IEEE P802.11  
Wireless LANs

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| CID 4076 Draft Text | | | | |
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| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Christopher Hansen | Peraso |  |  | chris@covariantcorp.com |
| Nelson Costa | Peraso |  |  | nelson@perasotech.com |
| Graham Smith | SR Technologies |  |  | gsmith@wi-ficonsulting.org |
| Lei Huang | Panasonic |  |  | Lei.huang@sg.panasonic.com |
| Hiroyuki Motozuka | Panasonic |  |  | Motozuka.hiroyuki@jp.panasonic.com |
| Rui Yang | Interdigital |  |  | Rui.Yang@interdigital.com |
|  |  |  |  |  |
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Abstract

Text changes to add optional 8 PSK MCS 10 and 11 to DMG SC PHY to IEEE 802.11md to resolve CID 4076.

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| --- | --- | --- | --- |
| **CID** | **Clause** | **Comment** | **Proposed Change** |
| 4076 | 20.5.3.1.1 | DMG SC modes defined in table 20-15 can be improved for better range. | Contribution to be provided. |

Resolution: Revise

Discussion:

Technical motivation and justification for the comment are in 802.11-20/0168-00-000mCID4076\_Technical\_Motivation.pptx. New modes are optional for DMG STAs and have no impact on legacy devices. Changes to the 802.11md 3.2 draft are in this document.

*Instruct the Editor to make changes to IEEE 802.11md D3.2 as noted below:*

* DMG STA Capability Information field

*Modify Figure 9-552 as shown:*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 B4 | | B5 B9 | B10 B14 | B15 B19 | B20 | B21 | B22 | B23 |
|  | Maximum SC Rx MCS | | Reserved | Maximum  SC Tx MCS | Reserved | Low-Power SC Mode  Supported | Code Rate 13/16 | π/2-8-PSK Capable | Reserved |
| Bits: | 5 | | 5 | 5 | 5 | 1 | 1 | 1 | 1 |
|  | | * Supported MCS Set subfield format(#64) | | | | | | | |

*Insert the text below Figure 9-552 as shown:*

The Code Rate 13/16 subfield specifies whether the STA supports rate 13/16. It is set to 1 to indicate that the STA supports rate 13/16 and is set to 0 otherwise. If this subfield is 0, MCS(#64) with 13/16 code rate specified in Table 20-15 (DMG SC mode modulation and coding schemes) is not supported regardless of the value in Maximum SC Tx/Rx MCS subfields(#64).

The π/2-8-PSK Capable subfield specifies whether the STA supports the use of π/2-8-PSK for MCS 10 and MCS 11. It is set to 1 to indicate the STA supports π/2-8-PSK for both transmission and reception and is set to 0 otherwise.

The A-PPDU Supported subfield is set to 1 to indicate that the STA supports A-PPDU aggregation as described in 10.14 (DMG A-PPDU operation). Otherwise, it is set to 0.

**10.6.7.3 Rate selection for group addressed Data and Management frames transmitted by**

**DMG STAs**

*Modify the 2nd paragraph as shown:*

If the transmit antenna pattern of a single transmission of a group addressed frame covers more than one

receiver, then the sender shall employ an MCS that is supported by all of the receivers. . Furthermore, the sender shall not employ π/2-8-PSK modulation unless all receivers support π/2-8-PSK modulation. If the capability of any receiver is not known, the frame shall be transmitted using an MCS from the mandatory MCS set of the DMG control or SC mode.

* Rate selection for individually addressed Data and Management frames transmitted by DMG STAs

*Insert the text below before the last paragraph:*

An individually addressed Data or Management frame with MCS 10 or MCS 11 shall only employ π/2-8-PSK modulation if the receiving STA supports π/2-8-PSK. The receiving STA indicates support by setting the π/2-8-PSK Capable bit to 1 in the Supported MCS Set subfield of the DMG STA Capability Information field of the DMG Capabilities element all DMG Capabilities fields that are included in transmitted Management frames..

* TXVECTOR and RXVECTOR parameters

*Add the following row to Table 20-1 TXVECTOR and RXVECTOR parameters*

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Value | TXVECTOR | RXVECTOR |
| |  | | --- | | PSK\_APPLIED | | |  | | --- | | Indicates if π/2-8-PSK is applied for MCS 10 or MCS 11. π/2-8-PSK cannot be applied for MCS other than 10 or 11.    Enumerated Type:  PSK\_APPLIED: indicates that π/2-8-PSK is applied.  PSK\_NOT\_APPLIED: indicates that π/2-8-PSK is not applied | | Y | Y |

* General

*Modify Table 20-13 as shown:*

|  |  |  |
| --- | --- | --- |
| Extended SC MCS Indication | B44 | The Extended SC MCS Indication field combined with the Base MCS field indicates the MCS.  The Extended SC MCS Indication field indicates whether the Length field shall be calculated according to Table 20-14 (Parameters for computing Length field value in SC header when Extended SC MCS Indication field is set to 1). |
| π/2-8-PSK Applied | B45 | Corresponds to TXVECTOR parameter PSK\_APPLIED. If this field is set to 1, π/2-8-PSK with corresponding LDPC shortening code with rates 2/3 or 5/6 is applied at the transmitter for MCS 10 or 11, respectively. If set to 0, π/2-16-QAM with LDPC code with rates ½ or 5/8 is applied at the transmitter for MCS 10 or 11, respectively. |
| Reserved | B46–B47 |  |
| HCS | B48–B63 | Header check sequence |

* Modulation and coding scheme

*Modify the text as shown:*

The modulation and coding scheme defines the modulation and code rate that is used in the PPDU. The modulation and coding schemes for SC are defined in Table 20-15 (DMG SC mode modulation and coding schemes) and Table 20-15a (DMG SC mode modulation and coding scheme when π/2-8-PSK Applied field is 1). PPDUs that have the π/2-8-PSK Applied field set to 0 in Table 20-13 (DMG SC mode feader fields) follow Table 20-15. PPDUs that have the π/2-8-PSK Applied field set to 1 in Table 20-13 (DMG SC mode feader fields) follow Table 20-15, except that MCS 10 and MCS 11 in this table shall be replaced by those in Table 20-15a.

*Add a new table and Note after Table 20-15:*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Table 20-15a DMG SC mode modulation and coding schemes when π/2-8-PSK Applied field is 1 | | | | | | |
| MCS | Base  MCS  Field | Extended SC MCS Indication field | Modulation | NCBPS | Repetition | Code rate | Data rate (Mb/s) |
| 10 | 10 | 0 | π/2-8-PSK | 3 | 1 | 2/3 | 3080 |
| 11 | 11 | 0 | π/2-8-PSK | 3 | 1 | 5/6 | 3850 |

NOTE—The LDPC code with rate 2/3 is generated by employing the LDPC code with rate 3/4 and applying the codeword shortening procedure to achieve the effective code rate. The LDPC code with rate 5/6 is generated by employing the LDPC code with rate 13/16 and applying the codeword shortening and puncturing procedure. See 20.5.3.2.3.3 2 LDPC encoding process.

*Modify the text as shown:*

Transmit and receive support for MCS 4 and below is mandatory. Other MCSs are optional. For STAs that support MCS 10, the support for π/2-16-QAM for MCS 10 is mandatory and the support for π/2-8-PSK or MCS 10 is optional. For STAs that support MCS 11, the support for π/2-8-16-QAM for MCS 11 is mandatory and the support for π/2-8-PSK for MCS 11 is optional.

* General

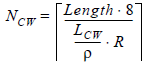
*Modify Table 20-17 as shown:*

|  |  |  |
| --- | --- | --- |
| * LDPC code rates | | |
| Code rate | Codeword size | Number of data bits |
| 1/2 | 672 | 336 |
| 5/8 | 672 | 420 |
| 2/3 | 504 | 336 |
| 3/4 | 672 | 504 |
| 13/16 | 672 | 546 |
| 5/6 | 468 | 390 |
| 7/8 | 624 | 546 |

* LDPC encoding process

*Modify as shown:*

1. First the total number of data pad bits NDATA\_PAD is calculated, using the number of LDPC codewords *NCW*:



if BRP packet and *NCW* < *NCWmin*; *NCW* = *NCWmin*



where

*LCW* is the LDPC codeword length, which is 624 for code rate R=7/8, 504 for code rate R=2/3, 468 for code rate R=5/6, or 672 for all other code rates

*Length* is the length of the PSDU (#1182)indicated by the TXVECTOR parameter LENGTH (in octets)

 is the repetition factor (1 or 2)

*R* is the code rate

*NCWmin* is defined for BRP PPDUs(#1379) in Table 20-21 (Zero filling for DMG SC mode BRP PPDUs(#1379)).

The scrambled PSDU is concatenated with NDATA\_PAD zeros. They are scrambled using the continuation of the scrambler sequence that scrambled the PSDU input bits.

1. The procedure for converting the scrambled PSDU data to LDPC codewords depends on the repetition factor.
   * 1. If  = 1 and the code rate is not one of 2/3, 5/6, 7/8,
        1. The output stream of the scrambler is broken into blocks of *LCWD* = *LCW ×R* bits such that the *m*th data word is .
        2. To each data word, *n-k*=*LCW-R×LCW* parity bits  are added to create the codeword  such that ****
     2. If  = 1 and the code rate is 7/8, 48 bits are punctured from the parity bits of the rate 13/16 parity bits:
        1. The output stream of the scrambler is broken into blocks of 546 bits such that the *m*th data word is .
        2. To each data word, 126 parity bits  are added to create the code word  such that . The code word is generated from  by removing the first 48 parity bits so that 
     3. If  = 1 and the code rate is 2/3,
        1. The output stream of the scrambler is broken into blocks of *LCWD* = 336 bits such that the *m*th data word is .
        2. To each data word, 168 zero bits **0**(*m*) = (01, 02, …,0168) and parity bits **p**(*m*) = (p1, p2, …,p168) are added to create the codeword  such that ****, applying the rate 3/4 LDPC code matrix.
        3. Finally, the zero bits are discarded to create the output codeword 
     4. If  = 1 and the code rate is 5/6,
        1. The output stream of the scrambler is broken into blocks of *LCWD* = 390 bits such that the *m*th data word is .
        2. To each data word, 156 zero bits **0**(*m*) = (01(*m*), 02(*m*), …,0156(*m*)) and parity bits **p**(m) = (p1(*m*), p2(*m*), …,p126(*m*)) are added to create the codeword  such that , applying the rate 13/16 LDPC code matrix.
        3. Finally, the zero bits are discarded and the first 48 parity bits are removed to create the output codeword 

*Instruct the Editor to Add a New Section:*

* a π/2-8-PSK modulation

A DMG STA shall only apply π/2-8-PSK modulation to a PPDU transmitted to a peer STA if the π/2-8-PSK Supported field in the peer STA’s DMG Capabilities element is equal to 1.

In π/2-8-PSK modulation, the input stream is grouped into sets of 3 bits and mapped according to the following equation:



where:

*k* is the symbol output index, *k* = 0, 1, ….

Each output symbol is then rotated according to the following equation: . The constellation bit encoding for 8-PSK before π/2 rotation is in Figure XYZ.



Figure XYZ— 8-PSK constellation bit encoding (before π/2 rotation)

*Instruct the Editor to Modify PICs Table in B.4.24 as shown below*



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| * DMG PHY features | | | | |
| Item | Protocol capability | References | Status | Support |
|  | Are the following PHY protocol features supported? |  |  |  |
| DMG-P1 | PHY operating modes |  |  |  |
| DMG-P1.1 | Operation according to Clause 20 (Directional multi-gigabit (DMG) PHY specification) | 20 (Directional multi-gigabit (DMG) PHY specification) | CFDMG:M | Yes  No  N/A  |
| DMG-P2 | PHY frame format |  |  |  |
| \*DMG-P2.1 | DMG control mode format | 20.4 (DMG control mode) | CFDMG:M | Yes  No  N/A  |
| \*DMG-P2.2 | DMG SC mode format | 20.5 (DMG SC mode) | CFDMG:M | Yes  No  N/A  |
| \*DMG-P2.3(#64) | DMG low-power SC mode format. The DMG low-power SC mode is obsolete. Support for this mechanism might be removed in a later revision of the standard.(#2021) | 20.6 (DMG low-power SC mode) | CFDMG:O | Yes  No  N/A  |
| DMG-P2.4(#64) | Modulation and coding schemes (MCS) |  |  |  |
| DMG-P2.5.1 | MCS 0 of DMG control mode |  | DMG-P2.1:M | Yes  No  N/A  |
| DMG-P2.5.2 | MCS 1-12 of DMG SC mode |  |  |  |
| DMG-P2.5.2.1 | MCS 1-4 |  | DMG-P2.2:M | Yes  No  N/A  |
| DMG-P2.5.2.2 | MCS 5-12 |  | DMG-P2.2:O | Yes  No  N/A  |
| DMG-P2.5.2.3 | π/2-8-PSK for MCS 10 and 11 |  | DMG-P2.2:O | Yes  No  N/A  |
| DMG-P2.5.3(#64) | MCS 25-31 of DMG low-power SC mode |  | DMG-P2.3:M(#64) | Yes  No  N/A  |
| DMG-P2.6 | Common preamble format | 20.3.6 (Common preamble) | CFDMG:M | Yes  No  N/A  |
| DMG-P2.7 | Use of LDPC codes | 20.3.8 (Common LDPC parity matrices) | CFDMG:M | Yes  No  N/A  |