IEEE P802.11
Wireless LANs

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| Resolution for CIDs related to EMLMR (CC34) – Part 2 |
| Date: 2021-5-4 |
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Abstract

This submission proposes resolutions for following 8 CIDs received for TGbe (CC34):

 1438, 2105, 2106, 2196, 2107, 2110, 2330, 3433

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Deleted 20 MHz-Only STA from EMLMR operation.

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

***Editing instructions formatted like this are intended to be copied into the TGbe 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.***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Pg/Ln** | **Section** | **Comment** | **Proposed Change** | **Resolution** |
| 1438 | Chien-Fang Hsu | 145/64 | 35.3.15 | During the initial frame exchange, the non-AP MLD may indicate EMLMR Rx NSS and/or EMLMR Tx NSS less then default values defined in the TBD subfield of TBD element since in some cases, the capabliity may change dyanmically based on resource allocation on the non-AP MLD side. | Add rules to allow Rx NSS and Tx NSS capability change indication during the initial frame exchange | Rejected:Even in baseline spec., dynamic change of Tx/Rx NSS based on OMI control subfield is applied from the next TXOP. As the EMLMR Tx/Rx NSS requires dynamic switching of Tx/Rx chains, it requires more complexity compared with baseline Tx/Rx NSS capability update. Therefore, we may need thorough investication for allowing dynamic change of EMLMR Tx/Rx NSS during the initial frame exchange, and it is not recommended to do this unless it shows meaningful technical benefits. |
| 2105 | Kaiying Lu | 145/51 | 35.3.15 | For EMLMR mode, please specify the values of EMLMR Rx NSS and EMLMR Tx NSS at a time on the link for which the initial frame exchange was made. | as in comment | Rejected:In EMLMR operation, EMLMR Tx/Rx NSS values are applied only after initial frame exchange, and the Tx/Rx NSS for the initial frame exchange follows its per-link spatial stream capabilities and operating mode of the link. And, this is also described in the current draft as follows in P214L40 “When a non-AP MLD operates in the EMLMR mode, after initial frame exchange subject to its per-link spatial stream capabilities and operating mode on one of the EMLMR links, …” |
| 2330 | Ming Gan | 145/37 | 35.3.15 | EMLMR Tx/RX NSS is not clear, could Supported MCS and NSS be resued for them? | As in comment | Revised:Agree in principle with the comment. However, current definition of Supported EHT MCS and Nss Set field is for each STA. Therefore, we need to have a separate field that corresponds to MLD level capability of MCS and NSS for EMLMR operation. Therefore, we used the same structure as Supported EHT MCS and Nss Set field but is applied to MLD level for EMLMR Tx/Rx NSS usage. In terms of the location of the field, as this is an MLD level capability signaling for EMLMR operation, it is straightforward to be in EML capabilities subfield in a Common Info field of Basic variant of ML element. In baseline Supported EHT MCS and Nss Set field, the presence of the field is determined by the STA’s bandwidth capability. However, if we use the same method for EML capabilities, the receiving STA cannot parse the field until the receiving STA parse all the Per-STA Profile of the ML element. Therefore, another subfield is added to indicate the presence of each subfield for the MCS and Nss Set field.Also, in the baseline Supported EHT MCS and Nss Set field, separate set of subfields are defined for 20 MHz-Only STA and its format is different from other channel width cases. If we follow the same logic, in case a STA affiliated with a non-AP MLD is a 20 MHz-Only STA, the indication of the supported Nss can be quite complicated while the purpose of 20 MHz-Only STA is limited for low cost implementation, which is not the case for EMLMR operation. In this sense, it is desirable not to include 20 MHz-Only STA in EMLMR operation.TGbe editor to make the changes shown in 11-21/0774rXX under all headings that include CID 2330. |
| 2106 | Kaiying Lu | 146/3 | 35.3.15 | For EMLMR mode, "Receive PPDUs with the number of spatial streams up to the value as indicated in the EMLMR Rx NSS subfield of TBD element at a time on the link for which the initial frame exchange was made". Please clarify if the number of spatial streams can be any number that is less or equal to EMLMR Rx NSS. | as in comment | Revised: Agree in principle with the comment. Defining an EMLMR Rx NSS subfield is not enough because in baseline PHY Capabilities element, the supported Nss is a function of supported channel width (or PPDU bandwidth) and MCS. Therefore, we need to define the similar structure for supported Tx/Rx Nss for EMLMR operation. Based on the resolution for CID 2330, we can define EMLMR Supported MCS and Nss Set subfield in the Basic variant ML element. With this definition, we can clearly define the supported Rx Nss for the EMLMR reception procedure.TGbe editor to make the changes shown in 11-21/0774rXX under all headings that include CID 2106. |
| 2107 | Kaiying Lu | 146/6 | 35.3.15 | For EMLMR mode, "Transmit PPDUs with the number of spatial streams up to the value as indicated in the EMLMR Tx NSS subfield of TBD element at a time on the link for which the initial frame exchange was made". Please clarify if the number of spatial streams can be any number that is less or equal to EMLMR Tx NSS. | as in comment | Revised: Agree in principle with the comment. Defining an EMLMR Rx NSS subfield is not enough because in baseline PHY Capabilities element, the supported Nss is a function of supported channel width (or PPDU bandwidth) and MCS. Therefore, we need to define the similar structure for supported Tx/Rx Nss for EMLMR operation. Based on the resolution for CID 2330, we can define EMLMR Supported MCS and Nss Set subfield in the Basic variant ML element. With this definition, we can clearly define the supported Tx Nss for the EMLMR reception procedure.TGbe editor to make the changes shown in 11-21/0774rXX under all headings that include CID 2107. |
| 2110 | Kaiying Lu | 145/51 | 35.3.15 | For EMLMR mode, please specify that the per link EMLMR Rx NSS and EMLMR Tx NSS are the same | as in comment | Rejected:Depending on implementation, different number of supported NSS for reception and for transmission happens quite frequently. To reflect this feature, even in baseline PHY capabilities definition, supported MCS and Nss for transmission and reception are indicated separately. Therefore, it restricts too much if we limit that the EMLMR Rx NSS and EMLMR Tx NSS are the same.  |
| 3433 | Yonggang Fang |  | 35.3.15 | It is not clear for following paragraph"- Receive PPDUs with the number of spatial streams up to the value as indicated in the EMLMR Rx NSS subfield of TBD element at a time on the link for which the initial frame exchange was made.-Transmit PPDUs with the number of spatial streams up to the value as indicated in the EMLMR Tx NSS subfield of TBD element at a time on the link for which the initial frame exchange was made."a) Does it means to support those Rx and Tx simultaneously over a pair of links?b) what is difference from STR if it is true, or difference from NSTR if it is not. Need to clarify those. | as suggested in comment. | Revised:Agree in principle with the comment that current text is not clear enough to identify the non-AP MLD’s behaviour as EMLMR Rx NSS and EMLMR Tx NSS subfields are not clearly defined. This is mainly because in baseline PHY Capabilities element, the supported Nss is a function of supported channel width (or PPDU bandwidth) and MCS. Therefore, we need to define the similar structure for supported Tx/Rx Nss for EMLMR operation. Based on the resolution for CID 2330, we can define EMLMR Supported MCS and Nss Set subfield in the Basic variant ML element. With this definition, we can clearly define the supported Rx/Tx Nss for the EMLMR reception procedure.Other than this definition, it is quite clear that reception requirement and transmission requirement mentioned in this subclause does not mean that Tx and Rx happens simultaneously, and in this sense, the EMLMR operation is applicable to both NSTR non-AP MLD and STR non-AP MLD.TGbe editor to make the changes shown in 11-21/0774rXX under all headings that include CID 3433. |
| 2196 | Li-Hsiang Sun | 146/7 | 35.3.15 | For TXOP initiated by non-AP MLD, it is not clear why initial frame exchange is needed before transmitting non-triggered UL PPDUs with EMLMR Tx NSS | clarify the 2nd bullet for the non-triggered case | Rejected:If a STA affiliated with a non-AP MLD intends to initiate a TXOP by sending a UL frame using more Tx NSS than it can support for the link, the non-AP MLD needs to switch its Tx RF chains of other link to the link before transmitting the UL frame, which requires a link switching delay. During this time, the non-AP MLD cannot receive a frame from an AP on the other link. Therefore, in case the AP’s backoff expires during this switching time on the other link, the AP’s transmission fails. To avoid this blindness during the channel switching, the STA needs to follow the similar procedure as the DL reception in the EMLMR operation. |

**Discussion:** *None.*

**Propose:**

***TGbe Editor to make the following changes in Subclause 9.4.2.295b.2 (Basic variant Multi-Link element):***

***[Note to Editor: This resolution is based on the assumption that resolutions shown in 11-21/319r7 and changes in 11-21/335r7 are incorporated into the draft specification.]***

**9.4.2.295b.2 Basic variant Multi-Link element**

(#2330)

The Basic variant Multi-link element is used to carry information of an MLD and its affiliated STAs during multi-link discovery (see 35.3.4.4 (Multi-link element usage rules in the context of discovery)) and multi-link setup (see 35.3.5.4 (Usage and rules of Basic variant Multi-link element in the context of multi-link setup)).

The format of the Common Info field of the Basic variant Multi-Link element is defined in Figure 9-788eh (Common Info field of the Basic variant Multi-Link element format).

|  |  |  |  |
| --- | --- | --- | --- |
|  | MLD MAC Address | EML Capabilities | TBD |
| Octets: | 0 or 6 | 0 or variable | TBD |

**Figure 9-788eh – Common Info field of the Basic variant Multi-Link element format**

The condition for the presence of the MLD MAC Address field in the Common Info field is defined in 35.3.5.4 (Usage and rules of Basic variant Multi-link element in the context of multi-link setup) and 35.3.4.4 (Multi-link element usage rules in the context of discovery).

The condition for the presence of the EML Capabilities field in the Common Info field is defined in 35.3.14 (Enhanced multi-link single radio operation) and 35.3.15 (Enhanced multi-link multi-radio operation).

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 B3 | B4 | B5 B7 | B8 B11 | B12 B13 | B14 B15 | B16 B31 |  |
|  | EMLSR Support | EMLSR Delay | EMLMR Support | EMLMR Delay | Transition Timeout | EMLMR Max Channel Width | Reserved | EMLMR Link Bitmap | EMLMR Supported MCS And NSS Set |
| Bits: | 1 | 3 | 1 | 3 | 4 | 2 | 2 | 16 | variable |

**Figure 9-788eh1—EML Capabilities subfield format**

The format of the EML Capabilities subfield is defined in Figure 9-788eh1 (EML Capabilities subfield format). The EML Capabilities subfield contains a number of subfields that are used to advertise the capabilities for EMLSR operation and EMLMR operation.

The EMLSR Support subfield indicates support of the EMLSR operation for an MLD. The EMLSR Support subfield is set to 1 if the MLD supports the EMLSR operation; otherwise set to 0. (#1773, 2603)

The EMLSR Delay subfield indicates the MAC padding duration of the Padding field of the initial Control frame defined in 35.3.14 (Enhanced multi-link single radio operation). The EMLSR Delay field is 3 bits and set to 0 for 0 µs, set to 1 for 32 µs, set to 2 for 64 µs, set to 3 for 128 µs, set to 4 for 256 µs, and the values 5 to 7 are reserved.(#1773, 2603, 3206, 2745, 2917)

The EMLMR Support subfield indicates support of the EMLMR operation for an MLD. The EMLMR Support subfield is set to 1 if the MLD supports the EMLMR operation; otherwise set to 0.

The EMLMR Delay subfield indicates the minimum padding duration required for a non-AP MLD for EMLMR link switch when operating in EMLMR mode (see 35.3.15 (Enhanced multi-link multi-radio operation)).

When the EMLMR Delay subfield is included in a frame sent by a STA affiliated with a non-AP MLD, the EMLMR Delay subfield is set to 0 for 0 µs, set to 1 for 32 µs, set to 2 for 64 µs, set to 3 for 128 µs, set to 4 for 256 µs, and the values 5 to 7 are reserved. When the EMLMR Delay subfield is included in a frame sent by an AP affiliated with an AP MLD, the EMLMR Delay subfield is set to 0.

The Transition Timeout subfield indicates the timeout value for EML Operating Mode Notification frame exchange in EMLMR mode (see 35.3.15 (Enhanced multi-link multi-radio operation)).

When the Transition Timeout subfield is included in a frame sent by an AP affiliated with an AP MLD, the Transition Timeout subfield is set to 0 for 0 TU, set to 1 for 1 TU, set to 2 for 2 TU, set to 3 for 4 TU, set to 4 for 8 TU, set to 5 for 16 TU, set to 6 for 32 TU, set to 7 for 64 TU, set to 8 for 128 TU, and the values 9 and 15 are reserved. When the Transition Timeout subfield is included in a frame sent by a non-AP STA affiliated with a non-AP MLD, the Transition Timeout subfield is set to 0.

The EMLMR Max Channel Width subfield indicates the maximum operating channel width of a non-AP MLD for EMLMR operation.

When the EMLMR Max Channel Width subfield is included in a frame sent by a STA affiliated with a non-AP MLD with dot11EHTEMLMROptionImplemented equal to true, the EMLMR Max Channel Width subfield is set to 0, 1, or 2 if the maximum of the supported channel width for STAs affiliated with the non-AP MLD operating on EMLMR links is equal to 80 MHz, 160 MHz, and 320 MHz, respectively, and the value 4 is reserved. Otherwise, the EMLMR Max Channel Width subfield is set to 0.

When the EMLMR Link Bitmap subfield is included in a frame sent by a STA affiliated with a non-AP MLD, the i-th bit in the EMLMR Link Bitmap subfield is set to 1 if a link with Link ID equal to i is a member of the EMLMR links; otherwise it is set to 0. When the EMLMR Link Bitmap subfield is included in a frame sent by an AP affiliated with a AP MLD, the EMLMR Links Bitmap subfield is set to all 0s.

The EMLMR Supported MCS And NSS Set subfield indicates the combinations of MCS and number of spatial streams Nss that a non-AP MLD supports for reception and transmission during EMLMR operation.

When the EML Capabilities subfield is included in a frame sent by an AP affiliated with an AP MLD, the EMLMR Supported MCS And NSS subfield is not present. When the EML Capabilities subfield is included in a frame sent by a STA affiliated with a non-AP MLD, the EMLMR Supported MCS And NSS Set subfield is present if the EMLMR Support subfield is equal to 1; otherwise it is not present. The format of the EMLMR Supported MCS And NSS Set subfield is shown in Figure 9-F1 (EMLMR Supported MCS and NSS Set subfield format).

|  |  |  |  |
| --- | --- | --- | --- |
|  | MCS Map(BW ≤ 80 MHz) | MCS Map(BW = 160 MHz) | MCS Map(BW = 320 MHz) |
| Octets: | 3 | 0 or 3 | 0 or 3 |

**Figure 9-F1 — EMLMR Supported MCS And NSS Set subfield format**

The subfields of the EMLMR Supported MCS And NSS Set subfield, and their presence, are defined in Table 9-T1 (Subfields of the EMLMR Supported MCS And NSS Set subfield).

**Table 9-T1 — Subfields of the EMLMR Supported MCS And NSS Set subfield**

|  |  |  |
| --- | --- | --- |
| Subfield | Definition | Encoding |
| MCS Map(BW 80 MHz) | If the maximum operating channel width of the non-AP MLD for EMLMR operation is greater than or equal to 80 MHz, indicates the maximum number of spatial streams supported for reception and the maximum number of spatial streams that STAs of the non-AP MLD can transmit during EMLMR operation, for each MCS value, in a PPDU with a bandwidth of 20, 40 or 80 MHz. | The format and encoding of this subfield are defined in Figure –F1 (EMLMR Supported MCS and NSS Set subfield format) and the associated description. |
| MCS Map(BW = 160 MHz) | If the maximum operating channel width of the non-AP MLD for EMLMR operation is greater than or equal to 160 MHz, indicates the maximum number of spatial streams supported for reception and the maximum number of spatial streams that STAs of the non-AP MLD can transmit during EMLMR operation, for each MCS value, in a PPDU with a bandwidth of 160 MHz. | The format and encoding of this subfield are defined in Figure –F1 (EMLMR Supported MCS and NSS Set subfield format) and the associated description.If EMLMR Max Channel Width subfield is set to 1 or 2, this field is present; otherwise, it is not present. |
| MCS Map(BW = 320 MHz) | If the maximum operating channel width of the non-AP MLD for EMLMR operation is 320 MHz, indicates the maximum number of spatial streams supported for reception and the maximum number of spatial streams that STAs of the non-AP MLD can transmit during EMLMR operation, for each MCS value, in a PPDU with a bandwidth of 320 MHz. | The format and encoding of this subfield are defined in Figure –F1 (EMLMR Supported MCS and NSS Set subfield format) and the associated description.If EMLMR Max Channel Width subfield is set to 2, this field is present; otherwise, it is not present. |

The MCS Map (BW ≤ 80 MHz), the MCS Map (BW = 160 MHz), and the MCS Map (BW = 320 MHz) subfields follow the format shown in Figure 9-F3 (EHT-MCS Map (BW ≤ 80 MHz, Except 20 MHz-Only STA), EHT-MCS Map (BW = 160 MHz) and EHT-MCS Map (BW = 320 MHz) subfield format) defined in 9.4.2.XXX.X (Supported EHT MCS And Nss Set Field), respectively.

*TGbe editor: Change 35.3.15 Enhanced multi-link multi-radio operation as follows (track change on):*

**35.3.15 Enhanced multi-link multi-radio operation**

A non-AP MLD may operate in the enhanced multi-link multi-radio (EMLMR) mode on a specified set of the enabled links between the non-AP MLD and its associated AP MLD. The specified set of the enabled links in which the EMLMR mode is applied is called EMLMR links.

An MLD with dot11EHTEMLMROptionImplemented equal to true shall set the EML Capabilities Present subfield to 1 and shall set the EMLMR Support subfield of the Common Info field of transmitted Basic variant ML elements to 1; otherwise, the MLD shall set the EMLMR Support subfield to 0.

A non-AP MLD with dot11EHTEMLMROptionImplemented equal to true shall indicate the combinations of MCS and number of spatial streams Nss that a non-AP MLD supports for reception and transmission during EMLMR operation in the EMLMR Supported MCS And NSS Set subfield of the Common Info field of transmitted Basic variant ML element. (#2330)

A STA affiliated with the non-AP MLD operating on any of EMLMR links shall not be a 20 MHz-Only non-AP EHT STA. (#2330)The supported rates, HT-MCS, VHT-MCS, and HE-MCS for a bandwidth and Nss shall be the same as the supported EHT-MCS for the corresponding bandwidth and Nss unless the corresponding MCS is not defined. If the MCS is not defined in the corresponding PHY amendment, the highest MCS support is implied. (#2330).

If a non-AP MLD with dot11EHTEMLMROptionImplemented equal to true intends to switch EMLMR mode after multi-link setup, then a non-AP STA affiliated with the non-AP MLD shall transmit an EML Operating Mode Notification frame with EMLMR Mode subfield equal to 1 or 0 to enable or disable EMLMR mode, respectively.

After successful transmission of the EML Operating Mode Notification frame from the non-AP STA affiliated with the non-AP MLD to an AP affiliated with an AP MLD, the non-AP STA and the AP initialize the Transition Timeout timer with the Transition Timeout subfield value in the EML Capabilities subfield of the Basic variant Multi-Link element received from the AP. The Transition Timeout timer begins counting down from the end of the PPDU containing the immediate response to the EML Operating Mode Notification frame. The AP should send an EML Operating Mode Notification frame to the non-AP STA with EML Control field set to the same value as EML Control field in the received EML Operating Mode Notification frame from the non-AP STA before the Transition Timeout expires. If the AP cannot send the EML Operating Mode Notification frame to the non-AP STA before the Transition Timeout expires, the AP shall discard the EML Operating Mode Notification frame.

The non-AP MLD shall transition to the indicated mode right after successfully receiving the EML Operating Mode Notification frame from the AP or right after the Transition Timeout timer expires, whichever comes first.

A non-AP MLD with dot11EHTEMLMROptionImplemented equal to true shall indicate the minimum padding duration required for the non-AP MLD for EMLMR link switch in the EMLMR Delay subfield in the Common Info field of transmitted Basic variant ML elements. .

NOTE — The link switching can happen during the transmission time of the initial response frame. However, the duration of initial response frame can be different depending on the initial frame. The non-AP MLD might determine the minimum padding duration such that it can be satisfied even when the shortest initial response frame is used on EMLMR links (E.g., a CTS frame in non-HT PPDU with the highest rate in the BSSBasicRateSet parameters).

When an AP of an AP MLD transmits a PPDU that initiates a frame exchange with a non-AP MLD operating in EMLMR mode, the AP shall ensure that the padding duration of the PPDU is longer than or equal to the minimum padding duration value indicated by the EMLMR Delay field of the Basic variant Multi-Link element received from the non-AP MLD.

When a non-AP MLD operates in the EMLMR mode, after initial frame exchange subject to its per-link spatial stream capabilities and operating mode on one of the EMLMR links, the non-AP MLD shall be able to support the following until the end of the frame exchange sequence initiated by the initial frame exchange:

* Receive PPDUs with the MCS and the number of spatial streams up to the value as indicated in the EMLMR Supported MCS And NSS Set subfield of the Common Info field of transmitted Basic variant ML element at a time on the link for which the initial frame exchange was made. (#2106, 3433)
* Transmit PPDUs with the MCS and the number of space-time streams up to the value as indicated in the EMLMR Supported MCS And NSS Set subfield of the Common Info field of transmitted Basic variant ML element at a time on the link for which the initial frame exchange was made. (#2107, 3433)

After the end of the frame exchange sequence, each STA of the non-AP MLD in the EMLMR mode shall be able to transmit or receive PPDU, subject to its per-link spatial stream capabilities and operating mode and subject to any switching delay indicated by the non-AP MLD.