IEEE P802.11
Wireless LANs

|  |
| --- |
| LB225 11ax D1.0 Comment Resolution 27.10.4 Part 1 |
| Date: 2017-08-17 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Mark RISON | Samsung |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Abstract

This submission proposes resolutions for multiple comments related to TGax D1.0 with the following CIDs :

* 6187, 6183, 7605, 4793, 5402, 9392, 9393, 10332, 8136, 8135, 7947, 7944, 7943, 7942, 7941, 7940, 7949, 7950, 7948, 7962, 7863, 7864, 8401, 8393.

Revisions:

* r0: Initial version of the document, based on 17/0553r2.
* r1: Version after teleconf on 2017-06-29.
* r2: Version after teleconf on 2017-08-03 (includes discussion and areas of consensus/non-consensus).
* r3: Version prior to teleconf on 2017-08-17

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 TGax Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGax Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

***TGax Editor: Editing instructions preceded by “TGax Editor” are instructions to the TGax editor to modify existing material in the TGax draft. As a result of adopting the changes, the TGax editor will execute the instructions rather than copy them to the TGax Draft.***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **PP** | **LL** | **Comment** | **Proposed Change** | **Resolution** |
| 6187 | 193 | 32 | The criteria for distinguishing among S-MPDU, A-MPDU, and multiple TID A-MPDU is not clear enough | Need to clarify | **Rejected.****S-MPDU and A-MPDU is defined in IEEE 802.11 2016 specification. Multi-TID A-MPDU is defined in 27.10.4.** |
| 6183 | 193 | 58 | As discussed till now, the shorter Multi-STA BlockAck frame is desirable.When a STA receives all of nonzero length MPDUs with the corresponding EOF subfield set to 0 in a multi-TID A-MPDU, the STA can acknowledge the reception for the MPDUs using a Multi-STA BlockAck frame without the bitmap for the MPDUs indicating each TID. | Please extend the case of a Per STA Info subfield without the Block Ack Starting Sequence Control field and the Block Ack Bitmap field. | RejectedDiscussion: if the other modes of M-BA optimization are introduced, the implementation of M-BA becomes more complicated. We believe opther optimization of M-BA is not needed.  |
| 7605 | 193 | 44 | Change the text to "AnHE transmitter shall not aggregate MPDU that asks for Ack in a multiple-TID A-MPDU to the HE recipientunless the HE transmitter received the recipient's HE Capabilities element with Ack Enabled Multi-TID A-MPDU Support subfield being set to 1" | As in comment | Revised.Agree with the commenter in principle. TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 7605. |
| 4793 | 193 | 34 | A multi-TID A-MPDU can also contain QoS Data frames of one TID and one Action frame and still be called MT A-MPDU. Ensure this definition is consistent. Also there is a certain independence between multi-TID A-MPDU that contains contiguous valued EOFs and multi-TID A-MPDU that contains non-contiguous EOFs. Please use two different terms for these cases so that it is clear that they are not the same, and as such tx, rx and operation for these MPDUs. | As in comment. | Revised Agree with the commenter in principle.TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 4793. |
| 5402 | 193 | 58 | A multi-TID A-MPDU may contain A-MPDU subframes with the EOF subfield set to 1 and the MPDU Length subfield set to nonzero value. The STA that receives the A-MPDU acknowledges successful receptions of MPDUs in the above mentioned A-MPDU subframes with Per STA Info fields indicating an Ack. The TID value of a frame in an A-MPDU subframe with the EOF subfield set to 1 and the MPDU Length subfield set to nonzero value is unique among TID values of frames in the A-MPDU.Therefore, when every unsuccessful receptions of MPDUs are for a MPDU in an A-MPDU subframe with the EOF subfield set to 1 and the MPDU Length subfield set to nonzero, the Per STA Info field without Block Ack Starting Sequence Control and Block Ack Bitmap can acknowledge the successful reception of all MPDUs of a TID value without the ambiguity.This can reduce the length of the Multi-STA BlockAck frame. | An HE STA that receives a multi-TID A-MPDU shall respond with a Multi-STA BlockAck frame that contains- One Per STA Info field indicating an Ack for each successfully received MPDU that solicits a response that is preceded by a nonzero length MPDU delimiter whose EOF is 1 (TID value equals that of the QoS Data/QoS Null frame or 15 for the Action frame),- One Per STA Info field indicating a BlockAck for each TID of a successfully received MPDU that solicits a response that is preceded by a nonzero length MPDU delimiter whose EOF is 0 (TID value equals that of the QoS Data frame),- One Per STA Info field with the Ack Type subfield set to 1 for each TID of a successfully received MPDU that solicits a response that is preceded by a nonzero length MPDU delimiter whose EOF is 0 (TID value equals that of the QoS Data frame) only when every unsuccessful receptions are for MPDUs of which the corresponding MPDU delimiter includes the EOF subfield set to 1 and the MPDU Length subfield set to nonzero value. | RejectedDiscussion: if the other modes of M-BA optimization are introduced, the implementation of M-BA becomes more complicated. We believe opther optimization of M-BA is not needed. |
| 9392 | 193.54 | 54 | The baseline says "The STA shall not add an A-MPDU subframe with EOF equal to 0 after any A-MPDU subframe with EOFset to 1." It is better to clarify MPDU aggregation rule for consistency and receiver's procedure | MPDUs with EOF 1 and non-zero length should not be present before MPDUs with EOF 0 | **Revised****Generally agreed with the commenter. Please also see the discussion under CID 8393**TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 9392 |
| 9393 | 193.32 | 32 | An MPDU with EOF 1 and non-zero length may be aggregated with other MPDUs not soliciting immediate responses (QoS Data No Ack, Action No Ack, QoS Null) in an A-MPDU. Is the A-MPDU an S-MPDU or a single TID A-MPDU or a Multi TID A-MPDU? | Need to clarify | RevisedDiscussion: The TIDs of QoS Data No Ack, Action No Ack, QoS Null in A-MPDU are not counted when deciding whether a A-MPDU is a single TID A-MPDU or multi-TID A-MPDU.TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 9393. |
| 10332 | 193 | 53 | "A multi-TID A-MPDU may contain multiple noncontiguous nonzero length MPDU delimiters with EOFsubfield equal to 1, one for each TID that solicits Ack and/or multiple noncontiguous nonzero length MPDUdelimiters with EOF subfield equal to 0, one for each TID that solicits BlockAck." is conflicting with the baseline that says"An A-MPDU subframe with EOF set to 0 shall not be added after any A-MPDu subframe with EOF set to 1 " clarify the benefit of allowing this flexibility in terms of supporting MPDU with different ACK policy, othwise remove this | per comment | **Revised****See the discussion under CID 8393**TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 10332. |
| 8136 | 193 | 50 | The use of the word "solicits" here is interesting, because a few lines later, it says that the response shall be MBA, so is it really soliciting an immediate ACK, or is it soliciting an MBA? Does it depend on what the contents of the AMPDU were? i.e. single VHT vs Multi-TID, etc? | Make the language consistent. | **Revised****Generally agree with the commenter**TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 8136. |
| 8135 | 193 | 58 | How does the recipient know whether the received PPDU was a multi-TID AMPDU or a single TID AMPDU? If some of the delimiters are bad, the recipient could mistake a multi-TID AMPDU for a single AMPDU. | Make the response always the same - i.e. it is always an MBA, even if the recipient thinks it was a single TID AMPDU. | **Rejected****Discussion: if the responder always uses MBA, the initiator’s assumption of responding PPDU length may not be right. The assumption of initiator’s accurate estimation of responding PPDU length is not true. If the recipient correctly receives MPDUs of one TID from a multi-TID A-MPDU, the respnding C-BA has no harm.**  |
| 7947 | 194 | 1 | "One Per STA Info field indicating a BlockAck for each TID of a successfully received MPDU thatsolicits a response that is preceded by a nonzero length MPDU delimiter whose EOF is 0 (TID valueequals that of the QoS Data frame)." -- this is unclear in the case where there is more than one such frame per TID | Change to "One Per STA Info field indicating a BlockAck for each TID present in the successfully received MPDUs thatsolicited a response that is preceded by a nonzero length MPDU delimiter whose EOF is 0 (TID valueequals that of the QoS Data frame)." | **Revised****Agree with the commenter in general**TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 7947. |
| 7944 | 193 | 58 | "that receives a multi-TID A-MPDU" -- it is not clear how such an A-MPDU is identified | Change to "that receives an A-MPDU with more than one MPDU delimiter with the EOF subfield equal to 1 and the MPDU Length subfield not equal to 0, or with MPDUs from more than one TID, or with both Management and Data frames" | **Rejected****Discussion: multi-TID A-MPDU is described in the first paragraph in subclause 27.10.4** |
| 7943 | 193 | 53 | "A multi-TID A-MPDU may contain multiple noncontiguous nonzero length MPDU delimiters with EOFsubfield equal to 1, one for each TID that solicits Ack and/or multiple noncontiguous nonzero length MPDUdelimiters with EOF subfield equal to 0, one for each TID that solicits BlockAck." -- this is extremely unclear (and some aspects seem wrong, e.g. there can be more than one per TID for the BA case) | Change to "A multi-TID A-MPDU may contain multiple nonzero length MPDU delimiters with EOF subfield equal to 1, but no more than one for each TID. A multi-TID A-MPDU may contain multiple nonzero length MPDU delimiters with EOF subfield equal to 0.NOTE---The MPDUs may be in any order, irrespective of their TID and the EOF subfield of their delimiter." | **Revised****Agree with the commenter in general**TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 7943. |
| 7942 | 193 | 56 | " that solicits BlockAck" -- this is unclear | Change to "[...] that solicits a BlockAck indication in a Multi-STA Block Ack frame" | **Revised****Agree with the commenter in general**TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 7942. |
| 7941 | 193 | 50 | " if the QoS Data frame or Action frame solicits an immediate Ack frame." -- as indicated at line 61, it does not solicit an Ack frame, it solicits a MSBA frame | Change to "[...] that solicits an Ack indication in a Multi-STA Block Ack frame" | **Revised****Agree with the commenter in general**TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 7941. |
| 7940 | 193 | 32 | There are 5 instances of "nonzero length MPDU delimiter". All MPDU delimiters have non-zero length (they all have a length of 4 octets) | Change each instance to "MPDU delimiter with the MPDU Length subfield not equal to 0" | **Revised****Agree with the commenter in general**TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 7940. |
| 7949 | 193 | 56 | "that solicits BlockAck" -- it is not clear what the condition is | Add a "NOTE---A QoS Data frame solicits an immediate block acknowledgement if the Ack Policy is Normal Ack or Implicit Block Ack Request and the TID corresponds to a block ack agreement." | **Revised****Agree with the commenter in general**TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 7949. |
| 7950 | 193 | 47 | There is no need for this overloading of the EOF field | Replace lines 193.47 to 194.4 with:An HE STA shall construct a multi-TID A-MPDU as defined in 9.7 (Aggregate MPDU (A-MPDU)) and10.13 (A-MPDU operation) except that there may be QoS Data frames with different TIDs inthe A-MPDU (but no more than one per TID if not sent under a block ack agreement) andthere may be an Action frame in the A-MPDU.An HE STA that receives a multi-TID A-MPDU shall respond with a Multi-STA BlockAck frame thatcontains (see 27.4 (Block acknowledgement)) one Per STA Info field per TID of the successfullyreceived MPDUs and also one Per STA Info field if an Action frame was successfully received, where:- For MPDUs sent under a block ack agreement, the Ack Type subfield shall be set to 0and the TID subfield set to that of the QoS Data frame- For MPDUs not sent under a block ack agreement, the Ack Type subfield shall be set to 1and the TID subfield set to that of the QoS Data frame, or to 15 in the case of anAction frameAlternatively, if all MPDUs in the A-MPDU were successfully received, the Multi-STA BlockAck framemay contain just a Per STA Info field with the Ack Type subfield set to 1 and the TID subfield to 14.NOTE---A STA does not consider all MPDUs in an A-MPDU successfully received if any MPDU delimiters were received with errors. | **Revised****See the discussion under CID 8393**TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 7950. |
| 7948 | 193 | 50 | " if the QoS Data frame or Action frame solicits an immediate Ack frame." -- it is not clear what the condition is | Add a "NOTE---A QoS Data frame solicits an immediate non-block acknowledgement if the Ack Policy is Normal Ack or Implicit Block Ack Request and the TID does not correspond to a block ack agreement. An Action frame always solicits an immediate acknowledgement." | **Revised****See the discussion under CID 8393**TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 7948. |
| 7962 | 193 | 49 | In an A-MPDU containing multiple MPDUs of different TID, each with EOF = 1, it is unclear whether each of these MPDUs is to be treated as a VHT Single MPDU | At the end of the sentence add "(these frames are treated as S-MPDUs)" | **Revised****See the discussion under CID 8393**TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 7962. |
| 7863 | 193 | 49 | Setting EOF to 1 in this manner is inconsistent with the statement "set to 0 otherwise" in first row of Table 9-422 | Remove from 27.10.4 all mentions of EOF | **Revised****See the discussion under CID 8393**TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 7863. |
| 7864 | 193 | 49 | Setting EOF to 1 in this manner conveys no additional information and is unnecessary | Remove from 27.10.4 all mentions of EOF | **Revised****See the discussion under CID 8393**TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 7864. |
| 8401 | 193 | 47 | 11ax introduces new EOF setting rule. However, the EOF setting rule in 10.13.7 and table 9-422 in 9.7.1 is not changed correspondingly. | Make sure that the description for EOF setting in 10.13.7 and Talbe 9-422 are consistent with the new EOF setting rule added in 27.10.4. | **Revised****See the discussion under CID 8393**TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 8401.  |
| 8393 | 193 | 58 | Currently, it is required that Multi-STA Block Ack is used for response to multi-TID A-MPDU. However, if the receiver only receives one MPDU with EOF in the delimiter set to 1 due to error of receiving other MPDUs, and the A-MPDU is carried in VHT PPDU, then the receiver may treat the MPDU as VHT single MPDU and responds with Ack frame rather than Multi-STA Block Ack. Similarly, if the receiver only receivers one MPDU carrying QoS Data with EOF in the delimiter set to 0 due to error of receiving other MPDUs, then the receiver may treat the MPDU as single TID and respond with Block Ack rather than Multi-STA Block Ack. | There are several options to resolve the ambiguity. Option 1: Have an indication to differentiate multi-TID A-MPDU from single TID A-MPDU or S-MPDU. The reserved bit in MPDU delimiter can be used for this purpose. Option 2: HE STA always responds Multi-STA Block Ack to A-MPDU sent from HE STA that supports Multi-STA Block Ack. Option 3: Relax the restriction that response to multi-TID A-MPDU shal be Multi-STA Block Ack and allow Ack and Block Ack. Add the condition that in multi-TID A-MPDU, there is only one MPDU that solicits Ack frame. | Revised.Discussion: generally agree with the commenter. When only a MPDU with EoF being 1 and Length being non zero in a A-MPDU is received correctly, the receiver will always respond with M-BA. The reason is that the receiver can’t figure out whether the transmitter transmits a S-MPDU or multi-TID A-MPDU. However, this may make medium time of S-MPDU responding longer which is not desirable. There are three possible solutions: option 1 is that at most one MPDU in multi-TID A-MPDU can ask for Ack, option 2 is that MPDU asking for Ack is the only MPDU from TID with no BA agreement, option 3 is that the reserved bit in MPDU delimiter is used to indicate the Ack acknowledgement. We propose to use option 1.TGax editor to make the changes shown in 11-17/0553r2 under all headings that include CID 8393. |

## Discussion:

We need to agree on how we think multi-TID A-MPDUs work. Proposal:

1) A multi-TID A-MPDU is an A-MPDU that contains QoS Data frames with different TIDs that need acknowledgement, or an A-MPDU that contains an Action frame and one or more QoS Data frames that need acknowledgement. There may be QoS Null frames that have an ack policy that does not indicate the need for acknowledgement (i.e. “No Ack”), and Action No Ack frames etc., but no additional Action frames.

Note: “need acknowledgment” for a QoS Data frame means the ack policy is “Normal Ack or Implicit Block Ack Request”, “HTP Ack” or “Block Ack”, i.e. anything except “No Ack”.

2) A non-ack-enabled multi-TID A-MPDU is a multi-TID A-MPDU where none of the MPDUs is an Action frame and none of the MPDUs specifically requests acknowledgement as an Ack (as opposed to a BlockAck). EOF is set to 0 in the delimiter for all the MPDUs. All the QoS Data MPDUs are sent under BA agreements.

3) An ack-enabled multi-TID A-MPDU is a multi-TID A-MPDU where one or more of the MPDUs (each of which can be a QoS Data frame or an Action frame) specifically request acknowledgement as an Ack (as opposed to a BlockAck, for QoS Data). This is signalled by setting EOF = 1 in the delimiter for those MPDUs. All the EOF = 0 QoS Data MPDUs are sent under BA agreements. The TID of an EOF = 1 QoS Data MPDU is different from the TID of all the other MPDUs. There is no more than one Action frame (and if present it has EOF = 1).

4) A STA (AP) that receives frames needing immediate acknowledgment from multiple STAs may use a broadcast M-BA to acknowledge the frames, where for each STA the M-BA contents are as described below for M-BA acknowledgment to a single STA. Alternatively, the STA (AP) may send a separate acknowledgment to each STA using DL MU, where for each STA the acknowledgment is as described below for acknowledgment to a single STA.

Note: “needing immediate acknowledgment” means a QoS Data frame with an ack policy of “Normal Ack or Implicit Block Ack Request” or (when sent by an AP) “HTP Ack” (but not “Block Ack”, nor of course “No Ack”), or an Action frame.

5) A STA that receives frames needing immediate acknowledgment from a STA for more than one TID, or one TID and an Action frame, shall respond with an M-BA containing (except for the special case immediately below):

- one Per AID TID Info field with Ack Type = 1 for each EOF = 1 MPDU needing immediate acknowledgment (TID = 15 if it's an Action frame, else the TID of the QoS Data frame)

- one Per AID TID Info field with Ack Type = 0 for each TID in the EOF = 0 MPDUs needing immediate acknowledgment (necessarily QoS Data frames)

except if the frames are in a DL HE MU PPDU, the ack policy for the QoS Data frame(s) is “HTP Ack”, and no Trigger or UMRS was received (in which case it shall not respond).

The special case is that if all the MPDUs were received (no MPDU delimiter or FCS errors), it may instead respond with just:

- one Per AID TID Info field with Ack Type = 1 and TID = 14

6) A STA that receives multiple frames needing immediate acknowledgment from a STA for exactly one TID (no Action frame) shall respond with a C-BA, except if the frames are in a DL HE MU PPDU, the ack policy for the QoS Data frame(s) is “HTP Ack”, and no Trigger or UMRS was received (in which case it shall not respond).

Note: it shall not respond with an M-BA, not even the “special case” form of M-BA.

7) A STA that receives exactly one frame needing immediate acknowledgment from a STA, where EOF = 0 (necessarily a QoS Data frame sent under a BA agreement), shall respond with a C-BA, except if the frame is in a DL HE MU PPDU, the ack policy for the QoS Data frame is “HTP Ack”, and no Trigger or UMRS was received (in which case it shall not respond).

8) A STA that receives a BAR from a STA shall respond with a C-BA.

9) A STA that receives exactly one frame needing immediate acknowledgment from a STA, where EOF = 1, shall respond with an Ack frame, except if the frame is in a DL HE MU PPDU, the ack policy is “HTP Ack” if the frame a QoS Data frame, and no Trigger or UMRS was received (in which case it shall not respond).

Note: if the transmitter of an ack-enabled A-MPDU with more than one MPDU requesting acknowledgment as an Ack (as opposed to a BlockAck) receives an Ack frame in response, it does not know which of the MPDUs is being acknowledged and hence needs to retransmit all of them (subject to retry/timeout limits).

Some possible areas of disagreement:

* Can ack-enabled multi-TID A-MPDUs can be sent in VHT PPDUs?
* Can non-ack-enabled multi-TID A-MPDUs can be sent in VHT PPDUs?
* Can ack-enabled multi-TID A-MPDUs can be sent in HT PPDUs (need to extend spec to add EOF field)?
* Can non-ack-enabled multi-TID A-MPDUs can be sent in HT PPDUs?
	+ Consensus: allow in VHT PPDU between HE STAs (not in HT PPDU or if at least one side is not an HE STA)
* Can you have more than one “Ack”ed MPDU (as long as TIDs differ)?
	+ Proposal: yes (see above)
* What does “EOF” really mean?
	+ Consensus: end of frame is now signalled by EOF = 1 **and** Length = 0, for VHT/HE PPDUs between HE STAs
* Do(es) the “Ack”ed MPDU(s) (EOF = 1) need to be in any particular position (e.g. “last”)?
	+ Consensus: EOF = 1 MPDUs can be anywhere in an ack-enabled multi-TID A-MPDU (i.e. there can be EOF = 0 MPDUs before or after (and EOF = 0 Length = 0 delimiters before or after too))
* For a given TID can you have both an "Ack"ed MPDU (EOF = 1) and some "BlockAck"ed MPDUs (EOF = 0)?
	+ Consensus: no, if one EOF = 1 for a TID then no EOF = 0s (see above)
* Do “Block Ack” ack policy MPDUs count towards constituting a multi-TID A-MPDU?
	+ Consensus: yes (but note do not count towards the form of acknowledgement) (see above)
* Should a BAR be allowed together with QoS Data MPDUs (for different TIDs) and/or an Action frame?
	+ Note they are already allowed in the absence of QoS Data MPDUs
	+ No consensus yet
* Is there something special about Trigger frames (e.g. whether to ack an Action frame, if the Trigger frame was corrupted)?
	+ Consensus: Action frame only allowed with Trigger frame or UMRS in the case of an HE MU PPDU; only respond to Action frame if you also got the Trigger frame too (see above)
* What is the point of allowing QoS Nulls?
	+ To carry BSR and HE variant HT Control – basic principle is don’t send QoS Null if sending QoS Data for that TID, and QoS Null is always sent with ack policy No Ack
* Do “No Ack” MPDUs contribute towards making an A-MPDU a multi-TID A-MPDU
	+ Proposal: no (see above)
* Should other MMPDUs be allowed in an A-MPDU, e.g. Disassociate?
	+ No consensus yet (not allowed above)
* Can an “all-ack” M-BA be used instead of a C-BA or Ack?
	+ No consensus yet (not allowed above)

## Resolution:

**10.13 A-MPDU Operation**

**10.13.7 Setting the EOF field of the MPDU delimiter**

***TGax editor: Change subclause 10.13.7 as follows (CID 9392):***

The EOF field may be set to 1 in an A-MPDU subframe carried in a VHT PPDU or HE PPDU if the subframe’s MPDU Length field is nonzero and the subframe is the only subframe that has a nonzero MPDU Length field. The EOF field of each A-MPDU subframe with an MPDU Length field with a nonzero value that is not the only AMPDU subframe with MPDU Length field with a nonzero value in the A-MPDU carried in a VHT PPDU shall be set to 0. In an A-MPDU with more than one MPDU carried in an HE PPDU, the last A-MPDU subframe with a nonzero value in the MPDU Length field may have the value 1 in the EOF field. All other A-MPDU subframes with a nonzero value in the MPDU Length field shall have the value 0 in the EOF field. Additional rules about when an A-MPDU subframe may have the value 1 in the EOF field and a nonzero value in the MPDU Length field can be found in Subclause 27.5.1 (HE DL MU operation) and Subclause 27.10.4 (A-MPDU with multiple TIDs). The EOF field shall be set to 0 in all A-MPDU subframes that are carried in an HT PPDU.

An MPDU that is the only MPDU in an A-MPDU and that is carried in an A-MPDU subframe with 1 in the EOF field is called a *VHT single MPDU*.

**27.5.1 HE DL MU operation**

**27.5.1.1 General**

***TGax editor: Add the following paragraph at the end of 27.5.1.1:***

If an HE AP has received from an HE STA an HE Capabilities element with the Ack Enabled Multi-TID A-MPDU Support subfield equal to 1, the AP may send to the STA in a DL MU PPDU either of the following:

* an A-MPDU with a Trigger frame, and exactly one QoS Data frame with an Ack Policy of HTP Ack and 1 in the EOF field in the MPDU delimiter that contains it
* an A-MPDU with a Trigger frame, and exactly one Action frame with 1 in the EOF subfield in the MPDU delimiter that contains it

See 27.4.4 for the acknowledgement rules.

**27.10.4 A-MPDU with multiple TIDs**

***TGax editor: Modify the first paragraph until 5th paragraph of 27.10.4 as following:***

An HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to true shall set the Multi-TID Aggregation Support subfield of the HE Capabilities element it transmits to a nonzero value; otherwise, the HE STA shall set it to 0. An HE STA with dot11MPDUAskedforAckInMultiTIDAMPDU set to true shall set dot11AMPDUwithMultipleTIDOptionImplemented to true. An HE STA with dot11MPDUAskedforAckInMultipleTIDAMPDU set to true shall set the Ack Enabled Multi-TID A-MPDU Support subfield of the HE Capabilities element it transmits to 1; otherwise, the HE STA shall set it to 0 (CID 7949, 8136, 8393, 9392, 8401, 7864, 7863, 7962, 7948, 7950, 10332).

A multi-TID A-MPDU is either a non-Ack-enabled multi-TID A-MPDU or an Ack-enabled multi-TID A-MPDU. An HE STA may transmit a non-Ack-enabled multi-TID A-MPDU to an HE STA if it has received from that STA an HE Capabilities field whose Multi-TID Aggregation Support subfield is nonzero. An HE STA may transmit an Ack-enabled multi-TID A-MPDU to an HE STA if it has received from that STA an HE Capabilities field whose Multi-TID Aggregation Support subfield is nonzero and whose Ack Enabled Multi-TID A-MPDU Support subfield is 1. Otherwise an HE STA shall not transmit a multi-TID A-MPDU to that STA (CID 7949, 8136, 8393, 9392, 8401, 7864, 7863, 7962, 7948, 7950, 10332).

An HE STA shall construct a multi-TID A-MPDU as defined in 9.7 (Aggregate MPDU (A-MPDU)), 10.13 (A-MPDU operation) and 27.10.4 (A-MPDUs with multiple TIDs) (CID 7949, 8136, 8393, 9392, 8401, 7864, 7863, 7962, 7948, 7950, 10332).

27.10.4.1 Non-Ack-Enabled Multi-TID A-MPDU

A non-Ack-enabled multi-TID A-MPDU is an A-MPDU that follows the definition in Subclauses 9.7 (Aggregate MPDU (A-MPDU)) and 10.13 (A-MPDU operation) and contains:

* QoS Data frames sent under block ack agreements with two or more different TID values and whose Ack Policy fields are Implicit Block Ack Request, HTP Ack, or Block Ack(CID 9393)
* zero or more QoS Data frames not sent under block ack agreements and whose Ack Policy fields are No Ack
* no Action frames or other QoS Data frames

In a non-Ack-enabled multi-TID A-MPDU the EOF subfield in all MPDU delimiters that have a nonzero value in the MPDU Length field shall be 0.

See 27.4.4 for the acknowledgement rules.

27.10.4.2 Ack-Enabled Multi-TID A-MPDU

An Ack-enabled multi-TID A-MPDU is an A-MPDU that follows the definition in Subclauses 9.7 (Aggregate MPDU (A-MPDU)) and 10.13 (A-MPDU operation) and contains one of the following sets of frames:

* + exactly one QoS Data frame whose Ack Policy field is Normal Ack or HTP Ack and whose MPDU delimiter has the EOF subfield equal to 1; the EOF subfield in all other MPDU delimiters that have a nonzero value in the MPDU Length field shall be 0
	+ one or more QoS Data frames sent under block ack agreements and whose Ack Policy fields are Implicit Block Ack Request, HTP Ack, or Block Ack(CID 9393)
	+ zero or more QoS Data frames not sent under block ack agreements and whose Ack Policy fields are No Ack
	+ no Action frames or other QoS Data frames
	+ exactly one Action frame whose MPDU delimiter has the EOF subfield equal to 1; the EOF subfield in all other MPDU delimiters that have a nonzero value in the MPDU Length field shall be 0
	+ one or more QoS Data frames sent under block ack agreements and whose Ack Policy fields are Implicit Block Ack Request, HTP Ack, or Block Ack (CID 9393, 4793)
	+ zero or more QoS Data frames not sent under block ack agreements and whose Ack Policy fields are No Ack
	+ no other Action frames or QoS Data frames

~~In an Ack-enabled multi-TID A-MPDU with an Action frame, the A-MPDU subframe containing the Action frame shall have the value 1 in the EOF subfield. The EOF subfield in all other MPDU delimiters that have a nonzero value in the MPDU Length field shall be 0.~~

~~In an Ack-enabled multi-TID A-MPDU without an Action frame, the last A-MPDU subframe whose MPDU Length subfield has a nonzero value shall contain a QoS Data frame and shall have the value 1 in the EOF subfield. The EOF subfield in all other MPDU delimiters that have a nonzero value in the MPDU Length field shall be 0.~~

 (CID 4793, 7943, 7942, 7941,7940, 8393, 9392, 8401, 7864, 7863, 7962, 7948, 7950, 10332)

See 27.4.4 for the acknowledgement rules.