IEEE P802.11Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Proposed Resolutions to 11be LB271 CIDs on EMLSR and P2P Co-existence | | | | |
| Date: 2023-06-25 | | | | |
| Author(s): | | | | |
| Name | Company | Address | Phone | email |
| Qi Wang | Apple Inc. |  |  | qi\_wang2@apple.com |
| Yong Liu | Apple Inc. |  |  |  |

Abstract

This submission proposes the resolutions to 11be LB271CIDs 16337 and 16338, both on EMLSR and P2P co-existence.

The page and line numbers refer to those in 11be\_D3.2 [1].

**Introduction**

This submission proposes the resolutions to 11be LB271CIDs 16337 and 16338, both on the EMLSR and P2P co-existence issue.

The page and line numbers refer to those in 11be\_D3.2 [1].

**Comments:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| CID | Commenter | Page.  Line | Clause | Comment | Proposed change | Resolution |
| 16337 | Yongho Kim | 576.44 | 35.3.21.1 | There is no clear description of the behavior of the AP MLD and other peer non-AP MLDs (or non-AP STAs) when the EMLSR non-AP MLD performs P2P operations, such as TDLS or other direct communications. If the EMLSR non-AP MLD stops performing EMLSR operation and performs as a normal STA, then such period should be informed to the AP in order for the AP not to transmit a packet during the P2P period. | Please clarify the behavior of the AP MLD and Peer MLD for P2P communications with EMLSR non-AP MLD. | Revised.  Agree with the commenter that coordination between an AP MLD and an non-AP MLD is needed for the EMLSR operation if the non-AP MLD has concurrent P2P communication. We proposes to enable a non-AP MLD to indicate its co-existence activities (e.g., P2P) to the AP MLD, so the AP MLD takes the appropriate actions for transmission to the non-AP MLD if the AP MLD doesn’t receive a response to the EMLSR ICF that the AP MLD sends to the non-AP MLD.  TGbe editor: Please incorporate the proposed text change tagged with 16337 in this document. |
| 16338 | Yongho Kim | 473.58 | 35.2.1.2.1 | When EMLSR STA MLD (or STA affiliated with EMLSR STA MLD) is a recipient of P2P(Triggered TXOP Sharing mode 2), EMLSR operating STA can not receive PPDU from non-AP STA without initial control frame. | Please define a procedure to communication with EMLSR operating STA in triggered TXOP sharing mode 2. | Revised.  Agree with the commenter that coordination between an AP MLD and an non-AP MLD is needed for the EMLSR operation if the non-AP MLD has concurrent P2P communication.  We proposes to enable a non-AP MLD to indicate its co-existence activities (e.g., P2P) to the AP MLD, so the AP MLD takes the appropriate actions for transmission to the non-AP MLD if the AP MLD doesn’t receive a response to the EMLSR ICF that the AP MLD sends to the non-AP MLD.  TGbe editor: Please incorporate the proposed text change tagged with 16338 in this document. |

1. **Discussion**

CIDs 16337 and 16338 raise the issue of necessary coordination between infrastructure EMLSR operation and the concurrent P2P operation. We propose to enable an non-AP MLD to indicate its in-device coexistence actives during the EMLSR operation to the AP MLD, so that the AP MLD understand that the co-existence issue is the reason that the non-AP MLD does not respond to the EMLSR ICF that the AP MLD transmits to the non-AP MLD. As a result, the AP MLD takes the appropriate actions for transmission to the non-AP MLD.

1. **Proposed resolution:**

***TGbe editor: Please change the 11be spec as shown below. The reference version is 11be\_D3.2.***

**9.4.1.70 EML Control field**

The EML Control field is defined in Figure 9-189b (EML Control field format).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B3 | B4 B7 |  |  |  |
|  | EMLSR Mode | EMLMR Mode | EMLSR Parameter Update Control | In-device coexistence activities | Reserved | EMLSR/EMLMR Link Bitmap | MCS Map Count Control | EMLMR Supported MCS And NSS Set |
| Bits | 1 | 1 | 1 | 1 | 4 | 0 or 16 | 0 or 8 | Variable |

**Figure 9-189b—EML Control field format** (#166337, #16338)

…

(#166337, #16338) The In-device Co-existence Activities subfield indicates whether the non-AP MLD has in-device coexistence activities on its EMLSR link(s). The subfield is set to 1 to indicate the non-AP MLD has in-device coexistence activities on its EMLSR link(s), and otherwise is set to 0 to indicate the non-AP MLD has no, or does not know whether it has, in-device coexistence activities on the EMLSR link(s).

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 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 EMLSR mode and is a member of the EMLSR links; otherwise the bit position is set to 0. An AP MLD with dot11EHTEMLSROptionImplemented equal to true sets the EMLSR Link Bitmap subfield to the value obtained from the EMLSR Link Bitmap subfield of the received EML Operating Mode Notification frame. The EMLSR Link Bitmap subfield is present if the EMLSR Mode subfield is equal to 1 and is not present otherwise.

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

**….**

When a non-AP MLD with dot11EHTEMLSROptionActivated equal to true intends to enable the EMLSR mode on the EMLSR links, (#15075)then:

— An non-AP STA affiliated with the non-AP MLD shall transmit an EML Operating Mode Notification frame with the EMLSR Mode subfield of the EML Control field of the frame set to 1 to an AP affiliated with (#15562)its associated AP MLD with dot11EHTEMLSROptionActivated equal to true.

— A non-AP MLD may set the Coexistence Activities subfield of the EML Control field of the EML Operating Mode Notification frame to 1 to indicate that it has in-device coexistence activities on the EMLSR links, and to 0 to indicate that it has no, or does not know whether it has, in-device coexistence activities on the EMLSR link(s). (#166337, #16338)

— An AP affiliated with the AP MLD (#16675)should (#15592)successfully transmit an EML Operating Mode Notification frame, after the AP MLD is ready to serve the non-AP MLD in the EMLSR (#15112)operation, as a response to the received EML Operating Mode Notification frame, to (#16675)a non-AP STA that is in (#16258)the awake state and affiliated with the non-AP MLD(#16918), within the (#15080)transition timeout interval, and the following rules apply:

a)  (#15884)The transition timeout interval is indicated in the Transition Timeout subfield in the EML Capabilities subfield of the Basic Multi-Link element.

b)  The transition timeout interval starts at the end of the PPDU[+SigExt] that is transmitted by the AP affiliated with the AP MLD carrying the immediate acknowledgement to the EML Operating Mode Notification frame transmitted by the STA affiliated with the non-AP MLD.

c)  The EML Control field of the EML Operating Mode Notification frame transmitted by the AP affiliated with the AP MLD is set to the same value as the EML Control field in the received (#16232)EML Operating Mode Notification frame.

…..

When a non-AP MLD is operating in the EMLSR mode with an AP MLD supporting the EMLSR mode, the following applies:

a) The non-AP MLD shall be able to listen on the EMLSR link(s), by having its affiliated non-AP STA(s) corresponding to those links in the awake state. The listening operation includes CCA and receiving the initial Control frame of frame exchanges that are initiated by the AP MLD.

NOTE 2—A non-AP STA operating on one of the EMLSR links can change its power management mode and follows the procedure in 11.2 (Power management). A non-AP STA can listen on one of the EMLSR links in active mode or in PS mode when it is in the awake state.

b) On the EMLSR link(s), the group addressed frame(s) that are expected to be received by the non-AP MLD shall be buffered and delivered following the rules defined in 35.3.15 (Multi-link operation group addressed frames).

c) An AP affiliated with the AP MLD that initiates frame exchanges that are neither group addressed Data nor group addressed Management frames 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 below.

• The initial Control frame of frame exchanges shall be sent in the non-HT PPDU or non-HT duplicate PPDU format using a rate of 6 Mb/s, 12 Mb/s, or 24 Mb/s.

• The non-AP MLD shall indicate the EMLSR padding delay, which is the minimum MAC padding duration of the initial Control frame, in the EMLSR Padding Delay sub- field of the EML Capabilities subfield in the Common Info field of the Basic Multi-Link element carried in a (Re)Association Request frame that it transmits.

• The non-AP MLD may update the EMLSR padding delay by including an updated EMLSR Padding Delay duration in the EMLSR Parameter Update field in the EML Operating Mode Notification frame.

• The AP affiliated with the AP MLD shall set the length of the Padding field of the initial Control frame based on the rules defined in 35.5.2.2.3 (Padding for a triggering frame) to ensure that the MAC padding duration of the initial Control frame is greater than or equal to the EMLSR padding delay last indicated by the non-AP MLD either in the EMLSR Padding Delay subfield of the EML Capabilities subfield in the Common Info field of the Basic Multi-Link ele- ment or in the EMLSR Padding Delay subfield of the EMLSR Parameter Update field in the last successfully transmitted EML Operating Mode Notification frame.

• The initial Control frame shall be an MU-RTS Trigger frame or a BSRP Trigger frame. A non- AP STA affiliated with a non-AP MLD that is in the listening operation and that receives an MU- RTS Trigger Frame or BSRP Trigger frame addressed to it shall respond as defined in 35.5.2.3 (Non-AP STA behavior for UL MU operation) except when the frame exchanges initiated by the initial Control frame on one of the EMLSR links overlap with group addressed frame transmissions on the other EMLSR link where the non-AP STA intends to receive the group addressed frames. The number of spatial streams for the response to the BSRP Trigger frame shall be limited to one, which shall be indicated in the BSRP Trigger frame.

NOTE 3—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.

(#166337, #16338) NOTE x – If an AP MLD has received an EML Operating Mode Notification frame with the In-device Coexistence Activities subfield of the EML Control field set to 1 from a non-AP MLD, and the AP MLD does not receive a response to an initial Control frame that it transmits to the non-AP MLD, then the AP can consider the non-response as a result of the in-device coexistence events at the non-AP MLD on the link where the frame was transmitted. The AP is recommended to consider the in-device coexistence indication and select appropriate transmission parameters (e.g., transmission rate) and methods (e.g., SU or MU transmission) for the non-AP MLD.

d) After receiving the initial Control frame of frame exchanges and transmitting an immediate response frame as a response to the initial Control frame, a non-AP 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 on 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 the minimum MAC padding duration of the Padding field of the initial Control frame, the non-AP STA affiliated with the non-AP MLD shall be capable of receiving a PPDU that is sent using more than one spatial stream on the link on which the initial Control frame was received a SIFS after the end of its response frame transmission solicited by the initial Control frame. During the frame exchanges, the other AP(s) affiliated with the AP MLD shall not transmit frames to the other non-AP STA(s) affiliated with the non-AP MLD on the other EMLSR link(s).

e) The non-AP MLD shall indicate its EMLSR transition delay in the EMLSR Transition Delay subfield of the EML Capabilities subfield in the Common Info field of the Basic Multi-Link element carried in a (Re)Association Request frame that it transmits. The non-AP MLD may update its EMLSR transition delay by including the EMLSR Parameter Update field in an EML Operating Mode Notification frame.

f) When the EMLSR Parameter Update field is present in an EML Operating Mode Notification frame, the EMLSR Link Bitmap subfield of the EML Control field shall contain a different value than the EMLSR Link Bitmap value contained in the most recent EML Operating Mode Notification frame successfully transmitted by the non-AP MLD.

g) The non-AP MLD shall be switched back to the listening operation on the EMLSR links after the EMLSR transition delay time most recently indicated by the non-AP MLD, if any of the following conditions is met and this is defined as the end of the frame exchanges:

• The MAC of the non-AP STA affiliated with the non-AP MLD that received the initial Control frame does not receive a PHY-RXSTART.indication primitive during a timeout interval of aSIFSTime + aSlotTime + aRxPHYStartDelay, where aRxPHYStartDelay is equal to 20 μs, starting at the end of the PPDU transmitted by the non-AP STA affiliated with the non-AP MLD as a response to the most recently received frame from the AP affiliated with the AP MLD or starting at the end of the reception of the PPDU containing a frame for the non-AP STA from the AP affiliated with the AP MLD that does not require immediate acknowledgement.

• The MAC of the non-AP STA affiliated with the non-AP MLD that received the initial Control frame receives a PHY-RXSTART.indication primitive during a timeout interval of aSIFSTime + aSlotTime + aRxPHYStartDelay starting at the end of the PPDU transmitted by the non-AP STA affiliated with the non-AP MLD as a response to the most recently received frame from the AP affiliated with the AP MLD or starting at the end of the reception of the PPDU containing a frame for the non-AP STA from the AP affiliated with the AP MLD that does not require imme- diate acknowledgement and this non-AP STA does not detect, within the PPDU corresponding to the PHY-RXSTART.indication any of the following frames:

-  an individually addressed frame with the RA equal to the MAC address of the non-AP STA affiliated with the non-AP MLD

-  a Trigger frame that has one of the User Info fields addressed to the non-AP STA affiliated with the non-AP MLD

-  a CTS-to-self frame with the RA equal to the MAC address of the AP affiliated with the AP MLD

-  a Multi-STA BlockAck frame that has one of the Per AID TID Info fields addressed to the non-AP STA affiliated with the non-AP MLD

-   an NDP Announcement frame that has one of the STA Info fields addressed to the non-AP STA affiliated with the non-AP MLD and a sounding NDP

• The non-AP STA affiliated with the non-AP MLD that received the initial Control frame does not respond to the most recently received frame from the AP affiliated with the AP MLD that requires an immediate response after a SIFS.

h) The AP affiliated with the AP MLD should transmit before the TXNAV timer expires another initial Control frame addressed to the non-AP STA affiliated with the non-AP MLD if the AP intends to continue the frame exchanges with the STA and did not receive the response frame from this STA for the most recently transmitted frame that requires an immediate response after a SIFS.

i) Any one of the non-AP STAs affiliated with the non-AP MLD that is operating on one of the EMLSR links may nitiate frame exchanges with the AP MLD.

j) When a non-AP STA affiliated with the non-AP MLD initiates a TXOP, the following applies:

• The non-AP MLD shall be switched back to the listening operation on the EMLSR links after the EMLSR transition delay time indicated by the non-AP MLD after the end of the TXOP.

NOTE 4—A non-AP 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 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.

NOTE 5—The rules above also apply to a sounding sequence.

NOTE 6—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 (#16621)the length of the Padding field of the initial Control frame is calculated based on the rules in 35.5.2.2.3 (Padding for a triggering frame) to ensure that the MAC padding duration 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 elements received from the non-AP MLDs with which the frame exchanges are initiated.

NOTE 7—A non-AP STA affiliated with the non-AP MLD follows the rules defined in 11.2.3.7 (Receive operation for STAs in PS mode) and 11.2.3.8 (Receive operation using APSD).

NOTE 8—A non-AP STA affiliated with a non-AP MLD that is operating in the EMLSR mode can receive Beacon frames at scheduled beacon transmission times (i.e., TBTT).

NOTE 9—The MU-RTS Trigger frame can be used to initiate frame exchanges with one or more STAs affiliated with non-AP MLDs in the EMLSR mode.

Examples of frame exchanges during EMLSR operation are shown in AF.14 (Examples of enhanced multi-link single radio operation).

**References**

[1] IEEE P802.11be™/D3.2, Draft standard for information technology – Telecommunications and information exchange between systems local and metropolitan area networks – Specific requirements Part 11: Wireless LAN medium access control (MAC) and physical layer (PHY) specifications, Amendment 9: Enhancements for extremely high throughput (EHT)

Amendment 4: Enhancements for positioning