IEEE P802.11  
Wireless LANs

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| Comment Resolution on MIMO BF: Part I | | | | |
| Date: 2019-03-13 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | Email |
| Lei Huang | Panasonic |  |  | lei.huang@sg.panasonic.com |

Abstract

This submission proposes resolution of comments on MIMO BF received from LB #239 (TGay Draft 3.0).

- 14 CID: 4098, 4122, 4123, 4126, 4127, 4128, 4240, 4242, 4244, 4246, 4249, 4334, 4335, 4336

**CIDs regarding MIMO BF related information elements:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page.Line Number** | **Comment** | **Proposed Change** | **Resolution** |
| 4098 | 144.09 | "transmission of the last M TRN subfields" - M is undefined | Add a note that "M is equal to the Requested EMDG TRN-Unit M field" | Revised- |
| 4128 | 151.01 | "Indicates the RX AWV or RX DMG antenna": the device sending this element, has no information about RX AWVs. All feebacks are about TX Sectors, TX antennas IDs and RX antenna ID - how can the initiator of MIMO or MU-MIMO have information RX AWVs? | Remove RX AWV from the table. (or explain where the information about RX AWV came from). | Revised-  Note that a receiver is able to derive the RX AWV based on the SISO ID subset index. The proposed modifications clarify that the SISO ID subset index indicates the RX AWV from a receiver’s perspective. |
| 4249 | 197.07 | MIMO BF Feedback frame does not contain Channel Measurement Feedback element and EDMG Channel Measurement Feedback element when the Comeback Delay field in the MIMO Feedback Control element is set to a non-zero value. | Table 36: Change "One or more Channel Measurement Feedback elements" to "Zero or more Channel Measurement Feedback elements" Change "One or more EDMG Channel Measurement Feedback elements" to "Zero or more EDMG Channel Measurement Feedback elements" | Accepted- |

**CIDs regarding MIMO BF:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page.Line Number** | **Comment** | **Proposed Change** | **Resolution** |
| 4334 | 279.10 | "The EDMG Sector ID Order and BRP CDOWN fields shall be present in the EDMG Channel Measurement Feedback element included in any MIMO BF Feedback frame transmitted during SU-MIMO or MU-MIMO BF training" May help to define specific fields in EDMG Sector ID order | The EDMG Sector ID Order (containing the AWV feedback ID and the TX antenna ID) and BRP CDOWN fields shall be present in the EDMG Channel Measurement Feedback element included in any MIMO BF Feedback frame transmitted during SU-MIMO or MU-MIMO BF training | Rejected-  Which specific subfields of EDMG Sector ID Order field is included in the EDMG Channel Measurement Feedback element vary depending on whether the element is transmitted during SISO phase or MIMO phase and which training packet is used during the SISO phase. Therefore, it is not necessary to define specific subfield of EDMG Sector ID Order field in this introductory section. |
| 4122 | 280.12 | "larger than 16." avoid using constants - replace with "aminTXSSSectorsFBCnt" in all of 10.43 | submission willl be provided | Revised-  Agreed in principle with the commenter. |
| 4123 | 280.31 | "The last responder TXSS may have been performed using DMG Beacon frames" - DMG beacon frames are always part of initiator TXSS, not respodner. If the intent is TXSS from the respodner, replace throughtout the subclause, otherwise, remove beacon frames from the text on respdoner TXSS | Either remove "DMG beacon frames" or replace "responder TXSS" with "TXSS from the respodner" thourghout the subclause. | Revised-  Agreed in principle with the commenter. It is proposed to remove “DMG Beacon frames” throughout whole paragraph. |
| 4240 | 280.31 | It is unclear which field/element is used to indicate whether the last responder TXSS was performed using DMG Beacon frames, SSW frames, Short SSW packets or EDMG BRP-TX packets. | add the text to specify the field/element which is used to indicate whether the last responder TXSS was performed using DMG Beacon frames, SSW frames, Short SSW packets or EDMG BRP-TX packets. | Revised-  Agreed in principle with the commenter. |
| 4335 | 280.36 | "Feedback element indicates the CDOWNs, TX antennas 36 and RX antennas of all or a su". TX antennas is reserved for the short SSW | remove Tx antennas from sentence. See also pg 281 line 8, pg 290 line 23 | Revised-  Agreed in principle with the commenter. |
| 4242 | 282.11 | "each subphase shall be separated by an MBIFS" may not be true if the non-reciprocal MIMO phase is performed in a TDD SP. | delete this sentence | Accepted- |
| 4336 | 284.40 | "If the ComeBack Delay field is set to 0 and for a 2.16+2.16 GHz or 4.32+4.32 GHz channel, the Channel Aggregation Present subfield of the MIMO FBCK-TYPE field should be set to 1." Why is the comeback delay field tied to the channel aggregation field? | Decouple both fields or explain why they are coupled. See also pg 292 line 25, | Rejected-  The Channel Aggregation Present subfield indicates whether in case of channel aggregation channel measurement feedback per channel is present. If the ComeBack Delay field is set to a non-zero value, the Channel Aggregation Present subfield shall be set to 0. In other words, the Channel Aggregation Present subfield cannot decouple with the Comeback Delay field. |
| 4244 | 288.27 | It is unclear whether MU-MIMO beamforming can be performed within a TDD SP. | P288L27: add the following paragraph "MU-MIMO beamforming shall not be performed within a TDD SP". | Accepted- |
| 4126 | 289.04 | "MIMO BF Setup frames, MIMO BF Poll frames and MIMO BF Selection frames should be sent using the EDMG control mode": why limit to EDMG control mode. EMDG control mode is necessary if an EDMG TRN field is added, which is not the case for these frames. | replace "EDMG control mdoe" with "MCS 0" | Revised-  Agreed in principle with the commenter. |
| 4246 | 290.18 | It is unclear which field/element is used to indicate whether the last Initiator TXSS was performed using DMG Beacon frames, SSW frames, Short SSW packets or EDMG BRP-TX packets. | add the text to specify the field/element which is used to indicate whether the last Initiator TXSS was performed using DMG Beacon frames, SSW frames, Short SSW packets or EDMG BRP-TX packets. | Revised-  Agreed in principle with the commenter. |
| 4127 | 291.30 | "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 Requested 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.": I don't think the intent is that the initiator may reduce the number of TRN subfield needed for RX training, it control only the number of TX sectors used. | replace with "To reduce the MU-MIMO BF training time, the initiator may select a subset of TX sectors for each DMG antenna. The number of TRN subfields required for receive AWV training is based on the L-TX-RX field and the Requested 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." | Accepted- |

**Proposed changes to D3.0:**

**TGay editor: change Table 17 as follows (CID 4098):**

**Table 17 —MIMO Setup Control element format**

|  |  |  |
| --- | --- | --- |
| **Field** | **Size (bits)** | **Meaning** |
| **…** | **…** | **…** |
| 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 or when the SU/MU field is set to 0, the Non-reciprocal/Reciprocal MIMO phase field is set to 1 and the Initiator field is set to 1.  Note: M is equal to the value of the Requested EDMG TRN-Unit M field. |
| **…** | **…** | **…** |

**TGay editor: change Table 21 as follows (CID 4128):**

**Table 21 —** **MIMO Selection Control element format**

|  |  |  |  |
| --- | --- | --- | --- |
| 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 from a receiver’s perspective 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 from a receiver’s perspective 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 from a receiver’s perspective 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 from a receiver’s perspective 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 from a receiver’s perspective 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 from a receiver’s perspective 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 from a receiver’s perspective 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 from a receiver’s perspective 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 from a receiver’s perspective 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 from a receiver’s perspective 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 from a receiver’s perspective 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 from a receiver’s perspective 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 from a receiver’s perspective 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 from a receiver’s perspective 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 from a receiver’s perspective 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 from a receiver’s perspective 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 |

**TGay editor: change Table 36 as follows (CID 4249):**

**Table 36 —MIMO BF Feedback frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| **…** | **…** |
| 5 | Zero or more Channel Measurement Feedback elements |
| 6 | Zero or more EDMG Channel Measurement Feedback elements |
| **…** | **…** |

**TGay editor: insert the following row at the end of Table 11-23 (DMG MAC sublayer attribute values) (CID 4122):**

|  |  |
| --- | --- |
| **Attribute** | **Value** |
| aMinTXSSSectorFBCnt | 16 |

**TGay editor: change the paragraghs (P280L6) as follows (CID 4122, 4123, 4240, 4335):**

In the BRP frame sent by the initiator during the feedback phase, the EDMG Sector ID Order field in the EDMG Channel Measurement Feedback element indicates AWV feedback IDs, TX antennas and RX antennas of all or a subset of sectors that were received in the Responder BRP TXSS. The BRP CDOWN subfield in the EDMG Channel Measurement Feedback element indicates BRP CDOWNs of the packets in which these sectors were received. The SNR subfield in the Channel Measurement Feedback element indicates the SNRs with which these sectors were received. If the number of sectors for a pair of TX and RX DMG antennas that were received in the responder BRP TXSS is larger than aMinTXSSSectorFBCnt, the BRP frame shall contain feedback for at least aMinTXSSSectorFBCnt received sectors for the pair of TX and RX DMG antennas. Otherwise, the BRP frame shall contain feedback for all the received sectors for the pair of TX and RX DMG antennas.

In the BRP frame sent by the responder during the feedback phase, the EDMG Sector ID Order field in the EDMG Channel Measurement Feedback element indicates AWV feedback IDs, TX antennas and RX antennas of all or a subset of sectors that were received in the Initiator BRP TXSS. The BRP CDOWN subfield in the EDMG Channel Measurement Feedback element indicates BRP CDOWNs of the BRP packets in which these sectors were received. The SNR subfield in the Channel Measurement Feedback element indicates the SNRs with which these sectors were received. If the number of sectors for a pair of TX and RX DMG antennas that were received in the initiator BRP TXSS is larger than aMinTXSSSectorFBCnt, the BRP frame shall contain feedback for at least aMinTXSSSectorFBCnt received sectors for the pair of TX and RX DMG antennas. Otherwise, the BRP frame shall contain feedback for all the received sectors for the pair of TX and RX DMG antennas.

…

The last responder TXSS may have been performed using SSW frames, Short SSW packets or EDMG BRP-TX packets. If the Sector Sweep Frame Type field in the DMG Beam Refinement element is set to 0, the EDMG Sector ID Order field in the EDMG Channel Measurement Feedback element indicates the sector IDs, TX antennas and RX antennas of all or a subset of sectors that were received in the last responder TXSS. If the Sector Sweep Frame Type field in the DMG Beam Refinement element is set to 1, the EDMG Sector ID Order field in the EDMG Channel Measurement Feedback element indicates the CDOWNs and RX antennas of all or a subset of sectors that were received in the last responder TXSS. If the Sector Sweep Frame Type field in the DMG Beam Refinement element is set to 2, the EDMG Sector ID Order field in the EDMG Channel Measurement Feedback element indicate AWV feedback IDs, TX antennas and RX antennas of all or a subset of sectors that were received in the last responder TXSS. The BRP CDOWN subfield in the EDMG Channel Measurement Feedback element indicates the BRP CODWNs of the BRP packets in which these sectors were received. The SNR subfield in the Channel Measurement Feedback element indicates the SNRs with which these sectors were received. If the number of sectors for a pair of TX and RX DMG antennas that were received in the last responder TXSS is larger than aMinTXSSSectorFBCnt, the BRP frame shall contain feedback for at least aMinTXSSSectorFBCnt received sectors for the pair of TX and RX DMG antennas. Otherwise, the BRP frame shall contain feedback for all the received sectors for the pair of TX and RX DMG antennas.

…

The last initiator TXSS may have been performed using DMG Beacon frames, SSW frames, Short SSW packets or EDMG BRP-TX packets. If the Sector Sweep Frame Type field in the DMG Beam Refinement element is set to 0, the EDMG Sector ID Order field in the EDMG Channel Measurement Feedback element indicates the sector IDs, TX antennas and RX antennas of all or a subset of sectors that were received in the last initiator TXSS. If the Sector Sweep Frame Type field in the DMG Beam Refinement element is set to 1, the EDMG Sector ID Order field in the EDMG Channel Measurement Feedback element indicates the CDOWNs and RX antennas of all or a subset of sectors that were received in the last initiator TXSS. If the Sector Sweep Frame Type field in the DMG Beam Refinement element is set to 2, the EDMG Sector ID Order field in the EDMG Channel Measurement Feedback element indicates AWV feedback IDs, TX antennas and RX antennas of all or a subset of sectors that were received in the last initiator TXSS. The BRP CDOWN subfield in the EDMG Channel Measurement Feedback element indicates the BRP CODWNs of the BRP packets in which these sectors were received. The SNR subfield in the Channel Measurement Feedback element indicates the SNRs with which these sectors were received. If the number of sectors for a pair of TX and RX DMG antennas that were received in the last initiator TXSS is larger than aMinTXSSSectorFBCnt, the BRP frame shall contain feedback for at least aMinTXSSSectorFBCnt received sectors for the pair of TX and RX DMG antennas. Otherwise, the BRP frame shall contain feedback for all the received sectors for the pair of TX and RX DMG antennas.

**TGay editor: change the paragraghs (P290L18) as follows (CID 4122, 4246, 4335):**

The last initiator TXSS may have been performed using DMG Beacon frames, SSW frames, Short SSW packets or EDMG BRP-TX packets. If the Sector Sweep Frame Type field in the DMG Beam Refinement element is set to 0, the EDMG Sector ID Order field in the EDMG Channel Measurement Feedback element indicates the sector IDs, TX antennas and RX antennas of all or a subset of sectors that were received in the last initiator TXSS. If the Sector Sweep Frame Type field in the DMG Beam Refinement element is set to 1, the EDMG Sector ID Order field in the EDMG Channel Measurement Feedback element indicates the CDOWNs and RX antennas of all or a subset of sectors that were received in the last initiator TXSS. If the Sector Sweep Frame Type field in the DMG Beam Refinement element is set to 2, the EDMG Sector ID Order field in the EDMG Channel Measurement Feedback element indicates AWV feedback IDs, TX antennas and RX antennas of all or a subset of sectors that were received in the last Initiator TXSS. The BRP CDOWN subfield in the EDMG Channel Measurement Feedback element indicates the BRP CDOWNs of the packets in which these sectors were received. The SNR subfield in the Channel Measurement Feedback element indicates the SNRs with which these sectors were received. If the number of sectors for a pair of TX and RX DMG antennas that were received in the last initiator TXSS is larger than aMinTXSSSectorFBCnt, the BRP frame shall contain feedback for at least aMinTXSSSectorFBCnt received sectors for the pair of TX and RX DMG antennas. Otherwise, the BRP frame shall contain feedback for all the received sectors for the pair of TX and RX DMG antennas.

**TGay editor: change the paragraghs (P282L9) as follows (CID 4242):**

The non-reciprocal MIMO phase is shown in Figure 135 and consists of four subphases: an SU-MIMO BF setup subphase, an initiator SU-MIMO BF training (SMBT) subphase, a responder SMBT subphase, and an SU-MIMO BF feedback subphase.

**TGay editor: add the following new paragragh after the first paragraph of 10.43.10.2.3.1 (P288L26) (CID 4244):**

MU-MIMO beamforming shall not be performed within a TDD SP.

**TGay editor: change the paragraghs (P281L33) as follows (CID 4126):**

The MIMO BF Setup frame, MIMO BF Poll frame and MIMO BF Feedback frame sent in the MIMO phase of an SU-MIMO beamforming shall be transmitted by applying spatial expansion and mapping a single space-time stream to all *NTX* transmit chains to be trained in the procedure. The MIMO BF Setup frame, MIMO BF Poll frame and MIMO BF Feedback frame should be sent using the non-EDMG or EDMG control mode.

**TGay editor: change the paragraghs (P289L3) as follows (CID 4126):**

…. MIMO BF Setup frames, MIMO BF Poll frames and MIMO BF Selection frames should be sent using the non-EDMG or EDMG control mode.

In the non-reciprocal MU-MIMO BF feedback subphase, MIMO BF Feedback frame sent by each responder shall be transmitted by applying spatial expansion and mapping a single space-time stream to all *NTX* transmit chains. If an implementation has not yet determined AWVs to use in some of its transmit chains for the transmission of MIMO BF Feedback frame, the AWVs used by such chains should be selected in an implementation dependent manner. MIMO BF Feedback frame should be sent using the non-EDMG or EDMG control mode.

**TGay editor: change the paragraghs (P291L30) as follows (CID 4127):**

…To reduce the MU-MIMO BF training time, the initiator may select a subset of TX sectors for each DMG antenna. The number of TRN subfields required for receive AWV training is based on the L-TX-RX field and the Requested 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….