IEEE P802.11Wireless LANs

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| Proposed Resolutions to A few 11be LB275 CIDs on EMLSR  |
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Abstract

This submission proposes the resolutions to 11be LB275 CIDs 19521, 19522, and 19904, all on EMLSR.

The page and line numbers refer to those in 11be\_D4.1 [1].

**Introduction**

This submission proposes the resolutions to 11be LB275 CIDs 19521, 19522, and 19904, all on EMLSR.

The page and line numbers refer to those in 11be\_D4.1 [1].

**Comment:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| CID | Commenter | Page.Line | Clause | Comment | Proposed change | Resolution |
| 19521 | Qi Wang | 564.35 | 35.3.17 | "A non-AP MLD may set the In-Device 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)." A non-AP MLD may need to update the setting of the In-Device Coexistence Activities subfield during the EMLSR operation. | After the cited text, please add a new sentence: "During the EMLSR operation, a non-AP MLD may transmit an EML Operating Mode Notification frame to modify the value of the In-Device Coexistence Activities subfield of the EML Control field of the EML Operating Mode Notification frame." | Revised. Agree with the commenter that the In-Device Coexistence Activities subfield of the EML Control field of the EML Operating Mode Notification frame can be updated after the initial setting. In addition, the 11be spec needs to specify that this field is reserved in the EML Operating Mode Notification frame transmitted by an AP affiliated with an AP MLD. TGbe editor: Please incorporate the proposed text change tagged with 19521 in this document.  |

***TGbe editor: Please change the 11be spec as shown below. The reference version is 11be\_D4.1 (#19521).***

**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**

…

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). When included in a frame transmitted by an AP affiliated with an AP MLD, the In-device Coexistence Activities subfield is reserved.

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

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

…

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) A non-AP STA affiliated with the non-AP MLD may transmit an EML Operating Mode Notification frame to update the value of the In-Device Coexistence Activities subfield of the EML Control field of the most recent EML Operating Mode Notification frame successfully transmitted by a non-AP STA affiliated with the non-AP MLD.(# 19521)

**Comment:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 19522 | Qi Wang | 583.64 | 35.3.17 | "...The specified set of the enabled links on 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." The 11be spec should explicitly allow the setting of a single bit in the EMLSR Link Bitmap to 1. | Please modify the cited text to: "...The specified set of the enabled links on which the EMLSR mode is applied is called EMLSR link(s). The EMLSR link(s) 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 position(s) of the EMLSR Link Bitmap subfield to 1." And, add a note after the cite text: "NOTE - A non-AP MLD might only set one bit to 1 in the bit positions of the EMLSR Link Bitmap subfield when the non-AP MLD enables the EMLSR mode. " | Revised. Agree with the commenter that an explicit statement that a non-AP MLD may set one or more bits to 1 in the bit position of the EMLSR Link Bitmap subfield when the non-AP MLD enables the EMLSR mode. Other text changes are needed to specify consistently that EMLSR mode can be operated on one or more links. TGbe editor: Please incorporate the proposed text change tagged with 19522 in this document.  |
| 19904 | Liwen Chu | 563.47 | 5.3.17 | some place allows single link EMLSR, some places don't allow single link EMLSR. | Fix the issue | Revised. Agree with the commenter the 11be spec text needs to be consistent on this issue. TGbe editor: Please incorporate the proposed text change tagged with 19522 in this document.  |

***TGbe editor: Please change the 11be spec as shown below. The reference version is 11be\_D4.1 (#19522)***

**9.4.1.70 EML Control field**

**….**

***TGbe editor: 11be\_D4.1, page 211, line 7—16:***

The EMLSR Link Bitmap subfield indicates the subset of the enabled link(s) 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 link(s); 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**

***TGbe editor:11be\_D4.1, page 574 line 28 – P579, line 2***

The EMLSR operation defined in this subclause allows a non-AP MLD with multiple receive chains to listen on one or more EMLSR links when the corresponding non-AP STA(s) affiliated with the non-AP MLD being in the awake state, as defined below, for an initial Control frame sent by an AP affiliated with an AP MLD in a non-HT (duplicate) PPDU, followed by frame exchanges on the link on which the initial Control frame was received.

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

An AP MLD with dot11EHTEMLSROptionActivated equal to true shall follow the rules defined in this subclause.

A non-AP MLD may operate in the EMLSR mode on a specified set of the enabled link(s) between the non-AP MLD and its associated AP MLD. The specified set of the enabled link(s) on which the EMLSR mode is applied is called EMLSR link(s). The EMLSR link(s) 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 position(s) of the EMLSR Link Bitmap subfield to 1. A non-AP MLD may set one or more bits to 1 in the bit position(s) of the EMLSR Link Bitmap subfield of the EML Control field of the EML Operating Mode Notification frame when the non-AP MLD requests to enable the EMLSR mode. The EMLSR Link Bitmap subfield value of the latest EML Operating Mode Notification frame successfully transmitted by the non-AP MLD indicates the link(s) of the EMLSR operation. (#19522) 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 enabled link(s) that corresponds to the bit position(s) of the EMLSR Link Bitmap subfield equal to 0 shall be in doze state if a non-AP STA affiliated with the non-AP MLD that operates on one of the EMLSR link(s) is in awake state.

When a non-AP MLD with dot11EHTEMLSROptionActivated equal to true (re)associates with an AP MLD, the EMLSR mode is disabled by default.

An MLD with dot11EHTEMLSROptionActivated equal to true shall set the EML Capabilities Present subfield to 1 and shall set the EMLSR Support subfield in the Common Info field of the Basic Multi-Link element (9.4.2.312.2 (Basic Multi-Link element)) to 1 in all Management frames that include the Basic Multi-Link element except Authentication frames. An MLD with dot11EHTEMLSROptionActivated equal to false and dot11EHTEMLMROptionActivated equal to true (see 35.3.18 (Enhanced multi-link multi-radio operation)) shall set the EML Capabilities Present subfield to 1 and shall set the EMLSR Support subfield of the EML Capabilities subfield to 0. An MLD with dot11EHTEMLSROptionActivated equal to false and dot11EHTEMLMROptionActivated equal to false shall set the EML Capabilities Present subfield to 0.

When a non-AP MLD is operating in EMLSR mode on the EMLSR link(s), the non-AP STA(s) operating on the EMLSR link(s) and affiliated with the non-AP MLD shall not operate in dynamic SM power save mode (11.2.6 (SM power save)) on the EMLSR link(s).

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

—  A 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 its associated AP MLD with dot11EHTEMLSROptionActivated equal to true.

—  A non-AP MLD may set the In-Device 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 link(s), 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).

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

a)  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 EML Operating Mode Notification frame.

—  The non-AP MLD shall operate in the EMLSR mode on the EMLSR link(s) and the other non-AP STA(s) affiliated with the non-AP MLD operating on the corresponding EMLSR link(s), which did not transmit the EML Operating Mode Notification frame, shall transition to active mode without being required to transmit a frame with the Power Management subfield set to 0, either:

a) At the end of the transition timeout interval, or

1. Before the end of the transition timeout interval, immediately after transmitting an acknowledgment as a response to the received EML Operating Mode Notification frame from one of the APs affiliated with the AP MLD,

whichever comes first.

—  Any of the other non-AP STA(s) operating on the corresponding EMLSR link(s) shall not transmit a frame with the Power Management subfield set to 1 before receiving the EML Operating Mode Notification frame from one of the APs affiliated with the AP MLD or before the end of the transition timeout interval, whichever comes first.

When a non-AP MLD with dot11EHTEMLSROptionActivated equal to true intends to disable the EMLSR mode, then:

— A 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 0 to an AP affiliated with its associated AP MLD with dot11EHTEMLSROptionActivated equal to true.

— An AP affiliated with the AP MLD should successfully transmit an EML Operating Mode Notification frame, after the AP MLD is no longer serving the non-AP MLD in the EMLSR operation, as a response to the received EML Operating Mode Notification frame, to a non-AP STA that is in the awake state and affiliated with the non-AP MLD, within the transition timeout interval, and the following rules apply:

a) 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 non-AP 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 EML Operating Mode Notification frame.

— The non-AP MLD shall disable the EMLSR mode and the other non-AP STA(s) affiliated with the non-AP MLD operating on the corresponding EMLSR link(s), which did not transmit the EML Operating Mode Notification frame, shall transition to power save mode without being required to transmit a frame with the Power Management subfield set to 1, either:

a) At the end of the transition timeout interval, or

b) Before the end of the transition timeout interval, immediately after transmitting an acknowledgment as a response to the received EML Operating Mode Notification frame from one of the APs affiliated with the AP MLD,

whichever comes first.

— Any of the other non-AP STA(s) operating on the corresponding EMLSR link(s) shall not transmit a frame with the Power Management subfield set to 0 before receiving the EML Operating Mode Notification frame from one of the APs affiliated with the AP MLD or before the end of the transition timeout interval, whichever comes first.

NOTE 1—Each of the STAs on the other link(s) of the EMLSR links can transmit a frame with the Power Management subfield set to 1 and transition to power save mode immediately after successful transmission of the frame as described in 11.2.3.2 (Non-AP STA power management modes).

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 link(s) 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 link(s) 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 pad- ding duration of the initial Control frame, in the EMLSR Padding 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 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 element 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.

NOTE 4—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 nonresponse 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 and methods 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).

1. 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.
2. 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.
3. The non-AP MLD shall be switched back to the listening operation on the EMLSR link(s) 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 aSIF- STime + 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 immediate 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 STA(s) affiliated with the non-AP MLD that is operating on one of the EMLSR link(s) may initiate 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 link(s) after the EMLSR transition delay time indicated by the non-AP MLD after the end of the TXOP.

NOTE 5—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 6—The rules above also apply to a sounding sequence.

NOTE 7—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 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 8—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 9—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 10—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™/D4.1, 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