

Course ID
WIRELESS-TI
Course Duration
4-5 days

Course Title
Architecture & Operation of Wireless Networks for Technical Investigators: From Their Analog Origins to the Emerging 3G Technologies

Related Courses

- State-of-the-art of WiMAX for Non-engineering Professionals, Managers, and Executives (WIMAX, 1 day)
- WiMAX: A Business Perspective (WIMAX-BIZ, 1 day)
- State-of-the-art of WiFi for Non-engineering Professionals, Managers, and Executives (WIFI, 1 day)
- State-of-the-art of Satellite Communications for Non-engineering Professionals, Managers, and Executives (SATCOM- EXEC, 1 day)
- GSM: A Technology Overview (GSM-B, 1 day)
- iDEN™: A Technology Overview (IDEN-O, 1 day)
- Wireless Network Structure, Operation, and Technologies (WIRELESSNET, 3 days)
- Technologies: A Comparative Study (COMPARISON; 2-4 days)

Aimed At

Are you a technical investigations, public safety, law enforcement, or homeland security professional who needs to have a good working knowledge of today's wireless networks? If so, this course has been designed specifically for you.

Group Size

5-25

Prerequisites

There are no formal prerequisites, but some exposure to the fixed communications networks and a degree of ease with technology-related issues will be helpful. However, all prerequisite material will be reviewed as needed.

Course in a Nutshell

In this four-to-five day course, you will undertake a non-technical yet fairly deep review of wireless technologies from the perspective of law enforcement. The optional fifth day adds a day-long case study of the particular technology of interest to the audience.

We will start by describing radio waves, their properties, and their application in various communication systems environments, from radio to TV to cellular systems. By studying real systems that are similar yet very different at the same time, you will acquire a concrete framework for understanding what can be a difficult set of concepts. We will then engage in a broad study of the structure and operation of wireless networks starting with AMPS and evolving to IS54, TDMA, CDMA, GSM, GPRS, EDGE, and now WCDMA, cdma2000, and WiMAX. While at a high level these technologies are quite similar, they differ greatly in their details. Our intention, at all times, is to help you identify the areas and mechanisms that may prove useful to you in your work as well as those that may serve to make your job more difficult.

Customize It! Customize this course at little to no added cost. Let us know the backgrounds and job requirements of and the equipment used by your staff, and we will tailor the course to your needs and interests.

This course comes in a four-day basic and five-day extended version. The extended version adds a day-long case study of the particular technology of interest to the audience.

- Learn How To**
- Learn the key telecommunications, networking, and cellular communications concepts that underlie all wireless networks
 - Define the important terms related to wireless networks and technologies
 - Explain how the wireless technologies evolved, the various families of technologies, and their interrelationships
 - Describe the strengths, limitations, and operation of each of the major wireless technologies currently in use around the world
 - List the factors that are driving the emergence of 2.5/3G, WiFi, and WiMAX technologies
 - Describe how 2.5G/3G, WiFi, and WiMAX technologies fit into the wireless landscape
 - Identify those areas and mechanisms that may help or hinder the investigations and law enforcement personnel in the performance of their duties

Course Outline

Part1: Radio Waves and Their Properties

- Radio waves: What they are
 - “RF” or “radio frequencies”: What are they?
 - Amplitude, frequency, and phase: Three properties that define a radio wave
 - Some basic trigonometry: Sine function, the building block of all that follows
 - The electromagnetic spectrum from zero to infinity
 - Radio waves versus RF versus X-rays versus light: What stays the same, what changes?
- Radio waves: How they propagate
 - Amplitude, power, and signal strength: Why 4+4 makes 16 and 9+25 makes 64
 - Transmitted power versus received power: Distance dependencies
 - Free space propagation
 - Plane earth model
 - Propagation in urban, suburban, and rural areas, over water and mountains
 - Propagation versus fading, fading models and countermeasures
- Modulation techniques
 - Modulation: What is it? Or: without it there is no communication!
 - Analog modulation techniques and their historical usage
 - Amplitude Modulation (AM)
 - Frequency Modulation (FM)
 - Digital modulation techniques and their historical usage

- Amplitude Shift Keying (ASK)
- Frequency Shift Keying (FSK)
- Phase Shift Keying (PSK)
- Binary versus multi-level digital modulation techniques

Part 2: A Primer on Telecommunication Systems

- Analog communications revisited
 - Time functions as signals; prime example: human speech
 - Power spectral density
 - AM and FM revisited
 - Noise characteristics and statistical description
 - Spectrum and bandwidth as a public resource
- Digital communications
 - The end-to-end digital path: What are the issues and tradeoffs
 - Channel capacity, bit rate, modulation complexity, and spectral efficiency: ASK, FSK, PSK revisited
 - Modulation complexity as it relates to the evolving technologies
 - Multiple access: The problem and solutions
 - FDMA versus TDMA versus CDMA
- Key concepts of networking
 - Circuit and packet switching concepts
 - Voice and data networks
 - Evolution to voice over IP

Part 3: Wireless Communication Systems

- Fundamental architecture of cellular systems
 - Frequency reuse, reuse factor
 - Control versus traffic channels
 - Capacity and channel assignment issues
 - Overlapping cells and hand-off (handover) process
- Call processing and signaling issues
 - Camping process and mobile identification/registration procedures
 - Mobile originated call set up procedures
 - Mobile terminated call set up procedures
 - Location area updates and (mobile) paging procedures
 - Key aspects of call progress, measurements, reports, and their functionality
 - Roaming issues, signaling, and authentication procedures

Part 4: Wireless Technologies: Their Drivers and Implementations

- Analog systems and AMPS
- Evolution of AMPS and the FDMA/TDMA/CDMA “mega” debate
- Evolution of IS-54 and IS-136: The Cingular and ATT Wireless paradigms

- Qualcomm, CDMA, and IS-95: The impossible-to-work technology that actually works phenomenally well!
- A relatively small but important player: iDEN™, Nextel, and the merger of Nextel and Sprint
- Development of GSM in Europe and its “export” to the rest of the world, including the USA
- Evolution of GSM to GPRS and EDGE and on to UMTS
- Evolution of IS95 to 1xRTT, 3xRTT, 1xEVDO, and 1xEVDO
- A brief glimpse into the more distant future: UWB CDMA, OFDM, and what next?

Part 4 : Case Study: An In-depth study of the Technology of Interest to the Audience (optional fifth day)

- Detailed structure and operation
- Strengths and limitations
- Areas of interest or concern from the investigations/enforcement perspective

Conclusion: Course Recap, Q/A, and Evaluations

How You Will Learn

- A seasoned instructor will present this course in interactive lecture format
- Along with lecture, we use exercises, puzzles, case studies, and interesting group activities to enrich the instruction and drive home the essential points.
- If you already know something about the technology, we will build on that. We’ll compare and contrast what’s familiar with what’s new, making new ideas easier to learn as well as more relevant.
- If your background is less technical, we will use meaningful and ingenious examples and analogies to simplify the complex subject matter.
- You will learn about the key areas of interest or concern from the vantage point of investigations and enforcement.
- You will receive a printed Participant Handbook which will help you remember and retain what you learned in class and apply it on your job.

Revised

July 16, 2006