IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Resolution of TDD Sector Switch Related CIDs | | | | |
| Date: 2018-11-07 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Oren Kedem | Intel |  |  | oren.kedem@intel.com |
| Carlos Cordeiro | Intel |  |  | carlos.cordeiro@intel.com |
| Payam Torab | Facebook |  |  | [ptorab@fb.com](mailto:ptorab@fb.com) |

Abstract

This submission proposes resolutions to CIDs 3472, 3473, 3512, 3487, 3511 and 3631.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Comment** | **Proposed change** | **Resolution** |
| 3472 | 6.3.118.4.1 | What is a "TDD sector switch acknowledgement"? It's not a "TDD sector switch acknowledge" as used in clause 10, but appears to be an Ack frame in response to the TDD sector switch frame. This (getting an Ack) is no normally signed to the SME, as there is little content in such a frame that the remote peer actually understood (and is processing) the request. Rather the Ack only says the frame was received at the lowest level of the MAC and passed transfer validation checks. | If there is a need to know that the remote entity received the request (and is processing it) another frame exchange should be used. Otherwise, multiple things can still happen above the lower-MAC that might cause the frame to not be processed fully by the remote peer. If such confirmation of processing being started is not needed, then remove this local MLME indication. | Revised  The concern in TDD Sector Switch procedure is in the fact that the two communicating stations need to perform sector switch at the same time, however it is communicated via a **TDD link access method.**  In TDD, the Ack is not delivered immediately after the message was sent but some time afterward. There is a significance to allow the responder time to acknowledge the receiving of the message, hence the text keep the functionality depending on the Ack received on delivered frame. |
| 3473 | 11.36.3 | The "Annonce" frames in Figure 152 are confusing. Are these really "TDD Beamforming frame"s of various types? | Clarify this Figure (and check similar ones in 11.36) to use well-defeined frame referneces. | Revised  Frame name was changed to clarify |
| 3512 | 11.36.3 | The TDD sector switch procedure restricts only AP/PCP to initiate the procedure. It should be allowed for non AP/PCP STAs to request the sector switch and to initiate the procedure if it is allowed by the PCP/AP. | Please consider allowing non AP/PCP STAS to initiate the sector switch procedure | Rejected  A non-PCP/non-AP STA does not have the same perspective as an AP/PCP. The AP knows about all the sectors that being used by the STAs in the BSS, knows about the interference environment, etc. On the other hand, a non-PCP/non-AP STA does not know any of this. Allowing a STA to initiate sector switch could cause bad consequences to the network.    Once initiated, there is no way for a peer to explicitly reject the sector switch.  Hence, we should keep this procedure centralized as it is now |

**6.3.118.4 MLME-TDD-SECTOR-SWITCH.indication  
6.3.118.4.1 Function***Change text at P50, L19 as follow*

This primitive indicates that a TDD sector switch request has been received successfully.

**6.3.118.4.3 When generated***Change text at P50, L19 as follow*

This primitive is generated by the MLME to indicate successful reception of a TDD sector switch request  
by a STA.

**11.36.3 TDD sector switch procedure**The TDD sector switch procedure allows a pair of DMG STAs operating in an SP with TDD channel  
access to synchronize the switch of transmit and receive sectors for communication between them. Only a PCP or AP shall initiate the TDD sector switch procedure. An AP or PCP can make use of the information in TDD Feedback Results subelements and the results of measurements undertaken by STAs in the BSS to determine when to invoke a TDD sector switch procedure.

Upon receipt of an MLME-TDD-SECTOR-SWITCH.request primitive, a DMG STA shall send to the peer STA indicated by the PeerSTAAddress parameter an Announce frame of subtype Action with a TDD Route element that includes a TDD Sector Setting subelement with the Set Sector Request subfield set to 1. This is referred to as a TDD sector switch request message. Messages with Set Sector Response subfield set to 1 and messages with Set Sector Acknowledge subfield set to 1 are referred to as TDD sector response and TDD sector acknowledge messages, respectively. A STA shall not set to 1 more than one subfield of the TDD Sector Setting Control field in a given transmitted element.

The Responder TX Antenna ID, Responder RX Antenna ID, Initiator TX Antenna ID and Initiator RX Antenna ID subfields in the TDD Sector Setting subelement shall be set to, respectively, the ResponderTXAntennaID,

ResponderRXAntennaID, InitiatorTXAntennaID and InitiatorRXAntennaID parameters of the request primitive.

The Responder TX Sector ID, Responder RX Sector ID, Initiator TX Sector ID and Initiator RX Sector ID subfields in the TDD Sector Setting subelement shall be set to, respectively, the ResponderTXSectorID,

ResponderRXSectorID, InitiatorTXSectorID and InitiatorRXSectorID parameters of the request primitive.

The Set Sector Request subfield in the TDD Sector Setting subelement shall be set to 1.

The Switch Timestamp subfield in the TDD Sector Setting subelement shall be set to the value of the

SectorSwitchTimestamp parameter of the request primitive. The Switch Timestamp subfield value shall be set to a time value that allows at least three retransmissions of the Announce frame and the corresponding

Ack frame sent in response.

The Revert Timestamp subfield in the TDD Sector Setting subelement shall be set to the value of the

SectorRevertTimestamp parameter of the request primitive. The Revert Timestamp subfield value shall be set to a time value that allows the responder at least three retransmissions of a TDD sector response message, for the case the responder does not receive the TDD sector acknowledge message from the initiator, plus time to allow the initiator at least three retransmissions of a TDD sector acknowledge message, for the case the initiator does not receive the Ack frame from the responder.

An initiator STA that does not receive an Ack frame in response to a TDD sector switch request message should retransmit the message until the time indicated by the Switch Timestamp subfield.

A MLME-TDD-SECTOR-SWITCH.request primitive incorporating a new SectorSwitchTimestamp value shall not be issued until the SectorRevertTimestamp of the previous request primitive has elapsed.

A responder that receives a TDD sector switch request message shall perform the following:

* Issue an MLME-TDD-SECTOR-SWITCH.indication primitive with the PeerSTAAddress parameter set to the TA of the received message, the ResponderTXAntennaID, ResponderRXAntennaID, InitiatorTXAntennaID and InitiatorRXAntennaID parameters of the primitive set to, respectively, Responder TX Antenna ID, Responder RX Antenna ID, Initiator TX Antenna ID and Initiator RX Antenna ID parameters and the ResponderTXSectorID, ResponderRXSectorID, InitiatorTXSectorID and InitiatorRXSectorID parameters of the primitive set to, respectively, the Responder TX Sector ID, Responder RX Sector ID, Initiator TX Sector ID and Initiator RX Sector ID subfields of the TDD Sector Setting subelement within the received message.
* Respond with an Ack frame to any TDD sector switch request messages that arrive before the time indicated by the Switch Timestamp subfield value within the message.
* Set its receive and transmit antenna configuration corresponding to the Responder RX Antenna ID, Responder RX Sector ID, Responder TX Antenna ID and Responder TX Sector ID subfield values in the TDD sector switch request message, respectively, at the time indicated by the Switch Timestamp subfield.
* Send to the initiator a TDD sector switch response message by transmitting an Announce frame of subtype Action No Ack with the same Sector Setting subelement that was received by the responder, except that the Set Sector Request subfield shall be set to 0 and the Set Sector Response subfield shall be set to 1. The TDD sector switch message should be sent at the earliest TDD slot occurring after the time indicated by the value of the Switch Timestamp subfield.

An initiator transmitting a TDD sector switch request message shall perform the following:

* Issue an MLME-TDD-SECTOR-SWITCH.indication primitive with theResponderTXAntennaID, ResponderRXAntennaID, Initiator TXAntennaID and InitiatorRXAntennaID parameters of the primitive set to, respectively, Responder TX Antenna ID, Responder RX Antenna ID, Initiator TX Antenna ID and Initiator RX Antenna ID parameters and the ResponderTXSectorID, ResponderRXSectorID, InitiatorTXSectorID and InitiatorRXSectorID parameters of the primitive set to the Responder TX Sector ID, Responder RX Sector ID, Initiator TX Sector ID and Initiator RX Sector ID subfields in the TDD Sector Setting subelement that was sent in the respective TDD sector switch request message.
* Set its receive and transmit antenna configuration corresponding to the Initiator TX Antenna ID, Initiator TX Sector ID, Initiator RX Antenna ID and Initiator RX Sector ID subfield values, respectively, at the time indicated by the value of the Switch Timestamp subfield.

An initiator receiving a TDD sector switch response message shall send the responder a TDD sector switch acknowledge message by transmitting an Announce frame of subtype Action with the same Sector Setting subelement that was received by the initiator, except that the Set Sector Response subfield shall be set to 0

and the Set Sector Acknowledge subfield shall be set to 1. The TDD sector switch acknowledge message should be sent at the earliest TDD slot occurring after the time indicated by the value of the Switch Timestamp subfield.

A responder receiving a TDD sector switch acknowledge message before the time indicated by the Revert Timestamp value shall issue an MLME-TDD-SECTOR-SWITCH.confirm primitive. The TXAntennaID, RXAntennaID, TXSectorID and RXSectorID parameters of the primitive shall be set to the new transmit DMG antenna and sector index and to the receive DMG antenna and sector indexes, respectively, and the ResultCode parameter shall be set to SUCCESS.

An initiator transmitting a TDD sector switch acknowledge message

before the time indicated by the Revert Timestamp value shall issue MLME-TDD-SECTOR-SWITCH.confirm primitive. The TXAntennaID, RXAntennaID, TXSectorID and RXSectorID parameters of the primitive shall be set to the new transmit DMG antenna and sector index and to the receive DMG antenna and sector indexes, respectively, and the ResultCode parameter shall be set to SUCCESS.

A responder that did not receive a TDD sector switch acknowledge message in response to a transmitted

TDD sector switch response message should retransmit the TDD sector switch message before the time indicated by the Revert Timestamp subfield value.

An initiator STA that did not receive an Ack frame in response to a transmitted TDD sector switch acknowledge message should retransmit the TDD sector switch acknowledge message before the time indicated by the Revert Timestamp subfield value.

A responder that did not received TDD sector switch acknowledge message by the time indicated by the Revert Timestamp subfield value shall issue an MLME-TDD-SECTOR-SWITCH.confirm primitive with the ResultCode parameter set to FAILURE and shall revert to the antenna configuration used at the start of the TDD sector switch procedure.

An initiator STA that did not receive TDD sector switch response message by the time indicated by the Revert Timestamp subfield value shall issue an MLME-TDD-SECTOR-SWITCH.confirm primitive with the ResultCode parameter shall be set to FAILURE and shall revert to the antenna configuration used at the start of the TDD sector switch procedure.

An initiator STA that reverted to the previous antenna configuration at the time indicated by the Revert Timestamp subfield value shall send a PPDU that requires Ack frame at the earliest TDD slots occurring after the Revert Timestamp subfield value. An initiator STA receiving a PPDU after the time indicated by the Revert Timestamp subfield shall issue an MLME-TDD-SECTOR-SWITCH.confirm primitive. The TXSectorID and RXSectorID parameters of the primitive shall be set to the sectors used at the start of the TDD sector switch procedure and the ResultCode parameter shall be set to SUCCESS.

A responder receiving a PPDU after the time indicated by the Revert

Timestamp subfield value shall issue an MLME-TDD-SECTOR-SWITCH.confirm primitive. The

TXSectorID and RXSectorID parameters of the primitive shall be set to the sectors used at the start of the

TDD sector switch procedure and the ResultCode parameter shall be set to SUCCESS.

A TDD initiator that did not receive an Ack frame in response to a transmitted PPDU shall initiate the TDD

beamforming procedure as described in 10.43.10.

A responder that reverted to the antenna configuration at the time indicated by the Revert Timestamp

subfield value and that did not receive a PPDU from the initiator at a TDD slot occurring after the Revert

Timestamp subfield value shall start the TDD beamforming procedure as a responder as described in

10.43.10.

Figure 152 illustrates an example of a successful TDD sector switch procedure.



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Comment** | **Proposed change** | **Resolution** |
| 3487 | 9.4.2.268 | The Set Sector Request, Set Sector response and Set Sector Acknowledge subfields should be set zero in cases other than one defined | Add a statement at the end of each paragraph defining the Set Sector Request, Set Sector response and Set Sector Acknowledge subfields to state that otherwise the subfield should be zero. | Rejected |

**Discussion**

The requested rule is given in the normative text

“A STA shall not set to 1 more than one subfield of the TDD Sector Setting Control field in a given transmitted element.”

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Comment** | **Proposed change** | **Resolution** |
| 3511 | 11.36.3 | The TDD sector switch procedure currently is such that when a pair of TDD DMG STAs need to switch sectors it should be initiated by the AP/PCP and should be communicated between the AP/PCP STA and the non AP/PCP STA. In case the link is broken or blocked this will trigger a new TDD BF training which is time consuming | Please consider defining a new way to use the information available to the AP/PCP and the non AP/PCP STAs during the previous beamform training about the other TX/RX sectors that can be switched to in case of blocked/broken connection. | Rejected  At the end of TDD Beamforming, both stations have the peers sectors list in which reception was successful and associated SNR.  Link maintenance/tracking is typically implementation dependent, the time each station may identify its link deterioration may be very different hence the algorithm for independent switch is not trivial. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Comment** | **Proposed change** | **Resolution** |
| 3631 | 6.3.118.2.4 | A reference to the normative subclause 11.36. TDD sector switch procedure is not accurate | Replace by 11.36.3 | Accepted |

**6.3.118.2 MLME-TDD-SECTOR-SWITCH.request***change text at P49, L20 as follow*

On receipt of this primitive, the MLME invokes the MAC sublayer sector switch procedure defined in 11.36.3.

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