

## WIRELESS TECHNOLOGY

---

### WIRELESS TECHNOLOGY—WHAT IT IS, AND HOW IT CAN HELP YOU

Toshiba recognizes the importance of developing wireless technology to offer convenience, portability and productivity for mobile computer users everywhere.

Now, wireless technology has advanced to not only providing data connections between computing devices but networks as well—offering complete mobility at the office, home, on the road—or anywhere! People no longer are forced to have cable connections for their hardware—wireless means total mobility and freedom to work more productively, wherever their job takes them.

In reaching its goal of helping people to get connected easily and increase the number of places in which people can get connected, Toshiba is leading the industry in wireless technologies such as Bluetooth™ and Wi-Fi™ (Wireless Fidelity). Toshiba is among the first to introduce new products, specifications and innovations to expand this exciting new market.

According to the Los Angeles Times, “Bluetooth is the next ‘big wave’ in mobile computing, and will revolutionize how people work, interact and communicate.” Merrill Lynch Emerging Technology estimates that by the year 2003, more than 200 million people will be using Bluetooth enabled devices, and that by 2005, the number will explode to more than 1.4 billion.

Leading the “wireless wave,” Toshiba, (a founding member of Bluetooth) has partnered with other industry leaders including Microsoft, Ericsson, Nokia, Intel, IBM, Motorola, 3Com, Lucent Technologies, and many other companies, to develop various wireless technologies and standards such as:

**IEEE802.11b** – a standard for wireless LAN, operating in the 2.45 GHz frequency spectrum, enabling devices to link to a network over a range of 300 feet, at speeds of up to 11 Mb per second.

**Wi-Fi (Wireless Fidelity)** – Wi-Fi is a specification and certification for IEEE802.11b equipment based on an interoperability test plan. Wi-Fi is the seal of approval that the equipment will work with all other brands of Wi-Fi certified equipment.

**Bluetooth** – a new technology based on short-range radio transmission in the 2.45 GHz frequency spectrum. Connections are secure, instant and maintained even if devices are not within line of sight.

**HiperLAN2** – a new European standard for wireless LAN, operating in the 5 GHz frequency spectrum, that delivers higher quality of service and allows voice data to be prioritized over other data.

**IEEE802.11a** – a new specification for wireless LAN operating in the 5 GHz frequency spectrum, enabling devices to link to a network at speeds of up to 54Mb per second.

## WIRELESS TECHNOLOGY

---

### WHAT WIRELESS TECHNOLOGY CAN DO

Wireless (cable-less) technologies enable flexible access in a network in every conceivable situation. In today's business environments, people are called into meetings many times throughout the day, thereby limiting their access to email, calendars and databases. Wireless technology enables these people to stay connected to process information, or retrieve data to help them make business decisions from wherever they are on the corporate campus.

Because of the huge demand for connectivity to corporate databases and the Internet, people need 24/7 access, no matter where they might be.

Wireless technology can also help multiple-PC households easily share a single Internet connection. Computers within the house can share data or resources such as a printer—all without running cables throughout the home. Additionally, innovative wireless technology enables networking from anywhere cellular service can be obtained.

### WHERE WIRELESS TECHNOLOGY CAN BE UTILIZED

Three main areas where wireless technology is important are:

- Wide Area Networks (WANs) – which use cellular phone systems to transmit data
- Local Area Networks (LANs) – which are used in office, residential and public access environments to connect a number of computers together
- Personal Area Networks (PANs) – which create a connection between two or more portable devices without the need for cables or connectors

### HOW WIRELESS TECHNOLOGY WORKS IN OPEN AREAS

The biggest revolution in wireless communications began with mobile phones. Wireless technology uses individual radio frequencies, and divides a service area into separate geographic zones called "cells." A wide area network (WAN), consists of a low-powered radio base station and antennas that provide coverage in cells.

Calls from these cells are managed by base stations, or mobile switches, which serve as an interface between the wireless network and the wired telephone network. A wireless carrier within a defined geographic area provides this WAN access to the mobile user, sending the signal (call) to a cell close to where the caller is traveling. As soon as the signal becomes weak, it is again transferred to the next nearest antenna.

In Europe, many users connect their GSM mobile phones to their notebook PCs via cables or infrared to enable dialing into their company's mail server. Now, U.S. network operators are offering phones and PC cards with this capability.

## WIRELESS TECHNOLOGY

---

### WI-FI WIRELESS TECHNOLOGY — AN OVERVIEW

#### How Wi-Fi wireless technology works in an office environment

In an office environment, wireless technology works in a similar way.

Rather than running miles of cable throughout an office building to enable use of the Ethernet, today's Wi-Fi technology was created specifically for operating as a wireless Ethernet. Wi-Fi uses direct-sequence, spread spectrum technology to create a wireless connection between PCs and networks via "access points" that are connected to the network and placed in various areas (usually mounted on a wall or in the ceiling) where they send and receive network signals between wireless users and the wired network in a building or home. End users access the wireless LAN with Toshiba Wi-Fi adapters that are built into notebook computers or with Toshiba Wi-Fi PCMCIA cards that seamlessly upgrade desktop and notebook computers to wireless computing devices.

Wi-Fi operates in the 2.45 GHz spectrum, (the same as a microwave oven) and at speeds of up to 11 Mbps and achieves Ethernet levels of performance, throughput and reliability—all without cables! Each wireless LAN system typically covers up to 100 meters. A single access point typically supports up to 30 wireless stations, and more can be added to increase capacity. Especially flexible for growing businesses, Wi-Fi access points can be added as the business grows, or easily removed and redesigned should the business relocate.

Wi-Fi can be implemented in PCs using PC cards or USB dongles, (small modules that can be attached to an existing PC card, a PCI adapter, or a printer port to provide quick cable connection or extended capability) and a wide variety of access points can be connected to an Ethernet wall jack or hub to create a "wireless bridge" from computing device to the LAN.

The result? Wireless-Ethernet gives users the freedom to roam the workplace! Because it allows wireless connection to the Ethernet, Wi-Fi can transmit large amounts of data safely between computers on various floors of a building with ease.<sup>1</sup>

#### How Wi-Fi wireless technology works in public access locations

In addition to the ability to connect using cellular networks, there are growing numbers of public access locations. These locations are typically equipped with Wi-Fi access points and offer wireless Internet access for either free or a fee. Today, public access locations are found in coffee shops, airports and hotels. In the future, public access locations will appear almost anywhere groups of people congregate.

1. At transmission speeds of up to 11Mbps, the same or better performance as a wired LAN connection.

## WIRELESS TECHNOLOGY

---

### BLUETOOTH WIRELESS TECHNOLOGY – AN OVERVIEW

#### How Bluetooth works

In 1998, a consortium of leaders in the telecommunications and computer manufacturing industries, including, Ericsson, Nokia, Intel, IBM, Microsoft, Motorola, 3Com, Lucent Technologies and of course, Toshiba, united to develop a new way for users to connect devices without cables. This technology called “Bluetooth,” was named for Harald Blatand, the first Viking monarch of Denmark whose name literally translates as “blue tooth.” Blatand is important because he united many small tribes into the nation of Denmark (much like the wireless technology unites many PANs together without cables). Thus, on May 20, 1998 “Bluetooth” wireless technology was born!

Bluetooth is a fast frequency-hopping, packet-switched protocol, which means it provides extremely flexible and fast connections, even in noisy radio environments, so there is no disruption of signal. Additionally, it uses low power, which translates into lower cost and maximum battery life for mobile devices. Because it is specifically designed for small form factor (mobile devices and portable peripherals) Bluetooth devices may be small in size.

Bluetooth technology uses short-range radio links to detect Bluetooth-enabled mobile computers, mobile phones and other mobile devices within thirty to one hundred feet of each other. These radio links allow communication both within and outside of the office. By incorporating Bluetooth technology into notebooks, printers, copy machines or cameras, data can be exchanged without using computer cables.

At work, Bluetooth can be used to create wireless workgroups. Within these personal area networks (PANs), workers can synchronize data between their personal devices or exchange files between their notebook PC and other PCs. Users can also wirelessly print directly from a notebook, or even a phone to a Bluetooth-enabled printer!

Bluetooth also can enable a notebook PC to access the Internet over a PCS cellular network. The notebook is linked to a mobile phone, turning the phone into a modem for Internet access. Users will no longer need to find a data jack on a public phone to dial into their email.

With SPANworks collaboration software (a Toshiba software package that facilitates the transfer of data via a wireless solution available on all Toshiba notebooks) users can use multi-point Bluetooth connections to hold ad hoc meetings, share files or presentations, chat or exchange virtual business cards—all without cables. Toshiba, already the leader in notebook computing, was the world’s first manufacturer to offer Bluetooth PC cards that enable file sharing and conferencing anywhere!

WIRELESS TECHNOLOGY

**How Bluetooth will impact the future**

In the future, not only will Bluetooth technology connect devices to each other wirelessly, but it also will allow users to automatically synchronize PDAs to notebooks. Bluetooth will enable the transfer of pictures from digital cameras, and will make loading music to MP3 players almost effortless, and headphones will work without physical connections. Bluetooth will be used in many other applications utilizing a universal “no cable needed” system. Through their PDAs, users will direct Bluetooth-enabled services through kiosks such as ATMs. At home, Bluetooth will enable various computers in different rooms to transmit to one printer—all without cables.

In automotive applications, Bluetooth will create a link between automobile and diagnostic hardware to query on-board computers in diagnosing problems, predict equipment failures and update software. It also will enable users to change personal preferences such as radio stations, mirrors, seat adjustments, etc.

The uses for Bluetooth are endless, and Toshiba will be there—continually developing new applications of wireless technology to enrich people’s lives.

**Wi-Fi and Bluetooth Wireless Technologies—Side-by-Side Comparison**

Bluetooth	Wi-Fi
<p>Lower cost Uses less power Data Rate=1Mbps Typical distance=100 feet</p>	<p>Higher cost Uses more power Data Rate=11 Mbps Typical distance=300 feet</p>
<p>Use to replace cable PAN (Personal Area Network) Ad-hoc network (links notebooks with cell phone or PDA) Localized voice connectivity</p>	<p>Use to access Ethernet without cables or wires to become WLAN (Wireless Local Area Network) Excellent for corporate infrastructure, small business/home business LAN-in-a-box Extension or replacement of a wired LAN infrastructure</p>

## WIRELESS TECHNOLOGY

---

### GLOSSARY OF TERMS:

#### **Access Point**

A wireless LAN transceiver that acts as a center-point and bridges between wireless and wired networks.

#### **Bridge**

A device that connects two LANs, or two segments of the same LAN. A bridge can connect dissimilar LANs, such as Ethernet with Token-ring.

#### **Direct Sequence**

A method of wireless transmission that can provide higher data rates and greater robustness in radio-noisy environments than frequency hopping. When Bluetooth is operating in the same space as Wi-Fi, Bluetooth performance is not as severely affected as Wi-Fi. Tests have shown that Wi-Fi performance is slightly more affected from Bluetooth interference. The trade-off is higher cost and fewer users for a given area.

#### **Dongle**

An adapter which attaches to a device via an input/output port such as the USB or parallel port.

#### **IEEE802.11b**

The standard for wireless networking that operates in the 2.45 GHz frequency spectrum range, specified by the Institute of Electrical and Electronic Engineers (IEEE).

#### **Infrastructure network**

A wireless network centered around an Access Point (AP). In this environment, the AP not only provides communication with the wired network, but also mediates wireless network traffic in the immediate neighborhood.

#### **NIC**

Network Interface Card

#### **PAN**

Personal Area Network

#### **PC Card**

Describes the types of cards that can be plugged into the slot found in some computers—most typically notebooks—to add extra functionality, such as networking.

#### **Peer-to-peer**

Peer-to-peer is a communication model in which each party has the same capabilities and either party can initiate a communication session.

## WIRELESS TECHNOLOGY

---

### Protocol

A kind of language which two or more devices have in common and which allows them to inter-communicate. The best example is the Internet Protocol (IP) which all devices connected to the Internet must use in order to exchange information.

### Radio Frequency (RF) Terms – GHz, MHz, Hz

The international unit for measuring frequency is Hertz (Hz), which is equivalent to the older unit of cycles per second. One Megahertz (MHz) is one million Hertz. One Gigahertz (GHz) is one billion-Hertz. For reference: the standard U.S. electrical power frequency is 60 Hz; the AM broadcast radio frequency band is 0.55-1.6 MHz; the FM broadcast radio frequency band is 88-108 MHz; and microwave ovens typically operate at 2.45 GHz.

### Roaming

Movement of a wireless node between two microcells. Roaming usually occurs in infrastructure networks built around multiple APs.

### SPANworks

A Toshiba software package that facilitates the transfer of data between two or more devices via a wireless or wired connection.

### WAN (Wide Area Network)

A wide area network connects local area networks together. Typical WAN interfaces include plain old telephone system (POTS) lines, digital subscriber lines (DSL), cable, ISDN and T1/T3. Wide area network also is used to describe wireless networks that cover large areas, such as cellular networks.

### Wireless Ethernet Compatibility Alliance (WECA)

The Wireless Ethernet Compatibility Alliance (WECA) was founded by six influential market makers including: 3Com, Cisco Systems, Intersil, Lucent Technologies, Nokia and Symbol Technologies. The group enables true multi-vendor interoperability by certifying that systems from different manufacturers can be used within the same wireless infrastructure. WECA's mission is to certify interoperability of Wi-Fi™ as the global wireless LAN standard across all markets.

### Wireless LAN (WLAN)

A Local Area Network whose cabling has been replaced by radio waves.

### Wi-Fi (Wireless Fidelity)

Wi-Fi is the brand name for all products that are developed to conform to the IEEE802.11b HR (high rate) specification.

### Wi-Fi Certification

For those products that meet the Wi-Fi specifications, there is a certification process whereby the equipment is tested to confirm interoperability with all brands of Wi-Fi-certified equipment. The equipment maker must be a WECA member and must pass the test plan to call its products Wi-Fi-certified.

## WIRELESS TECHNOLOGY

---

### FREQUENTLY ASKED QUESTIONS (FAQs)

#### What is Bluetooth?

Bluetooth is a short-range radio interface that enables inter-connectivity between a broad range of electronic devices such as mobile phones, digital cameras and PCs. Its 1 Mbps data rate makes it suitable for the exchange of varieties of data including files, business cards, digital photos, voice, music, email and Web content from the Internet.

#### What is Wi-Fi?

The 802.11b Wi-Fi technology has been designed specifically to be the best solution for one particular application—wireless Ethernet. It is meant for implementation in PCs and in network access points. In PCs, it may be directly built in, or added on in the form of PC cards and USB dongles. Because it offers data rates of up to 11 Mbps, Wi-Fi is a good technology to wirelessly link multiple users to broadband network equipment such as DSL or cable modems.

#### Where does Wi-Fi fit best?

Cable-less Wi-Fi works well within a highly mobile workforce, with a high concentration of notebook users. It is used in conference rooms and common areas, and is an excellent alternative to using cables for organizations experiencing rapid growth.

#### What are the benefits of Wi-Fi to business users?

Wi-Fi allows PC users a more flexible way of working, enabling them to communicate using portable computing devices rather than traditional hard-wired devices. Wi-Fi achieves the same performance as a wired 10BaseT LAN connection, while offering flexibility with sustained performance and seamless add-on to an Ethernet intranet in the office.

#### Does Toshiba offer Wi-Fi and/or Bluetooth capabilities in its products?

Toshiba offers a complete family of mobile client products for wireless applications, including, Wi-Fi PC cards, Wi-Fi access points, Wi-Fi integrated notebooks, Bluetooth PC Cards, Bluetooth integrated notebooks, and Bluetooth-enabled personal devices. Toshiba will continue to expand their wireless solutions in the future.

#### Does Toshiba provide installation services and support for Wi-Fi in the corporate environment?

Toshiba Wireless Services Advisors provide comprehensive, wireless services and specialize in this area. Our team can design, install and support your wireless LAN solution.

#### Are there conflicts when Wi-Fi and Bluetooth are built into a single device?

The Bluetooth wireless technology and the 802.11b Wi-Fi technology both operate in the 2.45 GHz ISM band, so each may create some interference. Because Bluetooth “hops” frequently from

## WIRELESS TECHNOLOGY

---

one channel to another and Wi-Fi technology uses a subset of the ISM band channels, slight interference may occur. Toshiba is considering various methods of ensuring the best possible co-existence between Bluetooth and Wi-Fi technologies, including the development of “connection management” software to ensure compatibility.

**In what market segments will Wi-Fi certified products be sold?**

Wi-Fi standard products are being developed for use across all market segments including enterprise, small business, home, public sector and education.

**What are the benefits of Bluetooth to its users?**

Bluetooth technology uses short-range radio links to automatically connect Bluetooth-enabled devices such as mobile computers, mobile phones and other mobile devices within one hundred feet of each other. These radio links allow communication both within and outside of the office. By incorporating Bluetooth technology into notebooks, printers, copy machines or cameras, data can be exchanged without using computer cables. The Bluetooth technology delivers, and enables users connect to rapidly for ad hoc meetings via a single radio link.

**What is the Bluetooth SIG?**

The Bluetooth Special Interest Group (SIG) was formed as a group of companies working together to define, develop and promote a specification for wireless connectivity and cable replacement for a wide variety of devices designed for mobile use.

**Which companies are members of the SIG?**

The founding member companies are Toshiba, Ericsson, Intel, IBM, and Nokia. Today, more than 2000 adopter companies have joined, including Compaq, Lucent, Motorola and 3Com.

**Can a Bluetooth-enabled device be connected to multiple devices?**

Yes. A Bluetooth-enabled device can actively communicate with seven devices simultaneously. The specification defines both point-to-point and multi-point connections in a personal area network (PAN).

**How does Bluetooth work?**

Bluetooth uses a frequency hopping, spread spectrum technique. Spectrum spreading is accomplished by frequency hopping up to 1600 hops per second on 79 channels between 2.402GHz and 2.480 GHz.

**Are Bluetooth transmissions secure in a business or home computing environment?**

Bluetooth wireless technology has sufficient built-in encryption and authentication, and is secure in any environment. Additionally, because of Bluetooth's frequency hopping scheme, together with an automatic output power adaption to reduce the range exactly to requirement, it is extremely difficult to “eavesdrop” the system.

WIRELESS TECHNOLOGY

---

**Will Bluetooth technology expand the market for mobile data and mobile products?**

It is anticipated that tens of millions of Bluetooth-enabled devices will be available by 2002. Recent Dataquest research indicates that although only two percent of mobile users today are using mobile data—however nearly 40 percent indicate that they would do so if the facilitating technology were easier to use. According to Cahners-Instat, it is expected that by 2005, nearly 700 million Bluetooth devices will be shipped annually.

**Will consumers have to pay a higher price for Bluetooth-enabled products?**

It is anticipated that consumers will not experience any significant increase in product pricing directly associated with integration of Bluetooth technology.

**Is it possible to upgrade current communications or computing technology to make it Bluetooth-ready?**

Several solutions are available for easy upgrade, including PC cards and USB dongles for PCs, and add-on devices for phones.

**What are Toshiba's global wireless initiatives?**

Toshiba's global wireless initiatives involve the development of a wide range of new products, as well as enhancements of existing products. Toshiba also has formed alliances with key strategic partners in the hardware, software, networking and telecommunications sectors to bring computer and electronic device users complete mobility at the office, home or on the road.

**When you think about wireless computing, think Toshiba!**