IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CC36 Comment Resolution Clause 35.3.17 EMLSR Operation | | | | |
| Date: 2022-1-31 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Minyoung Park | Intel Corporation |  |  | Minyoung.park@intel.com |
|  |  |  |  |  |
|  |  |  |  |  |

Abstract

This submission proposes comment resolution(s) for the following 21 CID(s) received in CC36 on TGbe D1.0 related to 35.3.17 EMLSR operation:

CIDs:

4760,5668,6882,5612,5844,6551,4697,7336,5933,4241

6960,7831,7832,7334,6325,4422,4698,6963,7063,7337

8357

Revisions:

* Rev 0: Initial version of the document.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause Number** | **Page.**  **Line** | **Comment** | **Proposed Change** | **Resolution** |
| 4760 | Chunyu Hu | 35.3.15 | 281.17 | This subclause is lack of a general description of this mode. Please add. | As commented | Revised.  Agree with the commenter. A paragraph is added at the beginning of the subclause to describe the general description of the EMLSR operation.  TGbe editor to make the changes with the CID tag (#4760) in doc.: IEEE 802.11-22/214r0  [https://mentor.ieee.org/802.11/dcn/22/11-22-214-00-00be-cc36-cr-emlsr.docx] |
| 5668 | Julien Sevin | 35.3.15 | 281.17 | Give a definition of an Enhanced multi-link single radio | As in comment | Revised.  Agree with the commenter. A paragraph is added at the beginning of the subclause to describe the general description of the EMLSR operation.  TGbe editor to make the changes with the CID tag (#5668) in doc.: IEEE 802.11-22/214r0  [https://mentor.ieee.org/802.11/dcn/22/11-22-214-00-00be-cc36-cr-emlsr.docx] |
| 6882 | Rubayet Shafin | 35.3.15 | 281.17 | There is no clear definition of EMLSR operation in the spec | Please provide a clear definition/explanation of what is meant by EMLSR operation. | Revised.  Agree with the commenter. A paragraph is added at the beginning of the subclause to describe the general description of the EMLSR operation.  TGbe editor to make the changes with the CID tag (#6882) in doc.: IEEE 802.11-22/214r0  [https://mentor.ieee.org/802.11/dcn/22/11-22-214-00-00be-cc36-cr-emlsr.docx] |
| 5612 | John Wullert | 35.3.15 | 281.19 | The section does not clearly define Enhanced multi-link single-radio operation. | Add a description of the intentions and functionality of Enhanced multi-link single radio and in what way it is "enhanced". | Revised.  Agree with the commenter. A paragraph is added at the beginning of the subclause to describe the general description of the EMLSR operation.  TGbe editor to make the changes with the CID tag (#5612) in doc.: IEEE 802.11-22/214r0  [https://mentor.ieee.org/802.11/dcn/22/11-22-214-00-00be-cc36-cr-emlsr.docx] |
| 5844 | Lei Wang | 35.3.15 | 281.20 | What's the EMLSR mode? Could not find a clear definition in the 11be/D1.0 spec, although it is used many times in the spec and also there are capability indicators specified for it. | Add the EMLSR definition at beginning of Section 35.3.15. The following text is just a suggestion: The EMLSR mode is an operation mode for a Multi-Link Single Radio Non-AP MLD, where it listens to and receives control frames on two or more enabled links simultaneously by using its spatial multiplexing capability. | Revised.  Agree with the commenter. A paragraph is added at the beginning of the subclause to describe the general description of the EMLSR operation. Also added a sentence what it means to be in the EMLSR mode.  TGbe editor to make the changes with the CID tag (#5844) in doc.: IEEE 802.11-22/214r0  [https://mentor.ieee.org/802.11/dcn/22/11-22-214-00-00be-cc36-cr-emlsr.docx] |
| 6551 | Patrice Nezou | 35.3.15 | 281.20 | The EMLSR mode is not defined. Please give a definition | As in comment | Revised.  Agree with the commenter. A paragraph is added at the beginning of the subclause to describe the general description of the EMLSR operation. Also added a sentence what it means to be in the EMLSR mode.  TGbe editor to make the changes with the CID tag (#5844) in doc.: IEEE 802.11-22/214r0  [https://mentor.ieee.org/802.11/dcn/22/11-22-214-00-00be-cc36-cr-emlsr.docx] |
| 4697 | Chien-Fang Hsu | 35.3.15 | 281.19 | The rule here allows the non-AP MLD to operate in the EMLSR mode on a subset of enabled links. On the AP MLD side, it increases the complexity to handle the DL traffic over different links which are in EMLSR mode or not. Also, the complexity of the EMLSR MLD increases. | An EMLSR non-AP STA in EMLSR mode shall apply EMLSR to all enabled links. | Rejected.  A non-AP MLD needs to operate on a subset of the enabled links for the EMLSR operation since there are scenarios where not all the enabled links can be used for the EMLSR operation. For example, a non-AP MLD enabling 2.4, 5, and 6 GHz links but using the EMLSR operation on only 5 and 6 GHz links. |
|  |  |  |  |  |  |  |

**TGbe Editor to make the following changes in Subclause 35.3.17 in TGbe D1.4 :**

**35.3.17 Enhanced multi-link single radio operation**

(#4760, 5668, 6882, 5612, 5844, 6551)The enhanced multi-link single radio (EMLSR) operation defined in this subclause allows a non-AP MLD with multiple receive chains to listen on multiple links and enables an AP affiliated with an AP MLD to initiate frame exchanges on any link on which the non-AP MLD is listening and exchange frames with more than one spatial stream on that link.

(#5844)In EMLSR mode, a non-AP MLD shall follow the rules defined in this subclause.

(#4759)(#5766)(#6342)A non-AP MLD may operate in the EMLSR mode on a specified set of the enabled links between the non-AP MLD and its associated AP MLD(#2332). The specified set of the enabled links in which the EMLSR mode is applied is called EMLSR links. The EMLSR links shall be indicated in the EMLSR Link Bitmap subfield of the EML Control field of the EML Operating Mode Notification frame by setting the bit positions of the EMLSR Link Bitmap subfield to 1. For the EMLSR mode enabled in a single-radio non-AP MLD, the STA(s) affiliated with the non-AP MLD that operates on the link(s) that corresponds to the bit position(s) of the EMLSR Link Bitmap subfield set to 0 shall be in doze state if a STA affiliated with the non-AP MLD that operates on one of the EMLSR links is in awake state.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause Number** | **Page.**  **Line** | **Comment** | **Proposed Change** | **Resolution** |
| 7336 | stephane baron | 35.3.15 | 281.31 | Please clarify that non-AP MLD operating in EMLSR mode shal only transmit data after a successful initial frame exchange initiated by the AP-MLD. | please add a sub bullet in the list : "- a non-AP MLD shall not transmit or receive on any link before a successful initial frame exchange and shall not transmit or receive on any link after the end of the frame exchange sequence." | Revised.  Disagree with the commenter. A non-AP MLD in the EMLSR mode is allowed to initiate frame exchanges with an AP MLD. Please see below in TGbe D1.4: “— (#6351)When a STA of the non-AP MLD initiates a TXOP the following applies: • The non-AP MLD shall switch back to the listening operation on the EMLSR links after the time duration indicated in the EMLSR Transition Delay subfield after the end of the TXOP. — (#6777)Only one STA affiliated with the non-AP MLD that is operating on one of the EMLSR links may initiate frame exchanges with the AP MLD.”  There is, however, clarification needed that frame exchanges after receiving the initial control frame on one of the EMLSR link and no frame exchanges on the other EMLSR links is applied after transmitting an immediate response frame as a response to the initial control frame.  TGbe editor to make the changes with the CID tag (#7336) in doc.: IEEE 802.11-22/214r0  [https://mentor.ieee.org/802.11/dcn/22/11-22-214-00-00be-cc36-cr-emlsr.docx] |
| 5933 | Li-Hsiang Sun | 35.3.1.5 | 281.51 | The eMLSR non-AP MLD should be able to monitor NAV on all enabled links when it is not transmitting/ receiving data or switching link. An AP may send multiple MU-RTS on multiple links simultaneously for the non-AP to choose a better link to reply CTS/BSR if starting a TXOP with 1 non-AP MLD | change the sentence "the non-AP MLD shall be able to transmit or receive frames on the link in which the initial Control frame was received" to "the non-AP MLD shall be able to transmit or receive frames on the link in which the CTS/BSR frame was transmitted" | Revised.  TGbe D1.4 defines that the initial Control frame is transmitted on one of the EMLSR links: “(#4759)(#5766)(#6342)(#6350)An AP affiliated with the AP MLD initiates frame exchanges with the non-AP MLD on one of the EMLSR links shall begin the frame exchanges by transmitting the initial Control frame to the non-AP MLD with the limitations specified above.”  There is, however, clarification needed that frame exchanges after receiving the initial control frame on one of the EMLSR link and no frame exchanges on the other EMLSR links is applied after transmitting an immediate response frame as a response to the initial control frame.  TGbe editor to make the changes with the CID tag (#5933) in doc.: IEEE 802.11-22/214r0  [https://mentor.ieee.org/802.11/dcn/22/11-22-214-00-00be-cc36-cr-emlsr.docx] |
| 4241 | Alfred Asterjadhi | 35.3.15 | 281.32 | Several instances throughout the subclause refer to the MLD receiving or transmitting. I am thinkning that the STAs affiliated witht eh MLD are the ones that do so. Suggest using a consisntent terminology throughout. | As in comment. | Revised.  Agree with the commenter. The text in the subclause was revised in TGbe D1.4.  Note to the editor: no changes needed. |
| 6960 | Sanghyun Kim | 35.3.15 | 281.32 | It is not clear whether a STA of an EMLSR MLD can receive Beacon frame during the listening operation or not. | Make clear that a STA of an EMLSR mode MLD can receive Beacon frame during the listening operation. | Rejected.  The current spec TGbe D1.4 defines the listening operation as follows: “The listening operation includes CCA and receiving the initial Control frame of (#4758)frame exchanges that is initiated by the AP MLD.”  Whether a STA that is in the listening operation can receive a beacon frame is implementation dependent. |

**TGbe Editor to make the following changes in Subclause 35.3.17 in TGbe D1.4 :**

**…**

— (#4759)(#5766)(#6342)(#4758)After receiving the initial Control frame of frame exchanges (#7336, 5933)and transmitting an immediate response frame as a response to the initial Control frame, a STA affiliated with the non-AP MLD that was listening on the corresponding link shall be able to transmit or receive frames on the link in which the initial Control frame was received and shall not transmit or receive on the other EMLSR link(s) until the end of the frame exchanges, and subject to its spatial stream capabilities, operation mode, and link switch delay, the STA affiliated with the non-AP MLD shall be capable of receiving a PPDU that is sent using more than one spatial stream (#6658)on the link in which the initial Control frame was received a SIFS after the end of its response frame transmission solicited by the initial Control frame. During frame exchanges, the other AP(s) affiliated with the AP MLD shall not transmit frames to other STA(s) affiliated with the non-AP MLD on the other EMLSR link(s)(#5222).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause Number** | **Page.**  **Line** | **Comment** | **Proposed Change** | **Resolution** |
| 7831 | Yong Liu | 35.3.15 | 281.33 | It is not clear what would be the NAV setting rules for an EMLSR device to support both DL and EDCA UL chanenl access. | Please clarify the frame receiving and processing requirments for an EMLSR device, e.g. frame receiving BW and frame format, in order to set NAV sufficiently. | Revised.  A STA affiliated with a non-AP MLD that is in EMLSR mode uses the same rules for NAV setting and EDCA channel access. Clarified this in a note.  TGbe editor to make the changes with the CID tag (#7831) in doc.: IEEE 802.11-22/214r0  [https://mentor.ieee.org/802.11/dcn/22/11-22-214-00-00be-cc36-cr-emlsr.docx] |
| 7832 | Yong Liu | 35.3.15 | 281.33 | It is not clear what would be the UL EDCA channel access requirments. Would both links have the same requirments? Are the requirments same as those defined for single link operations? | Please clarify the frame receiving and processing requirments for an EMLSR device, e.g. frame receiving BW and frame format, in order to set NAV sufficiently. | Revised.  A STA affiliated with a non-AP MLD that is in EMLSR mode uses the same rules for NAV setting and EDCA channel access. Clarified this in a note.  TGbe editor to make the changes with the CID tag (#7832) in doc.: IEEE 802.11-22/214r0 |

**TGbe Editor to make the following changes in Subclause 35.3.17 in TGbe D1.4 :**

**…**

(#6777)NOTE 1—A STA affiliated with a non-AP MLD operating in the EMLSR mode does not need to transmit an initial Control frame to initiate frame exchanges with the AP MLD (#7831, #7832)and follows the rules defined in 10.3.2.4 (Setting and resetting the NAV) and in 10.23.2 (HCF contention based channel access (EDCA)) to access the WM.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause Number** | **Page.**  **Line** | **Comment** | **Proposed Change** | **Resolution** |
| 7334 | stephane baron | 35.3.15 | 281.43 | EMLSR "delay time duration" is not defined nor used later on. | Please replace "delay time duration" by "padding duration required for the non-AP MLD for EMLSR link switch". | Revised.  Agree with the commenter. ‘delay time duration’ is revised to ‘the minimum MAC padding duration of the Padding field of the initial Control frame’, which is used to define the EMLSR Padding Delay subfield in subclause 9.4.2.312.2.  TGbe editor to make the changes with the CID tag (#7831) in doc.: IEEE 802.11-22/214r0  [https://mentor.ieee.org/802.11/dcn/22/11-22-214-00-00be-cc36-cr-emlsr.docx] |
| 6325 | Ming Gan | 35.3.15 | 281.44 | "The delay time duration" is not clear, when does it start? After the initial control frame or after the response frame to initial control frame? | as in the comment | Revised.  For clarity, the ‘delay time duration’ is replaced with the ‘minimum MAC padding duration.’  TGbe editor to make the changes with the CID tag (#6325) in doc.: IEEE 802.11-22/214r0  [https://mentor.ieee.org/802.11/dcn/22/11-22-214-00-00be-cc36-cr-emlsr.docx] |
| 4422 | Arik Klein | 35.3.15 | 281.44 | The AP expected normative behaviour to the EMLSR delay time indication is not clear: the non-AP MLD is required to "indicate the delay time duration in the EMLSR Delay subfield of the EML Capabilities subfield in the Common Info field of the Basic variant MultiLink element". It is not clear what the AP MLD is required to do with this information | Please add a requirement for the AP MLD to send the initiating control frame with padding duration as indicated by the non-AP MLD on any link that the initiating control frame is transmitted. | Revised.  Agree with the commenter. Added a sentence that describes how the value is used for the AP MLD.  TGbe editor to make the changes with the CID tag (#4422) in doc.: IEEE 802.11-22/214r0  [https://mentor.ieee.org/802.11/dcn/22/11-22-214-00-00be-cc36-cr-emlsr.docx] |
| 4698 | Chien-Fang Hsu | 35.3.15 | 281.47 | It is not clear how the AP MLD to select which control frame to initialize the frame exchange. It is could be implementation specific or other rules need to apply. | Adding a note to specify selection of initial control frame is implementation specific or adding rules to clarity when to use MU-RTS and when to use BSRP | Revised.  Added a note saying whether to use MU-RTS or BSRP is implementation specific.  TGbe editor to make the changes with the CID tag (#4698) in doc.: IEEE 802.11-22/214r0  [https://mentor.ieee.org/802.11/dcn/22/11-22-214-00-00be-cc36-cr-emlsr.docx] |

**TGbe Editor to make the following changes in Subclause 35.3.17 in TGbe D1.4 :**

…

— (#2916)(#1773)(#3206)The non-AP MLD shall indicate (#7334, 6325)the minimum MAC padding duration of the Padding field of the initial Control frame in the (#6346)EMLSR Padding Delay subfield of the EML Capabilities subfield in the Common Info field of the (#6700)Basic Multi-Link element.

— (#4759)(#5766)(#6342)(#6350)An AP affiliated with the AP MLD that initiates frame exchanges with the non-AP MLD on one of the EMLSR links shall begin the frame exchanges by transmitting the initial Control frame to the non-AP MLD with the limitations specified above (#4422)and with the padding duration of the Padding field of the initial Control frame set to a value greater than or equal to the value indicated in the EMLSR Padding Delay subfield.

(#4698)NOTE — Whether to use the MU-RTS Trigger frame or the BSRP Trigger frame as the initial Control frame to initiate the frame exchanges is implementation specific and out of scope of this standard.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause Number** | **Page.**  **Line** | **Comment** | **Proposed Change** | **Resolution** |
| 6963 | Sanghyun Kim | 35.3.15 | 281.60 | The non-AP MLD may have switching delay. It is recommended to modify the sentence for reflecting the delay component. | As in the comment | Revised.  Agree with the commenter. In TGbe D1.4, the procedure related to the switching delay has been added as follows:  “— (#5222)The non-AP MLD shall be switched back to the listening operation on the EMLSR links after the time indicated in the EMLSR Transition Delay subfield…”  Note to the editor: no changes needed. |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause Number** | **Page.**  **Line** | **Comment** | **Proposed Change** | **Resolution** |
| 7063 | Sigurd Schelstraete | 35.3.15 | 282.12 | Figures 35-13 to 35-15 provide a nice illustration of sounding. However, it would be more useful to have similar figures for data transmission. | Include figures showing EMLSR frame sequence for data. | Revised.  Agree with the commenter. Added two figures illustrating EMLSR frame exchanges for data.  TGbe editor to make the changes with the CID tag (#7063) in doc.: IEEE 802.11-22/214r0  [https://mentor.ieee.org/802.11/dcn/22/11-22-214-00-00be-cc36-cr-emlsr.docx] |
| 7337 | stephane baron | 35.3.15 | 282.15 | There are 3 example of usage of this mode for sounding. Is the EMLSR mode restricted to the sounding ? Please add a simple example for data transmission. | As in comment | Revised.  Agree with the commenter. Added two figures illustrating EMLSR frame exchanges for data.  TGbe editor to make the changes with the CID tag (#7337) in doc.: IEEE 802.11-22/214r0  [https://mentor.ieee.org/802.11/dcn/22/11-22-214-00-00be-cc36-cr-emlsr.docx] |
| 8357 | Zhiqiang Han | 35.3.15 | 282.16 | There is no difference between EHT non-TB sounding in the EMLSR operation and normal non-TB sounding in Figure 35-13. In normal non-TB sounding, MU-RTS/CTS can be used to reserve the channel.It's better to show the difference in the EMLSR operation in Figure 35-13 | Please clarify it | Rejected.  The figure is illustrating an example to clarify that the frame exchange sequence for the EHT non-TB sounding starts with one of the initial Control frames (in this case MU-RTS) when the beamformee is in EMLSR mode, which is not necessary for the non-EMLSR case. |

**TGbe Editor to make the following changes and insert Figure 35-x1 and Figure 35-x2 in Subclause 35.3.17 in TGbe D1.4 :**

(#6964)NOTE 3—When an AP affiliated with the AP MLD transmits an initial Control frame that initiates frame  
exchanges with more than one non-AP MLD operating in the EMLSR mode, the AP ensures that the padding duration of  
the Padding field of the initial Control frame is greater than or equal to the maximum of the values indicated in the  
EMLSR Padding Delay subfield of the Basic Multi-Link element received from the non-AP MLDs with which the frame  
exchanges are initiated.

(#7063, 7337) An example of a frame exchange sequence that starts with the MU-RTS Trigger frame between an AP affiliated with an AP MLD and a STA affiliated with an non-AP MLD that is in the EMLSR mode is shown in Figure 35-x1(An example of a frame exchange sequence between an AP affiliated with an AP MLD and a STA affiliated with an non-AP MLD that is in the EMLSR mode). An example of a frame exchange sequence that starts with the BSRP Trigger frame between an AP (AP 1) affiliated with an AP MLD and n STAs affiliated with n different non-AP MLDs that are in the EMLSR mode is shown in Figure 35-x2(An example of a frame exchange sequence between an AP (AP 1) affiliated with an AP MLD and n STAs affiliated with n different non-AP MLDs that are in the EMLSR mode).



**Figure 35-x1—An example of a frame exchange sequence between an AP affiliated with an AP MLD and a STA affiliated with an non-AP MLD that is in the EMLSR mode(#7063, 7337)**



**Figure 35-x2— An example of a frame exchange sequence between an AP (AP 1) affiliated with an AP MLD and n STAs affiliated with n different non-AP MLDs that are in the EMLSR mode(#7063, 7337)**