13203, 13204, 13205, 13206, 13209, 13210, 13212, 13213, 13214, 13215, 13216, 13217, 14271

# Comments

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Page** | **Comment** | **Proposed Change** | **Resolution** |
| 12511 | Liwen Chu | 263.50 | it should be described per STA's BW capability. | Fix the issue mentioned in comment. | REVISEDIn the context of the sounding protocol, the “bandwidth” in Bandwidth STS <= 80 MHz and Bandwidth STS > 80 MHz applies to the bandwidth of the received HE NDP.Editor to apply changes in <this doc> tagged #12511 which describe this more clearly. |
| 12668 | Mark RISON | 263.26 | There is no normative behaviour associated with the SU/MU Beamformee and Triggered SU/MU/CQI fields | Add at the end of 27.6.2 (or in 27.6.3?) wording like "A STA shall not request non-trigger-based SU-type feedback from another STA unless it has received from that STA an HE PHY Capabilities Indication field with the SU Beamformee subfield equal to 1" and "A STA shall not request trigger-based MU-type feedback from another STA unless it has received from that STA an HE PHY Capabilities Indication field with the Triggered MU Beamforming Feedback subfield equal to 1" | REVISED (MU: 2018-01-24 04:09:38Z)TGax editor to make the changes shown in 11-18/0042r1 under all headings that include CID 12688.RevisitedAgree in principle with the commenter.Editor to apply the changes in <this doc>. The changes define the normative behavior associated with the SU/MU Beamformee and Triggered SU/MU/CQI fields. |
| 13203 | Robert Stacey | 263.29 | All the statements in the subclause are or should be covered in the frame formats clause. The purpose of the frame formats clause is to assign meaning to bits. This is descriptive: "when a bit is set 1 it means that the STA supports the SU beamformer role." Adding additional shall statements that then say "An SU beamformer shall set the bit to 1" is redundent. | Remove subclause 27.6.2. If anything present here is missing in the the HE Capabilities element field descriptions, add it. | REVISEDAgree in principle with the commenter.Editor to apply the changes in <this doc>. The changes define normative OTA behavior for the HE beamformer and HE beamformee based on the capabilities they declare. |
| 13204 | Robert Stacey | 263.33 | What "being an SU beamformer" entails is not defined. | Define what being an SU beamformer entails. If it is initiating a non-TB sounding sequence why do we need to indicate this capability? | REVISED (MU: 2018-01-24 05:38:35Z)TGax editor to make the changes shown in 11-18/0042r1 under all headings that include CID 13204.RevisitedEditor to apply the change in <this doc> tagged #13204. The changes define an SU beamformer as a STA that declares a certain capability and then adds normative requirements for a STA that makes that declaration. |
| 13205 | Robert Stacey | 263.37 | What "being an MU beamformer entails is not defined | Define what being an MU beamformer entails. | REVISED (MU: 2018-01-24 05:46:27Z)TGax editor to make the changes shown in 11-18/0042r1 under all headings that include CID 13205.RevisitedEditor to apply the changes in <this doc> tagged #13205. The changes define an MU beamformer as a STA that declares a certain capability and then adds normative requirements for a STA that makes that declaration. |
| 13206 | Robert Stacey | 263.40 | What "being an SU beamformee" entails is not defined | Define what being an SU beamformee entails. | REVISED (MU: 2018-01-24 05:46:57Z)TGax editor to make the changes shown in 11-18/0042r1 under all headings that include CID 13206.RevisitedEditor to apply the changes in <this doc> tagged #13206. The changes define an SU beamformee as a STA that declares a certain capability and then adds normative requirements for a STA that makes that declaration. |
| 13207 | Robert Stacey | 263.45 | What "being an MU beamformee" entails is not defined | Define what being an MU beamformee entails. | REVISED (MU: 2018-01-24 05:47:34Z)TGax editor to make the changes shown in 11-18/0042r1 under all headings that include CID 13207.RevisitedEditor to apply the change in <this doc> tagged #13207. The changes define an MU beamformee as a non-AP HE STA and the adds normative requirements for a non-AP HE STA. |
| 13209 | Robert Stacey | 263.50 | The first shall statement here makes no sense. A shall statement is not needed on what is supported. A shall statement is needed on what can be transmitted. A shall statement might be needed on how a STA reponds based on what is indicated in the capability field. | Remove the first shall statement. Add a statement to the effect that an HE beamformer shall not send to an HE beamformee and HE NDP PPDU with a bandwidth less than or equal to 80 Mhz and with more than x HE LTF symbols unless the STA has a value greater than or equal to x in its Beamformee <= 80 MHz subfield. | REVISED (MU: 2018-01-24 05:48:23Z)TGax editor to make the changes shown in 11-18/0042r1 under all headings that include CID 13209.RevisitedEditor to apply changes in <this doc> tagged #13209. The changes are roughly the commenter’s proposed changes. |
| 13210 | Robert Stacey | 263.52 | Its not the channel width in which it is received (whatever that is) that matters. It is the bandwidth of the HE NDP PPDU (the value indicated in the BW field of HE-SIG-A) that is important. A STA operating with 160 MHz channel width might receive an 80 MHz NDP, in which case it is the Beamformee STS <= 80 MHz that applies. | Rewrite the statement to apply to the what the STA is capable of receiving (and move it to the appropriate subclause). For example, an HE STA that indicates support for channel widths of 80 MHz or greater shall support receiption of an HE NDP PPDU with up to 4 OFDM symbols in the HE LTF field. There is already a statement in the capability field description to the effect that the minimum field value is 3 so remove the NSTS,max requirements. An appropriate behavioral statement for a given Beamformee STS <= 80 MHz subfield setting is something like: an HE beamformee that receives an HE NDP PPDU with bandwidth less than or equal to 80 MHz and that has x OFDM symbols in the HE LTF field shall generate a HE compressed beamforming feedback (see ) provided x is less than or equal to the value indicated by the Beamformee STS <= 80 MHz field. | REVISED (MU: 2018-01-24 05:49:09Z)Proposed resolution is to clarify that the BW is that of the HE NDP as obtained from the RXVECTOR parameter CH\_BANDWITH, inline with the comment’s suggestion. Please note that while the statement in clause 9 is there it is still not normative behavior. As such a normative statement is needed in clause 27.TGax editor to make the changes shown in 11-18/0042r1 under all headings that include CID 13210.RevisitedEditor to apply changes in <this doc> tagged #13210. The changes define the requirement using terms such as “20 MHz, 40 MHz or 80 MHz HE NDP” |
| 13212 | Robert Stacey | 263.64 | This statement is not necessary. It is the behavior when the field is set a certain way that is important. For SU-type feedback, the beamformee shall not send feedback with parameters the beamformer doesn't support. For SU-type and MU-type feedback, the beamformer shall not set the Feedback Type And Ng field in the HE NDP Annoucnement frame to a value the beamformee does not support. | Remove the statement. Add statements for restrictions on what can be transmitted based on the recipient capability (if necessary). | REVISED (MU: 2018-01-24 05:50:22Z)TGax editor to make the changes shown in 11-18/0042r1 under all headings that include CID 13212.RevisitedEditor to apply the changes in <this doc>. The changes align with the proposed change.  |
| 13213 | Robert Stacey | 264.04 | This statement is not necessary. It's the behavior when the field is set a certain way that is important. | Remove the statement. Add a statement to the effect that the STA shall not send an HE Compressed Beamforming Report field with codebook x unless the HE beamformer support codebook x as indicated by its Codebook Size subfield. | REVISED (MU: 2018-01-24 05:50:59Z)TGax editor to make the changes shown in 11-18/0042r1 under all headings that include CID 13213.Revised.Editor to make the changes in <this doc>. The statement tagged #13213 essentially adopts the proposed change. |
| 13214 | Robert Stacey | 264.09 | This statement is not necessary. An HE beamfomer controls what it receives: it sets the Feedback Type And Ng field in the HE NDP Announcement frame appropriately. | Remove the statement. | REVISED (MU: 2018-01-24 05:51:29Z)TGax editor to make the changes shown in 11-18/0042r1 under all headings that include CID 13214.Revised.Editor to make the changes in <this doc>.The statement tagged #13214 places a requirement on the beamformer to not send a HE NDP Announcement frame in an HE TB sounding sequence that solicits partial bandwidth MU feedback unless the beamformer has set the capability. |
| 13215 | Robert Stacey | 264.14 | This statement is not necessary. It's the behavior when the field is set a certain way that is important. | Remove the statement. | REVISED (MU: 2018-01-24 05:51:58Z)TGax editor to make the changes shown in 11-18/0042r1 under all headings that include CID 13215.RevisitedThe editor to apply changes in <this doc>. The statement tagged #13215 places normative requirements on the HE beamformer along the lines indicated in the comment. |
| 13216 | Robert Stacey | 264.18 | This statement is not necessary. The behavior that is important is the restriction on the HE beamformer sending an HE NDP Announcement frame requesting partial bandwidth to an HE beamformee that has not set the Trigger MU Beamforming subfield to 1. And, BTW, this subfield is poorly named. | Remove the statement. | REVISED (MU: 2018-01-24 05:52:25Z)TGax editor to make the changes shown in 11-18/0042r1 under all headings that include CID 13216.RevisitedThe editor to apply changes in <this doc>. The statement tagged #13216 palces normative requirements on the HE beamformer as suggested in the comment. |
| 13217 | Robert Stacey | 264.23 | This statement is not necessary. The behavior that is important is that the HE beamformer not send the HE beamformee an HE NDP Announcement with certain settings in the Feedback Type And Ng field unless the HE beamformee has indicated approriate support for those settings. | Remove the statement. | REVISED (MU: 2018-01-24 05:52:59Z)TGax editor to make the changes shown in 11-18/0042r1 under all headings that include CID 13217.RevisitedThe editor to apply changes in <this doc>. The statement tagged #13217 places normative requirements on the HE beamformer as suggested in the comment. |
| 14271 | Yusuke Tanaka | 263.33 | "a STA" and "an HE STA" are mixed in this list. This subclause describe HE sounding so attribute should "an HE STA". | As commented. | ACCEPTED |

# Discussion

This document revisits resolutions to 27.6.2 to clarify the meaning of the broad statement quoted below that was added as a resolution to many of the comments listed above:

*An HE beamformer shall not request a type of sounding feedback or feedback using sounding parameters that are not supported by the HE beamformee. The HE beamformer shall not solicit sounding feeback using an HE sounding sequence that is not supported by the HE beamformee.*

It revisits the resolutions to 13204, 13205, 13206 and 13207 and defines the terms SU beamformer, SU beamformee, MU beamformer and MU beamformee as STAs that declare a certain capability. Normative behavior then follows, e.g., “An SU Beamformer shall do this…” This tells the implementor that a STA that declares a certain capability is required to exhibit certain OTA behavior.

It defines the terms “partial bandwidth feedback” and “full bandwidth feedback,” and clarifies the conditions under which partial bandwidth feedback and full bandwidth feedback may be solicited.

# Editing instructions

* HE sounding protocol
* General

Transmit beamforming and DL MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmit signal to optimize reception at one or more receivers. HE STAs use the HE sounding protocol to determine the channel state information. (#11508)The HE sounding protocol provides explicit feedback mechanisms, defined as HE non-trigger-based (non-TB) sounding and trigger-based (TB) sounding,(#12758) where the HE beamformee measures the channel using a training signal (i.e., an HE NDP PPDU)(#13286) transmitted by the HE beamformer and sends back a transformed estimate of the channel state. The HE beamformer uses this estimate to derive the steering matrix.

The HE beamformee returns an estimate of the channel state in an HE compressed beamforming and CQI report(#12775) carried in one or more HE Compressed Beamforming And CQI Report frames. There are three types of HE compressed beamforming and CQI report(#Ed):

* SU feedback: The HE compressed beamforming and CQI report consists of an HE Compressed Beamforming Report field
* MU feedback: The HE compressed beamforming and CQ report consists of an HE Compressed Beamforming Report field and HE MU Exclusive Beamforming Report field
* CQI feedback: The HE compressed beamforming and CQI report consists of an HE CQI-only Report field

(#12758)The HE compressed beamforming and CQI report(#12775) is carried in a single HE Compressed Beamforming And CQI Report frame if the resulting frame is less than or equal to 11 454 octets in length (see 27.6.3 (Rules for HE sounding protocol sequences))(#11764). Otherwise, the HE beamforming feedback is segmented and each segment is carried in an HE Compressed Beamforming And CQI Report frame.

* Sounding sequences and support

 (#12668, #13209, #13212, #13213, #13214, #13215, #13216, #13217)

(#13204)An SU beamformer is an HE STA that sets the SU Beamformer subfield in the HE PHY Capabilities Information field of the HE Capabilities element to 1.

(#13206)An SU beamformee is an HE STA that sets the SU Beamformee subfield in the HE PHY Capabilities Information field in the HE Capabilities element to 1. A non-AP HE STA shall set the SU Beamformee subfield to 1. An HE AP may set the SU Beamformee subfield to 1.

 (#13205)An MU beamformer is an HE AP that sets the MU beamformer subfield in the HE PHY Capabilities Information field in the HE Capabilities element to 1. An HE AP that indicates support for 4 or more space-time streams in the Tx HE-MCS Map <= 80 MHz subfield in the Supported HE-MCS And NSS field in the HE Capabilities element shall set the MU Beamformer subfield to 1. A non-AP HE STA shall set the MU Beamformer subfield to 0. An MU beamformer is also an SU beamformer and shall set the SU Beamformer subfield to 1.

(#13207)An MU beamformee is a non-AP HE STA (support for the MU beamformee role is mandatory in a non-AP HE STA).

(#13208)The term HE beamformer refers to both the SU beamformer and MU beamformer. The term HE beamformee refers to both the SU beamformee and MU beamformee.

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 addressed to the HE beamformee in the HE NDP Announcement frame as defined in Table 9-25a (Feedback Type And Ng subfield and Codebook Size subfield encoding).

The bandwidth (partial or full) of the feedback solicited by an HE beamformer from and HE beamformee depends on the Partial BW subfield in the STA Info field addressed to the HE beamformee in the HE NDP Announcement frame and the bandwidth of the HE NDP that follows the HE NDP Annoucement frame. Full bandwidth feedback is solicited if the RU Start Index subfield in the Partial BW subfield is 0 and the following conditions apply:

* The RU End Index subfield in the Partial BW subfield is 8 and the bandwidth of the HE NDP is 20 MHz
* The RU End Index subfield is 17 and the bandwidth of the HE NDP is 40 MHz
* The RU End Index subfield is 36 and the bandwidth of the HE NDP is 80 MHz
* The RU End Index subfield is 73 and the bandwidth of the HE NDP is 80+80 MHz or 160 MHz

Other settings solicit partial bandwidth feedback.

(#12668)An SU beamformer may solicit full bandwidth SU feedback from an SU beamformee in an HE non-TB sounding sequence. An SU beamformer shall not solicit partial bandwidth SU feedback in an HE non-TB sounding sequence. An SU beamformer may solicit partial bandwidth or full bandwidth SU feedback from an SU beamformee in an HE TB sounding sequence if the SU beamfomee indicates support by setting the Triggered SU Feedback subfield in the HE PHY Capabilities Information field in the HE Capabilities element it transmits.

(#12668)An MU beamformer may solicit full bandwidth MU feedback from an MU beamformee in an HE TB sounding sequence. An MU Beamformer may solicit partial bandwidth MU feedback from an MU beamformee in an HE TB sounding sequence if the MU beamformee indicates support by setting the Triggered MU Beamforming Partial BW Feedback subfield to 1.

(#12668)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 Feedback subfield to 1.

An HE beamformer shall not send an HE NDP Announcement frame that initiates an HE TB sounding sequence with a STA Info field addressed to an HE beamformee if the STA Info field and the PHY Capabilities Information field in the HE Capabilities element last received from the HE beamformee meet the following conditions: (#13212, #13213)

* The Feedback Type And Ng subfield in the STA Info field indicates SU and Ng = 16, and the Ng = 16 SU Feedback subfield in the HE PHY Capabilities Information field is 0
* The Feedback Type And Ng subfield in the STA Info field indicates SU, the Codebook Size subfield indicates codebook resolution (ϕ, ψ) = {4, 2} and the Codebook Size (ϕ, ψ) ={4, 2} SU Feedback subfield in the HE PHY Capabilities Information field is 0
* The Feedback Type And Ng subfield in the STA Info field indicates MU and Ng = 16 and the Ng = 16 MU Feedback subfield in the HE PHY Capabilities Information field is 0
* The Feedback Type And Ng subfield in the STA Info field indicates MU, the Codebook Size subfield in the STA Info field indicates codebook resolution (ϕ, ψ) = {7, 5} and the Codebook Size (ϕ, ψ) ={7, 5} MU Feedback subfield in the HE PHY Capabilities Information field is 0
* The Feedback Type And Ng and Codebook Size subfields in the STA Info field indicate CQI only feedback and the Triggered CQI Feedback subfield in the HE PHY Capabilities Information field is 0(#13217, #12668)
* The Feedback Type And Ng subfield in the STA Info field indicates MU, the Partial BW subfield in the STA Info field indicates partial bandwidth and the Triggered MU Beamforming Partial BW subfield in the HE PHY Capabilities Information field is 0(#13215, #12668)
* The Feedback Type And Ng subfield indicates SU and the Triggered SU Feedback subfield in the HE PHY Capabilities Information field is 0(#13217, #12668)

An HE beamformer shall not transmit an HE NDP Announcement frame that initiates an HE TB sounding sequence and that solicits SU feedback, partial bandwidth MU feedback or CQI feedback unless the HE beamformer has set the Trigger SU feedback subfield, Triggered MU Beamforming Partial BW subfield or Triggered CQI Feedback subfield, respectively, to 1.(#13214, #13216, #12668)

An HE beamformee indicates the maximum number of HE-LTFs it can receive in a 20 MHz, 40 MHz or 80 MHz HE 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. 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 Annoucement frame. (#12511, #13209, #13210)

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 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 support 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 beamformee that supports neither 80+80 MHz nor 160 MHz channel widths sets the Beamformee > 80 MHz subfield to 0. An HE beamformer shall not transmit a 160 MHz or 80+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 Annoucement frame. (#12511, #13209, #13210)

An HE beamformer indicates the maximum number of HE-LTF symbols it might transmit in a 20 MHz, 40 MHz or 80 MHz HE NDP in the Number Of Sounding Dimensions <= 80 MHz subfield and the maximum number of HE-LTF symbols it might transmit in an 80+80 MHz or 160 MHz HE 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 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 80+80 MHz HE NDP where the number of HE-LTF symbols exceeds the value indicated in the Number Of Sounding Dimensions > 80 MHz subfield.(#13211)