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Out line:

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Introduction:

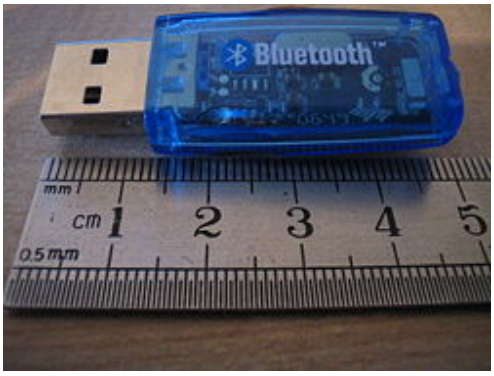
Bluetooth technology is a wireless short range communication technology founded to replace the connection between devices which using cables by using electrical signal.

Bluetooth technology able to users to make small network (ad hoc network) known as piconet, through that network users can enjoy variety of innovative solutions such as hands-free headset for voice and video calls, and synchronizing laptop, and mobile phone applications to name a few.

List of applications

Mobile phone headset [1]

Computer requirements



A typical Bluetooth USB dongle, shown here next to a metric ruler [1]

An internal notebook Bluetooth card (14×36×4 mm) [1]

Bluetooth Versions:

- Version 1.2, adopted November, 2003
- Version 2.0 Enhanced Data Rate (EDR), adopted November, 2004
- Version 2.1 , adopted on July 26, 2007
- Version Bluetooth 3.0 (in future). This will allow Bluetooth use over UWB radio

Operation Frequency:

Bluetooth technology operates in 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 per sec. The 2.4 GHz ISM band is available and unlicensed in most countries.

Interference with other wireless technologies:

Bluetooth technology's adaptive frequency hopping (AFH) capability was designed to reduce interference between wireless technologies sharing the 2.4 GHz frequency. AFH works within the spectrum to take advantage of the available frequency. This is done by detecting other devices in the spectrum and avoiding the frequencies they are using. This adaptive hopping allows for more efficient transmission within the spectrum, providing users with greater performance even if using other technologies along with Bluetooth technology. The signal hops among 79 frequencies at 1 MHz intervals to give a high degree of interference immunity.

Bluetooth devices classes:

- Class 1 radios.
- Class 2 radios.
- Class 3 radios.

Operation range:

The operation range depends on the devices class:-

- Class 1 radios:
  It is used in industrial use cases – have a range of 100 meters.
- Class 2 radios:
  It is used in mobile devices – have a range of 10 meters.
- Class 3 radios
  It is have a range of up to 1 meter.

Data rate:

- 1 Mbps for version 1.2
- Up to 3 Mbps for version 2.0 (EDR)
- Up to 480 Mbps for featured version 3.0

Power consumption:

Bluetooth technology is designed to have very low power consumption. The most commonly used radio is class 2 and uses 2.5 mW.

Class	Maximum Permitted Power mW(dBm)	Range (approximate)
Class 1	100 mW (20 dBm)	~100 meters
Class 2	2.5 mW (4 dBm)	~10 meters
Class 3	1 mW (0 dBm)	~1 meter

Data rate:

- 1 Mbps for version 1.2
- Up to 3 Mbps for version 2.0 (EDR)
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Bluetooth work idea:

Bluetooth networking transmits data via low power radio waves. It communicates on a frequency of 2.45 GHz. This frequency band has been set aside by international agreement for the use of industrial, scientific, and medical devices(ISM).

A number of devices that you may already use take advantage of this same radio frequency band, baby monitors, garage door openers and the newest generation of cordless phones all make use of frequencies in the ISM band. Making sure that Bluetooth and these other devices do not interfere with one another has been a crucial part of the design process.

One of the ways Bluetooth devices avoid interfering with other systems is by sending out very weak signals of about 1 mW. By comparison, the most powerful cell phones can transmit a signal of 3W. The low power limits the range of a Bluetooth device to about 10 meters, cutting the chances of interference between your computer system and your portable telephone or television. Even with the low power, Bluetooth does not require line of sight between communicating devices. The walls in your house will not stop a Bluetooth signal, making the standard useful for controlling several devices in different rooms.

Bluetooth can concept up to eight devices simultaneously. With all of those devices in the same 10-meter radius, you might think they had interfered with one another, but it is unlikely. Bluetooth uses a technique called spread spectrum frequency hopping that make it rate for more than one device to be transmitting on the same frequency at the same time. In this technique, a device will use 79 individual, randomly chosen frequencies within a designated range. Changing from one to another on a regular basis. In the case of Bluetooth, the transmitters change frequencies 1,600 times every second, meaning that more devices can make full use of a limited slice of the radio spectrum. Since every Bluetooth transmitter uses spread spectrum transmitting automatically, it is unlikely that two transmitters will be on the same frequency at the same time. This same technique minimizes the risk that portable phones or baby monitors will disrupt Bluetooth devices, since any interference on a particular frequency will last only a tiny fraction of a second**.**

When Bluetooth capable devices come within range of one another, an electronic conversation takes place to determine whether they have data to share or whether one needs to control the other. The user does not have to press a button or give a command, the electronic conversation happens automatically. Once the conversation has occurred, the devices form a network. Bluetooth systems create a personal area network **(PAN**). Or piconet, that may fill a room or may encompass no more distance than that between the cell phone on a belt-clip and the headset on your head. Once a piconet is established, the members randomly hop frequencies unison so they stay in touch with one another and avoid other piconets that may operate in the same room. Let’s check out an example of a Bluetooth connected system.

Compare with Other Technologies

The wireless world continues to grow as engineers develop faster, more robust

Technologies to free us from wires for greater simplicity, convenience, and efficiency.

From short range to long range ,the wireless landscape has taken shape in our lives.

Bluetooth wireless technology, though one among many, has a wide variety of applications. A comparison of Bluetooth technology with other technology is helpful

When deciding which technology to implement or products to purchase**.**

Ultra-Wideband (UWB)

UWB is a revolutionary wireless technology for transmitting digital data over a wide spectrum of frequency bands with very low power . It can transmit data at Very high rates (for wireless local area network applications)

To data, UWB only has regulatory approval in the United States. UWB

Products are slow to come to market due to the disagreements over the standard and the lack of global regulatory approval

Ideally , it will have low power consumption, low price, high speed, use a wide swath of radio spectrum, carry signals through obstacles (doors, etc.)and apply to a wide range of applications (defense, industry, home, etc.)

Currently, there are two competing **UWB** standards. The **UWB** Forum is promoting one standard based on direct sequence (**DS-UWB**). The WiMedia Alliance is promoting another standard based on Multi- band Orthogonal Frequency Division Modulation (**OFDM**)

Each standard allows for data rates from approximately 0-500 Mbps at arrange of 2 meters and a data rate of approximately 110 Mbps at a range of up to 10 meters

The Bluetooth SIG announced in May 2005 its intentions to work with both groups behind **UWB** to develop a high rate Bluetooth specification on the **UWB** radio

Wi-Fi (IEEE 802.11) :

Bluetooth technology costs a third of Wi-Fi to implement.

Bluetooth technology uses a fifth of the power of **Wi-Fi**.

The **Wi-Fi** Alliance tests and certifies 802.11 based wireless equipment.

- **802.11a*:*** This uses **OFDM**, operates in the 5 GHz range, and has a maximum

Data rate of 54 Mbps.

- **802.11b*:***Operates in the 2.4 GHz range, has a maximum data rate of 11 Mbps

And uses **DSSS**.802.11b is the original Wi-Fi standard.

- **802.11g*:*** Operates in the 2.4 GHz range, uses **OFDM** and has a maximum data

Rate of 54 Mbps. This is backwards compatible with 802.11b.

- **802.11e*:*** This standard will improve quality of service.
- **802.11h*:*** This standard is a supplement to 802.11a in Europe and will provide

Spectrum and power control management. Under this standard, dynamic

Frequency selection (**FS**) and transmit power control (**TPC**) are added to the 802.11a a specification.

- **802.11i*:*** This standard is for enhanced security. It includes the advanced encryption standard (**AES**). This standard is not completely backwards compatible and some users will have to upgrade their hardware. The full 802.11i support is also referred to as **WPA2**.
- **802.11k*:*** Under development, this amendment to the standard should allow for

Increased radio resource management on 802.11 networks.

- **802.11n*:*** This standard is expected to operate in the 5 GHz range and offer a maximum data rate of over 100 Mbps (though some proposals are seeking upwards of 500 Mbps). 802.11n will handle wireless multimedia applications better than the other 802.11 standards.
- **802.11p*:*** This standard will operate in the automotive-allocated 5.9 GHz Spectrum. It will be basis for the dedicated short range communications **(DSRC)** in North America. The DSRC will allow vehicle an vehicle to Roadside infrastructure communication.
- **802.11r*:*** This amendment to the standard will improve users , ability to Roam between access points or base stations. The task group developing This form in spring\summer 2004.
- **802.11s*:*** Under development, this amendment to the standard will allow for Mesh networking on 802.11 networks. The task group developing this formed In spring\summer 2004

WiMAX (Worldwide Interoperability for Microwave Access and IEEE 802.16) :

WiMAX is a wireless metropolitan area network **(MAN)** technology.
WiMAX has a range of 50 km with data rates of 70 Mbps. Typical cell has a Shorter range.
The original 802.16 standard operated in the 10-66 GHz frequency bands With line of sight environments.

The newly completed 802.16a standard operates between 2 and 11 GHz and Does not need line of sight.

Delays in regulatory approval in Europe due to issues regarding the use of the spectrums in the 2.8 GHz and 3.4 GHz range.

Supports vehicle mobility for between 20 to 100+ km\hr. The 802.16e standard will allow nomadic portability

The **IEEE 802**.16a and the **ETSI HIPERMAN** (High performance Radio Metropolitan Area Network) share the same **PHY** and **MAC.** 802.16 has been Designed from the beginning to be compatible with the European standard.

Created to compare with **DSL** and cable modem access, the technology is Considered ideal for rural, hand to wire areas

Infrared (IrDA)

IrDA is used to provide wireless connectivity for devices that would normally Use cables to connect. **IrDA** is a point-to-point, narrow angle (**30 cone**), ad-hoc Data transmission standard designed to operate over a distance of 0 to 1 meter and At speeds of 9600 bps to 16 Mbps.

IrDA is not able to penetrate solid objects and has limited data exchange Applications compared to other wireless technologies.

IrDA is mainly used in payment systems, in remote control scenarios or when Synchronizing two **PDAs** with each other.

ZigBee (IEEE 802.15.4):

The nine promoter companies of the **ZigBee** Alliance include Philips, Honeywell, Mitsubishi Electric, Motorola, Samsung, **BM** Group, Chipcon, Free scale and Ember More than 70 members.

Capacity of 250 Kbits at 2.4 GHz, 40 Kbps at 915 MHz, and 20 Kbps at 868 MHz with a range of 10-100 M

Its purpose is to become a wireless standard for remote control in the Industrial field

The **ZigBee** technology is targeting the control applications industry, which Does not require high data rates, but must have low power, low cost and ease

Of use (remote control, home automation, etc.).

The specification was formally adopted in December 2004.

Security was not considered in the initial development of the specification

Currently there are three levels of security.

ZigBee and ***Bluetooth*** chips are both low cost

Health concerns

Bluetooth uses the microwave radio frequency spectrum in the 2.4 GHz to 2.4835 GHz range. Maximum power output from a Bluetooth radio is 100 mW, 2.5 mW, and 1 mW for Class 1, Class 2, and Class 3 devices respectively, which puts Class 1 at roughly the same level as mobile phones, and the other two classes much lower. Accordingly, Class 2 and Class 3 Bluetooth devices are considered less of a potential hazard than mobile phones, and Class 1 may be comparable to that of mobile phones [1].

Conclusion:

- Bluetooth wireless technology is geared towards voice and data applications.
- Bluetooth wireless technology operates in the unlicensed 2.4 GHz freq.
- Bluetooth wireless technology can operate over a distance of 10 meters or 100 meters depending on the Bluetooth devices class.
- Bluetooth technology is omni-directional and does not require line-of-sight positioning of connected devices
- The cost of Bluetooth chips is under 3$.

References :

[1]:Web site www.wikipedia.com