IEEE P802.11
Wireless LANs

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| CR for CIDs related to EMLSR Beacon Transmission and Reception |
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 Abstract

This submission proposes resolution for 1 CID received for TGbe CC36:

SP: Do you agree to the resolutions provided in doc 11-22/xxxxr0 for the following CIDs for inclusion in the latest 11be draft?

6946 5378

**Revisions:**

* Rev 0: Initial version of the document.

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 to negotiate 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/xxxxr0.** |
| 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. | **Revised**Agree in principle with the comment. Behavior of group-addressed data frame buffering when one of the recipients is an EMLSR non-AP MLD with a primary link negotiated, is specified.**TGbe editor: Please implement all changes tagged as 5378 as shown in doc 11-22/xxxxr0.** |

## 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 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 initial control frame it transmits initiates the TXOP. Therefore, an AP of the AP MLD should not transmit an initial control frame to a STA of an EMLSR non-AP MLD if the initial control frame 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.



Since there is no existing way for an AP MLD to know on which link and which group-addressed frames the non-AP MLD intends to receive, as per baseline the aforementioned procedures may need to be followed for all other 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 initial control frames 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 negotiate a primary link receiving group-addressed frames. This enables the AP MLD to only follow the aforementioned procedures on terminating frame exchange sequences and restriction on transmitting initial control frames, for group-addressed frames that are only transmitted on the primary link, thus improving the downlink throughput of an EMLSR non-AP MLD. Another advantage of the primary link negotiation is that the AP MLD need not buffer group-addressed frames on a non-primary link of the EMLSR non-AP MLD if the other recipient STAs of the group-cast frames are in active mode.

***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 2 4

 **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 to 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 shall 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 negotiated.

**35.3.15.1 Group addressed frame delivery**

***TGbe editor: Please revise the subclause as follows (#6946)***

Each AP affiliated with an AP MLD shall schedule for transmission buffered group addressed frames immediately after every DTIM beacon except that a TWT scheduling AP affiliated with that AP MLD shall schedule for transmission the buffered group addressed frames during the broadcast TWT SPs located within the beacon interval during which the DTIM Beacon frame is transmitted (see 26.8.3.2 (Rules for TWT scheduling AP)).

(#6946)(#5378)An AP MLD shall not buffer group addressed data frames on a link where there is no non-MLD non-AP STA associated or no non-MLD non-AP STAs operating in the PS mode, and no associated non-AP MLDs in EMLSR mode that are expected to receive the group addressed data frames on that link.

**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 negotiated a primary link with the associated AP MLD by transmitting an EML Operating mode notification frame with the EMLSR Primary Link sub-field of the EML Control field set to a non-zero value, shall use the STA affiliated with the primary link for receiving the group addressed frames.

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

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

(#6946)When a non-AP MLD with dot11EHTEMLSROptionImplemented equal to true intends to negotiate or change 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 value, to an AP affiliated with the associated AP MLD with dot11EHTEMLSROptionImplemented equal to true. The associated AP MLD may either accept or reject a primary link negotiation with an EMLSR non-AP MLD by setting, in the response EML Operating Mode Notification frame that is transmitted by an AP affiliated with the AP MLD, the EMLSR primary link subfield of the EML Control field to either the same value as in the received EML Control field from the non-AP MLD or to zero. Upon receiving, in response to a transmitted EML Operating Mode Notification Frame, an EML Operating Mode Notification frame from an AP affiliated the associated AP MLD on one of the EMLSR links by the STA affiliated with the non-AP MLD with a matching EMLSR primary link subfield in the EML Control field to the transmitted EML Operating Mode Notification Frame, the primary link negotiation is deemed successful. Upon failure of a primary link negotiation, the existing primary link negotiation, if any, shall continue to be applied. When a non-AP MLD with dot11EHTEMLSROptionImplemented equal to true that is operating in EMLSR mode intends to terminate a primary link negotiation 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 zero value to an AP affiliated with the associated AP MLD with dot11EHTEMLSROptionImplemented equal to true.

(#6946)An EMLSR non-AP MLD that has negotiated 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. When a STA affiliated with an EMLSR non-AP MLD that has negotiated a primary link receives a BSS Parameter Change Count subfield for an AP operating on a non-primary link that is affiliated with an AP MLD with which the non-AP MLD has performed multi-link setup and the value of the BSS Parameter Change Count subfield for the AP is different from the previously received value and if there is no exception, then an STA of the non-AP MLD shall transmit a probe request frame to the associated AP soliciting information of the AP as defined in 35.3.8 (BSS parameter critical update procedure).

***…***

* 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 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 a non-AP MLD can be inferred at the AP MLD from, for example, the primary link negotiation, wake TBTT negotiation as defined in 26.8.6 (Negotiation of wake TBTT and wake interval).

* (#6946)A STA affiliated with the non-AP MLD that initiates frame exchanges in one of the EMLSR links 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 STA intends to receive the Beacon frame(s) that are scheduled to be transmitted in those TBTT(s)

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