IEEE P802.11
Wireless LANs

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| TXOP Limit Rules Text |
| Date: 2013-10  |
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Abstract

This document contains proposed changes to satisfy CID 0166, 0117

**CID 166**

**CID 166**

**Comment**

“The rules for non-zero TXOP Limits are (a) incomprehensible (5 lines with about 26 conditionals separated by a random mix of commas and conjunctions) (b) self-contradictory (STAs shall limit the duration of TXOPs to the TXOP Limit ... The TXOP Limit may be exceeded) and (c) incomplete (to account for e.g. A-MPDUs, PS-Polls, QoS Nulls, etc.)” (166)

“QoS Nulls should allowed in a TXOP” (117)

“Clarify exactly when the TXOP Limit may be violated (stealing some input from The Other Place, perhaps)”

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**Discussion**

The commenter is correct that even if one could parse the sentences correctly, the existing text does not account for aggregation, PS-Polls or QoS Nulls, etc. The following proposed text is the result of a detailed study of this problem and covers all possible packets that are affected by TXOP Limit.

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The basic idea is to forbid TXOP Limit violation when the MAC could avoid it, but allow it when the MAC is subject to constraints outside its control.

The following table lists the rules which apply in all possible situations and the justifications therefore.

| **Rule** | **Context** | **Reason** |
| --- | --- | --- |
| *MSDUs* |
| (see fragment rules) | MSDU not in A-MSDU and not under BA | (see fragment rules) |
| may violate | MSDU not in A-MSDU, under BA but not in A-MPDU – even if this is the first tx of the MSDU | MAC cannot fragment MSDUs sent under a BA agreement, and has no control over their size |
| (see A‑MPDU rules) | MSDU not in A-MSDU, but in A‑MPDU | (see A-MPDU rules) |
| *MMPDUs* |
| (see fragment rules) | MMPDU not in A-MPDU | (see fragment rules) |
| (see A‑MPDU rules) | MMPDU in A-MPDU | (see A-MPDU rules) |
| *Fragments* |
| shall not violate, unless 16 fragments | MPDU first tx of first fragment of (fragmentable, i.e. unicast, and not under BA if MSDU) MSDU/MMPDU | MAC can choose fragmentation size |
| shall not violate, unless 16 fragments | MPDU first tx of (fragmentable) MSDU/MMPDU when no previous fragment of the MSDU/MMPDU retxed | MAC fragments are all the same size, except the last, which cannot be bigger |
| may violate | MPDU first tx when previous fragment of the MSDU/MMPDU retxed | MAC must be able to rate select down in case of worsening radio conditions |
| may violate | MPDU first tx of any fragment of maximally-fragmented MSDU/MMPDU – even if no previous fragments retxed (not under BA or in A-MSDU, by definition) | MAC cannot fragment into more than 16 fragments |
| *A-MSDUs* |
| shall not violate | A-MSDU first tx, not under BA | MAC can choose (A-MSDU) aggregation size |
| shall not violate | A-MSDU first tx, under BA but not in A-MPDU | MAC can choose (A-MSDU) aggregation size |
| (see A‑MPDU rules) | A-MSDU in A-MPDU | (see A-MPDU rules) |
| *A-MPDUs* |
| may violate | A-MPDU with only one MPDU, not containing an A-MSDU or unicast Management MPDU – even if this is the first tx of that MPDU | MAC cannot fragment MSDUs sent under a BA agreement or group MMPDUs etc., and has no control over their size, but can choose (A-MSDU) aggregation size |
| shall not violate | A-MPDU with only one MPDU, containing first tx of an A-MSDU or unicast Management MPDU | MAC can fragment unicast MMPDUs and can choose (A‑MSDU) aggregation size |
| shall not violate | A-MPDU with more than one MPDU – even if some or all of these MPDUs are retxes | MAC can choose (A-MPDU) aggregation size |
| *Other* |
| may violate | MPDU other than QoS Data and Management,(e.g. QoS Null, PS-Poll, RTS/CTS) except for an A‑MPDU with more than one MPDU – even if this is the first tx of that MPDU; also NDP (for beam forming aficionados) | MAC must be able to send these even if the TXOP Limit is 32 us, but can choose (A-MPDU) aggregation size |
| may violate | Group-addressed, except for an A‑MPDU with more than one MPDU | MAC cannot fragment group frames and has no control over their size, but can choose (A‑MPDU) aggregation size |
| may violate | MPDU retx (including first fragment and A-MSDU), except for an A‑MPDU with more than one MPDU | MAC must be able to rate select down in case of worsening radio conditions, but can choose (A‑MPDU) aggregation size |

Note: these rules apply to downgraded frames too, per the TXOP Limit on the AC downgraded to.

In the cases where TXOP Limit violation is allowed, however, the device should be enjoined to use as high a PHY rate as the operating environment will allow. Furthermore, if the TXOP Limit is violated, there should not be more than one QoS Data, QoS Null or Management frame in the TXOP (but e.g. RTS-CTS-QoS Data-ACK is allowed (as long as the QoS Data does not contain an A-MSDU), even if the RTS violates the TXOP Limit).

Discussion in Nanjing:

As per the Table under “Other” (first category) there is no problem that a PS Poll or QoS Null must be sent and can exceed if a really low TXOP limit is in place. The question is if RTS/CTS (or CTS-to-Self) is used, then the packet must follow immediately otherwise the NAV is of no use. So, in this case should the RTS/CTS be part of the TXOP Limit or not?

Q? - Do you agree that RTS/CTS when preceding a transmission should be included as part of the transmission within the TXOP Limit”?

A - Yes, since the whole point of TXOP Limit is to measure the time the medium is locked out for, we should include it as part of the duration of the TXOP.

Q? - What happens if there is only time for the RTS/CTS and not time for the packet?
A - It should go out. If the transmitter feels RTS/CTS is necessary to ensure successful data exchange, then so be it.
Q? - Do we just assume that the packet must be fragmented to get within the limit
A - Yes, unless it's a QoS Null or an MSDU sent under BA or something like that.

….and RTS/CTS time will always in practice be much less than the TXOP Limit?
A - That will probably be the case, yes.

Q - Any thoughts on how to express this?

A - It "just works" if you just say that if the TXOP Limit is violated you can't have more than one Data or Management MPDU in the TXOP.

**Proposal**

In Clause 9.19.2.2,

Replace

“STAs shall limit the duration of TXOPs obtained using the EDCA rules to the value specified by the TXOP limit. The duration of a TXOP is the duration during which the TXOP holder maintains uninterrupted control of the medium, and it includes the time required to transmit frames sent as an immediate response to the TXOP holder’s transmissions.

When the TXOP limit is nonzero, a STA shall fragment an individually addressed MSDU so that the transmission of the first MPDU of the TXOP does not cause the TXOP limit to be exceeded at the PHY rate selected for the initial transmission attempt of that MPDU. The TXOP limit may be exceeded, when using a lower PHY rate than selected for the initial transmission attempt of the first MPDU, for a retransmission of an MPDU, for the initial transmission of an MPDU if any previous MPDU in the current MSDU has been retransmitted, or for group addressed MSDUs. When the TXOP limit is exceeded due to the retransmission of an MPDU at a reduced PHY rate, the STA shall not transmit more than one MPDU in the TXOP.”

with

“A STA obtaining a TXOP (the TXOP holder) shall, subject to the exceptions below, ensure that the duration of a TXOP does not exceed the TXOP Limit, when non-zero. The duration of a TXOP is the time the TXOP holder maintains uninterrupted control of the medium, and it includes the time required to transmit frames sent as an immediate response to TXOP holder transmissions.

The TXOP holder may exceed the TXOP Limit only if it does not transmit more than one Data or Management MPDU in the TXOP, and only for:

* + Retransmission of an MPDU, not in an A-MPDU consisting of more than one MPDU
	+ Initial transmission of an MSDU, not in an A-MPDU consisting of more than one MPDU and not in an A-MSDU, under a Block Ack agreement
	+ Transmission of a Control MPDU or a QoS Null MPDU, not in an A‑MPDU consisting of more than one MPDU
	+ Initial transmission of a fragment of an MSDU/MMPDU, if a previous fragment of that MSDU/MMPDU was retransmitted
	+ Transmission of a fragment of an MSDU/MMPDU fragmented into 16 fragments
	+ Transmission of an A-MPDU consisting of the initial transmission of a single MPDU not containing an A‑MSDU and which is not an individually addressed Management MPDU
	+ Transmission of a group addressed MPDU, not in an A-MPDU consisting of more than one MPDU
	+ Transmission of a Null Data Packet (NDP)

Except as described above, a STA shall fragment an individually addressed MSDU/MMPDU so that the initial transmission of the first fragment does not cause the TXOP Limit to be exceeded.

NOTE -- The TXOP Limit is not exceeded for:

* + Initial transmission of an MPDU containing an unfragmented though fragmentable (see 9.2.7) MSDU/MMPDU
	+ Initial transmission of the first fragment of a fragmented MSDU/MMPDU, except for an MSDU/MMPDU fragmented into 16 fragments
	+ Initial transmission of an A-MSDU
	+ Initial transmission of a fragment of a fragmented MSDU/MMPDU, if no previous fragment of that MSDU/MMPDU was retransmitted, except for an MSDU/MMPDU fragmented into 16 fragments
	+ Transmission of an A-MPDU consisting of a single MPDU containing an A‑MSDU or individually addressed Management MPDU, unless this is a retransmission of that MPDU
	+ Transmission of an A-MPDU consisting of more than one MPDU, even if some or all of the MPDUs are retransmissions

If the TXOP holder exceeds the TXOP Limit, it should use as high a PHY rate as possible to minimize the duration of the TXOP.

The rules in this subclause apply to priority-downgraded MSDUs/A-MSDUs too (see 9.19.4.2.1), per the TXOP Limit on the AC downgraded to.”