### IEEE P802.11Wireless LANs

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| Proposed Draft Specification for MLD inidividual addressed data delivery without BA negotiation |
| Date: 2020-09-08 |
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Abstract

We propose the draft specification skeleton for MLD to help the creation of TGbe draft D0.1. This document proposes texts for the motions and SPs listed in the following pages.

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Revision based on the feedback received offline.
* Rev 2: Revision based on the feedback received during the conference call to merge some texts with the baseline.
* Rev 3: Revision based on the feedback received offline.

After multi-link setup, the following is enabled to deliver individual addressed QoS traffic of a TID without BA negotiation across links, where the TID is mapped, in R1.

* For Transmitter:
	+ Expand Table 10-5—Transmitter sequence number spaces to have a new entry Indexed by <destined MLD Address, TID> .
	+ Continue to transmit the failed QoS Data frame until the retry counter is met.
	+ Cannot transmit other QoS Data frame from the same TID in any link until the current frame finish transmission or dropped.
* For Receiver:
	+ Maintain at least the most recent record of <peer MLD address, TID, sequence number>.
	+ Drop the frame with retry bit set and record match.

[Motion 122, #SP158, [10] and [146]]

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

***Editing instructions formatted like this are intended to be copied into the TGbe D0.1 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.***

**Discussion:** *None.*

**Propose:**

***TGbe editor: Insert clause 33.3.x as follows except green tag:***

33. Extreme High Throughput (EHT) MAC specification

**33.3 Multi-link operation**

**33.3.x Multi-link device individually addressed data delivery without BA negotiation** (Motion 122, #SP158)

A non-AP MLD or an AP MLD may deliver individual addressed QoS Data frames belonging to a TID without BA negotiation to an associated AP MLD or non-AP MLD, respectively, on the setup links subject to additional constraints in 33.3.4 (Link management).

An MLD shall follow the rule as described in 10.3.2.14.2 (Transmitter requirements) to determine the sequence number of an individually addressed QoS Data frames belonging to a TID that is delivered to the associated MLD.

An MLD shall follow the rules as described in 10.3.2.14.3 (Receiver requirements) to discard duplicate individually addressed QoS Data frames belonging to a TID without BA negotiation that is delivered from the associated MLD. .

An MLD shall continue to deliver the failed individually addressed QoS Data frame belonging to a TID without BA negotiation to an associated MLD, on the setup links subject to additional constraints (see 33.3.4 (Link management)) until the retry limit is met, and a STA affiliated with the MLD shall not transmitother individually addressed QoS Data frames belonging to the TID without BA negotiation to another STA affiliated with the associated MLD on the corresponding link until the current individually addressed QoS Data frame belonging to the TID without BA negotiation finishes transmission or dropped. ***TGbe editor: Change clause 10.3.2.14 as follows (track change on):***

* Duplicate detection and recovery
* General

Because MAC-level acknowledgments and retransmissions are incorporated into the protocol, there is the possibility that a frame may be received more than once. The procedures defined in this subclause attempt to filter out these duplicates. Additional duplicate filtering is performed during Receive Buffer Operation for frames that are part of a block ack agreement as described in (Ed#57)10.25.6 (HT-immediate block ack extensions).

Duplicate frame filtering is facilitated through the inclusion of a Sequence Control field(consisting of a sequence number and fragment number) within Data, Management, and Extension frames, a TID subfield in the QoS Control field within QoS Data frames, and an ACI subfield in the Sequence Number field within QMFs(11ah), and a PTID/Subtype subfield in the Frame Control field within PV1 Data frames.

NOTE—In 10.3.2.14 (Duplicate detection and recovery), Data frames with a value of 1 in the QoS subfield of the Subtype subfield are collectively referred to as *QoS Data frames*.

* Transmitter requirements

A STA maintains one or more sequence number spaces that are used when transmitting a frame to determine the sequence number for the frame. An MLD maintains one or more sequence number spaces that are used when delivering an individually addressed QoS data frame to an associated MLD to determine the sequence number for the frame. When multiple sequence number spaces are supported, the appropriate sequence number space is determined by information from the MAC control fields of the frame to be transmitted. Except as noted below, each sequence number space is represented by a modulo 4096 counter, starting at 0 and incrementing by 1, for each MSDU or MMPDU transmitted using that sequence number space. (11aq)If dot11MACPrivacyActivated is true, the counter in each sequence number space shall be set to a random number modulo 4096 when the STA’s MAC address is changed.

NOTE—Group addressed retransmissions of BUs use the same sequence number as the initial group addressed transmission of the BU. Individually addressed retransmissions of a group addressed BU delivered via DMS use the same sequence number as the initial individually addressed transmission of the BU. When a BU is delivered both using group addressing and individual addressing (e.g., when DMS is active but there are other associated STAs not using DMS), the sequence number might differ between the group addressed and individually addressed transmissions of the same BU.(M101)

MPDUs that are part of the same MSDU or A‑MSDU shall have the same sequence number. Different MSDUs or A‑MSDUs have (with a high probability) a different sequence number.

(#4281)A transmitting STA shall support the applicable sequence number spaces defined in Table 10-5 (Transmitter sequence number spaces) unless specified otherwise. An MLD shall support the applicable sequence number spaces defined in Table 10-5 (Transmitter sequence number spaces). A STA affiliated with an MLD shall not support SNS2 in Table 10-5 (Transmitter sequence number spaces) to determine the sequence number of an individually addressed QoS Data frames that is delivered to the associated MLD. Applicability is defined by the Applies to column. The Status column indicates the level of support that is required if the Applies to column matches the transmission. The Multiplicity column indicates whether the sequence number space contains a single counter, or multiple counters and in the latter case identifies any indexes. The Transmitter requirements column identifies requirements for the operation of this sequence number space. The referenced requirements are defined at the end of the table.

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| * Transmitter sequence number spaces
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| Sequence number space identifier | Sequence number space | Applies to | Status | Multiplicity | Transmitter requirements |
| SNS1 | Baseline | A STA transmitting a frame that is not covered by any of the other sequence number spaces. | Mandatory | Single Instance | TR1 |
| SNS2 | Individually addressed QoS Data | A STA transmitting an individually addressed QoS Data frame, excluding SNS5 | Mandatory | Indexed by <Address 1, TID> |  |
| SNS3 | Time Priority Management | A QoS STA transmitting a Time Priority Management frame | Optional | Indexed by <Address 1, TID> |  |
| SNS4 | QMF | A QMF STA transmitting a QMF  | Mandatory | Indexed by <Address 1, AC> | TR2 |
| SNS5 | QoS (+)Null | A STA transmitting a QoS (+)Null frame | Mandatory | None | TR3 |
| (11ah)SNS6 | Individually addressed PV1 Data frame | A STA operating as an S1G STA transmitting a PV1 Data frame | Mandatory | Indexed by <STA MAC Address identified by Address 1, PTID> |  |
| (11ah)SNS7 | Individually addressed PV1 Management frame | A STA operating as an S1G STA transmitting a PV1 Management frame | Mandatory | Indexed by <STA MAC Address identified by Address 1> |  |
| MSNS1 | Individually addressed QoS Data | Any STA affiliated with an MLD transmitting an individually addressed QoS Data frame | Mandatory | Indexed by <Destined MLD MAC Address, TID> per MLD |  |
| TR1: A transmitting STA should cache the last used sequence number per RA for frames that are assigned sequence numbers from this sequence number space. The STA should check that the successively assigned sequence numbers for frames transmitted to a single RA do not have the same value as is found in the cache for that RA. If the check fails the STA should increment the counter by 2, rather than 1.TR2: The STA shall assign the sequence number from one modulo 1024 counter per <Address 1, AC> tuple starting at 0 and incrementing by 1 for each MMPDU carried in one or more QMFs with Address 1 and ACI fields matching the <Address 1, AC> tuple values corresponding to that counter.TR3: Sequence numbers for transmitted QoS (+)Null frames may be set to any value. |

* Receiver requirements

A STA maintains one or more duplicate detection caches. An MLD maintains one or more duplicate detection caches. Table 10-6 (Receiver caches) defines the conditions under which a duplication detection cache is supported and the rules followed by the receiver for the cache. When a Data, Management or Extension frame is received, a record of that frame is inserted in an appropriate cache. That record is identified by a sequence number and possibly other information from the MAC control fields of the frame. When a Data, Management or Extension frame is received in which the Retry subfield of the Frame Control field is equal to 1, the appropriate cache, if any, is searched for a matching frame. In DMG, when a group addressed frame is received the appropriate cache is searched for a matching frame. (11ah)When a PV1 Data frame or PV1 Management frame is received, the appropriate cache is searched for a matching frame, regardless of the presence of the Retry subfield of the Frame Control field. If the search is successful, the frame is considered to be a duplicate. Duplicate frames are discarded.

NOTE—The receiver STA performs the Ack and (for an AP) PS procedures on all received frames requiring immediate acknowledgment(#1442), even if the frame is discarded due to duplicate filtering.

There is a small possibility that a frame may be improperly rejected due to such a match; however, this occurrence is rare and simply results in a lost frame (similar to an FCS error in other LAN protocols).

(#4281)A receiving STA shall implement the applicable receiver requirements defined in Table 10-6 (Receiver caches) with Status indicated as Mandatory unless specified otherwise. An MLD shall implement the applicable receiver requirements defined in Table 10-6 (Receiver caches) with Status indicated as Mandatory. A STA affiliated with an MLD shall not implement RC2 in Table 10-6 (Receiver caches) to discard duplicate individually addressed QoS Data frames belonging to a TID without BA negotiation that is delivered from the associated MLD. A receiving STA should implement the applicable receiver requirements defined in Table 10-6 (Receiver caches) with Status indicated as Recommended. A receiving STA may implement the applicable receiver requirements defined in Table 10-6 (Receiver caches) with Status indicated as Optional. Applicability is defined by the Applies to column. The Status column indicates the level of support that is required if the Applies to column matches the received frame. The Multiplicity / Cache size column indicates the indexes that identify a cache entry and the number of entries that shall be supported. The Receiver requirements column identifies requirements for the operation of this cache. The referenced requirements are defined at the end of the table. The requirements relate to caching information that identifies a cache entry and discarding duplicate MPDUs.

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| * Receiver caches
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| Receiver cache identifier | Cache name  | Applies to | Status | Multiplicity / Cache size | Receiver requirements |
| RC1 | Not QoS Data | A STA receiving frames (individually or group addressed) that are not QoS Data, excluding if supported:RC4RC5RC6RC7RC8RC10 | Mandatory | Indexed by: <Address 2, sequence number, fragment number>.At least the most recent cache entry per <Address 2>. | RR1RR2RR5 |
| RC2 | QoS Data | A STA receiving an (individually or group addressed) QoS Data frame, excluding RC3, and if supported:RC7, RC8, RC9, and RC10 | Mandatory | Indexed by: <Address 2, TID, sequence number, fragment number>.At least the most recent cache entry per <Address 2, TID> pair in this cache. | RR1RR5 |
| RC3 | QoS (+)Null | A QoS STA receiving a QoS (+)Null frame | Mandatory | None | RR4 |
| RC4 | Non-time priority Management | A STA receiving an individually addressed non-time priority Management frame, excluding RC6 if RC6 is supported | Recommended | Indexed by: <Address 2, sequence number, fragment number>At least the most recent cache entry per <Address 2> value. | RR1RR2RR5 |
| RC5 | Time priority Management | A STA receiving an individually addressed time priority Management frame | Supported if RC4 is supported; otherwise not supported | Indexed by: <Address 2, sequence number, fragment number>.At least the most recent cache entry per <Address 2> value. | RR5 |
| RC6 | QMFs | A STA receiving an individually addressed QMF  | Mandatory | Indexed by: <Address 2, AC, sequence number, fragment number>The most recent cache entry per <Address 2, AC, sequence-number, fragment-number>. | RR2RR3RR5 |
| RC7 | Nonmesh GCR | A nonmesh STA receiving a group addressed frame subject to a GCR agreement. | Mandatory | Indexed by: <DA, sequence number>One cache entry per <DA, sequence-number> tuple for each group address subject to a GCR agreement. | RR5 |
| RC8 | Mesh GCR | A mesh STA receiving a group addressed frame subject to a GCR agreement. | Mandatory | Indexed by: <DA, Address 2, sequence number>.One cache entry per <DA, Address 2, sequence-number> tuple for each group address subject to a GCR agreement. | RR5 |
| RC9 | QoS Data under BA | A non-DMG QoS STA receiving a QoS Data frame sent under a (#156)block ack agreement | Recommended | None | RR4 |
| RC10 | DMG Group Addressed | A DMG STA receiving a group addressed frame. | Mandatory | Indexed by: <Address 1, Address 2, sequence number, fragment number>The most recent cache entry per <Address 1, Address 2, sequence-number>. | RR6 |
| (11ah)RC11 | Individually addressed PV1 Data frame | An S1G STA receiving an individually addressed PV1 Data frame | Mandatory | Indexed by <STA MAC Address identified by Address 2, PTID, sequence number, fragment number>.At least the most recent cache entry per <STA MAC Address identified by Address 2, PTID> pair in this cache. | RR1 |
| (11ah)RC12 | Individually addressed PV1 Management frame | An S1G STA receiving an individually addressed PV1 Management frame | Mandatory | Indexed by <STA MAC Address identified by Address 2, sequence number, fragment number>.At least the most recent cache entry per <STA MAC Address identified by Address 2> pair in this cache. | RR1RR2 |
| MRC1 | Individually addressed QoS Data | Any STA affiliated with an MLD receiving an individually addressed QoS Data frame | Mandatory | Indexed by <originator MLD MAC Address, TID, sequence number > per MLD.At least the most recent cache entry per <originator MLD MAC Address, TID> pair in this cache. | MRR1 |
| RR1: A receiving non-DMG STA with dot11QMFActivated false or not present and with dot11RobustAVStreamingImplemented false or not present should omit tuples obtained from group addressed frames from this cache.RR2: A receiving STA should omit tuples obtained from ATIM frames from this cache.RR3: A receiving QMF STA that is a non-DMG STA with dot11RobustAVStreamingImplemented false or not present shall omit from the cache all tuples obtained from group addressed Data frames.RR4: For the purposes of duplicate detection using receiver caches, QoS (+)Null frames and, in a non-DMG BSS, QoS Data frames under a (#156)block ack agreement, shall be ignored.RR5: The STA shall discard the frame if the Retry subfield of the Frame Control field is 1 and it matches an entry in the cache.RR6: The STA shall discard the frame if it matches an entry in the cache.MRR1: The MLD shall discard the frame if the Retry subfield of the Frame Control field is 1 and it matches an entry in the cache. |