**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) |
| Title | **Kookmin PHY 4 PPDU frame formats** |
| Date Submitted | [September, 2016] |
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| Re: |  |
| Abstract | Details of Resolutions regarding to the submitted Comments on D0 are suggested.  PHY 4 modes: PPDU frame formats are presented. |
| Purpose | D0 Comments Resolutions and Editorial Revision. |
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# PHY 4 PPDU formats

**9.6.6.4 S2-PSK PPDU format**

|  |  |
| --- | --- |
| **Preamble**  (see 9.6.6.4.1) | **PSDU**  (see 9.6.6.4.2) |
| SHR | PHY payload |

The S2-PSK PPDU frame structure consists of the preamble field and the PSDU PHY payload. No PHR field is used.

**9.6.6.4.1 S2-PSK Preamble field**

The preamble field for S2-PSK is two bit time long. The optical clock rate used at the preamble field is the same as the optical clock at PSDU PHY payload (200Hz for example).

The preamble (defined as follow) is distinguishable among RLL coded PHY payload (defined on the next sub-clause).

|  |  |  |
| --- | --- | --- |
| Duration | one bit time | one bit time |
| Preamble | 1 1 | 1 1 |

**9.6.6.4.2 S2-PSK PSDU PHY payload**

The number of payload bits is variable, counted from the preamble of the PPDU frame to the preamble of the next PPDU frame.

The PPDU utilizes RLL code at code rate 1/2 as follows.

|  |  |  |
| --- | --- | --- |
| Duration | one bit time | one bit time |
| Data bit | 0 | 1 |
| RLL coding | 0 0 | 0 1 |

The half of bit time is specified at longer than the maximum interframe interval of camera sampling to make sure that every bit is sampled at least twice.

**9.6.6.5 S2+DSM-PSK (Divided into two sub-clauses as follows)**

**9.6.6.5 S8-PSK PPDU format**

|  |  |  |
| --- | --- | --- |
| **Preamble**  (see 9.6.6.5.1) | **PHY header**  (see 9.6.6.5.2) | **PSDU**  (see 9.6.6.5.3) |
| SHR | PHR | PHY payload |

The S8-PSK PPDU frame structure consists of the preamble field, PHR field, and the PSDU PHY payload.

**9.6.6.5.1 S8-PSK Preamble field**

The length of preamble field for S8-PSK is equal to the S2-PSK preamble. Notably, the symbol time of S8-PSK equals to the bit time of S2-PSK because the S8-PSK does not utilize the 1/2-rate line code as S2-PSK. Therefore, the S8-PSK preamble field is four symbol times long.

The S8-PSK preamble signal is the same as the preamble for S2-PSK in which LEDs in each light sources are synchronized and considered as one. And then, two light sources blink at the same frequency (200Hz) and inverse phases.

|  |  |
| --- | --- |
| Duration | Four S8-PSK symbols time (= two S2-PSK bit time) |
| Preamble | 1 1 1 1 |

1 means that the two light sources blink at the same frequency (200Hz) and inverse phases.

**9.6.6.5.2 S8-PSK PHR field**

The PHY header shall be transmitted with S8-PSK modulation at the same optical clock rate as at PSDU PHY payload (four times of the S2-PSK optical clock rate, e.g. 800Hz).

The PHY header will support the related communication modes those are specified by MAC frame, at least low-overhead beacon mode, bidirectional communications mode, and V2V mode will be supported. The PHY header is TBD, will be clarified along with MAC frame when D1 comes out.

**9.6.6.5.3 S8-PSK PSDU PHY payload**

The number of payload symbols is variable. Each S8-PSK symbol carries 3-bits.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | symbol 1 | symbol 2 | … | symbol N |
| Data bits | 3 bits | 3 bits |  | 3 bits |

The symbol time of S8-PSK is a half the bit time of S2-PSK because the S2-PSK utilizes 1/2-rate line code but S8-PSK does not. Also, the symbol time of S8-PSK is specified at longer than the maximum interframe interval of camera sampling to make sure that every symbol is sampled at least once.

**9.6.6.6 Hybrid Spatial PSK (HS-PSK)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Preamble**  (see 9.6.6.6.1) | **PHY header**  (see 9.6.6.6.2) | **HCS**  (see 9.6.6.6.3) | **PSDU**  (see 9.6.6.6.4) |
| SHR | PHR | | PHY payload |

The HS-PSK PPDU frame structure consists of the preamble field, PHR sub-fields, and the PSDU PHY payload.

**9.6.6.5.1 HS-PSK Preamble field**

The preamble field for HS-PSK the same as S8-PSK preamble in which two light sources (LEDs inside are spatial redundancy grouped) blink at the same frequency (e.g. 200Hz) and inverse phases.

Since HS-PSK is the hybrid modulation of S2-PSK and DSM-PSK, the duration for HS-PSK preamble is exactly equivalent to the S2-PSK preamble.

|  |  |
| --- | --- |
| Duration | two S2-PSK bit times |
| S2-PSK state | 1 1 1 1 |
| DS8-PSK data | None |

1 means that the two light sources blink at the same frequency (200Hz) and inverse phases.

**9.6.6.5.2 HS-PSK PHY header**

The PHY header will support the related communication modes those are specified by MAC frame, at least low-overhead beacon mode, bidirectional communications mode, and V2V mode will be supported. The PHY header is TBD, will be clarified along with MAC frame when D1 comes out.

**9.6.6.5.3 HS-PSK HSC**

TBD along with PHY header.

**9.6.6.5.4 HS-PSK PSDU PHY payload**

The PSDU consists of multiple data symbols, each symbol carries 3-bits data. Either the low dimming or the high dimming duration of S2-PSK carries N symbols.

The interval of S2-PSK is related to the frame-rate of low-speed camera whereas the symbol rate of DS8-PSK is related to the frame-rate of high-speed camera. The DS8-PSK symbol rate must ensure that the high-speed camera captures at least once per symbol.

**PSDU PHY payload**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Low dimming | | | | high dimming | | | |
| symbol 1 | symbol 2 | … | symbol N | symbol 1 | symbol 2 | … | symbol N |