IEEE P802.11
Wireless LANs

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| HE Multirate Support and 2G4 40MHz HE STA |
| Date: 2016-11-05 |
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Abstract

11ax multirate support is still missing. This submission defines rules for HE multirate support. It additionally solved CID 203.

Revisions

* Rev 0: Initial version of the document

Interpretation of a Motion to Adopt

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGax Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGax Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

***TGax Editor: Editing instructions preceded by “TGax Editor” are instructions to the TGax editor to modify existing material in the TGax draft. As a result of adopting the changes, the TGax editor will execute the instructions rather than copy them to the TGax Draft.***

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| **CID** | **Commenter** | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 203 | Alfred Asterjadhi | 63.24 | MCS selection rules for sending M-BA by a STA is not defined | As in comment. | Revised – Agree in principle with the comment. This comment resolution provides clarity on a plurality of open items that remain with respect to selection of MCS, BW, PPDU, NSS, DCM rules that are currently missing in the draft. Refer to 11-16-1419r0 for more information.TGax editor to make the changes shown in 11-16-1418r0 under all headings that contain CID 203. |

**Discussion:**

A HE STA with >=80MHz capability in 5GHz band is VHT STA also. TXOP BW operation defined by VHT applies to HE STA with >=80MHz capability. A HE STA with 40MHz capability in 2.4GHz band is not VHT STA. However VHT TXOP BW operation can help to protect the TXOP. The similar rules should be applied to HE STAs with >=80MHz capability.

As VHT/HT STAs, a HE STA supports multiple <MCS, NSS> pairs. The rules to select MCS, NSS for HE PPDU should be defined. The rules about when to transmit control frames in HE PPDU should also be defined.

**3.2 Definitions specific to IEEE Std 802.11**

***TGax Editor: Change the definition of bandwidth singaling TA as follows:***

**bandwidth signaling transmitter address (TA):** A TA that is used by a very high throughput (VHT) station (STA) or a HE station (STA) to indicate the presence of additional signaling related to the bandwidth to be used in subsequent transmission in an enhanced distributed channel access (EDCA) transmission opportunity (TXOP). It is represented by the IEEE medium access control (MAC) individual address of the transmitting VHT STA but with the Individual/Group bit set to 1.

**9.3.1.2 RTS frame format**

***TGax Editor: Change the 3rd paragraph as follows:***

The TA field is the address of the STA transmitting the RTS frame or the bandwidth signaling TA of the STA transmitting the RTS frame. In an RTS frame transmitted by a VHT STA or a HE STA in a non-HT or non-HT duplicate format and where the scrambling sequence carries the TXVECTOR parameters CH\_BANDWIDTH\_IN\_NON\_HT and DYN\_BANDWIDTH\_IN\_NON\_HT (see 10.3.2.6 (VHT/HE RTS procedure)), the TA field is a bandwidth signaling TA.

**9.3.1.5 PS-Poll frame format**

***TGax Editor: Change the 2nd paragraph as follows:***

The BSSID is the address of the STA contained in the AP. The TA field is the address of the STA transmitting the frame or a bandwidth signaling TA. In a PS-Poll frame transmitted by a VHT STA or a HE STA in a non-HT or non-HT duplicate format and where the scrambling sequence carries the TXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT, the TA field value is a bandwidth signaling TA. The ID field contains the AID value assigned to the STA transmitting the frame by the AP in the (Re)Association Response frame that established that STA’s current association, with the two MSBs set to 1.

**9.3.1.6 CF-End frame format**

***TGax Editor: Change the last paragraph as follows:***

When transmitted by a non-DMG STA, the BSSID (TA) field is the address of the STA contained in the AP except that the Individual/Group bit of the BSSID (TA) field is set to 1 in a CF-End frame transmitted by a VHT STA to a VHT AP or a HE STA to a HE AP in a non-HT or non-HT duplicate format to indicate that the scrambling sequence carries the TXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT. When transmitted by a DMG STA, the TA field is the MAC address of the STA transmitting the frame.

**9.3.1.8 BlockAckReq frame format**

**9.3.1.8.1 Overview**

***TGax Editor: Change the 4th paragraph as follows:***

The TA field value is the address of the STA transmitting the BlockAckReq frame or a bandwidth signaling TA. In a BlockAckReq frame transmitted by a VHT STA or a HE STA in a non-HT or non-HT duplicate format and where the scrambling sequence carries the TXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT, the TA field value is a bandwidth signaling TA.

**9.3.1.9 BlockAck frame format**

**9.3.1.9.1 Overview**

***TGax Editor: Change the 4th paragraph as follows:***

The TA field value is the address of the STA transmitting the BlockAck frame or a bandwidth signaling TA in the context of HT-delayed Block Ack. In a BlockAck frame transmitted in the context of HT-delayed Block Ack by a VHT STA or a HE STA in a non-HT or non-HT duplicate format and where the scrambling sequence carries the TXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT, the TA field value is a bandwidth signaling TA.

**10.7 Multirate support**

**10.7.1 Overview**

***TGax Editor: Change the last two paragraphes in subcaluse 10.7.1 as follows:***

For specific PHYs, the value of the Duration/ID field is determined using the PLME-TXTIME.request primitive and the PLME-TXTIME.confirm primitive. These specific PHYs are defined in:

— Clause 16 (High rate direct sequence spread spectrum (HR/DSSS) PHY specification) for HR/DSSS

— Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) for OFDM

— Clause 18 (Extended Rate PHY (ERP) specification) for ERP

— Clause 19 (High Throughput (HT) PHY specification) for HT

— Clause 20 (Directional multi-gigabit (DMG) PHY specification) for DMG

— Clause 21 (Very High Throughput (VHT) PHY specification) for VHT

— Clause 22 (Television Very High Throughput (TVHT) PHY specification) for TVHT

—Clause 26 (High Efficiency (HE) PHY specification) for HE

The two PLME-TXTIME primitives are defined in the respective PHY specifications:

— 16.3.4 (HR/DSSS TXTIME calculation) for HR TXTIME calculation

— 17.4.3 (OFDM TXTIME calculation) for OFDM TXTIME calculation

— 18.5.3.2 (ERP-OFDM TXTIME calculations)

— 19.4.3 (TXTIME calculation) for HT TXTIME calculation

— 20.12.3 (TXTIME calculation) for DMG PLME TXTIME calculation

— 21.4.3 (TXTIME and PSDU\_LENGTH calculation) for VHT PLME TXTIME calculation

— 22.4.3 (TXTIME and PSDU\_LENGTH calculation) for TVHT PLME TXTIME calculation

— 26.4.3 (TXTIME and PSDU\_LENGTH calculation) for HE PLME TXTIME calculation

**10.7.9 Modulation classes**

***TGax Editor: Change Table 10-6 in subcaluse 10.7.9 as follows:***

|  |  |
| --- | --- |
| * Modulation classes (#1407)
 |  |
| Description of modulation | Condition that selects this modulation class |
| Clause 15 (DSSS PHY specification for the 2.4 GHz band designated for ISM -applications)(#63) to Clause 18 (Extended Rate PHY (ERP) specification) PHYs or Clause 20 (Directional multi-gigabit (DMG) PHY specification) PHY(11ad)(Ed) | Clause 19 (High Throughput (HT) PHY specification) PHY | Clause 21 (Very High Throughput (VHT) PHY specification) PHY(11ac) | Clause 26 (High Efficiency(HE PHY specification) PHY |
| DSSS and HR/DSSS | Clause 15 (DSSS PHY specification for the 2.4 GHz band designated for ISM -applications) or Clause 16 (High rate direct sequence spread spectrum (HR/DSSS) PHY -specification) transmission  | FORMAT is NON\_HT.NON\_HT\_MODULATION is ERP-DSSS or ERP-CCK. | N/A(11ac) | N/A |
| ERP-OFDM | 18.4 (ERP operating specifications (general)) (#2052)transmission  | FORMAT is NON\_HT.NON\_HT\_MODULATION is ERP-OFDM. | N/A(11ac) | N/A |
| OFDM | Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) 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. (11ac) | FORMAT is NON\_HT.NON\_HT\_MODULATION is OFDMor NON\_HT\_DUP\_OFDM. |
| HT | N/A | FORMAT is HT\_MF or HT\_GF. | FORMAT is HT\_MF or HT\_GF.(11ac) | FORMAT is HT\_MF or HT\_GF. |
| DMG Control | Clause 20 (Directional multi-gigabit (DMG) PHY specification) transmission and MCS is 0(#2053) | NA | NA | N/A |
| DMG SC | Clause 20 (Directional multi-gigabit (DMG) PHY specification) transmission and  (#2053)(#7142) | NA | NA | N/A |
| DMG OFDM | Clause 20 (Directional multi-gigabit (DMG) PHY specification) transmission and  (#2053) | NA | NA | N/A |
| DMG Low-power SC(#3086) | Clause 20 (Directional multi-gigabit (DMG) PHY specification) transmission and  (#2053) | NA | NA | N/A |
| VHT(11ac) | N/A | N/A | FORMAT is VHT. | FORMAT is VHT. |
| HE | N/A | N/A | N/A | FORMAT is HE SU, HE extended range SU, HE MU, HE Trigger-based  |

**10.7.10 Non-HT basic rate calculation**

***TGax Editor: Change subcaluse 10.7.10 as follows:***

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

a) Use the modulation and coding rate determined from the HT MCS (defined in 19.5 (Parameters for HT MCSs)),VHT-MCS (defined in 21.5 (Parameters for VHT-MCSs)), or HE-MCS (defined in 26.5 (Parameters for HE-MCSs)) to locate a non-HT reference rate by lookup into Table 10-7 (Non-HT reference rate).32 In the case of an MCS with UEQM, the modulation of stream 1 is used.

b) The non-HT basic rate is the highest rate in the BSSBasicRateSet that is less than or equal to this non-HT reference rate.

|  |
| --- |
| * Non-HT reference rate
 |
| Modulation | Coding rate (R) | Non-HT reference rate (Mb/s) |
| BPSK | 1/2 | 6 |
| BPSK | 3/4 | 9 |
| QPSK | 1/2 | 12 |
| QPSK | 3/4 | 18 |
| 16-QAM | 1/2 | 24 |
| 16-QAM | 3/4 | 36 |
| 64-QAM | 1/2 | 48 |
| 64-QAM | 2/3 | 48 |
| 64-QAM | 3/4 | 54 |
| 64-QAM | 5/6 | 54 |
| 256-QAM(11ac) | 3/4 | 54 |
| 256-QAM(11ac) | 5/6 | 54 |
| 1024-QAM | 3/4 | 54 |
| 1024-QAM | 5/6 | 54 |

NOTE—In a TVWS band, the non-HT reference rate is scaled as described in 22.2.4 (Support for NON\_HT and HT formats).

***TGax Editor: Add the following subclause (CID 203):***

**25.2. PPDU format, BW, MCS, NSS, and DCM selection rules**

**25.2.1 General**

An HE STA can transmit different PPDUs formats, with different transmit parameters, such as channel width, MCS, NSS, DCM. This subclause defines the rules followed by an HE STA for selecting these parameters depending on the capabilities of the intended receiver(s) and other considerations.

**25.2.2 PPDU format selection**

An HE STA may transmit non-HT, HT, VHT PPDUs following the rules defined in 10.7 (Multirate support). An HE STA may transmit an HE SU PPDU or a 242-tone HE ER SU PPDU to a peer HE STA.

An HE AP transmits DL MU PPDUs as defined in 25.5.1 (HE DL MU Operation). An HE non-AP STA transmits HE Trigger-based PPDUs as defined in 25.5.2 (UL MU operation).

An HE STA may transmit a 106-tone HE ER SU PPDU to a peer STA if it has received from the peer STA an HE Capabilities element with the ER SU PPDU Payload field equal to 1; otherwise the STA shall not transmit a 106-tone HE ER SU PPDU to the peer STA.

An HE non-AP STA may transmit an HE UL MU PPDU to a peer STA if it has received from the peer STA an HE Capabilities element with the UL MU PPDU Support field equal to 1; otherwise the STA shall not transmit an HE UL MU PPDU to the peer STA.

An HE STA shall send Control frames in non-HT PPDU format following the rules defined in 10.7.6 (Rate selection for Control frames)) with the following exceptions:

* A Control frame sent in response to an ER\_SU, SU, or UL MU PPDU that uses STBC shall be carried in the same format as the soliciting PPDU
* A Control frame sent by the AP as a response to an HE Trigger-based PPDU may be carried in any PPDU format that is supported by the intended receiver(s)
* A Control frame sent as a response to an HE PPDU, containing a Trigger frame that is not an MU RTS or containing an UL MU Response Scheduling A-Control field, is carried in an HE Trigger-based PPDU (see 25.5.2 (UL MU operation)
* An Ack frame sent as a response to an ER\_SU, SU, or UL MU PPDU containing an FTM frame shall be sent in the same PPDU format as the soliciting PPDU
* If a Control frame is sent as a response to a soliciting ER SU PPDU the frame shall be carried in an ER\_SU PPDU except when the most recent successfully received PPDU sent by the responding STA to the soliciting STA after association was not an ER SU PPDU in which case the control frame shall be carried in non-HT PPDU
* If the Control frame is sent as a response to a soliciting HE non-ER SU PPDU then the frame shall be carried in non-HT PPDU except when the most recent successfully received PPDU sent by the responding STA to the soliciting STA after association was an ER SU PPDU in which case the control frame shall be carried in HE ER SU PPDU

NOTE—PPDU format switching between non-HT and ER SU PPDU occurs in subsequent TXOPs. A STA that solicits a control frame from a peer STA accounts for the PPDU format of the control frame to calculate the expected duration of the TXOP.

**25.2.3 MCS, NSS, BW and DCM selection**

An HE STA shall follow the rules defined in 10.7 (Multirate support) and 25.X.4 (Rate selection constraints for HE STAs) for selecting the rate, MCS, NSS, and the rules defined in 10.3.2.6 (VHT RTS procedure), 10.3.2.7 (CTS and DMG CTS procedure), 10.7.6.6 (Channel Width selection for Control frames) and 10.7.11 (Channel Width in non-HT and non-HT duplicate PPDUs) for selecting the channel width (BW) of transmitted PPDUs with the following exceptions:

* MCS, NSS, and BW selection for a Trigger-based PPDU are defined in 25.5.2.3 (STA behavior).
* Rate and BW selection for a CTS sent in response to MU RTS are defined in 10.3.2.8a.3 (CTS response to MU RTS)
* MCS, and NSS for a Control frame sent in response to an ER SU PPDU shall be <MCS0, 1> and BW shall be 20 MHz.
* NSS and BW selection is further constrained as defined in 25.8 (Operating mode indication) and 11.42 (Notification of operating mode changes).

An HE STA that transmits an HE PPDU shall use an <HE-MCS, NSS> tuple supported by the receiver STA. A <HE-MCS, NSS> tuple is supported if reported as such in the Supported HE-MCS and NSS Set field in the HE Capabilities element received from that STA. When the Supported HE-MCS and NSS set of the receiving STA or STAs is not known, the transmitting STA shall transmit using a <HE-MCS, NSS> tuple in the basic HE-MCS and NSS set. The STA shall select a <HE-MCS, NSS> tuple from the basic HE-MCS and NSS set when protection is required (as defined in 10.26 (Protection mechanisms)) and shall select a <HE-MCS, NSS> tuple from the operational HE-MCS and NSS set parameter of the intended receiver when protection is not required.

If a control response frame is to be transmitted within an HE SU PPDU, HE MU PPDU, the channel width (CH\_BANDWIDTH parameter of the TXVECTOR) shall be selected first according to 10.7.6.6 (Channel Width selection for Control frames), and then the <HE-MCS, NSS> tuple shall be selected from a set of <HE-MCS, NSS> tuples called the CandidateMCSSet as described in 10.7.6.5.3 (Control response frame MCS computation).

An HE STA may transmit an HE PPDU with DCM to a peer STA if it has received from the peer STA an HE Capabilities element with the DCM Encoding Rx field equal to 1; otherwise the STA shall not transmit a HE PPDU with DCM to the peer STA. An HE STA transmits an HE Trigger-based PPDU with DCM as defined in 25.5.2.3 (STA behavior).

An HE STA that sends a control frame in an ER SU PPDU format shall use:

* DCM encoding if the most recent successfully received PPDU sent by the HE STA to the soliciting STA after association used DCM; otherwise the STA shall not use DCM for the control frame.
* 106-tone ER SU PPDU if the most recent successfully received PPDU sent by the HE STA to the soliciting STA after association was a 106-tone ER SU PPDU.

NOTE—TX parameter switching occurs in subsequent TXOPs. A STA that solicits a control frame from a peer STA accounts for the TX parameter of the control frame to calculate the expected duration of the TXOP.

**25.2.4 Rate selection constraints for HE STAs25.2.4.1 Rx Supported HE-MCS and NSS Set**

The Rx Supported HE-MCS and NSS Set of a first(#5960) HE STA is determined by a second HE STA(#5960) for each <HE-MCS, NSS> tuple NSS = 1, …, 8 and bandwidth (20 MHz, 40 MHz, 80 MHz, and 160 MHz or 80+80 MHz) from the Supported HE-MCS and NSS Set field received from the first STA(#5960) as follows:

* If support for the HE-MCS for NSS spatial streams at that(#7690) bandwidth(#7693) is mandatory (see 26.5 (Parameters for HE-MCSs)), then the <HE-MCS, NSS> tuple at that bandwidth is supported by the first(#7689) STA on receive.
* Otherwise, if the Max HE-MCS For *n* SS subfield (*n* = NSS) in the Rx HE-MCS Map subfield indicates support, then
* the <HE-MCS, NSS*>* tuple at that bandwidth is supported by the first(#7689) STA on receive as defined in 9.4.2.213.3 Tx Rx HE MCS Support field.(#7684)(#5960)
* Otherwise, the <HE-MCS, NSS> tuple at that bandwidth is not supported by the first(#7689) STA on receive.

The <HE-MCS, NSS> tuples excluded by 25.X.2.3 (Additional rate selection constraints for HE PPDUs) can also be eliminated from the Rx Supported HE-MCS and NSS Set.

An HE STA shall not, unless explicitly stated otherwise, transmit a HE PPDU unless the <HE-MCS, NSS> tuple and bandwidth used are in the Rx Supported HE-MCS and NSS Set of the receiving STA(s).

**25.2.2.2 Tx Supported HE-MCS and NSS Set**

The Tx Supported HE-MCS and NSS Set of a first(#5960) HE STA is determined by a second STA(#5960) for each <HE-MCS, NSS> tuple NSS = 1, …, 8 and bandwidth (20 MHz, 40 MHz, 80 MHz, and 160 MHz or 80+80 MHz) from the Supported HE-MCS and NSS Set field received from the first STA(#5960) as follows:

* If support for the <HE-MCS, NSS> tuple at that bandwidth is mandatory (see 21.5 (Parameters for HE-MCSs)), then the <HE-MCS, NSS> tuple at that bandwidth is supported by the first(#7692) STA on transmit.
* Otherwise, if the Max HE-MCS For *n* SS subfield (*n* = NSS) in theTx HE-MCS Map subfield indicates support, then
* the <HE-MCS, NSS*>* tuple at that bandwidth is supported by the first(#7689) STA on receive as defined in 9.4.2.213.3 Tx Rx HE MCS Support field.(#7684)(#5960)
* Otherwise, the <HE-MCS, NSS> tuple at that bandwidth is not supported by the first(#7692) STA on transmit.~~(#5960)~~

**25.2.2.3 Additional rate selection constraints for HE PPDUs**

The following apply for a STA that transmits a HE PPDU with a number of spatial streams (NSS) less than or equal to 8:

* If the channel width of the PPDU is equal to CBW20 or CBW40, then the STA should not use a <HE-MCS, NSS> tuple if the HE-MCS is equal to 0, 1, 2, or 3 and the HT MCS with value VHT‑MCS + 8(NSS – 1) 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 <HE-MCS, NSS> tuple if the HE-MCS is equal to 0 or 1 and both the HT MCS values 2HE‑MCS + 8(NSS – 1) and 2(HE‑MCS + 1) + 8(NSS – 1) are marked as unsupported in the Rx MCS bitmask of the HT capabilities element of the receiver STA.

An example tabulation of this behavior is given in Table 25-x (Example of rate selection for HE PPDUs).

|  |
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| Table 25-x Example of rate selection for HE PPDUs |
| HT MCSs that are marked as unsupported | <HE-MCS, NSS> tuples that are not used for CBW20 and CBW40 | <HE-MCS, NSS> tuples that are not used for CBW80, CBW160, and CBW80+80 |
| 0, 8, 16 | <0, 1>, <0, 2>, <0, 3> | — |
| 1, 9 | <1, 1>, <1, 2> | — |
| 10 | <2, 2> | — |
| 3 | <3, 1> | — |
| 0, 1 | <0, 1>, <1, 1> | <0, 1> |
| 2, 3 | <2, 1>, <3, 1> | <1, 1> |
| 0, 1, 8, 9 | <0, 1>, <1, 1>, <0, 2>, <1, 2> | <0, 1>, <0, 2> |