**IEEE P802.15**

**Wireless Personal Area Networks**

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## 5.2.5 Packet PWM/PPM MAC frame format

The native MPDU has too much overhead for this MAC frame and most of the fields are not needed for a short, repetitive MSDU. The alternative MAC frame for Packet PWM/PPM uses only the MSDU (frame payload).

## 8.6.7.4 Packet PWM/PPM PPDU format

The Packet PWM/PPM PPDU frame structure consists of SHR preamble filed, PSDU PHY payload field, and Optional field.

### 8.6.7.4.1 Packet PWM/PPM SHR Preamble field

The patterns of preamble specifies mode of the transmitted signal.

### 8.6.7.4.2 Packet PWM/PPM PSDU PHY Payload field

PSDU PHY Payload field contains packet address bits, data bits, and a stop bit.

### 8.6.7.4.3 Packet PWM/PPM Optional field

Packet PWM/PPM field is utilized for DC compensation and dimming control.

# 14.4 Packet PWM/PPM

## 14.4.1 Specifications

### 14.4.1.1 Packet PWM specifications

Packet PWM is modulated with pulse width and pulse is shown as two state of brightness, bright and dark state, which are typically transmitted by on and off of a light. A chunk of PHY signal, which is called a packet, corresponds to a MAC frame. A transmitter transmits PHY packet repetitively and can transmit a set of PHY packets in no particular order.

### 14.4.1.2 Packet PPM specifications

Packet PPM is modulated with position of short pulse. Packet PPM realizes deep dimming. Formats, wave forms and characteristics other than specially described are given same as Packet PWM.

## 14.4.2 Bit encoding

### 14.4.2.1 Bit encoding of Packet PWM/PPM mode 1

PHY payload contains of 6 bits of data (*x0* – *x5*). Packet address A (*a0, a1*) is represented as (*x1, x4*) and packet data D (*d0, d1, d2, d3*) is represented as (*x0, x2, x3, x5*).

MSDU consists of 16 bits of data D00 D10 D01 D11, where Dk is data D of packet whose address A is k.

### 14.4.2.2 Bit encoding of Packet PWM/PPM mode 2

PHY payload contains of 12 bits of data (*x0* – *x11*). A packet consists of address A (*a­­0* – *a3*), data Da (*da0­* – *da6*), data Db (*db0* – *db3*), and stop bit S (*s*). They correspond as

$$\left(\begin{matrix}x\_{0}&x\_{1}&x\_{2}\\x\_{3}&x\_{4}&x\_{5}\\x\_{6}&x\_{7}&x\_{8}\\x\_{9}&x\_{10}&x\_{11}\end{matrix}\right)=\left(\begin{matrix}d\_{a0}&s&d\_{b0}\\d\_{a1}&a\_{0}/d\_{a6}&d\_{b1}\\d\_{a2}&a\_{1}/d\_{a5}&d\_{b2}\\d\_{a3}&a\_{2}/d\_{a4}&a\_{3}/d\_{b3}\end{matrix}\right)$$

*x4, x7, x10,* and *x11* correspond either of them in accordance with the packet division rule described below.

MSDU is divided into some packets as shown in Figure 78 to Figure 84.

(Figure 78 to 84)

When a transmitter transmits data of more than 112 bits or stream data, stop bit of packet 15 is 0, and the following data is transmitted from packet 0.

### 14.4.2.3 Bit encoding of Packet PWM/PPM mode 3

(Upload later)

## 14.4.3 Modulation

### 14.4.3.1 Packet PWM modulation

Packet PWM is modulated as shown in Figure 232 to Figure 234.

(Figure 232 – 234)

SHR field consists of two or four pulses. Patterns of the pulse width specifies transmission mode as shown in the Table 145.

(Table 145)

PHY payload contains of 6 bits of data (*x0* – *x5*) in mode 1, 12 bits of data (*x0* – *x11*) in mode 2, or variable bits of data (*x0* – *xn*) in mode 3. Let yk are defined as

$$y\_{k}=x\_{3k}+x\_{3k+1}×2+x\_{3k+2}×4$$

In mode 1 and 2, they are modulated to pulse width [micro seconds] as

$$P\_{Ak}=120+30 ×\left(7-y\_{k}\right)$$

$$P\_{Bk}=120+30×y\_{k}$$

In mode 3, they are modulated to pulse width [micro seconds] as

$$P\_{Bk}=100+20×y\_{k}$$

In mode 1 and 2, PHY payload A and PHY payload B fields are half-optional. A transmitter can transmit both of them, one of them, or a part of them, i.e., PA3, PA4, PB1, and PB2 in mode 2.

In mode 3, PHY payload lasts until SFT or next SHR field is transmitted.

SFT field in mode 3 consists of pulses with (40, 50, 60, 40) micro seconds. SFT field is optional field. A transmitter can transmit next SHR field instead of SFT field.

A transmitter can transmit any kind of signal in Optional field. However, the signal must not contain SHR field pattern. Optional field can be used for DC compensation and dimming control.

### 14.4.3.2 Packet PPM modulation

Packet PPM is modulated as shown in Figure 235 to Figure 237.

(Figure 235 - 237)

SHR field consists of three intervals of successive four pulses. The patterns of intervals show transmission mode as shown in Table 146.

(Table 146)

PHY payload contains of 6 bits of data (*x0* – *x5*) in mode 1, 12 bits of data (*x0* – *x11*) in mode 2, or variable bits of data (*x0* – *xn*) in mode 3. Let yk are defined as

$$y\_{k}=x\_{3k}+x\_{3k+1}×2+x\_{3k+2}×4$$

In mode 1 and 2, they are modulated to pulse width [micro seconds] as

$$P\_{k}=180+30×y\_{k}$$

In mode 3, they are modulated to pulse width [micro seconds] as

$$P\_{Bk}=100+20×y\_{k}$$

In mode 3, PHY payload lasts until SFT or next SHR field is transmitted.

SFT field in mode 3 consists of pulses intervals with (90, 80, 90) micro seconds. SFT field is optional field. A transmitter can transmit next SHR field instead of SFT field.

Transmitter can transmit any kind of signal in Optional field. However, the signal must not contain SHR field pattern. Optional field can be used for DC compensation and dimming control.