IEEE P802.11
Wireless LANs

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| Resolution of TDD BF Related CIDs |
| Date: 2018-11-07 |
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|  |  |  |  |  |

Abstract

This submission proposes resolutions to CIDs 3476, 3508, 3509, 3548, 3220, 3477, 3478, 3547, 3222, 3546, 3498, 3224, 3499, 3500, 3501, 3502, 3503, 3504, 3507, 3508, 3509, 3542, 3632, 3639 and 3589.

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| --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Comment** | **Proposed change** | **Resolution**  |
| 3476 | 9.3.1.24.1 | The End of Training subfield is defined for TDD individual BF and TDD group BF and is not defined for TDD beam measurement | define the use of the End of Training subfield for TDD beam measurement | Revised End of Training field by itself may not be robust enough as responder may not receive the TDD SSW sent in the last specific direction. A New field was defined to indicate the future time of the end of beam measurement |
| 3508 | 10.43.10.6 | The initiator operation does not define how the TDD beam measurement ends | Please consider using the End of Training subfield in the transmitted SSW frames to announce the end of TDD beam measurement | RevisedSee note for CID 3476 |
| 3509 | 10.43.10.6 | The responder operation does not define how the TDD beam measurement procedure ends | Please consider using the End of Training subfield in the received SSW frame to know the end of TDD beam measurement. The responder shall report the measurement results to the SME after detecting the end of the TDD beam measurement procedure | Revised See note for CID 3476 |
| 3548 | 9.3.1.24 | End of Training field should be defined for TDD Measurement usage as well | As commented | Revised See note for CID 3476 |

**9.3.1.24 TDD Beamforming frame format
9.3.1.24.1 Overview**

*Change text at P74 L14 as follow*

End of Training subfield is set as follows:

* The End of Training subfield is set to 1 in a TDD SSW frame to indicate that the initiator intends to end the TDD individual beamforming training or the TDD beam measurement after the transmission of the remaining TDD SSW frames with the current Sector ID; this subfield is set to 0 otherwise.
* The End of Training subfield is set to 1 in a TDD SSW Feedback frame sent as part of a TDD individual beamforming training if the TDD SSW Feedback is sent in response to a TDD SSW frame in which its End of Training subfield was set to 1; this subfield is set to 0 otherwise.
* The End of Training subfield is set to 1 in a TDD SSW Ack frame to indicate that the TDD individual beamforming training has completed; otherwise, this subfield is set to 0.

For TDD group BF, the End of Training subfield is reserved.

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| **CID** | **Clause** | **Comment** | **Proposed change** | **Resolution**  |
| 3220 | 9.3.1.24.2 | There is no way to indicate antenna Id in TDD beamforming information id - this is important for MIMO | ADD "TX Antenna Id" to the TDD Beamforming Information field format | Revised Antenna ID field was added to all relevant frames and elements  |
| 3477 | 9.3.1.24.2 | The Beamforming Information field of the TDD SSW frame is defined when TDD individual BF and TDD Group BF is defined however not defined for TDD beam measurement | Figure 11 should represent the TDD Beamforming Information field format for both TDD individual BF and TDD beam measurement | Revised A new TDD Beamforming Information field format was defined for TDD beam measurement |

**Discussion**

TDD Beam Measurement is used by the initiator to collect receive measurements from responders: During the TDD Beam Measurement the following is applied:

* All involved STA are notified through MLME request command
* Initiator sends multiple TDD SSW frames
* Stations that receive the TTD SSW for the TDD beam measurement are expected to start receive sector sweeping.
* NO TDD SSW Feedback are sent by the responders and NO TDD SSW Ack are sent as confirmations by the initiator

During the TDD BF, ending of the procedure is signaled by the Initiator to the responder via the “End of Training” field within the TDD SSW Ack (which was transmitted in best link sector hence most likely to be received).

In TDD Beam Measurement there is no TDD SSW Ack transmission hence “End of Training” cannot be communicated in the same method.

Hence, there is an issue to signal it in the last TDD SSW sweep as there is low probability that it will be received by all responders. As solution to the above, a new SSW Count Down is used as running counter of TDD SSW frames left to be transmitted. The responders can utilize the field to calculate the expected end time of the beam measurement procedure.

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| --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Comment** | **Proposed change** | **Resolution**  |
| 3478 | 9.3.1.24.4 | The Initiator Transmit Offset subfield and the Responder Transmit Offset subfield should be only valid when the End of Training subfield is 1 and is reserved otherwise | Please consider making the Initiator Transmit Offset subfield and the Responder Transmit Offset subfield reserved when the End of Training field is zero and defined only when End of Training subfield is one. | Rejected Protocol should give the originator the option to exchange beamforming result through Announce frame without the necessity to end the beamforming procedure. |
| 3547 | 9.3.1.24 | Responder Feedback Offset and Initiator AckOffset should be defined as reserved for the case of TDD Beam measurement usage as the responder does not transmit any response back | As commented | AcceptedFrame format was change so that Responder Feedback Offset and Initiator AckOffset are no longer fields in the TDD SSW frame, other bits were defined as reserved  |

**9.3.1.24 TDD Beamforming frame format
9.3.1.24.1 Overview**

**Table 5—TDD Beamforming frame usage**

|  |  |  |  |
| --- | --- | --- | --- |
| **TDD GroupBeamforming fieldvalue** | **TDD BeamMeasurement fieldvalue** | **RA fieldvalue** | **Beamforming procedure** |
| 0 | 0 | Individual address | TDD individual BF with a known STA |
| 0 | 0 | Broadcast address  | TDD individual BF with an unknown STA |
| 0 | 1 | Individual address | TDD beam measurement with a known STA |
| 0 | 1 | Broadcast address | TDD beam measurement with all neighboring STAs |
| 1 | 0 | Individual address | Reserved |
| 1 | 0 | Broadcast address | TDD group BF with two or more STAs |
| 1 | 1 | Individual address | Reserved |
| 1 | 1 | Broadcast address | Reserved  |

**9.3.1.24.2 TDD Sector Sweep (SSW)**

*Change text as follow*

The TDD Beamforming Information field of a TDD SSW frame when TDD individual BF is used is shown

in Figure 11. The TDD Beamforming Information field of a TDD SSW frame when TDD group BF is used

is shown in Figure 12. The TDD Beamforming Information field of a TDD SSW frame when TDD beam measurement is used is shown in Figure 13.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | TX SectorID | TX AntennaID | CountIndex | Beamforming TimeUnit | TransmitPeriod | ResponderFeedback Offset | Initiator AckOffset | Reserved |
| Bits:  | 10 | 2 | 3 | 3 | 8 | 10 | 10 | 2 |

**Figure 11 —TDD Beamforming Information field format (TDD individual BF )**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | TXSectorID | TX AntennaID | CountIndex | AckCountIndex | Beamforming Time Unit | TransmitPeriod | Number ofResponders | ResponderInfo | … | ResponderInfo | Reserved |
| Bits | 10 | 2 | 3 | 3 | 3 | 8 | 8 | 32 |  | 32 | 3 |

**Figure 12 —TDD Beamforming Information field format (TDD group BF)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | TX SectorID | TX AntennaID | CountIndex | Beamforming TimeUnit | TransmitPeriod | TDD Slot CDOWN  | Reserved |
| Bits:  | 10 | 2 | 3 | 3 | 8 | 10 | 12 |

**Figure 13 —TDD Beamforming Information field format (TDD beam measurement)**

The TX Sector ID subfield is set to indicate the antenna sector through which the TDD SSW frame is transmitted.

The TX Antenna ID subfield indicates the DMG antenna ID through which the TDD SSW frame is transmitted.

The Count Index subfield indicates the repetition of the initiator TDD Beamforming frames within a TDD slot, with the subfield set to 0 for the first transmission and increased by one for each successive transmission within a TDD slot.

The Beamforming Time Unit (BTU) subfield is defined in Table 7. The BTU subfield indicates the

beamforming time unit for the Transmit Period, Responder Feedback Offset and Initiator Ack Offset

subfields in the TDD Beamforming Information field of TDD SSW frames. This subfield also defines the

time unit for the Transmit Period, Initiator Transmit Offset and Responder Transmit Offset subfields in the

TDD Beamforming Information field of TDD SSW Ack frames.

**Table 7—Beamforming Time Unit subfield**

|  |  |
| --- | --- |
| **Value** | **Time unit** |
| 0 | 1 µsec |
| 1 | 100 µsec |
| 2 | 400 µsec |
| 3 – 7 | Reserved |

The Transmit Period subfield indicates the time interval, in units of BTUs, between TDD SSW transmissions with the same Count Index subfield value in different TDD slots. If the Transmit Period Offset subfield is 0, the transmission periodicity is unknown.

The TDD Slot CDOWN subfield is a down-counter indicating the number of remaining TDD SP slots to the end of the TDD beam measurement. This subfield is set to 0 in the last TDD SSW frame transmission.

**9.3.1.24.3 TDD SSW Feedback***Change text as follow*

The TDD Beamforming Information field of a TDD SSW Feedback frame is shown in Figure 14.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | TX Sector ID | TX AntennaID | Decoded TX Sector ID | Decoded TX Antenna ID | SNR Report | Reserved |
| Bits:  | 10 | 2 | 10 | 2 | 8 | 16 |

**Figure 14 —TDD Beamforming Information field format**

The TX Sector ID subfield is set to indicate the sector through which the TDD SSW Feedback frame is
transmitted.

The TX Antenna ID subfield indicates the DMG antenna ID through which the TDD SSW Feedback frame is transmitted.

The Decoded TX Sector ID subfield contains the value of the TX Sector ID subfield from the TDD SSW
frame that the feedback frame is sent in response to and that the TDD SSW frame was received from the
initiator with the best quality.

The Decoded TX Antenna ID subfield contains the value of the TX Antenna ID subfield from the TDD SSW frame that the feedback frame is sent in response to and that was received with the best quality.

**9.3.1.24.4 TDD SSW Ack***Change text as follow*

The TDD Beamforming Information field of a TDD SSW Ack frame is shown in Figure 15.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Decoded TX Sector ID | Decoded TX Antenna ID | CountIndex | TransmitPeriod | SNRReport | InitiatorTransmitOffset | ResponderTransmitOffset | Reserved |
| Bits:  | 10  | 2 | 3  | 8  | 8  | 8  | 8 | 1 |

**Figure 15 —TDD Beamforming Information field format**

The Decoded TX Sector ID subfield contains the value of the TX Sector ID subfield from the TDD SSW
Feedback frame that was received from the responder.

The Decoded TX Antenna ID subfield contains the value of the TX Antenna ID subfield from the TDD SSW Feedback frame that was received from the responder.

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| **CID** | **Clause** | **Comment** | **Proposed change** | **Resolution**  |
| 3222 | 10.43.10.3 | "A responder STA that has received a TDD SSW frame shall sweep its receiver antenna configuration through its receive sectors between TDD beamforming frames received in a TDD slot and between TDD slots used for BF training according to the period as indicated by the Transmit Period subfield of the received TDD SSW frame." For this to work, the initiator must keep the Transmit Period constant in all TDD SSW packets and TDD SSW ACKS in a BF session. This requires a shall statement | Add a shall statement to transmitter behaviour saying that the Transmit Period must be constant during sector sweep | Accepted Shall normative was added  |
| 3546 | 10.43.10.3 | Section 10.43.10 TDD beamforming does not describe the flow of TDD individual BF with an unknown peer as indicated in table 5 | Please add flow and rules | RevisedNormative text was added  |
| 3498 | 10.43.10.2 | For the initiator to end the BF training, the End of Training subfield should be set in the SSW frame from the initiator to the responder, and to follow the SSW feedback from the responder to the initiator and then the SSW Ack from the initiator to the responder. It should be possible for the initiator to terminate the training by only setting the End of Training field at the SSW ACK even if it was not set in the SSW frame. This is needed to enable quick connection setup with the initiator and later a more extensive BF can be carried. | The initiator should be able to end the BF training upon receiving SSW feedback that is considered good for setting up a connection with the responder. The Initiator can do so by setting End of Training subfield in the SSW Ack even if it was not set in the SSW frame the was send before. The responder upon receiving the Ack should get information about time to receive and transmit the announce frames to the initiator. | Revised Normative text clarified the initiator option to end the TDD beam forming. |
| 3502 | 10.43.10.3 | The figure shows that the Responder stops sweeping its sectors after receiving the TDD SSW frame till the next TX TDD interval and the start of the new TX sector ID SSW frames transmission. The responder should keep sweeping its sectors though and do not stop as stated in the text | Extend the brackets after the TDD SSW frame reception to include the TDD interval after the TDD SSW reception | Accepted  |

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| **CID** | **Clause** | **Comment** | **Proposed change** | **Resolution**  |
| 3499 | 10.43.10.2 | The Initiator Ack Offset definition is such that it is a summation of two factors. The first factor is the duration from the end of the first TDD SSW frame or TDD SSW Ack frame to the start of the corresponding Announce frame. It is not clear when it is from the end of the first TDD SSW frame and when it is from the end of the TDD SSW Ack frame | Change the first factor as follows:"(a) The first factor is the duration from the end of the first TDD SSW frame if the first transmitted frame was a TDD SSW frame or TDD SSW Ack frame if the first transmitted frame was a TDD SSW Ack to the start of the corresponding Announce frame;". The same should be applied to other definitions of Initiator Ack Offset for the responder section. | Rejected  |

**Discussion**

Initiator Transmit Offset is described by equation, figure 142 and the respective text. The addition text the commenter ask to add doesn’t provide more clarity to the overall description and is not necceseraly true.

*InitiatorTransmitOffset – [(CountIndex + 1) × TXTIME(TDD SSW) + (CountIndex × SBIFS)] (5)*

where:

*InitiatorTransmitOffset* is the Initiator Transmit Offset subfield value, in microseconds, in the TDD SSW

Ack frame with the End of Training subfield set to 1. This value is the summation of two factors:

a) the first factor is the duration from the end of the first TDD SSW frame or TDD SSW Ack

frame if the first transmitted frame was TDD SSW Ack to the start of the corresponding Announce frame; b)

the second factor is TXTIME(TDD SSW), which is a fixed value.

CountIndex is the Count Index subfield value from the received TDD SSW or TDD SSW Ack frame

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| --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Comment** | **Proposed change** | **Resolution**  |
| 3500 | 10.43.10.2 | The Initiator Transmit Offset definition is such that it is a summation of two factors. The first factor is the duration from the end of the first TDD SSW frame or TDD SSW Ack frame to the start of the corresponding Announce frame. It is not clear when it is from the end of the first TDD SSW frame and when it is the end of the TDD SSW Ack frame | Change the first factor as follows:"(a) The first factor is the duration from the end of the first TDD SSW frame if the first transmitted frame was a TDD SSW frame or TDD SSW Ack frame if the first transmitted frame was a TDD SSW Ack to the start of the corresponding Announce frame;". The same should be applied to other definitions of Initiator Transmit Offset for the responder section. | Rejected  |
| 3501 | 10.43.10.2 | The Responder Transmit Offset definition is such that it is a summation of two factors. The first factor is the duration from the end of the first TDD SSW frame or TDD SSW Ack frame to the start of the corresponding Announce frame. It is not clear when it is from the end of the first TDD SSW frame and when it is the end of the TDD SSW Ack frame | Change the first factor as follows:"(a) The first factor is the duration from the end of the first TDD SSW frame if the first transmitted frame was a TDD SSW frame or TDD SSW Ack frame if the first transmitted frame was a TDD SSW Ack to the start of the corresponding Announce frame;" The same should be applied to other definitions of Responder Transmit Offset for the responder section. | Rejected  |
|  |  |  |  |  |

**Discussion**

Comment suggest unjustified editorial change for the existing text hence rejected.

**Current Text**

“In order to receive the Announce frame from the responder, the initiator shall set its receive antenna to the
same sector as was indicated in the TX Sector ID subfield of the respective TDD SSW Ack frame with the
End Of Training subfield equal to 1 at the time offset indicated by the following equation:

*ResponderTransmitOffset* – [(*CountIndex* + 1) × TXTIME(TDD SSW) + (*CountIndex* × SBIFS)] (6)

where:

*ResponderTransmitOffset* is the Responder Transmit Offset subfield value, in microseconds, in the TDD
SSW Ack frame with the End of Training subfield equal to 1. This value is the summation of two
factors: a) the first factor is the duration from the end of the first TDD SSW frame or TDD SSW
Ack frame to the start of the corresponding Announce frame; b) the second factor is
TXTIME(TDD SSW), which is a fixed value. *CountIndex* is is the Count Index subfield value from the respective TDD SSW or TDD SSW Ack frame”

**Suggested change**

"(a) The first factor is the duration from the end of the first TDD SSW frame if the first transmitted frame was a TDD SSW frame or TDD SSW Ack frame if the first transmitted frame was a TDD SSW Ack to the start of the corresponding Announce frame;"

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Comment** | **Proposed change** | **Resolution**  |
| 3504 | 10.43.10.3 | It should be indicated that the responder selects the best link quality among the SSW frames received from the same TX beam ID | Consider changing the first sentence to: "The responder shall transmit a TDD SSW Feedback frame using the sector from which the responder received the TDD SSW with the best link quality **among the TDD SSW frames received with the same TX beam ID** at the time indicated by equation (3)." | Rejected Suggested added text is not essential, the “TDD SSW with the best quality” is among all other received TDD SSW frames including those received with the same TX Beam ID |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Comment** | **Proposed change** | **Resolution**  |
| 3503 | 10.43.10.3 | "Upon reception of one or more TDD SSW frames on a single receive sector, the responder shall switch to its next receive sector to be ready to receive the next TDD SSW frame transmission within SBIFS interval or at the time instant specified by the Transmit Period in the TDD SSW frame." It is not clear how the second part of the sentence "or the time instant specified by the Transmit Period in the TDD SSW frame." can be applied in this case. The same stateemnt is repeated in multiple places in the document. | Please clarify | Revised Suggested text leaves the responder the decision whether to switch it’s receive sectors after each receive of TDD SSW or only at the end of TDD SP at period interval indicated by the transmit period. The responder informs the initiator how many TDD SSW were received in the current TDD BF training therefore initiator may decide to continue with TDD SSW transmission in case needed.  |

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| --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Comment** | **Proposed change** | **Resolution**  |
| 3224 | 10.43.10.4 | "the initiator shall configure its DMG antenna to the sector index as indicated in the Decoded TX Sector ID subfield of the TDD SSW Feedback frame received from the corresponding responder during the respective TDD beamforming training in which its End of Training subfield was set to 1." - set to the sector at which times? The sector sweep may continue with other responders | Indicate that the sector shall be used in time used for scheduled transmissions to the responder | Rejected It is indicated throughout the TDD BF that the sector will be used as follow “The initiator shall use this sector for its subsequent transmissions and receptions with the correspondingresponder, until another sector is negotiated.”  |

**10.43.11 TDD beamforming
10.43.11.1 General**

*Change figure 143 in P292 L1 as follow*



*Add text after the second paragraph in P292 L14 as follow*

NOTE - Tx Antenna ID field allows using up to four separate transmit antennas. Implementations can define transmit sectors in a way that captures different antennas in case more than four antennas are used for sector sweep. (e.g., 1024 sectors per antenna for up to 4 antennas, 512 sectors per antenna for 5-8 antennas..)

**10.43.10.2 Initiator operation for TDD individual beamforming**

*Change text at p292 L23 as follow*

For TDD individual beamforming, the BFType parameter is set to TDD Individual BF in the MLME-TDD-

BF-TRAINING.request primitive.

To initiate TDD individual beamforming with a known responder, the initiator shall send multiple TDD SSW frames with the RA field set to the Responder STA’s MAC address as indicated by the PeerSTAAddress parameter of the
MLME-TDD-BF-TRAINING.request primitive.

To initiate TDD individual beamforming with an unknown responder, the initiator shall send TDD SSW frames with the RA field set to the broadcast MAC address. The initiator should switch the RA field in transmitted TDD SSW frames to responder’s MAC address after receiving a TDD SSW Feedback frame from the intended responder.

TDD SSW frames that are sent from the same transmit DMG antenna shall have the same TX Antenna ID subfield value. TDD SSW frames that are sent from the same transmit antenna sector shall have the same TX Sector ID subfield value. These frames shall be transmitted with the same transmit power and the PPDUs carrying these frames shall not include TRN fields.

The initiator shall send TDD SSW frames through all the DMG antennas and through all the sectors indicated by the TX antenna index and TX sector index values as indicted in the TXAntennaSectorIDList parameter of the MLME-TDD-BF-TRAINING.request primitive. Moreover, for each DMG antenna and for each sector, the initiator shall send TDD SSW frames with the same TX Antenna ID and TX Sector ID subfields for the number of times indicated in the NumOfTDDSlotPerTXSector parameter multiplied by the number of NumOfSSWPerTDDSlot parameter of the MLME-TDD-BF-TRAINING.request primitive. If the initiator transmits a TDD SSW Ack frame, the initiator shall send as many TDD SSW Ack frames as the number indicated in the NumOfAckPerTDDSlot parameter of the MLME-TDD-BF-TRAINING.request primitive.

The Transmit Period subfield value within TDD SSW frames shall remain the same throughout a TDD beamforming training. If Transmit Period subfield is nonzero, the initiator shall transmit any two consecutive TDD SSW frames of the TDD beamforming training with the same Count Index value at the time offset equal to Transmit Period value.

TDD SSW and TDD SSW Ack frames transmitted in the same TDD slot shall be separated with SBIFS

interval and shall have a strictly increasing Count Index subfield value. The first TDD SSW frame or TDD

SSW Ack frame transmitted in a TDD slot shall have the Count Index subfield set to zero.

NOTE—It is recommended to transmit all TDD SSW frames, if any, before transmitting TDD SSW Ack frames in the same TDD slot.

To receive the TDD SSW Feedback frame from the responder, the initiator shall set its receive antenna to

the same DMG antenna and sector as was indicated in the TX Antenna ID and TX Sector ID subfields of the respective TDD SSW frame at the time offset indicated by the following equation:

*Change text at P294 L22 as follow*

For TDD individual BF, an initiator may request the responder to stop receive sector sweeping by setting the End of Training subfield to 1 in transmitted TDD SSW frames.

Upon reception of a TDD SSW Feedback frame with the End of Training subfield equal to 1, the initiator shall send one or more TDD SSW Ack frames with End of Training subfield set to 1 to the responder at the time offset indicated by equation (4). The initiator may also set the End of Training subfield in SSW Ack frames to 1 even if the End of Training subfield in received TDD SSW Feedback frame is not set to 1. After sending a TDD SSW Ack frame with End of Training subfield equal to 1, the initiator shall configure its receive and transmit DMG antenna and sector index as indicated in the Decoded TX Antenna ID and Decoded TX Sector ID subfields of the TDD SSW Feedback frame received from the corresponding responder in which its End of Training subfield was set to 1. The initiator shall use this DMG antenna and sector for its subsequent transmissions and receptions with the corresponding responder, until another sector is negotiated.

**10.43.11.3 Responder operation for TDD individual beamforming**

*Change text as follow*

A responder STA that has lost its network configuration, or has not yet received a TDD SSW frame, or has

not yet acquired the TDD Slot Structure element used by the BSS shall sweep its receiver antenna through

all its receive sectors while dwelling on each sector for a time equal to SectorDwellTime as indicted by the

MLME-TDD-BF-SCAN.request primitive.

NOTE—To increase the likelihood of detecting the initiator’s TDD SSW frame, the responder SME can set

SectorDwellTime to at least [2 × TXTIME (TDD SSW) + SBIFS].

A responder STA that receives a TDD SSW frame with RA field set to its MAC address or to the broadcast address may sweep its receiver antenna configuration through its receive sectors between TDD beamforming frames received in a TDD slot and shall switch its receive sectors at the beginning of every TDD slots used for BF training according to the time interval indicated by the nonzero Transmit Period subfield of the received TDD SSW frame.

Figure 146 gives an example of the responder’s receiver sweeping procedure for TDD individual BF.



**Figure 146 —Responder’s receiver sweeping for TDD individual BF**

Once the first TDD SSW frame is received, the responder proceeds with the following operation.

Upon reception of one or more TDD SSW frames on a single receive sector, the responder may switch within the TDD slot to its next receive sector to be ready to receive the next TDD SSW frame transmission within SBIFS interval. The responder shall switch its receive sectors at the beginning of every TDD slots used for BF training at the time specified by the Transmit Period in the TDD SSW frame. While sweeping through its

receive sectors, the responder shall continue decoding all the received TDD SSW frames.

The responder shall transmit a TDD SSW Feedback frame using the antenna and sector from which the responder

received the TDD SSW with the best link quality at the time indicated by equation (3). The TDD SSW

Feedback frame shall include the antenna index and sector index used by the initiator to transmit the TDD SSW frame in the Decoded TX Antenna ID and Decoded TX Sector ID subfields, the antenna index and sector index used by the responder to transmit the TDD SSW Feedback frame in the TX Antenna ID and TX Sector ID subfield, and the SNR of the TDD SSW frame received with best quality in the SNR Report subfield.

At the time offset indicated by equation (4) of the decoded TDD SSW frame, the responder shall set its receiver to the same DMG antenna and to the same sector that was indicated in the TX Antenna ID and TX Sector ID subfields of the TDD SSW Feedback frame in order to be ready to receive a TDD SSW Ack frame from the initiator.

The responder shall continue sweeping through its receive sectors until successfully receiving and decoding

a TDD SSW Ack frame with End of Training subfield equal to 1. Upon reception of a TDD SSW Ack

frame with End of Training subfield equal to 1, the responder shall stop its receive sweeping and shall

configure its DMG antenna as indicated in the Decoded TX Antenna ID and its and sector as indicated in the Decoded TX Sector ID subfield of the TDD SSW Ack frame received from the initiator that has the End of Training subfield equal to 1. The responder shall use this antenna and sector for its subsequent frame exchanges with the initiator, until another sector is negotiated.

A responder that transmits a TDD SSW Feedback frame in response to a TDD SSW frame sent with End of

Training subfield equal to 1 shall set the End of Training subfield in the TDD SSW Feedback frame to 1.

Upon reception of a TDD SSW Ack frame with End of Training subfield equal to 1, the responder shall be

ready to receive an Announce frame from the initiator at the time offset indicated by equation (5). The

responder shall then, at the time offset indicated by equation (6), transmit to the initiator an Announce

frame containing a TDD Route element listing the ordered pairs of TX sector IDs and decoded TX sector

IDs obtained from the TDD beamforming training with the initiator.

A STA that has started to sweep its receive antenna configuration in response to a TDD SSW frame with RA field set to the broadcast address and during the same beamforming process receives a TDD SSW frames with RA field set to an individual address other than the STA’s MAC address, shall stop its receive sweeping and shall configure its DMG antenna to the sector as indicated in the last sucssesful TDD beamforming or TDD sector switch procedure and shall use this sector for its subsequent frame exchanges with the initiator, until another sector is negotiated.

**10.43.10.4 Initiator operation for TDD group beamforming**

*Change paragraphs starting at P298 L27 as follow*

TDD SSW frames that are sent from the same transmit DMG antenna shall have the same TX Antenna ID subfield value. TDD SSW frames that are sent from the same transmit antenna sector shall have the same TX Sector ID

subfield value. TDD SSW frames shall be transmitted at the same transmit power and shall not include BRP training fields.

The initiator shall send TDD SSW frames through all the DMG antennas and through all the sectors indicated by the TX antenna index and TX sector index values as indicted in the TXAntennaSectorIDList parameter of the MLME-TDD-BF-TRAINING.request primitive. Moreover, for each DMG antenna and for each sector, the initiator shall send TDD SSW frames with the same TX Antenna ID and TX Sector ID subfields for the number of times indicated in the NumOfTDDSlotPerTXSector parameter multiplied by the number of NumOfSSWPerTDDSlot parameter of the MLME-TDD-BF-TRAINING.request primitive. If the initiator transmits a TDD SSW Ack frame, the initiator shall send as many TDD SSW Ack frames as the number indicated in the NumOfAckPerTDDSlot parameter of the MLME-TDD-BF-TRAINING.request primitive.

The Transmit Period subfield value within TDD SSW frames shall remain the same throughout a TDD beamforming training. If Transmit Period subfield is nonzero, the initiator shall transmit any two consecutive TDD SSW frames of the TDD beamforming training with the same Count Index value at the time offset equal to Transmit Period value.

TDD SSW and TDD SSW Ack frames transmitted in the same TDD slot shall be be separated with SBIFS

interval and shall have a strictly increasing Count Index subfield value, with the first transmitted TDD SSW

frame or TDD SSW Ack frame in a TDD slot having this subfield equal to 0.

An initiator shall set its receiver to the same DMG antenna and to the same sector as was indicated in the TX Antenna ID and TX Sector ID subfields of a transmitted TDD SSW frame to be ready to receive a responder’s TDD SSW Feedback frame at the time offset indicated by the following equation:

*Change paragraphs starting at P300 L12 as follow*

The TDD SSW Ack frame shall include the DMG antenna and the sector used by the initiator to transmit the TDD SSW Ack frame in the TX Antenna ID and TX Sector ID subfields, the DMG antenna and sector used by the responder to transmit the TDD SSW Feedback frame in the Decoded TX Antenna ID and Decoded TX Sector ID subfield, the measured SNR of the decoded TDD SSW Feedback frame in the SNR Report subfield and the time offsets to exchange Announce frames with STA capabilities and network configuration.

For TDD group BF, an initiator may request one or more responders to stop their receive sector sweeping by

setting the End of Training subfield to 1 in the Responder Info subfield corresponding to each responder in a transmitted TDD SSW frame. Upon reception of a TDD SSW Feedback frame with the End of Training subfield equal to 1 from target responder, the initiator shall send one or more TDD SSW Ack frame with the End of Training subfield set to 1 to the responder at the time offset indicated by equation (8). The initiator may also set the End of Training subfield in SSW Ack frames to 1 even if the End of Training subfield in received TDD SSW Feedback frame is not set to 1. After sending a TDD SSW Ack frame with End of Training subfield equal to 1, the initiator shall configure its receive and transmit DMG antenna and sector index as indicated in the Decoded TX Antenna ID and Decoded TX Sector ID subfields of the TDD SSW Feedback frame received from the corresponding responder in which its End of Training subfield was set to 1. The initiator shall use this DMG antenna and sector for its subsequent transmissions and receptions with the corresponding responder, until another sector is negotiated.

*Change paragraph at P301 L1 as follow*

The initiator shall set its receive and transmit DMG antenna and sector as was indicated in the TX Antenna ID and TX Sector ID subfields of the respective TDD SSW Ack frame with the End Of Training subfield set to 1, in order to receive the Announce frame transmitted by the responder at the time offset indicated by the following equation:

**10.43.11.5 Responder operation for TDD group beamforming**

*Change paragraph at P301 L26 as follow*

A responder STA that receives a TDD SSW frame may sweep its receiver antenna configuration

through its receive sectors between TDD beamforming frames received in a TDD slot and shall switch its receive sectors at the beginning of every TDD slots used for BF training according to the time interval indicated by the nonzero Transmit Period subfield of the received TDD SSW frame.

*Change paragraphs starting at P302 L6 as follow*

Upon reception of one or more TDD SSW frames on a single receive sector, the responder may switch within the TDD slot to its next receive sector to be ready to receive the next TDD SSW frame transmission within SBIFS interval. The responder shall switch its receive sectors at the beginning of every TDD slots used for BF training at the time specified by the Transmit Period in the TDD SSW frame. While sweeping through its

receive sectors, the responder shall continue decoding all the received TDD SSW frames.

The responder shall transmit a TDD SSW Feedback frame using the antenna and sector from which the responder

received the TDD SSW with the best link quality at the time indicated by equation (3). The TDD SSW

Feedback frame shall include the antenna index and sector index used by the initiator to transmit the TDD SSW frame in the Decoded TX Antenna ID and Decoded TX Sector ID subfields, the antenna index and sector index used by the responder to transmit the TDD SSW Feedback frame in the TX Antenna ID and TX Sector ID subfield, and the SNR of the TDD SSW frame received with best quality in the SNR Report subfield.

At the time offset indicated by equation (4) of the decoded TDD SSW frame, the responder shall set its receiver to the same DMG antenna index and to the same sector that was indicated in the TX Antenna ID and TX Sector ID subfields of the TDD SSW Feedback frame in order to be ready to receive a TDD SSW Ack frame from the initiator.

The responder shall continue sweeping through its receive sectors until successfully receiving and decoding

a TDD SSW Ack frame with End of Training subfield equal to 1. Upon reception of a TDD SSW Ack

frame with End of Training subfield equal to 1, the responder shall stop its receive sweeping and shall

configure its DMG antenna as indicated in the Decoded TX Antenna ID and its and sector as indicated in the Decoded TX Sector ID subfield of the TDD SSW Ack frame received from the initiator that has the End of Training subfield equal to 1. The responder shall use this antenna and sector for its subsequent frame exchanges with the initiator, until another sector is negotiated.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Comment** | **Proposed change** | **Resolution**  |
| 3507 | 10.43.10.6 | The TDD beam measurement define techniques for both the initiator and the responder to start and perform TDD beam measurement. It is not clear how the initiator will tell the responder or the responder will request from the initiator to start the TDD beam measurement procedure | Please define how the TDD beam measurement campaign is scheduled between the initiator and the responder | RevisedTDD Beam Measurement procedure start point for the initiator and responder are done with MLME-TDD-BEAM-MEASUREMENT.request for both the initiator and responder and is described in sections :**10.43.10.6 Initiator operation for TDD beam measurement** **10.43.10.7 Responder operation for TDD beam measurement** There is no over the air message that delivers the initiator intention to start TDD Beam Measurement but the TDD SSW frame, the procedure is communicated over higher layers (MLME, SME) or via the TDD SSW frame itself. Normative was added to section 10.43.10.6 and 10.43.10.7 to specify the responder behaviour in case TDD SSW for beam measurement is received  |
| 3508 | 10.43.10.6 | The initiator operation does not define how the TDD beam measurement ends | Please consider using the End of Training subfield in the transmitted SSW frames to announce the end of TDD beam measurement | RevisedEnd of Training field may not be robust enough as responder may not receive the TDD SSW sent in the last specific direction. A new TDD Slot CDOWN field is defined to indicate the future time of the end of beam measurement  |
| 3509 | 10.43.10.6 | The responder operation does not define how the TDD beam measurement procedure ends | Please consider using the End of Training subfield in the received SSW frame to know the end of TDD beam measurement. The responder shall report the measurement results to the SME after detecting the end of the TDD beam measurement procedure | Revised As indicated for CID 3507 |
| 3542 | 10.43.10.6 | What is the meaning of MAC address in case the BFRole is responder? Does the responder should know which TDD Beam Measurement is targeted (unicast or broadcast). How the STA behavior should be different? | Please clarify | Revised Responder behaviour for beam measurement is similar in case the unicast MAC Address is its own and in case Broadcast MAC address. Responder shall not participate in unicast beam measurement if MAC address does not match its own MAC.Added text to clarify in section 10.43.10.6 and 11.36.4 |

*Change text as follow*

**10.43.10.6 Initiator operation for TDD beam measurement**The initiator operation during a TDD beam measurement is the same as the initiator operation for TDD individual BF, with the following differences:

* TDD beam measurement is started upon receiving an MLME-TDD-BEAM-
MEASUREMENT.request primitive with BFRole parameter set to Initiator.
* During a TDD beam measurement, the TDD Slot CDOWN field in each transmitted frame shall contain the total number of TDD slots remaining until the end of the initiator TDD beam measurement, such that the last TDD SSW frame transmission by the initiator has the TDD Slot CDOWN field set to 0.
* No TDD SSW Ack frame shall be transmitted

**10.43.10.7 Responder operation for TDD beam measurement**

The responder operation during a TDD beam measurement procedure is the same as the responder operation for TDD individual BF, with the following differences:

* TDD beam measurement is started upon receiving an MLME-TDD-BEAM-MEASUREMENT.request primitive with BFRole parameter set to Responder, or by receiving a TDD SSW frame with the RA field equal to STA’s MAC address or the broadcast address.
* The responder shall not transmit any frames to the initiator and shall report the measurement results to the SME instead.
* TDD beam measurement ends at the end of the TDD slot during which the initiator transmits the last TDD SSW frames with the TDD Slot CDOWN field set to 0.

**11.36.4 TDD beam measurement**Upon receipt of an MLME-TDD-BEAM-MEASUREMENT.request primitive, a DMG STA shall assume
the role of initiator or responder, as specified by the BFRole parameter, and shall perform the beam
measurement procedure with the STA(s) indicated by the PeerSTAAddress parameter according to the
procedures defined in 10.43.11. The beam measurement procedure shall start at the time indicated by the
BeamMeasurementStartTimestamp parameter.

A STA that receives an MLME-TDD-BEAM-MEASUREMENT.request primitive with BFRole parameter
set to initiator shall issue an MLME-TDD- BEAM-MEASUREMENT.confirm primitive on completion of the
beam measurement procedure as specified in 10.43.11.

A STA that performs TDD beam measurement procedure with a peer STA at the request of the peer MAC STA shall issue an MLME-TDD-BEAM-MEASUREMENT.indication primitive on completion of the TDD beam measurement procedure as specified in 10.43.11. The STA shall set the parameters DecodedRXAntennaID, DecodedRXSectorID and SNR Report according to the TDD SSW frames received from the initiator.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Comment** | **Proposed change** | **Resolution**  |
| 3639 | 9.4.2.268 | Size of the Tx Beam Feedback subfield mentioned as "variable" depends on Number of Decoded RX Sectors in the Tx Beam Feedback subfield format so size of the Tx Beam Feedback subfield can be computed. | Replace "variable" by an expression of Tx Beam Feedback subfield size computing | Revised |

*Change text start in P142 L1 as follow*

**9.4.2.268 TDD Route element**The TDD Route element is used to communicate TDD beamforming results and sector switch
configuration as described in 10.43.10 and 11.36. The format of the TDD Route element is shown in Figure 91.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Element ID  | Length  | Element ID Extension  | TDD Route Subelements |
| Octets: | 1 | 1 | 1 | Variable |

**Figure 91 —TDD Route element format**

The Element ID, Length and Element ID Extension fields are defined in 9.4.2.1.
The TDD Route Subelements field is defined in Table 23. The TDD Route element contains one or more of the subelements indicated in Table 23.

**Table 23 —TDD Route Subelements field format**

|  |  |  |
| --- | --- | --- |
| Subelement ID | Name | Length |
| 0 | TDD Feedback Results | Variable |
| 1 | TDD Sector Setting | 25 |
| 2 – 220 | Reserved |  |
| 221 | Vendor specific |  |
| 222 – 225 | Reserved |  |

The TDD Feedback Results subelement is used to communicate all the initiator TX Sector IDs as received
by the responder during a TDD beamforming training procedure described in 10.43.10. The format of the
TDD Feedback Results element is shown in Figure 92.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Subelement ID  | Length  | Number of Tx Beams (Ntx) | Tx Beam Feedback 1  | …  | Tx Beam Feedback (Ntx) |
| Octets: | 1 | 1 | 2 | Variable |  | Variable |

**Figure 92 —TDD Feedback Results subelement format**

The Subelement ID subfield is defined in Table 23.
The Length subfield is defined in 9.4.2.1.
The Number of Tx Beams (Ntx) subfield indicates the number of Tx Beam Feedback subfields included in the
subelement.
Each Tx Beam Feedback subfield has a variable size and is defined as shown in Figure 93.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 B9 | B10 B11 | B12 B19  | B20 B23 | B24 B55 |  |  |
|  | TX SectorID | TX Antenna ID | Number of Decoded RX Sectors (Nrx) | Reserved | Decoded RX SectorInformation 1 | … | Decoded RX SectorInformation Nrx |
| Bits:  | 10 | 2 | 8 | 4 | 32 |  | 32 |

**Figure 93 —Tx Beam Feedback subfield format**

The TX Sector ID subfield contains the value of the TX Sector ID subfield in the TDD SSW frame to which the Tx Beam Feedback subfield applies.

The TX Antenna ID subfield contains the value of the TX Antenna ID subfield in the TDD SSW frame to which
the Tx Beam Feedback subfield applies.

The Number of Decoded RX Sectors (Nrx) subfield indicates the number of subsequent Decoded RX Sector
Information subfields.

The Decoded RX Sectors Information subfield is defined in Figure 94.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | B0 B9  | B10 B11 | B12 B15  | B16 B23  | B24 B31 |
|  | Decoded RX Sector ID  | Decoded RX Antenna ID | Reserved  | SNR Report  | RSSI Report |
| Bits:  | 10 | 2 | 4 | 8 | 8 |

**Figure 94 —Decoded RX Sectors Information subfield format**

The Decoded RX Sector ID subfield indicates the receive sector index used by the responder when it
decoded a TDD SSW frame with TX Sector ID and Tx Antenna ID subfields matching the corresponding fields in the Tx Beam Feedback subfield.

The Decoded RX Antenna ID subfield indicates the receive DMG antenna index used by the responder when it decoded a TDD SSW frame with TX Sector ID and TX Antenna ID subfields matching the corresponding subfields in the Tx Beam Feedback subfield.

The SNR Report subfield is set to the value of the SNR achieved while decoding TDD SSW frame(s)

with TX Sector ID and TX Antenna ID subfields matching the corresponding subfields in the Tx Beam Feedback subfield . The SNR Report

subfield is an unsigned integer 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 RSSI Report subfield is set to the value of the received power while receiving the L-STF field of

TDD SSW frame(s) with TX Sector ID and TX Antenna ID subfields matching the corresponding subfields in the Tx Beam Feedback subfield.

The RSSI Report is a signed integer in the range -128 dBm to 127 dBm and is measured by the PHY as the

power observed at the input of the antenna plus the antenna gain, or the equivalent antenna gain for phased-array antennas, used to receive the TDD SSW frame(s).

NOTE—When multiple TDD SSW frames are received for the same combination of transmit and receive DMG antennas and transmit and receive sectors, the SNR and RSSI values reported in the SNR Report and RSSI Report subfields can be a combination of measurements taken over any subset of the received TDD SSW frames.

The TDD Sector Setting subelement is used to request the peer to configure its antenna to a specific receive

and transmit sector combination as described in 11.36. The format of the TDD Sector Setting subelement is

shown in Figure 95.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|   |   |   |   |  |  |   |
|   | Subelement ID | Length | TDD Sector Setting Control  | Switch Timestamp | Revert Timestamp | TDD Switch Sectors |
| Octets : | 1 | 1 |  1 | 8 | 8 | 6 |

**Figure 9-X10---TDD Sector Setting subelement format**

The Subelement ID field is defined in Table 9 – T2.

The Length field is defined in 9.4.2.1.

The TDD Sector Setting Control field is defined in Figure 9-x11

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   | B0  | B1 | B2 | B3 – B7 |
|   | Set SectorRequest | Set Sector Response | Set Sector Acknowledge | Reserved |
| Bits : | 1 | 1 | 1 | 5 |

**Figure 9-X11---TDD Sector Setting Control field format**

The Set Sector Request subfield set to 1 by the initiator to indicate the responder to change its receiver sector setting according to the Responder RX Sector ID subfield and its transmitter sector setting according to Responder TX Sector ID subfield in the TDD Switch Sectors field.

The Set Sector Response subfield set to 1 by the responder to indicate the reception of a successful TDD Sector Setting subelement with Set Sector Request subfield set to 1.

The Set Sector Acknowledge subfield set to 1 by the initiator to acknowledge the reception of a successful TDD Sector Setting subelement with Sector Response subfield set to 1.

The Reserved subfield should be set to 0.

The Switch Timestamp subfield indicates the future TSF timer value (see 9.4.1.10) in which the new sector configuration setting is to take effect.

The Revert Timestamp subfield indicates the future TSF timer value (see 9.4.1.10) in which the previous sector configuration will be reverted to in case sector switching fails.

The TDD Switch Sectors field is defined in Figure 97

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|   | B0 B9 | B10 B11 | B12 B21 | B22 B23 | B24 B33 | B34 B35 | B36 B45 | B46 B47 |
|   | Responder RX Sector ID  | Responder RX Antenna ID | Responder TX Sector ID  | Responder TX Antenna ID | Initiator RX Sector ID  | Initiator RX Antenna ID  | Initiator TX Sector ID  | Initiator TX Antenna ID  |
| Bits : | 10 | 2 | 10 | 2 | 10 | 2 | 10 | 2 |

**Figure 9-X12---TDD Switch Sectors field format**

The Responder RX Sector ID subfield contains the value of the sector ID the responder uses to set its receive sector.

The Responder RX Antenna ID subfield contains the antenna ID the responder uses to set its receive DMG antenna.

The Responder TX Sector ID subfield contains the value of the sector ID the responder uses to set its transmit sector.

The Responder TX Antenna ID subfield contains the antenna ID the responder uses to set its transmit DMG antenna.

The Initiator RX Sector ID subfield contains the value of the sector index the initiator uses to set its receive sector.

The Initiator RX Antenna ID subfield contains the antenna ID the initiator uses to set its receive DMG antenna.

The Initiator TX Sector ID subfield contains the value of the sector index the initiator uses to set its transmit sector.

The Initiator TX Antenna ID subfield contains the antenna ID the initiator uses to set its transmit DMG antenna.

*Change below sections as follow :*

**6.3.3.2 MLME-SCAN.request**

**6.3.3.2.2 Semantics of the service primitive**

The primitive parameters are as follows:

MLME-SCAN.request(

BSSType,

BSSID,

SSID,

ScanType,

ProbeDelay,

ChannelList,

MinChannelTime,

MaxChannelTime,

ScanAntennaSectorIDList,

SectorDwellTime,

RequestInformation,

SSID List,

ChannelUsage,

AccessNetworkType,

HESSID,

MeshID,

DiscoveryMode,

VendorSpecificInfo

)

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Description** |
| … |  |  |  |
| ScanType | Enumeration | ACTIVE, PASSIVE, TDD PASSIVE | Indicates either active, passive or TDD passive Scanning |
| ….. |  |  |  |
| MaxChannelTime | … |  |  |
|  |  |  |  |
| ScanAntennaSectorIDList | List of DMG antenna and sector configurations  | Each DMG antenna and sector configuration is a valid configuration for the scanning STA. | Ordered list of DMG antennas and sector configurations to be used during the scan using TDD beamforming. |
| SectorDwellTime | Integer | N/A | The time (in microseconds) to dwell on each sector during TDD beamfoming. |
| RequestInformation | … |  |  |
| … |  |  |  |

*Change below sections as follow :*

**6.3.117.2.2 Semantics of the service primitive**The primitive parameters are as follows:

MLME-TDD-BF-TRAINING.request (

BFType

PeerSTAAddress,

BeamformingStartTimestamp,

TXAntennaSectorIDList,

NumOfTDDSlotPerTXSector,

NumOfSSWPerTDDSlot,

NumOfAckPerTDDSlot,

)

|  |  |  |  |
| --- | --- | --- | --- |
| **Name**  | **Type**  | **Valid range**  | **Description** |
| BFType  | Enumeration | TDD IndividualBF, TDD GroupBF,  | Indicates TDD individual BF or TDD groupBF |
| PeerSTAAddress  | MACAddress  | Any valid individualMAC address | Specifies the address of the peerMAC entity with which to perform TDD beamforming training. |
| BeamformingStartTimestamp  | Integer | N/A | Timestamp that indicates when the TDD beamforming procedure should be started by the STA |
| TXAntennaSectorIDList | List of DMG antenna and sector configurations  | Each DMG antenna and sector tuple is a valid configuration for the transmitting STA. | Ordered list ofDMG antenna and sector configurations, in no particular order, to be used during the TDD beamforming transmission. |
| NumOfTDDSlotPerTXSector | Integer  | 1 - 1024 | Indicates the number of TDD slot repetitions for each TX Sector ID being utilized.  |
| NumOfSSWPerTDDSlot | Integer  | 1 – 7 | Indicates the number of TDD SSW frame transmissions using a DMG antenna configuration during a TDD slot.The sum of NumOfSSWPerTDDSlot and NumOfAckPerTDDSlot is limited to 8. |
| NumOfAckPerTDDSlot | Integer  | 1 – 7 | Indicates the number of TDD SSW Ack frame transmissions using a DMG antenna configuration during a TDD slot.The sum of NumOfSSWPerTDDSlot and NumOfAckPerTDDSlot is limited to 8. |

*Change below sections as follow :*

**6.3.118.2.2 Semantics of the service primitive**The primitive parameters are as follows:

MLME-TDD-SECTOR-SWITCH.request (

PeerSTAAddress,

SectorSwitchTimestamp,

SectorRevertTimestamp,

InitiatorTXAntennaID,

InitiatorRXAntennaID,

ResponderTXAntennaID,

ResponderRXAntennaID,

InitiatorTXSectorID,

InitiatorRXSectorID,

ResponderTXSectorID,

ResponderRXSectorID

)

|  |  |  |  |
| --- | --- | --- | --- |
| **Name**  | **Type**  | **Valid range**  | **Description** |
| PeerSTAAddress  | MACAddress  | Any valid individualMAC address | Specifies the address of the peerMAC entity with which to perform TDD sector switch procedure. |
| SectorSwitchTimestamp | Integer | N/A | Timestamp that indicates when the sector switch should take effect |
| SectorRevertTimestamp | Integer | N/A | Timestamp that indicates when the sector revert should take effect in case of failure. The timestamp indicated by SectorRevertTimestamp is always later than the timestamp indicated by SectorSwitchTimestamp. |
| InitiatorTXAntennaID | Integer  | 0 – 3 | Indicates the TX Antenna ID to be utilized by the initiator STA.  |
| InitiatorRXAntennaID | Integer  | 0 – 3 | Indicates the RX Antenna ID to be utilized by the initiator STA.  |
| ResponderTXAntennaID | Integer  | 0 – 3 | Indicates the TX Antenna ID to be utilized by the responder STA.  |
| ResponderRXAntennaID | Integer  | 0 – 3 | Indicates the RX Antenna ID to be utilized by the responder STA.  |
| InitiatorTXSectorID | Integer  | 0 – 1023 | Indicates the TX Sector ID to be utilized by the initiator STA.  |
| InitiatorRXSectorID | Integer  | 0 – 1023 | Indicates the RX Sector ID to be utilized by the initiator STA.  |
| ResponderTXSectorID | Integer  | 0 – 1023 | Indicates the TX Sector ID to be utilized by the responder STA.  |
| ResponderRXSectorID | Integer  | 0 – 1023 | Indicates the RX Sector ID to be utilized by the responder STA.  |

*Change below sections as follow :*

**6.3.95.4.2 Semantics of the service primitive**The primitive parameters are as follows:

MLME- SECTOR-SWITCH.indication (

PeerSTAAddress,

SectorSwitchTimestamp,

SectorRevertTimestamp,

InitiatorTXAntennaID,

InitiatorRXAntennaID,

ResponderTXAntennaID,

ResponderRXAntennaID,

InitiatorTXSectorID,

InitiatorRXSectorID,

ResponderTXSectorID,

ResponderRXSectorID

)

|  |  |  |  |
| --- | --- | --- | --- |
| **Name**  | **Type**  | **Valid range**  | **Description** |
| PeerSTAAddress  | MACAddress  | Any valid individualMAC address | Specifies the address of the peerMAC entity with which to perform TDD sector switch procedure. |
| SectorSwitchTimestamp | Integer | N/A | Timestamp that indicates when the sector switch should take effect |
| SectorRevertTimestamp | Integer | N/A | Timestamp that indicates when the sector revert should take effect in case of failure. The timestamp indicated by SectorRevertTimestamp is always later than the timestamp indicated by SectorSwitchTimestamp. |
| InitiatorTXAntennaID | Integer  | 0 – 3 | Indicates the TX Antenna ID to be utilized by the initiator STA.  |
| InitiatorRXAntennaID | Integer  | 0 – 3 | Indicates the RX Antenna ID to be utilized by the initiator STA.  |
| ResponderTXAntennaID | Integer  | 0 – 3 | Indicates the TX Antenna ID to be utilized by the responder STA.  |
| ResponderRXAntennaID | Integer  | 0 – 3 | Indicates the RX Antenna ID to be utilized by the responder STA.  |
| InitiatorTXSectorID | Integer  | 0 – 1023 | Indicates the TX Sector ID to be utilized by the initiator STA.  |
| InitiatorRXSectorID | Integer  | 0 – 1023 | Indicates the RX Sector ID to be utilized by the initiator STA.  |
| ResponderTXSectorID | Integer  | 0 – 1023 | Indicates the TX Sector ID to be utilized by the responder STA.  |
| ResponderRXSectorID | Integer  | 0 – 1023 | Indicates the RX Sector ID to be utilized by the responder STA.  |

*Change below sections as follow :*

**6.3.95.3.2 Semantics of the service primitive**The primitive parameters are as follows:

MLME-TDD- SECTOR-SWITCH.confirm (

TXAntennaID,

RXAntennaID,

TXSectorID,

RXSectorID,

ResultCode

)

|  |  |  |  |
| --- | --- | --- | --- |
| **Name**  | **Type**  | **Valid range**  | **Description** |
| PeerSTAAddress  | MACAddress  | Any valid individualMAC address | Specifies the address of the peerMAC entity with which to perform TDD sector switch procedure |
| TXAntennaID | Integer  | 0 – 3 | Indicates the TX Antenna ID to be utilized by the STA.  |
| RXAntennaID | Integer  | 0 – 3 | Indicates the RX Antenna ID to be utilized by the STA.  |
| TXSectorID | Integer  | 0 – 1023 | Indicates the TX Sector ID to be utilized by the STA.  |
| RXSectorID | Integer  | 0 – 1023 | Indicates the RX Sector ID to be utilized by the STA.  |
| ResultCode  | Enumeration  | SUCCESS, FAILURE | Indicates the result of the TDDsector switch procedure. |

**6.3.119.2.2 Semantics of the service primitive**The primitive parameters are as follows:
MLME-TDD-BEAM-MEASUREMENT.request (

BFRole,
PeerSTAAddress,
BeamMeasurementStartTime,
AntennaSectorIDList,
NumOfTDDSlotPerTXSector ,

NumOfSSWperTDDSlot,
SlotSchedule)

|  |  |  |  |
| --- | --- | --- | --- |
| **Name**  | **Type**  | **Valid range**  | **Description** |
| BFRole  | Enumeration  | Initiator or Responder  | Set to Initiator or Responder. |
| PeerSTAAddress  | MACAddress | Any valid individualMAC address or thebroadcast MACaddresses | Specifies the address of the peer MACentity with which to perform TDDbeam measurement, or none if allMAC entities within reach aretargeted. |
| BeamMeasurementStartTime  | Integer  | N/A  | TDD beam measurement procedurestart time. |
| AntennaSectorIDList | List of DMG antenna and sector configurations | Each DMG antenna and sectorconfiguration is a validconfiguration for thetransmitting STA. | Ordered list of Sector IDconfigurations to be used by theInitiator or the Responder during TDDbeam measurement. |
| NumOfTDDSlotPerTXSector  | Integer  | 1 – 1024 | Indicates the number of TDD Slot repetitions foreach TX sector ID being utilized.Applicable only when BFRole is set toInitiator. |
| NumOfSSWperTDDSlot | Integer  | 1 - 7 | Indicates the number of TDD SSW frame transmissions using a DMG antenna configuration during a TDD slot.Applicable only when BFRole is set to Initiator. |
| SlotSchedule  | Bitmap | Indicates the TDD slots to be used fortransmitting TDD SSW frames, or theTDD slots used for measurement. |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Comment** | **Proposed change** | **Resolution**  |
| 3633 | 6.3.119 | There is no reference to the normative subclause 11.36.4 TDD beam measurement that uses the primitives | Add reference to 11.36.4 in the commented line | Accepted  |

*Change below sections as follow :*

**6.3.119.2.4 Effect on receipt**On receipt of this primitive, the MLME invokes the MAC sublayer TDD beam measurement procedures
defined in 10.43 and 11.36.4.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Comment** | **Proposed change** | **Resolution**  |
| 3589 |  | Make beamforming protocol symmetric for TDD mode devices | Define/extend protocol operation so that initiator/responder role is independent of AP/non-AP role | RejectedText was verified to allow TDD beamforming initiation by STA  |

**SP/M:** Do you accept the resolutions given in this document?