IEEE P802.11
Wireless LANs

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| [Draft text for MU-MIMO channel access flow] |
| Date: 2017-09-08 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Tony Xiao Han | Huawei |  |  | Tony.hanxiao@huawei.com |
| Yan Xin | Huawei |  |  | yan.xin@huawei.com |
| George Calcev | Huawei |  |  | George.Calcev@huawei.com |
| Min Yan | Huawei |  |  | yanmin.yan@huawei.com |
| Qian Wang | Huawei |  |  | emy.wangqian@huawei.com |
| Cheng Chen | Intel |  |  | cheng.chen@intel.com |
| Carlos Cordeiro | Intel |  |  | carlos.cordeiro@intel.com |
| Oren Kedem | Intel |  |  | oren.kedem@intel.com |
| Claudio da Silva | Intel |  |  | claudio.da.silva@intel.com |
| Solomon Trainin | Qualcomm |  |  | strainin@qti.qualcomm.com |
| Jinsoo Choi | LG |  |  | js.choi@lge.com |

Abstract

[This document proposes draft changes to include MU-MIMO channel access procedure for EDMG STAs.]

10.36.11.4.4 MU-MIMO Channel Access Procedure

*Insert the following to this subclause:*

An EDMG STA is MU-MIMO capable if the MU-MIMO Supported field in the STA’s EDMG Capabilities element is one. An MU-MIMO TXOP is a TXOP where an MU-MIMO capable initiator and multiple MU-MIMO capable responders in an MU group exchange one or more EDMG MU PPDUs. The MU-MIMO channel access procedure describes how an MU-MIMO capable initiator and multiple MU-MIMO capable responders establish an MU-MIMO TXOP. Prior to the transmission of an EDMG MU PPDU to a set of responder STAs within an MU group, the initiator shall:

* Include the MU group within the EDMG Group ID Set element and communicate the resulting element to the STAs in the BSS (see Section 10.38.9.2.4.1).
* Perform MU-MIMO beamforming with the responders of the MU group (see Section 10.38.9.2.4).

An EDMG STA establishes an MU-MIMO TXOP by transmitting an RTS frame or a DMG CTS-to-self frame to the intended MU-MIMO group of responders. The EDMG STA shall transmit the RTS frame or DMG CTS-to-self frame with a control trailer to the group of responders to indicate the intent to transmit an EDMG MU PPDU. The RTS and DMG CTS-to-self frame shall be transmitted using the MU-MIMO antenna setting obtained through the last successful MU-MIMO beamforming training with the group of responders. For the transmitted RTS and DMG CTS-to-self frame, the TXVECTOR parameter CONTROL\_TRAILER shall be set to Present and the parameter CT\_TYPE shall be set to GRANT\_RTS\_CTS2self. In the control trailer, the SISO/MIMO field shall be set to 1, and the SU/MU MIMO field shall be set to 1 to indicate that the following PPDU transmitted by the initiator is an EDMG MU PPDU. The EDMG Group ID field shall be set to the value that identifies the corresponding group of responders that are the intended destinations of the EDMG MU PPDU to be transmitted. The RA field of the RTS shall be set to the broadcast MAC address. After transmitting the RTS frame, the initiator shall configure its receive antenna to quasi-omni receive pattern to receive the DMG CTS. The responders should not configure its receive antenna to SISO configuration when it is not in the transmit or receive sequence.

A STA that receives an RTS frame addressed to an MU group that the STA belongs to shall transmit a DMG CTS frame back to the initiator employing the most recent SISO antenna configuration used between the responder and the initiator. The DMG CTS frame shall be transmitted a SIFS interval following the reception of the RTS frame. The TA field of the DMG CTS shall be set to the broadcast MAC address and the Scrambler Initialization field in the PHY header shall be set to the same value as the Scrambler Initialization field of the PPDU that contained in the received RTS frame. For the STA addressed by the DMG CTS frame to successfully receive the frame, the difference in time between all the DMG CTS transmissions as measured at the receiving STA should be no more than ±30 ns. A STA that transmits the DMG CTS should pre-compensate for carrier frequency offset (CFO) error. After compensation, the absolute value of residual CFO error with respect to the RTS should not exceed 12 KHz. Following transmission of the DMG CTS, the responder shall then configure its antennas based on the antenna setting obtained during the last MU-MIMO beamforming training for the MU group. The MU-MIMO transmission begins SIFS interval following the reception or expected reception of the DMG CTS frame by the initiator. This is shown in Figure 1.

A STA that receives a DMG CTS-to-self frame addressed to an MU group that the STA belongs to shall configure its antennas based on the antenna setting obtained during the last successful MU-MIMO beamforming training for the MU group. The MU-MIMO transmission begins SIFS interval following the end of the DMG CTS-to-self frame transmission by the initiator. This is shown in Figure 2.

Section 10.3.2.10 describes the MU PPDU acknowledgement procedure.

The initiator may send a CF-End frame to one or more responders in an MU-MIMO TXOP to truncate the TXOP.



 Figure 1: MU-MIMO channel access flow when RTS/DMG CTS is used



Figure 2: MU-MIMO channel access flow when DMG CTS-to-self is used

*Change Table 31 (Control trailer definition when CT\_TYPE is GRANT\_RTS\_CTS2self) as follows::*

|  |  |  |  |
| --- | --- | --- | --- |
| **Field** | **Number of bits** | **Start bit** | **Description** |
| Channel Aggregation | 1 | 0 | See Table 16 |
| BW | 8 | 1 | See Table 16 |
| Primary Channel Number | 3 | 9 | See Table 16 |
| SISO/MIMO | 1 | 12 | Set to 0 to indicate that the following transmission from this STA is performed in SISO. Set to 1 to indicate that the following transmission from this STA is performed in MIMO. |
| SU/MU MIMO | 1 | 13 | Set to 0 to indicate SU-MIMO, and set to 1 to indicate MU-MIMO. Reserved when SISO/MIMO is set to 0. |
| EDMG Group ID | 8 | 14 | This field indicates the MU-MIMO group of STAs that will be involved in the following MU-MIMO transmission. Reserved when SU/MU MIMO is set to 0. |
| Number of SS | 3 | 23 | The value of this field plus one indicates the number of SSs transmitted to the EDMG STA that is the recipient of the control trailer. Reserved if SISO/MIMO is set to 0. |
| TX Sector ID for SS1 | 6 | 26 | This field indicates the sector that the transmitter of this control trailer uses for SS1. Reserved if SISO/MIMO is set to 0. |
| TX DMG antenna ID for SS1 | 2 | 32 | This field indicates the DMG antenna that the transmitter of this control trailer uses for SS1. Reserved if SISO/MIMO is set to 0. |
| RX DMG antenna ID for SS1 | 2 | 34 | This field indicates the DMG antenna that the recipient of this control trailer uses for SS1. Reserved if SISO/MIMO is set to 0. |
| TX Sector ID for SS2 | 6 | 36 | This field indicates the sector that the transmitter of this control trailer uses for SS2. Reserved if SISO/MIMO is set to 0. |
| TX DMG antenna ID for SS2 | 2 | 42 | This field indicates the DMG antenna that the transmitter of this control trailer uses for SS2. Reserved if SISO/MIMO is set to 0. |
| RX DMG antenna ID for SS2 | 2 | 44 | This field indicates the DMG antenna that the recipient of this control trailer uses for SS2. Reserved if SISO/MIMO is set to 0. |
| TX Sector ID for SS3 | 6 | 46 | This field indicates the sector that the transmitter of this control trailer uses for SS3. Reserved if SISO/MIMO is set to 0. |
| TX DMG antenna ID for SS3 | 2 | 52 | This field indicates the DMG antenna that the transmitter of this control trailer uses for SS3. Reserved if SISO/MIMO is set to 0. |
| RX DMG antenna ID for SS3 | 2 | 54 | This field indicates the DMG antenna that the recipient of this control trailer uses for SS3. Reserved if SISO/MIMO is set to 0. |
| TX Sector ID for SS4 | 6 | 56 | This field indicates the sector that the transmitter of this control trailer uses for SS4. Reserved if SISO/MIMO is set to 0. |
| TX DMG antenna ID for SS4 | 2 | 62 | This field indicates the DMG antenna that the transmitter of this control trailer uses for SS4. Reserved if SISO/MIMO is set to 0. |
| RX DMG antenna ID for SS4 | 2 | 64 | This field indicates the DMG antenna that the recipient of this control trailer uses for SS4. Reserved if SISO/MIMO is set to 0. |
| TX Sector ID for SS5 | 6 | 66 | This field indicates the sector that the transmitter of this control trailer uses for SS5. Reserved if SISO/MIMO is set to 0. |
| TX DMG antenna ID for SS5 | 2 | 72 | This field indicates the DMG antenna that the transmitter of this control trailer uses for SS5. Reserved if SISO/MIMO is set to 0. |
| RX DMG antenna ID for SS5 | 2 | 74 | This field indicates the DMG antenna that the recipient of this control trailer uses for SS5. Reserved if SISO/MIMO is set to 0. |
| TX Sector ID for SS6 | 6 | 76 | This field indicates the sector that the recipient of this control trailer uses for SS6. Reserved if SISO/MIMO is set to 0. |
| TX DMG antenna ID for SS6 | 2 | 82 | This field indicates the DMG antenna that the transmitter of this control trailer uses for SS6. Reserved if SISO/MIMO is set to 0. |
| RX DMG antenna ID for SS6 | 2 | 84 | This field indicates the DMG antenna that the recipient of this control trailer uses for SS6. Reserved if SISO/MIMO is set to 0. |
| TX Sector ID for SS7 | 6 | 86 | This field indicates the sector that the transmitter of this control trailer uses for SS7. Reserved if SISO/MIMO is set to 0. |
| TX DMG antenna ID for SS7 | 2 | 92 | This field indicates the DMG antenna that the transmitter of this control trailer uses for SS7. Reserved if SISO/MIMO is set to 0. |
| RX DMG antenna ID for SS7 | 2 | 94 | This field indicates the DMG antenna that the recipient of this control trailer uses for SS7. Reserved if SISO/MIMO is set to 0. |
| TX Sector ID for SS8 | 6 | 96 | This field indicates the sector that the recipient of this control trailer uses for SS8. Reserved if SISO/MIMO is set to 0. |
| TX DMG antenna ID for SS8 | 2 | 102 | This field indicates the DMG antenna that the transmitter of this control trailer uses for SS8. Reserved if SISO/MIMO is set to 0. |
| RX DMG antenna ID for SS8 | 2 | 104 | This field indicates the DMG antenna that the recipient of this control trailer uses for SS8. Reserved if SISO/MIMO is set to 0. |
| Reserved | 21 | 106 | Set to 0 by the transmitter and ignored by the receiver. |
| CTCS | 16 | 127 | Contains the CRC-16 computed over the content of the control trailer. This field is computed as defined in section 20.3.7 |