IEEE P802.11
Wireless LANs

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| Resolution to CIDs related to MU BA and RD |
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Abstract

This document proposes resolution for the following CIDs: 1075, 1076, 1129, 1404, 1411, 1642, 1650, 1651, 1762, 1763, 1860, 1944, 1947, 1960, 1962, 2175, 2252, 2258, 2259, 2285, 2288 and 2295

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 1762 | 106.17 | 10.3.2.10 | In Figure 84, "QoS Data frame" should be "A-MPDU subframe". | In Figure 84, replace "QoS Data frame" with "A-MPDU subframe". |

**Proposed resolution: Revised**

**Discussion:**

The paragraph above the figure says: “An example of an A-MPDU transmitted in an EDMG MU PPDU is shown in Figure 84”. So Figure 84 introduces only an example but not the general case. In this example A-MPDU subframes are QoS Data frames.

Clarification for Ack Policy value of QoS Data frames was added (see proposed text below).

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 1960 | 37.05 | 9.3.1.23 | EOF field is already presented in the delimiter and provides any relevant functionality, No need to duplicate the field. (9.7.1 A-MPDU format) | Remove EOF in the Figure 11 and remove text in lines 5, 6 on P37Remove sentence that starts with "The MU-MIMO initiator shall set the EOF..." at P105L38Remove EOF in P106L12 and in Figure 84 |

**Proposed resolution:** **Accepted**

**Discussion:**

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 2258 | 105.37 | 10.3.2.10 | The AP sending the Block Ack Schedule frame should calculate schedule based on BA sent in MCS0 with CT | add such requirement |

**Proposed resolution:** **Rejected**

**Discussion:**

There is no need to specify that. The STA follows the schedule received from the AP and the way AP calculates the schedule is implementation dependent

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 2259 | 36.22 | 9.3.1.23 | Add 8 reserve bits to Block Ack Schedule frame for future extension because in AMPDU the frame needs 1 byte padding anyway | change reserved bits to 13 bits |

**Proposed resolution: Revised**

**Discussion:**

Five octets were added (see proposed text below)

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 1642 | 105.36 | 10.3.2.10 | is Block Ack Schedule frame the mandatory MU acknowledgement procedure for DL MU? If 11ac-like poll based acknowledgement procedure is not allowed, please clarify. It might be better to have poll-based solution as the basic option for better synchronization and robustness in case BA schedule frame is corrupted | Explicitly point out the default behavior |

**Proposed resolution: Rejected**

**Discussion:**

The behavior is explicitly defined by modal word “shall” used in Clause 10.3.2.12. The robustness may be provided by allowed repetition of Block Ack Schedule frame in A-MPDU.

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 1075 | 106.21 | 10.3.2.10 | It says Figure 85 shows the case when "scheduling information delivered to one of them (STA2)". Where in the figure says so? In the A-MPDU to STA2 in the first DL MU PPDU? Describe it in the figure. | As in comment. |
| 1076 | 106.22 | 10.3.2.10 | In Figure 85, it says "At this moment:AP may start transmitting PPDU to STA2STA2 shall start listening to AP"The AP is transmitting an DL MU PPDU to STAs 1 to 3, not only STA2. What does it mean? Clarify. | As in comment. |
| 1763 | 106.17 | 10.3.2.10 | Figure 85 illustrate a case where scheduling inforamtion is delivered to 2 STAs (STA2 and STA3), whereas the text in 106.20 mentioned that the scheduling information delivered to one of them (STA2). It is not reader friendly to have this inconsistency. | Please eliminate STA3 from figure 85, and align with the text describing the figure. OR, change the text to read there are 2 STAs scheduled and complete the Figure 85. |

**Proposed resolution: Revised**

**Discussion:**

Figure 85 was changed. Illustration of scheduling information for all STAs (STA1, STA2 and STA3) was added (see proposed text below)

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 1944 | 31.21 | 9.2.4.5.4 | "Scheduled Ack" appears in frame formats, no normative text found associated with. | Provide normative text how the Scheduled Ack is used. |
| 2175 | 31.21 | 9.2.4.5.4 | The term "Scheduled Ack" is not used anywhere in normative behaviors. Either the different terms should be unified or this term should be deleted if no normative behavior is associated with it. | Unified the term used for "Scheduled Ack" with the term used for normative behavior or delete this term if there is no associated normative behavior. |
| 1962 | 105.36 | 10.3.2.10 | The existent definition does not pay attention if an immediate BlockAck policy is indicated or not, that makes substantial difference to the normative behavior. | An MU-MIMO initiator shall include a Block Ack Schedule frame in each A-MPDU transmitted within an EDMG MU PPDU if Ack policy of MPDUs contained in the A-MPDU is equal to normal ACK or BlocAckReq is aggregated in the A-MPDU and shall not be included otherwise. |
| 1860 | 31.21 | 9.2.4.5.4 | The term "Scheduled Ack" is used in updates to Table 9-9. It's not clearly defined. In some instances it's reference to as PSMP ACK/Scheduled Ack and others as Block Ack Schedule. | Define Scheduled Ack and update Table 9-9 |

**Proposed resolution: Revised.**

**Discussion:**

The normative behaviour associated with “Scheduled Ack” was added to clause 10.3.2.12 (MU acknowledgment procedure) and 10.29 (Reverse direction protocol). See proposed text below.

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 1411 |  | 10.3.2.10 | If the reverse directon protocol for MU-MIMO is used (see 10.28.5), how does the AP estimate the BATT Start offset which determines the required time for the STA to transmit BA back. For example, if STA1 uses reverse direction and transmits additional data together with the BA, STA2 and STA3 may have to wait longer to transmit their BAs back to AP. Otherwise the BA would collide with the data transmitted by STA1. | Study and analyze the impact of reverse direction protocol on MU acknowledgement process and see if changes are needed. |
| 1129 | 131.00 | 10.28.5 | Does the use of BlockAck Schedule frame is allowed to be used with MU MIMO Reverse Direction? If yes please indicate how? if not, please exclude |  |
| 1651 | 131.19 | 10.28.5 | how RDG for EDMG DL MUMIMO works with BA Schedule frame. The current rules do not have such option. Is it allowed to use BA Schedule Frame without the need to send out BlockAckRequest? | Please clarify |
| 2252 | 105.36 | 10.3.2.10 | The shall requirement may not be necessary as the STA scheduled to ack first can have ack policy set to implicit block ack. Also for MU-MIMO with RDG, not all receiver of a MU-PPDU needs to ack | change shall to may |

**Proposed resolution: Revised**

**Discussion:**

The scheduled procedure for EDMG MU-MIMO with RDG is proposed. MU-MIMO initiator shall use Ack Policy=01 and include Block Ack Schedule frame to grant RD. New field was added to Block Ack Schedule frame – *Response Duration*, which limits the response transmission time (see proposed text below)

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 1947 | 36.18 | 9.3.1.23 | "The Duration field is set to the time until the end of the current allocation." Unclear when the time starts and how end of the current allocation is known. | Propose "The Duration field is set equal to Duration field of Data MPDU frame in the EDMG MU PPDU frame the Block Ack Schedule frame is sent" |

**Proposed resolution: Revised**

**Discussion:**

The proposed change is accepted except the type of PPDU carrying the Block Ack Schedule frame. Now Block Ack Schedule can be sent also within RDG PPDU. “EDMG PPDU” is used instead of “EDMG MU PPDU” (see proposed text below)

|  |  |  |  |  |
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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 2285 | 131.05 | 10.28.1 | MPDU with ack policy value PSMP Ack is actually scheduled Ack and should be allowed for carrying RDG | Revise the first 2 bullets as follows:- For non-DMG and non-EDMG STAs, a QoS Data frame with the Ack Policy field equal to any value except PSMP Ack (i.e., including 3 Implicit Block Ack Request), or- For EDMG STAs, a QoS Null frame or a QoS Data frame with the Ack Policy field equal to any value |

**Proposed resolution: Revised**

**Discussion:**

The proposed change is accepted except the usage of QoS Null frame which is not needed any more (see proposed text below)

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 2288 | 131.19 | 10.28.5 | Ack Policy could also be '01' Scheduled Ack | add 'or 01' |

**Proposed resolution: Revised**

**Discussion:**

Ack Policy=01 is now the only one option for MPDUs transmitted within the EDMG MU PPDU (see proposed text below)

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 1404 | 131.00 | 10.28.5 | The EDMG DL MU-MIMO mechanism shall be used only among EDMG STAs that spport reverse directin for EDMG DL MU-MIMO."---This sentence is confusing. 10.28.1 already says "The RD protocol shall be supported by an EDMG STA". As a result, it makes no sense to emphasize here that the mechanism is only applicable for "EDMG STAS that support reverse direction...". | Delete this sentence. |

**Proposed resolution: Accepted**

**Discussion:**

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 1650 | 131.19 | 10.28.5 | "set ACK Policy to 0" should be rewritten as "set Ack Policy to Implicit Block Ack Request" | Modify as suggested in the comment |

**Proposed resolution: Revised**

**Discussion:**

The comment is not relevant any more, because the corresponding section was changed and the text from the comment was removed.

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| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 2295 | 142.30 | 10.36.11.4.4 | The sentence mandates STA must send DMG CTS using SISO antenna configuration. What if the STA sending DMG CTS is a RD responder that wishes to use SU-MIMO in the reverse direction? | In the CT of RTS frame there should be an early indication which STA in a MU group is the RD responder, and only this STA performs DMG CTS, orProhibits RD responder using MIMO in the granted TXOP. |

**Proposed resolution: Rejected**

**Discussion:**

The STA sending DMG CTS cannot be an RD responder as far as RD cannot be granted by DMG RTS frame. The STA may become an RD responder through the reception of EDMG MU PPDU after an MU-MIMO TXOP was established.

The first option proposed by the commenter is not applicable because it allows only one STA of MU group to be RD responder during MU-MIMO TXOP.

The second option proposed by the commenter is already implicitly in the Draft. SU-MIMO in reverse direction in MU-MIMO flow is prohibited by default as there is no way to establish it.

**Proposed text**

**9.2.4.5.4 Ack Policy subfield**

|  |  |  |
| --- | --- | --- |
| 0 | 1 | No explicit acknowledgment or PSMP Ack~~/~~ or 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 Dataframe 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 transmissiontime (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 PSMPUTT is to be received in alater PSMP-DTT.The acknowledgment for a frame indicating Scheduled Ack when it appears in an EDMG ~~MU~~ PPDU is to bereceived in a scheduled time slot as described in 10.3.2.12 (MU acknowledgment procedure), 10.29.4 (Rules for RD responder), 10.29.5 (Reverse direction for EDMG DL MU-MIMO).NOTE—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 CFAck +CF-Poll frame, but does not signify an acknowledgment of data. When set to 0, the QoS Data frame contains a FrameBody field, which is acknowledged as described in 10.29.2.7. |

* + - 1. Block Ack Schedule frame format

The frame format for the Block Ack Schedule frame is defined in Figure 10

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Frame Control | Duration | RA | TA | Block Ack Schedule Information | FCS |
| Octets: | 2 | 2 | 6 | 6 | ~~3~~ 8 | 4 |

1. — Block Ack Schedule frame format

The Duration field is set ~~to the time until the end of the TXOP or SP~~  to be equal to the Duration field of Data MPDU frame in the EDMG PPDU frame the Block Ack Schedule frame is sent.

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 Figure 11.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | ~~BATT Start~~ Response Offset | Response Duration | Next PPDU Start Offset | ~~EOF~~ | Reserved |
| Bits: | ~~9~~ 16 | 16 | ~~9~~ 16 | ~~1~~ | ~~5~~ 16 |

1. — Block Ack Schedule Information field format

The ~~BATT Start~~ Response Offset field indicates the offset in units of 1us from the end of the transmitted PPDU to the time when the response ~~Block Ack frame~~ is expected to be transmitted by the intended responder. The response may be either RD response burst (10.28) or Block Ack frame.

The Response Duration field indicates the maximum duration of the responder transmission in units of 1us.

The Next PPDU Start Offset field indicates the offset in units of 1us from the end of the transmitted PPDU to the time when initiator is expected to ~~transmit~~ start transmitting its next PPDU. If the transmitter does not intend to transmit its next PPDU to a responder the Next PPDU Start Offset field is set to 0.

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

9.4.2.250.6 EDMG MAC Capability subelement ~~field~~  (CID1204)

The EDMG MAC Capability data field is defined in Figure 28.

|  |  |  |
| --- | --- | --- |
|  | ~~EDMG Multi-TID Capability~~ | ~~SM Power Save Capability~~ |
| ~~Octets:~~ | ~~1~~ | ~~1~~ |

1. ~~—MAC Capability field format~~

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B0 B3 | B4 | B5 B6 | B7 | B8 B15 |
|  | EDMG Multi-TID Aggregation Support | EDMG All Ack Support | SM Power Save | Scheduled RD Supported | Reserved |
| Bits: | 4 | 1 | 2 | 1 | 8 |

1. — EDMG MAC Capability data field format

~~The EDMG Multi-TID Capability subfield is defined in Figure 44.~~

|  |  |  |  |
| --- | --- | --- | --- |
|  | ~~B0 B3~~ | ~~B4~~ | ~~B5 B7~~ |
|  | ~~EDMG Multi-TID Aggregation Support~~ | ~~EDMG All Ack Support~~ | ~~Reserved~~ |
| ~~Bits:~~ | ~~4~~ | ~~1~~ | ~~3~~ |

1. ~~—EDMG Multi-TID Capability subfield format~~

The EDMG Multi-TID Aggregation Support subfield contains the number of TIDs minus one of QoS Data frames that the STA is able to receive or aggregate in a multi-TID A-MPDU as described in 10.63. A value of zero indicates that the STA does not support EDMG multi-TID aggregation.

The EDMG All Ack Support subfield is set to one to indicate support for the reception of a Multi-TID BlockAck frame under the all ack context when the AckType subfield value is 11 (see 10.63.2). The EDMG All Ack Support subfield is set to 0 otherwise. CID1956

~~The SM Power Save Capability subfield is defined in Figure 45.~~

|  |  |  |
| --- | --- | --- |
|  | ~~B0 B1~~ | ~~B2 B7~~ |
|  | ~~SM Power Save~~ | ~~Reserved~~ |
| ~~Bits:~~ | ~~2~~ | ~~6~~ |

1. ~~—SM Power Save Capability subfield format~~

The SM Power Save subfield indicates the support for spatial multiplexing power save for an EDMG STA (see 11.2.6). It also indicates the spatial multiplexing power save mode that is in operation immediately after (re)association. This subfield is set to 0 for static SM power save mode, 1 for dynamic SM power save mode, and 3 for SM power save disabled or not supported. The value of 2 is reserved.

It is only valid in a (Re)Association Request frame sent to an AP or a PCP. Otherwise this subfield is set to 0 or 3 upon transmission and it ignored upon reception.

NOTE—This subfield indicates the operational state immediately after (re)association as well as (if not set to 3) a capability.

The Scheduled RD Supported subfield is set to one to indicate that the EDMG STA supports the scheduling procedure of RD protocol described in 10.29.3 and 10.29.4. This field is set to 1 if MU-MIMO Supported field in the STA’s EDMG Capabilities element is equal to 1.

**10.3.2.12 MU acknowledgment procedure**

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 set the Ack policy of MPDUs contained in each A-MPDU transmitted within an EDMG MU PPDU to Scheduled Ack and shall include ~~a~~ at least one Block Ack Schedule frame 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 one only if no A-MPDU subframes with nonzero value in the MPDU Length field follow, except for the A-MPDU subframe carrying Block Ack Schedule frame. Except for the EOF subfield, all other~~ The values of all subfields of the Block Ack Schedule frame~~s~~ shall not change if transmitted multiple times in the same A-MPDU ~~shall have the same value~~.

An EDMG STA shall transmit a BlockAck frame in response to a received EDMG MU PPDU after a period of time equal to the value of ~~BATT Start~~ Response Offset subfield from the end of EDMG MU PPDU. The ~~BATT Start~~ Response Offset subfield is contained in the Block Ack Schedule frame within the MU PPDU. If no Block Ack Schedule frame was received correctly, EDMG STA should remain in receive mode.

If an MU-MIMO initiator does not intend to elicit a BlockAck frame from a STA addressed by an A-MPDU within a transmitted MU PPDU, it ~~does not need to include a Block Ack Schedule frame addressed to the STA in the A-MPDU or may include a Block Ack Schedule frame in the A-MPDU and~~ shall set the values of the ~~BATT Start~~ Response Offset field and Response Duration field within the frame to 0.

If an expected BlockAck frame from a STA was not received by an MU-MIMO 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 starting from the end of EDMG MU PPDU. The Next PPDU Start Offset subfield is contained in the Block Ack Schedule frame within the MU PPDU.

An example of an A-MPDU transmitted in an EDMG MU PPDU is shown in Figure 84. In this example, an A-MPDU contains three Block Ack Schedule frame – one in the beginning and two in the end of A-MPDU. ~~the first A-MPDU subframe contains a 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 85. In this example the value of the Next PPDU Start Offset field is the same for all STAs.

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



1. — Example of TXOP containing EDMG MU PPDU transmission

**10.29.3 Rules for RD initiator**

*Change the first paragraph as follows*

An RDG shall not be present unless the MPDU carrying the grant, or every MPDU carrying the grant in an A-MPDU, matches one of the following conditions:

* For non-DMG or non-EDMG STAs a ~~A~~ QoS Data frame with the Ack Policy field equal to any value except PSMP Ack (i.e., including Implicit Block Ack Request), or
* ~~In EDMG, a QoS Null frame with the Ack Policy field equal to any value except PSMP Ack (i.e., including Implicit Block Ack Request), or~~
* For EDMG STAs, a QoS Data frame with the Ack Policy field equal to any value, or
* A BlockAckReq frame related to an HT-immediate block ack agreement, or
* An MPDU not needing an immediate response (e.g., block ack under an HT-immediate block ack agreement, or Action No Ack).

*Insert the following paragraphs after the 7th paragraph starting with “*An RD initiator that sets the …*”*

If an RD initiator and an RD responder are EDMG STAs with Scheduled RD Supported subfield of EDMG Capabilities element equal to 1, then an RD initiator may set the Ack policy of MPDUs contained in A-MPDU transmitted within an RDG PPDU to Scheduled Ack. In that case an RD initiator shall include at least one Block Ack Schedule frame with Response Offset and Response Duration fields set to non-zero values in A-MPDU transmitted within an RDG PPDU.

**10.29.4 Rules for RD responder**

*Change the first paragraph as follows:*

If reverse direction was granted by MPDUs contained in A-MPDU with the Ack policy not equal to Scheduled Ack an ~~An~~ RD responder shall transmit the initial PPDU of the RD response burst a SIFS after the reception of the RDG PPDU. PPDUs in a response burst are separated by SIFS or RIFS. The RIFS rules in the RD are the same as in the forward direction; the use of RIFS is constrained as defined in 10.3.2.3.2 and 10.26.3.3S

*Add the following paragraph after the first paragraph*

An RD responder that receives an EDMG frame with the Ack policy of MPDUs contained in A-MPDU equal to Scheduled Ack shall transmit RD response burst after a period of time equal to the value of Response Offset subfield from the end of RDG PPDU. The duration of the RD response burst shall be equal to the value of the Response Duration subfield of the last Block Ack Schedule frame received from the RD initiator.

*Insert the following subclause*

**10.29.5** **Reverse direction for EDMG DL MU-MIMO**

An EDMG STA that has the MU-MIMO Supported field in the STA’s EDMG Capabilities element equal to one shall support the reverse direction for EDMG DL MU-MIMO mechanism described in this subclause. ~~The EDMG DL MU-MIMO mechanism shall be used only among EDMG STAs that support reverse direction for EDMG DL MU-MIMO~~.

~~To start a DL MU-MIMO PPDU transmission with reverse direction, an AP or PCP shall grant an RD to a STA that is addressed within the PPDU using one of the following methods:~~

* ~~The AP or PCP shall set the RDG/More PPDU to 1 and set the ACK Policy to 0 in the QoS Control field of the MPDU addressed to the intended RD responder.~~
* ~~The AP or PCP shall aggregate a BlockAckReq frame and a QoS Null frame with the RDG/More PPDU subfield in the QoS Control field equal to 1 into an A-MPDU which is transmitted to the intended RD responder.~~

To start a DL MU PPDU transmission with reverse direction, an AP or PCP shall set the RDG/More PPDU to 1 and the Ack Policy to Scheduled Ack in the QoS Control field of the MPDU addressed to the intended RD responder and shall include at least one Block Ack Schedule frame with non-zero Response Offset and Response Duration fields in A-MPDU addressed to the intended RD responder.

Upon receiving an RD grant as part of a DL MU-MIMO transmission, an RD responder shall respond according to the rules that are defined in ~~10.28.4~~ 10.29.4.

An RD responder that intends to elicit a BlockAck frame from the RD initiator, shall set the Ack Policy of MPDUs addressed to RD initiator to Scheduled Ack if the value of Next PPDU Start Offset subfield of the received Block Ack Schedule frame is not equal to 0. Otherwise an RD responder shall set the Ack Policy of MPDUs addressed to RD initiator to Implicit Block Ack Request. In this case an RD responder shall ensure that its PPDU transmission(s) and the response from an RD initiator shall not exceed the value of Response Duration subfield of the received Block Ack Schedule frame.

Upon receiving an RD response burst with the Ack policy of MPDUs contained in A-MPDU equal to Scheduled Ack, the RD initiator that granted an RD as part of a DL MU-MIMO transmission shall acknowledge the RD responder by aggregating the BlockAck into the next MU PPDU to the RD responder.

For more accurate setting of the value of Response Duration subfield RD initiator may get information about an amount of channel time required for RD responder using SPR frame received from corresponding STA. This frame can be either requested by AP using Poll frame or sent by STA without the request before or during the MU-MIMO transmission and reception flow.

~~If the RD response burst requires immediate BlockAck, the RD initiator that granted an RD as part of a DL MU-MIMO transmission shall acknowledge the RD responder using one of the following methods:~~

* ~~The RD initiator may transmit the immediate BlockACK to the RD responder using MU-MIMO fashion along with the next BlockACKReq frame, which is transmitted to another MU-MIMO destination STA.~~
* ~~The RD initiator may aggregate the immediate BlockACK into the next MU PPDU to the RD responder.~~

Figure 100 illustrates an example of the RD sequence~~s~~ during DL MU-MIMO transmissions when an RDG PPDU is not the last MU PPDU transmitted in MU sequence (the value of the Next PPDU Start Offset subfield is not equal to 0). The RD initiator (e.g., an AP) transmits a MU PPDU to STA 1 and STA 2. The RD initiator requests a BlockAck and ~~first~~ grants an RD to STA 1 by setting RDG/More PPDU to 1 ~~in the PPDU to STA 1~~, ~~and requests an immediate BlockAck~~ Ack Policy subfield to Scheduled Ack and including Block Ack Schedule frame with the schedule for RD response burst in the A-MPDU to STA 1. The A-MPDU sent to STA 2 has RDG/More PPDU set to 0, Ack Policy set to Scheduled Ack and includes Block Ack Schedule frame with the schedule for BlockAck frame transmission. ~~STA 1 responds with an A-MPDU, which includes a BlockAck and a QoS Data frame with RDG/More PPDU equal to 0.~~ ~~After SIFS, the AP transmits the following PPDUs in MU-MIMO fashion:~~

* ~~A BlockACK to STA 1 to acknowledge its RD response burst, and~~
* ~~An aggregated BlockAck and QoS Null with RDG/More PPDU equal to 1 to STA 2 in order to collect BlockAck and grant an RD to STA 2.~~

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1. —Example of reverse direction for DL MU-MIMO when the value of the Next PPDU Start Offset subfield is not equal to 0

Following the reception of the RD grant, STA ~~2~~1 transmits its RD response burst in multiple PPDUs during the scheduled timeslot defined by Response Offset and Response Duration subfields of Block Ack Schedule frame received with RD grant. The first PPDU is an A-MPDU, which includes the BlockAck to the RD initiator and QoS Data frames with RDG/More PPDU equal to 1. A PPDU in the RD response burst contains QoS Data with RDG/More PPDU equal to 1 if it is not the last PPDU, and it contains QoS Data with RDG/More PPDU equal to 0 if it is the last PPDU of the RD response burst. STA 1 requests the acknowledgement for RD response burst by setting Ack Policy to Scheduled Ack. STA 2 did not receive an RD grant, so it uses the scheduled timeslot only for transmission of the BlockAck frame. After a period of time equal to the value of Next PPDU Start Offset subfield starting from the end of EDMG MU PPDU ~~After SIFS,~~ the AP transmits another MU PPDU to both STA 1 and STA 2. In addition to QoS Data frame and Block Ack Schedule frame, the A-MPDU sent to STA 1 includes a BlockAck to the RD response burst. ~~with RDG/More PPDU set to 1 and ACK Policy set to 0 for the MU PPDU sent to STA 1, and a PPDU sent to STA 2 containing an aggregated BlockAck to the RD response burst and a QoS Data frame.~~

Figure 101 illustrates an example of the RD sequences during DL MU-MIMO transmissions when an RDG PPDU is the last MU PPDU transmitted in MU sequence (the value of the Next PPDU Start Offset subfield is equal to 0). In this example STA 1 requests the immediate acknowledgement for RD response burst by setting Ack Policy to Implicit Block Ack Request. STA 1 also reserves a part of its scheduled timeslot for AP to transmit the acknowledgement. SIFS after receiving the PPDU with Ack Policy equal to Implicit Block Ack Request from STA 1, AP responds with a BlockAck to that PPDU.



1. —Example of reverse direction for DL MU-MIMO when the value of the Next PPDU Start Offset subfield is equal to 0

**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 procedures.

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

* First period: 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 or RD response burst to the initiator (see 10.3.2.12 and 10.29.5).
* Second period: from the time of sending back the BA or RD response burst to the time indicated in Next PPDU Start Offset subfield in the Block Ack Schedule frame starting from the end of EDMG MU PPDU.

A STA that did not receive a Block Ack Schedule frame within a received MU-MIMO PPDU shall remain
awake in receive mode until it receives a BAR or Block Ack Schedule frame from the initiator or until the
end of the TXOP, whichever comes first.

Once awake at the end of 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.

References

1. Draft P802.11ay\_D1.1

**Straw Poll:**

* **Do you agree to accept comment resolutions as proposed in doc 11-18/0757r0?**