### IEEE P802.11Wireless LANs

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| 11ax D1.0 Comment Resolution for RDG MU |
| Date: 2017-09-10 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| David Xun Yang | Huawei Technologies | F1-17, Huawei Base, Longgang District, Shenzhen 518129 | +86-15914117462 | David.yangxun@huawei.com |
| Yunbo Li | Huawei Technologies | F1-17, Huawei Base, Longgang District, Shenzhen 518129 | +86-18666203037 | liyunbo@huawei.com |
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Abstract

This submission proposes resolutions for CID 9472 and 9492.

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 D0.1 Draft. This introduction is not part of the adopted material.

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

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| **CID** | **P.L** | **Clause** | **Comment** | **Proposed Change** | **Resolution** |
| 9472 | 136.18 | 10.28 | Is HE MU PPDU allowed to be transmit by AP in RDP initiated by non-AP STA? Is HE trigger-based PPDU allowed to be triggered by AP in RDP initiated by non-AP STA? | It is natural to follow 11ac to allow AP to transmit HE MU PPDU or trigger HE trigger-based PPDU in RDP initiated by non-AP STA. | Revised – agree in pricipleThe DL MU-MIMO already adopted in 11ax draft 1.3 (see CR of CID 3160).The UL MU procedure is proposed to be enabled by AP as a RD responder to fully use the resource while not reduce the transmit rate of RD initiator.Make changes as in doc 17/1440r1. |
| 9492 | 115.63 | 10.3.2.8 | Current MU-RTS/CTS uses a fundamental assumption that a STA only need to have available 20MHz channel set which is a subset of AP's available 20MHz channel set. It considers the case of AP initiated RTS. It lacks the consideration over the case that, STA may also initiate RTS which occupies a subset of AP's available 20MHz channels. Without considering this case, the adavantage of MU transmission can't be full utilized and the system proformance will be degraded.On receiving RTS from HE-STA, AP shall be able to reply with CTS to occupy AP's available 20MHz/40MHz/80MHz/160MHz. Then AP can to RDG to trigger MU transmission. | Insert "On receiving RTS from HE-STA, AP shall be able to reply with CTS to occupy AP's available 20MHz/40MHz/80MHz/160MHz. Then AP can to RDG to trigger MU transmission." | Revised – agree in principleThe UL MU procedure is proposed to be enabled by AP as a RD responder to fully use the resource while not reduce the transmit rate of RD initiator.Make changes as in doc 17/1440r1. |

**Discussion:**

In 11ax, RD Protocol allows AP to use HE MU PPDU to transmit DL PPDUs to multiple STAs, which include the RD initiator.



The above procedures are only for DL MU transmission. However, DL MU transmission is only helpful after the initiator finishes its own transmission.

The benefits to allow AP to employ UL MU transmission can be much more than DL MU only in RD protocol, because the UL MU transmission can include the ongoing transmission from the initiator without any hurt to the ongoing transmission. That is, 2x~3x throughput gain expected at AP side without any hurt to the ongoing transmission from the initiator.

**UL MU-MIMO:**

When the initiator starts a TXOP with limited number of streams, e.g., two streams, it can only transmit an SU PPDU to AP in two streams. However, AP has four antennas and AP can only use these four antennas for receiving diversity in this case. AP cannot utilize its extra number of antennas to increase its throughput. It is kind of waste the extra degree of freedom provided by AP.

**UL OFDMA:**

When the initiator starts a TXOP with limited bandwidth, e.g., 20MHz, it can only transmit an SU PPDU to AP in primary 20MHz. However, the channels are all clean at AP side (e.g., 80MHz) but AP can only respond to the initiator in primary 20MHz. That is, AP has to waste the other 60MHz channels..

The procedure can be as follows:



To support the procedure, the following rules are necessary:

1. The responder cannot extend the duration of the TXOP.
2. The responder cannot reduce the initiator’s bandwidth or number of spatrial streams.

For UL OFDMA, another two things need to be considered:

1. BW Extension in TXOP.

Currently the bandwidth in TXOP is limited by the previous PPDU:

*“If a TXOP is protected by an RTS or CTS frame carried in a non-HT or a non-HT duplicate PPDU, the TXOP holder shall set the TXVECTOR parameter CH\_BANDWIDTH of a PPDU as follows:*

*— To be the same or narrower than RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT of the last received CTS frame in the same TXOP, if the RTS frame with a bandwidth signaling TA and TXVECTOR parameter DYN\_BANDWIDTH\_IN\_NON\_HT set to Dynamic has been sent by the TXOP holder in the last RTS/CTS exchange.*

*— Otherwise, to be the same or narrower than the TXVECTOR parameter CH\_BANDWIDTH of the RTS frame that has been sent by the TXOP holder in the last RTS/CTS exchange in the same TXOP.*

*If a TXOP is protected by an MU-RTS or CTS frame carried in a non-HT or a non-HT duplicate PPDU, the TXOP holder shall set the TXVECTOR parameter CH\_BANDWIDTH of a PPDU as follows:*

*— To be the same or narrower than the TXVECTOR parameter CH\_BANDWIDTH of the MU-RTS frame that has been sent by the TXOP holder in the last MU-RTS/CTS exchange in the same TXOP, if the RU Allocation subfields of the MU-RTS frame for all intended receiver are equal to the BW subfield in the Common Info field of the MU-RTS frame.*

*— Otherwise, to be the same or narrower than the TXVECTOR parameter CH\_BANDWIDTH of the preceding PPDU that it has transmitted in the same TXOP.*

*If there is no RTS/CTS or MU-RTS/CTS exchange in non-HT duplicate format in a TXOP, and the TXOP includes at least one non-HT duplicate frame exchange that does not include a PS-Poll, then the TXOP holder shall set the CH\_BANDWIDTH parameter in TXVECTOR of a PPDU sent after the first non-HT duplicate frame that is not a PS-Poll to be the same or narrower than the CH\_BANDWIDTH parameter in TXVECTOR of the initial frame in the first non-HT duplicate frame exchange in the same TXOP.*

*If there is no non-HT duplicate frame exchange in a TXOP, the TXOP holder shall set the TXVECTOR parameter CH\_BANDWIDTH of a non-initial PPDU to be the same or narrower than the TXVECTOR parameter CH\_BANDWIDTH of the preceding PPDU that it has transmitted in the same TXOP.*

*If a TXOP is protected by a CTS-to-self frame carried in a non-HT or non-HT duplicate PPDU, the TXOP holder shall set the TXVECTOR parameter CH\_BANDWIDTH of a PPDU to be the same or narrower than the TXVECTOR parameter CH\_BANDWIDTH of the CTS-to-self frame in the same TXOP.*

*”*

OFDMA in RD does not conflict with the rules above, because AP is not the TXOP holder. Then no change is needed.

1. CCA in the available channels except the channel occupied by initiator.

CCA value shall be detected PIFS before transmission. If so, we need to change the IFS before trigger frame to be PIFS.

Q: Is there fairness issue in non-primary channel when expanding bandwidth in RDP?

A: Firstly, in the BSS deployment, the OBSSs are suggested to align their primary channels, when the OBSSs share the same primary channel, there is not fairness issue.

There are corner cases that OBSS don’t align their primary channels. Under these cases, the fairness issue in non-primary channel is the same as what happens when STA try to obtain the channel at the beginning of the TXOP. So expanding bandwidth in RDP doesn’t introduce extra fairness issue.

*SP1: Do you agree AP as a RD responder to trigger UL MU-MIMO transmissions in RDP?*

*SP2: Do you agree AP as a RD responder to trigger UL OFDMA transmissions in RDP?*

Two options of spec text modifications are provided based on the result of SP1 and SP2.

**Option 1: When the RDG responder only allows to trigger UL MU-MIMO, the proposed modification as below:**

***TGax editor: Modify the Paragraphs on section 25.5.3 as the following:***

**10.28.2 Reverse direction (RD) exchange sequence**

If the RD initiator is an HE-STA and the RD responder is an HE AP, the RD responder may transmit trigger frames to trigger more than one STA to do UL MU-MIMO transmission. The triggerred STAs shall include the RD initiator.

**10.28.4 Rules for RD responder**

When the RD responder transmits a trigger frame, the allocated number of streams for the initiator in the trigger frame shall not be smaller than the number of streams of the RD initiator’s last PPDU.

**Option 2: When the RDG responder allows to trigger both UL MU-MIMO and UL OFDMA, the proposed modification as below:**

***TGax editor: Modify the Paragraphs on section 25.5.3 as the following:***

**10.28.2 Reverse direction (RD) exchange sequence**

If the RD initiator is an HE-STA and the RD responder is an HE AP, the RD responder may transmit HE MU PPDUs that haveTXVECTOR parameter CH\_BANDWIDTH wider than the TXVECTOR parameter CH\_BANDWIDTH of the last frame that has been sent by the TXOP holder in the same TXOP.

If the RD initiator is an HE-STA and the RD responder is an HE AP, the RD responder may transmit trigger frames to trigger more than one STA to transmit HE Trigger-Based PPDUs. The triggerred STAs shall include the RD initiator.

If the HE MU PPDU or the trigger frames transmitted by RD responder occupy wider bandwidth than the TXVECTOR parameter CH\_BANDWIDTH of the last frame that has been sent by the TXOP holder in the same TXOP, the IFS before the HE MU PPDU or the trigger frame shall be PIFS. And the channel required to be idle based on CCA during this PIFS time.

**10.28.4 Rules for RD responder**

When the RD responder transmits HE MU PPDU, it shall not transmit to the RD initiator in a RU that occupies smaller bandwidth than the bandwidth of the RD initiator’s last PPDU. And the RU allocated to the RD initiator shall in the same sub-channels as the RD initiator’s last PPDU to the RD responder.

When the RD responder transmits a trigger frame, the allocated RU for the initiator in the trigger frame shall not be smaller than the bandwidth of the RD initiator’s PPDU and shall in the same sub-channel as the RD initiator’s last PPDU to the RD responder, and the allocated number of streams for the initiator in the trigger frame shall not be smaller than the number of streams of the RD initiator’s last PPDU.