# Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

**Submission Title:** [Comment resolution of No.320]
**Date Submitted:** [17th March, 2011]
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**Re:** [Response to the SB 1st recirculation for the IEEE 802.15.7 standard]

**Abstract:** [This document describes the comment resolution of No.320]

**Purpose:** [To provide the comment resolution of No.320]

# Comment resolution of No.320

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# Comment No.320

| Comment No. | Name | Page | Subclause | Line | Comment | Proposed Change |
|---|---|---|---|---|---|---|
| 320 | Joachim Walewski | 247 | 10.6 | 4 | According to subclause 8.5.2.3 the duty cycle d in Table 103 can only be changed in increments of 0.1. Possible values are thus 0.1, 0.2, ..., 0.9. No indication is provided in subclause 10.6 how this translates into the dimming level, and how to achieve intermediate dimming levels. According to sublclause 8.5.2.3, intermediate dimming levels are generally -i.e., also during data transmission- achieved with the "mixing" algorithm in Figure 113. However, Figure 113 only works for instances of visibility-frame transmission (explicit reliance on visibility patterns!). The reader is thus left in the unfortunate situation that subclause 8.5.2.3 clearly contains wrong information, and that subclause 10.6 does not explain, how intermediate dimming levels are to be achieved. | Change the wrongful statement in subclause 8.5.2.3 (contradiction with subclause 10.6). Indicate in subclause 10.6, how intermediate dimming levels are achieved. If this is done by changing the optical power associated to "low" and "high" simply state so. |

# Summary of Comment #320

1. Define the *d* value mapping mechanism according to the dimming level in 10.6 because 10.6 in the current draft describes only the range of "*d*" value.
2. 8.5.2.3 contains the description explaining the dimming mechanism to achieve the high resolution dimming level, 0.1%, in VPPM mode, but it's wrong. So, Rewrite 8.5.2.3.
3. 10.6 does not explain how to achieve the intermediate dimming levels in VPPM mode. So, Add how to achieve the intermediate dimming levels in VPPM-mode to10.6.

- *2nd issue and 3rd issue are the same. If we definitely describe the dimming mechanism to achieve the high resolution dimming level in 8.5.2.3, we don't need to describe it again in 10.6.*

# 1st Issue on Comment #320

- According to subclause 8.5.2.3 the duty cycle ***d*** in Table 103 can only be changed in increments of 0.1. Possible values are thus 0.1, 0.2, ..., 0.9. No indication is provided in subclause 10.6 how this translates into the dimming level.

➢ *Define the d value mapping mechanism according to the dimming level in 10.6 because 10.6 in the current draft describes only the range of "d" value.*

Table 103—Definition of data mapping for VPPM mode

| Logical value | Physical value<br>$d$ is the VPPM duty cycle ($0.1 \le d \le 0.9$) | |
|---|---|---|
| 0 | High | $0 \le t < dT$ |
| | Low | $dT \le t < T$ |
| 1 | Low | $0 \le t < (1-d)T$ |
| | High | $(1-d)T \le t < T$ |

**10.6 Data mapping for VPPM**

The data mapping for VPPM shall be defined as in Table 103. The physical value mapped from the logical data '0' has a transition from 'high' to 'low', and the physical value mapped from the logical data '1' has a transition from 'low' to 'high', as shown in Table 103. 'Low' and 'high' values are defined in 8.3.2. The variable d in Table 103 is the VPPM duty cycle.

# ETRI's understanding on 1st issue

## Key Points of 1st Issue

- VPPM waveform depends on "*d*" value which means VPPM duty cycle.
- "*d*" value is strongly coupled with the dimming level.
- 10.6 in the current draft describes only the range of "*d*" value.
- The mapping mechanism of *d* value according to the dimming level is not defined in the current draft.

➢ *So, we need to define the d value mapping mechanism according to the dimming level in 10.6.*

Table 103—Definition of data mapping for VPPM mode

| Logical value | Physical value<br>*d* is the VPPM duty cycle ($0.1 \le d \le 0.9$) | |
|---|---|---|
| 0 | High | $0 \le t < dT$ |
| | Low | $dT \le t < T$ |
| 1 | Low | $0 \le t < (1-d)T$ |
| | High | $(1-d)T \le t < T$ |

# Resolution of 1st issue

### 10.6 Data mapping for VPPM

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Change

10.6 Data mapping for VPPM

The data mapping for VPPM shall be defined as in Table 103. The physical value mapped from the logical data '0' has a transition from 'high' to 'low', and the physical value mapped from the logical data '1' has a transition from 'low' to 'high', as shown in Table 103. 'Low' and 'high' values are defined in 8.3.2. The variable *d* in Table 103 is the VPPM duty cycle, and it is assigned by the VPPM-mode dimming mechanism described in 8.5.2.3.

# 2nd Issue on Comment #320

- No indication is provided in subclause 10.6 how this translates into the dimming level, and how to achieve intermediate dimming levels. According to sublclause 8.5.2.3, intermediate dimming levels are generally -i.e., also during data transmission- achieved with the "mixing" algorithm in Figure 113. However, Figure 113 only works for instances of visibility-frame transmission (explicit reliance on visibility patterns!). The reader is thus left in the unfortunate situation that subclause 8.5.2.3 clearly contains wrong information.

- *8.5.2.3 contains the description explaining the dimming mechanism to achieve the high resolution dimming level, 0.1%, in VPPM mode, but it's wrong.*
- *So, Rewrite 8.5.2.3.*

# 2nd Issue on Comment #320 (*cont.*)

- **8.5.2.3 VPPM-mode dimming**

  The VPPM-mode dimming is described in 4.4.3.1.5. The VPPM PHY shall have basic dimming level support at 10% duty cycle resolution. To support higher resolution for dimming from 0 to 100% in steps of 0.1%, the VPPM PHY shall use *the algorithm as provided in Figure 113.* For example, for supporting 25% dimming, the PHY shall alternately send 20% and 30% duty cycle VPPM symbols. It is recommended that the receiver change the matched filtering in step with the change in the transmitter symbol shape to enable optimum detection.

  ~ ~ ~.

➢ *Only the algorithm to achieve the high resolution dimming level is similar to Figure 113 shown in 8.5.1.2, but we also think this text and Figure 113 can cause the reader to confuse.*

# Main concept to achieve the high resolution dimming level in VPPM-mode *(yesterday)*

- **Let the following values be defined as**
  - Supported VPPM symbols : $VS_0$, $VS_1$, $VS_2$, … $VS_K$ --> K=10
  - Desired dimming level = *Vd_L* (expressed as a percentage value) e.g., for a 25.3% dimming level, *Vd_L* = 25.3
  - Desired precision = *p*, $p \leq 0$, *p* is an integer (expressed as a logarithm value) e.g., for 0.1%, precision, *p* = -1
  - $d_1$ and $d_2$ are the duty cycle of VPPM symbol
- $K = 10, p = -1$
- $sel\_Vd\_level\_1 = \lfloor Vd\_L \cdot 0.1 \rfloor$
- $sel\_Vd\_level\_2 = \lceil Vd\_L \cdot 0.1 \rceil$
- $d_1 = 0.1 \cdot sel\_Vd\_level\_1$
- $d_2 = 0.1 \cdot sel\_Vd\_level\_2$
- $rep\_Vd\_level\_2 = 10 \cdot (Vd\_L - 10 \cdot sel\_Vd\_level\_1)$
- $rep\_Vd\_level\_1 = 100 - rep\_Vd\_level\_1$
- **Then, to achieve the desired dimming level Vd_L :**
  - Assign VPPM symbol with $d_1$ duty cycle *rep_Vd_level_*1 times, and
  - Assign VPPM symbol with $d_2$ duty cycle *rep_Vd_level_*2 times

# Issues in doc. 11/264/r1 (from Rick)

- *Using slide 12 as an example, we see that VS2 is sent 47 times and VS3 is sent 53 times. In order that the receiver follow the transmitter as the symbol shape is changed, the standard needs to specify in which order these are sent. For example, is VS2 sent first, followed by VS3? Are all the symbols of VS2 sent before VS3 is sent or are VS2 and VS3 interleaved, or what?*
- *Also, using the slide 12 example, we see that a complete "dimming compensation" process requires 100 symbols be sent. So what do we do if the number of bits to be sent results in a packet length that is not modulo 100? For example, what do we do if we have 139 symbols to be sent? In this case would the result be a dimming that is not correct for this particular packet? Or would we "stuff" the packet with 61 stuff bits to round it out to 200 symbols so that the dimming is correct? I think the standard needs to specify this based upon the text on slide 12.*

# Issues in doc. 11/264/r1 (from Joachim)

- *It is not clear, how you implement the algorithm so that any receiver knows what to do. Take for example slide 12: are you first sending 47 VS2 symbols and then 53 VS3 symbols, or the other way round. Or are you sending 47 frames with VS2 symbols and then 53 frames with VS3 symbols? So, in other words, does the receiver need to change its demodulation scheme (for instance, the matched filter) during the reception of one packet?*
- *More importantly, what do you do for packets that do not have a length of integer multiples of 100 symbols. For instance, what do I does the transmitter (and hence the receiver) do, when a data package of 357 symbols length is to be sent?*

# Summary of Issues in doc. 11/264/r1

- The standard needs to specify in which order these are sent.
- *We definitely describe the order in which "d1 duty cycle" VPPM symbols and "d2 duty cycle" VPPM symbols are sent in the new figure showing the algorithm.*

- What do you do for packets that do not have a length of integer multiples of 100 symbols.
- *If the number of VPPM data symbols to be sent is not the multiples of 100, then make use of idle pattern VPPM symbol so that it becomes the multiples of 100.*
- *This sentence is also added to the new figure showing the algorithm.*

# Main concept to achieve the high resolution dimming level in VPPM-mode *(today)*

- $K = 10, p = -1$
- $sel\_Vd\_level\_1 = \lfloor Vd\_L \cdot 0.1 \rfloor$
- $sel\_Vd\_level\_2 = \lceil Vd\_L \cdot 0.1 \rceil$
- $d_1 = 0.1 \cdot sel\_Vd\_level\_1$
- $d_2 = 0.1 \cdot sel\_Vd\_level\_2$
- $rep\_Vd\_level\_2 = 10 \cdot (Vd\_L - 10 \cdot sel\_Vd\_level\_1)$
- $rep\_Vd\_level\_1 = 100 - rep\_Vd\_level\_1$
- **Then, to achieve the desired dimming level Vd_L :**
  - Sequentially assign first "$d_1$ duty cycle" VPPM symbol with *rep_Vd_level_*1 times, and then,
  - Assign "$d_2$ duty cycle" VPPM symbol with *rep_Vd_level_*2 times, sequentially.
  - If the number of VPPM data symbols to be sent is not the multiples of 100, then make use of idle pattern VPPM symbol so that it becomes the multiples of 100.

# An example

- VPPM has 10% diming level
  - $K = 10$
- Dimming resolution is 0.1%
  - $p = -1$
- Desired dimming level $Vd\_L = 25.3\%$

- $sel\_Vd\_level\_1 = \lfloor 25.3 \cdot 0.1 \rfloor = \lfloor 2.53 \rfloor = 2$
- $sel\_Vd\_level\_2 = \lceil 25.3 \cdot 0.1 \rceil = \lceil 2.53 \rceil = 3$
- $d_1 = 0.1 \cdot sel\_Vd\_level\_1 = 0.2$
- $d_2 = 0.1 \cdot sel\_Vd\_level\_2 = 0.3$
- $rep\_Vd\_level\_2 = 10 \cdot (25.3 - 20) = 53$
- $rep\_Vd\_level\_1 = 100 - 53 = 47$

- Then, to achieve the desired dimming level 25.3%:
  - Assign $VS_2$ 47 times, and
  - Assign $VS_3$ 53 times

# Resolution of 2nd Issue

- *We believe that this issue can be resolve if we restate the VPPM-mode dimming mechanism to achieve the high dimming resolution in 8.5.2.3.*
- *The modified text can be shown tomorrow.*

# 3rd Issue on Comment #320

- The reader is thus left in the unfortunate situation that subclause 10.6 does not explain, how intermediate dimming levels are to be achieved.

- *10.6 does not explain how to achieve the intermediate dimming levels in VPPM mode. So, Add how to achieve the intermediate dimming levels in VPPM-mode to10.6.*
- *We don't need to describe it again in 10.6 because the dimming mechanism to achieve the high resolution dimming level in VPPM-mode is already described in 8.5.2.3. In addition, 10.6 is for the data mapping, not for the dimming mechanism.*