### IEEE P802.11Wireless LANs

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| 11ax D3.0 MAC Comment Resolution for MU-RTS/CTS – Part I |
| Date: 2018-09-05 |
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Abstract

This submission proposes resolutions for comments of TGax Draft D3.0 with the following CIDs:

15717, 16021, 16023, 16024, 17073, 15911, 15913, 15959, 16562, 16563, 16564, 16565, 16566, 16567, 16568, 16592, 16906, 17087, 16014, 16930, 17145

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Transfer CID 16014 to Hongyuan. Defer CID 17145. Revision based on the discussion during the meeting.

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 D3.0 Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGax D3.0 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** |
| 15717 | 106.10 | 9.3.1.23.4 | What address is the broadcast address? There are more than one. | Do you mean FF-FF-FF-FF-FF-FF specifically? | Rejected – The term broadcast address has been widely used in 802.11-2016.Specifically, the definition in 9.2.4.3.3 Address designation says that it is all 1s. Please see the cited text below.*A MAC sublayer address is one of the following two types:**a) Individual address. The address assigned to a particular STA on the network.b) Group address. A multidestination address, which might be in use by one or more STAs on a givennetwork. The two kinds of group addresses are as follows:1) Multicast-group address. An address associated by higher level convention with a group oflogically related STAs.2) Broadcast address. A distinguished, predefined group address that always denotes the set of all STAs on a given LAN. All 1s are interpreted to be the broadcast address. This group is predefined for each communication medium to consist of all STAs actively connected to that medium; it is used to broadcast to all of the active STAs on that medium.*  |
| 16021 | 106.14 | 9.3.1.23.4 | "The UL BW subfield in the Common Info field indicates the total PPDU bandwidth, and is defined inTable 9-25c (UL BW subfield encoding)." -- the concept of a "total PPDU bandwidth" is undefined | Change the cited text at the referenced location to "The UL BW subfield in the Common Info field indicates the bandwidth in the HE-SIG-A of the HE TB PPDU as described in 9.3.1.23." | Revised - The CTS solicited by MU-RTS does not have HE-SIG-A. We revise by saying that this indicates the bandwidth of the PPDU carrying the MU-RTS Trigger frame. TGax editor to make the changes shown in 11-18/1418r1 under all headings that include CID 16021. |
| 16023 | 106.32 | 9.3.1.23.4 | " For 160 MHz and 80+80 MHz indication, B12 of the RU Allocation subfieldis set to 1." indicates that for >80M only the secondary 80M can be used. I don't think that's the intent | Replace the paragraph at the referenced location with "B0 of the RU Allocation subfield is reserved." | Revised – The setting of B12 has been discussed and revised in 9.3.1.23 Trigger frame format D3.0. We do the revision to align with the agreement.TGax editor to make the changes shown in 11-18/1418r1 under all headings that include CID 16023. |
| 16024 | 106.32 | 9.3.1.23.4 | The rules allow the position of the primary 20 and primary 40 to be described, but not the primary 80 in an 80+80/160 | If the UL BW field indicates 80+80 or 160, use 67 to say the primary 80 is the lowest-frequency one (clarify meaning of 67), 69 to say the primary 80 is the highest-frequency one (new) and 68 to say the whole 160/80+80 is used (no change) | Rejected – We note that the designed rule follows the design in 9.3.1.23 Trigger frame. Primary 80 does not need to be described due to the following the reason. Specifically, if the UL BW field indicates 160/80+80, and only primary 80 is solicited, then B12 is set to 0 to indicate that. Further, solicitation of CTS in secondary 80 MHz has not been agreed in 11ax design. |
| 17073 | 106.23 | 9.3.1.23.4 | old names in "The MCS, Coding Type, DCM, SS Allocation and Target RSSI fields" | Replace with "The UL MCS, UL FEC Coding Type, UL DCM, SS Allocation / RA-RU Information and UL Target RSSI subfields". | Accepted –TGax editor to make the changes shown in 11-18/1418r1 under all headings that include CID 17073. |
| 15911 | 257.47 | 27.2.5.1 | Remove "from one or" from the sentnce. | As in the comment | Revised –We revise the sentences to say from one or more non-AP HE-STAs.Note that this is similar to the sentence used by other variatns of Trigger frame, and we do not specify additional rule to limit the number of user info fields in the MU-RTS Trigger frame. This kinds of decision should be implementation specific for the TXOP holder.TGax editor to make the changes shown in 11-18/1418r1 under all headings that include CID 15911. |
| 15913 | 259.23 | 27.2.5.2 | MU-RTS shouldn't be in HE SU/ER-SU PPDU otherwise legacy STA (11a/g, HT/VHT STA can't set NAV correctly). | As in the comment | Rejected – We note that there are multiple ways to achieve legacy protection from the TXOP holder. For example, the TXOP holder can start the sequence with CTS-to-self carrying in non-HT format, then continue with MU-RTS not carried in non-HT format. It is better to leave all the possible sequences to the decision of TXOP holder rather than adding further rules in the spec. |
| 15959 | 259.37 | 27.2.5.3 | There are three instances of "TA set" and one of "RA set" | Insert "field" before "set" in each of the instances | Accepted –  |
| 16562 | 258.00 | 27.2.5.1 | MU-RTS is targeted to non-AP HE STAs only | Change STA to non-AP HE STA for the entire sub clause. | Revised –In 27.2.5.1, we have revised the description of general procedure to say that MU-RTS solicits response from non-AP HE STAs. We also have revised other sections including the MU clause to make sure that consistent message are used across the spec.TGax editor to make the changes shown in 11-18/1418r1 under all headings that include CID 16562. |
| 16563 | 259.28 | 27.2.5.3 | MU-RTS is targeted to non-AP HE STAs only | Change STA to non-AP HE STA for the entire sub clause. | Revised –In 27.2.5.1, we have revised the description of general procedure to say that MU-RTS solicits response from non-AP HE STAs. We also have revised other sections including the MU clause to make sure that consistent message are used across the spec.TGax editor to make the changes shown in 11-18/1418r1 under all headings that include CID 16562. |
| 16564 | 258.00 | 27.2.5.1 | Trigger frames, including MU RTS, are only transmitted from HE AP | Change "..., the transmitter of the MU-RTS Trigger frame shall request ..." to "the HE AP shall request ..." | Revised –In 27.2.5.1, we have revised the description of general procedure to say that MU-RTS solicits response from non-AP HE STAs. We also have revised other sections including the MU clause to make sure that consistent message are used across the spec.TGax editor to make the changes shown in 11-18/1418r1 under all headings that include CID 16562. |
| 16565 | 259.01 | 27.2.5.2 | Trigger frames, including MU RTS, are only transmitted from HE AP | Change "the transmitter" to "the HE AP" | Revised –In 27.2.5.1, we have revised the description of general procedure to say that MU-RTS solicits response from non-AP HE STAs. We also have revised other sections including the MU clause to make sure that consistent message are used across the spec.TGax editor to make the changes shown in 11-18/1418r1 under all headings that include CID 16562. |
| 16566 | 259.05 | 27.2.5.2 | Trigger frames, including MU RTS, are only transmitted from HE AP | Change "the STA shall wait" to "the HE AP shall wait" | Revised –In 27.2.5.1, we have revised the description of general procedure to say that MU-RTS solicits response from non-AP HE STAs. We also have revised other sections including the MU clause to make sure that consistent message are used across the spec.TGax editor to make the changes shown in 11-18/1418r1 under all headings that include CID 16562. |
| 16567 | 259.09 | 27.2.5.2 | Trigger frames, including MU RTS, are only transmitted from HE AP | Change "the STA shall conclude" to "the HE AP shall conclude" | Revised –In 27.2.5.1, we have revised the description of general procedure to say that MU-RTS solicits response from non-AP HE STAs. We also have revised other sections including the MU clause to make sure that consistent message are used across the spec.TGax editor to make the changes shown in 11-18/1418r1 under all headings that include CID 16562. |
| 16568 | 259.18 | 27.2.5.2 | Trigger frames, including MU RTS, are only transmitted from HE AP | Change "the STA may process" to "the HE AP may process" | Revised –In 27.2.5.1, we have revised the description of general procedure to say that MU-RTS solicits response from non-AP HE STAs. We also have revised other sections including the MU clause to make sure that consistent message are used across the spec.TGax editor to make the changes shown in 11-18/1418r1 under all headings that include CID 16562. |
| 16592 | 259.19 | 27.2.5.2 | It is described here that if MU-RTS initiates a TXOP and has transmission failure, then backoff procedure is invoked. It may be useful to add a note to describe that PIFS recovery can be used if MU-RTS does not initates a TXOp and has transmission failure. | Add a note as described in the comment. | Revised – Agree in principle with the commenter. TGax editor to make the changes shown in 11-18/1418r1 under all headings that include CID 16592. |
| 16906 | 259.64 | 27.2.5.3 | As an AP cannot distinguish CTSs from multiple STAs, the RU Allocation subfield of the User Info field is not that important for the STAs to follow. There is already the UL BW subfield of the Common Info field that can be used instead. | Change the sentence from "A CTS frame sent in response to an MU-RTS Trigger frame shall be transmitted on the 20 MHz channels indicated in the RU Allocation subfield of the User Info field of the MU-RTS Trigger frame." to "A CTS frame sent in response to an MU-RTS Trigger frame shall be transmitted on the 20 MHz channels indicated in the UL BW subfield of the Common Info field or the RU Allocation subfield of the User Info field of the MU-RTS Trigger frame." | Rejected – The UL BW subfield is basically the bandwidth occupied by the MU-RTS frame. However, the CTS response may not need to be the same bandwidth as the bandwidth covered by MU-RTS frame. For example, if the MU-RTS covers 80 MHz, then the CTS response can be primary 20, primary 40, or primary 80. This is good for alleviating the situation that the STA is allocating in the following transmission on primary 20 MHz, but the protection is done in the whole 80 MHz.  |
| 17087 | 259.57 | 27.2.5.3 | It is not clear how the SCRAMBLER\_INITIAL\_VALUE is used. | Make use of the "switch" in Figure 17-7 in 802.11-2016 to clearly describe how the scrambling is 'coordinated' for CTS transmissions in response to MU-RTS. | Revised – Agree in principle with the commenter. We add a note to clarify that bandwidth signaling TA is not used in MU-RTS and CTS response to MU-RTS. As a result, CH\_BANDWIDTH\_IN\_NON\_HT is not present for MU-RTS and CTS response to MU-RTS when refer to Figure 17-7. TGax editor to make the changes shown in 11-18/1418r1 under all headings that include CID 17087.  |
| 16930 | 257.42 | 27.2.5 | MU-CTS won't work in practice. STAs within earshot of two or more MU-CTS transmissions may not be able to decode any of the CTS frames due to a variety of PHY layer issues, thus defeating the whole purpose of reserving the medium. | Remove this "feature" | Rejected –Decoding of simultaneous CTS is similar to the decoding of simultaneously HE-SIG-A field in HE TB response. Various simulations have shown that it will work (see 15/867 and 15/806), and various design has done to make sure that different STAs can respond the same CTS frame.  |
| 17145 | 259.00 | 27.2.5.2 | "If the MAC does not receive a PHYRXSTART.indication primitive during the CTSTimeout interval, the STA shall conclude that the transmissionof the MU-RTS Trigger frame has failed, and, if the MU-RTS Trigger frame initiated a TXOP," This spec text was added to allow all other type of trigger frame exchange before the MU-RTS/CTS to enhance the protection of DL transmission to far end STA. However, to support this mechanims, the TXOP holder has to record what type of frame initialized the TXOP which is not a good design. In addition, this mechanism requires long frame exchange for DL frame protection and is very easy to break. So the whole mechanism of DL protection for the far end STA need a major enhancement. | as in the comment | Rejected – We note that various Trigger frame design hints that multiple variants may happen in sequence, and this is allowed in various places in the spec. For example, BQRP/BSRP/NFRP Trigger frame may be used to assist the following UL MU operation. We further note that how TXOP holder will use different variants of Trigger frame is implementation specific, and TXOP holder can consider various conditions to make the decision.  |

**Discussion:** *None.*

**Propose:** Revised for CID 16021, 16023, 17073 per discussion and editing instructions in 11-18/1418r1.

***TGax editor: Change 9.3.1.23.4 MU-RTS variant: (Track change on)***

* MU-RTS variant

The Trigger Dependent Common Info subfield and Trigger Dependent User Info subfield are not present in the MU-RTS Trigger frame.

The RA field of the MU-RTS Trigger frame is set to the broadcast address.

The CS Required subfield in the Common Info field is set as described in 27.5.3.5 (UL MU CS mechanism).

The UL BW subfield(#11372) of the Common Info field indicates the bandwidth of the PPDU carrying the MU-RTS Trigger frame and(#16021) is defined in Table 9-25c (UL BW subfield encoding).

The UL Length, GI And LTF Type, MU-MIMO LTF Mode, Number Of HE-LTF Symbols and Midamble Periodicity, UL STBC, LDPC Extra Symbol Segment, AP TX Power, UL Packet Extension, UL Spatial Reuse, Doppler and UL HE-SIG-A2 Reserved subfields(#11372) in the Common Info field are reserved.(#17073)

The UL MCS, UL FEC Coding Type, UL DCM, SS Allocation/RA-RU Information and UL Target RSSI fields in the User Info field are reserved.(#17073)

The RU Allocation subfield in the User Info field addressed to the STA indicates whether the CTS frame is transmitted on the primary 20 MHz channel, primary 40 MHz channel, primary 80 MHz channel, 160 MHz channel, or 80+80 MHz channel.

B12 of the RU Allocation subfield is set to 0 to indicate primary 20 MHz channel, primary 40 MHz channel and primary 80 MHz channel. For 160 MHz and 80+80 MHz indication, B12 of the RU Allocation subfield is set to 1. A non-AP STA ignores B12 for 160 MHz and 80+80 MHz indication. (#16023)

If the UL BW subfield(#11372) indicates 20 MHz, then the primary 20 MHz channel is indicated by setting B19-B13 of the RU Allocation subfield to 61.

If the UL BW subfield(#11372) indicates 40 MHz, then

* The primary 20 MHz channel is indicated by setting B19-B13 of the RU Allocation subfield to 61 if(#11060) the primary 20 MHz channel is the lowest frequency 20 MHz channel and 62 if(#11060) the primary 20 MHz channel is the second lowest frequency 20 MHz channel.
* The primary 40 MHz channel is indicated by setting B19-B13 of the RU Allocation subfield to 65.

If the UL BW subfield(#11372) indicates 80 MHz, 80+80 MHz or 160 MHz, then

* The primary 20 MHz channel is indicated by setting B19-B13 of the RU Allocation subfield to 61 if(#11060) the primary 20 MHz channel is the lowest frequency 20 MHz channel in the primary 80MHz channel, 62 if(#11060) the primary 20 MHz channel is the second lowest frequency 20 MHz channel in the primary 80MHz, 63 if(#11060) the primary 20 MHz channel is the third lowest frequency 20 MHz channel in the primary 80MHz, and 64 if(#11060) the primary 20 MHz channel is the fourth lowest frequency 20 MHz channel in the primary 80 MHz.
* The primary 40 MHz channel is indicated by setting B19-B13 of the RU Allocation subfield to 65 if(#11060) the primary 40 MHz channel is the lowest frequency 40 MHz channel in the primary 80 MHz channel and 66 if(#11060) the primary 40 MHz channel is the second lowest frequency 40 MHz channel in the primary 80 MHz channel.
* The primary 80 MHz channel is indicated by setting B19-B13 of the RU Allocation subfield to 67.

If the UL BW subfield(#11372) indicates 80+80 MHz or 160 MHz, then the primary and secondary 80 MHz is indicated by setting B19-B13 of the RU Allocation subfield to 68.

**Propose:** Revised for CID 15911, 15959, 16014, 16592, 17087, 16562 per discussion and editing instructions in 11-18/1418r1.

***TGax editor: Change 27.2.5.1 General: (Track change on)***

* General

The MU-RTS/CTS procedure allows an AP to initiate a TXOP and protect the TXOP frame exchanges. An AP may transmit an MU-RTS Trigger frame to solicit simultaneous CTS responses from one or more non-AP(#15911) STAs.

Figure 27-1 (Example of MU-RTS/CTS/DL MU PPDU/Acknowledgment Response and NAV setting) shows an example of the exchange of MU-RTS and simultaneous CTS responses to protect the DL MU PPDU and the acknowledgment(#11208) responses.

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| (#16562) |
| * Example of MU-RTS/CTS/DL MU PPDU/Acknowledgment(#11208) Response and NAV setting(#13825)
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Figure 27-2 (Example of MU-RTS/CTS/Trigger/HE TB PPDU/Multi-STA BlockAck and NAV setting) shows an example of the exchange of MU-RTS and simultaneous CTS responses to protect the HE TB PPDU and Multi-STA BlockAck frame.

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| (#16562) |
| * Example of MU-RTS/CTS/Trigger/HE TB PPDU/Multi-STA BlockAck and NAV setting
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* MU-RTS procedure

In each 20 MHz channel occupied by the PPDU that contains an MU-RTS Trigger frame, the transmitter of the MU-RTS Trigger frame shall request at least one non-AP(#16562) STA to send a CTS frame response that occupies the 20 MHz channel. The transmitter of an MU-RTS Trigger frame shall not request a non-AP(#16562) STA to send a CTS frame response in a 20 MHz channel that is not occupied by the PPDU that contains the MU-RTS Trigger frame.

After transmitting an MU-RTS Trigger frame, the AP(#16562) shall wait for a CTSTimeout interval of aSIFSTime + aSlotTime + aRxPHYStartDelay that begins when the MAC receives the PHY-TXEND.confirm primitive for the transmitted MU-RTS Trigger frame. If the MAC does not receive a PHY-RXSTART.indication primitive during the CTSTimeout interval, the AP(#16562) shall conclude that the transmission of the MU-RTS Trigger frame has failed, and, if the MU-RTS Trigger frame initiated a TXOP, the AP(#16562) shall invoke its backoff procedure(#14328). If the MAC receives a PHY-RXSTART.indication primitive during the CTSTimeout interval, then the MAC shall wait for the corresponding PHY-RXEND.indication primitive to determine whether the MU-RTS Trigger frame transmission was successful. The receipt of a CTS frame from any non-AP STA(#16562) addressed by the MU-RTS Trigger frame before the PHY-RXEND.indication primitive, shall be interpreted as the successful transmission of the MU-RTS Trigger frame, permitting the frame exchange sequence to continue. The receipt of any other type of frame shall be interpreted as a failure of the MU-RTS Trigger frame transmission. In this instance, the AP(#16562) may process the received frame and, if the MU-RTS Trigger frame initiated a TXOP, shall invoke its backoff procedure at the PHY-RXEND.indication primitive.

NOTE – If an AP transmits a MU-RTS Trigger frame in an already initiated TXOP and the MU-RTS Trigger frame transmission fails, then the AP can perform a PIFS recovery as described in 10.24.2.8 (Multiple frame transmission in an EDCA TXOP) or invoke a backoff procedure as described in 10.24.2.2 (EDCA backoff procedure). (#16592)

An MU-RTS Trigger frame shall not be carried in a VHT MU PPDU or an HE MU PPDU.

* CTS response to MU-RTS

If a non-AP(#16562) STA receives an MU-RTS Trigger frame, the non-AP(#16562) STA shall commence the transmission of a CTS frame response at the SIFS time boundary after the end of a received PPDU when all the following conditions are met:

* The MU-RTS Trigger frame has one of the User Info fields addressed to the non-AP(#16562) STA. The User Info field is addressed to a non-AP(#16562) STA if the AID12 subfield is equal to the 12 LSBs of the AID of the non-AP(#16562) STA and the MU-RTS Trigger frame is sent by the AP with which the non-AP(#16562) STA is associated (#12272)or by the AP corresponding to the transmitted BSSID if the non-AP(#16562) STA is associated with a nontransmitted BSSID and has indicated support for receiving Control frames with TA field(#15959) set to the transmitted BSSID(#13506) by setting the Rx Control Frame To MultiBSS subfield to 1 in the HE Capabilities element that the non-AP(#16562) STA transmits.(#13143)
* The UL MU CS condition indicates that the medium is idle (see 27.5.3.5 (UL MU CS mechanism)).
* The RU Allocation subfield in the User Info field addressed to the non-AP(#16562) STA indicates primary 20 MHz channel, primary 40 MHz channel, primary 80 MHz channel,160 MHz channel, or 80+80 MHz channel.

Otherwise, the non-AP(#16562) STA shall not send a CTS frame response.

NOTE—The ED-based CCA during the SIFS after receiving an MU-RTS Trigger frame and virtual CS functions are used to determine the state of the medium to respond to an MU-RTS Trigger frame. See 27.5.2.4 (UL MU CS mechanism) for details.

The CTS frame sent in response to an MU-RTS Trigger frame shall be carried in a non-HT or non-HT duplicate PPDU (see Clause 17).

A non-AP (#16562)STA transmitting a CTS frame in response to an MU-RTS Trigger frame shall set the
TXVECTOR parameter SCRAMBLER\_INITIAL\_VALUE to the same value as the RXVECTOR parameter SCRAMBLER\_INITIAL\_VALUE of the received MU-RTS Trigger frame.

NOTE 1 – Bandwidth signaling TA is not used in MU-RTS and CTS response to MU-RTS (see 9.3.1.23 Trigger frame format and 9.3.1.3 CTS frame format). As a result, TXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT is not present in MU-RTS and CTS response to MU-RTS, and in Figure 17-7 (Data scrambler), first 7 bits of Scrambling Sequence for MU-RTS and CTS response to MU-RTS is not defined by Table 17-7 (Contents of the first 7 bits of the scrambling sequence).(#17087)

The data rate to be used for the non-HT or non-HT duplicate PPDU response shall be 6 Mb/s.

A CTS frame sent in response to an MU-RTS Trigger frame shall be transmitted on the 20 MHz channels indicated in the RU Allocation subfield of the User Info field of the MU-RTS Trigger frame.

The Power Management subfield in a CTS frame sent in response to an MU-RTS Trigger frame shall be set to 0.

NOTE—The Frame Control field of the CTS frames sent in response to an MU-RTS Trigger frame are set to the same value (see Figure 9-19 and 9.2.4.1.8 (More Data subfield)).(#11077)

Figure 27-3 (An example of an MU-RTS Trigger frame soliciting CTS frame responses on the primary 40 MHz channel) shows an example of the exchange of MU-RTS and simultaneous CTS frame responses on the primary 40 MHz channel. In this example, MU-RTS Trigger frame is transmitted in a 40 MHz non-HT duplicate PPDU on the primary 40 MHz channel. Further, the MU-RTS Trigger frame requests non-AP(#16562) STA1 to transmit a CTS frame response in a non-HT PPDU on the primary 20 MHz channel and non-AP(#16562) STA2 to transmit a CTS frame response in a 40 MHz non-HT duplicate PPDU on the primary 40 MHz channel.

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| (#16562) |

A non-AP(#16562) STA that transmits a CTS frame in response to an MU-RTS Trigger frame shall follow the synchronization requirement defined in 17.3.9.10 (Pre-correction accuracy requirements).

***TGax editor: Change STA to non-AP STA in 27.5.3, if the STA represents the receiver of a Trigger frame.*** (#16562)