IEEE P802.11
Wireless LANs

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| Draft text for advanced MU-MIMO acknowledgement and PS flow |
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Abstract

This document proposes text changes for subclauses 9.2.4.5.4, 9.3.1.23, 9.5.10, 9.7.3, 10.3.2.10 and 11.2.7.5 of the spec

* + 1.

*Add the following subclause*

**9.2.4.5.4 Ack Policy subfield**

*Change Table 9-9 as follows*

|  |  |
| --- | --- |
| **Bits in QoS Control field** | **Meaning** |
| **Bit 5** | **Bit 6** |
| 0 | 1 | No explicit acknowledgment or PSMP Ack/Scheduled Ack.When bit 6 of the Frame Control field (see 9.2.4.1.3) is set to 1:There might be a response frame to the frame that is received, but it is neither the Ack frame nor any Data frame of subtype +CF-Ack.The Ack Policy subfield for QoS CF-Poll and QoS CF-Ack +CF-Poll Data frames is set to this value.When bit 6 of the Frame Control field (see 9.2.4.1.3) is set to 0: The acknowledgment for a frame indicating PSMP Ack when it appears in a PSMP downlink transmission time (PSMP-DTT) is to be received in a later PSMP uplink transmission time (PSMP-UTT).The acknowledgment for a frame indicating PSMP Ack when it appears in a PSMP-UTT is to be received in a later PSMP-DTTThe acknowledgment for a frame indicating Scheduled Ack when it appears in an EDMG MU PPDU is to be received in scheduled time slot as described in 10.3.2.10NOTE—Bit 6 of the Frame Control field (see 9.2.4.1.3) indicates the absence of a data Frame Body field. When equal to 1, the QoS Data frame contains no Frame Body field, and any response is generated in response to a QoS CF-Poll or QoS CF-Ack +CF-Poll frame, but does not signify an acknowledgment of data. When set to 0, the QoS Data frame contains a Frame Body field, which is acknowledged as described in 10.29.2.7. |

*Add the following subclause*

* + - 1. Block Ack Schedule frame format

The frame format for the Block Ack Schedule frame is defined in Figure 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Frame Control | Duration | RA | TA | Block Ack Schedule Information | FCS |
| Octets: | 2 | 2 | 6 | 6 | 3 | 4 |

1. — Block Ack Schedule frame format

The Duration field is set to the time until the end of the TXOP

The RA field contains the MAC address of the STA that is the intended receiver of the Block Ack Schedule frame

The TA field contains the MAC address of the STA transmitting the Block Ack Schedule frame.

The Block Ack Schedule Information field is defined in 9.5.10.

*Add the following subclause*

* + 1. Block Ack Schedule Information field

The Block Ack Schedule Information field is shown in Figure 2.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | BATT Start Offset | Next PPDU Start offset | EOF | Reserved |
| Bits: | 9 | 9 | 1 | 5 |

1. — Block Ack Schedule Information field format

The BATT Start Offset field indicates the offset in units of 1us from the end of transmitted PPDU to when the Block Ack frame should be transmitted by the intended responder.

The Next PPDU Start Offset field indicates the offset in units of 1us from the end of the transmitted PPDU to when initiator shall start transmitting its next PPDU

The EOF field is set to 1 if no A-MPDU subframes with nonzero value of MPDU Length field will follow except the A-MPDU subframe carrying Block Ack Schedule frame. It is set to 0 otherwise.

* 1.

9.7.3 A-MPDU contents

*Change Table 9-425 as follows*

|  |  |
| --- | --- |
| MPDU description | Conditions |
| Ack | If the preceding PPDU contains an MPDU that requires an Ack frame response, a single Ack frame at the start of the A-MPDU. | In a non-DMG STA: at most one of these MPDUs is present.In a DMG STA: at most one Ack frame is present, and zero or more HT-immediate BlockAck frames are present. |
| HT-immediate BlockAck | In a non-DMG STA: if the preceding PPDU contains an implicit or explicit block ack request for a TID for which an HT-immediate block ack agreement exists, at most one BlockAck frame for this TID, in which case it occurs at the start of the A-MPDU.In a DMG STA: if the preceding PPDU contains an implicit or explicit block ack request for a TID for which an HT-immediate block ack agreement or an unsolicited block ack extension agreement exists, one or more copies of the same BlockAck for this TID. |
| Delayed BlockAcks | BlockAck frames with the BA Ack Policy subfield equal to No Acknowledgment with a TID for which an HT-delayed block ack agreement exists. |
| Delayed block ack data | QoS Data frames with a TID that corresponds to a Delayed or HT-delayed block ack agreement.These have the Ack Policy field equal to Block Ack. |
| Action No Ack | Action No Ack frames. |
| Delayed BlockAckReqs | BlockAckReq frames with a TID that corresponds to an HT-delayed block ack agreement in which the BA Ack Policy subfield is equal to No Acknowledgment. |
| Data frames sent under an HT-immediate block ack agreement or under an unsolicited block ack extension agreement | QoS Data frames with the same TID, which corresponds to an HT-immediate block ack agreement.See NOTE. | Of these, at most one of the following is present in a non-DMG BSS:* One or more QoS Data frames with the Ack Policy field equal to Implicit Block Ack Request
* A BlockAckReq frame

Of these, at most one of the following is present in a DMG BSS:* One or more QoS Data frames with the Ack Policy field equal to Implicit Block Ack Request
* QoS Null MPDU with Ack Policy set to No Ack
* A BlockAckReq frame with an optional QoS Null MPDU with Ack Policy set to No Ack
 |
| QoS Null MPDUs with Ack Policy set to No Ack | In a DMG BSS, QoS Null MPDUs with Ack Policy set to No Ack. |
| Immediate BlockAckReq | At most one BlockAckReq frame with a TID that corresponds to an HT-immediate block ack agreement or an unsolicited block ack extension agreement.This is the last MPDU in the A-MPDU. It is not present if any QoS Data frames for that TID are present. |
| Management frame requires Ack or Action Ack frames | At most one Action Ack in case of an EDMG STA supporting Multi-TID BlockAck. |
| Block Ack Schedule  | In EDMG BSS, one or more copies of the Block Ack Schedule frame is present when transmitted within an EDMG MU PPDU. Except EOF subfield, all Block Ack Schedule frame subfields shall have the same value.  |
| NOTE—These MPDUs all have the Ack Policy field equal to the same value, which is either Implicit Block Ack Request or Block Ack or Scheduled Ack |

10.3.2.10 MU Acknowledgement procedure

*Insert the following paragraphs before the last paragraph (NOTE 2)*

The acknowledgment procedure performed by EDMG STAs that receive an MPDU within an EDMG MU PPDU from an MU-MIMO initiator shall follow the schedule, defined by the MU-MIMO initiator.

An MU-MIMO initiator shall include the Block Ack Schedule frames (see 9.3.1.23) in each A-MPDU transmitted within an EDMG MU PPDU. Each Block Ack Schedule frame shall contain the scheduling information for the EDMG STA which is an intended receiver of the A-MPDU. The MU MIMO initiator shall set the EOF subfield of the Block Ack Schedule frame to “1” only if no A-MPDU subframes with nonzero value of MPDU Length field will follow except the A-MPDU subframe carrying Block Ack Schedule frame, otherwise it shall set it to zero. Except the EOF subfield, all other subfields of the Block Ack Schedule frames transmitted in the same A-MPDU shall have the same value.

An EDMG STA shall transmit the BlockAck frame in response to received EDMG MU PPDU after a period of time equal to the value of BATT Start Offset subfield from the end of EDMG MU PPDU. If MU-MIMO initiator does not intend to elicit BA from a designated STA it may not include Block Ack Schedule in the A-MPDU or alternatively it may set the value of BATT Start Offset transmitted to that STA to 0.

If BlockAck frame from specific STA was not received by the initiator, the initiator may transmit BAR frame to that STA after a period of time equal to the value of Next PPDU Start Offset subfield in Block Ack Schedule frame starting from the end of EDMG MU PPDU

Example of A-MPDU transmitted in EDMG MU PPDU is shown in Figure 3. In below example, the first A-MPDU subframe contains Block Ack Schedule frame with EOF subfield set to 0 and the last two A-MPDU subframes before MAC padding contain Block Ack Schedule frames with EOF subfield set to 1.



1. — Example of A-MPDU transmitted in EDMG MU PPDU.

Example of EDMG MU PPDU frame acknowledgement procedure for three EDMG STAs with the illustration of scheduling information delivered to one of them (STA2) is shown in Figure 4.



1. — Example of TXOP containing EDMG MU PPDU transmission with illustration of scheduling information delivered to STA2.

*Insert the following subclause*

11.2.7.5 MU-MIMO Power Save

The MU-MIMO power save mechanism allows a non-AP and non-PCP EDMG STA in an infrastructure BSS or PBSS to go to PS mode during a TXOP where the STA is involved in a MU-MIMO transmission and acknowledgement procedure.

An EDMG STA that receives A-MPDUs within an EDMG MU PPDU may go to PS mode during the following two periods:

* From the time of detecting the EOF field in its individual A-MPDU within the EDMG MU PPDU to the time it needs to transmit its BA to the initiator (See 10.3.2.10).
* From the time of sending back the BA to the time indicated in Next PPDU Start Offset subfield in Block Ack Schedule frame counted from the end of EDMG MU PPDU.

STA that didn’t receive Block Ack Schedule frame during MU-MIMO A-MPDU shall not go to PS and shall remain in receive mode after the MU-MIMO PPDU transmission.

Once awake after the second period, the EDMG STA shall stay in awake state until it receives the next EDMG MU PPDU from the initiator or until the end of the current TXOP, whichever comes first.

Figure 3 illustrates an example of MU-MIMO power save performed in a MU group with three EDMG STAs.



1. — Example of MU-MIMO power save performed in a MU group with three EDMG STAs.

**SP:**

Do you agree to include the text changes proposed in (11-17-1691-00-00ay-Draft text for advanced MU-MIMO acknowledgement and PS flow) to the spec draft?

**References:**

1. IEEE802.11-2016
2. Draft P802.11ay\_D0.8