IEEE P802.11
Wireless LANs

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| 11be Spec text for MLO BA: share and extension of SN space |
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Abstract

We propose the draft specification skeleton for MLD to help the creation of TGbe draft D0.1.

Revisions:

* Rev 0: Initial version of the document.

The texts is prepared for the following motions.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| MAC | MLO-Multi-link block ack: sharing and extension of SN space | Liwen Chu, | Abhishek Patil, Po-kai Huang, Kaiying Lu, Jarkko Kneckt, Tomo Adachi, Rojan Chitrakar, Arik Klein, Taewon Song, Zhou Lan, Ryuichi Hirata Yusuke Tanaka, Xiaofei Wang, Sebastian Max, Jonghun Han, Jason Yuchen Guo, Gabor Bajko, Chunyu Hu, Liuming Lu | R1 |  | Motion 112, #SP7Motion 112, #SP25Motion 112, #SP22Motion 112, #SP23Motion 112, #SP24Motion 37 Motion 112, #SP6Motion 112, #SP27 |

Sequence numbers are assigned from a common sequence number space shared across multiple links of a MLD, for a TID that may be transmitted to a peer MLD over one or more links.

[Motion 37, [5] and [140]]

For each block ack agreement between two MLDs, there exists one transmit buffer control to submit MPDUs for transmission across links.

* TBD for separate transmit buffer control.

[Motion 112, #SP6, [15] and [148]]

802.11be extends the negotiated Block Ack buffer size to be smaller than or equal to 1024 and define 512-bits and 1024-bits BA bitmap in R1.

[Motion 112, #SP7, [15] and [148]]

For an M-BlockAck frame, add support for 512/1024 bitmap lengths by:

* Including new BA Bitmap lengths (of 512 and 1024 bits), where the length of the BA Bitmap field is signaled in the Per AID TID Info field addressed to an EHT STA
* The M-BA frame containing these Per AID TID Info fields is not sent as a response to an HE TB PPDU generated by at least one HE STA.

[Motion 112, #SP22, [15] and [150]]

For a Compressed BlockAck frame, use some of the reserved values of the Fragment Number field of the BlockAck frame to indicate the added bitmap lengths (512 and 1024).

[Motion 112, #SP23, [15] and [150]]

802.11be uses B3 equal to 1, B2 B1 equal to 0 and B0 equal to 0 in Fragment Number field to indicate 512 BA bitmap length and to use B3 equal to 1, B2 B1 equal to 0 and B0 equal to 1 in Fragment Number field to indicate 1024 BA bitmap length in compressed BA and multi-STA BA.

[Motion 112, #SP24, [15] and [151]]

802.11be extends Table 26-1 in 802.11ax D6.0 as shown below:

|  |  |  |
| --- | --- | --- |
| **Negotiated buffer size** | **Bitmap in compressed BA** | **Bitmap in multi-STA BA** |
| 1-64 | 64 | 32 or 64 |
| 65-128 | 64 or 256 | 32, 64, 128 |
| 129-256 | 64 or 256 | 32, 64, 128, or 256 |
| 257-512 | 64 or 256 or 512 | 32, 64, 128, 256, 512 |
| 513-1024 | 64 or 256 or 512 or 1024 | 32, 64, 128, 256, 512, or 1024 |

[Motion 112, #SP25, [15] and [149]]

After the BA agreement of a TID between two MLDs, the common reordering buffer of the TID are applied on all setup links.

[Motion 112, #SP27, [15] and [147]]

**Proposed spec text:**

The baseline for this text is 802.11 REVmd draft 3.4, 802.11ax D6.0.

**9.3.1.8.2 Compressed BlockAck variant**

***TGbe editor: Please change Figure 9-43 (BA Information field format (Compressed BlockAck)) as follows***

|  |  |  |
| --- | --- | --- |
|  | Block Ack Starting Sequence Control | Block Ack Bitmap |
| Octets: | 2 | 8, 32, 64, or 128 |
| * BA Information field format (Compressed BlockAck)
 |

***TGbe editor: Please change Table 9-30a (****Fragment Number subfield encoding for the Compressed BlockAck variant****) as follows***

|  |
| --- |
| * Fragment Number subfield encoding for the Compressed BlockAck variant
 |
| Fragment Number subfield | Fragmentation Level 3 (ON/OFF) | Block Ack Bitmap subfield length (octets) | Maximum number of MSDUs/A-MSDUs that can be acknowledged |
| B3 | B2-B1 | B0 |
| 0 | 0 | 0 | OFF | 8 | 64 |
| 0 | 1 | 0 | Reserved | Reserved |
| 0 | 2 | 0 | 32 | 256 |
| 0 | 3 | 0 | Reserved | Reserved |
| 0 | 0 | 1 | ON | 8 | 16 |
| 0 | 1 | 1 | Reserved | Reserved |
| 0 | 2 | 1 | 32 | 64 |
| 0 | 3 | 1 | Reserved | Reserved |
| 1 | 0 | 0 | OFF | 64 | 512 |
| 1 | 1 | 0 | 128 | 1024 |
| 1 | 2 and 3 | 0 | Reserved | Reserved |
| 1 | Any | 1 |  | Reserved | Reserved |
| NOTE—A Compressed BlockAck frame with B0 of the Fragment Number subfield set to 1 is not sent to an HE STA whose Dynamic Fragmentation Support subfield in the HE Capabilities element it transmits is not set to 3 (see 26.3 (Fragmentation and defragmentation)). |

***TGbe editor: Please make the changes to the following paragraph:***

If B0 of the Fragment Number subfield is 0 and B3 of of the Fragment Number subfield is 0, the Block Ack Bitmap subfield of the BA Information field of the Compressed BlockAck frame indicates the receive status of up to 64 or 256 MSDUs and/or A-MSDUs depending upon the value of B2-B1 in the Fragment Number subfield as shown in Table 9-30a (Fragment Number subfield encoding for the Compressed BlockAck variant), ~~The Block Ack Bitmap subfield of the BA Information field of the Compressed BlockAck frame is 8 octets in length and is used to indicate the received status of up to 64 entries, where each entry represents an MSDU or an A-MSDU.~~ Each bit that is equal to 1 in the compressed Block Ack Bitmap subfield acknowledges the reception of a single MSDU or A-MSDU in the order of sequence number, with the first bit of the Block Ack Bitmap subfield corresponding to the MSDU, ~~or~~ A-MSDU, or fragment thereof with the sequence number that matches the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield.

***TGbe editor: Please add the following paragraph at the end of 9.3.1.8.2:***

If B0 of the Fragment Number subfield is 0 and B3 of of the Fragment Number subfield is 1, the Block Ack Bitmap subfield of the BA Information field of the Compressed BlockAck frame indicates the receive status of up to 512 or 1024 MSDUs and/or A-MSDUs depending upon the value of B2-B1 in the Fragment Number subfield as shown in Table 9-30a (Fragment Number subfield encoding for the Compressed BlockAck variant). Each bit that is equal to 1 in the compressed Block Ack Bitmap subfield acknowledges the reception of a single MSDU or A-MSDU in the order of sequence number, with the first bit of the Block Ack Bitmap subfield corresponding to the MSDU, or A-MSDU, thereof with the sequence number that matches the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield.

**9.3.1.8.7 Multi-STA BlockAck variant**

***TGbe editor: Please change Table 9-47c (***Per AID TID Info subfield format if the AID11 subfield is not 2045***) as follows:***

|  |  |  |  |
| --- | --- | --- | --- |
|  | AID TID Info | Block Ack Starting Sequence Control | Block Ack Bitmap |
| Octets: | 2 | 0 or 2 | 0, 4, 8, 16, 32, 64, or 128 |
| * Per AID TID Info subfield format if the AID11 subfield is not 2045
 |

***TGbe editor: Please change Table 9-30c (****Fragment Number subfield encoding for the Multi-STA BlockAck variant****) as follows***

|  |
| --- |
| * Fragment Number subfield encoding for the Multi-STA BlockAck variant
 |
| Fragment Number subfield | Fragmentation Level 3 (ON/OFF) | Block Ack Bitmap subfield length (octets) | Maximum number of MSDUs/A-MSDUs that can be acknowledged |
| B3 | B2 B1 | B0 |
| 0 | 0 | 0 | OFF | 8 | 64 |
| 0 | 1 | 0 | 16 | 128 |
| 0 | 2 | 0 | 32 | 256 |
| 0 | 3 | 0 | 4 | 32 |
| 0 | 0 | 1 | ON | 8 | 16 |
| 0 | 1 | 1 | 16 | 32 |
| 0 | 2 | 1 | 32 | 64 |
| 0 | 3 | 1 | 4 | 8 |
| 1 | 0 | 0 | OFF | 64 | 512 |
| 1 | 1 | 0 | 128 | 1024 |
| 1 | 2 and 3 | 0 | Reserved | Reserved |
| 1 | Any | 1 |  | Reserved | Reserved |
| NOTE—A Multi-STA BlockAck frame with B0 of the Fragment Number subfield set to 1 cannot be sent to an HE STA unless the HE Capabilities element received from the HE STA has the Dynamic Fragmentation Support subfield equal to 3 (see 26.3 (Fragmentation and defragmentation)). |

***TGbe editor: Change the 11th paragraph as follows:***

If B0 of the Fragment Number subfield of the Block Ack Starting Sequence Control subfield is 0 and B3 of the Fragment Number subfield of the Block Ack Starting Sequence Control subfield is 0, the BA Information field of the Multi-STA BlockAck frame contains an 8-octet, 16-octet, 32-octet or 4-octet Block Ack Bitmap subfield depending on B2-B1 of the Fragment Number subfield as defined in Table 9-30c (Fragment Number subfield encoding for the Multi-STA BlockAck variant) indicating the receive status of up to 64, 128, 256 or 32 MSDUs (or fragments thereof) and/or A-MSDUs (or fragments thereof), respectively. Each bit that is equal to 1 in the Block Ack Bitmap subfield acknowledges the reception of a single MSDU (or fragment thereof) or A-MSDU (or fragment thereof) in the order of sequence number with the first bit of the Block Ack Bitmap subfield corresponding to the MSDU or A-MSDU with the sequence number that matches the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield.

***TGbe editor: Add the following paragraph after the 11th paragraph:***

If B0 of the Fragment Number subfield of the Block Ack Starting Sequence Control subfield is 0 and B3 of the Fragment Number subfield of the Block Ack Starting Sequence Control subfield is 1, the BA Information field of the Multi-STA BlockAck frame contains an 64-octet, or 128-octet Block Ack Bitmap subfield depending on B2-B1 of the Fragment Number subfield as defined in Table 9-30c (Fragment Number subfield encoding for the Multi-STA BlockAck variant) indicating the receive status of up to 512 or 1024 MSDUs and/or A-MSDUs, respectively. Each bit that is equal to 1 in the Block Ack Bitmap subfield acknowledges the reception of a single MSDU (or fragment thereof) or A-MSDU (or fragment thereof) in the order of sequence number with the first bit of the Block Ack Bitmap subfield corresponding to the MSDU or A-MSDU with the sequence number that matches the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield.

**10.25 Block acknowledgment (block ack)**

**10.25.2 Setup and modification of the block ack parameters**

TGbe editor: Change the 11th paragraph as follows:

When a block ack agreement is established between two HT STAs, DMG STAs, two S1G STAs, or two MLD, the originator may change the size of its transmission window if the value in the Buffer Size field of the ADDBA Response frame is larger than the value in the ADDBA Request frame. ~~If the value in the Buffer Size field of the ADDBA Response frame is smaller than the value in the ADDBA Request frame, the originator shall change the size of its transmission window (WinSizeO) so that it is not greater than the value in the Buffer Size field of the ADDBA Response frame and is not greater than the value 64.~~ If the value in the Buffer Size field of the ADDBA Response frame is smaller than the value in the ADDBA Request frame, the originator shall change the size of its transmission window (WinSizeO) so that it meets the following conditions:

* Not greater than the value in the Buffer Size field of the ADDBA Response frame
* Not greater than 64 if the sender of the ADDBA Response frame is a non-HE STA
* Not greater than 256 if the sender of the ADDBA Response frame is an HE STA
* Not greater than 1024 if the sender of the ADDBA Response frame is an MLD

33. Extreme High Throughput (EHT) MAC specification

***TGbe editor: Add new a subclause 33.x*. (EHT acknowledgment procedure) *under clause 33x as follows:***

**33.x EHT acknowledgment procedure**

**33.x.1 Overview**

The EHT acknowledgment procedure builds on the features defined for HT-immediate block ack (see 10.25.6 (HT-immediate block ack extensions)) and HE acknowledgement (see **26.4 HE acknowledgment procedure**), with the following extensions:

* Support for BlockAck Bitmap field lengths of 32, 64, 128, 256, 512 and 1024

An EHT AP shall not transmit a Multi-STA BA with at least one BA Bitmap lengths of either 512 or 1024 bits as a response to an HE TB PPDU generated by at least one HE STA.

A transmitting MLD shall maintain one sequence number space for each TID that may be transmitted to a peer receiving MLD over one or more links subject to TID to link mapping netotiated between the transmitting MLD and the peer receiving MLD.

An initiating MLD shall maintain one one transmission window for each block ack agreement negotiated with the responding MLD to submit MPDUs for transmission across links subjected to the TID to link mapping negotiated between the initiating MLD and the responding MLD.

**33.x.y Negotiation of block ack bitmap lengths**

Both the Compressed BlockAck frame and Multi-STA BlockAck frame allow different Block Ack Bitmap

subfield lengths. The length of the Block Ack Bitmap subfield is indicated in the Fragment Number subfield

of the Block Ack Starting Sequence Control field as defined in 9.3.1.8 (BlockAck frame format). The

allowed Block Ack Bitmap lengths for each of the negotiated buffer sizes are defined in Table 33-xxx (Negotiated buffer size and Block Ack Bitmap subfield length).

|  |  |  |
| --- | --- | --- |
| Negotiated buffer size | Block Ack Bitmap subfield length (bits) in a Compressed BlockAck frame | Block Ack Bitmap subfield length (bits) in a Multi-STA BlockAck frame |
| 1–64 | 64 | 32 or 64 |
| 65–128 | 64 or 256 | 32, 64 or 128 |
| 129–256 | 64 or 256 | 32, 64, 128 or 256 |
| 257-512 | 64 or 256 or 512 | 32, 64, 128, 256, 512 |
| 513-1024 | 64 or 256 or 512 or 1024 | 32, 64, 128, 256, 512, or 1024 |
| NOTE—A 32-bit Block Ack Bitmap subfield length is not allowed unless the originator has set the 32-bit BA Bitmap Support field in the HE MAC Capabilities Information field in the HE Capabilities element to 1. |

Table 33-xxx – Negotiated buffer size and Block Ack Bitmap subfield length