**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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# **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.”

# **Comment 2: Page 39 (line 30)**

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



**Figure 13—Mechanism for amplitude 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.**

**Insert the following text and table** 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 |

# 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 (no change)**

**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.*

**8.5.2.5.2 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.

**8.5.2.5.3 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.

**8.5.2.6 PHY VI dimming**

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