IEEE P802.11
Wireless LANs

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| 802.11 TGac WG Letter Ballot LB188Proposed resolutions for Clause 9.7 |
| Date: 2012-09-19 |
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Abstract

This submission contains proposed comment resolutions to comments received during WG letter ballot 188 in clause 9.7 (rate adaptation).

These comments were first discussion in document 11-12/0847. This document supersedes any resolutions for the same CID in 11-12/0847.

The comments with resolutions proposed are:

6274, 6552, 6276, 6553, 6554, 6022, 6115, 6117, 6701, 6024, 6026, 6675, 6116, 6118, 6119, 6028, 6029, 6030, 6120, 6035, 6282, 6812, 6036, 6811, 6281, 6021

R1: updated based on feedback + added 6281

R2: included edits to current definition of MCS

R3: updated during F2F.

R5: added resolution for 6502

# Note to database owner

Please substitute <this-document> with the document reference and approved revision number on entry into the database.

# Comments

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| 6274 | 105.06 | 9.7.5.3 | We talk of MCSs rather than (MCS,SS) tuples. Seems wrong. Ditto para at P107L31, P109L58, but really the whole clause | As in comment |

Proposed Resolution:

Revised.

Make changes as shown in <this-document> under CID 6273. These changes revise the terminology so that use of MCS by VHT is replaces by VHT-MCS or “<VHT-MCS, NSS> tuple” depending on context.

Discussion:

We have got into ourselves into a nomenclatural pickle in the baseline. “Rate” wasn’t a good enough term to describe the TXVECTOR parameters that controlled the transmit waveform, and certainly could not be used because multiple MCSs map on to the same rate.

But the 802.11 MCS is not really an MCS, but a tuple consisting of modulation, coding rate and number of space time streams. This term occurs about 600 times in 802.11-2012.

In 802.11ac, we explicitly call out a tuple consisting of MCS and number of spatial streams. And in at least one place we use a tuple consisting of MCS, number of spatial streams and bandwidth.

In 802.11ad, which comes before .11ac, and is therefore part of our baseline, MCS is used to determine modulation, coding and PHY type (i.e. single carrier or OFDM).

We discussed this at the July meeting and considered two sets of changes that would result in bulk renaming of MCS to something else, more or less wherever it occurred in our baseline. I now believe that this change is too radical – touching much material in our baseline that is not really in scope, and creating that challenge of distinguishing .11n and .11ad MCSs.

The outline of the proposed change is as follows: (scheme 4 – to distinguish from earlier discussions)

* Provide definition and abbreviation for VHT-MCS
* Adjust all use of MCS in .11ac to VHT-MCS
	+ with appropriate modifications where it is in a MIB variable or parameter name
* Review all use of VHT-MCS in 9.7 and replace by <VHT-MCS, NSS> or <VHT-MCS, NSS, CH\_BANDWIDTH> tuples as appropriate
* The “MCS” parameter of the \*XVECTOR is not changed

Note also that there are some possible choices related to terminology.

We have NUM\_STS, NSS, *NSS* and variously in the baseline. I’m proposing using NSS in these changes, because whatever term we agree on should be suitable to form part of a MIB attribute. Also I make a lot of use of <VHT-MCS, NSS> tuple. Italicising just the right hand part makes little sense.

**Proposed changes:**

***In 3.2 change the existing definition of MCS as follows:***

**modulation and coding scheme (MCS):** A specification of the physical layer (PHY)

parameters that consists of modulation order (e.g., BPSK, QPSK, 16-QAM, 64-QAM), forward error

correction (FEC) coding rate (e.g., 1/2, 2/3, 3/4, 5/6) and, depending on the context, the number of space-time streams.

***In 3.2 add a new definition:***

**very high throughput modulation and coding scheme (VHT-MCS):** A specification of the very high-throughput (VHT) physical layer (PHY) parameters that consists of modulation order (e.g., BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM) and forward error correction (FEC) coding rate (e.g., 1/2, 2/3, 3/4, 5/6) that is used in a VHT PPDU.

***In 3.3 add a new acronym:***

NSS number of spatial streams

***(Note to editor, please do the global changes after all other edits for D4, as other comment resolutions may introduce instances of these terms).***

***Globally replace all “VHT MCS” with “VHT-MCS”***

***Globally replace all “VHTBSSBasicMCS” with “BSSBasicVHTMCS\_NSS”***

***Globally replace all “VHT Basic MCS Set” with “Basic VHT-MCS and NSS Set”***

***Globally replace all “VHTOperationalMCSSet” with “OperationalVHTMCS\_NSSSet”***

***Globally replace all “VHTSupportedMCS” with “SupportedVHTMCS\_NSS”***

***Globally replace all “VHT Supported MCS Set” with “Supported VHT-MCS and NSS Set”***

***Globally replace all “VHT Rx Supported MCS Set” with “Rx Supported VHT-MCS and NSS Set”***

***Globally replace all “VHT Tx Supported MCS Set” with “Tx Supported VHT-MCS and NSS Set”***

***Change “MCS” to “VHT-MCS” at the following locations:***

***36.44, 36.46, 37.21, 37.44, 38.12, 38.17(x2), 49.65 (x2), 50.08, 80.47, 80.55 (x2), 80.64(x2),***

***81.03 (x8), 81.08 (x2), 81.20 (x2), 81.22-24, 81.34 (x2), 81.37-39, 81.49(x2), 82.50, 82.53, 82.54,***

***136.39, 146.24, 147.19, 158.13, 158.14(x2),***

***337.58, 337.61(x2), 337.62,***

***338.21, 338.24(x2), 338.25,***

***Change “MCS” to “VHT-MCS” throughout Clause 22 except at the following locations:***

***186.51, 278,52, 325.36,***

***Globally change “***dot11VHTRxMCSMap***” to “***dot11VHTRxVHTMCSMap***”***

***Globally change “***dot11VHTTxMCSMap***” to “***dot11VHTTxVHTMCSMap***”***

***Change 6.3.3.3.2 as follows:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| VHTBSSBasicMCSSet | Set of <VHT-MCS, NSS> tuples, constrained so that the MCS values are expressable using the encoding described for the VHT Basic MCS Set field in 8.4.2.161 (VHT Operation element). | As defined for the VHT Basic MCS Set field in 8.4.2.161 (VHT Operation element) | The VHT-MCS values for each number of spatial streams that are supported by all VHT STAs in the BSS. See 10.39.8 (VHTBSSBasicMCSSet operation(#6735)).(#6735) The parameter is present if dot11VHTOptionImplemented is true and a VHT Operation element was present in the Probe Response or Beacon frame from which the BSSDescription was determined, and not present otherwise.(#6796) | Adopt |
| VHTOperationalMCSSet | Set of <VHT-MCS, NSS> tuples, constrained so that the MCS values are expressable using the encoding described for the VHT Supported MCS Set field in 8.4.2.160.3 (VHT Supported MCS Set field) | As defined in the Rx MCS Map and Rx Highest Supported Data Rate fields in the VHT Supported MCS field in 8.4.2.160.3 (VHT Supported MCS Set field) | The VHT-MCS values for each number of spatial streams that the peer STA desires to use for communication within the BSS.This values are a superset of those contained in the VHTBSSBasicMCSSet parameter.The parameter is present if dot11VHTOptionImplemented is true and a VHT Capabilities element was present in the Probe Response or Beacon frame from which the BSSDescription was determined, and not present otherwise.(#6796) | Do not adopt |

***Change 6.3.4.2.2 as follows:***

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| --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** |
| VHTOperationalMCSSet | Set of <VHT-MCS, NSS> tuples, constrained so that the MCS values are expressable using the encoding described for the VHT Supported MCS Set field in 8.4.2.160.3 (VHT Supported MCS Set field) | As defined in the Rx MCS Map and Rx Highest Supported Data Rate fields in the VHT Supported MCS field in 8.4.2.160.3 (VHT Supported MCS Set field) | The VHT-MCS values for each number of spatial streams that the STA desires to use for communication within the BSS.The parameter is present if dot11VeryHighThroughputOptionImplemented is true, and not present otherwise.(#6796) |

***Change heading of 22.3.5 as follows:***

“**22.3.5 VHT modulation and coding scheme (VHT-MCS)**”

***Change 101.37 as follows:***

All VHT STAs that are members of a BSS are able to receive and transmit using all the <VHT-MCS, NSS> tuples indicated by 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)), except as constrained by the rules of 9.7.11 (Rate selection constraints for VHT STAs).

***Change 9.28.3 as follows:***

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| * Link adaptation using the VHT variant HT Control field

The behavior described in this subclause is specific to the VHT variant HT Control field.(#4920)A STA that supports VHT link adaptation using the VHT variant HT Control field shall set the VHT Link Adaptation Capable subfield in the VHT Capabilities Info field in the VHT Capabilities element to Unsolicited or Both, depending on its specific link adaptation feedback capability. A STA shall not send an MRQ to STAs that have not set VHT Link Adaptation Capable subfield to Both in the (#4167)VHT Capabilities Info field of the VHT Capabilities element. A STA whose (#4167)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 link adaptation feedback. In each request, the MFB requester shall set the MSI/STBC(#5247) field to a value in the ranges 0 to 6, 0 to 2 or 0 to 3, depending on the settings in the Unsolicited MFB and STBC fields (see 8.2.4.6.3 (VHT variant)).(#5256) The choice of MSI value is implementation dependent.NOTE—The MFB requester can use the MSI/STBC(#5247) field as an MRQ sequence number or it can implement any other encoding of the field.The appearance of more than one instance of a VHT variant HT Control field with the MRQ field equal(#4182) to 1 within a single PPDU shall be interpreted by the receiver as a single request for link adaptation feedback.(#5360)An MFB responder that has set the VHT Link Adaptation Capable subfield to Both in the (#4167)VHT Capabilities Info field of the VHT Capabilities element(#4297) shall support both of(#4419) the following:* computation and feedback of the MFB estimate(#4905) on the receipt of an MFB request (MRQ equal(Ed) to 1 in the VHT variant HT Control field) in a PPDU that is not a VHT NDP Announcement(#4921) frame.
* computation and feedback of the MFB estimate(#4905) on the receipt of an MFB request (MRQ equal(Ed) to 1 in VHT variant HT Control field) in a VHT NDP Announcement(#4921) frame and the receipt of VHT NDPs(#4923) (see 9.31 (Null data packet (NDP) sounding
* )) if this STA set the SU Beamformee Capable (#4421)subfield of the VHT Capabilities Info field of the VHT Capabilities element to 1.

On receipt of a VHT variant HT Control field with the MRQ field equal(#4182) to 1, an MFB responder computes the VHT-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(#4957) and labels the result of this computation with the MSI value from the VHT variant HT Control field in the received frame carrying the MRQ(#4673). The MFB responder may include the received MSI value in the MFSI field of the corresponding response frame. In the case of a delayed response, this allows the MFB requester to associate the MFB with the soliciting MRQ.When sending a solicited MFB, an MFB responder shall set the Unsolicited MFB subfield in VHT variant HT Control field to 0.The MFB responder may send a solicited response frame with any of the following combinations of VHT-MCS, N\_STS and MFSI:* VHT-MCS = 15, N\_STS = 7 in the MFB subfield, MFSI = 7: no information is provided for the immediately preceding request or for any other pending request. This combination is used when the responder is required to include a VHT variant HT Control field due to other protocols that use this field (e.g.,(#4422) the Reverse Direction Protocol) and when no MFB is available. It has no effect on the status of any pending MRQ.
* VHT-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 VHT-MCS and N\_STS, MFSI in the range 0 to 6: the responder is providing feedback for the request that had the MSI value that matches the MFSI value.

An MFB responder that discards or abandons the MFB estimates(#4906) computed in response to an MRQ may indicate that it has done so by setting the VHT-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.(#5378)The SNR feedback in the MFB subfield is defined as the SNR value averaged over all the space-time streams and data subcarriers, and is encoded as a 6-bit two’s complement number of , where SNR\_average is the sum of the values of SNR per frequency tone (in decibels) per space-time stream divided by the product of the number of space-time streams, as indicated in the N\_STS subfield of the MFB field,(#4425) and the number of frequency tones represented in the bandwidth in which the MFB was estimated. This encoding covers the SNR range from  dB to 53 dB in 1 dB steps. The STA receiving MFB may use the received MFB to compute the appropriate VHT-MCS, SNR, and N\_STS.(#4425)NOTE—When receiving an MU PPDU, the MFB responder may compute the interference level from the VHT-LTF field(#4426), and in this case the value in the(#4427) SNR subfield indicates the averaged signal(#5088) to interference and noise ratio (SINR).A STA sending unsolicited MFB feedback using the VHT variant HT Control field shall set the Unsolicited MFB subfield to 1.Unsolicited VHT-MCS, N\_STS, BW and SNR estimates reported in the MFB subfield of a VHT variant HT Control field sent by a STA are computed based on the most recent PPDU received by the STA that matches the description indicated by GID-L, GID-H, Coding Type, STBC Indication and FB Tx(#5486) Type fields in the same VHT variant HT Control field.In an unsolicited MFB response, the GID-L, GID-H, Coding Type, STBC Indication, FB Tx(#5487) Type and BW fields are set according to the RXVECTOR parameters of the received PPDU from which the VHT-MCS, SNR, BW and N\_STS are estimated, as follows:* If the VHT-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 VHT-MCS, SNR, BW and N\_STS are estimated from an SU PPDU, then the GID-L field and GID-H field are set to all ones
* The Coding Type field is set to 0 if the parameter FEC\_CODING is equal to BCC\_CODING and set to 1 if equal to LDPC\_CODING
* The STBC Indication field is set to 1 if the parameter STBC is equal to 1 and set to 0 if the STBC parameter is equal to 0
* The FB TX Type field is set to 1 if the parameter BEAMFORMED is equal to 1 and set to 0 if equal to 0
* The BW field shall indicate a bandwidth equal to or less than the bandwidth indicated by the parameter CH\_BANDWIDTH

NOTE—The values of the GID-L and GID-H fields identify the unsolicited feedback as estimated from either an SU or an MU PPDU.(#4428)In an MFB response solicited by(Ed) 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.(#5360)In an MFB response solicited by(Ed) an MRQ that was not carried in a VHT NDP Announcement(#4921) frame, the MFB is computed based on RXVECTOR parameters CH\_BANDWIDTH, GROUP\_ID, NUM\_STS, N\_TX, FEC\_CODING, BEAMFORM and STBC of the received PPDU that carried the MRQ(#4957) and may additionally be based on other factors that(#4071) 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.(#5250)If the MFB is in the same MPDU(#4667) as a VHT Compressed Beamforming frame, the MFB responder shall estimate the recommended MFB under the assumption that the beamformer(#5251) 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.For unsolicited MFB that 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.(#5378)If the MFB requester sends MRQ in a VHT NDP Announcement(#4921) frame, then the MFB responder shall include the corresponding MFB in (all of) the VHT Compressed Beamforming frame(s) that is/are(#4667) the response to the same VHT NDP Announcement(#4921) frame and NDP sequence.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 a value equal to or smaller than the RXVECTOR parameter NUM\_STS of the received PPDU from which the MFB parameters are estimated.(#4196)For an MFB (solicited or unsolicited) that is based on an SU or MU PPDU, if the N\_STS subfield is set to a smaller value than the RXVECTOR parameter NUM\_STS, the MFB responder shall estimate the recommended VHT-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)).(#5250)In a VHT NDP Announcement(#4921) frame with multiple STA Info fields and carrying a VHT format of HT Control field with MRQ equal(#4182) to 1, the MRQ is intended to solicit an MFB response from all the STAs listed in the (#4430)STA Info fields.When the MFB requester sets the MRQ subfield to 1 and sets the MSI/STBC(#5247) subfield to a value that matches the MSI/STBC(#5247) 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(#5247) subfield value and start a new computation based on the new request(#4228).A STA may respond immediately to a current request for MFB with a frame containing an MFSI field value and MFB field value that correspond to a request that precedes the current request.NOTE 1—If 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 (VHT-MCS =15, N\_STS=7, and MFSI equal to the MSI in the PPDU that carried the MRQ).(#4957)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. |

***Change 149.05 as follows:***

“…subject to the constraint of the previous sentence, regardless of the value of the Supported VHT-MCS and NSS Set field of the VHT Capabilities element at either the transmitter or recipient of the NDP.”

***Change 152.04 as follows:***

“The SME shall refuse an association request from a VHT STA that does not support all the <VHT-MCS, NSS> tuples indicated by the VHTBSSBasicMCSSet parameter.”

***Change 152.20 as follows:***

“The SME shall refuse a reassociation request from a VHT STA that does not support all the <VHT-MCS, NSS> tuples indicated by the VHTBSSBasicMCSSet parameter.”

***Change 157.64 as follows:***

“The STA that is creating the BSS shall be able to receive and transmit at each of the <VHT-MCS, NSS> tuple values indicated by the VHTBSSBasicMCSSet and VHTOperationalMCSSet.”

***Change any resulting “an VHT-MCS” to “a VHT-MCS”***

***Change 9.7 as follows with this markup: (Note, changes resulting from Approved CIDs are shown as “D3.1” with CID number. Ignore artefacts of the conversion to Word, such as newlines in some cross-references):***

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| * Multirate support
* Basic Rate Set and Basic MCS Set for mesh STA

Change the last two paragraphs as follows:Mesh STAs should adopt the mandatory PHY rates as the default BSSBasicRateSet to reduce the risk that a candidate peer mesh STA utilizes a different BSSBasicRateSet. If the mesh STA is also an HT STA, it should adopt the ~~MCSs of~~ mandatory HT MCSs(#4367) as the default BSSBasicMCSSet. If the mesh STA is also a VHT STA, it should adopt the <VHT-MCS, NSS> tuples formed from the mandatory VHT-MCSs and NSS=1(#4367) as the default VHTBSSBasicMCSSet.Once the mesh STA establishes a mesh peering with a mesh STA, it shall not change ~~neither~~ (#4600)the BSSBasicRateSet, ~~nor the~~ BSSBasicMCSSet or VHTBSSBasicMCSSet parameters.* Rate selection for data and management frames
* Rate selection for other group addressed data and management frames

Change the last three paragraphs as follows:If the BSSBasicRateSet parameter is empty and the BSSBasicMCSSet parameter is not empty, the frame shall be transmitted in an HT PPDU using one of the MCSs included in the BSSBasicMCSSet parameter.If the BSSBasicRateSet parameter is empty and the BSSBasicMCSSet parameter is empty and the VHTBSSBasicMCSSet is not empty, the frame shall be transmitted in a VHT PPDU using one of the <VHT-MCS, NSS> tuples 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.**9.7.5.5a Rate selection for data frames sent within an FMS stream(#6021)**Data frames sent within an FMS stream are sent at a rate negotiated during the establishment of the FMS stream. See 10.23.7.* Rate selection for other individually-addressed(#6021) data and management frames

Change as follows:A data or management frame not identified in 9.7.5.1 through 9.7.5.5a shall be sent using any data rate, MCS or <VHT-MCS, NSS> tuple 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(#6021), 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 a <VHT-MCS, NSS> tuple that is not supported by the receiver STA(#6021), 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 using an MCS that is not in the the HTOperationalMCSSset or using a <VHT-MCS, NSS> tuple that is not in the VHTOperationalMCSSet(#4911, #4309, #4030), which are parameters of the MLME-JOIN.request primitive

When the supported rate set of the receiving STA(#6021) is not known, the transmitting STA shall transmit using a rate in the BSSBasicRateSet parameter, or an MCS in the BSSBasicMCSSet parameter, or a <VHT-MCS, NSS> tuple 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 9.7.5.6 (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 variant(#6553) HT Control field with the MRQ subfield equal to 1, or
* The control frame contains an HT variant(#6553) 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 anSTBC frame(#6022).
* 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 (#4817)a VHT single MPDU or not carried in an A-MPDU.***Insert the following paragraph at the end of 9.7.6.2: (#6115)***When transmitting a VHT PPDU, a STA shall select a <VHT-MCS, NSS> tuple from the BSSBasicVHTMCS\_NSSSet parameter when protection is required (as defined in 9.23) and shall select a <VHT-MCS, NSS> tuple from the SupportedVHTMCS\_NSSSet parameter of the intended receiver when protection is not required.(#4372)* Rate selection for control frames that are not control response frames

Change the 1st paragraph as follows:This subclause describes the rate selection rules for control frames that are not control response frames, are not the frame that initiates a TXOP, are not the frame that terminates a TXOP, and are either (#4817)a VHT single MPDU or not carried in an A-MPDU.(#6117)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~~ (#4167received(#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.(#4051).A frame that is carried in a(#6027) VHT PPDU shall be transmitted by the STA using a <VHT-MCS, NSS> tuple supported by the receiver STA, as reported in the VHT Supported MCS field in the VHT Capabilities element received from that STA. When the VHT Supported MCS set of the receiving STA or STAs is not known, the transmitting STA shall transmit using a <VHT-MCS, NSS> tuple in the VHTBSSBasicMCSSet parameter. (#4051)* Rate selection for control response frames
* Introduction

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

Change the 2nd bullet of the 1st paragraph as follows:* If a BlockAck frame is sent as an immediate response to either an implicit BlockAck request or to a BlockAckReq frame that was carried in an HT or VHT PPDU and the BlockAck frame is carried in a non- HT PPDU, the primary rate is defined to be the highest rate in the BSSBasicRateSet parameter that is less than or equal to the rate (or non-HT reference rate; see 9.7.9) of the previous frame. If no rate in the BSSBasicRateSet parameter meets these conditions, the primary rate is defined to be the highest mandatory rate of the attached PHY that is less than or equal to the rate (or non-HT reference rate; see 9.7.9) of the previous frame. The STA may select an alternate rate according to the rules in 9.7.6.5.4. The STA shall transmit the non-HT PPDU BlockAck control response frame at either the primary rate or the alternate rate, if one exists.

Change the 6th bullet as follows:* If the control response frame is carried in an HT or VHT PPDU, then it is transmitted using an MCS or <VHT-MCS, NSS> tuple 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 (#4375)PPDU, the channel width (CH\_BANDWIDTH parameter of the TXVECTOR) shall be selected first according to 9.7.6.6, and then the MCS or <VHT-MCS, NSS> tuple shall be selected from a set of MCSs and <VHT-MCS, NSS> tuples 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) (#4167)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 9.7.11 (Rate selection constraints for VHT STAs) and for HT PPDUs from(#4820) the supported MCS Set field in the HT Capabilities element received(#6025) (#4167)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 <VHT-MCS, NSS> tuple with the same MCS and number of spatial streams as the VHT PPDU. (#4820)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 MCSs and <VHT-MCS, NSS> tuples corresponding to the mandatory VHT PHY MCSs with NSS=1, if the STA eliciting the response is a(#5416) VHT STA.

MCS values from the CandidateMCSSet that cannot be transmitted with the selected CH\_BANDWIDTH parameter value shall be eliminated from the CandidateMCSSet.The choice of a response MCS is made as follows:* If the frame eliciting the response is within a non-HT PPDU,
* Eliminate from the CandidateMCSSet all <VHT (#4820)-MCS,NSS> tuples. 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 (#4820)-MCS,NSS> tuples. Moreover eliminate all MCSs that have an index that is higher than the index of the MCS of the received frame. Also eliminate all MCSs that have a number of spatial streams greater than that indicated in the Rx Nss subfield in the most recent Operating Mode field with the Rx Nss Type subfield equal to 0 from the intended receiver STA, if at least one Operating Mode field with the Rx Nss Type subfield equal to 0 was received from the intended receiver STA;(#6118)
* 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(#6029) is less than or equal to the coding rate(#6029) 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 and all <VHT-MCS, NSS> tuples that
* have a data rate that is higher than the data rate of the <VHT-MCS, NSS> tuple of the received frame using the largest possible value of CH\_BANDWIDTH that is no larger than the value of CH\_BANDWIDTH of the received frame;have a number of spatial streams greater than that indicated in the Rx Nss subfield in the most recent Operating Mode field with the Rx Nss Type subfield equal to 0 from the intended receiver STA, if at least one Operating Mode field with the Rx Nss Type subfield equal to 0 was received from the intended receiver STA;(#6118)
* have a number of spatial streams greater than that indicated in the Rx Nss subfield in the most recent Operating Mode field with the Rx Nss Type subfield equal to 1 from the intended receiver STA if at least one Operating Mode field with the Rx Nss Type subfield equal to 1 was received from the receiver STA and the control response frame is an SU PPDU frame with a beamforming steering matrix and 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). (#6118)
* Determine the highest number of spatial streams (*NSS*) value of the MCSs and <VHT-MCS, NSS> tuples in the CandidateMCSSet that is less than or equal to the *NSS* value 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 rate MCS or <VHT-MCS, NSS> tuple 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(#6029) is less than or equal to the coding rate(#6029) of the MCS from the received frame. This MCS or <VHT-MCS, NSS> tuple is the primary MCS for the response transmission. The mapping from MCS or <VHT-MCS, NSS> tuple to modulation and coding rate is dependent on the attached PHY. For the HT PHY, see 20.6; for the VHT PHY, see 22.5 (Parameters for VHT MCSs).(#4488) For the purpose of comparing modulation values, the following sequence shows increasing modulation values: BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM.(#4553)
* If no MCS meets the condition in step 3), remove each MCS or <VHT-MCS, NSS> tuple 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 or <VHT-MCS, NSS> tuple has been selected, the STA may select an alternate MCS according to 9.7.6.5.4. The STA shall transmit the ~~HT PPDU~~(#4820) control response frame using either the primary MCS or the alternate MCS, if one exists.***...**** Modulation classes

Change as follows (paragraph change as well as new row and column in Table 9-4 (Modulation classes)):~~In order to determine the rules for response frames given in 9.7 (~~~~Multirate support~~~~), the following modulation classes are defined in Table 9-4 (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.~~ Table 9-4 (Modulation classes) defines modulation(#6751) classes for the rules for response frames in 9.7 (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.

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| --- |
| * 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 Table 9-5 (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 addressed(#6811) to a non-VHT STA. A VHT STA shall not set the TA field to a signaling TA in a frame addressed(#6811) 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.* 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 <VHT-MCS, NSS> tuple NSS = 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 VHT-MCS for NSS spatial streams at that bandwidth is mandatory (see 22.5 (Parameters for VHT MCSs)), then the <VHT-MCS, NSS> tuple at that bandwidth is supported by the STA on receive.
* Otherwise(#6812), if the Max VHT-MCS For *n* SS subfield in the Rx VHT-MCS Map field indicates support and the Rx Highest Supported Long GI Data Rate subfield is equal to 0, then the <VHT-MCS, *n*> tuple at that bandwidth is supported by the STA on receive.
* Otherwise(#6812), 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 <VHT-MCS, *n*> tuple at that bandwidth is supported by the STA on receive.
* Otherwise the <VHT-MCS, NSS> tuple at that bandwidth is not supported by the STA on receive.

The <VHT-MCS, NSS> tuples excluded by 9.7.11.3 are also eliminated from the Rx Supported VHT-MCS and NSS Set. (#6282)A VHT STA shall not, unless explicitly stated otherwise, transmit a VHT PPDU unless the <VHT-MCS, NSS> tuple and bandwidth used are in the VHT Rx Supported MCS Set of the receiving STA(s).NOTE—Support for a <VHT-MCS, NSS> tuple 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 <VHT-MCS, NSS> tuple NSS = 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 <VHT-MCS, NSS> tuple at that bandwidth is mandatory (see 22.5 (Parameters for VHT MCSs)), then the <VHT-MCS,NSS> tuple at that bandwidth is supported by the STA on transmit.
* Otherwise 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 <VHT-MCS,*n*> tuple at that bandwidth is supported by the STA on transmit.
* Otherwise 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 <VHT-MCS,*n*> tuple at that bandwidth is supported by the STA on transmit.
* Otherwise the <VHT-MCS,NSS> tuple at that bandwidth is not supported by the STA on transmit.

NOTE—Support for short GI on transmit cannot be determined.* Additional rate selection constraints(#6036) for VHT PPDUs

***TGac editor: also change “VHT MCS” to “VHT-MCS” and change “NSS” to* “NSS” *in the equations below***When a STA transmits a VHT PPDU with a number of spatial streams (NSS) less than or equal to 4,* if the channel bandwidth of the PPDU is equal to CBW20 or CBW40, then the STA should not use a <VHT-MCS, NSS> tuple if the VHT-MCS is equal to 0, 1, 2 or 3 and the HT MCS with value  is marked as unsupported in the Rx MCS bitmask of the HT capabilities element of the receiver STA.
* if the channel bandwidth of the PPDU is equal to CBW80, CBW160 or CBW80+80, then the STA should not use a <VHT-MCS, NSS> tuple 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 Table 9-4a (Example tabulation of rate selection for VHT PPDUs).

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| * 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 |

 |

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| 6021 | 105.22 | 9.7.5.6 | 9.7.5.6 is ambivalent as to whether the receiver is singular or plural.105.22 says "STA or STAs". 105.34 says "the receiver STA".The "other" in the title arguably excludes group frames (except those transmitted using FMS). But 9.7.5.3 also cites 10.23.7 as describing rate selection for an FMS stream. So it is not clear whether this subclause needs to handle any group addressed frames. | Clarify whether this subclause needs to handle group addressed frames. And modify accordingly.One possible solution:1. Add a new subclause 9.7.5.5a to handle the FMS case (thereby exclusing them from .6), moving "described in 10.23.7, if the data frames are part of an FMS stream." (802.11-2012 855.55) into this new subclause.2. Change 105.22 and 105.58 "STA or STAs" to "STA" |

Discussion:

The rate of data sent within an FMS stream is subject to negotiation during the FMS setup.

Admittedly the form of negotiation is based solely on rate, and ignores differences in capability between the multiple STAs that may be receiving a single FMS stream. But that is not a problem introduced by .11ac, it was caused by .11v failing to consider .11n.

The best thing we can do is to exclude FMS from complicating 9.7.5.6, with the expectation that REVmc will fix up the errors in FMS. Having done that we can eliminate any “or STAs” from 9.7.5.6.

Proposed resolution:

Revised. Make the changes in <this-document> under comment 6274 tagged with CID 6021. These changes exclude FMS from 9.7.5.6 and remove the “or STAs” language from that subclause.

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| 6552 | 105.43 | 9.7.5.6 | This bullet states that " A STA shall not transmit a frame using a value of CH\_BANDWIDTH parameter of the TXVECTOR that is not supported by the receiver STA, as reported in the HT Operation or VHT Operation element.Shouldn't his be Capabilities element instead of Operation element? Operation element is per BSS, not per STA. | Change "Operation element" to "Capabilities element" |

Proposed Resolution:

Accepted.

Note changes made for CID 6808 make the same change.

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| 6276 | 105.61 | 9.7.5.6 | "mandatory rate set of the attached PHY" | A VHT STA's PHY is the VHT PHY (which in turn invokes the 11a/11n PHYs so arguably a VHT PHY includes an HT PHY); but I think the language here tries to make use of the idea that a VHT STA must also implement the mandatory 11n/11a rates. Is there language where "mandatory rates of attached PHY" is made clear as including 11a/11n mandatory rates for a VHT STA? If so, provide a reference, else add this language and provide a reference. Searching for "attached PHY" found nothing useful.Indeed sometimes "attached PHY" was not correctly updated for VHT, e.g. at P109L36 .. "If the frame eliciting the response is within an HT PPDU, .. the mapping from MCS to NSS is dependent on the attached PHY. For the HT PHY, see 20.6." which gives no help if the attached PHY is a VHT PHY. (Try "For the HT PHY, or a VHT PHY containing an HT PHY, see 20.6).Basically, search for "attached PHY" and check it is well defined and its usage is architecturally consistent with the PHY organization |

Proposed resolution:

Rejected.

The comment does not indicate an error in the cited text or a specific change to be made.

In reply to the commenter, a VHT STA is an HT STA. As such it necessarily supports the mandatory .11n MCSs. The text at 109.36 has been updated in response to comment 6274 to talk about <VHT-MCS, NSS> tuples.

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Update: 2012-09-03. Moved to 11-12/1007r1.

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| 6553 | 106.40 | 9.7.6.1 | Bullet c) mentions HT Control field without specifying the variant | Change HT Control field to HT variant HT Control field (sub-bullets 1 and 2) |

Proposed Resolution:

Accepted.Propo\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Proposed t on context.e of MCS by VHT is replaces by VHT-MCS or "changes revise teh art makes little sense..\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| 6554 | 106.46 | 9.7.6.1 | Bullet d) mentions HT Control field without specifying the variant | Change HT Control field to VHT variant HT Control field |

Proposed Resolution:

Rejected.

There is no requirement that a VHT PPDU carry any specific variant of the HT Control field.

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| 6022 | 106.47 | 9.7.6.1 | "is in STBC format"This is informal and inadequately defined. | Replace cited text with "is an STBC frame" |

Proposed Resolution:

Accepted.

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| 6115 | 106.59 | 9.7.6.2 | the rate selection of VHT control frame that initiate a TXOP is not defined. | Add the related rules. |

Proposed Resolution:

Revised. Make changes in <this-document> under CID 6274, which introduce a paragraph into 9.7.6.2 to describe rate selection in the case of a VHT PPDU.

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| 6117 | 107.13 | 9.7.6.4 | L11 to L20 is a duplicate paragraph with the paragraph L24 which should be removed. | Remove L13 to L20. |

Proposed Resolution:

Accepted.

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| 6701 | 107.15 | 9.7.6.4 | "STA. A frame that is carried in an VHT PPDU shall be transmitted by the STA using anMCS supported by the receiver STA, as reported in the VHT Supported MCS field in the VHT Capabilitieselement from that STA. When the supported rate set of the receiving STA or STAs is not known, the transmittingSTA shall transmit using an MCS in the BSSBasicMCSSet parameter." when not known, why not allow the VHT BSSBasicMCSSet set aslo, as in P105L58? | allow VHT BSSBasicMCSSet |

Proposed Resolution:

Rejected. The cited text has been removed in response to comment 6117. The functionality asked for by the commenter already exists at 107.33.

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| 6024 | 107.16 | 9.7.6.4 | The change "deletion of most recently received from" lost a technical change, which was that a STA makes decisions based on what it receives, not on what some other STA transmits - which might never ever be received. | Replace "transmitted by" with "received from" |

Proposed Resolution:

Rejected. The cited text has been removed in response to comment 6117. Another comment (6025) makes an equivalent change to the retained text at 107.27.

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| 6026 | 107.16 | 9.7.6.4 | "A frame that is carried in an VHT PPDU shall be transmitted by the STA using an MCS supported by the receiver STA,"This statement is duplicated at 107.31.Further, at 105.21 we have: "A STA shall not transmit a frame using a rate or, MCS or (MCS, number spatial streams) combination", which makes the point that in VHT we need to constrain both MCS and N\_SS to have the same effect as a constraint on MCS in the HT case. | At 107.16 replace "using an MCS" with "using a combination of MCS and number of spatial streams".At 107.31 delete the first sentence of the para: "A frame .. that STA." |

Proposed Resolution:

Revised. Delete the paragraph at 107.14.

Note, this is the same resolution as for CID 6117.

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| 6675 | 107.30 | 9.7.6.4 | "When the supported MCS set of the receiving STA or STAs is not known, the transmitting STA shall transmitusing an MCS in the VHTBSSBasicMCSSet parameter." would make sense to allow also (HT)VHTBSSBasicMCSSet since a VHT STA is also HT. | add HT set |

Proposed resolution:

Rejected.

This paragraph is specific to a VHT PPDU.

The previous paragraph covers the case of transmission of an HT PPDU, and allows use of the BSSBasicMCSSet parameter.

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| 6116 | 107.30 | 9.7.6.4 | The receiver's operation mode may be changed. | harmonize the text with the operation mode notification. |

Context: 105.26:

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| — 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 recent 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 recent 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). |

Proposed resolution:

Revised.

Ideally 9.7 should be re-organized to include “global constraints” before specific ones. Clearly, transmitting to a STA that has sent an operation mode frame creates a constraint, regardless of frame type. However, such a reorganization is beyond the scope of TGac.

So the following change is a “band-aid” that addresses the specific issue raised (with the expectation that the more general problem will be discussed in TGmc):

Copy the two dashed list items and their sub bullets at 105.26-105.40 and

paste at 106.58. Insert the following text before the pasted text:

“If an Operating Mode field has been received from the intended receiver STA, the following constraints also apply:”

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| 6118 | 109.01 | 9.7.6.5.3 | MCS removed by operation mode negotiation should not be used when select the MCS | Do the change per the comment. |

Discussion:

This is somewhat philosophical. What stops a STA from using more capabilities than it declares? There is no general statement that this is so. It is a reasonable assumption, but is this good enough?

CID 6116 adds constraints for all control frames, but doesn’t modify the detailed procedure in 9.7.6.5.3.

Proposed Resolution:

Revised.

Make changes in <this-document> under CID 6274 flagged with (#6118). These changes insert paragraphs to eliminate NSS that the STA is not able to receive following reception of an operation mode field.

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| 6119 | 109.19 | 9.7.6.5.3 | HT MCS should also be removed | remove "all VHT MCSs. Moreover, eliminate" |

Proposed Resolution:

Rejected.

The proposed change makes no sense as the Candidate MCS set has to contain either HT or VHT MCSs.

Moreover, it would make a change to legacy HT behaviour.

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| 6028 | 109.64 | 9.7.6.5.3 | "modulation value of each stream is less than or equal to the modulation value"We haven't defined a "modulation value" anywhere, so this test is undefined. | Define the "modulation value" of a stream or replace cited text with something that uses defined terms. |

Rejected.

The text at 110.05: “For the purpose of comparing modulation values, the following sequence shows increasing modulation values: BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM.” provides the necessary definition.

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| 6029 | 110.01 | 9.7.6.5.3 | "coding rate value is less than or equal to the coding rate value"I understand what a coding rate is: for example 5/6. This is a numeric quantity, and I know how to compare numbers.But I don't understand the value of that coding rate. Perhaps it is the net increase in aggregate throughput of the network, measured in Mbps/m^2/MHz.Or perhaps it is the value my time saved by having the higher coding rate, measure in nano-pound-sterling per octet per MHz per SS. | Either define the value of a coding rate in suitable units, or replace cited text with "coding rate is less than or equal to the coding rate" |

Proposed Resolution:

Revised.

Change “coding rate value” to “coding rate” at 109.40 (x2) and 110.01 (x2).

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| 6030 | 110.09 | 9.7.6.5.3 | "remove each MCS from the CandidateMCSSet that has the highest value of NSS in the CandidateMCSSet."In the VHT world, an MCS doesn't "have" a value of N\_SS.The problem is actually broader than this, because in the HT case this subclause is responsible for calculation of an MCS, but in the VHT case, it is responsible for calculation of an MCS \*and\* N\_SS.And HT is really at fault for misusing MCS to represent something that is more than just MCS. | What we need is (as the start of this subclause) statement that the Candidate MCS set contains MCS values for HT, and (MCS,N\_SS) tuples for VHT.Then review all VHT references to this set so that they refer to a combination of MCS and N\_SS, as appropriate.We could resolve the more general problem by defining terminology. The cleanest solution is to define a term for a combination of MCS and N\_SS, and then to modify all references to this concept to use this term. There are 713 references to MCS in the baseline, so this solution is probably a non-starter.Alternatively, we can restrict the scope of changes by defining a new term (e.g. MCS/N\_SS) and wherever HT and VHT "MCSs" are discussed, reference both terms. e.g. the title of 9.7.6.5.3 becomes "Control response frame MCS or MCS/N\_SS computation". |

Proposed resolution:

Revised. Make changes as shown in <this-document> under CID 6274. These changes make consistent use of <VHT-MCS, NSS> tuple terminology, when referring to an item that is uniquely a VHT MCS.

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| 6281 | 113.56 | 9.7.10 | 11n's "non-HT" language is unclear with the addition of VHT, and now we're doig it again. How about "pre-VHT" plus chronological definitions? | Here and elsewhere, as in comment | EDITOR |

Status: New in R1

Context:

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| 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. |

Discussion.

“pre-VHT” is precisely wrong, for the same reason that “legacy” is wrong. The standard describes what is, without any regard to the sequence that features were introduced.

So the question is whether the terminology is unclear, and whether the cited text is ambiguous. Our baseline defines non-HT PPDU, but not non-HT STA. There are many instances of non-HT STA in the baseline, so our predecessors don’t think this is a problem.

Proposed Resolution:

Rejected. We find the use of non-VHT STA, VHT STA and non-HT PPDU used in the cited location to be unambiguous.

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| 6120 | 114.09 | 9.7.11 | MCS and bandwidth removed by operation mode negotiation should not be used when select the MCS | Change the subclause per the comment |

Proposed Resolution:

Revised.

Resolution of comment CID 6116 shown in <this-document> eliminates MCS values excluded by an Operation Mode element in a control frame. These values are already excluded in a data/management frame at 105.26. The potential restriction of width is covered by the 159.10.

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| 6035 | 114.36 | 9.7.11.1 | "spatial streams and bandwidth used are in the VHT Rx Supported MCS Set of the receiving STA(s)."Oh no. It gets worse. Now an MCS also includes the bandwidth.This is terminology abuse of the highest order. As we've seen with the HT abuse of the term MCS to include N\_SS, abuse of the same term to mean different things causes confusion and mayhem. | Define a term to represent "a tuple consisting of modulation, code rate, N\_SS and bandwidth". Then rename the VHT [Rx|Tx] Supported MCS Set and all references to use this term.If nobody can come up with a good name, I propose we call it an "Iggle Piggle", resulting in the VHT Rx Supported Iggle Piggle set, etc... |

Proposed resolution:

Revised. Make changes as shown in <this-document> under CID 6274. These changes make consistent use of <VHT-MCS, NSS> tuple terminology, when referring to an item that is uniquely a VHT MCS.

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| 6282 | 114.49 | 9.7.11.2 | Not the whole story - caveat bullets 1, 2 and 3 with the additional recommendations in 9.7.11.3 | As in comment |

Proposed Resolution:

Revised.

At 114.34, insert the following new para:

“The <VHT-MCS, NSS> tuples excluded by 9.7.11.3 are also eliminated from the Rx Supported VHT-MCS and NSS Set.”

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| 6812 | 114.52 | 9.7.11.2 | Probably just whining by this point, but are we slipping, un-announced, into pseudo-code? Can one say "else" outside of the context of computer code, without including "or" in front of it? | Examine at least three scripts from each of the last seven decades from mobster movies that were made in the USA, to determine if any of the characters in those films uses "else" without "or" as in, for example, "You'd bettuh pay up, else you'll be swimming wit da fishes!" - If "or else" is good enough for Tony and da boys, it's good enough for 802.11. But wait, actually, I think that "or else" allows a choice, which is inappropriate here in the draft, so a better correction is to change "else, if" to "otherwise, if" - and oh, looky, the last bullet item begins with "otherwise", so I think that we're on da right track! |

Proposed resolution:

Revised.

Change “Else” to “Otherwise” at 114.22 and 114.26.

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| 6036 | 115.01 | 9.7.11.3 | "Rate selection for VHT PPDUs"This overly-general heading may mislead readers into assuming it is the last word on rate selection for VHT PPDUs. Not so. | Either rename it to indicate a more limited scope (e.g. Additional rate selection constraints for VHT PPDUs). Or add a note refering to the other sublcauses that contain normative description of rate selection for VHT PPDUs. |

Proposed resolution:

Revised.

Rename the heading “Additional rate selection constraints for VHT PPDUs”

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| 6811 | 116.61 | 9.7.10 | "sent to a non-VHT STA" - is this the correct verb? Is an RTS frame that is addressed to a VHT STA, but intended to be received by a non-VHT STA for protection purposes "sent to a non-VHT STA" - that non-VHT STA received it, so it must have been sent to it. | Consider changing "sent" to "addressed" - I think that there are quite a few instances of this sentence structure within this subclause and in 9.7 in general. |

Proposed resolution:

Revised.

Change “sent to” to “addressed to” in 9.7.10 (2 instances.

| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** | **Owning Ad-hoc** |
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| 6502 |  |  | The unqualified term "MCS" is confusing as it could be an HT MCS or a VHT MCS | Change "MCS" to "HT MCS" wherever the context does not clearly show VHT MCSes are being referred to (e.g. by the presence of "VHT" just before) | MAC |

Proposed Resolution:

Revised. Make changes under CID 6274 in <this-document>. These changes introduce VHT-MCS and <VHT-MCS,NSS> tuple terminology to avoid confusion in the material introduced by 802.11ac. Any wholesale change of MCS to HT-MCS throughout the .11n baseline material is out of scope, and will have to wait for attention in 802.11REVmb.MCS throughout the .11n baseline materoid confusion in