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Wireless LANs

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| A-BFT  |
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Abstract

This submission provides normative text corresponding to Subsection 3.2.1 A-BFT of the 11ay SFD.

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* + 1. A-BFT

3.2.1.1 A-BFT over multiple channels in TGay

Modification to “802.11-2016”

**10.38.5 Beamforming in A-BFT**

**10.38.5.1 Allocation of A-BFT**

***Insert the following paragraph after the third paragraph of 10.38.5.1***

An EDMG PCP or AP may schedule an A-BFT that spans more than one channel. An EDMG STA that supports this type of A-BFT may access the A-BFT over the different channels where the A-BFT is scheduled.

**10.38.5.2 Operation during the A-BFT**

***Insert the following subclause 10.38.5.2a (including Figure 10-69 and Figure 10-70) after the last paragraph of 10.38.5.2***

**10.38.5.2a A-BFT over multiple channels**

When the EDMG PCP/AP and EDMG STAs in a BSS or PBSS have capabilities to operate over multiple channels, an EDMG STA can transmit SSW frames to the EDMG PCP/AP and the EDMG PCP/AP can transmit an SSW Feedback frame to an EDMG STA over either the primary channel or a secondary channel with the bandwidth of 2.16 GHz. The A-BFT for a DMG STA operates over the primary channel only.

In EDMG, the A-BFT is slotted in the time domain as it in DMG (10.38.5.2). The random backoff procedure for selecting an SSW slot can be specified as that a DMG STA or an EDMG STA randomly selects a SSW slot number from a uniform distribution [0, A-BFT Length-1], where A-BFT Length is the value in the A-BFT Length subfield in the last received DMG Beacon. In the frequency domain, the EDMG STA selects either the primary channel or a secondary channel randomly with the uniform distribution based on the *BSS Operating Channels* in the *EDMG Operation element*. Then SSW frames shall be sent on the selected SSW slot and the selected channel.

The EDMG PCP/AP transmits an SSW-Feedback frame to an STA over the channel on which the SSW frames are sent from that STA to the EDMG PCP/AP. In the case that there is no SSW slot collision due to the random backoff procedure at the start of A-BFT, the SSW-Feedback frame for an STA is sent in the same SSW slot as which the SSW frames are sent from this STA to the EDMG PCP/AP. Otherwise, in the case that there is an SSW slot collision due to the random backoff procedure at the start of A-BFT, the SSW-Feedback frames for SSW slot-collided STAs may be sent in the next available SSW slot(s) if the best Sector ID/Antenna ID in the EDMG PCP/AP for the directions to STAs are different (as shown in Figure 10-69); or the SSW-Feedback frames for SSW slot-collided STAs may be sent in the same SSW slot in which the SSW frames are sent from the STAs over different channels if the best Sector ID/Antenna ID in the EDMG PCP/AP for the directions to the STAs are the same (as shown in Figure 10-70).

**Example of A-BFT with A-BFT Length = 8 over the primary channel and a secondary channel (the same assumption as in Figure 10-68). A possible contention between 3 STAs is shown in the figure below:** STAs A, B and C are competing for access. All STAs choose a random value between [0,7]. STA A chooses value = 2, while STAs B and C choose value = 5. STA B is a DMG STA and STAs A and C are EDMG STAs. STA B can only select the primary channel while STAs A and C select the primary channel and the secondary channel, respectively. Although STAs B and C collide on SSW slot #5, STAs B and C transmit SSW frames over different channels permitting the EGDM PCP/AP to correctly decode the SSW frames sent from STA B and STA C simultaneously. The SSW-Feedback frames for STAs A and B are sent from the EDMG PCP/AP in the same SSW slots (SSW slot #2 and SSW slot #5) in which the SSW frames are sent from STAs A and B respectively. The SSW-Feedback frame for STA C is sent in a next available SSW slot (e.g., SSW slot #6) if the best Sector ID/Antenna ID in the EDMG PCP/AP for the directions to STA B and SAT C are different.

**Figure 10-69 – EDMG A-BFT over multiple channels (the best Sector ID/Antenna ID in the EDMG PCP/AP for the directions to STA B and SAT C are different).**

**Example of A-BFT with A-BFT Length = 8 over the primary channel and a secondary channel (the same assumption as in Figure 10-68). A possible contention between 3 STAs is shown in the figure below:**

Transmission of SSW frames is the same as that in Figure 9-56A. The SSW-Feedback frames for STAs A and B are sent from the EDMG PCP/AP in the same SSW slots (SSW slot #2 and SSW slot #5) over the primary channel, in which the SSW frames are sent from the STAs respectively. If the best Sector ID/Antenna ID in the EDMG PCP/AP for the directions to STA B and SAT C are the same, the SSW-Feedback frame for STA C can also be sent in the SSWS slot #5 but over the secondary channel.

**Figure 10-70 – EDMG A-BFT over multiple channels (the best Sector ID/Antenna ID in the EDMG PCP/AP for the directions to STA B and SAT C are the same).**

3.2.1.2 Dynamic load balance in A-BFT

Modification to “802.11-2016”

**10.38.5.2 Operation during the A-BFT**

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Each STA maintains a counter, FailedRSSAttempts, of the consecutive number of times the STA initiates RSS during A-BFTs but does not successfully receive an SSW-Feedback frame as a response. If FailedRSSAttempts exceeds dot11RSSRetryLimit, the STA shall select a backoff count as a random integer drawn from a uniform distribution [0, dot11RSSBackoff), i.e., 0 to dot11RSSBackoff – 1. The responder shall decrement the backoff count by one at the end of each A-BFT period in the following beacon intervals. The responder may re-initiate RSS only during an A-BFT when the backoff count becomes zero. The STA shall set FailedRSSAttempts to 0 upon successfully receiving an SSW-Feedback frame during the A-BFT.

***Insert the following paragraph as follows:***

The RSSRetryLimit and RSSBackoff subfields in the EDMG Operation element are used for the purpose of dynamic load balancing in A-BFT. Each EDMG STA follows the same RSS operation as DMG STA using RSSRetryLimt and RSSBackoff parameters instead of dot11RSSRetryLimit and dot11RSSBackoff, respectively.

3.2.1.3 Extending the length of the A-BFT

Modification to “802.11-2016”

**10.38.5 Beamforming in A-BFT**

**10.38.5.1 Allocation of A-BFT**

***Insert the following paragraph after the first paragraph of 10.38.5.1***

To accommodate a larger number of STAs attempting access during the A-BFT, the number of SSW slots available to EDMG STAs can be increased compared to what is available to non-EDMG STAs. If present, these additional SSW slots start an MBIFS after the last DMG Beacon frame transmission with Next A-BFT = 0.

**10.38.5.2 Operation during the A-BFT**

***Insert the following subclause 10.38.5.2b (including Figure 10-71) after the last paragraph of 10.38.5.2***

**10.38.5.2b Extending the length of the A-BFT**

The number of additional SSW slots in a beacon interval shall be equal to the value of the A-BFT Length subfield multiplied by the value of the A-BFT Multiplier subfield, where both of these subfields are present in the DMG Beacon frame, and the A-BFT Multiplier subfield is indicated using reserved bits from the Beacon Interval Control field of the DMG Beacon frame. Figure 10-71 depicts how non-EDMG STAs interpret the insertion of the added SSW slots in the beacon interval.

**Figure 10-71**: Additional SSW slots for use by EDMG STAs in relation to the legacy A-BFT

When Next A-BFT is equal to 0 and A-BFT Multiplier is greater than 0, the value of the Duration field within all DMG Beacons shall be increased by A-BFT Length multiplied by A-BFT Multiplier plus the length of an MBIFS to accommodate the additional SSW slots. This guarantees that non-EDMG STAs calculate the correct start time for the legacy A-BFT.