

# UNDERSTANDING WIRELESS

A comprehensive two-day course covering fundamentals, Wireless LANs, cellular, 3G and the wireless web

## Course Objectives

- Review fundamental radio concepts.
- Understand wireless LANs in detail: concepts, standards, practical deployment, performance, security.
- Cover cellular in detail: concepts, standards, analog, digital and 3G; understand CDMA, TDMA/GSM.
- Survey other technologies: LMDS, Bluetooth, satellite, ...
- Explore the Wireless Web.

## What you will learn

- All about radio: analog and digital, frequencies, bands.
- Wireless LAN concepts, standards, equipment.
- Data formats: Ethernet frames and IP packets.
- How to deploy Wi-LAN "hotspots" with Access Points.
- How to allocate channels when using multiple APs.
- DHCP, private IP addresses and IP address translation.
- How to set up a wireless LAN in Windows XP.
- Sharing printers and files.
- What performance to expect: obstacles, loading.
- Wireless LAN security: SSIDs, encryption.
- Overview of LMDS, SMDS, Bluetooth and more .
- Overview of satellites and two-way internet access.
- All about cellular. Concepts, terminology, buzzwords.
- Analog vs. digital cellular. GSM, TDMA and GPRS.
- CDMA and how "spread spectrum" works.
- 3G technologies: cdma2000, 1X, EV and UMTS .
- Sort out 3G hype from 3G reality.
- Understand i-mode, SMS, wireless email, Blackberry.
- The Wireless Web, WAP and XML.

## Prerequisites

None

## Who should attend

- Those needing to get up to speed, fill in the gaps and put in place a solid understanding of today's wireless technologies.
- Anyone wanting to improve their career- and productivity-enhancing knowledge base with a detailed understanding of wireless LANs, cellular and the migration to 3G, and the technologies and issues behind the Wireless Web.

## Course Content (High-Level Summary)

### 1. Basic Radio Principles

- Radio concepts; analog vs. digital; radio bands

### 2. Wireless LANs

- Wi-LAN standards, 802.11a/b/g, Wi-Fi
- Wireless Access Points (APs), adapter cards
- Ethernet frames and IP packets

### 3. Deploying Wi-LAN Hotspots

- Integrated AP/switch/NAT/router devices
- DHCP, private IP addresses, translation
- Single access point configuration
- Multiple APs: channel allocation, interference

### 4. Wireless LAN Setup and Configuration

- Setup in Windows XP; file and printer sharing
- CLASS DEMONSTRATION: Setup and test

### 5. Wireless LAN Performance

- Distance limitations, obstacles and penetration
- Claimed vs. actual throughput; loading curves

### 6. Wireless LAN Security

- Hacking and jamming; access control, SSID
- Encryption, WEP, WPA, beacon frames

### 7. Other Wireless Technologies

- LMDS, MMDS, Bluetooth, point-to-point microwave
- Two-way paging, trunked radio
- Satellite: geosynchronous, LEO; internet access

### 8. Cellular and PCS

- Cellular concepts: cells, registration, handoffs
- 1G analog; 2G digital: CDMA and TDMA/GSM
- Understanding CDMA: spread spectrum and codes
- 911 and location technologies

### 9. 3G and Data over Cellular

- Cellular modems; packet radio; CDPD
- Data over TDMA/GSM: CSD, HSCSD; GPRS
- 3G technologies and issues
- cdma2000; 1X, 3X and 1xEV; W-CDMA, UMTS
- Throughput comparisons; players

### 10. The Wireless Web

- SMS, i-mode, wireless e-mail
- Device evolution
- CLASS DEMONSTRATION: WAP
- Content delivery: WAP and XML

## Here's What Seminar Attendees Like You Are Saying

Hundreds of people like you have benefited from Teracom's telecommunications training. Many tell us this was their best seminar ever; filled gaps in their knowledge and tied everything together... knowledge they've been needing for years. Here's a sampling of comments:

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- Rusty Walther, Vice President, Client Services, AboveNet Communications

*"The selection of material - the order of its presentation - the way it was presented... incredibly effective at presenting concepts and ideas - uses great analogies and stays on topic."*

- Susan Lennon, Nortel

*"The seminar delivered exactly what was advertised, at a very high quality.*

*Truth in advertising!" - Gary Lundberg, Copper Mountain Networks*

Whether you work for an organization that produces telecom, datacom or networking products or services; or you buy these products and services - or just have to get up to speed on what all the rest of them are talking about when they say "DS1", "Ethernet frame", "CDMA" and "802.11"...

*"Best course we have ever had onsite at 3Com"*

*"Perfect content; well organized, well paced, building block approach, resulted in a very nice cathedral" - Jim George, Qualcomm*

*"Course was excellent! One of the best I have taken. Extremely well organized and presented. Seminar workbook is outstanding - a very valuable reference" - Kieran Delaney, Maritime Life*

*"I liked most the use of analogies to explain complex concepts. It delivered exactly what the brochure promoted. Gave me a thorough understanding so I feel more confident."*

- Judith Myers, Ameritech

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*"Filled in a lot of gaps in my knowledge of networking... able to deliver the knowledge effectively and entertainingly. Excellent seminar"- Kirk Kroeker, IEEE Computer Society*

*"Great information that I will be able to use at work. Very easy to understand all the information especially the IP networking part. I wouldn't change a thing"*

- Orlando Jasso, AboveNet Communications.

*"Layman's terms with humor was very relaxing - helped me concentrate... understanding is now CLEAR ... the manual will be very helpful" - Linda Côté, Bell Canada*

*"Best instructor I have had on a course - excellent explainer in layman terms, not techie terms"*

- Susan Coleman, Bell Sygma

*"Best course materials ever; the full text descriptions are invaluable. Course filled in so many gaps for me. Bravo!" - Ross Brooks, Vertek*

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## Six Reasons to Take a Teracom Seminar

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2. Build the career-enhancing knowledge tools you need to succeed in the fast-changing world of communications.
3. Build a structural understanding of telecommunications and networking, allowing you to make meaningful comparisons and informed decisions.
4. Understand mainstream solutions to today's requirements, and obtain templates you can put to immediate use.
5. Obtain detailed workbooks / textbooks that will serve as a valuable reference for years.
6. Understand how it all fits together.

Develop a structure for understanding technologies and solutions, allowing you to make informed choices and meaningful comparisons -- knowledge you can't get on the job, reading trade magazines or talking to vendors.

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## Detailed Course Description

*Understanding Wireless* is a two-day intensive course designed for those needing to get up to speed, fill in the gaps and put in place a solid understanding of today's wireless technologies... and anyone wanting to improve their career- and productivity-enhancing knowledge base.

We'll review basic radio principles and frequency bands, then cover Wireless LANs in detail: concepts, standards, equipment, deployment, configuration, performance and security. We'll survey other wireless technologies, including LMDS, Bluetooth and satellite internet access, then cover cellular in detail: mobility concepts, handoffs, registration, first generation analog, second generation digital, and put in place a good understanding of what CDMA is, how it works, why it's called *spread spectrum*, and how it compares to TDMA/GSM. We'll finish off with the third generation of cellular, 3G, competing technologies cdma2000 and UMTS, data over 3G and applications: i-mode, SMS, wireless email, WAP, XML and the Wireless Web... and explain all of this in plain English.

We'll start at the beginning of the story, progress through key concepts in a logical order, and finish at the end. Our goal is to bust the buzzwords, cut through the jargon and doubletalk to put in place a clear, structured understanding of today's wireless communications.

### 1. General Principles

We'll begin with a high-level overview of how and where radio is used, radio bands and allocations, then understand radio as a physical means of communication: "analog" and "digital" radio, propagation, fading and interference.

- A. Wireless Communications
- B. Applications and Technology Areas
- C. The Radio Spectrum, Frequency Bands of Interest
- D. Analog Radio
- E. Digital Radio
- F. Limitations and Impairments
  - 1. Fading and Propagation
  - 2. Spectrum Clearing
  - 3. In-building Penetration

### 2. Wi-LAN Standards

Wireless LAN technology is becoming ubiquitous - and has already started changing the way we work. From Starbucks to home to warships, wireless LANs have gained enough momentum that a detailed understanding of the concepts, technologies, deployment, performance and security issues is becoming a valuable knowledge asset.

We begin with an overview and comparison of the different standards: 802.11a, 802.11b and 802.11g. We'll also cover Wireless LAN equipment including Wireless Access Points and adapter cards for PCs, and review how data is formatted for access control and transmission: Ethernet frames and IP packets.

- A. IEEE 802 Standards
  - 1. ISM Unlicensed Bands
  - 2. 802.11 Wireless LANs
  - 3. Wi-Fi, 802.11a, 802.11b and 802.11g
  - 4. Comparing 802.11a, b and g
- B. Wireless LAN Equipment
  - 1. Wireless Access Points
  - 2. PCI Plug-in Card for Desktops
  - 3. PCMCIA Card for Laptops
- C. Channels and Segments
- D. Ethernet Frames and IP Packets

### 3. Deploying Hotspots

Next, we turn to the practical: how to implement a Wireless LAN by deploying Access Points (APs) to create “hotspots”. We’ll understand the functions performed by many current home / small office Wireless LAN “router” products, including how they assign private IP addresses to stations, perform Network Address Translation (NAT) to allow Internet connection, and include Ethernet switches for hardwired connections.

Then we’ll look at deploying a Wireless LAN in a larger office or meeting area, using multiple APs and assigning each a different channel. You’ll understand channel allocation design, interference and location considerations. All of this is information you can put to immediate practical use.

- A. Home / Small Office Deployment
- B. Integrated “Access Point - Switch - NAT - Edge Router”
  - 1. DHCP and Private IP Addresses
  - 2. Network Address Translation
  - 3. Ethernet Switching
- C. Single Wireless Access Point with DSL/Cable Internet Connection
- D. Peer-to-Peer or Ad-Hoc Connections
- E. Larger Office / Meeting Area Deployment
  - 1. Multiple Access Points
  - 2. Wireless Segments
  - 3. Channels and Channel Allocation Design
  - 4. Interference Considerations
- F. Equipment Locations

### 4. Setting up the Wireless LAN

Continuing with practical information, we’ll do an in-class demonstration of how to set up a Wireless LAN using Windows XP and a home / small office Access Point. You’ll understand how, in a matter of minutes, you can connect all the computers in your home or small office together, share a centralized printer, share files, and share a single DSL/Cable Internet connection, without having to pull any wires!

- A. Setup in Windows XP
- B. Windows XP Zero Configuration
- C. File and Printer Sharing
- D. CLASS DEMONSTRATION: Setting up a Wireless LAN and testing connectivity

### 5. Performance

Should we believe the distance claims written on the Access Point box by the marketing department? 800 feet?? What happens if there is a brick wall in the way? What happens when more than one person starts uploading files?

- A. Distance Limitations
- B. Obstacles and Penetration
- C. Claimed vs. Actual Throughput
- D. Automatic Data Rate Selection
- E. Performance Under Load
- F. How 802.11 Manages Access Control
- G. Contention Resolution: Loading Curves
- H. CSMA/CA and Hidden Node

### 6. Security

Why bother setting up a wireless LAN? Why not just sneak around the corridors of your building, or drive around with a laptop until you get a “dial tone”? And while you’re at it, wouldn’t it be fun to listen in on other people’s email? We’ll complete our understanding of Wireless LANs with security - and show you how to prevent other people from doing this to you.

- A. Basic Wireless Security
  - 1. Hacking – Drive Wars
  - 2. Interference, Jamming

- B. Access Control
  1. Service Set Identifiers – SSID
  2. “Join any network” option in Windows XP
- C. Encryption of data
  1. Public Key Infrastructure - PKI
  2. Wired Equivalent Privacy – WEP keys
  3. WEP Vulnerabilities
- D. Wi-Fi Protected Access - WPA
- E. Beacon Frames and Effect On Performance

## 7. Other Wireless Technologies

With a comprehensive understanding of Wireless LANs in place, we’ll move on and survey other wireless technologies, including LMDS and MMDS fixed wireless systems, microwave, Bluetooth, paging, trunked radio and satellites: geosynchronous and Low Earth Orbit, Direct-to-Home digital satellite TV - and how it can be used for one-way or two-way “high speed” Internet access.

- A. Fixed Wireless
  1. LMDS and MMDS
  2. Point-to-Point Microwave
  3. Bluetooth
- B. Two-Way Paging
- C. Trunked Radio
- D. Satellites
  1. Geosynchronous Satellites
  2. Low Earth Orbit
  3. Internet Access via Satellite
  4. One-way vs. Two-way

## 8. Cellular

The second major topic in this course is wireless communications that allow mobility: cellular. We’ll take the time to understand basic mobility concepts including cells, handoffs, registration, and the infrastructure to support this. In the final three chapters of the course, we’ll trace the evolution of cellular technologies from first generation “analog” to second generation “digital” to third generation and the Wireless Web.

To begin, we’ll sort out the confusing kaleidoscope of technologies, standards and buzzwords; and understand the structure and operation of a cellular network. In plain English, we’ll understand what CDMA is and how it works, why it’s called “spread spectrum”, and its advantages over TDMA and GSM.

- A. Mobile Communications
- B. Cellular Standards: Alphabet Soup; 2G, 2.5G, 3G Migration
- C. Cellular Principles
- D. 1G: Analog
- E. 2G: Digital - Voice Communications
  1. TDMA (IS-136)
  2. GSM; GSM System Architecture
  3. CDMA (IS-95, CDMAOne)
- F. Understanding CDMA
  1. CDMA and Codes: The Cocktail Party Analogy
  2. Why CDMA is called “Spread Spectrum”
  3. CDMA Particularities: Soft Handoffs, Synchronization, Power Control
  4. Why CDMA is superior to TDMA and GSM

## 9. 3G and Data over Cellular

With an understanding of cellular concepts and technologies in place, we'll look toward the future which includes both voice and data over these wireless networks. We'll discuss competing technologies - the "2.5G" kludge called GPRS, and 3G technologies cdma2000 vs. UMTS and Wideband CDMA. We'll compare migration paths, expected data rates; and understand which one may eventually dominate the market and who's backing it. Strategic knowledge!

- A. Modems over 1G
- B. CDPD: Packets over 1G
- C. Data over 2G Cellular
  - 1. Data over TDMA/GSM
  - 2. GPRS: 2.5G
- D. Data over CDMA
- E. 3G
  - 1. IMT-MC: cdma2000
  - 2. 1X, 3X and 1xEV-DO
  - 3. IMT-DS: UMTS and Wideband CDMA
- F. Throughput Comparisons
- G. Service Providers
- H. Problems with 3G

## 10. The Wireless Web

To complete the picture, we'll look at the applications for data over cellular, covering text messaging, wireless e-mail and the Wireless Web. We'll examine issues related to surfing the web on your cell phone, why WAP is so painful and where we're trying to get to with XML.

- A. SMS and i-mode
- B. Wireless E-mail
- C. Device Evolution
  - 1. Issues: Screen and Keyboard, Bandwidth, Battery Heating
- D. Delivering Web Content
  - 1. WAP
  - 2. XML
- E. CLASS DEMONSTRATION: WAP

Understanding the concepts and technologies behind today's wireless communications in this structured way will give you career- and productivity-enhancing knowledge, sure to be a valuable asset. We invite you to join us!

Register online today at [www.teracomtraining.com](http://www.teracomtraining.com).

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## About the Author



Eric Coll is an international expert in telecommunications, data communications and networking and has been actively involved in the industry since 1983. He holds Bachelor's and Master of Engineering (Electrical) degrees, and is licensed as a Professional Engineer in his home jurisdiction.

Mr. Coll has taught telecommunications technology training seminars to wide acclaim across North America since 1992, and has broad experience working as an engineer in the telecommunications industry.

He has worked for Nortel's R&D labs as a design engineer on projects including digital voice and data communications research and digital network equipment design; on satellite radar systems; Wide Area Network design for HMO applications; and many other projects in capacities ranging from detailed design and implementation to systems engineering, project leader and consultant.