

## 2 PHYSICAL CHANNEL

### 2.1 FREQUENCY BAND AND RF CHANNELS

Bluetooth operates in the 2.4 GHz ISM band. Although globally available, the exact location and the width of the band may differ by country. In the US and Europe, a band of 83.5 MHz width is available; in this band, 79 RF channels spaced 1 MHz apart are defined. In Japan, Spain, and France, a smaller band is available; in this band, 23 RF channels spaced 1 MHz apart are defined.

Country	Frequency Range	RF Channels	
Europe* & USA	2400 - 2483.5 MHz	$f = 2402 + k$ MHz	$k = 0, \dots, 78$
Japan	2471 - 2497 MHz	$f = 2473 + k$ MHz	$k = 0, \dots, 22$
Spain	2445 - 2475 MHz	$f = 2449 + k$ MHz	$k = 0, \dots, 22$
France	2446.5 - 2483.5 MHz	$f = 2454 + k$ MHz	$k = 0, \dots, 22$

Table 2.1: Available RF channels

\*. except Spain and France

### 2.2 CHANNEL DEFINITION

The channel is represented by a pseudo-random hopping sequence hopping through the 79 or 23 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1600 hops/s. All Bluetooth units participating in the piconet are time- and hop-synchronized to the channel.

### 2.3 TIME SLOTS

The channel is divided into time slots, each 625  $\mu$ s in length. The time slots are numbered according to the Bluetooth clock of the piconet master. The slot numbering ranges from 0 to  $2^{27}-1$  and is cyclic with a cycle length of  $2^{27}$ .

In the time slots, master and slave can transmit packets.

A TDD scheme is used where master and slave alternatively transmit, see [Figure 2.1 on page 44](#). The master shall start its transmission in even-numbered time slots only, and the slave shall start its transmission in odd-numbered time slots only. The packet start shall be aligned with the slot start. Packets transmitted by the master or the slave may extend over up to five time slots.

The RF hop frequency shall remain fixed for the duration of the packet. For a single packet, the RF hop frequency to be used is derived from the current Bluetooth clock value. For a multi-slot packet, the RF hop frequency to be used for the entire packet is derived from the Bluetooth clock value in the first slot of the packet. The RF hop frequency in the first slot after a multi-slot packet shall use the frequency as determined by the current Bluetooth clock value. [Figure 2.2 on page 44](#) illustrates the hop definition on single- and multi-slot packets. If a packet occupies more than one time slot, the hop frequency applied shall be the hop frequency as applied in the time slot where the packet transmission was started.

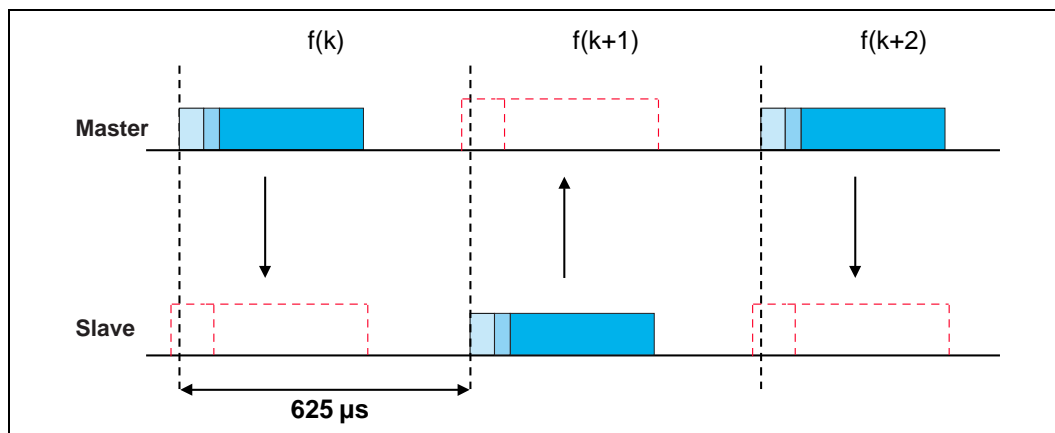


Figure 2.1: TDD and timing

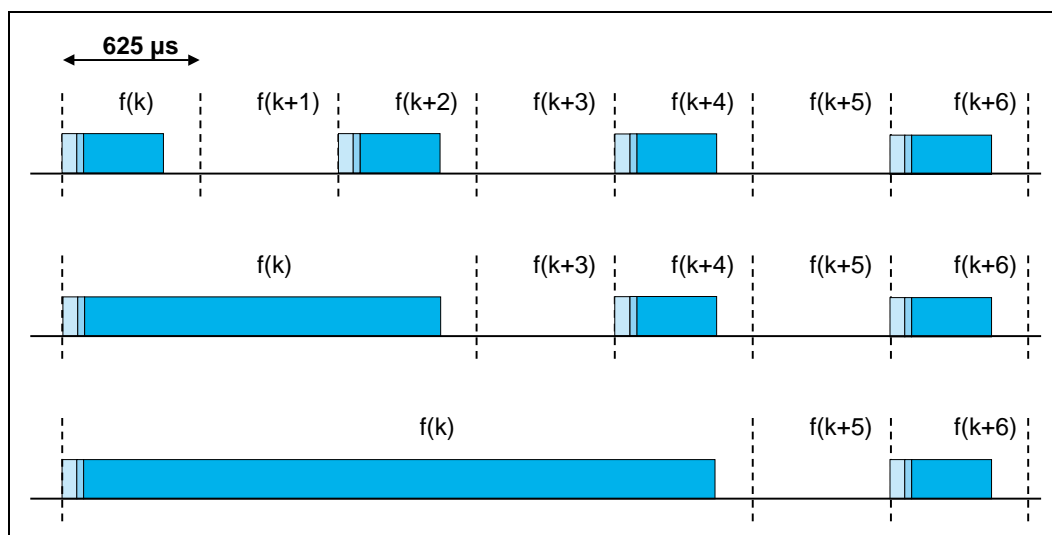


Figure 2.2: Multi-slot packets

## 2.4 MODULATION AND BIT RATE

The data transmitted has a symbol rate of 1 Ms/s. A Gaussian-shaped, binary FSK modulation is applied with a *BT* product of 0.5. A binary one is represented by a positive frequency deviation, a binary zero by a negative frequency deviation. The maximum frequency deviation shall be between 140 kHz and 175 kHz.