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A Look at the Basics of *Bluetooth* Wireless Technology

Bluetooth technology is a short-range communications technology that is simple, secure, and everywhere. You can find it in billions of devices ranging from mobile phones and computers to medical devices and home entertainment products. It is intended to replace the cables connecting devices, while maintaining high levels of security.

The key features of *Bluetooth* technology are robustness, low power, and low cost. The *Bluetooth* Specification defines a uniform structure for a wide range of devices to connect and communicate with each other.

When two *Bluetooth* enabled devices connect to each other, this is called pairing. The structure and the global acceptance of *Bluetooth* technology means any *Bluetooth* enabled device, almost everywhere in the world, can connect to other *Bluetooth* enabled devices located in proximity to one another.

Connections between *Bluetooth* enabled electronic devices allow these devices to communicate wirelessly through short-range, ad hoc networks known as piconets. Piconets are established dynamically and automatically as *Bluetooth* enabled devices enter and leave radio proximity meaning that you can easily connect whenever and wherever it's convenient for you.

Each device in a piconet can also simultaneously communicate with up to seven other devices within that single piconet and each device can also belong to several piconets simultaneously. This means the ways in which you can connect your *Bluetooth* devices is almost limitless.

A fundamental strength of *Bluetooth* wireless technology is the ability to simultaneously handle data and voice transmissions. which provides users with a variety of innovative solutions such as hands-free headsets for voice calls, printing and fax capabilities, and synchronization for PCs and mobile phones, just to name a few.

The range of *Bluetooth* technology is application specific. The Core Specification mandates a minimum range of 10 meters or 30 feet, but there is no set limit and manufacturers can tune their implementations to provide the range needed to support the use cases for their solutions.

Bluetooth Core Specification

Unlike other wireless standards, the *Bluetooth* Core Specification provides product developers both link layer and application layer definitions, which support data and voice applications. For more information about the *Bluetooth* Core Specification, visit our *Bluetooth*.org member site (member sign-in required for some sections of the site).

Spectrum

Bluetooth technology operates in the unlicensed industrial, scientific and medical (ISM) band at 2.4 to 2.485 GHz, using a spread spectrum, frequency hopping, full-duplex signal at a nominal rate of 1600 hops/sec. The 2.4 GHz ISM band is available and unlicensed in most countries.

Interference

Bluetooth technology's adaptive frequency hopping (AFH) capability was designed to reduce interference between wireless technologies sharing the 2.4 GHz spectrum. AFH works within the spectrum to take advantage of the available frequency. This is done by the technology detecting other devices in the spectrum and avoiding the frequencies they are using. This adaptive hopping among 79 frequencies at 1 MHz intervals gives a high

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degree of interference immunity and also allows for more efficient transmission within the spectrum. For users of *Bluetooth* technology this hopping provides greater performance even when other technologies are being used along with *Bluetooth* technology.

Range

Range is application specific and although a minimum range is mandated by the Core Specification, there is not a limit and manufacturers can tune their implementation to support the use case they are enabling.

Range may vary depending on class of radio used in an implementation:

- Class 3 radios – have a range of up to 1 meter or 3 feet
- Class 2 radios – most commonly found in mobile devices – have a range of 10 meters or 33 feet
- Class 1 radios – used primarily in industrial use cases – have a range of 100 meters or 300 feet

Power

The most commonly used radio is Class 2 and uses 2.5 mW of power. *Bluetooth* technology is designed to have very low power consumption. This is reinforced in the specification by allowing radios to be powered down when inactive.

The Generic Alternate MAC/PHY in Version 3.0 HS enables the discovery of remote AMPs for high speed devices and turns on the radio only when needed for data transfer giving a power optimization benefit as well as aiding in the security of the radios.

Bluetooth low energy technology, optimized for devices requiring maximum battery life instead of a high data transfer rate, consumes between 1/2 and 1/100 the power of classic *Bluetooth* technology.

Bluetooth technical information

If you're an engineer, product manager, or anyone else looking for detailed technical information, visit our *Bluetooth*.org member site. You'll find a large Technical Resources section (member sign-in required) that covers testing and qualification, profiles, the *Bluetooth* Core Specification, and much more.

The Bluetooth SIG runs this website, www.bluetooth.org, which is dedicated to members and serves as the definitive source of information around Bluetooth SIG programs, initiatives, and *Bluetooth* wireless technology development. If you are associated with a member company or interested in Bluetooth SIG membership, learn more at www.bluetooth.org.