IEEE P802.11
Wireless LANs

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| CR for CIDs related to EMLSR Group-addressed frame Reception |
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 Abstract

This submission proposes resolution for 3 CIDs received for TGbe CC36:

SP: Do you agree to the resolutions provided in doc 11-22/0335r2 for the following CIDs for inclusion in the latest 11be draft?

6946 6646 5378

Result: Yes/No/Abstain

**Revisions:**

* Rev 0: Initial version of the document.
* Rev 1: Based on offline comments from Jay Yang, Yiqing Li.
* Rev 2: Based on further offline comments from Yongho Seok, Xiangxin Gu.

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.***

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| **CID** | **Commenter** | **Section** | **Pg.Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 6946 | Saju Palayur | 10.49 | 0.00 | an AP MLD should allow EMLSR to receive management frames (e.g. beacons) transmitted over multi-links. Hence it should not transmit to EMLSR while Beacon is transmitted on the other link. The standard need to provide normative or mechanism to address | add normative that disallow the AP MLD to transmit EMLSR while beacon is transmitted on the other link.Add normative that synchronize the transmission time of beacons in multi-link | **Revised**Agree with the comment. Behavior of AP MLD and EMLSR non-AP MLD for the transmission and reception of group addressed frames is specified. A procedure for non-AP MLD operating in EMLSR mode to nominate a primary link for receiving group addressed frames is provided.**TGbe editor: Please implement all changes tagged as 6946 as shown in doc 11-22/0335r2.** |
| 6646 | Prabodh Varshney | 35.3.13 | 0.00 | Define a mechanism to address the constraint issue between two non-AP MLDs that elect different links to receive groupcast data frame and operate others into PS mode, and the similar issue between non-AP MLDs and legacy STAs. | In order to address the groupcast data frame delay issue caused by non-AP MLD ,AP MLD may not buffer the groupcast data frame on the link where the associated non-AP MLD doesn't intend to receive the groupcast data frame. | **Rejected.**No consensus was reached based on 1261r3  |
| 5378 | Jay Yang | 35.3.13 | 0.00 | 11be shall define a mechanism to address the constraint issue between two non-AP MLDs that elect different links to receive groupcast data frame and operate others into PS mode, and the similar issue between non-AP MLDs and legacy STAs.e.g. non-AP MLD1 and non-AP MLD2 set up multiple link connection with AP MLD on link1 and link2, non-AP MLD1 elects link1 on awake state to receive groupcast data frame, let link2 enter PS mode. while non-AP MLD2 keep awake on link2 to receive groupcast data frame, and let link1 enter PS mode. The groupcast frame will be buffered on both links and cause a higher delay issue. | In order to address the group-cast data frame delay issue caused by non-AP MLD, AP MLD may not buffer the group-cast data frame on the link where the associated non-AP MLD doesn't intend to receive the group-cast data frame. | **Rejected.**No consensus was reached based on 1261r3 |

## Discussion:

Since an EMLSR non-AP MLD can only receive frames on one EMLSR-enabled link at a time, an AP of an AP MLD should terminate a frame exchange sequence with an EMLSR non-AP MLD before the group-addressed frame transmission time on another EMLSR link, if the non-AP MLD is expected to receive those group-addressed frames. This is so that the non-AP MLD can switch to the corresponding link and decode the group-addressed frames. Similarly, when an EMLSR non-AP MLD is receiving group-addressed frames on an EMLSR-enabled link, it may not be able to receive and respond to initial control frames (ICFs) transmitted by an AP of the AP MLD on another EMLSR-enabled link. This can cause the AP to lose the TXOP and suffer a back-off if the ICF it transmits initiates the TXOP. Therefore, an AP of the AP MLD should not transmit an ICF to a STA of an EMLSR non-AP MLD if the ICF overlaps in time with the group-addressed frame transmission time on another EMLSR link, if the non-AP MLD is expected to receive those group-addressed frames. Additional ‘guard time’ should also be considered to account for the EMLSR Transition delay which is required by the EMLSR non-AP MLD to switch between links. The above discussion is depicted pictorially below, where a beacon frame on link 2 is used as an example for the group addressed frame to be decoded by STA2 of the non-AP MLD, and to enable such reception, a frame exchange sequence on link 1 is terminated and an ICF restriction region is used on link 3.



Since there is no existing way for an AP MLD to know which group-addressed frames the non-AP MLD intends to receive and on which link, as per baseline the aforementioned procedures may need to be followed for all EMLSR links. However, such a termination of frame exchange sequences before group-addressed frame transmissions on all other EMLSR links and the avoidance of group addressed frame times for transmission of ICFs can significantly impact both the downlink throughput and uplink throughput (in case of trigger-based uplink) of an EMLSR device that has two or more EMLSR links. Correspondingly, it is beneficial to add an optional procedure whereby an EMLSR non-AP MLD can nominate a primary link for receiving group-addressed frames. This enables the AP MLD to only follow the aforementioned procedures on terminating frame exchange sequences and restriction on transmitting ICFs, for group-addressed frames that are transmitted on the primary link, thus improving the downlink throughput of an EMLSR non-AP MLD. Note that an EMLSR non-AP MLD that has nominated a primary link can still occasionally receive group-addressed frames on a non-primary link, albeit without the protection of frame exchange terminations on other links.

***TGbe editor: Please note Baseline is 11be D1.******4***

**9.4.1.74 EML Control field**

***TGbe editor: Please insert the following paragraphs at the end of the subclause (#6946)***

 B0 B1 B2 B17 B18 B19 B20 B23

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| EMLSR mode | EMLMR Mode | EMLSR Link Bitmap | EMLSR Primary Link | Reserved |

 Bits: 1 1 16 3 3

 **Figure 9-144i—EML Control field format**(#6946)

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.

(#6946)The EMLSR Primary link subfield, in conjunction with the EMLSR Link Bitmap subfield, indicates the link ID of the primary link that should be used by the non-AP MLD in EMLSR mode for receiving group-addressed frames from the associated AP MLD. A value of *i* in the EMLSR Primary link subfield indicates that the position of the *i*-th bit that is set to 1 in the EMLSR Link Bitmap subfield corresponds to the link ID that should be used for receiving group-addressed frames. A value of 0 in the EMLSR Primary link subfield indicates that a primary link has not been nominated.

**35.3.15.2 Group addressed frame reception**

***TGbe editor: Please insert the following paragraphs at the end of the subclause (#6946)***

If an indication of buffered group addressed frames in the TIM element about an AP in an AP MLD is received by any STA affiliated with a non-AP MLD, the STA affiliated with the non-AP MLD that is associated with the AP and that stays awake to receive group addressed BUs shall elect to receive all group addressed frames that are scheduled for delivery in that link.

(#6946)An EMLSR non-AP MLD that has nominated a primary link with the associated AP MLD intends to use the STA operating on the primary link for receiving the group addressed frames, unless there is an exception requiring a STA on a non-primary link to receive group addressed frames.

NOTE: Such exceptions include a STA affiliated with an EMLSR non-AP MLD receiving a TIM element indicating buffered group-addressed frames at an AP operating on a non-primary link, or receiving a BSS Parameter Change Count subfield for an AP operating on a non-primary link that is different from the previously received value.

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

***TGbe editor: Please insert the following paragraphs to the subclause (#6946)***

When a non-AP MLD with dot11EHTEMLSROptionImplemented equal to true intends to operate in the EMLSR mode on the EMLSR links, a 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 an AP MLD with dot11EHTEMLSROptionImplemented equal to true. An AP affiliated with the AP MLD that received the EML Operating Mode Notification frame from the STA affiliated with the non-AP MLD should transmit an EML Operating Mode Notification frame to one of the STAs affiliated with the non-AP MLD within the timeout interval indicated in the Transition Timeout subfield in the EML Capabilities subfield of the Basic Multi-Link element starting at the end of the PPDU transmitted by the AP affiliated with the AP MLD as an acknowledgement to the EML Operating Mode Notification frame transmitted by the STA affiliated with the non-AP MLD. After the successful transmission of the EML Operating Mode Notification frame on one of the EMLSR links by the STA affiliated with the non-AP MLD, the non-AP MLD shall operate in the EMLSR mode and the STAs on the other links of the EMLSR links shall transition to active mode after the transition delay indicated in the Transition Timeout subfield in the EML Capabilities subfield of the Basic Multi-Link element or immediately after receiving an EML Operating Mode Notification frame from one of the APs operating on the EMLSR links and affiliated with the AP MLD. A STA on one of the other links of the EMLSR links shall not transmit a frame with the Power Management subfield set to 1 before receiving the EML Operating Mode Notification frame from the AP affiliated with the AP MLD or before the end of the timeout interval.

(#6946)To nominate or terminate a primary link for group-addressed frame reception, a STA affiliated with the non-AP MLD shall transmit an EML Operating Mode Notification frame with the EMLSR primary link subfield of the EML Control field of the frame set to a non-zero or zero value, respectively, to an AP affiliated with the associated AP MLD. The AP affiliated with the AP MLD that receives the EML Operating Mode Notification frame should set the EMLSR primary link subfield of the EML Control field in the response EML Operating Mode Notification frame to the same value as in the received EML Operating Mode Notification frame from the non-AP MLD. Upon receiving, by an STA affiliated with the non-AP MLD, a response EML Operating Mode Notification frame from the associated AP, the primary link nomination or termination is deemed successful. If unsuccessful, an existing primary link, if any, shall continue to be applicable. An EMLSR non-AP MLD that has nominated a primary link with the associated AP MLD shall follow the rules defined in 35.3.15.2 (Group addressed frame reception) for receiving the group addressed frames.***…***

* The AP affiliated with the AP MLD should transmit before the TXNAV timer expires another initial Control frame addressed to the 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.
* (#6946)An AP affiliated with the AP MLD should end frame exchanges initiated with a STA affiliated with the non-AP MLD in one of the EMLSR links at least an EMLSR transition delay, indicated in the EMLSR Transition Delay subfield, before another AP affiliated with the same AP MLD schedules for transmission group addressed MPDUs in another EMLSR link, if the STA affiliated with the non-AP MLD in the other EMLSR link is expected to receive those group addressed frames.
* (#6946)An AP affiliated with the AP MLD should not initiate a frame exchanges with a STA affiliated with the non-AP MLD in one of the EMLSR links either during or within an EMLSR transition delay, indicated in the EMLSR Transition Delay subfield, of the end of group addressed MPDU transmissions by another AP affiliated with the same AP MLD in another EMLSR link, if the STA affiliated with the non-AP MLD in the other EMLSR link is expected to receive those group addressed frames.
* (#6946)If an AP affiliated with the AP MLD initiates frame exchanges with a STA that is affiliated with the non-AP MLD on one of the EMLSR links and the frame exchanges overlap in time with the reception of group addressed MPDUs in another EMLSR link, then the STA affiliated with the non-AP MLD may not respond to the initial Control frame that is transmitted by the AP affiliated with the AP MLD to initiate the frame exchanges.

NOTE: The expectation to receive group addressed frames on a link by an EMLSR non-AP MLD can be inferred at the AP MLD from, for example, the primary link nomination, wake TBTT negotiation as defined in 26.8.6 (Negotiation of wake TBTT and wake interval).

* 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.
	+ (#6946)The STA should end the TXOP at least EMLSR transition delay, indicated in the EMLSR Transition Delay subfield, before the TBTT(s) of the other EMLSR link(s) if the non-AP MLD intends to receive the Beacon frame(s) that are scheduled to be transmitted in those TBTT(s)
* 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.

NOTE—The STA might not do so if it is not aware of the TSF of the other link(s).