

Wireless Technology

Toshiba White Paper

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Introduction

Wireless technology has already made a huge impact on our lives and it will only continue to do so to a point where we cannot imagine a time without it.

Wireless capabilities offer convenience, portability and true functionality from anywhere. However, this functionality must work across platforms and across brands if the technology is to be widely adopted by end-users. Would-be competitors are therefore coming together to establish standards which ensure compatibility and/or interoperability to end-users.

Whether we realise it or not, wireless technology has been all around us for quite some time. Radio, infrared, micro and sound waves penetrate our world in many forms - all without cables or wires. Wireless technology has gone one step further by providing data connections between computing devices and networks, and data connections between computing devices.

Toshiba Strategy

It is Toshiba's goal to:

- Help people get connected, easily
- Extend the places in which people can get connected
- Offer meaningful services to connected people.

In using many of the technologies discussed in this guide, Toshiba is striving to bring a broad range of innovative mobile solutions to customers

How to Use This Guide

The information in this guide is intended to help you understand the available wireless technologies with special emphasis on the new Bluetooth technology, its applications, benefits and how it fits into the wireless world today and in the future.

This guide will provide you with information on the following:

- Overview and history of wireless technologies
- Wide area networks – mobile (cellular/PCS) phones and network access (CDMA, TDMA and GSM)
- Local area and wireless local area networks
- Personal area networks
- How wireless technologies work together
- Overview of wireless technologies including Bluetooth, 802.11b (Wi-Fi), IrDA, HomeRF, HiperLAN2 and 802.11a
- Usage scenarios for Bluetooth and 802.11b
- Wireless security issues

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The Basics

Wireless Overview

Today's business environment consists of an increasingly mobile workforce. No longer chained to a desk for eight or more hours each day, employees equipped with notebook computers spend more time in situations outside of traditional work boundaries. They're on the road, sitting in traffic, in between flights, in a taxi, working from a hotel room, or by the pool. Reliance on the Internet as a powerful information and communications medium has created a huge demand for 24/7 access, no matter what the location. Since most productivity occurs in meetings and away from desks, people require flexible access to a network in any conceivable situation.

Until now, that hasn't been easy. But, once people experience and become accustomed to a particular computer or communications service in the office or home, they soon expect and demand similar capabilities while on the move. Remember how quickly desktop computers migrated to notebook computers? Consumers are demanding a similar transition for mobile multimedia capabilities for sound, data, images and video.

New innovative technologies allow access to the Internet, a corporate intranet or your own home-based network from wherever you can obtain cellphone service. And in an electronic future with smaller, cheaper, and more powerful devices, the speed and convenience at which information is accessible will be exponentially more important.

What does the wireless future hold? According to analysts, 60 percent of all key electronic products will be portable by 2006 and many will need connections to other devices. The new wireless economy will probably enable us to have all our medical and financial records available at the click of a button. We'll soon be able to check and book travel itineraries in real-time while on the road. We'll have cellular systems that remain constantly connected to the Internet, mobile videophones and mobile video conferencing. Wireless is revolutionising telecommunications; new devices and personal connectivity together will drive the wireless future - no cables allowed.

The three main wireless categories covered in this guide include:

- Wide area networks (WANs) – Using cellular phone systems to transmit data instead of voice
- Local area or wireless local area networks (LANs) – Used to connect several computers together in an office environment
- Personal area networks (PANs) – Used to create a connection between two or more portable devices without the need for cables or connectors

This section provides a brief overview on these three main wireless categories – their benefits and limitations, standards, competing technologies, future trends and more.

“...people require flexible access to a network in every conceivable situation.”

Wide Area Networks

The Basics

The biggest revolution in wireless communications began with mobile phones. Mobile phones have been the most successful electronic product of all time with over 264 million handsets shipped in 1999 a number that's predicted to increase threefold by 2004

When they first became popular, mobile phones had one main function - to provide voice communication - but that has changed. Today, telephony systems are no longer separate and different from computing technologies. With increased battery life, intelligent interfaces, voice recognition and a higher speed, mobile phone usage is destined to accelerate even more in the near future. People will continue to use their wireless services more and their standard phone services less.

Cellular Access Methods

Users in a given geographical area must contend for a limited number of channels – and there are various ways to divide the spectrum to provide access in an organised way:

FDMA (Frequency Division Multiple Access) divides an available spectrum into non-overlapping slots in the frequency dimension or domain. FDMA is the most familiar way of dividing a spectrum and has traditionally been assigned with analogue systems.

TDMA (Time Division Multiple Access) divides an available spectrum into non-overlapping slots in the time dimension or domain. Digital systems are typically a combination of FDMA and TDMA, where capacity is divided into both frequency and time dimensions for a channel and time slot usage within that channel.

GSM (Global System for Mobile Communications) is a type of TDMA digital wireless network with encryption features and is widely used throughout Europe at 900 MHz.

CDMA (Code Division Multiple Access) is based upon the spread spectrum concept, which means that multiple conversations share an available spectrum simultaneously and are distinguished through coding vs. frequency or time channels.

“...telephony systems are no longer separate and different from computing technologies.”

Timeline of Cellular Telephony

1947	Basic concept for cellular phones begins
1947	AT&T proposes the FCC allocate a large number of radio frequencies, which was declined
1968	The FCC reconsiders its position to allocate increased frequencies to free airwaves for mobile phones
1977	AT&T constructs and operates a prototype of a cellular system
1979	The first commercial cellular telephone system begins operation in Tokyo
1982	The FCC authorises commercial cellular service for the U.S.
1987	Cellular telephone subscribers in U.S. exceeds 1 million
1987	GSM (Global System for Mobile Communications) standard for Europe created based on a hybrid of FDMA (analogue) and TDMA (digital) technologies
1993	CDMA (Code Division Multiple Access) accepted as a standard to separate voice signals using spread spectrum technology
1994	TDMA (Time Division Multiple Access) released as standard for wireless networking
1994-1997	The FCC begins to auction space for the new PCS band, a higher frequency band
2000/2001	GPRS (General Packet Radio Services) arrives, offering a faster link for data over a standard GSM link that is always connected

Wireless technology uses individual radio frequencies over and over again by dividing 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 small geographical areas called cells. Calls from these cells are managed by base stations or mobile switches. The mobile switches are connected to databases that provide an interface between the wireless network and the wired telephone network.

When you use a mobile phone and approach the boundary of one cell, a WAN senses that the signal is becoming weak and automatically transfers the call to the antenna in the nearby cell where the caller is travelling. And since the system operates at such a low power level, one frequency used to carry a phone conversation in one cell is transferred to a nearby cell without any interference.

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Wide Area Networks

The Basics

A wireless carrier within a defined geographic area provides this WAN access to the mobile user through a variety of monthly calling plans and options. When subscribers travel beyond a determined geographical area, they are considered "roaming." Their local carrier transfers the service to an outside carrier at a higher call rate. This is not generally seen in the UK, but would be more apparent when travelling across large landmasses – i.e. Europe or America

There are two basic types of signals – analogue and digital. An analogue signal varies continuously between a maximum and minimum value. An example of an analogue signal is the human voice. A digital signal does not take on a continuous set of values. At any time, it takes a limited set of values called a symbol, which can represent a number or alphabetical characters. Examples of a digital signal are the current pulse on a wire or a light pulse on a fibre optic cable. The trend in wireless systems is toward digital systems and the use of advanced forms of digital modulation. This is because a digital signal is more immune to noise, and is easier to manipulate or process than an analogue signal.

What is the difference between cellular and PCS phones? A cellular phone uses a short-wave analogue or digital transmission via a wireless connection. A PCS phone is similar to a cellular phone, but utilises a digital transmission exclusively and offers extended mobility and operates at higher frequencies for a higher quality connection. What does all this mean for Personal Digital Assistants (PDAs) and Personal Computers (PCs)? Increasingly, cellular/PCS service providers are providing data transmission services over their network. Just like when your PC uses the landline phone system for access to e-mail, corporate databases and the Internet, certain cellular/PCS systems allow this functionality without wires. The PC still uses a modem, although in this case the modem is the cellular phone or a PC Card which contains a cellular/PCS radio and antenna.

Factors contributing to increased WAN usage include:

- Larger coverage areas and lower pricing
- Simplified charging schemes
- Commoditization of the cellphone
- Increased digitalisation of wireless networks
- Mobility, convenience and accessibility

Local Area Network

The Basics

Local Area Network Traditional Local Area Networks (LANs)

A local area network (LAN) is a group of computers and other related hardware that share a common communications line and server within a relatively limited geographic area, such as an office building

The server usually contains applications and drivers that anyone connected to the LAN can utilise – a common set of files and information. LANs can consist of two users or computers to thousands of users and computers. Users can also share the same printers or scanners configured for a LAN

While fairly expensive to implement due to hardware and cabling, LANs provide an effective way for a group of people to share a common set of information and communicate electronically, without the need to exchange floppy disks or wonder whether the most recent version of files are being used. Software upgrades are made once on the server, reducing expense and administration time.

LAN Terminology

ARCNET – (Attached Resource Computer Network) or Arcnet, is a widely installed LAN technology that uses a token-bus scheme and is the least expensive to install, allowing long cable lengths without bandwidth loss.

Ethernet is the most widely installed LAN technology and typically uses coaxial cable or special grades of twisted pair wires for faster transmission speeds (10Base-T provides speeds up to 10 Mbps, while Fast Ethernet or 100Base-T provides speeds up to 100 Mbps).

FDDI (Fibre Distributed Data Interface) is a standard for data transmission on fibre optic lines that can extend up to 124 miles. Based on the Token Ring protocol, FDDI can cover large geographic areas and support thousands of users.

Routers A special purpose computer (or software package) that handles the connection between two or more networks and examine the destination addresses of the packets passing through them, deciding on which route to send them.

Servers A computer that shares its resources, such as printers and files, with other computers on a LAN.

Switches A network device that selects a path or circuit for sending a unit of data to its next destination.

Token Ring Where all computers are connected in a ring or star formation to prevent data collision between two computers that send messages at the same time. This is the second most widely used protocol for LANs

Wireless Local Area Networks (WLANs)

A wireless local area network (WLAN) provides wireless access to the full resources and services of a corporate network (LAN) in a building, or site setting. And since users need to access company databases and servers while mobile, the only real-time solution is a wireless one.

WLANs provide more freedom in the work environment for network access to mobile workers. Through a wireless network, workers can access information from anywhere in the corporation - a conference room, cafeteria or remote branch office. Although confined somewhat by limited geographic boundaries, WLANs liberate users from dependence on hardwired access to the network backbone, giving them anytime, anywhere network access.

This freedom to roam offers numerous user benefits:

- Easy, real-time network access for onsite consultants and auditors
- Improved database access for roving supervisors such as product line managers, warehouse auditors or construction engineers
- Simplified network configuration with minimal MIS involvement for growing installations of public access locations such as airports, hotels and convention centres
- Faster access to customer information for service vendors and retailers
- Location-independent access for network administrators, for easier onsite troubleshooting and support

“Through a wireless network, workers can access information from anywhere in the corporation...”

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Personal Area Networks

The Basics

Personal Area Networks

A personal area network (PAN) is a network that exists within a relatively small area, connecting electronic devices such as desktop computers, printers, scanners, fax machines, PDAs, and notebook computers – without cables and connectors for information to flow between them.

To connect these devices in the past required extensive cabling, connectors and adapters. USB, serial, parallel – along with those options came incompatibilities, inconvenience, lack of reliability limitations.

In March 1998, the WPAN Study Group was formed with the goal of investigating the need for a wireless network standard for devices within a personal operating area. Just two months later, in May 1998, the Bluetooth™ Special Interest Group (SIG) was formed and, ten months later, the WPAN study group became IEEE 802.15, the WPAN Working Group. The Bluetooth SIG, now led by 9 promoter companies - Toshiba, Ericsson, Nokia, IBM, Lucent, 3Com, Microsoft, Motorola, and Intel, continues to define the Bluetooth standard and promote the technology.

The WPAN wireless communications standard focuses on the key issues of low power consumption (to lengthen the battery life of portable products), small size (to make them easy to carry about or even wear), and low cost (so that they can become as universal as possible).

Obvious applications for WPANs are in the office, where electronic devices in your workspace will be wirelessly networked together. These could include your desktop PC or notebook computer, a printer, your personal digital assistant, your cellular phone, your pager, and your portable stereo - and the list continues. Limited only to geographic range at this time, the future offers exciting possibilities for WPANs with applications in and around the office, home, automobile, public transportation or any location.

NOTE: Bluetooth is a trademark owned by its proprietor and used by Toshiba under license.

“The WPAN wireless communications standard focuses on the key issues of low power consumption, small size, and low cost.”

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How It All Works Together

With new technologies such as Bluetooth available today, the lines between WANs, LANs and PANs have become blurred. As long as the devices all contain Bluetooth technology, anything is possible.

By creating one PAN between portable devices, you can then create another PAN to an existing WAN, LAN or WLAN

For instance, let's say you enter a client's office building for a meeting with a team of five other consultants. In the conference room, your team creates a PAN and reviews a Power Point™ presentation together on five separate notebook computers and a desktop computer. An individual PAN also exists between each separate computer and its accompanying peripherals - including mice, keyboards, fax machines, scanners or printers.

After sharing a couple of documents with two of the consultants, you realise that you need to access your client's intranet for a piece of missing information.

While you create a separate PAN between your notebook and the client's LAN to access that information, one of your colleagues uses his mobile phone and notebook to obtain a connection to a WAN through his wireless network provider.

After checking his e-mail, he returns to the meeting and creates another PAN between his notebook and printer to print the attachment to the new e-mail. He then shares that attachment with four of the five other consultants through the existing PAN between everyone's PC and notebook computers

You can see how WANs, LANs and PANs now work together in a compatible, cordless and simple manner - a powerful possibility that just never existed in the past.

“As long as the devices all contain Bluetooth technology, anything is possible.”

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Available Wireless Technologies

What are the differences between the wireless technologies available today?

Bluetooth, IEEE 802.11b, HomeRF and HiperLAN all use radio frequencies to replace cables. But Bluetooth uses between 100 and 1000 times less power than established systems like 802.11b, while HomeRF is more expensive than Bluetooth to implement. And HiperLAN, although boasting greater data transmission speed, or bandwidth, currently requires more power than IEEE 802.11b and works over a shorter range.

Technology	Application(s)	Frequency	Range	Speed
Bluetooth	WAN/LAN/PAN	2.45GHz	to 100'	1Mbps
IEEE802.11	WAN	2.45Ghz	to 300'	2Mbps
IEEE802.11b	WAN	2.45Ghz	to 300'	2Mbps - 11Mbps
IrDA	PAN	N/A	to 24'	4Mbps
HomeRF	LAN	2.45Ghz	to 100'	1.6Mbps
HiperLAN2/802.11a	LAN	5GHz	TBA	54Mbps

Bluetooth™

Imagine a world where cables are not necessary, where many devices can communicate wirelessly, regardless of manufacturer or model. Imagine the ability to effortlessly connect to the Internet anytime, anywhere with only a mobile phone and notebook computer.

This wireless connection between mobile phones and mobile computers has been the driving force behind the development of a new communications standard – Bluetooth.

Bluetooth is a new technology that eliminates the need for cables between electronic devices: PCs, mobile phones, headsets, handheld computers, printers, local area networks, etc. The technology is based on short-range radio transmission on a globally available frequency. Bluetooth provides convenient/quick, reliable, and secure wireless communications aimed at eliminating cables, connectors and adapters. It is a small design that is inexpensive to manufacture and install to ensure manufacturers will include it in all portable devices. Only a few millimetres in size, the Bluetooth module will revolutionise the world of wireless voice and data communications.

Bluetooth uses short-range radio, which offers an advantage over infrared solutions: walls, furniture, pockets or other obstructions no longer impede or compromise data transmissions. Connections are instant and maintained even when devices are not within line of sight. The range is approximately 10 meters, which you can extend to 100 meters. And because it's designed for short-range radio transmissions, it will interfere as little as possible with other types of wireless devices in the vicinity.

“Bluetooth uses between 100 and 1000 times less power... [and] provides fast, reliable, and secure wireless communications...”

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Available Wireless Technologies

How It All Works Together

The first mobile telephones, mobile PCs and accessories are being prepared with Bluetooth technology for its initial market launch. The range of products predicted for Bluetooth includes mobile (telephones, computers and digital cameras), stationary (desktop computers, peripherals and accessories) and consumer electronics (cordless telephones, TVs, radios, stereos, VCRs and CD players).

Once fitted inside every device that needs to connect to another, Bluetooth will eliminate the need for you to locate and connect a cable. It will provide increased reliability, improved connectivity and much better ease of use. And a cordless connection of desktop or notebook computers to printers, scanners and to the LAN increases your sense of freedom and functionality.

Bluetooth Special Interest Group (SIG)
In May 1998, specialists from Toshiba, Ericsson, IBM, Intel and Nokia founded the Bluetooth Special Interest Group, or SIG, which was later expanded to include companies such as 3Com Corporation, Lucent Technologies, Microsoft and Motorola Inc. These nine companies became the drivers and the decision-makers behind the entire Bluetooth™ development. Today, worldwide there are more than 1,800 member companies from diverse sectors of industry support this innovative and useful new technology.

The group now draws its strength from a very wide range of companies and industries, many from well outside the IT business. In the IT space, among the hundreds of members you can find well-known IT names including Acer, AMD, Alcatel, Casio, Cirrus Logic, Digianswer, Fujitsu, Harris Corp, LG Electronics, Mitsubishi Electric, Philips, Psion, Samsung, Siemens, TDK, Tektronix, Texas Instruments, and Xircom. The technology aims to seamlessly connect electronic devices together and this will influence and shape our lives in ways we can't even yet imagine. And since the success of the Bluetooth technology relies upon the rapid adoption of a standard for combined voice and data radio transmission, the Bluetooth SIG has made the specification available to all companies involved with the technology, without license fees.

Bluetooth Technical Features

Bandwidth – A Bluetooth radio link has a maximum data transfer rate of 724 kbit/s, or three voice channels; the data rate for a voice channel is 64 kbit/s.

Data or voice – Use a Bluetooth radio for data transfer, voice communication or both simultaneously.

Device discovery – When two or more Bluetooth devices are within range, a link is established through a device discovery process.

Link establishment – Establish and maintain a robust link between two or more devices almost instantly, even if the devices are not within line of sight, without interference from other radio signals operating in the same frequency band.

Low power consumption – The Bluetooth radio is very economical, limiting its output power exactly to what is actually needed.

Piconet – Bluetooth forms small wireless networks between two or more devices (up to 8) known as piconets.

Range – Based on short-range radio transmission with a normal range of either 10 meters or 100 meters.

Security – Two advanced security mechanisms ensure a high level of security: authentication and encryption.

Small size – The Bluetooth radio resides in a small microchip integrated in any electronic device.

Standardization – Bluetooth operates in the 2.45 GHz band, which is license-free and available to any radio system in the world.

Bluetooth is an exciting technology that is going to change the way that people use devices and the way that applications work together. Applications could be distributed over a number of devices - mobile phone, PDA and notebook computer - and work together in a co-ordinated fashion to improve people's lives, productivity and provide instant access to information when and where it's needed. Bluetooth is complementary to existing modern technologies, like WAN and LAN implementations, mobile network and input devices.

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Available Wireless Technologies

How It All Works Together

IEEE802.11b

In 1997, a group of engineers (the Institute of Electrical and Electronics Engineers or IEEE) united to create standards for wireless LANs. The IEEE ratified the original 802.11 specification, which provided 1 Mbps and 2 Mbps data rates and a set of fundamental signalling methods and other services.

Once it became apparent that these data rates were too slow to support most general business applications, the IEEE ratified the 802.11b standard (also known as 802.11 High Rate) to add transmission speeds of 5.5 Mbps and 11 Mbps.

By using radio waves to communicate, 802.11b WLANs allowed mobile users to achieve Ethernet levels of performance, throughput and availability.

Wireless industry leaders then united to form the Wireless Ethernet Compatibility Alliance (WECA) in July 1999. WECA's mission is to certify cross-vendor interoperability and compatibility of IEEE 802.11b wireless networking products and to promote that standard under the brand Wi-Fi (Wireless Fidelity) for the enterprise, the small business and the home.

WECA members include WLAN semiconductor manufacturers, WLAN providers, computer system vendors and software developers such as 3Com, Aironet, Apple, Breezecom, Cabletron, Compaq, Dell, Fujitsu, IBM, Intersil, Lucent Technologies, No Wires Needed, Nokia, Samsung, Symbol Technologies, Wayport and Zoom.

WECA's mission is to certify interoperability of Wi-Fi products and promote Wi-Fi as the global wireless LAN standard across all market segments.

Bluetooth and IEEE802.11b

Bluetooth and 802.11b are often positioned as competing wireless technologies. Toshiba believes they are complementary technologies. Bluetooth is the key wireless technology in the PAN arena, used primarily to connect computing devices together to share data, and 802.11b is the key technology in the LAN arena, used for connecting computing devices to a network. Connections over Bluetooth are generally non-persistent in nature; devices stay linked only long enough to perform a task like synchronisation or to send a file. Connections over 802.11b are generally persistent in nature; devices remain linked to the network to share resources and access data for extended periods of time. Bluetooth components will be generally smaller, less expensive and have lower power consumption than their 802.11b counterparts. 802.11b, on the other hand, boasts higher data transmission rates and can easily roam from access point to access point. The difference will allow Bluetooth to be built into a wide variety of devices, where 802.11b will remain primarily in the PC and handheld computer world. Nevertheless there will be instances where the two technologies overlap in their functions.

Bluetooth devices will find themselves moving through a world populated by other Bluetooth devices, and they will be able to discover those other devices and communicate with them where appropriate. 802.11b-based systems cannot do that, because when roaming between access points, connectivity options are limited to wireless gateways to the same network and systems offered by the previous access point.

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Available Wireless Technologies

How It All Works Together

802.11b LANs are designed to maintain a connection between a computing device and the central corporate infrastructure. The 802.11b-based system will connect the notebook PC to the corporate network when inside the building and, when outside, Bluetooth will take over and provide links via the cellular phone and other devices to the rest of the world, thanks to its low cost and consequent ubiquity.

Because these two wireless technologies share the same 2.45 GHz band of the radio frequency spectrum, there may be some interference issues when they are both used in close proximity to each other. Since Bluetooth uses frequency-hopping, it may tend to affect the performance of any 802.11b radios in very close proximity. The level of interference is related to proximity and the power of the Bluetooth radio so it may be possible for engineers to design systems in which Bluetooth and 802.11b coexist with no apparent performance degradation.

IrDA

IrDA, the InfraRed Data Association, is creating and promoting interoperable, low cost infrared data interconnection standards that support a walk-up, point-to-point user model. The IrDA standards support a broad range of appliances, computing and communications devices.

This technology is found in many notebook computers and a growing number of cellular phones, especially those from leading manufacturers such as Nokia and Ericsson. IrDA offers line of sight, point to point cordless data transfer at a range of about one meter with data transmission rates of up to 4 Mbit/sec. IrDA is working on infrared networking technology.

The IrDA connection is through the IR port found on a computer, telephone or laptop. It allows bi-directional continuous operation from contact to a distance of a meter or two. There is also a short-range, low power version that operates at about 20 cm between low power devices and 30 cm between low power and standard power devices, offering 10 times lower power consumption.

Transmission speeds are up to 4 Mbit/sec, and data integrity is protected by using a 32-bit cyclic redundancy check (CRC).

Today's IrDA applications include printing a document directly from a notebook, synchronising electronic telephone books and schedulers, exchanging business cards between handheld PCs, sending and receiving faxes or e-mails directly from a notebook PC through a cellular or traditional public telephone, or storing bank records from ATM machines by making a simple, walk up and point infrared connection.

Future devices will be able to access home entertainment, security, and automated environment control systems, says the IrDA. New application software development will enable data file exchange between many types and brands of computer and communications devices, such as desktop and notebook PCs, printers, fax machines, network nodes, data modems, telephone, automated tellers, handheld mobile units (PDAs), electronic organisers, and many other devices.

IrDA requires line of sight for successful communication between devices. This could create awkward situations for users trying to line up the IR ports on various devices.

Available Wireless Technologies

How It All Works Together

However, line of sight offers some basic security advantages because it requires a concerted effort to establish communication.

To overcome the line of sight problem, IrDA has enlarged its standards to include an Area InfraRed (AIR) proposal. Existing IrDA devices have a 30 degrees beam angle and a strict point-to-point connectivity. AIR will increase this to 120 degrees, replacing the point-to-point connectivity of existing IrDA with up to 10 network nodes. AIR will also provide a longer range - up to eight meters with a data rate of 250 Kbit/sec. Even higher data rates are obtainable within a shorter range, peaking at 4 Mbit/sec below four metres.

HomeRF

HomeRF is designed by the HomeRF Working Group (HRFWG), a consortium that developed a single specification, the Shared Wireless Access Protocol (SWAP), for a range of interoperable consumer devices. The 90-plus member HRFWG core members include market-leading companies from the PC, consumer electronics, peripherals, communications, software, and semiconductor industries. Some of HRFWG's members are Toshiba, Compaq, Ericsson, Motorola, Hewlett-Packard, IBM, Intel, Microsoft, Philips, Proxim and Symbionics, Harris Semiconductor, National Semiconductor, Rockwell and Samsung. HomeRF probably represents Bluetooth's biggest challenge because this consortium is comprised of many large and influential networking and wireless companies. HomeRF plans to use the same frequencies as Bluetooth, as well as the same 1 Mbit/sec data rate. It is centred around the 2.4 GHz band and uses frequency hopping technology called SWAP (Shared Wireless Access Protocol).

SWAP is an open industry specification that allows PCs, peripherals, cordless telephones and other consumer electronic devices to share and communicate voice and data in and around the home without the complication and expense associated with running new wires. SWAP plans "to provide the foundation for a broad range of interoperable consumer devices by establishing an open industry specification for wireless digital communication between PCs and consumer electronic devices anywhere in and around the home."

SWAP, like Bluetooth, operates in the 2.4 GHz ISM band, which is available worldwide. It combines elements of the existing Digital Enhanced Cordless Telecommunications (DECT), which is most familiar as the technology standard behind the digital cordless phone, and the IEEE 802.11 standards. SWAP's architecture closely resembles the IEEE 802.11 wireless LAN standards and can support both data-oriented services, such as TCP/IP, and the DECT/GAP protocols for voice.

The HRFWG feels that the SWAP specification will enable users to set up a wireless home network - sharing voice and data between PCs, peripherals, PC-enhanced cordless phones, and new devices such as portable remote display pads. Access to the Internet will be available from anywhere in and around the home using portable devices with a display, sharing an ISP connection between multiple PCs and other new devices, sharing files, modems and printers in the home. Consumer electronics and small appliances in and around the home will contain technology that will enable

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Available Wireless Technologies

How It All Works Together

them to talk to each other without being tethered to the existing wiring in the home, while distributing the power of the PC throughout the home.

HomeRF and Bluetooth are directed at a similar segment of the home networking market. HomeRF replaces cables as does Bluetooth, but HomeRF is targeted at the home/consumer markets only. HomeRF is a wireless network protocol providing blanket coverage within the home and its close environs. HomeRF is not concerned with low cost and small form factor because the environment in which HomeRF will exist contains devices that are neither highly mobile nor ubiquitous.

HomeRF's SWAP is a peer-to-peer networking protocol, allowing for multiple simultaneous device interactions at ranges of over 50 meters at the same speed as Bluetooth: a nominal rate of 1 Mbit/sec. HomeRF, like Bluetooth, uses the frequency hopping spread spectrum specifications used by the IEEE 802.11 wireless networking standard. They also share the same modulation and spread spectrum scheme used by 802.11 1 Mbit/sec and 2 Mbit/sec wireless technologies.

Due to a recent FCC rule change, HomeRF will evolve to a new version supporting data rates of up to 10 Mbit/sec.

HiperLAN/802.11a

HiperLAN is a new European standard first ratified by the European Telecommunications Institute (ETSI) in 1995. Originally HiperLAN used the same 2.4 GHz band as Bluetooth to provide ad hoc, peer-to-peer and traditional client-server networking at data rates of 1 Mbit/sec or 2 Mbit/sec.

HiperLAN designers have redesigned their system to work at the 5 GHz radio frequency in an effort to achieve data rates of up to 54 Mbit/s to deliver higher throughput and quality of service so that voice traffic would be prioritized over other data.

Because HiperLAN plans to use a different frequency (5 GHz) from the one used by Bluetooth (2.45 GHz), there should be no reason why Bluetooth and HiperLAN cannot coexist in the same device. However, the power consumption of such a system would be high, and this may rule out its inclusion in smaller devices.

In 1999, the IEEE ratified the wireless LAN standard 802.11a, which operates at 5 GHz and can achieve data rates as high as 54 Mbit/sec. Multipath effects (radio reflections from walls, floors, ceilings, etc.) are minimized due to the use of Coded Orthogonal Frequency Division Multiplexing (COFDM).

Though the lab test results of HiperLAN2 and 802.11a look very promising, 802.11b, due to its good performance and low cost, will enjoy a full life. Most wireless LAN equipment makers expect to evolve their product lines to one of the 5 GHz technologies.

The existence now of two 5 GHz wireless LAN standards - ETSI HiperLAN2 and IEEE 802.11a - poses a problem for wide spread adoption since the customer must choose between standards and the standards are not interoperable. There is however work underway to develop a harmonized standard.

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TOSHIBA

Access Existing Cellular Service (WAN)

Wireless Usage Scenarios

This section covers numerous exciting possibilities for Bluetooth in business, home, school and travel and includes a discussion about its applications in the near future. Present and future usage scenarios for Bluetooth are divided into the following three sections:

- Access existing cellular service (WANs) with a mobile phone and notebook computer to obtain anywhere access to the Internet.
- Access local area/wireless local area networks (LAN/WLANs) with any number of devices without cables or connectors for unlimited possibilities.
- Create a wireless communications link, or personal area network (PAN) between two or more devices in a wide variety of business or personal applications.

Access Existing Cellular Service (WAN)

Using a mobile phone equipped with Bluetooth technology is one of the most anticipated applications by those inside and outside of the IT industry. Whether for transferring data between phones, synchronizing with a PC, connecting to a PC as a wireless modem, or connecting to an adapter for wireless telephony in the office or home is a superior solution for road warriors on the move who need to access the Internet from wherever they find themselves.

You can use Bluetooth technology in a mobile phone and notebook computer to access the Internet via an existing mobile service (WAN):

- While you are working in your notebook computer in open spaces by using your mobile telephone to send e-mail.
- When you want to send e-mails composed in flight, and retrieve those that have arrived whilst you were out of touch.
- While you are in a car and want to discover information about local attractions, for example: restaurants, movies, directions and more.
- When you want to download and print files from the Internet.

As long as you can establish a regular mobile phone connection, Bluetooth makes it possible to access the Internet from anywhere. This gives you unprecedented convenience and flexibility, making your business and personal life more efficient.

“Bluetooth makes it possible to access the Internet from anywhere.”

Choose freedom.

TOSHIBA

Access Existing Cellular Service (WAN)

Wireless Usage Scenarios

Using Bluetooth to Access Existing Cellular Service

You're in the middle of a busy business trip taking you across the country. Whilst sitting in the motorway services/traffic jam, a hotel lobby or restaurant, you wish to check your e-mail.

Using your mobile phone and notebook computer, you can access the Internet without a phone jack or power cord.

Even if your phone is sitting across the room, in a drawer or in your coat pocket, you can create a PAN between your notebook computer and the phone to access the Internet without leaving the chair, bed or sofa.

Simply power on your notebook computer and it will automatically perform a device discovery to obtain a PAN connection to your mobile phone. As long as the phone is within a 10 meter range, the notebook computer will use the mobile phone to dial your Internet Service Provider (ISP). Once the Internet connection is made, you can send and receive e-mail, or surf the Internet.

Equipment	Software	Distance(s)
Bluetooth-enabled mobile phone	Cellular service which supports data calls	varies by area
Notebook PC with Bluetooth PC Card	Bluetooth software suite, Data suite, Internet service provider account	to 100'
Other (optional) Bluetooth-enabled portable devices (printer or keyboard, for example)	depends on optional device	to 30'

Review the instructions included with your Bluetooth mobile phone to create a pairing between it and your notebook computer. Most phones will connect only with devices that have been paired using a security code. This prevents others from using your phone to access the Internet. You should also check that your cellular service supports data calls. Some service providers may charge a separate fee to enable this service.

Depending on the portable peripherals you brought on your trip, you might print an e-mail and its attachments by choosing a wireless printer from the device discovery list on your notebook computer. Or you can take your notebook computer to a business center, connect to a Bluetooth-enabled printer and print out your e-mail and attachments there.

Next, you're are on a plane, going to the another meeting in another country. While in flight, you've composed several e-mails on your notebook computer.

Access Existing Cellular Service (WAN)

Wireless Usage Scenarios

As soon as you reach the airport terminal, your PC uses Bluetooth to connect to your cellular phone to dial your ISP for Internet access, silently transferring the new undelivered e-mails from your notebook computer - all without taking the phone out of its carrying case.

And while you're looking for the hire car desk/taxi rank that same connection via your mobile phone will also download unread e-mail from the Internet or company server to your notebook computer.

By the time you leave the terminal, your computer has sent and/or received e-mails and you're ready to respond to a new batch as soon as you reach your destination.

In the near future, you can accomplish this without needing your mobile phone. If the airport terminal or lounge contains a wireless LAN or access point, you will be able to use your notebook computer or PDA to obtain a connection.

As luck would have it, your flight gets diverted because of bad weather and you end up in on a Caribbean island instead of your original destination.

On the beach you are far away from a phone line or electrical outlet. With your Bluetooth-enabled mobile phone and notebook computer, you simply dial your cellular service carrier and connect to the Internet, while keeping in touch with your clients and maintaining your project schedule.

As long as you can obtain a wireless phone connection, it doesn't matter where you are when you have Bluetooth: you can have access to the Internet at any time and from any location.

Before Bluetooth

Before Bluetooth, connecting to the Internet involved rummaging around in your luggage for the right power leads, phone leads and connectors and finding accessible power outlets and phone jack. If you travelled abroad, this process becomes even more cumbersome with possible incompatibilities between connectors, jacks and voltage levels. No matter what country you are in, fees might be charged every time you use the phone line in the hotel room. Printing and faxing required access to the appropriate machines and further additional charges.

Other Methods for Accessing Existing Cellular Service

Cellular PC card modems are now available in notebook computers and PDAs. These replace a cellular phone, or they can allow a user to access the Internet and talk on their cellular phone at the same time.

Access Local Area/ Wireless Local Area Networks

Wireless Usage Scenarios

Access Local Area/Wireless Local Area Networks

Today's environments rely more heavily on mobile devices – and 802.11b brings everything together smoothly and effortlessly, offering you more capabilities than ever before.

Work Environment

In any work environment, 802.11b technology enhances any existing LAN infrastructure, providing true mobility, reducing expenses and freeing valuable IT resources.

At the office (yours, a client's or business partner's), you can use 802.11b technology to access an existing local area network:

- To obtain network access to your company's intranet upon entering the office.
- To connect to network resources such as databases and printers.
- To quickly access e-mail and up-to-date calendar information from anywhere within the organization.
- To share files with colleagues

802.11b cuts network administrative costs and logistics challenges, making it possible to create a WLAN anywhere within an office environment – even in the car park !

Home Environment

Changes in our lifestyles mean that many households have more than one PC. Multiple PCs often mean multiple Internet users, especially with school – age children. These are the trends driving the growth of Internet access in homes and the growth of residential networks.

You can use 802.11b technology to connect the PCs in your home easily and inexpensively:

- When you want to access the Internet from anywhere around the house.
- So you use one PC to work on the family accounts, sort recipes, or access the Web for e-mail while your kids play games, use the Internet for homework research or an online course, or send e-mails and pictures to friends on their PC
- To share network resources such as printers.

“...802.11b will provide mobile capabilities and Internet access never before possible.”

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TOSHIBA

Access Local Area/ Wireless Local Area Networks

Wireless Usage Scenarios

School/University Environments

802.11b technology has unlimited possibilities within a school or university environment to increase a student's efficiency and eliminate stress. At school or university, you can use 802.11b technology:

- For real-time access to study group meetings and research links.
- When you want to share notes and homework with other classmates.
- When you need to send a paper or assignment to your tutor's e-mail or the school/university intranet.
- For a classroom presentation.
- When you need to access the Internet from the classroom, cafeteria or anywhere else on site

Bluetooth will enable much more feasible and cost-effective options to students, offering a wider range of readily accessible services and possibilities to make academic life run more smoothly.

Through a Fixed Wireless Hotspot (Access Point)

Through a 802.11b-enabled notebook computer or PDA, you can access the Internet via a public access location. In the future, these public access locations will reside anywhere and everywhere – in public transport terminals, cafeterias, airport lounges, remote branch offices, cafés, book shops, libraries, shopping centres and more.

You can use 802.11b technology to take advantage of public access locations for Internet access:

- While conducting research at the library.
- To locate sales or product information while walking through a shopping centre.
- When you're at a bus or train station and you need to send e-mail.
- To print a document from your PDA while at a restaurant.
- When you enter a conference room that has a LAN access point (LAP) with network-based services.
- When you arrive by car in an unfamiliar city and want to use your portable device to acquaint yourself with the surrounding area.

With the large-scale rollout of public access locations in the near future, you can see how 802.11b will provide mobile capabilities and Internet access never before possible.

Choose freedom.

TOSHIBA

Access Local Area/ Wireless Local Area Networks

Using 802.11b to Access LANs/WLANs

You enter the office building at work and need to move some files onto the corporate intranet. While you're walking through the hallway, you can transfer the files from your notebook computer to the corporate LAN wirelessly before you even get to your desk.

Upon reaching your office, you decide to send an e-mail message to a colleague. Since you've already established a wireless connection to the corporate LAN from your notebook computer, you quickly type and send the e-mail.

At lunch, you take your notebook computer to the company cafeteria where you can access the Internet or corporate intranet via a wireless access point. While eating lunch, you send e-mail to your brother across the country. Then, you

spot a colleague on the other side of the cafeteria. You establish contact between your notebook computers and play a quick game before heading back to your office.

After lunch you attend a meeting. Through a wireless connection from your notebook computer to the LAN, you can easily access real-time information and use it in your meeting, or download information from a database on the corporate intranet. If someone in the meeting room has a network printer or fax machine, it can be used by anyone in the room.

Before leaving your office for the evening, you decide to download a copy of a document from the corporate LAN onto your notebook computer. With 802.11b, there's no need for disks or CDs. A connection is established and the file is copied from the LAN to your notebook computer within seconds.

Check with your network administrator(s) to configure your network settings (DHCP, etc.) and Access Point name(s) (SSID). Many wireless LAN software packages allow multiple network profiles. Check the user manual for your wireless LAN device for more information.

After work you attend evening classes. At the class you can explore information located on the school's intranet. While in class, the school's WLAN provides supplemental study aids and presentations to enhance your learning experience. You can access these via your notebook computer or PDA while sitting at your desk – and then use the network printer in the classroom to print a detailed diagram for further study.

Access Local Area/ Wireless Local Area Networks

You can perform research on the public Internet, download information to your notebook computer or send homework to your tutor via e-mail.

You can order textbooks, send e-mail to fellow classmates, post course-related questions in a class's chat room and fill out an online application for financial assistance. You can create a PAN with friends to exchange notes or create interactive study groups.

While sitting in the library or courtyard with your notebook computer or PDA, you can wirelessly connect to the intranet to investigate courses, financial assistance, schedule changes, posted assignments, extracurricular activities, general student resources or the bookshop

Equipment	Software	Distance(s)
802.11b-integrated notebook computer or a notebook computer with an 802.11b PC Card	802.11b driver software (optional SPANworks 2000)	to 300'
PDA with 802.11b card or module	Internet service provider account	up to 300'
Network peripheral such as a printer	Driver software	N/A
Access point	Configuration/management software	to 300'

Before 802.11b

Before 802.11b, access to information was not as simple as it is when a W/LAN is used wirelessly. Users had to share Ethernet jacks, or hubs and cables had to be installed on meeting rooms tables. Now, information can be downloaded or accessed instantly using a W/LAN, and no wires are needed.

Wireless Usage Scenarios

Creating a Connection Between Two or More Devices (PAN)

A device equipped with a Bluetooth radio establishes an instant connection to another Bluetooth radio as soon as it comes into range.

A technology that eliminates the need for cables offers a number of potential applications and the possibilities are virtually unlimited. Simply place Bluetooth-enabled devices in the same area for them to communicate with one another wirelessly.

You can use Bluetooth technology to form a wireless connection (network) between two or more devices:

- To connect two or more computers to share presentations, conduct conferences, exchange files, electronic card information and more; when you and a colleague arrive early for a meeting and want to finalize details beforehand; or when you want to use a PDA to control a presentation.
- To immediately enter and/or synchronize stored information (such as telephone numbers, addresses, agendas, task lists, contact databases, schedules or standardized applications) between your mobile telephone, PDA, notebook computer or PC.
- During lunch in a cafeteria, so you can play the latest interactive game on a portable gaming device with another person.
- When you and a business partner find yourselves sitting in the club lounge at an airport before your flight.
- When you want to sit back in your chair or on the sofa with the keyboard on your lap and the mouse placed close at hand without cables or cords in the way.
- Any time you need to print e-mail and other documents from mobile phones, laptops, PDAs or desktop computers without cabling.
- When you turn your PC into a telephone with a wireless, hands-free headset that provides excellent voice quality.

Creating a Connection Between Two or More Devices (PAN) Wireless Usage Scenarios

Using Bluetooth to Create a PAN Between Two or More Devices

You and a business colleague are waiting for a flight in the airport's club lounge at the airport waiting for a flight to a clients office. Through your club membership and a Bluetooth PAN workgroup in the club lounge, you are allowed access to the Internet via your notebook computers. Comfortably seated in a cushioned chair, your notebook computer connects to the PAN at the airport.

You receive an e-mail message containing a large attachment that you need for your meeting. You can share the e-mail message and attachment.

Using Bluetooth extended service discovery, you find a printer in the club lounge and print the document within seconds. You confidentially discuss the document using the "chat" features in your Bluetooth software.

On the road to the meeting with the clients, you rely heavily on several mobile devices including a notebook computer, mobile phone and PDA to synchronize information within your devices and with your office. **You never need to re-enter the same information.** Data can include telephone numbers, addresses, schedules, agendas, task lists, entire contact databases - and even applications such as MS Outlook, MS Office or Lotus Notes.

You're in charge of conducting the presentation on project strategies to a group of five managers. With the Bluetooth technology, this is easy. You can create a PAN between everyone's notebook computer in the conference room, displaying the presentation simultaneously on all designated computers, without wired connections. You can use your PDA to actually drive the presentation. At the same time, two or more managers can create a second PAN to share notes during the presentation - without disturbing the presentation or other managers.

"Simply place Bluetooth-enabled devices in the same area for them to communicate with one another wirelessly."

Creating a Connection Between Two or More Devices (PAN) Wireless Usage Scenarios

At the end of the presentation, three managers request a copy of the PowerPoint presentation data file for further review. With a click of the button, the file is wirelessly copied to the hard drives on those three notebook computers. Before the meeting ends, the managers can also exchange updated electronic card/contact information and they can share their contact databases.

Once the meeting is over, you e-mail the presentation to a manager who was unable to attend. Using your mobile phone or a wireless connection to the company's intranet or LAN, you obtain Internet access and the presentation is instantly on its way.

Equipment	Software	Distance(s)
Bluetooth-enabled PC, notebook computer or PDA; Notebook PC with Bluetooth PC Card	Internet service provider account; basic Bluetooth software and SPANworks 2000	to 100'
Bluetooth-enabled PAN infrastructure at the airport	Server software, optional for roaming or other services	to 100'
Bluetooth-enabled printer or fax	Appropriate software	to 100'
Bluetooth-enabled mobile phone	PC data suite	System dependent

Before Bluetooth

Before Bluetooth, you had to wait until you re-entered the world of wires, cables, electrical outlets and phone jacks before you could send or receive e-mail and other documentation. You had to re-enter information when and if you had the time. More often than not, only one device contained current information, while integrity and accuracy were compromised within the others. You could run the presentation from your notebook computer, but not without wires - and other attendees had to view the presentation via a projector and screen. To get a copy of the presentation, attendees had to wait until you were able to copy it onto a disk or e-mail it to them.

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Creating a Connection Between Two or More Devices (PAN) Wireless Usage Scenarios

SPANworks TM 2000 - Conversational Networking

SPANworks 2000 is the first comprehensive Wireless Productivity Solution for mobile computers. This software eliminates potential connection glitches and frees you to focus on real work. SPANworks 2000 is specifically designed for the unique demands of networking in a mobile environment while making it effortless to establish connections. The process is as easy when connecting one-to-one as it is connecting many-to-many. In fact, it is so simple you won't even know it is happening. There is no addressing, no set-up, and no hassle.

SPANworks 2000 software provides a spontaneous, seamless network over any wireless devices. This enables your entire group to get work done in an entirely new, spontaneous and natural way. SPANworks 2000 consists of four applications: File Utilities, Presentation, Contacts, and Chat. Each application enables individuals, groups and teams to focus on their work.

With SPANworks 2000 you can effortlessly transfer files to one or more people in your proximity with a simple drag and drop. You can give a slide presentation on several machines, with or without using a digital projector. Or "whisper" among friends using the Chat application.

SPANworks 2000 allows you to receive files or other data automatically in the background. You have various security settings that provide warnings and confirmations before, during, or after data transmission, so you know exactly what is happening.

Transfer your business card from one computer to another...even transfer that card simultaneously to everyone in the room, quickly and easily...with SPANworks and your chosen wireless adapter.

With SPANworks 2000, you can:

- Connect with one or more other computers that are located indoors or outdoors, in a conference room, a classroom or a coffee shop.
- Automatically recognise others in your proximity and display their presence without prior identification.
- Connect and exchange data among several users simultaneously.
- Use any of various devices to establish a connection.
- Transfer files, browse "permitted" locations on other computers, or maintain synchronicity among folders with other computers.
- Share your slide presentation wirelessly with a nearby audience, store the slides automatically on anyone's notebook computer, and capture individual notes on each slide electronically.
- Exchange electronic business card information.

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Creating a Connection Between Two or More Devices (PAN) Wireless Usage Scenarios

- Use the Chat feature to “whisper” text messages to those you select that are in your proximity. You can even send comments to your technical team during a management presentation, or exchange messages across a classroom.
- Communicate and share data with other computers using identical devices or standards-compliant devices (e.g. several 10/100 devices to a hub, or several IEEE 802.11 adapters).

Bluetooth Software Suite

With the Bluetooth Software Suite, you can establish wireless links between your computer and other Bluetooth-enabled devices. Without using an inch of cable, you can:

- Transfer sound, objects and files
- Access the Internet using dial-up networking
- Connect to local area networks
- Send faxes using the fax software of your computer
- Establish Bluetooth ad hoc networks consisting of two or more Bluetooth devices
- Connect to serial devices (legacy applications)

Most operations are carried out from an application called the Bluetooth Neighbourhood (BN). The BN includes the processes of device discovery, service discovery, and establishing links to remote devices. The BN is equivalent to a network neighbourhood. Where a network neighbourhood is a wired network, the BN is a wireless network of Bluetooth devices within range. You can communicate with a number of remote devices at once by creating a device folder and then distributing objects and files to the devices within that folder. Bluetooth neighbourhood features include:

- Inbox - your device can receive objects such as electronic business cards, messages, notes and calendar objects. Contents can be copied, renamed, dragged and dropped.
- Shared files - You can make files available to remote users who, in turn, can be given permission to place files in your shared files folder, or delete files.
- Displayed icons for the devices located during device discovery. Indicates whether they are within range or out of range at the time.
- Displayed icons for the services located during service discovery including audio, business card, dial-up networking (DUN), fax, inbox, LAN, network, and shared files. Provides reasons why a service discovery cannot be conducted. This might be because a remote user set up a device to reject link establishment attempts, or because a device is out of range. Establish a link by making use of any service that both your device and a remote device support.

Future Usage Scenarios for Bluetooth Wireless Usage Scenarios

Future Usage Scenarios for Bluetooth

Office Environment

- Eliminate the need for PC cards and zip drives. With a Bluetooth-enabled back-up device, wirelessly copy data from your PC to a portable device. You can then copy the data onto another computer.

Home Environment

- Transfer video recordings and images to notebook computers, send holiday photographs to friends and family via e-mail. Appliances such as a VCR could talk to a TV or the phone system without cabling or remote controls. Remotely set your VCR using your mobile phone to record a favourite program while you are standing in line at the post office or are stuck in traffic on the motorway.

Cordless Headsets with Bluetooth Technology

Bluetooth technology will allow the development of cordless headsets, which will offer additional functionality and freedom of movement over conventional corded headsets. A headset will make it possible to move more freely while on the phone, and with a Bluetooth-enabled cordless phone, the levels of freedom will be further increased.

Bluetooth-enabled headsets should prove easy to operate, since the specification provides for a single button, which can either initiate an outgoing connection, such as when you want to talk on the phone, or accept an incoming connection, such as when you want to take a call or listen to the output of your computer's sound subsystem. And depending on the features that hardware vendors choose to build in, there's scope for other controls such as volume and so on to be managed from the computer or phone.

With a Bluetooth-enabled cordless headset, you can:

- Use your notebook or personal computer as a phone via a lightweight, wireless headset with a microphone at its tip. Or use the headset with a standard mobile phone, setting the phone down in one corner of the room or walk around the room.
 - Use a headset with a Bluetooth-enabled MP3 player in a large public facility, such as a stadium. Many announcement services about the stadium facilities and events are available centrally on a network within the stadium and are available to Bluetooth devices at several voice access points. You can discover these audio announcements and receive them on the Bluetooth headset.
 - Use the headset for handsfree operation of a phone in the office, at home, in the car or anywhere.
 - Connect a cordless headset to your portable PC's built-in microphone and loudspeaker, and use the portable PC as a speaker-phone.
 - Work with a standard fixed line telephone, a mobile phone or a PC based phonewhile in the car, walk into your office and, without changing headsets, use it with your desk phone.
 - For audio products and devices like disk players, hi-fi systems and gamesconsoles and as a general replacement for any application or device that currently make use of a corded headset.
-
- The oven will send a message to the TV you are watching to let you know when your dinner is ready.
 - Eliminate wiring between your stereo system and speakers.
 - Your refrigerator knows when it is running short of food and, after consulting your Bluetooth-enabled oven, will compile a shopping list which includes the ingredients for your favourite meals. The list is passed on to a Bluetooth mobile phone which sends the shopping list to the grocery store.
 - If your refrigerator breaks down, it can call the service centre itself.
 - On receipt of your shopping list, the supermarket sends a message to you via your mobile phone asking if you want the provisions delivered.

Bluetooth will make home and office life simpler and more efficient, giving you more free time.

Choose freedom.

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Future Usage Scenarios for Bluetooth

Wireless Usage Scenarios

- A smart shopping trolley at a grocery store includes a display, a Bluetooth chip, and a loyalty card reader. Once the shopping trolley has verified that you are the person you claim to be – it will interrogate either your mobile phone's Bluetooth chip or your loyalty card – it can retrieve your shopping list from the database and point you toward any special offers that are available.
- Your digital television, which has been monitoring your viewing habits for the past few months, calls to let you know that your favourite football team is about to kick off and asks if you want to record the match. Press a button on your phone and the VCR takes appropriate action.
- Stereo equipment no longer needs close proximity to the TV or home cinema system to accommodate the wiring. The wires needed to connect various pieces of equipment to each other are eliminated. You no longer have to worry about where to locate consumer devices around the home.
- You are downstairs working, and your favourite music is on the stereo upstairs. You can listen to it without installing extra speakers by using a wireless connection from the stereo to your Bluetooth-enabled headphones. With a wireless connection, sending control and audio signals is easy. And a wireless signal can be boosted to just the right power to get data across successfully without any loss of quality.
- Your bathroom cabinet monitors your consumption of toothpaste, soap, deodorant, and moisturiser, and reminds you to buy more.
- HID devices with the Bluetooth wireless technology allow easy of multi-player gaming. Players are no longer tethered to the gaming machine and can be seated casually within a standard sized living room. A game controller with Bluetooth technology can provide rich audio input and output to improve the realism of the game and to enable wireless chat and voice commands. Interactive TV, Web TV, and PC-based satellite receiver type devices designed for the home will be able to take advantage of Bluetooth HID input devices. Bluetooth keyboards and pointing devices will provide a superior user experience to the existing infrared wireless keyboards. Bluetooth devices will not require line of sight alignment with the receiver and the two-way capability allows remote displays and user feedback devices.
- Print images from cameras or scanners.

Fixed Wireless Hotspots

- The shelves in a PAN-enabled market will contain sensors that keep tabs on items. Shoppers broadcast their shopping list to the market to determine if there are matches for the items on the list. The PAN and sensor combination detects the current inventory in the market to provide current information to the customer. Shoppers are informed of prices, sale items, alternatives for items not available, and even directions detailing product location.

Future Usage Scenarios for Bluetooth Wireless Usage Scenarios

Mobile Environment

- Use a hands-free voice input device in a car.
- You're sitting on a train listening to a CD through cordless headphones while working on your notebook computer. Your mobile phone rings and sends its signal to the headphones, taking precedence over the CD's signal.
- Used in cars to replace wiring - for electronic mirrors and stereo systems for example - and to perform common functions such as controlling electric windows. Additionally, a Bluetooth key fob, or your mobile phone, could be used to operate door locks, the ignition system, or the stereo.
- Track stolen cars, or switch the alarm on or the headlights off remotely. Send diagnostic reports of the car's engine to service stations.
- Your Bluetooth-enabled car entertainment system could combine the existing concept of an integrated hands-free phone and music centre where the music centre switches off and becomes a hands-free phone when an incoming call is detected.
- The mobile phone handset can remain in your briefcase rather than be set in the proprietary cradle when you enter your car. Connected wirelessly, the phone's functions are voice controlled.
- Interactive services could retrieve information from the Internet for pre-trip planning and hotel booking, weather information, news, stock pricing as well as sharing corporate data.
- Synchronization services of common data between car and computer could be part of the mobile information services.
- Incident warnings such as traffic alerts and news or information flashes could also be delivered while on route.
- For the comfort and entertainment of passengers, there are on-demand audio and video services that could be made available, while seamless connectivity with the office would allow the user to really work on the move.
- Services available in the family car could be accessed by a personalised card used in conjunction with portable devices such as a phone, PDA or notebook computer.
- John owns a car that is equipped with a Bluetooth-enabled head rest unit. However, the head rest is missing a link to the cellular network. This link is provided by John's portable phone which connects to the head rest via Bluetooth when his portable phone is inside the car. John can now answer and place calls using the dashboard display and the steering wheel buttons. The car-embedded microphones and speakers are used for hands-free call conversation.
- Vicky's car has a dashboard display and some steering wheel buttons. She can connect several portable devices to the car via Bluetooth, using the display and the steering wheel buttons as output and input devices. For example, her portable phone exports its menu structure and her PDA exports the user interface of its calendar application. She can use her phone and electronic calendar without having to hold them while driving.
- Simone is a traveling salesperson, who uses a different company car almost every week. Whenever she enters a new car, she uploads her phone book, the frequencies of her favourite radio stations and her personal seat and mirror settings from her Bluetooth equipped PDA to the car. She also transfers authentication information to the car phone so that she can be reached at her normal telephone number and all outgoing calls are billed to her account.

- Roger approaches his car with his Bluetooth-enabled mobile phone. The Bluetooth module of the car detects the Bluetooth module of the mobile device. Roger's phone beeps and offers to unlock the doors by simply pressing a key on his phone. When leaving the car, Roger uses his phone again, this time to lock the car and switch on the car alarm.
- Paul owns a mobile and a car-embedded phone. Whenever he brings his mobile phone into the car, the two devices detect each other and establish a Bluetooth connection. The embedded device offers a call divert so that the higher power car-embedded phone is used for all incoming and outgoing calls. Upon leaving the car, Paul can reverse call diversion at the mobile phone so that incoming calls for the embedded phone are diverted to his portable phone. In the case of an ongoing call conversation while leaving or entering the car, the number of the party Paul is talking to is transferred from one phone to the other. Bluetooth seamlessly and automatically ends the call at one phone and establishes it again at the other phone.
- Mike has a Bluetooth equipped PDA with a location based application. The application uses positioning data obtained via Bluetooth from a car embedded positioning system.
- Susan and Martin are on the way to their holiday destination. During the journey, the car connects via Bluetooth to various roadside kiosks. They obtain the most current information about traffic jams and accidents on the highway and can pay highway tolls automatically without having to worry about having coins in the right currencies.
- Mark pulls into his dealership to have his "new" used car serviced. The technician connects his scanner to the vehicle bus with Bluetooth and tells Mark about the car's service history. His oxygen sensor has malfunctioned and needs to be replaced. Cylinder number 3 is misfiring indicating that the injector needs to be checked. Bluetooth allows dealers, fleet owners/operators to monitor engine parameters or vehicle location via Bluetooth intra-vehicle links by sending information over a cellular network.

Network Security

For years, the concern of network managers has been the danger involved in connecting devices together to share data and resources. As authorised users use the network to access data on other devices, there exists the risk of unauthorised users gaining access to the same devices.

Network security must examine all methods of access to a given network. Because wireless LANs connect fewer devices across a wider geographical range, much of the authorisation is delegated to the operating systems on client devices, servers and other network resources.

Wireless technologies increase the risk of unauthorised access because the user does not have to plug into a physical connection. The physical range of wireless technology may extend access beyond the walls of the corporate office.

Bluetooth Security

BluetoothTM guarantees security at bit-transfer level. Authentication and coding mechanisms are implemented in every transmitter/receiver. Authentication is controlled by the user employing a 128-bit key and can be uni or bi-directional or can be disabled entirely, if desired.

In a piconet, for example, it is possible to configure each of the devices so that they each have different access rights to one another.

Security is a potential concern for Bluetooth, which is by nature indiscriminate. As you walk into a room, any active Bluetooth device you are carrying will attempt to make a connection with another that is within range. More specifically, because not all communications need to be secure, Bluetooth offers three security modes. Before describing these it's worth noting that there's a good degree of security inherent in Bluetooth's radio frequency-hopping system, which is pretty hard to break into in the first place unless you know the hopping schedule; and all Bluetooth links benefit from this system.

Bluetooth's first security mode provides no security at all and is intended for communication such as swapping electronic business cards and other non-sensitive transfers.

The second mode, called service-level security, offers flexibility when accessing multiple links with differing security requirements, while the third, link-level security, is less flexible but provides a secure link from the start of communications.

- Setting up security requires risk assessment to determine direct costs vs. indirect factors such as revenue or business loss

The following measures are suggested to ensure network security when wireless technologies are implemented.

- Monitor the physical locations of servers and have in place high-level security policies to prevent information from being damaged, altered or stolen.
- Use switching hubs rather than repeated hubs.
- Implement encryption wherever possible; 802.11b WLAN equipment generally offers an encryption option between the client device and the access point.
- Utilise user names, passwords or digital certificates to assign authorised usage levels and to authenticate users.
- Install virus, damage and intrusion detection tools for your network. With these measures, your network can remain secure and will be less prone to avoidable problems and disaster.

Mode 3 involves two devices swapping authentication keys, which will have been derived from a PIN entered by the user into both devices at the first time of communicating only. It involves a device-to-device challenge and response scheme with a 128-bit common secret link key, a 128-bit challenge and a 32-bit response. Future communications are then encrypted.

Wireless technology requires increased security measures.

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Network Security

Wireless Security

Wired Equivalent Privacy (WEP)

802.11b provides for both a Media Access Control (MAC) layer and encryption mechanisms, known as Wired Equivalent Privacy (WEP), to provide wireless LANs with security levels equivalent to wired LANs. For example, WEP encrypts data sent in the radio signal between the client device (such as an 802.11b PC Card) and an access point.

The WEP 40-bit encryption built into 802.11b WLANs is sufficient for most applications, but most equipment can be purchased with WEP 128-bit encryption. Other access control techniques are available in addition to the 802.11 WEP authentication technique, including an ESSID programmed into each access point to identify which its subnet.

Certificates (x.509)

The ISO x.509 certificate is the international standard upon which most commercial digital certificates are based. Digital certificates represent the certification of an individual, business, or organisational public key. It shows the privileges and roles for a holder. The certificate can be downloaded from a server to a client upon initial authentication, and will be checked every time the user tries to access that server.

Digital certificates are used to authenticate a server or Web site or verify a user. The certificate can also provide keys that are used for encryption purposes. This guarantees the confidentiality, integrity and security of the communications and transactions.

Virtual Private Network (VPN)

As more workers telecommute and travel, traditional remote access services have become expensive and cumbersome in serving the needs of an increasingly dispersed and mobile workforce. Changes in work habits create a strain on conventional network infrastructures, especially as the once-clear distinction between the corporate LAN and the public WAN blurs.

Features and Benefits of VPNs

- Network managers can cost-effectively increase the span of the corporate network
- Remote users can securely and easily access their corporate network
- Corporations can securely communicate with business partners
- Enterprises can outsource the hosting of servers and applications
- Service providers can grow their businesses by providing substantial incremental bandwidth and value-added services

The limitations of traditional WAN services can be surmounted by a low- cost, robust, worldwide data network that can connect anyone, at any time, anywhere. Similar networks already exist in the form of the Internet "cloud" and the dedicated IP backbone networks maintained by dozens of network service providers. The Internet has clearly started a revolution based on the wide availability of low-cost, ad hoc data communications. But the worldwide communications revolution created by the Internet is not a suitable medium for business communications due to reliability and quality of service problems, operational manageability, and security.

Network Security

Wireless Security

A properly designed VPN can solve these problems, providing the end user with a greatly improved business communications infrastructure at a significantly reduced cost. A VPN links remote offices over a network and gives allows workers to efficiently share ideas and information throughout a company. Firewalls can be easily added to a VPN to provide solid encryption to secure data as it travels over the Internet.

VPNs provide access from anywhere the Internet reaches and enables rich, flexible communications with customers, suppliers and business partners over extranets.

VPNs provide an inexpensive way to extend the corporate network to outlying offices, home workers, salespeople, and business partners. Rather than using expensive dedicated leased lines to reach distant offices, VPNs make use of worldwide IP network services, including the Internet, and service provider IP networks. Any computer system that is configured to run on an IP network can be incorporated into a VPN without modification. The installation of remote software is all that is required. VPNs can also link corporations across the Internet.

Frequently Asked Questions

What are Toshiba's global wireless initiatives?

Toshiba's global wireless initiatives involve the development of a wide range of new products, the enhancement of existing products, and the formation of alliances with key strategic partners from the hardware, software, networking and telecommunications sectors. Designed to meet a wide range of customer needs, Toshiba's wireless products and services will be developed in three different segments: Wide Area Networks (WAN); Local Area Networks (LAN); and "personal area" connectivity, that is, cable replacement and Personal Area Networks (PAN).

Within Japan, many different laboratories (researching communication platforms, multimedia devices, mobile communications, computer and network systems) and development centres (for mobile computing and communications, personal and multimedia systems, computer and network systems) are working on applied research in the area of wireless technology. Outside of Japan, Toshiba America Research Inc. (TARI) in New Jersey is investigating mobile Internet technology, and Toshiba Research Laboratory (TRL) in Bristol, UK is investigating next-generation (3G and beyond) wireless communication technology.

What is Bluetooth?

The Bluetooth wireless technology is a low-cost, low-power, small-size radio subsystem enabling easy-to-use wireless connections between a very wide variety of product classes. The characteristics above, along with a range of up to 100' and a gross data rate of 1Mbps (megabit per second), make Bluetooth technology suitable for notebook PCs, desktop and server PCs, handheld PCs / PDAs, mobile phones, printers, mice and other pointing devices, LCD projectors, network access points, security devices, audio equipment, toys, and many other types of product. Unlike the IEEE 802.11b Wi-Fi technology, which is designed specifically for wireless networking, the Bluetooth technology is suited to a very wide range of application – from file transfer and device / personal information synchronisation to dial-up networking through mobile phones, and LAN access through network access points. These early applications will be followed by many more, in the consumer electronics and automotive domains, as well as in the PC and telecommunications markets.

What is the Bluetooth SIG?

The Bluetooth Special Interest Group was established early in 1998. It is a consortium of approximately 2000 companies from the computing, telecommunications and networking industries. The principal charter of the Bluetooth SIG is the creation of the Bluetooth Core Specification and a suite of Profiles that define how to implement the specification in a standard way, so that products from different vendors will inter-operate well with one another. The Bluetooth SIG also engages in promotional activities, such as the very well-attended Bluetooth Developers Conferences.

The Bluetooth SIG is led by nine Promoter companies: Toshiba, 3Com, Ericsson, Intel, IBM, Agere (formerly Lucent), Microsoft, Motorola, and Nokia.

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Frequently Asked Questions

What will Bluetooth wireless technology deliver to end users?

Bluetooth will enable users to connect a wide range of computing and telecommunications devices easily and simply, without the need to buy, carry, or connect cables. It delivers opportunities for rapid ad hoc connections, and the possibility of automatic, unconscious, connections between devices. It will virtually eliminate the need to purchase additional or proprietary cabling to connect individual devices. Because Bluetooth wireless technology can be used for a variety of purposes, it will also potentially replace multiple cable connections via a single radio link. It creates the possibility of using mobile data in different ways, for different applications such as "Surfing from the sofa", "The instant postcard", "Three in one phone" and many others. It will allow users to think about what they are working on, rather than how to make their technology work.

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

Yes, a Bluetooth-enabled device will be able to actively communicate with seven devices simultaneously. The specification defines both point-to-point and multi-point connections. This workgroup of eight devices forms what is called a piconet. Using Bluetooth LAN-access devices and servers, many piconets can be connected to form a scatternet.

How is this technology going to be licensed? Is this technology royalty-free? Are there any patents involved?

There are several patents on various parts of the Bluetooth technology. All licensees will benefit from a zero-cost license agreement covering all Bluetooth intellectual property (IP) and name usage rights as long as they comply with the specification.

What are Toshiba's plans for the PAN environment and Bluetooth™ technology?

Toshiba has already brought a series of new wireless products and services to market. The first product being a Bluetooth PC Card and SPANworks software application. Portable computers, such as the Toshiba Tecra®, Portégé®, and Satellite Pro®, with built-in Bluetooth wireless capabilities have also launched this year. Toshiba is also working on a series of other new wireless products such as LAN access points, LCD projectors, handhelds and digital cameras.

What are Toshiba's plans in the wireless LAN environment? What products and service will be available?

Toshiba initiated the first phase of its entry into the WLAN environment in April 2000 by announcing its relationship with Wayport Inc., an Austin, Texas company that provides high-speed mobile Internet solutions for people on the move. Expanding this relationship and forming additional alliances with fixed wireless ISPs and ASPs will enable Toshiba to deliver comprehensive mobility solutions that give travellers and remote workers the freedom to work anytime and anywhere through faster access to the Internet and corporate intranets to upload and download e-mail and other documents and files. Access to these services is available via "hot spots" in airports, hotels and other public facilities.

To complement the wireless access services, Toshiba has introduced a range of new products based on the Wi-Fi™ (IEEE 802.11b 11 Mbps) wireless LAN standard. The first of these products is a Wi-Fi PC Card and access point. The PC Card is designed for any portable computers with a PC Card slot that is running Windows 95, Windows 98, Windows ME, Windows 2000 or Windows NT 4.0.

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Frequently Asked Questions

What are Toshiba's plans in the WAN environment?

Toshiba is building alliances with leading infrastructure providers to create a seamless environment for simple and fast communications between notebook computers and mobile phones. For example, customers using Bluetooth-enabled mobile phones and notebook computers can enjoy secure, wireless Internet access via cellular carriers from nearly any location.

Does Toshiba have any handheld products to announce with its wireless strategy?

We have been studying the handheld market for some time now, and have determined that we will introduce a handheld device only as part of a complete solution offering. Bluetooth wireless technology offers users greater functionality in handheld devices, and offers Toshiba a greater opportunity to develop compelling solutions for our customers. There are Toshiba groups in Japan that have been developing and marketing wireless handheld devices, so these devices could become available in Europe in the near future.

Tell us more about building wireless technology into your notebook computers.

Toshiba engineers are working to integrate both Bluetooth wireless technology and Wi-Fi wireless LAN technology into the same notebook computer for shipment in 2001. Building wireless technology into notebook computers is no trivial task. With wireless technology, it is necessary to allow RF signals to pass from inside the case to outside with ample signal strength and wide dispersion. Toshiba engineers are working on state-of-the-art antenna and case design to ensure the highest level of wireless performance. By the end of 2001, Toshiba expects the majority of the Toshiba notebook computer line to either contain integrated wireless technology or to it as an option.

Can you provide Bluetooth PC Card details?

The Bluetooth PC Card is an extended Type II PC Card. The card has an attached antenna, which extends from the computer's PC Card slot when the card is inserted. The radio's transmit power automatically adjusts from 0 dBm to 20 dBm, for a range of up to 100 feet. The PC Card includes a Bluetooth software suite and SPANworks 2000, a wireless "team computing" software application. With two Bluetooth PC Cards, two notebook computer users will be able to share files, use text-based chat, share presentations and exchange electronic business cards. The Bluetooth PC Card can be used with Toshiba and other brands of notebook PCs that have a Type II PC Card slot and the following minimum configurations: Pentium 133MHz, 64MB RAM, and either Windows 98 SE or Windows 98 ME.

Do you expect any 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" very rapidly (1600 times per second) from one channel to another, and the Wi-Fi technology uses a subset of the ISM band channels, the interference tends to be intermittent and of short duration. In tests carried out by Ericsson in a WiFi/Bluetooth mixed environment, Bluetooth will slowly decline in speed by a maximum of 22% as it concedes bandwidth to WiFi. Toshiba is considering various methods to assure the best possible co-existence experience between the Bluetooth and Wi-Fi technologies, including the development of "connection management" software to insure that it is easy for users to select the technology most appropriate for their application and environment.

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Frequently Asked Questions

What is SPANworks and how does it work?

SPANworks, the first comprehensive Wireless Productivity Solution for mobile computers, will be included with every Toshiba Bluetooth PC Card. SPANworks 2000 software, developed at Toshiba's communications platforms lab, will provide a spontaneous, seamless personal area network connecting two or more notebook computers (up to 7 total) with Bluetooth PC Cards. SPANworks consists of four applications: File Utilities, Presentation, Contacts, and Chat. Each enables you to focus your group or team efforts on the work at hand. With SPANworks you can effortlessly transfer files to workers in your proximity with a simple drag and drop. You can instantly exchange electronic business cards at the beginning of a meeting, give a slide presentation from one machine to several others with or without the use of a digital projector, and "whisper" among friends using the "Chat" application. In the future, we plan to make SPANworks an integral part of all Toshiba wireless products.

What can you tell potential enterprise customers about the security of their network should they want to enable wireless access to that network?

Toshiba believes that good network security is key. If the wired network is vulnerable to unauthorised access, the wireless network is vulnerable to unauthorised access. Being able to talk to a network access point with a Wi-Fi or Bluetooth device is only the first step to accessing a network. If a network is not secure, unauthorised wireless access would not much differ from someone plugging equipment into a RJ-45 jack in an empty office. In the context of someone intercepting a wireless signal, WEP (Wired Equivalent Privacy) 64- and 128-bit encryption can be enabled on Wi-Fi PC Cards and access points, and Bluetooth uses fast frequency hopping and 128-bit encryption for secure transport.

Are transmissions secure in a business and home environment?

Bluetooth wireless technology has sufficient built-in encryption and authentication and is thus secure in any environment. In addition, a frequency-hopping scheme with 1600 hops/sec is employed. All of this, together with an automatic output power adoption to reduce the range exactly to requirement, makes the system extremely difficult to eavesdrop.

Will Bluetooth products work only in certain areas of the world?

Use of the Bluetooth wireless technology is currently restricted only in a few countries. One such country is France. The French government has recently changed their telecommunications law to permit operation of Bluetooth beginning in the year 2001.

What is the anticipated volume for Bluetooth-enabled devices in the near future?

The Bluetooth technology is designed for integration into products. We anticipate tens of millions of Bluetooth-enabled devices by the year 2002. According to Cahners-Instat, it is expected that by year 2005 close to 700 million Bluetooth devices will be shipped annually.

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

Yes. Adoption of the Bluetooth technology is anticipated to be widespread throughout the computer and telecommunications industries. The move to implement this technology is expected to grow the market for personal mobile devices and increase airtime usage for mobile data. Recent Dataquest research shows that although only 2 percent of mobile users today are using mobile data, almost 40 percent indicate that they would do so if the facilitating technology were easier to use.

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Frequently Asked Questions

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

Due to the low unit cost and royalty-free adoption model, it is anticipated that consumers will not experience any significant increase in product pricing directly associated with integration of the Bluetooth technology. Bluetooth modules will likely be available to add on to other products and it is anticipated that these type peripherals should also be very affordable.

Is it possible to "upgrade" my current communications/computing technology to make it Bluetooth-enabled?

We anticipate a broad range of legacy solutions to facilitate easy upgrading of current technology, including PC cards and USB "dongles" for PCs, and add-on devices for phones.

What is Toshiba's involvement with WECA?

Toshiba joined WECA in June, 2000. Working together with other WECA members, Toshiba will promote the international adoption of the Wi-Fi (IEEE 802.11b High Rate) standard for interoperability in wireless local area networking (LAN) for enterprises, small businesses, homes and schools.

What is WECA? What is Wi-Fi?

The Wireless Ethernet Compatibility Alliance (WECA) is a non-profit organization formed in 1999 to certify interoperability of Wi-Fi (IEEE 802.11b High Rate) products and to promote Wi-Fi as the global wireless LAN standard across all market segments. WECA has defined a test suite that defines how member products are tested to certify that they are interoperable with other vendor products. An independent test lab, The Silicon Valley Networking Lab, Inc. (www.svnl.com) conducts the testing. When a product successfully passes the test, the company will be granted the Wi-Fi seal of interoperability and may display the Wi-Fi logo on that product and its corresponding collateral material. Consumers are assured that any product bearing the Wi-Fi logo will work with other Wi-Fi products.

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 with traditional hard wired devices. Wi-Fi achieves the same performance as a wired 10BaseT LAN connection. Wi-Fi also offers flexibility with sustained performance in the office and provides seamless add-on to an Ethernet intranet.

In what markets and target segments will Wi-Fi certified products be sold?

Wi-Fi standard products are being developed for use across all market segments, from enterprise, small business, home, public access, education, so that everyone can benefit from using wireless LANs.

How does Wi-Fi compare to 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 all sorts of data, including files, business cards, digital pictures, voice, music, e-mail, and Web content from the Internet.

The 802.11bWi-Fi technology, on the other hand, has been designed specifically to be today's best solution for one particular application: wireless Ethernet. Therefore, it is meant for implementation in PCs and in network access points. In PCs it may be directly built in, or it may be 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 like DSL or cable modems.

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Glossary

Access point	Any point where access to a network can be found, such as a wireless transceiver that connects to a fixed network.
Asymmetrical	Describes a two-flow of data where the data rate in one direction differs from the other. For instance, with Asymmetrical DSL (ADSL), the downstream data rate from the Internet is much faster than that going back upstream to the Internet.
Asynchronous	Literally, not synchronised. Usually refers to communications where a data stream is not tied to a specific clock speed. Modems transfer data asynchronously.
Authentication	Security mechanism that prevents access to critical data and makes it impossible to falsify the origin of a message.
Baseband	Low bandwidth
Broadband	High bandwidth
CardBus	A 32-bit interface that describes how PC Cards communicate with a computer
CDMA	Code Division Multiple Access (CDMA) is a standard that separates voice signals using spread spectrum technology
Cellular phone	A mobile telephone that works using radio frequencies arranged in cells, such as is used in GSM phones
Circuit switching	Describes a circuit that is held open as long as the parties are communicating. This is how a standard voice telephone call works. Circuit switching ensures consistent throughput, but is very bandwidth inefficient in managing silences between and within words and sentences.
Cordless headset	A headset, which includes a microphone, that connects without wires.
Cordless phone	A telephone that connects without wires.
DECT	The signalling system that describes how digital cordless phones work.
Device address	The unique address of a Bluetooth device.
Device discovery	Before a link can be established, a Bluetooth device needs to discover other Bluetooth devices that are active within its range
Device name	The name that a Bluetooth device presents itself with when supplying identity information to another device.
Direct sequence	A method of wireless transmission that can provide higher data rates and greater robustness than frequency hopping in radio- noisy environments. The trade-off is higher cost and fewer users for a given area

Glossary

DSP	Digital signal processor – a chip specifically designed and optimised for processing signals such as voice and video.
Encryption	Security mechanism that prevents eavesdropping and maintains link privacy
EPOC	EPOC is a 32-bit operating environment used in Psion's Series 5 palmtop computers. It is comprised of a suite of applications, customised user interfaces, connectivity options and a range of development tools.
FireWire	Apple's name for IEEE 1394.
Frequency hopping	Describes a system of communication based on radio waves whose frequencies change (or hop) over time. For example, the frequencies used by Bluetooth hop 1600 times a second. The advantage is that it is less susceptible to interference, and confers some security on the signal
GPRS	General Packet Radio Service - a technology that bundles data on top of GSM transmissions to increase data rates by sharing bandwidth, allowing users to get data rates of up to 115 KBPS.
GSM	Global System for Mobile Communications is the standard cellular phone technology used in Europe and most of Africa and Asia.
IEEE 1394	A high speed serial link, currently working at 400 Mbps
IEEE 802.11	A standard that describes a wireless networking standard, currently working at 1 Mbps. This standard is the basis for most modern wireless networking systems
iLink	Sony's name for IEEE 1394
IrDA	The InfraRed Data Association is the industry body whose name has become synonymous with the infrared based communication standard that it developed. IrDA has become the standard in the computer industry, but not in consumer areas such as remote controls
ISDN	Integrated Services Digital Network is a system invented in the 1970s that passes data down a standard phone line digitally. Most common is the Basic Rate ISDN, which offers two 64 Kbps channels plus a 16 Kbps control channel
ISM band	Industrial, Scientific and Medical Band is a set of radio frequencies centred around 2.4 GHz. These frequencies are available for use by wireless technologies such as Bluetooth.
Java	A technology invented by Sun Microsystems that allows programs to be run on almost any type of computer that includes a Virtual Java Machine (JVM). Java is almost completely platform independent. Such programs are generally small and can be quickly downloaded across a typical Internet connection for execution within a browser.

Glossary

Linux	A version of Unix rewritten by Linus Torwalds that is by developers running Web sites.
MAC layer	The Media Access Control layer of networking - in other words, the circuitry (often a network interface card) that manages access to the physical layer of the network (such as the cable or fibre). MAC can also refer to a wireless link.
MAN	Metropolitan Area Network is a network that spans several buildings spread out over an area as large or larger than a town.
Master	The device that initiates a connection and, during this connection, controls all traffic in a piconet.
Notebook	A portable PC, that includes a display, runs a full copy of a standard operating system. It can run standard applications. It often cannot accept adapter cards.
Open technology	A flexible term often used to describe a computing technology, such as software, whose source code is either open to all to modify as they see it, or which has been developed by a committee composed of members of the computing industry.
Packet switching	Describes a data signal that has been chopped into discrete pieces or packets. Like parcels, these packets can be sent individually to their various destinations by the switching fabric. The advantage is that one message or series of messages do not take over a communication channel which allows much greater bandwidth efficiency. See circuit switching.
Palm	A palm-sized PDA running PalmOS. The Palm was invented by Palm Computing which was subsequently acquired by 3Com.
PAN	Personal Area Network ensures that all the electronic devices on and around an individual can communicate. A PAN is the type of network set up by Bluetooth.
Parallel port	Sends data in a parallel stream, typically to a printer
Park mode	Economical, low-power "sub-mode" of standby. In park mode, a slave does not participate in the piconet but remains synchronized to it. Park mode is used to increase the number of slaves connected to a master.
PBX	Private Branch Exchange is a type of switchboard found in many businesses.
PC Card	Describes the types of cards that can be plugged into the slots found in computers to add functionality such as networking, a modem or Bluetooth.
PDA	Personal Digital Assistant is a small, usually palm-sized electronic organiser that includes a calendar, schedule, to-do list, contacts database and memo pad.

Glossary

Piconet	An ad hoc network that can be initiated by Bluetooth devices as they encounter other Bluetooth devices to allow all of them to inter-communicate. [A wireless network formed by two or more Bluetooth devices.]
PIN	Personal Identification Number.
PPP	Point-to-Point Protocol is a way of setting up a two-ended link using the Internet Protocol (IP). Most often encountered when dialling an ISP but can also be used by Bluetooth to set up an IP link.
Profile	Application that a Bluetooth device facilitates. For one device to communicate with another, the two devices must have a shared profile. For instance, to transfer files from one computer to another, both computers must feature the file transfer profile.
Protocol	A kind of language that two or more devices have in common which allows them to inter-communicate. An example is the Internet Protocol (IP) which all devices connected to the Internet must use in order to exchange information.
PSTN	Public Service Telephone Network
Quality of Service	When used in the context of data communications, QoS refers a guarantee of a certain level of service for a particular type of traffic, most often voice or video. These types of traffic are very sensitive to delayed or lost information.
Scatternet	A group of piconets with overlapping coverage areas Connections exist between them
Serial port	Sends data in a serial stream, typically to a modem
SIG	Special Interest Group is group that comes together with a common aim or purpose, such as the Bluetooth SIG.
Slave	A device in a piconet controlled by another device (the master).
Smart phone	A GSM terminal with enhanced display capabilities and new functions to enable users to access e-mail, faxes and company intranets easily and quickly. Smart phones have larger displays, often a QWERTY or touch-sensitive keypad, and specialised built-in software linked to specific services and applications, combining the functions of phone and PDA.
Spread spectrum	Refers to the type of frequency hopping that Bluetooth uses, that is, it hops across a spectrum of frequencies one after the other. Another technique is called direct sequence spread spectrum, which spreads data packages across several frequencies at the same time. Direct sequence spread spectrum is less cost-effective, consumes more power, and does not allow several access points to coexist in the same area to transmit and receive signals because they would block each other.

Glossary

Symbian	A joint venture between Psion, Ericsson, Nokia and Motorola to promote the EPOC operating system for wireless information devices.
Synchronous	A data stream tied to a particular clock speed. An example is leased lines
TCP	Transport Control Protocol refers to the layer below IP that allows devices on the Internet to communicate and pass messages along.
TDMA	Time Division Multiple Access (TDMA) is a standard used for wireless networking.
UMTS	Universal Mobile Telecommunications System is a third generation cellular mobile standard operating in the 2 GHz band. It enables networks to offer packet-based global roaming with voice, data and multimedia services. UMTS promises data rates up to 2 Mbps.
USB	Universal Serial Bus is the PC industry's attempt to standardise PC hardware around a single, space-efficient port that could eventually replace serial, parallel and other types of ports used on PCs.
WAN	Wide Area Network is a network that can span the globe. The Internet is a form of WAN, although it actually consists of multiple networks interworking.
WAP	Wireless Access Protocol, invented by Nokia, is a standardised way of allowing small devices such as cellular phones and PDAs to present data from the Internet to the user in a meaningful way, mainly by stripping off the graphics and reformatting the text. It is optimised for use on the narrow band radio channels used by GSM and GPRS. When combined with Bluetooth, WAP is a cornerstone technology that can permit Web surfing from anywhere.
Wireless LAN	A Local Area Network whose physical layer (the cabling) has been replaced by radio waves.
xDSL	Digital Subscriber Loop is a technology designed to provide high speed access to the Internet over existing phone lines without requiring a phone call or interrupting phone calls. Always on, the most common form is Asymmetric DSL (ADSL) which provides a high-speed link (up to 2 Mbps) to the user's computer with slower transfer upstream.