**IEEE P802.15**

**Wireless Personal Area Networks**

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# #1: PHY A,B,C tables

**Table 01. PHY A operating modes**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Modulation**  *(phyOccMcsID)* | **RLL**  *(phyOccRLLCode)* | **Optical clock rate**  *(phyOccOpticalClockRate)* | **FEC**  *(phyOccFec)* | **Bit Rate** |
| **PHY A operating modes** | | | | |
| UFSOOK | NA | multiple of frame rate | MIMO path dependent | (1/2)\*(code rate)\*Frame Rate) |
| Twinkle VPPM | NA | 4x bit rate | RS(15, 11) | 4 kbps |
| S2-PSK | Differential code | 10 Hz | Temporal error correction | 5 bps |
| S8-PSK | Grey code | 10 Hz | Temporal error correction | 30 bps |
| HS-PSK | ½ code rate for S2-PSK; none for DS8-PSK | 10 kHz | Temporal error correction;  Outer FEC with GF(16) | 22 kbps |
| **PHY B operating modes** | | | | |
| NS-FSK | None | 30 Hz | XOR FEC | 60/90 bps |
| C-OOK | Manchester/ 4B6B | 2.2 kHz/ 4.4 kHz | Temporal error correction  (DS rate=100/ DS rate=60) | 60/150/580/700 bps |
| CM-FSK | None | 10 Hz | Temporal error correction | 40/50/60  bps |
| Packet PWM/PPM | None | 100 kHz | Temporal error correction | 5.5/ 8 kbps |
| **PHY C operating modes** | | | | |
| A-QL | None | 10 Hz | Hamming (11,15)/ None | 5.28/ 7.56 kbps  (16x16 cells) |
| HA-QL | Differential code | 10 Hz | Hamming (11,15)/ None | 220/ 300 bps  (8x8 cells) |
| VTASC | None |  |  |  |
| Invisible data embedded | None |  |  |  |

# #4: PHY constants and attributes table

**Table 188- PHY PIB attributes**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Attribute** | **Ident.** | **Type** | **Range** | **Description** |
| phyOccMcsID | - | Int. | 0-TBD | This attribute identifies the OCC modulation.  0: S2-PSK  1: S8-PSK  2: HS-PSK  3: C-OOK  4: CM-FSK  5: A-QL  6: Hidden A-QL (HA-QL)  7: NS-FSK  8-TBD: Reserved |
| phyOccOpticalClockRate | - | Int. | 0-15 | The optical clock rate (or symbol rate) applied for S2-PSK, S8-PSK, CM-FSK, and screen modulations (A-QL, and HA-QL); C-OOK; and DSM-PSK modulations respectively.  0-3: 5 Hz/10 Hz/15 Hz/20 Hz4-6: 30 Hz/ 60 Hz/ 120 Hz  6-8: Reserved  9-10: 2.2 kHz/ 4.4 kHz  11-12: 10 kHz/ 50 kHz  13-14: Reserved  15: Use the value specified in phyOccCustomOpticalClockRate |
| phyOccCustomOpticalClockRate |  | float |  | Custom optical clock rate, used when phyOccOpticalClockRate = 15 |
| phyOccDim | - | Int. | 0-1000 | Refer to *phyDim* (0x02 Identifier), IEEE 802.15.7-2011 std.  OCC dimming is configured in steps of TBD %. |
| phyOccRLLCode | - | Int. | 0-7 | This specifies the RLL coding corresponding to the specific OCC modulation (phyOccMcsID):  In case of S2-PSK modulation, the RLL coding is  0: None  1: Differential code ½ rate  Other values: Reserved  In case of S8-PSK modulation, the RLL coding is  0: None  1: 3 bits Grey code  Other values: Reserved  In case of HS-PSK, the RLL coding is  0: None  1: 1/2 code rate for S2-PSK and none for DS8-PSK  Other values: Reserved  In case of C-OOK modulation, the RLL coding is  0: Manchester  1: 4B6B coding  Other values: Reserved  In case of CM-FSK modulation, the RLL coding is  0: None  Other values: Reserved  In case of NS-FSK modulation, the RLL coding is  0: None  Other values: Reserved  In case of A-QL modulation, the RLL coding is  0: None  Other values: Reserved  In case of HA-QL modulation, the RLL coding is  0: None  1: Differential ½ code  Other values: Reserved |
| phyOccFec | - | Int. | 0-7 | This attribute specifies FEC corresponding to the specific OCC modulation (phyOccMcsID):  In case of S2-PSK modulation,  0: None  Other values: Reserved  In case of S8-PSK modulation,  0: None  Other values: Reserved  In case of HS-PSK modulation,  0: None for both S2-PSK and DS8-PSK  1: None for S2-PSK and RS (15, 11) for DS8-PSK  Other values: Reserved  In case of C-OOK modulation,  0: Temporal repeating code DS rate=100  1: Temporal repeating code DS rate=60  Other values: Reserved  In case of CM-FSK modulation,  0: None  Other values: Reserved  In case of NS-FSK modulation  0: XOR FEC  Other values: Reserved  In case of A-QL modulation,  0: None  1: Hamming (11,15)  Other values: Reserved  In case of HA-QL modulation,  0: None  1: Hamming (11,15)  Other values: Reserved |
| Below PHY attributes shall be present if phyOccMcsID = 0 (i.e. S2-PSK modulation). | | | | |
| phyS2pskNoLightSources | - | Int. | 0-3 | The number of light sources used to modulate S2-PSK signal.  0: two light sources  1-3: Reserved |
| phyS2pskModulationRate | - | Int. | 0-7 | This attribute specifies the modulation frequency used for S2-PSK.  0: 200 Hz  1: 125 Hz  2-7: Reserved |
| Below PHY attributes shall be present if phyOccMcsID = 1 (i.e. S8-PSK modulation). | | | | |
| phyS8pskNoLightSources | - | Int. | 0-3 | The number of light sources used to modulate S8-PSK signal.  0: two light sources, each consists of 4 LEDs.  1: four light sources, each consists of 4 LEDs (4x4 Digital Signage Tx).  2-3: Reserved |
| phyS8pskModulationRate | - | Int. | 0-7 | This attribute specifies the modulation frequency used for S8-PSK.  0: 800 Hz  1-7: Reserved |
| Below PHY attributes shall be present if phyOccMcsID = 2 (i.e. HS-PSK modulation). | | | | |
| phyHSpskNoLightSources | - | Int. | 0-7 | The number of light sources used to modulate HS-PSK signal.  0: two light sources, each consists of 8 LEDs.  1: two light sources, each consists of 10 LEDs.  1-7: Reserved |
| phyHSpskHighStreamMode | - | Int. | 0-7 | The modulation of high data stream.  0: DS8-PSK mode  1: DS10-PSK mode  2-7: Reserved |
| phyHSpskModulationRate | - | Int. | 0-7 | This attribute specifies the modulation frequency used for S2-PSK and DSM-PSK of HS-PSK.  0: 200Hz for S2-PSK and 80 kHz for DS8-PSK  1: 200Hz for S2-PSK and 400 kHz for DS8-PSK  2-7: Reserved |
| phyHSpskPsduLength | - | Int. | TBD | This is to specify the length of the high-speed link of HS-PSK.  TBD |
| Below PHY attributes shall be present if phyOccMcsID = 3 (i.e. C-OOK modulation). | | | | |
| phyCookDSrate | - | Int. | 0-7 | This attribute specifies the data sub-frame rate (DS rate) of C-OOK.  0: 60 DS/sec  1: 100 DS/sec  2-7: Reserved |
| phyCookSFsymbol | - | Int. | 0-7 | This attribute specifies the SF symbol of PSDU of C-OOK.  0: 6B symbol  1: 10B symbol  2-3: Reserved |
| phyCookAb | - | Int. | 0-3 | This attribute specifies the amount of Asynchronous bit (Ab) per data sub-frame of C-OOK.  0: 1 bit  1: 2 bit  2-3: Reserved |
| Below PHY attributes shall be present if phyOccMcsID = 4 (i.e. CM-FSK modulation). | | | | |
| phyCmfskNoFrequency | - | Int. | 0-3 | This attribute specifies the number of frequencies used to modulate data in CM-FSK.  0: 32-FSK  1: 64-FSK  2-3: Reserved |
| phyCmfskFrequencySeparation | - | Int. | 0-7 | This attribute specifies the frequency separation in CM-FSK.  0: 50 Hz  1: 100 Hz  2-7: Reserved |
| phyCmfskNoPhase | - | Int. | 0-3 | This attribute specifies the number of phases used to modulate data in CM-FSK.  0: None  1: 2-PSK  2-3: Reserved |
| phyCmfskPreamble1 | - | Int. | 0-3 | This attribute specifies the frequency value of the first preamble in CM-FSK.  0: 200Hz  1-3: Reserved |
| phyCmfskSplitterEnable | - | Boolean | T/F | This attribute enables whether the splitter usage in between frequency symbols in CM-FSK.  FALSE: Disable (Default)  TRUE: Enable |
| Below PHY attributes shall be present if phyOccMcsID = 5 (i.e. A-QL modulation). | | | | |
| phyAqlNoCells | - | Int. | 0-7 | The number of individual cells on Tx in A-QL mode.  0: 16x16 cells  1-7: Reserved |
| phyAqlNoCellReference | - | Int. | 0-3 | The number of cells per each of four reference corners in A-QL mode.  0: 1 cell reference  1: 2x2 cell reference  2-3: Reserved |
| phyAqlByteOrientedEnable | - | Boolean | T/F | The enabler of byte-oriented mode in A-QL mode.  FALSE: Disable (bit-oriented)  TRUE: Enable (byte-oriented) |
| phyAqlNoColors | - | Int. | 0-3 | The number of colors used in A-QL mode.  0: Grey marking (no color)  1: 2 colors  2: 4 colors  3: 8 colors |
| phyAqlPsduLength | - | Int. | TBD | This is to specify the length of PSDU  TBD |
| Below PHY attributes shall be present if phyOccMcsID = 6 (i.e. HA-QL modulation). | | | | |
| phyHAqlNoCells | - | Int. | 0-7 | The number of individual cells on Tx in HA-QL mode.  0: 8x8 cells  1: 16x16 cells  2-7: Reserved |
| phyHAqlNoCellReference | - | Int. | 0-3 | The number of cells per each of four reference corners in HA-QL mode.  0: 1 cell reference  1-3: Reserved |
| phyHAqlByteOrientedEnable | - | Boolean | T/F | The enabler of byte-oriented mode in HA-QL mode.  FALSE: Disable (bit-oriented)  TRUE: Enable (byte-oriented) |
| Below PHY attributes shall be present if phy OccMcsID = 7 | | | | |
| phyNsfskInvFrequencyGap |  | int | 0-3 | Indicates the frequency differences between the frequency sets. This is represented by the inverse of frequency gap. i.e. the time difference in seconds.  0: 3.75e-4  1-2: Reserved  3: Use the value specified in phyOccCustomOpticalClockRate |
| phyNsfskCustomInvFrequencyGap |  | float |  | Custom inverse frequency gap, used when phyNsfskInvFrequencyGap = 3 |
| phyNsfskGroupCount |  | int | 0-7 | Indicates the maximum sequence number. i.e., how many frequency sets exist.  N: n+1 frequency set |
| phyNsfskFEC |  | int | 0-7 | Indicates the number of data symbols protected by one XOR FEC symbol.  N: n+1 symbols |
| phyNsfskSplitterSymbolEnable |  | boolean | T/F | Indicates whether the device uses SSs or not. |
| phyNsfskSplitterFrequency |  | int | 0-3 | Indicates the splitter frequency. This is represented as a ratio of the splitter frequency to the preamble frequency. If the SS is already in used, it will use the original phyNsfskSplitterFrequency until next cycle.  0: 1.4  1-2: Reserved  3: Custom |
| phyNsfskCustomSplitterFrequency |  | float |  | Custom splitter frequency, used when phyNsfskSplitterFrequency = 3­ |
| phyNsfskSplitterDuration |  | int | 0-7 | Indicates the duration of the SS. This is represented as a ratio of symbol duration to splitter duration in integer.  0: 15  1: 30  2: 60  3: 120  4-7: Reserved |
| phyNsfskSymbolDurationExp |  | int | 0-7 | Indicates the duration of a data symbol in the PSDU. This is represented as a ratio of the symbol duration to 1/30 second in the base 2 exponentiation. For example, if the symbol duration is 1/120 second, then the exponent would be -2. Note that this does not affect the duration of the preamble field and the optional field.  0: 0  1: 1  2: 2  3: -1  4: -2  5-6: Reserved  7; Custom |
| phyNsfskEndSymbolEnable |  | boolean | T/F | Indicates whether the device uses end symbol or not. |