IEEE P802.11
Wireless LANs

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| Spec Text for SFD clause 3.2 |
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Abstract

This document spec text to cover the text in clause 3.2 of the SFD.

General

This document proposes text to deal with SFD proposal on the SFD BF clause 3.2. The text is proposed as an amendment to REVmc draft 8.1 beamforming and frame format clauses.

The 11ay SLS beamforming protocol shall enable feedback of one or more sectors per TX and RX antenna.

Proposed Solution:

Add a bit to the SSW-Feedback and SSW-ACK packets. This bit will go into the EDMG BRP Request field This bit will indicate the need for additional feedback. The additional feedback frames will follow the SS-ACK frame. These frames will be BRP frames with an addition mode of feedback that will enable multiple sector feedback for multiple TX and Rx antennas.

***TGay Editor: Replace figure 9-639 at page 1105 by the following figure:***



Figure 1-BRP request field format

***TGay Editor: Insert the following text at the end of subclause 9.5.4:***

The Extended Feedback Requested field, when set to 1 in an SSW-Feedback or SSW-ACK frame indicates that additional sector feedback is required. In this case the other request fields should be ignored. This field may be set to 1 only when both the initiator and the responder are DMG STA.

***TGay Editor: Add the following figure after figure 9-638 SSW feedback field format when not transmitted as part of an ISS:***



Figure 2-SSW Feedback field format when the SSW flag is set to 1

***TGay Editor: Add the following field at the end of 9.5.3***

When the long SSW flag is set to 1, bits B17-B21 are the most significant bits of the Sector Select field and those fields should be combined to get the selected sector. When the long SSW flag is set to 1, bits 22 indicates the most significant bit of the DMG Antenna Select and the those fields should be combined to get the selected DMG antenna.

***TGay Editor: Add the following field to subclasue 9.5***

**9.5.n EDMG BRP request field**

The EDMG Request field is defined in Figure 1.



Figure 3- EDMG BRP request field

The L-RX, TX-TRN-REQ, MID-REQ, BC-REQ, MID-Grant, BC-Grant, Chan-FBCK-CAP, TX Sector ID and Other\_AID field are interpreted in the same way as these fields in the BRP request field (9.5.4), even though some of these fields have a larger number of bits in the EDMG BRP request field.

***TGay Editor: Add the following element to subclasue 9.4.2***

**9.4.2.n EDMG Beam Refinement element**

The EDMG Beamf Refinement element is defined as shown in Figure 2.

The Element ID and Length fields are defined in 9.4.2.1

The Initiator, TX-train-response, RX-train-response TX-TRN-OK, BS-FBCK, BS-FBCK Antenna ID, MID Extension have the same interpretation in in the DMG Beam Refinemement Elemennt (9.4.2.130), although the BS-FBCK and BS-FBCK Antenna ID have a larger number of bits to support a larger number of sectors and DMG antennas.

The FBCK-REQ has an additional bit at the end (Bit 39) to indicate a request for multiple antenna sector feedback.

The FBCK-TYPE field has an additional bits at the end: (Bit 60) “Beam Track Feedback” indicates that Beam Tracking feedback field is present. The Number of Measurements field is extened to 10 bits. The Number of measurement indicates the number of measurements per all RX antennas.



Figure 4 -EDMG Beam Refinement Element

***TGay Editor: Add the following element to subclasue 9.4.2***

9.4.2.n EDMG Channel Measurement Feedback element

The EDMG Channel Measurement Feedback element is used to carry the channel measurement feedback data that the STA has measured on the TRN-T fields of the BRP packet that contained the Channel Measurement request, to provide a list of sectors identified during a sector sweep, or during beam combination (10.38.6.3 (MIDC (multiple sector ID capture) subphase)) and during beam tracking. The format and size of the Channel Measurement Feedback element are defined by the parameter values specified in the accompanying DMG Beam Refinement element.

The Channel Measurement Feedback element, as shown in Table, is composed of 6 subfields: the SNR subfield, the Channel Measurement subfield, the Tap Delay subfield, the Sector ID Order subfield, the Multiple Antenna feedback element, and the beam track feedback subfield.

| Field | Size | Meaning |
| --- | --- | --- |
| Element Id | 8 bits |  |  |
| Length | 8 bits |  |  |
| SNR | $$SNR\_{1} $$ | 8 bits | SNR as measured in the first TRN-T subfield or at the first sector which SSW is received |
| $$SNR\_{1}$$ | 8 bits | SNR as measured in the second TRN-T subfield or at the second sector which SSW is received |
| $$\vdots $$ |  |  |
| $$SNR\_{N\_{meas}}$$ | 8 bits | SNR as measured in the $N\_{meas}$ TRN-T subfield or at the $N\_{meas}$ sector which SSW is received |
| Channel Measurement | Channel Measurement 1 | $$N\_{taps}×16 bits$$ | Channel Measurement for the first TRN-T subfield |
| Channel Measurement 2 | $$N\_{taps}×16 bits$$ | Channel Measurement for the second TRN-T subfield |
| $$\vdots $$ |  |  |
| $$ Channel Measurement N\_{meas}$$ | $$N\_{taps}×16 bits$$ | Channel Measurement for the $N\_{meas}$ TRN-T subfield |
| TAP delay | Relative Delay tap #1 | 8 bits | The delay of Tap #1 in units of Tc relative to the path with the shortest delay detected |
| Relative Delay tap #2 | 8 bits | The delay of Tap #2 in units of Tc relative to the path with the shortest delay detected |
| $$\vdots $$ |  |  |
| $$Relative Delay tap \#N\_{meas}$$ | 8 bits | The delay of Tap $\#N\_{meas}$ in units of Tc relative to the path with the shortest delay detected |
| Sector ID Order | Sector ID1 | 10 bits | Sector ID of SNR1 begin obtained, or sector ID of the first detected beam |
| TX Antenna ID1 | 3 bits | TX Antenna ID corresponding to sector ID1 |
| RX Antenna ID1 | 3 bits | RX Antenna ID on which SNR1 was observed |
| Sector ID2 | 10 bits | Sector ID of SNR2 begin obtained, or sector ID of the first detected beam |
| TX Antenna ID2 | 3 bits | TX Antenna ID corresponding to sector ID2 |
| RX Antenna ID2 | 3 bits | RX Antenna ID on which SNR2 was observed |
| $$\vdots $$ |  |  |
| Sector $ID\_{N\_{meas}}$ | 10 bits | Sector ID of $SNR\_{N\_{meas}}$ begin obtained, or sector ID of the first detected beam |
| TX Antenna $ID\_{N\_{meas}}$ | 3 bits | TX Antenna ID corresponding to sector $ID\_{N\_{meas}}$ |
| RX Antenna $ID\_{N\_{meas}}$ | 3 bits | RX Antenna ID on which $SNR\_{N\_{meas}}$ was observed |
| Beam Track feedback | 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 $N\_{meas}$ AWV 1 | 11 bits | Contains the AWV for TX DMG antenna 1 |
| Tx Sector Combination $N\_{meas}$ AWV 2 | 11 bits | Contains the AWV for TX DMG antenna 2 |
| … |  |  |
| Tx Sector Combination $N\_{meas}$ AWV NTX | 11 bits | Contains the AWV for TX DMG antenna NTX |

The SNR, Channel ID and Tap Delay fields have the same interpretation as in the Channel Measurement Feedback Element.

The Sector ID order has the same interpretation as in the Channel Measurement Feedback Element, except that here each group has both a TX antenna ID and RX DMG antenna ID. A specific TX sector may have been received by several RX DMG antenna IDs, each of them will have a different SNR value in the SNR field.

The Beam Track Feedback contains $N\_{meas}$ Tx Sector combinations, each contains the best sector received from DMG antenna.

***TGay Editor: Modify the text at the beginning of 10.38.2.1 as follows:***

The SLS phase can include as many as four components: an initiator sector sweep (ISS) to train the initiator link as described in 10.38.2.2 (Initiator Sector Sweep (ISS)), a responder sector sweep (RSS) to train the responder link as described in 10.38.2.3 (Responder sector sweep (RSS)), an SSW feedback procedure as described in 10.38.2.4 (Sector Sweep Feedback), and an SSW ack procedure as described in 10.38.2.5

(Sector Sweep Ack). When both the initiator and responder(s) are EDMG STAs, the SLS phase may have an additional component: Long Sector Sweep Feedb (10.38.2.5)

***TGay Editor: Add the following text at the end of subclause 10.32.2.4 (Sector Sweep Feedback)***

The initiator may indicate the additional feedback, for more than one TX DMG antenna and more than one RX DMG antenna needs to be sent to the responder by setting the Extended Feedback Requested field to 1 in the BRP-request field. In this case, the rest of these fields shall be ignored by the receiver.

***TGay Editor: Add the following text at the end of subclause 10.32.2.5 (Sector Sweep ACK)***

The initiator may indicate the additional feedback, for more than one TX DMG antenna and more than one RX DMG antenna needs to be sent to the responder by setting the Extended Feedback Requested field to 1 in the BRP-request field. In this case, the rest of these fields shall be ignored by the receiver.

***TGay Editor: Add the following subclause after 10.38.2.5***

**10.38.2.6 Long Sector Sweep Feedback**

The long sector sweep feedback procedure follows SIFS after the SSW ACK procedure when either the initiator or responder set the the Extended Feedback requested field to 1 in the BRP-request field.

This procedure is performed only when both the initiator and the responder are EDMG STAs.

This procedure starts by the initiator transmitting an EDMG BRP Frame than includes an EDMG BRP element. This element may include an EDMG Channel Feedback element with the sector ID order field and the SNR fields, indicating sectors that were received from different responder TX DMG antennas by several initiator RX DMG antennas. If the initiator have not set Extended Feddback request field to 1, it shall transmit an EDMG BRP frame with the SNR requested and Sector Id Order requested set to 1. Values in the EDMG BRP request field of this frame override the values in the BRP request field that were sent in the SS-Feedback frame.

The responder responds with and EDMG BRP frame SIFS after the transmission of the initiator. This element may include an EDMG Channel Feedback element with the sector ID order field and the SNR fields, indicating sectors that were received from different initiator TX DMG antennas by several responder RX DMG antennas. Values in the EDMG BRP request field of this frame override the values in the BRP request field that were sent in the SS-ACK frame.