IEEE P802.11
Wireless LANs

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| Draft Spec Text for Frame Formats related to SU and MU MIMO Beamforming  |
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Abstract

This document proposes draft specification text for frame formats related to the 11ay SFD clause 3.3 SU-MIMO beamforming and clause 3.4 MU-MIMO beamforming.

***#1: Insert a SU-MIMO Support subfield into the EDMG Capabilities element and insert the following description:***

The SU-MIMO Support subfield sets to 1 to indicate that the EDMG STA supports SU-MIMO transmission and reception. The SU-MIMO Support subfield sets to 0 to indicate that the EDMG STA does not support SU-MIMO transmission and reception.

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***#2: Insert a MU-MIMO Support subfield into the EDMG Capabilities element and insert the following description:***

The MU-MIMO Support subfield sets to 1 to indicate the support of MU-MIMO transmission for an EDMG AP or MU-MIMO reception for an EDMG non-AP STA. The MU-MIMO Support subfield sets to 0 to indicate no support of MU-MIMO transmission for an EDMG AP or MU-MIMO reception for an EDMG non-AP STA.

***#3:***

**9.2.4.1.3 Type and Subtype subfields**

 ***Change Table 9-2 (Control Frame Extension) as follows:***

Table 9-2—Control Frame Extension

|  |  |  |  |
| --- | --- | --- | --- |
| **Type value****B3 B2** | **Subtype value****B7 B6 B5 B4** | **Control Frame Extension value****B11 B10 B9 B8** | **Description** |
| 01 | 0110 | 1011 | SISO Feedback Poll |
| 01 | 0110 | 1100 | MIMO Feedback Poll |
| 01 | 0110 | ~~1011~~1101-1111 | Reserved |

**------------------------------------------------------------------------------------------------------------------------------------------*#4: insert the following clause:***

9.3.1.22 SISO Feedback Poll frame format

The format of the SISO Feedback Poll frame is shown in Figure 9-52a (SISO Feedback Poll frame format).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Frame Control | Duration | RA | BSSID(TA) | FCS |
| Octets: | 2 | 2 | 6 | 6 | 4 |

**Figure 9-52a— SISO Feedback Poll frame format**

The Duration field is set to the time until the end of the SISO phase as part of MU-MIMO beamforming.

The RA field is set to the MAC address of the STA that is the intended receiver of the SISO Feedback Poll frame.

The BSSID field is the address of the STA contained in the AP.

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*#5: insert the following clause:*

9.3.1.23 MIMO Feedback Poll frame format

The format of the MIMO Feedback Poll frame is shown in Figure 9-52b (MIMO Feedback Poll frame format).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Frame Control | Duration | RA | BSSID(TA) | Dialog Token | FCS |
| Octets: | 2 | 2 | 6 | 6 | 1 | 4 |

**Figure 9-52b— MIMO Feedback Poll frame format**

The Duration field is set to the time until the end of the MIMO phase as part of MU-MIMO beamforming.

The RA field is set to the MAC address of the STA that is the intended receiver of the MIMO Feedback Poll frame.

The BSSID field is the address of the STA contained in the AP.

The Dialog Token field is set to a value chosen by the STA sending the frame to uniquely identify the transaction.

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***#6: Insert the following clause***

9.4.2.176 Sector Sweep Feedback element(11ad)

The Sector Sweep Feedback element is used to carry the channel measurement feedback data that the STA has measured on the Short SSW frames to provide a list of sectors identified during a sector sweep. In a SISO Feedback frame, the format and size of the Sector Sweep Feedback element are defined by the parameter values specified in the accompanying SISO Feedback Control field.

The Sector Sweep Feedback element, as shown in Table 9-262a (Sector Sweep Feedback element format), is composed of 2 subfields: the SNR subfield and the CDOWN subfield.

|  |
| --- |
| Table 9-262a Sector Sweep Feedback element format  (11ad) |
| Field | Size | Meaning |
| Element ID | 8 bits |  |
| Length | 8 bits |  |
| Element ID Extension | 8 bits |  |
| SNR |  | 8 bits | SNR as measured at the first sector from which Short SSW frame is received.  |
|  | 8 bits | SNR as measured at the second sector from which Short SSW frame is received. |
|  |  |  |
|  | 8 bits | SNR as measured at sector *Nmeas* from which Short SSW frame is received.  |
| CDOWN | CDOWN1 | 11 bits | CDOWN value for SNR1 being obtained. |
| CDOWN2 | 11 bits | CDOWN value for SNR2 being obtained. |
|  |  |  |
| CDOWN*Nmeas* | 11 bits | CDOWN value for SNR*Nmeas*being obtained. |
| Padding | 1~7 bits | Padding bits are added so that the length of the element is a multiple of bytes. |

The Element ID, Length and Element ID Extension fields are defined in 9.4.2.1 (General).

The number of SNR measurements reported is equal to the number of Short SSW frames received during the sector sweep.

The SNR subfield levels are unsigned integers referenced to a level of –8 dB. Each step is 0.25 dB. SNR values less than or equal to –8 dB are represented as 0. SNR values greater than or equal to 55.75 dB are represented as 0xFF.

The CDOWN subfield indicates the CDOWN values corresponding to the SNRs in the SNR subfield.

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***#7: Insert the following clause***

9.4.2.177 BRP Configuration element(11ad)

The BRP Configuration element is used to carry the configuration information of each BRP frame transmitted in a SU-MIMO training subphase or a MU-MIMO training subphase.

The BRP Configuration element, as shown in Table 9-262b (BRP Configuration element format), is composed of 3 subfields: the Number of BRP Frames subfield, the Number of TX Sectors per BRP Frame subfield and the Sector ID subfield.

|  |
| --- |
| Table 9-262b BRP Configuration element format  (11ad) |
| Field | Size | Meaning |
| Element ID | 8 bits |  |
| Length | 8 bits |  |
| Element ID Extension | 8 bits |  |
| Number of BRP Frames | 4 bits | Number of BRP frames, *Nbrp*, to be transmitted in the corresponding MIMO training subphase. |
| Number of TX Sectors per BRP Frame  | *N1* | 8 bits | Number of TX sectors to be used in the first BRP frame. |
| *N2* | 8 bits | Number of TX sectors to be used in the second BRP frame. |
|  |  |  |
| *NNbrp* | 8 bits | Number of TX sectors to be used in the *Nbrp* BRP frame. |
| Sector ID | Sector ID(1,1) | 8 bits | Sector ID of the first sector to be used in the first BRP frame. |
| Antenna ID(1,1) | 3 bits | Antenna ID corresponding to the first sector to be used in the first BRP frame. |
| Sector ID(2,1) | 8 bits | Sector ID of the second sector to be used in the first BRP frame. |
| Antenna ID(2,1) | 3 bits | Antenna ID corresponding to the second sector to be used in the first BRP frame. |
|  |  |  |
| Sector ID(N1, 1) | 8 bits | Sector ID of the last sector to be used in the first BRP frame. |
| Antenna ID(N1,1) | 3 bits | Antenna ID corresponding to the last sector to be used in the first BRP frame. |
|  |  |  |
| Sector ID(1, *N*brp) | 8 bits | Sector ID of the first sector to be used in the ***Nbrp*** BRP frame. |
| Antenna ID(1, *N*brp) | 3 bits | Antenna ID corresponding to the first sector to be used in the ***Nbrp*** BRP frame. |
| Sector ID(2, *N*brp) | 8 bits | Sector ID of the second sector to be used in the ***Nbrp*** BRP frame. |
| Antenna ID(2, *N*brp) | 3 bits | Antenna ID corresponding to the second sector to be used in the ***Nbrp*** BRP frame. |
|  |  |  |
| Sector ID(*NN*brp, *N*brp) | 8 bits | Sector ID of the last sector to be used in the ***Nbrp*** BRP frame. |
| Antenna ID(*NN*brp, *N*brp) | 3 bits | Antenna ID corresponding to the last sector to be used in the *Nbrp* BRP frame. |
| Padding | 1~7 bits | Padding bits are added so that the length of the element is a multiple of bytes. |

The Element ID, Length and Element ID Extension fields are defined in 9.4.2.1 (General).

The Number of BRP Frames subfield indicates the number of BRP frames to be transmitted in the corresponding SU-MIMO training subphase or MU-MIMO training subphase.

The Number of TX Sectors per BRP Frame subfield indicates the number of TX sectors to be used per BRP frame in the corresponding SU-MIMO training subphase or MU-MIMO training subphase.

The Sector ID subfield indicates the TX sector IDs for the TX sectors to be used per BRP frame in the corresponding SU-MIMO training subphase or MU-MIMO training subphase.

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***#8: Insert the following clause***

9.4.2.178 EDMG Channel Measurement Feedback element(11ad)

The EDMG Channel Measurement Feedback element is used to carry the channel measurement feedback data that the EDMG STA has measured on the TRN fields of the BRP packets, to provide a list of TX and RX sector combinations identified during MIMO training. In a MIMO Feedback frame, the format and size of the EDMG Channel Measurement Feedback element are defined by the parameter values specified in the accompanying MIMO Training Control element.

The EDMG Channel Measurement Feedback element, as shown in Table 9-262c (EDMG Channel Measurement Feedback element format), is composed of 7 subfields: the SNR/SINR subfield, the Channel Measurement subfield, the Tap Delay subfield, the Sector ID Order subfield, the TX Sector Combinations subfield, the RX Sector Combinations subfield and the AID subfield.

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

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| --- |
| Table 9-262c EDMG Channel Measurement Feedback element format  |
| Field | Size | Meaning |
| Element ID | 8 bits |  |
| Length | 8 bits |  |
| Element ID Extension | 8 bits |  |
| SNR/SINR | *SNR1* or S*INR1* | 8 bits | SNR or SINR as measured in the first TRN unit  |
| *SNR2* or S*INR2* | 8 bits | SNR or SINR as measured in the second TRN unit  |
| … | … | … |
| *SNRNmeas* or *SINRNmeas* | 8 bits | SNR or SINR as measured in the *Nmeas*TRN unit.  |
| Channel Measurement | Channel Measurement 1 | *Ntaps×*16 bits | Channel measurement for the first TRN unit |
| Channel Measurement 2 | *Ntaps×*16 bits | Channel measurement for the second TRN unit |
| … | … | … |
| Channel Measurement *Nmeas* | *Ntaps×*16 bits | Channel measurement for the *Nmeas* TRN unit |
| Tap Delay | Relative Delay Tap #1 | 8 bits | The delay of Tap #1 in units of *Tc*(#2127)/*NCB* relative to the path with the shortest delay detected. |
| Relative Delay Tap #2 | 8 bits | The delay of Tap #2 in units of *Tc*(#2127)/*NCB* (#2127) relative to the path with the shortest delay detected. |
| … | … | … |
| Relative Delay Tap #*Ntaps* | 8 bits | The delay of Tap #*Ntaps* in units of *Tc*(#2127)/*NCB* (#2127) relative to the path with the shortest delay detected. |
| Sector ID Order | TX Sector ID1 | 8 bits | TX sector ID for SNR1/SINR1 being obtained |
| TX Antenna ID1 | 3 bits | TX antenna ID corresponding to TX (#2217)sector ID1. |
| RX Sector ID1 | 8 bits | RX sector ID for SNR1/SINR1 being obtained. |
| RX Antenna ID1 | 3 bits | RX antenna ID corresponding to RX (#2217)sector ID1. |
| TX Sector ID2 | 8 bits | TX sector ID for SNR2/SINR2 being obtained |
| TX Antenna ID2 | 3 bits | TX antenna ID corresponding to TX (#2217)sector ID2. |
| RX Sector ID2 | 8 bits | RX sector ID for SNR2/SINR2 being obtained |
| RX Antenna ID2 | 3 bits | RX antenna ID corresponding to RX (#2217)sector ID2. |
| … | … | … |
| TX Sector ID*Nmeas* | 8 bits | TX sector ID for SNR*Nmeas*/SINR*Nmeas* being obtained |
| TX Antenna ID*Nmeas* | 3 bits | TX antenna ID corresponding to TX (#2217)sector ID*Nmeas* |
| RX Sector ID*Nmeas* | 8 bits | RX sector ID for SNR*Nmeas*/SINR*Nmeas* being obtained |
| RX Antenna ID*Nmeas* | 3 bits | RX antenna ID corresponding to RX (#2217)sector ID*Nmeas* |
| TX Sector Combinations  | **Tx Sector Combination 1 AWV 1** | **11 bits** | **Contains the AWV for TX DMG antenna 1** |
| **Tx Sector Combination 1 AWV 2** | 11 bits | Contains the AWV for TX DMG antenna 2 |
| … | … | … |
| Tx Sector Combination 1 AWV *NTX* | 11 bits | Contains the AWV for TX DMG antenna *NTX* |
| Tx Sector Combination 2 AWV 1 | 11 bits | Contains the AWV for TX DMG antenna 1 |
| Tx Sector Combination 2 AWV 2 | 11 bits | Contains the AWV for TX DMG antenna 2 |
| … | … | … |
| Tx Sector Combination 2 AWV *NTX* | 11 bits | Contains the AWV for TX DMG antenna *NTX* |
| … | … | … |
| Tx Sector Combination *NT* AWV 1 | 11 bits | Contains the AWV for TX DMG antenna 1 |
| Tx Sector Combination *NT* AWV 2 | 11 bits | Contains the AWV for TX DMG antenna 2 |
| … | … | … |
| Tx Sector Combination *NT* AWV *NTX* | 11 bits | Contains the AWV for TX DMG antenna *NTX* |
| RX Sector Combinations  | **Rx Sector Combination 1 AWV 1** | **11 bits** | **Contains the AWV for RX DMG antenna 1** |
| **RX Sector Combination 1 AWV 2** | 11 bits | Contains the AWV for RX DMG antenna 2 |
| … | … | … |
| RX Sector Combination 1 AWV *NRX* | 11 bits | Contains the AWV for RX DMG antenna *NRX* |
| RX Sector Combination 2 AWV 1 | 11 bits | Contains the AWV for RX DMG antenna 1 |
| RX Sector Combination 2 AWV 2 | 11 bits | Contains the AWV for RX DMG antenna 2 |
| … | … | … |
| RX Sector Combination 2 AWV *NRX* | 11 bits | Contains the AWV for RX DMG antenna *NRX* |
| … | … | … |
| RX Sector Combination *NR* AWV 1 | 11 bits | Contains the AWV for RX DMG antenna 1 |
| RX Sector Combination *NR* AWV 2 | 11 bits | Contains the AWV for RX DMG antenna 2 |
| … | … | … |
| RX Sector Combination *NR* AWV *NRX* | 11 bits | Contains the AWV for RX DMG antenna *NRX* |
| AID | AID(1,1) | 8 bits | AID for STA corresponding to **RX Sector Combination 1 AWV 1**  |
| AID(1,2) | 8 bits | AID for STA corresponding to **RX Sector Combination 1 AWV 2**  |
|  | … | … | … |
|  | AID(1,NRX) | 8 bits | AID for STA corresponding to **RX Sector Combination 1 AWV** NRX  |
|  | AID(2,1) | 8 bits | AID for STA corresponding to **RX Sector Combination 2 AWV 1**  |
| AID(2,2) | 8 bits | AID for STA corresponding to **RX Sector Combination 2 AWV 2**  |
| … | … | … |
| AID(2,NRX) | 8 bits | AID for STA corresponding to **RX Sector Combination 2 AWV** NRX  |
|  | … | …  | … |
|  | AID(NR,1) | 8 bits | AID for STA corresponding to **RX Sector Combination NR AWV 1**  |
| AID(NR,2) | 8 bits | AID for STA corresponding to **RX Sector Combination NR AWV 2**  |
| … | … | … |
| AID(NR,NRX) | 8 bits | AID for STA corresponding to **RX Sector Combination NR AWV** NRX  |

 (11ad) |

NOTE—*NCB* is equal to 1, 2, 3 and 4 for the TRN field transmission in a 2.16GHz, 4.32GHz, 6.48GHz and 8.64GHz channel, respectively.

The Element ID, Length and Element ID Extension fields are defined in 9.4.2.1 (General).

The number of SNR/SINR/channel measurements reported, *Nmeas*, is equal to the number of TRN units that were appended to the BRP packets on which the measurements were performed.

The SNR/SINR subfield levels are unsigned integers referenced to a level of –8 dB. Each step is 0.25 dB. SNR/SINR values less than or equal to –8 dB are represented as 0. SNR/SINR values greater than or equal to 55.75 dB are represented as 0xFF.

The Channel Measurement subfield and the Tap Delay subfield are defined in 9.4.2.136 (Channel Measurement Feedback element).

The Sector ID Order subfield indicates the TX sector IDs and RX sector IDs corresponding to the SNR/SNIR in the SNR/SINR subfield or the channel measurements in the Channel Measurement subfield.

The TX Sector Combinations subfield indicates the AWVs for *NTX* transmit antennas corresponding to *NT* TX sector combinations.

The RX Sector Combinations subfield indicates the AWVs for *NRX* receive antennas corresponding to *NR* RX sector combinations. In MU-MIMO beamforming, *NRX* is the total number of RX antennas of all the users in a MU-MIMO group.

The AID subfield indicates the AIDs for STAs owning the AWVs for *NRX* receive antennas corresponding to *NR* RX sector combinations.

When the EDMG Channel Measurement Feedback element is included in a MIMO Feedback frame transmitted during the SU-MIMO Feedback subphase, the AID subfield is not present.

When the EDMG Channel Measurement Feedback element is included in a MIMO Feedback frame transmitted during the MU-MIMO Feedback subphase, the TX Sector Combinations subfield, the RX Sector Combinations subfield and the AID subfield are not present.

When the EDMG Channel Measurement Feedback element is included in a MIMO Feedback frame transmitted during the MU-MIMO Selection subphase, the SNR/SINR subfield, the Channel Measurement subfiled, the Tap Delay subfield, the Sector ID Order subfield and the TX Sector Combinations subfield are not present.

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***#9: Insert the following clause:***

9.4.2.179 MIMO Training Control element

The MIMO Training Control element is defined as shown in Figure 9-52c (MIMO Training Control element format).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 B7 | B8 B15 | B16 B23 | B24 | B25 | B26 B34 | B35 B66 | B67 B71 |
|  | Element ID | Length | Element ID Extension | SU/MU | Initiator | MIMO FBCK-REQ | MIMO FBCK-TYPE | Reserved |
| Bits: | 8 | 8 | 8 | 1 | 1 | 9 | 32 | 5 |

  Figure 9-52c— MIMO Training Control element format

The Element ID, Length and Element ID Extension fields are defined in 9.4.2.1 (General).

A value of 1 in the SU/MU field indicates SU-MIMO beamforming. Otherwise, this field is set to 0.

A value of 1 in the Initiator field indicates that the sender is the initiator. Otherwise, this field is set to 0.

The MIMO FBCK-REQ field is defined in Figure 9-52d and is described in Table 9-262d.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B26  | B27  | B28 B29 | B30 | B31 B34 |
|  | SNR/SINR Requestred | Channel Measurement Requested | Number of Taps Requested | Sector ID Order Requested | Number of TX Sector Combinations Requested |
| Bits: | 1 | 1 | 2 | 1 | 4 |

  Figure 9-52d— MIMO FBCK-REQ field format

|  |
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| Table 9-262d— FBCK-REQ field description(11ad) |
| Subfield(#3097) | Meaning |
| SNR/SINR Requested | If set to 1, the SNR/SINR subfield is requested as part of the channel measurement feedback. Otherwise, set to 0. |
| Channel Measurement Requested | If set to 1, the Channel Measurement subfield is requested as part of the channel measurement feedback. Otherwise, set to 0. |
| Number of Taps Requested | Number of taps in each channel measurement:0x0 – 1 tap0x1 – 5 taps0x2 – 15 taps0x3 – 63 taps |
| Sector ID Order Requested  | If set to 1, the Sector ID Order subfield is requested as part of the channel measurement feedback. Otherwise, set to 0.  |
| Number of TX Sector Cominations Requested | Set to 0 to indicate no TX Sector Combinations subfield requested. Set to either of other values to indicate number of TX sector combinations requested. |

The MIMO FBCK-TYPE field is defined in Figure 9-52e and is described in Table 9-262e. When *Nmeas*, *NT* and NR in this field are equal to 0, the EDMG Channel Measurement Feedback element is not present.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B35  | B36 | B37 | B38 B39 | B40 B50 | B51 |
|  | SNR/SINR Present | Channel Measurement Present | Tap DelayPresent | Number of Taps Present | Number of Measurements | Sector ID Order Present |
| Bits: | 1 | 1 | 1 | 2 | 11? | 1 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B52 B55 | B56 B59 | B60 | B61 B65 | B66 |
|  | Number of TX Sector Combinations (*NT*) | Number of RX Sector Combinations (*NR*) | AID Present | NRX | Link Type |
| Bits: | 4 | 4 | 1 | 5 | 1 |

  Figure 9-52e— MIMO FBCK-TYPE field format

|  |
| --- |
| Table 9-262e MIMO FBCK-TYPE field description(11ad) |
| Subfield(#3097) | Meaning |
| SNR/SINR Present | Set to 1 to indicate that the SNR/SINR subfield is present as part of the channel measurement feedback. Set to 0 otherwise. |
| Channel Measurement Present | Set to 1 to indicate that the Channel Measurement subfield is present as part of the channel measurement feedback. Set to 0 otherwise. |
| Tap Delay Present | Set to 1 to indicate that the Tap Delay subfield is present as part of the channel measurement feedback. Set to 0 otherwise. |
| Number of Taps Present(#3106) | Number of taps in each channel measurement:0x0 – 1 tap0x1 – 5 taps0x2 – 15 taps0x3 – 63 taps |
| Number of Measurements(#3106) | Number of measurements in the SNR/SNIR subfield and the Channel Measurement subfield. It is equal to the number of TRN units in the BRP packets on which the measurement is based.  |
| Sector ID Order Present | Set to 1 to indicate that the Sector ID Order subfield is present as part of the channel measurement feedback. Set to 0 otherwise. |
| Number of TX Sector Combinations (*NT*) | Number of TX sector combinations  |
| Number of RX Sector Combinations (*NR*) | Number of RX sector combinations |
| AID Present (#2033) | Set to 1 to indicate that the AID subfield is present as part of the channel measurement feedback. Set to 0 otherwise. |
| Link Type(#2033) | Set to 0 for the initiator link and to 1 for the responder link |
| NRX | Total number of RX antennas for the users in a MU-MIMO group |

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***#10:***

9.5.5 Beamforming Control field

*Change Figure 9-640 and Table 9-638 as follows:(11ad)*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B3 B9 | B10 B11 | B12 B1~~5~~3 | B14 B15 |
|  | Beamforming Training | IsInitiatorTXSS | IsResponderTXSS | Total Number of Sectors | Number of RX DMG Antennas | Reserved | Beamforming Mode |
| Bit: | 1 | 1 | 1 | 7 | 2 | ~~4~~2 | 2 |
| Figure 9-640—BF Control field format when both IsInitiatorTXSS and IsResponderTXSS subfields are equal to 1 and the BF Control field is transmitted in Grant or Grant Ack frames (11ad) |
|    | B0 | B1 | B2 | B3 B8 | B9 | B10 B1~~53~~ | B14 B15 |
|  | Beamforming Training | IsInitiatorTXSS | IsResponderTXSS | RXSS Length | RXSSTxRate | Reserved | Beamforming Mode |
| Bit: | 1 | 1 | 1 | 6 | 1 | ~~6~~4 | 2 |
| Figure 9-641—BF Control field format in all other cases *(11ad)* |

***Insert the following paragraph at the end of 9.5.5:***

The Beamforming Mode subfield sets to 0 to indicate SISO beamforming, sets to 1 to indicate SU-MIMO beamforming, and sets to 2 to indicate MU-MIMO beamforming. The value of 3 is reserved.

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***#11: Insert the following clause***

**9.5.7 SISO Feedback Control field**

The SISO Feedback Control field is 3 octets in length. The format of the SISO Feedback Control field is defined in Figure 9-642a (SISO Feedback Control field).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B0 | B1 B11 | B12 | B13 B21 | B22 B23 |
|  | SU/MU | Number of Measurements | Link Type | L-RX | Reserved |
| Bits: | 1 | 11 | 1(#2033) | 9? | 2 |

Figure 9-642a—SISO Feedback Control field

The SU/MU subfield sets to 1 to indicate SU-MIMO beamforming and sets to 0 to indicate MU-MIMO beamforming.

The Number of Measurements subfield indicates the number of measurements in the SNR subfield of the SISO Feedback frame.

The Link Type subfield sets to 0 for the initiator link and to 1 for the responder link. It shall set to 0 when the SU/MU subfield sets to 0.

The L-RX subfield indicates the compressed number of RX TRN units requested by the transmitting STA as part of the corresponding MU-MIMO training subphase. This subfield is reserved when the SU/MU subfield sets to 1.

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

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

***#12:***

**9.6.22.1 Unprotected DMG Action field**

***Change Table 9-415(Unprotected DMG Action field values) as follows:***

|  |
| --- |
| Table 9-415—Unprotected DMG Action field values(11ad) |
| Unprotected DMG Action field value | Meaning |
| 0 | Announce |
| 1 | BRP |
| 2 | SISO Feedback |
| 3 | MIMO Setup |
| 4 | MIMO Feedback |

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

***#13: Insert the following clause***

***9.6.22.4 SISO Feedback frame format***

The SISO Feedback frame is an Action No Ack frame. The format of a SISO Feedback frame Action field is shown in Table 9-417a (SISO Feedback frame Action field format).

|  |
| --- |
| Table 9-417a− SISO Feedback frame Action field format(11ad) |
| Order | Information |
| 1 | Category |
| 2 | Unprotected DMG Action |
| 3 | Dialog Token |
| 4 | SISO Feedback Control field |
| 5 | One or more Sector Sweep Feedback elements |

The Category field is defined in 9.4.1.11 (Action field).(#3403)

The Unprotected DMG Action field is defined in 9.6.22.1 (Unprotected DMG Action field).(#3403)

The Dialog Token field is set to a value chosen by the STA sending the frame to uniquely identify the transaction.

The SISO Feedback Control field is defined in 9.5.7 (SISO Feedback Control field).

The Sector Sweep Feedback element is defined in 9.4.2.176 (Sector Sweep Feedback element).

The SISO Feedback frame contains more than one Sector Sweep Feedback element if the measurement information exceeds 255 octets(#1650). The content of each Sector Sweep Feedback element that follows the first one in a single SISO Feedback frame is a continuation of the content in the previous element. The SNR and CDOWN subfields can be split between several elements. Each Sector Sweep Feedback element that is not the last Sector Sweep Feedback element in the frame is 258 octets(#1650) long. Measurement information for a single sector sweep measurement is always contained within a single SISO Feedback frame.

NOTE—The length of a SISO Feedback frame can limit the choice of the number of measurements.

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

***#14: Insert the following clause:***

9.6.22.5 MIMO Setup frame format

The MIMO Setup frame is an Action No Ack frame. The format of a MIMO Setup frame Action field is shown in Table 9-417b (MIMO Setup frame Action field format).

|  |
| --- |
| Table 9-417b−MIMO Setup frame Action field format(11ad) |
| Order | Information |
| 1 | Category |
| 2 | Unprotected DMG Action |
| 3 | Dialog Token |
| 4 | EDMG BRP Request field |
| 5 | MIMO Training Control element |
| 6 | One or more BRP Configuration elements |

The Category field is defined in 9.4.1.11 (Action field).(#3403)

The Unprotected DMG Action field is defined in 9.6.22.1 (Unprotected DMG Action field).(#3403)

The Dialog Token field is set to a value chosen by the STA sending the frame to uniquely identify the transaction.

The EDMG BRP Request field is defined in 9.x.x (EDMG BRP Request field).

The MIMO Training Control element is defined in 9.4.2.179 (MIMO Training Control element).

The BRP Configuration element is defined in 9.4.2.177 (BRP Configuration element).

The MIMO Setup frame contains more than one BRP Configuration element if the BRP configuration information exceeds 255 octets(#1650). The content of each BRP Configuration element that follows the first one in a single MIMO Setup frame is a continuation of the content in the previous element. The Number of TX Sectors per BRP Frame and the Sector ID subfields can be split between several elements. Each BRP Configuration element that is not the last BRP Configuration element in the frame is 258 octets(#1650) long. The BRP configuration information for a SU-MIMO training subphase or a MU-MIMO training subphase is always contained within a single MIMO Setup frame.

NOTE—The length of a MIMO Setup frame can limit the choice of training parameters such as the number of BRP frames.

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***#15: Insert the following clause:***

9.6.22.6 MIMO Feedback frame format

The MIMO Feedback frame is an Action No Ack frame. The format of a MIMO Feedback frame Action field is shown in Table 9-417c (MIMO Feedback frame Action field format).

|  |
| --- |
| Table 9-417c−MIMO Feedback frame Action field format(11ad) |
| Order | Information |
| 1 | Category |
| 2 | Unprotected DMG Action |
| 3 | Dialog Token |
| 4 | MIMO Training Control element |
| 5 | One or more EDMG Channel Measurement Feedback elements |

The Category field is defined in 9.4.1.11 (Action field).(#3403)

The Unprotected DMG Action field is defined in 9.6.22.1 (Unprotected DMG Action field).(#3403)

The Dialog Token field is set to a value chosen by the STA sending the frame to uniquely identify the transaction.

The MIMO Training Control element is defined in 9.4.2.179 (MIMO Training Control element).

The EDMG Channel Measurement Feedback element is defined in 9.4.2.178 (EDMG Channel Measurement Feedback element).

The MIMO Feedback frame contains more than one EDMG Channel Measurement Feedback element if the measurement information exceeds 255 octets(#1650). The content of each EDMG Channel Measurement Feedback element that follows the first one in a single MIMO Feedback frame is a continuation of the content in the previous element. The Channel Measurement, Tap Delay, TX Sector Combinations, RX Sector Combinations and AID subfields can be split between several elements. Each EDMG Channel Measurement Feedback element that is not the last EDMG Channel Measurement Feedback element in the frame is 258 octets(#1650) long. The feedback information for a SU-MIMO training subphase or a MU-MIMO training subphase is always contained within a single MIMO Feedback frame.

NOTE—The length of a MIMO Feedback frame can limit the channel measurement parameters such as the number of measurements and the number of taps.

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**References:**

1. IEEE Std 802.11™-2016, Dec 2016