IEEE P802.11  
Wireless LANs

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| --- | --- | --- | --- | --- |
| BF Correction | | | | |
| Date: 2012-06-14 | | | | |
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|  |  |  |  |  |

Abstract

This document proposes corrections to BF bugs in TGad D8.0.

Link Measurement improvement.

Make link margin an optional element, defines the reference PER

***TGad Editor: modify P202L36-29 As follows:***

The Link Margin field contains the measured link margin of data frames received from the peer STA indicated in the RA field of the Link Measurement Report frame and is coded as a 2’s complement signed integer in units of decibels. A value of -128 indicates that no link margin is provided. The measurement method of link margin is beyond the scope of this standard.

***TGad Editor: modify P202L31-24 As follows:***

The MCS field is set to an MCS value that the STA sending this element recommends that the peer STA indicated in the RA field of the Link Measurement Report frame use to transmit frames to this STA. The reference PER for selection of the MCS is 10-2 for an MPDU length of 4096 octets. The method by which the sending STA determines a suitable MCS for the peer STA is implementation specific.

TSPEC PER requirement too low

***TGad Editor: modify table 8-110a as follows:***

|  |  |
| --- | --- |
| Reliability index | PER |
| 0 | Not specified |
| 1 | 10-2 |
| 2 | 10-3 |
| 3 | 10-4 |

Remove restrictions from operation in CBAP

***TGad Editor: Remove P295L23-24***

Aggregation of BRP packets

***TGad Editor: modify P361L40***

Two or more BRP fraems shall not be aggregated in the same A-MPDU. A BRP farema may be aggregaegd with another frame in the same A-MPDU only if the other frame is a single, ACK, BA, or QoS-Null data frame.

**Disallowing an SLS to break across allocations**

***TGad Editor: modify P350L25-29 as follows:***

The initiator shall begin an ISS (9.35.2.2) at the start of the allocation with an initiator TXSS, except when the allocation is an SP and the isInitiatorTXSS field for this SP is equal to 0 in which case the initiator shall begin an ISS with an initiator RXSS.

***TGad Editor: Modify P350L36-39 as follows:***

an SSW frame from the initiator during the ISS.

**Defining Multi-Antenna BF after link loss**

***TGad Editor: Add the following text after P350L29:***

If the initiator begins the SLS within a CBAP and the responder has more than one DMG antenna, the initiator shall repeat its ISS *k+1* times, where *k* is the value indicated by the responder in the last negotiated Number of RX DMG Antennas field transmitted by the responder, Repetitions of the ISS are separated by an interval equal to LBIFS. The value of the CDOWN field within SSW frames transmitted in the ISS indicates the number of sectors until the end of transmission from all of the initiator’s DMG antennas to all of the responder’s DMG antennas.

**Defining the order in which transmit DMG antennas antennas are used**

***TGad Editor: Modify P336L42- as follows***

The responder shall set the CDOWN field in each transmitted SSW frame to contain the total number of transmissions remaining to the end of the responder TXSS, such that the last SSW frame transmission of the responder TXSS has the CDOWN field set to 0. The responder shall transmit from its DMG antennas in increasing order of Antenna IDs. Each transmitted SSW frame shall be separated by an interval of time equal to SBIFS. Transmissions are not separated by SBIFS if the allocation ends as described in 9.35.4 2

Allow two RXSS in the same grant.

***TGad Editor: Modify P223L37-38 as follows:***

with a responder RXSS.

***TGad Editor: RemoveP332L16-17:***

***TGad Editor Remove P335L13-14:***

***TGad Editor: Add the following text after P224L15:***

If both isInitiatorTXSS and isResponderTXSS are set to 0 and the BF Control field is sent within a Grant 21 frame, the RXSSTxRate subfield refers to the RSS only. If both isInitiatorTXSS and isResponderTXSS are set to 0 and the BF Control field is sent within a Grant ACK frame, the RXSSTxRate subfield refers to the ISS only.

Grant/Grant ACK combination

Initiating a sector sweep using a Grant frame enables control of beamforming parameters. The initiator cannot be sure however that the grant frame was received by the responder. It is better to add a frame that acknowledges the receipt of the grant and also enable update for the responder BF parameters.

***TGad Editor: Modify P333L16-19 as follows:***

initiator TXSS (see also 9.35.4). During a CBAP an initiator may obtain a TXOP with an initiator TXSS or may transmit a Grant frame to the responder with the Beamforming Training and isInitiatorTXSS fields of the BF Control field set to 1. A responder that receives such a Grant frame in a CBAP and that has the Grant ACK Supported field equal to 1 in the responder’s DMG Capabilities element shall respond with a Grant ACK frame SIFS interval after the reception of the Grant frame. In the Grant ACK frame, the responder shall set the Beamforming Training field to 1. The initiator starts the initiator TXSS SIFS interval after the reception of the Grant ACK frame if the Grant ACK Supported field in the responder’s DMG Capabilities element is 1, or PIFS interval after the transmission the Grant frame otherwise. To transmit a Grant frame during a TXOP, the TXOP holder shall first terminate the TXOP by transmitting a CF-End frame followed by the transmission of the Grant frame PIFS interval after the end of the last CF-End frame transmission.

***TGad Editor: Modify P334L28-31 as follows***

During a CBAP, an initiator shall not obtain a TXOP with an initiator RXSS. Within a CBAP, an initiator may transmit a Grant frame to the responder with the Beamforming Training field set to 1 and the isInitiatorTXSS field set to 0. A responder that receives such a Grant frame in a CBAP and that has the Grant ACK Supported field equal to 1 in the responder’s DMG Capabilities element shall respond with a Grant ACK frame SIFS interval after the reception of the Grant frame. In the Grant ACK frame, the responder shall set the Beamforming Training field to 1. The initiator starts the initiator RXSS SIFS interval after the reception of the Grant ACK frame if the Grant ACK Supported field in the responder’s DMG Capabilities element is 1, or PIFS interval after the transmission the Grant frame otherwise.

***TGad Editor: Modify table 8-1a as follows:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Type value**  **b3 b2** | **Subtype value**  **b7 b6 b5 b4** | **Control Frame Extension value**  **b11 b10 b9 b8** | **Description** |
| 01 | 0110 | 0111 | Grant ACK |

***TGad Editor: Add the following subclause***

**8.3.1.x Grant Ack frame format**

The format of the Grant frame is shown in Figure xyz.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Frame control | Duration | RA | TA | Reserved | BF Control | FCS |
| Octets | 2 | 2 | 6 | 6 | 5 | 2 | 4 |

**Figure xyz Grant Ack frame format**

The duration value is the value obtained from the Duration/ID field of the immediately previous Grant

frame minus the time, in microseconds, required to transmit the Grant ACK frame and its SIFS interval.

The RA field of the Grant ACK frame is copied from the Address 2 field of the immediately previous individually addressed Grant frame

The TA field contains the MAC address of the STA that has transmitted the Grant ACK frame.

The BF Control field is defined in 8.4a.5 Beamforming Control field.

The Grant ACK frame is sent only in response to grant frame with the BF training field set to 1.

***TGad Editor: Modify P137L25***

The value in the Duration/ID field within Poll, SPR, Grant, Grant ACK, DMG CTS, DMG DTS, SSW, SSW-

***TGad Editor: add Grant ACK field to the 8.4.2.130.2 DMG STA Capability Information field. Use B60 for Grant ACK capability. Update the number of reserved bits.***

***TGad Editor: Add the following text at the end of 8.4.2.130.2:***

The Grant ACK Supported field is set to 1 to indicate that the STA is capable of responding to a Grant 3 frame with a Grant ACK frame. Otherwise, this field is set to 0.

***TGad Editor: Modify P233L30-31***

that is an immediate response to either a BlockAckReq frame or an A-MPDU, a DMG CTS frame, a DMG DTS frame, an SSW-ACK frame, A Grant ACK frame, a response frame transmitted in the ATI, the second or

Allow an A-BFT with only one slot

***TGad Editor: In Table 10-18 change aMinSSSlotsPerABFT to 1.***

Performing RXSS on MCS >0 only if receiver allows it.

Making the RXSS with MCS 1 (RXSSTxRate = 1) dependent on STA capability.

***TGad Editor: Add a single-bit field called the “RXSSTxRate” to the DMG STA Capability Information field at bit 60 (B60).***

The RXSSTxRate field is set to 1 to indicate that the STA can perform a RXSS operation with SSW frames transmitted in MCS1 of the DMG SC modulation class. Otherwise it is set to 0.

TGad Editor: Modify P273L33-34 as follows

RXSSTxRate subfield equal to 1, and the RXSSTxRate Supported field in the DMG Capabilities element of the STA performing the RXSS is 1, the first SSW frame of the RXSS shall be transmitted using the DMG Control modulation class and the remaining frames of the RXSS shall be transmitted using

Modifying Multi-antenna BF to deal with short allocations.

We believe that multi-antenna BF flow is an important flow since we expect to see devices with multiple antennas (antenna arrays).

We also think that fast beamforming recovery after link loss or an impending link loss is essential for applications with small jitter buffers such as video and audio..

Due to the uncertainty in the starting point of service periods and CBAPS, it is impossible (or actually risky), to split multi-antenna BF over different allocations.

We therefore seek to enable the transmitter and responder to shorten their sweeps, to deal with small allocations, or with a limited time remaining up to the end of the allocation.

Allowing control of the length of the sector sweep in BF control field.

According to the current text, whenever a device with multiple antennas participate in a sector sweep, it has to use the total number of sector indicated in its capabilities element for transmission and the number of antennas for reception. We propose to allow the grant frame to modify that.

***TGad Editor Modify P223L22 as follows:***

The beamforming control field is formatted as shown in Figure 8-431g when both the isInitiatorTXSS and isResponderTXSS subfields are equal to 1, and the Beamforming Control field is transmitted in either a Grant or Grant ACK frames. In all other cases, the Beamforming Control field is formatted as shown in Figure 8-431f

***TGad Editor Modify the caption of 8-431f as follows:***

**– BF Control field format in all other cases**

*TGad Editor: Add the following figure After 8-431f*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B3-B9 | B10-B11 | B12  -B15 |
|  | Beamforming Training | isInitiatorTXSS | isResponderTXSS | Total Number of Sectors | Number of RX DMG Antennas | Reserved |
| Bit: | 1 | 1 | 1 | 7 | 2 | 4 |

Figure 8-431g: BF Control field format when both isInitiatorTXSS and isResponderTXSS are equal to 1 and the field is transmitted in either a Grant or a Grant ACK frame

**TGad Editor: modify P224L4**the total number of transmit DMG antennas of the peer device.

***TGad Editor: Modify P224L15 as follows.***

the remaining frames use MCS1 of the DMG SC modulation class. If both isInitiatorTXSS and isResponderTXSS are set to 0 and the BF Control field is sent within a Grant frame, the RXSSTxRate subfield refers to the RSS only. If both isInitiatorTXSS and isResponderTXSS are set to 0 and the BF Control field is sent within a Grant ACK frame, the RXSSTxRate subfield refers to the ISS only.

When the BF Control field is transmitted in a Grant frame, the Total Number of Sectors subfield indicates the total number of sectors the initiator uses during the ISS. When the BF Control field is transmitted in a Grant ACK frame, the Total Number of Sectors subfield indicates the total number of sectors the responder uses during the RSS.

When the BF Control field is transmitted in a Grant frame, the Number of RX DMG Antennas subfield indicates the number of receive DMG antennas the initiator uses during the RSS. When the BF Control field is transmitted in a Grant ACK frame, the Number of RX DMG Antennas subfield indicates the number of receive DMG antennas the responder uses during the ISS.

Enabling the initiator to control the number of receive antennas in RSS.

When the link is lost, BF cannot be initiated using grant frames. The only way to shorten it is to allow the transmitter to limit the number of receive antennas it uses during the RSS. This can be done using reserved bits in the sector sweep feedback field when used in the ISS.

***TGad Editor: Modify Figure 8-431c as follows:***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B0-B8 | B9-B10 | B11-B15 | B16 | B17-B23 |
|  | Total Sectors in ISS | Number of RX DMG Antennas | Reserved | Poll Required | Reserved |
| Bits: | 9 | 2 | 5 | 1 | 7 |

***TGad Editor: Add the following after P231L32:***

The Number of RX DMG Antennas subfield indicates the number of receive DMG antennas the initiator uses during the following RSS.

***TGad Editor Modify P333L59 as follows:***

The initiator shall set the Total Sectors in ISS subfield within the SSW Feedback field to the total number of sectors that it is using in the ISS. The total is computed as the sum of all sectors employed on all antennas in the ISS multiplied by the number of the responder’s receive DMG antennas. For example, if 4 sectors are used on antenna 0, 3 sectors on antenna 1, 5 sectors on antenna 2, then the Total Sectors in ISS subfield is set to 24..

***TGad Editor: Modify P333L31- as follows***

If the initiator has more than one DMG antenna, the initiator transmits the BF frame through a number of sectors equal to the value of the last negotiated Total Number of Sectors field that was transmitted by the initiator to the responder. In each transmitted BF frame, the initiator shall set the Sector ID and DMG Antenna ID fields to uniquely identify the sector and the DMG Antenna ID, respectively, the initiator is using for the frame transmission and shall set the CDOWN field to the total number of transmissions remaining from all of the initiator’s DMG antennas.

For an ISS outside the BTI and if the responder has more than one DMG antenna, the initiator repeats its initiator sector sweep for the number of DMG antennas indicated by the responder in the last negotiated Number of RX DMG Antennas field that was transmitted by the responder . Repetitions of the initiator sector sweep are separated by an interval equal to 6×SIFS time. In this case CDOWN indicates the number of sectors until the end of transmission from all initiator’s DMG antennas to all responder’s DMG antennas. At the start of an initiator TXSS, the responder should have its first receive DMG antenna configured to a quasi-omni pattern and should not change its receive antenna configuration for a time corresponding to the value of the last negotiated Total Number of sectors field transmitted by the initiator multiplied by the time to transmit a single SSW frame, plus appropriate IFSs (9.3.2.3 IFS). After this time, the responder may switch to a quasi-omni pattern in another DMG antenna.

***TGad Editor: Modify P334L33-35 as follows:***

During the initiator RXSS, the initiator shall transmit from each of the initiators’s DMG antennas the number of BF frames indicated by the responder in the last negotiated RXSS Length field transmitted by the responder . Each transmitted BF frame shall be transmitted with the same fixed antenna sector or pattern. The initiator shall set the Sector ID and

***TGad Editor: modify P336L25-31 as follows:***

If the initiator has more than one DMG antenna, the responder repeats its responder sector sweep for the number of DMG antennas indicated by the initiator in the last negotiated Number of RX DMG Antennas field trasnmitted by the initiator. At the start of a responder TXSS, the initiator should have its receive antenna array configured to a quasi-omni antenna pattern in one of its DMG antennas for a time corresponding to the value of the last negotiated Total Number of Sectors field transmitted by the responder multiplied by the time to transmit a single SSW frame, plus any appropriate IFSs (9.3.2.3 IFS). After this time, the initiator may switch to a quasi-omni pattern in another DMG antenna.

***TGad Editor Modify P337L16-19 as follows:***

During the responder RXSS, the responder shall transmit the number of SSW frames indicated by the initiator in the initiator’s most recently transmitted RXSS Length field (non-A-BFT) or FSS field (A-BFT) from each of the responder’s DMG antennas, each time with the same antenna sector or pattern fixed for all SSW frames transmission originating

***TGad Editor: Add the following after P336L12***

The length of the sector sweep to each of the initiator’s DMG antennas is not dependent on the DMG Antenna Reciprocity field.

Making RXSS in A-BFT optional

TGad Editor: Modify P346L14-16 as follows:

transmit the number of SSW frames announced in the FSS field in the DMG Beacon. If the PCP/AP allocates the A-BFT as a responder RXSS, it should set the value of the FSS field within

***TGad Editor: insert the following subclauses after 9.3.2.3.9***

**9.3.2.3.10 MBIFS**

The MBIFS (Medium Beamforming Interframe Spacing) is used between the BTI and the A-BFT and between the ISS, RSS, SS-Feedback and SS-ACK. MBIFS is equal to 3×aSIFStime. An implementation of a DMG STA shall not allow the space between frames that are separated by MBIFS time, as measured on the medium, to vary from the nominal MBIFS value by more than -0% or +10 of aSlotTime.

***TGad Editor: Please illustrate the MBIFS parameter in Figure 105 and Figure 106 and Figure 112.***

**9.3.2.3.10 LBIFS**

The LBIFS (Long Beamforming Interface Spacing) is used between transmissions between different DMG antennas and when the intended receiver may switch DMG antennas. LBIFS is equal to 6×aSIFStime. An implementation of a DMG STA shall not allow the space between frames that are separated by LBIFS time, as measured on the medium, to vary from the nominal LBIFS value by more than -0% or +10 of aSlotTime.

***TGad Editor: Please illustrate the LBIFS parameter in Figure 107,108.***

***TGad Editor: Replace all instances of 3xSIFS by MBIFS***

***TGad Editor: Replace all instances of 6xSIFS by LBIFS***

Allowing an Allocation Destination to recommend BF training

***WGA Editor: insert the following line as a penultimate raw in table 8-183p – Activity field values***

|  |  |
| --- | --- |
| 6 | recommending SLS |

SNR report in SLS

***TGad Editor: Modify P336L23as follows:***

SNR Report field to the SNR measured for the frame indicated by the Sector Select field and DMG Antenna Select field .

***TGad Editor: Modify P33813-14 as follows:***

SNR Report field to the SNR measured for the frame received by the sector and DMG antenna 9 indicated by the Sector Select field and DMG Antenna Select field. The SSW-Feedback frame shall be transmitted through the sector identified by the value of the