IEEE P802.11  
Wireless LANs

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| MLO – 35.3.11.4 | | | | |
| Date: 2022-01-25 | | | | |
| Author(s): | | | | |
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| Laurent Cariou | Intel |  |  |  |
| Minyoung Park | Intel |  |  |  |
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| **CID** | **Commenter** | **Clause Number(C)** | **Page** | **Comment** | **Proposed Change** | **Resolution** |
| 6766 | Romain GUIGNARD | 9.4.2.295e | 154.15 | The text suggests that the recommendation for a link is only for default mapping mode. I do not understand why is it excluded negociated TID-link mapping which may have several links (not all links) for one TID | as in comment | Revised – Add an additional signaling that will apply to all modes and for both UL and DL. Apply the changes marked as #6766 in this document. |
| 6767 | Romain GUIGNARD | 35.3 | 246.15 | The link recommendation addressed in 35.3.10.4 is for the downlink traffic, it may be necessary to have a mechanism of link recommendation for uplink traffic. | Propose an equivalent mechanism of link recommendation for uplink traffic to help AP for the scheduling. For instance, add the link id information in the buffer status report | Revised – Add an additional signaling that will apply to all modes and for both UL and DL. Apply the changes marked as #6766 in this document. |
| 6895 | Rubayet Shafin | 35.3.10.4 | 267.17 | The sentence says "An AP MLD may recommend a non-AP MLD to use one or more enabled links to retrieve individually addressed buffered BU(s)". Through what signaling mechanism this recommendation is done? Is the recommendation made by using the Multi-Link Traffic element? Specifically, by using the Per-Link Traffic Indication Bitmap subfield in Multi-Link Traffic element? | The spec needs to provide clarification on how (signaling mechanism) the recommendation is made | Revised – Clarify the signaling and add an additional signaling that will apply to all modes and for both UL and DL. Apply the changes marked as #6766 in this document. |
| 7671 | Wookbong Lee | 35.3.10.4 | 267.17 | It says "An AP MLD may recommend a non-AP MLD to use one or more enabled links to retrieve individually addressed buffered BU(s)" But how to recommend is missing. Please clarify. | See comment. | Revised – Clarify the signaling and add an additional signaling that will apply to all modes and for both UL and DL. Apply the changes marked as #6766 in this document. |
| 8179 | Yunbo Li | 35.3.10.4 | 267.17 | "An AP MLD may recommend a non-AP MLD to use one or more enabled links to retrieve individually addressed buffered BU(s)" It only happens under default mapping, please clarify. | as in comment | Revised – Provide clarification for this signaling and add an additional signaling that will apply to all modes and for both UL and DL. Apply the changes marked as #6766 in this document. |
| 5030 | Evgeny Khorov | 35.3.10.4 | 267.18 | It is not clear from the spec, how to recommend to use specific links to retrieve BUs between the beacons | Add a special control field | Revised – agree with the commenter. Reformulate to better capture how the recommendation is made. Apply the changes marked as #5030 in this document. |
| 5759 | Laurent Cariou | 35.3.10.4 | 267.18 | "The AP's indication may be carried in a broadcast or a unicast frame". Current spec has specified the broadcast version, but we still miss the unicast version of it, which will be useful to recommend a link when the STA is awake/active or for UL. | define signaling for a link recommendation that would be sent in a unicast manner (A-ctrl, management frame, ...) | Revised – agree with the commenter. Define a new Link Recommendation frame that can include recommendation in a broader way for DL and UL and also for active STAs. Apply the changes marked as #5759 in this document. |
| 6347 | Minyoung Park | 35.3.10.4 | 267.18 | The detail of how an AP MLD recommends one or more enabled links to a non-AP MLD in an individually addressed frame is missing. | Define a signaling that an AP MLD can recommend one or more enabled links to a non-AP MLD. One way is to use the A-Control field of a frame from the AP MLD to include the recommended links. | Revised – agree with the commenter. Define a new Link Recommendation frame that can include recommendation in a broader way for DL and UL and also for active STAs. Apply the changes marked as #6347 in this document. |

1. **Introduction**
2. **Proposed spec text**

**35.3.11.4 Traffic indication**

***TGbe editor: Please modify the 4th paragraph in subclause 35.3.11.4 Traffic indication as follows***) (#5030, #6743, #5759)

An AP MLD may recommend a non-AP MLD to use one or more enabled links to retrieve individually addressed buffered BU(s), if present, by advertising the recommended links in the Multi-Link Traffic element in the Beacon frames it transmits.(#3256)(#3322). An AP MLD may also recommend a non-AP MLD to use one or more enabled links for all exchanges both for DL and UL by advertising the recommended links in a Link Recommendation frame.

***TGbe editor: Please modify the following paragraph in subclause 35.3.11.4 Traffic indication as follows (#***6766, #6767, #6895, #7671, #8179)

When a non-AP MLD in PS mode that is in the default mapping mode (see 35.3.6.1.2 (Default mapping mode)) 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, any STA affiliated with the non-AP MLD that operates on the link(s) indicated as recommended for that non-AP MLD in the MultiLink Traffic element 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) in the AP MLD.

***TGbe editor: Please insert the following paragraphs after paragraph 11 in subclause 35.3.11.4 Traffic indication (#***6766, #6767, #6895, #7671, #8179, #6743, #5759)

The APs affiliated with an AP MLD may also schedule for transmission a group-addressed Link Recommendation frame to provide link recommendation for a set of non-AP MLDs as follows:

* The bit corresponding to the AID of a non-AP MLD shall be set to 1 in the Partial Virtual Bitmap subfield of the TIM element in the Link Recommendation frame if the AP wants to provide a link recommendation for this non-AP MLD.
* The Multi-Link Traffic element includes Per-Link Traffic Indication Bitmap subfield(s) that corresponds to the AID(s) of the non-AP MLD(s), starting from the bit number *k* of the traffic indication virtual bitmap, in the Per-Link Traffic Indication Bitmap List field. The AID Offset subfield of the Multi-Link Traffic Control field of the Multi-Link Traffic 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 carried in the Link Recommendation frame that corresponds to the AID(s) of the non-AP MLD(s). The bit position *i* of the Per-Link Traffic Indication Bitmap subfield in the Multi-Link Traffic element that corresponds to the link with the link ID equal to *i* on which a STA affiliated with the non-AP MLD is operating shall be set to 1 to indicate to the non-AP MLD that it should exchange frames on this link both in DL and UL.

If a non-AP MLD receives a Link Recommendation frame with the bit corresponding to its AID set to 1 in the Partial Virtual Bitmap subfield of the TIM element in the Link Recommendation frame, it should exchange frames both in DL and UL on enabled links identified as recommended in the Multi-Link Traffic element in the Link Recommendation frame.

* + 1. **EHT Action frame details(#1119)(#1488)**
       1. **EHT Action field**

***TGbe editor: Please change the following Table 9-623a EHT Action field values as follows (#***6766, #6767, #6895, #7671, #8179, #6743, #5759)

**Table 9-623a—EHT Action field values**

|  |  |
| --- | --- |
| **Value** | **Meaning** |
| 0 | EHT Compressed Beamforming/CQI |
| 1 | EML Operating Mode Notification. |
| 2 | Link Recommendation |
| 3–255 | Reserved |

***TGbe editor: Please add the following subclause 9.6.34.4 Link Recommendation frame format as follows (#***6766, #6767, #6895, #7671, #8179, #6743, #5759)

**9.6.34.4 Link Recommendation frame format**

The Link Recommendation frame is an Action No Ack frame of category EHT. The Action field of an Link Recommendation frame contains the information shown in [Table 9-xxx](#bookmark188) [(Link Recommendation frame Action field format(#6078))](#bookmark188).

**Table 9-xxx—Link Recommendation frame Action field format(#6078)**

|  |  |
| --- | --- |
| **Order(#6078)** | **Meaning** |
| 1 | Category |
| 2 | EHT Action |
| 3 | TIM element (see 9.4.2.5 (TIM element)) |
| 4 | Multi-Link Traffic element (see 9.4.2.315 (Multi-Link Traffic element)) |

The Category field is defined in Table 9-79 (Category values). The EHT Action field is defined in Table 9-623a (EHT Action field values). The TIM element is described in 9.4.2.5 (TIM element) and is used to identify the non-AP MLDs for which a link recommendation is provided.

The Multi-Link Traffic element is described in 9.4.2.315 (Multi-Link Traffic element) and is used to describe the link recommendations for all the non-AP MLDs that are identified in the TIM element.

***TGbe editor: Please modify subclause 9.4.2.311 Multi-Link Traffic element as follows (#***6766, #6767, #6895, #7671, #8179, #6743, #5759)

* + - 1. **Multi-Link Traffic element(#2341)**

The Multi-Link Traffic element contains a list of per-link traffic indication bitmap(s) for non-AP MLD(s).

The Multi-Link Traffic element is defined in [Figure 9-xxy (Multi-Link Traffic element format)](#bookmark163).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Element ID | Length | Element ID Extension | Multi-Link Traffic Control | Per-Link Traffic Indication List |

Octets: 1 1 1 2 variable

**Figure 9-xxy—Multi-Link Traffic element format**

The Element ID, Length, and Element ID Extension fields are defined in [9.4.2.1 (General)](#bookmark85).

The Multi-Link Traffic Control field is defined in [Figure 9-xxz (Multi-Link Traffic Control field for](#bookmark164) [mat)](#bookmark164).

B0 B3 B4 B14 B15

|  |  |  |
| --- | --- | --- |
| Bitmap Size | AID Offset | Reserved |

Bits: 4 11 1

**Figure 9-xxz—Multi-Link Traffic Control field format**

The Bitmap Size subfield indicates the size of each Per-Link Traffic Indication Bitmap subfield, in bits. The subfield is encoded to *m*, where *m* + 1 is the size of the Per-Link Traffic Indication Bitmap subfield. A value of 0 in the Bitmap Size subfield is reserved. The AID Offset subfield indicates a bit numbered *k* of the traffic indication virtual bitmap.

The Per-Link Traffic Indication List field is defined in [Figure 9-1002ad (Per-Link Traffic Indication List](#bookmark165) [field format)](#bookmark165). The Per-Link Traffic Indication List field contains Per-Link Traffic Indication Bitmap sub- fields that correspond to the AIDs of the non-AP MLDs starting from the bit numbered *k* of the traffic indi- cation virtual bitmap. The Per-Link Traffic Indication List field contains *l* Per-Link Traffic Indication Bitmap subfields, where *l* is the number of the bits that correspond to the AIDs of the non-AP MLDs set to 1, counting from the bit numbered *k* of the traffic indication virtual bitmap, in the Partial Virtual Bitmap sub- field of the TIM element that is included in a Beacon frame with the Multi-Link Traffic element or in a Link Recommendation frame with the Multi-Link Traffic element.

|  |  |  |  |
| --- | --- | --- | --- |
| Per-Link Traffic Indication Bitmap 1 | … | Per-Link Traffic Indication Bitmap *n* | Padding |

Bits: *m*+1 *m*+1 variable (0–7)

**Figure 9-1002ad—Per-Link Traffic Indication List field format**

The Per-Link Traffic Indication Bitmap subfield is defined in [Figure 9-1002ae (Per-Link Traffic Indication](#bookmark166) [Bitmap subfield format)](#bookmark166). Each Per-Link Traffic Indication Bitmap subfield indicates per-link traffic indica- tions for a non-AP MLD that has negotiated a TID-link mapping with an AP MLD or link recommendation for a non-AP MLD that is in the default mapping mode.

B0 B*m*

Per-Link Traffic Indication Bitmap

Bits: *m*+1

**Figure 9-1002ae—Per-Link Traffic Indication Bitmap subfield format**

Each bit in the Per-Link Traffic Indication Bitmap subfield corresponds to a link on which a STA affiliated with a non-AP MLD is operating, with the bit position *i* of the bitmap, B*i*, corresponding to a link with link ID equal to *i*. In a Beacon frame, when the Per-Link Traffic Indication Bitmap subfield corresponds to a non-AP MLD that has successfully negotiated TID-to-link mapping, a value of 1 in the bit position *i* in the bitmap indicates that there is buffered BU(s) with TID(s) mapped to the link with the link ID equal to *i* or MMPDU(s); a value of 0 in a bit position in the bitmap indicates that there is no buffered BU(s) with TID(s) mapped to the corre- sponding link nor MMPDU(s). In a Beacon frame, when the Per-Link Traffic Indication Bitmap subfield corresponds to a non- AP MLD that is in the default mapping mode, a value of 1 in the bit position *i* in the bitmap indicates that the link with the link ID equal to *i* is recommended for retrieving buffered BU(s).

In a Link Recommendation frame, when the Per-Link Traffic Indication Bitmap subfield corresponds to a non- AP MLD, a value of 1 in the bit position *i* in the bitmap indicates that the link with the link ID equal to *i* is recommended for frame exchanges both in DL and in UL.

The Padding subfield contains 0–7 padding bits so that the length of the Per-Link Traffic Indication List field is a multiple of 8 bits. The padding bits are set to 0.

**9.4.2.5 TIM element  
9.4.2.5.1 General  
*TGbe editor: Insert the following at the end of the subclause: (#***6766, #6767, #6895, #7671, #8179, #6743, #5759)If included in an Link Recommendation frame send by an AP affiliated with an AP MLD, the following apply:  
— The DTIM Count field is reserved  
— The DTIM Period field is reserved  
— Bit *N* in the traffic indication virtual bitmap that corresponds to an non-AP MLD with AID *N* is  
determined as follows:  
• Bit *N* in the traffic indication virtual bitmap is set to 1 if the AP MLD provides a link recommendation to the non-AP MLD in the Link Recommendation frame.  
• Otherwise, bit *N* in the traffic indication virtual bitmap for the non-AP MLD is set to 0.