IEEE P802.11  
Wireless LANs

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| CR for Group addressed BUs by TIM | | | | |
| Date: Jan 10, 2022 | | | | |
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Abstract

This submission proposes resolutions for following x CIDs received for TGbe CC36 based on TGbe D1.5:

4279 6306 6307 8043 4074 4075 5943 5992 6609 6610 6611 6612 6635 7885 (14 CIDs)

Revisions:

* Rev 0: Initial version of the document.
* Rev 3: Add the flexibility to the number of bits per AP MLD and the limit on the total number of bits for group addressed BU indication as suggested by George and Laurent

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** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Resolution** |
| 4279 | Alfred Asterjadhi | 35.3.13.1 | 273.40 | Signaling is missing here. Add signaling. Same for next paragraph. | As in comment. | Revised-  Proposed resolution completes the missing part about mapping signaling.  TGbe editor to make the changes shown in 21/0184r3 under all headings that include CID 4297 |
| 6306 | Ming Gan | 35.3.13.1 | 273.50 | Please specify the mapping between bits and APs, this part is missing | as in the comment | Revised-  Agree with the comment. Propose resolution to clarify the mapping between the contiguous bits in Partial Virtual Bitmap field and each affiliated AP.  TGbe editor:  Please implement the changes as shown in doc 11-22/0184r3 tagged as 6306 |
| 6307 | Ming Gan | 35.3.13.1 | 274.02 | Please specify the mapping between bits and APs, this part is missing | as in the comment | Revised-  Agree with the comment. Propose resolution to clarify the mapping between the contiguous bits in Partial Virtual Bitmap field and each affiliated AP.  TGbe editor:  Please implement the changes as shown in doc 11-22/0184r3 tagged as 6307 |
| 8043 | Yuchen Guo | 35.3.13.1 | 273.50 | The mapping of the bit location in the TIM and the other APs in the same AP MLD is missing. Same for the next paragraph. | Please add the corresponding mapping | Revised-  Agree with the comment. Propose resolution to clarify the mapping between the contiguous bits in Partial Virtual Bitmap field and *each affiliated AP.*  *TGbe editor:*  Please implement the changes as shown in doc 11-22/0184r3 tagged as 8043 |
| 4074 | Abhishek Patil | 35.3.13.1 | 273.40 | There are limited number of bits in the Partial Virtual Bitmap of TIM element. And as such, the standard must be careful when setting aside bits for any form of indication. With a 4 bit link ID field, an AP MLD can have up to 16 links. In theory there can be up to 255 VAPs. However in practice, it is common to see n=4 i.e., up to 16 BSSIDs in a multiple BSSID set. Therefore, a large number of bits in the TIM element would get consumed to signal group addressed for other links of the AP MLDs corresponding to each AP in a multiple BSSID set. Such wasteful a assignment of bit from PVB of TIM element must be avoided. | Provide an efficient mechanism to signal cross link group addressed BUs | Revised-  In practice, it is hard to see 4 links per AP MLD and 16 BSSIDs in an MBSSID set on each link. Even if the above numbers are true, Partial Virtual Bitmap still have space to accommodate it. Proposed resolution completes the missing part about mapping.  TGbe editor to make the changes shown in 21/0184r3 under all headings that include CID 4074 |
| 4075 | Abhishek Patil | 35.3.13.1 | 273.40 | The spec needs to clarify how the cross-link group address BU signaling works with Method B encoding. TGax mandates 6 GHz AP (and APs that have all associated STAs supporting MBSSID) to use Method B encoding (see 11.1.3.8.5). | As in comment | Revised-  As per offline discussion, method B still works if the description of method B, including the value of N0, is kept. That is to say, the bit corresponding to the group addressed BU of each AP is treated as the bit corresponding to the individual addressed BU  TGbe editor to make the changes shown in 21/0184r3 under all headings that include CID 4075 |
| 5943 | Li-Hsiang Sun | 35.3.13.1 | 273.54 | Need to add procedure for a non-AP to derive the mapping of bits for nontransmitted BSSID in virtual bitmap to the actual BSSID. For example, using the difference between BSSID with Transmitted BSSID=1 and BSSID with transmitted BSSID=0 with the same link ID in RNR | as in comment | Revised-  Proposed resolution completes the missing part about mapping.  TGbe editor to make the changes shown in 21/0184r3 under all headings that include CID 5943 |
| 5992 | Liwen Chu | 35.3.13.1 | 273.43 | The "after" is not clear, right after or after with some bits in between. The TIM has method A and method B. With method A the size of TIM is longer. If the "after" is right after, method B can't be used sine non-EHT STAs can't understand the bits of APs in other links. | Putting the indications of APs in other links at the end of TIM element. | Revised-  It is "right after" for the AP MLD with which the reporting AP is affiliated, add the correspond mapping signaling to clarify this.  As per offline discussion, method B still works if the description of method B, including the value of N0, is kept. That is to say, the bit corresponding to the group addressed BU of each AP is treated as the bit corresponding to the individual addressed BU  TGbe editor to make the changes shown in 22/0184r3 under all headings that include CID 5992 |
| 6609 | Po-Kai Huang | 35.3.13.1 | 273.40 | Several clarification is required on the indication of buffered group addressed BUs for APs affiliated with in an MLD in this paragraph. Specifically, we need to clarify that for indication of an AP MLD, the first bit of the contiguous bits is for link ID 0, the second bit of the contigous bits is for link 1, and so on. This will aligns with the design we have in Multi-Link Traffic element. See texts below. "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, Bi, corresponding to a link with link ID equal to i. " | clarify that for indication of an AP MLD, the first bit of the contiguous bits is for link ID 0, the second bit of the contigous bits is for link 1, and so on. | Revised-  Proposed resolution com-pletes the missing part about mapping signaling.  TGbe editor to make the changes shown in 21/0184r3 under all headings that include CID 6609 |
| 6610 | Po-Kai Huang | 35.3.13.1 | 274.54 | Several clarification is required on the indication of buffered group addressed BUs for APs affiliated with in an MLD in this paragraph. Specifically, we need to clarify that for indication of an AP MLD, the first bit of the contiguous bits is for link ID 0, the second bit of the contigous bits is for link 1, and so on. This will aligns with the design we have in Multi-Link Traffic element. See texts below. "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, Bi, corresponding to a link with link ID equal to i. " | clarify that for indication of an AP MLD, the first bit of the contiguous bits is for link ID 0, the second bit of the contigous bits is for link 1, and so on. | Revised-  Proposed resolution com-pletes the missing part about mapping signaling.  TGbe editor to make the changes shown in 21/0184r3 under all headings that include CID 6610 |
| 6611 | Po-Kai Huang | 35.3.13.1 | 274.54 | Several clarification is required on the indication of buffered group addressed BUs for APs affiliated with in an MLD in this paragraph. Specifically, the client needs to knows the size of the bitmap without the need to search for the current frame. Similar to Multi-link Traffic element provides an indication on the size of the bitmap for an MLD in a element (ex multi-link element). | Similar to Multi-link Traffic element provides an indication on the size of the bitmap for an MLD in a element (ex multi-link element). | Revised-  Proposed resolution com-pletes the missing part about mapping signaling.  TGbe editor to make the changes shown in 21/0184r3 under all headings that include CID 6611 |
| 6612 | Po-Kai Huang | 35.3.13.1 | 274.54 | Several clarification is required on the indication of buffered group addressed BUs for APs affiliated with in an MLD in this paragraph. Specifically, clarify that the bitmap for an AP MLD with affiliated AP that has BSSID x will appear after corresponding indication with BSSID 0 to BSSID x-1. | clarify that the bitmap for an AP MLD with affiliated AP that has BSSID x will appear after corresponding indication with BSSID 0 to BSSID x-1. So the bitmap will starts at bit positon (indicated size of a bitmap)\*BSSID index. Note that the first bit after the group addressed BUs indication for multiple BSSID is bit position 0. | Revised-  Proposed resolution com-pletes the missing part about mapping signaling.  TGbe editor to make the changes shown in 21/0184r3 under all headings that include CID 6612 |
| 6635 | Po-Kai Huang | 35.3.13.1 | 273.40 | Putting the additional indication in TIM that is not for the individual addressed BU indication has the obvious problem of shrinking AID assigned space. The only way to avoid this problem is to move the indication to a different element. However, if we can not do that, then we also need to clarify how the indication will not confuse the existing associated STAs on top of whatever optimization we are doing. Specifically, if the bitmap size maybe variable, so 40 bits at one time and 24 bits at another time, then 16 bits can not be used for AID assignment anyway because when you expand to configuration that needs 40 bits, you have a problem. A general sentence needs to be in place in case whatever compression scheme we try to have in place is really not workable. | Add a sentence that the provided additional indication of group addressed Buffered BU of other links can not be misinterpreted by the associated STA as indication for individual addressed BUs. A more specific rule is that all the potential bits that maybe used for indication due to reconfiguration needs to be reserved without AID assignment if we put the bitmap at the front of the TIM. If we put it at the end of the TIM, then we lose the compression capability at the end when all the trailing bits are 0, which also needed to be highlighted. . | Revised-  Proposed resolution com-pletes the missing part about mapping signaling.  TGbe editor to make the changes shown in 21/0184r3 under all headings that include CID 6635 |
| 7885 | Yongho Seok | 35.3.13.1 | 273.42 | "If an AP affiliated with an AP MLD is not part of a multiple BSSID set or the AP corresponds to a transmitted BSSID in a multiple BSSID set, then the AP shall indicate if each of the other AP(s) in the same AP MLD has buffered group addressed frames by using a bit in the Partial Virtual Bitmap field of the TIM element after the last bit corresponding to a nontransmitted BSSID (if any) (maximum possible number of BSSIDs" Using the TIM element is too complicated. | Please reconsider reusing TIM element and design a new IE to indicate if each of the other AP(s) in the same AP MLD has buffered group addressed frames. | Revised-  The TIM element is used to provide an indication about group addressed buffered BU and Individual addressed buffered BU. This way is straightforward. Proposed resolution completes the missing part about mapping.  TGbe editor to make the changes shown in 21/0184r3 under all headings that include CID 7885. |

***TGbe editor: Please note baselines are REVmd D5.0, 11ax D8.0 and 11be D1.5***

Discussion

Regarding the group addressed BU indication for AP MLD, the mapping between the contiguous bits in Partial Virtual Bitmap field and each affiliated AP is TBD



An example for group addressed BUs indication for AP MLD in the TIM element, assume BSSID-2y is reporting AP. For MLD1, the last 2 bits are reserved and are set to 0. The MLD 2 and MLD 3, the last 3 bits are reserved and are set to 0.



**35.3.12 Multi-link group addressed frame delivery and reception**

**35.3.12.2 Group addressed frame delivery**

***TGbe editor: Please modify the subclause as follows*** (CID #4074 4075 4279 5943 5992 6306 6307 6609 6610 6611 6612 6635 7885 8043)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)).

An AP MLD that broadcasts the group addressed MPDU received from an associated non-AP MLD shall set the SA field of the broadcast group addressed MPDU to the MLD MAC address of the non-AP MLD.Each AP affiliated with an AP MLD shall schedule:

—the transmission of the buffered group addressed Management frames independently from the transmission of buffered group addressed Management frames of other AP(s) affiliated with the same AP MLD.

—the transmission of the buffered group addressed data frames that are expected to be received by a non-AP MLD in all the links setup with the non-AP MLD.

If an AP affiliated with an AP MLD is not part of a multiple BSSID set or the AP corresponds to a transmitted BSSID in a multiple BSSID set, then the AP shall indicate if each of the other AP(s) in the same AP MLD has buffered group addressed frames by using a bit in the Partial Virtual Bitmap field of the TIM element after the last bit corresponding to a nontransmitted BSSID (if any) (maximum possible number of BSSIDs – 1) which is in the same multiple BSSID as the AP.

—The indication is in the DTIM beacon sent by the AP and is based on the latest information about the other APs that the AP has when the AP schedules the DTIM beacon.

—These bits in the Partial Virtual Bitmap field of the TIM element for the other AP(s) in the same AP MLD shall be contiguous.

* The bits X to X+N-1 of the bitmap in the Partial Virtual Bitmap field are for the AP MLD where X-1 is the last bit corresponding to the nontransmitted BSSID (if any) that is in the same multiple BSSID as the AP and N is equal to 2^( Group Addressed BU Indication Exponent +1)-1, and the Group Addressed BU Indication Exponent is carried in the Group Ad-dressed BU Indication Exponent subfield of the EHT Operation Parameters field.
* The first n bits of N bits are used to indicate that one or more group addressed frames are buffered for each AP of the other AP(s) in the same AP MLD in an increasing order of their link IDs, and n is the number of affiliated APs in this AP MLD. The remaining bits of N bits are set to 0.

NOTE—The AP indicates the presence of its buffered group addressed frames following 11.2.3.6 (AP operation).

If an AP affiliated with an AP MLD is a nontransmitted BSSID in a multiple BSSID set, then the AP that corresponds to the transmitted BSSID in the same multiple BSSID set shall indicate if each of the other AP(s) in the same AP MLD as the nontrasnmitted BSSID has buffered group addressed frames by using a bit in the Partial Virtual Bitmap field of the TIM element after the last bit corresponding to the nontransmitted BSSID (if any) (maximum possible number of BSSIDs – 1) which is in the same multiple BSSID as the AP.

—The indication is in the DTIM beacon corresponding to that nontransmitted BSSID sent by the transmitted BSSID of the same multiple BSSID set as the nontransmitted BSSID and is based on the latest information about the other APs of the AP MLD that the transmitted BSSID has when it schedules the DTIM beacon.

—These bits in the Partial Virtual Bitmap field of the TIM element for the other AP(s) in the same AP MLD shall be contiguous. The AP shall set the Group Addressed BU Indication Limit subfield to 1 if the total number of bits needed to indicate the presence of buffered group addressed frames of all other APs affiliated with the same AP MLDs as all nontransmitted BSSIDs in the TIM element is greater than 48 bits, otherwise the AP shall set the Group Addressed BU Indication Limit subfield to 0. For the kth nontransmitted BSSID affiliated with an MLD, where k is numbered in increasing order of MLD ID of this MLD and starts from 1

* The bits Y+(k-1)\*N to Y+k\*N-1 of the bitmap in the Partial Virtual Bitmap field, if less than Y+48, are for the AP MLD with which the kth nontransmitted BSSID is affiliated where Y-1 is the last bit corresponding to an AP affiliated with the same AP MLD as the AP that corresponds to the transmitted BSSID and N is equal to 2^( Group Addressed BU Indication Exponent +1)-1, and the Group Addressed BU Indication Exponent is carried in the Group Ad-dressed BU Indication Exponent subfield of the EHT Operation Parameters field.
* The first n bits of N bits are used to indicate that one or more group addressed frames are buffered for each AP of the other AP(s) in the same AP MLD as the kth nontransmitted BSSID in increasing order of their link IDs. The remaining bits of N bits are set to 0.

**9.4.2.311 EHT Operation element**

***TGbe editor: modify Figure 9-1002b as follows:***

The EHT Operation Parameters field is defined in [Figure 9-1002b (EHT Operation Parameters field format)](#bookmark119).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B3 B4 | B5 B7 |
|  | EHT Operation Information Present | Disabled Subchannel Bitmap Present | Group Addressed BU Indication Limit | Group Addressed BU Indication Exponent | Reserved |
| Bits: | 1 | 1 | 1 | 2 bits | 3 |

**Figure 9-1002b—EHT Operation Parameters field format(#6603)**

***TGbe editor: insert the following after the paragraph (The Disabled Subchannel Bitmap Present subfield is set to 1 …) (D1.5P186L49) as follows:***

The Group Addressed BU Indication Limit subfield indicates whether there is limit on the number of bits to indicate the presence of buffered group addressed frames of all other APs affiliated with the same AP MLDs as all nontransmitted BSSIDs in a multiple BSSID set in the TIM element or not.

The Group Addressed BU Indication Limit subfield is set to 0 if one of the conditions is met

—The AP is not in multiple BSSID set.

—The AP is in a multiple BSSID set and the total number of bits needed to indicate the presence of buffered group addressed frames of all other APs affiliated with the same AP MLDs as all nontransmitted BSSIDs in the TIM element is not greater than 48 bits.

Otherwise, the Group Addressed BU Indication Limit subfield is set to 1.

The Group Addressed BU Indication Exponent subfield is set to the exponent from which the N is calculated as defined in subclause 35.3.12.2 (Group addressed frame delivery).