IEEE P802.11
Wireless LANs

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| LB266 CR for subclause 35.3.15  |
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Abstract

This submission proposes resolutions of comments received from TGbe comment collection LB266 based on TGbe D2.0.

13899 12825 13799 12325 10007 13922 13800 12113 11752 13517 12111 12112 11084 13995 13923 13996 11591 13388 13389 13695 13997 13697 13924 13801 12385 13698 12816 13696 13998 11592 11753 (31 CIDs)

Revisions:

* Rev 0: Initial version of the document.
1. **Introduction**

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. The introduction and the explanation of the proposed changes are 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 802.11be 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** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Resolution** |
| 13899 | 35.3.15 | 450.27 | the AIDs corresponding to the bits for group addressed BU of MLD can't be assigned to non-AP MLD | please complete the missing case | Revised-Agree with the comment in principle. Apply the changes marked as #13899 in this document.  |
| 12825 | 35.3.15.1 | 451.10 | With MLO, some additional bits in the TIM element are reserved for group address indication and these values shall not be assigned as AIDs to associated STAs or non-AP MLDs. | add the corresponding rule | Revised-Agree with the comment in principle. Apply the changes marked as #12825 in this document.  |
| 13799 | 35.3.15.1 | 450.27 | In MLO, group addressed data frames are duplicatedly transmitted on all the setup links, while group addressed management frames are transmitted independently on each setup link, but the current group addressed BU indication does not differentiate data MPDU or MMPDU. When a non-AP MLD is monitoring on one link, and receives an indication that there is group addressed BU to be received on another link, it doesn't know whether it needs to wake up on the other link to see whether there's any group addressed management frame to be received. Hence, it needs to always wake up on the other link. But sometimes, it will not receive nothing for it. | Add corresponding signaling to differentiate data MPDU or MMPDU | Rejected-As per subclause 35.3.15.2 (Group addressed frame reception) of 802.11be draft 2.0, the corresponding STA needs to receive the group addressed frames as per the group addressed frame indication. This mechanism works well and no group addressed frames will be missed. Given it has a global SN for group addressed data frames, it is not an issue to receive duplicated group addressed data frames. Note that Group addressed data frames are not exactly duplicated on each link since the TBTT of each link is different. On the other hand, the commenter’s proposal on signaling will add extra complexity to differentiate group addressed data frames from group addressed management frames. |
| 12325 | 35.3.15.1 | 450.29 | we should allow an AP MLD that no schedule for Beacon and Probe frames on some link, just similar to the NSTR mobile AP MLD. This design can provide a restriction on setting up some special link, e.g.the link on which only the low-latency traffic is allowed. | As in comment | Revised-The exception case of an NSRT mobile AP MLD where the transmissions of Beacon and Probe Response frames and group addressed Data frames only on the primary link is described in Note 2 of 35.3.15.2 (Group addressed frame reception) of 802.11be draft 2.0. A part of that note is moved to this subclause. For other AP MLD, such limitation is not necessary. Apply the changes marked as #12325 in this document.  |
| 10007 | 35.3.15.1 | 450.29 | This sentence is somewhat difficult to follow and could probably be rephrased more clearly: "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))." | Consider a rephrasing of the sentence/paragraph, e.g.,Each AP affiliated with an AP MLD that is not a TWT scheduling AP shall schedule buffered group addressed frames immediately after every DTIM beacon. A TWT scheduling AP shall schedule the buffered group addressed frames for transmission 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))" | Revised-Agree with the comment in principle. Apply the changes marked as #10007 in this document.  |
| 13922 | 35.3.15.1 | 450.29 | This sentence is too long, please separate it | rephrase this sentence | Revised-Agree with the comment in principle. Apply the changes marked as #13922 in this document.  |
| 13800 | 35.3.15.1 | 450.29 | what if there is no broadcast TWT SP located within the beacon interval during which the DTIM Beacon frame is transmitted? | please clarify | Revised –Agree in principle with the comment. Proposed resolution clarifies that this condition only applies when the AP has scheduled certain broadcast TWT SPs that would contain the delivery of group addressed BUs as defined in 26.8.3.2.Apply the changes marked as #13922 in this document. |
| 12113 | 35.3.15.1 | 450.35 | Add description for how does non-AP MLD transmit group addressed Data frames, ie., non-AP MLD shall transmit group addressed Data frames in only one link. Or if we allow non-AP MLD duplicate the transmission of group addressed Data frames in all enabled links, then a description is required for how does AP MLD perform duplication detection. | As commented | Rejected-The commenter fails to identity the technical issue. There is no case where non-AP MLD transmit group addressed frames behave in this manner.For duplicated one, the receiver can detect it by using the global SN of the group addressed data frames. |
| 11752 | 35.3.15.1 | 450.36 | Replace "distributes" with "transmits". | as in comment | Revised-The corresponding sentence is removed according to the CID 13517. Apply the changes marked as #11752 in this document.  |
| 13517 | 35.3.15.1 | 450.36 | An AP cannot modify the SA of a Data frame received from an associated non-AP STA. This breaks the ability of the final receiver of the Data frame to respond to the true source (and violates the MAC layer deliver transparency of MSDUs). Besides, if this MSDU was generated locally on the associated non-AP STA (in a higher layer above the MAC interface, presumably), it would have the non-AP STA's MLD MAC address as the SA already. Only a Data frame that was sourced in another end station, and is being forwarded by the associated non-AP STA would have a different SA, and that SA must be preserved. | Delete this paragraph. | Accepted- |
| 12111 | 35.3.15 | 450.37 | What is the "broadcast group addressed Data frame"? Does it mean broadcast addressed only? | Remove the word "broadcast" | Revised-The corresponding sentence is removed according to the CID 13517. Apply the changes marked as #12111 in this document.  |
| 12112 | 35.3.15.1 | 450.46 | "Each AP ... shall schedule ... in all the enabled links... " looks like one AP will operate on other links, which is not the intention. And it is not clear that whether it's the same one frame transmitted in all links, or many frames distributed uniformly among all links. | Remove it and add a new paragraph "an AP MLD shall schedule the transmission of any buffered group addressed Data frame that are expected to be received by a non-AP MLD in all the enabled links setup with the non-AP MLD." | Revised-Agree with the comment in principle. Apply the changes marked as #12112 in this document.  |
| 11084 | 35.3.15.1 | 450.50 | The description from 450.50 to 451.41 is not about group addressed frame delivery. It may confuse reader to think that the rules from 450.50 to 451.41 actually changes group addressed delivery procedure. | Move 450.50 to 451.41 to a different subclase. Say 35.3.15.3 Group addressed frame indication. Change the title of 35.3.15 correspondingly. | Revised-According to the comment, change the title of each subclause correspondingly. Apply the changes marked as #11084 in this document.  |
| 13995 | 35.3.15.1 | 450.54 | Need to specify "the last bit" when an AP is not part of a multiple BSSID set. | Please add that when an AP is not part of a multiple BSSID set, the last bit is the bit that corresponds to AID 0. | Revised-Agree with the comment in principle. Separate this paragraph into two parts. Apply the changes marked as #13995 in this document.  |
| 13923 | 35.3.15.1 | 450.55 | It is not clear, please describe the cases of multiple BSSID and non-multiple BSSID separately | split this for two cases | Revised-Agree with the comment in principle. Separate this paragraph into two parts. Apply the changes marked as #13923 in this document.  |
| 13996 | 35.3.15.1 | 450.63 | Need to specify "the last bit" when an AP is not part of a multiple BSSID set. | Please add that when an AP is not part of a multiple BSSID set, the last bit is the bit that corresponds to AID 0. | Revised-Agree with the comment in principle. Separate this paragraph into two parts. Apply the changes marked as #13996 in this document.  |
| 11591 | 35.3.15.1 | 450.60 | Group addressed management frames are not buffered on all links, unlike group addressed data frames. Thus a nonAP MLD may desire to prioritize reception of group addressed management frames on each link over reception group-addressed data frames. However with just 1 bit indication of pending group-addressed traffic, this is not possible. | Provide separate indication in either the TIM element or multi-link traffic element to indicate presence of buffered group addressed data and management frames | Rejected-As per subclause 35.3.15.2 (Group addressed frame reception) of 802.11be draft 2.0, the corresponding STA needs to receive the group addressed frames as per the group addressed frame indications. This mechanism works well and no group addressed frames will be missed. Given it has a global SN for group addressed data frames, it is not an issue to receive duplicated group addressed data frames. Note that Group addressed data frames are not exactly duplicated on each link, since the TBTT of each link is different. On the other hand, the commenter’s proposal on a separate indication adds extra complexity to differentiate group addressed data frames from group addressed management frames. |
| 13388 | 35.3.15.1 | 450.63 | vhange "in the same multiple BSSID" to "in the same multiple BSSID set" | as in the comment | Accepted- |
| 13389 | 35.3.15.1 | 450.64 | The definition of Group Addressed BU Indication Exponent should be clearly defined (e.g. in a device where all AP MLDs have not >4 links, the Group Addressed BU Indication Exponent shall be 1) so that the TIM element so that the TIM element is shortest.Another bug that needs to be fixed is that N should be equal to 2^(Group Addressed BU Indication Exponent + 1) | As in comment. | Revised-Agree with the comment partially, the first part is true, but the second the part is not an issue, since the original text can cover an additional link besides the reporting link. Apply the changes marked as #13389 in this document.  |
| 13695 | 35.3.15.1 | 451.03 | for simplifying the implementation, suggest to change n to the Highest value of Link IDs for the transmitting AP MLD, so that the nth bit of the N bits corresponding to the AP with link ID n+1. | as in comment. | Rejected-It adds complexity to let a non-AP STA track the highest value of all link IDs and this may result in large overhead since the link ID may not be contiguous. The existing way can achieve balance between flexibility and overhead reduction. |
| 13997 | 35.3.15.1 | 451.04 | A non-AP MLD may not setup all the links that the associated AP MLD operates, and the non-AP MLD's setup links may be a part of all links of the AP MLD. Therefore, it is unclear how the non-AP MLD determines which bits of the first n bits correspond to its setup links. | Need to specify that the non-AP MLD should receive and track link IDs of all links which the associated AP MLD are operating on. | Rejected-While it is true that a non-AP may not have multi-link setup for all links with an AP MLD, both the link IDs associated with the setup links and the link IDs associated with group addressed frames indication bits are known to the non-AP MLD. Regarding the specification that the commenter asked for about the behavior of group addressed frames indication reception, it is in subclause 35.3.15.2 (Group addressed frame reception). |
| 13697 | 35.3.15.1 | 451.15 | If an AP affiliated with an AP MLD is a nontransmitted BSSID in a multiple BSSID set, the bits corresponding to the nontransmitted BSSID must exist, so don't need "(if any)". | remove "(if any)" | Accepted- |
| 13924 | 35.3.15.1 | 451.15 | It is not clear, please describe the cases of multiple BSSID and non-multiple BSSID separately | split this for two cases | Rejected-In this paragraph, there is no such case of a non-multiple BSSID. |
| 13801 | 35.3.15.1 | 451.24 | Where is the "Group Addressed BU Indication Limit" subfield located? Better to clarify that. | add "of the EHT Operation element" after "Group Addressed BU Indication Limit subfield" | Revised-Agree with the comment in principle. Apply the changes marked as #13801 in this document.  |
| 12385 | 35.3.15.1 | 451.27 | The significance of the number 48 is not clear, e.g., why 48 and not 64? | Add a NOTE to explain how the value 48 is chosen as the max number of bits. | Revised-Agree with the comment in principle. A note is added. Apply the changes marked as #12385 in this document.  |
| 13698 | 35.3.15.1 | 451.32 | need a note to explain where the number 48 comes from. | as in comment. | Revised-Agree with the comment in principle. A note is added. Apply the changes marked as #13698 in this document.  |
| 12816 | 35.3.15.1 | 451.33 | "where Y - 1 is the last bit corresponding to an AP affiliated with the same AP MLD". The sentence is not fully correct as there may be less number of affiliated APs than the number of bits that are assigned for the AP MLD, in which case the bit Y-1 doesn't correspond to any AP. | fix the issue indicated in the comment by simply rephrasing that part of the sentence. | Revised-Agree with the comment in principle. Apply the changes marked as #12816 in this document.  |
| 13696 | 35.3.15.1 | 451.39 | for simplifying the implementation, suggest to change n to the Highest value of Link IDs for the transmitting AP MLD, so that the nth bit of the N bits corresponding to the AP with link ID n+1. | as in comment. | Rejected-The commenter’s proposal adds extra complexity to let a non-AP STA track the highset value of all link IDs and may result in large overhead, since the link ID may not be contiguous. The existing way can achieve balance between flexibility and overhead reduction. |
| 13998 | 35.3.15.1 | 451.39 | A non-AP MLD may not setup all the links that the associated AP MLD operates, and the non-AP MLD's setup links may be a part of all links of the AP MLD. Therefore, it is unclear how the non-AP MLD determines which bits of the first n bits correspond to its setup links. | Need to specify that the non-AP MLD should receive and track link IDs of all links which the associated AP MLD are operating on. | Rejected-While it is true that a non-AP may not have multi-link setup for all links with an AP MLD, both the link IDs associated with the setup links and the link IDs associated with group addressed frames indication bits are known to the non-AP MLD. Regarding the specification that the commenter asked about the behavior of group addressed frames indication reception, it is in subclause 35.3.15.2 (Group addressed frame reception). |
| 11592 | 35.3.15.2 | 451.50 | Buffered group addressed management frames are only transmitted on a link, while buffered group addressed data frames are transmitted on every enabled link. So if a bit for group addressed traffic from an AP is set to 1 in the TIM, does it indicate presence of BUs that can only be fetched on that link (management) or presence of BUs that can also be fetched from other links as well (data). How does the nonAP MLD intepret this indication? | Please clarify. | Rejected-The commenter fails to identity a technical issue. To answer the question, the corresponding interpretation is in subclause 35.3.15.2 (Group addressed frame reception) of 802.11be draft 2.0. |
| 11753 | 35.3.15.2 | 451.56 | This sentence assumes that a non-AP MLD receiving a group addressed MPDU has originated necessarily at a non-AP MLD. This is not always the case. Rephrase the existing sentence to: "A non-AP MLD shall filter out the group addressed MPDU with the SA field." The case where an group addressed MDPU's SA contains MLD MAC address when such an MPDU originates at a non-AP MLD is covered in Subclause - 35.3.15.1, Page 450, Line 36 and so need to cover it here. | as in comment | Rejected-The rephrased sentence the commenter suggested is not correct. Moreover, on Page 450, Line 36, subclause - 35.3.15.1 of 802.11be draft 2.0 is removed according to the CID 13517. |

**Discussion:** None.

**35.3.12 Multi-link operation group addressed frames (#11084)**

**35.3.12.1 AP MLD operation for group addressed frames (#11084)**

***TGbe editor: Please modify the subclause as follows***

Each AP affiliated with an AP MLD shall schedule for transmission all buffered group addressed frames immediately after every DTIM beacon except when the AP is a TWT scheduling AP that schedules buffered group addressed frames during specific broadcast TWT SPs as defined in 26.8.3.2 (Rules for TWT scheduling AP) (#10007, 13922).

Each AP affiliated with an AP MLD that is not a TWT scheduling AP shall schedule buffered group addressed frames immediately after every DTIM beacon. A TWT scheduling AP shall schedule the buffered group addressed frames for transmission 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))"

 (#13517, 11752, 12111)

Each AP affiliated with an AP MLD shall schedulethe 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.

An AP MLD shall schedule the transmission of the buffered group addressed Data frames that are expected to be received by a non-AP MLD on all the enabled links setup with the non-AP MLD. (#12112)

NOTE 1—Additional and exceptional rules of group addressed frame delivery for an NSTR mobile AP MLD are defined in 35.3.19 (NSTR mobile AP MLD operation). (#12325)

If an AP affiliated with an AP MLD is not part of 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 bit corresponding to AID 0.

—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. (#13995, 13923, 13996)

* The bits 1 to N of the bitmap in the Partial Virtual Bitmap field are for the AP MLD where N is equal to 2^( Group Addressed BU Indication Exponent +1)-1, and the Group Addressed BU Indication Exponent is carried in the Group Addressed BU Indication Exponent subfield of the EHT Operation Parameters field (#13995, 13923, 13996). The AIDs from 1 to N shall not be allocated to a STA, and a non-AP MLD that has a multi-link setup with the AP MLD and has a setup link on which the AP operates. (#13899, 12825)
* 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 (N-n) bits are set to 0. (#13995, 13923, 13996)

If an AP affiliated with an AP MLD 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 (maximum possible number of BSSIDs – 1) which is in the same multiple BSSID as the AP. (#13995, 13923, 13996)

—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 set (#13388) 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 AIDs from X to X+N-1 shall not be allocated to a STA, and a non-AP MLD that has a multi-link setup with the AP MLD and has a setup link on which the AP operates. (#13899, 12825)
* 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 (N-n) bits are set to 0.

NOTE 2—The AP indicates the presence of its buffered group addressed frames following 11.2.3.6 (AP operation). (#12325)

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 (#13697) (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 of the EHT Operation element (#13801) 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 for the AP MLD with which the AP that corresponds to the transmitted BSSID is affiliated with (#12816) 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 AIDs from Y+(k-1)\*N to Y+k\*N-1 shall not be allocated to a STA, and a non-AP MLD that has a multi-link setup with the AP MLD and has a setup link in which the AP operates. (#13899, 12825)
* 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 (N-n) bits are set to 0.

When the AP MLD has less than 5 links, the Group Addressed BU Indication Exponent subfield shall be set to 1. (#13389)

NOTE 3—48 bits can cover almost all typical scenarios where the AP MLD has less than 5 links and the multiple BSSID set in which the reporting AP is, has less than 17 nontransmitt BSSIDs, (#12385, 13698)

**35.3.15.2 Non-AP MLD receive operation for group addressed frames (#11084)**

NOTE 2—Additional and exceptional rules of group addressed frame reception for an NSTR mobile AP MLD are defined in 35.3.19 (NSTR mobile AP MLD operation). (#12325)