6.4.2 PHY PIB attributes

The PHY PIB comprises the attributes required to manage the PHY of a device. Each of these attributes can be read or written using the PLME-GET.request and PLME-SET.request primitives, respectively. The attributes contained in the PHY PIB are presented in Table 19.

Table 19—PHY PIB attributes

Attribute	Identifier	Type	Range	Description
phyCurrentChannel	0 x 00	Integer	0–26	The RF channel to use for all following transmissions and receptions (see 6.1.2).
phyChannelsSupported	0 x 01	Bitmap	See description	The 5 most significant bits (MSBs) (b_{27},... , b_{31}) of *phyChannelsSupported* shall be reserved and set to 0, and the 27 LSBs (b_0, b_1, ... b_{26}) shall indicate the status (1=available, 0=unavailable) for each of the 27 valid channels (b_k shall indicate the status of channel *k* as in 6.1.2).
phyTransmitPower	0 x 02	Bitmap	0 x 00–0xbf	The 2 MSBs represent the tolerance on the transmit power: 00 = ± 1 dB 01 = ± 3 dB 10 = ± 6 dB The 6 LSBs represent a signed integer in twos-complement format, corresponding to the nominal transmit power of the device in decibels relative to 1 mW. The lowest value of *phyTransmitPower* shall be interpreted as less than or equal to –32 dBm.
phyCCAMode	0 x 03	Integer	1–3	The CCA mode (see 6.7.9).

6.5 2450 MHz PHY specifications

The requirements for the 2450 MHz PHY are specified in 6.5.1 through 6.5.3.

6.5.1 Data rate

The data rate of the IEEE 802.15.4 (2450 MHz) PHY shall be 250 kb/s.

6.5.2 Modulation and spreading

The 2450 MHz PHY employs a 16-ary quasi-orthogonal modulation technique. During each data symbol period, four information bits are used to select one of 16 nearly orthogonal pseudo-random noise (PN) sequences to be transmitted. The PN sequences for successive data symbols are concatenated, and the aggregate chip sequence is modulated onto the carrier using offset quadrature phase-shift keying (O-QPSK).

6.5.2.1 Reference modulator diagram

The functional block diagram in Figure 18 is provided as a reference for specifying the 2450 MHz PHY modulation and spreading functions. The number in each block refers to the subclause that describes that function.

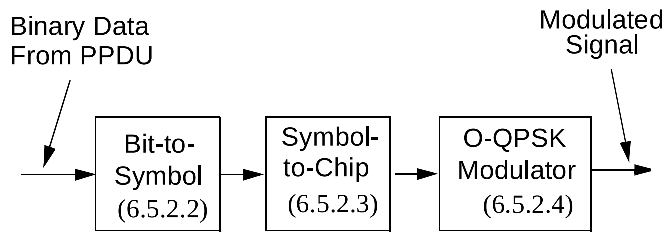

Figure 18—Modulation and spreading functions

6.5.2.2 Bit-to-symbol mapping

All binary data contained in the PPDU shall be encoded using the modulation and spreading functions shown in Figure 18. This subclause describes how binary information is mapped into data symbols.

The 4 LSBs (b_0, b_1, b_2, b_3) of each octet shall map into one data symbol, and the 4 MSBs (b_4, b_5, b_6, b_7) of each octet shall map into the next data symbol. Each octet of the PPDU is processed through the modulation and spreading functions (see Figure 18) sequentially, beginning with the preamble field and ending with the last octet of the PSDU. Within each octet, the least significant symbol (b_0, b_1, b_2, b_3) is processed first and the most significant symbol (b_4, b_5, b_6, b_7) is processed second.

6.5.2.3 Symbol-to-chip mapping

Each data symbol shall be mapped into a 32-chip PN sequence as specified in Table 20. The PN sequences are related to each other through cyclic shifts and/or conjugation (i.e., inversion of odd-indexed chip values).

Table 20—Symbol-to-chip mapping

Data symbol (decimal)	Data symbol (binary) (b_0, b_1, b_2, b_3)	Chip values (c_0 c_1 ... c_{30} c_{31})
0	0 0 0 0	1 1 0 1 1 0 0 1 1 1 0 0 0 0 1 1 0 1 0 1 0 0 1 0 0 0 1 0 1 1 1 0
1	1 0 0 0	1 1 1 0 1 1 0 1 1 0 0 1 1 1 0 0 0 0 1 1 0 1 0 1 0 0 1 0 0 0 1 0
2	0 1 0 0	0 0 1 0 1 1 1 0 1 1 0 1 1 0 0 1 1 1 0 0 0 0 1 1 0 1 0 1 0 0 1 0
3	1 1 0 0	0 0 1 0 0 0 1 0 1 1 1 0 1 1 0 1 1 0 0 1 1 1 0 0 0 0 1 1 0 1 0 1
4	0 0 1 0	0 1 0 1 0 0 1 0 0 0 1 0 1 1 1 0 1 1 0 1 1 0 0 1 1 1 0 0 0 0 1 1
5	1 0 1 0	0 0 1 1 0 1 0 1 0 0 1 0 0 0 1 0 1 1 1 0 1 1 0 1 1 0 0 1 1 1 0 0
6	0 1 1 0	1 1 0 0 0 0 1 1 0 1 0 1 0 0 1 0 0 0 1 0 1 1 1 0 1 1 0 1 1 0 0 1
7	1 1 1 0	1 0 0 1 1 1 0 0 0 0 1 1 0 1 0 1 0 0 1 0 0 0 1 0 1 1 1 0 1 1 0 1
8	0 0 0 1	1 0 0 0 1 1 0 0 1 0 0 1 0 1 1 0 0 0 0 0 0 1 1 1 0 1 1 1 1 0 1 1
9	1 0 0 1	1 0 1 1 1 0 0 0 1 1 0 0 1 0 0 1 0 1 1 0 0 0 0 0 0 1 1 1 0 1 1 1
10	0 1 0 1	0 1 1 1 1 0 1 1 1 0 0 0 1 1 0 0 1 0 0 1 0 1 1 0 0 0 0 0 0 1 1 1
11	1 1 0 1	0 1 1 1 0 1 1 1 1 0 1 1 1 0 0 0 1 1 0 0 1 0 0 1 0 1 1 0 0 0 0 0
12	0 0 1 1	0 0 0 0 0 1 1 1 0 1 1 1 1 0 1 1 1 0 0 0 1 1 0 0 1 0 0 1 0 1 1 0
13	1 0 1 1	0 1 1 0 0 0 0 0 0 1 1 1 0 1 1 1 1 0 1 1 1 0 0 0 1 1 0 0 1 0 0 1

Table 20—Symbol-to-chip mapping *(continued)*

Data symbol (decimal)	Data symbol (binary) (b_0, b_1, b_2, b_3)	Chip values (c_0 c_1 ... c_{30} c_{31})
14	0 1 1 1	1 0 0 1 0 1 1 0 0 0 0 0 0 1 1 1 0 1 1 1 1 0 1 1 1 0 0 0 1 1 0 0
15	1 1 1 1	1 1 0 0 1 0 0 1 0 1 1 0 0 0 0 0 0 1 1 1 0 1 1 1 1 0 1 1 1 0 0 0

6.5.2.4 O-QPSK modulation

The chip sequences representing each data symbol are modulated onto the carrier using O-QPSK with half-sine pulse shaping. Even-indexed chips are modulated onto the in-phase (I) carrier and odd-indexed chips are modulated onto the quadrature-phase (Q) carrier. Because each data symbol is represented by a 32-chip sequence, the chip rate (nominally 2.0 Mchip/s) is 32 times the symbol rate. To form the offset between I-phase and Q-phase chip modulation, the Q-phase chips shall be delayed by T_c with respect to the I-phase chips (see Figure 19), where T_c is the inverse of the chip rate.

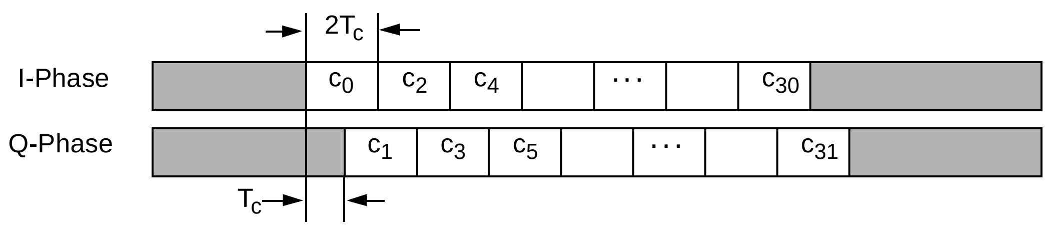

Figure 19—O-QPSK chip offsets

6.5.2.5 Pulse shape

The half-sine pulse shape used to represent each baseband chip is described by Equation (1):

$$p(t) = \begin{cases} \sin\left(\pi \dfrac{t}{2T_c}\right), & 0 \le t \le 2T_c \\ 0, & otherwise \end{cases} \tag{1}$$

Figure 20 shows a sample baseband chip sequence with half-sine pulse shaping.

6.5.2.6 Chip transmission order

During each symbol period the least significant chip, c_0, is transmitted first and the most significant chip, c_{31}, is transmitted last.

6.5.3 2450 MHz band radio specification

In addition to meeting regional regulatory requirements, devices operating in the 2450 MHz band shall also meet the radio requirements in 6.5.3.1 through 6.5.3.4.