IEEE P802.11
Wireless LANs

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| Comment Resolution on MIMO BF Misc |
| Date: 2018-2-21 |
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Abstract

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

- 17 CID:

1145, 1343, 1344, 1345, 1498, 1499, 1752, 1148, 1403, 1244

1339, 1902, 1809, 2006, 2314, 1818, 2309

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Page Number** | **Line Number** | **Comment** | **Proposed Change** | **Resolution** |
| 1145 | 75 | 1 | The MIMO Setup Control element transmitted by initiator comprises setup info for initiator link and responder link. Therefore, the Link Type field does not make sense. | "Link Type" field shall be replaced by "Initiator" field, which indicates whether the sender is the initiator. | Accepted-TGay editor to make the changes shown in 11-18/0299r0 under all headings that include CID 1145. |
| 1498 | 75 | 1 | The SU/MU field of the MIMO Setup Control element is set to 1 in case of SU, while the SU/MU format field in the EDMG-Header-A field is set to 0 in that case. The MAC and PHY have different rules, and it is confusing and inconvinient. | Use the same rule as PHY: 0/1 for SU/MU, instead of 1/0. Additionally, the field name can be changed to "MU mode" for example. | Revised-Agreed to use the same rule for SU/MU field as PHY. But it is unnecessary to rename the SU/MU field to the MU mode field.Similar change should be made on the SU/MU field in the MIMO Poll Control element and the MIMO Feedback Control element.TGay editor to make the changes shown in 11-18/0299r0 under all headings that include CID 1498. |
| 1752 | 75 | 14 | "Aggregation Requested field" should be defined to be "Channel Aggregation Requested field" to make this field name more intuitive. | Replace "Aggregation Requested field" with "Channel Aggregation Requested field", and change all references to the field accordingly. | Accepted-Similar change should also be made on the Aggregation Present subfield of the MIMO FBCK-TYPE field in the MIMO Feedback Control element.TGay editor to make the changes shown in 11-18/0299r0 under all headings that include CID 1752. |
| 1499 | 75 | 19 | The definition for the encoding of the Number of Taps Requested field is missing. | Add the following text to P75L20:"The value for the subfield according to the number of taps is specified in 9.4.2.130 (Table 9-234)." | Revised-Similar change should also be made on the Number of Taps Present subfield of the MIMO FBCK-TYPE field of the MIMO Feedback Control element. TGay editor to make the changes shown in 11-18/0299r0 under all headings that include CID 1499. |
| 1343 | 77 | 1 | "Sets to 1 to indicate SU-MIMO beamforming and sets to 0 to indicate MU-MIMO beamforming." - language | replace with "Is set to 1 to in..." | Revised-TGay editor to make the changes shown in 11-18/0299r0 under all headings that include CID 1343. |
| 1344 | 77 | 1 | "Sets to 1 to indicate initiator link and sets to 0 otherwise." - language | replace with "Is set to 1 to in..." | Revised-TGay editor to make the changes shown in 11-18/0299r0 under all headings that include CID 1344. |
| 1345 | 77 | 1 | "This field shall be set to 1 when the SU/MU field is set to 0." - no "shall's" in clause 9 | replace with "This field is set to 1 when the SU/MU field is set to 0." | Revised-TGay editor to make the changes shown in 11-18/0299r0 under all headings that include CID 1345. |
| 1244 | 166 | 1 | Font in figure should be sans. | "Change font to sans. | Revised-Similar change should also be made on Figures 100, 101 and 102.TGay editor to make the changes shown in 11-18/0299r0 under all headings that include CID 1244. |
| 1339 | 166 | 7 | "a MBIFS" should be "an MBIFS" | replace "a MBIFS" with "an MBIFS" (see also P171L74 | Revised-This error has been fixed in 17/1233r1. |
| 1902 | 166 | 5 | The first occurrence of each frame or element type should have a hyperlink reference beside it to enable readability.: MIMO BF Setup Frame | MIMO BF Setup Frame (9.6.22.4) | Accepted-Similar change should also be made on the first occurrence of other elements and frames.TGay editor to make the changes shown in 11-18/0299r0 under all headings that include CID 1902. |
| 2309 | 167 | 15 | received in the feedback from the responder in the SISO phase'? | change to 'received in the MIMO setup frame from the responder, | Revised-This error has been fixed in 17/1233r1. |
| 1818 | 171 | 16 | "Both the TA and RA fields of each transmitted EDMG BRP-RX/TX packet shall be set to the MAC address of the initiator". Why shall the RA be set to the MAC address of the initiator? | Suggested sentence: "The TA field of each transmitted EDMG BRP-RX/TX packet shall be set to the MAC address of the initiator, and the RA field of each transmitted EDMG BRP-RX/TX packet shall be set to the Broadcast MAC address" | Rejected-Please refer to 17/1659r0. By setting both the TA and RA fields of each transmitted EDMG BRP-RX/TX packet to the MAC address of the initiator during MU-MIMO BF trining, the third party STAs that did not receive the MIMO BF Setup frame can skip receive AWV training.  |
| 1148 | 170 | 9 | For MIMO phase of MU-MIMO beamforming, "downlink MIMO phase" and "uplink MIMO phase" are very confusing since only downlink MU-MIMO is supported in 11ay | change "downlink MIMO phase" and "uplink MIMO phase" to "non-reciprocal MIMO phase" and "reciprocal MIMO phase" respectively in whole draft standard. | Revised-TGay editor to make the changes shown in 11-18/0299r0 under all headings that include CID 1148. |
| 1403 | 172 |  | The name "Uplink MIMO phase" is misleading because it may indicate the capability to support UL MU-MIMO transmission, while 11ay does not support. From the description this field actully indicates the capability to support a simplified MU-MIMO beamforming protocol. As a result, suggest to change the name to "Reciprocal MIMO phase" | Change the name "Uplink MIMO phase" to "Reciprocal MIMO phase". Please also change other places where "Uplink MIMO" occur. | Revised-See resolution to AID 1148.TGay editor to make the changes shown in 11-18/0299r0 under all headings that include CID 1403. |
| 1809 | 172 | 20 | Spelling mistake "selup" top left in figure 101 | change spelling to "setup" | Accepted-TGay editor to make the changes shown in 11-18/0299r0 under all headings that include CID 1809. |
| 2006 | 173 | 5 | Typo in frame name in MU-MIMO BF Setup subphase in Figure 102. | Change "MIMO BF Selection" to "MIMO BF Setup" for the MU-MIMO BF Setup subphase. | Accepted-TGay editor to make the changes shown in 11-18/0299r0 under all headings that include CID 2006. |
| 2314 | 173 | 6 | The name of MIMO setup frame is incorrect | change to MIMO setup | Revised-See resolution to AID 2006.TGay editor to make the changes shown in 11-18/0299r0 under all headings that include CID 2314. |

**Proposed changes to D1.0:**

**---------------------------------------------------------------------------------------------------------------------**

***Modify Figure 29 as follows (CID 1148, 1403)***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B0 B4 | B5 | B6 | B7 | B8 |
|  | Requested BRP SC Blocks | MU-MIMO Supported | Reciprocal MU-MIMO Supported | SU-MIMO Supported | Grant Required |
| Bits: | 5 | 1 | 1 | 1 | 1 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B9 | B10 | B11 | B12 | B13 B15 |
|  | DMG TRN RX Only Capable | First Path Training Supported | Hybrid Beamforming and MU-MIMO Supported | Hybrid Beamforming and SU-MIMO Supported | Reserved |
| Bits: | 1 | 1 | 1 | 1 | 3 |

Figure 29—Beamforming Capability field format

***P57L12: Modify the following paragraph (CID 1148, 1403):***

The Reciprocal MU-MIMO Supported subfield is set to one to indicate that the STA supports the reciprocal MU-MIMO protocol specified in 10.38.9.2.3.3.3. The subfield is set to zero otherwise. This subfield is reserved if the MU-MIMO Supported field is zero.

**9.4.2.259 MIMO Setup Control element**

***Modify this subclause as follows (CID 1145, 1498, 1499, 1752, 1148, 1403):***

*…*

Table 9—MIMO Setup Control element format

|  |  |  |
| --- | --- | --- |
| Field | Size (bits) | Meaning |
| Element ID | 8 |  |
| Length | 8 |  |
| Element ID Extension | 8 |  |
| SU/MU | 1 | This field is set to 0 to indicate SU-MIMO beamforming and set to 1 to indicate MU-MIMO beamforming. |
| Non-reciprocal/Reciprocal MIMO Phase | 1 | This field is set to 0 to indicate the non-reciprocal MIMO phase and set to 1 to indicate the reciprocal MIMO phase.  |
| EDMG Group ID | 8 | Indicates the EDMG Group ID of target MU group. This field is reserved when the SU/MU field is set to 0. |
| Group User Mask | 32 |  |
|  |  |  |
| L-TX-RX | 8 | Indicates the requested number of consecutive TRN-Units in which the same AWV is used in the transmission of the last M TRN subfields of each TRN-Unit. This field is reserved when the SU/MU field is set to 1. |
| Requested EDMG TRN-Unit M | 4 | The value of this field plus one indicates the requested number of TRN subfields in a TRN-Unit transmitted with the same AWV following a possible AWV change. This field is reserved when the SU/MU field is set to 1. |
| Initiator | 1 | This field is set to 1 to indicate the sender is the initiator and set to 0 otherwise. This field is set to 1 when the SU/MU field is set to 1. |
| MIMO FBCK-REQ | 10 | Indicates requested channel measurement feedback. |
| Reserved | 7 |  |

…

The Group User Mask field is a bitmap that indicates whether an EDMG STA in the target MU group is requested to engage in the subsequent MU-MIMO BF training. … This Group User Mask field is reserved when the SU/MU field is set to 0. If the number of EDMG STAs in the target MU group is smaller than 32, the corresponding bits in the Group User Mask field are set to 0.

The MIMO FBCK-REQ field is defined in Figure 60.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Channel Measurement Requested | Number of Taps Requested | Number of TX Sector Combinations Requested | Channel Aggregation Requested |
| Bits: | 1 | 2 | 6 | 1 |
| Figure 60—MIMO FBCK-REQ field format |

…

The Number of Taps Requested subfield indicates the number of taps requested in each channel measurement. The encoding for this subfield is specified in Table 9-234.

…

The Channel Aggregation Requested subfield is set to 1 to indicate that the TRN field is transmitted over a 2.16+2.16 GHz or 4.32+4.32 GHz channel and to request the channel measurement feedback per channel, in case channel aggregation is used as part of MIMO BF feedback. Otherwise, this subfield is set to 0.

***Modify Table 10 as follows (CID 1148, 1403):***

**Table 10 —MIMO Poll Control element format**

|  |  |  |
| --- | --- | --- |
| Field | Size (bits) | Meaning |
| Element ID | 8 |  |
| Length | 8 |  |
| Element ID Extension | 8 |  |
| Poll Type | 1 | This field is set to 1 to indicate training packet poll used in reciprocal MIMO phase of MU-MIMO beamforming and set to 0 to indicate MIMO BF feedback poll used in non-reciprocal MIMO phase of MU-MIMO beamforming. |
| L-TX-RX | 8 | Indicates the requested number of consecutive TRN-Units in which the same AWV is used in the transmission of the last M TRN subfields of each TRN-Unit. This field is reserved when the Poll Type field is set to 0. |
| Requested EDMG TRN-Unit M | 4 | The value of this field plus one indicates the requested number of TRN subfields in a TRN-Unit transmitted with the same AWV following a possible AWV change. This field is reserved when the Poll Type field is set to 0. |
| Requested EDMG TRN-Unit P | 2 | Indicates the requested number of TRN subfields at the start of a TRN-Unit that use the same AWV. A value of zero indicates zero requested TRN subfields, a value of one indicates one requested TRN subfield, a value of two indicates two requested TRN subfields and a value of three indicates four requested TRN subfields. This field is reserved when the Poll Type field is set to 0. |
| Reserved | 1 |  |

**9.4.2.261 MIMO Feedback Control element**

***Modify this subclause as follows (CID 1343, 1344, 1345):***

…

Table 11—MIMO Feedback Control element format

|  |  |  |
| --- | --- | --- |
| Field | Size (bits) | Meaning |
| Element ID | 8 |  |
| Length | 8 |  |
| Element ID Extension | 8 |  |
| SU/MU | 1 | This field is set to 0 to indicate SU-MIMO beamforming and set to 1 to indicate MU-MIMO beamforming. |
| Link Type | 1 | This field is set to 0 to indicate initiator link and set to 1 otherwise. This field is set to 0 when the SU/MU field is set to 1. |
| MIMO FBCK-TYPE | 12 |  |
| Reserved | 2 |  |

…

The MIMO FBCK-TYPE field is defined in Figure 61.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Channel Measurement Present | Tap Delay Present | Number of Taps Present | Number of TX Sector Combinations Present | Precoder Information Present | Channel Aggregation Present |
| Bits: | 1 | 1 | 2 | 6 | 1 | 1 |

 |  |  |
| Figure 61—MIMO FBCK-TYPE field format |

…

The Number of Taps Present subfield indicates the number of taps present in each channel measurement. This subfield has the same encoding as the Number of Taps Requested subfield specified in Table 9-234.…

The Channel Aggregation Present subfield is set to 1 to indicate that, in case of channel aggregation, channel measurement feedback per channel is present. Otherwise, it is set to 0.

***Modify Table 12 as follows (CID 1148, 1403):***

Table 12—MIMO Selection Control element format

|  |  |  |
| --- | --- | --- |
| Field | Size (bits) | Meaning |
| Element ID | 8 |  |
| Length | 8 |  |
| Element ID Extension | 8 |  |
| EDMG Group ID | 8 | Indicates the EDMG group ID of target MU group. |
| Number of MU-MIMO Transmission Configurations | 3 | Indicates the number of MU-MIMO transmission configurations, *N*conf.  |
| MU-MIMO Transmission Configuration Type | 1 | This field is set to 0 to indicate the MU-MIMO transmission configurations obtained from the non-reciprocal MU-MIMO BF training; and set to 1 to indicate the MU-MIMO transmission configurations obtained from the reciprocal MU-MIMO BF training. |
| … |  |  |  |

10.38.9.2.2.3 MIMO phase**10.38.9.2.2.3.2 Non-reciprocal MIMO phase**

***Replace Figure 99 by the following figure (CID 1244):***



Figure 99—The non-reciprocal MIMO phase of the SU-MIMO beamforming

***Modify the following paragraphes (CID 1145, 1498, 1752, 1148, 1403, 1902):***

In the SU-MIMO BF setup subphase, the initiator shall send a MIMO BF Setup frame (see 9.6.22.4) with the SU/MU field set to 0, the Non-reciprocal/Reciprocal MIMO Phase field set to 0 and the Initiator field set to 1 to the responder. In case of channel aggregation, the Channel Aggregation Requested subfield of the MIMO FBCK-REQ field in the MIMO BF Setup frame should set to 1. ...

...

The responder shall send a MIMO BF Setup frame with the SU/MU field set to 0, the Non-reciprocal/Reciprocal MIMO Phase field set to 0 and the Initiator field set to 0 a SIFS following the reception of the MIMO BF Setup frame from the initiator. In case of channel aggregation, the Channel Aggregation Requested subfield of the MIMO FBCK-REQ field in the MIMO BF Setup frame should set to 1. …

…

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 SU/MU field set to 0 and the Link Type field set to 1. In case of channel aggregation, the Aggregation Present subfield of the MIMO FBCK-TYPE field in the MIMO BF Feedback frame should be set to 1. The TA field of the MIMO BF Feedback frame shall be set to the MAC address of the initiator and the RA field shall be set to the MAC address of the responder. …

The responder shall send a MIMO BF Feedback frame to the initiator with the SU/MU field set to 0 and the Link Type field set to 0 a SIFS following reception of a MIMO BF Feedback frame from the initiator. In case of channel aggregation, the Aggregation Present subfield of the MIMO FBCK-TYPE field in the MIMO BF Feedback frame should be set to 1. 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. …

…

**10.38.9.2.2.3.3 Reciprocal MIMO phase**

***Replace Figure 100 by the following figure (CID 1244):***

Figure 100—The reciprocal MIMO phase of the SU-MIMO beamforming

***Modify the following paragraphes (CID 1145, 1498, 1752, 1148, 1403, 1902):***

In the SU-MIMO BF setup subphase, the initiator shall send a MIMO BF Setup frame (see 9.6.22.4) with the SU/MU field set to 0, the Non-reciprocal/Reciprocal MIMO Phase field set to 1 and the Initiator field set to 1 to the responder. In case of channel aggregation, the Channel Aggregation Requested subfield of the MIMO FBCK-REQ field in the MIMO BF Setup frame should set to 1. The TA field and the RA field of the MIMO BF Setup frame shall be set to the MAC addresses of the initiator and the responder, respectively. …

The responder shall send a MIMO BF Setup frame with the SU/MU field set to 0, the Non-reciprocal/Reciprocal MIMO Phase field set to 1 and the Initiator field set to 0 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 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 SU/MU field set to 0 and the Link Type field set to 0. In case of channel aggregation, the Aggregation Present subfield of the MIMO FBCK-TYPE field in the MIMO BF Feedback frame should be set to 1. 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. …

MIMO phase

***Modify the following paragraphes (CID 1148, 1403, 2314):***

General

The MIMO phase consists of a non-reciprocal MIMO phase or of a reciprocal MIMO phase.

The non-reciprocal MIMO phase shall be supported by all EDMG STAs that are MU-MIMO capable. The reciprocal MIMO phase may be supported by EDMG STAs that are MU-MIMO capable.

Non-reciprocal MIMO phase

The initiator shall start the MIMO phase MBIFS following the end of the SISO phase. The non-reciprocal MIMO phase is shown in Figure 101 and consists of four subphases, namely, an MU-MIMO BF setup subphase, an MU-MIMO BF training subphase, an MU-MIMO BF feedback subphase, and an MU-MIMO BF selection subphase. Each subphase shall be separated by MBIFS.

…

In the MU-MIMO BF setup subphase, the initiator shall transmit one or more MIMO BF Setup frame (see 9.6.22.4) with the SU/MU field set to 1 and the Non-reciprocal/Reciprocal MIMO Phase field set to 0 to each responder in the MU group. In case of channel aggregation, the Channel Aggregation Requested field in each MIMO BF Setup frame should be set to 1. The initiator should transmit the minimum number of MIMO BF Setup frames to reach all responders in the MU group. …

…

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) with the Poll Type field set to 0 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. 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) with the SU/MU field set to 1 to the initiator. In case of channel aggregation, the Aggregation Present field in the MIMO BF Feedback frame should be set to 1. 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 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) with the MU-MIMO Transmission Configuration Type set to 0 to each responder in the MU group.

***Replace Figure 101 by the following figure and modify the figure title (CID 1244, 1809):***



Figure 101—The Non-reciprocal MIMO phase of MU-MIMO beamforming

***Modify the following paragraphes (CID 1148, 1403, 2314):***

Reciprocal MIMO phase

The reciprocal MIMO procedure might shorten the MU-MIMO BF training duration. The initiator may initiate a reciprocal MIMO phase procedure if the following conditions are met:

* The Reciprocal MU-MIMO Supported field in initiator’s and intended recipients’ EDMG Capabilities element equals one; and
* The Antenna Pattern Reciprocity field in the initiator’s DMG Capabilities element equals one

The reciprocal MIMO phase is shown in Figure 102 and consists of three subphases, namely, an MU-MIMO BF setup subphase, an MU-MIMO BF training subphase and an MU-MIMO selection subphase. Each subphase shall be separated by MBIFS.

Based on the feedback from the SISO phase, in the reciprocal MU-MIMO BF setup subphase the initiator may exclude some responders from the following reciprocal MU-MIMO BF training subphase. This might happen if the multiuser interference the responders are expected to suffer due to MU-MIMO transmission is negligible or if they do not support the reciprocal MU-MIMO BF training subphase. If all of the responders are excluded from the following reciprocal MU-MIMO BF training subphase, this subphase is not present in the reciprocal MIMO phase.

In the MU-MIMO BF setup subphase, the initiator shall transmit one or more MIMO BF Setup frame (see 9.6.22.4) with the SU/MU field set to 1 and the Non-reciprocal/Reciprocal MIMO Phase field set to 1 to each responder in the MU group. In case of channel aggregation, the Channel Aggregation Requested field in each MIMO BF Setup frame should be set to 1. The initiator should transmit the minimum number of MIMO BF Setup frames to reach all responders in the MU group…

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) with the Poll Type field set to 1 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 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) with the MU-MIMO Transmission Configuration Type set to 1 to each responder in the MU group. …

***Replace Figure 102 by the following figure and modify the figure title (CID 1244, 2006):***



Figure 102—The reciprocal MIMO phase of MU-MIMO beamforming