IEEE P802.11  
Wireless LANs

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Abstract

This submission proposes resolutions of comments received from TGbe comment collection LB266 based on TGbe D3.0.

17843 16193 15412 17363 15019 15640 16844 17364 17991 18253 15413 15488 16845 16846 17365 17992 16847 16848 16849 15873 17366 16547 16380 16609 16850 16610 16548 16611 15689 16851 16549 (31 CIDs)

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Minor update

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** |
| 17843 | 35.3.15 | 0.00 | The rule AID assignment of non-AP MLD in case of multiple BSSID set is missing | Please define the rule, The commenter will bring the contributition. | Revised-  Agree with the comment in principle. Apply the changes marked as #17843 in this document. |
| 16193 | 35.3.15.1 | 506.63 | This note is about AID assignment of non-AP MLD in case of multiple BSSID set, it should be normative behavior. | Please change it to be normative behavior and move this to the general subcaluse of multi-link operation. The commenter will bring the contributition. | Revised-  Agree with the comment in principle. Apply the changes marked as #16193 in this document. |
| 15412 | 35.3.15.1 | 547.41 | Commas in the sentence are incorrect and confusing | Rephrase as: "Each AP affiliated with an AP MLD shall schedule for transmission all buffered group-addressed frames that arrive via the DS immediately following the next DTIM beacon, with the following exceptions:" | Revised-  Agree with the comment in principle. Following the description in 11.2.3.6 (AP operation), rephrase this sentence. Apply the changes marked as #15412 in this document. |
| 17363 | 35.3.15.1 | 547.42 | I don't think that all BUs are delivered immediately after the next DTIM. E.g., if FMS is used then they are sent in specific DTIMs. Please ensure that this statement is correct. | As in comment. | Revised-  Agree with the comment in principle. Add the reference 11.2.3.6 (AP operation) and rephrase this sentence. Apply the changes marked as #17363 in this document. |
| 15019 | 35.3.15.1 | 547.44 | if a link advertised as disabled link following the rule define in 35.3.7.1.7, legacy STA can't associate as well | an AP that operates on a link that has been advertised as disabled for all associated non-AP MLDs and legacy STAs. | Rejected-  Advertised T2LM can't be recognized by legacy STAs. According to the rules defined in 35.3.7.1.7, the AP will transmit the BTM Request and Disassociation frames to all associated non-AP STAs that are not affiliated with non-AP MLDs. |
| 15640 | 35.3.15.1 | 547.47 | "." is missing at the end of this sentence. | Add a period "." at the end of this sentence. | Revised-  The corresponding bullet is rephrased based on the CID 15412 and 17363.  Apply the changes marked as #15640 in this document. |
| 16844 | 35.3.15.1 | 547.51 | "An AP MLD that schedules for transmission a group addressed Data frame received from an associated non- AP MLD shall set the SA field of the group addressed Data frame equal to the MLD MAC address of the non-AP MLD." -- the non-AP MLD does not transmit a group addressed Data frame, so the AP MLD can't have received it. Also, why can't the AP just use the SA as specified by the non-AP device, as for non-MLO operation? | As it says in the comment | Rejected-  The commenter fails to identify the technical issue. To answer the commenter's first question, that is the assumption that the AP MLD received a group addressed Data frame from the non-AP MLD. For the second question, let each non-AP STA affiliated with the MLD filter out the group addressed Data frame it has sent; for details refer to 20/0672r1. |
| 17364 | 35.3.15.1 | 547.53 | Remove "equal" | As in comment. | Accepted- |
| 17991 | 35.3.15 | 547.58 | 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. With current indication of pending group-addressed traffic, this is not possible. | Provide an indication in either the TIM element or multi-link traffic indication element to indicate presence of buffered group addressed management frames |  |
| 18253 | 35.3.15.1 | 547.58 | It is hard to understand "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." | There is no duplicate detection mechanism for the same greoup addressed MMPDU delivered on different links, neither there is a mechanism to identify the intended link when the group addressed MMPDU is delivered on another link, so the a group addressed MMPDU cannot be delivered on multiple links.  Clarify the sentence to say a group addressed MMPDU is sent only on 1 link. Group addressed MMPDUs of the same category/action and same dialog token delivered on different links shall not be considered as the same MMPDU | Revised-  A note is added to clarify this bullet. Apply the changes marked as #18253 in this document. |
| 15413 | 35.3.15.1 | 547.61 | The final bullet of this requirement seems to be saying that the AP MLD schedules group addressed Data frames using all links. This seems to ignore the concept of TID to Link mapping | Revise text to address discrepancy or add note indicating why there is no discrepancy | Rejected-  TID to link mapping applies only to individual addressed Data frames, so there is no any text change for it. |
| 15488 | 35.3.15.1 | 547.62 | This limitation will lead to EML frame exchanges to be stopped by group addressed frames transmission on any enabled links. However, it is unnecessary for an EMLMR non-AP MLD which has remained RF chain to receive the group addressed frames. | It is proposed for a non-AP MLD to indicate whether it has remain RF chain(s) to receive group addressed frames on the other links during an EMLMR frame exchange on a link. | Rejected-  This was a previous discussion in 22/1815r2 within the task group and they did not reach consensus on a suitable solution that they feel will satisy the comment. |
| 16845 | 35.3.15.1 | 547.62 | "-- the transmission of the buffered group addressed Data frames that are expected to be received by a non-AP MLD in all the enabled links setup with the non-AP MLD." -- but typically all non-AP MLDs will be interested in the broadcast, so it doesn't make sense to do this on a per-non-AP MLD basis | Change to "-- the transmission of the buffered group addressed Data frames on all the links that are enabled with at least one non-AP MLD." | Rejected-  The comment fails to identify a technical issue. The AP MLD schedules for delivery group addressed frames of other links on a link if the non-AP MLD has an affiliated STA on that link. If there is no STA operating on that link then there is no need for the AP MLD to schedule the delivery of group addressed frames. This way it reduces the usage of of the wireless medium for sending duplicate frames. |
| 16846 | 35.3.15.1 | 548.04 | ", is not part of a multiple BSSID set" spurious comma | Delete comma | Accepted- |
| 17365 | 35.3.15.1 | 548.05 | If the APs are scheduling the delivery of group addressed frames on all enabled links then what is the use of this per-link separation of the DTIM bits? | As in comment. |  |
| 17992 | 35.3.15 | 548.05 | Since group addressed data frames are buffered for transmission on all links and the sequence numbers are MLD level, the need for cross-link group addressed frame indication is not clear. Note that with MLO and with multiple BSSIDs, this can eat up significant number of AIDs and can also bloat DTIM beacon. Hence it is better to allow an AP MLD to skip such indication. | Provide an indication field in the MLD Capabilities and Operations subfield transmitted by an AP MLD about whether it shall provide cross-link group addressed frame indication. |  |
| 16847 | 35.3.15.1 | 548.15 | ^ could be XOR | Use superscript instead. Also at line 38 and next page | Accepted- |
| 16848 | 35.3.15.1 | 548.15 | "and the Group Addressed BU Indication Exponent is carried in the Group Addressed BU Indication Exponent subfield of the EHT Operation Parameters field" should be "and the Group Addressed BU Indication Exponent is the Group Addressed BU Indication Exponent subfield of the EHT Operation Parameters field" | As it says in the comment. Also at line 41 and next page | Accepted- |
| 16849 | 35.3.15.1 | 548.18 | "and or" is confusing | I think "or" is intended here | Revised-  Agree with the comment in principle. Apply the changes marked as #16849 in this document. |
| 15873 | 35.3.15.1 | 548.19 | The sentence is broken: "and or a non-AP MLD that ...". | Remove "and". | Revised-  Agree with the comment in principle. Apply the changes marked as #15873 in this document. |
| 17366 | 35.3.15.1 | 548.19 | And or....at least one of them is wrong. Please fix | As in comment. | Revised-  Agree with the comment in principle. Apply the changes marked as #17366 in this document. |
| 16547 | 35.3.15.1 | 548.21 | Need to specify that the indication "that one or more group addressed frames are buffered for each AP of the other AP(s) in the same AP MLD" is done by setting the corresponding bit value to 1. Please modify the sentence as suggested. | The sentence should be revised as follows: " 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 \*by setting the corresponding bit value to 1\* in an increasing order of their link IDs" | Accepted- |
| 16380 | 35.3.15.1 | 548.22 | "of the other AP(s)" is ambiguous. | Change "for each AP of the other APs" to "for each AP affiliated with the same AP MLD" at 548.22, 548.27, 548.33, 548.47 | Revised-  Agree with the comment in principle. Apply the changes marked as #16380 in this document. |
| 16609 | 35.3.15.1 | 548.22 | Add a period after the word "IDs" due to end of the sentence. | As in comment | Accepted- |
| 16850 | 35.3.15.1 | 548.24 | "The first n bits of N bits are used to indicate that one or more group addressed frames are buff- ered for each AP of the other AP(s) in the same AP MLD in an increasing order of their link IDs " -- this is a bit subtle. Also n not defined | Add a "NOTE---If for example the other APs have link IDs 3, 6 and 7, bit 1 is for the AP with link ID 3 and bit 3 is for the AP with link ID 7." In the cited text change "of the other AP(s)" to "of the other n AP(s)" with n italicised (also make this change at line 47 and next page) | Revised-  Agree with the comment in principle. Apply the changes marked as #16850 in this document. |
| 16610 | 35.3.15.1 | 548.30 | typo: replace "multiple BSSID" with "multiple BSSID set" in the following sentence: "...which is in the same multiple BSSID as the AP" | As in comment | Accepted- |
| 16548 | 35.3.15.1 | 548.46 | Need to specify that the indication "that one or more group addressed frames are buffered for each AP of the other AP(s) in the same AP MLD" is done by setting the corresponding bit value to 1. Please modify the sentence as suggested. | The sentence should be revised as follows: " 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 \*by setting the corresponding bit value to 1\* in an increasing order of their link IDs" | Accepted- |
| 16611 | 35.3.15.1 | 548.57 | typo: replace "multiple BSSID" with "multiple BSSID set" in the following sentence: "...which is in the same multiple BSSID as the AP" | As in comment | Accepted- |
| 15689 | 35.3.15.1 | 549.06 | Oren Kedem | In case "Group Addressed BU Indication Limit" is set to "1", does the indications should stop at 48bits or continue as much as required per the number of non-TX Affiliated-APs ? | Rejected-  The comment fails to identity the technical issue. To answer the question, the AP still could provide more than 48 bits for indications, but that is not mandatory for AP. |
| 16851 | 35.3.15.1 | 549.15 | "Ad-dressed" should be "Addressed" | As it says in the comment | Accepted- |
| 16549 | 35.3.15.1 | 549.21 | Need to specify that the indication "that one or more group addressed frames are buffered for each AP of the other AP(s) in the same AP MLD" is done by setting the corresponding bit value to 1. Please modify the sentence as suggested. | The sentence should be revised as follows: " 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 \*by setting the corresponding bit value to 1\* in an increasing order of their link IDs" | Accepted- |

**Discussion:** None.

***TGbe Editor: please modify the following paragraphs***

###### 35.3.15 Multi-link operation group addressed frames

**35.3.15.1 AP MLD operation for group addressed frames**

Each AP affiliated with an AP MLD shall schedule for transmission all buffered group addressed frames following the rules defined in 11.2.3.1 (General) and 11.2.3.6 (AP operation) with the following exception(#15412, 17363):

* an AP that operates on a link that has been advertised as disabled for all associated non-AP MLDs according to procedures defined in [35.3.7.1.7 (Advertised TID-to-link mapping in Beacon and Probe](#bookmark54) [Response frames)](#bookmark54) is exempt from this rule.(#15412, 17363, 15640)

(#15412, 17363)

An AP MLD that schedules for transmission a group addressed Data frame received from an associated non- AP MLD shall set the SA field of the group addressed Data frame (#17364) 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 enabled links setup with the non-AP MLD.

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)](#bookmark100).

NOTE 2—Each AP affiliated with an AP MLD uses SNS in Table 10-5 (Transmitter sequence number spaces) maintained by itself to determine the sequence number of a group addressed Management frame. (#18523)

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) affiliated with (#16380) 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) affiliated with (#16380) the same AP MLD shall be contiguous.
  + 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(#16847), and the Group Addressed BU Indication Exponent is (#16848) the Group Addressed BU Indication Exponent subfield of the EHT Operation Parameters field. The AIDs from 1 to *N* shall not be allocated to a non-AP STA, (#15873, 16849, 17366) or a non-AP MLD that has a multi-link setup with the AP MLD and has a setup link on which the AP operates.
  + The first *n* bits of *N* bits are used to indicate that one or more group addressed frames are buffered for each AP of all the other (#16850) AP(s) that are affiliated with (#16380) the same AP MLD and that operate on enabled link(s) by setting the corresponding bit value to 1 (#16547) in an increasing order of their link IDs.(#16609) The remaining (*N* – *n*) bits are set to 0.

NOTE 3---For example, if all the other APs have link IDs 3, 6 and 7, bit 1 is for the AP with link ID 3 and bit 3 is for the AP with link ID 7. (#16580)

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) affiliated with 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 set (#16610) 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) affiliated with 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 as the AP and *N* is equal to 2 (Group Addressed BU Indication Exponent + 1) – 1(#16847), and the Group Addressed BU Indication Exponent is (#16848) the Group Addressed BU Indication Exponent subfield of the EHT Operation Parameters field. The AIDs from *X* to *X* + *N* – 1 shall not be allocated to a non-AP STA, and to a non-AP MLD that has a multi-link setup with the AP MLD and has a setup link on which the AP operates.
  + The first *n* bits of *N* bits are used to indicate that one or more group addressed frames are buff- ered for each AP of all (#16850) the other AP(s) affiliated with (#16380)the same AP MLD by setting the corresponding bit value to 1(#16548) in an increasing order of their link IDs. 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).

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) affiliated with the same AP MLD as the nontransmitted 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 (maximum possible number of BSSIDs – 1) which is in the same multiple BSSID set (#16611) 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 affiliated with 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) affiliated with the same AP MLD shall be contiguous. The AP shall set the Group Addressed BU Indication Limit subfield of the EHT Operation element 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 *k*th nontransmitted BSSID affiliated with an MLD, where *k* is numbered in an increasing order of AP 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 *k*th 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 and *N* is equal to 2^(Group Addressed BU Indication Exponent + 1) – 1, and the Group Addressed BU Indication Exponent is (#16848)the Group Addressed(#16581) 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 non-AP STA, and to a non-AP MLD that has a multi- link setup with the AP MLD and has a setup link in which the AP operates.
  + The first *n* bits of *N* bits are used to indicate that one or more group addressed frames are buff- ered for each AP of all the other AP(s) affiliated with (#16380) the same AP MLD as the *k*th nontransmitted BSSID by setting the corresponding bit value to 1 (#16549) in an increasing order of their link IDs. The remaining (*N* – *n*) bits are set to 0.

**35.3.5.1 Multi-link (re)setup procedure**

(#17843, 16193)

An AP affiliated with an AP MLD shall not assign, to a non-AP MLD, an AID value that is less than 2n where n is the maximum of the value carried in the MaxBSSID Indicator (n) field of the Multiple BSSID element, corresponding to each link that is accepted as part of the multi-link (re)setup, if at least one of the APs affiliated with the AP MLD belongs to a multiple BSSID set. (#17843, 16193)

NOTE 2- In a multiple BSSID set, the first 2n bits of the partial virtual bitmap of the TIM element are reserved for the indication of group addressed frame for the BSSIDs in the set (see 11.1.3.8.5 (Traffic advertisement in a multiple BSSID set)). (#17843, 16193)

NOTE 3- An AP affiliated with an AP MLD does not assign, to a non-AP STA or a non-AP MLD that has a multi-link setup with the AP MLD and has a setup link on which the AP operates, an AID corresponding to a bit of the bitmap in the Partial Virtual Bitmap field that is for the indication of group addressed frames for the other AP(s) affiliated with the same AP MLD, as the AP or the other AP(s) affiliated with the same AP MLD as a nontransmitted BSSID that is in the same multiple BSSID as the AP (see 35.3.15.1 (AP MLD operation for group addressed frames)). (#17843, 16193)

**35.15 EHT BSS operation**

**35.15.1 Basic EHT BSS operation**

The basic EHT-MCS and NSS set is the set of <EHT-MCS, NSS> tuples that are supported by all EHT STAs that are members of an EHT BSS. It is established by the STA that starts the EHT BSS, indicated by the Basic EHT-MCS And NSS Set field of the EHT Operation parameter in the MLME-START.request primitive. Other EHT STAs determine the basic EHT-MCS and NSS set from the Basic EHT-MCS And NSS Set field of the EHT Operation element in the BSS Description derived through the scan mechanism (see 11.1.4.1 (General)).

An EHT STA shall not attempt to join (MLME-JOIN.request primitive) a BSS unless it supports (i.e., is able to both transmit and receive using) all of the <EHT-MCS, NSS> tuples in the basic EHT-MCS and NSS set.

If an EHT STA supports transmitting or receiving a PPDU, where the PPDU bandwidth is less than 320 MHz, at an <EHT-MCS, NSS> tuple, where the EHT-MCS is equal to the HE-MCS and less than 12, then it shall also support the corresponding transmitting or receiving <HE-MCS, NSS> tuple, respectively. For a lower EHT-MCS, the EHT STA shall support an equal or greater NSS than a higher EHT-MCS.

If the peer AP is operating as an EMA AP, an EHT non-AP STA should follow the procedure described in 11.1.3.8.3 (Discovery of a nontransmitted BSSID profile) for efficient discovery during scanning and to save power after association.

NOTE 1—A non-AP EHT STA is also a non-AP HE STA (see 4.3.16a (Extremely high throughput (EHT) STA)). Support for multiple BSSID capability is mandatory for a non-AP HE STA (see 11.1.3.8.1 (General)) and therefore, support for multiple BSSID capability is also mandatory for a non-AP EHT STA.

An EHT AP shall not assign an AID value of 2007 to any STA or non-AP MLD.