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Technical Comparison

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 technologies is helpful when deciding which technologies to implement or products to purchase.

Quick Reference	
Bluetooth Wireless Technology	Radio Frequency Identification (RFID)
Ultra-Wideband (UWB)	Near Field Communication (NFC)
Certified Wireless USB	Near Field Magnetic Communication
Wi-Fi (IEEE 802.11)	HiperLan
WiMax (Worldwide Interoperability for Microwave Access and IEEE 802.16)	HIPERMAN
WiBro (Wireless Broadband)	802.20
Infrared (IrDA)	Zigbee (IEEE 802.15.4)

Also view the [Technical Comparison](#).

Bluetooth Wireless Technology

- *Bluetooth* wireless technology is geared towards voice and data applications
- *Bluetooth* wireless technology operates in the unlicensed 2.4 GHz spectrum
- *Bluetooth* wireless technology can operate over a distance of 10 meters or 100 meters depending on the *Bluetooth* device class. The peak data rate with EDR is 3 Mbps
- *Bluetooth* wireless technology is able to penetrate solid objects
- *Bluetooth* technology is omni-directional and does not require line-of-sight positioning of connected devices
- Security has always been and continues to be a priority in the development of the *Bluetooth* specification. The *Bluetooth* specification allows for three modes of security
- The cost of *Bluetooth* chips is under \$3

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 date, 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 a range 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

Certified Wireless USB

- Speed: Wireless USB is projected to be 480 Mbps up to 2 meters and 110 Mbps for up to 10 meters. Wireless USB hub can host up to 127 wireless USB devices
- Wireless USB will be based on and run over the UWB radio promoted by the WiMedia Alliance.
- Allows point-to-point connectivity between devices and the Wireless USB hub
- Intel established the Wireless USB Promoter Group in February 2004
- The USB Implementers Forum, Inc. (USB-IF) tests and certifies the "certified Wireless USB" based wireless equipment

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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 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 the basis for the dedicated short range communications (DSRC) in North America. The DSRC will allow vehicle to vehicle and 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 compete with DSL and cable modem access, the technology is considered ideal for rural, hard to wire areas

WiBro (Wireless Broadband)

- Portable Internet Service (WiBro) is to provide a high data rate wireless internet access with PSS (Personal Subscriber Station) under

- the stationary or mobile environment, anytime and anywhere. Primarily based in South Korea based on TTA specifications.
- 2300-2400 MHz, TDD, OFDMA, channel bandwidth 10 MHz, etc.
- System shall support mobile users at a velocity of up to 60km/h
- Throughput (per user) Max. DL / UL = 3 / 1 [Mbps], Min. DL / UL = 512 / 128 [Kbps]
- Will come online Q1 2006

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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

Radio Frequency Identification (RFID)

- There are over 140 different ISO standards for RFID for a broad range of applications
- With RFID, a passive or unpowered tag can be powered at a distance by a reader device. The receiver, which must be within a few feet, pulls information off the 'tag,' and then looks up more information from a database. Alternatively, some tags are self-powered, 'active' tags that can be read from a greater distance
- RFID can operate in low frequency (less than 100 MHz), high frequency (more than 100 MHz), and UHF (868 to 954 MHz)
- Uses include tracking inventory both in shipment and on retail shelves

Near Field Communication (NFC)

- The NFC Forum is involved in the development and promotion of NFC. The 12 sponsor members of the NFC Forum include MasterCard International, Microsoft, Motorola, NEC, Nokia, Panasonic, Philips, Renesas, Samsung Electronics, Sony, Texas Instruments and Visa
- Capacity: 212 kbps over a distance from 0 to 20 centimeters over the 13.56 Mhz frequency range
- The NFC standard is based on RFID technology
- Applications suggested for NFC include ticketing, payment and gaming.
- Support for a passive mode of communication leads to savings on battery power

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Near-Field Magnetic Communication

- Proprietary wireless technology developed, patented and licensed by Aura Communications.
- Range: 1.5 to 2 meters; Power: about 100 nanowatts; and frequency: 10 to 15 MHz. Creates a weak magnetic bubble of 4 to 6 feet in diameter in which it works
- Currently this technology is only used for wireless headsets. An adapter must be attached to the phone since it is not integrated in any handset
- Only available in the U.S. to-date

HiperLAN

- Speed: HiperLAN 2 = 54 Mbps, and has a 50 to 100 m capacity
- No present killer application

HIPERMAN

- Fixed wireless access standard developed by the European Telecommunications Standards Institute (ETSI)
- Operates in the spectrum between 2 GHz and 11 GHz and is compatible/interoperable with the IEEE 802.16a-2003 standard

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802.20

- Considered to be mobile wireless broadband wireless access.
- Maximum data rate expected to be 1 Mbps, operating in licensed bands below 3.5 GHz
- Supports vehicle mobility up to 250 km/hr

ZigBee (IEEE 802.15.4)

The nine promoter companies of the ZigBee Alliance include Philips, Honeywell, Mitsubishi Electric, Motorola, Samsung, BM Group, Chipcon, Freescale 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 controls, 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.

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