IEEE P802.11
Wireless LANs

|  |
| --- |
| Proposed Draft Text (PDT-Joint): Fix TBDs in Spatial Stream and MIMO Protocol Enhancement Part 1 |
| Date: 2021-01-20 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Wook Bong Lee | Samsung |  |  | wookbong.lee@samsung.com |
| Rui Cao | NXP |  |  | rui.cao\_2@nxp.com |

Abstract

This submission proposed the text modification on spatial stream and MIMO protocol enhancement.

This document is based on P802.11be D0.3.

* VHT/HE/EHT NDP Announcement frame based on VHT/HE NDP Announcement frame format
* EHT Control field based on HE Control field
* EHT Compressed Beamforming Report field based on HE Compressed Beamforming Report field
* EHT MU Exclusive Beamforming Report field based on HE MU Exclusive Beamforming Report field

Yellow highlighted texts are TBD.

Rev 1: updated based on comments.

This document is based on following motions:

A 9-bit to signal NDPA partial BW info field is defined as follows.



* 1 bit indicates bitmap resolution for 20 MHz or 40 MHz
	+ Set to 0 for 20 MHz for NDP BW < 320MHz.
	+ Set to 1 for 40 MHz for NDP BW = 320MHz.
* 8-bit bitmap to indicate the request for each resolution size.

[Motion 150, #SP367, [92] and [321]]

The followings are defined for the sounding to STAs of mixed bandwidths.

* Beamformer can group STAs of mixed bandwidths in one NDPA and NDP with NDP bandwidth larger or equal to the STA’s operating bandwidth.
* Beamformee supports receiving NDP of bandwidth wider than its operating bandwidth.
* 20 MHz operating STA participating in 320 MHz NDP is TBD.
* 40 MHz operating STA is excluded.

[Motion 144, #SP318, [35] and [148]]

The beamformee support of receiving NDP with bandwidth wider than the STA’s operating BW is

* mandatory for STAs with operating BW ≥ 80 MHz.
* optional for STAs with operating BW = 20 MHz.

[Motion 144, #SP319, [35] and [148]]

Proposed Changes:

*Instruction to 11be Editor: Underline text is for addition, and strikeout text is for deletion.*

## ***Change the title of the subclause 9.3.1.19 as follows:***

57

### 58**9.3.1.19 VHT/HE/EHT NDP Announcement frame format**

59

60

## 61 ***Change the first paragraph as follows:***

62

63 The VHT/HE/EHT NDP Announcement frame has ~~two~~three variants, the VHT NDP Announcement frame,

64

65 ~~and~~ the HE NDP Announcement frame, and the EHT NDP Announcement frame. The variants~~two formats~~

1. are distinguished by the setting of the HE subfield and the Ranging subfield in the Sounding Dialog Token
2. field.

3

4

## 5 ***Change the fourth and fifth paragraphs as follows:***

6

1. The VHT/HE/EHT NDP Announcement frame contains at least one STA Info field. If the VHT/HE/EHT
2. NDP Announcement frame contains only one STA Info field, then the RA field is set to the address of the
3. STA that can provide feedback (see 10.37.5.2 (Rules for VHT sounding protocol sequences)). If the VHT/

10

1. HE/EHT NDP Announcement frame contains more than one STA Info field, then the RA field is set to the
2. broadcast address.

13

1. The TA field is set to the address of the STA transmitting the VHT/HE/EHT NDP Announcement frame or
2. the bandwidth signaling TA of the STA transmitting the VHT/HE/EHT NDP Announcement frame. In a

16

1. VHT/HE/EHT NDP Announcement frame transmitted by a VHT, ~~or~~ HE or EHT STA in a non-HT or non-
2. HT duplicate format and where the scrambling sequence carries the TXVECTOR parameter CH\_BAND-
3. WIDTH\_IN\_NON\_HT, the TA field is set to a bandwidth signaling TA. In an EHT NDP Announcement
4. frame transmitted by an EHT STA in a non-HT duplicate format with bandwidth greater than 160 MHz, the
5. TBD field in the SERVICE field carries the TXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT as

22

1. in Table 36-1 (TXVECTOR and RXVECTOR parameters) and the TA field value is a bandwidth signaling
2. TA.

25

## **26 *Change the seventh paragraph as follows:***

27

28

1. The HE subfield and Ranging subfield in the Sounding Dialog Token field are set to 0 to identify the frame
2. as a VHT NDP Announcement frame; the HE subfield and Ranging subfield are set to 1 and 0 respectively
3. to identify the frame as an HE NDP Announcement frame; the HE subfield and Ranging subfield are set to 1
4. to identify the frame as a an EHT NDP Announcement frame.

33

34

#### **35 Insert the following paragraphs at the end of the subclause:**

36

1. The frame format of the EHT NDP Announcement frame is the same as the HE NDP Announcement frame
2. shown in Figure 9-61a (HE NDP Announcement frame format).

39

40

41 The Duration, RA, and TA fields are set as in a VHT NDP Announcement frame.

42

1. The HE subfield and Ranging subfield are set to 1 to identify the frame as an EHT NDP Announcement
2. frame.

45

46

1. The Sounding Dialog Token Number field in the Sounding Dialog Token field contains a value selected by
2. the beamformer to identify the EHT NDP Announcement frame.

49

1. 50 The format of a STA Info field in an EHT NDP Announcement frame is defined in [Figure 9-61e (STA Info field format in an EHT NDP Announcement frame)](#bookmark4) . The EHT NDP Announcement frame does not contain a STA Info field with the AID 11 subfield set to 2047.

51

54

55

56 B0 B10 B11 B19 B20 B21 B24 B25 B26 B27 B28 B29 B31

57

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| AID11 | Partial BW Info  | Reserved | Nc  | Feedback Type And Ng | Disambigu ation | Codebook Size  | Reserved  |

58

59

60

61

62 Bits: 11 9 1 4 2 1 1 3

63 **Figure 9-61e—STA Info field format in an EHT NDP Announcement frame**

64

#### **1**

6

7 An EHT NDP Announcement frame contains at most one STA Info field per STA.

8

9

#### **10**

11

12

1. The AID11 subfield contains an identifier of a STA expected to process the fol-
2. lowing EHT sounding NDP and prepare the sounding feedback.

15

16

17 The Partial BW Info subfield is defined in [Figure 9-61f (Partial BW Info subfield format)](#bookmark5).

18

19

20

|  |  |
| --- | --- |
| B0 | B1 B8 |
| Resolution | Feedback Bitmap |
| 1 | 8 |

Figure 9-61f—Partial BW Info subfield format

21

22 The Resolution subfield in the Partial BW Info subfield indicates the resolution bandwidth for each bit in Feedback Bitmap. The Feedback Bitmap indicates the request of each resolution bandwidth from lowest frequency to highest frequency with B1 indicating the lowest resolution bandwidth. Each bit in the Feedback Bitmap is set to 1 if the feedback is requested on the corresponding resolution bandwidth.

When the bandwidth of EHT NDP Announcement frame is less than 320 MHz, set the Resolution bit B0 to value 0, indicating resolution of 20 MHz.

* When the bandwidth of EHT NDP Announcement frame is 20 MHz, B1 is set to value 1 to indicate the request of feedback on the 242-tone RU. B2-B8 are Reserved and set to 0.
* When the bandwidth of EHT NDP Announcement frame is 40 MHz, B1 and B2 indicates the request of feedback on each of the two 242-tone RUs from lower frequency to higher frequency. B3-B8 are Reserved and set to 0.
* When the bandwidth of EHT NDP Announcement frame is 80 MHz, B1 to B4 indicates the request of feedback on each of the four 242-tone RUs from lower frequency to higher frequency. B5-B8 are Reserved and set to 0. If B1 to B4 are all set to 1, it indicates the feedback request on 996-tone RU.
* When the bandwidth of EHT NDP Announcement frame is 160 MHz, B1 to B8 indicates the request of feedback on each of the eight 242-tone RUs from lower frequency to higher frequency. If B1 to B4 are all set to 1, it indicates the feedback request on the lower 996-tone RU, and if B5 to B8 are all set to 1, it indicates the feedback request on the higher 996-tone RU.

When the bandwidth of EHT NDP Announcement frame is 320 MHz, set the Resolution bit B0 to value 1, indicating resolution of 40 MHz. B1 to B8 indicates the request of feedback on the each of the eight 484-tone RUs from lower frequency to higher frequency. If B1 and B2 are both set to 1, it indicates the feedback request on the lowest 996-tone RU, and if B3 and B4 are both set to 1, it indicates the feedback request on the second lowest 996-tone RU, and if B5 and B6 are both set to 1, it indicates the feedback request on the second highest 996-tone RU, and if B7 and B8 are both set to 1, it indicates the feedback request on the highest 996-tone RU.

The Partial BW Info subfield is defined in Table 9-X (Settings for BW, Partial BW Info subfield in EHT NDP Announcement frame).

|  |
| --- |
| **Table 9-X- Settings for BW, Partial BW Info subfield in EHT NDP Announcement frame** |
| **Operating channel width of the EHT beamformee (MHz)** | **Bandwidth of EHT NDP Announcement frame** | **Feedback RU/MRU Size** | **Partial BW Info subfield values** |
| 20, 40, 80, 160, 320 | 20 MHz | 242 | 010000000 |
| 20, 40, 80, 160, 320 | 40 MHz | 242 | 010000000, 001000000 |
| 484 | 011000000 |
| 20, 80, 160, 320 | 80 MHz | 242 | 010000000, 001000000, 000100000, 000010000 |
| 484 | 011000000, 000110000 |
| 484+242 | 011100000, 011010000, 010110000, 001110000 |
| 996 | 011110000 |
| 20, 80, 160, 320 | 160 MHz | 242 | 010000000, 001000000, 000100000, 000010000, 000001000, 000000100, 000000010, 000000001 |
| 484 | 011000000, 000110000, 000001100, 000000011 |
| 484+242 | 011100000, 011010000, 010110000, 001110000, 000001110, 000001101, 000001011, 000000111 |
| 996 | 011110000, 000001111 |
| 996+484 | 011111100, 011110011, 011001111, 000111111 |
| 996+484+242 | 011101111, 011011111, 010111111, 001111111, 011111110, 011111101, 011111011, 011110111 |
| 2x996 | 011111111 |
| 80, 160, 320 | 320 MHz | 484 | 110000000, 101000000, 100100000, 100010000, 100001000, 100000100, 100000010, 100000001 |
| 996 | 111000000, 100110000, 100001100, 100000011 |
| 996+484 | 111100000, 111010000, 110110000, 101110000, 100001110, 100001101, 100001011, 100000111 |
| 2x996 | 111110000, 100001111, |
| 2x996+484 | 111111000, 111110100, 111101100, 111011100, 100111110, 100111101, 100111011, 100110111 |
| 3x996 | 111111100, 111110011, 111001111, 100111111 |
| 4x996 | 111111111 |

23

24

25

### 26

27

28

31

32

1. The Feedback Type And Ng and Codebook Size subfields for EHT TB sounding are defined in Table 9-29a
2. (Feedback Type And Ng subfield and Codebook Size subfield encoding for HE TB sounding).

35

36

1. The Feedback Type And Ng and Codebook Size subfields for EHT non-TB sounding are defined in
2. Table 9-29b (Feedback Type And Ng subfield and Codebook Size subfield encoding for HE non-TB sound-
3. ing).

40

41

42 The Disambiguation subfield is set to 1.

43

1. NOTE—Setting the Disambiguation subfield to 1 prevents a non-EHT VHT STA from wrongly identifying its AID in
2. the EHT NDP Announcement frame. The Disambiguation subfield coincides with the MSB of the AID12 subfield of a
3. VHT NDP Announcement frame if the EHT NDP Announcement field is parsed as VHT NDP Announcement frame by
4. a non-EHT VHT STA. The MSB of the AID12 subfield is always 0 since the maximum AID is 2007. 48

49

1. In a broadcast EHT NDP Announcement frame that has more than one STA Info field, the following applies:

52

1. — If the Feedback Type And Ng subfield and the Codebook Size subfield indicate SU or MU, the Nc
2. subfield indicates the number of columns, *Nc* , in the compressed beamforming feedback matrix and
3. is set to *Nc* – 1 .

56

1. — If the Feedback Type And Ng subfield and the Codebook Size subfield indicate CQI, the Nc subfield
2. indicates the number of spatial streams, *Nc* , in the CQI report and is set to *Nc* – 1 .

59

60

1. In an individually addressed EHT NDP Announcement frame with a single STA Info field, the Nc subfield is reserved.

63

64

#### 65

### **9.4.1.67a EHT MIMO Control field**

2

3 The EHT MIMO Control field is defined in [Figure 9-144b (EHT MIMO Control field format)](#bookmark21).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B0   B3 | B4   B7 | B8   B10 | B11 | B12   B13 | B14   B16 |
|  | Nc Index | Nr Index | BW | Grouping | Feedback Type | Reserved |
| Bits | 4 | 4 | 3 | 1 | 2 | 3 |
|  |  |  |  |  |  |  |
|  | B17   B19 | B20 | B21   B29 | B30   B35 | B36 | B37   B39 |
|  | Remaining Feedback Segments | First Feedback Segment | Partial BW Info | Sounding Dialog Token Number | Codebook Information | Reserved |
| Bits | 3 | 1 | 9 | 6 | 1 | 3 |

4

5

22

### 23**Figure 9-144b—EHT MIMO Control field format**

24

#### 25

26

27

31

32

1. The subfields of the EHT MIMO Control field are defined in [Table 9-91i (EHT MIMO Control field encod-](#bookmark22)
2. [ing)](#bookmark22).

35

36

### **37** **Table 9-91i—EHT MIMO Control field encoding**

38

39

|  |  |
| --- | --- |
| **Subfield** | **Description** |
| Nc Index | If the Feedback Type subfield indicates SU or MU, the Nc Index subfield indicates the number of columns, *Nc* , in the com- pressed beamforming feedback matrix and is set to *Nc* – 1 .If the Feedback Type subfield indicates CQI, the Nc Index subfield indicates the number of spatialstreams, *Nc* , in the CQI report and is set to *Nc* – 1 . |
| Nr Index | If the Feedback Type subfield indicates SU or MU, the Nr Index subfield indicates the number of rows, *Nr* , in the compressed beamforming feedback matrix and is set to *Nr* – 1 . The value 0 is reserved.If the Feedback Type subfield indicates CQI, then the Nr Index subfield is reserved. |

40

41

42

43

44

45

46

47

48

49

50

51

52

53

54

55

56

57

58

59

60

61

62

63

64

65

### **1 Table 9-91i—EHT MIMO Control field encoding**

2

3

|  |  |
| --- | --- |
| **Subfield** | **Description** |
| BW | Indicates the channel width used to determine the starting and ending subcarrier indices when interpreting the Partial BW Info subfields. The value of the BW subfield corresponds to the bandwidth of EHT NDP.Set to 0 for 20 MHzSet to 1 for 40 MHzSet to 2 for 80 MHzSet to 3 for 160 MHzSet to 4 for 320 MHz |
| Grouping | If the Feedback Type subfield indicates SU or MU, then the Grouping subfield indicates the subcarrier grouping, *Ng* , used for the compressed beamforming feedback matrix:Set to 0 for *Ng* = 4 Set to 1 for *Ng* = 16If the Feedback Type subfield indicates CQI, then the Grouping subfield is reserved. |
| Codebook Information | Indicates the size of codebook entries.If the Feedback Type subfield indicates SU: Set to 0 for 4 bits for  and 2 bits for  Set to 1 for 6 bits for  and 4 bits for If the Feedback Type subfield indicates MU: Set to 0 for 7 bits for  and 5 bits for  Set to 1 for 9 bits for  and 7 bits for If the Feedback Type subfield indicates CQI, then the Codebook Information subfield is reserved.NOTE—The codebook size for MU feedback with *Ng* = 16 is limited to   = 9 7 . |
| Feedback Type | Indicate the feedback type: Set to 0 for SUSet to 1 for MU Set to 2 for CQI 3 is reserved |
| Remaining Feedback Segments | Indicates the number of remaining feedback segments for the associated EHT Compressed Beamforming/CQI frame:Set to 0 for the last feedback segment of a segmented report or the only feedback segment of an unsegmented report.Set to a value between 1 and 7 for a feedback segment that is not the last feedback segment of a segmented report. |
| First Feedback Segment | Set to 1 for the first feedback segment of a segmented report or the only feedback segment of an unsegmented report.Set to 0 if not the first feedback segment or if the EHT Compressed Beamforming Report field and EHT MU Exclusive Beamforming Report field are not present in the frame.NOTE—The First Feedback Segment subfield is always set to 0 if the Feedback Type subfield indicates CQI because the EHT Compressed Beamforming/CQI Report frame is always less than 11454 octets in length. |
| Partial BW Info  |  This field is defined as in Figure 9-61f— Partial BW Info subfield format. The Resolution bit indicates the feedback resolution bandwidth. Set to 0 to indicate resolution of 20 MHz if BW subfield is set to 0 to 3. Set to 1 to indicate resolution of 40 MHz if BW subfield is set to 4. The Feedback Bitmap indicates each resolution bandwidth that the beamformer is requesting feedback. Each bit in the Feedback Bitmap is set to 1 if the feedback on the corresponding resolution bandwidth is requested, and is set to 0 otherwise. |

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

36

37

38

39

40

41

42

43

44

45

46

47

48

49

50

51

52

53

54

55

56

57

58

59

60

61

62

63

64

65

|  |  |
| --- | --- |
| Sounding Dialog Token Number | Set to the same value as the Sounding Dialog Token Number field in the corresponding EHT NDP Announcement frame. |

1. In an EHT Compressed Beamforming/CQI frame not carrying all or part of an EHT compressed beamform-
2. ing/CQI report (see 35.X (EHT sounding protocol) for a description of such a case), the Nc Index, Nr
3. Index, BW, Grouping, Codebook Information, Feedback Type, and Sounding Dialog Token Number sub-
4. fields are reserved, the First Feedback Segment subfield is set to 0, and the Remaining Feedback Segments

5

6 subfield is set to 7.

7

### 8**9.4.1.67b EHT Compressed Beamforming Report field**

9

10

1. The EHT Compressed Beamforming Report field carries the average SNR of each spatial stream and
2. compressed beamforming feedback matrices *V* for use by a transmit beamformer to determine steering
3. matrices *Q* , as described in 10.34.3 (Explicit feedback beamforming) and 19.3.12.3 (Explicit feedback

14

15 beamforming).

16

#### 17

18

19

1. The size of the EHT Compressed Beamforming Report field depends on the values in the EHT MIMO Con-
2. trol field. The EHT Compressed Beamforming Report field contains EHT compressed beamforming report
3. information or successive (possibly zero-length) portions thereof in the case of segmented EHT compressed

23

1. beamforming/CQI report (see 35.X.4 (Rules for generating segmented feedback) ). EHT compressed
2. beamforming report information is included in the EHT compressed beamforming/CQI report if the Feed-
3. back Type subfield in the EHT MIMO Control field indicates SU or MU.

27

28

1. The EHT Compressed Beamforming Report information contains the channel matrix elements indexed,
2. first, by matrix angles in order shown in Table 9-71 (Order of angles in the compressed beamforming feed-
3. back matrix when used in a non-S1G band), and second, by data and pilot subcarrier index from lowest fre-
4. quency to highest frequency. An explanation of how these angles are generated from the beamforming

33

1. feedback matrix *V* is given in 19.3.12.3.6 (Compressed beamforming feedback matrix), where *Nc* is the
2. number of columns in a compressed beamforming feedback matrix determined by the Nc Index subfield of
3. the EHT MIMO Control field, and *Nr* is the number of rows in a compressed beamforming feedback matrix
4. determined by the Nr Index subfield of the EHT MIMO Control field.

38

39

1. The beamforming feedback matrix *V* is formed by the beamformee as follows. The beamformer transmits
2. an EHT sounding NDP with *NSS* *NDP* spatial streams, where *NSS* *NDP* takes a value between 2 and 16.
3. Based on this EHT sounding NDP, the beamformee estimates the *NRX* *BFEE*  *NSS* *NDP* channel, and based on
4. that channel it determines a *Nr*  *Nc* orthogonal matrix *V* , where *Nr* and *Nc* satisfy Equation (9-1).

44

45 *NRX* *BFEE* is the number of receiver chains used to receive the EHT sounding NDP at the beamformee.

46

1. Further restrictions on *Nc* are described in 36.2 (EHT PHY service interface). The angles are quantized as
2. defined in Table 9-74 (Quantization of angles) with *b* defined by the Codebook Information field of the

49



50 EHT MIMO Control field (see [9.4.1.67a (EHT MIMO Control field)](#bookmark20)).

51

52 The EHT Compressed Beamforming Report information has the structure and order defined in Table 9-

53

1. 91b (HE Compressed Beamforming Report information), where *Na* is the number of angles used for the
2. compressed beamforming feedback matrix (see Table 9-73 (Order of angles in the compressed beamforming
3. feedback matrix when used in a non-S1G band)).

57

58

1. In Table 9-91b (HE Compressed Beamforming Report information), *Ns* is the number of subcarriers for
2. which a compressed beamforming feedback matrix is sent back to the beamformer. A beamformer or beam-
3. formee, depending upon which of the two determines the feedback parameters, reduces *Ns* by using a
4. method referred to as grouping, in which only a single compressed beamforming feedback matrix is reported
5. for each group of *Ng* adjacent subcarriers. *Ns* is a function of the BW, Partial BW Info, and Group-

64

65 ing subfields in the EHT MIMO Control field (see [9.4.1.67a (EHT MIMO Control field)](#bookmark20)).

1. Subcarrier indices *scidx**i* *i* = 0, ..., *NS*-1 are a concatenation of the subcarrier indices for each 242-tone RU or 996-tone RU in the frequency order, identified by the Partial BW Info subfields
2. together with the BW and Grouping subfields. The subcarrier indices for each 242-tone RU or 996-tone RU are defined in [Table 9-91j (Subcarrier indices when feedback](#bookmark24)
3. [request does not cover the entire 80 MHz segment)](#bookmark24), [Table 9-91k (Subcarrier indices when feedback request](#bookmark25)
4. [cover the entire 80 MHz segment for Ng = 4)](#bookmark25), and [Table 9-91l (Subcarrier indices when feedback request](#bookmark26)

5

6 [cover the entire 80 MHz segment for Ng = 16)](#bookmark26) .

7

The Partial BW Info subfield values are set according to the bandwidth of EHT NDP Announcement frame and the RU/MRU in which the feedback is solicited, see Table 9-X (Settings for BW, Partial BW Info subfield in EHT NDP Announcement frame).

For an EHT NDP Announcement frame of bandwidth 20 MHz or 40 MHz, the subcarrier indices of 242-tone RU for each 20 MHz indicated in Partial BW Info subfield is included in the feedback report.

For an EHT NDP Announcement frame of bandwidth larger than or equal to 80 MHz, in each 80 MHz segment, if Partial BW Info subfield indicates the feedback of the entire 80 MHz, the subcarrier indices of the corresponding 996-tone RU is included in the feedback, otherwise, the subcarrier indices of 242-tone RU for each 20 MHz indicated by Partial BW Info subfield are included in the feedback report.

NOTE 1—This implicitly defines *Ns*.

8

### 9**Table 9-91j—Subcarrier indices when feedback request does not cover the entire 80 MHz**

### 10 **segment**

11

12

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **242-tone RU index** | **20 MHz** | **40 MHz** | **80 MHz** | **160 MHz** | **320 MHz** |
| 1 | *Ng* = 4 | [–122,–120:4:–4,–2, 2,4:4:120, 122] | [–244:*Ng*:–4] | [–500:*Ng*:–260] | [–1012:*Ng*:–772] | [–2036:*Ng*:–1796] |
| *Ng* = 16 | [–122,–116:16:–4,–2, 2,4:16:116, 122] |
| 2 |  | [4:*Ng*:244] | [–252:*Ng*:–12] | [–764:*Ng*:–524] | [–1788:*Ng*:–1548] |
| 3 |  |  | [12:*Ng*:252] | [–500:*Ng*:–260] | [–1524:*Ng*:–1284] |
| 4 |  |  | [260:*Ng*:500] | [–252:*Ng*:–12] | [–1276:*Ng*:–1036] |
| 5 |  |  |  | [12:*Ng*:252] | [–1012:*Ng*:–772] |
| 6 |  |  |  | [260:*Ng*:500] | [–764:*Ng*:–524] |
| 7 |  |  |  | [524:*Ng*:764] | [–500:*Ng*:–260] |
| 8 |  |  |  | [772:*Ng*:1012] | [–252:*Ng*:–12] |
| 9 |  |  |  |  | [12:*Ng*:252] |
| 10 |  |  |  |  | [260:*Ng*:500] |
| 11 |  |  |  |  | [524:*Ng*:764] |
| 12 |  |  |  |  | [772:*Ng*:1012] |
| 13 |  |  |  |  | [1036:*Ng*: 1276] |
| 14 |  |  |  |  | [1284:*Ng*: 1524] |
| 15 |  |  |  |  | [1548:*Ng*: 1788] |
| 16 |  |  |  |  | [1796:*Ng*: 2036] |
| NOTE–:*Ng*: denotes an arithmetic progression in *Ng* increments. |

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

36

37

38

39

40

41

42

43

44

45

46

47

48

49

50

51

52

53

54

55

56

57

58

59

60

61

62

63

64

65

### **Table 9-91k—Subcarrier indices when feedback request cover the entire 80 MHz segment**

### **for Ng = 4**

3

4

|  |  |  |  |
| --- | --- | --- | --- |
| **996-tone RU index** | **80 MHz** | **160 MHz** | **320 MHz** |
| 1 | [–500:4:–4,4:4:500] | [–1012:4:–516,–508:4:-12] | [–2036:4:–1540,–1532:4:–1036] |
| 2 |  | [12:4:508,516:4:1012] | [–1012:4:–516,–508:4:–12] |
| 3 |  |  | [12:4:508,516:4:1012] |
| 4 |  |  | [1036:4:1532,1540:4:2036] |

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

### **Table 9-91l—Subcarrier indices when feedback request cover the entire 80 MHz segment**

### **for Ng = 16**

22

23

24

|  |  |  |  |
| --- | --- | --- | --- |
| **996-tone RU index** | **80 MHz** | **160 MHz** | **320 MHz** |
| 1 | [–500:16:–260, | [–1012:16:–772, | [–2036:16:–1796, |
|  | –252:16:–12, | –764:16:–524, | –1788:16:–1548, |
|  | –4, 4, | –516, –508, | –1540, –1532, |
|  | 12:16:252, | –500:16:–260, | –1524:16:–1284, |
|  | 260:16:500] | –252:16:–12] | –1276:16:–1036] |
| 2 |  | [12:16:252, | [–1012:16:–772, |
|  | 260:16:500, | –764:16:–524, |
|  | 508, 516, | –516, –508, |
|  | 524:16:764, | –500:16:–260, |
|  | 772:16:1012] | –252:16:–12] |
| 3 |  |  | [12:16:252, |
|  | 260:16:500, |
|  | 508, 516, |
|  | 524:16:764, |
|  | 772:16:1012] |
| 4 |  |  | [1036:16:1276, |
|  | 1284:16:1524, |
|  | 1532, 1540, |
|  | 1548:16:1788, |
|  | 1796:16:2036] |

25

26

27

28

29

30

31

32

33

34

35

36

37

38

39

40

41

42

43

44

45

46

47

48

49

50

51

63

64

65

1. The Average SNR of Space-Time Stream *i* subfield in Table 9-91b (HE Compressed Beamforming Report
2. information) is an 8-bit 2s complement integer defined in Table 9-77 (Average SNR of Space-Time Stream i
3. subfield).

4

5

1. The *AvgSNRi* in Table 9-77 (Average SNR of Space-Time Stream i subfield) is found by computing the
2. SNR per subcarrier in decibels for the subcarriers identified in [Table 9-91j (Subcarrier indices when feed-](#bookmark24)
3. [back request does not cover the entire 80 MHz segment)](#bookmark24), [Table 9-91k (Subcarrier indices when feedback](#bookmark25)
4. [request cover the entire 80 MHz segment for Ng = 4)](#bookmark25), and [Table 9-91l (Subcarrier indices when feedback](#bookmark26)
5. [request cover the entire 80 MHz segment for Ng = 16)](#bookmark26), and then computing the arithmetic mean of those val-

11

1. ues. Each SNR value per subcarrier in stream *i* (before being averaged) corresponds to the SNR associated
2. with column *i* of the beamforming feedback matrix *V* determined at the beamformee. Each SNR corre-
3. sponds to the predicted SNR at the beamformee when the beamformer applies all columns of the matrix *V* .

15

16 Padding is not present between angles in the EHT compressed beamforming report information, even if they

17

1. correspond to different subcarriers. If the size of the EHT compressed beamforming report information is
2. not an integer multiple of 8 bits, up to seven 0s are appended to the end of the field to make its size an inte-
3. ger multiple of 8 bits.

21

22

### 23**9.4.1.67c EHT MU Exclusive Beamforming Report field**

24

1. The EHT MU Exclusive Beamforming Report field carries explicit feedback in the form of delta SNRs. The
2. information in the EHT Compressed Beamforming Report field and the EHT MU Exclusive Beamforming
3. Report field can be used by the transmit MU beamformer to determine the steering matrices *Q* , as described

28

29 in 36.3.3.1 (DL MU-MIMO).

30

1. The size of the EHT MU Exclusive Beamforming Report field depends on the values in the EHT MIMO
2. Control field. The EHT MU Exclusive Beamforming Report field contains EHT MU Exclusive Beamform-
3. ing Report information or successive (possibly zero-length) portions thereof in the case of segmented EHT

34

1. compressed beamforming/CQI report (see 35.X.4 (Rules for generating segmented feedback)). EHT
2. MU Exclusive Beamforming Report information is included in the EHT compressed beamforming/CQI
3. report (in addition to EHT compressed beamforming report information) if the Feedback Type subfield in
4. the EHT MIMO Control field indicates MU.

39

40

1. The EHT MU exclusive beamforming report information consists of Delta SNR subfields for each of the
2. spatial streams, 1 to *Nc* , of a subset of subcarriers typically spaced *Ng* apart, where *Ng* is signaled in
3. the Grouping subfield of the EHT MIMO Control field. The subset of subcarriers starts from the lowest fre-
4. quency subcarrier and continues to the highest frequency subcarrier. The subcarrier indices of the feedback
5. for each Delta SNR subfield are identical to the subcarrier indices for the compressed beamforming feed-

46

1. back matrix *V* .
2. NOTE—The feedback subcarrier spacings are mostly equal to *Ng* , but there are a few exceptions, generally around the
3. RU edge and the DC tone, where extra feedback subcarriers are added to improve the channel interpolation/extrapolation
4. quality.

51

52

1. No padding is present between *SNRk* *i* in the EHT MU Exclusive Beamforming Report field, even if they
2. correspond to different subcarriers. The subset of subcarriers included is determined by the values of the
3. Partial BW Info and Grouping subfields of the EHT MIMO Control field. For each subcarrier
4. included, the deviation in decibels of the SNR of that subcarrier for each column of *V* relative to the average
5. SNR of the corresponding spatial stream is computed using Equation (9-2) except that *k* is the subcarrier

58

1. index in the range *scidx*0  *scidx**Ns* – 1 and *SNRi* is the average SNR of spatialstream *i*
2. reported in the Average SNR of Space-Time Stream *i* field of the EHT Compressed Beamforming Report
3. Information field.

62

63 The EHT MU Exclusive Beamforming Report information has the structure and order defined in Table 9-

64

65 91f (HE MU Exclusive Beamforming Report information).

1. In Table 9-91f (HE MU Exclusive Beamforming Report information), *Ns* and *scidx*() are defined in
2. [9.4.1.67b (EHT Compressed Beamforming Report field)](#bookmark23).

3

4

### 5**9.4.1.67d EHT CQI Report field**

6

1. The EHT CQI Report field carries the per-RU average SNRs of each spatialstream, where each per-RU
2. average SNR is the arithmetic mean of the SNR in decibels over a 26-tone RU for which the feedback is
3. being requested. The EHT CQI Report field contains information about the quality of the link.

10

11

14

15

1. The size of the EHT CQI Report field depends on the values in the EHT MIMO Control field. The EHT CQI
2. Report field contains EHT CQI report information. EHT CQI Report information is included in the EHT
3. compressed beamforming/CQI report if the Feedback Type subfield in the EHT MIMO Control field indi-
4. cates CQI feedback.

20

21

22 The EHT CQI Report field has the structure and order defined in Table 9-91f (HE CQI Report information).

23

1. *Ncqi* is the number of RU indices for which the CQI report is sent back to the beamformer. *Ncqi* is based
2. on the number of 26-tone RU indicated in the Partial BW Info subfield of the EHT MIMO Control field

26

1. (TBD). The 26-tone RU subcarrier indices for 20 MHz, 40 MHz, 80 MHz, 160 MHz, and 320 MHz are
2. defined in Table 27-7 (Data and pilot subcarrier indices for RUs in a 20 MHz HE PPDU and in a non-
3. OFDMA 20 MHz HE PPDU), Table 27-8 (Data and pilot subcarrier indices for RUs in a 40 MHz HE PPDU
4. and in a non-OFDMA 40 MHz HE PPDU), Table 36-5 (Data and pilot subcarrier indices for RUs in an
5. 80 MHz EHT PPDU), Table 36-6 (Data and pilot subcarrier indices for RUs in a 160 MHz EHT PPDU), and

32

33 Table 36-7 (Data and pilot subcarrier indices for RUs in a 320 MHz EHT PPDU), respectively.

34

1. The Average SNR of space-time stream *i* for the RU index *k* subfield in Table 9-91f (HE CQI Report infor-
2. mation) is a 6-bit 2s complement integer whose definition is shown in Table 9-91h (Average SNR of RU

37

38 index k for space-time stream i subfield).

39

1. The *AvgSNRk* *i* in Table 9-91h (Average SNR of RU index k for space-time stream i subfield) is found by
2. computing the arithmetic mean of the SNR per subcarrier in decibels for spatialstream *i* over the sub-
3. carriers in RU index *k* for which the feedback is being requested. The SNR per subcarrier calculation is

43

44 defined in [9.4.1.67b (EHT Compressed Beamforming Report field)](#bookmark23).

45

1. Padding is not present between per-RU average SNRs of each spatialstream information, even if they
2. correspond to different RUs and spatialstreams. If the size of the EHT CQI report information is not an
3. integer multiple of 8 bits, up to seven 0s are appended to the end of the field to make its size an integer mul-

49

50 tiple of 8 bits.

---- End of text proposal ----