IEEE P802.11
Wireless LANs

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| CC36 CR for EMLMR Links |
| Date: 2021-10-10 |
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Abstract

This submission proposes resolutions of comments received from TGbe comment collection CC36 based on TGbe D1.2.

* 4704 5671 6216 ~~6217~~ 6778 6883 8358 4425

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Incorporated offline discussion and updated based on draft 1.3.
* Rev 2: Updated based on draft 1.3.
* Rev 3: Incorporate CID 4425, updated based on draft 1.4 and offline comments from Mickael Lorgeoux
1. **Introduction**

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. The introduction and the explanation of the proposed changes are 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 802.11be 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.***

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| **CID** | **Commenter** | **Clause**  | **P.L** | **Comment** | **Proposed Change** | **Resolution** |
| 4704 | Chien-Fang Hsu | 35.3.16 | 284.82 | It is not clear how the non-AP MLD specifies the subset of enabled links as the EMLMR links. | clarify how to specify the EMLMR links among enabled links | Revised.Agree with the commenter. Proposed resolution addresses the suggested change TGbe editor to make the changes shown in 21/1840r3 under all headings that include CID 4704. |
| 5671 | Julien Sevin | 35,3,16 | 282.62 | How to advertise the EMLMR links? | Specify the corresponding protocol and frame format | Revised.Agree with the commenter. Proposed resolution addresses the suggested change TGbe editor to make the changes shown in 21/1840r3 under all headings that include CID 5671. |
| 6216 | Mikael Lorgeoux | 35.3.16 | 282.62 | The signaling of the EMLMR links by the non-AP MLD to the AP MLD is missing. | A dedicated signaling for EMLMR links must be added in Per-STA profile and/or EML Capabilities of one or more variant(s) of Multi-Link element. | Revised.Agree with the commenter. Proposed resolution addresses the suggested change TGbe editor to make the changes shown in 21/1840r3 under all headings that include CID 6216. |
| ~~6217~~ | Mikael Lorgeoux | 35.3.16 | 282.61 | The current text considers only one set of EMLMR links, it is restrictive. | The signaling added for EMLMR links must support the non-AP MLD implementations with several sets of radios supporting the EMLMR mode independtly. | Reject.Although agree with the commenter that multiple sets can increase the flexibility, this will also introduce more complexity.Suggest the commenter to bring up a contribution for the group to consider. |
| 6778 | Romain GUIGNARD | 35.3.16 | 282.61 | It is not explained in the draft how specify the EMLMR links | Please add specification to set the EMLMR links. | Revised.Agree with the commenter. Proposed resolution addresses the suggested change TGbe editor to make the changes shown in 21/1840r3 under all headings that include CID 6778. |
| 6883 | Rubayet Shafin | 35.3.16 | 282.60 | "...on a specified set of enabled links..." There is no mechanism present in the spec that indicates how to specify the EMLMR links | Please provide a signaling mechanism to specify the EMLMR links. | Revised.Agree with the commenter. Proposed resolution addresses the suggested change TGbe editor to make the changes shown in 21/1840r3 under all headings that include CID 6883. |
| 8358 | Zhiqiang Han | 35.3.16 | 282.64 | Here is a term EMLMR links. But how a enabled link can become an EMLMR link, there is no description.Please clarify it | Please clarify it | Revised.Agree with the commenter. Proposed resolution addresses the suggested change TGbe editor to make the changes shown in 21/1840r3 under all headings that include CID 8358. |
| 4425 | Arik Klein | 35.3.16 | 284.01 | It is not clear why do we need this sentence " After the end of the frame exchange sequence, each STA of the non-AP MLD in the EMLMR mode shall be ... by the non-AP MLD"? In the prvious paragraph it is clearly specified that the the capability to receive PPDU with the number of spatial streams up to the value as indicated in the EMLMR RxNSS subfield and the capability to transmit PPDUs with the number of spatial streams up to the value as indicated in the EMLMR Tx NSS subfield is only until the end of the frame exchange - so what is the additional information that is included in this text? | Consider to remove the sentence. Otherwise - please explain why this sentence is needed (what is the new information included within) and add it as a note to this text. | Revised. Incorporated the missing definition of the EMLMR Supported MCS And NSS Set and related text to address the commenter’s concern. Some clarification to the comment can be provided as follows. There are two different supported MCS and NSS capabilities for two different statuses of the EMLMR mode. One capability for per-link, and the other for the EMLMR operation. After the initial frame exchange, the capability is subject to the EMLMR Supported MCS And NSS, while after the end of the frame exchange sequences, subject to the capability indicated in the Supported EHT-MCS And NSS Set subfield in the EHT Capabilities elementTGbe editor to make the changes shown in 21/1840r3 under all headings that include CID 4425. |

**Discussion:** None.

**9.4.1.74 EML Control field**

***TGbe Editor to make the following changes in Figure 9-144i – EML Control field format:***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  | B0 | B1 | B2 B17 |  | B18 B33 | B34 B35 | B36 B59/83/107 |
|  | EMLSR Mode | EMLMR Mode | EMLSR Link Bitmap |  | EMLMR Link Bitmap | MCS Map Count | EMLMR Supported MCS And NSS Set |
| Bits: | 1 | 1 | 0 or 16 |  | 0 or 16 | 0 or 2 | 0 or Variable |
|  | **Figure 9-144i – EML Control field format**(#4704, 5671, 6216, 6778, 6883, 8358, 4425) |  |  |  |  |

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A non-AP MLD that supports enhanced multi-link single radio operation (see 35.3.17 (Enhanced multi-link single radio operation)) sets the EMLSR Mode subfield to 1 to indicate that the non-AP MLD operates in EMLSR mode and to 0 to indicate that the non-AP MLD does not operate in EMLSR mode. (#7563)A non-AP MLD that does not support enhanced multi-link single radio operation (see 35.3.17 (Enhanced multi-link single radio operation)) sets the EMLSR Mode subfield to 0. (#7843)The EMLSR Mode subfield is set to 0 if the EMLMR Mode subfield is set to 1. (#7699)An AP MLD with dot11EHTEMLSROptionImplemented equal to true that receives an EML Operating Mode Notification frame from a STA affiliated with a non-AP MLD sets the EMLSR Mode subfield of the EML Operating Mode Notification frame that is sent in response to the value obtained from the received EML Operating Mode Notification frame.

A non-AP MLD that supports enhanced multi-link multi-radio operation (see 35.3.18 (Enhanced multi-link multi-radio operation)) sets the EMLMR Mode subfield to 1 to indicate that the non-AP MLD operates in EMLMR mode and to 0 to indicate that the non-AP MLD does not operate in EMLMR mode. (#7564)A non-AP MLD that does not support enhanced multi-link multi-radio operation (see 35.3.18 (Enhanced multi-link multi-radio operation)) sets the EMLMR Mode subfield to 0. (#7843)The EMLMR Mode sub-field is set to 0 if the EMLSR Mode subfield is set to 1. (#7699)An AP MLD with dot11EHTEMLMROp-tionImplemented equal to true that receives an EML Operating Mode Notification frame from a STA affiliated with a non-AP MLD sets the EMLMR Mode subfield of the EML Operating Mode Notification frame that is sent in response to the value obtained from the received EML Operating Mode Notification frame.

(#6664)NOTE 1—The EMLSR Mode and EMLMR Mode subfields are used to enable or disable the EMLSR and EMLMR modes, respectively. An EML Operating Mode Notification frame sets either of these subfields to a nonzero value only when the corresponding mode is supported by the receiving MLD. An MLD indicates which mode(s) it supports in the EML Capabilities field of the Basic Multi-Link element that it transmits (see 9.4.2.312.2 (Basic Multi-Link element(#6700))).

(#4759)(#5766)(#6342)The EMLSR Link Bitmap subfield indicates the subset of the enabled links that is used by the non-AP MLD in the EMLSR mode. The bit position *i* of the EMLSR Link Bitmap subfield cor-responds to the link with the Link ID equal to *i* and is set to 1 to indicate that the link is used by the non-AP MLD for the EMLSR mode and is a member of the EMLSR links; otherwise the bit position is set to 0. The EMLSR Link Bitmap subfield is present if the EMLSR Mode subfield is equal to 1 and is not present otherwise.

(#4759)(#5766)(#6342)NOTE 2—As an example, when a non-AP MLD enables three links and the first link has Link ID equal to 0, the second link has Link ID equal to 1, and the third link has Link ID equal to 2, and the two links with Link ID equal to 1 and Link ID equal to 2 are used for the EMLSR operation, the two bit positions, the second bit and the third bit positions, of the EMLSR Link Bitmap subfield are set to 1 and other bit positions are set to 0.

(#4704, 5671, 6216, 6778, 6883, 8358, 4425)The EMLMR Link Bitmap subfield indicates the subset of the enabled links that is used by the non-AP MLD in the EMLMR mode. The bit position *i* of the EMLMR Link Bitmap subfield corresponds to the link with the Link ID equal to *i* and is set to 1 to indicate that the link is used by the non-AP MLD for the EMLMR mode and is a member of the EMLMR links; otherwise the bit position is set to 0. The EMLMR Link Bitmap subfield is present if the EMLMR Mode subfield is equal to 1 and is not present otherwise.

(#4759)(#5766)(#6342)NOTE 3—As an example, when a non-AP MLD enables three links and the first link has Link ID equal to 0, the second link has Link ID equal to 1, and the third link has Link ID equal to 2, and the two links with Link ID equal to 1 and Link ID equal to 2 are used for the EMLMR operation, the two bit positions, the second bit and the third bit positions, of the EMLMR Link Bitmap subfield are set to 1 and other bit positions are set to 0.

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 the EMLMR operation. The MCS Map Count subfield is set to 0, 1, or 2 if the maximum of the supported channel widths 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 3 is reserved. Otherwise, the MCS Map Count subfield is set to 0. The MCS Map Count subfield is present if the EMLMR Mode subfield is equal to 1 and is not present otherwise.

The EMLMR Supported MCS And NSS Set subfield is present if the EMLMR Mode 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 $\leq $ 80 MHz) | Except for a 20 MHz-only non-AP STA, 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 MCS Map Count 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 equal to 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 MCS Map Count 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 9-1002ab (EHT-MCS Map (BW ≤ 80 MHz, Except 20 MHz-Only Non-AP STA), EHT-MCS Map (BW = 160 MHz) and EHT-MCS Map (BW = 320 MHz) subfield format) defined in 9.4.2.313.4 (Supported EHT-MCS And NSS Set field), respectively.

**9.4.2.312.2 Basic Multi-Link element**

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***TGbe Editor to make the following changes in Figure 9-1002h– EML Capabilities subfield format:***

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 B3 | B4 | B5 B7 | B8 B11 | B12 B15 |  |  |
|  | EMLSR Support | EMLSR Delay | EMLMR Support | EMLMR Delay | Transition Timeout | Reserved |  |  |
| Bits: | 1 | 3 | 1 | 3 | 4 | 4 |   |  |  |

**Figure 9-1002h —EML Capabilities subfield format** (#4704, 5671, 6216, 6778, 6883, 8358, 4425)

***TGbe Editor to make the following changes for paragraphs describing the EML Capabilities subfield:***

…

 (#4704, 5671, 6216, 6778, 6883, 8358, 4425)

*TGbe editor: Change 35.3.19 Enhanced multi-link multi-radio operation as follows:*

**35.3.19 Enhanced multi-link multi-radio operation**

A non-AP MLD may operate in the 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. The EMLMR links shall be indicated in the EMLMR Link Bitmap subfield of the EML Control field of the EML Operating Mode Notification frame by setting the bit positions of the EMLMR Link Bitmap subfield to 1. (#4704, 5671, 6216, 6778, 6883, 8358)

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 Multi-Link elements to 1; otherwise, the MLD shall set the EMLMR Support subfield to 0.

 (#4704, 5671, 6216, 6778, 6883, 8358, 4425)A non-AP MLD with dot11EHTEMLMROptionImplemented equal to true shall indicate the 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 EML Control field of the EML Operating Mode Notification frame.

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.

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.

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 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.

The non-AP MLD shall transition to the indicated mode immediately after successfully receiving the EML Operating Mode Notification frame from the AP or immediately 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 Multi-Link 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 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:

* (#4704, 5671, 6216, 6778, 6883, 8358, 4425)Receive PPDUs with the number of spatial streams up to the value as indicated in the EMLMR Supported MCS And NSS Set subfield of the EML Control field of the EML Operating Mode Notification frame at a time on the link for which the initial frame exchange was made.
* (#4704, 5671, 6216, 6778, 6883, 8358, 4425)Transmit PPDUs with the number of spatial streams up to the value as indicated in the EMLMR Supported MCS And NSS Set subfield of the EML Control field of the EML Operating Mode Notification frame at a time on the link for which the initial frame exchange was made.

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.