IEEE P802.11  
Wireless LANs

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| Comment Resolution on MIMO BF misc | | | | |
| Date: 2018-4-4 | | | | |
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Abstract

This submission proposes resolution of comments on MIMO BF received from LB# 231 (TGay Draft 1.0).

- 7 CID:

1342, 1903, 1904, 1976, 2001, 2020, 2239

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Page Number** | **Line Number** | **Comment** | **Proposed Change** | **Resolution** |
| 1903 | 166 | 7 | The MIMO BF setup frame has many sub-fields/elements/parameters that also may have sub-fields/elements/parameters that are located at different places in the text. This paragraph was written like all the sub-fields are at the same level. e.g. the Aggregation Requested Field is part of the MIMO FBCK-REQ while the SU/MU filed is part of the MIMO Setup Control Element. and the Dialog Token field is part of the MMO BF set frame in a different part of the text. This makes it very difficult to read. | Please group parameters on the same level together. In a simple example, start with defining all the parameters at the MIMO BF setup frame level, then at the MIMO setup control element level, then at sub-levels. Also, please refer to the correct section. | Revised-  Agreed in principle.  In addition to the MIMO BF Setup frame, similar changes shall also be made on the MIMO BF Poll frame, MIMO BF Feedback frame and MIMO BF Selection frame.  TGay editor to make the changes shown in 11-18/0610r0 under all headings that include CID 1903. |
| 1904 | 166 | 24 | The MIMO BF setup frame has many sub-fields/elements/parameters that also may have sub-fields/elements/parameters that are located at different places in the text. This paragraph was written like all the sub-fields are at the same level. e.g. the Aggregation Requested Field is part of the MIMO FBCK-REQ while the SU/MU filed is part of the MIMO Setup Control Element. and the Dialog Token field is part of the MMO BF set frame in a different part of the text. This makes it very difficult to read. | Please group parameters on the same level together. In a simple example, start with defining all the parameters at the MIMO BF setup frame level, then at the MIMO setup control element level, then at sub-levels. Also, please refer to the correct section. | Revised-  See resolution to CID 1903  TGay editor to make the changes shown in 11-18/0610r0 under all headings that include CID 1904. |
| 1976 | 78 | 1 | MIMO Selection Control Elelment - size of the element may not be a multiple of 8 - need padding at the end | Add a padding to octets at the end of table 12 | Revised-  Agreed in principle.  TGay editor to make the changes shown in 11-18/0610r0 under all headings that include CID 1976. |
| 2001 | 78 | 2 | It is not clear how to use "Configuration 1 User 1  SISO ID Subset Index for Antenna 1" subfield to indicate the RX AWV. | Please clarify it. | Revised-  In 9.4.2.253, it is clearly stated that an SISO ID subset index indicates the channel between a specific TX antenna (with a TX AWV) and a specific RX antenna (with a RX AWV). In other word, based on the “Configuration 1 User 1 SISO ID Subset Index for Antenna 1”, User 1 is able to know which RX AWV is associated with Antenna 1 in MU-MIMO transmission configuration 1.  Proposed to add the reference 9.4.2.253 for better readability.  TGay editor to make the changes shown in 11-18/0610r0 under all headings that include CID 2001. |
| 2020 | 78 |  | In Table 12, for the downlink type MU-MIMO, the meaning of the field "Configuration .. User .. SISO ID" is somewhat misleading. The RX AWVs cannot be known by the initiator, since multiple RX AWVs can be tested for one id. They can only be inferred by responder, based on the SISO id. | Please clarify the meaning of the fields specified in comment. | Revised-  See resolution to CID 2001.  TGay editor to make the changes shown in 11-18/0610r0 under all headings that include CID 2020. |
| 2239 | 78 | 1 | A STA can be excluded from MIMO training and feedback phases of MU-MIMO BF training. In this case the excluded STA does not have a SISO ID subset index, but still needs to be signaled in the MIMO selection frame to know which RX antenna should be activated | Change field name to Configureation x User y SISO ID Subset Index for antenna z / RX antenna ID  add description in 10.38.9.2.3.3 for STAs excluded from MU-MIMO BF training and Feddback phases in the procedure of MIMO selection | Revised-  Agreed in principle.  TGay editor to make the changes shown in 11-18/0610r0 under all headings that include CID 2239. |
| 1342 | 171 | 19 | The connection between the MU-MIMO configuration and spatial streams that can be assigned to users in (e.g.) 30.4.10.5 is extremely opaque. There is a need to define which user gets which streams | Define an assignement of streams to users in each configuration | Rejected-  Assignment of spatial streams to users is signalled in the EDMG-Header-A field of EDMG MU PPDU. It is not necessary to assign spatial streams to users in MU-MIMO transmission configuration. |

**Proposed changes to D1.1 and 18/0299r1:**

***Modify the change on Table 15 as follows (CID 1976, 2001, 2020, 2239):***

|  |  |  |  |
| --- | --- | --- | --- |
| Field | | Size (bits) | Meaning |
| Element ID | | 8 |  |
| …. | |  |  |
| Non-reciprocal MU-MIMO BF Training Based Transmission Configuration | Configuration 1 Group User Mask for Antenna 1 | 32 | Indicates the STA(s) in the target MU group associated with the first TX DMG antenna in the first MU-MIMO transmission configuration. |
| Configuration 1 User 1 SISO ID Subset Index/RX Antenna ID for Antenna 1 | 12 | Indicates the RX AWV or RX DMG antenna of the first STA associated with the first TX DMG antenna in the first MU-MIMO transmission configuration (see 9.4.2.253). |
| … |  |  |
| Configuration 1 User SISO ID Subset Index/RX Antenna ID for Antenna 1 | 12 | Indicates the RX AWV or RX DMG antenna of the STA associated with the first TX DMG antenna in the first MU-MIMO transmission configuration. |
| … |  |  |
| Configuration 1 Group User Mask for Antenna *N*TX | 32 | Indicates the STA(s) in the target MU group associated with the *N*TX TX DMG antenna in the first MU-MIMO transmission configuration. |
| Configuration 1 User 1 SISO ID Subset Index/RX Antenna ID for Antenna *N*TX | 12 | Indicates the RX AWV or RX DMG antenna of the first STA associated with the *N*TX TX DMG antenna in the first MU-MIMO transmission configuration. |
| … |  |  |
| Configuration 1 User SISO ID Subset Index/RX Antenna ID for Antenna *N*TX | 12 | Indicates the RX AWV or RX DMG antenna of the STA associated with the *N*TX TX DMG antenna in the first MU-MIMO transmission configuration. |
| … |  |  |
| Configuration *N*conf Group User Mask for Antenna 1 | 32 | Indicates the STA(s) in the target MU group associated with the first TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
| Configuration *N*conf User 1 SISO ID Subset Index/RX Antenna ID for Antenna 1 | 12 | Indicates the RX AWV or RX DMG antenna of the first STA associated with the first TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
| … |  |  |
| Configuration *N*conf User SISO ID Subset Index/RX Antenna ID for Antenna *N*TX | 12 | Indicates the RX AWV or RX DMG antenna of the STA associated with the first TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
| … |  |  |
| Configuration *N*conf Group User Mask for Antenna *N*TX | 32 | Indicates the STA(s) in the target MU group associated with the *N*TX TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
| Configuration *N*conf User 1 SISO ID Subset Index/RX Antenna ID for Antenna *N*TX | 12 | Indicates the RX AWV or RX DMG antenna of the first STA associated with the *N*TX TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
| … |  |  |
| Configuration *N*conf User SISO ID Subset Index/RX Antenna ID for Antenna *N*TX | 12 | Indicates the RX AWV or RX DMG antenna of the STA associated with the *N*TX TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
| Reciprocal MU-MIMO BF Training Based Transmission Configuration | Configuration 1 Group User Mask for Antenna 1 | 32 | Indicates the STA(s) in the target MU group associated with the first TX DMG antenna in the first MU-MIMO transmission configuration. |
| Configuration 1 User 1 AWV feedback ID for Antenna 1 | 11 | Indicates the RX AWV or RX DMG antenna of the first STA associated with the first TX DMG antenna in the first MU-MIMO transmission configuration. |
| Configuration 1 User 1 BRP CDOWN for Antenna 1 | 6 |
| Configuration 1 User 1 RX Antenna ID for Antenna 1 | 3 |
| … |  |  |
| Configuration 1 User AWV feedback ID for Antenna 1 | 11 | Indicates the RX AWV or RX DMG antenna of the STA associated with the first TX DMG antenna in the first MU-MIMO transmission configuration. |
| Configuration 1 User BRP CDOWN for Antenna 1 | 6 |
| Configuration 1 User RX Antenna ID for Antenna 1 | 3 |
| … |  |  |
| Configuration 1 Group User Mask for Antenna *N*TX | 32 | Indicates the STA(s) in the target MU group associated with the *N*TX TX DMG antenna in the first MU-MIMO transmission configuration. |
| Configuration 1 User 1 AWV feedback ID for Antenna *N*TX | 11 | Indicates the RX AWV or RX DMG antenna of the first STA associated with the *N*TX TX DMG antenna in the first MU-MIMO transmission configuration. |
| Configuration 1 User 1 BRP CDOWN for Antenna *N*TX | 6 |
| Configuration 1 User 1 RX Antenna ID for Antenna *N*TX | 3 |
| … |  |  |
| Configuration 1 User AWV feedback ID for Antenna *N*TX | 11 | Indicates the RX AWV or RX DMG antenna of the STA associated with the *N*TX TX DMG antenna in the first MU-MIMO transmission configuration. |
| Configuration 1 User BRP CDOWN for Antenna *N*TX | 6 |
| Configuration 1 User RX Antenna ID for Antenna *N*TX | 3 |
| … |  |  |
| Configuration *N*conf Group User Mask for Antenna 1 | 32 | Indicates the STA(s) in the target MU group associated with the first TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
| Configuration *N*conf User 1 AWV feedback ID for Antenna 1 | 11 | Indicates the RX AWV or RX DMG antenna of the first STA associated with the first TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
| Configuration *N*conf User 1 BRP CDOWN for Antenna 1 | 6 |
| Configuration *N*conf User 1 RX Antenna ID for Antenna 1 | 3 |
| … |  |  |
| Configuration *N*conf User AWV feedback ID for Antenna 1 | 11 | Indicates the RX AWV or RX DMG antenna of the STA associated with the first TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
| Configuration *N*conf User BRP CDOWN for Antenna 1 | 6 |
| Configuration *N*conf User RX Antenna ID for Antenna 1 | 3 |
| … |  |  |
| Configuration *N*conf Group User Mask for Antenna *N*TX | 32 | Indicates the STA(s) in the target MU group associated with the *N*TX TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
| Configuration *N*conf User 1 AWV feedback ID for Antenna *N*TX | 11 | Indicates the RX AWV or RX DMG antenna of the first STA associated with the *N*TX TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
| Configuration *N*conf User 1 BRP CDOWN for Antenna *N*TX | 6 |
| Configuration *N*conf User 1 RX Antenna ID for Antenna *N*TX | 3 |
| … |  |  |
| Configuration *N*conf User AWV feedback ID for Antenna *N*TX | 11 | Indicates the RX AWV or RX DMG antenna of the STA associated with the *N*TX TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
| Padding | | 0~7 | Zero padding to make the MIMO Selection Control element length a multiple of 8 bits |

**10.38.9.2.2.3.2 Non-reciprocal MIMO phase**

***Modify the paragraphs as follows (CID 1903, 1904):***

In the SU-MIMO BF setup subphase, the initiator shall send a MIMO BF Setup frame (see 9.6.22.4) with the TA field and the RA field set to the MAC addresses of the initiator and the responder, respectively. The MIMO BF Setup frame shall indicate a unique dialog token in the Dialog Token field for identifying SU-MIMO BF training. In the MIMO Setup Control element (see 9.4.2.259) of the MIMO BF Setup frame, the SU/MU and Non-reciprocal/Reciprocal MIMO Phase fields shall be set to 0 and the Initiator field shall be set to 1. The L-TX-RX field and the Requested EDMG TRN-Unit M field shall indicate the number of TRN subfields requested for receive AWV training in the following responder SMBT subphase. The number of transmit sector combinations requested for the initiator link () shall be indicated in the Number of TX Sector Combinations Requested subfield of the MIMO FBCK-REQ field. Whether time domain channel response is requested as part of SU-MIMO BF feedback shall be indicated in the Channel Measurement Requested subfield of the MIMO FBCK-REQ field. If the time domain channel response is requested as part of SU-MIMO BF feedback, the Channel Measurement Requested subfield of the MIMO FBCK-REQ field shall be set to 1 and the Number of Taps Requested subfield of the MIMO FBCK-REQ field shall indicate the number of channel taps requested in time domain channel response. In case of channel aggregation, the Channel Aggregation Requested subfield of the MIMO FBCK-REQ field should be set to 1. Additionally, based on the SNRs of the transmit sectors collected from the responder in the SISO phase, the initiator may select a subset of candidate transmit sectors per DMG antenna to reduce the initiator SMBT training time. Each DMG antenna should have the similar number of candidate transmit sectors in order to avoid biasing a DMG antenna.

…

The responder shall send a MIMO BF Setup frame a SIFS following the reception of the MIMO BF Setup frame from the initiator. The TA field and the RA field of the MIMO BF Setup frame shall be set to the MAC address of the responder and the initiator, respectively. The MIMO BF Setup frame shall indicate a unique dialog token in the Dialog Token field for identifying SU-MIMO BF training. In the MIMO Setup Control element of the MIMO BF Setup frame, the SU/MU, Non-reciprocal/Reciprocal MIMO Phase and Initiator fields shall be set to 0. The L-TX-RX field and the Requested EDMG TRN-Unit M field shall indicate the number of TRN subfields requested for receive AWV training in the following initiator SMBT subphase. The number of transmit sector combinations requested for the responder link () shall be indicated in the Number of TX Sector Combinations Requested subfield of the MIMO FBCK-REQ field. Whether time domain channel response is requested as part of SU-MIMO BF feedback shall be indicated in the Channel Measurement Requested subfield of the MIMO FBCK-REQ field. If the time domain channel response is requested as part of SU-MIMO BF feedback, the Channel Measurement Requested subfield of the MIMO FBCK-REQ field shall be set to 1 and the Number of Taps Requested subfield of the MIMO FBCK-REQ field shall indicate the number of channel taps requested in time domain channel response. In case of channel aggregation, the Channel Aggregation Requested subfield of the MIMO FBCK-REQ field should be set to 1. Additionally, based on the SNRs of the transmit sectors collected from the initiator in the SISO phase, the responder may select a subset of candidate transmit sectors per DMG antenna to reduce the responder SMBT training time. Each DMG antenna should have the similar number of candidate transmit sectors in order to avoid biasing a DMG antenna.

…

The initiator shall initiate the SU-MIMO BF feedback subphase an MBIFS following the reception of an EDMG BRP-RX/TX packet with the BRP CDOWN field set to 0 from the responder. All frames transmitted during the SU-MIMO BF feedback subphase should be sent using the DMG control mode. In the SU-MIMO BF feedback subphase, the initiator shall send to the responder a MIMO BF Feedback frame (see 9.6.22.6) with the TA field set to the MAC address of the initiator and the RA field set to the MAC address of the responder. The MIMO BF Feedback frame shall carry the dialog token in the Dialog Token field that identifies the SU-MIMO BF training. In the MIMO Feedback Control element (see 9.4.2.261) of the MIMO BF Feedback frame, the SU/MU field shall be set to 0 and the Link Type field shall be set to 1. In case of channel aggregation, the Channel Aggregation Present subfield of the MIMO FBCK-TYPE field should be set to 1. The Number of TX Sector Combinations Present subfield of the MIMO FBCK-TYPE field shall indicate the number of best transmit sector combinations, , recommended by the initiator for responder link. The EDMG Channel Measurement Feedback element (see 9.4.2.253) in the MIMO BF Feedback frame shall indicate best transmit sector combinations in the EDMG Sector ID Order field and the BRP CDOWN field, which are determined based on channel measurement data captured from the responder SMBT subphase. The Channel Measurement Feedback element (see 9.4.2.136) in the MIMO BF Feedback frame shall contain SNRs corresponding to the transmit sector combinations in the SNR field. If the Channel Measurement Requested subfield of the MIMO FBCK-REQ field in the MIMO BF Setup frame received from the responder in the preceding SU-MIMO BF setup subphase is 1, the Channel Measurement Present subfield of the MIMO FBCK-TYPE field in the MIMO Feedback Control element shall be set to 1 and the Channel Measurement Feedback element shall contain channel measurements corresponding to the transmit sector combinations in the Channel Measurement field. If the Tap Delay Requested subfield of the MIMO FBCK-REQ field in the MIMO BF Setup frame received from the responder in the preceding SU-MIMO BF setup subphase is 1, the Tap Delay Present subfield of the MIMO FBCK-TYPE field in the MIMO Feedback Control element shall be set to 1 and the EDMG Channel Measurement Feedback element shall contain relative tap delays for the measurements in the Tap Delay field.

The responder shall send a MIMO BF Feedback frame to the initiator a SIFS following reception of a MIMO BF Feedback frame from the initiator.The TA field of the MIMO BF Feedback shall be set to the MAC address of the responder and the RA field shall be set to the MAC address of the initiator. The MIMO BF Feedback frame shall carry the dialog token in the Dialog Token field that identifies the SU-MIMO BF training. In the MIMO Feedback Control element of the MIMO BF Feedback frame, the SU/MU and Link Type fields shall be set to 0. In case of channel aggregation, the Channel Aggregation Present subfield of the MIMO FBCK-TYPE field should be set to 1. The Number of TX Sector Combinations Present subfield of the MIMO FBCK-TYPE field shall indicate the number of best transmit sector combinations, , recommended by the responder for initiator link. The EDMG Channel Measurement Feedback element in the MIMO BF Feedback frame shall indicate best transmit sector combinations in the EDMG Sector ID Order field and the BRP CDOWN field, which are determined based on channel measurement data captured from the initiator SMBT subphase. The Channel Measurement Feedback element in the MIMO BF Feedback frame shall contain SNRs corresponding to the transmit sector combinations in the SNR field. If the Channel Measurement Requested subfield of the MIMO FBCK-REQ field in the MIMO BF Setup frame received from the initiator in the preceding SU-MIMO BF setup subphase is 1, the Channel Measurement Present subfield of the MIMO FBCK-TYPE field in the MIMO Feedback Control element shall be set to 1 and the Channel Measurement Feedback element shall contain channel measurements corresponding to the transmit sector combinations in the Channel Measurement field. If the Tap Delay Requested subfield of the MIMO FBCK-REQ field in the MIMO BF Setup frame received from the initiator in the preceding SU-MIMO BF setup subphase is 1, the Tap Delay Present subfield of the MIMO FBCK-TYPE field in the MIMO Feedback Control element shall be set to 1 and the EDMG Channel Measurement Feedback element shall contain tap delays corresponding to the transmit sector combinations in the Tap Delay field.

**10.38.9.2.2.3.3 Reciprocal MIMO phase**

***Modify the paragraphs as follows (CID 1903, 1904):***

In the SU-MIMO BF setup subphase, the initiator shall send a MIMO BF Setup frame (see 9.6.22.4) with . the TA field and the RA field of the MIMO BF Setup frame set to the MAC addresses of the initiator and the responder, respectively. The MIMO BF Setup frame shall indicate a unique dialog token in the Dialog Token field for identifying SU-MIMO BF training. In the MIMO Setup Control element (see 9.4.2.259) of the MIMO BF Setup frame, the SU/MU field shall be set to 0, and both the Non-reciprocal/Reciprocal MIMO Phase and Initiator field shall be set to 1. The number of transmit sector combinations requested for the initiator link () shall be indicated in the Number of TX Sector Combinations Requested subfield of the MIMO FBCK-REQ field. Whether time domain channel response is requested as part of SU-MIMO BF feedback shall be indicated in the Channel Measurement Requested subfield of the MIMO FBCK-REQ field. If the time domain channel response is requested as part of SU-MIMO BF feedback, the Channel Measurement Requested subfield of the MIMO FBCK-REQ field shall be set to 1 and the Number of Taps Requested subfield of the MIMO FBCK-REQ field shall indicate the number of channel taps requested in time domain channel response. In case of channel aggregation, the Channel Aggregation Requested subfield of the MIMO FBCK-REQ field should be set to 1. Additionally, based on the SNRs of the transmit sectors collected from the responder in the SISO phase, the initiator may select a subset of candidate transmit sectors per DMG antenna to reduce the initiator SMBT training time. Each DMG antenna should have the similar number of candidate transmit sectors in order to avoid biasing a DMG antenna.

The responder shall send a MIMO BF Setup frame a SIFS following the reception of the MIMO BF Setup frame from the initiator. The TA field and the RA field of the MIMO BF Setup frame shall be set to the MAC address of the responder and the initiator, respectively. The MIMO BF Setup frame shall indicate a unique dialog token in the Dialog Token field for identifying SU-MIMO BF training. In the MIMO Setup Control element of the MIMO BF Setup frame, the SU/MU and Initiator fields shall be set to 0, and the Non-reciprocal/Reciprocal MIMO Phase field shall be set to 1. The L-TX-RX field and the Requested EDMG TRN-Unit M field shall indicate the number of TRN subfields requested for receive AWV training in the following initiator SMBT subphase. Based on the SNRs of the transmit sectors collected from the initiator in the SISO phase, the responder may select a subset of candidate receive sectors per DMG antenna to reduce the initiator SMBT training time. Each DMG antenna should have the similar number of candidate receive sectors in order to avoid biasing a DMG antenna.

The responder shall initiate the SU-MIMO BF feedback subphase an MBIFS following the reception of an EDMG BRP-RX/TX packet with the BRP CDOWN field set to 0 from the initiator. The responder shall send a MIMO BF Feedback frame (see 9.6.22.6) to the initiator with the TA field set to the MAC address of the responder and the RA field set to the MAC address of the initiator. The MIMO BF Feedback frame shall carry the dialog token in the Dialog Token field that identifies the SU-MIMO BF training. In the MIMO Feedback Control element (see 9.4.2.261) of the MIMO BF Feedback frame, the SU/MU and Link Type field shall be set to 0. In case of channel aggregation, the Channel Aggregation Present subfield of the MIMO FBCK-TYPE field should be set to 1. The Number of TX Sector Combinations Present subfield of the MIMO FBCK-TYPE field shall indicate the number of best transmit sector combinations, , recommended by the responder for initiator link. The EDMG Channel Measurement Feedback element (see 9.4.2.253) in the MIMO BF Feedback frame shall indicate best transmit sector combinations in the EDMG Sector ID Order field and the BRP CDOWN field, which are determined based on channel measurement data captured from the initiator SMBT subphase. The Channel Measurement Feedback element (see 9.4.2.136) in the MIMO BF Feedback frame shall contain SNRs corresponding to the transmit sector combinations in the SNR field. If the Channel Measurement Requested subfield of the MIMO FBCK-REQ field in the MIMO BF Setup frame received from the initiator in the preceding SU-MIMO BF setup subphase is 1, the Channel Measurement Present subfield of the MIMO FBCK-TYPE field in the MIMO Feedback Control element shall be set to 1 and the Channel Measurement Feedback element shall contain channel measurements corresponding to the transmit sector combinations in the Channel Measurement field. If the Tap Delay Requested subfield of the MIMO FBCK-REQ field in the MIMO BF Setup frame received from the initiator in the preceding SU-MIMO BF setup subphase is 1, the Tap Delay Present subfield of the MIMO FBCK-TYPE field in the MIMO Feedback Control element shall be set to 1 and the EDMG Channel Measurement Feedback element shall contain tap delays corresponding to the transmit sector combinations in the Tap Delay field.

Non-reciprocal MIMO phase

***Modify the paragraphs as follows (CID 1903, 1904):***

In the MU-MIMO BF setup subphase, the initiator shall transmit one or more MIMO BF Setup frame (see 9.6.22.4) to each responder in the MU group. The initiator should transmit the minimum number of MIMO BF Setup frames to reach all responders in the MU group. The MIMO BF Setup frames should be sent using the DMG control mode or using a non-EDMG duplicate PPDU transmitted with the DMG Control modulation class. The TA field of each MIMO BF Setup frame shall be set to the BSSID of the initiator and the RA field shall be set to the broadcast address. Each MIMO BF Setup frame shall indicate a unique dialog token in the Dialog Token field for identifying MU-MIMO BF training. In the MIMO Setup Control element (see 9.4.2.259) of each MIMO BF Setup frame, the SU/MU field shall be set to 1, the Non-reciprocal/Reciprocal MIMO Phase field shall be set to 0, and the Initiator field shall be set to 1. The EDMG group ID of the MU group shall be indicated in the EDMG Group ID field and each remaining responder shall be indicated in the Group User Mask field. Whether time domain channel response is requested as part of MU-MIMO BF feedback shall be indicated in the Channel Measurement Requested subfield of the MIMO FBCK-REQ field. If the time domain channel response is requested as part of MU-MIMO BF feedback, the Channel Measurement Requested subfield of the MIMO FBCK-REQ field shall be set to 1 and the Number of Taps Requested subfield of the MIMO FBCK-REQ field shall indicate the number of channel taps requested in time domain channel response. In case of channel aggregation, the Channel Aggregation Requested subfield of the MIMO FBCK-REQ field should be set to 1. To reduce the MU-MIMO BF training time, the initiator may select a subset of TX sectors for each DMG antenna and the number of TRN subfields required for receive AWV training based on the L-TX-RX field and the EDMG TRN-Unit M field of the EDMG BRP Request element included in the BRP frame received from each responder during the SISO feedback subphase. A responder whose corresponding bit in the Group User Mask field of the MIMO Setup Control element included in the received MIMO BF Setup frame is set to 0 can ignore frames transmitted in the following MU-MIMO BF training subphase and MU-MIMO BF feedback subphase.

…

The initiator shall initiate the MU-MIMO BF feedback subphase a MBIFS following the transmission of the EDMG BRP RX-TX packet with the BRP CDOWN field set to 0. In the MU-MIMO BF feedback subphase, the initiator shall transmit a MIMO BF Poll frame (see 9.6.22.5) to poll each remaining responder to collect MU-MIMO BF feedback from the preceding MU-MIMO BF training subphase. The MIMO BF Poll frames should be sent using the DMG control mode. The TA field of each MIMO BF Poll frame shall be set to the BSSID of the initiator and the RA field shall be set to the MAC address of the corresponding responder. Each MIMO BF Poll frame carries the dialog token in the Dialog Token field that identifies the MU-MIMO BF training. In the MIMO Poll Control element (see 9.4.2.260) of each MIMO BF Poll frame, the Poll Type field shall be set to 0. Upon receiving a MIMO BF Poll frame for which a remaining responder is the addressed recipient, the responder shall transmit a MIMO BF Feedback frame (see 9.6.22.6) to the initiator. The RA field of the MIMO BF Feedback frame shall be set to the BSSID of the initiator and the TA field shall be set to the MAC address of the responder. The MIMO BF Feedback frame carries the dialog token in the Dialog Token field that identifies the MU-MIMO BF training. In the MIMO Feedback Control element (see 9.4.2.261) of the MIMO BF Feedback frame, the SU/MU field shall be set to 1 and the Link Type field shall be set to 0. In case of channel aggregation, the Channel Aggregation Present subfield of the MIMO FBCK-TYPE field should be set to 1. The Number of TX Sector Combinations Present subfield of the MIMO FBCK-TYPE field shall indicate the number of transmit sector combinations, . The EDMG Channel Measurement Feedback element (see 9.4.2.253) in the MIMO BF Feedback frame shall indicate transmit sector combinations in the EDMG Sector ID Order field and the BRP CDOWN field, which are obtained through the channel measurement data captured from the MU-MIMO BF training subphase. The Channel Measurement Feedback element (see 9.4.2.136) in the MIMO BF Feedback frame shall indicate SNRs corresponding to transmit sector combinations in the SNR field. If the Channel Measurement Requested subfield of the MIMO FBCK-REQ field in the MIMO BF Setup frame received from the initiator in the preceding MU-MIMO BF setup subphase is 1, the Channel Measurement Present subfield of the MIMO FBCK-TYPE field in the MIMO Feedback Control element shall be set to 1 and the Channel Measurement Feedback element shall contain the channel measurements corresponding to transmit sector combinations in the Channel Measurement field. If the Tap Delay Requested subfield of the MIMO FBCK-REQ field in the MIMO BF Setup frame received from the initiator in the preceding MU-MIMO BF setup subphase is 1, the Tap Delay Present subfield of the MIMO FBCK-TYPE field in the MIMO Feedback Control element shall be set to 1 and the EDMG Channel Measurement Feedback element shall contain tap delays corresponding to the transmit sector combinations in the Tap Delay field. Each MIMO BF Poll frame and MIMO BF Feedback frame shall be separated by SIFS.

The initiator shall initiate the MU-MIMO BF selection subphase an MBIFS following reception of the MIMO BF Feedback frame from the last remaining responder. In the MU-MIMO BF selection subphase, the initiator shall transmit one or more MIMO BF Selection frames (see 9.6.22.7) to each responder in the MU group. The initiator should transmit the minimum number of MIMO BF Selection frames to reach all responders in the MU group. The MIMO BF Selection frames should be sent using the DMG control mode. The TA field of the MIMO BF Selection frame shall be set to the BSSID of the initiator and the RA field shall be set to the broadcast address. Each MIMO BF Selection frame contains the dialog token in the Dialog Token field for identifying the MU-MIMO BF training. In the MIMO Selection Control element (see 9.4.2.262) of each MIMO BF Selection frame, the MU-MIMO Transmission Configuration Type field shall be set to 0 and the Reciprocal MU-MIMO BF Training Based Transmission Configuration field shall not be present. The EDMG group ID corresponding to the MU group shall be indicated in the EDMG Group ID field and the number of MU-MIMO transmission configurations, *Nconf*, shall be indicated in the Number of MU-MIMO Transmission Configurations field. Which responder(s) in the MU group is associated with each of *NTX* TX DMG antennas for each of *Nconf* MU-MIMO transmission configurations shall be indicated in the Configuration *i* Group User Mask for Antenna *j* subfields (i = 1, 2, …, *Nconf* and j = 1, 2, …, *NTX*) of the Non-reciprocal MU-MIMO BF Training Based Transmission Configuration field. The TX sector of each of *NTX* TX DMG antennas and the corresponding RX AWVs or RX DMG antennas of all associated responders used in each of *Nconf* MU-MIMO transmission configurations shall be indicated in the Configuration *i* User *k* SISO ID Subset Index/RX Antenna ID for Antenna *j* subfields (k = 1, 2, …, , i = 1, 2, …, *Nconf* and j = 1, 2, …, *NTX*) of the Non-reciprocal MU-MIMO BF Training Based Transmission Configuration field. In more details, if User *k* in Configuration *i* participated in the non-reciprocal MU-MIMO BF training, the Configuration *i* User *k* SISO ID Subset Index/RX Antenna ID for Antenna *j* subfield indicates the RX AWV of User *k* corresponding to TX DMG Antenna *j* in Configuration *i*. Otherwisethe Configuration *i* User *k* SISO ID Subset Index/RX Antenna ID for Antenna *j* subfield indicates the RX DMG antenna of User *k* corresponding to TX DMG Antenna *j* in Configuration *i*.

Reciprocal MIMO phase

***Modify the paragraphs as follows (CID 1903, 1904):***

In the MU-MIMO BF setup subphase, the initiator shall transmit one or more MIMO BF Setup frame (see 9.6.22.4) to each responder in the MU group. The initiator should transmit the minimum number of MIMO BF Setup frames to reach all responders in the MU group. The MIMO BF Setup frames should be sent using the DMG control mode or using a non-EDMG duplicate PPDU transmitted with the DMG control modulation class. The TA field of each MIMO BF Setup frame shall be set to the BSSID of the initiator and the RA field shall be set to the broadcast address. Each MIMO BF Setup frame shall indicate a unique dialog token in the Dialog Token field for identifying MU-MIMO BF training. In the MIMO Setup Control element (see 9.4.2.259) of each MIMO BF Setup frame, all the SU/MU, Non-reciprocal/Reciprocal MIMO Phase and Initiator fields shall be set to 1. The EDMG group ID of the MU group shall be indicated in the EDMG Group ID field and each remaining responder shall be indicated in the Group User Mask field. In case of channel aggregation, the Channel Aggregation Requested subfield of the MIMO FBCK-REQ field should be set to 1. A responder whose corresponding bit in the Group User Mask field of the MIMO Setup Control element included in the received MIMO BF Setup frame is set to 0 can ignore the subsequent MU-MIMO BF training subphase. The initiator shall initiate an MU-MIMO BF training subphase a MBIFS following the transmission of the MIMO BF Setup frame. In the MU-MIMO BF training subphase, the initiator shall transmit a MIMO BF Poll frame (see 9.6.22.5) to each remaining responder in the MU group. Each MIMO BF Poll frame should be sent using the DMG control mode or using a non-EDMG duplicate PPDU transmitted with the DMG control modulation class. The TA field of each MIMO BF Poll frame shall be set to the BSSID of the initiator and the RA field shall be set to the MAC address of the corresponding responder. Each MIMO BF Poll frame carries the dialog token in the Dialog Token field that identifies the MU-MIMO BF training. In the MIMO Poll Control element (see 9.4.2.260) of each MIMO BF Poll frame, the Poll Type field shall be set to 1. Additionally, in order to reduce training time, the initiator may reduce the number of TRN subfields used for receive AWV training in the following EDMG BRP-RX/TX packets transmitted by each remaining responder based on the SNRs of transmit sectors collected from each remaining responder in the SISO phase. The L-TX-RX field and the Requested EDMG TRN-Unit M field shall indicate the number of TRN subfields required for receive AWV training in the following EDMG BRP-RX/TX packets to be transmitted by the corresponding responder. The Requested EDMG TRN-Unit P field shall indicate the number of TRN subfields in a TRN-Unit which need to be transmitted with the same AWV as the preamble and Data field in the following EDMG BRP-RX/TX packets to be transmitted by the corresponding responder.

The initiator shall initiate the MU-MIMO BF selection subphase an MBIFS following reception of the EDMG BRP RX/TX packet with the BRP CDOWN field equal to 0 from the last responder in the MU group. In the MU-MIMO BF selection subphase, the initiator shall transmit one or more MIMO BF Selection frame (see 9.6.22.7) to each responder in the MU group. The initiator should transmit the minimum number of MIMO BF Selection frames to reach all responders in the MU group. The MIMO BF Selection frames should be sent using the DMG control mode. The TA field of the MIMO BF Selection frame shall be set to the BSSID of the initiator and the RA field shall be set to the broadcast address. Each MIMO BF Selection frame contains the dialog token in the Dialog Token field for identifying the MU-MIMO training. In the MIMO Selection Control element (see 9.4.2.262) of each MIMO BF Selection frame, the MU-MIMO Transmission Configuration Type field shall be set to 1 and the Non-reciprocal MU-MIMO BF Training Based Transmission Configuration field shall not be present. The EDMG group ID corresponding to the MU group shall be indicated in the EDMG Group ID field and the number of MU-MIMO transmission configurations, *Nconf*, shall be indicated in the Number of MU-MIMO Transmission Configurations field. Which responder(s) in the MU group is associated with each of *NTX* TX DMG antennas for each of *Nconf* MU-MIMO transmission configurations shall be indicated in the Configuration *i* Group User Mask for Antenna *j* subfields (i = 1, 2, …, *Nconf* and j = 1, 2, …, *NTX*) of the Reciprocal MU-MIMO BF Training Based Transmission Configuration field. The RX AWVs or RX DMG antennas of all responders associated with each of *NTX* TX DMG antennas used in each of *Nconf* MU-MIMO transmission configurations shall be indicated in the Configuration *i* User *k* AWV feedback ID for Antenna *j* subfields, the Configuration *i* User *k* BRP CDOWN for Antenna *j* subfields and the Configuration *i* User *k* RX Antenna ID for Antenna *j* subfields (k = 1,2, …, , i = 1, 2, …, *Nconf* and j = 1, 2, …, *NTX*) of the Reciprocal MU-MIMO BF Training Based Transmission Configuration field. In more details, if User *k* in Configuration *i* participated in the reciprocal MU-MIMO BF training, the Configuration *i* User *k* AWV feedback ID for Antenna *j* subfield, the Configuration *i* User *k* BRP CDOWN for Antenna *j* subfield and the Configuration *i* User *k* RX Antenna ID for Antenna *j* subfield indicate the RX AWV of User *k* corresponding to TX DMG Antenna *j* in Configuration *i*. Otherwisethe Configuration *i* User *k* AWV feedback ID for Antenna *j* subfield and the Configuration *i* User *k* BRP CDOWN for Antenna *j* subfield are reserved and the Configuration *i* User *k* RX Antenna ID for Antenna *j* subfield indicates the RX DMG antenna of User *k* corresponding to TX DMG Antenna *j* in Configuration *i*.