**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) |
| Title | **Discussion on Dimming methods and Proposed Changes** |
| Date Submitted | [July 2017] |
| Source | Trang Nguyen, Yeong Min Jang (Kookmin University)Hideki Aoyama (Panasonic) |
| Re: | D3 comments and resolutions  |
| Abstract | Dimming methods for OCC, Proposed changes in **4.4.3 and** 8.5.2.4  |
| Purpose | D3 comments and resolution |
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# Subclause 4.4.3.2

Remove from Line 36 to Line 47. Connect paragraphs of line 34 and line 49.

(This information is shown in the Table ABC. And these normative sentences conflict a description in 8.5 (*The PHY shall support dimming using one of the techniques specified in either 8.5.1 or 8.5.2, when the phyDim PHY PIB attribute is set.*).)

# Subclause 4.4.3.2.1

* Correct reference in Line 16: Figure 8 to Figure 7
* Remove duplicated sentence “An example … Figure 8” in Line 31 to 32.
* Correct reference in Line 38: Figure 9 to Figure 8
* Replace Figure 9 with the following figure



# Comment 1: Page 37 – Section 4.4.3.2.2

**1- Insert a figure** at the beginning of Section **4.4.3.2.2 Dimming by controlling pulse width (PWM)** to describe an overall method for pulse width dimming (see figure 10 below)



**Figure 10. Mechanism for pulse width dimming**

**2- Also, add a sentence** to describe the inserted figure

“The mechanism for dimming by controlling the pulse width is illustrated in Figure 10.”

3- Remove a sentence “An example of MPM dimming by controlling PWM is as shown in Figure 11.” and Figure 12. (This content is moved to 4.4.3.2.4.)

# Comment 2: Page 39 (line 30)

**Replace Figure 13 and 14 with a new figure (below)**



**Figure 13—Mechanism for amplitude dimming**

# Subclause 4.4.3.2.4 (new subclause)

4.4.3.2.4 Dimming by controlling brightness in out-of-band frequency

Controlling duty cycle in out-of-band frequency region can adjust averaged brightness. The modulated signal is received like amplitude dimming signal via receiver’s band pass filter as shown in Figure AAA.



Figure AAA – Out-of-band dimming

# Comment 3: Page 262 –line 46:

**Change** "The PHY shall support dimming using one of the techniques specified in either 8.5.1 or 8.5.2, when the phyDim PHY PIB attribute is set"

**into=>** "The PHY shall support dimming using at least one of the techniques specified in either 8.5.1 or 8.5.2 or both, when the phyDim PHY PIB attribute is set."

# Comment 4: Page 264 –line 38: Section 8.5.2 Dimming during transmission.

## Tran’s proposal

**Insert the following text and table as the second paragraph of the subclause 8.5.2** to summarize the dimming methods being used for individual PHY modes:

The dimming methods are applied to individual PHY operating modes as descried as follows:

1. **Dimming method 1** (Compensation symbol insertion) shall be applied for PHY-I OOK and PHY-V MPM.
2. **Dimming method 2** (Pulse width modulation) shall be applied for PHY-II VPPM; PHY-IV UFSOOK, Twinkle VPPM, and HS-PSK; PHY-V MPM, RS-FSK, and CM-FSK.
3. **Dimming method 3** (Amplitude modulation) shall be applied for PHY-III CSK; PHY-IV S2-PSK, Twinkle VPPM, and HS-PSK; PHY-V C-OOK.

Table ABC summaries the selection of dimming methods for PHY operating modes.

**Table ABC- Choice of Dimming methods for PHY operating modes**

|  |  |  |
| --- | --- | --- |
| **Mode** | **Selection of dimming method** | **Remark** |
| **PHY I, II, III** |
| OOK | Compensation insertion dimming | Method 1 |
| VPPM | PWM dimming | Method 2 |
| CSK | AM dimming | Method 3 |
| **PHY IV** |
| UFSOOK | PWM dimming | Method 2 |
| S2-PSK | AM dimming | Method 3 |
| Twinkle VPPM | PWM dimming/ AM dimming | Method 2/ hybrid method |
| HS-PSK | PWM dimming/ AM dimming |
| Offset-VPPM | Not supported | Flicker mode |
| **PHY V** |
| RS-FSK | PWM dimming | Method 2 |
| CM-FSK | PWM dimming |
| C-OOK | AM dimming | Method 3 |
| MPM | PWM dimming/ Compensation insertion dimming/AM dimming  | Method 2/ Method 1/Method 3 |
| **PHY VI** |
| A-QL | Not supported | Screen modulation modes operate at optical clock rates below the flicker-limit. |
| HA-QL | Not supported |
| VTASC | Not supported |
| Invisible data embedded display | Not supported |

## Hideki’s proposal

**(Insert the following text and table as the second paragraph of the subclause 8.5.2** to summarize the dimming methods being used for individual PHY modes.)

The PHY modes utilizes compensation symbol insertion dimming (4.4.3.2.1), pulse width dimming (4.4.3.2.2), amplitude dimming (4.4.3.2.3), and/or out-of-band dimming (4.4.3.2.4). Table ABC shows a summary of available dimming methods for each PHY operating modes.

Table ABC – Available dimming methods for PHY operating modes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Mode** | **Compensation symbol insertion dimming** | **Pulse width dimming** | **Amplitude dimming** | **out-of-band dimming** |
| **PHY I, II, III** |
| OOK | x |  | x | x |
| VPPM |  | x | x | x |
| CSK |  |  | x | x |
| **PHY IV** |
| UFSOOK |  | x | x | x |
| S2-PSK |  |  | x | x |
| Twinkle VPPM |  | x | x | x |
| HS-PSK |  | x | x | x |
| Offset-VPPM |  |  | x | x |
| **PHY V** |
| RS-FSK |  | x | x | x |
| CM-FSK |  | x | x | x |
| C-OOK |  |  | x | x |
| MPM | x | x | x | x |
| **PHY VI** |
| all | Dimming is not supported |

# Comment 5: Kookmin Updates their dimming subsections of Section 8.5.2 according to updates in 4.4.3 as described bellows

**8.5.2.4 PHY IV dimming**

**8.5.2.4.1 UFSOOK dimming (no change)**

**8.5.2.4.2 Offset VPWM dimming**

Offset VPWM is flicker, and dimming is not supported.

**8.5.2.4.3 S2-PSK dimming**

S2-PSK dimming is achieved by amplitude modulation as described in the sub-clause **“4.4.3.2.3 dimming by controlling pulse amplitude (AM)”**

The configuration of dimming level for S2-PSK shall be implemented over the PHY PIB attribute *phyDim*.

**8.5.2.4.4 HS-PSK dimming**

HS-PSK is a hybrid modulation method, it may implement both PWM dimming and AM dimming as a hybrid dimming. The DS8-PSK implements dimming over PWM because the DS8-PSK waveform consists of multiple VPPM waveforms. However, two dimming levels (a low dimming level and a high dimming level) shall be applied to the DS8-PSK to generate the AM envelop of the HS-PSK output waveform.

The configuration of two dimming levels is implemented via two PHY PIB attributes *phyHSpskLowDim* and *phyHSpskHighDim*.

The configuration of either the PHY PIB attribute *phyHSpskLowDim* or the PHY PIB attribute *phyHSpskHighDim* or both is to change to OFF and ON of the AM envelope of the HS-PSK waveform.

**8.5.2.5 PHY V dimming**

**8.5.2.5.1 Twinkle VPPM**

**Twinkle VPPM utilizes amplitude dimming.**

**8.5.2.5.2 RS-FSK dimming**

RS-FSK dimming is achieved by controlling the pulse width as described in the sub-clause **“4.4.3.2.2 dimming by controlling pulse width (PWM)”.**

The configuration of RS-FSK dimming level shall be implemented via the PHY PIB*phyDim.*

**8.5.2.5.3 CM-FSK dimming**

CM-FSK and RS-FSK both implement the FSK waveform, thus CM-FSK dimming is achieved by the same manner as RS-FSK.

**8.5.2.5.4 C-OOK dimming**

The preamble symbol and data symbols are all symmetric symbols, and the average brightness of those is constant at 50%. The optical clock rate is also constant at a considerable low frequency, 2.2kHz or 4.4kHz.

C-OOK PHY modes achieve dimming by controlling the amplitude of either ones or zeros or both in OOK signal. The configuration of ones' amplitude generates the average brightness output at the dimmed level (<50%). Meanwhile, the configuration of zeros' amplitude achieves the average brightness output at the bright level (>50%). The achieved dimming level is the average brightness of one and zero.

**8.5.2.5.5 MPM dimming**

(Replace original text and Figure 127 with the following text.)

MPM utilizes dimming by compensation symbol insertion, amplitude dimming, and out-of-band dimming. Additionally, MPPM utilizes pulse width dimming.

**8.5.2.6 PHY VI dimming**

PHY VI modes operates with flicker, and dimming is not supported.

# MPM mode rename

To avoid confusion with “PWM dimming”, rename MPM PWM mode to MPWM mode (and rename MPM PPM mode to MPPM mode).

* PDF page 25

Add the following two acronyms into the list

MPWM: Mirror Pulse Width Modulation

MPPM: Mirror Pulse Position Modulation

* PDF page 317, line 23, Table 125

Replace

0: PWM mode

1: PPM mode

with

0: MPWM mode

1: MPPM mode

* PDF page 370, line 18

replace

"PWM mode and PPM mode,"

with

"MPWM mode and MPPM mode,"

* PDF page 371, line 16

replace "In PWM mode" with "In MPWM mode"

* PDF page 371, line 22

replace "In PPM mode" with "In MPPM mode"

* PDF page 372 line 20

replace "In PWM mode" with "In MPWM mode"

* PDF page 372, line 52, Title of Figure 209

replace "MPM PHY PWM mode waveform" with "MPWM mode waveform"

* PDF page 373 line 1

replace "In PPM mode" with "In MPWM mode"

* PDF page 373, line 33, Title of Figure 210

replace "MPM PHY PPM mode waveform" with "MPPM mode waveform"