IEEE P802.11
Wireless LANs

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| HTC field vs PPDU FORMAT |
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Abstract

This document is not based on a comment from WG LB 232 of D1.0.

This document discusses an issue regarding the +HTC field as it relates to restrictions regarding the TXVECTOR FORMAT and NON\_HT\_MODULATION parameter values. For example, the existing TGmd D1.4 forbids the inclusion of the HTC field within a PPDU with a TXVECTOR parameter FORMAT value of NON\_HT and a TXVECTOR NON\_HT\_MODULATION parameter with a value of ERP-CCK. This document discusses why this prohibition exists and why the restriction is unnecessary and proposes removing that restriction.

Proposed changes in this document are with reference to TGmd D1.4.

**REVISION NOTES:**

**R0**:

Initial

**END OF REVISION NOTES**

Interpretation of a Motion to Adopt

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGax Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGmd Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

***TGmd Editor: Editing instructions preceded by “TGmd Editor” are instructions to the TGmd editor to modify existing material in the TGmd draft. As a result of adopting the changes, the TGmd editor will execute the instructions rather than copy them to the TGmd Draft.***

**CIDs**

There is no CID of reference for this proposal.

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**Discussion:**

**The current restriction:**

A QOS Data subtype MPDU sent in a CCK PPDU cannot have the Frame Control field +HTC subfield set to 1 to indicate that the HT Control field is present in the MAC header of the MPDU. More generally, the field cannot be present in any NON\_HT FORMAT which includes all of the following NON\_HT\_MODULATION choices:

ERP-DSSS

ERP-CCK

ERP-OFDM

OFDM

NON\_HT\_DUP\_OFDM

From REVmdD1.4:

**9.2.4.1.10 +HTC(#66) subfield**

The +HTC(#66) subfield is 1 bit in length. The setting of the (Ed)subfield is as follows(11ah):

— (#66)It is set to 1 in a QoS Data or Management frame transmitted with a value of HT\_GF, HT\_MF,

VHT or S1G(11ah) for the FORMAT parameter of the TXVECTOR to indicate that the frame

contains an HT Control field.

— It is set to 1 in an RTS frame transmitted with a value of S1G for the FORMAT parameter of the

TXVECTOR to indicate that the intended recipient of the frame has permission to extend the TXOP

as described in 10.55.5.4 (Relay-shared TXOP protection mechanisms).(11ah)

— It is set to 1 in a QoS Data or Management frame transmitted by a QoS CMMG STA to indicate that

the frame contains a CMMG Control field.(11aj)

Otherwise, the +HTC(#66) subfield is set to 0.

NOTE—The +HTC(#66) subfield is always set to 0 for frames transmitted by a DMG STA.

**Why is this restriction a problem?**

For an HT STA or a VHT STA or some future amendment STA that has queued an MPDU at a selected modulation and rate and encoding which allows the +HTC field to be present in the MPDU, the queued and stored MPDU sits in the transmit buffer with the +HTC field included. At some point, the MAC gains access to the channel and the MPDU is transmitted. Suppose that the transmission fails. In that case, the transmitting STA might decide to down shift the selected PPDU parameters to a more robust encoding and modulation. At some point, this down shift might mean a change from OFDM format to CCK format. If this happens, then the MPDU header contents must be changed because +HTC is not allowed in the CCK formatted PPDU. But modifying the MPDU contents is not generally a fun thing for the lower level of the MAC to have to do dynamically and therefore, it would be simpler to allow the MAC to continue to include the +HTC field in the MPDU, even though it is about to be transmitted in a CCK FORMAT.

I.e. for a simpler MAC design, it would be nice to be able to drop the selected MCS/FORMAT of the MPDU to CCK without having to make a MAC header change.

**A proposed change to the standard:**

Based on the reasoning above, the authors propose to allow the +HTC bit to be set to 1 for any QoS Data type that is sent using a FORMAT value of NON\_HT.

There is a need to include a capability bit to signal whether a STA supports the use of +HTC for QoS Data frames using FORMAT values CCK and NON\_HT.

And the transmission of a +HTC MPDU with a FORMAT of NON\_HT should be restricted to recipient STAs that signal the optional support for this combination.

**What is the impact of the proposed change?**

For devices capable of transmitting and receiving the +HTC in NON\_HT FORMATs that are communicating with similarly capable devices, there is no problem.

A capable device will only transmit +HTC NON\_HT to other capable devices.

A capable device will only receive +HTC NON\_HT from other capable devices, as +HTC NON\_HT was NOT allowed before this proposed change.

For incapable devices, no capable device would transmit +HTC NON\_HT to the incapable device as the intended recipient.

For incapable devices receiving third-party PPDUs with +HTC NON\_HT that are directed from a capable device to another capable device, the third party incapable device would incorrectly parse the MAC header, but this should not matter, because once it examines the RA field, the only other fields it should pay attention to are FC, DUR and CRC and these fields are unaltered by the proposal and will therefore be correctly interpreted.

In the case of an AP which is +HTC NON\_HT capable and that has a mix of +HTC NON\_HT capable and +HTC NON\_HT incapable devices associated, there are two choices when the AP receives an MPDU of FORMAT == NON\_HT with the +HTC bit set to 1:

1. The AP could determine MAC header contents of each received FORMAT == NON\_HT PPDU that has +HTC == 1, based on the TA value. The AP would have to perform a lookup per TA to determine if the STA identified by the TA value is +HTC NON\_HT capable or not in order to interpret the +HTC field meaning.
	1. In the case that the corresponding STA is not +HTC NON\_HT capable, the value 1 in the HTC field would have the old meaning of Strictly Ordered service class, with no +HTC field present in the MAC header.
	2. In the case that the corresponding STA is +HTC NON\_HT capable, the value 1 in the HTC field would have the new meaning of +HTC field present
2. The AP could always assume that +HTC means that a +HTC field is present, because the Strictly Ordered service class has been deprecated and has been removed from the standard, so it is possible for the AP to ignore the Strictly Ordered interpretation of the bit. No per TA lookup is necessary.

Note that an AP receiving an MPDU will likely always perform a TA-based lookup operation anyway, in order to find the decryption key for that STA.

For transmission of an MPDU within a PPDU with FORMAT == NON\_HT, a lookup is necessary to determine if the STA identified by the RA supports the use of +HTC within an MPDU sent in a PPDU with FORMAT == NON\_HT before the transmitter can include the +HTC field and set the +HTC subfield to 1.

**Some background on the +HTC bit**

Formerly, the ORDER subfield of the FC field, this subfield was at some point, relabled as the +HTC subfield and the ORDER function was deprecated.

Note that when the QoS Data frame was created by TGe, the Order bit was always set to 0 for all QoS Data frames, as the ORDER function was deemed unnecessary at that point already:

From 802.11e-2005:

**7.1.3.1.10 Order field**

***Change the text of 7.1.3.1.10 as shown:***

The Order field is 1 bit in length and is set to 1 in any non-QoS data ~~type~~ frame that contains an MSDU, or

fragment thereof, which is being transferred using the StrictlyOrdered service class. This field is set to 0 in

all other frames. All QSTAs set this subfield to 0.

A while later, TGn modified the setting of the Order bit for QoS Data frames only, allowing it to be set to indicate the presence of the +HT field, but requiring it to be 0 for QoS Data frames transmitted in formats other than HT\_GF, HT\_MF, meaning that for example, a QoS Data frame sent in NON\_HT FORMAT, ERP-CCK NON\_HT\_MODULATION would NOT have the +HT field present.

Note that it is not clear to the author why this prohibition was created, except possibly for the case that legacy QoS STA might have an expectation to receive the field value as 0, and might declare the frame invalid if they encounter a value of 1. But legacy QoS STA are differentiable from +HT capable STA because of the lack of HT Capabilities elements. If this is the only reason for the restriction, then the language could have been narrower in scope, allowing the transmission of a QoS Data frame with Order==1 in PPDUs of FORMAT == NON\_HT between HT STAs, instead of completely prohibiting the combination.

From 802.11n-2009:

**7.1.3.1.9 Order field**

***Change 7.1.3.1.9 as follows :***

The Order field is 1 bit in length. ~~and is set to 1 in any non-QoS data frame that contains an MSDU, or~~

~~fragment thereof, which is being transferred using the StrictlyOrdered service class. This field is set to 0 in~~

~~all other frames. All QoS STAs set this subfield to 0.~~ It is used for two purposes:

— When set to 1 in a non-QoS data frame transmitted by a non-QoS STA, it indicates that the frame

contains an MSDU, or fragment thereof, which is being transferred using the StrictlyOrdered service

class.

— When set to 1 in a QoS data or management frame transmitted with a value of HT\_GF or HT\_MF

for the FORMAT parameter of the TXVECTOR, it indicates that the frame contains an HT Control

field.

Otherwise, the Order field is set to 0.

TGax has proposed a slight modification:

From TGaxD3.0:

**9.2.4.1.10 +HTC/Order subfield**

***Change this subclause as follows:***

The +HTC/Order subfield is 1 bit in length. It is used for two purposes:

— It is set to 1 in a non-QoS Data frame transmitted by a non-QoS STA to indicate that the frame con-tains an MSDU, or fragment thereof, that is being transferred using the StrictlyOrdered service class.

— It is set to 1 in a QoS Data, QoS Null or Management frame transmitted with a value of HT\_GF, HT\_MF, VHT, HE or S1G for the FORMAT parameter of the TXVECTOR to indicate that the frame contains an HT Control field.

— It is set to 1 in an S1G RTS frame to indicate that the intended recipient of the frame has permission to extend the TXOP as described in 10.51.5.4 (Relay-shared TXOP protection mechanisms).

Otherwise, the +HTC/Order field is set to 0.

NOTE—The +HTC/Order field is always set to 0 for frames transmitted by a DMG STA.

**Proposed text changes for TGmd D1.4:**

**9.4.2.27 Extended Capabilities element**

***TGmd editor: within TGmd D1.4, add another row to Table 9-135 – Extended Capabilities field as shown:***

**Table 9-153—Extended Capabilities field**

|  |  |  |
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| **Bit** | **Information** | **Notes** |
| 77 | TWT Requester Support | A STA sets the TWT Requester Support field to 1 when dot11TWTOptionActivated is true, dot11HEOptionImplemented is true and TWT requester functionality is supported. Otherwise, the STA sets the TWT Requester Support field to 0. See 10.43 (Target wake time (TWT)). |
| 78 | TWT Responder Support | A STA sets the TWT Responder Support field to 1 when dot11TWTOptionActivated is true, dot11HEOptionImplemented is true and TWT responder functionality is supported. Otherwise, the STA sets the TWT Responder Support field to 0. See 10.43 (Target wake time (TWT)). |
| 79 | OBSS Narrow Bandwidth RU In OFDMA Tolerance Support | An AP STA sets the OBSS Narrow Bandwidth RU In OFDMA Toler-ance Support field to 1 if dot11OBSSNarrowBWRUinOFDMAToler-ated is true, and sets it to 0 otherwise.A non-AP STA sets the OBSS Narrow Bandwidth RU In OFDMA Tolerance Support field to 0. |
| <ANA> | HTC All Formats Support | A STA sets the HTC All Formats Support field to 1 if dot11HTCAllFormatsActivated is true and sets it to 0 otherwise. |

***TGmd editor: modify the text as shown:***

**9.2.4.1.10 +HTC(#66) subfield**

The +HTC(#66) subfield is 1 bit in length. The setting of the (Ed)subfield is as follows(11ah):

— (#66)It is set to 1 in a QoS Data or Management frame to indicate that the frame

contains an HT Control field.

— It is set to 1 in an RTS frame transmitted with a value of S1G for the FORMAT parameter of the

TXVECTOR to indicate that the intended recipient of the frame has permission to extend the TXOP

as described in 10.55.5.4 (Relay-shared TXOP protection mechanisms).(11ah)

— It is set to 1 in a QoS Data or Management frame transmitted by a QoS CMMG STA to indicate that

the frame contains a CMMG Control field.(11aj)

Otherwise, the +HTC(#66) subfield is set to 0.

NOTE—The +HTC(#66) subfield is always set to 0 for frames transmitted by a DMG STA.

***TGmd editor: modify the text as shown:***

**10.8 HT Control field operation**

If dot11HTControlFieldSupported is true, a STA shall set the +HTC-HT Support subfield of the HT Extended Capabilities field of the HT Capabilities element to 1 in HT Capabilities elements that it transmits. If dot11VHTControlFieldOptionImplemented is true, a STA shall set the +HTC-VHT Support subfield of the VHT Capabilities Information field of the VHT Capabilities element to 1 in VHT Capabilities elements that it transmits. If dot11HTCAllFormatsActivated is true, a STA shall set the HTC All Formats Support subfield to 1 in Extended Capabilities element that it transmits.

A STA in which at least one of dot11RDResponderOptionImplemented, dot11MCSFeedbackOptionImplemented, and dot11AlternateEDCAActivated is true shall set dot11HTControlFieldSupported or dot11VHTControlFieldOptionImplemented or both to true.

An HT variant HT Control field shall not be present in a frame addressed to a STA unless that STA declares support for +HTC-HT in the HT Extended Capabilities field of its HT Capabilities element (see 9.4.2.55 (HT Capabilities element)).

A VHT variant HT Control field shall not be present in a frame addressed to a STA unless that STA declares support for +HTC-VHT in the VHT Capabilities Information field of its VHT Capabilities element (11ah)or in the S1G Capabilities Information field of S1G Capabilities elements that it transmits.

An HT Control field shall not be present in a frame addressed to a STA and transmitted with TXVECTOR parameter FORMAT equal to NON\_HT unless that STA declares support for HTC All Formats Support in the Extended Capabilities element (see 9.4.2.26 (Extended Capabilities element)).

**TGmd Editor: *Add a new MIB variable in C.3 MIB Detail within the dot11StationConfigEntry group as shown:***

**C.3 MIB Detail**

dot11HTCAllFormatsActivated OBJECT-TYPE **(#15757)**

SYNTAX TruthValue

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This is a capability variable. Its value is determined by device capabilities.

This attribute, when true, indicates that the STA implementation is capable of transmitting and receiving the +HTC field in a QoS Data or Management frame regardless of TXVECTOR parameter FORMAT value. The capability is disabled, otherwise."

DEFVAL { false }

::= { dot11StationConfigEntry <XX>}

**End of proposed changes.**