IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Allowed frames and transmit order for different TDD slot categories | | | | |
| Date: 2019-05-14 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | Email |
| Payam Torab | Facebook |  |  | [ptorab@fb.com](mailto:ptorab@fb.com) |
| Lakshmi Pradeep |  |  | [lpradeep@fb.com](mailto:lpradeep@fb.com) |
| Praveen Gupta |  |  | [gopalap@fb.com](mailto:gopalap@fb.com) |
| Djordje Tujkovic |  |  | [djordjet@fb.com](mailto:djordjet@fb.com) |
| Solomon Trainin | Qualcomm |  |  | [strainin@qti.qualcomm.com](mailto:strainin@qti.qualcomm.com) |
| Carlos Cordeiro | Intel |  |  | [carlos.cordeiro@intel.com](mailto:carlos.cordeiro@intel.com) |

Abstract

We clarify and extend transmit order of different frame types and subtypes during each TDD slot category. Also, rules are brought together in a table for clarity.

Addressed CIDs: 4392, 4406, 4407, 4408, 4410

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page** | **Line** | **Comment** | **Proposed Change** |
| 4392 | 10.40.6.2.2 | 244 | 23 | "In a Basic TDD slot the transmission of all frame types defined in 9.2.4.1.3 shall be allowed."  the above normative contradict the normative in line 30 as Grant frame is not allowed to be transmitted | Provide one text that summarize the allowed control frames to transmit in TDD SP |

**Discussion:** Revised

Proposed text below lists all allowed control framed, together with their relative transmission priorities in a table.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page** | **Line** | **Comment** | **Proposed Change** |
| 4406 | 10.40.6.2.2 | 244 | 23 | "In a Basic TDD slot the transmission of all frame types defined in 9.2.4.1.3 shall be allowed. In a Basic TDD slot the transmission of TDD SSW Feedback frames shall have the highest priority; this is followed by the transmission of Control and Management frames, which should be given priority over transmission of other frame types."  (1) Finer priority rules are needed, in this order: Ack, Block Ack, all the other allowed control frames, Management frames, and Data frames. Prioritizing Ack over Block Ack is important to prioritize retransmission of (less frequent but more impactful) Management (Action Ack) frames over (more frequent but repeatable) Data frames, in case of a bandwidth allocation conflict. Note slots are normally allocated to enable all these frames go through, and this rule is for the less common scenarios where a decision has been made to sacrifice some frames due to some conflict.  (2) There is a separate comment to send the TDD SSW Feedback frame in a TDD BF slot and using different beam; assuming that comment goes through TDD SSW Feedback is also dropped from the list of frames here. Related, with the addition of TDD BF slots all TDD Beamforming frames are limited to those slots.  (3) "Transmission of all frame types in ... shall be allowed" is a strange sentence; we can say all these frames may be transmitted.  (4) Intention was probably "all frames defined in 9.2.4.1.3" instead of "all frame types defined in 9.2.4.1.3" (there are only 4 types). | Change to "Except TDD Beamforming frames, all frames defined in 9.2.4.1.3 can be transmitted during Basic TDD slots, and in the following priority order: Ack, Block Ack, all other Control frames, Management frames, and data frames."  [Editor's note: It seems a table would be the best way to capture allowed frames in each slot category, together with their relative priority within the slot; recommend switching to table format once rules are settled (there are few elated comments)]. |
| 4407 | 10.40.6.2.2 | 244 | 27 | Limit TDD Beamforming frames to TD BF slots only | Change to "Only TDD Beamforming frames may be transmitted during TDD BF slots." |
| 4408 | 10.40.6.2.2 | 244 | 27 | "In a Data-only TDD slot, only Data frames and BlockAckReq frames shall be allowed."  No need to limit to Day (and BAR) frames all long as these frames are prioritized. Discussion: Reason for Data-only slots is to help implementations make better data A-MPDU aggregation decisions by removing uncertainties in transmitted frames. This is still satisfied by prioritizing Data frames and BAR over everything else (i.e., for a full transmit buffer slot remains data-only in the current sense), but no reason to prohibit using the airtime for other type/subtypes once done with Data frames.  Data frames can be disallowed after sending the BAR (this rule is probably present in the baseline in a non-TDD form, and there is no need to add anything new along as the existing rule is also applicable to TDD).  To summarize, we have 3 slot types,  -- "TDD BF": Exclusively for TDD Beamforming frames -- "Data": Data + BAR, Block Ack, Ack, other control, Management -- "Basic": Block Ack, Ack, other control, Management, Data + BAR  (see related comments to unify) | Prioritize frames in this order: Data + BAR, Block Ack, Ack, other control, Management And also rename the slot category (won't be data-only slot) |
| 4410 | 10.40.6.2.2 | 244 | 23 | Clear up TDD slot names and frame priorities in a table format; proposed names,  "TDD BF" -- > "Beamforming" (not BF) "Data-only" --> "Data" "Basic" --> "Basic"  Notes for the names: (1) Do not use TDD in the name (we should say "Beamforming TDD slot" not "TDD Beamforming slot", or worse, "TDD BF TDD Slot" (2) Data only is not data only; it prioritizes data over everything else, hence the simple name "Data" | Create a table, listing the 3 slot types as columns, and under each list he frames that can appear in each, in the order of decreasing priority. Table contents below.  Beamforming --------------- TDD SSW TDD SSW Feedback TDD SSW Ack  Data ----- Data frames BAR (no Data frames once BAR is transmitted) ACK Block Ack All other control frames except TDD Beamforming Management frames  Basic ------ ACK Block Ack All other control frames except TDD Beamforming Management frames Data frames BAR (no Data frames once BAR is transmitted) |

**Discussion:** Revised

Proposed text below lists all slot categories and transmission rules in a table.

***>>> Edit P244L23 as follows:***

Each TDD slot is of one of the following categories: Basic, Data and Beamforming. Table X lists the frames that are allowed to be transmitted during each slot category, together with the transmit order of those frames within the TDD slot.

**Table X – Allowed frames and transmit order for each TDD slot category**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **TDD slot category** | **Allowed frames** | **MPDU transmit order** | **Conditions** | |
| Basic | Control: Ack, BlockAck, DMG CTS-to-self, BlockAckReq  Extension  Management  Data | 1. Ack (as standalone PPDU, or as part of an A-MPDU; see NOTE 1) 2. BlockAck (as standalone PPDU, or as part of an A-MPDU; see NOTE 1) 3. As many Extension and Management frames as available, or fitting in the TDD slot 4. Zero or more Data frames, optionally followed by a BlockAckReq frame   Optionally, repeat the steps until the end of the TDD slot. See NOTE 3. | * If present, Ack shall be the first frame in the slot. * If present, BlockAck shall be the first frame in the slot, unless preceded by an Ack frame. * Management and Data frames can be aggregated following the rules in Section 9.7.3, as long as all buffered Management frames are present in the A-MPDU. | * The following frames may appear only once during the TDD slot: Ack, BlockAck, and BlockAckReq. * PPDUs containing Data or Management frames may be preceded and/or followed by DMG CTS-to-self frames. |
| Data | 1. As many Data frames as available, or fitting in the TDD slot, optionally followed by a BlockAckReq frame 2. Ack (as standalone PPDU, or as part of an A-MPDU; see NOTE 1 and NOTE 2) 3. BlockAck (as standalone PPDU, or as part of an A-MPDU; see NOTE 1 and NOTE 2) 4. Zero or more Extension and Management frames   Optionally, repeat the steps until the end of the TDD slot. See NOTE 4. | * Data and Management frames can be aggregated following the rules in Section 9.7.3, as long as all buffered Data frames are present in the A-MPDU. |
| Beamforming | TDD Beamforming | 1. TDD SSW 2. TDD SSW Feedback 3. TDD SSW ACK |  |  |
| NOTE 1—Action No Ack frames can also be aggregated with Ack or BlockAck frames and sent as part of an A-MPDU in control response context, as defined in Section 9.7.3 (A-MPDU contents). Action No Ack frames sent in this fashion are allowed to not follow the MPDU transmit order defined for the slot category.  NOTE 2—Opportunistic transmission of Ack and BlockAck frames in Data TDD slots does not change the timeout rules defined in Section 10.3.2.11 (Acknowledgement procedure).  NOTE 3—Repeating these steps during the TDD slot means that once STA has transmitted all buffered Management frames, it can transmit zero or more Data frames (optionally followed by a BlockAckReq frame) before it checks for new Management frames to transmit.  NOTE 4—Repeating these steps during the TDD slot means that once STA has transmitted all buffered Data frames, it can transmit Ack, BlockAck, and zero or more Management frames before it checks for new Data frames to transmit. | | | | |

***>>> Edit P244L30 as follows:***

***>>> Rename “Data-only” slot category to “Data”.***

***>>> Rename “TDD BF” slot category to “Beamforming”.***

***>>> Add the following rows to Table G-1 (note Table G-1 entries are alphabetically sorted)***

***>>> (Editorial suggestion) Make CT and TRN attributes in Table G-1 lower case (I’ve used* [*+ct*] *below)***

|  |  |
| --- | --- |
| **Attribute** | **Description** |
| *…* | *…* |
| *ssw* | *TDD Beamforming frame with TDD Beamforming Frame Type subfield set to 0.* |
| *ssw-ack* | *TDD Beamforming frame with TDD Beamforming Frame Type subfield set to 2.* |
| *ssw-feedback* | *TDD Beamforming frame with TDD Beamforming Frame Type subfield set to 1.* |
| *…* | *...* |

***>>> Add the following sequences to the end of the DMG sequences in Annex G (P761 L52 in Draft 3.0)***

(\* Series of frames transmitted during Beamforming TDD slots. \*)

dmg-tdd-beamforming-sequence = ({**TDD Beamforming** +*ssw*}{[**TDD Beamforming** +*ssw-ack*})|{[**TDD Beamforming** +*ssw-feedback*};

(\* Series of frames transmitted during Basic TDD slots; dmg-tdd-ack and dmg-tdd-block-ack sequences can appear only once during the slot. \*)

dmg-tdd-basic-slot-sequence = {dmg-tdd-ack}{dmg-tdd-block-ack}{dmg-tdd-mgmt}{dmg-tdd-extension}{dmg-tdd-mgmt-data}{dmg-tdd-data}

(\* Series of frames transmitted during Data TDD slots; dmg-tdd-ack and dmg-tdd-block-ack sequences represent acknowledgement of Management and Data frames received in a prior TDD slot, and can appear only once during the slot. \*)

dmg-tdd-data-slot-sequence = {dmg-tdd-data}{dmg-tdd-ack}{dmg-tdd-block-ack}{dmg-tdd-extension}{dmg-tdd-mgmt}

dmg-tdd-ack = **Ack** | (1{**Ack** +*a-mpdu*} 1{**Management** +*action-no-ack*+*a-mpdu*}*+a-mpdu-end*);

dmg-tdd-block-ack = [**BlockAck**] | (1{**BlockAck** +*a-mpdu*} 1{**Management** +*action-no-ack*+*a-mpdu*}*+a-mpdu-end*);

dmg-tdd-mgmt = {([**DMG CTS** +*self[*[*+ct*]] 1{**Management**}[**DMG CTS** +*self*[*+ct*]])};

dmg-tdd-extension = 1{**Extension**};

dmg-tdd-mgmt-data = {([**DMG CTS** +*self* [*+ct*]] 1{**Management** +*a-mpdu*}1{**Data** +*a-mpdu*}[**DMG CTS** +*self*[*+ct*]])};

dmg-tdd-data = {[**DMG CTS** +*self*[*+ct*]] 1{**Data}** [**DMG CTS** +*self*[*+ct*]] **[BlockAckReq]**};

***>>> Remove the NOTE on P325L42:***

***>>> Move the TDD SSW Ack shown in Figure 156 to after the TDD SSW frames, and caption the 4 frames on the top left corner as following (in order):***

***TDD SSW Count Index = 0, Ack Count Index = 0***

***TDD SSW Count Index = 1, Ack Count Index = 0***

***TDD SSW Count Index = 2, Ack Count Index = 0***

***TDD SSW ACK Count Index = 3, Ack Count Index = 0***

