

Course ID
All-IN-ONE
Course Duration
5 days

Course Title
Wireless All-in-One: RF Propagation, Cellular Principles, Personal Radio Services, WiFi, WiMAX, CDMA, and GSM-to-UMTS Evolution

Related Courses

- RF Systems: Principles, Design, and Deployment (RFSYS, 3 days)
- Wireless Network Structure, Operation, and Technologies (WIRELESSNET, 3 days)
- RF Propagation, Fading, and Link Budget Analysis (RFPROP, 2-3 days)
- Microwave and Fixed Line-of-Sight Link Design Principles (MICROWAVE2, 2 days)
- WiMAX and Mobile WiMAX: An Advanced Tutorial Including 802.16e (WIMAX-TECH, 3 days)
- GSM: Network Architecture, Operation, and Design (GSM-I, 5 days)
- GPRS: Network Architecture, Operation, and Design (GPRS, 3 days)
- EDGE: Network Architecture, Operation, and Design (EDGE, 2 days)
- cdmaOne/IS95: Network Architecture, Operation, and Design (IS95, 2 days)
- CDMA Technology and Its Evolution to cdma2000 (CDMA, 3 days)
- 1xRTT: Network Architecture, Operation, and Design (1XRTT, 2 days)
- EVDO: Network Architecture, Operation, and Design (EVDO, 3 days)
- UMTS-FDD: Network Architecture, Operation, and Design (UMTSFDD, 3 days)
- UMTS-TDD: Network Architecture, Operation, and Design (UMTSTDD, 2 days)
- iDEN™: Network Architecture, Operation, and Design (IDEN, 4 days)
- Wireless Technologies: A Comparative Study (COMPARISON, 2-4 days)
- Cell Planning and Site Development (CELLPLAN, 3 days)
- RF Systems Optimization Workshop: GSM, GPRS, EDGE, UMTS, cdmaOne, 1xRTT, EVDO (RFOPT, 3-5 days)
- Traffic Engineering Models for Network Design (TRAFFIC, 3 days)

Aimed At

Those whose job involves working with a variety of wireless technologies or who require a broad, technical understanding of the entire field of fixed and/or mobile wireless. This includes individuals in national defense, homeland security, technical investigations, and the private sector.

Group Size

5-25

Prerequisites

The course assumes that the audience is well versed with Physics, Mathematics, and general engineering principles but does not have any prior experience with wireless communications technologies.

Course in a Nutshell

We designed this course for the unique needs of those who are new to the wireless technology, have some technical (engineering or Mathematics/Physics) background, and need a comprehensive A-to-Z treatment of both the principles of wireless communications and a technical overview of the major wireless technologies in use today.

Customize It

We can customize this course, usually at little to no added cost, in a number of ways that include:

- If you are familiar with some aspects of wireless, such as RF propagation, we can omit or shorten their discussion.
- If you are interested in some technologies more than others, we can adjust the emphasis place on the various topics or build the course around the mix of technologies of interest to you.
- If your background does not include Mathematics and Physics and you want us to present the course in a non-technical manner, we can do that as well.

Learn How To

Describe and apply the key concepts, principles, techniques, and technologies of wireless communications including:

- RF transmission and reception
- RF bands, applications, and regulation
- RF propagation and fading principles and models
- Link budget analysis
- Modulation and signaling
- Personal Radio Services
- Architecture and operation of cellular networks: GSM and CDMA
- Evolution of GSM to GPRS, EDGE, and UMTS
- WiFi
- OFDM
- WiMAX

Course Outline

- The Electromagnetic Spectrum
 - FCC's Wireless Telecommunications Bureau (WTB): WTB structure and mission
 - Types of FCC licensed radio services
 - Spectrum Groups
 - HF
 - VHF
 - UHF/SHF
 - Microwave
 - Millimeter wave
- Radio Frequency (RF) Mathematics and System Measurements.
 - Gain and loss

- Calculating EIRP
- Power measurement using the decibel
- Impedance
- Bit error rate
- Signal to noise ratio
- Signal to interference ratio
- Radio Frequency (RF) Transmission, Reception, and Propagation
 - Theory of propagation
 - Radio wave components: (E) and (H) fields
 - Sky wave vs. ground wave propagation
 - Line-of-Sight (LOS) propagation
 - Free space path loss models
 - Frequency and wavelength calculations
 - Basic modulation theory
 - Bits per second per hertz efficiency
 - Digital and analog modulation
- Factors That Affect the Behavior of Radio Waves
 - Reflection
 - Refraction
 - Scattering
 - Diffraction
 - Earth's curvature
 - Fresnel Zones
- Radio Propagation in a Mobile Environment
 - Multipath
 - Rician and Rayleigh fading
 - Delay spread
 - Doppler shift
 - Coherence time and coherence bandwidth
 - Forward error correction (FEC)
 - Channel coding theory and practice
 - Basics of voice coding and decoding
- Radio Modulation and Signaling Theory
 - Signal characteristics that can be modified
 - Analog vs. digital modulation
 - Digital modulation: Types and advantages
 - FSK
 - PSK
 - QPSK and OQPSK
 - MSK GMSK
 - QAM
- Personal Radio Services
 - Personal radio services at a glance

- FCC mandated licensed and unlicensed radio service
- 218-219 MHz service
- Citizen Band (CB) radio service
- Family Radio Service (FRS)
- General Mobile Radio Service (GMRS)
- Low Power Radio Service (LPRS)
- Medical Implant Radio Services (MIRS)
- Multiuse Radio Service (MURS)
- Personal Locater Beacons (PLB)
- Radio Control radio service (R/C)
- Wireless Medical Telemetry Service (WMTS)
- WiFi (802.11) Basics
 - WiFi radio bands
 - Hot spots
 - Point-to-point and point-to-multipoint service
 - WiFi applications
 - EIRP limitations
 - Modulation types for WiFi
 - Security issues
- WiMAX (IEEE 802.16) Basics
 - Overview of WiMAX and the IEEE 802.16 standard
 - Evolution of IEEE 802.16 to 802.16e WiMAX standard
 - WiMAX network architecture and protocol stacks
 - Orthogonal Frequency Division Multiplexing (OFDM)
 - OFDM as a multiple access technique: Orthogonal Frequency Division Multiple Access (OFDMA)
 - WiMAX and OFDMA
 - OFDM in conjunction with CDMA: Best of both worlds
- Cellular Radio Network Architecture, Design, and Operation
 - Multiple access technologies: Evolution and standards
 - Analog, FDMA, TDMA, CDMA
 - Cellular licensed radio spectrum allocations
 - Frequency reuse patterns
 - Subscriber capacity and cell sizing calculations
 - Co-channel interference
 - Cell sectorization
 - Macro cell, mini cell, pico cell structures
 - Cellular radio system components
 - Radio subsystem design components
 - Synthesizers
 - Frequency converters
 - Modulators and demodulators
 - Amplifiers
 - Modulation types for cellular systems
 - Speech coding and compression

- Channel coding and error control methodologies
- Base station components
 - Towers/antenna configurations
 - RF amplifiers
 - Transmit and receive chains
- Cellular mobile station components
- Base station controller
- Core network components
 - Authentication, authorization and accounting
 - Home location register
 - Visitor location register
 - Mobile switching center
- Link Budgets
 - Understanding the link budget equation
 - Line-of-Sight (LOS) path loss models
 - The Fresnel zone
 - Path loss and free space path loss
 - Antenna gain
 - Frequency considerations
 - Atmospheric, weather and rain attenuation
 - Terrain factors
 - Multipath loss
 - Rician and Rayleigh fading
 - Cochannel interference
 - Transmission line loss
 - A typical link budget calculation for a cellular network
- GSM: A Technology Overview
 - GSM history and deployment status
 - GSM network architecture and system overview
- GSM System Architecture
 - GSM Radio Access Network (RAN)
 - Base Station Subsystem (BSS)
 - Base Transceiver Station (BTS)
 - Base Station Controller (BSC)
 - The Mobile station (MS)
 - The Mobile Station International Mobile Equipment Identity (IMEI)
- The GSM Air Interface (MS-BSS)
- Network Switching Subsystem (NSS): The Core Network
- NSS Components
 - Mobile Services Switching Center (MSC)
 - Home Location Register (HLR)
 - Visitor Location Register (VLR)
 - Equipment Identity Register (EIR)

- Authentication Center (AuC)
- Subscriber Identity Module (SIM)
- Authentication Requirements
- Security Procedures and Algorithms
- GSM Global Frequency Bands: “The GSM Family”
- GSM Services
- GSM Standards
- Mobility Management
 - Cell identification
 - PLMN selection
 - Cell selection
 - Location areas and identity numbers
 - Location registration
 - Roaming and call routing
- Basics of Speech Coding
- GSM Modulation
- GSM Cell Planning
- GSM Key Performance Indicators (KPIs) and Measurements
- Frame Structures and Frame Hierarchy
- GSM Transmitting and Receiving Chain
- GSM Protocols
 - Signaling System #7 (SS7) in GSM
 - SS7 links and protocols
 - Message Transfer Part (MTP) 1-3
 - Signaling Connection Control Part
 - Transaction Capabilities Application Part (TCAP)
 - Mobile Applications Part (MAP)
- Introduction to GPRS and EDGE (or EGPRS)
 - GSM circuit-switched data capabilities
 - GPRS architecture
 - Point-to-point services
 - Network access points
 - Attaching to the GPRS network
 - Sending a data packet
 - Dynamic resource allocation
 - GPRS architecture
 - GPRS interfaces
 - Channel types
 - Setting up a Call
 - The use of existing GSM Channels

- Introduction to 3rd Generation (3G) Wireless Systems
 - UMTS/WCDMA introduction
 - UMTS system architecture
 - UMTS performance
 - IMT-2000 harmonization
 - Air interface evolution
 - Core network evolution
 - WCDMA radio interface
 - Physical channel structure
 - Spreading and modulation
- Course Wrap-up:
 - Future of wireless: 4G and beyond
 - Recap, Q/A, and evaluation

How You Will Learn

- You will learn in interactive lecture format from an instructor who's a subject matter expert in a variety of wireless technologies as well as an excellent teacher.
- If you already know something about an aspect of wireless communications, we will build on that. If your background is less technical, we will use appropriate examples and analogies to convey the important information in an easy-to-understand manner.
- You will receive a copy of the instructor's presentation to which you can add the information and insight acquired in real-time, turning it into a handy back-to-the-job reference resource.

Revised

May 2, 2007f