IEEE P802.11  
Wireless LANs

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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | D4.0 CID20395 – Unused Tone EVM | | | | | | Date: 2019-3-11 | | | | | | Author(s): | | | | | | Name | Affiliation | Address | Phone | email | | Youhan Kim | Qualcomm |  |  | youhank@qti.qualcomm.com | | Lisa Ward | Rhode & Schwartz |  |  | Lisa.Ward@rsa.rohde-schwarz.com | | Matthias Roth | Rhode & Schwartz |  |  | Matthias.Roth@rohde-schwarz.com | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |

Abstract

This submission proposes resolution for the following comment from the letter ballot on P802.11ax D4.0:

20395

NOTE – Set the Track Changes Viewing Option in the MS Word to “All Markup” to clearly see the proposed text edits.

**Revision History:**

R0: Initial version.

R1: Updated resolution in an attempt to make the equations more readable per offline discussion.

R2: Added some explanation to the Resolution. Changed back “UnusedToneEVM” to “UnusedToneError”.

R3: Editorial update per discussion on the floor.

R4: Changed “HE MU PPDU” to “HE TB PPDU” in the definition of *N*RU26

# CID 20395

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| --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page.Line** | **Comment** | **Proposed Change** |
| 20395 | 27.3.18.4.4 | 623.52 | Equation 27-131 for the Unusedtoneerror(k) does not seem to work if the allocated RU is greater than an RU26 (that is more than 26 tone sized RU) | Contribution will be made |

**Discussion**

Equation (27-131) in draft 4.0 of 802.11ax works when the allocated RU is a 26 tone RU, but it may not work if the allocated RU is not a 26 tone RU.

D4.0 P623:

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|  |

*m* and *k* are defined for 26 tone RU but *i*RU is defined as the index of the occupied RU. This index, though, is not limited to the RU26 index. For example, the allocated RU could be a 52 tone RU in a 40 MHz bandwidth PPDU with index 5.

NRU as defined in table 28-15 says only that it is the number of occupied RUs in the transmission so it too is not limited to 26 tone RUs.

For example, consider the following figure, where the 5th 52-tones RU (*i*RU=5) is transmitted. The figure shows the intended requirement of the unused tones EVM as well as what D4.0 Equation (27-131) is requiring.



Another point to be clarified is when testing 80+80 MHz HE TB PPDUs, whether the unused tone EVM needs to be checked only in the 80 MHz segment in which the RU is transmitted or not. See figure below. Proposed resolution in this document clarifies that in case of 80+80 MHz HE TB PPDU, the unused tones EVM is tested only in the 80 MHz segment in which the occupied RU is located in.



Lastly, if a 160 or 80+80 MHz HE TB PPDU is using 2x996-tones RU, then there are no unused tones. Hence, there is no need to test the unused tones EVM. This is also clarified in the proposed resolution.

**Proposed Resolution: CID 20395**

**Revised**.

Agree with the commenter that Equation (27-131) has an error when used for RU sizes greater than 26-tones. Proposed text update in 11-19/0378r4 fixes the equation. It also clarifies that a) unused tone error is not measured when the RU size is 2x996 tones and b) unused tone error is measured only in the 80 MHz segment in which the occupied RU is in when the HE TB PPDU is 80+80 MHz.

Instruction to Editor: Implement the proposed text changes in 11-19/0378r4 for CID 20395.

**Proposed Text Updates: CID 20395**

*TGax Editor: Update D4.0 P622L35 as shown below.*

For an HE TB PPDU using RUs with size less than 2x996 tones, additional transmit modulation accuracy test for the unoccupied subcarriers of the PPDU shall be performed.

*TGax Editor: Update D4.0 P623L47 as shown below.*

* For all MCS, for an occupied RU bandwidth of *r* in units of a 26-tone RU as defined by Equation (27-130)

|  |  |
| --- | --- |
|  | (27-130) |

the average unused tone error vector magnitude for each unoccupied 26-tone RU as calculated in step f) shall meet the staircase mask requirement in Equation (27-131) and (27-131a), where *m* defines the gap in the units of 26-tone RU to the occupied RU from either side with *m*= ±1 being the adjacent 26-tone RUs.

 (27-131)

Valid range of *m* for Equation (27-131) is as follows.

* PPDU is a 20, 40, 80 or 160 MHz PPDU: Valid range of *m* is -*i*RU26,start+ 1 ≤ *m* ≤ -1.
* PPDU is an 80+80 MHz PPDU and *i*RU26,start is less than or equal to 37: Valid range of *m* is -*i*RU26,start+ 1 ≤ *m* ≤ -1.
* PPDU is an 80+80 MHz PPDU and *i*RU26,start is greater than 37: Valid range of *m* is -*i*RU26,start+ 38 ≤ *m* ≤ -1.

 (27-131a)

Valid range of *m* for Equation (27-131a) is as follows.

* PPDU is a 20, 40, 80 or 160 MHz PPDU: Valid range of *m* is 1 ≤ *m* ≤ *N*RU26 - *i*RU26,end.
* PPDU is an 80+80 MHz PPDU and *i*RU26,start is less than or equal to 37: Valid range of *m* is 1 ≤ *m* ≤ 37- *i*RU26,end.
* PPDU is an 80+80 MHz PPDU and *i*RU26,start is greater than 37: Valid range of *m* is 1 ≤ *m* ≤ 74- *i*RU26,end.

where

*i*RU26,startis equal to *i*RU if the occupied RU is a 26-tones RU, and is defined in Table 27-X1 for other RU sizes

*i*RU26,endis equal to *i*RU26,start + *r* - 1

*iRU* is the index of the occupied RU

*N*RU26is the maximum number of of 26-tone RUs for the given bandwidth of the HE TB PPDU as defined in Table 27-6

ε is the relative constellation error requirement for an occupied RU in an HE TB PPDU as defined in Table 27-48

NOTE – In case of 80+80 MHz PPDUs, unused tone error is measured only in the 80 MHz segment in which the occupied RU is located in. This leads to the different valid range for *m* in Equations (27-131) and (27-131a) in case of 80+80 MHz PPDUs.

**Table 27-X1 - *i*RU26,Start for each RU size**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***i*RU** | **52-tone RU** | **106-tone RU** | **242-tone RU** | **484-tone RU** | **996-tone RU** |
| 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 3 | 6 | 10 | 20 | 38 |
| 3 | 6 | 10 | 20 | 38 | - |
| 4 | 8 | 15 | 29 | 57 | - |
| 5 | 10 | 20 | 38 | - | - |
| 6 | 12 | 25 | 47 | - | - |
| 7 | 15 | 29 | 57 | - | - |
| 8 | 17 | 34 | 66 | - | - |
| 9 | 20 | 38 | - | - | - |
| 10 | 22 | 43 | - | - | - |
| 11 | 25 | 47 | - | - | - |
| 12 | 27 | 52 | - | - | - |
| 13 | 29 | 57 | - | - | - |
| 14 | 31 | 62 | - | - | - |
| 15 | 34 | 66 | - | - | - |
| 16 | 36 | 71 | - | - | - |
| 17 | 38 | - | - | - | - |
| 18 | 40 | - | - | - | - |
| 19 | 43 | - | - | - | - |
| 20 | 45 | - | - | - | - |
| 21 | 47 | - | - | - | - |
| 22 | 49 | - | - | - | - |
| 23 | 52 | - | - | - | - |
| 24 | 54 | - | - | - | - |
| 25 | 57 | - | - | - | - |
| 26 | 59 | - | - | - | - |
| 27 | 62 | - | - | - | - |
| 28 | 64 | - | - | - | - |
| 29 | 66 | - | - | - | - |
| 30 | 68 | - | - | - | - |
| 31 | 71 | - | - | - | - |
| 32 | 73 | - | - | - | - |

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