IEEE P802.11
Wireless LANs

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| LB188 (D3.0) resolution for regulatory generalisation |
| Date: 2012-09-13 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Mark RISON | CSR | CB4 0WZ, U.K. | +44 1223 692000 | Mark.RISON@csr.com |
|  |  |  |  |  |

Abstract

This document proposes a resolution for CID 6439 on P802.11ac/D3.0 (LB188), regarding generalisation of the new regulatory stuff to non-VHT STAs.

## Revision History

r0: Initial revision.

r1: Updated following feedback from Brian (but all mistakes remain mine, of course). Caught some more rogue “VHT STA”s. Tidied up some more.

## Comments

|  |  |  |  |
| --- | --- | --- | --- |
| 6439 | Mark RISON | The new power/constraint/operating class stuff should be usable by non-11ac devices | A proposal will be brought to effect this |

## Discussion

We initially did channel switch in 11h. Unfortunately (a) we didn't have operating classes at the time and (b) we didn't have 40 MHz channels, so we didn't support either of those.

Then we did extended channel switch in 11y. By then we had operating classes, so we fixed (a) but still didn't have 40 MHz channels, so (b) was still a problem.

Then we introduced 40 MHz channels in 11n, and extended the Channel Switch Announcement MMPDU to support this. Unfortunately, we failed to extend the Channel Switch Announcement element to support this, so we still had a problem that (c) you can't do a 40 MHz channel switch via CSA elements in Beacons/Probe Responses.

Now we've introduced 80, 160 and 80+80 MHz channels in 11ac, so have made further extensions to all this stuff. This fourth attempt is looking good, with a lot of attention paid to forward compatibility[[1]](#footnote-1).

So maybe this is The One! If so, it would be nice if pre-VHT STAs could take advantage of it (though there will still be a need to support the previous attempts if devices which don’t support the latest attempt are present).

This document proposes changes to clauses 8-10 to allow this. Specifically, it:

* Allows pre-VHT STA support for all the new stuff to be signalled
* Attempts to ensure that PCPs and IBSS STAs are not forgotten
* Allows the SCO to be specified for a 40M switch signalled using a Channel Switch Announcement element in Beacons/Probe Responses
* Allows a new Country to be specified for a switch signalled using a Channel Switch Announcement MMPDU (as already possible when using an Extended Channel Switch Announcement MMPDU)
* Restricts the Wide Bandwidth Switch element/subelement to 80M+ switches, to minimise the risk of confusion
* Ensures the regulatory constraints expressed in the Country element are always honoured, unless an explicit (VHT) Transmit Power Envelope element is present
* Requires that there be no conflict between the position of the primary 40 MHz channel indicated by the operating class and that indicated by the combination of the primary channel number and segment 0 centre frequency

It also:

* Generalises the VHT Transmit Power Envelope element not to be VHT-specific
* Makes various bits of terminology consistent
* Fixes various bugs spotted along the way
* Further clarifies the structure of the Country element
* Softens definite statements about element presence when the element isn't always present
* Ensures that existing STAs are not required to do any of the new stuff
* Has some open questions

The use of the various elements is shown in the table below, where the following abbreviations are used:

* [SM]: if and only if the Spectrum Management subfield in the Capability Information field is 1
* [ECS]: if and only if the Extended Channel Switching field in the Extended Capabilities element is 1
* [EECS]: if and only if the Extended Extended Channel Switching field in the Extended Capabilities element is 1 or the STA is a VHT STA
* *CW: channel width after switch*
* *C: channelisation after switch*
* NCN: New Channel Number subfield in CSA or ECSA element or ECSA MMPDU
* NOC: New Operating Class field in ECSA element/MMPDU
* SCOe: Secondary Channel Offset element
* SCOs: Secondary Channel Offset subelement in CSW
* SCONe: Secondary Channel Offset element indicating SCN
* SCOABe: Secondary Channel Offset element indicating SCA or SCB
* SCOABs: Secondary Channel Offset subelement in CSW indicating SCA or SCB
* WBCSe: Wide Bandwidth Channel Switch element
* WBCSs: Wide Bandwidth Channel Switch subelement in CSW
* NCNTPEe: New Country and/or New TPE elements
* NCNTPEs: New Country and/or New TPE subelements in CSW

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| New operating channel width | Using CSA MMPDU [SM] | Using CSA element in Beacon/Probe Response (not in CSA MMPDU) [SM] | Using ECSA MMPDU [ECS] | Using ECSA element in Beacon/Probe Response [ECS] |
| 20 MHz | SCONe optionalNo WBCSeNCNTPEe optional [EECS]*CW: implicit from SCON/lack of SCO and lack of WBCS**C: from NCN* | No SCOsNo WBCSe/WBSCsNCNTPEs optional [EECS]*CW: implicit from lack of SCO and lack of WBCS**C: from NCN* | No SCOeNo WBCSeNCNTPEe optional [EECS]*CW: from NOC**C: from NCN* | No SCOsNo WBCSe/WBSCsNCNTPEs optional [EECS]*CW: from NOC**C: from NCN* |
| 40 MHz | SCOABe required No WBCSeNCNTPEe optional [EECS]*CW: implicit from presence of SCOABe**C: from NCN and SCOABe* | [EECS]SCOABs requiredNo WBCSe/WBSCsNCNTPEs optional*CW: implicit from presence of SCOABs**C: from NCN and SCOABs* | No SCOeNo WBCSeNCNTPEe optional [EECS]*CW: from NOC**C: from NCN and NOC* | No SCOsNo WBCSe/WBSCsNCNTPEs optional [EECS]*CW: from NOC**C: from NCN and NOC* |
| 80, 160 or 80+80 MHz[EECS] | No SCOeWBCSe requiredNCNTPEe optional *CW: from WBCSe**C: from NCN and WBCSe* | No SCOsNo WBCSeWBCSs requiredNCNTPEs optional *CW: from WBCSs**C: from NCN and WBCSs* | No SCOeWBCSe requiredNCNTPEe optional *CW: from WBCSe and NOC (must match)**C: from NCN and WBCSe and from NCN and NOC (must match)* | No SCOsNo WBCSeWBCSs requiredNCNTPEs optional *CW: from WBCSs and NOC (must match)**C: from NCN and WBCSs and from NCN and NOC (must match)* |

## Proposed changes

The changes are relative to D3.1 (not D3.0). The changes are shown using Word change tracking. Select “Final Showing Markup” or “Final” as appropriate. Editorial instructions w.r.t. the baseline, to be given as-is in the draft, are shown using bold italics (as in the current draft). Editorial instructions w.r.t. the latest draft, to be effected by the editor before the next draft, are shown using bold italics and wavy underline. Any Word comments should be ignored when merging the proposed changes in.

<http://cybertext.wordpress.com/2010/06/02/word-jump-to-next-track-change-with-keyboard/> may be helpful.

* Frame formats
* MAC frame formats
* General frame format

Change the second paragraph as follows:

The Frame Body field is of variable size, constrained as defined in General(#6225). ~~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.~~

The maximum MPDU length transmitted by a DMG STA is 7995 octets.(11ad)

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 |
| FrameControl | Duration /ID | Address 1 | Address 2 | Address 3 | Sequence Control | Address 4 | QoS Control | HT Control | Frame Body | FCS |
| MAC Header |  |  |
| * MAC frame format
 |

Delete Table 8-0a.

* 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 valueb3 b2 | Type description | Subtype valueb7 b6 b5 b4 | Subtype description |
| 01 | Control | 0000-~~0101~~ 0011 | Reserved |
| 01 | Control | 0100 | Beamforming Report Poll |
| 01 | Control | 0101 | VHT NDP Announcement |

* More Data field

Insert the following after the 5th paragraph:

The More Data field is set to 1 in individually addressed frames transmitted by a VHT AP to a VHT STA when both support the TXOP power save feature (as determined from their VHT Capabilities elements) to indicate that at least one additional buffered BU is present for the STA. See 10.2.1.4a (Power management during VHT transmissions).(#6685)

* 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 bandwidth signaling TA, indicating that the frame carries(#6227) additional information in the scrambling sequence (see RTS frame format, 9.7.6.6 (Channel Width selection for control frames) and 9.7.10 (Channel Width in non-HT and non-HT duplicate PPDUs)(#6228)). ~~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 a ~~non-A-MPDU frame~~ single MPDU(#6413):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 a non-DMG STA, this(11ad) is the only permissible value for the Ack Policy subfield for individually addressed QoS Null (no data) frames.~~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 | HT Control Middle | ACConstraint | 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 two forms differ in the format of the HT Control Middle subfield, described in HT variant for(#6392) the HT variant and in VHT variant for the 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:

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

Insert a new figure:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B1 B15 | B16 B17 | B18 B19 | B20 B21 | B22 B23 | B24 | B25 B28 | B29 |
|  | LinkAdaptationControl | CalibrationPosition | CalibrationSequence | Reserved | CSI/Steering | NDP Announcement | Reserved | DEI(11aa) |
| Bits: | 15 | 2 | 2 | 2 | 2 | 1 | 4 | 1 |
| * HT Control Middle subfield of 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

The format of the HT Control Middle subfield of the VHT variant HT Control field is shown in HT Control Middle subfield of 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 |
| * HT Control Middle subfield of 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) indicates whether or not the estimate in the MFB subfield is computed based on a PPDU using STBC encoding:Set to 0 if the PPDU was not STBC encodedSet to 1 if the PPDU was STBC encodedThe 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 | 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 of that PPDU from which the MFB was estimated (bit 0 of the group ID 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 of MCS=15 and N\_STS=7 indicates that no feedback is present. |
| GID-H | MSB of group ID | 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 of the PPDU from which the unsolicited MFB was estimated (bit 3 of the group ID 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 the measured PPDU | If the Unsolicited MFB subfield is 1, the Coding Type subfield contains the Coding information (0 for BCC and 1 for LDPC) of the PPDU(#6230) from which the unsolicited MFB was estimated.Otherwise this subfield is reserved. |
| FB Tx Type | Transmission type of the measured PPDU | If the Unsolicited MFB subfield is 1 and FB Tx Type subfield is 0, the unsolicited MFB is estimated from a VHT PPDU with RXVECTOR parameter BEAMFORMED equal to 0.If the Unsolicited MFB subfield is 1 and the FB Tx Type subfield is 1, the unsolicited MFB is estimated from a VHT PPDU with RXVECTOR parameter BEAMFORMED equal to 1.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 MHzSet to 1 for 40 MHzSet to 2 for 80 MHzSet to 3 for 160 MHz and 80+80 MHz.If the Unsolicited MFB subfield is 0, the 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). |

* Frame Body field
* General

Change as follows:

The Frame Body is a variable-length field that contains information specific to individual frame types and subtypes. The minimum length of the frame body is 0 octets. The maximum length of the frame body is ~~defined by the maximum length MSDU plus the length of Mesh Control field as defined in 8.2.4.7.3, if present, plus any overhead for encryption as defined in Clause 11, or by the maximum length A-MSDU plus any overhead for encryption as defined in Clause 11.~~constrained or affected by:(#6225)

* 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.,(#6016) HT\_MF L SIG L\_LENGTH, HT\_GF, VHT or DMG aPPDUMaxTime(#6446) (see Maximum DU sizes (in octets) and durations (in microseconds) per PPDU forma); any nonzero(#6773) TXOP Limit; any regulatory constraints (e.g.,(#6016) CS4-msBehavior))
* the fields present in the MAC header (e.g.,(#6016) QoS Control, Address 4, HT Control)
* any security encapsulation (e.g.,(#6016) TKIP/CCMP/GCMP Header and MIC) or Mesh Control fields; see 8.2.4.7.2

Insert new Table 8-13a:

|  |
| --- |
| * 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(#6669) | VHT PPDU(#6669) | DMG PPDU |
| MMPDU size | 2304 | 2304 | See NOTE 1 | 2304 |
| MSDU size | 2304 | 2304 | 2304 | 7920 |
| A-MSDU size | 3839 or 4065 (see NOTE 2) or 7935 (HT STA, see also Table 8-124) or N/A (non-HT STA, see also 9.11 (A-MSDU operation))(#6446) | 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, see 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 21-31(#6446)) |
| 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 sizeNOTE 4—No direct constraint on the maximum MPDU size; indirectly constrained by the maximum MSDU/MMPDU or (for HT STAs only) A-MSDU sizeNOTE 5—No direct constraint on the maximum MPDU size; indirectly constrained by the maximum A-MSDU(#6446) sizeNOTE 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 values for maximum PSDU size and maximum PPDU duration are informative only. References to the normative requirements are provided.(#6684) |

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

Change the first paragraph as follows:

Within a frame (excluding data frames containing QoS CF-Poll, PSMP frames, and frames that have the RDG/More PPDU subfield equal to 1) transmitted under EDCA by a STA that initiates a TXOP, there are two classes of duration settings: single protection and multiple protection. In single protection, the value of the Duration/ID field of the frame can set a NAV value at receiving STAs that protects up to the end of any following data, management, or response frame plus any additional overhead frames as described below. In multiple protection, the value of the Duration/ID field of the frame can set a NAV that protects up to the estimated end of a sequence of multiple frames. Frames that have the RDG/More PPDU subfield equal to 1 always use multiple protection. PSMP frames always use multiple protection. The STA selects between single and multiple protection when it transmits the first frame of a TXOP. All subsequent frames transmitted by the STA in the same TXOP use the same class of duration settings. VHT NDP Announcement frames and Beamforming Report Poll frames always use multiple protection settings.

NOTE—Any TXOP involving transmission of VHT NDP Announcement frames and Beamforming Report Poll frames (#6686) uses multiple protection settings.

Change the TSINGLE-MSDU and TPENDING description in “Multiple protection settings” 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 HT NDP, VHT NDP or Beamforming Report Poll frame transmissions and explicit feedback response frames
* Applicable IFS durations
* Any RDG

Insert as the last paragraph of this subclause:

The estimated duration for a VHT Compressed Beamforming frame response is determined by assuming that:

* All feedback(#6422) segments (see 9.31.5 (VHT sounding protocol)) are transmitted, even if a Beamforming Report Poll frame is used and not all the bits in the Feedback(#6422) Segment Retransmission Bitmap therein are equal to 1.
* They are transmitted at a rate no lower than that which would be used if they were control response frames (see 9.7.5.6 (Rate selection for other data and management frames)).
* The VHT MIMO Control field subfield values are as follows:
* The Feedback Type, Nr Index and Channel Width are as specified in 9.31.5 (VHT sounding protocol).
* The Nc Index is as specified in 9.31.5 (VHT sounding protocol) if the Feedback Type is MU, or to the greatest value allowed by 9.31.5 (VHT sounding protocol) if the Feedback Type is SU.
* The Grouping indicates no grouping.
* The Codebook Information has the value 1.

NOTE—For a TXOP that includes the transmission of a VHT Compressed Beamforming frame by the TXOP responder, the TXOP holder can, if the duration estimates prove excessive, indicate truncation of the TXOP by using a CF-End frame, provided that the remaining duration of the TXOP after the transmission of the last frame can accommodate the CF-End frame (see 9.19.2.7 (Truncation of a TXOP)).

* 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 bandwidth signaling TA. The TA field is set to a bandwidth 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)).

* 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 set to a non-bandwidth signaling TA obtained ~~copied~~ from the TA field of the immediately previous RTS frame to which the CTS is a response. 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 NDP Announcement
* frame format and
* Beamforming Report Poll

 frame format:

* VHT NDP Announcement
* frame format

The frame format of the VHT NDP Announcement frame is shown in VHT NDP Announcement.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Frame Control | Duration | RA | TA | Sounding Dialog Token(#6236) | STA Info 1 | … | STA Info *n* | FCS |
| Octets: | 2 | 2 | 6 | 6 | 1 | 2 |  | 2 | 4 |
| * VHT NDP Announcement
 |

* The Duration field is set as defined in

Duration/ID field.

The VHT NDP Announcement frame contains at least one STA Info field. If the VHT NDP Announcement 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 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 frame.

The format of the Sounding Dialog Token(#6236) field is shown in Sounding Dialog Token.

|  |  |  |
| --- | --- | --- |
|  | B0 B1 | B2 B7 |
|  | Reserved | Sounding Dialog Token Number(#6236) |
| Bits: | 2  | 6 |
| * Sounding Dialog Token(#6236) field
 |

The Sounding Dialog Token Number(#6236) subfield in the Sounding Dialog Token(#6236) field contains a value selected by the beamformer to identify the VHT NDP Announcement frame.

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

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 B11 | B12 | B13 B15 |
|  | AID12 | 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 |
| AID12 | Contains the 12 least significant bits of the AID of a STA expected to process the following VHT NDP 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. |
| 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, then Nc Index indicates the number of columns, *Nc*, in the Compressed Beamforming Feedback Matrix subfield minus one:Set to 0 to request *Nc* = 1Set to 1 to request *Nc* = 2…Set to 7 to request *Nc* = 8Reserved if the Feedback Type field indicates SU. |

*
* Beamforming Report Poll
* frame format

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Frame Control | Duration | RA | TA | Feedback 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 Feedback Segment Retransmission Bitmap field indicates the feedback 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 (VHT sounding protocol)). The bit in position *n* (*n=0* for LSB and *n=7* for MSB) is set to 1 when the feedback(#6422) segment with the Remaining Feedback Segments subfield in the(#6239) VHT MIMO Control field set to *n* is requested. The bit in position *n* is set to 0 when the frequency(#6422) segment with the Remaining Feedback Segments subfield in the(#6239) 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 notes that follow):

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

NOTE 1—The maximum Frame Body size (11 424 octets) is derived(#6799) 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.

NOTE 2—The maximum Frame Body size for a data frame carried in a non-VHT PPDU is 7951 octets for CCMP encryption of a maximum-size A-MSDU (note that TKIP encryption is not allowed in this case and any Mesh Control fields are part of the A-MSDU subframes). The maximum frame body size if A-MSDUs are not used is 2338 octets for CCMP encryption of a maximum-size MSDU and 2342 octets for TKIP encryption of a maximum-size MSDU, including in both cases an 18-octet Mesh Control field. The frame body size might in all these cases be greater if a vendor-specific cipher suite is used.

* 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) 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. In an MMPDU carried in one or more PPDU(s), 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. In an MMPDU carried in one or more PPDU(s), none of which are VHT PPDU(s), the maximum unencrypted MMPDU size is 2304 octets.

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 derived(#6799) 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 frame(#6195) 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 frame(#6195) size is 2356 octets.

* Beacon frame format

Insert new rows for Order 60 through 66 after Order 59 in Beacon frame body as follows:

* Order 1 to 55 in 802.11-2012, +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 dot11VHTOptionImplemented is true; otherwise it is not present. |
| 61 | VHT Operation | The VHT Operation element is present when dot11VHTOptionImplemented is true; otherwise it is not present. |
| 62 | VHT Transmit Power Envelope element | One VHT Transmit Power Envelope element is present for each distinct value of the Local Maximum Transmit Power Units Interpretation subfield that is supported for the BSS if both the following conditions are met:* dot11ExtendedExtendedChannelSwitching is true;
* Either dot11SpectrumManagementRequired is true or dot11RadioMeasurementActivated is true.

Otherwise this element is not present. |
| 63 | Channel Switch Wrapper element | The Channel Switch Wrapper element is optionally present if dot11ExtendedExtendedChannelSwitching is true and at least one of a Channel Switch Announcement element or an Extended Channel Switch Announcement element is also present; otherwise it is not present. |
| 64 | Extended BSS Load element | The Extended BSS Load element is optionally present if dot11QosOptionImplemented, dot11QBSSLoadImplemented and dot11VHTOptionImplemented are true; otherwise it is not present. |
| 65 | Quiet Channel | Either one Quiet Channel element containing an AP Quiet Mode field equal to 0 or one or more Quiet Channel elements each containing an AP Quiet Mode field equal to 1 are(#6241) optionally present if dot11VHTOptionImplemented is true, and either dot11SpectrumManagementRequired or dot11RadioMeasurementActivated is true; otherwise it is not present. |
| 66 | Operating Mode Notification | The Operating Mode Notification element is optionally present if dot11OperatingModeNotificationImplemented is true; otherwise it is not present. |

* 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 802.11-2012, 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 dot11VHTOptionImplemented is true; otherwise it is not present. |
| 23 | Operating Mode Notification | The Operating Mode Notification element is optionally present if dot11OperatingModeNotificationImplemented is true; otherwise it is not present. |

* 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 802.11-2012, +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 dot11VHTOptionImplemented is true; otherwise it is not present. |
| 28 | VHT Operation | The VHT Operation element is present when dot11VHTOptionImplemented is true; otherwise it is not present. |
| 29 | Operating Mode Notification | The Operating Mode Notification element is optionally present if dot11OperatingModeNotificationImplemented is true; otherwise it is not present. |

* Reassociation Request frame format

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

* Order 1 to 23 in 802.11-2012, +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 dot11VHTOptionImplemented is true; otherwise it is not present. |
| 29 | Operating Mode Notification | The Operating Mode Notification element is optionally present if dot11OperatingModeNotificationImplemented is true; otherwise it is not present. |

* 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 802.11-2012, +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 dot11VHTOptionImplemented is true; otherwise it is not present. |
| 32 | VHT Operation | The VHT Operation element is present when dot11VHTOptionImplemented is true; otherwise it is not present. |
| 33 | Operating Mode Notification | The Operating Mode Notification element is optionally present if dot11OperatingModeNotificationImplemented is true; otherwise it is not present. |

* 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 802.11-2012, 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 dot11VHTOptionImplemented is true; otherwise it is not present. |

*
* 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 802.11-2012, +1 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 dot11VHTOptionImplemented is true; otherwise it is not present. |
| 62 | VHT Operation | The VHT Operation element is present when dot11VHTOptionImplemented is true; otherwise it is not present. |
| 63 | VHT Transmit Power Envelope element | One VHT Transmit Power Envelope element is present for each distinct value of the Local Maximum Transmit Power Units Interpretation subfield that is supported for the BSS if both the following conditions are met:* dot11ExtendedExtendedChannelSwitching is true;
* Either dot11SpectrumManagementRequired is true or dot11RadioMeasurementActivated is true.

Otherwise this element is not present. |
| 63 | Channel Switch Wrapper element | The Channel Switch Wrapper element is optionally present if dot11ExtendedExtendedChannelSwitching is true and at least one of a Channel Switch Announcement element or an Extended Channel Switch Announcement element is also present; otherwise it is not present. |
| 65 | Extended BSS Load element | The Extended BSS Load element is optionally present if dot11QosOptionImplemented, dot11QBSSLoadImplemented and dot11VHTOptionImplemented are true; otherwise it is not present. |
| 66 | Quiet Channel | Either one Quiet Channel element containing an AP Quiet Mode field equal to 0 or one or more Quiet Channel elements each containing an AP Quiet Mode field equal to 1 are(#6241) optionally present if dot11VHTOptionImplemented is true, and either dot11SpectrumManagementRequired or dot11RadioMeasurementActivated is true; otherwise it is not present. |
| 67 | Operating Mode Notification | The Operating Mode Notification element is optionally present if dot11OperatingModeNotificationImplemented is true; otherwise it is not present. |

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

Insert a new row into Table 8-37 maintaining numerical order and adjusting the reserved values as appropriate:

|  |
| --- |
| * Status codes
 |
| Status code | Name | Meaning |
| <ANA> |  | Association denied because the requesting STA does not support VHT features.(#6795) |

* Action field

Insert the following row into Category values:

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

* CSI Report field

Change the 1st paragraph as follows:

The CSI Report field is used by the CSI frame (see 8.5.12.6) to carry explicit channel state information to a transmit HT beamformer, as described in 9.29.3.

* Noncompressed Beamforming Report field

Change the 1st paragraph as follows:

The Noncompressed Beamforming Report field is used by the Noncompressed Beamforming frame to carry explicit feedback in the form of noncompressed beamforming feedback matrices V for use by a transmit HT beamformer to determine steering matrices Q, as described in 9.29.3 and 20.3.12.3.

Change the 4th paragraph as follows:

The SNR values in Table 8-46 and Table 8-47 are encoded as an 8-bit twos complement value of 4 × (SNR\_average – 22), where SNR\_average is the sum of the values of SNR per tone (in decibels) divided by the number of tones represented. This encoding covers the SNR range from –10 dB to 53.75 dB in 0.25 dB steps. The SNR in space-time stream i corresponds to the SNR associated with the column i of the beamforming feedback matrix V. Each SNR corresponds to the predicted SNR at HT beamformee when the HT beamformer applies the matrix V.

* Compressed Beamforming Report field

Change the 1st paragraph as follows:

The Compressed Beamforming Report field is used by the Compressed Beamforming frame (see 8.5.12.8) to carry explicit feedback information in the form of angles representing compressed beamforming feedback matrices V for use by a transmit HT beamformer to determine steering matrices Q, as described in 9.29.3 and 20.3.12.3.

Change the 6th paragraph as follows:

The SNR values in Table 8-50 and Table 8-51 are encoded as an 8-bit twos complement value of 4 × (SNR\_average – 22), where SNR\_average is the sum of the values of SNR per tone (in decibels) divided by the number of tones represented. This encoding covers the SNR range from –10 dB to 53.75 dB in 0.25 dB steps. 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 HT beamformee. Each SNR corresponds to the predicted SNR at the HT beamformee when the HT beamformer applies the matrix *V*.

* 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 is 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).

If MCS Selector is 3, 4, 5 or 6, the MCS Index field format is as shown in MCS Index field format when the MCS Selector field is 3, 4, 5 or 6. 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 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 Feedback Segments | First Feedback Segment | Reserved | Sounding Dialog Token Number(#6236) |
| 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 feedback matrix minus one:Set to 0 for *Nc* = 1Set to 1 for *Nc* = 2…Set to 7 for *Nc* = 8 |
| Nr Index | Indicates the number of rows, *Nr*, in the compressed beamforming feedback matrix minus one:Set to 0 for *Nr* = 1Set 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 feedback matrix was made:Set to 0 for 20 MHzSet to 1 for 40 MHzSet to 2 for 80 MHzSet to 3 for 160 MHz or 80+80 MHz |
| Grouping | Indicates the subcarrier grouping, *Ng*, used for the compressed beamforming feedback matrix:Set to 0 for *Ng* = 1 (No grouping)Set to 1 for *Ng* = 2Set to 2 for *Ng* = 4The value 3 is reserved |
| Codebook Information | Indicates the size of codebook entries:If Feedback Type is SU: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: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 SUSet to 1 for MU |
| Remaining Feedback Segments | Indicates the number of remaining feedback segments for the associated VHT Compressed Beamforming frame:Set to 0 for the last feedback segment of a segmented report or the only feedback(#6422) segment of an unsegmented report.Set to a value between 1 and 6 for a feedback segment that is neither the first nor the last of a segmented report.Set to a value between 1 and 7 for a feedback segment that is not the last feedback(#6422) segment of a segmented report.In a retransmitted feedback segment, the field is set to the same value associated with the feedback(#6422) segment in the original transmission. |
| First Feedback Segment | Set to 1 for the first feedback segment of a segmented report or the only feedback segment of an unsegmented report; set to 0 if it is not the first feedback segment or if the VHT Compressed Beamforming Report field and MU Exclusive Beamforming Report field are not present in the frame.In a retransmitted feedback(#6422) segment, the field is set to the same value associated with the feedback segment in the original transmission. |
| Sounding Dialog Token Number(#6236) | The sounding dialog token(#6236) from the VHT NDP Announcement frame soliciting feedback |

In a VHT Compressed Beamforming frame not carrying all or part of a VHT Compressed Beamforming report(#6454), the Nc Index, Nr Index, Channel Width, Grouping, Codebook Information, Feedback Type and Sounding Dialog Token Number(#6236) fields(Ed) are reserved, the First Feedback(#6422) Segment field is set to 0 and the Remaining Feedback 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(#6454) (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) 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 thereof(#6527) in the case of a segmented VHT Compressed Beamforming report (see 9.31.5 (VHT sounding protocol)). 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 beamforming feedback matrix *V* is formed by the beamformee as follows. The beamformer transmits an NDP with *NSTS* space-time streams. Based on this NDP, the beamformee estimates the  channel, and based on that channel it determines a *Nr×Nc* orthonormal matrix *V*, where *Nr* and *Nc* satisfy

.

*

Further restrictions on *Nc* are described in 9.31.5 (VHT sounding protocol).(#6169)

The angles are quantized as defined in Quantization of angles. The value of *k* for each angle is transmitted LSB to MSB.

|  |
| --- |
| * Quantization of angles
 |
| Quantized | Quantized |
|  radianswhere 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) |  radianswhere 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 information , 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 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 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 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 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 |

*Ns* is the number of subcarriers for which the Compressed Beamforming Feedback Matrix subfield is sent back to the beamformer. A(#6239) 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 the(#6239) VHT MIMO Control field(#6242) (see VHT MIMO Control field). Subcarriers for which a Compressed Beamforming Feedback Matrix subfield is lists *Ns*, the exact subcarrier indices and their order for which the Compressed Beamforming Feedback Matrix subfield is sent back. No padding is present between angles in the VHT Compressed Beamforming Report information, even if they correspond to different subcarriers. If the size of the VHT Compressed Beamforming Report information is not an 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, 28NOTE—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, 58NOTE—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, 122NOTE—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, -171, -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, ‑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, 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, 250NOTE—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, 250NOTE—DC subcarriers(#6243) 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, 250NOTE—DC subcarriers(#6243) ±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 1—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 2—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 information  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 found by computing the SNR per subcarrier in decibels for the subcarriers identified in Subcarriers for which a Compressed Beamforming Feedback Matrix subfield is, and then computing the arithmetic mean of those values.(#6788) 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 all columns of the matrix *V*(#6535).

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

A STA with a 160 MHz or 80+80 MHz operating channel width and sending feedback for an 80 MHz channel width 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. The information in the VHT Compressed Beamforming Report field and the MU Exclusive Beamforming Report field can be used by the transmit MU beamformer to determine steering matrices *Q*, as described in 9.29.3 (Explicit feedback beamforming), 20.3.12.3 (Explicit feedback beamforming), and Table 22.3.11 (SU-MIMO and DL-MU-MIMO(#6205) Beamforming).(#6170)

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 (VHT sounding protocol)). 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 typically(#6244) 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. No padding is present between  in the MU Exclusive Beamforming Report field, even if they correspond to different subcarriers. 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

.

*

where

*k* is the subcarrier index in the range of *sscidx*(0), …, *sscidx*(*Ns*'-1)(#6245)

*i* is the space-time stream index in the range of 1, …, *Nc*

 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, 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 with 1 dB granularity. The structure of the MU Exclusive Beamforming Report field is shown in MU Exclusive Beamforming Report information .

|  |
| --- |
| * MU Exclusive Beamforming Report information
 |
| Field | Size (Bits) | Meaning |
| Delta SNR for space-time stream 1 for subcarrier *k = sscidx(0)*(#6245) | 4 | * as defined in
 |
| … | … | … |
| Delta SNR for space-time stream  for subcarrier *k = sscidx(0)* | 4 | * as defined in
 |
| Delta SNR for space-time stream 1 for subcarrier *k = sscidx(1)* | 4 | * as defined in
 |
| … | … | … |
| Delta SNR for space-time stream  for subcarrier *k = sscidx(1)* | 4 | * as defined in
 |
| … | … | … |
| Delta SNR for space-time stream 1 for subcarrier *k = sscidx(Ns’-1)* | 4 | * as defined in
 |
| … | … | … |
| Delta SNR for space-time stream  for subcarrier *k = sscidx(Ns’-1)* | 4 | * as defined in
 |

In MU Exclusive Beamforming Report information ,

 *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: *sscidx*(0), *sscidx*(1), … *sscidx*(*Ns'*-1)(#6245) |
| 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, 250NOTE—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, 250NOTE—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)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. |
| 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) |
| NOTE—*sscidx*() is defined in MU Exclusive Beamforming Report information .(#6245) |

* Operating Mode field
* The Operating Mode field is present in the Operating Mode Notification frame (see Operating Mode Notification

 frame format) and Operating Mode Notification element (see 8.4.2.168)(#6437).

The Operating Mode field is shown in Operating Mode field.

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

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 Operating Mode field.

|  |
| --- |
| * Subfield values of the Operating Mode field
 |
| Subfield | Description |
| Channel Width | If the Rx Nss Type subfield is 0, indicates the supported channel width:Set to 0 for 20 MHzSet to 1 for 40 MHzSet to 2 for 80 MHzSet to 3 for 160 MHz or 80+80 MHzReserved if the Rx Nss Type(#6672) subfield is 1. |
| Rx Nss | If the Rx Nss Type subfield is 0, indicates the maximum number of spatial streams that the STA can receive.If the Rx Nss Type subfield is 1, indicates the maximum number of spatial streams that 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* = 1Set 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 the STA can receive.Set to 1 to indicate that the Rx Nss subfield carries the maximum number of spatial streams that the STA can receive in(#6246) an SU PPDU using a beamforming steering matrix derived from a VHT Compressed Beamforming report(#6454) with the Feedback Type subfield indicating MU in the VHT Compressed Beamforming frame(s). |

* 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) consists of a 1-bit Membership Status subfield for each of the 64 group IDs, 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 Membership Status subfield for each group ID 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 0 (transmissions to AP) and group ID 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 User Position subfield for each of the 64 group IDs, 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 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 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 0 (transmissions to AP) and group ID 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 |
| VHT Operation (see VHT Operation element) | 192 | 7 | Yes |
| Extended BSS Load (see Extended BSS Load element) | 193 | 8 | 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 | 4 to 7 | Yes |
| Channel Switch Wrapper (see Channel) | 196 | 5 to 257 | Subelements |
| AID (see AID element) | 197 | 4 |  |
| Quiet Channel | 198 | 3 or 9 | Yes |
| Operating Mode Notification | 199 | 3 | Yes |

* Supported(#6247) 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 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. |

* Country element

Replace Figure 8-90 with the following:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | Country String | Triplet | Pad (if *Q* is even) |
| Octets: | 1 | 1 | 3 | 3×*Q* | 0 or 1 |
| * Country element format
 |

Change the 2nd through 7th paragraphs as follows and insert new figures as shown:

~~The element ID for this element is set to the value for Country, specified in Table 8-54. The length of the element is variable, as the element may contain more than one triplet comprising the First Channel Number, Number of Channels, and Maximum Transmit Power Level fields and referred to as subband triplets. Alternatively, where dot11OperatingClassesRequired is true and the First Channel Number/Operating Extension Identifier octet has a positive integer value of 201 or greater, then that triplet comprises the Operating Extension Identifier, Operating Class, and Coverage Class fields. Together they are referred to as an operating triplet. The minimum length of the element is 8 octets.~~

The Element ID field is set to the value for the Country element specified in Element IDs.

The length of the element is variable; the Length field is set accordingly (minimum 6).

If dot11OperatingClassesRequired is false, then the Triplet field is a single Subband Triplet Sequence subfield, as shown in Subband Triplet Sequence sub2, that is composed of *Q* Subband Triplet subfields, where *Q* is one or more, as shown in Figure 8-90a. The format of the Subband Triplet subfield is shown in Subband Triplet subfield.

|  |  |
| --- | --- |
|  | One or moreSubband Triplets |
|  | Subband Triplet |
| Octets: | variable |
| * Subband Triplet Sequence subfield
 |
|  | Subband Triplet Sequence |
| Octets: | variable |
| Figure 8-90a2— Triplet field if dot11OperaratingClassRequired is false |

|  |  |  |  |
| --- | --- | --- | --- |
|  | First Channel Number | Number of Channels | Maximum Transmit Power Level |
| Octets: | 1 | 1 | 1 |
| * Subband Triplet subfield
 |

If dot11OperatingClassesRequired is true, then the Triplet field is composed of *M* Operating/Subband Sequences, where *M* is one or more, as shown in Triplet field if dot11OperaratingClassRequired is true. Each Operating/Subband Sequence is composed of one Operating Triplet subfield followed by one Subband Triplet Sequence subfield, as shown in Format of . Each Subband Triplet Sequence subfield is composed of *P(m)* Subband Triplet(#6248) subfields, where *m* is the Operating/Subband Sequence subfield index and *P(m)* is zero or more. The number of triplets in the Triplet field is .

|  |  |
| --- | --- |
|  | One or more Operating/Subband Sequences indexed by  |
|  | Operating/Subband Sequence |
| Octets: | variable |
| * Triplet field if dot11OperaratingClassRequired is true
 |

|  |  |  |
| --- | --- | --- |
|  | Operating Triplet | Subband Triplet Sequence made up of P(m) Subband Triplet subfields, where  |
|  | Operating Extension Identifier | Operating Class | Coverage Class |
| Octets: | 1 | 1 | 1 | 3*×P(m)* |
| * Format of *m*-th Operating/Subband Sequence subfield
 |

The number *Q* of Subband or Operating Triplet subfields in the element is determined by the Length field.

An operating class for an 80+80 MHz channel width is expressed by two consecutive Operating/Subband Sequences, where the first Operating/Subband Sequence subfield contains an Operating Triplet subfield for an 80 MHz channel spacing with an 80+ Behavior Limit and the second Operating/Subband Sequence subfield contains an Operating Triplet subfield for an 80 MHz channel spacing without an 80+ Behavior Limit.

Operating/Subband Sequence subfields for 80, 160 or 80+ MHz operating classes contain no Subband Triplet subfields.

NOTE—The VHT Transmit Power Envelope element is always used for TPC for 80 MHz, 160 MHz or 80+80 MHz operating classes instead of subband triplets (see 10.39.1 (Basic VHT BSS functionality)).

The Operating Extension Identifier in an Operating Triplet subfield has a value of 201 or greater.

NOTE—Operating Extension Identifiers are not required to have the value 201, or to be unique within the Country element.

The Country String field of the element is 3 octets in length. An AP, PCP, STA in an IBSS or mesh STA sets this field to the value contained in dot11CountryString before transmission in a Beacon or Probe Response frame. Upon reception of this element, a STA sets the value of dot11CountryString to the value contained in this field.

NOTE—The three octets of the Country String have additional structure as defined by dot11CountryString (see Annex C).

The First Channel Number~~/Operating Extension Identifier~~ subfield in a Subband Triplet subfield has a nonzero value less than 201 (the value 0 is reserved) and ~~is 1 octet in length. If the field has a positive integer value less than 201, then it contains a positive integer value that~~ indicates the lowest channel number in the subband triplet ~~subband described in this element~~. The group of channels described by each pair of the First Channel Number and the Number of Channels subfields within a Subband Triplet Sequence subfield do not have overlapping channel identifiers. [For example, the pairs (2,4) and (5,2) overlap and are not used within the same Subband Triplet Sequence subfield ~~together~~.]

The First Channel Numbers are monotonically increasing within a Subband Triplet Sequence subfield ~~where dot11OperatingClassesRequired is not true.Where dot11OperatingClassesRequired is true, consecutive subband triplets following an operating triplet have monotonically increasing First Channel Number fields~~.

The Number of Channels subfield of the subelement is 1 octet in length.

The Maximum Transmit Power Level subfield is a signed number and is 1 octet in length. ~~It~~ The Maximum Transmit Power Level subfield indicates the maximum power, in dBm, allowed to be transmitted. As the method of measurement for maximum transmit power level differs by regulatory domain, the value in this subfield is interpreted according to the regulations applicable for the domain identified by the Country String.

An operating class is an index into a set of values for radio equipment sets of rules. The Operating Class subfield is 1 octet in length.

A coverage class is an index into a set of values for aAirPropagationTime. The Coverage Class subfield is 1 octet in length.

The Coverage Class subfield of the Operating Triplet subfield specifies the aAirPropagationTime characteristic used in BSS operation, as shown in Table 8-56. The characteristic aAirPropagationTime describes variations in actual propagation time that are accounted for in a BSS and, together with maximum transmit power level, allow control of BSS diameter.

The Pad field is 0 or 1 octet in length. The Pad field is used to add a single octet to the element where *Q* is even so that the length of the Country element is evenly divisible by 2. The value of the Pad field is 0.

* Power Capability element

Change the 3rd and 4th paragraphs as follows:

The Minimum Transmit Power Capability field is set to the nominal minimum transmit power with which the STA is capable of transmitting in the current channel, with a tolerance ± 5 dB. The field is coded as a signed integer in units of decibels relative to 1 mW. Further interpretation of this field is defined in 10.8.3 (Interpretation of transmit power capability)(#6007).

The Maximum Transmit Power Capability field is set to the nominal maximum transmit power with which the STA is capable of transmitting in the current channel, with a tolerance ± 5 dB. The field is coded as a signed integer in units of decibels relative to 1 mW. Further interpretation of this field is defined in 10.8.3 (Interpretation of transmit power capability)(#6007).

* Secondary Channel Offset element

Change the first paragraph as follows:

The Secondary Channel Offset element is used by an AP in a BSS, a STA in an IBSS, or a mesh STA in an MBSS ~~together with the Channel Switch Announcement element~~ when channel switching (but not extended channel switching) to a new 40 MHz channel and optionally when channel switching (but not extended channel switching) using a Channel Switch Announcement frame to a new 20 MHz channel. The format of the Secondary Channel Offset element is shown in Figure 8-103.(#6423)

* RSN element
* Cipher suites

Insert the following paragraph after the 3rd paragraph:

The 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 bits 61 and 62 as shown below in Capabilities field and change the range of the reserved bits in the last row 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. A 160 MHz bandwidth is defined to be identical to a 80+80 MHz bandwidth (i.e. one is not wider than the other).(#6312) |
| 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. |
| 63 | Extended Extended Channel Switching | If dot11ExtendedExtendedChannelSwitching is true, the Extended Extended Channel Switching subfield is set to 1 by a non-VHT STA to indicate support for:* The New Country, Wide Bandwidth Channel Switch and New Transmit Power Envelope elements in Channel Switch Announcement frames, if the STA supports these frames
* The New Country, Wide Bandwidth Channel Switch and New Transmit Power Envelope elements in Extended Channel Switch Announcement frames, if the STA supports these frames
* The Transmit Power Envelope and Channel Switch Wrapper elements in Beacon and Probe Response frames, if the STA supports channel switching or extended channel switching

This subfield may be set to 0 by a VHT STA, even though VHT STAs support these.Otherwise this subfield is set to 0 to indicate these are not supported. |

* EDCA Parameter Set element(#6396)

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 16 and Clause 17 | For PHYs defined in Clause 18, Clause 19, ~~and~~ Clause 20 and Clause 22 | 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 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 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 8th paragraph as follows:

The Non-Transmitted BSSID Profile subelement contains a list of elements for one or more APs or DMG 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 1st paragraph as follows:

The Supported MCS Set field of the HT Capabilities element indicates which HT MCSs a STA supports.

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.

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 supportedSet to 1 if supported |

* Transmit Beamforming Capabilities

Change Table 8-128 as follows (“beamformee/r” to “HT beamformee/r”).

|  |
| --- |
| * Subfields of the Transmit Beamforming Capabilities field
 |
| Subfield | Definition | Encoding |
| CSI Number ofBeamformerAntennas Supported | Indicates the maximum number of beamformer antennas the HT beamformee can support when CSI feedback is required | Set to 0 for single Tx antenna soundingSet to 1 for 2 Tx antenna soundingSet to 2 for 3 Tx antenna soundingSet to 3 for 4 Tx antenna sounding |
| NoncompressedSteering Number ofBeamformerAntennas Supported | Indicates the maximum number of beamformer antennas the HT beamformee can support when noncompressed beamforming feedback matrix is required | Set to 0 for single Tx antenna soundingSet to 1 for 2 Tx antenna soundingSet to 2 for 3 Tx antenna soundingSet to 3 for 4 Tx antenna sounding |
| CompressedSteering Number ofBeamformerAntennas Supported | Indicates the maximum number of beamformer antennas the HT beamformee can support when compressed beamforming feedback matrix is required | Set to 0 for single Tx antenna soundingSet to 1 for 2 Tx antenna soundingSet to 2 for 3 Tx antenna soundingSet to 3 for 4 Tx antenna sounding |
| CSI Max Number ofRows BeamformerSupported | Indicates the maximum number of rows of CSI explicit feedback from the HT beamformee or calibration responder or transmit ASEL responder that an HT beamformer or calibration initiator or transmit ASEL initiator can support when CSI feedback is required. | Set to 0 for a single row of CSISet to 1 for 2 rows of CSISet to 2 for 3 rows of CSISet to 3 for 4 rows of CSI |

* HT Operation element

Change the Basic MCS Set row in Table 8-130 as follows:

|  |
| --- |
| * HT Operation element fields and subfields
 |
| Subfield | Definition | Encoding | Reserved in IBSS? | Reserved in MBSS? |
| Basic MCS Set | Indicates the HT MCS values that are supported by all HT STAs in the BSS.Present in Beacon, Probe Response, Mesh Peering Open and Mesh Peering Confirm frames. Otherwise reserved. | The Basic MCS Set is a bitmap of size 128 bits. Bit 0 corresponds to MCS 0. A bit is set to 1 to indicate support for that MCS and 0 otherwise.MCS values are defined in 8.4.2.58.4. | N | N |

* Event Report element
* Peer-to-Peer Link event report

Change the 5th paragraph follows:

The STA Tx Power field indicates the target transmit power at the antenna (i.e., EIRP) in dBm with a tolerance of ± 5 dB of the lowest basic rate of the reporting STA.

* Diagnostic Request element
* Diagnostic Information subelement descriptions

Change the paragraph describing the Tx Power field as follows:

The Tx Power field indicates the target transmit power level(s) at the antenna(s) (i.e., EIRP), where the actual power is within ±5 dB to the target. Each transmit power level is encoded in a single octet as a 2's complement value in dBm, rounded to the nearest integer. If the Tx Power Mode field is 0 then the Tx Power field contains one or more transmit power levels in increasing numerical order. If the Tx Power Mode field is 1, the Tx Power field contains the STA's minimum and nonzero maximum transmit power levels, in that order.

* Location Parameters element
* Radio Information subelement

Change the 4th paragraph follows:

The Transmit Power field is the transmit power used to transmit the current Location Track Notification frame containing the Location Parameters element with the Radio Information subelement and is a signed integer, one octet in length, reported as an EIRP in dBm. A value of -128 indicates that the transmit power is unknown. The tolerance for the transmit power value reported in the Radio Information subelement is ± 5 dB. This tolerance is defined as the maximum possible difference, in decibels, between the reported power value and the total transmitted power across all antennas of the STA, which are measured when transmitting Location Request frames.

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
 |

The Element ID field is set to the value for the VHT Capabilities element specified in Element IDs.

The Length field is set to 12.

* 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.Set to 1 for 7991 octets.Set to 2 for 11 454 octets.The value 3 is reserved. |
| Supported Channel Width Set | Indicates the channel widths supported by the STA. See 10.39 (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 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 or 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 an SU 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 an SU 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 | The maximum number of space-time streams that the STA can receive in a VHT NDP, the maximum value for *NSTS,total* that can be sent to the STA in an MU PPDU if the STA is MU beamformee capable and the maximum value of *Nr* that the STA transmits in a VHT Compressed Beamforming frame. | If SU beamformee capable, set to the maximum number of supported beamformer antennas minus 1.Otherwise reserved. |
| Number of Sounding Dimensions | Beamformer’s capability indicating the maximum value of the TXVECTOR parameter NUM\_STS for a VHT NDP | If SU beamformer capable, set to the maximum supported value of the TXVECTOR parameter NUM\_STS 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 SU Beamformer Capable is set to 0 or if sent by a non-AP STA.Set to 1 if supported and SU Beamformer Capable is set to 1. |
| 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 SU Beamformee Capable is set to 0 or if sent by an AP.Set to 1 if supported and SU Beamformee Capable is set to 1. |
| VHT TXOP PS | Indicates whether or not the AP supports VHT TXOP Power Save Mode or whether or not the non-AP STA has enabled VHT TXOP Power Save mode. | When transmitted by a VHT AP(#6509):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 non-AP VHT STA(#6509):Set to 0 when the VHT STA has not enabled (#6253)TXOP Power Save Mode.Set to 1 when the VHT STA has enabled 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 supportedSet to 1 if supported |
| Maximum A-MPDU Length Exponent | Indicates the maximum length of A-MPDU that the STA can receive. EOF padding is not included in this limit. | 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. | If +HTC-VHT Capable is 1: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. |
| 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 the current association.Set to 1 if Rx antenna pattern does not change during the lifetime of the current association.See 10.39.6 (VHT STA antenna indication). |
| 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 the current association.Set to 1 if Tx antenna pattern does not change during the lifetime of the current association.See 10.39.6 (VHT STA antenna indication). |

NOTE 1—An AP that sets MU Beamformer Capable to 1 can transmit a VHT MU PPDU with only one nonzero(#6773) TXVECTOR parameter NUM\_STS[*p*], for . However, a STA that sets MU Beamformee Capable to 0 is not required to be able to demodulate a VHT MU PPDU with only one nonzero(#6773) RXVECTOR parameter NUM\_STS[*p*], for .

NOTE 2—The value for the Maximum MPDU Length in the VHT Capabilities Info field imposes a constraint on the allowed value of the Maximum MPDU Length in the HT Capabilities Info field of the HT Capabilities element carried in the same frame (see 9.11 (A-MSDU operation)).

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

* VHT Supported MCS Set field

The VHT Supported MCS Set field is used to convey the combinations of MCSs and spatial streams that 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 Long GI Data Rate(#6430) | Reserved | Tx MCS Map | Tx Highest Supported Long GI Data Rate(#6430) | Reserved |
| Bits: | 16 | 13 | 3 | 16 | 13 | 3 |
| * VHT Supported MCS Set field
 |

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 value of the RXVECTOR parameter MCS of a PPDU that can be received at all channel widths supported by this STA for each number of spatial streams. | The format and encoding of this subfield are defined in VHT Supported MCS Set field.(#6256) |
| Rx Highest Supported Long GI Data Rate(#6430) | Indicates the highest long GI VHT PPDU data rate that the STA is able to receive. | In units of 1 Mb/s (see 9.7.11.1 (VHT Rx Supported MCS Set)). 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 value of the TXVECTOR parameter MCS of a PPDU that can be transmitted at all channel widths supported by this STA for each number of spatial streams. | The format and encoding of this subfield are defined in VHT Supported MCS Set field.(#6256) |
| Tx Highest Supported Long GI Data Rate(#6430) | Indicates the highest long GI VHT PPDU data rate that the STA is able to transmit at. | In units of 1 Mb/s (see 9.7.11.2 (VHT Tx Supported MCS Set)). 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. |

The Rx MCS Map subfield, the Tx MCS Map subfield and the VHT Basic MCS Set field 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 Max MCS For *n* SS subfield (where *n* = 1, ..., 8) is encoded as follows:

* 0 indicates support for MCS 0-7 for *n* spatial streams
* 1 indicates support for MCS 0-8 for *n* spatial streams
* 2 indicates support for MCS 0-9 for *n* spatial streams
* 3 indicates that *n* spatial streams is not supported(#6256)

NOTE—An MCS indicated as supported in the MCS Map fields for a particular number of spatial streams might not be valid at all bandwidths (see 22.5 (Parameters for VHT MCSs)).(#6256)

* 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 the VHT Operation element specified in Element IDs.

The Length field is set to 5.

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

|  |  |  |  |
| --- | --- | --- | --- |
|  | Channel Width | Channel Center FrequencySegment 0 | Channel Center FrequencySegment 1 |
| 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 10.39.1 (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 0 | Defines the channel center frequency for an 80 and 160 MHz VHT BSS and the frequency(#6422) segment 0 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 0 on which the VHT BSS operates.Reserved otherwise. |
| Channel Center Frequency Segment 1 | Defines the frequency(#6422) segment 1 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 1 on which the VHT BSS operates. Reserved otherwise. |

The VHT Basic MCS Set field indicates the MCSs 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*(#6431) 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 | 1 | 1 | 1 | 1 |
| * Extended BSS Load element format
 |

The Element ID field is set to the value for the Extended BSS Load element specified in Element IDs.

The Length field is set to 6.

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 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 spatial stream underutilization is calculated only for the primary channel. This percentage is computed using the formula,



where

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

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

 is , where  is the time interval, in units of microseconds, during which the primary 20 MHz channel is busy due to the transmission of one or more spatial streams by the AP to MU capable STAs, *NSS,i* 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.

 If  is 0(#6739), the Spatial Stream Underutilization field is reserved.

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,



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,



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,



 where

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

, , 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 0(#6740), the VHT 40 MHz Utilization, 80 MHz Utilization and 160 MHz Utilization fields are reserved.

The measurements for the Spatial Stream Underutilization field, VHT 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).

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 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 for a switch to a channel width of 80 MHz or wider in Channel Switch Announcement frames, as described in 8.5.2.6 (Channel Switch Announcement frame format), Extended Channel Switch Announcement frames, as described in <whatever>, and TDLS Channel Switch Request frames, as described in 8.5.13.7 (TDLS Channel Switch Request frame format). The format of the Wide Bandwidth Channel Switch element is shown in Wide Bandwidth Channel Switch element format.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Element ID | Length | NewChannel Width | NewChannel Center Frequency Segment 0 | NewChannel Center Frequency Segment 1 |
| Octets: 1 | 1 | 1 | 1 | 1 |
| * Wide Bandwidth Channel Switch element format
 |

The Element ID field is set to the value for the Wide Bandwidth Channel Switch element specified in Element IDs.

The Length field is set to 3.

The subfields New Channel Width, New Channel Center Frequency Segment 0 and New Channel Center Frequency Segment 1 have the same definition, respectively, as Channel Width, Channel Center Frequency Segment 0 and Channel Center Frequency Segment 1 in the VHT Operation Information field, described in VHT Operation Information subfields; the value 0 is not used in the New Channel Width field.

* VHT Transmit Power Envelope element

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | Transmit Power Information | Local Maximum Transmit Power For 20 MHz | Local Maximum Transmit Power For 40 MHz | Local Maximum Transmit Power For 80 MHz | Local Maximum Transmit Power For 160/80+80 MHz |
| Octets: | 1 | 1 | 1 | 1 | 0 or 1 | 0 or 1 | 0 or 1 |
| * VHT Transmit Power Envelope element format
 |

The Element ID field is set to the value for the VHT Transmit Power Envelope element specified in Element IDs.

The length of the element is variable; the Length field is set accordingly (minimum 2).

The format of the Transmit Power Information field is defined in Transmit Power Information field.

|  |  |  |  |
| --- | --- | --- | --- |
| Bits: | B0 B2 | B3 B5 | B6 B7 |
|  | Local Maximum Transmit Power Count | Local Maximum Transmit Power Units Interpretation | Reserved |
| * Transmit Power Information field
 |

The Local Maximum Transmit Power Count subfield indicates the number of Local Maximum Transmit Power for *X* MHz fields (where *X* = 20, 40, 80 or 160/80+80) minus 1 in the VHT Transmit Power Envelope element, as shown in Meaning of Local Maximum Transmit Power Count subfield.

|  |
| --- |
| * Meaning of Local Maximum Transmit Power Count subfield
 |
| Value | Field(s) present |
| 0 | Local Maximum Transmit Power For 20 MHz |
| 1 | Local Maximum Transmit Power For 20 MHzLocal Maximum Transmit Power For 40 MHz |
| 2 | Local Maximum Transmit Power For 20 MHzLocal Maximum Transmit Power For 40 MHzLocal Maximum Transmit Power For 80 MHz |
| 3 | Local Maximum Transmit Power For 20 MHzLocal Maximum Transmit Power For 40 MHzLocal Maximum Transmit Power For 80 MHzLocal Maximum Transmit Power For 160/80+80 MHz |
| 4-7 | Reserved |

The Local Maximum Transmit Power Units Interpretation subfield provides additional interpretation for the units of the Local Maximum Transmit Power for *X* MHz fields (where *X* = 20, 40, 80 or 160/80+80) and is defined in Definition of Local Maximum Transmit Power Units Interpretation subfield. Allowed values are further constrained as defined in Annex E.

|  |
| --- |
| * Definition of Local Maximum Transmit Power Units Interpretation subfield
 |
| Value | Units Interpretation of the Local Maximum Transmit Power for *X* MHz fields |
| 0 | EIRP |
| 1-7 | Reserved |
| NOTE—This table is only expected to be updated if regulatory domains mandate the use of transmit power control with limits that cannot be converted into an EIRP value per PPDU bandwidth. |

Local Maximum Transmit Power For *X* MHz fields (where *X* = 20, 40, 80 or 160/80+80) define the local maximum transmit power limit of the transmission bandwidth *X* MHz. Each Local Maximum Transmit Power For *X* MHz field is encoded as an 8-bit 2's complement signed integer in the range of -64 dBm to 63 dBm with a 0.5 dB step. The value of 63.5 dBm indicates 63.5 dBm or higher (i.e.,(#6016) no local maximum transmit power constraint).

* Channel(#6005) Switch Wrapper element

The Channel Switch Wrapper contains one or more subelements that indicate characteristics of the BSS after a channel switch. The format of the Channel Switch Wrapper element is defined in Channel Switch Wrapper element format.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  | Zero or one | Zero or one | Zero or one | Zero or more |
|  | Element ID | Length | New Secondary Channel Offset subelement | New Country subelement | Wide Bandwidth Channel Switch subelement | New VHT Transmit Power Envelope subelement |
| Octets: | 1 | 1 | 0 or 3 | variable | 0 or 5 | variable |
|  |  | * Channel Switch Wrapper element format
 |

The Element ID field is set to the value for the Channel Switch Wrapper element specified in Element IDs.

The length of the element is variable; the Length field is set accordingly (minimum 3).

The New Secondary Channel Offset subelement is present when channel switching (but not if only extended channel switching) to a BSS operating channel width of 40 MHz; if switching to a non-40 MHz BSS operating channel width then it is not present. The format of the New Secondary Channel Offset subelement is the same as the Secondary Channel Offset element (see 8.4.2.22). The New Secondary Channel Offset subelement indicates the secondary 20 MHz channel offset after channel switching (see 10.39.1 (Basic VHT BSS functionality)).

The New Country subelement is present when an AP, PCP, STA in an IBSS or mesh STA(#6007) performs channel switching or extended channel switching to a new Country, operating class table or a changed set of operating classes relative to the contents of the Country element sent in the Beacon; otherwise it is not present. The format of the New Country subelement is defined to be the same as the format of the Country element (see Country element), except that no Subband Triplet subfields are present in the New Country subelement. The Country String within the New Country subelement indicates the Country and operating class table of the BSS after channel switching or extended channel switching and Operating Triplet subfields within the New Country subelement indicate the operating classes of the BSS after channel switching or extended channel switching (see 10.39.1 (Basic VHT BSS functionality)).

The Wide Bandwidth Channel Switch subelement is present when channel switching or extended channel switching to a BSS operating channel width of 80 MHz or wider; otherwise it is not present. The format of the Wide Bandwidth Channel Switch subelement is (Ed)the same as the Wide Bandwidth Channel Switch element (see Wide Bandwidth Channel Switch element). The Wide Bandwidth Channel Switch subelement indicates the BSS operating channel width after channel switching or extended channel switching (see 10.39.1 (Basic VHT BSS functionality)).

Each New VHT Transmit Power Envelope subelement that is present is defined to have the same format as the VHT Transmit Power Envelope element (see VHT Transmit Power Envelope element) and includes a distinct value of the Local Maximum Transmit Power Units Interpretation subfield. If present, each New VHT Transmit Power Envelope subelement indicates the local maximum transmit powers for the BSS for the indicated bandwidths with the indicated units interpretation after channel switching or extended channel switching (see 10.39.1 (Basic VHT BSS functionality)).

* AID element

The AID element indicates 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 Element ID field is set to the value for the AID element specified in Element IDs.

The Length field is set to 2.

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 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).(#6263)

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 set to the value for the Quiet Channel element specified in Element IDs.

The length of the element is variable; the Length field is set accordingly (minimum 1).

The AP Quiet Mode field specifies STA behavior during the quiet intervals. When communications to the AP are allowed within the primary 80 MHz channel of the BSS, then the AP Quiet Mode field is set to 1; otherwise it 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 they are not.

The Quiet Count field, Quiet Period field, Quiet Duration field and Quiet Offset field have the same definition as described in 8.4.2.25 (Quiet element).

* Operating Mode Notification element

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 Element ID field is set to the value for the Operating Mode Notification element specified in Element IDs.

The Length field is set to 1.

The Operating Mode field is defined in Operating Mode field.

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

Change Figure 8-436 as follows:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | Zero or one | Zero or one | Zero or one | Zero or more |
|  | Category | Spectrum Management Action | Channel Switch Announcement element | Secondary Channel Offset element | Mesh Channel Switch Parameters element | Wide Bandwidth Channel Switch element | New VHT Transmit Power Envelope element |
| Octets: | 1 | 1 | 5 | 0 or 3 | 0 or 6 | 0 or 5 | variable |
| * 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 BSS operating channel width of 40 MHz. It may be present when switching to a BSS operating channel width of 20 MHz (in which case the Secondary Channel Offset field is set to SCN). Otherwise it is not present.

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 it 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 element is present when switching to a BSS operating channel width of 80 MHz or wider; otherwise it is not present.

Each New VHT Transmit Power Envelope element that is present is defined to have the same format as the VHT Transmit Power Envelope element (see VHT Transmit Power Envelope element) and includes a distinct value of the Local Maximum Transmit Power Units Interpretation subfield. If present, each New VHT Transmit Power Envelope element indicates the local maximum transmit powers for the BSS for the indicated bandwidths with the indicated units interpretation after channel switching (see 10.39.1 (Basic VHT BSS functionality)).

* 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 AID element of the STA sending the frame is present if dot11VHTOptionImplemented is true; otherwise it is not present. |
| 11 | VHT Capabilities | The VHT Capabilities element is present if dot11VHTOptionImplemented is true; otherwise it is not present. |

* 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 AID element of the STA sending the frame is present if dot11VHTOptionImplemented is true; otherwise it is not present. |
| 11 | VHT Capabilities | The VHT Capabilities element is present if dot11VHTOptionImplemented is true; otherwise it is not present. |

* Public Action details
* Extended Channel Switch Announcement frame format

Change Figure 8-449 as shown:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  | Zero or one | Zero or one | Zero or more |
|  | Category | Public Action | Channel Switch Mode | New Operating Class | New Channel Number | Channel Switch Count | Mesh Channel Switch Parameters element | New Country element | Wide Bandwidth Channel Switch element | New VHT Transmit Power Envelope element |
| Octets: | 1 | 1 | 1 | 1 | 1 | 1 | 6 | variable | 0 or 5 | variable |
| * Extended Channel Switch Announcement frame Action field format
 |

Insert the following paragraphs at the end of this subclause:

The New Country element is present when an AP, PCP, STA in an IBSS or mesh STA(#6007) performs extended channel switching to a new Country, operating class table or a changed set of operating classes relative to the contents of the Country element sent in the Beacon; otherwise it is not present. The format of the New Country element is defined to be the same as the format of the Country element (see Country element), except that no Subband Triplet subfields are present in the New Country element. The Country String within the New Country element indicates the Country and operating class table of the BSS after extended channel switching and Operating Triplet subfields within the New Country element indicate the operating classes of the BSS after extended channel switching (see 10.39.1 (Basic VHT BSS functionality)).

The Wide Bandwidth Channel Switch element is present when an AP, PCP, STA in an IBSS or mesh STA performs extended channel switching to a BSS operating channel width of 80 MHz or wider; otherwise it is not present. The Wide Bandwidth Channel Switch element is defined in Wide Bandwidth Channel Switch element. The Wide Bandwidth Channel Switch element indicates the BSS operating channel width after extended channel switching (see 10.39.1 (Basic VHT BSS functionality)).

Each New VHT Transmit Power Envelope element that is present is defined to have the same format as the VHT Transmit Power Envelope element (see VHT Transmit Power Envelope element) and includes a distinct value of the Local Maximum Transmit Power Units Interpretation subfield. If present, each New VHT Transmit Power Envelope element indicates the local maximum transmit powers for the BSS for the indicated bandwidths with the indicated units interpretation after extended channel switching (see 10.39.1 (Basic VHT BSS functionality)).

* TDLS Discovery Response frame format

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

* Order 1 to 15 in 802.11-2012, none in P802.11ae, none in P802.11aa, none in P802.11ad

|  |
| --- |
| * Information for TDLS Discovery Response frame
 |
| Order | Information | Notes |
| 16 | VHT Capabilities | VHT Capabilities element (optional). The VHT Capabilities element is present if dot11VHTOptionImplemented is true; otherwise it is not present. The VHT Capabilities element is defined in VHT Capabilities element. |

* TDLS Action frame details
* TDLS Setup Request frame format

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

* Order 1 to 17 in 802.11-2012, none in P802.11ae, none in P802.11aa, +1 in P802.11ad

|  |
| --- |
| * Information for TDLS Setup Request frame
 |
| Order | Information | Notes |
| 19 | AID | The AID element of the STA sending the frame is present if dot11VHTOptionImplemented is true; otherwise it is not present. |
| 20 | VHT Capabilities | The VHT Capabilities element is present if dot11VHTOptionImplemented is true; otherwise it is not present. |

* TDLS Setup Response frame format

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

* Order 1 to 18 in 802.11-2012, none in P802.11ae, none in P802.11aa, +1 in P802.11ad

|  |
| --- |
| * Information for TDLS Setup Response frame
 |
| Order | Information | Notes |
| 20 | AID | The AID element of the STA sending the frame is present if dot11VHTOptionImplemented is true; otherwise it is not present. |
| 21 | VHT Capabilities | The VHT Capabilities element is present if dot11VHTOptionImplemented is true; otherwise it is not present. |
| 22 | Operating Mode Notification | The Operating Mode Notification element is optionally present if the TDLS Setup Request frame contained an Extended Capabilities element with the Operating Mode Notification field equal to 1; otherwise it is not present.(#6150) |

* 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 dot11VHTOptionImplemented 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; otherwise it is not present. The VHT Operation element is defined in <give the right reference, not one to the VHT Capabilities element>. |
| 22 | Operating Mode Notification | The Operating Mode Notification element is optionally present if the TDLS Setup Request frame contained an Extended Capabilities element with the Operating Mode Notification field equal to 1; otherwise it is not present.(#6150) |

* TDLS Channel Switch Request frame format

Insert a rows for Orders 8, 9 and 10 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 present when a switch to a direct link channel width of 80 MHz or wider is indicated; otherwise it is not present. See Wide Bandwidth Channel Switch element. |
| 9 | Country | Country element (optional). The Country element is present to change operating classes when a switch to a direct link is indicated; otherwise it is not present. The Country element indicates the same country as the BSS and includes no Subband Triplet subfields. |
| 10 | VHT Transmit Power Envelope | VHT Transmit Power Envelope element (zero or more). Each VHT Transmit Power Envelope element that is present includes a distinct value of the Local Maximum Transmit Power Units Interpretation subfield. If present, the New VHT Transmit Power Envelope element indicates the maximum transmit powers for the direct link for the indicated bandwidths with the indicated units interpretation after a switch to a direct link (see 10.22.6.4.1 (General)).(#6266) |

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

Insert a row for Order 19, 20 and 21 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; otherwise it is not present. |
| 20 | VHT Operation | The VHT Operation element is present when dot11VHTOptionImplemented is true; otherwise it is not present. |
| 21 | Operating Mode Notification | The Operating Mode Notification element is optionally present if dot11OperatingModeNotificationImplemented is true; otherwise it is not present.(#6002) |

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

Insert a row for Order 15, 16 and 17 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; otherwise it is not present. |
| 16 | VHT Operation | The VHT Operation element is present when dot11VHTOptionImplemented is true; otherwise it is not present. |
| 17 | Operating Mode Notification | The Operating Mode Notification element is optionally present if dot11OperatingModeNotificationImplemented is true; otherwise it is not present.(#6003) |

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 functionality. 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 | Time Priority |
| 0 | VHT Compressed Beamforming | Yes |
| 1 | Group ID Management |  |
| 2 | 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 Feedback Type, Remaining Feedback Segments and First Feedback Segment subfields of the VHT MIMO Control field (see VHT MIMO Control field, VHT Compressed Beamforming Report field, MU Exclusive Beamforming Report field and 9.31.5 (VHT sounding protocol)).

No vendor-specific elements are present in a VHT Compressed Beamforming frame.

* 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. 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.

* Operating Mode Notification
* frame format

The 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.

The Action field of the Operating Mode Notification frame contains the information shown in Operating Mode Notification frame Action field format.

|  |
| --- |
| * Operating Mode Notification frame Action field format
 |
| Order | Information |
| 1 | Category |
| 2 | VHT Action |
| 3 | Operating Mode (see Operating Mode 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 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(#6506), 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(#6506) |
| 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 (see 9.12.6 (A-MPDU padding for VHT PPDU))(#6549). In an HT PPDU, the last A-MPDU subframe is not padded. In a VHT PPDU, the number of EOF pad(#6506) octets is determined as described in 9.12.6. In an HT PPDU the EOF Pad field is not present.(#6268)

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 the MPDU Length field and 1 in the EOF field are present.

NOTE—An A-MPDU pre-EOF padding includes any A-MPDU subframes with 0 in the MPDU Length field and 0 in the EOF field inserted in order to meet the minimum MPDU start spacing requirement.(#6482)

The ~~A-MPDU~~ maximum length of an A-MPDU in an HT PPDU is 65 535 octets. The maximum length of an A-MPDU pre-EOF padding in a VHT PPDU is 1 048 575 octets.(#6482) 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(#6506) |
| 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 (non-DMG).

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 (non-DMG)
 |

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 that has(#6270) 0 in the MPDU Length field and(#6270) 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 of a VHT single MPDU as described in 9.12.7 (Setting the EOF field of the MPDU delimiter). 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.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.

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:

* 

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 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 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 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).

An MU PPDU does not carry more than one A-MPDU that contains one or more MPDUs soliciting an immediate response.

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.

 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~~ACKBlockAck 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 transmitted(#6551) 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.(#6412) |

* MAC sublayer functional description
* MAC architecture
* Hybrid coordination function (HCF)
* General

Change the last paragraph as follows:

Time priority management frames are transmitted outside of the normal MAC queuing process as per individually described transmission rules. Frames listed in Table 8-229 and Table 8-281ah (VHT Action field values) with a value of "Yes" in the "Time Priority" column are time priority management frames. No other frames are time priority management frames.

* HCF contention-based channel access (EDCA)

Change the 7th paragraph as follows:

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 shall 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 frame or Beamforming Report Poll frame using any access category and without being restricted by admission control procedures.

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 the secondary 20 MHz channel, secondary 40 MHz channel and secondary 80 MHz channel, and helps the VHT STA transmitting the RTS determine the available bandwidth at the responder.

Change the 2nd to last paragraph as follows:

All STAs 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))(#6690) except as constrained by the rules of Rate selection constraints for VHT STAs. To support the proper operation of the RTS/CTS by non-DMG STAs, RTS/DMG CTS by DMG STAs(11ad) and the virtual CS mechanism, all STAs shall be able to interpret control frames with the Subtype field equal to RTS or CTS and all DMG STAs shall be able to interpret control frames with the Subtype field set to RTS or DMG CTS(11ad).

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

Insert as the first paragraph:

The use of RIFS by non-DMG STAs is obsolete and support for such use might(#6745) be subject to removal in a future revision of the 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 bandwidth 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
* A PCP/AP continuing to transmit in the AT after a transmission failure during the AT (9.33.3)(11ad)
* A source DMG STA of an SP continuing to transmit after a transmission failure as described in 9.33.6.2 (Service period (SP) allocation)(11ad)
* An DMG STA performing EDCA access during an allocated CBAP as described in 9.33.5 (Contention-based access period (CBAP) transmission rules)(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 bandwidth 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 capable of dynamic bandwidth operation (see CTS an), the STA(#6264) 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 with the TA field set to a bandwidth signaling TA shall not send an RTS frame to a non-VHT STA for the duration of the TXOP.

* CTS and DMG CTS(11ad) procedure

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

A STA that receives an RTS frame addressed to it considers the NAV to determine whether to respond 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 zero(#6271) or that the NAV count is nonzero(#6271)(#6773) but the non-bandwidth signaling TA obtained from the TA field of the RTS frame matches the saved TXOP holder address.

A VHT STA that is addressed by an RTS frame in a non-HT or non-HT duplicate PPDU that has a bandwidth 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 (secondary 20 MHz channel, secondary 40 MHz channel and secondary 80 MHz channel) in the channel width indicated by the RTS frame's RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT for(#6272) a PIFS period prior to the start of the RTS frame, then the STA shall respond with a CTS frame carried in a non-HT or non-HT duplicate PPDU 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 an RTS frame in a non-HT or non-HT duplicate PPDU that has a bandwidth 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 CTS frame in a non-HT or non-HT duplicate PPDU 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 for a(#6272) 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 RTS frame carried in a non-HT or non-HT duplicate PPDU that has a non-bandwidth 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~~ non-bandwidth signaling TA obtained from the TA field of the RTS frame to which this CTS frame is a response. 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:

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

A VHT AP shall not transmit an HT Operation element with the Dual CTS Protection field set to 1.

* 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 non-AP VHT 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 as the default BSSBasicMCSSet. If the mesh STA is also a VHT STA, it should adopt the mandatory VHT MCSs as the default VHTBSSBasicMCSSet.

Once the mesh STA establishes a mesh peering with a mesh STA, it shall not change ~~neither~~ 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 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 field in management frames transmitted by the receiver STA.(#6020)
* A STA shall not transmit a frame using an MCS and number spatial streams combination that is not supported by the receiver STA or STAs, as reported in any VHT Supported MCS Set field in management frames transmitted by the receiver STA.(#6020)
* If at least one 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 recently received(#6807) Operating Mode field with the Rx Nss Type subfield equal to 0 from the receiver STA.
* If at least one 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 recently received(#6807) 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).
* 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 Capabilities element or VHT Capabilities element received from the intended receiver.(#6808)
* Except as described below, an HT STA that is a member of a BSS and that is not a VHT STA shall not transmit a frame using a value for the CH\_BANDWIDTH parameter of the TXVECTOR that is not permitted for use in the BSS, as reported in the most recently received HT Operation element.(#6808)
* Except as described below a VHT STA that is a member of a BSS shall not transmit a frame using a value for the CH\_BANDWIDTH parameter of the TXVECTOR that is not permitted for use in the BSS, as reported in the most recently received VHT Operation element.(#6808)
* Exceptions:
* Transmissions on a TDLS off-channel link follow the rules described in 10.22.6.1 and 10.22.6.2
* Transmissions by a VHT STA on a TDLS link follow the rules described in 10.22.1 and 10.22.6.4(#6808)
* If at least one 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 recently received(#6807) Operating Mode field with the Rx Nss Type subfield equal to 0 from the receiver STA.
* 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, 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, or a rate from the mandatory rate set of the attached PHY if ~~both~~ 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.

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.

The following rules determine whether a control frame is carried in a~~n HT PPDU or~~ non-HT, HT or VHT(#6277) 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:
* 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 control frame may be carried in a(#6027) VHT PPDU when the control frame contains an HT Control field or is in STBC format.
* A control frame that is a control response frame shall be carried in a VHT PPDU if the eliciting frame was an RTS frame carried in a VHT PPDU that contains an(#6840) HT Control field with MRQ equal to 1.
* 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 a VHT single MPDU or not carried in an A-MPDU.

* 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 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 by that STA. A frame that is carried in a(#6027) 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 received(#6025) 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~~ received(#6025) 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.

A frame that is carried in a(#6027) 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 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.

* 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 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 a(#6027) 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 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 received(#6025) 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 for VHT PPDUs as described in Rate selection constraints for VHT STAs and for HT PPDUs from the supported MCS Set field in the HT Capabilities element received(#6025) from the STA as folllows:

* 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.

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 frame eliciting the response was an RTS frame carried in a VHT PPDU, then the CandidateMCSSet may additionally include the same MCS and number of spatial streams as the VHT PPDU. 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 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. Moreover, eliminate all 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. Moreover eliminate 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). For the purpose of comparing modulation values, the following sequence shows increasing modulation values: BPSK, QPSK, 16-QAM, 64-QAM, 256-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 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 paragraphs after the note above:(#6033)

A VHT STA that transmits a control frame that is not an RTS frame in a non-HT duplicate PPDU (channel width 40 MHz or wider)(#6031), addressed to a VHT STA and eliciting a control response frame or a VHT Compressed Beamforming frame shall set the TA field to a bandwidth 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 bandwidth 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.

NOTE(#6034)—The BSSID (TA)(#6748) field of a CF-End frame is treated as a TA field when the value is(#6749) a signaling TA.

A STA that sends a control frame in response to a frame carried in an HT PPDU or a VHT PPDU(#6032) 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 the frame eliciting the response.

A STA that sends a control frame in response to a frame carried in a non-HT or non-HT duplicate PPDU with a non-bandwidth 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 width occupied by the frame, either by design or because the frame was received over a channel width 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 bandwidth signaling TA and that is not a CTS 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 bandwidth 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 an.

Insert the following at the end of the subclause:

The TXOP holder should set the TXVECTOR parameter CH\_BANDWIDTH of a CF-End frame to the maximum bandwidth allowed by the rules in Multiple frame transmission in an EDCA TXOP.

NOTE(#6034)—A CF-End frame transmitted by an AP a SIFS duration after receiving a CF-End frame is considered a control response frame.(#6750)

* 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 modulation(#6751) classes for the rules for response frames in Multirate support.

* P802.11ad adds modulation classes 9 to 12 so the VHT modulation class is 13. Also, P802.11ad does not quote the baseline correctly for column headings.

|  |
| --- |
| * Modulation classes
 |
| Modulation class | Description of modulation | Condition that selects this modulation class |
| Clause 14 to Clause 19 PHYs and Clause 21 PHY | 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-OFDMThe 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 OFDMor NON\_HT\_DUP\_OFDM |
| 8 | HT | N/A | FORMAT is HT\_MF or HT\_GF. | FORMAT is HT\_MF or HT\_GF |
| 9(11ad) | DMG Control | Clause 21.4 transmission | N/A | N/A |
| 10(11ad) | DMG SC | Clause 21.6 transmission | N/A | N/A |
| 11(11ad) | DMG OFDM | Clause 21.5 transmission | N/A | N/A |
| 12(11ad) | DMG low power SC | Clause 21.7 transmission | N/A | N/A |
| 13 | VHT | N/A | N/A | FORMAT is VHT |

* Non-HT basic rate calculation

Change as follows:

This subclause defines how to convert ~~an~~ HT MCSs and VHT MCSs to a non-HT basic rate for the purpose of determining the rate of ~~the~~ a response frame. It consists of two steps as follows:

* Use the modulation and coding rate determined from the HT MCS (defined in 20.6 (Parameters for HT MCSs)) or VHT MCS (defined in 22.5 (Parameters for VHT MCSs)) to locate a non-HT reference rate by lookup into Non-HT reference rate.27 In the case of an MCS with UEQM, the modulation of stream 1 is used.
* The non-HT basic rate is the highest rate in the BSSBasicRateSet that is less than or equal to this non-HT reference rate.

Insert two new rows for 256-QAM in Table 9-5 as shown below:

|  |
| --- |
| * Non-HT reference rate
 |
| Modulation | Coding rate(R) | Non-HT reference(Mb/s) |
| 256-QAM | 3/4 | 54 |
| 256-QAM | 5/6 | 54 |

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 bandwidth signaling TA. A VHT STA shall include neither the CH\_BANDWIDTH\_IN\_NON\_HT parameter nor the DYN\_BANDWIDTH\_IN\_NON\_HT parameter in the Clause 22 TXVECTOR of a non-HT PPDU sent to a non-VHT STA. A VHT STA shall not set the TA field to a signaling TA in a frame sent to a non-VHT STA. 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 bandwidth signaling TA may only be included in non-HT and non-HT duplicate (#6479)PPDUs and shall not be included otherwise. 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 bandwidth 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.

The TXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT shall not be present in PPDUs carrying management or data frames.(#6287)

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

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

* if the channel width 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 width 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, dot11MCSFeedbackOptionImplemented and dot11AlternateEDCAImplemented shall(11aa) set 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)).

A VHT 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).

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 received(#6025) 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.

The length of an A-MSDU transmitted in a VHT PPDU is limited by the maximum MPDU size supported by the recipient STA (see Transport of A-MPDU by the PHY data service).

NOTE 1—An A-MSDU that meets the A-MSDU length limit for transmission in a VHT PPDU might exceed the A-MSDU length limit for an HT PPDU and thus cannot 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:

(#6482)A~~n HT~~ STA ~~and a DMG STA~~ indicates ~~a value~~ in the Maximum A-MPDU Length Exponent field in its HT Capabilities element ~~or DMG Capabilities element, respectively, that defines~~ the maximum A-MPDU length that it can receive in an HT\_MF or HT\_GF PPDU. 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 DMG STA indicates in the Maximum A-MPDU Length Exponent field in its DMG 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 8-183f for a DMG 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 DMG~~ STA shall not transmit an A-MPDU in an HT\_MF or HT\_GF PPDU that is longer than the value indicated by the Maximum A-MPDU Length Exponent field in the HT Capabilities element received from ~~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 received from the intended receiver. A DMG STA shall not transmit an A-MPDU that is longer than the value indicated by the Maximum A-MPDU Length Exponent field in the DMG Capabilities element.

A STA shall not transmit a VHT PPDU if the PPDU duration exceeds aPPDUMaxTime defined in Table 22-29.

NOTE—The restriction limits the LENGTH field in the L-SIG field of a VHT PPDU to 4095.

~~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 DMG~~ 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 8-183f for a DMG 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 DMG 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 APs, VHT APs, ~~and an~~ HT mesh STAs and VHT mesh STAs can transmit ~~an~~ A-MPDUs containing MPDUs with a group addressed RAs.(#6756)

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

* In the first and second bullet, “Maximum A-MPDU Length Exponent subfields”, “Minimum MPDU Start Spacing subfields”, “A-MPDU Parameters fields” and “HT Capabilities elements” are made plural.

When a STA transmits a PPDU containing at least one A-MPDU that contains MPDUs with a group addressed RA, the following rules shall apply:(11ad)

* 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 an HT 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 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 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 HT 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 PPDU is a DMG PPDU, 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 DMG Capabilities element across all DMG STAs associated with the PCP/AP.(11ad)
* If the PPDU is a DMG PPDU, the value of minimum MPDU start spacing that applies is the maximum value in the Minimum MPDU Start Spacing subfield of the A-MPDU Parameters field of the DMG Capabilities element across all DMG STAs associated with the PCP/AP.(11ad)(#6508)
* 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 RXVECTOR parameter FORMAT is equal to VHT.

MPDUs in an A-MPDU carried in an HT\_MF or HT\_GF PPDU shall be limited to a maximum length of 4095 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 received(#6025) from the recipient STA.

Insert new subclauses 9.12.6 through 9.12.8 following section 9.12.5:

* A-MPDU padding for VHT PPDU

A VHT STA that delivers one or more A-MPDUs to the PHY (using PHY-DATA.request primitives) as one or more PSDUs for a VHT PPDU shall construct the A-MPDU(s) as described in this subclause.

An A-MPDU pre-EOF padding (see A-MPDU length limit rules) is constructed for each user from any of the following:

* A-MPDU subframes constructed from the MPDUs available for transmission that have a TID value that maps to the primary AC
* A-MPDU subframes with 0 in the MPDU Length field provided that each added subframe and the complete A-MPDU meet all the following:
* A-MPDU content constraints (see 9.12.1 (A-MPDU contents)) for the intended recipient
* length limit constraints (see 8.6.1 (A-MPDU format) and A-MPDU length limit rules) for the intended recipient
* minimum MPDU start spacing constraints (see Minimum MPDU Start Spacing field) for the intended recipient
* TXOP duration limits (see EDCA TXOPs) for the primary AC

The A-MPDU\_Length[*n*] for user *n* is initialized as the length of the resulting A-MPDU pre-EOF padding.

The A-MPDU\_Length[*n*] for user *n* is used as the APEP\_LENGTH[*n*] parameter value for the PLME-TXTIME.request (see 6.5.7 (PLME-TXTIME.request)) primitive, which is then invoked once for each VHT PPDU. The PLME-TXTIME.confirm (see 6.5.8 (

PLME-TXTIME.confirm)) primitive provides the TXTIME parameter and PSDU\_LENGTH[] parameters for all the users for the transmission.

Subsequently, for each user *n*, as permitted by the rules for EDCA TXOP Sharing (see 9.19.2.2a Sharing an EDCA TXOP), a VHT STA may add A-MPDU subframes to the A-MPDU for that user that meet either of the following conditions:

* have a TID that maps to an AC that is not the primary AC
* have 0 in the MPDU Length field provided that each added sub-frame and the complete A-MPDU meets all of the following:
* A-MPDU content constraints (see 9.12.1 (A-MPDU contents)) for the intended recipient
* length limit constraints (see 8.6.1 (A-MPDU format) and A-MPDU length limit rules) for the intended recipient
* MPDU start spacing constraints (see Minimum MPDU Start Spacing field) for the intended recipient

and provided that, after incrementing the A-MPDU\_Length[*n*] with the length of each such added A-MPDU subframe, the relationship A-MPDU\_Length[*n*]  PSDU\_LENGTH[*n*] is true.

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[*n*] < PSDU\_LENGTH[*n*] and A-MPDU\_Length[*n*] mod 4  0, add a subframe pad octet and increment A-MPDU\_Length[*n*] by 1
* Then, while A-MPDU\_Length[*n*] + 4  PSDU\_LENGTH[*n*], add an A-MPDU subframe with 0 in the MPDU Length field and 1 in the EOF field and increment A-MPDU\_Length[*n*] by 4
* Finally, while A-MPDU\_Length[*n*] < PSDU\_LENGTH[*n*], add an EOF pad octet and increment A-MPDU\_Length[*n*] 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 octet shall not be added before any A-MPDU subframe.

The values of the subframe pad octet and EOF pad octet are unspecified.

* Setting the EOF field of the MPDU delimiter

The EOF field in an A-MPDU subframe with a nonzero(#6773) MPDU Length field that is the only A-MPDU subframe with a nonzero(#6773) 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 nonzero(#6773) MPDU Length field that is not the only A-MPDU subframe with a nonzero(#6773) 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 single MPDU operation with other types of single MPDU(#6413).

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 solicits(#6503) 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 9.13b following 9.13a:

* 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 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.

* 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 shall not(#6288) transmit a frame with TXVECTOR parameters CH\_BANDWIDTH set to CBW80 and GI\_TYPE set to SHORT\_GI unless(#6288) 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 VHT Capabilities element contained a value of 1.
* dot11VHTShortGIOptionIn80Activated is present and is true.

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 VHT Capabilities element contained a value of 1.
* dot11VHTShortGIOptionIn160and80p80Activated is present and is true.

A STA may transmit a frame with TXVECTOR parameters FORMAT set to VHT,(#6760) 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 correspond(#6761) to STAs for which the Short GI subfield of the following conditions are satisfied:
* If the TXVECTOR parameter CH\_BANDWIDTH is set to CBW20, the Short GI for 20 MHz subfields of the 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 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 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 VHT Capabilities element contained a value of 1 dot11VHTShortGIOptionIn160and80p80Activated 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 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.

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
 |
| 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 orsent by a DLS or TDLS STA in a direct path to a DLS or TDLS peer STA | 63 | *

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 PPDU carrying MPDUs

* sent to a STA in an IBSS,
* sent by an AP to a non associated STA, and
* any other condition not explicitly listed elsewhere in the table.(#6762)

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*] represents(#6763) 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*] represents(#6763) 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 shall include the values computed in Settings for the TXVECTOR parameters GROUP\_ID and PARTIAL\_AID in the PHYCONFIG\_VECTOR paramter PARTIAL\_AID\_LIST.(#6311)

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. 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 is set to 229.

NOTE—Per IEEE Std 802-2001, the use of hyphens for the BSSID indicates hexadecimal representation rather than bit-reversed representation.(#6425)

* Operation across regulatory domains

Change subclause 9.18.5 as follows:

* Operation with operating classes and the VHT Transmit Power Envelope element

When dot11OperatingClassesImplemented is true, the following statements apply:

* When dot11OperatingClassesRequired is false, or where operating classes domain information is not present in a STA, that STA is not required to change its operation in response to an element or element-specific Information field that contains an operating class.
* When dot11OperatingClassesRequired is true, or where operating classes domain information is present in a STA, the STA shall indicate current operating class information in the Country element and Supported Operating Classes element, except(#6064) that a VHT STA may omit, from the Country element, any Operating Triplet subfield for an operating class for which the Channel spacing (MHz) column indicates 80 MHz or wider and for which the Behavior limits set column in Annex E contains only any subset of "80+" and "UseEirpForVHTTxPowEnv" (including a blank entry).
* When dot11OperatingClassesRequired and dot11ExtendedChannelSwitchActivated are true and a STA is capable of operating as specified in more than one operating class, the STA shall include the Supported Operating Classes element in Association frames and Reassociation frames.
* When dot11OperatingClassesRequired is true, or where operating classes domain information is present and the STA parsing a Country element finds an invalid First Channel Number field or Operating Class field with a value that is reserved, the STA shall ignore the remainder of the Country element and shall parse any remaining management frame body for additional elements.

A STA that has dot11ExtendedExtendedChannelSwitching equal to true and dot11SpectrumManagementRequired or dot11RadioMeasurementActivated equal to true shall be capable of determining a local maximum transmit power from a VHT Transmit Power Envelope element for which the Local Maximum Transmit Power Units Interpretation subfield indicates EIRP.

A STA that sends two or more VHT Transmit Power Envelope elements in an MMPDU shall order the elements by increasing values of their Local Maximum Transmit Power Units Interpretation subfields(#6764).

When a STA finds an unknown value in the Local Maximum Transmit Power Units Interpretation subfield in a VHT Transmit Power Envelope element, then the STA shall ignore that and subsequent VHT Transmit Power Envelope elements.

A STA that has dot11ExtendedExtendedChannelSwitching equal to true and that receives two or more VHT Transmit Power Envelope elements in the same frame with known values in their Local Maximum Transmit Power Units Interpretation subfields(#6765) shall process all the elements according to the local regulations known at the STA.

NOTE—In the case of two VHT Transmit Power Envelope elements received in the same frame by a STA, each with a known value in the(#6766) Local Maximum Transmit Power Units Interpretation subfield, then the expected possibilities are a) the STA complies with either element (shared spectrum), b) the STA complies with both elements (tightened regulations) or c) the STA complies with the second element (changed regulations).

* HCF
* HCF contention-based channel access (EDCA)
* 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 corresponding 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 sent in response to either a VHT NDP Announcement 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, a single MMPDU, a single A-MSDU or an 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 frame and NDP,(#6454) 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, a VHT STA shall save the non-bandwidth signaling TA value obtained from the Address 2 field. 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.

* 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, 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.

Change the 4th paragraph 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.

Insert new subclause 9.19.2.3a

 following 9.19.2.3(#6820)

* Sharing an EDCA TXOP

This mode only applies to an AP that supports DL-MU-MIMO. The AC associated with the EDCAF that gains(#6635) 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. In addition, each A-MPDU shall contain frames from the same TC (#6368)as defined in 8.6.3 (A-MPDU contents). 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 contains(#6636) 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
 |

* 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 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 bandwidth 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 group addressed frame, a frame transmitted with No Ack policy (for which there is no expected acknowledgment), or an individually addressed frame followed by a correctly received ACK frame transmitted by a STA (either a non-AP STA or an AP).~~

A frame exchange may be one of the following:(#6638)

* 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
* 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
* Either
* a VHT NDP Announcement 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 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) do apply.

In the case of a DL-MU-MIMO(#6205) 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.

The channel width obtained for a TXOP is the bandwidth of the initial frame of the TXOP, if the initial frame does not have a signaling TA or does not require a response. The channel width obtained for a TXOP is the bandwidth of the response to the initial frame if the initial frame has a signaling TA and requires a response. When a TXOP is obtained for a channel width that is greater than 20 MHz by a 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 obtained for the TXOP.

 If a TXOP is protected by an RTS or CTS frame carried in a non-HT or a non-HT duplicate PPDU, 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 bandwidth 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 sent after the first non-HT duplicate frame 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 a CTS-to-self(#6470) frame carried in a non-HT or non-HT duplicate PPDU, 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(#6470) 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.(11aa)
* ~~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).(11aa)
* 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.(11aa)
* 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.(11aa)
* The recognition of anything else, including any other valid frame, shall be interpreted as failure of the MPDU transmission.(11aa)

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 of all MPDUs in the final PPDU transmitted by the TXOP holder ~~initiated~~ during the TXOP for that AC was successful as defined in this subclause 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.
* The transmission attempt of a STA coordinated by an MM-SME collides internally with another STA coordinated by the same MM-SME (see 10.33 (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 the EDCAF(s)(#6369) of the lower priority AC(s) can share the TXOP with the winning AC, then(#6370) one or more secondary ACs shall keep their CW[AC]s and backoff timer values unchanged before transmitting in a TXOP.

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 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 MU transmission or the only AC in an 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 MU transmission, the value of CW[AC] shall be kept unchanged.

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.(11aa)

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].(11aa)
* 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
* General

Change the 7th paragraph as follows:

For internal collisions occurring with the EDCA access method, the appropriate retry counters of the colliding ACs that did not contribute an MPDU to a 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 dot11RobustAVStreamingImplemented 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:

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(TA) 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 non-AP VHT 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 considered idle are defined in Channels indicated idle by the channel-list parameter.

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

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 0(#6770).

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 (as described in EDCA backoff procedure, backoff procedure invoked for event a)).

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

* 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, if present, includes the element primary.

* ~~The channel-list parameter is absent, or~~
* ~~The channel-list is equal to {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)).~~
* 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 set the HT Capabilities element HT Capabilities Info field L-SIG TXOP Protection Support subfield to 0(#6771) during association and re-association. A VHT AP shall set the HT Operation element HT Operation Information field L-SIG TXOP Protection Full Support subfield to zero.

Insert a new subclause 9.23.6:

* Protection Rules for VHT STAs

A VHT STA is subject to all of the rules for HT STAs that apply to its operating band. This defines protection accorded to non-HT STAs.

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

Change the note and add a note as follows:

NOTE 1—An RD initiator might include multiple RD exchange sequences within a single TXOP. Each RD exchange sequence within a single TXOP might be addressed to a different recipient, and any single recipient might be given more than one RDG within a single TXOP.

NOTE 2—If the RD responder is a VHT AP, the RD response burst can contain(#6048) MU PPDUs.

* Rules for RD initiator

Change the 3rd paragraph as follows:

Transmission of a +HTC frame by an RD initiator with the RDG/More PPDU subfield equal to 1 (either transmitted as a ~~non-A-MPDU frame~~ single MPDU(#6413) or within an A-MPDU) indicates that the duration indicated by the Duration/ID field is available for the RD response burst and RD initiator final PPDU (if present).

Change the last paragraph as follows:

A STA that transmits a QoS +CF-ACK data frame according to the rules in 9.19.3.5 may also include an RDG in that frame provided that

* It is a ~~non-A-MPDU frame~~ single MPDU(#6413), and
* The target of the +CF-ACK is equal to the Address 1 field of the frame.
* Rules for responder

Change the 3rd paragraph as follows:

An RD responder may transmit a +CF-ACK ~~non-A-MPDU frame~~ single MPDU(#6413) in response to a ~~non-A-MPDU~~ single MPDU QoS Data +HTC MPDU that has the Ack Policy field equal to Normal Ack and the RDG/More PPDU subfield equal to 1.

Change the 8th paragraph as follows:

During an RDG, any PPDU transmitted by an(#6804) RD responder shall contain at least one MPDU with an Address 1 field that matches the MAC address of the RD initiator, and the inclusion of traffic to STAs other than the(#6804) RD initiator in an MU PPDU shall not increase the duration of the MU PPDU beyond that required to transport the traffic to the(#6804) 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.

* PSMP Operation
* Frame transmission mechanism during PSMP
* PSMP downlink transmission (PSMP-DTT)

Change the 3rd paragraph as follows:

The PSMP-DTT may contain one or more PPDUs, each of which may contain either an A-MPDU or a single ~~(non-A-MPDU)~~ MPDU. Data may be transmitted using either format, provided that the format is supported by both the transmitter and the receiver.

* 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.

Change the 2nd though 4th paragraph as follows:

A STA transmits sounding PPDUs when it operates in the following roles:

* MFB requester (see 9.28.2)
* HT beamformee ~~Beamformee~~ responding to a training request, calibration initiator, or responder involved in implicit transmit beamforming (see 9.29.2.2, 9.29.2.3, and 9.29.2.4)
* HT beamformer ~~Beamformer~~ involved in explicit transmit beamforming (see 9.29.3)
* ASEL transmitter and ASEL sounding-capable transmitter involved in ASEL (see 9.30.2)

A STA receives sounding PPDUs when it operates in the following roles:

* MFB responder (see 9.28.2)
* HT beamformer ~~Beamformer~~ sending a training request, calibration initiator, or responder involved in implicit transmit beamforming (see 9.29.2.2, 9.29.2.3, and 9.29.2.4)
* HT beamformee ~~Beamformee~~ involved in explicit transmit beamforming (see 9.29.3)
* Transmit ASEL responder and ASEL receiver involved in ASEL (see 9.30.2)

When transmitting a sounding PPDU, the transmitting STA follows the rules stated below to determine the maximum number of space-time streams for which channel coefficients can be simultaneously estimated:

* When transmitting a sounding PPDU that
* Contains a +HTC frame with the MRQ subfield equal to 1, or
* Is sent as a response to a +HTC frame with the TRQ field equal to 1, or
* Is sent during a calibration sounding exchange, or
* Is sent by an HT beamformer involved in explicit transmit beamforming, or
* Is sent in transmit or receive ASEL exchanges,
* 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.

Change the last paragraph as follows:

If an HT beamformer transmits a PPDU with the TXVECTOR EXPANSION\_MAT\_TYPE set to either COMPRESSED\_SV or NON\_COMPRESSED\_SV, it should use the recommended MCS associated with those matrices reported in a Noncompressed Beamforming frame or a Compressed Beamforming frame.

Insert new subclause 9.28.3 following 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.

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 VHT Capabilities Info field of the VHT Capabilities element. A STA whose 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/STBC 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)). The choice of MSI value is implementation dependent.

NOTE—The MFB requester can use the MSI/STBC 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 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 that has set the VHT Link Adaptation Capable subfield to Both in the VHT Capabilities Info field of the VHT Capabilities element shall support both of the following:

* computation and feedback of the MFB estimate on the receipt of an MFB request (MRQ equal to 1 in the VHT variant HT Control field) in a PPDU that is not a VHT NDP Announcement frame.
* computation and feedback of the MFB estimate on the receipt of an MFB request (MRQ equal to 1 in VHT variant HT Control field) in a VHT NDP Announcement frame and the receipt of VHT NDPs (see Null data packet (NDP) sounding) if this STA set the SU Beamformee Capable 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 to 1, an MFB responder computes the MCS, N\_STS and SNR estimates based on the PPDU carrying the MRQ, or in the case of a VHT NDP Announcement carrying the MRQ, based on the subsequent VHT NDP 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. 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., 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 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.

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, 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.

NOTE—When receiving an MU PPDU, the MFB responder may compute the interference level from the VHT-LTF field, and in this case the value in the SNR subfield indicates the averaged signal 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 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 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.

In an MFB response solicited by an MRQ that was carried in a VHT NDP Announcement frame, the MFB shall be computed based on the VHT NDP following the VHT NDP Announcement frame.

In an MFB response solicited by an MRQ that was not carried in a VHT NDP Announcement 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 that carried the MRQ and may additionally be based on other factors that 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 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 beamformer 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 an unsolicited MFB is not in the same PPDU as a VHT Compressed Beamforming frame, 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 MFB parameters are estimated.

If the MFB requester sends MRQ in a VHT NDP Announcement 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 frame and NDP sequence.

(#6696)If the N\_STS subfield of the MFB field (solicited or unsolicited) is set to a smaller value than the RXVECTOR parameter NUM\_STS of the received PPDU on which the MFB is based(#6697), the MFB responder shall estimate the recommended MCS under the assumption that the MFB requester will transmit the first *NSTS* space-time streams in the corresponding PPDU carrying MRQ. If the MFB is based on an SU PPDU the first *NSTS* space-time streams correspond to columns 1, ..., *NSTS* of the spatial mapping matrix *Q*. If the MFB is based on an MU PPDU, the first *NSTS* space-time streams correspond to columns *Mu*+1, ...,*Mu*+*NSTS,u* of the spatial mapping matrix *Q* (*Mu* and *NSTS,u* are defined in 22.3.10.11.1 (Transmission in VHT format)).

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

When the MFB requester sets the MRQ subfield to 1 and sets the MSI/STBC subfield to a value that matches the MSI/STBC 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/STBC subfield value and start a new computation based on the new request.

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 a STA fails to respond immediately to an MRQ, it can send an unsolicited MFB to update the MFB which was computed based on the most recent PPDU matching the GID, Coding type, STBC and FB type of the PPDU that carried the MRQ, and can also send an MFB that signals that the MRQ is discarded (MCS =15, N\_STS=7, and MFSI equal to the MSI in the PPDU that carried the MRQ).

NOTE 2—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 3—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

Change as follows:

* ~~General~~ HT steering matrix calculations(#6772)

This subclause assumes that only HT PPDUs are used and any HT Control field is an HT variant HT Control field.

In order for an HT beamformer to calculate an appropriate steering matrix for transmit spatial processing when transmitting to a specific HT beamformee, the HT beamformer needs to have an accurate estimate of the channel over which it is transmitting. Two methods of calculation are defined as follows:

* *Implicit feedback*: When using implicit feedback, the beamformer receives long training symbols transmitted by the HT beamformee, which allow the MIMO channel between the HT beamformee and HT beamformer to be estimated. If the channel is reciprocal, the HT beamformer can use the training symbols that it receives from the HT beamformee to make a channel estimate suitable for computing the transmit steering matrix. Generally, calibrated radios in MIMO systems can improve reciprocity. See 9.29.2.
* *Explicit feedback*: When using explicit feedback, the HT beamformee makes a direct estimate of the channel from training symbols sent to the HT beamformee by the HT beamformer. The HT beamformee may prepare CSI or steering feedback based on an observation of these training symbols. The HT beamformee quantizes the feedback and sends it to the HT beamformer. The HT beamformer can use the feedback as the basis for determining transmit steering vectors. See 9.29.3.

An HT STA shall not transmit a PPDU with the TXVECTOR EXPANSION\_MAT parameter present if dot11BeamFormingOptionActivated is false.

* HT t~~T~~ransmit beamforming with implicit feedback(#6772)
* General

This subclause assumes that only HT PPDUs are used and any HT Control field is an HT variant HT Control field.

Transmit beamforming with implicit feedback can operate in a unidirectional or bidirectional manner. In unidirectional implicit transmit beamforming, only the HT beamformer sends beamformed transmissions. In bidirectional implicit transmit beamforming, both STAs send beamformed transmissions, i.e., a STA may act as both HT beamformer and HT beamformee.

Calibration of receive/transmit chains should be done to improve performance of transmit beamforming using implicit feedback. Over-the-air calibration is described in 9.29.2.4. For implicit transmit beamforming, only the HT beamformer, which is sending the beamformed transmissions, needs to be calibrated.

A STA that advertises itself as being capable of being an HT beamformer and/or HT beamformee using implicit feedback shall support the requirements in Table 9-11.

A STA that performs one of the roles related to transmit beamforming with implicit feedback shall support the associated capabilities shown in Table 9-12.

Change “beamformee” to “HT beamformee” in Table 9-12.

When an HT beamformee transmits a sounding PPDU, the SOUNDING parameter in the TXVECTOR in the PHY-TXSTART.request(#6357) primitive shall be set to SOUNDING. If the HT beamformee is capable of implicit transmit beamforming and the HT beamformer is capable of receiving implicit transmit beamforming, the sounding PPDU from the HT beamformee may be steered.

A PPDU containing one or more +HTC MPDUs in which the TRQ field is equal to 1 shall not be sent to a STA that sets the Implicit Transmit Beamforming Receiving Capable subfield of the Transmit Beamforming field of the HT Capabilities element to 0.

If a PPDU containing one or more +HTC MPDUs in which the TRQ field is equal to 1 requires an immediate response, either the response from the HT beamformee shall be included in a sounding PPDU, or the NDP Announcement subfield of the HT Control field shall be set to 1 and the PPDU shall be followed by an NDP. If the PPDU in which the TRQ field is equal to 1 does not require an immediate response, either the HT beamformee shall transmit a sounding PPDU in the next TXOP obtained by the HT beamformee, or the HT beamformee shall transmit a PPDU in the next TXOP obtained by the HT beamformee in which the NDP Announcement subfield of the HT Control field is set to 1 and that PPDU shall be followed by an NDP. The use of NDP as a sounding PPDU is described in 9.31.

NOTE—A STA that acts as an HT beamformer using implicit feedback expects to receive a sounding PPDU in response to a training request. The STA can compute steering matrices from the channel estimates obtained from the received sounding PPDU.

At the end of the TXOP, the final PPDU from the HT beamformer shall not have the TRQ field set to 1 in a frame that requests an immediate response if there is not enough time left in the TXOP for the HT beamformee to transmit the longest valid sounding PPDU with its response.

* Bidirectional implicit transmit beamforming

Change the first paragraph as follows:

Figure 9-36 shows an example of a PPDU exchange used in bidirectional implicit transmit beamforming, using the Clause 20 PHY. In this example, sounding PPDUs are used that carry MPDUs. STA A initiates the frame exchange, and STA A and STA B alternate in the roles of HT beamformer and HT beamformee.

* Calibration

Change all occurrences in this subclause of “beamformer” to “HT beamformer” and “beamformee” to “HT beamformee”.

* Explicit feedback beamforming

Insert the following as the new 1st paragraph:

This subclause assumes that only HT PPDUs are used and any HT Control field is an HT variant HT Control field.

Change all occurrences in this subclause (except for the inserted paragraph below) of “beamformer” to “HT beamformer” and “beamformee” to “HT beamformee”.

Insert the following text after the thirteenth paragraph:

The value of *Nr* within an explicit Beamforming feedback frame transmitted by a VHT beamformee will not exceed the value indicated in the Compressed Steering Number of Beamformer Antennas Supported subfield of the VHT Capabilities element(#6708).

* VHT MU Beamforming

A MU Beamformer(#6205) may transmit a VHT MU PPDU with a single nonzero(#6773) TXVECTOR parameter NUM\_STS[*p*], where .

A MU Beamformer(#6205) shall not transmit a VHT MU PPDU with a nonzero(#6773) TXVECTOR parameter NUM\_STS[*p*], where , to a STA whose MU Beamformee Capable field is equal to 0.

* Antenna selection (ASEL)
* Introduction

Insert the following as the 1st paragraph:

This subclause assumes that only HT PPDUs are used and any HT Control field is an HT variant HT Control field.

* Null data packet (NDP) sounding

Change 9.31.1 to 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 single 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(#6416) and DL-MU-MIMO(#6205) 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 VHT beamformer and a STA for which reception is optimized is called a VHT beamformee. An explicit feedback mechanism is used where the VHT beamformee directly measures the channel from the training symbols transmitted by the VHT beamformer and sends back a transformed estimate of the channel state to the VHT beamformer. The VHT beamformer then uses this estimate, perhaps combining estimates from multiple VHT beamformees, to derive the steering matrix.

If dot11VHTSUBeamformerOptionImplemented is true, a STA shall set the SU Beamformer Capable field in the VHT Capabilities element to 1. If dot11VHTSUBeamformeeOptionImplemented is true, a STA shall set the SU Beamformee Capable field in the VHT Capabilities element to 1.

If dot11VHTMUBeamformerOptionImplemented is true, a STA shall set the MU Beamformer Capable field in the VHT Capabilities element to 1. If dot11VHTMUBeamformeeOptionImplemented is true, a STA shall set the MU Beamformee Capable field in the VHT Capabilities element to 1.

If dot11VHTMUBeamformerOptionImplemented is true, a STA shall set dot11VHTSUBeamformerOptionImplemented to true. If dot11VHTMUBeamformeeOptionImplemented, a STA shall set dot11VHTSUBeamformeeOptionImplemented to true.

A STA is a VHT 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.

If dot11VHTSUBeamformerOptionImplemented is false, a STA shall not act in the role of a VHT beamformer. If dot11VHTSUBeamformeeOptionImplemented is false, a STA shall not act in the role of a VHT beamformee.

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

 A VHT NDP shall only be transmitted SIFS after a VHT NDP Announcement frame.

NOTE―A STA that transmits a VHT NDP Announcement 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 VHT beamformer shall not transmit either a VHT NDP Announcement+HTC frame or a Beamforming Report Poll+HTC frame that contains an HT variant HT Control field.

A VHT NDP shall be transmitted only following a SIFS after a VHT NDP Announcement frame. A VHT NDP Announcement frame shall be followed by a VHT NDP after SIFS. A VHT beamformer shall not transmit a frame other than a VHT NDP a SIFS period after a VHT NDP Announcement frame.

A VHT beamformer(#6264) shall not transmit

* a VHT NDP Announcement frame that is addressed to a STA or that includes a STA’s AID in one of the STA Info fields, or
* a Beamforming Report Poll frame to a STA

unless the VHT beamformer(#6264) 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.(#6483)

A VHT beamformer that transmits a VHT NDP Announcement frame to a VHT SU-only beamformee shall include only one STA Info field in the VHT NDP Announcement frame and set the Feedback Type subfield of the STA Info field to SU. An example of the VHT sounding protocol with a single VHT beamformee is shown in Example of the sounding protocol with a single VHT beamformee.

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| * Example of the sounding protocol with a single VHT beamformee
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If the VHT NDP Announcement frame includes more than one STA Info field, the RA of the VHT NDP Announcement frame shall be set to the broadcast address. If the VHT NDP Announcement frame includes a single STA Info field, the RA of the VHT NDP Announcement frame shall be set to the MAC address of the VHT beamformee.

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

A VHT beamformer that transmits a(#6027) VHT NDP Announcement frame to a VHT 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 frame and shall set the AID field in the STA Info field to 0.

A VHT NDP Announcement frame with more than one STA Info field shall not carry an HT variant HT Control field, unless all the STAs listed in the AID field of the STA Info fields have set +HTC-HT Support to 1 in the HT Extended Capabilities field. A VHT NDP Announcement frame with more than one STA Info field shall not carry a(#6027) VHT variant 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.

A VHT beamformer that transmits a VHT NDP Announcement 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 VHT beamformees in the same TXOP. If the duration of the TXOP that contained the VHT NDP Announcement frame is not of sufficient duration to accommodate the transmission of all of the feedback reports, the VHT beamformer may poll for the remaining VHT Compressed Beamforming reports in subsequent TXOPs.

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

An example of the VHT sounding protocol with more than one VHT beamformee is shown in Example of the sounding protocol with more than one VHT beamformee

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| * Example of the sounding protocol with more than one VHT beamformee
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A VHT beamformer that sets the Feedback Type subfield of a STA Info field to MU(#6441) shall set the Nc Index subfield of the same STA Info field to a value equal to or less than the minimum of the following:

* the maximum number of supported spatial streams according to the corresponding VHT beamformee's Rx MCS Map in the VHT Supported MCS Set field, or
* the maximum number of supported spatial streams according to the Rx Nss subfield value in the Operating Mode field of the most recently received Operating Mode Notification frame or Operating Mode Notification element(#6437) with the Rx Nss Type subfield equal to 0 from the corresponding VHT beamformee.

A non-AP VHT beamformee that receives a VHT NDP Announcement frame from a VHT beamformer with which it is associated or has an established DLS or TDLS session and that contains the VHT beamformee's AID in the AID subfield of the first (or only) STA Info field and also receives a VHT NDP a SIFS after the VHT NDP Announcement, shall transmit the PPDU containing its VHT Compressed Beamforming report a SIFS after the VHT NDP. A VHT beamformee that is an AP, mesh STA, or STA that is a member of an IBSS, that receives(#6055) a VHT NDP Announcement frame with the RA matching its MAC address and the AID subfield of the only STA Info field set to 0, and that also receives(#6055) a VHT NDP a SIFS after the VHT NDP Announcement, shall transmit the PPDU containing its VHT Compressed Beamforming report(#6459) 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 VHT NDP frame. A STA shall ignore received VHT NDP Announcement, VHT NDP, and Beamforming Report Poll frames if dot11VHTSUBeamformeeActivated is false.

A non-AP VHT beamformee that receives a VHT NDP Announcement from a VHT beamformer with which it is associated or with which it has an established DLS or TDLS session and that contains the VHT 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 a non-bandwidth signaling TA obtained from the TA field matching the MAC address of the VHT 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.

The RA field of the VHT Compressed Beamforming frame(s) of the VHT Compressed Beamforming report shall be set to the MAC address obtained from the TA field of the VHT NDP Announcement 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 VHT beamformee that transmits a VHT Compressed Beamforming report shall not include the VHT Compressed Beamforming Report information and the 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 VHT beamformee shall transmit 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 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 minimum of the following:

* the Nc Index field value in the corresponding STA Info field in the VHT NDP Announcement frame, or
* the maximum number of supported spatial streams according to its Rx MCS Map in the VHT Supported MCS Set field, or
* the maximum number of supported spatial streams according to its Rx Nss subfield value in the Operating Mode field(#6440) of the most recently transmitted Operating Mode Notification frame or Operating Mode Notification element(#6437).

If the Feedback Type indicates SU, the Nc Index field value in the VHT MIMO Control field is determined by the VHT beamformee.

The Nr Index field in the VHT MIMO Control field shall be set to the same value as the RXVECTOR parameter NUM\_STS of 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 VHT 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 VHT NDP frame.

A VHT 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 VHT 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 Dialog Token Number(#6236) subfield in the VHT MIMO Control field shall be set to the same value as the Sequence Number subfield in the Sounding Sequence field in the corresponding VHT NDP Announcement frame.

NOTE—The VHT beamformer can use the sounding dialog token(#6236) in the VHT Compressed Beamforming frame(s) of the VHT Compressed Beamforming report to associate the feedback with a prior VHT NDP Announcement-VHT NDP sounding sequence and thus compute the delay between sounding and receiving the feedback. The VHT 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 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 VHT beamformer's maximum MPDU length capability.

NOTE—The VHT 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 VHT beamformer’s maximum MPDU length capability, the VHT Compressed Beamforming report shall be split into up to 8 feedback segments, with each feedback(#6422) 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 feedback segments except the last shall contain the maximum number of octets allowed by the VHT beamformer’s maximum MPDU length capability. The last feedback segment may be smaller. Each feedback segment is identified by the value of the Remaining Feedback Segments subfield and the First Feedback Segment subfield in the VHT MIMO Control field as defined in 8.4.1.47 (VHT MIMO Control field); the other non-reserved subfields of the VHT MIMO Control field shall be the same for all feedback segments. All feedback segments shall be sent in a single A-MPDU and shall be included in the A-MPDU in the descending order of the Remaining Feedback Segments subfield values.

NOTE—The feedback(#6422) 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.

A VHT beamformer, in its first attempt to retrieve a VHT Compressed Beamforming report from a VHT beamformee that is not the one indicated by the first STA Info field, (#6264)shall transmit a Beamforming Report Poll frame to poll all possible feedback segments of the VHT Compressed Beamforming report from the VHT beamformee, by setting all the bits in the Feedback(#6422) Segment Retransmission Bitmap field of the Beamforming Report Poll frame to 1.

If a VHT beamformer fails to receive some or all feedback segments of a VHT Compressed Beamforming report, the VHT beamformer may, subject to the condition on VHT SU-only beamformees described at the end of this subclause, request a selective retransmission of missing feedback(#6422) segments by transmitting a Beamforming Report Poll frame with the Feedback Segment Retransmission Bitmap field set as described in 8.3.1.20 (

Beamforming Report Poll

 frame format) to indicate the feedback(#6422) segments requested for retransmission. If the VHT beamformer fails to receive the feedback(#6422) segment with the First Feedback Segment field set to 1, the VHT beamformer (#6264) may request a selective retransmission of missing feedback(#6422) segments assuming the VHT Compressed Beamforming report is split into 8 feedback segments. The VHT beamformer may also request the retransmission of all feedback segments by setting all the bits in the Feedback(#6422) Segment Retransmission Bitmap field of the Beamforming Report Poll frame to 1.

A VHT 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 only the feedback(#6422) segments indicated in the Feedback Segment Retransmission Bitmap field in the Beamforming Report Poll frame excluding the indicated feedback(#6422) segments that do not exist at the VHT beamformee or transmit all the feedback segments that exist at the VHT beamformee disregarding the Feedback Segment Retransmission Bitmap field in the Beamforming Report Poll fame.

A VHT beamformer shall not transmit a Beamforming Report Poll frame to a VHT SU-only beamformee unless the VHT beamformer(#6263) has received at least one feedback segment of the VHT Compressed Beamforming report from the VHT 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 frame
* GROUP\_ID and PARTIAL\_AID are set as described in Group ID and partial AID in VHT PPDUs

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. 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 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 frame.

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

* MLME
* Synchronization
* Maintaining synchronization
* Beacon generation in infrastructure networks

Change the last paragraph as follows:

An AP whose last transmitted values for the Tx STBC subfield and Rx STBC subfield of the HT Capabilities Info field of the HT Capabilities element are both nonzero may transmit an STBC Beacon frame and group addressed traffic using the basic STBC MCS, as defined in 9.7.3. An AP that transmits an STBC Beacon shall set the Dual Beacon field to 1 in transmitted HT Operation elements. A VHT AP shall set the Dual Beacon field to 0 in transmitted HT Operation elements. The STBC Beacon field shall be set to 1 to identify an STBC Beacon frame. The TBTT for the STBC Beacon frame shall be offset by half of a beacon interval from the TBTT of the non-STBC Beacon frame. Except for the setting of the STBC Beacon field, TIM field, and TSF field, all other fields inside the STBC Beacon frame shall be identical to the non-STBC Beacon frame.

* Power management
* Power management in a non-DMG infrastructure network(11ad)

Insert new subclause 10.2.1.4a below following 10.2.1.4:

* Power management during VHT transmissions

A VHT AP supports the operation of non-AP VHT STAs in TXOP power save mode in a BSS when dot11VHTTXOPPowerSaveOptionImplemented at the VHT AP is true. Non-AP VHT STAs that are in Active mode (see Table 10-1 (Power Management modes)) and have dot11VHTTXOPPowerSaveOptionImplemented equal to true operate in TXOP power save mode. A VHT AP may allow non-AP VHT STAs in TXOP power save mode to enter the Doze state during a TXOP. A VHT AP shall indicate this by transmitting a VHT PPDU with the TXVECTOR parameter TXOP\_PS\_NOT\_ALLOWED set to 0. The value of this parameter in the TXVECTOR of all VHT PPDUs  transmitted by the VHT AP may be changed from 1 to 0 during the TXOP to enable TXOP PS for the remainder of the TXOP. The value of this parameter in the TXVECTOR of all VHT PPDUs transmitted by the VHT AP shall not be changed from 0 to 1 during the TXOP. If dot11VHTTXOPPowerSaveOptionImplemented at the VHT AP is false then the VHT AP shall set the TXOP\_PS\_NOT\_ALLOWED to 1 in the TXVECTOR of the frames with FORMAT VHT.

If the AP allows non-AP VHT STAs to enter Doze state during a TXOP, then a non-AP VHT STA that is in VHT TXOP power save mode may enter the Doze state till the end of that TXOP when one of the following conditions is met(#6805):

* On receipt of an MU PPDU, the STA determines that it is not a member of the group indicated by the RXVECTOR parameter GROUP\_ID.
* On receipt of an SU PPDU, the STA determines that the RXVECTOR parameter PARTIAL\_AID is neither equal to 0 nor does it match the STA’s partial AID.
* The STA finds that the PARTIAL\_AID in the RXVECTOR matches its partial AID but the RA in the MAC header of the corresponding frame that is received correctly does not match the MAC address of the STA.
* The STA receives a frame with an RXVECTOR parameter NUM\_STS equal to 0, if it is a member of group indicated by RXVECTOR GROUP\_ID.
* In a received VHT NDP Announcement frame, the STA finds that the RXVECTOR parameter PARTIAL\_AID is 0 and the AID in the STA Info field is not its AID.
* The STA receives a frame intended for it with the More Data field equal to 0 and the Ack Policy subfield in the QoS Control field is equal to No Ack or sends an acknowledgement if Ack Policy subfield is not equal to No Ack.

The VHT AP shall include a NAV-set sequence (e.g., RTS/CTS) at the beginning of such a TXOP with the Duration/ID value set to the remainder of the TXOP duration. A VHT AP shall not transmit frames to a non-AP VHT STA that has been allowed to enter Doze state according to the conditions above for the remainder of the TXOP.

NOTE—A VHT AP does(#6775) not transmit VHT SU PPDUs in the current TXOP if the AP has already transmitted a VHT PPDU with the TXVECTOR parameter TXOP\_PS\_NOT\_ALLOWED set to 0 in the same TXOP and does not want the STAs that are in Awake state to enter the Doze state.

If a VHT AP truncates the TXOP in which it allowed STAs to enter Doze state, then the VHT AP shall not transmit frames to the STAs that were allowed to enter the Doze state until the NAV set at the start of the TXOP has expired.

If the AP does not receive an acknowledgment after transmitting an individually addressed frame containing all or part of an MSDU, A-MSDU or MMPDU sent with the More Data field equal to 0 to a non-AP VHT STA that is in VHT TXOP power save mode and the AP had set the TXVECTOR parameter TXOP\_PS\_NOT\_ALLOWED to 0, it shall retransmit that frame at least once within the same TXOP, subject to applicable retry or lifetime limit, TXOP limit and the rules on TXOP sharing (see 9.19.2.3a (Sharing an EDCA TXOP)). If an acknowledgment to the retransmission of this last frame in the same TXOP is not received, it may wait until the next TXOP to further retransmit that frame, subject to its applicable retry or lifetime limit.

NOTE—An AP that receives from a VHT STA in TXOP power save mode a BlockAck frame that is a response to an A-MPDU containing MPDUs with the More Data field equal to 0, cannot expect to receive a response to subsequent MPDUs retransmitted in the same TXOP because the VHT STA might be in the Doze state.(#6377)

If a VHT STA that is in TXOP power save mode and has entered Doze state during a TXOP is changing its state to Awake shall not access the medium until

* it receives a PHY-RXSTART.indication, or
* a period equal to the ProbeDelay has transpired.
* STA authentication and association
* Association, reassociation, and disassociation
* PCP/AP association receipt procedures(11ad)

Change the 2nd paragraph by inserting a new list element h) following element g) and re-lettering subsequent elements as follows:

Upon receipt of an Association Request frame from a non-PCP/non-AP STA for which the state is State 2, State 3, or State 4, the PCP/AP's MLME shall associate with the non-PCP/non-AP STA using the following procedure:

* The SME shall refuse an association request from an HT STA that does not support all the MCSs in the BSSBasicMCSSet parameter.
* The SME shall refuse an association request from a VHT STA that does not support all the MCSs in the VHTBSSBasicMCSSet parameter.
* PCP/AP reassociation receipt procedures

Change the 2nd paragraph by inserting a new list element g) following element h) and re-lettering subsequent elements as follows:

Upon receipt of a Reassociation Request frame from a STA for which the state is State 2, State 3, or State 4, the PCP/AP's MLME shall reassociate with the STA using the following procedure:

* The SME shall refuse a reassociation request from an HT STA that does not support all the MCSs in the BSSBasicMCSSet parameter.
* The SME shall refuse a reassociation request from a VHT STA that does not support all the MCSs in the VHTBSSBasicMCSSet parameter.
* TPC procedures
* Association based on transmit power capability

Insert the following at the end of this subclause:

If a STA sends a Country element, a Power Constraint element and a VHT Transmit Power Envelope element, where the interpretation of the Maximum Transmit Power Level field in the Country element for a 20 MHz or 40 MHz Subband Triplet subfield is the same as the Local Maximum Transmit Power Units Interpretation subfield, then the lower of the local maximum transmit powers indicated by the Local Maximum Transmit Power for 20 MHz and Local Maximum Transmit Power for 40 MHz fields in the VHT Transmit Power Envelope element shall be the same as the indicated local maximum transmit power expressed by the combination of Country element and Power Constraint element.

NOTE—An example of when the interpretation of the Maximum Transmit Power Level field in the Country element for a 20 MHz or 40 MHz Subband Triplet subfield is the same as the Local Maximum Transmit Power Units Interpretation subfield is when both are EIRP.

Insert the following new subclause after 10.8.3:(#6007)

* Interpretation of transmit power capability

If the Beacon or Probe Response frame most recently received from an AP by a STA that has dot11ExtendedExtendedChannelSwitching equal to true and dot11SpectrumManagementRequired or dot11RadioMeasurementActivated equal to true (#6776)includes one or more VHT Transmit Power Envelope elements, then the units of the Minimum Transmit Power Capability and Maximum Transmit Power Capability fields within the Power Capability element sent in the STA's (Re)Association Request frame to the AP shall be interpreted according to the Local Maximum Transmit Power Units Interpretation subfield in the Transmit Power Information field in the VHT Transmit Power Envelope element (see 8.4.2.164 (VHT Transmit Power Envelope element)) sent first in the Beacon or Probe Response frame; otherwise the units of the Minimum Transmit Power Capability and Maximum Transmit Power Capability fields within the Power Capability element sent in the STA's (Re)Association Request frame to the AP shall be interpreted as EIRP.

If the Beacon or Probe Response frame most recently received from a neighbor mesh STA(Ed) by a mesh STA that has dot11ExtendedExtendedChannelSwitching equal to true and dot11SpectrumManagementRequired or dot11RadioMeasurementActivated equal to true includes one or more VHT Transmit Power Envelope elements, then the units of the Minimum Transmit Power Capability and Maximum Transmit Power Capability fields within the Power Capability element sent in the Mesh Peering Open frame to the neighbor mesh STA shall be interpreted according to the Local Maximum Transmit Power Units Interpretation subfield in the Transmit Power Information field in the VHT Transmit Power Envelope element (see 8.4.2.164 (VHT Transmit Power Envelope element)) sent first in the Beacon or Probe Response frame; otherwise the units of the Minimum Transmit Power Capability and Maximum Transmit Power Capability fields within the Power Capability element sent in the VHT mesh STA's Mesh Peering Open frame to the neighbor mesh STA shall be interpreted as EIRP.

* Specification of regulatory and local maximum transmit power levels

Change the 2nd and 3rd paragraph and insert a subsequent paragraph as follows:

A STA shall determine a local maximum transmit power for the current channel by selecting the minimum of the following:

* Unless dot11ExtendedExtendedChannelSwitching is equal to true and excepting the transmission bandwidths for which the STA has received a local maximum transmit power constraint via a VHT Transmit Power Envelope element,
* Any global maximum transmit power received in a Country element from the AP in its BSS, PCP in its PBSS, another STA in its IBSS or a neighbor peer mesh STA in its MBSS,
* ~~A~~Any local maximum transmit power received in the combination of a Country element and a Power Constraint element from the AP in its BSS, PCP in its PBSS(11ad), another STA in its IBSS, or a neighbor peer mesh STA in its MBSS ~~and~~,
* If dot11ExtendedExtendedChannelSwitching is equal to true, any local maximum transmit power for the transmission bandwidth received in a VHT Transmit Power Envelope element from the AP in its BSS, PCP in its PBSS, another STA in its IBSS, or a neighbor peer mesh STA in its MBSS, and
* Any local maximum transmit power for the channel regulatory domain known by the STA from other sources.

The Local Power Constraint field of any transmitted Power Constraint element and each Local Maximum Transmit Power for *X* MHz field (where *X* = 20, 40, 80 or 160/80+80) in any transmitted VHT Transmit Power Envelope element shall be set to a value that allows the mitigation requirements to be satisfied in the current channel.

A STA that transmits a VHT Transmit Power Envelope element shall set the Local Maximum Transmit Power Units Interpretation subfield in the Transmit Power Information field to an allowed value as defined in Annex E.

Insert the following after the 6th paragraph (that begins “An AP in a BSS, a STA in an IBSS, ...”):

An AP in a BSS, a PCP in a PBSS, a STA in an IBSS, or a mesh STA in a MBSS shall, if dot11ExtendedExtendedChannelSwitching is equal to true, advertise the local maximum transmit power for that STA's operating channel in Beacon frames and Probe Response frames using one VHT Transmit Power Envelope element for each distinct value of the Local Maximum Transmit Power Units Interpretation subfield that is supported by the BSS, IBSS or MBSS respectively. Each(#6777) VHT Transmit Power Envelope element shall include a local maximum transmit power for all channel widths supported by the BSS.

STAs that have dot11RadioMeasurementActivated equal to true should be able to reduce their EIRP to 0 dBm.

NOTE—When the local maximum transmit power is set by an AP for radio resource management, a typical low value for the local maximum transmit power is 0 dBm. A STA that cannot reduce its transmit power to this level or below will not be able to associate to the AP or transmit to the AP while associated.

* P802.11ad inserts a paragraph here to cover PBSS

Change the last paragraph as follows:

Where TPC is being used for radio measurement without spectrum management, the inclusion of a Power Constraint element and a(#6027) VHT Transmit Power Envelope element in Beacon, DMG Beacon, Announce(11ad) and Probe Response frames shall be optional.

* DFS procedures
* Quieting channels for testing
* P802.11ad inserts a new first paragraph

Change the second and subsequent paragraphs as follows (breaking up the second and last paragraph):

An AP in a BSS or a mesh STA in an MBSS may schedule quiet intervals by transmitting one or more Quiet elements and/or one or more Quiet Channel elements with the AP Quiet Mode field equal to 1 in Beacon frames and Probe Response frames.

A non-VHT AP shall not transmit a Quiet Channel element. An AP shall not transmit a Quiet Channel element with the AP Quiet Mode equal to 0 in frames that do not include at least one Quiet element. An AP shall not transmit more than one Quiet Channel element with the AP Quiet Mode equal to 0. An AP shall not transmit a Quiet Channel element if the BSS operating channel width is not either 160 MHz or 80+80 MHz.

The AP or mesh STA may stop scheduling quiet intervals or change the value of the Quiet Period field, the Quiet Duration field, and the Quiet Offset field in Quiet elements as required or Quiet Channel elements with the AP Quiet Mode field equal to 1. Only the most recently received Beacon frame or Probe Response frame defines all future quiet intervals; therefore, quiet intervals based on older Beacon frames or Probe Response frames shall be discarded.

A STA in an IBSS may schedule quiet intervals only if it is the DFS owner. ~~It shall~~ In order to set a quiet interval schedule, the STA transmits ~~by transmitting~~ (#6061)one or more Quiet elements or Quiet Channel elements with the AP Quiet Mode field equal to 1 in the first Beacon frame establishing the IBSS. All STAs in an IBSS shall continue these quiet interval schedules by including appropriate Quiet elements or Quiet Channel elements with the AP Quiet Mode field equal to 1 in any transmitted Beacon frames or Probe Response frames.

Multiple independent quiet intervals may be scheduled, so that not all quiet intervals have the same timing relationship to TBTT, by including multiple Quiet elements or Quiet Channel elements with the AP Quiet Mode field equal to 1 in Beacon frames or Probe Response frames.

Control of the channel is lost at the start of a quiet interval, and the following quieting rules apply:

* the NAV is set by all the non-VHT STAs in the BSS for the length of the quiet interval established by a Quiet element
* the NAV set by all the VHT STAs in the BSS for the duration of the quiet interval established by a Quiet element if a Quiet Channel element was not sent or received with the Quiet element
* a VHT STA in the BSS shall not transmit PPDUs that occupy the secondary 80 MHz channel or transmit PPDUs to the AP during the quiet interval established by a Quiet element if a Quiet Channel element with the AP Quiet Mode equal to 0 was sent or received with the Quiet element.
* a VHT STA shall not transmit PPDUs that occupy the secondary 80 MHz channel during the quiet interval established by a Quiet Channel element with the AP Quiet Mode field in the Quiet Channel element equal to 1.
* Transmission by any non-VHT STA in the BSS of any MPDU and any associated acknowledgment of the BSS within either the primary channel or the secondary channel (if present) shall ~~be~~ (#6806)complete before the start of the quiet interval.
* Transmission by any VHT STA in the BSS of any MPDU and any associated acknowledgment of the BSS shall (#6806)complete before the start of the quiet interval established by a Quiet element if a Quiet Channel element was not sent or received with the Quiet element.
* Transmission by any VHT STA in the BSS of any PPDUs that occupy the secondary 80 MHz channel or are directed to the AP, and any associated acknowledgment of the BSS, shall (#6806)complete before the start of the quiet interval established by a Quiet element if a Quiet Channel element with the AP Quiet Mode equal to 0 was sent or received with the Quiet element.
* Transmission by any VHT STA in the BSS of any PPDUs that occupy the secondary 80 MHz channel and any associated acknowledgment of the BSS shall (#6806)complete before the start of the quiet interval established by a Quiet Channel element with the AP Quiet Mode field in the Quiet Channel element equal to 1.

If, before starting transmission of an MPDU, there is not enough time remaining ~~to allow the transmission~~ for an exchange to complete so that the first transmission in the exchange would be disallowed by the quieting rules ~~before the quiet interval starts~~, then the STA shall defer the transmission by selecting a random backoff time, using the present CW (without advancing to the next value in the series). The short retry counter and long retry counter for the MSDU or A-MSDU are not affected.

* 20/40 MHz BSS
* Support for DSSS/CCK in 40 MHz

Change as follows:

Transmission and reception of PPDUs using DSSS/CCK by FC HT STAs is managed using the DSSS/CCK Mode in 40 MHz subfield of the HT Capabilities Info field in the HT Capabilities element (see 8.4.2.58.2).

An HT STA declares its capability to use DSSS/CCK rates while it has a 40 MHz operating channel width through ~~the DSSS/CCK Mode in 40 MHz~~ this subfield of its (Re)Association Request frames.

If ~~the DSSS/CCK Mode in 40 MHz~~ this subfield is equal to 1 in Beacon and Probe Response frames, an associated HT STA in a 20/40 MHz BSS may generate DSSS/CCK transmissions. If the subfield is equal to 0, then the following apply:

* Associated HT STAs shall not generate DSSS/CCK transmissions.
* The AP shall not include an ERP element in its Beacon and Probe Response frames.
* The AP shall not include DSSS/CCK rates in the Supported Rates element.
* The AP shall refuse association requests from a STA that includes only DSSS/CCK rates in its Supported Rates and Extended Supported Rates elements.

A STA not operating in the 2.4 GHz band shall set this subfield to 0.

* STA CCA sensing in a 20/40 MHz BSS

Insert the following as the first paragraph of this subclause:

This subclause defines CCA sensing rules for an HT STA that is not a VHT STA. For rules related to a VHT STA see 9.3.2.5a (VHT RTS procedure), 9.19.2.4 (Multiple frame transmission in an EDCA TXOP) and 9.19.2.8 (EDCA channel access in a VHT BSS).

* Switching between 40 MHz and 20 MHz

Insert the following at the end of this subclause:

A VHT STA is not required to perform any of the behavior described in this subclause associated with Information Request and 20 MHz BSS Width Request.

* Phased coexistence operation (PCO)
* General description of PCO

Insert as the last paragraph of 10.16.1:

A VHT STA shall not transmit VHT PPDUs during a PCO 40 MHz phase.

* BSS Coexistence Management frame usage

Change the last paragraph as follows:

A non-VHT STA that receives a 20/40 BSS Coexistence element with the Information Request field equal to 1, a value for the Address 1 field that matches the receiving STA using an individual address, and a nonwildcard BSSID field that matches the STA's BSS shall immediately queue for transmission a 20/40 BSS Coexistence Management frame with the transmitting STA as the recipient.

* Tunneled direct link setup
* General

Change the 5th paragraph of 10.22.1 and insert a subsequent paragraph as follows:

Features that are not supported by the BSS but that are supported by both TDLS peer STAs may be used on a TDLS direct link between those STAs, except PCO. An example is the use of an HT MCS on a TDLS direct link between HT STAs when these STAs are associated with a non-HT BSS. Features that are supported by the BSS shall follow the BSS rules when they are used on a TDLS direct link on the base channel. The channel width of the TDLS direct link on the base channel shall not exceed the channel width of the BSS to which the TDLS peer STAs are associated, except when the TDLS Wider Bandwidth subfield in the Extended Capabilities element of the TDLS Setup Request frame or the TDLS Setup Response frame is 1 for both TDLS peer STAs. A TDLS direct link on the base channel shall not have a wider bandwidth than the BSS bandwidth if either of the STAs indicate that they are incapable of supporting wider bandwidth operation on the base channel.(#6312)

A VHT STA with a TDLS link that is not an off-channel link, shall use the HT BSS primary channel as its primary channel. The channel width of a VHT TDLS link shall not be wider than the maximim channel width supported by either the TDLS initiator STA or the TDLS responder STA.

A 160 MHz bandwidth is defined to be identical to a 80+80 MHz bandwidth (i.e. one bandwidth is not wider than the other).(#6312)

A STA shall not participate in a TDLS direct link with the same primary 80 MHz channel as the infrastructure BSS or another TDLS direct link of the STA but with a different secondary 80 MHz channel.(#6312)

Insert the following as the last paragraph of 10.22.1:

The VHT Operation element shall be present in a TDLS Setup Confirm frame when both STAs are VHT capable but the BSS is not a VHT BSS.

* TDLS channel switching

Insert a new subclause 10.22.6.4 following 10.22.6.3 as follows:

* Setting up a wide bandwidth off-channel direct link
* General

A wideband TDLS off-channel TDLS direct link is a 40 MHz, 80 MHz, 160 MHz or 80+80 MHz off-channel TDLS direct link.

A wideband off-channel TDLS direct link may be started if both TDLS peer STAs indicated wideband support in the Supported Channel Width Set subfield of the VHT Capabilities element VHT Capabilities Info field included in the TDLS Setup Request frame or the TDLS Setup Response frame.

Switching to a wideband off-channel direct link is achieved by including any of the following information in the TDLS Channel Switch Request frame:

* an Operating Class element indicating 40 MHz channel spacing
* a Secondary Channel Offset element indicating SCA or SCB
* a Wide Bandwidth Channel Switch element indicating 80 MHz/160 MHz/80+80 MHz channel width

The operating class in TDLS Channel Switch Request frame shall have a value representing 5 GHz for the channel starting frequency.

When announcing new TPC parameters for an off-channel direct link(#6062) that come into effect at the same time as the switch to the direct link, the TDLS peer VHT STA initiating the switch shall include at least one VHT Transmit Power Envelope element in a transmitted TDLS Channel Switch Request frame. The recipient TDLS peer VHT STA that has dot11SpectrumManagementRequired or dot11RadioMeasurementActivated equal to true shall use the parameters in these received element(s) in the recipient STA's TPC calculations for the off-channel.

When announcing new operating classes or both a new operating class table index and new operating classes, that come into effect at the same time as the switch to the direct link and that express new regulatory requirements, the TDLS peer VHT STA initiating the switch shall include a Country element in a transmitted TDLS Channel Switch Request frame. The Country element shall contain all the operating classes for the off-channel direct link in Operating Triplet subfields and no Subband Triplet subfields. The Country element shall include one Operating Triplet subfield that contains the same operating class as the Operating Class field in the same frame. The country indicated by the Country String in the TDLS Channel Switch Request frame shall be equal to the country indicated by the Country String of the BSS. The receipient TDLS peer VHT STA that has dot11MultiDomainCapabilityActivated, dot11SpectrumManagementRequired or dot11RadioMeasurementActivated equal to true shall use the parameters in the received Country element in the TDLS Channel Switch Request frame in order to maintain regulatory compliance.

The TDLS peer STA initiating the switch to the wideband off-channel shall be the DO STA on that channel.

* Basic wideband functionality

TDLS peer STAs may transmit up to 40 MHz, 80 MHz, 160 MHz or 80+80 MHz PPDUs on a 40 MHz, 80 MHz, 160 MHz or 80+80 MHz direct link, respectively. A TDLS peer STA shall not transmit a 20 MHz PPDU in the non-primary channel of its 80 MHz, 160 MHz or 80+80 MHz direct link.

* Channel selection for a wideband off-channel direct link

If a TDLS peer STA chooses to start a wideband direct link, the TDLS peer STA(#6263) shall follow the primary channel selection rules as defined in Channel selection methods for a VHT BSS and 10.23.14 (Channel usage procedures) and the secondary 80 MHz channel rule defined in General.(#6312)

* Switching from a wideband to a 20 MHz direct link

Switching from a wideband off-channel direct link to a 20 MHz off-channel direct link is established through a TDLS channel switch. When on a wideband off-channel direct link, a requested switch to a 20 MHz direct link shall be accepted.

* CCA sensing and NAV assertion in an 80 MHz, 160 MHz or 80+80 MHz direct link

TDLS peer STAs shall follow the CCA rules as defined in NAV and the NAV rules as defined in **Error! Reference source not found.**.

Insert the new subclauses 10.39 and 10.40 below as the last subclauses of Clause 10:

* VHT BSS operation
* Basic VHT BSS functionality

The STA that is creating the BSS shall be able to receive and transmit at each of the MCS values listed in the VHTBSSBasicMCSSet and VHTOperationalMCSSet.

A STA that has a value of true for dot11VHTOptionImplemented shall set dot11HighThroughputOptionImplemented to true.

A STA that is a VHT AP, a VHT STA in an IBSS or a VHT mesh STA declares its(#6063) channel width capability in the Supported Channel Width Set subfield of the VHT Capabilities element VHT Capabilities Info field as described in Table 8-183u.

A VHT STA shall set the Supported Channel Width Set subfield in its HT Capabilities element HT Capabilities Info field to 1, indicating that both 20 MHz operation and 40 MHz operation are supported.

A VHT STA sets the Rx MCS Bitmask of the Supported MCS Set field of its HT Capabilities element according to the setting of the Rx MCS Map subfield of the VHT Supported MCS Set field of its VHT Capabilities element as follows: for each subfield Max MCS For *n* SS, , of the Rx MCS Map field with a value other than 3 (no support for that number of spatial streams), the STA shall indicate support for MCSs 8(*n*-1) to 8(*n*-1)+7 in the Rx MCS Bitmask, where *n* is the number of spatial streams.

A STA that is a VHT AP, a VHT STA in an IBSS or a VHT mesh STA(#6063) shall set the STA Channel Width subfield in the HT Operation element HT Operation Information field and the Channel Width subfield in the VHT Operation element VHT Operation Information field to indicate the BSS operating channel width as shown in VHT BSS operating channel width.

|  |
| --- |
| * VHT BSS operating channel width
 |
| HT Operation element STA Channel Width field | VHT Operation element Channel Width field | BSS operating channel width |
| 0 | 0 | 20 MHz |
| 1 | 0 | 40 MHz |
| 1 | 1 | 80 MHz |
| 1 | 2 | 160 MHz |
| 1 | 3 | 80+80 MHz |

A VHT STA shall determine the channelization using the combination of the information in the HT Operation element Primary Channel field and the VHT Operation element VHT Operation Information field Channel Center Frequency Segment 0 and Channel Center Frequency Segment 1 subfields (see 22.3.14 (Channelization)).

A VHT AP shall set the HT Operation element HT Operation Information field Secondary Channel Offset subfield as appropriate to the secondary 20 MHz channel, if the BSS operating channel width is more than 20 MHz.

A VHT STA that is a member of a VHT BSS shall not transmit a 20 MHz VHT PPDU on a channel other than the primary 20 MHz channel of the BSS, except for a 20 MHz VHT PPDU transmission on an off-channel TDLS direct link.

A VHT STA that is a member of a VHT BSS with a 40 MHz, 80 MHz, 160 MHz or 80+80 MHz operating channel width shall not transmit a 40 MHz VHT PPDU that does not use the primary 40 MHz channel of the BSS, except for a 40 MHz VHT PPDU transmission on an off-channel TDLS direct link.

A VHT STA that is a member of a VHT BSS with an 80 MHz, 160 MHz or 80+80 MHz operating channel width shall not transmit an 80 MHz VHT PPDU that does not use the primary 80 MHz channel of the BSS, except for an 80 MHz VHT PPDU transmission on an off-channel TDLS direct link.

A VHT STA that is a member of a VHT BSS with a 160 MHz(Ed) or 80+80 MHz operating channel width shall not transmit a 160 MHz(Ed) or 80+80 MHz VHT PPDU that does not use the primary 80 MHz channel and the secondary 80 MHz channel of the BSS, except for a 160 MHz(Ed) or 80+80 MHz VHT PPDU transmission on an off-channel TDLS direct link.

A VHT STA shall not transmit to a second(#6305) VHT STA using a bandwidth that is not indicated as supported in the Supported Channel Width Set subfield in the HT Capabilities element or VHT Capabilities element(#6148) received from that VHT STA.

Except in the case of a TDLS off-channel direct-link (which is independently constrained by 10.22.6.3), a STA shall not transmit a PPDU with a TXVECTOR parameter CH\_BANDWIDTH indicating a channel width that is wider than the BSS operating channel width.

The use of RIFS in a VHT BSS is not allowed. A VHT AP shall set the RIFS Mode field in the HT Operation element to 0.

* Channel selection methods for a VHT BSS

Before a STA starts a VHT BSS, the STA shall perform a minimum of dot11VHTOBSSScanCount OBSS scan operations to search for existing BSSs (see Scanning requirements for VHT STA).

If an AP, a STA in an IBSS or a mesh STA starts a VHT BSS that occupies some or all channels of any existing BSSs, the AP may select a primary channel of the new VHT BSS that is identical to the primary channel of any one of the existing BSSs.

If an AP, a STA in an IBSS or a mesh STA chooses to select a primary channel of a new VHT BSS with a 40 MHz, 80 MHz, 160 MHz or 80+80 MHz operating channel width from among the channels on which no beacons are detected during the OBSS scans, the selected primary channel

* shall not be identical to the secondary 20 MHz channel of any existing BSSs with a 40 MHz, 80 MHz, 160 MHz or 80+80 MHz operating channel width, and
* should not be overlapped with the secondary 40 MHz channel of any existing BSSs with a 160 MHz or 80+80 MHz operating channel width.

A STA that is an AP, a STA in an IBSS or a mesh STA(#6063) should not start a VHT BSS with a 20 MHz operating channel width on a channel that is the secondary 20 MHz channel of any existing BSSs with a 40 MHz, 80 MHz, 160 MHz or 80+80 MHz operating channel width, or is overlapped with the secondary 40 MHz channel of any existing BSSs with a 160 MHz or 80+80 MHz operating channel width.

NOTE—An AP, a STA in an IBSS or a mesh STA operating a VHT BSS with a 40 MHz, 80 MHz, 160 MHz or 80+80 MHz operating channel width, on detecting an OBSS whose primary channel is the AP's, the STA in the IBSS’s or the mesh STA’s secondary 20 MHz channel, can switch to 20 MHz BSS operation and/or can move to a different channel.

* Scanning requirements for VHT STA

An OBSS scan operation is a passive or active scan of a set of channels that are potentially affected by VHT BSS operation (see 10.1.4.1). Each channel in the set may be scanned more than once during a single OBSS scan operation. OBSS scans are performed by STAs that start a VHT BSS.

During an individual scan within an OBSS scan operation, the minimum per-channel scan duration is dot11OBSSScanPassiveDwell TU (for a passive scan) or dot11OBSSScanActiveDwell TU (for an active scan). During an OBSS scan operation, each channel in the set is scanned at least once per dot11BSSWidthTriggerScanInterval seconds, and the minimum total scan time (i.e., the sum of the scan durations) per channel within a single OBSS scan operation is dot11OBSSScanPassiveTotalPerChannel TU (for a passive scan) or dot11OBSSScanActiveTotalPerChannel TU (for an active scan).

NOTE—The values provided in the previous paragraph indicate the minimum requirements. For some combinations of parameter values, it is necessary to exceed the minimum values of some of the parameters in order to meet the minimum value constraints of all parameters.

* Extended Extended Channel switching methods

A STA supports the methods specified in this subclause if dot11ExtendedExtendedChannelSwitching is true. A VHT STA shall set dot11ExtendedExtendedChannelSwitching to true.

An AP announces a switch of operating channel, operating bandwidth or both, by either

* using the Channel Switch Announcement element, Channel Switch Announcement frame or both, following the procedure described in 10.9.8.2 (Selecting and advertising a new channel in an infrastructure BSS)
* using the Extended Channel Switch Announcement element, Extended Channel Switch Announcement frame or both, following the procedure described in 10.10 (Extended channel switching (ECS))

and, in addition, following the procedures in this section.

A mesh STA announces a switch attempt of operating channel, operating bandwidth or both, by either

* using the Channel Switch Announcement element, Channel Switch Announcement frame or both, following the procedure described in 10.9.8.4 (MBSS channel switching)
* using the Extended Channel Switch Announcement element, Extended Channel Switch Announcement frame or both, following the procedure described in 10.10 (Extended channel switching (ECS)) and in addition following the procedures in this section.

An AP, STA in an IBSS or mesh STA(#6007) can also announce a new Country String (including a new Operating Table index), new operating classes or new TPC parameters for the BSS that come into effect at the same time as the switch of operating channel, operating bandwidth, or both.

The New Channel Number field in the Channel Switch Announcement element, Extended Channel Switch Announcement element, Channel Switch Announcement frame or Extended Channel Switch Announcement frame, identifies the primary 20 MHz channel after the switch. For HT STAs, dot11CurrentPrimaryChannel is set equal to the value of the New Channel Number field after the switch.

When announcing a switch to a 20 MHz operating bandwidth, neither a Wide Bandwidth Channel Switch element nor a Wide Bandwidth Channel Switch subelement shall be transmitted.

When announcing a switch to a 20 MHz operating bandwidth, a Secondary Channel Offset element shall not be transmitted, except(#6064) that a Secondary Channel Offset element may be transmitted in a Channel Switch Annnouncement frame if the Secondary Channel Offset field within the Secondary Channel Offset element has the value SCN.

NOTE—A Secondary Channel Offset element is never transmitted with the Extended Channel Switch Announcement element in a frame, unless the frame also contains a Channel Switch Announcement element, or in the Extended Channel Switch Announcement frame. Instead, the indicated operating class within the Extended Channel Switch Announcement element or frame identifies the operating bandwidth after the switch.

When announcing a switch to a 40 MHz or wider operating bandwidth using a Channel Switch Announcement element, a Secondary Channel Offset element shall be transmitted. The Secondary Channel Offset field in the Secondary Channel Offset element identifies the secondary 20 MHz channel after the switch.
NOTE—A Channel Switch Announcement element might be carried in a Channel Switch Announcement frame.

When announcing a switch to a 40 MHz operating bandwidth, neither a Wide Bandwidth Channel Switch element nor a Wide Bandwidth Channel Switch subelement shall be transmitted.

NOTE—Instead, the absence of a Wide Bandwidth Channel Switch element or subelement but presence of a Secondary Channel Offset element with a value of SCA or SCB in the Secondary Channel Offset field in the MMPDU containing a Channel Switch Announcement element, or the indicated operating class within the Extended Channel Switch Announcement element or frame identifies the bandwidth and the relative position of the primary 20 MHz and secondary 20 MHz channels after the switch.

When announcing a switch to a 80 MHz, 80+80 MHz or 160 MHz operating bandwidth, a Wide Bandwidth Channel Switch element (for frames other than Beacon and Probe Response frames) and/or a Wide Bandwidth Channel Switch subelement in a Channel Switch Wrapper element (for Beacon and Probe Response frames) shall be transmitted.

NOTE—A Secondary Channel Offset element is never transmitted when announcing a switch to a 80 MHz, 80+80 MHz or 160 MHz operating bandwidth using a Channel Switch Announcement element. Instead, the information in the Wide Bandwidth Channel Switch element or subelement and the New Channel Number also present in the MMPDU identifies the bandwidth and the relative positions of the primary 20 MHz and secondary 20 MHz, secondary 40 MHz and (where appropriate) secondary 80 MHz channels after the switch.

When announcing a switch to a 80 MHz, 80+80 MHz or 160 MHz operating bandwidth using a Channel Switch Announcement element, Extended Channel Switch Announcement element, Channel Switch Announcement frame or Extended Channel Switch Announcement frame, the value of the New Channel Center Frequency Segment 0 field in the Wide Bandwidth Channel Switch element or subelement together with the New Channel Number field in the Channel Switch Announcement element, Extended Channel Switch Announcement element, Channel Switch Announcement frame or Extended Channel Switch Announcement frame identifies the primary 40 MHz channel after the switch as described in 22.3.7 (Mathematical description of signals).

When announcing a switch to a 80 MHz, 80+80 MHz or 160 MHz operating bandwidth using an Extended Channel Switch Announcement element or Extended Channel Switch Announcement frame, a) the value of the New Operating Class field identifies the primary 40 MHz channel after the switch and b) the Operating Triplet subfields within the New Country subelement or element respectively shall indicate all the operating class(es) for the switched BSS. The primary 40 MHz channel so identified after the switch shall be the same as that identified from the value of the New Channel Center Frequency Segment 0 field in the Wide Bandwidth Channel Switch subelement together with the New Channel Number field in the Extended Channel Switch Announcement element or Extended Channel Switch Announcement frame as described in 22.3.7 (Mathematical description of signals).

When announcing new BSS TPC parameters (#6782)that come into effect at the same time as the switch, a STA that is an AP, a PCP in a PBSS, a STA in an IBSS, or a mesh STA in an MBSS(#6063) shall include:

* at least one New VHT Transmit Power Envelope element in any Channel Switch Announcement frame or Extended Channel Switch Announcement frames it transmits;
* at least one New VHT Transmit Power Envelope subelement in a Channel Switch Wrapper element in any Beacon and Probe Response frames it transmits.

A receipient STA in the BSS that has dot11SpectrumManagementRequired or dot11RadioMeasurementActivated equal to true and that maintains association with the BSS after the switch shall use the parameters in these received elements and subelements in the recipient STA's TPC calculations for the new operating channel and operating bandwidth (see 10.8 (TPC procedures)). If both New VHT Transmit Power Envelope elements and New VHT Transmit Power Envelope subelements are transmitted for the switch, the set of New VHT Transmit Power Envelope elements and set of subelements shall contain the same set of values for the Local Maximum Transmit Power Units Interpretation subfield, and New VHT Transmit Power Envelope elements and subelements that have the same value for the Local Maximum Transmit Power Units Interpretation subfield shall also have the same values for their other fields.

When announcing a new Country String (including Operating Table index), new operating classes or both, that come into effect at the same time as the switch, a STA that is an AP, a PCP in a PBSS, a STA in an IBSS, or a mesh STA(#6063) in an MBSS shall include:

* a New Country element in any Extended Channel Switch Announcement frames it transmits;
* a New Country subelement in any Channel Switch Wrapper element it transmits.

The New Country element or subelement shall contain all the operating classes for the BSS after the switch. The New Country element or subelement, transmitted in an Extended Channel Switch Announcement frame or in the same frame as an Extended Channel Switch Announcement element respectively, shall include one Operating Triplet subfield that contains the same operating class as the New Operating Class field in the Extended Channel Switch Announcement frame or Extended Channel Switch Announcement element. A recipient STA in the BSS that has dot11MultiDomainCapabilityActivated, dot11SpectrumManagementRequired or dot11RadioMeasurementActivated equal to true and that maintains association with the BSS after the switch shall use the parameters in these received elements and subelements in order to maintain regulatory compliance. If both New Country elements and New Country subelements are transmitted for the switch, their fields shall be the same.

A Channel Switch Wrapper element shall not be included in Beacons and Probe Responses if it would contain no subelements.

NOTE—A Channel Switch Wrapper would not carry subelements in the case of a switch to 20 MHz and when no change to the Country String, operating classes or TPC parameters is announced.

A STA uses only the VHT Transmit Power Envelope element for TPC of 80 MHz, 160 MHz and 80+80 MHz transmissions.

NOTE—This is why a STA includes no Subband Triplet subfields in a Operating/Subband Sequence subfield in the Country element of an 80, 160 or 80+ MHz operating class.

When switching the BSS to a lower operating bandwidth, the AP may recalculate the TS bandwidth budget and may delete one or more active TSs by invoking the MLME-DELTS.request primitive with a ReasonCode value of SERVICE\_CHANGE\_PRECLUDES\_TS.

A STA that is a member of an IBSS adopts the values indicated by any Secondary Channel Offset element and Wide Bandwidth Channel Switch elements in received frames according to the rules in 10.1.5 (Adjusting STA timers) and shall not transmit a value for any Wide Bandwidth Channel Switch element and Secondary Channel Offset element that differs from the most recently adopted value.

* NAV assertion in a VHT BSS

A VHT STA shall update its NAV using the Duration/ID field value in any frame that does not have an RA matching the STA’s MAC address and that was received in a 20 MHz PPDU in the primary 20 MHz channel or received in a 40 MHz PPDU in the primary 40 MHz channel or received in a 80 MHz PPDU in the primary 80 MHz channel or received in a 160 MHz or 80+80 MHz PPDU.

A STA may discard without setting its NAV a frame carried in a) a(#6027) VHT SU PPDU with RXVECTOR parameters GROUP\_ID and PARTIAL\_AID fields that indicate that the STA cannot be a recipient of the frame according to 9.17a (Group ID and partial AID in VHT PPDUs) or b) a(#6027) VHT MU PPDU containing a Group ID field for which either the STA is not a member or the STA is a member but the number of space time streams assigned to the user position of the STA for that group is zero.

* VHT STA antenna indication

A VHT STA that does not change its Rx antenna pattern after association shall set the Rx Antenna Pattern Consistency subfield in the VHT Capabilities Info field to 1; otherwise the STA shall set it to 0.

A VHT STA that does not change its Tx antenna pattern after association shall set the Tx Antenna Pattern Consistency subfield in the VHT Capabilities Info field to 1; otherwise the STA shall set it to 0.

* VHTBSSBasicMCSSet operation(#6735)

A VHT STA shall not attempt to join (MLME-JOIN.request) or start (MLME-START.request) a BSS unless it supports (i.e., is able to both transmit and receive using) all the VHT MCSs in the VHTBSSBasicMCSSet of the related BSSDescription.

A VHT STA shall not attempt to (re)associate (MLME-ASSOCIATE.request and MLME-REASSOCIATE.request) with a VHT AP unless the STA supports (i.e., is able to both transmit and receive using) all the VHT MCSs in the VHTBSSBasicMCSSet transmitted by the AP.

* Group ID management operation

Assignments or changes of user positions corresponding to one or more Group IDs shall be performed using a Group ID Management frame defined in 8.5.23.3 (Group ID Management

 frame format).

A STA may be assigned to multiple groups by setting multiple subfields of the Membership Status Array field (see 8.4.1.51 (Membership Status Array field)) to 1 in the Group ID Management frame addressed to that STA.

A STA’s user position in each group of which the STA(#6264) is a member is indicated by the associated subfield in the User Position Array field (see 8.4.1.52 (User Position Array field)) in the Group ID Management frame addressed to the STA. For each Group ID, an AP can assign the same user position to multiple STAs(#6146). A STA shall have only one user position in each group of which the STA(#6264) is a member.(#6627)

An AP may transmit a Group ID Management frame only if dot11VHTOptionImplemented is true. A Group ID Management frame shall not be sent to a VHT STA that does not have the MU Beamformee Capable field in the VHT Capabilities element equal to 1(#6069).

A Group ID Management frame shall be sent as an individually addressed frame.

A STA that receives a Group ID Management frame with a RA matching its MAC address shall issue a PHYCONFIG\_VECTOR primitive with the GROUP\_ID\_MANAGEMENT parameter(#6628) based on the content of the received Group ID Management frame. Group ID values of 0 and 63 are used for SU PPDU and the PHY filtering of such PPDUs is controlled by the PHYCONFIG\_VECTOR primitive LISTEN\_TO\_GID00 and LISTEN\_TO\_GID63 parameters.(#6310)

Transmission of a Group ID Management frame to a STA and any associated acknowledgement from the STA shall be complete before the transmission of an MU PPDU to the STA.

An MU PPDU shall be transmitted to a STA based on the content of the Group ID Management frame most recently transmitted to the STA and for which an acknowledgement was received.

* Notification of operating mode changes(#6148)

A STA that has the value true for dot11OperatingModeNotificationImplemented shall set the Operating Mode Notification field in the Extended Capabilities element to 1. A VHT STA shall set dot11OperatingModeNotificationImplemented(#6067) to true. A STA that has the Operating Mode Notification field in the Extended Capabilities element equal to 1 is referred to as operating mode notification capable.(#6149)

A STA notifies other STAs that are operating mode notification capable of a change in its operating mode using the Operating Mode Notification frame or by including the Operating Mode Notification element in the Beacon, Probe Response, Association Request, Association Response, Reassociation Request, or Reassociation Response , TDLS Setup Response, TDLS Setup Confirm,(#6150) Mesh Peering Open or Mesh Peering Confirm(#6004) frames. The Operating Mode field in the Operating Mode Notification frame or the Operating Mode Notification element is set to indicate that the STA is capable of receiving frames with a bandwidth up to and including the indicated channel width and with a number of spatial streams up to and including the value indicated by the Rx Nss subfield(#6431).

A STA shall not transmit an individually addressed frame that contains the Operating Mode field unless the recipient is operating mode notification capable.(#6066)

An AP should notify associated STAs of a change in the maximum number of space-time streams it is able to receive through one or more of the following mechanisms:(#6066)

* Using individually addressed Operating Mode Notification frames
* Including the Operating Mode Notification element in Beacon frames for a period of time that ensures that STAs in PS mode will receive the notification(#6308)
* Using the SM power save mechanism defined in 10.2.4 for HT STAs that are not operating mode notification capable

The notification should occur prior to a decrease in the maximum number of space-time streams and following an increase in the maximum number of space-time streams.

NOTE—An AP that is reducing the maximum number of space-time streams the AP is able to receive and that has associated HT STAs that are not operating mode notification capable would use the SM power save mechanism to notify the STAs that the AP is operating with a single receive chain.

An AP should notify associated STAs of a change in its operating channel width through one or more of the following mechanisms:(#6066)

* Using the Channel Switch Announcement element, Channel Switch Announcement frame or both following the procedure defined in 10.9.8.2 (Selecting and advertising a new channel in an infrastructure BSS)
* Using the Extended Channel Switch Announcement element, Extended Channel Switch Announcement frame or both, following the procedure described in 10.10 (Extended channel switching (ECS))
* Using individually addressed Operating Mode Notification frames
* Using the STA Channel Width field in the HT Operation element and/or Channel Width field in the VHT Operation element

An HT AP that is not a VHT AP that changes its operating channel width shall indicate the new operating channel width in the STA Channel Width field in the HT Operation element. A VHT AP that changes its operating channel width shall indicate the new operating channel width in the Channel Width field in the VHT Operation element and STA Channel Width field in the HT Operation element (see VHT BSS operating channel width).(#6066)

An AP shall not include the Operating Mode Notification element in Beacon, Probe Response, Association Response and Reassociation Response frames when not changing the maximum number of space-time streams the AP is able to receive.(#6066)

A STA shall not transmit an Operating Mode field(#6445) with the value of the Rx Nss subfield indicating a number of spatial streams not supported by the STA, as reported in any Supported Rates element, Extended Supported Rates element, Supported MCS Set or VHT Supported MCS Set field in management frames transmitted by the STA.

A STA shall not transmit an Operating Mode field with the value of the Channel Width subfield indicating a bandwidth not supported by the STA, as reported in the Supported Channel Width Set subfield in the HT Capabilitites Info field or the VHT Capabilities Info field in management frames transmitted by the STA.

A STA that is operating mode notification capable shall not transmit a PPDU to a STA that uses a bandwidth that is greater than the channel width indicated in the most recently received Operating Mode Notification element or Operating Mode Notification frame from that STA. A STA that is operating mode notification capable shall not transmit a PPDU to a STA that uses a greater number of space-time streams than indicated in the most recently received Operating Mode Notification element or Operating Mode Notification frame received from that STA.(#6437)

NOTE 1—To avoid possible frame loss, a STA that sends an individually addressed Operating Mode Notification frame to a second STA indicating reduced operating bandwidth and/or reduced active receive chains(#6431) can continue with its current operating bandwidth and active receive chains(#6431) until it infers that the second STA has processed this notification. The first STA(#6264) might make this inference as follows:

* By receiving a frame addressed to itself from the second STA in a PPDU with a bandwidth and *NSS* that are equal to or less than the channel width and *NSS*, respectively, indicated in the Operating Mode Notification frame, or
* Based on the passage of time in some implementation dependent way, which is outside the scope of this standard.

NOTE 2—It might take a long time for a STA to change its operating mode following the transmission of the Operating Mode Notification frame and during that time the STA might not be able to receive frames resulting in frame loss. If a non-AP STA cannot tolerate frame loss during that period it can set the Power Management subfield of the Frame Control field of the Operating Mode Notification frame to 1 to indicate that the STA has entered power save. When the non-AP STA has completed its operating mode change, it can send another frame (such as a QoS Null) with the Frame Control Power Management subfield set to 0 to indicate that the STA has exited power save.

***At 218.44 in 22.3.7 change idx1 to idx0 (twice). At 220.23 delete the definitions of fc,idx<n> (as these are already given at 218.30).***

***In Table D-2 delete the “a” in “one or more a VHT Transmit Power Envelope elements”.***

***Add a MIB variable dot11ExtendedExtendedChannelSwitching, along the lines of dot11ExtendedChannelSwitching.***

***Globally delete the “VHT” in “VHT Transmit Power Envelope”, including where it is preceded by e.g. “New”.***

***Globally change “channel bandwidth” to “channel width”, irrespective of case, including in the baseline.***

## Proposed resolution

6439: REVISED. See Proposed changes in 12/1037r<last revision>, which agree in principle with the commenter.

1. TGaf has introduced in D2.0 a Channel Power Management Announcement element, but it is understood that this is accepted to be a mistake and TGaf will in subsequent drafts align itself with the framework introduced by TGac. [↑](#footnote-ref-1)