### IEEE P802.11Wireless LANs

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| Proposed Draft Specification for EHT OM in A-control |
| Date: 2021-01-20 |
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Abstract

We propose pdt for EHT OM in A-Control based on the following motion.

***A new Control ID in A-Control is defined for EHT Operating mode (OM) that enables indication of 320 MHz, Tx NSTS larger than 8, and Rx NSS larger than 8.***

***Signaling TBD.***

***[Motion 137, #SP277, [3] and [167]]***

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Revision based on comments by Arik to clarify that clause 35 is for EHT STA and OMI originator/responder definition in Clause 26.9 will apply.
* Rev 2: Revision on discussion to add clear reasoning.

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 TGbe 0.4 Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGbe D0.4 Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

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

Discussion: There are two options on the table for the frame format of EHT OM that can preserve the current implementation consideration of only seeing fixed length control information and enable all the exiting functionalities of legacy OM.

Option 1: Extend one bit of Rx NSS, Channel Width and Tx NSTS followed by existing OM

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Control ID (EHT OM)** | **Rx NSS** | **Channel Width** | **Tx NSTS** | Reserved | **Control ID (OM)** | **Rx NSS** | **Channel Width** | **UL MU Disable** | **Tx NSTS** | **ER SU Disable** | **DL MU-MIMO Resound Recommendation** | **UL MU Data Disable** |
| Bits: | 4 | 1 | 1 | 1 | TBD | 4 | 3 | 2 | **1** | 3 | **1** | **1** | **1** |

* Since legacy OM always follows EHT OM. Implementation can still assume fixed control information after seeing EHT OM control ID. At the same time, all the bits of legacy OM are still there without the need of further debate.

Option 2: Copy everything and expand size of Rx NSS, Channel Width and Tx NSTS

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Control ID (EHT OM)** | **Rx NSS** | **Channel Width** | **UL MU Disable** | **Tx NSS** | **ER SU Disable** | **DL MU-MIMO Resound Recommendation** | **UL MU Data Disable** | **Rserved** |
| **Bits:** | **4** | **4** | **3** | **1** | **4** | **1** | **1** | **1** | TBD |

* Putting everything we need in one EHT OM. There may be discussion again on downselecting existing functionalities. We can also put everything there by default.

We hear people want option 1 to preserve functionalities of legacy OM directly and propose texts for option 1.

***TGbe editor: Modify Table 9-22a as follows: (Track change on)***

* HE variant

(…existing texts…)

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| * Control ID subfield values
 |
| Control ID value | Meaning | Length of the Control Information subfield (bits) | Content of the Control Information subfield |
| 0 | Triggered response scheduling (TRS) | 26 | See 9.2.4.6a.1 (TRS Control) |
| 1 | Operating mode (OM) | 12 | See 9.2.4.6a.2 (OM Control) |
| 2 | HE link adaptation (HLA) | 26 | See 9.2.4.6a.3 (HLA Control) |
| 3 | Buffer status report (BSR) | 26 | See 9.2.4.6a.4 (BSR Control) |
| 4 | UL power headroom (UPH) | 8 | See 9.2.4.6a.5 (UPH Control) |
| 5 | Bandwidth query report (BQR) | 10 | See 9.2.4.6a.6 (BQR Control) |
| 6 | Command and status (CAS) | 8 | See 9.2.4.6a.7 (CAS Control)) |
| 7 | EHT Operating Mode (EHT OM) | TBD | See 9.2.4.6a.8 (EHT OM) |
| 8-14 | Reserved |  |  |
| 15 | Ones need expansion surely (ONES) | 26 | See 10.8 (HT Control field operation) |

Option 1:

***TGbe editor: Insert new subclause in 9.2.4.6a HE variant***

9.2.4.6a.x EHT OM Control

The Control Information subfield in an EHT OM Control subfield contains information related to the operating mode (OM) changes of 320 MHz, Tx NSTS larger than 8, and Rx NSS larger than 8 of the STA transmitting the frame containing this information (see 35.x (Operating mode indication)). The format of the subfield is shown in Figure 9-xxx (Control Information subfield format in an EHT OM Control subfield).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 |  |
|  | Rx NSS |  Channel Width | Tx NSTS | Reserved |
| Bits: | 1 | 1 | 1 | TBD |

Figure 9-xxx (Control Information subfield format in an EHT OM Control subfield)

If the operating channel width of the STA is greater than 80 MHz, then the Rx NSS subfield in EHT OM subfield together with the Rx NSS subfiled in OM Control subfield indicates the maximum number of spatial streams, *NSS*, that the STA supports in reception for PPDU bandwidths less than or equal to 80 MHz. *NSS* – 1 is equal to the indicated value of the Rx NSS subfield in EHT OM subfield multiplied by 8 plus the indicated value of the Rx NSS subfield in OM subfield.

If the operating channel width of the STA is less than or equal to 80 MHz, then the Rx NSS subfield in EHT OM subfield together with the Rx NSS subfiled in OM Control subfield indicates the maximum number of spatial streams, *NSS*, that the STA supports in reception. *NSS* – 1 is equal to the indicated value of the Rx NSS subfield in EHT OM subfield multiplied by 8 plus the indicated value of the Rx NSS subfield in OM subfield.

The Channel Width subfield in EHT OM subfield together with the Channel Width subfield in OM subifled indicates the operating channel width supported by the STA for both reception and transmission.

The encoding of the Channel Width subfield in EHT OM subfield together with the Channel Width subfield in OM subifled is described in Table xxx

Table xxx - The encoding of the Channel Width subfield in EHT OM subfield together with the Channel Width subfield in OM subifled

|  |  |  |
| --- | --- | --- |
| Channel Width subfield in EHT OM subfield | Channel Width subfield in OM subfield | Indication of the operating channel width |
| 0 | 0 | Primary 20 MHz  |
| 0 | 1 | Primary 40 MHz |
| 0 | 2 | Primary 80 MHz |
| 0 | 3 | Primary 160 MHz |
| 1 | 0 | 320 MHz |
| 1 | 1-3 | Reserved |

The Tx NSTS subfield in EHT OM subfield together with the Tx NSTS subfield in OM subfield indicates the maximum number of space-time streams, *NSTS*, that the STA supports in transmission. *NSTS* – 1 is equal to the indicated value of the Tx NSTS subfield in EHT OM subfield multiplied by 8 plus the indicated value of the Tx NSTS subfield in OM subfield.

***TGbe editor: Add one bit in Figure 9-xxx (EHT MAC Capabilities Information field format) of 9.4.2.295c.2 EHT MAC Capabilities Information field as follows:***

***note to the TGbe editor that B0 and clause 9.4.2.295c.2 EHT MAC Capabilities Information field is proposed in 11-21-0253. For the bit number of EHT OM Control Support, the number of the next available bit will be sufficient.***

|  |  |
| --- | --- |
|  | B1 |
|  | EHT OM Control Support |
| Bits: | 1 |

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| Figure 9-xxx - EHT MAC Capabilities Information field format |

***TGbe editor: Add one row in Table 9-xxxa Subfields of the EHT MAC Capabilities Information field ) of 9.4.2.295c.2 EHT MAC Capabilities Information field as follows:***

***note to the TGbe editor that 9.4.2.295c.2 EHT MAC Capabilities Information field is proposed in 11-21-0253.***

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| Table 9-xxxa Subfields of the EHT MAC Capabilities Information field  |
| Subfield | Definition | Encoding |
| EHT OM Control Support | Indicates support for receiving a frame with an EHT OM Control subfield. | If the +HTC-HE Support subfield is 1 in a STA:Set to 1 if the STA supports reception of the EHT OM Control subfield.Set to 0 otherwise.Reserved if the +HTC-HE Support subfield is 0 in a STA. |

***TGbe editor: Insert new subclause in clause 35.x Operating mode indication as follows: (Track change on)***

35. Extremely high throughput (EHT) MAC specification

35.x Operating mode indication

35.x.1 General

An EHT STA with dot11EHTOMIOptionImplemented equals to true shall set the EHT OM Control Support subfield in the EHT MAC Capabilities Information field in(#Ed) the EHT Capabilities element it transmits to 1; otherwise the EHT STA shall set the EHT OM Control Support subfield to 0.

An EHT STA with dot11EHTOMIOptionImplemented equals to true shall have dot11OMIOptionImplemented equal to true and shall set the OM Control Support subfield in the HE MAC Capabilities Information field in(#Ed) the HE Capabilities element it transmits to 1.

An EHT AP that supports 320 MHz or more than 8 spatial streams shall set dot11EHTOMIOptionImplemented to true and the EHT AP shall implement the reception of the EHT OM Control subfield.

An EHT STA that transmits a frame with A-Control subfield of HE variant HT Control field, which includes an EHT OM Control subfield shall concatenate the OM Control subfield within the same A-Control subfield following the EHT OM control field.

NOTE - An EHT STA is an HE STA. Further, 26.9.1 General defines an HE STA that transmits a frame including an OM Control subfield as an OMI initiator and defines an HE STA with dot11OMIOptionImplemented equal to true that receives a frame including an OM Control subfield as an OMI responder. As a result, based on the requirement to concatenate the OM Control subfield after an EHT OM control subfield, an EHT STA that transmits a frame including an EHT OM Control subfield is an OMI initiator, and an EHT STA with dot11EHTOMIOptionImplemented to true that receives a frame including an EHT OM Control subfield is an OMI responder

An HE STA that transmits a frame including an OM Control subfield is defined as an OMI initiator. An HE STA with dot11OMIOptionImplemented equal to true that receives a frame including an OM Control subfield is defined as an OMI responder.

An OMI initiator may send to an OMI responder an individually addressed QoS Data, QoS Null or Class 3 Management frame after association that contains the EHT OM Control subfield and that solicits an immediate acknowledgment to indicate a change in its receive operating mode (ROM) as defined in 35.x.2 (Receive operating mode (ROM) indication) and/or transmit operating parameters (TOM) as defined in 35.x.3 (Transmit operating mode (TOM) indication). An OMI responder implements the reception of an individually addressed QoS Data, QoS Null or Class 3 Management frame that contains the EHT OM Control subfield that indicates a change in ROM and/or TOM parameters

The OMI initiator shall indicate a change in its ROM parameters by including the OM Control subfield or EHT OM Control field together with the OM Control field in a QoS Data, QoS Null or Class 3 Management frame that solicits acknowledgment and is addressed to the OMI responder as defined in 35.x.2 (Receive operating mode (ROM) indication)

NOTE—Frames that solicit an immediate acknowledgment are, for example, QoS Null frames and QoS Data frames
with Normal Ack or Implicit BAR ack policy and Action frames.

An EHT STA can change its operating mode setting using either operating mode notification as described in 11.42 (Notification of operating mode changes) or the operating mode indication (OMI) procedure described in 26.9 (Operating mode indication) or the operating mode indication (OMI) procedure described in this subclause. An EHT STA should not transmit an EHT OM Control subfield and an Operating Mode field in the same PPDU. If a EHT STA transmits both an EHT OM Control subfield and Operating Mode field in the same PPDU, then the OMI responder shall use the channel width and the maximum number of spatial streams indicated by the most recently received EHT OM Control subfield or Operating Mode field from the OMI initiator.

NOTE—An EHT OM Control field is transmitted before an Operating Mode field in the same frame.

The OMI initiator supports receiving PPDUs with a bandwidth up to the value indicated by the Channel Width subfield of the EHT OM subfield together with the the Channel Width subfield of the OM subfield.

The OMI initiator shall indicate a change in its TOM parameters by including the OM Control subfield or EHT OM Control field together with the OM Control subfield in a QoS Data, QoS Null or Class 3 Management frame that solicits an immediate acknowledgment frame and is addressed to the OMI responder as defined in 35.x.3 (Transmit operating mode (TOM) indication).

An EHT non-AP STA OMI initiator that sends an EHT OM control subfield together with an OM Control subfield with UL MU Disable subfield equal to 0, supports transmitting an HE or EHT TB PPDU with an RU allocation that is within the operating channel width indicated in the Channel Width subfield and with a number of space-time streams, *NSTS*, that is up to the value indicated by the Tx NSTS subfield of the EHT OM Control subfield together with the OM Control subfield as defined in 35.x.2 (Transmit operating mode (TOM) indication).

NOTE 1—To avoid possible frame loss, an OMI initiator can continue with its current operating channel width and active receive chains and active transmit chains in HE or EHT TB PPDUs and not suspend HE or EHT TB PPDUs or Data frames in HE or EHT TB PPDUs until it infers that the OMI responder has processed an EHT OM Control subfield together with an OM Control subfield from the OMI initiator indicating any of the following changes:

* Reduced operating channel width
* Reduction in the number of active receive chains
* Reduction in the number of active transmit chains in HE or EHT TB PPDUs
* Suspension of UL MU operation

The OMI initiator might make this inference from any combination of the following:

* By receiving a frame addressed to itself from the second EHT STA in a PPDU with a bandwidth and NSS that are less than or equal to the channel width and NSS, respectively, indicated in the EHT OM Control subfield together with an OM Control subfield
* Based on the passage of time in some implementation dependent way, which is outside the scope of this Standard

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

35.x.2 Receive operating mode (ROM) indication

An OMI initiator that sends a frame that includes an EHT OM Control subfield should change its OMI parameters, Rx NSS and Channel Width, as follows:

* When the OMI initiator changes a ROM parameter from higher to lower, it should make the change for that parameter only after the TXOP in which it received the immediate acknowledgment from the OMI responder.
* When the OMI initiator changes a ROM parameter from lower to higher, it should make the change for that parameter only after the TXOP in which it expects to receive acknowledgment from the OMI responder.

An OMI initiator that is an EHT AP should be capable of receiving PPDUs within an operating channel width and with *NSS* that are up to the values of the most recently transmitted Channel Width subfield and Rx NSS subfield that the OMI initiator has successfully indicated in the EHT OM Control subfield together with the the OM Control subfield.

NOTE—In the event of transmission failure of the frame containing the EHT OM Control subfield, the OMI initiator attempts the recovery procedure defined in 10.23.2.8 (Multiple frame transmission in an EDCA TXOP).

The OMI responder shall update the operating channel width and the maximum *NSS* values as indicated by the most recently received EHT OM Control subfield sent by the OMI initiator to send SU PPDUs and to assign an RU allocation in sent MU PPDUs, subject to restrictions defined in 27.3.1.2 (OFDMA) and 36.3.2 (Subcarrier and resource allocation) addressed to the OMI initiator in subsequent TXOPs.

After transmitting the acknowledgment for the frame containing the EHT OM Control subfield, the OMI responder may transmit subsequent SU PPDUs or MU PPDUs that are addressed to the OMI initiator.

NOTE—The acknowledgment is transmitted a SIFS after the frame. A subsequent PPDU is a PPDU that is intended for the OMI initiator and need not be the PPDU immediately following the acknowledgment.

35.x.3 Transmit operating mode (TOM) indication

An OMI initiator that is an EHT non-AP STA may indicate changes in its transmit parameters by sending a frame that contains the EHT OM Control subfield together with the OM control subfield to the OMI responder. The OMI initiator shall set:

* The Tx NSTS subfield to the maximum *NSTS* that the EHT non-AP STA will use for an HE or EHT TB PPDU sent in response to a Trigger frame or frame carrying a TRS Control subfield subject to the limitation of maximum spatial stream that can be used in HE or EHT TB PPDU
* The Channel Width subfield to the maximum operating channel width that the EHT non-AP STA will use for an HE or EHT TB PPDU sent in response to a Trigger frame or frame carrying a TRS Control subfieldsubject to the limitation of maximum RU allocation that can be used in HE or EHT TB PPDU

An OMI initiator that sent a frame including the EHT OM Control subfield should change its TOM parameters, Tx NSTS and Channel Width, as follows:

* If the OMI initiator changes a TOM parameter from higher to lower, it should make the change for that parameter only after the TXOP in which it received the immediate acknowledgment from the OMI responder.
* If the OMI initiator changes a TOM parameter from lower to higher, it should make the change for that parameter only after the TXOP in which it expects to receive acknowledgment from the OMI responder.

An OMI responder that receives a frame containing an EHT OM Control subfield from an OMI initiator performs the following operations.

An OMI responder shall consider the OMI initiator as participating in UL MU operation for subsequent TXOPs if the UL MU Disable subfield is 0 in the most recently received EHT OM Control subfield together with the OM Control subfield with the following restrictions:

* The maximum *NSTS* that the OMI initiator can transmit in an HE or EHT TB PPDU is indicated jointly in the Tx NSTS subfield of the EHT OM Control subfield together with the Tx NSTS subfield of the OM Control subfield subject to the limitation of maximum spatial stream that can be used in HE or EHT TB PPDU.
* The maximum operating channel width over which the OMI initiator can transmit in an HE or EHT TB PPDU is indicated jointly in the Channel Width subfield of the EHT OM Control subfield together with the Channel Width subfield of the EHT OM Control subfield subject to the limitation of maximum RU allocation that can be used in HE or EHT TB PPDU.

The OMI responder shall indicate a number of spatial streams, *NSS*, in the User Info field of a Trigger frame, which contains the AID of the OMI initiator, that is less than or equal to the *NSTS* that is calculated jointly from the Tx NSTS subfield of the EHT OM Control subfield together with the Tx NSTS subfield of the OM Control subfield received from the OMI initiator.

The OMI responder shall indicate an RU allocation in the RU Allocation subfield of the User Info field of a Trigger frame or TRS Control subfield addressed to the OMI initiator, that is within the operating channel width specified jointly in the Channel Width subfield of the EHT OM Control subfield together with the Channel Width subfield of the OM Control subfield received from the OMI initiator and subject to the restrictions defined in 27.3.1.2 (OFDMA) and 36.3.2 (Subcarrier and resource allocation) .

**Straw Poll: Do you support to incorporate the proposed draft text in 11-21-0131r2 to the TGbe Draft?**