IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 30.3.6 LDPC Parity Matrices | | | | |
| Date: 2017-11-19 | | | | |
| 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 |
| Claudio da Silva | Intel |  |  | claudio.da.silva@intel.com |
| Carlos Cordeiro | Intel |  |  | carlos.cordeiro@intel.com |

Abstract

This document proposes editorial changes to the LDPC matrices description (30.3.6 LDPC Parity Matrices), [1].

*Editor: it is proposed to introduce changes in D0.8 as below*

**30.3.6 LDPC encoding matrices**

**30.3.6.1 General**

The EDMG PHY shall support the LDPC parity matrices specified in 20.3.8 and may support the additional matrices described in this subclause.

The EDMG PHY defines an additional rate-7/8 LDPC code matrix for a codeword of size equal to 672 bits, which is the same codeword size used in the DMG PHY. The definition of this LDPC code matrix follows the approach specified in 20.3.8.

In addition, the EDMG PHY also defines an LDPC codeword of size equal to 1344 bits through the use of lifting matrices. A lifting matrix acts on the code matrix to generate a larger matrix as follows:

* A nonblank ‘0’ element in the lifting matrix acts on the Z×Z cyclic-permutation matrix *Pi* in the code matrix (at the same location) to create the 2Z×2Z matrix:

|  |  |
| --- | --- |
| *i* |  |
|  | *i* |

* A nonblank ‘1’ element in the lifting matrix acts on the Z×Z cyclic-permutation matrix *Pi* in the code matrix (at the same location) to create the 2Z×2Z matrix:

|  |  |
| --- | --- |
|  | *i* |
| *i* |  |

* A blank entry in the lifting matrix acts on the blank entry in the code matrix representing the Z×Z zero matrix (at the same location) to create the blank entry representing the 2Z×2Z zero matrix:

|  |  |
| --- | --- |
|  |  |
|  |  |

NOTE — Each element *i* in the matrices represents the cyclic permutation matrix *Pi*, and a blank entry represents the zero matrix of size *Z* x *Z*. The cyclic-permutation matrix *Pi* is defined in 20.3.8.

**30.3.6.2 Rate-7/8 LDPC code matrix H = 84 rows x 672 columns, Z = 42**

The rate-7/8 LDPC code matrix with codeword length 672 is defined in Table 44. It is derived using the rate-3/4 LDPC code matrix specified in Table 20-8 by rows 1st and 3rd, 2nd and 4th modulo-2 addition of the original rate-3/4 LDPC matrix.

**Table 44 - Rate 7/8 LDPC code matrix (Each nonblank element *i* or *i* ⊕ *j* is the cyclic permutation matrix *Pi* of size *Z* × *Z* or the modulo-2 addition of the cyclic permutation matrices *Pi* and *Pj* of size *Z* × *Z* (denoted by *Pi* ⊕ *Pj*) respectively;**

**blank entries represent the zero matrix of size Z × Z)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 37⊕35 | 31⊕19 | 18⊕41 | 23⊕22 | 11⊕40 | 21⊕41 | 6⊕  39 | 20⊕  6 | 32⊕28 | 9⊕  18 | 12⊕17 | 29⊕  3 | 28 | 0 | 13 |  |
| 25⊕29 | 22⊕30 | 4⊕0 | 34⊕  8 | 31⊕33 | 3⊕  22 | 14⊕17 | 15⊕  4 | 4⊕  27 | 28 | 14⊕20 | 18⊕27 | 13⊕24 | 13⊕23 | 22 | 24 |

**30.3.6.3 Rate-1/2 LDPC code matrix H = 672 rows x 1344 columns, Z = 42**

The rate-1/2 LDPC code matrix with codeword length 1344 is defined in Table 45. It is derived using rate-1/2 LDPC code matrix specified in Table 20-6 by application of lifting matrix specified in Table 46.

**Table 45 - Rate-1/2 LDPC code matrix**

**(Each nonblank element *i* in the table is the cyclic permutation matrix *Pi* of size *Z* × *Z*;**

**blank entries represent the zero matrix of size *Z* ×*Z*)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 40 |  |  |  |  | 38 |  |  | 13 |  |  |  |  | 5 |  |  | 18 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 40 |  |  | 38 |  |  |  |  | 13 |  |  | 5 |  |  |  |  | 18 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 34 |  |  |  | 35 |  |  |  |  | 27 |  |  |  |  |  | 30 | 2 |  | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 34 |  |  |  | 35 |  |  | 27 |  |  |  |  |  | 30 |  |  | 2 |  | 1 |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | 36 |  |  |  |  | 31 |  |  | 7 |  |  |  |  | 34 |  |  |  | 10 | 41 |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | 36 |  |  | 31 |  |  |  |  | 7 |  |  | 34 |  |  |  | 10 |  |  | 41 |  |  |  |  |  |  |  |  |  |  |
|  |  |  | 27 |  |  |  | 18 |  |  |  | 12 | 20 |  |  |  |  |  |  |  | 15 |  | 6 |  |  |  |  |  |  |  |  |  |
|  |  | 27 |  |  |  | 18 |  |  |  | 12 |  |  | 20 |  |  |  |  |  |  |  | 15 |  | 6 |  |  |  |  |  |  |  |  |
| 35 |  |  |  |  | 41 |  |  |  | 40 |  |  | 39 |  |  |  | 28 |  |  |  |  |  |  | 3 | 28 |  |  |  |  |  |  |  |
|  | 35 |  |  | 41 |  |  |  | 40 |  |  |  |  | 39 |  |  |  | 28 |  |  |  |  | 3 |  |  | 28 |  |  |  |  |  |  |
|  | 29 |  |  |  | 0 |  |  |  |  |  | 22 |  |  | 4 |  |  |  |  | 28 |  |  |  | 27 |  |  | 23 |  |  |  |  |  |
| 29 |  |  |  | 0 |  |  |  |  |  | 22 |  |  |  |  | 4 |  |  | 28 |  |  |  | 27 |  |  |  |  | 23 |  |  |  |  |
|  |  | 31 |  |  |  | 23 |  |  |  |  | 21 |  |  | 20 |  |  |  |  |  | 12 |  |  |  |  |  |  | 0 | 13 |  |  |  |
|  |  |  | 31 |  |  |  | 23 |  |  | 21 |  |  |  |  | 20 |  |  |  |  |  | 12 |  |  |  |  | 0 |  |  | 13 |  |  |
|  |  | 22 |  |  |  |  | 34 | 31 |  |  |  | 14 |  |  |  | 4 |  |  |  |  |  |  |  |  | 13 |  |  | 22 |  | 24 |  |
|  |  |  | 22 |  |  | 34 |  |  | 31 |  |  |  | 14 |  |  |  | 4 |  |  |  |  |  |  | 13 |  |  |  |  | 22 |  | 24 |

**Table 46 - Rate-1/2 lifting matrix**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 |  | 1 |  | 0 |  | 1 |  | 0 |  |  |  |  |  |  |  |
| 0 |  | 0 |  | 1 |  |  | 1 | 0 | 0 |  |  |  |  |  |  |
|  | 0 |  | 1 |  | 0 |  | 1 |  | 1 | 0 |  |  |  |  |  |
|  | 1 |  | 1 |  | 1 | 0 |  |  |  | 0 | 0 |  |  |  |  |
| 0 |  | 1 |  | 1 |  | 0 |  | 0 |  |  | 1 | 0 |  |  |  |
| 1 |  | 1 |  |  | 1 |  | 0 |  | 1 |  | 1 |  | 0 |  |  |
|  | 0 |  | 0 |  | 1 |  | 0 |  |  | 0 |  |  | 1 | 0 |  |
|  | 0 |  | 1 | 0 |  | 0 |  | 0 |  |  |  | 1 |  | 0 | 0 |

**30.3.6.4 Rate-5/8 LDPC code matrix H = 504 rows x 1344 columns, Z = 42**

The rate-5/8 LDPC code matrix with codeword length 1344 is defined in Table 47. It is derived using rate-5/8 LDPC code matrix specified in Table 20-7 by application of lifting matrix specified in Table 48.

**Table 47 - Rate-5/8 LDPC code matrix**

**(Each nonblank element *i* in the table is the cyclic permutation matrix *Pi* of size *Z* × *Z*;**

**blank entries represent the zero matrix of size *Z* ×*Z*)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 20 |  | 36 |  |  | 34 |  | 31 | 20 |  | 7 |  |  | 41 |  | 34 |  |  |  | 10 | 41 |  |  |  |  |  |  |  |  |  |  |  |
|  | 20 |  | 36 | 34 |  | 31 |  |  | 20 |  | 7 | 41 |  | 34 |  |  |  | 10 |  |  | 41 |  |  |  |  |  |  |  |  |  |  |
| 30 |  |  | 27 |  |  |  | 18 |  |  |  | 12 | 20 |  | 14 |  |  | 2 |  | 25 | 15 |  | 6 |  |  |  |  |  |  |  |  |  |
|  | 30 | 27 |  |  |  | 18 |  |  |  | 12 |  |  | 20 |  | 14 | 2 |  | 25 |  |  | 15 |  | 6 |  |  |  |  |  |  |  |  |
| 35 |  |  |  |  | 41 |  |  |  | 40 |  |  | 39 |  |  |  | 28 |  |  |  |  |  |  | 3 | 28 |  |  |  |  |  |  |  |
|  | 35 |  |  | 41 |  |  |  | 40 |  |  |  |  | 39 |  |  |  | 28 |  |  |  |  | 3 |  |  | 28 |  |  |  |  |  |  |
|  | 29 |  |  |  | 0 |  |  |  |  |  | 22 |  |  | 4 |  |  |  |  | 28 |  |  |  | 27 |  | 24 | 23 |  |  |  |  |  |
| 29 |  |  |  | 0 |  |  |  |  |  | 22 |  |  |  |  | 4 |  |  | 28 |  |  |  | 27 |  | 24 |  |  | 23 |  |  |  |  |
|  |  | 31 |  |  |  | 23 |  |  |  |  | 21 |  |  | 20 |  |  |  | 9 |  | 12 |  |  |  |  |  |  | 0 | 13 |  |  |  |
|  |  |  | 31 |  |  |  | 23 |  |  | 21 |  |  |  |  | 20 |  |  |  | 9 |  | 12 |  |  |  |  | 0 |  |  | 13 |  |  |
|  |  | 22 |  |  |  |  | 34 | 31 |  |  |  | 14 |  |  |  | 4 |  |  |  |  |  |  |  |  |  |  |  | 22 |  | 24 |  |
|  |  |  | 22 |  |  | 34 |  |  | 31 |  |  |  | 14 |  |  |  | 4 |  |  |  |  |  |  |  |  |  |  |  | 22 |  | 24 |

**Table 48 - Rate-5/8 lifting matrix**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |  | 1 | 0 |  |  |  |  |  |
| 0 | 1 |  | 1 |  | 1 | 0 | 0 | 1 | 1 | 0 | 0 |  |  |  |  |
| 0 |  | 1 |  | 1 |  | 0 |  | 0 |  |  | 1 | 0 |  |  |  |
| 1 |  | 1 |  |  | 1 |  | 0 |  | 1 |  | 1 | 1 | 0 |  |  |
|  | 0 |  | 0 |  | 1 |  | 0 |  | 0 | 0 |  |  | 1 | 0 |  |
|  | 0 |  | 1 | 0 |  | 0 |  | 0 |  |  |  |  |  | 0 | 0 |

**30.3.6.5 Rate-3/4 LDPC code matrix H = 336 rows x 1344 columns, Z = 42**

The rate-3/4 LDPC code matrix with codeword length 1344 is defined in Table 49. It is derived using rate-3/4 LDPC code matrix specified in Table 20-8 by application of lifting matrix specified in Table 50.

**Table 49 - Rate-3/4 LDPC code matrix**

**(Each nonblank element *i* in the table is the cyclic permutation matrix *Pi* of size *Z* × *Z*;**

**blank entries represent the zero matrix of size *Z* ×*Z*)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 35 |  | 19 |  |  | 41 |  | 22 |  | 40 | 41 |  | 39 |  |  | 6 | 28 |  | 18 |  |  | 17 |  | 3 | 28 |  |  |  |  |  |  |  |
|  | 35 |  | 19 | 41 |  | 22 |  | 40 |  |  | 41 |  | 39 | 6 |  |  | 28 |  | 18 | 17 |  | 3 |  |  | 28 |  |  |  |  |  |  |
|  | 29 | 30 |  |  | 0 |  | 8 |  | 33 |  | 22 | 17 |  | 4 |  |  | 27 |  | 28 | 20 |  |  | 27 |  | 24 | 23 |  |  |  |  |  |
| 29 |  |  | 30 | 0 |  | 8 |  | 33 |  | 22 |  |  | 17 |  | 4 | 27 |  | 28 |  |  | 20 | 27 |  | 24 |  |  | 23 |  |  |  |  |
| 37 |  | 31 |  | 18 |  | 23 |  | 11 |  |  | 21 | 6 |  | 20 |  | 32 |  | 9 |  | 12 |  |  | 29 |  |  |  | 0 | 13 |  |  |  |
|  | 37 |  | 31 |  | 18 |  | 23 |  | 11 | 21 |  |  | 6 |  | 20 |  | 32 |  | 9 |  | 12 | 29 |  |  |  | 0 |  |  | 13 |  |  |
|  | 25 | 22 |  |  | 4 |  | 34 | 31 |  |  | 3 | 14 |  |  | 15 | 4 |  |  |  |  | 14 | 18 |  |  | 13 | 13 |  | 22 |  | 24 |  |
| 25 |  |  | 22 | 4 |  | 34 |  |  | 31 | 3 |  |  | 14 | 15 |  |  | 4 |  |  | 14 |  |  | 18 | 13 |  |  | 13 |  | 22 |  | 24 |

**Table 50 - Rate-3/4 lifting matrix**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 |  |  |  |
| 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |  |  |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |  | 1 | 0 |  |
| 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |  | 1 | 0 | 1 | 0 | 0 | 0 |

**30.3.6.6 Rate-13/16 LDPC code matrix H = 252 rows x 1344 columns, Z = 42**

The rate-13/16 LDPC code matrix with codeword length 1344 is defined in Table 51. It is derived using rate-13/16 LDPC code matrix specified in Table 20-9 by application of lifting matrix specified in Table 52.

**Table 51 - Rate-13/16 LDPC code matrix**

**(Each nonblank element *i* in the table is the cyclic permutation matrix *Pi* of size *Z* × *Z*;**

**blank entries represent the zero matrix of size *Z* ×*Z*)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 29 | 30 |  |  | 0 |  | 8 |  | 33 |  | 22 | 17 |  | 4 |  |  | 27 |  | 28 | 20 |  |  | 27 |  | 24 | 23 |  |  |  |  |  |
| 29 |  |  | 30 | 0 |  | 8 |  | 33 |  | 22 |  |  | 17 |  | 4 | 27 |  | 28 |  |  | 20 | 27 |  | 24 |  |  | 23 |  |  |  |  |
| 37 |  | 31 |  | 18 |  | 23 |  | 11 |  |  | 21 | 6 |  | 20 |  | 32 |  | 9 |  | 12 |  |  | 29 |  | 10 |  | 0 | 13 |  |  |  |
|  | 37 |  | 31 |  | 18 |  | 23 |  | 11 | 21 |  |  | 6 |  | 20 |  | 32 |  | 9 |  | 12 | 29 |  | 10 |  | 0 |  |  | 13 |  |  |
|  | 25 | 22 |  |  | 4 |  | 34 | 31 |  |  | 3 | 14 |  |  | 15 | 4 |  | 2 |  |  | 14 | 18 |  |  | 13 | 13 |  | 22 |  | 24 |  |
| 25 |  |  | 22 | 4 |  | 34 |  |  | 31 | 3 |  |  | 14 | 15 |  |  | 4 |  | 2 | 14 |  |  | 18 | 13 |  |  | 13 |  | 22 |  | 24 |

**Table 52 - Rate-13/16 lifting matrix**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |  |  |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |  |
| 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |

**30.3.6.7 Rate-7/8 LDPC code matrix H = 168 rows x 1344 columns, Z = 42**

The rate-7/8 LDPC code matrix with codeword length 1344 is defined in Table 53. It is derived using rate-3/4 LDPC code matrix specified in Table 20-8 applying two steps. At the first step, the lifting matrix in Table 54 is applied to the rate-3/4 LDPC code matrix. At the second step, rows 1st and 5th, 2nd and 6th, 3rd and 7th, and 4th and 8th modulo-2 addition of the lifted matrix is performed to produce the resulting rate-7/8 LDPC code matrix specified in Table 53.

**Table 53 - Rate-7/8 LDPC code matrix**

**(Each nonblank element *i* in the table is the cyclic permutation matrix *Pi* of size *Z* × *Z*;**

**blank entries represent the zero matrix of size *Z* ×*Z*)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 37 | 35 | 31 | 19 | 41 | 18 | 22 | 23 | 40 | 11 | 41 | 21 | 39 | 6 | 20 | 6 | 32 | 28 | 18 | 9 | 12 | 17 | 3 | 29 | 28 |  | 0 |  |  | 13 |  |  |
| 35 | 37 | 19 | 31 | 18 | 41 | 23 | 22 | 11 | 40 | 21 | 41 | 6 | 39 | 6 | 20 | 28 | 32 | 9 | 18 | 17 | 12 | 29 | 3 |  | 28 |  | 0 | 13 |  |  |  |
| 25 | 29 | 30 | 22 | 0 | 4 | 34 | 8 | 31 | 33 | 3 | 22 | 14 | 17 | 15 | 4 | 4 | 27 |  | 28 | 14 | 20 | 27 | 18 | 13 | 24 | 13 | 23 | 22 |  | 24 |  |
| 29 | 25 | 22 | 30 | 4 | 0 | 8 | 34 | 33 | 31 | 22 | 3 | 17 | 14 | 4 | 15 | 27 | 4 | 28 |  | 20 | 14 | 18 | 27 | 24 | 13 | 23 | 13 |  | 22 |  | 24 |

**Table 54 - Rate-7/8 lifting matrix**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |  |  |  |
| 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |  |  |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 |  | 0 | 1 |  |
| 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |  | 0 | 1 | 0 | 0 | 0 | 0 |







**SP:**

Do you agree to accept the proposed editorial changes in (11-17-1802-00-00ay 30 3 6 LDPC Parity Matrices) to subclause 30.3.6?

**References:**

1. Draft P802.11ay\_D0.8