IEEE P802.11
Wireless LANs

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| CID Resolution – Part IV, Clause 30.4 |
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|  |  |  |  |  |

Abstract

This document proposes resolution for CIDs 1310, 1506, 2008, 1507, 1508, 1509, 1632, (7) [1].

**CID 1310, 1506**

*Comment:*

"""In the non-EDMG control mode PPDU waveform, the TRN field may be present in a 2.16 GHz non-

EDMG PPDU transmission and shall not be present in a 4.32 GHz, 6.48 GHz, or 8.64 GHz non-EDMG PPDU transmission."" - Doesn't this preclude the use of control trailer in duplicate non-EDMG transmission?"

The signal r\_TRN for the non-EDMG duplicate PPDU is not defined

*Proposed change:*

Remove this requirement or allow for a special case of CT

Add the following text after P274L12. "r\_TRN(nTc) is the waveform of the AGC and TRN fields for the control mode defined in 20.10.2.2."

*Resolution:*

Revised.

**CID 2008**

*Comment:*

Typo in Cyclic shift (CSD).

*Proposed change:*

Change to "Cyclic shift diversity (CSD)".

*Resolution:*

Accepted.

**CID 1507**

*Comment:*

There are duplicated plus (+) functions on the end of the first line and the beginning of the second line. The notation may not be common.

*Proposed change:*

Remove the plus (+) on the end of the first line. Apply similar changes on P275L17, P276L1,L10,L22, and so on...

*Resolution:*

Accepted.

**CID 1508**

*Comment:*

The function "length(x)" is not defined.

*Proposed change:*

"change P274L23-24 as follows

""where N is the number of symbols in the non-EDMG PPDU, and defined as N=TXTIME / Tc"""

*Resolution:*

Revised.

**CID 1509**

*Comment:*

"If delta.t1 and delta.t2 intend delay, -delta.t1 and -delta.t2 instead of +delta.t1 and +delta.t2 should be used in the equation.

The similar comments for P276L1 (case of 6.48 GHz), P276L10 (case of 8.48 GHz.)"

*Proposed change:*

As per comment

*Resolution:*

Revised.

**CID 1632**

*Comment:*

EDMG control mode transmission over the multiple channels should use non-EDMG duplicate format. However, non-EDMG duplicate format does not have EDMG Header-A.

*Proposed change:*

EDMG duplicate format having EDMG Header-A should be defined for EDMG control mode transmission over the multiple channels.

*Resolution:*

Revised.

* 1. EDMG and non-EDMG control mode
		1. General

(CID 1632)

Transmission and reception of 2.16 GHz PPDU using EDMG and non-EDMG control mode and 4.32 GHz PPDU using EDMG duplicate and non-EDMG duplicate control mode is mandatory.

Transmission and reception of 2.16+2.16 GHz PPDU using EDMG and non-EDMG control mode is optional. Transmission and reception of 4.32 GHz PPDU, 6.48 GHz PPDU, 8.64 GHz PPDU, and 4.32+4.32 GHz PPDU using EDMG duplicate and non-EDMG duplicate control mode is optional.

The transmission block diagrams for non-EDMG and EDMG control modes are defined in 30.4.2.2 and 30.4.2.3, respectively. The PPDU format, non-EDMG portion and EDMG portion of the EDMG control mode PPDU are defined in 30.4.3, 30.4.4, and 30.4.5, respectively.

The non-EDMG and EDMG PPDU transmissions are defined in 30.4.7.2 and 30.4.7.3, respectively.

The non-EDMG control trailer encoding and modulation is defined in 30.4.6.

The non-EDMG and EDMG control mode PPDUs are transmitted using MCS 0 and EDMG-MCS 0 modulation and coding schemes, respectively.

The performance requirements are defined in 30.4.8.

* + 1. Transmitter block diagram
			1. General

EDMG and non-EDMG control mode PPDU transmissions may be generated using a transmitter consisting of the following blocks:

* Scrambler scrambles the data to reduce the probability of long sequences of 0s and 1s; see 30.4.5.2.2.
* LDPC encoder encodes the data to enable error correction; see 30.4.5.2.3.
* Constellation mapper maps the sequence of bits to constellation points; see 30.4.5.2.4.
* Spreader spreads out a single constellation point to 32 chips applying the Ga Golay sequence of length 32; see 30.4.5.2.4.
* Golay builder builds π/2-BPSK modulated Ga and Gb Golay sequences comprising the L-STF, L-CEF, and TRN units; see 30.10;
* (CID 2008) Cyclic shift diversity (CSD) prevents the signal from unintentional beamforming. A CSD is specified per transmitter chain for EDMG and non-EDMG duplicate PPDU transmissions.
* Pulse shaping performs convolution of constellation points with shape filter impulse response with possible sampling rate change. For duplicate transmissions, pulse shaping may include a relative time delay between the primary and secondary channels. The exact definition of shape filter impulse response is implementation dependent.
	+ - 1. Non-EDMG PPDU transmission

Figure 126 shows the transmitter blocks used to generate a non-EDMG PPDU. The L-STF, L-CEF, and TRN units of the PPDU are generated using the Golay builder block. The L-Header and Data fields of the PPDU are generated using the scrambler, LDPC encoder, constellation mapper, and spreader. The encoded and modulated bit stream is mapped to *NTX* transmit chains applying spatial expansion with relative cyclic shift over the chains as defined in 30.4.6.2.



Figure 126 —Control mode transmitter block diagram for a non-EDMG PPDU transmission

* + - 1. EDMG PPDU transmission

Figure 127 shows the transmitter blocks used to generate an EDMG PPDU. The L-STF, L-CEF, and TRN units of the PPDU are generated using the Golay builder block. The L-Header, EDMG-Header-A, and Data fields of PPDU are generated using the scrambler, LDPC encoder, constellation mapper, and spreader. The encoded and modulated bit stream is mapped to the *NTX* transmit chains applying spatial expansion with relative cyclic shift over the transmit chains as defined in 30.4.6.3. The cyclic shift is not applied to TRN units included in the TRN field and each transmit chain transmits its own TRN field as defined in 30.9.2.2.5.



Figure 127 —Control mode transmitter block diagram for an EDMG PPDU transmission

* + 1. PPDU format

An EDMG control mode PPDU shall contain the L-STF, L-CEF, L-Header, and EDMG-Header-A fields, but shall not contain the EDMG-STF, EDMG-CEF or EDMG-Header-B fields.

An EDMG control mode PPDU may contain a TRN field as defined in 30.9.2.2.5.

An EDMG control mode PPDU may contain the DMG AGC and TRN fields defined in 20.10.2.2.5 and 20.10.2.2.6 respectively, indicated by the DMG TRN field in the EDMG-Header-A. In that special case the TRN field defined in 30.9.2.2.5 shall not be transmitted.

A non-EDMG PPDU format shall be as defined in 20.4.2.

* + 1. Non-EDMG portion of the EDMG control mode PPDU

The non-EDMG portion of the EDMG control mode PPDU is composed of the L-STF, the L-CEF, and the L-Header. These fields are defined at the chip rate *Fc* = 1.76 GHz and transmitted in the EDMG control mode for 2.16 GHz and 2.16+2.16 GHz channel and the EDMG duplicate control mode for 4.32 GHz, 6.48 GHz, 8.64 GHz, and 4.32+4.32 GHz channel as defined in 30.4.6.3.1 and 30.4.6.3.2.

The L-STF, L-CEF, and L-Header fields of an EDMG control mode PPDU are defined in 30.3.3.2.2, 30.3.3.2.3, and 30.3.3.2.4, respectively.

* + 1. EDMG portion of the EDMG control mode PPDU
			1. General

The EDMG portion of the EDMG control mode PPDU is composed of the EDMG-Header-A field, the Data field, and the TRN field.

The EDMG-Header-A and the Data fields are defined at the chip rate *Fc* = 1.76 GHz and transmitted in the EDMG control mode for 2.16 GHz and 2.16+2.16 GHz channel and the EDMG duplicate mode control for 4.32 GHz, 6.48 GHz, 8.64 GHz, and 4.32+4.32 GHz channel as defined in 30.4.6.3.1 and 30.4.6.3.2.

The TRN field, if present, is transmitted at the chip rate *NCB*×*Fc* as defined in 30.4.6.3.3.

The EDMG control mode PPDU transmission with TRN field is defined in 30.4.6.3.4.

The special case of the EDMG control mode PPDU transmission with DMG AGC and TRN fields is defined in 30.4.6.3.5.

* + - 1. Data field
				1. General

The Data field contains the PSDU. The PSDU shall be scrambled, encoded, modulated and spread as described in the following subclauses.

* + - * 1. Scrambler

The operation of the scrambler is defined in 20.3.9. Bits x1, x2, x3, x4 of the scrambler shift register shall be initialized using the bits in the scrambler initialization bits from the L-Header and bits x5, x6, x7 shall be set to 1. The L-Header is scrambled starting from bit 5. The scrambling of the EDMG-Header-A shall continue the scrambling of the L-Header with no reset. The scrambling of the Data field shall continue the scrambling of the EDMG-Header-A with no reset.

* + - * 1. Encoder

The L-Header, EDMG-Header-A, and Data field are encoded using an effective LDPC code rate less than or equal to 1/2, generated from the data PHY rate 3/4 LDPC parity check matrix, with shortening. The maximum number of data bits in each LDPC codeword is *LCWD* = 168. The following steps are used for the encoding:

* *LL-Header* = 5 is the length of L-Header in octets. *LEDMG-Header-A1* = 6 is the length of EDMG-Header-A1 subfield in octets. Therefore, the total number of bits in the first LDPC codeword is *LDPFCW* = (*LL-Header* + *LEDMG-Header-A1*)×8 = 88 bits.
* *LEDMG-Header-A2* = 3 is the length of EDMG-Header-A2 subfield in octets. The EDMG-Header-A2 subfield is transmitted in the second LDPC codeword.
* The number of LDPC codewords is , where *Length* is the value of the PSDU Length subfield in the EDMG-Header-A field.
* The number of bits in the second and, if present, any subsequent LDPC codeword except the last one is .
* The number of bits in the last LDPC codeword is *LDPLCW* = (*Length* + *LEDMG-Header-A2*)×8 – (*NCW* – 2)×*LDPCW*.

NOTE — For example, if *Length* is 128 octets, then *NCW* = 8, *LDPCW* = 150, and *LDPLCW* = 148. In the first LDPC block, the *LDPFCW* = 88 bits consist of 40 bits from the L-Header field along with 48 bits from the EDMG-Header-A1 subfield. In the second LDPC block, the *LDPCW* = 150 bits consist of 24 bits from the EDMG-Header-A2 subfield along with 126 data bits.

* + - * 1. Modulation and spreading

The scrambled and coded bit stream shall be converted into a stream of complex constellation points by using the procedure defined in 20.4.3.3.4. The constellation points shall then be spread using the sequence Ga32(*n*), as defined in 20.4.3.3.5.

* + 1. Non-EDMG control trailer encoding and modulation

For a special case of control trailer transmission defined in 30.3.7 and the value of the Training Length field is equal to 2, the control trailer takes the place of the AGC and TRN fields following the Data field.

The non-EDMG control trailer has a length of 18 data octets. The control trailer field continues scrambling of the Data field with no seed reset as defined in 20.4.3.3.2. The control trailer is encoded using the rate-3/4 LDPC parity check matrix defined in 20.3.8.4 with shortening to achieve the effective LDPC rate of 6/13.

The encoding procedure includes the follwing steps:

* The input 144 data bits (18 octets) are padded with 360 zeros to get an LDPC codeword length of 504 bits
* Compute the 168 parity bits applying the rate-3/4 LDPC parity check matrix
* Discard the padded 360 zero bits and form the output LDPC codewrod of length 312 bits

The control trailer LDPC codeword continues the DBPSK modulation as defined in 20.4.3.3.4 and then applies the spreading as defined in 20.4.3.3.5.

* + 1. PPDU transmission
			1. General

This subclause defines the waveform for a control mode PPDU transmitted using the non-EDMG format and EDMG format over a 2.16 GHz, 4.32 GHz, 6.48 GHz, 8.64 GHz, 2.16+2.16 GHz, and 4.32+4.32 GHz channel using *NTX* transmit chains. The non-EDMG PPDU transmission shall be as defined in 30.4.6.2. The EDMG PPDU transmission shall be as defined in 30.4.6.3.

The frequently used symbol notations in this subclause are summarized in Table 55.

Table 55—Frequently used parameters

|  |  |
| --- | --- |
| Symbol | Explanation |
|  | Transmit chain number |
|  | Total number of transmit chains |
|  | SC chip rate, equal to 1.76 GHz |
|  | SC chip time duration, equal to 1/*Fc* |
|  | *NCB* = 1 for 2.16 GHz and 2.16+2.16 GHz, *NCB* = 2 for 4.32 GHz and 4.32+4.32 GHz, *NCB* = 3 for 6.48 GHz, and *NCB* = 4 for 8.64 GHz channel |
|  | Shaping filter impulse response defined at the *Nup*×1.76 GHz sampling rate. *Nup* defines an up-sampling parameter. |
|  | Up-sampling parameter |

* + - 1. Non-EDMG PPDU transmission

**30.4.7.2.1 Non-EDMG PPDU transmission over a 2.16 GHz and 2.16+2.16 GHz channel**

The non-EDMG control mode PPDU waveform shall be defined at the SC chip rate equal to 1.76 GHz and include the following modulated fields:

(CID 1507)



where:

 is the duration of the L-STF field of the PPDU

 is the total duration of the L-STF and L-CEF fields of the PPDU

 is the total duration of the L-STF, L-CEF, and L-Header fields of the PPDU

 is the total duration of the L-STF, L-CEF, L-Header, and Data fields of the PPDU

(CID 1310, 1506)

In the non-EDMG control mode PPDU waveform, the AGC and TRN fields may be present in a 2.16 GHz non-EDMG PPDU transmission and shall not be present in a 4.32 GHz, 6.48 GHz, 8.64 GHz, 2.16+2.16 GHz, or 4.32+4.32 GHz non-EDMG PPDU transmission.

For a special case of control trailer transmission defined in 30.3.7 and the value of the Training Length field is equal to 2, the control trailer takes the place of the AGC and TRN fields following the Data field. In that particular case the AGC and TRN fields may be present in a 2.16 GHz, 4.32 GHz, 6.48 GHz, 8.64 GHz 2.16+2.16 GHz, or 4.32+4.32 GHz non-EDMG PPDU transmission.

Unless specified, the chip index *n* is defined in the range [0, *NField* - 1], where *NField* defines the total number of samples for a given signal field. The definition of the L-STF, L-CEF, and L-Header fields is provided in 30.3.3.2.2, 30.3.3.2.3, and 30.3.3.2.4, respectively. The definition of the AGC and TRN fields is provided in 20.10.2.2.5 and 20.10.2.2.6, respectively. The L-Header and Data fields encoding and modulation is provided in 20.4.3.2.3 and 20.4.3.3, respectively.

To transmit a non-EDMG waveform using multiple transmit chains, a spatial expansion with cyclic shift diversity (CSD) is applied. The non-EDMG PPDU waveform for the *iTXth* transmit chain includes a CSD, , that is dependent on the particular transmit chain number. The time shift, , is defined in SC chip units as (*iTX*– 1)×*Nc*×*Tc*, where *Nc* is equal to 4 chips and *Tc* is a chip time duration.



where:

(CID 1508) *N* is the total number of chips in the non-EDMG PPDU waveform , chip time duration is *Tc*

The non-EDMG PPDU waveform for *iTXth* transmit chain is obtained by up-sampling and filtering and then appropriate carrier frequency shift of the  waveform, if required. The up-sampling procedure is applied using a factor of *Nup*. The filtering procedure is performed with a pulse shaping filter  defined at the *Nup*×1.76 GHz sampling rate as follows:



where:

 is the length of  in samples



(CID 1508) *N* is the total number of chips in the non-EDMG PPDU waveform , chip time duration is *Tc*

The pulse shaping filter impulse response  and the *Nup* parameter definition are implementation dependent.

The non-EDMG PPDU waveform for the *iTXth* transmit chain with transmission over a 2.16 GHz or 2.16+2.16 GHz channel shall be defined as follows:



For 2.16+2.16 GHz transmission, the total number of transmit chains, *NTX*, shall be an even number. The first *NTX*/2 transmit chains shall be used for transmission on the primary channel and the second *NTX*/2 transmit chains shall be used for transmission on the secondary channel (see 30.3.4).

**30.4.7.2.2 Non-EDMG duplicate PPDU transmission over a 4.32 GHz, 6.48 GHz, 8.64 GHz, and 4.32+4.32 GHz channel**

The non-EDMG PPDU waveform for the *iTXth* transmit chain with duplicate transmission over a 4.32 GHz or 4.32+4.32 GHz channel shall be defined as follows:

(CID 1507)



where:

(CID 1509) ∆*F* defines the channel spacing and is equal to 2.16 GHz

∆*t*1 and ∆*t*2 are in the range [0, *Tc*]

∆*t* equal to 0 corresponds to the primary channel

For 4.32+4.32 GHz transmission, the total number of transmit chains, *NTX*, shall be an even number. The first *NTX*/2 transmit chains shall be used for transmission on the primary and secondary channels and the second *NTX*/2 transmit chains shall be used for transmission on the secondary1 and secondary2 channels (see 30.3.4).

The non-EDMG PPDU waveform for the *iTXth* transmit chain with duplicate transmission over a 6.48 GHz channel shall be defined as follows:

(CID 1507)



where:

(CID 1509) ∆*t*1, ∆*t*2, and ∆*t*3 are in the range [0, *Tc*]

∆*t* equal to 0 corresponds to the primary channel

The non-EDMG PPDU waveform for the *iTXth* transmit chain with duplicate transmission over a 8.64 GHz channel shall be defined as follows:

(CID 1507)



where:

(CID 1509) ∆*t*1, ∆*t*2, ∆*t*3, and ∆*t*4 are in the range [0, *Tc*]

∆*t* equal to 0 corresponds to the primary channel

* + - 1. EDMG PPDU transmission

The EDMG control mode PPDU is composed of a preamble, a Data field and a TRN field. The total number of transmit chains, *NTX*, used for transmission shall be constant over the different fields of EDMG PPDU.

For a special case of DMG AGC and TRN fields’ transmission over 2.16 GHz channel, indicated by the DMG TRN field in the EDMG-Header-A, the EDMG control mode PPDU is composed of a preamble, a Data field, and DMG AGC and TRN fields.

**30.4.7.3.1 EDMG preamble and Data field transmission over a 2.16 GHz and 2.16+2.16 GHz channel**

(CID 1507)

The preamble and Data field shall be defined at the SC chip rate equal to 1.76 GHz and include the following modulated fields:



where:

 is the duration of the L-STF field of the PPDU

 is the total duration of the L-STF and L-CEF fields of the PPDU

 is the total duration of L-STF, L-CEF, and L-Header fields of the PPDU

 is the total duration of the L-STF, L-CEF, L-Header, and EDMG-Header-A fields of the PPDU

(CID 1310, 1506)

The definition of the L-STF, L-CEF, and L-Header fields is provided in 30.3.3.2.2, 30.3.3.2.3, and 30.3.3.2.4, respectively. The definition of EDMG-Header-A is provided in 30.3.3.3.2.2 and 30.3.3.3.2.4. The definition of the Data field is provided in 30.4.5.2.

To transmit the preamble and Data field using multiple transmit chains, a spatial expansion with cyclic shift diversity (CSD) is applied. The preamble and Data field of the PPDU waveform for the *iTXth* transmit chain includes a cyclic shift, , dependent on the particular transmit chain number. The time shift, , is defined in SC chip units as (*iTX* – 1)×*Nc*×*Tc*, where *Nc* is equal to 4 chips and *Tc* is a chip time duration.



where:

(CID 1508) *N* is the total number of chips in the EDMG preamble and Data fields  of the EDMG PPDU waveform, chip time duration is *Tc*

The EDMG PPDU waveform for the *iTXth* transmit chain is obtained by up-sampling and filtering and then appropriate carrier frequency shift of the  waveform, if required. The up-sampling procedure is applied using a factor of *Nup*. The filtering procedure is performed with a pulse shaping filter  defined at the *Nup*×1.76 GHz sampling rate as follows:



where:

 is the length of  in samples



(CID 1508) *N* is the total number of chips in the EDMG preamble and Data fields  of the EDMG PPDU waveform, chip time duration is *Tc*

The pulse shaping filter impulse response  and *Nup* parameter definition is implementation dependent.

The preamble and Data field of the EDMG PPDU waveform for the *iTXth* transmit chain with transmission over a 2.16 GHz or 2.16+2.16 GHz channel shall be defined as follows:



For 2.16+2.16 GHz transmission, the total number of transmit chains, *NTX*, shall be an even number. The first *NTX*/2 transmit chains shall be used for transmission on the primary channel and the second *NTX*/2 transmit chains shall be used for transmission on the secondary channel (see 30.3.4).

**30.4.7.3.2 EDMG duplicate preamble and Data field transmission over a 4.32 GHz, 6.48 GHz, 8.64 GHz, and 4.32+4.32 GHz channel**

The preamble and Data field of the EDMG PPDU waveform for the *iTXth* transmit chain with duplicate transmission over a 4.32 GHz or 4.32+4.32 GHz channel shall be defined as follows:

(CID 1507)



where:

(CID 1509) ∆*F* defines the channel spacing and is equal to 2.16 GHz

∆*t*1 and ∆*t*2 are in the range [0, *Tc*]

∆*t* equal to 0 corresponds to the primary channel

For 4.32+4.32 GHz transmission, the total number of transmit chains, *NTX*, shall be an even number. The first *NTX*/2 transmit chains shall be used for transmission on the primary and secondary channels and the second *NTX*/2 transmit chains shall be used for transmission on the secondary1 and secondary2 channels (see 30.3.4).

The preamble and Data field of the EDMG PPDU waveform for the *iTXth* transmit chain with duplicate transmission over a 6.48 GHz channel shall be defined as follows:

(CID 1507)



where:

(CID 1509) ∆*t*1, ∆*t*2, and ∆*t*3 are in the range [0, *Tc*]

∆*t* equal to 0 corresponds to the primary channel

The preamble and Data field of the EDMG PPDU waveform for the *iTXth* transmit chain with duplicate transmission over a 8.64 GHz channel shall be defined as follows:

(CID 1507)



where:

(CID 1509) ∆*t*1, ∆*t*2, ∆*t*3, and ∆*t*4 are in the range [0, *Tc*]

∆*t* equal to 0 corresponds to the primary channel

**30.4.7.3.3 TRN field transmission over a 2.16 GHz, 4.32 GHz, 6.48 GHz, 8.64 GHz, 2.16+2.16 GHz, and 4.32+4.32 GHz channel**

The TRN field, , shall be defined at the SC chip rate equal to *NCB*×1.76 GHz per *iTXth* transmit chain as defined in 30.9.2.2.5. The TRN field is defined using *NTX* orthogonal waveforms and transmitted over the entire channel bandwidth.

The TRN field is filtered and resampled with conversion rate ratio *Nup*/*NCB*. For example, the resampling procedure for the ratio *Nup*/*NCB* equal to 3/2 can be defined as follows:



where:

 is the length of  in samples



(CID 1508) *N* is the total number of chips in the TRN field , chip time duration is *Tc*/*NCB*

**30.4.7.3.4 EDMG PPDU transmission with TRN field transmission over a 2.16 GHz, 4.32 GHz, 6.48 GHz, 8.64 GHz, 2.16+2.16 GHz, and 4.32+4.32 GHz channel**

The EDMG control mode PPDU waveform for the *iTXth* transmit chain concatenates the preamble and Data field defined in 30.4.6.3.1 and 30.4.6.3.2 with the TRN field defined in 30.4.6.3.3 and shall be defined as follows:



where:

 is the total duration of the L-STF, L-CEF, L-Header, EDMG-Header-A, and Data fields of the PPDU

**30.4.6.3.5 EDMG PPDU transmission with DMG AGC and TRN fields over a 2.16 GHz channel**

For a special case of a DMG AGC and TRN fields transmission over a 2.16 GHz channel, indicated by the DMG TRN field in the EDMG-Header-A, the EDMG control mode PPDU is composed of a preamble, a Data field and a DMG AGC and TRN fields.

The EDMG control mode PPDU shall be defined at the SC chip rate equal to 1.76 GHz and include the following modulated fields:

(CID 1507)



where:

 is the duration of the L-STF field of the PPDU

 is the total duration of the L-STF and L-CEF fields of the PPDU

 is the total duration of L-STF, L-CEF, and L-Header fields of the PPDU

 is the total duration of the L-STF, L-CEF, L-Header, and EDMG-Header-A fields of the PPDU

 is the total duration of the L-STF, L-CEF, L-Header, EDMG-Header-A, and Data fields of the PPDU

(CID 1310, 1506)

The definition of the L-STF, L-CEF, and L-Header fields is provided in 30.3.3.2.2, 30.3.3.2.3, and 30.3.3.2.4, respectively. The definition of EDMG-Header-A is provided in 30.3.3.3.2.2 and 30.3.3.3.2.4. The definition of the Data field is provided in 30.4.5.2. The definition of the DMG AGC and TRN fields is provided in 20.10.2.2.5 and 20.10.2.2.6, respectively.

To transmit the EDMG PPDU using multiple transmit chains, a spatial expansion with cyclic shift diversity (CSD) is applied. The EDMG PPDU waveform for the *iTXth* transmit chain includes a cyclic shift, , dependent on the particular transmit chain number. The time shift, , is defined in SC chip units as (*iTX* – 1)×*Nc*×*Tc*, where *Nc* is equal to 4 chips and *Tc* is a chip time duration.



where:

(CID 1508) *N* is the total number of chips in the EDMG PPDU waveform , chip time duration is *Tc*

The EDMG PPDU waveform for the *iTXth* transmit chain is obtained by up-sampling and filtering. The up-sampling procedure is applied using a factor of *Nup*. The filtering procedure is performed with a pulse shaping filter  defined at the *Nup*×1.76 GHz sampling rate as follows:



where:

 is the length of  in samples



(CID 1508) *N* is the total number of chips in the EDMG PPDU waveform , chip time duration is *Tc*

The pulse shaping filter impulse response  and *Nup* parameter definition is implementation dependent.

* + 1. Performance requirements

The performance requirements of the EDMG control mode shall be the same as the DMG control mode and defined in 20.4.4.

**SP:**

Do you agree to accept the proposed resolutions for CIDs 1310, 1506, 2008, 1507, 1508, 1509, 1632 in (11-18-0307-03-00ay CID Resolution - Part IV)?

**References:**

1. 11-18-0067-01-00ay-11ay-d1-0-comment-database
2. Draft P802.11ay\_D1.0