IEEE P802.11  
Wireless LANs

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| --- | --- | --- | --- | --- |
| LB187 (D2.0) resolution for beamforming report segmentation | | | | |
| Date: 2012-05-16 | | | | |
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|  |  |  |  |  |

Abstract

This document proposes a resolution for CID 4667 on P802.11ac/D2.0 (LB187), regarding segmentation of beamforming reports.

## Revision History

r0: Initial revision.

r1: Updated following presentation in Atlanta on Monday.

r2: Updated following suggestion by Simone.

## Comments

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 4667 | kaiying Lv | 9.19.2.4 (115.44) | A frame exchange may be an NDPA followed by a VHT NDP and followed by a correctly received VHT Compressed Beamforming frame or at least one segment of a VHT Compressed Beamforming frame. | as modified."A frame exchange may be......an NDPA followed by a VHT NDP and followed by a correctly received VHT Compressed Beamforming frame or at least one segment of a VHT Compressed Beamforming frame, or......." |

## Discussion

Looking into this can has revealed a large number of worms!

The fundamental issue is that "segment" is poorly defined in D2.0.

A segment is basically all or part of the information returned by the BFee to the BFer. It is held in exactly one VHT Compressed Beamforming frame (i.e. MPDU), which contains all or part of the stuff described in "8.4.1.47 VHT Compressed Beamforming Report field" and/or, for MU only, all or part of the stuff described in "8.4.1.48 MU Exclusive Beamforming Report field". It is not something a VHT Compressed Beamforming frame can be broken up into.

There is additional confusion because what 8.4 describes as the VHT Compressed Beamforming Report field is not the same thing as what 8.5 describes as being what goes in the VHT Compressed Beamforming frame, even though a reference to 8.4 is given.

The proposal below introduces the concept of a VHT Compressed Beamforming report, which is the thing contained in one or more VHT Compressed Beamforming frames, all transmitted in one PPDU (in an A‑MPDU) a SIFS after the VHT NDP or BRP, and contains the stuff (or, for BRPs with selective retx, perhaps just a subset of the stuff) described in “8.4.1.47 VHT Compressed Beamforming Report field” and, for MU only, “8.4.1.48 MU Exclusive Beamforming Report field”. The thing actually described in 8.4 is the Blah information, though, while the thing referred to in 8.5 is the Blah field.

Other issues addressed include:

* Being clear about what constitutes a "frame exchange" (addressing the original comment!)
* Being clear about whether fields are reserved or set to 0
* Being clear about which of the VHT Compressed Beamforming frames are to carry the MFB, in the case of LA (answer: all of them)

## Acknowledgements

Valuable input was received from a number of people, and in particular Adrian (Intel) and Simone (Qualcomm).

## Proposed changes

The changes are relative to D2.1. The changes are shown using Word change tracking. Select “Final Showing Markup” or “Final” as appropriate. Editorial instructions are shown using bold italics. Any Word comments should be ignored when merging the proposed changes in.

* Frame formats
* MAC frame formats
* General frame format

Change the second paragraph as follows:(#4473)

The Frame Body field is of variable size, but constrained or affected by:

* the maximum MMPDU, MSDU, A-MSDU and MPDU sizes supported by the recipient(s) for the PPDU format in use, as specified in Maximum DU sizes (in octets) and durations (in microseconds) per PPDU forma
* the maximum PPDU duration (e.g. HT\_MF L SIG L\_LENGTH, HT\_GF or VHT aPPDUMaxTime, or DMG aDMGPPDUMaxTime (see Maximum DU sizes (in octets) and durations (in microseconds) per PPDU forma); any non-zero TXOP Limit; any regulatory constraints (e.g. CS4-msBehavior))
* the fields present in the MAC header (e.g. QoS Control, Address 4, HT Control)
* any security encapsulation (e.g. TKIP/CCMP/GCMP Header and MIC) or Mesh Control fields

~~The maximum frame body size is determined by the maximum MSDU size, plus the length of the Mesh Control field (6, 12 or 18 octets) if present, the maximum unenerypted MMPDU size (see Table 8-0a), plus any overhead from security encapsulation.~~

Replace Figure 8-1 with the following (changing the frame body length range):

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Octets: 2 | 2 | 6 | 6 | 6 | 2 | 6 | 2 | 4 | 0-11424 | 4 |
| Frame  Control | Duration  /ID | Address  1 | Address  2 | Address  3 | Sequence  Control | Address  4 | QoS  Control | HT  Control | Frame  Body | FCS |
| MAC Header | | | | | | | | |  |  |
| * MAC frame format(#4473) | | | | | | | | | | |

Replace Table 8-0a with the following:(#4473)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| * Maximum DU sizes (in octets) and durations (in microseconds) per PPDU format | | | | |
|  | Non-HT non-VHT non-DMG PPDU and non-HT duplicate PPDU | HT PPDU other than non-HT duplicate PPDU | VHT PPDU other than non-HT duplicate PPDU | DMG PPDU |
| MMPDU size | 2304 | 2304 | See NOTE 1 | 2304 |
| MSDU size | 2304 | 2304 | 2304 | 7920 |
| A-MSDU size | 3839 or 4065 (HT STA) or N/A (non-HT STA) | 3839 or 7935 (see also Table 8-124) | See NOTE 3 | 7935 |
| MPDU size | See NOTE 4 | See NOTE 5 | 3895 or 7991 or 11 454 (see also Subfields of the VHT Capabilities Info field ) | See NOTE 5 |
| PSDU size (see NOTE 7) | 213-1 (Clause 16, Table 16-2)  212-1 (others, see Table 17-5, Table 18-7, Table 19-8) | 216-1 (see Table 20-25) | 4 692 480 (~222.16) (see Table 22-29 (VHT PHY characteristics)) | 218-1 (see Table 21-17) |
| PPDU duration (see NOTE 7) | See NOTE 6 | 5484 (HT\_MF; see 9.23.4) or 10000 (HT\_GF; see Table 20-25) | 5484 (see Table 22-29 (VHT PHY characteristics)) | 2000 (see Table 10-18) |
| NOTE 1—No direct constraint on the maximum MMPDU size; indirectly constrained by the maximum MPDU size (see Format of management frames)  NOTE 2—Indirect constraint from the maximum PSDU size: 212-1 octets minus the minimum QoS Data MPDU overhead (26 octets for the MAC header and 4 octets for the FCS)  NOTE 3—No direct constraint on the maximum A-MSDU size; indirectly constrained by the maximum MPDU size  NOTE 4—No direct constraint on the maximum MPDU size; indirectly constrained by the maximum MSDU/MMPDU or (for HT STAs only) A-MSDU size  NOTE 5—No direct constraint on the maximum MPDU size; indirectly constrained by the maximum A MSDU size  NOTE 6—No direct constraint on the maximum duration, but a PLCP header LENGTH value above 2332 might not be supported by some receivers (see last NOTE in 9.23.4)  NOTE 7—The information given here on maximum PSDU sizes and on maximum PPDU durations is informative only; see the normative references given | | | | |

* Frame fields
* Frame Control field
* Type and subtype fields

Change Table 8-1 as follows, inserting rows for the VHT NDP Announcement and Beamforming Report Poll control frames and updating the reserved subtype range appropriately:

|  |  |  |  |
| --- | --- | --- | --- |
| * Valid type and subtype combinations | | | |
| Type value  b3 b2 | Type description | Subtype value  b7 b6 b5 b4 | Subtype description |
| 01 | Control | 0000-~~0101~~ 0011 | Reserved |
| 01 | Control | 0100 | Beamforming Report Poll |
| 01 | Control | 0101 | VHT NDP Announcement(#4921) |

* More Data field

Insert the following after the 5th paragraph:

In a VHT BSS, if(#4021) the TXOP power save feature is supported at both the AP and an individual STA (as determined from its VHT Capabilities(#5237) element), the More Data field indicates that more BUs are buffered for that STA at the AP (see 10.2.1.4a (Power management during VHT transmissions) for the operation of TXOP power save). A value of 1 in individually addressed frames transmitted by the VHT AP to a VHT STA in TXOP PS mode indicates that at least one additional buffered BU is present for the same STA.

* Order field

Change the second bullet in the first paragraph as follows:

* It is set to 1 in a QoS data or management frame transmitted with a value of HT\_GF ~~or~~, HT\_MF or VHT for the FORMAT parameter of the TXVECTOR to indicate that the frame contains an HT Control field.
* Duration/ID field

Change the fourth paragraph as follows:

The Duration/ID fields in the MAC headers of MPDUs in an A-MPDU all carry the same value. The Duration/ID fields in the MAC headers of MPDUs in A-MPDUs carried in the same MU PPDU all carry the same value.

* Address fields
* TA field

Change the paragraph in this section as follows:

The TA field contains an IEEE MAC ~~individual~~ address that identifies the STA that has transmitted, onto the WM, the MPDU contained in the frame body field. If the Individual/Group bit is 0, then the TA field is the individual address of the STA; otherwise the TA field is a signaling TA, indicating that the frame caries additional information in the scrambling sequence (see RTS frame format)(#4485). ~~The Individual/Group bit is always transmitted as a zero in the transmitter address.~~

* QoS Control field
* Ack Policy subfield

Change Table 8-6 as follows:

|  |  |  |
| --- | --- | --- |
| * Ack Policy subfield in QoS Control field of QoS data frames | | |
| Bits in QoS Control field | | Meaning |
| Bit 5 | Bit 6 |
| 0 | 0 | Normal Ack or Implicit Block Ack Request.  In a frame that is either a VHT single MPDU or not carried in an A-MPDU~~a non-A-MPDU frame~~(#4817):  The addressed recipient returns an ACK or QoS +CF-Ack frame after a short interframe space (SIFS) period, according to the procedures defined in 9.3.2.8 (ACK procedure) and 9.19.3.5 (HCCA transfer rules). For QoS Null (no data) frames, this is the only permissible value for the Ack Policy subfield.  ~~In a frame that is part of an A-MPDU~~Otherwise:  The addressed recipient returns a BlockAck MPDU, either individually or as part of an A-MPDU starting a SIFS after the PPDU carrying the frame, according to the procedures defined in 9.3.2.9 (BlockAck procedure), 9.21.7.5 (Generation and transmission of BlockAck by an HT STA), 9.21.8.3 (Operation of HT-delayed Block Ack), 9.25.3 (Rules for RD initiator), 9.25.4 (Rules for RD responder) and 9.29.3 (Explicit feedback beamforming). |

* HT Control field

Insert a subsection heading 8.2.4.6.1 before the first paragraph:

* General

Replace Figure 8-5 with the following:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B0 | B1 B29 | B30 | B31 |
|  | VHT | fields specific to the HT or VHT variant | AC  Constraint | RDG/More PPDU |
| Bits | 1 | 29 | 1 | 1 |
| * HT Control field | | | | |

Insert the following after the 3rd paragraph:

The HT Control field has two forms, the HT variant and the VHT variant. The VHT field is set to 0 to indicate use of the HT variant as described in HT variant. The VHT field is set to 1 to indicate use of the VHT variant as described in VHT variant.

The AC Constraint subfield of the HT Control field indicates whether the mapped AC of an RD data frame is constrained to a single AC, as defined in Table 8-12 (AC Constraint subfield values).

The RDG/More PPDU subfield of the HT Control field is interpreted differently depending on whether it is transmitted by an RD initiator or an RD responder, as defined in Table 8-13 (RDG/More PPDU subfield values).

Insert a new subsection heading 8.2.4.6.2 after these new paragraphs:

* HT variant

Insert a new paragraph at the head of the new subsection:

Fields specific to the HT variant HT Control field are shown in Fields specific to the HT variant HT Control field.

Insert a new figure:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B1 B15 | B16 B17 | B18 B19 | B20 B21 | B22 B23 | B24 | B25 B28 | B29 |
|  | Link  Adaptation  Control | Calibration  Position | Calibration  Sequence | Reserved | CSI/Steering | NDP  Announcement | Reserved | DEI(11aa) |
| Bits: | 15 | 2 | 2 | 2 | 2 | 1 | 4 | 1 |
| * Fields specific to the HT variant HT Control field | | | | | | | | |

The format of the Link Adaptation Control subfield of the HT variant HT Control field is defined in Figure 8-6 (Link Adaptation Control subfield).

Replace Figure 8-6 with the following (removing the ‘Reserved’ field):

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B1 | B2 B5 | B6 B8 | B9 B15 |
|  | TRQ | MAI | MFSI | MFB/ASELC |
| Bits: | 1 | 4 | 3 | 7 |
| * Link Adaptation Control subfield | | | | |

Change the following paragraphs in the remainder of this section:

The Calibration Position and Calibration Sequence subfields of the HT variant HT Control field are defined in Table 8-10 (Calibration control subfields).

The CSI/Steering subfield of the HT variant HT Control field indicates the type of feedback, as shown in Table 8-11 (CSI/Steering subfield values).

The NDP Announcement subfield of the HT variant HT Control field indicates that an NDP will be transmitted after the frame (according to the rules described in 9.31 (Null data packet (NDP) sounding)). It is set to 1 to indicate that an NDP will follow; otherwise, it is set to 0.

~~The AC Constraint subfield of the HT Control field indicates whether the mapped AC of an RD data frame is constrained to a single AC, as defined in Table 8-12 (AC Constraint subfield values).~~

~~The RDG/More PPDU subfield of the HT Control field is interpreted differently depending on whether it is transmitted by an RD initiator or an RD responder, as defined in Table 8-13 (RDG/More PPDU subfield values).~~

Insert the following as a new subclause 8.2.4.6.3:

* VHT variant

Fields specific to the VHT variant HT Control field are shown in Fields specific to the VHT variant HT Control field.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| B1 | B2 | B3 B5 | B6 B8 | B9 B23 | B24 B26 | B27 | B28 | B29 |
| Reserved | MRQ | MSI/STBC | MFSI/  GID-L | MFB | GID-H | Coding Type | FB Tx Type | Unsolicited MFB |
| Bits: 1 | 1 | 3 | 3 | 15 | 3 | 1 | 1 | 1 |
| * Fields specific to the VHT variant HT Control field | | | | | | | | |

The subfields of VHT variant HT Control field are defined in VHT variant HT Control field subfields .

|  |  |  |
| --- | --- | --- |
| * VHT variant HT Control field subfields | | |
| Subfield | Meaning | Definition |
| MRQ | VHT MCS feedback request | Set to 1 to request VHT MCS feedback (solicited MFB), otherwise set to 0. |
| MSI/STBC | MRQ sequence identifier/STBC indication | If the Unsolicited MFB subfield is 0 and the MRQ subfield is 1, the MSI/STBC subfield contains a sequence number in the range 0 to 6 that identifies the specific request.  If the Unsolicited MFB subfield is 0 and the MRQ subfield is 0, the MSI/STBC subfield is reserved.  If the Unsolicited MFB subfield is 1, the MSI/STBC field contains the Compressed MSI and STBC Indication subfields as shown in MSI/STBC subfield when the Unsolicited MFB subfield is 1.  The STBC Indication subfield(#4023) contains:  Set to 0 if STBC is not transmitted  Set to 1 if STBC is transmitted  The Compressed MSI contains a sequence number that identifies the specific request. It is in the range 0 to 3 if STBC Indication equals 0 or in the range 0 to 2 if STBC Indication equals 1. |
| MFSI/GID-L | MFB sequence identifier/LSB of group ID(#4829) | If the Unsolicited MFB subfield is 0, the MFSI/GID-L subfield contains the received value of MSI contained in the frame to which the MFB information refers.  If the Unsolicited MFB subfield is 1 and the MFB is estimated from an MU PPDU, the MFSI/GID-L subfield contains the lowest 3 bits of group ID(#4829) of that PPDU from which the MFB was estimated (bit 0 of the group ID(#4829) appears in the lowest numbered bit of the field MFSI/GID-L). If the unsolicited MFB is estimated from an SU PPDU, the MFSI/GID-L subfield is set to all ones. |
| MFB | N\_STS, MCS, BW and SNR feedback | MFB subfield is interpreted as defined in MFB subfield in the VHT variant HT Control field. This subfield contains the recommended MFB. The combination(#4282) of MCS=15 and N\_STS=7 indicates that no feedback is present. |
| GID-H | MSB of group ID(#4829) | If the Unsolicited MFB subfield is 1 and the unsolicited MFB is estimated from an MU PPDU, the GID-H subfield contains the highest 3 bits of group ID(#4829) of the PPDU from which the unsolicited MFB was estimated (bit 3 of the group ID(#4829) appears in the lowest numbered bit of the field GID-H). If the unsolicited MFB is estimated from an SU PPDU, the GID-H subfield is set to all ones.  Otherwise this subfield is reserved. |
| Coding Type | Coding type of MFB response | If the Unsolicited MFB subfield is 1, the Coding Type subfield contains the Coding information (0 for BCC and 1 for LDPC) of the frame(#5241) from which the unsolicited MFB was estimated.  Otherwise this subfield is reserved. |
| FB Tx Type | Transmission type of MFB response | If the Unsolicited MFB subfield is 1 and FB Tx Type subfield is 0, the unsolicited MFB is estimated from an unbeamformed VHT PPDU.  If the Unsolicited MFB subfield is 1 and the FB Tx Type subfield is 1, the unsolicited MFB is estimated from a beamformed VHT SU PPDU.  Otherwise this subfield is reserved. |
| Unsolicited MFB | Unsolicited MCS feedback indicator | Set to 1 if the MFB is not a response to an MRQ.  Set to 0 if the MFB is a response to an MRQ. |

The format of the MSI/STBC subfield when the Unsolicited subfield is 1 is shown in MSI/STBC subfield when the Unsolicited MFB subfield is 1.

|  |  |  |
| --- | --- | --- |
|  | B3 B4 | B5 |
|  | Compressed MSI | STBC Indication |
| Bits: | 2 | 1 |
| * MSI/STBC subfield when the Unsolicited MFB subfield is 1 | | |

The format of the MFB subfield in the VHT variant HT Control field is shown in MFB subfield in the VHT variant HT Control field.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B9 B11 | B12 B15 | B16 B17 | B18 B23 |
|  | N\_STS | MCS | BW | SNR |
| Bits: | 3 | 4 | 2 | 6 |
| * MFB subfield in the VHT variant HT Control field | | | | |

The MFB subfields in the VHT variant HT Control field are defined in MFB subfield in the VHT variant HT Control field.

|  |  |  |
| --- | --- | --- |
| * MFB subfield in the VHT variant HT Control field | | |
| Subfield | Meaning | Definition |
| N\_STS | Recommended *NSTS* | Indicates the recommended *NSTS* as defined in 9.28.3 (Link adaptation using the VHT variant HT Control field). |
| MCS | Recommended MCS | Indicates the recommended VHT MCS as defined in 9.28.3 (Link adaptation using the VHT variant HT Control field). |
| BW | Bandwidth of the recommended MCS | If the Unsolicited MFB subfield is 1, the BW subfield indicates the bandwidth for which the recommended MCS is intended, as defined in 9.28.3 (Link adaptation using the VHT variant HT Control field):  Set to 0 for 20 MHz  Set to 1 for 40 MHz  Set to 2 for 80 MHz  Set to 3 for 160 MHz and 80+80 MHz.(Ed)  If the Unsolicited MFB subfield is 0, the(#4744) BW subfield is reserved. |
| SNR | Average SNR | Indicates the average SNR, which is an SNR averaged over data subcarriers and space-time streams as defined in 9.28.3 (Link adaptation using the VHT variant HT Control field). |

* Duration/ID field
* Setting for single and multiple protection under enhanced distributed channel access (EDCA)
* Single protection settings.

Insert a sub-bullet 7) and 8) following sub-bullet 6) as shown below:

* For a VHT NDP Announcement(#4921) frame for which any pending frames are to be transmitted within the same TXOP as the VHT NDP Announcement(#4921) frame, the Duration/ID field is set to the estimated time required to transmit the subsequent NDP and VHT Compressed Beamforming frame response(s) plus two SIFS intervals plus the pending frame and its acknowledgement if required (including appropriate IFS values)(#4026).
* For a Beamforming Report Poll frame for which any pending frames are to be transmitted within the same TXOP as the Beamforming Report Poll frame, the Duration/ID field is set to the estimated time required to transmit the VHT Compressed Beamforming frame response(s) plus one SIFS interval plus the pending frame and its acknowledgement if required (including appropriate IFS values)(#4026).
* Multiple protection settings. The Duration/ID field is set to a value D as follows:

Change the TSINGLE-MSDU and TPENDING description as follows:

* *TSINGLE-MSDU* is the estimated time required for the transmission of the allowed frame exchange sequence defined in ~~8.4.2.31~~9.19.2.2 (EDCA TXOPs) (for a TXOP limit value of 0), including applicable IFS durations
* *TPENDING* is the estimated time required for the transmission of
* Pending MPDUs of the same AC
* Any associated immediate response frames
* Any NDP transmissions and explicit feedback response frames
* Any Beamforming Report Poll(#4789) and VHT Compressed Beamforming response frames
* Applicable IFS durations
* Any RDG
* Format of individual frame types
* Control frames
* RTS frame format

Change the third paragraph as follows:

The TA field is the address of the STA transmitting the RTS frame or a signaling TA. The TA field is set to a signaling TA in an RTS frame transmitted by a VHT STA in a non-HT or non-HT duplicate format to indicate that the scrambling sequence carries the TXVECTOR parameters CH\_BANDWIDTH\_IN\_NON\_HT and DYN\_BANDWIDTH\_IN\_NON\_HT (see 9.3.2.5a (VHT RTS procedure)). Otherwise the TA field is the address of the STA transmitting the RTS frame.

* CTS frame format

Change the second paragraph as follows:

When the CTS frame follows an RTS frame, the RA field of the CTS frame is copied from the TA field of the immediately previous RTS frame to which the CTS is a response and the Individual/Group bit in the RA field is set to 0. When the CTS is the first frame in a frame exchange, the RA field is set to the MAC address of the transmitter.

Insert new subclauses VHT ND and Beamforming Report Poll frame format:

* VHT NDP Announcement(#4921)
* frame format

The frame format of the VHT NDP Announcement(#4921) frame is shown in VHT NDP Announcement.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Frame Control | Duration | RA | TA | Sounding Sequence | STA Info 1 | … | STA Info *n* | FCS |
| Octets: | 2 | 2 | 6 | 6 | 1 | 2 |  | 2 | 4 |
| * VHT NDP Announcement(#4921) | | | | | | | | | |

The Duration field is set as defined in Duration/ID field.

The VHT NDP Announcement(#4921) frame contains at least one STA Info field. If the VHT NDP Announcement(#4921) frame contains only one STA Info field, then the RA field is set to the address of the STA identified by the AID in the STA Info field. If the VHT NDP Announcement(#4921) frame contains more than one STA Info field, then the RA field is set to the broadcast address.

The TA field is set to the address of the STA transmitting the VHT NDP Announcement(#4921) frame.

The format of the Sounding Sequence field is shown in Sounding Sequence field.

|  |  |  |
| --- | --- | --- |
|  | B0 B1 | B2 B7 |
|  | Reserved | Sequence Number |
| Bits: | 2 | 6 |
| * Sounding Sequence field | | |

The Sequence Number subfield in the Sounding Sequence field contains a value selected by the beamformer to identify the VHT NDP Announcement frame(#4286).

The format of the STA Info field is shown in STA Info field.

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 B11 | B12 | B13 B15 |
|  | AID | Feedback Type | Nc Index |
| Bits: | 12 | 1 | 3 |
| * STA Info field | | | |

The subfields in the STA Info field are described in STA Info subfields.

|  |  |
| --- | --- |
| * STA Info subfields | |
| Field | Description |
| AID | Contains the AID of a(#4287) STA expected to process the following NDP frame and prepare the sounding feedback. Equal to 0 if the STA is an AP, mesh STA or STA that is a member of an IBSS.(#4287) |
| Feedback Type | Indicates the type of feedback requested.  Set to 0 for SU.  Set to 1 for MU. |
| Nc Index | If the Feedback Type field indicates MU(#4289), then Nc Index indicates the number of columns, *Nc*, in the compressed beamforming matrix minus one:(#4655)  Set to 0 to request *Nc* = 1  Set to 1 to request *Nc* = 2  …  Set to 7 to request *Nc* = 8  Reserved if the Feedback Type field indicates SU(#4289). |

* Beamforming Report Poll frame format

The Beamforming Report Poll frame is shown in Beamforming Report Poll.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Frame Control | Duration | RA | TA | Segment Retransmission Bitmap | FCS |
| Octets: | 2 | 2 | 6 | 6 | 1 | 4 |
| * Beamforming Report Poll | | | | | | |

The Duration field is set as defined in Duration/ID field.

The RA field is the address of the intended recipient.

The TA field is the address of the STA transmitting the Beamforming Report Poll.

The Segment Retransmission Bitmap field indicates the segments to be polled in a VHT Compressed Beamforming report, which is contained in one or more VHT Compressed Beamforming frames (see 9.31.5). The bit in position *n* (*n=0* for LSB and *n=7* for MSB) is set to 1 when the segment with the Remaining Segments subfield in VHT MIMO Control field set to *n* is requested. The bit in position *n* is set to 0 when the segment with the Remaining Segments subfield in VHT MIMO Control field set to *n* is not requested.

* Data frames
* Data frame format

Change Data frame as shown (changing Frame Body field size range to 0-11424 and inserting the note that follows):

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Octets:  2 | 2 | 6 | 6 | 6 | 2 | 6 | 2 | 4 | ~~0-7599~~  0-11424 | 4 |
| Frame  Control | Duration/  ID | Address  1 | Address  2 | Address  3 | Sequence  Control | Address  4 | QoS  Control | HT  Control | Frame  Body | FCS |
| MAC Header | | | | | | | | |  |  |
| * Data frame | | | | | | | | | | |

NOTE—The maximum Frame Body size (11 424 octets) is arrived at by subtracting the length of the shortest QoS Data frame MAC header (26 octets) and FCS from the maximum MPDU length of 11 454 octets.

* Management frames
* Format of management frames

Change the 1st paragraph as follows:

The format of a management frame is defined in Figure 8-34. The Frame Control, Duration, Address 1, Address 2, Address 3, and Sequence Control fields are present in all management frame subtypes. ~~The~~ In an MMPDU carried in one or more non-VHT PPDU(s)(#4529) the maximum unencrypted MMPDU size~~, excluding the MAC header and FCS, is 2304 octets~~ is specified in Maximum DU sizes (in octets) and durations (in microseconds) per PPDU forma(#4473). In an MMPDU carried in one or more PPDU(s),(#4529) all of which are VHT PPDU(s), the maximum unencrypted MMPDU size is the maximum MPDU size supported by the recipient(s) less the shortest management frame MAC header and FCS.

Change Management frame format as follows (Changing the Frame Body field size range and inserting the associated note):

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Octets: | 2 | 2 | 6 | 6 | 6 | 2 | 4 | ~~0-2320~~  0-11426 | 4 |
|  | Frame Control | Duration | Address 1 | Address 2 | Address 3 | Sequence Control | HT  Control | Frame Body | FCS |
| * Management frame format | | | | | | | | | |

NOTE 1—The maximum frame body size shown in Management frame format is arrived at by subtracting the length of the shortest management frame MAC header and FCS from the maximum MPDU length of 11 454 octets.

Change the existing note as follows:

NOTE ~~1~~2—The maximum frame body size ~~shown in Figure 8-34 is~~ for a management frame carried in a non-VHT PPDU is 2320 octets for CCMP encryption with a maximum-size MMPDU (note TKIP encryption is not allowed and any Mesh Control field is held within the MMPDU, not as a separate header). The frame body size might be greater if a vendor-specific cipher suite is used.

Insert the following as the second paragraph (after the notes):

If a management MPDU is sent using a VHT PPDU, the size of the MPDU is constrained by the maximum MPDU size supported by the recipient. Otherwise, the maximum management MPDU size is 2356 octets.

* Beacon frame format

Insert new rows for Order 60 through 64 after Order 59 in Beacon frame body as follows:

* Order 1 to 55 in REVmb, +1 in P80211ae, +2 in P802.11aa, +1 in P802.11ad

|  |  |  |
| --- | --- | --- |
| * Beacon frame body | | |
| Order | Information | Notes |
| 60 | VHT Capabilities | The VHT Capabilities element is present when the dot11VHTOptionImplemented (#4028)is true |
| 61 | VHT Operation | The VHT Operation element is present when the dot11VHTOptionImplemented (#4028)is true; otherwise it is not present(#4880). |
| 62 | VHT Transmit Power Envelope element | (#4748)The VHT Transmit Power Envelope element is present if both the following conditions are met:   * dot11VHTOptionImplemented is true; * Either dot11SpectrumManagementRequired is true or (#4748)dot11RadioMeasurementActivated is true.   Otherwise, this parameter is not present. |
| 63 | Extended Power Constraint element | The Extended Power Constraint element is present if dot11VHTOptionImplemented (#4028)is true, (#4844)and dot11SpectrumManagementRequired is true. |
| 64 | Extended BSS Load element | The Extended BSS Load element is present if dot11QosOptionImplemented,(#4531) dot11QBSSLoadImplemented and dot11VHTOptionImplemented are true. |
| 65 | Quiet Channel | The Quiet Channel element is optionally present if dot11VHTOptionImplemented is true, and either dot11SpectrumManagementRequired or dot11RadioMeasurementActivated is true. |
| 66 | Operating Mode Notification | The Operating Mode Notification element is optionally present if dot11OperatingModeNotificationImplemented is true.(#5096) |

* Association Request frame format

Insert a row for Order 22 after Order 21 in Association Request frame body as follows:

* Order 1 to 18 in REVmb, none in P80211ae, none in P802.11aa, +3 in P802.11ad

|  |  |  |
| --- | --- | --- |
| * Association Request frame body | | |
| Order | Information | Notes |
| 22 | VHT Capabilities | The VHT Capabilities element is present when the dot11VHTOptionImplemented (#4028)is true |
| 23 | Operating Mode Notification | The Operating Mode Notification element is optionally present if dot11OperatingModeNotificationImplemented is true.(#5096) |

* Association Response frame format

Insert rows for Order 27 and 28 after Order 26 in Association Response frame body as follows:

* Order 1 to 21 in REVmb, +1 in P80211ae, none in P802.11aa, +4 in P802.11ad

|  |  |  |
| --- | --- | --- |
| * Association Response frame body | | |
| Order | Information | Notes |
| 27 | VHT Capabilities | The VHT Capabilities element is present when the dot11VHTOptionImplemented (#4028)is true |
| 28 | VHT Operation | The VHT Operation element is present when the dot11VHTOptionImplemented (#4028)is true; otherwise it is not present(#4880). |
| 29 | Operating Mode Notification | The Operating Mode Notification element is optionally present if dot11OperatingModeNotificationImplemented is true.(#5096) |

* Reassociation Request frame format

Insert a row for Order 28 after Order 27 in Table 8-24 as follows:

* Order 1 to 23 in REVmb, +1 in P80211ae, none in P802.11aa, +3 in P802.11ad

|  |  |  |
| --- | --- | --- |
| * Reassociation Request frame body | | |
| Order | Information | Notes |
| 28 | VHT Capabilities | The VHT Capabilities element is present when the dot11VHTOptionImplemented (#4028)is true |
| 29 | Operating Mode Notification | The Operating Mode Notification element is optionally present if dot11OperatingModeNotificationImplemented is true.(#5096) |

* Reassociation Response frame format

Insert rows for Order 31 and 32 after Order 30 in Table 8-25 as follows:

* Order 1 to 25 in REVmb, +1 in P80211ae, none in P802.11aa, +4 in P802.11ad

|  |  |  |
| --- | --- | --- |
| * Reassociation Response frame body | | |
| Order | Information | Notes |
| 31 | VHT Capabilities | The VHT Capabilities element is present when the dot11VHTOptionImplemented (#4028)is true |
| 32 | VHT Operation | The VHT Operation element is present when the dot11VHTOptionImplemented (#4028)is true; otherwise it is not present(#4880). |
| 33 | Operating Mode Notification | The Operating Mode Notification element is optionally present if dot11OperatingModeNotificationImplemented is true.(#5096) |

* Probe Request frame format

Insert a row for Order 17 after Order 16 in Probe Request frame body as follows:

* Order 1 to 13 in REVmb, none in P80211ae, none in P802.11aa, +3 in P802.11ad

|  |  |  |
| --- | --- | --- |
| * Probe Request frame body | | |
| Order | Information | Notes |
| 17 | VHT Capabilities | The VHT Capabilities element is present when the dot11VHTOptionImplemented (#4028)is true |

* Probe Response frame format

Insert new rows for Order 61 through 66 after Order 60 in Probe Response frame body as follows:

* Order 1 to 54 in REVmb, 55 in P80211ae, +1 in P802.11aa, +4 in P802.11ad

|  |  |  |
| --- | --- | --- |
| * Probe Response frame body | | |
| Order | Information | Notes |
| 61 | VHT Capabilities | The VHT Capabilities element is present when the dot11VHTOptionImplemented (#4028)is true |
| 62 | VHT Operation | The VHT Operation element is present when the dot11VHTOptionImplemented (#4028)is true; otherwise it is not present(#4880). |
| 63 | VHT Transmit Power Envelope element | (#4748)The VHT Transmit Power Envelope element is present if both the following conditions are met:   * dot11VHTOptionImplemented is true; * Either dot11SpectrumManagementRequired is true or (#4748)dot11RadioMeasurementActivated is true.   Otherwise, this parameter is not present. |
| 64 | Extended Power Constraint element | The Extended Power Constraint element is present if dot11VHTOptionImplemented (#4028)is true, (#4844)and dot11SpectrumManagementRequired is true. |
| 65 | Extended BSS Load element | The Extended BSS Load element is present if dot11QosOptionImplemented,(#4531) dot11QBSSLoadImplemented and dot11VHTOptionImplemented are true. |
| 66 | Quiet Channel | The Quiet Channel element is optionally present if dot11VHTOptionImplemented is true, and either dot11SpectrumManagementRequired or dot11RadioMeasurementActivated is true. |
| 67 | Operating Mode Notification | The Operating Mode Notification element is optionally present if dot11OperatingModeNotificationImplemented is true.(#5096) |

* Management and Extension frames(11ad) body components
* Fields that are not information elements
* Action field

Insert the following row into Category values:

|  |  |  |  |
| --- | --- | --- | --- |
| * Category values | | | |
| Code | Meaning | See subclause | Robust |
| 21 | VHT | VHT Action frame details | No |

* Rate Identification field

Change the 3rd and subsequent paragraphs and insert new figure as follows:

The MCS Selector field set to 0 indicates the MCS Index field is reserved. The MCS Selector field set to 1 indicates the MCS Index field specifies an index value that is taken from Table 20-30 (MCS parameters for mandatory 20 MHz, NSS = 1, NES = 1) through Table 20-33 (MCS parameters for optional 20 MHz, NSS = 4, NES = 1, EQM) and Table 20-39 (MCS parameters for optional 20 MHz, NSS = 2, NES = 1, UEQM) through Table 20-41 (MCS parameters for optional 20 MHz, NSS = 4, NES = 1, UEQM) in 20.6 (Parameters for HT MCSs). The MCS Selector field set to 2 indicates the MCS Index field specifies an index value that is taken from Table 20-34 (MCS parameters for optional 40 MHz, NSS = 1, NES = 1) through Table 20-38 (MCS parameters for optional 40 MHz MCS 32 format, NSS = 1, NES = 1) and Table 20-43 (MCS parameters for optional 40 MHz, NSS = 3, UEQM) through Table 20-44 (MCS parameters for optional 40 MHz, NSS = 4, UEQM) in 20.6 (Parameters for HT MCSs).

The MCS Selector field set to 3 indicates that the MCS Index field specifies values that are taken from Table 22-30 (VHT MCSs for mandatory 20 MHz, NSS = 1) through Table 22-37 (VHT MCSs for optional 20 MHz, NSS = 8), indicating a VHT MCS for a 20 MHz channel width.

The MCS Selector field set to 4 indicates that the MCS Index field specifies values that are taken from Table 22-38 (VHT MCSs for mandatory 40 MHz, NSS = 1) through Table 22-45 (VHT MCSs for optional 40 MHz, NSS = 8), indicating a VHT MCS for a 40 MHz channel width.

The MCS Selector field set to 5 indicates that the MCS Index field specifies values that are taken from Table 22-46 (VHT MCSs for mandatory 80 MHz, NSS = 1) through Table 22-53 (VHT MCSs for optional 80 MHz, NSS = 8), indicating a VHT MCS for an 80 MHz channel width.

The MCS Selector field set to 6 indicates that the MCS Index field specifies values that are taken from Table 22-54 (VHT MCSs for optional 160 MHz and 80+80 MHz, NSS = 1) through Table 22-61 (VHT MCSs for optional 160 MHz and 80+80 MHz, NSS = 8), indicating a VHT MCS for a 160 MHz or 80+80 MHz channel width.

The MCS Selector field value~~s 3 to~~ of 7 ~~are~~ is reserved.

The Rate Type field set to 0 indicates the Rate field is reserved. The Rate Type field set to 1 indicates the Rate field specifies a data rate that is in the basic rate set. The Rate Type field set to 2 indicates the Rate field specifies a data rate that is not in the basic rate set.

If MCS Selector(#4532) is (#4533)1 or 2, t~~T~~he MCS Index field is a 1 octet unsigned integer that specifies the row index for one of the MCS parameter tables in 20.6 (Parameters for HT MCSs)(#4953).

If MCS Selector(#4532) is (#4533)3, 4, 5 or 6, the MCS Index field format is as shown in MCS Index field format when the MCS Selector field is . The Nss subfield indicates the number of spatial streams and the MCS Index Row subfield indicates a value from the MCS Index column of the MCS table in 22.5 (Parameters for VHT MCSs) that corresponds to the channel width and *NSS* values.

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 B2 | B3 B6 | B7 |
|  | Nss | MCS Index Row | Reserved |
| Bits | 3 | 4 | 1 |
| * MCS Index field format when the MCS Selector field is (#4533)3, 4, 5 or 6 | | | |

The Rate field contains a 2-octet unsigned integer that specifies the PHY rate in 0.5 Mb/s units.

Insert new subclauses VHT MIMO Control field through User Position Array field following the last subclause of 8.4.1:

* VHT MIMO Control field

The VHT MIMO Control field is defined in VHT MIMO Control field.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| B0 B2 | B3 B5 | B6 B7 | B8 B9 | B10 | B11 | B12 B14 | B15 | B16 B17 | B18 B23 |
| Nc Index | Nr Index | Channel Width | Grouping | Codebook Information | Feedback Type | Remaining Segments | First Segment | Reserved | Sounding Sequence Number |
| Bits: 3 | 3 | 2 | 2 | 1 | 1 | 3 | 1 | 2 | 6 |
| * VHT MIMO Control field | | | | | | | | | |

The subfields of the VHT MIMO Control field are defined in Subfields of the VHT MIMO Control field .

|  |  |
| --- | --- |
| * Subfields of the VHT MIMO Control field | |
| Subfield | Description |
| Nc Index | Indicates the number of columns, *Nc*, in the compressed beamforming matrix minus one:  Set to 0 for *Nc* = 1  Set to 1 for *Nc* = 2  …  Set to 7 for *Nc* = 8 |
| Nr Index | Indicates the number of rows, *Nr*, in the compressed beamforming matrix minus one:  Set to 0 for *Nr* = 1  Set to 1 for *Nr* = 2  …  Set to 7 for *Nr* = 8 |
| Channel Width | Indicates the width of the channel in which the measurement to create the compressed beamforming matrix was made:  Set to 0 for 20 MHz  Set to 1 for 40 MHz  Set to 2 for 80 MHz  Set to 3 for 160 MHz or 80+80 MHz |
| Grouping | Indicates the subcarrier grouping, *Ng*, used for the compressed beamforming matrix(#4720):  Set to 0 for *Ng* = 1 (No grouping)  Set to 1 for *Ng* = 2  Set to 2 for *Ng* = 4  The value 3 is reserved |
| Codebook Information | Indicates the size of codebook entries:  If Feedback Type is SU:(Ed)  Set to 0 for 2 bits for ψ, 4 bits for   Set to 1 for 4 bits for ψ, 6 bits for   If Feedback Type is MU:(Ed)  Set to 0 for 5 bits for ψ, 7 bits for   Set to 1 for 7 bits for ψ, 9 bits for  |
| Feedback Type | Indicates the feedback type:  Set to 0 for SU  Set to 1 for MU |
| Remaining Segments | Indicates the number of remaining segments for the associated VHT Compressed Beamforming frame:  Set to 0 for the last segment of a segmented report or the only segment of an unsegmented report.  Set to a value between 1 and 6 for a segment that is neither the first nor the last segment of a segmented report.  Set to a value between 1 and 7 for a segment that is the first but not the last segment of a segmented report.  In a retransmitted segment, the field is set to the same value associated with the segment in the original transmission. |
| First Segment | Set to 1 for the first segment of a segmented report or the only segment of an unsegmented report; set to 0 otherwise.  In a retransmitted segment, the field is set to the same value associated with the segment in the original transmission. |
| Sounding Sequence Number | Sequence number from the VHT NDP Announcement frame(#4921) soliciting feedback |

In a VHT Compressed Beamforming frame not carrying all or part of a VHT(#4713) Compressed Beamforming report, the fields Nc Index, Nr Index, Channel Width, Grouping, Codebook Information, Feedback Type and Sounding Sequence Number are reserved, the First Segment field is set to 0 and the Remaining Segments field is set to 7.

* VHT Compressed Beamforming Report field

The VHT Compressed Beamforming Report field is used by the VHT Compressed Beamforming report (see VHT Compressed Beamforming frame format) to carry explicit feedback information in the form of angles representing compressed beamforming feedback matrices *V* for use by a transmit beamformer to determine steering matrices *Q*, as described in 9.29.3 (Explicit feedback beamforming)(#4954) and 20.3.12.3 (Explicit feedback beamforming).

The size of the VHT Compressed Beamforming Report field depends on the values in the VHT MIMO Control field. The VHT Compressed Beamforming Report field contains VHT Compressed Beamforming Report information or successive (possibly zero-length) portions of this in the case of a segmented VHT Compressed Beamforming report (see 9.31.5). VHT Compressed Beamforming Report information is always included in the VHT Compressed Beamforming report.

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

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

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

|  |  |  |
| --- | --- | --- |
| * Order of angles in the Compressed Beamforming Feedback Matrix subfield | | |
| Size of *V* (*Nr × Nc*) | Number of angles (*Na*) | The order of angles in the Compressed Beamforming Feedback Matrix subfield |
| 2×1 | 2 | 11, 21 |
| 2×2 | 2 | 11, 21 |
| 3×1 | 4 | 11, 21, 21, 31 |
| 3×2 | 6 | 11, 21, 21, 31, 22, 32 |
| 3×3 | 6 | 11, 21, 21, 31, 22, 32 |
| 4×1 | 6 | 11, 21, 31, 21, 31, 41 |
| 4×2 | 10 | 11, 21, 31, 21, 31, 41, 22, 32, 32, 42 |
| 4×3 | 12 | 11, 21, 31, 21, 31, 41, 22, 32, 32, 42, 33, 43 |
| 4×4 | 12 | 11, 21, 31, 21, 31, 41, 22, 32, 32, 42, 33, 43 |
| 5×1 | 8 | 11, 21, 31, 41, ψ21, ψ31, ψ41, ψ51 |
| 5×2 | 14 | 11, 21, 31, 41, ψ21, ψ31, ψ41, ψ51, 22, 32, 42, ψ32, ψ42, ψ52 |
| 5×3 | 18 | 11, 21, 31, 41, ψ21, ψ31, ψ41, ψ51, 22, 32, 42, ψ32, ψ42, ψ52, 33, 43, ψ43, ψ53 |
| 5×4 | 20 | 11, 21, 31, 41, ψ21, ψ31, ψ41, ψ51, 22, 32, 42, ψ32, ψ42, ψ52, 33, 43, ψ43, ψ53, 44, ψ54 |
| 5×5 | 20 | 11, 21, 31, 41, ψ21, ψ31, ψ41, ψ51, 22, 32, 42, ψ32, ψ42, ψ52, 33, 43, ψ43, ψ53, 44, ψ54 |
| 6×1 | 10 | 11, 21, 31, 41, 51, ψ21, ψ31, ψ41, ψ51, ψ61 |
| 6×2 | 18 | 11, 21, 31, 41, 51, ψ21, ψ31, ψ41, ψ51, ψ61, 22, 32, 42, 52, ψ32, ψ42, ψ52, ψ62 |
| 6×3 | 24 | 11, 21, 31, 41, 51, ψ21, ψ31, ψ41, ψ51, ψ61, 22, 32, 42, 52, ψ32, ψ42, ψ52, ψ62, 33, 43, 53, ψ43, ψ53, ψ63 |
| 6×4 | 28 | 11, 21, 31, 41, 51, ψ21, ψ31, ψ41, ψ51, ψ61, 22, 32, 42, 52, ψ32, ψ42, ψ52, ψ62, 33, 43, 53, ψ43, ψ53, ψ63, 44, 54, ψ54, ψ64 |
| 6×5 | 30 | 11, 21, 31, 41, 51, ψ21, ψ31, ψ41, ψ51, ψ61, 22, 32, 42, 52, ψ32, ψ42, ψ52, ψ62, 33, 43, 53, ψ43, ψ53, ψ63, 44, 54, ψ54, ψ64, 55, ψ65 |
| 6×6 | 30 | 11, 21, 31, 41, 51, ψ21, ψ31, ψ41, ψ51, ψ61, 22, 32, 42, 52, ψ32, ψ42, ψ52, ψ62, 33, 43, 53, ψ43, ψ53, ψ63, 44, 54, ψ54, ψ64, 55, ψ65 |
| 7×1 | 12 | 11, 21, 31, 41, 51, 61, ψ21, ψ31, ψ41, ψ51, ψ61, ψ71 |
| 7×2 | 22 | 11, 21, 31, 41, 51, 61, ψ21, ψ31, ψ41, ψ51, ψ61, ψ71, 22, 32, 42, 52, 62, ψ32, ψ42, ψ52, ψ62, ψ72 |
| 7×3 | 30 | 11, 21, 31, 41, 51, 61, ψ21, ψ31, ψ41, ψ51, ψ61, ψ71, 22, 32, 42, 52, 62, ψ32, ψ42, ψ52, ψ62, ψ72, 33, 43, 53, 63, ψ43, ψ53, ψ63, ψ73 |
| 7×4 | 36 | 11, 21, 31, 41, 51, 61, ψ21, ψ31, ψ41, ψ51, ψ61, ψ71, 22, 32, 42, 52, 62, ψ32, ψ42, ψ52, ψ62, ψ72, 33, 43, 53, 63, ψ43, ψ53, ψ63, ψ73, 44, 54, 64, ψ54, ψ64, ψ74 |
| 7×5 | 40 | 11, 21, 31, 41, 51, 61, ψ21, ψ31, ψ41, ψ51, ψ61, ψ71, 22, 32, 42, 52, 62, ψ32, ψ42, ψ52, ψ62, ψ72, 33, 43, 53, 63, ψ43, ψ53, ψ63, ψ73, 44, 54, 64, ψ54, ψ64, ψ74, 55, 65, ψ65, ψ75 |
| 7×6 | 42 | 11, 21, 31, 41, 51, 61, ψ21, ψ31, ψ41, ψ51, ψ61, ψ71, 22, 32, 42, 52, 62, ψ32, ψ42, ψ52, ψ62, ψ72, 33, 43, 53, 63, ψ43, ψ53, ψ63, ψ73, 44, 54, 64, ψ54, ψ64, ψ74, 55, 65, ψ65, ψ75, 66, ψ76 |
| 7×7 | 42 | 11, 21, 31, 41, 51, 61, ψ21, ψ31, ψ41, ψ51, ψ61, ψ71, 22, 32, 42, 52, 62, ψ32, ψ42, ψ52, ψ62, ψ72, 33, 43, 53, 63, ψ43, ψ53, ψ63, ψ73, 44, 54, 64, ψ54, ψ64, ψ74, 55, 65, ψ65, ψ75, 66, ψ76 |
| 8×1 | 14 | 11, 21, 31, 41, 51, 61, 71, ψ21, ψ31, ψ41, ψ51, ψ61, ψ71, ψ81 |
| 8×2 | 26 | 11, 21, 31, 41, 51, 61, 71, ψ21, ψ31, ψ41, ψ51, ψ61, ψ71, ψ81, 22, 32, 42, 52, 62, 72, ψ32, ψ42, ψ52, ψ62, ψ72, ψ82 |
| 8×3 | 36 | 11, 21, 31, 41, 51, 61, 71, ψ21, ψ31, ψ41, ψ51, ψ61, ψ71, ψ81, 22, 32, 42, 52, 62, 72, ψ32, ψ42, ψ52, ψ62, ψ72, ψ82, 33, 43, 53, φ63, 73, ψ43, ψ53, ψ63, ψ73, ψ83 |
| 8×4 | 44 | 11, 21, 31, 41, 51, 61, 71, ψ21, ψ31, ψ41, ψ51, ψ61, ψ71, ψ81, 22, 32, 42, 52, 62, 72, ψ32, ψ42, ψ52, ψ62, ψ72, ψ82, 33, 43, 53, 63, 73, ψ43, ψ53, ψ63, ψ73, ψ83,44, 54, 64, 74, ψ54, ψ64, ψ74, ψ84 |
| 8×5 | 50 | 11, 21, 31, 41, 51, 61, 71, ψ21, ψ31, ψ41, ψ51, ψ61, ψ71, ψ81, 22, 32, 42, 52, 62, 72, ψ32, ψ42, ψ52, ψ62, ψ72, ψ82, 33, 43, 53, 63, 73, ψ43, ψ53, ψ63, ψ73, ψ83,44, 54, 64, 74, ψ54, ψ64, ψ74, ψ84, 55, 65, 75, ψ65, ψ75, ψ85 |
| 8×6 | 54 | 11, 21, 31, 41, 51, 61, 71, ψ21, ψ31, ψ41, ψ51, ψ61, ψ71, ψ81, 22, 32, 42, 52, 62, 72, ψ32, ψ42, ψ52, ψ62, ψ72, ψ82, 33, 43, 53, 63, 73, ψ43, ψ53, ψ63, ψ73, ψ83,44, 54, 64, 74, ψ54, ψ64, ψ74, ψ84, 55, 65, 75, ψ65, ψ75, ψ85, 66, 76, ψ76, ψ86 |
| 8×7 | 56 | 11, 21, 31, 41, 51, 61, 71, ψ21, ψ31, ψ41, ψ51, ψ61, ψ71, ψ81, 22, 32, 42, 52, 62, 72, ψ32, ψ42, ψ52, ψ62, ψ72, ψ82, 33, 43, 53, 63, 73, ψ43, ψ53, ψ63, ψ73, ψ83,44, 54, 64, 74, ψ54, ψ64, ψ74, ψ84, 55, 65, 75, ψ65, ψ75, ψ85, 66, 76, ψ76, ψ86, 77, ψ87 |
| 8×8 | 56 | 11, 21, 31, 41, 51, 61, 71, ψ21, ψ31, ψ41, ψ51, ψ61, ψ71, ψ81, 22, 32, 42, 52, 62, 72, ψ32, ψ42, ψ52, ψ62, ψ72, ψ82, 33, 43, 53, 63, 73, ψ43, ψ53, ψ63, ψ73, ψ83,44, 54, 64, 74, ψ54, ψ64, ψ74, ψ84, 55, 65, 75, ψ65, ψ75, ψ85, 66, 76, ψ76, ψ86, 77, ψ87 |

The angles are quantized as defined in Quantization of angles. All angles are transmitted LSB to MSB.

|  |  |
| --- | --- |
| * Quantization of angles | |
| Quantized | Quantized |
| radians  where  is the number of bits used to quantize (defined by the Codebook Information field of the VHT MIMO Control field (see VHT MIMO Control field) | radians  where  is the number of bits used to quantize (defined by the Codebook Information field of the VHT MIMO Control field (see VHT MIMO Control field) |

The VHT Compressed Beamforming Report information has the structure defined in VHT Compressed Beamforming Report , where *Na* is the number of angles used for the compressed beamforming feedback matrix subfield (see Order of angles in the Compressed Beamforming Feedback Matrix subfield ).

|  |  |  |
| --- | --- | --- |
| * VHT Compressed Beamforming Report information | | |
| Field | Size  (bits) | Meaning |
| Average SNR of Space-Time Stream 1 | 8 | Signal-to-noise ratio at the beamformee for space-time stream 1 averaged over all data subcarriers. See Average SNR of Space-Time Stream . |
| ... | … | … |
| Average SNR of Space-Time Stream *Nc* | 8 | Signal-to-noise ratio at the beamformee for space-time stream *Nc* averaged over all datasubcarriers. See Average SNR of Space-Time Stream . |
| Compressed(#4295) Beamforming Feedback Matrix *V* for subcarrier | *Na×*(*b +b*)/2 | Compressed beamforming feedback matrix as defined in Order of angles in the Compressed Beamforming Feedback Matrix subfield |
| Compressed(#4295) Beamforming Feedback Matrix *V* for subcarrier | *Na×*(*b +b*)/2 | Compressed beamforming feedback matrix as defined in Order of angles in the Compressed Beamforming Feedback Matrix subfield |
| Compressed(#4295) Beamforming Feedback Matrix *V* for subcarrier | *Na×*(*b +b*)/2 | Compressed beamforming feedback matrix as defined in Order of angles in the Compressed Beamforming Feedback Matrix subfield |
| ... | … | … |
| Compressed(#4295) Beamforming Feedback Matrix *V* for subcarrier | *Na*×( *b +b*)/2 | Compressed beamforming feedback matrix as defined in Order of angles in the Compressed Beamforming Feedback Matrix subfield |
| NOTE—*scidx(.)* is defined in Subcarriers for which a Compressed Beamforming Feedback Matrix subfield is sent ba | | |

*Ns* is the number of subcarriers for which the Compressed Beamforming Feedback Matrix subfield is sent back to the beamformer. Beamformee may choose to reduce *Ns* by using a method referred to as grouping, in which only a single Compressed Beamforming Feedback Matrix is reported for each group of *Ng* adjacent subcarriers. *Ns* is a function of the Channel Width and Grouping subfields in VHT MIMO Control Field (see VHT MIMO Control field). Subcarriers for which a Compressed Beamforming Feedback Matrix subfield is sent ba lists *Ns*, the exact subcarrier indices and their order for which the Compressed Beamforming Matrix subfield is sent back. No padding is present between angles (#4712)in the VHT Compressed Beamforming Report information, even if they correspond to different subcarriers. If the size of the VHT(#4714) Compressed Beamforming Report information is not an integral multiple of 8 bits, up to 7 zeros are appended to the end of the field to make its size an integral multiple of 8 bits.

|  |  |  |  |
| --- | --- | --- | --- |
| * Subcarriers for which a Compressed Beamforming Feedback Matrix subfield is sent back | | | |
| Channel Width | *Ng* | *Ns* | Subcarriers for which Compressed Feedback Beamforming Matrix subfield is sent: *scidx*(0), *scidx*(1), …, *scidx*(*Ns*-1) |
| 20 MHz | 1 | 52 | -28, -27, -26, -25, -24, -23, -22, -20, -19, -18, -17, -16, -15, -14, -13, -12, -11, -10, -9, -8, -6, -5, -4, -3, -2, -1, 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28  NOTE—Pilot subcarriers (±21, ±7) and DC subcarrier (0) are skipped |
| 2 | 30 | -28, -26, -24, -22, -20, -18, -16, -14, -12, -10, -8, -6, -4, -2, -1, 1, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28 |
| 4 | 16 | -28, -24, -20, -16, -12, -8, -4, -1, 1, 4, 8, 12, 16, 20, 24, 28 |
| 40 MHz | 1 | 108 | -58, -57, -56, -55, -54, -52, -51, -50, -49, -48, -47, -46, -45, -44, -43, -42, -41, -40, -39, -38, -37, -36, -35, -34, -33, -32, -31, -30, -29, -28, -27, -26, -24, -23, -22, -21, -20, -19, -18, -17, -16, -15, -14, -13, -12, -10, -9, -8, -7, -6, -5, -4, -3, -2, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 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, 54, 55, 56, 57, 58  NOTE—Pilot subcarriers (±53, ±25, ±11) and DC subcarriers (0, ±1) are skipped. |
| 2 | 58 | -58, -56, -54, -52, -50, -48, -46, -44, -42, -40, -38, -36, -34, -32, -30, -28, -26, -24, -22, -20, -18, -16, -14, -12, -10, -8, -6, -4,-2, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58 |
| 4 | 30 | -58, -54, -50, -46, -42, -38, -34, -30, -26, -22, -18, -14, -10, -6,-2, 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58 |
| 80 MHz | 1 | 234 | -122, -121, -120, -119, -118, -117, -116, -115, -114, -113, -112, -111, -110, -109,  -108, -107, -106, -105, -104, -102, -101, -100, -99, -98, -97, -96, -95, -94, -93,  -92, -91, -90, -89, -88, -87, -86, -85, -84, -83, -82, -81, -80, -79, -78, -77, -76, -74, -73, -72, -71, -70, -69, -68, -67, -66, -65, -64, -63, -62, -61, -60, -59, -58, -57, -56, -55, -54, -53, -52, -51, -50, -49, -48, -47, -46, -45, -44, -43, -42, -41, -40, -38, -37, -36, -35, -34, -33, -32, -31, -30, -29, -28, -27, -26, -25, -24, -23, -22, -21, -20, -19, -18, -17, -16, -15, -14, -13, -12, -10, -9, -8, -7, -6, -5, -4, -3, -2, 2, 3, 4, 5, 6, 7, 8, 9, 10, 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, 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, 66, 67, 68, 69, 70, 71, 72, 73, 74, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122  NOTE—Pilot subcarriers (±103, ±75, ±39, ±11) and DC subcarriers (0, ±1) are skipped. |
| 2 | 122 | -122, -120, -118, -116, -114, -112, -110, -108, -106, -104, -102, -100, -98, -96,  -94, -92, -90, -88, -86, -84, -82, -80, -78, -76, -74, -72, -70, -68, -66, -64, -62, -60, -58, -56, -54, -52, -50, -48, -46, -44, -42, -40, -38, -36, -34, -32, -30, -28, -26, -24, -22, -20, -18, -16, -14, -12, -10, -8, -6, -4, -2, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122 |
| 4 | 62 | -122, -118, -114, -110, -106, -102, -98, -94, -90, -86, -82, -78, -74, -70, -66, -62,  -58, -54, -50, -46, -42, -38, -34, -30, -26, -22, -18, -14, -10, -6, -2, 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58, 62, 66, 70, 74, 78, 82, 86, 90, 94, 98, 102, 106, 110, 114, 118, 122 |
| 160 MHz | 1 | 468 | -250, -249, -248, -247, -246, -245, -244, -243, -242, -241, -240, -239, -238, -237, -236, -235, -234, -233, -232, -230, -229, -228, -227, -226, -225, -224, -223, -222, -221, -220, -219, -218, -217, -216, -215, -214, -213, -212, -211, -210, -209, -208, -207, -206, -205, -204, -202, -201, -200, -199, -198, -197, -196, -195, -194, -193, -192, -191, -190, -189, -188, -187, -186, -185, -184, -183, -182, -181, -180, -179, -178, -177, -176, -175, -174, -173, -172, -170, -169, -168, -166, -165, -164, -163, -162, -161, -160, -159, -158, -157, -156, -155, -154, -153, -152, -151, -150, -149, -148, -147, -146, -145, -144, -143, -142, -141, -140, -138, -137, -136, -135, -134, -133, -132, -131, -130, -126, -125, -124, -123, -122, -121, -120, -119, -118, -117,  -116, -115, -114, -113, -112, -111, -110, -109, -108, -107, -106, -105, -104, -103,  -102, -101, -100, -99, -98, -97, -96, -95, -94, -93, -92, -91, -90, -88, -87, -86, -85, -84, -83, -82, -81, -80, -79, -78, -77, -76, -75, -74, -73, -72, -71, -70, -69, -68, -67, -66, -65, -64, -63, -62, -61, -60, -59, -58, -57, -56, -55, -54, -52, -51, -50, -49, -48, -47, -46, -45, -44, -43, -42, -41, -40, -39, -38, -37, -36, -35, -34, -33, -32, -31, -30, -29, -28, -27, -26, -24, -23, -22, -21, -20, -19, -18, -17, -16, -15, -14, -13, -12, -11, -10, -9, -8, -7, -6, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 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, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 130, 131, 132, 133, 134, 135, 136, 137, 138, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250  NOTE—Pilot subcarriers (±231, ±203, ±167, ±139, ±117, ±89, ±53, ±25), DC subcarriers (0, ±1, ±2, ±3, ±4, ±5) and subcarriers ±127, ±128, ±129 are skipped. |
| 2 | 244 | -250, -248, -246, -244, -242, -240, -238, -236, -234, -232, -230, -228, -226, -224, -222, -220, -218, -216, -214, -212, -210, -208, -206, -204, -202, -200, -198, -196, -194, -192, -190, -188, -186, -184, -182, -180, -178, -176, -174, -172, -170, -168, -166, -164, -162, -160, -158, -156, -154, -152, -150, -148, -146, -144, -142, -140, -138, -136, -134, -132, -130, -126, -124, -122, -120, -118, -116, -114, -112, -110,  -108, -106, -104, -102, -100, -98, -96, -94, -92, -90, -88, -86, -84, -82, -80, -78,  -76, -74, -72, -70, -68, -66, -64, -62, -60, -58, -56, -54, -52, -50, -48, -46, -44, -42, -40, -38, -36, -34, -32, -30, -28, -26, -24, -22, -20, -18, -16, -14, -12, -10, -8, -6, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160, 162, 164, 166, 168, 170, 172, 174, 176, 178, 180, 182, 184, 186, 188, 190, 192, 194, 196, 198, 200, 202, 204, 206, 208, 210, 212, 214, 216, 218, 220, 222, 224, 226, 228, 230, 232, 234, 236, 238, 240, 242, 244, 246, 248, 250  NOTE—Subcarriers 0, ±2, ±4 and ±128 are skipped. |
| 160 MHz | 4 | 124 | -250, -246, -242, -238, -234, -230, -226, -222, -218, -214, -210, -206, -202, -198, -194, -190, -186, -182, -178, -174, -170, -166, -162, -158, -154, -150, -146, -142, -138, -134, -130, -126, -122, -118, -114, -110, -106, -102, -98, -94, -90, -86, -82,  -78, -74, -70, -66, -62, -58, -54, -50, -46, -42, -38, -34, -30, -26, -22, -18, -14, -10, -6, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58, 62, 66, 70, 74, 78, 82, 86, 90, 94, 98, 102, 106, 110, 114, 118, 122, 126, 130, 134, 138, 142, 146, 150, 154, 158, 162, 166, 170, 174, 178, 182, 186, 190, 194, 198, 202, 206, 210, 214, 218, 222, 226, 230, 234, 238, 242, 246, 250  NOTE—Subcarriers ±2 are skipped. |
| 80+80 MHz | 1 | 468 | -122(L), -121(L), -120(L), -119(L), -118(L), -117(L), -116(L), -115(L), -114(L),  -113(L), -112(L), -111(L), -110(L), -109(L), -108(L), -107(L), -106(L), -105(L),  -104(L), -102(L), -101(L), -100(L), -99(L), -98(L), -97(L), -96(L), -95(L),  -94(L), -93(L), -92(L), -91(L), -90(L), -89(L), -88(L), -87(L), -86(L), -85(L),  -84(L), -83(L), -82(L), -81(L), -80(L), -79(L), -78(L), -77(L), -76(L), -74(L),  -73(L), -72(L), -71(L), -70(L), -69(L), -68(L), -67(L), -66(L), -65(L), -64(L),  -63(L), -62(L), -61(L), -60(L), -59(L), -58(L), -57(L), -56(L), -55(L), -54(L),  -53(L), -52(L), -51(L), -50(L), -49(L), -48(L), -47(L), -46(L), -45(L), -44(L),  -43(L), -42(L), -41(L), -40(L), -38(L), -37(L), -36(L), -35(L), -34(L), -33(L),  -32(L), -31(L), -30(L), -29(L), -28(L), -27(L), -26(L), -25(L), -24(L), -23(L),  -22(L), -21(L), -20(L), -19(L), -18(L), -17(L), -16(L), -15(L), -14(L), -13(L),  -12(L), -10(L), -9(L), -8(L), -7(L), -6(L), -5(L), -4(L), -3(L), -2(L), 2(L), 3(L), 4(L), 5(L), 6(L), 7(L), 8(L), 9(L), 10(L), 12(L), 13(L), 14(L), 15(L), 16(L), 17(L), 18(L), 19(L), 20(L), 21(L), 22(L), 23(L), 24(L), 25(L), 26(L), 27(L), 28(L), 29(L), 30(L), 31(L), 32(L), 33(L), 34(L), 35(L), 36(L), 37(L), 38(L), 40(L), 41(L), 42(L), 43(L), 44(L), 45(L), 46(L), 47(L), 48(L), 49(L), 50(L), 51(L), 52(L), 53(L), 54(L), 55(L), 56(L), 57(L), 58(L), 59(L), 60(L), 61(L), 62(L), 63(L), 64(L), 65(L), 66(L), 67(L), 68(L), 69(L), 70(L), 71(L), 72(L), 73(L), 74(L), 76(L), 77(L), 78(L), 79(L), 80(L), 81(L), 82(L), 83(L), 84(L), 85(L), 86(L), 87(L), 88(L), 89(L), 90(L), 91(L), 92(L), 93(L), 94(L), 95(L), 96(L), 97(L), 98(L), 99(L), 100(L), 101(L), 102(L), 104(L), 105(L), 106(L), 107(L), 108(L), 109(L), 110(L), 111(L), 112(L), 113(L), 114(L), 115(L), 116(L), 117(L), 118(L), 119(L), 120(L), 121(L), 122(L), -122(H), -121(H), -120(H), -119(H),  -118(H), -117(H), -116(H), -115(H), -114(H), -113(H), -112(H), -111(H),  -110(H), -109(H), -108(H), -107(H), -106(H), -105(H), -104(H), -102(H),  -101(H), -100(H), -99(H), -98(H), -97(H), -96(H), -95(H), -94(H), -93(H),  -92(H), -91(H), -90(H), -89(H), -88(H), -87(H), -86(H), -85(H), -84(H), -83(H),  -82(H), -81(H), -80(H), -79(H), -78(H), -77(H), -76(H), -74(H), -73(H), -72(H),  -71(H), -70(H), -69(H), -68(H), -67(H), -66(H), -65(H), -64(H), -63(H), -62(H),  -61(H), -60(H), -59(H), -58(H), -57(H), -56(H), -55(H), -54(H), -53(H), -52(H),  -51(H), -50(H), -49(H), -48(H), -47(H), -46(H), -45(H), -44(H), -43(H), -42(H),  -41(H), -40(H), -38(H), -37(H), -36(H), -35(H), -34(H), -33(H), -32(H), -31(H),  -30(H), -29(H), -28(H), -27(H), -26(H), -25(H), -24(H), -23(H), -22(H), -21(H),  -20(H), -19(H), -18(H), -17(H), -16(H), -15(H), -14(H), -13(H), -12(H), -10(H),  -9(H), -8(H), -7(H), -6(H), -5(H), -4(H), -3(H), -2(H), 2(H), 3(H), 4(H), 5(H), 6(H), 7(H), 8(H), 9(H), 10(H), 12(H), 13(H), 14(H), 15(H), 16(H), 17(H), 18(H), 19(H), 20(H), 21(H), 22(H), 23(H), 24(H), 25(H), 26(H), 27(H), 28(H), 29(H), 30(H), 31(H), 32(H), 33(H), 34(H), 35(H), 36(H), 37(H), 38(H), 40(H), 41(H), 42(H), 43(H), 44(H), 45(H), 46(H), 47(H), 48(H), 49(H), 50(H), 51(H), 52(H), 53(H), 54(H), 55(H), 56(H), 57(H), 58(H), 59(H), 60(H), 61(H), 62(H), 63(H), 64(H), 65(H), 66(H), 67(H), 68(H), 69(H), 70(H), 71(H), 72(H), 73(H), 74(H), 76(H), 77(H), 78(H), 79(H), 80(H), 81(H), 82(H), 83(H), 84(H), 85(H), 86(H), 87(H), 88(H), 89(H), 90(H), 91(H), 92(H), 93(H), 94(H), 95(H), 96(H), 97(H), 98(H), 99(H), 100(H), 101(H), 102(H), 104(H), 105(H), 106(H), 107(H), 108(H), 109(H), 110(H), 111(H), 112(H), 113(H), 114(H), 115(H), 116(H), 117(H), 118(H), 119(H), 120(H), 121(H), 122(H)  NOTE—Subcarrier *x*(L) denotes subcarrier index x in the frequency segment lower in frequency, and subcarrier *x*(H) denotes subcarrier index *x* in the frequency segment higher in frequency.  NOTE—Pilot subcarriers (±103, ±75, ±39, ±11) and DC subcarriers (0, ±1) are skipped in each frequency segment. |
| 80+80 MHz | 2 | 244 | -122(L), -120(L), -118(L), -116(L), -114(L), -112(L), -110(L), -108(L), -106(L),  -104(L), -102(L), -100(L), -98(L), -96(L), -94(L), -92(L), -90(L), -88(L), -86(L), -84(L), -82(L), -80(L), -78(L), -76(L), -74(L), -72(L), -70(L), -68(L), -66(L),  -64(L), -62(L), -60(L), -58(L), -56(L), -54(L), -52(L), -50(L), -48(L), -46(L),  -44(L), -42(L), -40(L), -38(L), -36(L), -34(L), -32(L), -30(L), -28(L), -26(L),  -24(L), -22(L), -20(L), -18(L), -16(L), -14(L), -12(L), -10(L), -8(L), -6(L), -4(L), -2(L), 2(L), 4(L), 6(L), 8(L), 10(L), 12(L), 14(L), 16(L), 18(L), 20(L), 22(L), 24(L), 26(L), 28(L), 30(L), 32(L), 34(L), 36(L), 38(L), 40(L), 42(L), 44(L), 46(L), 48(L), 50(L), 52(L), 54(L), 56(L), 58(L), 60(L), 62(L), 64(L), 66(L), 68(L), 70(L), 72(L), 74(L), 76(L), 78(L), 80(L), 82(L), 84(L), 86(L), 88(L), 90(L), 92(L), 94(L), 96(L), 98(L), 100(L), 102(L), 104(L), 106(L), 108(L), 110(L), 112(L), 114(L), 116(L), 118(L), 120(L), 122(L), -122(H), -120(H),  -118(H), -116(H), -114(H), -112(H), -110(H), -108(H), -106(H), -104(H),  -102(H), -100(H), -98(H), -96(H), -94(H), -92(H), -90(H), -88(H), -86(H),  -84(H), -82(H), -80(H), -78(H), -76(H), -74(H), -72(H), -70(H), -68(H), -66(H),  -64(H), -62(H), -60(H), -58(H), -56(H), -54(H), -52(H), -50(H), -48(H), -46(H),  -44(H), -42(H), -40(H), -38(H), -36(H), -34(H), -32(H), -30(H), -28(H), -26(H),  -24(H), -22(H), -20(H), -18(H), -16(H), -14(H), -12(H), -10(H), -8(H), -6(H),  -4(H), -2(H), 2(H), 4(H), 6(H), 8(H), 10(H), 12(H), 14(H), 16(H), 18(H), 20(H), 22(H), 24(H), 26(H), 28(H), 30(H), 32(H), 34(H), 36(H), 38(H), 40(H), 42(H), 44(H), 46(H), 48(H), 50(H), 52(H), 54(H), 56(H), 58(H), 60(H), 62(H), 64(H), 66(H), 68(H), 70(H), 72(H), 74(H), 76(H), 78(H), 80(H), 82(H), 84(H), 86(H), 88(H), 90(H), 92(H), 94(H), 96(H), 98(H), 100(H), 102(H), 104(H), 106(H), 108(H), 110(H), 112(H), 114(H), 116(H), 118(H), 120(H), 122(H) |
| 4 | 124 | -122(L), -118(L), -114(L), -110(L), -106(L), -102(L), -98(L), -94(L), -90(L),  -86(L), -82(L), -78(L), -74(L), -70(L), -66(L), -62(L), -58(L), -54(L), -50(L),  -46(L), -42(L), -38(L), -34(L), -30(L), -26(L), -22(L), -18(L), -14(L), -10(L),  -6(L), -2(L), 2(L), 6(L), 10(L), 14(L), 18(L), 22(L), 26(L), 30(L), 34(L), 38(L), 42(L), 46(L), 50(L), 54(L), 58(L), 62(L), 66(L), 70(L), 74(L), 78(L), 82(L), 86(L), 90(L), 94(L), 98(L), 102(L), 106(L), 110(L), 114(L), 118(L), 122(L),  -122(H), -118(H), -114(H), -110(H), -106(H), -102(H), -98(H), -94(H), -90(H),  -86(H), -82(H), -78(H), -74(H), -70(H), -66(H), -62(H), -58(H), -54(H), -50(H),  -46(H), -42(H), -38(H), -34(H), -30(H), -26(H), -22(H), -18(H), -14(H), -10(H),  -6(H), -2(H), 2(H), 6(H), 10(H), 14(H), 18(H), 22(H), 26(H), 30(H), 34(H), 38(H), 42(H), 46(H), 50(H), 54(H), 58(H), 62(H), 66(H), 70(H), 74(H), 78(H), 82(H), 86(H), 90(H), 94(H), 98(H), 102(H), 106(H), 110(H), 114(H), 118(H), 122(H) |

The Average SNR of Space-Time Stream *i* subfield in the VHT Compressed Beamforming Report is an 8-bit two's complement integer whose definition is shown in Average SNR of Space-Time Stream .

|  |  |
| --- | --- |
| * Average SNR of Space-Time Stream *i* subfield | |
| Average SNR of Space-Time Stream *i* subfield | *AvgSNRi* |
| -128 | -10 dB |
| -127 | -9.75 dB |
| -126 | -9.5 dB |
| … | … |
| +126 | 53.5 dB |
| +127 | 53.75 dB |

The *AvgSNRi* in Average SNR of Space-Time Stream is the sum of the values of SNR per tone (in decibels) divided by the number of tones represented. Each SNR value per tone in stream *i* (before being averaged) corresponds to the SNR associated with the column *i* of the beamforming feedback matrix *V* determined at the beamformee. Each SNR corresponds to the predicted SNR at the beamformee when the beamformer applies the matrix *V*.

A STA with a 40 MHz, 80 MHz or 160 MHz operating channel width and sending feedback for a 20 MHz channel width(#4297) includes subcarriers corresponding to the primary 20 MHz channel in the Compressed Feedback Beamforming Matrix subfield.

A STA with an 80 MHz or 160 MHz operating channel width and sending feedback for a 40 MHz channel width(#4297) includes subcarriers corresponding to the primary 40 MHz channel in the Compressed Feedback Beamforming Matrix subfield.

A STA with a 160 MHz operating channel width and sending feedback for an 80 MHz channel width(#4297) includes subcarriers corresponding to the primary 80 MHz channel in the Compressed Feedback Beamforming Matrix subfield.

* MU Exclusive Beamforming Report field

The MU Exclusive Beamforming Report field is used by the VHT Compressed Beamforming report (see VHT Compressed Beamforming frame format) to carry explicit feedback information in the form of delta SNRs for use by a transmit MU beamformer to determine steering matrices *Q*, as described in 9.29.3 (Explicit feedback beamforming)(#4954) and 20.3.12.3 (Explicit feedback beamforming).

The size of the MU Exclusive Beamforming Report field depends on the values in the VHT MIMO Control field. The MU Exclusive Beamforming Report field contains MU Exclusive Beamforming Report information or successive (possibly zero-length) portions of this in the case of a segmented VHT Compressed Beamforming report (see 9.31.5). The MU Exclusive Beamforming Report information is included in the VHT Compressed Beamforming report if the Feedback Type subfield in the VHT MIMO Control field indicates MU (see VHT MIMO Control field).

* The MU Exclusive Beamforming Report information consists of Delta SNR subfields for each space-time stream (1 to *Nc*) of a subset of the subcarriers spaced apart, where is signaled in the Grouping subfield of the VHT MIMO Control field, starting from the lowest frequency subcarrier and continuing to the highest frequency subcarrier. The subset of subcarriers included is determined by the values of the Channel Width and Grouping subfields of the VHT MIMO Control field as listed in Number of subcarriers and subcarrier mapping . For each subcarrier included, the deviation in dB of the SNR of that subcarrier for each column of *V* relative to the average SNR of the corresponding space-time stream is computed using



.



(#4194)where



is the estimated MIMO channel for subcarrier *k*



is column *i* of the beamforming matrix *V* for subcarrier *k*



is the average noise plus interference power, measured at the beamformee,(#4301) that was used to calculate



is the average SNR of space-time stream *i* reported in the VHT Compressed Beamforming Report information (Average SNR in Space-Time Stream *i* field)



* Each Delta SNR subfield contains the computed using



and quantized to 4 bits in the range -8 dB to 7 dB (#4300)with 1 dB granularity. The structure of the MU Exclusive Beamforming Report information is shown in MU Exclusive Beamforming Report .

|  |  |  |
| --- | --- | --- |
| * MU Exclusive Beamforming Report information | | |
| Field | Size (Bits) | Meaning |
| Delta SNR for space-time stream 1 for subcarrier *k = scidx(0)* | 4 | * as defined in |
| … | … | … |
| Delta SNR for space-time stream for subcarrier *k = scidx(0)* | 4 | * as defined in |
| Delta SNR for space-time stream 1 for subcarrier *k = scidx(1)* | 4 | * as defined in |
| … | … | … |
| Delta SNR for space-time stream for subcarrier *k = scidx(1)* | 4 | * as defined in |
| … | … | … |
| Delta SNR for space-time stream 1 for subcarrier *k = scidx(Ns’-1)* | 4 | * as defined in |
| … | … | … |
| Delta SNR for space-time stream for subcarrier *k = scidx(Ns’-1)* | 4 | * as defined in |

In MU Exclusive Beamforming Report , *Ns'* is the number of subcarriers for which the Delta SNR subfield is sent back to the beamformer. Number of subcarriers and subcarrier mapping  shows *Ns'*, the exact subcarrier indices and their order for which the Delta SNR is sent back.

|  |  |  |  |
| --- | --- | --- | --- |
| * Number of subcarriers and subcarrier mapping | | | |
| Channel Width | *Ng* | *Ns'* | Subcarriers for which the Delta SNR subfield is sent: *scidx*(0), *scidx*(1), … *scidx*(*Ns'*-1) |
| 20 MHz | 1 | 30 | -28, -26, -24, -22, -20, -18, -16, -14, -12, -10, -8, -6, -4, -2, -1, 1, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28 |
| 2 | 16 | -28, -24, -20, -16, -12, -8, -4, -1, 1, 4, 8, 12, 16, 20, 24, 28 |
| 4 | 10 | -28, -20, -12, -4, -1, 1, 4, 12, 20, 28 |
| 40 MHz | 1 | 58 | -58, -56, -54, -52, -50, -48, -46, -44, -42, -40, -38, -36, -34, -32, -30, -28, -26, -24, -22, -20, -18, -16, -14, -12, -10, -8, -6, -4,-2, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58 |
| 2 | 30 | -58, -54, -50, -46, -42, -38, -34, -30, -26, -22, -18, -14, -10, -6,-2, 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58 |
| 4 | 16 | -58, -50, -42, -34, -26, -18, -10, -2, 2, 10, 18, 26, 34, 42, 50, 58 |
| 80 MHz | 1 | 122 | -122, -120, -118, -116, -114, -112, -110, -108, -106, -104, -102, -100, -98, -96, -94, -92, -90, -88, -86, -84, -82, -80, -78, -76, -74, -72, -70, -68, -66, -64, -62, -60, -58, -56, -54, -52, -50, -48, -46, -44, -42, -40, -38, -36, -34, -32, -30, -28, -26, -24, -22, -20, -18, -16, -14, -12, -10, -8, -6, -4, -2, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122 |
| 2 | 62 | -122, -118, -114, -110, -106, -102, -98, -94, -90, -86, -82, -78, -74, -70, -66, -62, -58, -54, -50, -46, -42, -38, -34, -30, -26, -22, -18, -14, -10, -6, -2, 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58, 62, 66, 70, 74, 78, 82, 86, 90, 94, 98, 102, 106, 110, 114, 118, 122 |
| 4 | 32 | -122, -114, -106, -98, -90, -82, -74, -66, -58, -50, -42, -34, -26, -18, -10, -2, 2, 10, 18, 26, 34, 42, 50, 58, 66, 74, 82, 90, 98, 106, 114, 122 |
| 160 MHz | 1 | 244 | -250, -248, -246, -244, -242, -240, -238, -236, -234, -232, -230, -228, -226, -224, -222, -220, -218, -216, -214, -212, -210, -208, -206, -204, -202, -200, -198, -196, -194, -192, -190, -188, -186, -184, -182, -180, -178, -176, -174, -172, -170, -168, -166, -164, -162, -160, -158, -156, -154, -152, -150, -148, -146, -144, -142, -140, -138, -136, -134, -132, -130, -126, -124, -122, -120, -118, -116, -114, -112, -110, -108, -106, -104, -102, -100, -98, -96, -94, -92, -90, -88, -86, -84, -82, -80, -78, -76, -74, -72, -70, -68, -66, -64, -62, -60, -58, -56, -54, -52, -50, -48, -46, -44, -42, -40, -38, -36, -34, -32, -30, -28, -26, -24, -22, -20, -18, -16, -14, -12, -10, -8, -6, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160, 162, 164, 166, 168, 170, 172, 174, 176, 178, 180, 182, 184, 186, 188, 190, 192, 194, 196, 198, 200, 202, 204, 206, 208, 210, 212, 214, 216, 218, 220, 222, 224, 226, 228, 230, 232, 234, 236, 238, 240, 242, 244, 246, 248, 250  NOTE—Subcarriers 0, ±2, ±4 and ±128 are skipped. |
| 2 | 124 | -250, -246, -242, -238, -234, -230, -226, -222, -218, -214, -210, -206, -202, -198, -194, -190, -186, -182, -178, -174, -170, -166, -162, -158, -154, -150, -146, -142, -138, -134, -130, -126, -122, -118, -114, -110, -106, -102, -98, -94, -90, -86, -82, -78, -74, -70, -66, -62, -58, -54, -50, -46, -42, -38, -34, -30, -26, -22, -18, -14, -10, -6, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58, 62, 66, 70, 74, 78, 82, 86, 90, 94, 98, 102, 106, 110, 114, 118, 122, 126, 130, 134, 138, 142, 146, 150, 154, 158, 162, 166, 170, 174, 178, 182, 186, 190, 194, 198, 202, 206, 210, 214, 218, 222, 226, 230, 234, 238, 242, 246, 250  NOTE—Subcarriers ±2 are skipped. |
| 4 | 64 | -250, -242, -234, -226, -218, -210, -202, -194, -186, -178, -170, -162, -154, -146, -138, -130, -126, -118, -110, -102, -94, -86, -78, -70, -62, -54, -46, -38, -30, -22, -14, -6, 6, 14, 22, 30, 38, 46, 54, 62, 70, 78, 86, 94, 102, 110, 118, 126, 130, 138, 146, 154, 162, 170, 178, 186, 194, 202, 210, 218, 226, 234, 242, 250 |
| 80+80 MHz | 1 | 244 | -122(L), -120(L), -118(L), -116(L), -114(L), -112(L), -110(L), -108(L), -106(L), -104(L), -102(L), -100(L), -98(L), -96(L), -94(L), -92(L), -90(L), -88(L), -86(L), -84(L), -82(L), -80(L), -78(L), -76(L), -74(L), -72(L), -70(L), -68(L), -66(L), -64(L), -62(L), -60(L), -58(L), -56(L), -54(L), -52(L), -50(L), -48(L), -46(L), -44(L), -42(L), -40(L), -38(L), -36(L), -34(L), -32(L), -30(L), -28(L), -26(L), -24(L), -22(L), -20(L), -18(L), -16(L), -14(L), -12(L), -10(L), -8(L), -6(L), -4(L), -2(L), 2(L), 4(L), 6(L), 8(L), 10(L), 12(L), 14(L), 16(L), 18(L), 20(L), 22(L), 24(L), 26(L), 28(L), 30(L), 32(L), 34(L), 36(L), 38(L), 40(L), 42(L), 44(L), 46(L), 48(L), 50(L), 52(L), 54(L), 56(L), 58(L), 60(L), 62(L), 64(L), 66(L), 68(L), 70(L), 72(L), 74(L), 76(L), 78(L), 80(L), 82(L), 84(L), 86(L), 88(L), 90(L), 92(L), 94(L), 96(L), 98(L), 100(L), 102(L), 104(L), 106(L), 108(L), 110(L), 112(L), 114(L), 116(L), 118(L), 120(L), 122(L), -122(H), -120(H), -118(H), -116(H), -114(H), -112(H), -110(H), -108(H), -106(H), -104(H), -102(H), -100(H), -98(H), -96(H), -94(H), -92(H), -90(H), -88(H), -86(H), -84(H), -82(H), -80(H), -78(H), -76(H), -74(H), -72(H), -70(H), -68(H), -66(H), -64(H), -62(H), -60(H), -58(H), -56(H), -54(H), -52(H), -50(H), -48(H), -46(H), -44(H), -42(H), -40(H), -38(H), -36(H), -34(H), -32(H), -30(H), -28(H), -26(H), -24(H), -22(H), -20(H), -18(H), -16(H), -14(H), -12(H), -10(H), -8(H), -6(H), -4(H), -2(H), 2(H), 4(H), 6(H), 8(H), 10(H), 12(H), 14(H), 16(H), 18(H), 20(H), 22(H), 24(H), 26(H), 28(H), 30(H), 32(H), 34(H), 36(H), 38(H), 40(H), 42(H), 44(H), 46(H), 48(H), 50(H), 52(H), 54(H), 56(H), 58(H), 60(H), 62(H), 64(H), 66(H), 68(H), 70(H), 72(H), 74(H), 76(H), 78(H), 80(H), 82(H), 84(H), 86(H), 88(H), 90(H), 92(H), 94(H), 96(H), 98(H), 100(H), 102(H), 104(H), 106(H), 108(H), 110(H), 112(H), 114(H), 116(H), 118(H), 120(H), 122(H) |
| 2 | 124 | -122(L), -118(L), -114(L), -110(L), -106(L), -102(L), -98(L), -94(L), -90(L), -86(L), -82(L), -78(L), -74(L), -70(L), -66(L), -62(L), -58(L), -54(L), -50(L), -46(L), -42(L), -38(L), -34(L), -30(L), -26(L), -22(L), -18(L), -14(L), -10(L), -6(L), -2(L), 2(L), 6(L), 10(L), 14(L), 18(L), 22(L), 26(L), 30(L), 34(L), 38(L), 42(L), 46(L), 50(L), 54(L), 58(L), 62(L), 66(L), 70(L), 74(L), 78(L), 82(L), 86(L), 90(L), 94(L), 98(L), 102(L), 106(L), 110(L), 114(L), 118(L), 122(L), -122(H), -118(H), -114(H), -110(H), -106(H), -102(H), -98(H), -94(H), -90(H), -86(H), -82(H), -78(H), -74(H), -70(H), -66(H), -62(H), -58(H), -54(H), -50(H), -46(H), -42(H), -38(H), -34(H), -30(H), -26(H), -22(H), -18(H), -14(H), -10(H), -6(H), -2(H), 2(H), 6(H), 10(H), 14(H), 18(H), 22(H), 26(H), 30(H), 34(H), 38(H), 42(H), 46(H), 50(H), 54(H), 58(H), 62(H), 66(H), 70(H), 74(H), 78(H), 82(H), 86(H), 90(H), 94(H), 98(H), 102(H), 106(H), 110(H), 114(H), 118(H), 122(H) |
| 4 | 64 | -122(L), -114(L), -106(L), -98(L), -90(L), -82(L), -74(L), -66(L), -58(L), -50(L), -42(L), -34(L), -26(L), -18(L), -10(L), -2(L), 2(L), 10(L), 18(L), 26(L), 34(L), 42(L), 50(L), 58(L), 66(L), 74(L), 82(L), 90(L), 98(L), 106(L), 114(L), 122(L), -122(H), -114(H), -106(H), -98(H), -90(H), -82(H), -74(H), -66(H), -58(H), -50(H), -42(H), -34(H), -26(H), -18(H), -10(H), -2(H), 2(H), 10(H), 18(H), 26(H), 34(H), 42(H), 50(H), 58(H), 66(H), 74(H), 82(H), 90(H), 98(H), 106(H), 114(H), 122(H) |

* (#5096)Operating Mode field

The (#5096)Operating Mode field is used in the (#5096)Operating Mode Notification frame (see (#5096)) to indicate the number of spatial streams and optionally the operating channel width(#4306) on which the sending STA is able to receive. When Rx Nss Type subfield(#4911) is 1, only the Rx Nss(#4696) subfield has a non-reserved value(#5062). The length of the field is 1 octet.

The (#5096)Operating Mode field is shown in (#5096).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B0 B1 | B2 B3 | B4 B6 | B7 |
|  | Channel Width | Reserved | Rx Nss | Rx Nss Type |
| Bits: | 2 | 2 | 3 | 1 |
| * (#5096)Operating Mode field(#4911) | | | | |

The STA transmitting this field indicates its current operating channel width and the number of spatial streams it can receive using the settings defined in Subfield values of the .

|  |  |
| --- | --- |
| * Subfield values of the (#5096)Operating Mode field | |
| Subfield | Description |
| Channel Width | If the Rx Nss Type subfield(#4911) is 0, indicates the supported channel width:  Set to 0 for 20 MHz  Set to 1 for 40 MHz  Set to 2 for 80 MHz  Set to 3 for 160 MHz or 80+80 MHz  Reserved if the Rx Nss subfield(#4911) is 1. |
| Rx Nss | If the Rx Nss Type subfield(#4911) is 0, indicates the maximum number of spatial streams that(#4308) the STA can receive.  If the Rx Nss Type subfield(#4911) is 1, indicates the maximum number of spatial streams that(#4308) the STA can receive as a beamformee in an SU PPDU using a beamforming steering matrix derived from a VHT Compressed Beamforming report with Feedback Type subfield indicating MU in the VHT Compressed Beamforming frame(s).  Set to 0 for *NSS* = 1  Set to 1 for *NSS* = 2  …  Set to 7 for *NSS* = 8 |
| Rx Nss Type | Set to 0 to indicate that the Rx Nss subfield carries the maximum number of spatial streams that(#4308) the STA can receive.  Set to 1 to indicate that the Rx Nss subfield carries the maximum number of spatial streams that(#4308) the STA can receive as an SU PPDU using a beamforming steering matrix derived(#4911) from a VHT Compressed Beamforming report with the Feedback Type subfield indicating MU in the VHT Compressed Beamforming frame(s). |

(#4030)

* Membership Status Array field

The Membership Status Array field is used in the Group ID Management frame (see Group ID Management frame format). The length of the field is 8 octets. An 8 octet Membership Status Array field (indexed by the group ID(#4829)) consists of a 1-bit(#4756) Membership Status subfield for each of the 64 group IDs(#4829), as shown in Membership Status Array field.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B0 | B1 |  | B63 |
|  | Membership Status In Group ID 0 | Membership Status In Group ID 1 | … | Membership Status In Group ID 63 |
| Bits: | 1 | 1 |  | 1 |
| * Membership Status Array field | | | | |

Within the 8 octet Membership Status Array field, the 1-bit(#4756) Membership Status subfield for each group ID(#4829) is set as follows:

* Set to 0 if the STA is not a member of the group
* Set to 1 if STA is a member of the group

The Membership Status subfields for group ID(#4829) 0 (transmissions to AP) and group ID(#4829) 63 (downlink SU transmissions) are reserved.

* User Position Array field

The User Position Array field is used in the Group ID Management frame (see Group ID Management frame format). The length of the field is 16 octets. A 16 octet User Position Array field (indexed by the Group ID) consists of a 2-bit(#4757) User Position subfield for each of the 64 group IDs(#4829), as shown in User Position Array field.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B0 B1 | B2 B3 |  | B126 B127 |
|  | User Position In Group ID 0 | User Position In Group ID 1 | … | User Position In Group ID 63 |
| Bits: | 2 | 2 |  | 2 |
| * User Position Array field | | | | |

If the Membership Status subfield for a particular group ID(#4829) is 1, then the corresponding User Position subfield is encoded as shown in Encoding of User Position subfield.

|  |  |
| --- | --- |
| * Encoding of User Position subfield | |
| User Position subfield value | User position |
| 00 | 0 |
| 01 | 1 |
| 10 | 2 |
| 11 | 3 |

If the Membership Status subfield for a group ID(#4829) is 0 (meaning the STA is not a member of that group), then the corresponding User Position subfield in the User Position Array field is reserved.

The User Position subfields for group ID(#4829) 0 (transmissions to AP) and group ID(#4829) 63 (downlink SU transmissions) are reserved.

* Information elements
* General

Insert the new elements shown below into Element IDs:

|  |  |  |  |
| --- | --- | --- | --- |
| * Element IDs | | | |
| Element | Element ID | Length of indicated element (in octets) | Extensible |
| VHT Capabilities (see VHT Capabilities element) | 191 | 14 | Yes(#4311) |
| VHT Operation (see VHT Operation element) | 192 | 7 | Yes(#4311) |
| Extended BSS Load (see Extended BSS Load element) | 193 | 8(#4324) | Yes |
| Wide Bandwidth Channel Switch (see Wide Bandwidth Channel Switch element) | 194 | 5 | Yes |
| VHT Transmit Power Envelope (see VHT Transmit Power Envelope element) | 195 | 5 or 7 | Yes |
| Extended Power Constraint (see Extended Power Constraint element) | 196 | 4 or 6 | Yes |
| AID (see AID element) | 197 | 4 |  |
| Quiet Channel | 198 | 3 or 9 | Yes |
| Operating Mode Notification(#5096) | <ANA> | 3 | Yes |

* Support Rates element

Change BSS membership selector value encoding as follows (inserting a new row for the VHT PHY):

|  |  |  |
| --- | --- | --- |
| * BSS membership selector value encoding | | |
| Value | Feature | Interpretation |
| 127 | HT PHY | Support for the mandatory features of Clause 20 is required in order to join the BSS that was the source of the Supported Rates element or Extended Supported Rates element containing this value. |
| 126 | VHT PHY | Support for the mandatory features of Clause 22(#5011) is required in order to join the BSS that was the source of the Supported Rates element or Extended Supported Rates element containing this value. |

* RSN element
* Cipher suites

Insert the following paragraph after the 3rd paragraph:

Use of GCMP as a group cipher suite with a pairwise cipher suite other than GCMP is not supported.

* Extended Capabilities element

Insert a new row for bit 61 as shown below in Capabilities field and change the range of the reserved bits to exclude this bit:

|  |  |  |
| --- | --- | --- |
| * Capabilities field | | |
| Bit | Information | Description |
| 61 | TDLS Wider Bandwidth | The TDLS Wider Bandwidth subfield indicates whether the STA supports a wider bandwidth than the BSS bandwidth for a TDLS direct link on the base channel. The field is set to 1 to indicate that the STA supports a wider bandwidth on the base channel and to 0 to indicate that the STA does not support a wider bandwidth on the base channel. |
| 62 | Operating Mode Notification | If dot11OperatingModeNotificationImplemented is true, the Operating Mode Notification field is set to 1 to indicate support for reception of the Operating Mode Notification element and the Operating Mode Notification frame.  If dot11OperatingModeNotificationImplemented is false or not present, the Operating Mode Notification field is set to 0 to indicate lack of support for reception of the Operating Mode Notification element and the Operating Mode Notification frame.(#5096) |

(#4799)

Change Default EDCA Parameter Set element parameter values if dot11OCBActivated is as shown (PHYs listed in TXOP limit heading row):

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| * Default EDCA Parameter Set element parameter values if dot11OCBActivated is false | | | | | | |
| AC | CWmin | CWmax | AIFSN | TXOP limit | | |
| For PHYs defined in Clause 15 (DSSS PHY specification for the 2.4 GHz band designated for ISM -applications) and Clause 16 (High Rate direct sequence spread spectrum (HR/DSSS) PHY -specification) | For PHYs defined in Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification), Clause 18 (Extended Rate PHY (ERP) specification), ~~and~~ Clause 19 (High Throughput (HT) PHY specification) and Clause 22 (Very High Throughput (VHT) PHY specification) | Other PHYs |
| AC\_BK | aCWmin | aCWmax | 7 | 0 | 0 | 0 |
| AC\_BE | aCWmin | aCWmax | 3 | 0 | 0 | 0 |
| AC\_VI | (aCWmin+1)/2 – 1 | aCWmin | 2 | 6.016 ms | 3.008 ms | 0 |
| AC\_VO | (aCWmin+1)/4 – 1 | (aCWmin+1)/2 – 1 | 2 | 3.264 ms | 1.504 ms | 0 |

* Neighbor Report element

Replace Figure 8-216 with the following (adding the Very High Throughput field):

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 B1 | B2 | B3 | B4 B9 | B10 | B11 | B12 | B13 B31 |
|  | AP Reachability | Security | Key Scope | Capabilities | Mobility Domain | High Throughput | Very High Throughput | Reserved |
| Bits: | 2 | 1 | 1 | 6 | 1 | 1 | 1 | 19 |
| * BSSID Information field | | | | | | | | |

Insert the following paragraph after the paragraph that(#4490) starts “The High Throughput bit...”:

The Very High Throughput bit is set to 1 to indicate that the AP represented by this BSSID is a VHT AP and that the VHT Capabilities element, if included as a subelement in the report, is identical in content to the VHT Capabilities element included in the AP’s Beacon.

Change the subsequent paragraph as follows:

Bits ~~12~~13-31 are reserved.

Change Optional Subelement IDs for Neighbor Report as follows (adding Subelement 46 following 45 and Subelement 63 following 62):

|  |  |  |  |
| --- | --- | --- | --- |
| * Optional Subelement IDs for Neighbor Report | | | |
| Subelement ID | Name | Length field (octets) | Extensible |
| 46 | VHT Capabilities subelement | 12 | Yes |
| ~~46~~47-60 | Reserved |  |  |
| 63 | VHT Operation subelement | 5 | Yes |
| ~~63~~64-65 | Reserved |  |  |

Insert the following after the paragraph beginning “The Secondary Channel Offset subelement...”:

The VHT Capabilities subelement is the same as the VHT Capabilities element as defined in VHT Capabilities element.

The VHT Operation subelement is the same as the VHT Operation element as defined in VHT Operation element.

* RCPI element

Change the last paragraph of 8.4.2.40 as follows:

The RCPI field contains an RCPI value as specified for certain PHYs in Clause 15 (DSSS PHY specification(#5012) for the 2.4 GHz band designated for ISM applications), Clause 18 (Orthogonal frequency division multiplexing (OFDM) PHY specification), Clause 17 (High Rate direct sequence spread spectrum (HR/DSSS) PHY specification), Clause 19 (Extended Rate PHY (ERP) specification), ~~and~~ Clause 20 (High Throughput (HT) PHY specification) and Clause 22 (Very High Throughput (VHT) PHY specification).

* Multiple BSSID element

Change the last bullet in the paragraph following Table 8-116 as follows:

The Non-Transmitted BSSID Profile subelement contains a list of elements for one or more APs or DBand STAs(11ad) that have non-transmitted BSSIDs, and is defined as follows:

* The Timestamp and Beacon Interval fields, DS Parameter Set, FH Parameter Set, IBSS Parameter Set, Country, FH Parameters, FH Pattern Table, Channel Switch Assignment, Extended Channel Switch Announcement, Wide Bandwidth Channel Switch, VHT Transmit Power Envelope, Supported Operating Classes, IBSS DFS, ERP Information, HT Capabilities, ~~and~~ HT Operation, VHT Capabilities and VHT Operation elements are not included in the Non-Transmitted BSSID Profile field; the values of these elements for each non-transmitted BSSID are always the same as the corresponding transmitted BSSID element values.
* HT Capabilities element
* Supported MCS Set field

Change the 5th paragraph as follows:

The Rx Highest Supported Data Rate subfield of the Supported MCS Set field defines the highest HT PPDU data rate that the STA is able to receive, in units of 1 Mb/s, where 1 represents 1 Mb/s, and incrementing by 1 Mb/s steps to the value 1023, which represents 1023 Mb/s. If the maximum data rate expressed in Mb/s is not an integer, then the value is rounded ~~up~~ down to the next integer. The value 0 indicates that this subfield does not specify the highest HT PPDU data rate that the STA is able to receive; see 9.7.6.5.3.

* HT Extended Capabilities field

Change the name of the “+HTC Support” field to “+HTC-HT Support” in Figure 8-252.(#4156)

Change the row for “+HTC Support” in Subfields of the HT Extended Capabilities field as follows:

|  |  |  |
| --- | --- | --- |
| * Subfields of the HT Extended Capabilities field | | |
| Subfield | Definition | Encoding |
| +HTC-HT Support | Indicates support of the HT variant HT Control field. See 9.9 (HT Control field operation) | Set to 0 if not supported  Set to 1 if supported |

Insert new subclauses VHT Capabilities element through Operating Mode Notification element following the last subclause in 8.4.2:

* VHT Capabilities element
* VHT Capabilities element structure

A VHT STA declares that it is a VHT STA by transmitting the VHT Capabilities element.

The VHT Capabilities element contains a number of fields that are used to advertise VHT capabilities of a VHT STA. The VHT Capabilities element is defined in VHT Capabilities element format.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Element ID | Length | VHT Capabilities  Info | VHT Supported MCS Set |
| Octets: | 1 | 1 | 4 | 8 |
| * VHT Capabilities element format | | | | |

* VHT Capabilities Info field

The structure of the VHT Capabilities Info field is defined in VHT Capabilities Info field.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 B1 | B2 B3 | B4 | B5 | B6 | B7 | B8 B10 | B11 | B12 | B13 B15 |
|  | Maximum MPDU Length | Supported Channel Width Set | Rx LDPC | Short GI for 80 MHz | Short GI for 160 and 80+80 MHz | Tx STBC | Rx STBC | SU Beamformer Capable | SU Beamformee Capable | Compressed Steering  Number  of Beamformer  Antennas  Supported |
| Bits: | 2 | 2 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 3 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| B16 B18 | B19 | B20 | B21 | B22 | B23 B25 | B26 B27 | B28 | B29 | B30 B31 |
| Number Of Sounding Dimensions | MU Beamformer Capable | MU Beamformee Capable | VHT TXOP PS | +HTC-VHT Capable | Maximum A-MPDU Length Exponent | VHT Link Adaptation Capable | Rx Antenna Pattern  Consistency | Tx Antenna Pattern  Consistency | Reserved |
| 3 | 1 | 1 | 1 | 1 | 3 | 2 | 1 | 1 | 2 |
| * VHT Capabilities Info field | | | | | | | | | |

The subfields of the VHT Capabilities Info field are defined in Subfields of the VHT Capabilities Info field .

|  |  |  |
| --- | --- | --- |
| * Subfields of the VHT Capabilities Info field | | |
| Subfield | Definition | Encoding |
| Maximum MPDU Length | Indicates the maximum MPDU length (see 9.11 (A-MSDU operation)). | Set to 0 for 3895 octets (Maximum A-MSDU Length in HT Capabilities set to 3839  )  Set to 1 for 7991 octets (Maximum A-MSDU Length in HT Capabilities set to 7935)  Set to 2 for 11 454 octets (Maximum A-MSDU Length in HT Capabilities set to 7935)  The value 3 is reserved |
| Supported Channel Width Set | Indicates the channel widths supported by the STA. See 10.38 (VHT BSS operation) | Set to 0 if the STA does not support either 160 or 80+80 MHz  Set to 1 if the STA supports 160 MHz  Set to 2 if the STA supports 160 MHz and 80+80 MHz  The value 3 is reserved |
| Rx LDPC | Indicates support for receiving LDPC encoded(#4313) packets | Set to 0 if not supported  Set to 1 if supported |
| Short GI for 80 MHz | Indicates short GI support for the reception of packets transmitted with TXVECTOR parameters FORMAT equal to VHT and CH\_BANDWIDTH equal to CBW80 | Set to 0 if not supported  Set to 1 if supported |
| Short GI for 160 and 80+80 MHz | Indicates short GI support for the reception of packets transmitted with TXVECTOR parameters FORMAT equal to VHT and CH\_BANDWIDTH equal to CBW160 and CBW80+80 | Set to 0 if not supported  Set to 1 if supported |
| Tx STBC | Indicates support for the transmission of at least 2x1 STBC | Set to 0 if not supported  Set to 1 if supported |
| Rx STBC | Indicates support for the reception of PPDUs using STBC | Set to 0 for no support  Set to 1 for support of one spatial stream  Set to 2 for support of one and two spatial streams  Set to 3 for support of one, two and three spatial streams  Set to 4 for support of one, two, three and four spatial streams  The values 5, 6, 7 are reserved. |
| SU Beamformer Capable | Indicates support for operation as a single user beamformer (see 9.31.5 (VHT sounding protocol)) | Set to 0 if not supported  Set to 1 if supported |
| SU Beamformee Capable | Indicates support for operation as a single user beamformee (see 9.31.5 (VHT sounding protocol)) | Set to 0 if not supported  Set to 1 if supported |
| Compressed Steering Number of Beamformer Antennas Supported | Beamformee’s capability indicating(#5065) the maximum number of beamformer antennas the beamformee can support when sending compressed beamforming feedback | If SU beamformee capable, set to maximum value minus 1.  Otherwise reserved. |
| Number of Sounding Dimensions | Beamformer’s capability indicating the maximum value of the NUM\_STS parameter in the TXVECTOR of a VHT NDP | If SU beamformer capable, set to maximum(#4657) value minus 1.  Otherwise reserved. |
| MU Beamformer Capable | Indicates support for operation as an MU beamformer (see 9.31.5 (VHT sounding protocol)) | Set to 0 if not supported  or if sent by a non-AP STA  Set to 1 if supported |
| MU Beamformee Capable | Indicates support for operation as an MU beamformee (see 9.31.5 (VHT sounding protocol)) | Set to 0 if not supported  or if sent by an AP  Set to 1 if supported |
| VHT TXOP PS | Indicates whether or not the AP supports VHT TXOP Power Save Mode or whether or not the STA is in VHT TXOP Power Save mode. | When transmitted by a VHT AP in the VHT Capabilities element included in Beacon, Probe Response, Association Response and Reassociation Response frames:  Set to 0 if the VHT AP does not support VHT TXOP Power Save in the BSS.  Set to 1 if the VHT AP supports TXOP Power Save in the BSS  .  When transmitted by a VHT non-AP STA in the VHT Capabilities element included in Association Request, Reassociation Request and Probe Request frames:  Set to 0 when the VHT STA is not in TXOP Power Save Mode.  Set to 1 when the VHT STA is in TXOP Power Save Mode. |
| +HTC-VHT Capable | Indicates whether or not the STA supports receiving a VHT variant HT Control field | Set to 0 if not supported  Set to 1 if supported |
| Maximum A-MPDU Length Exponent | Indicates the maximum length of A-MPDU pre-EOF padding that the STA can receive. | This field is an integer in the range of 0 to 7.  The length defined by this field is equal to octets. |
| VHT Link Adaptation Capable | Indicates whether or not the STA supports link adaptation using VHT variant HT Control field.(#4036) | If +HTC-VHT Capable is 1(#4036):  Set to 0 (No Feedback) if the STA does not provide VHT MFB.  Set to 2 (Unsolicited) if the STA provides only unsolicited VHT MFB.  Set to 3 (Both) if the STA can provide VHT MFB in response to VHT MRQ and if the STA provides unsolicited VHT MFB.  The value 1 is reserved.  Reserved if +HTC-VHT Capable is 0.(#4036) |
| Rx Antenna Pattern Consistency | Indicates the possibility of Rx antenna pattern change | Set to 0 if Rx antenna pattern might change during the lifetime of an association.  Set to 1 if Rx antenna pattern does not change during the lifetime of an association.(#5268) |
| Tx Antenna Pattern Consistency | Indicates the possibility of Tx antenna pattern change | Set to 0 if Tx antenna pattern might change during the lifetime of an association.  Set to 1 if Tx antenna pattern does not change during the lifetime of an association.(#5269) |

NOTE 1—An AP that sets MU Beamformer Capable to 1 can transmit an VHT MU PPDU(#5399) with only one non-zero MU[*p*] NSTS subfield, for . However, a STA that sets MU Beamformee Capable to 0 is not required to be able to demodulate an VHT MU PPDU(#5399) with only one non-zero MU[*p*] NSTS subfield, for .



NOTE 2—The Compressed Steering Number of Beamformer Antennas Supported field also indicates the maximum number of space time streams in the NDP that the STA can support as a beamformee.

Support for short GI for the reception of packets with TXVECTOR parameter CH\_BANDWIDTH equal to CBW20 and CBW40 is indicated in HT Capability Info field.

* VHT Supported MCS Set field

The VHT Supported MCS Set field is used to convey the combinations of MCSs and spatial streams that(#4318) a STA supports for both reception and transmission. The structure of the field is shown in VHT Supported MCS Set field.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B0 B15 | B16 B28 | B29 B31 | B32 B47 | B48 B60 | B61 B63 |
|  | Rx MCS Map | Rx Highest Supported Data Rate | Reserved | Tx MCS Map | Tx Highest Supported Data Rate | Reserved |
| Bits: | 16 | 13 | 3 | 16 | 13 | 3 |
| * VHT Supported MCS Set field | | | | | | |

The Rx MCS Map subfield and the Tx MCS Map subfield have the structure shown in Rx MCS Map and Tx MCS Map.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 B1 | B2 B3 | B4 B5 | B6 B7 | B8 B9 | B10 B11 | B12 B13 | B14 B15 |
|  | Max MCS For 1 SS | Max MCS For 2 SS | Max MCS For 3 SS | Max MCS For 4 SS | Max MCS For 5 SS | Max MCS For 6 SS | Max MCS For 7 SS | Max MCS For 8 SS |
| Bits: | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| * Rx MCS Map and Tx MCS Map | | | | | | | | |

The VHT Supported MCS Set subfields are defined in VHT Supported MCS Set subfields.

|  |  |  |
| --- | --- | --- |
| * VHT Supported MCS Set subfields | | |
| Subfield | Definition | Encoding |
| Rx MCS Map | Indicates the maximum MCS that can be received for each number of spatial streams. | The 2-bit Max MCS For *n* SS field for each number of spatial streams *n* = 1, ..., 8 is encoded as follows (see NOTE):  0 indicates support for MCS 0-7  1 indicates support for MCS 0-8  2 indicates support for MCS 0-9  3 indicates that *n* spatial streams is not supported |
| Rx Highest Supported Data Rate | Indicates the highest long GI VHT PPDU data rate that the STA is able to receive. | In units of 1 Mb/s. The value 0 indicates that this subfield does not specify the highest long GI VHT PPDU data rate that the STA is able to receive. |
| Tx MCS Map | Indicates the maximum MCS that can be transmitted for each number of spatial streams. | The 2-bit Max MCS For *n* SS field for each number of spatial streams *n* = 1, ..., 8 is encoded as follows (see NOTE)  :  0 indicates support for MCS 0-7  1 indicates support for MCS 0-8  2 indicates support for MCS 0-9  3 indicates that *n* spatial streams is not supported |
| Tx Highest Supported Data Rate | Indicates the highest long GI VHT PPDU data rate that the STA is able to transmit at. | In units of 1 Mb/s.  The value 0 indicates that this subfield does not specify the highest long GI VHT PPDU data rate that the STA is able to transmit at. |
| NOTE—Some MCSs are not valid for particular combinations of bandwidth and number of spatial stream (see 22.5 (Parameters for VHT MCSs)).(#4320) | | |

* VHT Operation element

The operation of VHT STAs in the BSS is controlled by the HT Operation element and the VHT Operation element. The format of the VHT Operation element is defined in VHT Operation element format.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Element ID | Length | VHT Operation Information | VHT Basic MCS Set |
| Octets: | 1 | 1 | 3 | 2 |
| * VHT Operation element format | | | | |

The Element ID field is set to the value for VHT Operation element defined in Element IDs.

The structure of the VHT Operation Information field is defined in VHT Operation Information field.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Channel Width | Channel Center Frequency  Segment 1 | Channel Center Frequency  Segment 2 |
| Octets: | 1 | 1 | 1 |
| * VHT Operation Information field | | | |

The VHT STA gets the primary channel information from the HT Operation element. The subfields of the VHT Operation Information field are defined in VHT Operation Information subfields.

|  |  |  |
| --- | --- | --- |
| * VHT Operation Information subfields | | |
| Field | Definition | Encoding |
| Channel Width | This field, together with the HT Operation element STA Channel Width field, defines the BSS operating channel width (see 10.38.1 (Basic VHT BSS functionality)). | Set to 0 for 20 MHz or 40 MHz operating channel width.  Set to 1 for 80 MHz operating channel width.  Set to 2 for 160 MHz operating channel width.  Set to 3 for 80+80 MHz operating channel width  .  Values in the range 4 to 255 are reserved. |
| Channel Center Frequency Segment 1 | Defines the channel center frequency for an 80 and 160 MHz VHT BSS and the segment 1 channel center frequency for an 80+80 MHz VHT BSS. See 22.3.14 (Channelization). | For 80 MHz or 160 MHz operating channel width, indicates the channel center frequency index for the 80 MHz or 160 MHz channel on which the VHT BSS operates.  For 80+80 MHz operating channel width, indicates the channel center frequency index for the 80 MHz channel of frequency segment 1 on which the VHT BSS operates.  Set to 0 for 20 MHz or 40 MHz operating channel width. |
| Channel Center Frequency Segment 2 | Defines the segment 2 channel center frequency for an 80+80 MHz VHT BSS. See 22.3.14 (Channelization). | For an 80+80 MHz operating channel width, indicates the channel center frequency index of the 80 MHz channel of frequency segment 2 on which the VHT BSS operates. Reserved otherwise. |

The VHT Basic MCS Set field indicates the MCSs(#4323) for each number of spatial streams in VHT PPDUs that are supported by all VHT STAs in the BSS (including IBSS and MBSS). The VHT Basic MCS Set field is a bitmap of size 16 bits; each 2 bits indicates the supported MCS set for Nss from 1 to 8. The VHT Basic MCS Set field is defined as Rx MCS Map subfield in VHT Supported MCS Set field.

* Extended BSS Load element

The Extended BSS Load element reported by the AP contains information on bandwidth utilization and MIMO spatial stream underutilization by MU capable STAs. The element format is defined in Extended BSS Load element format. A STA receiving the element might use the information it conveys in an implementation specific AP selection algorithm.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | MU-MIMO Capable STA Count | Spatial Stream Underutilization | VHT 40 MHz Utilization | 80 MHz Utilization | 160 MHz Utilization |
| Octets: | 1 | 1 | 2(#4324) | 1 | 1 | 1 | 1 |
| * Extended BSS Load element format | | | | | | | |

The Element ID field is set to the value for the Extended BSS Load element in Element IDs.(#4324)

The Length field is set to 6.(#4324)

The MU-MIMO Capable STA Count field indicates the total number of STAs currently associated with this BSS that have a 1 in the MU Beamformee(#4326) Capable field of their VHT Capabilities element.

The Spatial Stream Underutilization field is defined as the percentage of time, linearly scaled with 255 representing 100%, that the AP has underutilized spatial domain resources for given busy time of the medium. The(#4327) spatial stream underutilization is calculated only for the primary channel. This percentage is computed using the formula,



where

is (Ed)the maximum number of spatial streams indicated by the Number of Sounding Dimensions subfield of the VHT Capabilities Info field of the AP.



is (Ed)the number of microseconds during which the AP is transmitting one or more spatial streams to MU capable STAs.



is (Ed)(#4328), where is the time interval during which the primary 20 MHz channel(#5069) is busy due to the transmission of one or more spatial streams by the AP to MU capable STAs, *NSS,i*(#4328) is the number of spatial streams transmitted during the time interval , and *N* is the number of busy events that occurred during the total measurement time which is less than or equal to dot11ChannelUtilizationBeaconIntervals consecutive beacon intervals(#5321).



If is zero, the Spatial Stream Underutilization field is reserved(#4802).(Ed)



The VHT 40 MHz Utilization field is defined as the percentage of time, linearly scaled with 255 representing 100%, that the 40 MHz operating BSS Channel Width was busy. This percentage is computed using the formula,

(#5319)



The 80 MHz Utilization field is defined as the percentage of time, linearly scaled with 255 representing 100%, that the 80 MHz operating BSS Channel Width was busy. This percentage is computed using the formula,

(#5319)



The 160 MHz Utilization field is defined as the percentage of time, linearly scaled with 255 representing 100%, that the 160 MHz or 80+80 MHz operating BSS Channel Width was busy. This percentage is computed using the formula,

(#5319)



where

(#5319) is (Ed)the number of microseconds during which the CS mechanism, as defined in 9.3.2.2 (CS mechanism), has indicated a channel busy condition(Ed).



, , and are defined to be the number of microseconds during which the AP was transmitting a 40 MHz PPDU to a VHT STA, 80 MHz PPDU, or a 160 MHz PPDU respectively.



If is zero, the VHT 40 MHz Utilization, 80 MHz Utilization and 160 MHz Utilization fields are reserved(#5309).



The measurements for the Spatial Stream Underutilization field, VHT(#5072) 40 MHz Utilization field, 80 MHz Utilization field, and 160 MHz Utilization field values are performed over a period of dot11ChannelUtilizationBeaconIntervals consecutive beacon intervals as described in 8.4.2.30 (BSS Load element).(#5071)

If the AP indicates a channel width of 20 MHz, 40 MHz or 80 MHz in the Channel Width field in the VHT Operation element, then the 160 MHz Utilization field is reserved. If the AP indicates a channel width of 20 MHz(#4804) or 40 MHz in the Channel Width field in the VHT Operation element, then the 80 MHz Utilization field is reserved. If the AP indicates a channel width of 20 MHz in the Channel Width field in the VHT Operation element, then the 40 MHz Utilization field is reserved.

* Wide Bandwidth Channel Switch element

The Wide Bandwidth Channel Switch element is included in Channel Switch Announcement frames, as described in 8.5.2.6 (Channel Switch Announcement frame format), and TDLS Channel Switch Request frames, as described in 8.5.13.7 (TDLS Channel Switch Request frame format)(#5259). The format of the Wide Bandwidth Channel Switch element is shown in Wide Bandwidth Channel Switch element format.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Element ID | Length | New(#4333)  Channel Width | New  Channel Center Frequency  Segment 1 | New  Channel Center Frequency  Segment 2 |
| Octets: 1 | 1 | 1 | 1 | 1 |
| * Wide Bandwidth Channel Switch element format | | | | |

The subfields New (#4333)Channel Width, New Channel Center Frequency Segment 1 and New Channel Center Frequency Segment 2 have the same definition, respectively, as (#4333)Channel Width, Channel Center Frequency Segment 1 and Channel Center Frequency Segment 2 in the VHT Operation Information element, described in VHT Operation Information subfields.

* VHT Transmit Power Envelope element

The VHT Transmit Power Envelope element conveys the maximum transmit power for various transmission bandwidths of VHT STAs. The format of the VHT Transmit Power Envelope element is shown in VHT Transmit Power Envelope element format.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  | The Channel Center Frequency Segment field and Segment Channel Width field pair are repeated as needed | |
|  | Element ID | Length | Maximum Transmit Power | Channel Center Frequency  Segment | Segment  Channel Width |
| Octets: | 1 | 1 | 1 | 1 | 1 |
| * VHT Transmit Power Envelope element format | | | | | |

The Length field, which is 1 octet in length, is variable and depends on the number of Channel Center Frequency Segment field and Segment Channel Width field pairs. A Channel Center Frequency Segment field and Segment Channel Width field pair is present per frequency segment. A Length field value of 5 indicates a single (contiguous) frequency segment. A Length field value of 7 indicates a two (non-contiguous) frequency segments.

The Channel Center Frequency Segment field, which is 1 octet in length, is set to the channel number corresponding to the channel center frequency of each segment (see VHT Operation Information subfields).

The Segment Channel Width field, which is 1 octet in length, is set to the number of channels in the frequency segment.

The Maximum Transmit Power field defines the maximum transmit power limit of the transmission bandwidth defined by the VHT Transmit Power Envelope element. The Maximum Transmit Power field is an 8-bit 2's complement signed integer in the range of -64 dBm to 63.5 dBm with a 0.5 dB step.

* Extended Power Constraint element

The Extended Power Constraint element determines the local maximum transmit power in each channel width. The format of the Extended Power Constraint element is shown in Extended Power Constraint element format.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  | The Channel Width field and Local Power Constraint field pair are repeated as needed | |
|  | Element ID | Length | Channel Width | Local Power Constraint |
| Octets: | 1 | 1 | 1 | 1 |
| * Extended Power Constraint element format | | | | |

The Element ID field is set to the value for the Extended Power Constraint element in Element IDs.(#4338)

The Length field is variable and depends on the number of Channel Width and Local Power Constraint pairs that are included in the element.

The Channel Width field uses the same encoding as the (#4339)Channel Width field of the VHT Operation element (see VHT Operation element). The encoding for 20 MHz and(Ed) 40 MHz operating channel width is not used. The power constraint for these operating channel widths is (Ed)specified in the Power Constraint element.(#4805)

The Local Power Constraint field is encoded as an 8-bit unsigned integer in the range 0 dB to 127.5 dB with a 0.5 dB step. The local maximum transmit power for a channel is defined as the maximum transmit power level specified for the channel in the VHT Transmit Power Envelope element minus the local power constraint specified for the channel in the Extended Power Constraint element.

The Extended Power Constraint element is included in Beacon frames, as described in Beacon frame format, and Probe Response frames, as described in Probe Response frame format.

* AID element

The AID element includes the AID assigned by an AP during association that represents the 16-bit ID of a STA. The format of the AID element is shown in AID element format.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Element ID | Length | AID |
| Octets: | 1 | 1 | 2 |
| * AID element format | | | |

The AID field is defined in 8.4.1.8 (AID field).

* Quiet Channel element

The Quiet Channel element is used to indicate that the secondary 80 MHz channel of a VHT BSS is to be quieted during a quiet interval indicated by either a Quiet element (see 8.4.2.25 (Quiet element)) or the Quiet Channel element if its AP Quiet Mode field is equal to 1. Furthermore, the Quiet Channel element indicates the conditions under which the primary 80 MHz channel of the VHT BSS may be used during the quiet interval. The format of the Quiet Channel element is shown in Quiet Channel element format.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | AP Quiet Mode | Quiet Count (optional) | Quiet Period (optional) | Quiet Duration (optional) | Quiet Offset (optional) |
| Octets: | 1 | 1 | 1 | 0 or 1 | 0 or 1 | 0 or 2 | 0 or 2 |
| * Quiet Channel element format | | | | | | | |

The Element ID field is defined in Element IDs.

The Length field specifies the number of octets in the element following the Length field.

The AP Quiet Mode field specifies STA behavior during the quiet intervals. When communications to the AP are allowed within the primary 80 MHz(#5361) channel of the BSS, then the AP Quiet Mode field is set to 1. Otherwise, the AP Quiet Mode field is set to 0.

If the AP Quiet Mode field is 1, then the Quiet Count field, Quiet Period field, Quiet Duration field and Quiet Offset field are present in the Quiet Channel element; otherwise these fields are not present in the Quiet Channel element.(#4806)

The Quiet Channel element may be included in Beacon frames, as described in Beacon frame format, and Probe Response frames, as described in Probe Response frame format. The use of Quiet Channel elements is described in 10.9.3 (Quieting channels for testing).

* Operating Mode Notification element(#5096)

The Operating Mode Notification element is used to notify STAs that the transmitting STA is changing its operating channel width, the maximum number of spatial streams it can receive, or both. The format of the Operating Mode Notification element is defined in Operating Mode Notification element.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Element ID | Length | Operating Mode |
| Octets: | 1 | 1 | 1 |
| * Operating Mode Notification element | | | |

The Operating Mode field is defined in (#5096.

* Action frame format details
* Spectrum management action frames
* Channel Switch Announcement frame format

Change Figure 8-436 as follows (adding Wide Bandwidth Channel Switch element):

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Category | Spectrum Management Action | Channel Switch Announcement element | Secondary Channel Offset element | Mesh Channel Switch Parameters element | Wide Bandwidth Channel Switch element |
| Octets: | 1 | 1 | 5 | 3 | 6 | 5 |
| * Channel Switch Announcement frame Action field format | | | | | | |

Change the last 2 paragraphs of this subclause and insert a subsequent paragraph as follows:

The Secondary Channel Offset element is defined in 8.4.2.22 (Secondary Channel Offset element). This element is present when switching to a 40 MHz or wider channel (in which case the Secondary Channel Offset field of this element represents the position of the secondary 20 MHz channel relative to the primary 20 MHz channel). It may be present when switching to a 20 MHz channel (in which case the Secondary Channel Offset field is set to SCN).

The Mesh Channel Switch Parameters element is defined in 8.4.2.105. This element is present when a mesh STA performs an MBSS channel switch. Otherwise, t~~T~~he Mesh Channel Switch Parameters element is not present ~~included for channel switch other than MBSS~~.

The Wide Bandwidth Channel Switch element is defined in Wide Bandwidth Channel Switch element. This information element is present when switching to a channel width wider than 40 MHz.

* DLS Action frame details
* DLS Request frame format

Insert rows for Order 10 and 11 in DLS Request frame Action field format as follows:

|  |  |  |
| --- | --- | --- |
| * DLS Request frame Action field format | | |
| Order | Information | Notes |
| 10 | AID | The Association ID (as specified in AID element) of the STA sending the frame is present if the dot11VHTOptionImplemented (#4028)is true. |
| 11 | VHT Capabilities | The VHT Capabilities element is present if the dot11VHTOptionImplemented (#4028)is true. |

* DLS Response frame format

Insert rows for Order 10 and 11 in DLS Response frame Action field format as follows:

|  |  |  |
| --- | --- | --- |
| * DLS Response frame Action field format | | |
| Order | Information | Notes |
| 10 | AID | The Association ID (as specified in AID element) of the STA sending the frame is present if the dot11VHTOptionImplemented (#4028)is true. |
| 11 | VHT Capabilities | The VHT Capabilities element is present if the dot11VHTOptionImplemented (#4028)is true. |

(#4347)

* Public Action details
* TDLS Discovery Response frame format

Insert a row for Order 16 in Information for TDLS Discovery Response frame as follows:

|  |  |  |
| --- | --- | --- |
| * Information for TDLS Discovery Response frame | | |
| Order | Information | Notes |
| 16 | VHT Capabilities | VHT Capabilities element (optional). The VHT Capabilities element is present if the dot11VHTOptionImplemented (#4028)is true. The VHT Capabilities element is defined in VHT Capabilities element. |

* TDLS Action frame details
* TDLS Setup Request frame format

Insert rows for Order 18 and 19 in Information for TDLS Setup Request frame as follows:

|  |  |  |
| --- | --- | --- |
| * Information for TDLS Setup Request frame | | |
| Order | Information | Notes |
| 18 | AID | The Association ID (as specified in AID element) of the STA sending the frame is present if the dot11VHTOptionImplemented (#4028)is true. |
| 19 | VHT Capabilities | The VHT Capabilities element is present if the dot11VHTOptionImplemented (#4028)is true. |

* TDLS Setup Response frame format

Insert rows for Order 19 and 20 in Information for TDLS Setup Response frame as follows:

|  |  |  |
| --- | --- | --- |
| * Information for TDLS Setup Response frame | | |
| Order | Information | Notes |
| 19 | AID | The Association ID (as specified in AID element) of the STA sending the frame is present if the dot11VHTOptionImplemented (#4028)is true. |
| 20 | VHT Capabilities | The VHT Capabilities element is present if the dot11VHTOptionImplemented (#4028)is true. |

* TDLS Setup Confirm frame format

Insert a row for Order 11 in Information for TDLS Setup Confirm frame as follows:

|  |  |  |
| --- | --- | --- |
| * Information for TDLS Setup Confirm frame | | |
| Order | Information | Notes |
| 11 | VHT Operation | VHT Operation element (optional). The VHT Operation element is present if the dot11VHTOptionImplemented (#4028)is true, the TDLS Setup Response frame contained a VHT Capabilities element, the status code is 0 (Successful), and the BSS does not support VHT. The VHT Operation element is defined in VHT Capabilities element. |

* TDLS Channel Switch Request frame format

Insert a row for Order 8 in Information for TDLS Channel Switch Request frame as follows:

|  |  |  |
| --- | --- | --- |
| * Information for TDLS Channel Switch Request frame | | |
| Order | Information | Notes |
| 8 | Wide Bandwidth Channel Switch | Wide Bandwidth Channel Switch element (optional). The Wide Bandwidth Channel Switch element is included when a switch to an 80 MHz, 160 MHz or 80+80 MHz direct link is indicated. See Wide Bandwidth Channel Switch element. |

* Self-protected Action frame details
* Mesh Peering Open frame format
* Mesh Peering Open frame details

Insert a row for Order 19 and 20 following the row for Order 18 in Mesh Peering Open frame Action field format as follows:

|  |  |  |
| --- | --- | --- |
| * Mesh Peering Open frame Action field format | | |
| Order | Information | Notes |
| 19 | VHT Capabilities | The VHT Capabilities element is present when dot11VHTOptionImplemented is true. |
| 20 | VHT Operation | The VHT Operation element is present when dot11VHTOptionImplemented is true. |

* Mesh Peering Confirm frame format
* Mesh Peering Confirm frame details

Insert a row for Order 15 and 16 following the row for Order 14 in Mesh Peering Confirm frame Action field format as follows:

|  |  |  |
| --- | --- | --- |
| * Mesh Peering Confirm frame Action field format | | |
| Order | Information | Notes |
| 15 | VHT Capabilities | The VHT Capabilities element is present when dot11VHTOptionImplemented is true. |
| 16 | VHT Operation | The VHT Operation element is present when dot11VHTOptionImplemented is true. |

Insert new section 8.5.23 following the last section in 8.5:

* VHT Action frame details
* VHT Action field

Several Action frame formats are defined to support VHT frames. A VHT Action field, in the octet immediately after the Category field, differentiates the VHT Action frame formats. The VHT Action field values associated with each frame format within the VHT category are defined in VHT Action field values.

|  |  |
| --- | --- |
| * VHT Action field values | |
| Value | Meaning |
| 0 | VHT Compressed Beamforming |
| 1 | Group ID Management |
| 2 | (#5096)Operating Mode Notification |
| 3-255 | Reserved |

* VHT Compressed Beamforming frame format

The VHT Compressed Beamforming frame is an Action No Ack frame of category VHT. The Action field of a VHT Compressed Beamforming frame contains the information shown in VHT Compressed Beamforming frame Action field format.

|  |  |
| --- | --- |
| * VHT Compressed Beamforming frame Action field format | |
| Order | Information |
| 1 | Category |
| 2 | VHT Action |
| 3 | VHT MIMO Control (see VHT MIMO Control field) |
| 4 | VHT Compressed Beamforming Report (see VHT Compressed Beamforming Report field) |
| 5 | MU Exclusive Beamforming Report (see MU Exclusive Beamforming Report field) |

The Category field is set to the value for VHT, specified in Category values.

The VHT Action field is set to the value for VHT Compressed Beamforming, specified in VHT Action field values.

The VHT MIMO Control field is always present in the frame. The presence and contents of the VHT Compressed Beamforming Report field and the MU Exclusive Beamforming Report field are dependent on the values of the Remaining Segments and Feedback Type subfields of the VHT MIMO Control field (see 8.4.1.46, 8.4.1.47, 8.4.1.48 and 9.31.5).



* Group ID Management frame format

The Group ID Management frame is an Action frame of category VHT. It is transmitted by the AP to assign or change the user position of a STA for one or more group IDs(#4829). The Action field of a Group ID Management frame contains the information shown in Group ID Management frame Action field format.

|  |  |
| --- | --- |
| * Group ID Management frame Action field format | |
| Order | Information |
| 1 | Category |
| 2 | VHT Action |
| 3 | Membership Status Array (see Membership Status Array field) |
| 4 | User Position Array (see User Position Array field) |

The Category field is set to the value for VHT, specified in Category values.

The VHT Action field is set to the value for Group ID Management, specified in VHT Action field values.

* (#5096)Operating Mode Notification frame format

The (#5096)Operating Mode Notification frame is an Action frame of category VHT. It is used to notify STAs that the transmitting STA is changing its operating channel width, the maximum number of spatial streams it can receive, or both.(#4355)

The Action field of the (#5096)Operating Mode Notification frame contains the information shown in (#5096).

|  |  |
| --- | --- |
| * (#5096)Operating Mode Notification frame Action field format | |
| Order | Information |
| 1 | Category |
| 2 | VHT Action |
| 3 | (#5096)Operating Mode (see (#5096) |

The Category field is set to the value for VHT, specified in Category values.

The VHT Action field is set to the value for (#5096)Operating Mode Notification, specified in VHT Action field values.

* Aggregate MPDU (A-MPDU)
* A-MPDU format

Change 8.6.1 as follows:

An A-MPDU consists of a sequence of one or more A-MPDU subframes and 0 to 3 octets of EOF Pad, as shown in A-MPDU format.

Change Figure 8-503 as follows (adding the EOF Pad field):

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | A-MPDU subframe 1 | A-MPDU subframe 2 | … | A-MPDU subframe n | EOF Pad |
| Octets: | variable | variable |  | variable | 0-3 |
| * A-MPDU format | | | | | |

The structure of the A-MPDU subframe is shown in A-MPDU subframe format. Each A-MPDU subframe consists of an MPDU delimiter optionally followed by an MPDU. Each A-MPDU subframe in an A-MPDU, except for the last, has ~~Except when an A-MPDU subframe is the last one in an A-MPDU,~~ padding octets ~~are~~ appended to make ~~each A-MPDU subframe~~ it a multiple of 4 octets in length. In a VHT PPDU, the last A-MPDU subframe is padded to the last octet of the PSDU or to a multiple of 4 octets in length, whichever comes first. In an HT PPDU, the last A-MPDU subframe is not padded.(#4356) The A-MPDU maximum length for an HT PPDU is 65 535 octets. The A-MPDU maximum length for a VHT PPDU excluding A-MPDU subframes with 0 in the MPDU Length field and 1 in the EOF field, and EOF Pad, is 1 048 575 octets. The length of an A-MPDU addressed to a particular STA may be further constrained as described in 9.12.2 (A-MPDU length limit rules).

|  |  |  |  |
| --- | --- | --- | --- |
|  | MPDU delimiter | MPDU | Pad |
| Octets: | 4 | variable | 0-3 |
| * A-MPDU subframe format | | | |

The MPDU delimiter is 4 octets in length. The structure of the MPDU delimiter is defined in MPDU delimiter.

Replace Figure 8-505 with the following (adding the EOF field and extending the MPDU Length field):

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| B0 | B1 | B2 B15 | B16 B23 | B24 B31 |
| EOF | Reserved | MPDU Length | CRC | Delimiter Signature |
| * MPDU delimiter | | | | |

The fields of the MPDU delimiter are defined in MPDU delimiter fields.

|  |  |  |
| --- | --- | --- |
| * MPDU delimiter fields | | |
| Field | Size (bits) | Description |
| EOF | 1 | End of frame indication. Set to 1 in an A-MPDU subframe with 0 in the MPDU Length field that is used to pad the A-MPDU in a VHT PPDU as described in 9.12.6 (A-MPDU padding for VHT PPDU). Set to 1 in the MPDU delimiter(#4969) of a VHT single MPDU as described in 9.12.7 (Setting the EOF field of the MPDU delimiter(#4969)). Set to 0 otherwise. |
| Reserved | ~~4~~1 |  |
| MPDU Length | ~~12~~14 | Length of the MPDU in octets. Set to 0 if no MPDU is present. An A-MPDU subframe with 0 in the MPDU Length field is used as defined in 9.12.3 (Minimum MPDU Start Spacing field) to meet the minimum MPDU start spacing requirement and also to pad the A-MPDU to fill the available octets in a VHT PPDU as defined in 9.12.6 (A-MPDU padding for VHT PPDU). |
| CRC | 8 | 8-bit CRC of the preceding 16 bits |
| Delimiter Signature | 8 | Pattern that may be used to detect an MPDU delimiter when scanning for an MPDU delimiter(#4969).  The unique pattern is set to the value 0x4E.  NOTE—As the Delimiter Signature field was created by the IEEE 802.11 Task Group n, it chose the ASCII value for the character ‘N’ as the unique pattern. |

The format of the MPDU Length field is shown in MPDU Length field. The MPDU Length Low subfield contains the 12 low order bits of the MPDU length. In a VHT PPDU, the MPDU Length High subfield contains the two high order bits of the MPDU length. In an HT PPDU, the MPDU Length High subfield is reserved.(#4357)

Insert the following figure:

|  |  |
| --- | --- |
| B2 B3 | B4 B15 |
| MPDU Length High | MPDU Length Low |
| * MPDU Length field | |

The MPDU length value is derived from the MPDU Length field subfields as follows:(#4358)



where

*Llow* is the value of the MPDU Length Low subfield

*Lhigh* is the value of the MPDU Length High subfield

NOTE—The format of the MPDU Length field maintains a common encoding structure for both VHT and HT PPDUs. For HT PPDUs only the MPDU Length Low subfield(#4811) is used, while for VHT PPDUs both subfields are used.

The purpose of the MPDU delimiter is to locate the MPDUs within the A-MPDU so that the structure of the A-MPDU can usually be recovered when one or more MPDU delimiters are received with errors. See S.2 (A-MPDU deaggregation) for a description of a deaggregation algorithm.

~~A delimiter with MPDU length zero is valid. This value is used as defined in 9.12.3 (Minimum MPDU Start Spacing field) to meet the minimum MPDU start spacing requirement.~~

* A-MPDU contents

Change 8.6.3 as follows:

An A-MPDU is a sequence of ~~MPDUs~~ A-MPDU subframes carried in a single PPDU

* with the TXVECTOR/RXVECTOR FORMAT parameter set to VHT, or
* with the TXVECTOR/RXVECTOR FORMAT parameter set to HT\_MF or HT\_GF and with the TXVECTOR/RXVECTOR AGGREGATION parameter set to 1.

All the MPDUs within an A-MPDU are addressed to the same RA. All QoS data frames within an A-MPDU that have a TID for which an HT-immediate Block Ack agreement exists have the same value for the Ack Policy subfield of the QoS Control field.

All protected MPDUs within an A-MPDU have the same Key ID.

The Duration/ID fields in the MAC headers of all MPDUs in an A-MPDU carry the same value.

An A-MPDU or a(#4659) VHT single MPDU is transmitted in one of the contexts specified in A-MPDU Contexts as defined by the description in the column labeled “Definition of Context”, independently of whether the A-MPDU or VHT single MPDU is contained in an MU PPDU or an SU PPDU. Ordering of MPDUs within an A-MPDU is not constrained, except where noted in these tables. See 9.12.1 (A-MPDU contents).(#4812)

An MU PPDU does(#4477) not carry more than one A-MPDU or VHT single MPDU that contains one or more MPDUs soliciting an immediate response.(#4812)

NOTE 1—The TIDs present in a data enabled A-MPDU context are also constrained by the channel access rules (for a TXOP holder, see 9.19.2 (HCF contention-based channel access (EDCA)) and 9.19.3 (HCCA)) and the RD response rules (for an RD responder, see 9.24.4 (Rules for RD responder)). This is not shown in these tables.

NOTE 2—~~MPDUs carried in an A-MPDU are limited to a maximum length of 4095 octets.~~ If a STA supports A-MSDUs of 7935 octets (indicated by the Maximum A-MSDU Length field in the HT Capabilities element), A-MSDUs transmitted by that STA within an A-MPDU carried in a PPDU with FORMAT HT\_MF or HT\_GF are constrained so that the length of the QoS data MPDU carrying the A-MSDU is no more than 4095 octets. The 4095 octet MPDU length limit does not apply to A-MPDUs carried in VHT PPDUs.(#4360) The use of A-MSDU within A-MPDU can be further constrained as described in 8.4.1.14 (Block Ack Parameter Set field) through the operation of the A-MSDU Supported field. Change A-MPDU Contexts as follows:

|  |  |  |
| --- | --- | --- |
| * A-MPDU Contexts | | |
| Name of Context | Definition of Context | Table defining permitted contents |
| Data Enabled Immediate Response | The A-MPDU is transmitted outside a PSMP sequence by a TXOP holder or an RD responder including potential immediate responses. | Table 8-284 (A-MPDU contents in the data enabled immediate response context) |
| Data Enabled No Immediate Response | The A-MPDU is transmitted outside a PSMP sequence by a TXOP holder that does not include or solicit an immediate response.  See NOTE. | Table 8-285 (A-MPDU contents in the data enabled no immediate response context) |
| PSMP | The A-MPDU is transmitted within a PSMP sequence. | Table 8-286 (A-MPDU contents in the PSMP context) |
| Control Response | The A-MPDU is transmitted by a STA that is neither a TXOP holder nor an RD responder that also needs to transmit one of the following immediate response frames:  ~~Ack~~ACK(#5485)  BlockAck with a TID for which an HT-immediate Block Ack agreement exists | Table 8-287 (A-MPDU contents MPDUs in the control response context) |
| VHT single MPDU context | The A-MPDU is tranmitted within a VHT PPDU and contains a VHT single MPDU. | A-MPDU contents in the VHT single MPDU context |
| NOTE—This context includes cases when no response is generated or when a response is generated later by the operation of the delayed Block Ack rules. | | |

Insert new table below:

|  |  |
| --- | --- |
| * A-MPDU contents in the VHT single MPDU context | |
| MPDU | Conditions |
| Any MPDU | A VHT single MPDU, which can be any single MPDU.(#4361)  [The A-MPDU is carried in a PPDU with the TXVECTOR FORMAT parameter set to VHT.]  The MPDU delimiter(#4969) of the subframe containing the MPDU has the EOF field set to 1. |

* MAC sublayer functional description
* MAC architecture
* Hybrid coordination function (HCF)
* HCF contention-based channel access (EDCA)

Change the 7th paragraph as follows:(#4175)

If dot11QMFActivated is false or not present for a QoS STA, a(11ae) QoS STA should send individually addressed Management frames that are addressed to a non-QoS STA using the access category AC\_BE and shall send all other management frames using the access category AC\_VO, whether or not it is associated with a BSS or there is a QoS facility in the BSS.(11ae) If dot11QMFActivated is false or not present for a QoS STA, a(11ae) QoS STA that does not send individually addressed Management frames that are addressed to a non-QoS STA using the access category AC\_BE shall send them using the access category AC\_VO. Management frames are exempted from any and all restrictions on transmissions arising from admission control procedures. If dot11QMFActivated is true for a STA, the STA shall send management frames as described in 10.25 (Quality-of-Service management frame).(11ae) BlockAckReq and BlockAck frames shall be sent using the same access category as the corresponding QoS data frames. PS-Poll frames shall be sent using the access category AC\_BE (to reduce the likelihood of collision following a Beacon frame) without being restricted by admission control procedures. When the first frame in a frame exchange sequence is an RTS or CTS frame, the RTS or CTS frame be sent using the access category of the corresponding QoS Data/QoS Null frame(s) or AC\_VO for management frames. Control Wrapper control frames shall be sent using the access category that would apply to the carried control frame. A beamformer may send a VHT NDP Announcement(#4921) frame or Beamforming Report Poll frame using any AC.

Note—A QoS STA can choose to use AC\_VO when transmitting management frames to a non-QoS STA when no prior data frames have been transmitted to the non-QoS STA.

* Fragmentation/defragmentation overview

Change the second and fifth paragraph as follows:

An MSDU transmitted under HT-immediate or HT-delayed Block Ack agreement shall not be fragmented even if its length exceeds dot11FragmentationThreshold. An MSDU transmitted within an A-MPDU that does not contain a VHT single MPDU (see Setting the EOF field of the MPDU delimiter) shall not be fragmented even if its length exceeds dot11FragmentationThreshold. Group addressed MSDUs or MMPDUs shall not be fragmented even if their length exceeds dot11FragmentationThreshold.

Except as described below, when an individually addressed MSDU is received from the LLC or an individually addressed MMPDU is received from the MLME that would result in an MPDU of length greater than dot11FragmentationThreshold, the MSDU or MMPDU shall be fragmented. The exception applies when an MSDU is transmitted using an HT-immediate or HT-delayed Block Ack agreement or when the MSDU or MMPDU is carried in an A-MPDU that does not contain a VHT single MPDU, in which case the MSDU or MMPDU is transmitted without fragmentation. Each fragment is a frame no longer than dot11FragmentationThreshold, if security encapsulation is not invoked for the MPDU. If security encapsulation is active for the MPDU, then the fragments shall be expanded by the encapsulation overhead and this may result in a fragment larger than dot11FragmentationThreshold. It is possible that any fragment may be a frame smaller than dot11FragmentationThreshold. An illustration of fragmentation is shown in Figure 9-2 (Fragmentation).

* DCF
* General

Change the 6th paragraph as follows:

The RTS/CTS exchange also performs both a type of fast collision inference and a transmission path check. If the return CTS is not detected by the STA originating the RTS, the originating STA may repeat the process (after observing the other medium-use rules) more quickly than if the long data frame had been transmitted and a return ACK frame had not been detected. An RTS/CTS exchange by VHT STAs also performs fast collision inference on secondary channels, and helps(#4886) the VHT STA transmitting the RTS determine the available bandwidth at the responder.

Change the 2nd to(#4495) last paragraph as follows:

All STAs(#4882) that are members of a BSS are able to receive and transmit at all the data rates in the BSSBasicRateSet parameter of the MLME-START.request primitive or BSSBasicRateSet parameter of the BSSDescription representing the SelectedBSS parameter of the MLME-JOIN.request primitive; see 6.3.4.2.4 (Effect of receipt) and 6.3.11.2.4 (Effect of receipt). All HT STAs that are members of a BSS are able to receive and transmit using all the MCSs in the BSSBasicMCSSet parameter of the MLME-START.request primitive or BSSBasicMCSSet parameter of the BSSDescription representing the SelectedBSS parameter of the MLME-JOIN.request primitive; see 6.3.4.2.4 (Effect of receipt) and 6.3.11.2.4 (Effect of receipt). All VHT STAs that are members of a BSS are able to receive and transmit using all the MCSs in the VHTBSSBasicMCSSet parameter of the MLME-START.request primitive or VHTBSSBasicMCSSet parameter of the BSSDescription representing the SelectedBSS parameter of the MLME-JOIN.request primitive; see 6.3.4.2.4 (Effect of receipt) and 6.3.11.2.4 (Effect of receipt). To support the proper operation of the RTS/CTS and the virtual CS mechanism, all STAs shall be able to interpret control frames with the Subtype field equal to RTS or CTS.

* Procedures common to both DCF and EDCAF
* IFS
* RIFS

Insert as the first paragraph:

RIFS in the OBand is an obsolete mechanism that is subject to removal in a future revision of this standard.

A VHT STA shall not transmit frames separated by a RIFS.

* PIFS

Change the second paragraph as follows:

The PIFS may be used as described in the following list and shall not be used otherwise:

* A STA operating under the PCF as described in 9.4 (PCF)
* A STA transmitting a Channel Switch Announcement frame as described in 10.9 (DFS procedures)
* A STA transmitting a TIM frame as described in 10.2.1.17 (TIM Broadcast)
* An HC starting a CFP or a TXOP as described in 9.19.3.2.3 (CAP generation)
* An HC or a non-AP QoS STA that is a polled TXOP holder recovering from the absence of an expected reception in a CAP as described in 9.19.3.2.4 (Recovery from the absence of an expected reception)
* An HT STA using dual CTS protection before transmission of the CTS2 as described in 9.3.2.8 (Dual CTS protection)
* A TXOP holder continuing to transmit after a transmission failure as described in 9.19.2.4 (Multiple frame transmission in an EDCA TXOP)
* A TXOP holder transmitting an RTS with a signaling TA within a multiple frame transmission sequence, as specified in Multiple frame transmission in an EDCA TXOP
* An RD initiator continuing to transmit using error recovery as described in 9.24.3 (Rules for RD initiator)
* An HT AP during a PSMP sequence transmitting a PSMP recovery frame as described in 9.25.1.3 (PSMP uplink transmission (PSMP-UTT))
* An HT STA performing clear channel assessment (CCA) in the secondary channel before transmitting a 40 MHz mask PPDU using EDCA channel access as described in 10.15.9 (STA CCA sensing in a 20/40 MHz BSS)
* An AP continuing to transmit in a GCR-Block-Ack TXOP after the failure to receive a BlockAck as described in 9.21.10(11aa)(#4176)
* A VHT STA performing clear channel assessment (CCA) in the secondary 20, 40 and 80 MHz channels before transmitting a 40, 80, 160 or 80+80 MHz mask PPDU using EDCA channel access as described in EDCA channel access in a VHT BSS(#4042)
* A PCP/AP operating in the DBand and continuing to transmit in the AT after a transmission failure during the AT (9.33.3)(11ad)
* A source DBand STA of an SP continuing to transmit after a transmission failure as described in 9.33.6.2 (Service period (SP) allocation)(11ad)

Insert new section 9.3.2.5a following section 9.3.2.5

* VHT RTS procedure

A VHT STA transmitting an RTS frame carried in non-HT or non-HT duplicate format and addressed to a VHT STA shall set the TA field to a signaling TA and shall set the TXVECTOR parameters CH\_BANDWIDTH\_IN\_NON\_HT and CH\_BANDWIDTH to the same value. If the STA sending the RTS frame is using dynamic bandwidth operation, it shall set the TXVECTOR parameter DYN\_BANDWIDTH\_IN\_NON\_HT to Dynamic. Otherwise, the STA shall set the TXVECTOR parameter DYN\_BANDWIDTH\_IN\_NON\_HT to Static.

A VHT STA that initiates a TXOP by transmitting an RTS frame(#4364) with the TA field set to a signaling TA(#4297) shall not send an RTS frame(#4364) to a non-VHT STA for the duration of the TXOP.

* CTS procedure

Insert the following as the first four paragraphs to this section:

A STA that receives an RTS frame addressed to it considers the NAV to determine whether to respond(#4889) with CTS unless the NAV was set by a frame originating from the STA sending the RTS frame (see 9.19.2.2 (EDCA TXOPs)). Thus, in this subclause, “NAV indicates idle” means that the NAV count is 0 or that the NAV count is not 0 but the address in the TA field of the RTS frame with the Individual/Group bit forced to 0 matches the saved TXOP holder address.

A VHT STA that is addressed by a non-HT or non-HT duplicate RTS frame that has a signaling TA and that has the RXVECTOR parameter DYN\_BANDWIDTH\_IN\_NON\_HT equal to Static, behaves as follows:

* If the NAV indicates idle and CCA has been idle for all secondary channels in the channel width indicated by the RTS frame's RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT a PIFS period(#4885) prior to the start of the RTS frame, then the STA shall respond with a non-HT or non-HT duplicate CTS frame after a SIFS period. The CTS frame's TXVECTOR parameters CH\_BANDWIDTH and CH\_BANDWIDTH\_IN\_NON\_HT shall be set to the same value as the RTS frame's RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT.
* Otherwise the STA shall not respond with a CTS frame.

A VHT STA that is addressed by a non-HT or non-HT duplicate RTS frame that has a signaling TA and that has the RXVECTOR parameter DYN\_BANDWIDTH\_IN\_NON\_HT equal to Dynamic, behaves as follows:

* If the NAV indicates idle, then the STA shall respond with a non-HT or non-HT duplicate CTS frame after a SIFS period. The CTS frame's TXVECTOR parameters CH\_BANDWIDTH and CH\_BANDWIDTH\_IN\_NON\_HT may be set to any channel width for which CCA on all secondary channels has been idle PIFS prior to the start of the RTS frame and that is equal to or less than the channel width indicated in the RTS frame's RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT.
* Otherwise the STA shall not respond with a CTS frame.

A non-VHT STA that is addressed by an RTS frame or a VHT STA that is addressed by an non-HT or non-HT duplicate RTS frame that has a non-signaling TA or a VHT STA that is addressed by an RTS frame in a format other than non-HT or non-HT duplicate behaves as follows:

* If the NAV indicates idle, the STA shall respond with a CTS frame after a SIFS period.
* Otherwise, the STA shall not respond with a CTS frame.

Change what was the first paragraph as follows:

~~A STA that is addressed by an RTS frame shall transmit a CTS frame after a SIFS period if the NAV at the STA receiving the RTS frame indicates that the medium is idle.~~

~~If the NAV at the STA receiving the RTS indicates the medium is not idle, that STA shall not respond to the RTS frame.~~

The RA field of the CTS frame shall be set to the ~~value~~address obtained from the TA field of the RTS frame to which this CTS frame is a response but with the Individual/Group bit in the RA field set to 0. The Duration field in the CTS frame shall be the duration field from the received RTS frame, adjusted by subtraction of aSIFSTime and the number of microseconds required to transmit the CTS frame at a data rate determined by the rules in Multirate support.

* Dual CTS protection
* Dual CTS protection procedure

Insert as the first paragraph of 9.3.2.7.1:

A VHT STA shall not transmit VHT PPDUs in a TXOP protected by dual CTS protection.(#4372)

* DCF access procedure
* Recovery procedures and retransmit limits

Insert as the last paragraph of this subclause:

An AP that fails to receive an acknowledgement after the AP transmits a frame with the More Data field set to 0 to a VHT non-AP STA that is in VHT TXOP power save mode retransmits the frame within the current TXOP under certain conditions as described in 10.2.1.4a (Power management during VHT transmissions).

* Fragmentation

Change the 3rd paragraph (breaking it into three parts) as follows:

A fragment is an MPDU, the payload of which carries all or a portion of an MSDU or MMPDU. When data are to be transmitted, the number of octets in the fragment (before processing by the security mechanism) shall be determined by dot11FragmentationThreshold and the number of octets in the MPDU that have yet to be assigned to a fragment at the instant the fragment is constructed for the first time. Once a fragment is transmitted for the first time, its frame body content and length shall be fixed until it is successfully delivered to the immediate receiving STA.

A STA shall be capable of receiving fragments, containing all or part of an MSDU, of arbitrary length that is less than or equal to the maximum ~~allowed~~ MSDU size as defined in 8.2.3 (General frame format), plus any security encapsulation ~~headers~~ overhead, plus MAC header and FCS.

A STA shall be capable of receiving fragments, containing all or part of an MMPDU, of arbitrary length that is less than or equal to the minimum of:

* The maximum MMPDU size as defined in 8.3.3.1 (Format of management frames), plus any security encapsulation overhead, plus MAC header and FCS,
* Any maximum MPDU length advertised by the STA.
* Multirate support
* Basic Rate Set and Basic MCS Set for mesh STA

Change the last two paragraphs as follows:

Mesh STAs should adopt the mandatory PHY rates as the default BSSBasicRateSet to reduce the risk that a candidate peer mesh STA utilizes a different BSSBasicRateSet. If the mesh STA is also an HT STA, it should adopt the ~~MCSs of~~ mandatory HT MCSs(#4367) as the default BSSBasicMCSSet. If the mesh STA is also a VHT STA, it should adopt the mandatory VHT MCSs(#4367) as the default VHTBSSBasicMCSSet.

Once the mesh STA establishes a mesh peering with a mesh STA, it shall not change ~~neither~~ any of(#4600)the BSSBasicRateSet, ~~nor the~~ BSSBasicMCSSet or VHTBSSBasicMCSSet parameters.

* Rate selection for data and management frames
* Rate selection for other group addressed data and management frames

Change the last three paragraphs as follows:

If the BSSBasicRateSet parameter is empty and the BSSBasicMCSSet parameter is not empty, the frame shall be transmitted in an HT PPDU using one of the MCSs included in the BSSBasicMCSSet parameter.

If the BSSBasicRateSet parameter is empty and the BSSBasicMCSSet parameter is empty and the VHTBSSBasicMCSSet is not empty, the frame shall be transmitted in a VHT PPDU using one of the MCSs included in the VHTBSSBasicMCSSet parameter. If ~~both~~ the BSSBasicRateSet parameter, ~~and~~ the BSSBasicMCSSet parameter and the VHTBSSBasicMCSSet parameter are empty (e.g., a scanning STA that is not yet associated with a BSS), the frame shall be transmitted in a non-HT PPDU using one of the mandatory PHY rates.

* Rate selection for other data and management frames

Change as follows:

A data or management frame not identified in 9.7.5.1 through 9.7.5.5 shall be sent using any data rate or MCS subject to the following constraints:

* A STA shall not transmit a frame using a rate or, MCS or (MCS, number spatial streams) combination that is not supported by the receiver STA or STAs, as reported in any Supported Rates element, Extended Supported Rates element, or Supported MCS Set or VHT Supported MCS Set(#4911,#4309,#4030) field in management frames transmitted by the receiver STA.
* If at least one (#5096)Operating Mode field with the Rx Nss Type subfield equal to 0 was received from the receiver STA:
* A STA shall not transmit a frame with the number of spatial streams greater than that indicated in the Rx Nss subfield in the most recent (#5096)Operating Mode field with the Rx Nss Type subfield equal to 0 from the receiver STA.
* If at least one (#5096)Operating Mode field with the Rx Nss Type subfield equal to 1 was received from the receiver STA:
* A STA shall not transmit an SU PPDU frame using a beamforming steering matrix with the number of spatial streams greater than that indicated in the Rx Nss subfield in the most recent (#5096)Operating Mode field with the Rx Nss Type subfield equal to 1 from the receiver STA if the beamforming steering matrix was derived from a VHT Compressed Beamforming report with Feedback Type subfield indicating MU in the VHT Compressed Beamforming frame(s). (#4911, #4309, #4030)
* A STA shall not transmit a frame using a value for the CH\_BANDWIDTH parameter of the TXVECTOR that is not supported by the receiver STA, as reported in any HT Operation element or VHT Operation element(#4911, #4309, #4030).
* If at least one (#5096)Operating Mode field with the Rx Nss Type subfield equal to 0 was received from the receiver STA:
* A STA shall not transmit a frame using a value for the TXVECTOR parameter CH\_BANDWIDTH that is not supported by the receiver STA as reported in the most recent (#5096)Operating Mode field with the Rx Nss Type subfield equal to 0 from the receiver STA.(#4911, #4309, #4030)
* A STA shall not initiate transmission of a frame at a data rate higher than the greatest rate in the OperationalRateSet, or the HTOperationalMCSSset or the VHTOperationalMCSSet(#4911, #4309, #4030), which are parameters of the MLME-JOIN.request primitive.

When the supported rate set of the receiving STA or STAs is not known, the transmitting STA shall transmit using a rate in the BSSBasicRateSet parameter, or an MCS in the BSSBasicMCSSet parameter, or an MCS in the VHTBSSBasicMCSSet parameter(#4046), or a rate from the mandatory rate set of the attached PHY if ~~both~~ (#4047)the BSSBasicRateSet, ~~and~~ the BSSBasicMCSSet and the VHTBSSBasicMCSSet are empty.

The rules in this subclause also apply to A-MPDUs that aggregate MPDUs of type Data or Management with any other types of MPDU.

* Rate selection for control frames
* General rules for rate selection for control frames

Change the 1st two paragraphs as follows:

Control frames carried in an A-MPDU that does not contain a VHT single MPDU shall be sent at a rate selected from the rules defined in Rate selection for other data and management frames(#5000).

NOTE—The rules defined in 9.7.6.2 through 9.7.6.5 apply only to control frames not carried in an A-MPDU that does not contain a VHT single MPDU(#4048).

The following rules determine whether a control frame is carried in a~~n HT PPDU or~~ non-HT, HT or VHT(#4369) PPDU:

* A control frame shall be carried in an HT PPDU when the control frame meets any of the following conditions:
* The control frame contains an L-SIG duration value (see 9.23.5), or
* The control frame is sent using an STBC frame.
* A control response frame shall be carried in an HT PPDU when the control frame is a response to a frame that meets any of the following conditions:
* (#5074)The frame eliciting the response included an HT variant HT Control field with the TRQ field equal to 1 and the NDP Announcement subfield equal to 0, and this responder set the Implicit Transmit Beamforming Receiving Capable field to 1 in its last transmitted HT Capabilities element; or
* The frame eliciting the response was an RTS frame carried in an HT PPDU; or
* The frame eliciting the response was an STBC frame, and the Dual CTS Protection field was equal to 1 in the last HT Operation element received from its AP or transmitted by the STA (see 9.3.2.7).
* A control frame may be carried in an HT PPDU when the control frame meets any of the following conditions:
* The control frame contains an HT Control field with the MRQ subfield equal to 1, or
* The control frame contains an HT Control field with the TRQ field equal to 1.

~~NOTE—In these cases, requirements specified in 9.27, 9.28.2, and 9.29 further constrain the choice of non-HT or HT PPDU.~~

* A (#4370)control frame that is not a control response frame may be carried in a VHT PPDU when the control frame includes an HT control field (#4371)(rules for control response frames are in clause 9.7.6.5)
* Otherwise, the control frame shall be carried in a non-HT PPDU.

NOTE—In these cases, requirements specified in 9.27, 9.28.2, and 9.29 further constrain the choice of non-HT, HT or VHT PPDU.

* Rate selection for control frames that initiate a TXOP

Change the 1st paragraph as follows:

This subclause describes the rate selection rules for control frames that initiate a TXOP and that are either (#4817)a VHT single MPDU or not carried in an A-MPDU.

(#4372)

* Rate selection for control frames that are not control response frames

Change the 1st paragraph as follows:

This subclause describes the rate selection rules for control frames that are not control response frames, are not the frame that initiates a TXOP, are not the frame that terminates a TXOP, and are either (#4817)a VHT single MPDU or not carried in an A-MPDU.

Change the 4th paragraph as follows:

A frame that is carried in an HT PPDU shall be transmitted by the STA using an MCS supported by the receiver STA, as reported in the Supported MCS field in the HT Capabilities element in management frames transmitted most recently received from ~~by~~ that STA. A frame that is carried in an VHT PPDU shall be transmitted by the STA using an MCS supported by the receiver STA, as reported in the VHT Supported MCS field in the VHT Capabilities element most recently received from that STA. When the supported rate set of the receiving STA or STAs is not known, the transmitting STA shall transmit using an MCS in the BSSBasicMCSSet parameter.

Change the last paragraph and insert a subsequent paragraph as follows:

A frame that is carried in an HT PPDU shall be transmitted by the STA using an MCS supported by the receiver STA, as reported in the Supported MCS field in the HT Capabilities element ~~in management frames transmitted by~~ most recently received from that STA. When the supported ~~rate~~ MCS set of the receiving STA or STAs is not known, the transmitting STA shall transmit using an MCS in the BSSBasicMCSSet parameter.(#4051)

A frame that is carried in an VHT PPDU shall be transmitted by the STA using an MCS supported by the receiver STA, as reported in the VHT Supported MCS field in the VHT Capabilities element most recently received from that STA. When the supported MCS set of the receiving STA or STAs is not known, the transmitting STA shall transmit using an MCS in the VHTBSSBasicMCSSet parameter.(#4051)

* Rate selection for control response frames
* Introduction

Change as follows:

Subclauses 9.7.6.5.2 through 9.7.6.5.5 describe the rate selection rules for control response frames that are either a VHT single MPDU or (#4816)not carried in an A-MPDU.

* Selection of a rate or MCS

Change the 2nd bullet of the 1st paragraph as follows:

* If a BlockAck frame is sent as an immediate response to either an implicit BlockAck request or to a BlockAckReq frame that was carried in an HT or VHT PPDU and the BlockAck frame is carried in a non- HT PPDU, the primary rate is defined to be the highest rate in the BSSBasicRateSet parameter that is less than or equal to the rate (or non-HT reference rate; see 9.7.9) of the previous frame. If no rate in the BSSBasicRateSet parameter meets these conditions, the primary rate is defined to be the highest mandatory rate of the attached PHY that is less than or equal to the rate (or non-HT reference rate; see 9.7.9) of the previous frame. The STA may select an alternate rate according to the rules in 9.7.6.5.4. The STA shall transmit the non-HT PPDU BlockAck control response frame at either the primary rate or the alternate rate, if one exists.

Change the 6th bullet as follows:

* If the control response frame is carried in an HT or VHT PPDU, then it is transmitted at an MCS as determined by the procedure defined in 9.7.6.5.3.

Change the 2nd paragraph as follows:

The modulation class of the control response frame shall be selected according to the following rules:

* If the received frame is of a modulation class other than HT or VHT and the control response frame is carried in a non-HT PPDU, the control response frame shall be transmitted using the same modulation class as the received frame. In addition, the control response frame shall be sent using the same value for the TXVECTOR parameter PREAMBLE\_TYPE as the received frame.
* If the received frame is of the modulation class HT or VHT and the control response frame is carried in a non-HT PPDU, the control response frame shall be transmitted using one of the ERP-OFDM or OFDM modulation classes.
* If the control response frame is carried in an HT PPDU, the modulation class shall be HT.
* If the control response frame is carried in an VHT PPDU, the modulation class shall be VHT.
* Control response frame MCS computation

Change as follows:

If a control response frame is to be transmitted within an HT or VHT (#4375)PPDU, the channel width (CH\_BANDWIDTH parameter of the TXVECTOR) shall be selected first according to 9.7.6.6, and then the MCS shall be selected from a set of MCSs called the *CandidateMCSSet* as described in this subclause.

If the frame eliciting the response was transmitted by an HT STA that is not a VHT STA, t~~T~~he Rx Supported MCS Set ~~of the STA that transmitted the frame eliciting the response~~ is determined from the ~~its s~~Supported MCS Set field in the HT Capabilities element most recently received from the STA, as follows:

* If a bit in the Rx MCS Bitmask subfield is equal to 0, the corresponding MCS is not supported.
* If a bit in the Rx MCS Bitmask subfield is equal to 1 and the integer part of the data rate (expressed in megabits per second) of the corresponding MCS is less than or equal to the rate represented by the Rx Highest Supported Data Rate subfield, then the MCS is supported by the STA on receive. If the Rx Highest Supported Data Rate subfield is equal to 0 and a bit in the Rx MCS Bitmask is equal to 1, then the corresponding MCS is supported by the STA on receive.

If the frame eliciting the response was transmitted by a VHT STA, the Rx Supported MCS Set is determined from the Supported MCS Set field in the VHT Capabilities element and the supported MCS Set field in the HT Capabilities element most recently received from the STA.

The CandidateMCSSet is determined using the following rules:

* If the frame eliciting the response was an STBC frame and the Dual CTS Protection bit is equal to 1, the CandidateMCSSet shall contain only the basic STBC MCS.
* If the frame eliciting the response had an L-SIG duration value (see 9.23.5) and initiates a TXOP, the CandidateMCSSet is the MCS Set consisting of the intersection of the Rx Supported MCS Set of the STA that sent the frame that is eliciting the response and the set of MCSs that the responding STA is capable of transmitting.
* If none of the above conditions is true, the CandidateMCSSet is the combination of the BSSBasicMCSSet and the VHTBSSBasicMCSSet parameters. If the combined BSSBasicMCSSet parameter is empty, the CandidateMCSSet shall consist of
* the set of mandatory HT PHY MCSs, if the STA eliciting the response is an HT STA that is not a VHT STA;
* the set of mandatory HT and VHT PHY MCSs, if the STA eliciting the response is a(#5416) VHT STA.

MCS values from the CandidateMCSSet that cannot be transmitted with the selected CH\_BANDWIDTH parameter value shall be eliminated from the CandidateMCSSet.

The choice of a response MCS is made as follows:

* If the frame eliciting the response is within a non-HT PPDU,
* Eliminate from the CandidateMCSSet all VHT MCSs and the MCSs that have a data rate greater than the data rate of the received PPDU (the mapping of MCS to data rate is defined in 20.6).
* Find the highest indexed MCS from the CandidateMCSSet. The index of this MCS is the index of the MCS that is the primary MCS for the response transmission.
* If the CandidateMCSSet is empty, the primary MCS is the lowest indexed MCS of the mandatory MCSs.
* If the frame eliciting the response is within an HT PPDU,
* Eliminate from the CandidateMCSSet all VHT MCSs and all MCSs that have an index that is higher than the index of the MCS of the received frame.
* Determine the highest number of spatial streams (*NSS*) value of the MCSs in the CandidateMCSSet that is less than or equal to the *NSS* value of the MCS of the received frame. Eliminate all MCSs from the CandidateMCSSet that have an *NSS* value that is not equal to this *NSS* value. The mapping from MCS to *NSS* is dependent on the attached PHY. For the HT PHY, see 20.6.
* Find the highest indexed MCS of the CandidateMCSSet for which the modulation value of each stream is less than or equal to the modulation value of each stream of the MCS of the received frame and for which the coding rate value is less than or equal to the coding rate value of the MCS from the received frame. ~~The index of this MCS is the index of the MCS that~~This is the primary MCS for the response transmission. The mapping from MCS to modulation and coding rate is dependent on the attached PHY. For the HT PHY, see 20.6. For the purpose of comparing modulation values, the following sequence shows increasing modulation values: BPSK, QPSK, 16-QAM, 64-QAM.
* If no MCS meets the condition in step 3), remove each MCS from the CandidateMCSSet that has the highest value of *NSS* in the CandidateMCSSet. If the resulting CandidateMCSSet is empty, then set the CandidateMCSSet to the HT PHY mandatory MCSs. Repeat step 3) using the modified CandidateMCSSet.
* If the frame eliciting the response is within a VHT PPDU,
* Eliminate from the CandidateMCSSet all MCSs that have a data rate that is higher than the data rate of the MCS of the received frame.
* Determine the highest number of spatial streams (*NSS*) value of the MCSs in the CandidateMCSSet that is less than or equal to the *NSS* value of the MCS of the received frame. Eliminate all MCSs from the CandidateMCSSet that have an *NSS* value that is not equal to this *NSS* value. The mapping from MCS to *NSS* is dependent on the attached PHY. For the HT PHY, see 20.6; for the VHT PHY, see 22.5 (Parameters for VHT MCSs).
* Find the highest rate MCS of the CandidateMCSSet for which the modulation value of each stream is less than or equal to the modulation value of each stream of the MCS of the received frame and for which the coding rate value is less than or equal to the coding rate value of the MCS from the received frame. This MCS is the primary MCS for the response transmission. The mapping from MCS to modulation and coding rate is dependent on the attached PHY. For the HT PHY, see 20.6; for the VHT PHY, see 22.5 (Parameters for VHT MCSs).(#4488) For the purpose of comparing modulation values, the following sequence shows increasing modulation values: BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM.(#4553)
* If no MCS meets the condition in step 3), remove each MCS from the CandidateMCSSet that has the highest value of *NSS* in the CandidateMCSSet. If the resulting CandidateMCSSet is empty, then set the CandidateMCSSet to the VHT PHY mandatory MCSs. Repeat step 3) using the modified CandidateMCSSet.

Once the primary MCS has been selected, the STA may select an alternate MCS according to 9.7.6.5.4. The STA shall transmit the ~~HT~~ PPDU control response frame using either the primary MCS or the alternate MCS, if one exists.

* Channel Width selection for control frames

Delete the first paragraph and Table 9-3.

Change the note, which becomes the first paragraph of this section, as follows:

NOTE—~~This rule~~The rules in this subclause, combined with the rules in 9.7.5.1 (General rules for rate selection for control frames), determine~~s~~ the format of control response frames.

Insert the following three paragraphs, note and fourth paragraph:

A VHT STA that transmits a control frame in a non-HT duplicate format (channel width 40 MHz or wider) that is not an RTS frame(#5075), addressed to a VHT STA and eliciting a control response frame or a VHT Compressed Beamforming frame shall set the TA field to a signaling TA and shall set the TXVECTOR parameters CH\_BANDWIDTH\_IN\_NON\_HT and CH\_BANDWIDTH to the same value.

A VHT STA that transmits a control frame that is not an RTS frame in a non-HT format (channel width 20 MHz), addressed to a VHT STA and eliciting a control response frame or a VHT Compressed Beamforming frame may set the TA field to a signaling TA, in which case it shall set the TXVECTOR parameters CH\_BANDWIDTH\_IN\_NON\_HT and CH\_BANDWIDTH to the same value. Channel width selection rules for RTS frames are described in VHT RTS procedure.

A STA that sends a control frame in response to an HT or VHT format frame(#4297) shall set the TXVECTOR parameter CH\_BANDWIDTH to indicate a channel width that is the same as the channel width indicated by the RXVECTOR parameter CH\_BANDWIDTH of(#4378) the frame eliciting the response.

A STA that sends a control frame in response to a non-HT or non-HT duplicate frame with a non-signaling TA:

* Should set the TXVECTOR parameter CH\_BANDWIDTH to the same value as the RXVECTOR parameter CH\_BANDWIDTH for the frame eliciting the response.
* Shall not set the TXVECTOR parameter CH\_BANDWIDTH to a value greater than the RXVECTOR parameter CH\_BANDWIDTH for the frame eliciting the response.

NOTE—This rule permits an implementation that receives a non-HT duplicate frame but is not able to detect the channel bandwidth occupied by the frame, either by design or because the frame was received over a channel bandwidth narrower than it was transmitted, to respond with a 20 MHz PPDU.

A VHT STA that sends a control frame that is in response to a non-HT or non-HT duplicate format frame with a signaling TA and that is not a CTS(#5075)(#4297) shall set the channel width indicated by the TXVECTOR parameter CH\_BANDWIDTH to the same value as the channel width indicated by the RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT for the frame eliciting the response. The Individual/Group field of the RA field of a control frame that is sent in response to a control frame with a signaling TA shall be set to 0. For the channel width selection rules for CTS sent in response to an RTS with the Individual/Group bit in the TA field equal to 1 see CTS procedure.

* Modulation classes

Change as follows (paragraph change as well as new row and column in Modulation classes ):

~~In order to determine the rules for response frames given in~~ Multirate support~~, the following modulation classes are defined in~~ Modulation classes ~~. Each row defines a modulation class. Modulations described within the same row have the same modulation class, while modulations described in different rows have different modulation classes. For Clause 20 PHY transmissions, the modulation class is determined by the FORMAT and NON\_HT\_MODULATION parameters of the TXVECTOR/RXVECTOR. Otherwise, the modulation class is determined by the clause or subclause number defining that modulation.~~ Modulation classes  defines modulations classes for the rules for response frames in Multirate support.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| * Modulation classes | | | | |
| Modulation class | Description of modulation | Condition that selects this modulation class | | |
| Clause 14, Clause 16, Clause 15, Clause 18, Clause 17, and Clause 19 PHYs | Clause 20 PHY | Clause 22 PHY |
| 1 | Infrared (IR) | Clause 15 transmission | N/A | N/A |
| 2 | Frequency-hopping spread spectrum (FHSS) | Clause 14 transmission | N/A | N/A |
| 3 | DSSS and HR/DSSS | Clause 16 or Clause 17 transmission | FORMAT is NON\_HT.  NON\_HT\_MODULATION is ERP-DSSS or ERP-CCK. | N/A |
| 4 | ERP-PBCC | 19.6 transmission | FORMAT is NON\_HT.  NON\_HT\_MODULATION is ERP-PBCC. | N/A |
| 5 | DSSS-OFDM  The use of the DSSS-OFDM option is deprecated, and this option may be removed in a later revision of the standard. | 19.7 transmission | FORMAT is NON\_HT.  NON\_HT\_MODULATION is DSSS-OFDM. | N/A |
| 6 | ERP-OFDM | 19.5 transmission | FORMAT is NON\_HT.  NON\_HT\_MODULATION is ERP-OFDM. | N/A |
| 7 | OFDM | Clause 18 transmission | FORMAT is NON\_HT.  NON\_HT\_MODULATION is OFDM or NON\_HT\_DUP\_OFDM. | FORMAT is NON\_HT.  NON\_HT\_MODULATION is OFDM  or NON\_HT\_DUP\_OFDM |
| 8 | HT | N/A | FORMAT is HT\_MF or HT\_GF. | FORMAT is HT\_MF or HT\_GF |
| 9 | VHT | N/A | N/A | FORMAT is VHT |

Insert a new subclauses 9.7.10 and 9.7.11 following 9.7.9 as follows:

* Channel Width in non-HT and non-HT duplicate PPDUs

A non-VHT STA shall include neither the CH\_BANDWIDTH\_IN\_NON\_HT parameter nor the DYN\_BANDWIDTH\_IN\_NON\_HT parameter in either of the Clause 18 TXVECTOR or RXVECTOR. A non-VHT STA shall not set the TA field to a signaling TA. A VHT STA that includes the DYN\_BANDWIDTH\_IN\_NON\_HT parameter in the TXVECTOR shall also include the CH\_BANDWIDTH\_IN\_NON\_HT parameter in the TXVECTOR. A VHT STA shall include both the CH\_BANDWIDTH\_IN\_NON\_HT and DYN\_BANDWIDTH\_IN\_NON\_HT parameters in the Clause 18 RXVECTOR.

A signaling TA shall only be included in non-HT and non-HT duplicate format PPDUs. If the TXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT is present and a control MPDU other than a CTS is being transmitted, then the TA field shall be set to a signaling TA; otherwise, the TA field shall be set to an individual address.

NOTE—A CTS frame, which does not have a TA field, can also be transmitted with the TXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT present.

* Rate selection constraints for VHT STAs
* VHT Rx Supported MCS Set

The VHT Rx Supported MCS Set of a VHT STA is determined for each MCS, number of spatial streams *n* = 1, …, 8 and bandwidth (20 MHz, 40 MHz, 80 MHz and 160 MHz or 80+80 MHz) from its VHT Supported MCS Set field as follows:

* If the Max MCS For *n* SS subfield in the Rx MCS Map subfield indicates support and the integer part of the data rate (expressed in megabits per second) for long GI of the MCS for *n* SS at that bandwidth is less than or equal to the rate represented by the Rx Highest Supported Long GI Data Rate subfield, then the MCS for *n* SS at that bandwidth is supported by the STA on receive.
* If the Max MCS For *n* SS subfield in the Rx MCS Map subfield indicates support and the Rx Highest Supported Long GI Data Rate subfield is equal to 0, then the MCS for *n* SS at that bandwidth is supported by the STA on receive.
* If support for the MCS for *n* SS at that bandwidth is mandatory (see 22.5 (Parameters for VHT MCSs)), then the MCS for *n* SS at that bandwidth is supported by the STA on receive.
* Otherwise the MCS for *n* SS at that bandwidth is not supported by the STA on receive.

A VHT STA shall not, unless explicitly stated otherwise, transmit a VHT PPDU unless the MCS, number of spatial streams and bandwidth used are in the VHT Rx Supported MCS Set of the receiving STA(s).

NOTE—Support for a MCS for a given number of spatial streams at a given bandwidth implies support for both long GI and short GI on receive, if short GI is supported at that bandwidth.

* VHT Tx Supported MCS Set

The VHT Tx Supported MCS Set of a VHT STA is determined for each MCS, number of spatial streams *n* = 1, …, 8 and bandwidth (20 MHz, 40 MHz, 80 MHz and 160 MHz or 80+80 MHz) from its VHT Supported MCS Set field as follows:

* If the Max MCS For *n* SS subfield in the Tx MCS Map subfield indicates support and the integer part of the data rate (expressed in megabits per second) for long GI of the MCS for *n* SS at that bandwidth is less than or equal to the rate represented by the Tx Highest Supported Long GI Data Rate subfield, then the MCS for *n* SS at that bandwidth is supported by the STA on transmit.
* If the Max MCS For *n* SS subfield in the Tx MCS Map subfield indicates support and the Tx Highest Supported Long GI Data Rate subfield is equal to 0, then the MCS for *n* SS at that bandwidth is supported by the STA on transmit.
* If support for the MCS for *n* SS at that bandwidth is mandatory (see 22.5 (Parameters for VHT MCSs)), then the MCS for *n* SS at that bandwidth is supported by the STA on transmit.
* Otherwise the MCS for *n* SS at that bandwidth is not supported by the STA on transmit.

NOTE—Support for short GI on transmit cannot be determined.

* Rate selection for VHT PPDUs(#4164)

When a STA transmits a VHT PPDU with a number of spatial streams (*NSS*) less than or equal to 4,

* if the channel bandwidth of the PPDU is equal to CBW20 or CBW40, then the STA should not use a (VHT MCS, *NSS*) combination if the VHT MCS is equal to 0, 1, 2 or 3 and the HT MCS with value is marked as unsupported in the Rx MCS bitmask of the HT capabilities element of the receiver STA.



* if the channel bandwidth of the PPDU is equal to CBW80, CBW160 or CBW80+80, then the STA should not use a (VHT MCS, *NSS*) combination if the VHT MCS is equal to 0 or 1 and both the HT MCS values and are marked as unsupported in the Rx MCS bitmask of the HT capabilities element of the receiver STA.



NOTE—An example tabulation of this behavior is described in Example tabulation of rate selection for VHT PPDUs.

|  |  |  |
| --- | --- | --- |
| * Example tabulation of rate selection for VHT PPDUs | | |
| HT MCS(s), in the range 0 to 31, that are marked as unsupported, listed as HT MCS(s) modulo 8 | VHT MCS that is not used for CBW20 and CBW40, for the *NSS* identified by the HT MCS that is marked as unsupported | VHT MCS that is not used for CBW80, CBW160 and CBW80+80, for the *NSS* identified by the HT MCSs that are marked as unsupported |
| 0 | 0 | - |
| 1 | 1 | - |
| 2 | 2 | - |
| 3 | 3 | - |
| 0 and 1 | - | 0 |
| 2 and 3 | - | 1 |

* HT Control field operation

Change section 9.9 as follows:

If the value of dot11HTControlFieldSupported is true, a STA shall set the +HTC-HT Support subfield of the HT Extended Capabilities field of the HT Capabilities element to 1 in HT Capabilities elements that it transmits. If the value of dot11VHTControlFieldSupported is true, a STA shall set the +HTC-VHT Support subfield of the VHT Capabilities Info field of the VHT Capabilities element to 1 in VHT Capabilities elements that it transmits.

A STA that has a value of true for at least one of dot11RDResponderOptionImplemented and dot11MCSFeedbackOptionImplemented shall set (#4384)dot11HTControlFieldSupported or dot11VHTControlFieldSupported or both to true.

An HT variant HT Control field shall not be present in a frame addressed to a STA unless that STA declares support for +HTC-HT in the HT Extended Capabilities field of its HT Capabilities element (see 8.4.2.58 (HT Capabilities element)).

An HT variant HT Control field shall not be present in a frame addressed to a STA unless that STA declares support for +HTC-VHT in the VHT Capabilities Info field of its VHT Capabilities element.

NOTE—An HT STA that does not support +HTC (HT or VHT format) that receives a +HTC frame addressed to another STA still performs the CRC on the actual length of the MPDU and uses the Duration/ID field to update the NAV, as described in 9.3.2.4 (Setting and resetting the NAV)(#4159).

If the HT Control field is present in an MPDU aggregated in an A-MPDU, then all MPDUs of the same frame type (i.e., having the same value for the Type subfield of the Frame Control field) aggregated in the same A-MPDU shall contain an HT Control field. The HT Control field of all MPDUs containing the HT Control field aggregated in the same A-MPDU shall be set to the same value.

* A-MSDU operation

Change the 3rd last paragraph as follows:

Support for the reception of an A-MSDU, where the A-MSDU is carried in a QoS data MPDU with Ack Policy equal to Normal Ack ~~and the A-MSDU is not aggregated within an A-MPDU, is mandatory for an HT STA~~ is mandatory in the following cases:

* for an HT or VHT STA if the A-MSDU is not aggregated within an A-MPDU
* for a VHT STA if the A-MSDU is sent as a VHT single MPDU.

Change the last paragraph and insert subsequent paragraphs as follows:

A STA shall not transmit an A-MSDU in an HT PPDU to a STA that exceeds ~~its~~the maximum A-MSDU length ~~capability~~ indicated by the Maximum A-MSDU Length field of the HT Capabilities element most recently received from the recipient STA.

A VHT STA that sets the Maximum MPDU Length in the VHT Capabilities element to indicate 3895 octets shall set the Maximum A-MSDU Length in the HT Capabilities element to indicate 3839 octets. A VHT STA that sets the Maximum MPDU Length in the VHT Capabilities element to indicate 7991 octets or 11 454 octets shall set the Maximum A-MSDU Length in the HT Capabilities element to indicate 7935 octets.

A STA shall not transmit an MPDU in a VHT PPDU to a STA that exceeds the maximum MPDU length capability indicated in the VHT Capabilities element most recently received from the recipient STA.

NOTE 1—An A-MSDU that meets the A-MSDU length limit for transmission in a VHT PPDU might(#4746) exceed the A-MSDU length limit for an HT PPDU and thus cannot(#4385) be retransmitted in an HT PPDU.

NOTE 2—Support for A-MSDU aggregation does not affect the maximum size of MSDU transported by the MA-UNITDATA primitives.

* A-MPDU operation
* A-MPDU length limit rules

Change 9.12.2 as follows:

An A-MPDU pre-EOF padding is

* the portion of the A-MPDU up to but excluding the first A-MPDU subframe with 0 in the MPDU Length field and 1 in the EOF field, or
* the portion of the A-MPDU up to and including the last A-MPDU subframe if no A-MPDU subframes with 0 in in the MPDU Length field and 1 in the EOF field are present

NOTE—An A-MPDU pre-EOF padding include any A-MPDU subframes with 0 in the MPDU Length field and 0 in the EOF field inserted in order to meet the MPDU start spacing requirement.

A~~n HT~~ STA ~~and a DBand STA~~ indicates ~~a value~~ in the Maximum A-MPDU Length Exponent field in its HT Capabilities element ~~or DBand Capabilities element, respectively, that defines~~ the maximum A-MPDU length that it can receive in an HT\_MF or HT\_GF PPDU(#4734). A STA indicates in the Maximum A-MPDU Length Exponent field in its VHT Capabilities element the maximum length of the A-MPDU pre-EOF padding that it can receive in a VHT PPDU. A DBand STA indicates in the Maximum A-MPDU Length Exponent field in its DBand Capabilities element the maximum A-MPDU length that it can receive. The encoding of ~~this field~~these fields is defined in Table 8-125 (Subfields of the A-MPDU Parameters field) for an ~~HT STA~~ HT\_MF or HT\_GF PPDU, in Table 8-183u (Subfields of the VHT Capabilities Info field) for a VHT PPDU and in Table 8-183j for a DBand STA.

A VHT STA that sets the Maximum A-MPDU Length Exponent field in its VHT Capabilities element to a value in the range 0 to 3 shall set the Maximum A-MPDU Length Exponent in its HT Capabilities to the same value. A VHT STA that sets the Maximum A-MPDU Length Exponent field in the VHT Capabilities element to a value larger than 3 shall set the Maximum A-MPDU Length Exponent in its HT Capabilities element to 3.

Using ~~this field~~the Maximum A-MPDU Length fields, the STA establishes at association the maximum length of ~~A-MPDUs~~an A-MPDU pre-EOF padding that can be sent to it. ~~The~~An HT STA shall be capable of receiving A-MPDUs of length up to the value indicated by ~~this field~~the Maximum A-MPDU Length Exponent field in its HT Capabilities element. A VHT STA shall be capable of receiving A-MPDUs where the A-MPDU pre-EOF padding length is up to the value indicated by the Maximum A-MPDU Length Exponent field in its VHT Capabilities element.

A~~n HT STA and a DBand~~ STA shall not transmit an A-MPDU in an HT\_MF or HT\_GF PPDU(#4734) that is longer than the value indicated by the Maximum A-MPDU Length Exponent field in the HT Capabilities element sent~~declared~~ by the intended receiver. A STA shall not transmit an A-MPDU in a VHT PPDU where the A-MPDU pre-EOF padding length is longer than the value indicated by the Maximum A-MPDU Length Exponent field in the VHT Capabilities element sent by the intended receiver. A DBand STA shall not transmit an A-MPDU that is longer than the value indicated by the Maximum A-MPDU Length Exponent field in the DBand Capabilities element.

~~NOTE—The A-MPDU length limit applies to the maximum length of the PSDU that might be received. If the A-MPDU includes any padding delimiters (i.e., delimiters with the Length field equal to 0) in order to meet the MPDU start spacing requirement, this padding is included in this length limit.~~

* Minimum MPDU Start Spacing field

Change the 1st paragraph as follows:

A~~n HT STA and a DBand~~ STA shall not start the transmission of more than one MPDU within the time limit described in the Minimum MPDU Start Spacing field declared by the intended receiver. To satisfy this requirement, the number of octets between the start of two consecutive MPDUs in an A-MPDU, measured at the PHY SAP, shall be equal or greater than



where

is the time (in microseconds) defined in the “Encoding” column of Table 8-125 (Subfields of the A-MPDU Parameters field) for an HT or VHT STA and of Table 8-183j for a DBand STA for the value of the Minimum MPDU Start Spacing field



*r* is the value of the PHY Data Rate (in megabits per second) defined in Clause 21 for a DBand STA, ~~and for an HT STA defined~~ in 20.6 (Parameters for HT MCSs) for HT\_MF and HT\_GF PPDUs and in 22.5 (Parameters for VHT MCSs) for VHT PPDUs ~~based on the TXVECTOR parameters: MCS, GI\_TYPE, and CH\_BANDWIDTH~~

* A-MPDU aggregation of group addressed data frames

Change 9.12.4 as follows:

A~~n HT~~ STA that is neither an AP nor a mesh STA shall not transmit an A-MPDU containing an MPDU with a group addressed RA.

NOTE—An HT AP, a VHT AP, ~~and~~ an HT mesh STA and a VHT mesh STA can each transmit an A-MPDU containing MPDUs with a group addressed RA.

A STA that is an~~An HT~~ AP ~~and an HT~~ or a mesh STA shall not transmit an A-MPDU containing group addressed MPDUs if the HT Protection field is equal to non-HT mixed mode.

A DBand STA may transmit an A-MPDU containing MPDUs with a group addressed RA.

* 11ad D5.0 has not accounted for the 11s incorporation in REMmb D10.0 in the following paragraph. I have made an attempt to merge the 11ad change with REVmb D10.0 and then apply the edits.

When a~~n HT AP or a DBand STA or an HT mesh~~ STA transmits a PPDU containing at least one ~~an~~ A-MPDU ~~containing~~ that contains MPDUs with a group addressed RA, both of the following rules shall apply:

* If the PPDU is an HT PPDU, the value of maximum A-MPDU length exponent that applies is the minimum value in the Maximum A-MPDU Length Exponent subfields of the A-MPDU Parameters fields of the HT Capabilities elements across all HT STAs associated with the transmitting AP or across all peer HT mesh STAs of the transmitting mesh STA. If the PPDU is a VHT PPDU, the value of maximum A-MPDU length exponent that applies is the minimum value in the Maximum A-MPDU Length Exponent subfields of the A-MPDU Parameters fields of the VHT Capabilities elements across all VHT STAs associated with the transmitting AP or across all peer VHT mesh STAs. If the transmitting STA is a DBand STA, the value of the maximum A-MPDU length exponent that applies is minimum value of the Maximum A-MPDU Length Exponent subfields of the A-MPDU Parameters fields of the DBand Capabilities elements across all DBand STAs assocaited with the transmitting AP/PCP~~The value of maximum A-MPDU length exponent that applies is the minimum value in the Maximum A-MPDU Length Exponent subfield of the A-MPDU Parameters field of the HT Capabilities element across all HT STAs associated with the AP or all peer HT mesh STAs or of the DBand Capabilities element across all DBand STAs associated with the PCP/AP~~.
* If the PPDU is an HT PPDU, t~~T~~he value of minimum MPDU start spacing that applies is the maximum value in the Minimum MPDU Start Spacing subfields of the A-MPDU Parameters fields of the HT Capabilities elements across all HT STAs associated with the transmitting AP ~~or of the DBand Capabilities element across all DBand STAs associated with the PCP/AP~~ or across all peer HT mesh STAs of the transmitting mesh STA. If the PPDU is a VHT PPDU, the value of minimum MPDU start spacing that applies is the maximum value in the Minimum MPDU Start Spacing subfields of the A-MPDU Parameters fields of the VHT Capabilities elements across all VHT STAs associated with the transmitting AP or across all peer VHT mesh STAs of the transmitting mesh STA. If the transmitting STA is a DBand STA, the value of the minimum MPDU spacing that applies is the maximum value in the Minimum MPDU Start Spacing subfields of the A-MPDU Parameters fields of the DBand Capabilitis elements across all DBand STA associated with the transmitting AP/PCP.
* Transport of A-MPDU by the PHY data service

Change 9.12.5 as follows:

An A-MPDU shall be transmitted in a PSDU associated with a PHY-TXSTART.request primitive with the TXVECTOR parameter AGGREGATION ~~parameter~~ set to 1 or the TXVECTOR parameter FORMAT set to VHT. A received PSDU is determined to be an A-MPDU when the associated PHY-RXSTART.indication primitive RXVECTOR parameter AGGREGATION ~~parameter~~ is equal to 1 or the TXVECTOR parameter FORMAT is equal to VHT.

MPDUs in an A-MPDU carried in an HT\_MF or HT\_GF PPDU(#4734) shall be limited to a maximum length of 4095 octets.

Insert new sections 9.12.6 and 9.12.7 following section 9.12.5:

* A-MPDU padding for VHT PPDU

The procedure in the subclause is applied for each user in an MU PPDU and for one user in an SU PPDU.

A VHT STA that delivers an A-MPDU to the PHY (using PHY-DATA.request primitives) as the PSDU for a VHT PPDU shall pad the A-MPDU as described in this subclause.

An A-MPDU pre-EOF padding (see A-MPDU length limit rules) is constructed from the MPDUs available for transmission and meeting the A-MPDU content (see 8.6.3 (A-MPDU contents)), length limit (see 8.6.1 (A-MPDU format)) and MPDU start spacing (see Minimum MPDU Start Spacing field) constraints. The length of the resulting A-MPDU pre-EOF padding, A-MPDU\_Length, is used as the APEP\_LENGTH parameter for the A-MPDU for each user in the PLME-TXTIME.request (see 6.5.7 (PLME-TXTIME.request)) primitive which is invoked once per PPDU (not once per user) and in the MAC padding procedure described in this subclause. The PLME-TXTIME.confirm (see 6.5.8 (PLME-TXTIME.confirm)) primitive provides the TXTIME parametr and PSDU\_LENGTH parameters for each user for the transmission.

Padding is then added for each user such that the resulting A-MPDU contains exactly PSDU\_LENGTH octets for that user as follows:

* First, while A-MPDU\_Length < PSDU\_LENGTH for that user and A-MPDU\_Length mod 4 != 0, add a subframe padding octet and increment A-MPDU\_Length by 1
* Then, while A-MPDU\_Length + 4 <= PSDU\_LENGTH for that user, add an A-MPDU subframe with 0 in the MPDU Length field and 1 in the EOF field and increment A-MPDU\_Length by 4
* Finally, while A-MPDU\_Length < PSDU\_LENGTH for that user, add an EOF padding octet and increment A-MPDU\_Length by 1

An A-MPDU subframe with EOF set to 1 and with MPDU Length field set to 0 shall not be added before any A-MPDU subframe with EOF set to 0.

An A-MPDU subframe with EOF set to 1 and with MPDU Length field set to 0 shall not be added before an A-MPDU subframe that contains a VHT single MPDU (see Setting the EOF field of the MPDU delimiter).

An EOF pad shall not be added before any A-MPDU subframe.

* Setting the EOF field of the MPDU delimiter(#4969)

The EOF field in an A-MPDU subframe with a non-zero MPDU Length field that is the only A-MPDU subframe with a non-zero MPDU Length field in an A-MPDU carried in a VHT PPDU may be set to 1. The EOF field in each A-MPDU subframe with a non-zero MPDU Length field that is not the only A-MPDU subframe with a non-zero MPDU Length field in the A-MPDU shall be set to 0.

The EOF field shall be set to 0 in all A-MPDU subframes that are carried in an HT PPDU.

An MPDU that is the only MPDU in an A-MPDU and that is carried in an A-MPDU subframe with 1 in the EOF field is called a VHT single MPDU.

* Transport of VHT single MPDUs

The rules for VHT single MPDU operation are the same as the rules for non-A-MPDU operation even though the MPDU is carried in an A-MPDU.

NOTE—This affects the following behavior:

* The MPDU could carry a fragment of an MSDU or MMPDU (see Fragmentation/defragmentation overview)
* Rate selection of control responses (see Multirate support)
* A data MPDU cannot indicate an Ack Policy of “Implicit Block Ack”, and does not generate a Block Ack response.
* A data MPDU could indicate an Ack Policy of “Normal Ack”, which generates an ACK immediate response. No Block Ack agreement is necessary in this case.
* The MPDU could be a management frame that elicits an ACK response.

Insert the new subclause 9.13a following 9.13:(#4045)

* Constraints on signalling channel bandwidth in non-HT frames

The TXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT shall not be present in PPDUs carrying management or data frames.

* STBC operation

Change as follows:

Only a STA that sets the Tx STBC subfield to 1 in the HT Capabilities element may transmit f~~rames~~ HT PPDUs with a TXVECTOR parameter STBC set to a nonzero value to an HT STA from which the most recently received value of the Rx STBC field of the HT Capabilities element is nonzero. Only a VHT STA that sets the Tx STBC subfield to 1 in the VHT Capabilities element may transmit VHT PPDUs with a TXVECTOR parameter STBC set to a nonzero value to a VHT STA from which the most recently received value of the Rx STBC field of the VHT Capabilities element is nonzero. The number of spatial streams of such a VHT PPDU shall not exceed the supported number of spatial streams of the receiving VHT STA as indicated by the Rx STBC field of its VHT Capabilities element.(#4394)

* Short GI operation

Change 9.16 as follows:

A STA may transmit a frame with TXVECTOR parameters CH\_BANDWIDTH set to ~~HT\_~~CBW20 and GI\_TYPE set to SHORT\_GI only if all of the following conditions are met:

* The STA is an HT STA or VHT STA.
* The TXVECTOR parameter FORMAT is equal to HT\_MF, ~~or~~ HT\_GF or VHT.
* The RA of the frame corresponds to a STA for which the Short GI for 20 MHz subfield of the most recently received HT Capabilities element contained a value of 1.
* dot11ShortGIOptionInTwentyActivated is present and is true.

A STA may transmit a frame with TXVECTOR parameters CH\_BANDWIDTH set to ~~HT\_~~CBW40 and GI\_TYPE set to SHORT\_GI only if all of the following conditions are met:

* The STA is an HT STA or VHT STA.
* The TXVECTOR parameter FORMAT is equal to HT\_MF, ~~or~~ HT\_GF or VHT.
* The RA of the frame corresponds to a STA for which the Short GI for 40 MHz subfield of the most recently received HT Capabilities element contained a value of 1.
* dot11ShortGIOptionInFortyActivated is present and is true.

A STA may transmit a frame with TXVECTOR parameters CH\_BANDWIDTH set to CBW80 and GI\_TYPE set to SHORT\_GI only if all of the following conditions are met:

* The STA is a VHT STA.
* The TXVECTOR parameter FORMAT is equal to VHT.
* The RA of the frame corresponds to a STA for which the Short GI for 80 MHz subfield of the most recently received VHT Capabilities element contained a value of 1.
* dot11ShortGIOptionIn80Activated is present and is true.(#4395)

A STA may transmit a frame with TXVECTOR parameters CH\_BANDWIDTH set to CBW160 or CBW80+80 and GI\_TYPE set to SHORT\_GI only if all of the following conditions are met:

* The STA is a VHT STA.
* The TXVECTOR parameter FORMAT is equal to VHT.
* The RA of the frame corresponds to a STA for which the Short GI for 160 and 80+80 MHz subfield of the most recently received VHT Capabilities element contained a value of 1.
* dot11ShortGIOptionIn160and80p80Activated is present and is true.

A STA may transmit a frame with TXVECTOR parameters FORMAT set to VHT and NUM\_USERS set to greater than 1 and GI\_TYPE set to SHORT\_GI only if all of the following conditions are met:

* The STA is a VHT STA.
* The TXVECTOR parameter FORMAT is equal to VHT.
* The RAs of all MPDUs in the MU PPDU corresponds to STAs for which the Short GI subfield of the following conditions are satisfied:(#4395)
* If the TXVECTOR parameter CH\_BANDWIDTH is set to CBW20, the Short GI for 20 MHz subfields of the most recently received HT Capabilities element contained a value of 1 and dot11ShortGIOptionInTwentyActivated is present and is true.
* If the TXVECTOR parameter CH\_BANDWIDTH is set to CBW40, the Short GI for 40 MHz subfields of the most recently received HT Capabilities element contained a value of 1 and dot11ShortGIOptionInFortyActivated is present and is true.
* If the TXVECTOR parameter CH\_BANDWIDTH is set to CBW80, the Short GI for 80 MHz subfields of the most recently received VHT Capabilities element contained a value of 1 and dot11ShortGIOptionIn80Activated is present and is true.
* If the TXVECTOR parameter CH\_BANDWIDTH is set to CBW160 or CBW80+80, the Short GI for 160 MHz and 80+80 MHz subfields of the most recently received VHT Capabilities element contained a value of 1 dot11ShortGIOptionIn160and80p80Activated is present and is true.

An HT STA shall not transmit a frame with the TXVECTOR parameter FORMAT set to HT\_GF and the GI\_TYPE parameter set to SHORT\_GI when the MCS parameter indicates a single spatial stream.

Further restrictions on TXVECTOR parameter values may apply due to rules found in 9.22 (Protection mechanisms) and Multirate support.

Insert new subclause 9.17a following 9.17:

* Group ID and partial(#4829) AID in VHT PPDUs

The partial AID is a non-unique identifier of a STA based on its AID and the BSSID of the BSS to which the STA is associated. The partial AID is carried in the TXVECTOR parameter PARTIAL\_AID of a VHT SU PPDU and is limited to 9 bits. The partial AID can be used for power saving.(#4505)

A STA transmitting a VHT SU PPDU carrying one or more group addressed MPDUs or transmitting a VHT NDP intended for multiple recipients shall set the TXVECTOR parameters GROUP\_ID to 63 and PARTIAL\_AID to 0. The intended recipient of a VHT NDP is defined in Transmission of a VHT NDP.

A STA transmitting a VHT SU PPDU carrying one or more individually addressed MPDUs or a VHT NDP intended for a single recipient shall set the TXVECTOR parameters GROUP\_ID and PARTIAL\_AID as shown in Settings for the TXVECTOR parameters GROUP\_ID and PARTIAL\_AID.

|  |  |  |
| --- | --- | --- |
| * Settings for the TXVECTOR parameters GROUP\_ID and PARTIAL\_AID(#5087) | | |
| Condition | GROUP\_ID | PARTIAL\_AID |
| Addressed to AP | 0 | BSSID[39:47] |
| Addressed to Mesh STA | 0 | RA[39:47] |
| Sent by an AP and addressed to a STA associated with that AP or  sent by a DLS or TDLS STA in a direct path to a DLS or TDLS peer STA(#4397) | 63 | (#5418)where  is a bitwise exclusive OR operation  *mod* X indicates the X-modulo operation  *dec*(A[*b*:*c*]) is the cast to decimal operator where *b* is scaled by 20 and *c* by 2*c-b* |
|
| Otherwise | 63 | 0 |

NOTE—In Settings for the TXVECTOR parameters GROUP\_ID and PARTIAL\_AID the last row includes the cases of a(#4398) PPDU carrying MPDUs

* sent to an IBSS STA
* sent by an AP to a non associated STA
* sent to a STA for which it is not known(#4662) which condition is applicable

and any other condition not explicitly listed in the other rows of the table.

In Settings for the TXVECTOR parameters GROUP\_ID and PARTIAL\_AID

* AID[*b*:*c*] represents bits *b* to *c* inclusive of the AID of the recipient STA with bit 0 being the first transmitted
* BSSID[*b*:*c*] represent bits *b* to *c* inclusive of the BSSID, with bit 0 being the Individual/Group bit. In this representation, the Individual/Group bit is BSSID[0] and BSSID[47] is the last transmitted bit.
* RA[*b*:*c*] represent bits *b* to *c* inclusive of the RA field, with bit 0 being the Individual/Group bit. In this representation, the Individual/Group bit is RA[0] and RA[47] is the last transmitted bit.

A STA that transmits a VHT PPDU to a DLS or TDLS peer STA obtains the AID for the peer STA from the DLS Setup Request, DLS Setup Response, TDLS Setup Request or TDLS Setup Response frame.

* An AP should not assign an AID to a STA that results in the PARTIAL\_AID value, as computed using

, being equal to 0.

A STA transmitting a VHT MU PPDU sets the TXVECTOR parameter GROUP\_ID as described in 22.3.11.4 (Group ID).

As an example of the GROUP\_ID and PARTIAL\_AID setting, consider the case of a BSS with BSSID 00-21-6A-AC-53-52 that has as a member a non-AP STA assigned AID 5. In VHT PPDUs sent to an AP, the GROUP\_ID is set to 0 and the PARTIAL\_AID is set to 164(#4623). In VHT PPDUs sent by the AP to the non-AP STA associated with that AP, the GROUP\_ID is set to 63 and PARTIAL\_AID(#4663) is set to 229(#4623).

* HCF
* HCF contention-based channel access (EDCA)
* Reference implementation
* EDCA TXOPs

Change the first 3 paragraphs as follows:

There are ~~two~~three modes of EDCA TXOP defined, the initiation of the EDCA TXOP, the sharing of the EDCA TXOP, and the multiple frame transmission within an EDCA TXOP. An initiation of the TXOP occurs when the EDCA rules permit access to the medium. The sharing of the EDCA TXOP occurs when an EDCAF has obtained access to the medium, making the associated AC the primary AC, and includes traffic from queues associated with other ACs in MU PPDUs transmitted during the TXOP. A multiple frame transmission within the TXOP occurs when an EDCAF retains the right to access the medium following the completion of a frame exchange sequence, such as on receipt of an ACK frame or on receipt of a VHT Compressed Beamforming frame(#5372) sent in response to either a VHT NDP Announcement(#4921) frame or a Beamforming Report Poll frame.

The TXOP limit duration values are advertised by the AP in the EDCA Parameter Set element in Beacon and Probe Response frames transmitted by the AP.

A TXOP limit value of 0 indicates that the TXOP holder may transmit or cause to be transmitted (as responses) the following within the current TXOP:

* ~~A single MSDU, MMPDU, A-MSDU, or A-MPDU~~ One of the following at any rate, subject to the rules in Multirate support:
* SU PPDUs carrying fragments of a single MSDU or MMPDU
* An SU PPDU carrying a single MSDU, MMPDU, A-MSDU, or A-MPDU
* An MU PPDU carrying A-MPDUs to different users
* Any required acknowledgments
* Any frames required for protection, including one of the following:
* An RTS/CTS exchange
* CTS to itself
* Dual CTS as specified in 9.3.2.8 (Dual CTS protection)
* Any frames required for beamforming as specified in Sounding PPDUs and in VHT sounding protocol
* Any frames required for link adaptation as specified in Link adaptation
* Any number of BlockAckReq and BlockAck frames

NOTE 1—This is a rule for the TXOP holder. A TXOP responder need not be aware of the TXOP limit nor of when the TXOP was started.

NOTE 2—This rule prevents the use of RD when the TXOP limit is 0.

When dot11OCBActivated is true, TXOP limits shall be 0 for each AC.

STAs shall limit the duration of TXOPs obtained using the EDCA rules to the value specified by the TXOP limit. The duration of a TXOP is the duration during which the TXOP holder maintains uninterrupted control of the medium, and it includes the time required to transmit frames sent as an immediate response to the TXOP holder’s transmissions.

When the TXOP limit is nonzero, a STA shall fragment an individually addressed MSDU so that the transmission of the first MPDU of the TXOP does not cause the TXOP limit to be exceeded at the PHY rate selected for the initial transmission attempt of that MPDU. The TXOP limit may be exceeded, when using a lower PHY rate than selected for the initial transmission attempt of the first MPDU, for a retransmission of an MPDU, for the initial transmission of an MPDU if any previous MPDU in the current MSDU has been retransmitted, or for group addressed MSDUs. The TXOP limit may also be exceeded by transmitting a VHT NDP Announcement(#4921) frame and NDP, or Beamforming Report Poll frame, in the sense that they fit within the TXOP limit but the response causes the TXOP limit to be exceeded. When the TXOP limit is exceeded due to the retransmission of an MPDU at a reduced PHY rate, the STA shall not transmit more than one MPDU in the TXOP.

Change the last paragraph of 9.19.2.2 as follows:

A STA shall save the TXOP holder address for the BSS in which it is associated, which is the MAC address from the Address 2 field of the frame that initiated a frame exchange sequence except when this is a CTS frame, in which case the TXOP holder address is the Address 1 field. If the TXOP holder address is obtained from a control frame, the STA shall save the value of the address with the Individual/Group bit forced to 0. If an RTS frame is received with the RA address matching the MAC address of the STA and the MAC address in the TA field in the RTS frame matches the saved TXOP holder address, then the STA shall send the CTS frame after SIFS, without regard for, and without resetting, its NAV. When a STA receives a frame addressed to it that requires an immediate response, except for RTS, it shall transmit the response independent of its NAV. The saved TXOP holder address shall be cleared when the NAV is reset or when the NAV counts down to 0.

Insert new subclause 9.19.2.2a

following 9.19.2.2

* Sharing an EDCA TXOP

This mode only applies to an AP that supports DL MU-MIMO. The AC associated with the EDCAF that is granted an EDCA TXOP becomes the primary AC. TXOP sharing is achieved when primary AC traffic is transmitted in an MU PPDU and resources permit traffic from secondary ACs to be included, targeting up to four STAs. The inclusion of secondary AC traffic in an MU PPDU shall not increase the duration of the MU PPDU beyond that required to transport the primary AC traffic. If a destination is targeted by frames in the queues of both the primary AC and at least one secondary AC, the frames in the primary AC queue shall be transmitted to the destination first, among a series of downlink transmissions within a TXOP. The decision of which secondary ACs and destinations are selected for TXOP sharing, as well as the order of transmissions, are implementation specific and out of scope for this specification.

NOTE—Each A-MPDU shall contain frames from the same AC as defined in 8.6.3 (A-MPDU contents).

When sharing, the TXOP duration is bounded by the TXOP limit of the primary AC.

An illustration of TXOP sharing is shown in Illustration of TXOP sharing and PPDU construction. In this figure, the AP has frames in queues of three of its ACs. It is assumed that the TXOP was obtained by AC\_VI and is shared by AC\_VO and AC\_BE. It is also assumed that these frames are targeting three STAs, STA-1 to STA-3.

|  |
| --- |
|  |
| * Illustration of TXOP sharing and PPDU construction |

* Obtaining an EDCA TXOP

Insert as the 1st paragraph of this subclause:

When a STA and the BSS, of which the STA is a member,(#4903) both support multiple channel widths, an EDCA TXOP is obtained based solely on activity of the primary channel. "Idle medium" in this subclause means "idle primary channel". Likewise "busy medium" means "busy primary channel". Once an EDCA TXOP has been obtained according to this subclause further constraints defined in 10.15.9 (STA CCA sensing in a 20/40 MHz BSS) and EDCA channel access in a VHT BSS might limit the width of transmission during the TXOP or deny the channel access, based on the state of CCA on secondary channel, secondary 40 MHz channel or secondary 80 MHz channel(#4742).

Change the 4th and subsequent paragraphs as follows:

On specific slot boundaries as determined on the primary channel, each EDCAF shall make a determination to perform one and only one of the following functions:

* Initiate the transmission of a frame exchange sequence for that access function.
* Decrement the backoff timer for that access function.
* Invoke the backoff procedure due to an internal collision.
* Do nothing for that access function.

(#4405)

The specific slot boundaries at which exactly one of these operations shall be performed are defined as follows, for each EDCAF:

* Following AIFSN[AC] × aSlotTime – aRxTxTurnaroundTime of idle medium after SIFS (not necessarily idle medium during the SIFS duration) as determined using the same antenna as was used during the reception of a frame with a correct FCS and occurring immediately after the ~~last~~end of the busy medium indication which ~~on the antenna that~~ was the result of ~~a~~that reception ~~of a frame with a correct FCS~~.
* Following EIFS – DIFS + AIFSN[AC] × aSlotTime – aRxTxTurnaroundTime of idle medium after the last indicated busy medium as determined by the physical CS mechanism that was the result of a frame reception that has resulted in FCS error, or PHY-RXEND.indication (-RXERROR) primitive where the value of RXERROR is not NoError.
* When any other EDCAF at this STA transmitted a frame requiring acknowledgment, the earlier of
* The end of the ACK-Timeout interval timed from the PHY\_TXEND.confirm primitive, followed by AIFSN[AC] x aSlotTime + aSIFSTime – aRxTxTurnaroundTime of idle medium, and
* The end of the first AIFSN[AC] × aSlotTime – aSIFSTime - aRxTxTurnaroundTime of idle medium after SIFS (not necessarily medium idle during the SIFS duration, the start of the SIFS duration implied by the length in the PLCP header of the previous frame) when a PHY-RXEND.indication primitive occurs as specified in 9.3.2.9 (ACK procedure).
* Following AIFSN[AC] × aSlotTime – aSIFSTime - aRxTxTurnaroundTime of idle medium after SIFS (not -necessarily medium idle during the SIFS duration) after the last busy medium on the antenna that was the result of a transmission of a frame for any EDCAF and which did not require an -acknowledgment.
* Following AIFSN[AC] × aSlotTime – aRxTxTurnaroundTime of idle medium after the last indicated idle medium as indicated by the CS mechanism that is not covered by a) to d).
* Following aSlotTime of idle medium, which occurs immediately after any of these conditions, a) to f), is met for the EDCAF.
* Multiple frame transmission in an EDCA TXOP

Change 9.19.2.4 as follows:

Multiple frames may be transmitted in an EDCA TXOP that was acquired following the rules in Obtaining an EDCA TXOP if there is more than one frame pending in the primary AC for which the channel has been acquired. However, those frames that are pending in other ACs shall not be transmitted in this EDCA TXOP except when sent in an(#4234) MU PPDU and if allowed by the rules in Sharing an EDCA TXOP. If a TXOP holder has in its transmit queue an additional frame of the ~~same~~ primary AC ~~as the one just transmitted~~ and the duration of transmission of that frame plus any expected acknowledgment for that frame is less than the remaining TXNAV timer value, then the ~~STA~~TXOP holder may commence transmission of that frame a SIFS (or RIFS, ~~under~~if the conditions defined in RIFS are met) after the completion of the immediately preceding frame exchange sequence. A STA shall not commence the transmission of an RTS with a signaling TA until at least PIFS time after the immediately preceding frame exchange sequence. An HT or VHT STA that is a TXOP holder may transmit multiple MPDUs of the same AC within an A-MPDU as long as the duration of transmission of the A-MPDU plus any expected BlockAck response is less than the remaining TXNAV timer value.

NOTE—An RD responder can transmit multiple MPDUs as described in 9.24.4 (Rules for RD responder)

The TXNAV timer is a timer that is initialized with the duration from the Duration/ID field in the frame most recently successfully transmitted by the TXOP holder. The TXNAV timer begins counting down from the end of the transmission of the PPDU containing that frame. Following the BlockAck response, the HT or VHT STA may start transmission of another MPDU or A-MPDU a SIFS after the completion of the immediately preceding frame exchange sequence. The HT or VHT STA may retransmit unacknowledged MPDUs within the same TXOP or in a subsequent TXOP.

After a valid response to the initial frame of a TXOP, if the Duration/ID field is set for multiple frame transmission and there is a subsequent transmission failure, the corresponding channel access function may transmit after the CS mechanism (see 9.3.2.2 (CS mechanism)) indicates that the medium is idle at the TxPIFS slot boundary (defined in 9.3.7 (DCF timing relations)) before the expiry of the TXNAV timer. At the expiry of the TXNAV timer, if the channel access function has not regained access to the medium, then the EDCAF shall invoke the backoff procedure that is described in EDCA backoff procedure. Transmission failure is defined in EDCA backoff procedure.

All other channel access functions at the STA shall treat the medium as busy until the expiry of the TXNAV timer.

A frame exchange may be

* a frame not requiring acknowledgement (such as a group addressed frame or a frame transmitted with No Ack policy) or an A-MPDU containing only such frames, or
* a frame requiring acknowledgement (such as an individually-addressed frame transmitted with Normal Ack policy) or an A-MPDU containing at least one such frame, followed after SIFS by a corresponding acknowledgement frame, or
* either
  + a VHT NDP Announcement(#4921) frame followed after SIFS by a VHT NDP, or
  + a Beamforming Report Poll frame

followed after SIFS by a PPDU containing one or more VHT Compressed Beamforming frames.

Note that, as for an EDCA TXOP, a multiple frame transmission is granted to an EDCAF, not to a STA, so that the multiple frame transmission is permitted only for the transmission of a frame of the same AC as the frame that was granted the EDCA TXOP, unless the EDCA TXOP obtained is used by an AP for a PSMP sequence or an MU(#4668) transmission.

In ~~such a~~ the case of PSMP, this AC transmission restriction does not apply to either the AP or the STAs participating in the PSMP sequence, but the specific restrictions on transmission during a PSMP sequence described in 9.26 (PSMP Operation)(#4616) do apply.

In the case of an MU-MIMO sequence and when permitted by the rules in Sharing an EDCA TXOP, traffic from secondary ACs may be transmitted in an MU PPDU carrying traffic for the primary AC.

A TXOP is obtained after a STA transmitting an initial frame successfully receives a response frame, or the initial frame is a CTS-to-self. When a TXOP is obtained for a channel width(#4406) that is greater than 20 MHz by a(#4406) non-HT duplicate frame exchange, the TXOP holder may transmit PPDUs using CH\_BANDWIDTH that are up to and including the bandwidth obtained for the TXOP. During the TXOP, the TXOP holder shall not transmit PPDUs with the TXVECTOR parameter CH\_BANDWIDTH set to a value indicating a channel width greater than the channel width(#4406) obtained for the TXOP.

If a TXOP is protected by a(#4406) non-HT or a(#4406) non-HT duplicate RTS/CTS, the TXOP holder shall set the TXVECTOR parameter CH\_BANDWIDTH of a PPDU as follows:

* To be the same or narrower than RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT of the last received CTS frame in the same TXOP, if the RTS frame with a signaling TA and TXVECTOR parameter DYN\_BANDWIDTH\_IN\_NON\_HT set to Dynamic has been sent by the TXOP holder in the last RTS/CTS exchange.
* Otherwise, to be the same or narrower than the TXVECTOR parameter CH\_BANDWIDTH of the RTS frame that has been sent by the TXOP holder in the last RTS/CTS in the same TXOP.

If there is no RTS/CTS exchange in non-HT duplicate format in a TXOP and there is at least one non-HT duplicate frame exchange in a TXOP, the TXOP holder shall set the CH\_BANDWIDTH parameter in TXVECTOR of a PPDU to be the same or narrower than the CH\_BANDWIDTH parameter in TXVECTOR of the initial frame in the first non-HT duplicate frame exchange in the same TXOP.

If there is no non-HT duplicate frame exchange in a TXOP, the TXOP holder shall set the TXVECTOR parameter CH\_BANDWIDTH of a non-initial PPDU to be the same or narrower than the TXVECTOR parameter CH\_BANDWIDTH of the preceding PPDU that it has transmitted in the same TXOP.

If a TXOP is protected by non-HT or non-HT duplicate CTS-to-Self, the TXOP holder shall set the TXVECTOR parameter CH\_BANDWIDTH of a PPDU to be the same or narrower than the TXVECTOR parameter CH\_BANDWIDTH of the CTS-to-Self in the same TXOP.

* EDCA backoff procedure

Change as follows:

Each EDCAF shall maintain a state variable CW[AC], which shall be initialized to the value of the parameter CWmin[AC].

For the purposes of this subclause, successful transmission and transmission failure of an MPDU are defined as follows:

* After transmitting an MPDU (~~regardless of whether~~ even if it is carried in an A-MPDU or as part of an MU PPDU) that requires an immediate frame as a response, the STA shall wait for a timeout interval of duration of aSIFSTime + aSlotTime + aPHY-RX-START-Delay, starting at the PHY-TXEND.confirm. If a PHYRXSTART.indication does not occur during the timeout interval, the STA concludes that the
* transmission of the MPDU has failed.
* If a PHY-RXSTART.indication does occur during the timeout interval, the STA shall wait for the
* corresponding PHY-RXEND.indication to determine whether the MPDU transmission was
* successful. The recognition of a valid response frame sent by the recipient of the MPDU requiring a
* response, corresponding to this PHY-RXEND.indication, shall be interpreted as a successful
* response.
* The recognition of a valid data frame sent by the recipient of a PS-Poll
* frame shall also be accepted as successful acknowledgment of the PS-Poll frame.
* ~~A~~ The transmission of an MPDU that does not require an immediate frame as a response is defined as a successful transmission, unless it is one of the non-final (re)transmissions of an MPDU that is delivered using the GCR unsolicited retry retransmission policy (9.19.2.6.2).
* The non-final (re)transmission of an MPDU that is delivered using the GCR unsolicited retry retransmission policy (9.19.2.6.2)) is defined to be a failure.
* The final (re)transmission of an MPDU that is delivered using the GCR unsolicited retry retransmission policy (9.19.2.6.2) is defined as a successful transmission.
* The recognition of anything else, including any other valid frame, shall be interpreted as failure of the MPDU transmission.

The backoff procedure shall be invoked for an EDCAF when any of the following events occurs:

* A frame with that AC is requested to be transmitted, the medium is busy on the primary channel as indicated by either
* physical or virtual CS, and the backoff timer has a value of zero for that AC.
* The final transmission by the TXOP holder initiated during the TXOP for that AC was successful and the TXNAV timer has expired.
* The ~~transmission of~~ expected immediate response to the initial frame of a TXOP of that AC ~~fails~~is not received.
* The transmission attempt collides internally with another EDCAF of an AC that has higher priority,
* that is, two or more EDCAFs in the same STA are granted a TXOP at the same time, and the EDCAF of the lower priority AC is not sharing the TXOP with the winning AC through TXOP sharing mode.
* The transmission attempt of a MAC entity within an MA-STA collides internally with another MAC entity of the same MA-STA (see 10.35 (MMAL cluster operation)), which is indicated to the first MAC entity with a PHY-TxBusy.indication (BUSY) as response to the PHY-TXSTART.request.(11ad)

In event d) above, if an internal collision can be resolved by one or more secondary ACs sharing the MU TXOP for downlink transmission, the one or more secondary ACs shall keep their CW[AC]s and backoff timer values unchanged before transmitting in an(#4234) MU TXOP. In addition, at the end of the transmissions, depending on the transmission results, a secondary AC shall invoke different backoff procedures defined for either event b) or event c).

In addition, the backoff procedure may be invoked for an EDCAF when the transmission of one or more MPDUs in a non-initial ~~frame~~ PPDU or MU PPDU by the TXOP holder fails.

NOTE—A STA can perform a PIFS recovery as described in Multiple frame transmission in an EDCA TXOP or perform a backoff as described in the previous paragraph as a response to transmission failure within a TXOP. How it chooses between these two is implementation dependent.

A STA that performs a backoff within its existing TXOP shall not extend the TXNAV timer value.

NOTE—In other words, the backoff is a continuation of the TXOP, not the start of a new TXOP.

If the backoff procedure is invoked for reason a) above, the value of CW[AC] shall be left unchanged. If the backoff procedure is invoked because of reason b) above and the AC is the primary AC in an(#4234) MU transmission or the only AC in an(#4234) SU transmission, the value of CW[AC] shall be reset to CWmin[AC]. If the backoff procedure is invoked because of reason b) above and the AC is a secondary AC in an(#4234) MU transmission, neither the value of CW[AC] nor the backoff timer shall be changed.

QoS STAs shall maintain a short retry counter and a long retry counter for each MSDU, A-MSDU, or MMPDU that belongs to a TC that requires acknowledgment. The initial value for the short and long retry counters shall be zero. QoS STAs also maintain a short retry counter and a long retry counter for each AC. They are defined as QSRC[AC] and QLRC[AC], respectively, and each is initialized to a value of zero. When dot11RobustAVStreamingImplemented is true, QoS STAs shall maintain a short drop-eligible retry counter and a long drop-eligible retry counter for each AC. They are defined as QSDRC[AC] and QLDRC[AC], respectively, and each is initialized to a value of zero. APs with dot11RobustAVStreamingImplemented true and mesh STAs with dot11MeshGCRImplemented true, shall maintain an unsolicited retry counter.

If the backoff procedure is invoked because of a failure event [reason c) or d) or e)(11ad) above or the transmission failure of a non-initial frame by the TXOP holder], the value of CW[AC] shall be updated as follows before invoking the backoff procedure:

* If the QSRC[AC] or the QLRC[AC] for the QoS STA has reached dot11ShortRetryLimit or dot11LongRetryLimit respectively, CW[AC] shall be reset to CWmin[AC].
* If the QSDRC[AC] or the QLDRC[AC] for the QoS STA in which dot11RobustAVStreamingImplemented is true has reached dot11ShortDEIRetryLimit or dot11LongDEIRetryLimit, respectively, CW[AC] shall be reset to CWmin[AC].
* Otherwise,
* If CW[AC] is less than CWmax[AC], CW[AC] shall be set to the value (CW[AC] + 1)\*2 – 1.
* If CW[AC] is equal to CWmax[AC], CW[AC] shall remain unchanged for the remainder of any retries.

The backoff timer is set to an integer value chosen randomly with a uniform distribution taking values in the range [0,CW[AC]] inclusive.

All backoff slots occur following an AIFS[AC] period during which the medium is determined to be idle on the primary channel for the duration of the AIFS[AC] period, or following an EIFS – DIFS + AIFS[AC] period during which the medium is determined to be idle on the primary channel for the duration of the EIFS – DIFS + AIFS[AC] period, as appropriate (see IFS), except as defined in Obtaining an EDCA TXOP, which allows the medium to be busy during the initial aSIFSTime of this period under certain conditions.

~~If the backoff procedure is invoked following the transmission of a 40 MHz mask PPDU, the backoff counter shall be decremented based on a medium busy indication that ignores activity in the secondary channel. Additional 40 MHz mask PPDU backoff rules are found in 10.15.9 (STA CCA sensing in a 20/40 MHz BSS).~~

* Retransmit procedures

Change the 4th paragraph as follows:

For internal collisions occurring with the EDCA access method, the appropriate retry counters of the colliding ACs that did not transmit in an(#4234) MU TXOP (short retry counter for MSDU, A-MSDU, or MMPDU and QSRC[AC] or long retry counter for MSDU, AMSDU, or MMPDU and QLRC[AC]) are incremented. For internal collisions occurring with the EDCA access method where dot11RobustAVStreamingImple-mented is true, the appropriate drop-eligible retry counters (QSDRC[AC], and QLDRC[AC]) are incremented when the collision occurs for MSDU, A-MSDU or MMPDU that has drop eligibility equal to one. For transmissions that use Block Ack, the rules in 9.21.3 (Data and acknowledgment transfer using immediate Block Ack policy and delayed Block Ack policy) also apply. STAs shall retry failed transmissions until the transmission is successful or until the relevant retry limit is reached.

* Truncation of a TXOP

Change the 4th paragraph and subsequent note as follows and insert an additional note as shown:

A STA shall interpret the reception of a CF-End frame as a NAV reset, i.e., it resets its NAV timer to zero at the end of the PPDU containing this frame. After receiving a CF-End frame with a matching BSSID without comparing Individual/Group bit, an AP may respond by transmitting a CF-End frame after SIFS.

NOTE 1—The transmission of a single CF-End frame by the TXOP holder resets the NAV of STAs hearing the TXOP holder. There may be STAs that could hear the TXOP responder that had set their NAV that do not hear this NAV reset. Those STAs are prevented from contending for the medium until the original NAV reservation expires.

NOTE 2—A CF-End sent by a VHT non-AP STA that is a member of a VHT BSS can include the TXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT as defined in Channel Width selection for control frames when it elicits a CF-End response.

Insert a new subclause following 9.19.2.7 as follows:

* EDCA channel access in a VHT BSS

If the MAC receives a PHY-CCA.indication primitive with the channel-list parameter present, the channels(#5014) considered idle are defined in Cha.

|  |  |
| --- | --- |
| * Channels indicated idle by the channel-list parameter(#5014) | |
| PHY-CCA.indication channel-list element | Idle channels(#5014) |
| primary | None |
| secondary | Primary 20 MHz channel(#5014) |
| secondary40 | Primary 20 MHz channel and secondary 20 MHz channel(#5014) |
| secondary80 | Primary 20 MHz channel, secondary 20 MHz channel and secondary 40 MHz channel(#5014) |

In the following description, the CCA is sampled according to the timing relationships defined in 9.3.7. Slot boundaries are determined solely by activity on the primary channel. "Channel idle for an interval of PIFS" means that whenever CCA is sampled during the period of PIFS that ends at the start of transmission, the CCA for that channel was determined to be idle.

If a STA is permitted to begin a TXOP (as defined in Obtaining an EDCA TXOP) and the STA has at least one MSDU pending for transmission for the AC of the permitted TXOP, the STA shall perform exactly one of the following steps:

* transmit a 160 MHz or 80+80 MHz mask PPDU if the secondary channel, the secondary 40 MHz channel and the secondary 80 MHz channel were idle during an interval of PIFS immediately preceding the start of the TXOP
* transmit an 80 MHz mask PPDU on the primary 80 MHz channel if both the secondary channel and the secondary 40 MHz channel were idle during an interval of PIFS immediately preceding the start of the TXOP.
* transmit a 40 MHz mask PPDU on the primary 40 MHz channel if the secondary channel was idle during an interval of PIFS immediately preceding the start of the TXOP.
* transmit a 20 MHz mask PPDU on the primary 20 MHz channel
* restart the channel access attempt by invoking the backoff procedure as specified in HCF contention-based channel access (EDCA) as though the medium is busy on the primary channel as indicated by either physical or virtual CS and the backoff timer has a value of zero.

NOTE 1—In the case of rule e), the STA selects a new random number using the current value of CW[AC], and the retry counters are not updated.(#4824)

NOTE 2—For both an HT and a VHT STA, an EDCA TXOP is obtained based on activity on the primary channel. The width of transmission is determined by the CCA status of the non-primary channels during the PIFS interval before transmission.

* HCCA
* HCCA procedure
* Recovery from the absence of an expected reception

Change the second paragraph as follows:

The beginning of reception of an expected response is detected by the occurrence of PHYCCA.indication(BUSY, channel-list) primitive at the STA that is expecting the response where

* The channel-list parameter is absent, or
* The channel-list ~~is equal to~~ contains at least {primary}. ~~and the HT STA expected to transmit the expected response supports 20 MHz operation only, or~~
* ~~The channel-list is equal to either {primary} or {primary, secondary} and the HT STA expected to transmit the expected response supports both 20 MHz and 40 MHz operation (see 10.15.2 (Basic 20/40 MHz BSS functionality)).~~(#4417)
* HCCA transfer rules

Insert a new subclause 9.19.3.5.4 as follows:

* HCCA transfer rules for a VHT STA

A VHT STA in a BSS that supports multiple channel widths is granted a TXOP for a specified duration and for a channel width that is equal to the channel width of the frame containing the QoS CF-Poll.

During a TXOP obtained in this fashion, the STA shall not transmit in a wider channel width than that granted.

* Protection mechanisms
* L-SIG TXOP protection
* L-SIG TXOP protection rules at the TXOP responder

Insert the following sentence at the end of this subclause:

A VHT STA shall (#4836)set the L-SIG TXOP Protection Support field to zero during association and re-association.

* Reverse Direction Protocol
* Reverse direction (RD) exchange sequence

Change the bullet b) of the first paragraph as follows:

* The transmission of one or more (MU) PPDUs (the RD response burst) by the STA addressed in the MPDUs of the RDG PPDU. The first (or only) PPDU of the RD response burst contains at most one immediate BlockAck or ACK response frame. The last (or only) PPDU of the RD response burst contains any MPDUs requiring an immediate BlockAck or ACK response. The STA that transmits the RD response burst is known as the RD responder. The rules for an RD responder apply only during a single RD exchange sequence, i.e., following the reception of an RDG PPDU and up to the transmission of a PPDU by the RD responder in which the RDG/More PPDU subfield is equal to 0.
* Rules for responder

Change the 3rd paragraph as follows:

An RD responder in the OBand(11ad) may transmit a +CF-ACK non-A-MPDU frame or VHT single MPDU in response to a non-A-MPDU QoS Data+HTC MPDU that has the Ack Policy field set to Normal Ack and the RDG/More PPDU subfield set to 1.

Change the 8th paragraph as follows:

During an RDG, any PPDU transmitted by RD responder shall contain at least one MPDU with an Address 1 field that matches the MAC address of the RD initiator. ~~t~~The RD responder shall not transmit any frames causing a response after SIFS with an Address 1 field that does not match the MAC address of the RD initiator. The RD responder shall not transmit any PPDUs with a CH\_BANDWIDTH that is wider than the CH\_BANDWIDTH of the PPDU containing the frame(s) that delivered the RD grant.

* Sounding PPDUs

Insert the following as the first paragraph of this subclause:

The behavior described in this subclause is specific to the use of the HT variant HT Control field.

* Link adaptation

Change the title on subclause 9.28.2 as follows:

* Link adaptation using the HT variant HT Control field

Insert the following as the first paragraph of this section:

The behavior described in this subclause is specific to the HT variant HT Control field.

Insert new section 9.28.3 following section 9.28.2:

* Link adaptation using the VHT variant HT Control field

The behavior described in this subclause is specific to the VHT variant HT Control field.(#4920)

A STA that supports VHT link adaptation using the VHT variant HT Control field shall set the VHT Link Adaptation Capable subfield in the VHT Capabilities Info field in the VHT Capabilities element to Unsolicited or Both, depending on its specific MCS feedback capability. A STA shall not send an MRQ to STAs that have not set VHT Link Adaptation Capable subfield to Both in the most recently transmitted VHT Capabilities Info field of the VHT Capabilities element. A STA whose most recently transmitted VHT Link Adaptation Capable subfield of the VHT Capabilities Info field of the VHT Capabilities element is either set to Unsolicited or Both may transmit unsolicited MFB in any frame that contains a VHT variant HT Control field.

The MFB requester may set the MRQ field to 1 in the VHT variant HT Control field of a frame to request a STA to provide MCS, N\_STS and SNR feedback. In each request, the MFB requester shall set the MSI field to a value in the ranges 0 to 6, 0 to 2 or 0 to 3, depending on the settings in the Unsolicited MFB and STBC fields (see 8.2.4.6.3 (VHT variant)).(#5256) The choice of MSI value is implementation dependent.

NOTE—The MFB requester can use the MSI field as an MRQ sequence number or it can implement any other encoding of the field.

The appearance of more than one instance of a VHT variant HT Control field with the MRQ field equal(#4182) to 1 within a single PPDU shall be interpreted by the receiver as a single request for MCS, N\_STS and SNR feedback.

An MFB responder sending MFB in response to MRQ in a VHT NDP Announcement(#4921) frame(#4297) shall compute the MFB based on the NDP following the VHT NDP Announcement(#4921) frame.

An MFB responder that has set the VHT Link Adaptation Capable subfield to Both in the most recently transmitted VHT Capabilities Info field of the VHT Capabilities element(#4297) shall support both of(#4419) the following:

* computation and feedback of the MFB estimate(#4905) on the receipt of an MFB request (MRQ equal(Ed) to 1 in the VHT variant HT Control field) in a PPDU that is not a VHT NDP Announcement(#4921) frame.
* computation and feedback of the MFB estimate(#4905) on the receipt of an MFB request (MRQ equal(Ed) to 1 in VHT variant HT Control field) in a VHT NDP Announcement(#4921) frame and the receipt of NDP frames (see Null data packet (NDP) sounding) if this STA set the SU Beamformee Capable (#4421)subfield of the VHT Capabilities Info field of the VHT Capabilities element to 1.

On receipt of a VHT variant HT Control field with the MRQ field equal(#4182) to 1, an MFB responder computes the MCS, N\_STS and SNR estimates based on the associated PPDU and labels the result of this computation with the MSI value from the VHT variant HT Control field in the received frame carrying the MRQ(#4673). The MFB responder may include the received MSI value in the MFSI field of the corresponding response frame. In the case of a delayed response, this allows the MFB requester to associate the MFB with the soliciting MRQ.

When sending a solicited MFB, an MFB responder shall set the Unsolicited MFB subfield in VHT variant HT Control field to 0.

The MFB responder may send a solicited response frame with any of the following combinations of MCS, N\_STS and MFSI:

* MCS = 15, N\_STS = 7 in the MFB subfield, MFSI = 7: no information is provided for the immediately preceding request or for any other pending request. This combination is used when the responder is required to include a VHT variant HT Control field due to other protocols that use this field (e.g.,(#4422) the Reverse Direction Protocol) and when no MFB is available. It has no effect on the status of any pending MRQ.
* MCS = 15, N\_STS = 7 in the MFB subfield, MFSI in the range 0 to 6: the responder is not now providing, and will never provide, feedback for the request that had the MSI value that matches the MFSI value.
* MFB contains valid MCS and N\_STS, MFSI in the range 0 to 6: the responder is providing feedback for the request that had the MSI value that matches the MFSI value.

An MFB responder that discards or abandons the MFB estimates(#4906) computed in response to an MRQ may indicate that it has done so by setting the MCS to 15 and N\_STS to 7 in the MFB subfield in the next frame addressed to the MFB requester that includes the VHT variant HT Control field. The value of the MFSI is set to the value of the MSI/STBC subfield of the frame that contains MRQ for which the computation was abandoned, regardless of whether the MSI/STBC subfield contains an MSI or a Compressed MSI and STBC Indication subfields.

NOTE—The MFB requester can advertise the maximum number of spatial streams that it can transmit in its VHT Supported MCS Set in the VHT Capabilities element.

An MFB responder sending an MFB estimate to an MFB requester shall indicate a combination of MCS, N\_STS and, for unsolicited MFB, BW field values in the MFB subfield that(#4960) is in the responder's VHT Rx Supported MCS Set (see VHT Rx Supported MCS Set) and the requester’s VHT Tx Supported MCS Set (see VHT Tx Supported MCS Set), where the BW for solicited MFB is that defined in Link adaptation using the VHT variant HT Control field.

The SNR feedback in the MFB subfield is defined as the SNR value averaged over all the space-time streams and data subcarriers, and is encoded as a 6-bit two’s complement number of , where SNR\_average is the sum of the values of SNR per frequency tone (in decibels) per space-time stream



divided by the product of the number of space-time streams, as indicated in the N\_STS subfield of the MFB field,(#4425) and the number of frequency tones represented in the bandwidth in which the MFB was estimated. This encoding covers the SNR range from  dB to 53 dB in 1 dB steps. The STA receiving MFB may use the received MFB to compute the appropriate MCS, SNR, and N\_STS.(#4425)



NOTE—When receiving an MU PPDU, the MFB responder may compute the interference level from the VHT-LTF field(#4426), and in this case the value in the(#4427) SNR subfield indicates the averaged signal(#5088) to interference and noise ratio (SINR).

A STA sending unsolicited MFB feedback using the VHT variant HT Control field shall set the Unsolicited MFB subfield to 1.

Unsolicited MCS, N\_STS, BW and SNR estimates reported in the MFB subfield of a VHT variant HT Control field sent by a STA are computed based on the most recent PPDU received by the STA that matches the description indicated by GID-L, GID-H, Coding Type, STBC Indication and FB Tx(#5486) Type fields in the same VHT variant HT Control field.

In an unsolicited MFB response, the GID-L, GID-H, Coding Type, STBC Indication, FB Tx(#5487) Type and BW fields are set according to the RXVECTOR parameters of the received PPDU from which the MCS, SNR, BW and N\_STS are estimated, as follows:

* If the MCS, SNR, BW and N\_STS are estimated from an MU PPDU, then the GID-L field is set to the 3 least significant bits and the GID-H field to the 3 most significant bits of the parameter GROUP\_ID
* If the MCS, SNR, BW and N\_STS are estimated from an SU PPDU, then the GID-L field and GID-H field are set to all ones
* The Coding Type field is set to 0 if the parameter FEC\_CODING is equal to BCC\_CODING and set to 1 if equal to LDPC\_CODING
* The STBC Indication field is set to 1 if the parameter STBC is equal to 1 and set to 0 if the STBC parameter is equal to 0
* The FB TX Type field is set to 1 if the parameter BEAMFORMED is equal to 1 and set to 0 if equal to 0
* The BW field shall indicate a bandwidth equal to or less than the bandwidth indicated by the parameter CH\_BANDWIDTH

NOTE—The values of the GID-L and GID-H fields identify the unsolicited feedback as estimated from either an SU or an MU PPDU.(#4428)

In a solicited MFB response to an MRQ that was not carried in a VHT NDP Announcement(#4921) frame, the MFB is computed based on RXVECTOR parameters CH\_BANDWIDTH, GROUP\_ID, NUM\_STS, N\_TX, FEC\_CODING, BEAMFORM and STBC of the received PPDU from which the MRQ was triggered and may additionally be based on other factors which are not part of the RXVECTOR. The N\_STS subfield of the MFB subfield of VHT variant HT Control field shall be set to an equal or smaller value than the RXVECTOR parameter NUM\_STS of the received PPDU from which the MRQ was triggered; If the N\_STS subfield is set to a smaller value than the RXVECTOR parameter NUM\_STS, the MFB responder shall estimate the recommended MCS under the assumption that the MFB requester will transmit the first N\_STS space-time streams in the corresponding PPDU carrying the(#4962) MRQ.

If the MFB is in the same MPDU as a VHT Compressed Beamforming frame, the MFB responder shall estimate the recommended MFB under the assumption that the MFB requester will use the steering matrices contained therein for performing an SU beamformed transmission. In this case, the value of the N\_STS field in the MFB subfield of the VHT variant HT Control field shall be the same as the value of the Nc Index field in the VHT MIMO Control field of the VHT Compressed Beamforming frame and, if the MFB is unsolicited, the Coding Type shall be set to BCC and the FB Tx Type shall be set to 0. Additionally, MFB estimate shall be based on the bandwidth indicated by the Channel Width subfield of the VHT MIMO Control field of the VHT Compressed Beamforming frame. In this case, the SNR and BW subfields are reserved and set to 0.

If the MFB requester sends MRQ in a VHT NDP Announcement(#4921) frame, then the MFB responder shall include the corresponding MFB in (all of) the VHT Compressed Beamforming frame(s) that is/are the response to the same VHT NDP Announcement(#4921) frame and NDP sequence.

In a VHT NDP Announcement(#4921) frame with multiple STA Info fields and carrying a VHT format of HT Control field with MRQ equal(#4182) to 1, the MRQ is intended to solicit an MFB response from all the STAs listed in the (#4430)STA Info fields.

When the MFB requester sets the MRQ subfield to 1 and sets the MSI subfield to a value that matches the MSI subfield value of a previous request for which the responder has not yet provided feedback, the responder shall discard or abandon the computation for the MRQ that corresponds to the previous use of that MSI subfield value and start a new computation based on the new request(#4228).

A STA may respond immediately to a current request for MFB with a frame containing an MFSI field value and MFB field value that correspond to a request that precedes the current request.

NOTE 1—If an MRQ is included in the last PPDU in a TXOP and there is not enough time for a response, the recipient can transmit the response MFB in a subsequent TXOP.

NOTE 2—Bidirectional request/responses are supported. In this case, a STA acts as the MFB requester for one direction of a duplex link and a MFB responder for the other direction and transmits both MRQ and MFB in the same VHT data frame.

* Transmit beamforming
* General

Change the last paragraph as follows:

An HT or VHT STA shall not transmit a PPDU with the TXVECTOR EXPANSION\_MAT parameter present if dot11BeamFormingOptionActivated is false.(#5110)

* Transmit beamforming with implicit feedback
* Unidirectional implicit transmit beamforming

Insert the following as the first paragraph of this section:

This section assumes that the HT Control field is in the HT format.

* Bidirectional implicit transmit beamforming

Insert the following as the first paragraph of this section:

This section assumes that the HT Control field is in the HT format.

* Calibration
* Sounding exchange for calibration

Insert the following as the first paragraph of this section:

This section assumes that the HT Control field is in the HT format.

* CSI reporting for calibration

Insert the following as the first paragraph of this section:

This section assumes that the HT Control field is in the HT format.

* Null data packet (NDP) sounding

Change 9.31.1 through 9.31.4 (including titles) as follows:

* NDP rules

Sounding may be accomplished using either staggered sounding PPDU or HT NDP, as described in 20.3.13 (HT Preamble format for sounding PPDUs). The MAC rules associated with sounding using HT NDP are described in NDP rules to Determination of .

An HT STA that has set the Receive NDP Capable field of its HT Capabilities element to 1 during association processes an HT NDP as a sounding packet if the destination of the sounding packet is determined to match itself as described in Determination of and if the source of the sounding packet can be ascertained as described in Determination of .

An RXVECTOR LENGTH parameter equal to 0 indicates that the PPDU is an HT NDP.

A STA that is a TXOP holder or an RD responder shall not set both the NDP Announcement and RDG/More PPDU subfields to 1 simultaneously. The Calibration Position subfield shall not be set to any value except 0 and 1 in any +HTC frame in a PPDU that is also an NDP announcement. The Calibration Position subfield shall be set to 0 in any +HTC frame in a PPDU that is an NDP announcement that also contains any +HTC frame with the MAI subfield equal to ASELI. The Calibration Position subfield shall be set to 0 in all +HTC frames in a PPDU that is an NDP announcement and that contains any +HTC frame with the MRQ subfield equal to 1. The TRQ field shall be set to 0 in all +HTC frames in a PPDU that is an NDP announcement.

An NDP sequence contains at least one non-NDP PPDU and at least one HT NDP PPDU. Only one PPDU in the NDP sequence may contain an NDP announcement. An NDP sequence begins with an NDP announcement. The NDP sequence ends at the end of the transmission of the last HT NDP PPDU that is announced by the NDP announcement. A STA that transmits the first PPDU of an NDP sequence is the NDP sequence owner. In the NDP sequence, only PPDUs carrying HT NDP and PPDUs carrying non-A-MPDU control frames may follow the NDP sequence’s starting PPDU.

A STA shall transmit only one HT NDP per NDP announcement, unless the NDP announcement includes a value in the ASEL Data subfield of the ASEL Command subfield of the HTC Control field that is greater than one. Each PPDU in an NDP sequence shall start a SIFS interval after end of the previous PPDU.

A STA shall not transmit a VHT NDP in a NDP sequence that contains an NDP announcement.

The +HTC field of a CTS frame shall not contain the NDP Announcement subfield set to 1.

NOTE—A CTS frame cannot be used for NDP announcement: if the CTS frame is a response to an RTS frame, the optional NAV reset timeout that starts at the end of the RTS frame does not include the additional HT NDP and SIFS duration (see 9.3.2.5 (Setting and resetting the NAV)). Also, if the CTS were the first frame of an NDP sequence, it would not be possible to determine the destination address of the HT NDP.

A STA shall transmit an HT NDP as follows:

* A SIFS interval after sending a PPDU that is an NDP announcement and that does not contain an MPDU that requires an immediate response.
* A SIFS interval after successfully receiving a correctly formed and addressed immediate response to a PPDU that is an NDP announcement and that contains an MPDU that requires an immediate response.
* A SIFS interval after transmitting an HT NDP if the NDP announcement contains an ASEL Command subfield equal to TXASSI, TXASSI-CSI, or RXASSI and the ASEL Data subfield is equal to value greater than zero and if the number of HT NDPs sent before this one is less than the value in the ASEL Data subfield + 1.

NOTE—The total number of sent HT NDPs is equal to the value of in the ASEL Data subfield + 1.

* A SIFS interval after receiving an HT NDP from a STA whose NDP announcement contained one or more +HTC frames with the Calibration Position subfield equal to 1, when the receiving STA supports transmitting sounding PPDUs for which more than one channel dimension can be estimated (i.e., more than one column of the MIMO channel matrix).

This rule enables the NDP receiver to know that it will receive an HT NDP and can determine the source and destination of the HT NDP. It enables the receiver and transmitter to know when the immediate response and HT NDP will be transmitted relative to the frame containing the NDP announcement indication.

A STA that has transmitted an NDP announcement in a frame that requires an immediate response and that does not receive the expected response shall terminate the NDP sequence at that point (i.e., the STA does not transmit an HT NDP in the current NDP sequence).

A STA that has received an NDP announcement in a +HTC with the Calibration Position equal to 1 or 2, and that does not receive the HT NDP PPDU expected shall terminate the NDP sequence at that point (i.e., does not transmit an HT NDP in the current NDP sequence) and not transmit any further frames that are a part of this calibration sequence shown in Step 1 of Figure 9-37 (Calibration procedure with NDP).

Feedback information generated from the reception of an HT NDP is transmitted using any of the feedback rules and signaling as appropriate, e.g., immediate or delayed.

* Transmission of an HT NDP

A STA that transmits an HT NDP shall set the LENGTH, SOUNDING, STBC, MCS, and NUM\_EXTEN\_SS parameters of the TXVECTOR as specified in this subclause.

* LENGTH shall be set to 0.
* SOUNDING shall be set to SOUNDING.
* STBC shall be set to 0.
* MCS shall indicate two or more spatial streams.

The number of spatial streams sounded is indicated by the MCS parameter of the TXVECTOR and shall not exceed the limit indicated by the Channel Estimation Capability field in the Transmit Beamforming Capabilities field transmitted by the STA that is the intended receiver of the HT NDP. The MCS parameter may be set to any value, subject to the constraint of the previous sentence, regardless of the value of the Supported MCS Set field of the HT Capabilities field at either the transmitter or recipient of the HT NDP. A STA shall set the NUM\_EXTEN\_SS parameter of the TXVECTOR to 0 in the PHY-TXSTART.request primitive corresponding to an HT NDP transmission.

A STA shall not transmit an NDP announcement with a RA corresponding to another STA unless it has received an HT Capabilities element from the destination STA in which the Receive NDP Capable field is equal to 1.

* Determination of HT NDP destination

The destination of an HT NDP is determined at the NDP receiver by examining the NDP announcement as follows:

* The destination of the first HT NDP in the NDP sequence is equal to the RA of any MPDU within NDP announcement.
* If Calibration Position subfield is equal to 1 in the NDP announcement at the NDP receiver, the destination of the second HT NDP is equal to the TA of that frame. Otherwise, the destination of the second and any subsequent HT NDPs is equal to the destination of the previous HT NDP.

See S.4 (Illustration of determination of NDP addresses) for an illustration of these rules.

* Determination of HT NDP source

The source of an HT NDP is determined at the NDP receiver by examining the NDP sequences’s starting PPDU as follows:

* If any MPDU within the NDP announcement contains two or more addresses, the source of the first HT NDP is equal to the TA of that frame.
* Otherwise (i.e., the NDP announcement contains one address), the source of the first HT NDP is equal to the RA of the MPDU to which the NDP announcement is a response.
* If the Calibration Position subfield is equal to 1 in an MPDU in the NDP announcement, the source of the second HT NDP is equal to the RA of that MPDU. Otherwise, the source of the second and any subsequent HT NDPs is equal to the source of the previous NDP.

See S.4 (Illustration of determination of NDP addresses)for an illustration of these rules.

Insert new subclauses 9.31.5 and 9.31.6 as shown below:

* VHT sounding protocol

Transmit Beamforming and DL MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmitted signal to optimize reception at one or more receivers. The STA transmitting using the steering matrix is called the beamformer and a STA for which reception is optimized is called a beamformee. An explicit feedback mechanism is used where the beamformee directly measures the channel from the training symbols transmitted by the beamformer and sends back a transformed estimate of the channel state to the beamformer. The beamformer then uses this estimate, perhaps combining estimates from multiple beamformees, to derive the steering matrix.

A STA that has the value true for dot11VHTSUBeamformerActivated shall set the SU Beamformer Capable field to 1 in transmitted VHT Capabilities elements. A STA that has the value true for dot11VHTSUBeamformeeActivated shall set the SU Beamformee Capable field to 1 in transmitted VHT Capabilities elements.

A STA that has the value true for dot11VHTMUBeamformerActivated shall set the MU Beamformer Capable field to 1 in transmitted VHT Capabilities elements. A STA that has the value true for dot11VHTMUBeamformeeActivated shall set the MU Beamformee Capable field to 1 in transmitted VHT Capabilities elements.

A STA that has the value true for dot11VHTMUBeamformerActivated shall set the value of dot11VHTSUBeamformerActivated to true. A STA that has the value true for dot11VHTMUBeamformeeActivated shall set the value of dot11VHTSUBeamformeeActivated to true.

A STA is an SU only beamformer if it sets the SU Beamformer Capable field to 1 but sets the MU Beamformer Capable field to 0 in transmitted VHT Capabilities elements. A STA is an SU only beamformee if it sets the SU Beamformee Capable field to 1 but sets the MU Beamformee Capable field to 0 in transmitted VHT Capabilities elements.

A STA that does not have the value true for dot11VHTSUBeamformerActivated shall not act in the role of a beamformer. A STA that does not have the value true for dot11VHTSUBeamformeeActivated shall not act in the role of a beamformee.

A beamformer shall initiate a sounding feedback sequence by transmitting(#4543) a VHT NDP Announcement(#4921) frame followed by a VHT NDP frame after a SIFS. The beamformer shall include in the VHT NDP Announcement(#4921) frame one STA Info field for each beamformee that is expected to prepare a VHT Compressed Beamforming report and shall identify the beamformee by including the beamformee's AID in the AID subfield of the STA Info field. The VHT NDP Announcement(#4921) frame shall include at least one STA Info field.

A VHT NDP frame shall only be transmitted SIFS after a VHT NDP Announcement(#4921) frame.

NOTE―A STA that transmits a VHT NDP Announcement(#4921) frame to a DLS or TDLS peer STA obtains the AID for the peer STA from the DLS Setup Request, DLS Setup Response, TDLS Setup Request or TDLS Setup Response frame.

A beamformer shall not transmit either a VHT NDP Announcement(#4921)+HTC frame or a Beamforming Report Poll+HTC frame that contains an HT variant HT Control field.

A beamformer shall not transmit a frame other than a VHT NDP a SIFS period(#5422) after a VHT NDP Announcement(#4921) frame.

A STA shall not transmit a VHT NDP Announcement(#4921) frame that is addressed to a STA or that includes a STA’s AID in one of the STA Info fields and shall not transmit a Beamforming Report Poll frame to a STA unless it has received from that STA a VHT Capabilities element and where the last VHT Capabilities element received from that STA has the SU Beamformee Capable field set to 1.

A beamformer that transmits a VHT NDP Announcement(#4921) frame to an SU only beamformee shall include only one STA Info field in the VHT NDP Announcement(#4921) frame and set the Feedback Type subfield of the STA Info field to SU. The VHT sounding protocol with a single beamformee is shown in Sounding protocol with a single beamformee.

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| * Sounding protocol with a single beamformee(#4921) |

If the VHT NDP Announcement(#4921) frame includes more than one STA Info field, the RA of the VHT NDP Announcement(#4921) frame shall be set to the broadcast address. If the VHT NDP Announcement(#4921) frame includes a single STA Info field, the RA of the VHT NDP Announcement(#4921) frame shall be set to the MAC address of the beamformee.

A VHT NDP Announcement frame shall not include two or more STA Info fields with same value of the AID subfield.(#4791)

A beamformer that transmits(#4543) an VHT NDP Announcement(#4921) frame to a beamformee that is an AP, mesh STA or STA that is a member of an IBSS, shall include a single STA Info field in the VHT NDP Announcement(#4921) frame and shall set the AID field in the STA Info field to 0.

A VHT NDP Announcement(#4921) frame with more than one STA Info field shall not carry an HT Control field, unless all the STAs listed in the AID field of the STA Info fields have set +HTC-VHT Capable to 1 in the VHT Capabilities Info field or set +HTC-HT Support to 1 in the HT Extended Capabilities field.

A beamformer that transmits a VHT NDP Announcement(#4921) frame with more than one STA Info field should transmit any Beamforming Report Poll frames needed to retrieve VHT Compressed Beamforming reports from the intended beamformees in the same TXOP. If the duration of the TXOP that contained the VHT NDP Announcement(#4921) frame is not of sufficient duration to accommodate the transmission of all of the feedback reports, the beamformer may poll for the remaining VHT Compressed Beamforming reports in subsequent TXOPs.

NOTE—The transmission of the(#4907) VHT NDP Announcement(#4921), NDP, VHT Compressed Beamforming (#5373)and Beamforming Report Poll frames is subject to the rules in Multiple frame transmission in an EDCA TXOP.

The VHT sounding protocol with more than one beamformee is shown in Sounding protocol with more than one beamformee.

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| * Sounding protocol with more than one beamformee(#4921) |

A beamformer that sets the Feedback Type subfield of a STA Info field to 1 shall set the Nc Index subfield of the same STA Info field to a value equal to(#4544) or less than the minimum of the following:

* the maximum number of supported spatial streams according to the corresponding beamformee's Rx MCS Map(#4840) in the VHT Supported MCS Set(#4840) field, or
* the maximum number of supported spatial streams according to the Rx Nss subfield value in the VHT Operation Mode field of the most recently received (#5096)Operating Mode Notification frame with the Rx Nss Type subfield equal to 0 from the corresponding beamformee.(#4911)

A beamformee that receives a VHT NDP Announcement(#4921) frame from a beamformer with which it is associated or (#4908)has an established DLS or TDLS session and that contains the beamformee's AID in the AID subfield of the first (or only) STA Info field and also receives a VHT NDP a SIFS after(#5423) the VHT NDP Announcement(#4921) shall transmit the PPDU containing its VHT Compressed Beamforming report a SIFS after the VHT NDP. The TXVECTOR parameter CH\_BANDWIDTH of the PPDU containing the VHT Compressed Beamforming report shall be set to indicate a bandwidth not wider than that indicated in the RXVECTOR parameter CH\_BANDWIDTH of the received NDP frame. A STA shall ignore received VHT NDP Announcement(#4921), VHT NDP, and Beamforming Report Poll frames unless it has the value true for dot11VHTSUBeamformeeActivated.

A beamformee that receives a VHT NDP Announcement(#4921) from a beamformer with which it is associated or with which it has an established DLS or TDLS session and that contains the beamformee’s AID in the AID subfield of a STA Info field that is not the first STA Info field shall transmit its VHT Compressed Beamforming report after receiving a Beamforming Report Poll with RA matching its MAC address and TA with the Individual/Group bit forced to 0 matching the MAC address of the beamformer. If the RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT of the received Beamforming Report Poll frame is valid, the TXVECTOR parameter CH\_BANDWIDTH of the PPDU containing the VHT Compressed Beamforming report shall be set to indicate a bandwidth not wider than that indicated by the RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT of the Beamforming Report Poll frame; otherwise, the TXVECTOR parameter CH\_BANDWIDTH of the PPDU containing the VHT Compressed Beamforming report shall be set to indicate a bandwidth not wider than that indicated by the RXVECTOR parameter CH\_BANDWIDTH of the Beamforming Report Poll frame.

NOTE—The RA field of the VHT Compressed Beamforming frame(s) of the VHT Compressed Beamforming report is set to the MAC address obtained from the TA field of the VHT NDP Announcement(#4921) frame or the Beamforming Report Poll frame to which this VHT Compressed Beamforming report is a response with the Individual/Group bit in the RA field set to 0.

A beamformee that transmits a VHT Compressed Beamforming report shall not include the VHT Compressed Beamforming Report information and any MU Exclusive Beamforming Report information if the transmission duration of the VHT Compressed Beamforming frame with the VHT Compressed Beamforming Report information and any MU Exclusive Beamforming Report information would exceed the maximum PPDU duration.

A beamformee shall transmit(#4543) a VHT Compressed Beamforming frame with the VHT MIMO Control Feedback Type field set to the same value as the Feedback Type field in the corresponding STA Info field in the VHT NDP Announcement(#4921) frame. If the Feedback Type field indicates MU, the STA shall send a feedback with the Nc Index field value in the VHT MIMO Control field equal to the Nc Index field value in the corresponding STA Info field in the VHT NDP Announcement(#4921) frame or the number of currently supported receiving spatial streams, whichever smaller. If the Feedback Type indicates SU, the Nc Index field value in the VHT MIMO Control field is determined by the beamformee.

The Nr Index field in the VHT MIMO Control field shall be set to the same value as the NUM\_STS field in the corresponding VHT NDP. The Nc Index field shall not be set to a value larger than the Nr Index value in the VHT MIMO Control field. A beamformee shall set the value of the Channel Width subfield in the VHT MIMO Control field of a VHT Compressed Beamforming frame to the same value as the RXVECTOR parameter CH\_BANDWIDTH of the corresponding NDP frame.

A beamformee shall not include MU Exclusive Beamforming Report information in a VHT Compressed Beamforming report if the Feedback Type subfield in the MIMO Control field of the VHT Compressed Beamforming frame(s) indicates SU. A beamformee shall include MU Exclusive Beamforming Report information in a VHT Compressed Beamforming report if the Feedback Type subfield in the MIMO Control field of the VHT Compressed Beamforming frame(s) indicates MU.

The value of the Sounding Sequence Number subfield in the VHT MIMO Control field shall be set to the same value as the Sounding Sequence field in the corresponding VHT NDP Announcement(#4921) frame.

NOTE—The beamformer can use the sequence number in the VHT Compressed Beamforming frame(s) of the VHT Compressed Beamforming report to associate the feedback with a prior VHT NDP Announcement(#4921)-NDP sounding sequence and thus compute the delay between sounding and receiving the feedback. The beamformer can use this delay time when making a decision regarding the applicability of the feedback for the link.

Recovery in the case of a missing response to a VHT NDP Announcement(#4921) or Beamforming Report Poll frame follows the rules for multiple frame transmission in an EDCA TXOP (see Multiple frame transmission in an EDCA TXOP). A VHT Compressed Beamforming report shall be transmitted in a single VHT Compressed Beamforming frame unless the result would be a VHT Compressed Beamforming frame that exceeds the beamformer's maximum MPDU length capability.

NOTE—The beamformee might therefore have to transmit an MPDU that is bigger than it is capable of receiving.

If a VHT Compressed Beamforming report would result in a VHT Compressed Beamforming frame that exceeds the beamformer’s maximum MPDU length capability, the VHT Compressed Beamforming report shall be split into up to 8 segments, with each segment sent in a different VHT Compressed Beamforming frame and containing successive portions of the VHT Compressed Beamforming Report information followed by any MU Exclusive Beamforming Report information. Each of the segments except the last shall contain the maximum number of octets allowed by the beamformer’s maximum MPDU length capability. The last segment may be smaller. Each segment is identified by the value of the Remaining Segments subfield and the First Segment subfield in the VHT MIMO Control field as defined in 8.4.1.46 (VHT MIMO Control field); the other non-reserved subfields of the VHT MIMO Control field shall be the same for all segments. All segments shall be sent in a single A-MPDU and shall be included in the A-MPDU in the descending order of the Remaining Segments subfield values(#4442).

NOTE—The segments of a VHT Compressed Beamforming report are not MSDU/MMPDU fragments and can be included in an A-MPDU as described in this section.(#4725)

In its first attempt to retrieve a VHT Compressed Beamforming report from a beamformee that is not the one indicated by the first STA Info field, a beamformer shall transmit a Beamforming Report Poll frame to poll all possible segments of the VHT Compressed Beamforming report from the beamformee, by setting all the bits in the Segment Retransmission Bitmap field of the Beamforming Report Poll frame to 1.

If a beamformer fails to receive some or all segments of a VHT Compressed Beamforming report, the beamformer may, subject to the condition on SU-only beamformees described at the end of this subclause, request a selective retransmission of missing segments by transmitting(#4543) a Beamforming Report Poll frame with the Segment Retransmission Bitmap field set as described in 8.3.1.21 (Beamforming Report Poll frame format) to indicate the segments requested for retransmission. If the beamformer fails to receive the segment with the First Segment field set to 1, it may request a selective retransmission of missing segments assuming the VHT Compressed Beamforming report is split into 8 segments. The beamformer may also request the retransmission of all segments by setting all the bits in the Segment Retransmission Bitmap field of the Beamforming Report Poll frame to 1.

A beamformee that transmits a VHT Compressed Beamforming report including the VHT Compressed Beamforming Report information and any MU Exclusive Beamforming Report information in response to a Beamforming Report Poll frame shall either transmit(#4543) only the segments indicated in the Segment Retransmission Bitmap field in the Beamforming Report Poll frame (#5254)or transmit(#4543) all the segments disregarding the Segment Retransmission Bitmap field in the Beamforming Report Poll fame.

A beamformer shall not transmit a Beamforming Report Poll frame to an SU only beamformee unless it has received at least one segment of the VHT Compressed Beamforming report from the beamformee in the current frame exchange sequence.

* Transmission of a VHT NDP

A STA shall transmit a VHT NDP using the following TXVECTOR parameters:

* APEP\_LENGTH set to 0
* NUM\_USERS set to 1
* NUM\_STS indicates two or more space-time streams
* CH\_BANDWIDTH set to the same value as the TXVECTOR parameter CH\_BANDWIDTH in the preceding VHT NDP Announcement(#4921) frame
* GROUP\_ID and PARTIAL\_AID are set as described in Group ID and partial

The number of space-time streams sounded and as indicated by the NUM\_STS parameter shall not exceed the value indicated in the Compressed Steering Number of Beamformer Antennas Supported field in the VHT Capabilities element of any intended recipient of the VHT NDP frame. The NUM\_STS parameter may be set to any value, subject to the constraint of the previous sentence, regardless of the value of the Supported MCS Set field of the VHT Capabilities element(#4738) at either the transmitter or recipient of the NDP.

The destination of a VHT NDP is equal to the RA of the immediately preceding VHT NDP Announcement(#4921) frame.

The source of a VHT NDP is equal to the TA of the immediately preceding VHT NDP Announcement(#4921) frame.

## Proposed resolution

REVISED. See Proposed changes in 12/587r2.