IEEE P802.11
Wireless LANs

|  |
| --- |
| 30.6.3 OFDM EDMG-CEF Definition |
| Date: 2017-04-14 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Artyom Lomayev | Intel | Turgeneva 30, Nizhny Novgorod 603024, Russia | +7 (831) 2969444 | artyom.lomayev@intel.com |
| Alexander Maltsev | Intel  |  |  | alexander.maltsev@intel.com |
| Miki Genossar | Intel |  |  | miki.genossar@intel.com |
| Claudio da Silva | Intel |  |  | claudio.da.silva@intel.com |
| Carlos Cordeiro | Intel  |  |  | carlos.cordeiro@intel.com |

Abstract

This document proposes specification text for subclause 30.6.3 and 30.11 of the spec describing OFDM EDMG-CEF and OFDM sequences definition, [1].

**30.6.3 EDMG-CEF definition**

**30.6.3.1 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 number, *i*STS = 1, 2, …, 8, of space-time streams.

The *Seqi*STS*left,N* and *Seqi*STS*right,N* sequences of length *N* used in the definition of the EDMG-CEF field for different space-time streams are defined in section 30.11 (OFDM sequences).

**30.6.3.2 EDMG-CEF definition**

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

* *EDMG-CEFi*STS-177, 177 = [*Seqi*STS*left*, 176, 0, 0, 0, *Seqi*STS*right*, 176], for *iSTS* =1, 2, 3, 4, 5, 6, 7, 8

The EDMG-CEF 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 the total number of active tones
*  is the spatial mapping matrix per *k*-th subcarrier
*  is the EDMG-CEF mapping matrix defined below
*  is the number of OFDM symbols in EDMG CEF for given total number of space-time streams *NSTS* defined below
*  is a matrix element from *m*-th row and *n*-th column
*  is a window function applied to smooth the transitions between consecutive OFDM symbols, it’s definition is implementation specific

The EDMG-CEF mapping matrix for *NSTS* = 1 is defined as follows:



The EDMG-CEF mapping matrix for *NSTS* = 2 is defined as follows:



The EDMG-CEF mapping matrix for *NSTS* = 3 is defined as follows:



The EDMG-CEF mapping matrix for *NSTS* = 4 is defined as follows:



The EDMG-CEF mapping matrix for *NSTS* = 5, 6 is defined as follows:



The EDMG-CEF mapping matrix for *NSTS* = 7, 8 is defined as follows:



**30.11 OFDM sequences**

**30.11.1 General**

The EDMG OFDM PHY uses the pairs of *SeqiSTSleft,N* and *SeqiSTSright,N* sequences, *iSTS* = 1, 2, …, 8, of length *N* = 176 to define EDMG-CEF field in frequency domain for PPDU transmission over a 2.16 GHz bandwidth.

**30.11.1 Sequences definition**

The sequence pairs *SeqiSTSleft,N* and *SeqiSTSright,N* of length *N* = 176 use {±1, ±j} symbols alphabet and defined in Table 2 - Table 3.

1. The sequence Seq*iSTSleft*, 176(k)

|  |
| --- |
| The Sequence Seq1left, 176(k), to be transmitted from left to right, up to down |
| -1 -j -j +1 +j -j +1 -1 +1 -j -1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 +1 +j +j -1 -j +j -1 +1 -1 +j +1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 +j -1 -1 -j +1 -1 -j +j -j -1 +j -j +j -j -1 +j +j +1 +1 +1 +j +j +j -1 -1 -j +1 -1 -j +j -j -1 +j +j -j +j +1 -j -j -1 -1 -1 -j -j +j -1 -1 -j +1 -1 -j +j -j -1 +j -j +j -j -1 +j +j +1 +1 +1 +j +j -j +1 +1 +j -1 +1 +j -j +j +1 -j -j +j -j -1 +j +j +1 +1 +1 +j +j -1 -j -j +1 +j -j +1 -1 +1 -j -1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 -1 -j -j +1 +j -j +1 -1 +1 -j -1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1  |
| The Sequence Seq2left, 176(k), to be transmitted from left to right, up to down |
| +j -1 -1 -j +1 -1 -j +j -j -1 +j +1 -1 +1 -j -1 -1 +j +j +j -1 -1 +j -1 -1 -j +1 -1 -j +j -j -1 +j -1 +1 -1 +j +1 +1 -j -j -j +1 +1 -1 -j -j +1 +j -j +1 -1 +1 -j -1 +j -j +j +1 -j -j -1 -1 -1 -j -j +1 +j +j -1 -j +j -1 +1 -1 +j +1 +j -j +j +1 -j -j -1 -1 -1 -j -j +1 +j +j -1 -j +j -1 +1 -1 +j +1 -j +j -j -1 +j +j +1 +1 +1 +j +j +1 +j +j -1 -j +j -1 +1 -1 +j +1 +j -j +j +1 -j -j -1 -1 -1 -j -j -j +1 +1 +j -1 +1 +j -j +j +1 -j -1 +1 -1 +j +1 +1 -j -j -j +1 +1 +j -1 -1 -j +1 -1 -j +j -j -1 +j -1 +1 -1 +j +1 +1 -j -j -j +1 +1  |
| The Sequence Seq3left, 176(k), to be transmitted from left to right, up to down |
| -1 -j -j +1 +j -j +1 -1 +1 -j -1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 -j +1 +1 +j -1 +1 +j -j +j +1 -j -j +j -j -1 +j +j +1 +1 +1 +j +j -1 -j -j +1 +j -j +1 -1 +1 -j -1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 +j -1 -1 -j +1 -1 -j +j -j -1 +j +j -j +j +1 -j -j -1 -1 -1 -j -j +j -1 -1 -j +1 -1 -j +j -j -1 +j -j +j -j -1 +j +j +1 +1 +1 +j +j -1 -j -j +1 +j -j +1 -1 +1 -j -1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1 -j +1 +1 +j -1 +1 +j -j +j +1 -j +j -j +j +1 -j -j -1 -1 -1 -j -j -1 -j -j +1 +j -j +1 -1 +1 -j -1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1  |
| The Sequence Seq4left, 176(k), to be transmitted from left to right, up to down |
| -j +1 +1 +j -1 +1 +j -j +j +1 -j -j +j -j -1 +j +j +1 +1 +1 +j +j -j +1 +1 +j -1 +1 +j -j +j +1 -j +j -j +j +1 -j -j -1 -1 -1 -j -j +j -1 -1 -j +1 -1 -j +j -j -1 +j +j -j +j +1 -j -j -1 -1 -1 -j -j -j +1 +1 +j -1 +1 +j -j +j +1 -j +j -j +j +1 -j -j -1 -1 -1 -j -j -1 -j -j +1 +j -j +1 -1 +1 -j -1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1 -1 -j -j +1 +j -j +1 -1 +1 -j -1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 -1 -j -j +1 +j -j +1 -1 +1 -j -1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1 +1 +j +j -1 -j +j -1 +1 -1 +j +1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1  |
| The Sequence Seq5left, 176(k), to be transmitted from left to right, up to down |
| -1 -j -j +1 +j -j +1 -1 +1 -j -1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 +j -1 -1 -j +1 -1 -j +j -j -1 +j +j -j +j +1 -j -j -1 -1 -1 -j -j +1 +j +j -1 -j +j -1 +1 -1 +j +1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1 +j -1 -1 -j +1 -1 -j +j -j -1 +j +j -j +j +1 -j -j -1 -1 -1 -j -j +j -1 -1 -j +1 -1 -j +j -j -1 +j -j +j -j -1 +j +j +1 +1 +1 +j +j +1 +j +j -1 -j +j -1 +1 -1 +j +1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 +j -1 -1 -j +1 -1 -j +j -j -1 +j -j +j -j -1 +j +j +1 +1 +1 +j +j -1 -j -j +1 +j -j +1 -1 +1 -j -1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1  |
| The Sequence Seq6left, 176(k), to be transmitted from left to right, up to down |
| -1 -j -j +1 +j -j +1 -1 +1 -j -1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1 +j -1 -1 -j +1 -1 -j +j -j -1 +j -j +j -j -1 +j +j +1 +1 +1 +j +j -1 -j -j +1 +j -j +1 -1 +1 -j -1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1 -j +1 +1 +j -1 +1 +j -j +j +1 -j +j -j +j +1 -j -j -1 -1 -1 -j -j +j -1 -1 -j +1 -1 -j +j -j -1 +j +j -j +j +1 -j -j -1 -1 -1 -j -j +1 +j +j -1 -j +j -1 +1 -1 +j +1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1 -j +1 +1 +j -1 +1 +j -j +j +1 -j -j +j -j -1 +j +j +1 +1 +1 +j +j +1 +j +j -1 -j +j -1 +1 -1 +j +1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1  |
| The Sequence Seq7left, 176(k), to be transmitted from left to right, up to down |
| -1 -j -j +1 +j -j +1 -1 +1 -j -1 -j +j -j -1 +j +j +1 +1 +1 +j +j -j +1 +1 +j -1 +1 +j -j +j +1 -j -1 +1 -1 +j +1 +1 -j -j -j +1 +1 -j +1 +1 +j -1 +1 +j -j +j +1 -j +1 -1 +1 -j -1 -1 +j +j +j -1 -1 -1 -j -j +1 +j -j +1 -1 +1 -j -1 +j -j +j +1 -j -j -1 -1 -1 -j -j +j -1 -1 -j +1 -1 -j +j -j -1 +j -1 +1 -1 +j +1 +1 -j -j -j +1 +1 -1 -j -j +1 +j -j +1 -1 +1 -j -1 +j -j +j +1 -j -j -1 -1 -1 -j -j +1 +j +j -1 -j +j -1 +1 -1 +j +1 +j -j +j +1 -j -j -1 -1 -1 -j -j -j +1 +1 +j -1 +1 +j -j +j +1 -j -1 +1 -1 +j +1 +1 -j -j -j +1 +1  |
| The Sequence Seq8left, 176(k), to be transmitted from left to right, up to down |
| +1 +j +j -1 -j +j -1 +1 -1 +j +1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1 +1 +j +j -1 -j +j -1 +1 -1 +j +1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 -j +1 +1 +j -1 +1 +j -j +j +1 -j +j -j +j +1 -j -j -1 -1 -1 -j -j +j -1 -1 -j +1 -1 -j +j -j -1 +j +j -j +j +1 -j -j -1 -1 -1 -j -j -j +1 +1 +j -1 +1 +j -j +j +1 -j +j -j +j +1 -j -j -1 -1 -1 -j -j -j +1 +1 +j -1 +1 +j -j +j +1 -j -j +j -j -1 +j +j +1 +1 +1 +j +j +1 +j +j -1 -j +j -1 +1 -1 +j +1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1 -1 -j -j +1 +j -j +1 -1 +1 -j -1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1  |

1. The sequence Seq*iSTSright*, 176(k)

|  |
| --- |
| The Sequence Seq1right, 176(k), to be transmitted from left to right, up to down |
| -1 -j -j +1 +j -j +1 -1 +1 -j -1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 +1 +j +j -1 -j +j -1 +1 -1 +j +1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 +j -1 -1 -j +1 -1 -j +j -j -1 +j -j +j -j -1 +j +j +1 +1 +1 +j +j +j -1 -1 -j +1 -1 -j +j -j -1 +j +j -j +j +1 -j -j -1 -1 -1 -j -j -j +1 +1 +j -1 +1 +j -j +j +1 -j +j -j +j +1 -j -j -1 -1 -1 -j -j +j -1 -1 -j +1 -1 -j +j -j -1 +j +j -j +j +1 -j -j -1 -1 -1 -j -j +1 +j +j -1 -j +j -1 +1 -1 +j +1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1 +1 +j +j -1 -j +j -1 +1 -1 +j +1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1  |
| The Sequence Seq2right, 176(k), to be transmitted from left to right, up to down |
| +j -1 -1 -j +1 -1 -j +j -j -1 +j +1 -1 +1 -j -1 -1 +j +j +j -1 -1 +j -1 -1 -j +1 -1 -j +j -j -1 +j -1 +1 -1 +j +1 +1 -j -j -j +1 +1 -1 -j -j +1 +j -j +1 -1 +1 -j -1 +j -j +j +1 -j -j -1 -1 -1 -j -j +1 +j +j -1 -j +j -1 +1 -1 +j +1 +j -j +j +1 -j -j -1 -1 -1 -j -j -1 -j -j +1 +j -j +1 -1 +1 -j -1 +j -j +j +1 -j -j -1 -1 -1 -j -j -1 -j -j +1 +j -j +1 -1 +1 -j -1 -j +j -j -1 +j +j +1 +1 +1 +j +j +j -1 -1 -j +1 -1 -j +j -j -1 +j +1 -1 +1 -j -1 -1 +j +j +j -1 -1 -j +1 +1 +j -1 +1 +j -j +j +1 -j +1 -1 +1 -j -1 -1 +j +j +j -1 -1  |
| The Sequence Seq3right, 176(k), to be transmitted from left to right, up to down |
| -1 -j -j +1 +j -j +1 -1 +1 -j -1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 -j +1 +1 +j -1 +1 +j -j +j +1 -j -j +j -j -1 +j +j +1 +1 +1 +j +j -1 -j -j +1 +j -j +1 -1 +1 -j -1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 +j -1 -1 -j +1 -1 -j +j -j -1 +j +j -j +j +1 -j -j -1 -1 -1 -j -j -j +1 +1 +j -1 +1 +j -j +j +1 -j +j -j +j +1 -j -j -1 -1 -1 -j -j +1 +j +j -1 -j +j -1 +1 -1 +j +1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 +j -1 -1 -j +1 -1 -j +j -j -1 +j -j +j -j -1 +j +j +1 +1 +1 +j +j +1 +j +j -1 -j +j -1 +1 -1 +j +1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1  |
| The Sequence Seq4right, 176(k), to be transmitted from left to right, up to down |
| -j +1 +1 +j -1 +1 +j -j +j +1 -j -j +j -j -1 +j +j +1 +1 +1 +j +j -j +1 +1 +j -1 +1 +j -j +j +1 -j +j -j +j +1 -j -j -1 -1 -1 -j -j +j -1 -1 -j +1 -1 -j +j -j -1 +j +j -j +j +1 -j -j -1 -1 -1 -j -j -j +1 +1 +j -1 +1 +j -j +j +1 -j +j -j +j +1 -j -j -1 -1 -1 -j -j +1 +j +j -1 -j +j -1 +1 -1 +j +1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 +1 +j +j -1 -j +j -1 +1 -1 +j +1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1 +1 +j +j -1 -j +j -1 +1 -1 +j +1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 -1 -j -j +1 +j -j +1 -1 +1 -j -1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1  |
| The Sequence Seq5right, 176(k), to be transmitted from left to right, up to down |
| -1 -j -j +1 +j -j +1 -1 +1 -j -1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 +j -1 -1 -j +1 -1 -j +j -j -1 +j +j -j +j +1 -j -j -1 -1 -1 -j -j +1 +j +j -1 -j +j -1 +1 -1 +j +1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1 +j -1 -1 -j +1 -1 -j +j -j -1 +j +j -j +j +1 -j -j -1 -1 -1 -j -j -j +1 +1 +j -1 +1 +j -j +j +1 -j +j -j +j +1 -j -j -1 -1 -1 -j -j -1 -j -j +1 +j -j +1 -1 +1 -j -1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1 -j +1 +1 +j -1 +1 +j -j +j +1 -j +j -j +j +1 -j -j -1 -1 -1 -j -j +1 +j +j -1 -j +j -1 +1 -1 +j +1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1  |
| The Sequence Seq6right, 176(k), to be transmitted from left to right, up to down |
| -1 -j -j +1 +j -j +1 -1 +1 -j -1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1 +j -1 -1 -j +1 -1 -j +j -j -1 +j -j +j -j -1 +j +j +1 +1 +1 +j +j -1 -j -j +1 +j -j +1 -1 +1 -j -1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1 -j +1 +1 +j -1 +1 +j -j +j +1 -j +j -j +j +1 -j -j -1 -1 -1 -j -j -j +1 +1 +j -1 +1 +j -j +j +1 -j -j +j -j -1 +j +j +1 +1 +1 +j +j -1 -j -j +1 +j -j +1 -1 +1 -j -1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 +j -1 -1 -j +1 -1 -j +j -j -1 +j +j -j +j +1 -j -j -1 -1 -1 -j -j -1 -j -j +1 +j -j +1 -1 +1 -j -1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1  |
| The Sequence Seq7right, 176(k), to be transmitted from left to right, up to down |
| -1 -j -j +1 +j -j +1 -1 +1 -j -1 -j +j -j -1 +j +j +1 +1 +1 +j +j -j +1 +1 +j -1 +1 +j -j +j +1 -j -1 +1 -1 +j +1 +1 -j -j -j +1 +1 -j +1 +1 +j -1 +1 +j -j +j +1 -j +1 -1 +1 -j -1 -1 +j +j +j -1 -1 -1 -j -j +1 +j -j +1 -1 +1 -j -1 +j -j +j +1 -j -j -1 -1 -1 -j -j -j +1 +1 +j -1 +1 +j -j +j +1 -j +1 -1 +1 -j -1 -1 +j +j +j -1 -1 +1 +j +j -1 -j +j -1 +1 -1 +j +1 -j +j -j -1 +j +j +1 +1 +1 +j +j -1 -j -j +1 +j -j +1 -1 +1 -j -1 -j +j -j -1 +j +j +1 +1 +1 +j +j +j -1 -1 -j +1 -1 -j +j -j -1 +j +1 -1 +1 -j -1 -1 +j +j +j -1 -1  |
| The Sequence Seq8right, 176(k), to be transmitted from left to right, up to down |
| +1 +j +j -1 -j +j -1 +1 -1 +j +1 -1 +1 -1 +j +1 +1 -j -j -j +1 +1 +1 +j +j -1 -j +j -1 +1 -1 +j +1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 -j +1 +1 +j -1 +1 +j -j +j +1 -j +j -j +j +1 -j -j -1 -1 -1 -j -j +j -1 -1 -j +1 -1 -j +j -j -1 +j +j -j +j +1 -j -j -1 -1 -1 -j -j +j -1 -1 -j +1 -1 -j +j -j -1 +j -j +j -j -1 +j +j +1 +1 +1 +j +j +j -1 -1 -j +1 -1 -j +j -j -1 +j +j -j +j +1 -j -j -1 -1 -1 -j -j -1 -j -j +1 +j -j +1 -1 +1 -j -1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1 +1 +j +j -1 -j +j -1 +1 -1 +j +1 +1 -1 +1 -j -1 -1 +j +j +j -1 -1  |

**References:**

1. P802.11ay\_D0.3