Bluetooth Radio and Baseband Operation.

Bluetooth operates using frequency hopping spread spectrum (FHSS) techniques with Gaussian frequency shift keying (GFSK) modulation. The parameters of these techniques are described in more detail, below.

For more information please refer to the radio and baseband specification chapters of the Bluetooth core specification version 1.1 available at:

https://www.bluetooth.org/spec/

Bluetooth Channel Definition.

The Bluetooth channel is represented by a pseudo random hopping sequence, hopping through 79 RF channels. The hop sequence is unique for each piconet (a piconet is a group of Bluetooth enabled devices comprising 1 master and up to 7 slaves all sharing the same channel) and is determined by the Bluetooth address of the master, the phase in the hopping sequence is determined by the Bluetooth clock of the master device. The channel is divided into time slots where each time slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies.

The nominal hop rate is 1600 hops per second. All Bluetooth enabled devices participating in the piconet are time and hop synchronized to the channel.

Time Slots.

The channel is divided into time slots, each 625 ms 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}, and is cyclic with a cycle length of 2^{27}.

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

A time division duplex scheme is employed where master and slave alternately transmit. 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 top 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 be use the frequency as

determined by the current Bluetooth clock value. 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.

Modulation and Bit Rate.
The data transmitted has a symbol rate of 1Ms/s. A Gaussian shaped, binary FSK modulation is applied with a BT product of 0.5. A binary 1 is represented by a positive frequency deviation, a binary 0 by a negative deviation. The maximum frequency deviation shall be between 140 kHz and 175 kHz.

Modulation Characteristics.
The modulation is GFSK with a BT = 0.5. The modulation index must be between 0.28 and0.35. The symbol timing shall be better than $\pm$ 20 ppm.
For each transmit channel, the minimum frequency deviation (F_{min} = the lesser of $\{F_{min}+, F_{min}-\}$) which corresponds to 1010 sequence shall be no smaller than $\pm$ 80 % of the frequency deviation (fd) which corresponds to a 00001111 sequence.

In addition, the minimum deviation shall never be smaller than 115 kHz.

The zero crossing error is the time difference between the ideal symbol period and the measured crossing time. This shall be less than $\pm$ 1/8 of a symbol period.