IEEE P802.11
Wireless LANs

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| LB266 CR on Measurement Report for Low-latency Traffic |
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Abstract

This submission contains proposed comment resolutions to comments on P802.11be D2.0. The following CIDs are resolved:

12413, 12809, 13919

10386, 12158, 10572

Revisions:

- Rev 0: Initial version of the document.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page.****Line** | **Comment** | **Proposed Change** | **Resolution** |
| 12413 | 35.3.12.4 | 442.43 | In draft 2.0, unicast traffic indication is stated:"An AP MLD may recommend a non-AP MLD to use one or more enabled links to retrieve individually addressed buffered BU(s). The AP's indication may be carried in a broadcast or a unicast frame."However, no unicast traffic indication method is defined in draft 2.0. | Please define a unicast ML taffic indication method. | RevisedAgreed in principle. It’s better to use the A-control subfield to carry the link recommendation info to exchange frames both in DL and UL. Instructions to the editor:Please make the changes with the CID tag (#12413) as shown in 11/22-1517r2 |
| 12809 | 35.3.12.4 | 442.44 | Define the unicast link recommendation mechanism. | Allow the link recommendation frame to be sent in unicast manner. | RevisedAgreed in principle. It’s better to use the A-control subfield to carry the link recommendation info to exchange frames both in DL and UL. Instructions to the editor:Please make the changes with the CID tag (#12413) as shown in 11/22-1517r2 |
| 13919 | 35.3.12.4 | 442.44 | unicast way is missing, please complete it | please complete the case of unicast way | RevisedAgreed in principle. It’s better to use the A-control subfield to carry the link recommendation info to exchange frames both in DL and UL. Instructions to the editor:Please make the changes with the CID tag (#12413) as shown in 11/22-1517r2 |
| 10386 | 9.4.2.315 | 0.00 | Remove the Multi-Link Traffic Indication element from the beacon, since it can cause beacon bloating, that can affect legacy clients | As in the comment | RevisedAgreed in principle. There needs to define a way to delivery the link recommendation info o retrieve buffered BU(s) from the AP MLD. Instructions to the editor:Please make the changes with the CID tag (#10386) as shown in 11/22-1517r2 |
| 12158 | 9.3.3.2 | 172.31 | Multi-Link Traffic Indication has variable size and can become very long, to the point the Beacon frames size increases beyond the valid limit. | We need to come up with a solution about how to communication information which does not fit in the Beacon. | RevisedAgreed in principle. There needs to define a way to delivery the link recommendation info o retrieve buffered BU(s) from the AP MLD. Instructions to the editor:Please make the changes with the CID tag (#10386) as shown in 11/22-1517r2 |
| 10572 | 9.4.2.315 | 250.02 | The Multi-Link Traffic element will cause beacon bloat which would further cause inter-op issues between an EHT AP affiliated with an AP MLD and a legacy client associated with it. The size of the Multi-Link Traffic Indication element is governed by the number of link bitmaps being signaled (including the ones for legacy and default mapping) in the element. The size of each link bitmap is the same and determined by the maximum bitmap to be signaled for any client. In addition, the number of bits in the link bitmap are based on the 'spread' of the Link ID value assigned to each link on which the AP MLD operates on and current there aren't any rules requiring continuous link IDs. | Move the Multi-Link Traffic Indication element out of the Beacon frame and provide the indication via a separate frame. | RevisedAgreed in principle. There needs to define a way to delivery the link recommendation info o retrieve buffered BU(s) from the AP MLD. Instructions to the editor:Please make the changes with the CID tag (#10386) as shown in 11/22-1517r2 |

Discussion:

Thanks to the cross-link delivery of the individually addressed Management frame, a non-AP MLD normally can allow only one of affiliated STAs to operate in the active mode to save power and meanwhile meet the data exchange requirement for the most of low-load cases. Only if any of the following cases occurs, the AP MLD will wake up non-AP MLD on other links to retrieve buffered BUs:

* The current link quality is not good
* The current traffic load on the current link is very high
* The size of buffered BUs is huge and a higher throughput is required
* There are group addressed Management buffered BUs on other links.

Thus it is possible the non-AP MLD can achieve a similar power consumption level to the current single-link device in most of cases. But based on the following draft text, the non-AP MLD may unnecessarily wake up on other links to retrieve buffered BUs just duo to the T2L mapping constraint even there is already an affiliated STA operating in the awake state. This design is not good for the non-AP MLD’s power save. Considering the T2L mapping is negotiated for a long-term period, it should not be applied to retrieve buffered BUs, which is operated in a short-term period. Especially considering we have already allowed the Link Recommendation frame to violate the T2L mapping constraint, it’s reasonable to extend this rule to retrieve buffered BUs.

*“An AP MLD shall buffer a BU with a TID at the AP MLD if the TID is not mapped to any link on which the corresponding STA of a non-AP MLD is in active mode, and it shall set the bit in the partial virtual bitmap of the TIM element that corresponds to the AID of the non-AP MLD to 1.”*

x-x-x-x-x-x- Start of changes for CID 12413 -x-x-x-x-x-x

**9.2.4.6.4 HE variant**

***TGbe editor: Please change the table as follows***

**Table 9-25—Control ID subfield values**

|  |  |  |  |
| --- | --- | --- | --- |
| Control ID Value | Meaning | Length of the Control Information subfield (bits) | Content of the Control Information subfield |
| 9 | AP assistance request (AAR) | 20 | See 9.2.4.7.10 (AAR Control) |
| 10 | MLO Link Information (MLI) | 20 | See 9.2.4.7.11 (MLI Control) |
| 11-14 | Reserved |  |  |
| 15 | One needs expansion surely (ONES) | 26 | Set all 1s |

***TGbe editor: Please add the following subclause:***

**9.2.4.7.11 MLI Control**

The Control Information subfield in a MLI Control subfield contains information related to the link ID bitmap and the type. The format of the subfield is shown in Figure 9-33d (Control Information subfield format in a MLI Control subfield).

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 B2 | B3 | B4 B19 |
|  | Type | Reserved | Link ID Bitmap |
| Bits: | 3 | 1 | 16 |
| **Figure 9-33d—Control Information subfield format in a MLI Control subfield** |

The Type subfield is defined in Table 9-xxx (Type subfield encoding). The MLI Control subfield with different types are used for different multi-link operations.

**Table 9-xxx—Type subfield encoding**

|  |  |  |
| --- | --- | --- |
| **Type subfield value** | Meaning | Content of the Control Information subfield |
| 0 | Link Recommendation | See 35.3.12.4 (Traffic Indication) |
| 1-7 | Reserved |  |

The Link Recommendation MLI Control field is used for recommending links to exchange frames both in DL and UL (See 35.3.12.4 (Traffic Indication)).

The Link ID Bitmap subfield indicates a set of link(s) for the receiving MLD.

**35.3.12.4 Traffic indication**

***TGbe editor: Please revise subclause 35.3.12.4 as follows:***

An AP MLD may (#12808) use Multi-Link Traffic Indication element and TIM element carried in a Beacon frame to recommend a non-AP MLD to use one or more enabled links to retrieve individually addressed buffered BU(s). An AP MLD may also use Multi-Link Traffic Indication element and AID Bitmap element in a Link Recommendation frame or use a Link Recommendation MLI Control subfield to recommend a non-AP MLD to use one or more enabled links for all exchanges both for DL and UL.

…

(#12808)If a non-AP MLD receives a Link Recommendation frame with the bit corresponding to its AID set to 1 in the Partial AID Bitmap subfield of the AID Bitmap element in the Link Recommendation frame or receives an individually addressed frame containing a Link Recommendation MLI Control subfield, it should exchange frames both in DL and UL on enabled links identified as recommended in the Multi-Link Traffic Indication element in the Link Recommendation frame, while following the rules defined in 35.3.7.1.1 (General).

…

x-x-x-x-x-x- End of changes for CID 12413 -x-x-x-x-x-x

x-x-x-x-x-x- Start of changes for CID 10386 -x-x-x-x-x-x

***TGbe editor: Please add the following subclause:***

**9.2.4.7.11 MLI Control**

The Control Information subfield in a MLI Control subfield contains information related to the link ID bitmap and the type. The format of the subfield is shown in Figure 9-33d (Control Information subfield format in a MLI Control subfield).

|  |  |  |  |
| --- | --- | --- | --- |
|  | B0 B2 | B3 | B4 B19 |
|  | Type | Reserved | Link ID Bitmap |
| Bits: | 3 | 1 | 16 |
| **Figure 9-33d—Control Information subfield format in a MLI Control subfield** |

The Type subfield is defined in Table 9-xxx (Type subfield encoding). The MLI Control subfield with different types are used for different multi-link operations.

**Table 9-xxx—Type subfield encoding**

|  |  |  |
| --- | --- | --- |
| **Type subfield value** | Meaning | Content of the Control Information subfield |
| 0 | Wake-up Request | See 35.3.12.4 (Traffic Indication) |
| 1-7 | Reserved |  |

The Wake-up Request MLI Control field is used for waking up one or more STAs affiliated with the receiving non-AP MLD and that are operating on the indicated links to retrieve buffered BU(s) (See 35.3.12.4 (Traffic Indication).

The Link ID Bitmap subfield indicates a set of link(s) for the receiving MLD.

**35.3.12.4 Traffic indication**

***TGbe editor: Please revise subclause 35.3.12.4 as follows:***

…

An AP MLD may (#12808) use Multi-Link Traffic Indication element and TIM element carried in a Beacon frame or Wake-up Request MLI Control subfield carried with an individually addressed frame to recommend a non-AP MLD to use one or more enabled links to retrieve individually addressed buffered BU(s). An AP MLD may also use Multi-Link Traffic Indication element and AID Bitmap element in a Link Recommendation frame to recommend a non-AP MLD to use one or more enabled links for all exchanges both for DL and UL. The AP’s indication may be carried in a broadcast or a unicast frame.

An AP MLD shall buffer a BU when all STAs affiliated with the non-AP MLD are in power save mode, and it shall set the bit in the partial virtual bitmap of the TIM element that corresponds to the AID of the non-AP MLD to 1. The traffic indication for a non-AP MLD shall be consistent across the Beacon frames transmitted by APs affiliated with an AP MLD, which are operating on the links that are part of the multi-link setup (i.e., the bit in the partial virtual bitmap of the TIM element that matches the AID of the non-AP MLD is set to a value that reflects the status of the BUs at the AP MLD for that non-AP MLD).

An AP MLD shall buffer an MMPDU that is not a TPC Request frame or a Link Measurement Request frame and intended for receipt by a STA affiliated with a non-AP MLD in the AP MLD and included a MLO Link Information element when all STAs affiliated with the non-AP MLD are in power save mode. In this case, the bit in the partial virtual bitmap of the TIM element that corresponds to the AID of the non-AP MLD shall be set to 1. An AP MLD shall not buffer a TPC Request frame or a Link Measurement Request frame.

An AP affiliated with an AP MLD may include the Multi-Link Traffic Indication element (see 9.4.2.315 (Multi-Link Traffic Indication element)) in a Beacon frame it transmits if at least one of the associated non-AP MLD has successfully negotiated a TID-to-link mapping (see 35.3.7.1.3 (Negotiation of TID-to-link mapping)) with the AP MLD for DL or bidirectional traffic and the AP MLD has buffered BU(s) for the non-AP MLD. The Multi-Link Traffic Indication element includes Per-Link Traffic Indication Bitmap subfield(s) in the Per-Link Traffic Indication Bitmap List field. The Per-Link Traffic Indication Bitmap subfield(s) corresponds to the AID(s) of the non-AP MLD(s) or STA(s), starting from the bit number k of the traffic indication virtual bitmap. The AID Offset subfield of the Multi-Link Traffic Indication Control field of the Multi-Link Traffic Indication element contains the value k. The order of the Per-Link Traffic Indication Bitmap subfield(s) follows the order of the bits that are set to 1 in the Partial Virtual Bitmap subfield of the TIM element that corresponds to the AID(s) of the non-AP MLD(s) or STA(s). The bit position i of the Per-Link Traffic Indication Bitmap subfield that corresponds to the link with the link ID equals to i on which a STA affiliated with the non-AP MLD is operating may be set to 1 to indicate to the non-AP MLD a link on which buffered BU(s) should be retrieved. An example of the construction of the Multi-Link Traffic Indication element is shown in Figure 35-16 (Example of Multi-Link Traffic Indication element construction).

When a non-AP MLD detects that the bit corresponding to its AID is 1 in the TIM element and the Multi-link Traffic element is not present in a Beacon frame, any non-AP STA affiliated with the non-AP MLD may issue a PS-Poll frame, or a U-APSD trigger frame if the STA is using U-APSD and all ACs are delivery enabled, to retrieve buffered BU(s) from the AP MLD.

When a non-AP MLD detects that the bit corresponding to its AID is 1 in the TIM element and the Multi-Link Traffic element is present in a Beacon frame and the Multi-Link Traffic Indication element includes a Per-Link Traffic Indication Bitmap subfield that corresponds to the non-AP MLD, any non-AP STA affiliated with the non-AP MLD that operates on the link(s) indicated as 1 in the Per-Link Traffic Indication Bitmap subfield should issue a PS-Poll frame, or a U-APSD trigger frame if the STA is using U-APSD and all ACs are delivery enabled, to retrieve buffered BU(s) from the AP MLD.

When a non-AP MLD detects that the bit corresponding to its AID is equal to 1 in the TIM element and any bit of the Per-Link Traffic Indication Bitmap subfield that corresponds to a link on which a non-AP STA affiliated with the non-AP MLD is operating is equal to 1 in the Multi-Link Traffic element (if present), the non-AP STA affiliated with the non-AP MLD that operates on that link may issue a PS-Poll frame, or a U-APSD trigger frame if the STA is using U-APSD and all ACs are delivery enabled, to retrieve buffered BU(s) from the AP MLD.

An AP affiliated with an AP MLD may transmit an individually addressed frame containing a Wake-up Request MLI Control subfield to provide link recommendation for a non-AP MLD to retrieve buffered BU(s) from the AP MLD. The bit position of the Link ID Bitmap subfield in the Wake-up Request MLI Control field and that corresponds to the link with the link ID equal to on which a STA affiliated with the non-AP MLD is operating in doze state is set to 1 to indicate that the non-AP MLD should transition from doze state to awake state and issue a PS-Poll frame, or a U-APSD trigger frame if the STA is using U-APSD and all ACs are delivery enabled, to retrieve buffered BU(s) from the AP MLD.

When a non-AP MLD receives an individually addressed frame containing a Wake-up Request MLI Control subfield, the STA(s) affiliated with the non-AP MLD and that is operating on the link(s) indicated as 1 in the Link ID Bitmap subfield of the Wake-up Request MLI Control field should transition from doze state to awake state and issue a PS-Poll frame, or a U-APSD trigger frame if the STA is using U-APSD and all ACs are delivery enabled, to retrieve buffered BU(s) from the AP MLD.

When an AP affiliated with an AP MLD receives a PS-Poll frame or a U-APSD trigger frame from a STA affiliated with an associated non-AP MLD that is in power save mode, it shall transmit buffered BU(s) to the STA, if one is available and not discarded for implementation dependent reasons, otherwise it may transmit a QoS Null frame.

…

An AP MLD shall set dot11MultiLinkTIMActivated to true if dot11TIDtoLinkMappingActivated is true and if any of the following conditions is met and otherwise shall set to false:

* The AP MLD intends to provide link recommendations in a Beacon frame to retrieve individually addressed buffered BUs to at least one of the associated non-AP MLD(s) that has successfully negotiated a TID-to-link mapping with the AP MLD and all TIDs are mapped to all the enabled links and the AP MLD has buffered BU(s) for that non-AP MLD
* The AP MLD intends to provide link recommendations in a Beacon frame to retrieve individually addressed buffered BUs to at least one of the associated non-AP MLD(s) that is in the default mapping mode (see 35.3.7.1.2 (Default mapping mode)) and the AP MLD has buffered BU(s) for that non-AP MLD.

x-x-x-x-x-x- End of changes for CID 10386 -x-x-x-x-x-x