Wireless Training Guide

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. Despite new and changing protocols, all of the large OEMs are jumping on board the wireless train – which guarantees universal standardization for wireless devices.

Whether we realize it or not, wireless 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 has gone one step further by providing mobile capabilities for computers – and now enables nearly any device to communicate with another.

How to Use This Manual

The information in this guide is intended to help you understand wireless technologies available, 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, history and timeline 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 the wireless technologies work together
- Overview of wireless technologies including Bluetooth, 802.11b, IrDA, HomeRF and HiperLAN
- Usage scenarios for Bluetooth
- Wireless security issues

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, riding in a cab, 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 24x7 access, no matter the location. And 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 laptop 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 cellular 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 video phones and mobile videoconferencing. Wireless is revolutionizing 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 – Used to provide mobile phone service
- Local area or wireless local area networks – Used to connect several computers together in an office environment
- Personal area networks – 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.

Wide Area Networks

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. And with increased battery life, intelligent interfaces, voice recognition and higher speeds, mobile phone usage is destined to skyrocket even more in the near future. People will continue to use their wireless services more and their standard phone services less.

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 authorizes 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 (analog) 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

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 organized 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 analog 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.

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 for small geographical areas, or 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 traveling. 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.

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.

There are two basic types of signals – analog and digital. An analog signal varies continuously between a maximum and minimum value. An example of an analog 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 fiber 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 analog signal.

And what is the difference between cellular and PCS phones? A cellular phone uses a short-wave analog or digital transmission via a wireless connection. A PCS phone is similar to a cellular phone, but utilizes a digital transmission exclusively and offers extended mobility and operates at higher frequencies for a higher quality connection.

Factors contributing to increased WAN usage include:

- Larger coverage areas and lower pricing
- Bundling of long-distance and local minutes without charges for roaming
- Increased use of prepaid services
- Increased digitalization of wireless networks
- Mobility, convenience and accessibility

Local Area Networks

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 utilize – a common set of files and information. LANs can consist of as few as two users or computers and as many as thousands. Users can also share the same printer or scanner 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

ARCN (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 (Fiber Distributed Data Interface) is a standard for data transmission on fiber 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 campus 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 to somewhat limited geographic boundaries, WLANs liberate users from dependence on hard-wired 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 on-site 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 temporary setups such as trade shows or conferences
- Faster access to customer information for service vendors and retailers
- Location-independent access for network administrators, for easier on-site troubleshooting and support

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, unreliability and 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 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.

How it All Works Together

With new technologies such as Bluetooth available today, the traditional 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 PowerPoint 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.