

How Bluetooth Works

Bluetooth devices will normally operate at 2.4 GHZ in the license free, globally available ISM radio band. The advantage to this band includes worldwide availability and compatibility. A disadvantage to this however, is that the devices must share this band with other RF emitters. This includes automobile security systems, other wireless devices, and other noise sources, such as microwaves.

To overcome this challenge, Bluetooth employs a fast frequency hopping scheme and therefore uses shorter packets than other standards within the ISM band. This scheme helps to make Bluetooth communication more robust and more secure.

Frequency hopping

Frequency hopping is basically jumping from frequency to frequency within the ISM radio band. After a bluetooth device sends or receives a packet, it and the device (or devices) it's communicating with hop to another frequency before the next packet is sent. This scheme offers three advantages:

1. Allows Bluetooth devices to use the entirety of the available ISM band, while never transmitting from a fixed frequency for more than a short period of time. This helps insure that Bluetooth conforms to the ISM restrictions on the transmission quantity per frequency.
2. Ensures that any interference won't last long. Any packet that doesn't arrive safely to its destination can be resent to the next frequency.
3. Provides a base level of security as it's very hard for an eavesdropping device to predict which frequency the Bluetooth devices will use next.

The connected devices however, must agree upon the frequency they will use next. The specification in Bluetooth ensures this in two ways. First, it defines a master and slave type relationship between

bluetooth devices. Next, it specifies an algorithm that uses device specific information when calculating the frequency hop sequences.

A Bluetooth device that operates in master mode can communicate with up to seven devices that are set in slave mode. To each of the slaves, the master Bluetooth device will send its own unique address and the value of its own internal clock. The information sent is then used to calculate the frequency hop sequences.

Because the master device and each of the slave devices use the same algorithm with the same initial input, the connected devices will always arrive together at the next frequency that they have agreed upon.

As a replacement for cable technology, it's no wonder that Bluetooth devices are usually battery powered, such as wireless mice and battery powered cell phones. To conserve the power, most devices operate in low power. This helps to give Bluetooth devices a range of around 5 - 10 meters.

This range is far enough for wireless communication but close enough to avoid drawing too much power from the power source of the device.

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