IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Comment Resolution on EDMG OFDM mode | | | | |
| Date: 2018-2-28 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Hiroyuki Motozuka | Panasonic | 600 Saedo-cho, Tsuzuki-ku, Yokohama, Kanagawa, Japan |  | motozuka.hiroyuki@jp.panasonic.com |
| Takenori Sakamoto |  |  | sakamoto.takenori@jp.panasonic.com |
| Yutaka Murakami |  |  | murakami.ytk@jp.panasonic.com |
| Lei Huang |  |  | lei.huang@sg.panasonic.com |
| Gaius Wee |  |  | yaohuang.wee@sg.panasonic.com |
| Kazu Takahashi |  |  | takahashi.kazu@jp.panasonic.com |
| Artyom Lomayev | Intel |  |  | artyom.lomayev@intel.com |

Abstract

This submission proposes resolution of comments on 30.6 EDMG OFDM mode and related subclauses received from LB# 231 (TGay Draft 1.0).

19 CIDs: 1522, 1523, 1524, 1525, 1526, 2325, 1550, 1530, 1531, 1319, 1533, 1532, 1623, 1621, 1535, 1622, 1536, 1537, 1538

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Proposed Resolution** |
| 1522 | 30.6.1.6 | 336.07 | n should mean the OFDM symbol number, so the range of n should be "0,1,...,N\_SYMS\_i\_user-1" instead of "0,1,...,N\_STS-1." | As per comment | **Revised** |

**Discussion**

**Typo. *NSYM*, which is simpler notation of *NSYMS iuser*, can be used instead. Explanation for the parameter should be added.**

**Proposed changes to D1.0**

***Editor: modify the equation in the last paragraph of subclause 30.6.1.6 of D1.0 and add a text after the paragraph as follows: (P336L7) (CID #1522)***

The deterministic component of common phase shift, *W(iSTS, n)*, is defined as

.

where:

*NSYM* is the total number of OFDM symbols

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Proposed Resolution** |
| 1523 | 30.6.3.1 | 339.09 | i\_STS is the space-time steam number and not the number of the space time streams.    The same for P341L14 | Remove "iSTS (iSTS = 1, 2, ..., 8)" from the texts | **Revised** |
| 1524 | 30.6.3.1 | 340.04 | In the equations in P340L4, L10, L16 and L22, rightt is a typo of right.  Also, the equation number (1) in P340L4 is not needed. | As per comment | **Accepted** |
| 1525 | 30.6.3.1 | 340.04 | EDMG-STF' should be a single parameter in the equation, but - looks like a subtraction in the equation. | use underbar \_ instad of - | **Revised** |
| 1526 | 30.6.3.1 | 340.06 | Duplication of the text, "i\_STS is the space time stream number and 1<=i\_STS<=8" in lines 6, 12, 18 and 24, should be avoided. | Remove the texts, and add the same text after the text P339L11. | **Revised** |

**Discussion**

**Editorial changes to subclauses 30.6.3 and 30.6.4 are proposed as follows.**

**Proposed changes to D1.0**

***Editor: Change the subclause 30.6.3 and 30.6.4 as follows: (CID #1523, #1524, #1525, #1526)***

1. * 1. EDMG-STF definition
        1. General

The EDMG-STF field has a fixed time duration independent on the number of space-time streams. The structure of the EDMG-STF field depends on the number of contiguous 2.16 GHz channels over which an EDMG PPDU is transmitted and the space-time stream number, *iSTS*, where 1 ≤ *iSTS* ≤ 8.(CID #1523, #1526)

 and , the sequences of length *N* used in the definition of the EDMG-STF field for different space-time streams, are defined in 30.11.1.

* + - 1. Definition

For EDMG OFDM transmissions using a single 2.16 GHz channel, the frequency sequence used to construct the EDMG-STF field for the *iSTSth* space-time stream is given by:

 (CID #1524, #1525)

For EDMG OFDM transmissions using a single 4.32 GHz channel, the frequency sequence used to construct the EDMG-STF field for the *iSTSth* space-time stream is given by:

 (CID #1524, #1525)

For EDMG OFDM transmissions using a single 6.48 GHz channel, the frequency sequence used to construct the EDMG-STF field for the *iSTSth* space-time stream is given by:

 (CID #1524, #1525)

For EDMG OFDM transmissions using a single 8.64 GHz channel, the frequency sequence used to construct the EDMG-STF field for the *iSTSth* space-time stream is given by:

 (CID #1524, #1525)

The EDMG-STF field transmit waveform in time domain shall be defined at the OFDM sampling rate *Fs* equal to NCB×2.64 GHz and sample time duration *Ts* = 1/*Fs* ns as follows:



where:

 is 88, 192, 296 and 400 for NCB = 1, 2, 3 and 4 respectively

 is the spatial mapping matrix per kth subcarrier

 is a matrix element from mth row and nth column

 is a window function applied to smooth the transitions between consecutive OFDM symbols, whose definition is implementation dependent

The fact that only spectral lines of  with indices that are a multiple of four have nonzero amplitude results in a periodicity of *TDFT*/4=48.48 ns. The interval *TEDMG-STF* is equal to thirty 48.48 ns periods (i.e., 1.455 µs).

* + 1. EDMG-CEF definition
       1. General

The structure of the EDMG-CEF field depends on the number of contiguous 2.16 GHz channels over which an EDMG PPDU is transmitted and the space-time stream number, *iSTS*.(CID #1523).

*SeqiSTSleft,N* and *SeqiSTSright,N*, the sequences of length *N* used in the definition of the EDMG-CEF field for different space-time streams, are defined in 30.11.2.

* + - 1. Definition

For an EDMG PPDU transmission using the EDMG OFDM mode over a 2.16 GHz channel, the EDMG-CEF sequence is defined in frequency domain for the *ith* space-time stream as follows:



For an EDMG PPDU transmission using the EDMG OFDM mode over a 4.32 GHz channel, the EDMG-CEF sequence is defined in frequency domain for the *ith* space-time stream as follows:



For an EDMG PPDU transmission using the EDMG OFDM mode over a 6.48 GHz channel, the EDMG-CEF sequence is defined in frequency domain for the *ith* space-time stream as follows:



For an EDMG PPDU transmission using the EDMG OFDM mode over an 8.64 GHz channel, the EDMG-CEF sequence is defined in frequency domain for the *ith* space-time stream as follows:



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Proposed Resolution** |
| 2325 | 30.6.8.2.3 | 352.14 | Spoofing error margin may contain more than 1 OFDM symbol boundaries of an OFDM A-PPDU. In this case the receiver may not be able to determine the start of TRN field | Add a sentence 'If there are more than one NsymSpoof values satisfy the above requirement, the largest value shall be used for NSYMSpoof' | **Revised** |

**Discussion**

**Agreed in principle. We propose to have a separate subclause similar to MU PPDU case to describe the definition of *NSYMSspoof* with padding calculation for A-PPDU. The similar text changes should be applied to EDMG SC mode subclauses for consistency.**

**Proposed changes to D1.0**

**30.5.9.4.3 LDPC encoding**

***Editor: Remove the last paragraph in 30.5.9.4.3: (CID #2325)***

**30.5.9.4.4 MU PPDU padding and space-time streams mapping**

*Editor: Add a new subclause after subclause 30.5.9.4.4 (MU PPDU padding and space-time streams mapping) as follows: (CID #2325)*

**30.5.9.4.5 SU A-PPDU padding**

For the last PPDU in an EDMG A-PPDU,  shall be set, at step d) in **30.5.9.4.3**, so that the spoofing error is non-negative and smaller than one SC symbol block (i.e., *TDFT*, defined in Table 56). If the last PPDU in an EDMG A-PPDU contains a BRP frame,  shall be equal to or greater than .  is calculated as follows:





**where:**

*iSTS* is the space-time stream number and 1 ≤ *iSTS* ≤ 8

***TXTIMEspoof* is the spoofed PPDU duration calculated based on L-Header**

***TL-STF*, *TL-CEF*, *TL-Header*, *TEDMG-STF*, *TEDMG-CEF*, *TEDMG-Header-A*, and *TTRN* are the durations of the L-STF, L-CEF, L-Header, EDMG-STF, EDMG-CEF, EDMG-Header-A and TRN fields that are defined in 30.12.3.3 [2]**

***TDFT* is defined in Table 56**

, for iPPDU=1, …, NPPDU – 1, is the duration of the data field of iPPDUth PPDU, except for the last PPDU, that is defined in 30.12.3.3 [2]

 is the maximum duration of the last PPDU which fulfills the spoofing error requirement.

**NOTE – In case of EDMG A-PPDU transmission, the spoofed values of the L-Header fields and the duration of the PPDUs except the last PPDU shall be determined so that**   is equal to or greater than .

* + 1. - 1. LDPC encoding

***Editor: Remove the last paragraph in 30.6.8.2.3: (CID #2325)***

**30.6.8.2.4 MU PPDU padding and space-time streams mapping**

*Editor: Add a new subclause after subclause 30.6.8.2.4 (MU PPDU padding and space-time streams mapping) as follows: (CID #2325)*

**30.6.8.2.5 SU A-PPDU padding**

For the last PPDU in an EDMG A-PPDU,  shall be set, at step d) in **30.6.8.2.3**, so that the spoofing error is non-negative and smaller than one SC symbol block (i.e., *T DFT*, defined in Table 56). If the last PPDU in an EDMG A-PPDU contains a BRP frame,  shall be equal to or greater than , and set so that the spoofing error is smaller than one OFDM symbol duration (i.e., *TSYM = TDFT+TGI*, where *TDFT* and *TGI* are defined in Table 71) to enable the receiver to determine the start of the TRN field.  is calculated as follows:





**where:**

***TXTIMEspoof* is the spoofed PPDU duration calculated based on L-Header**

***TL-STF*, *TL-CEF*, *TL-Header*, *TEDMG-STF*, *TEDMG-CEF*, *TEDMG-Header-A* and *TTRN* are the durations of the L-STF, L-CEF, L-Header, EDMG-STF, EDMG-CEF, EDMG-Header-A and TRN fields that are defined in 30.12.3.4 [2]**

, where *TDFT* and *TGI* are defined in Table 71, the *TGI* can be equal to *TGI short*, *TGI normal*, or *TGI long*

 is the duration of the EDMG-Header-A of the 2nd to the last PPDUs using OFDM modulation (see 30.6.6)

**, for iPPDU=1, …, NPPDU – 1, is the duration of the data field of iPPDUth PPDU, except for the last PPDU, that is defined in 30.12.3.4 [2]**

 is the maximum duration of the last PPDU which fulfills the spoofing error requirement.

**NOTE – The EDMG Header-A in the first PPDU is modulated with SC mode while the EDMG Header-As in the following PPDUs are modulated with OFDM mode as described in 30.6.6. The duration of the fields may be different from that of the field in the first PPDU.**

**NOTE – In case of EDMG A-PPDU transmission, the spoofed values of the L-Header fields and the duration of the PPDUs except the last PPDU shall be determined so that**   is equal to or greater than .

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Proposed Resolution** |
| 1550 | 30.6.8.2.4 | 352.23 | "Update the number of OFDM symbols at step e) in 30.6.8.2.3"  The parameter (N\_SYMS\_i\_user) shall be updated before the calculation of N\_SYM\_PAD\_i\_user in step e). | Modify the text in P352L23 as follows:  "Update the number of OFDM symbols at step d) in 30.6.8.2.3 ..." | **Accepted** |
| 1530 | 30.6.8.2.~~3~~4 | 352.26 | Typo. N\_SYM\_BLKSi\_user is a typo of N\_PAD\_SYMSi\_user | As per comment | **Accepted** |

**Discussion**

**None**

**Proposed changes to D1.0**

* + - * 1. MU PPDU padding and space-time streams mapping

*Editor: Change the first paragraph in 30.6.8.2.4 as follows:*

For an MU PPDU transmission, all user PPDUs shall be aligned in time. If necessary to achieve this, user PSDUs shall be padded according to the following steps:

* Compute the maximum number of OFDM symbols over all users  for iuser = 1, 2, …, Nuser.
* Update the number of OFDM symbols at step d)(CID #1550) in 30.6.8.2.3 as  for iuser = 1, 2, …, Nuser. Update the number of pad bits for the iuserth user, , accordingly.
* The number of pad OFDM symbols for the MU PPDU transmission for the iuserth user is defined as.(CID #1530)

The number of pad symbols  takes into account MU PPDU padding only and does not include the regular padding described in 30.6.8.2.3.

A receiver can compute the number of pad OFDM symbols, , using the overall PPDU time duration computed using the MCS and PSDU Length fields defined in the L-Header, MCS and PSDU Length fields defined in EDMG-Header-B, and TRN field duration defined in the EDMG-Header-A.

* In case of a non-zero spoofing error and if the spoofing error duration is shorter than one OFDM symbol duration (*TSYM = TDFT + TGI*), the fractional part of OFDM symbol is discarded.
* In case of a non-zero spoofing error and if the spoofing error duration is longer than or equal to an OFDM symbol duration, then one OFDM symbol and possible fractional part of OFDM symbol are discarded; this is signaled by the Spoofing Error Length Indicator field in the EDMG-Header-B.

This procedure also allows a receiver to determine the beginning of a TRN field if one is present in a received MU PPDU.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Proposed Resolution** |
| 1531 | 30.6.8.~~2.4~~3.1 | 353.22 | "The coded and padded bit stream is converted into a stream of complex constellation points, following the rules defined in this subclause for SQPSK, DCM SQPSK, QPSK, 16-QAM, and 64-QAM modulations."    Phase hopping is missing | Change the test as follows:  "The coded and padded bit stream is converted into a stream of complex constellation points, following the rules defined in this subclause for SQPSK, DCM SQPSK, QPSK, 16-QAM, 64-QAM and Phase hopping modulations." | **Accepted** |

**Discussion**

**None**

**Proposed changes to D1.0**

* + - * 1. General

*Editor: Change the second paragraph in 30.6.8.3.1 as follows:*

The coded and padded bit stream is converted into a stream of complex constellation points, following the rules defined in this subclause for SQPSK, DCM SQPSK, QPSK, 16-QAM, 64-QAM, and phase hopping modulations.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Proposed Resolution** |
| 1533 | 30.6.8.3.5 | 356.11 | The subsection in which P(k) is defined should be mentioned. | Change the first text in P356L11 as follows:  "where index P(k) is defined in range N\_SD/2 to N\_SD01 (see 30.6.8.3.8 Tone pairing for SQPSK and QPSK.)" | **Accepted** |
| 1319 | 30.6.8.3.5 | 356.11 | Add a reference to 30.6.8.3.8 where tone pairing is defined | as in comment | **Accepted** |
| 1532 | 30.6.8.3.5 | 356.03 | Typo, after "Each four bits." Subsripts of c shall be 4k, 4k+1, 4k+2 and 4k+3 instead of 2k, 2k+1, 2k+2 and 2k+3.  The same comment for 30.6.8.3.6 16-QAM (P356L15.) | As per comment | **Accepted** |
| 1535 | 30.6.8.3.7 | 356.25 | Typo, after "Each six bits." Subsripts of c shall be 6k, 6k+1, ... 6k+5 instead of 2k, 2k+1, ... 2k+5. | As per comment | **Accepted** |
| 1623 | 30.6.8.3.5 | 356.03 | QPSK for OFDM has incorrect bit assignment | c\_2k, c\_2k+1, c\_2k+2, c\_2k+3 seems to contradict to mapping described below. c\_4k, c\_4k+1, c\_4k+2, c\_4k+3 would do it | **Accepted** |
| 1621 | 30.6.8.3.6 | 356.15 | 16-QAM for OFDM has incorrect bit assignment | Instead of c\_2k, c\_2k+1, c\_2k+2, c\_2k+3 it should be c\_4k, c\_4k+1, ... | **Accepted** |
| 1622 | 30.6.8.3.6 | 356.25 | 64-QAM for OFDM has incorrect bit assignment | Instead of c\_2k, c\_2k+1, c\_2k+2, ... it should be c\_6k, c\_6k+1, c\_6k+2, ... | **Accepted** |

**Discussion**

**None**

**Proposed changes to D1.0**

* + - * 1. QPSK modulation

*Editor: Change the first paragraph in 30.6.8.3.5 as follows:*

The input encoded bits of the iSSth spatial stream are broken into the groups of NCBPS bits, , where q denotes the group number. Each four bits (CID #1532), k = 0, 1, …, NSD/2 – 1, are converted into the pair of complex points . The modulation is performed in two steps:

* First, two QPSK points are modulated as , 
* Second, two QPSK points  are converted to two 16-QAM points  by multiplication on mapping matrix Q as follows: 

where index *P(k)* is defined in the range NSD/2 to NSD – 1 as described in **30.6.8.3.8** (CID #1533). The qth modulated data block of the iSSth spatial stream is mapped to NSD data subcarriers of the qth OFDM symbol of the iSSth spatial stream.

* + - * 1. 16-QAM modulation

*Editor: Change the first paragraph in 30.6.8.3.6 as follows:*

The input encoded bits of the iSSth spatial stream are broken into the groups of NCBPS bits, , where q denotes the group number. Each four bits (CID #1532) k = 0, 1, …, NSD – 1, are converted into the single constellation point . The modulation is performed as follows:



The qth modulated data block of the iSSth spatial stream is mapped to NSD data subcarriers of the qth OFDM symbol of the iSSth spatial stream.

* + - * 1. 64-QAM modulation

The input encoded bits of the iSSth spatial stream are broken into the groups of NCBPS bits, , where q denotes the group number. Each six bits (CID #1535), k = 0, 1, …, NSD – 1, are converted into the single constellation point . The modulation is performed as follows:



The qth modulated data block of the iSSth spatial stream is mapped to NSD data subcarriers of the qth OFDM symbol of the iSSth spatial stream.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Proposed Resolution** |
| 1536 | 30.6.8.3.8.2 | 357.19 | Typo. Unnecessary "(" after P.  The same comment for P357L24 | As per comment | **Accepted** |
| 1537 | 30.6.8.3.8.3 | 357.24 | The mod function does not comply with how it is defined in the 802.11 std. | replace mod(k,N\_TPG) to (N\_TPG mod k) | **Accepted** |

**Discussion**

**None**

**Proposed changes to D1.0**



Static tone pairing

*Editor: Change the equation in the second paragraph in 30.6.8.3.8.2 as follows:*

The STP mapping defines P(k) index as follows: (CID #1536)

Dynamic tone pairing

*Editor: Change the equation in the second paragraph in 30.6.8.3.8.3 as follows:*

The DTP mapping defines P(k) index as follows:

(CID #1536, #1537)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Proposed Resolution** |
| 1538 | 30.6.8.3.11 | 360.19 | The phase hopping modulation is defined as one of the modulation mapping scheme, then the subclause should be placed right after 30.6.8.3.7 64-QAM modulation. (Subclause 30.6.8.3.8.) | As per comment | **Accepted** |

**Discussion**

**None**

**Proposed changes to D1.0**

***Editor: Change the order of the subclauses as follows:***

**30.6.8.3.7 64-QAM modulation**

**8**

**30.6.8.3.9 Tone pairing for SQPSK and QPSK**

**30.6.8.3.10 Interleaver**

**30.6.8.3.11 Space-time block coding**

**Straw Poll:**

* **Do you agree to accept the comment resolution for CIDs 1522, 1523, 1524, 1525, 1526, 2325, 1550, 1530, 1531, 1319, 1533, 1532, 1623, 1621, 1535, 1622, 1536, 1537, 1538 in 18/0332r2?**

**References**

[1] Draft P802.11ay D1.0

[2] 11-17/1806r3, 30.12.3 TXTIME Calculation