

Course ID

**CDMA**

Course Duration

**3 days**

**Related Courses**

Course Title

**CDMA Technology and Its Evolution to cdma2000**

- cdmaOne/IS95: Network Architecture, Operation, and Design (IS95, 2 days)
- 1xRTT: Network Architecture, Operation, and Design (1XRTT, 2 days)
- 1xEVDO: Network Architecture, Operation, and Design (EVDO, 2 days)
- UMTS-FDD: Network Architecture, Operation, and Design (UMTSFDD, 3 days)
- UMTS-TDD: Network Architecture, Operation, and Design (UMTSTDD, 2 days)
- Wi-Fi: Technology, Applications, Design, and Deployment (WIFI-TECH, 2 days)
- WiMAX and Mobile WiMAX: An Advanced Tutorial Including 802.16e (WIMAX-TECH, 3 days)
- IP-Based Systems: TCP/IP and Mobile IP (IPSYS, 2 days)
- Multimedia Applications: IMS, SIP, and VoIP (MULTIMEDIA, 2 days)
- IMS: The Technology, Applications, and Challenges (IMS, 2 days)
- Traffic Engineering Models for Network Design (TRAFFIC, 3 days)
- Traffic Engineering Models for 3G Network Design (TRAFFIC3G, 3 days)
- RF Systems Optimization Workshop: GSM, GPRS, EDGE, UMTS, cdmaOne, 1xRTT, EVDO (RFOPT, 3-5 days)

**Aimed At**

Those experienced with a non-CDMA technology who wish to work with any of the CDMA-based technologies, including cdmaOne (IS95), cdma2000 (1XRTT, EVDO, UMB, EVDV) or WCDMA (UMTS-FDD, UMTS-TDD) families of technologies.

**Group Size**

5-25

**Prerequisites**

The standard presentation of this course assumes a technical background and some prior exposure to wireless, though the course can be adapted to other needs.

**Course In a Nutshell**

Since all future technologies, 3G and beyond, will employ some form of CDMA, understanding the theory of CDMA and the common underpinnings of all CDMA-based networks is imperative for everyone already in or entering the field of mobile wireless technology, including those who work with UMTS. Imparting such understanding is the objective of this course.

In this course, we will lead you step-by-step from the propagation and fading of radio waves through the general principles that underlie the architecture and operation of all cellular networks to the basics of Direct Sequence Spread Spectrum (DSSS), the foundation of all CDMA systems.

Having mastered these key concepts, you will learn how several of the important features of CDMA are implemented in cdma2000 including system capacity and soft capacity, soft (and softer) handover, and RAKE receiver, to name a few. We will study the entire process of cdma2000 evolution from IS95 to 1xRTT and EVDO, as well as the future 2008 releases, viz., EVDO Revision B and C (UMB).

If UMTS is the primary technology of interest to you, the discussion of cdma2000 evolution can be replaced by that of UMTS.

### **Customize It!**

There are several ways in which the course can be customized to your particular situation and requirements.

- We can tailor the topics to the needs of a particular audience, such as network design/optimization engineers or equipment/application designers.
- We can give the course a business, strategy, or operational emphasis to cater to the needs of those involved with business planning or strategy, marketing or sales, operations and support, or management.
- If WCDMA is the 3G technology of prime interest to you, we can gear the discussion to UMTS.
- If you are already familiar with the DSSS and CDMA basics and wish to focus on the cdma2000 evolution, we can do that.
- If cdmaOne (IS95) is the technology of interest to you, you can combine this course with its natural sequel, cdmaOne/IS95: Network Architecture, Operation, and Design (IS95, 2 days).
- If you're already well versed in the RF and cellular basics, we can shorten the course or cover additional technologies (such as both cdma2000 and WCDMA) while keeping its duration the same.

### **Course Outline**

- Introduction: Course Structure and Overview
- The Electromagnetic Spectrum
  - FCC Wireless Telecommunications Bureau (WTB) structure and mission
  - Types of FCC licensed radio services
  - Spectrum Groups
    - HF
    - VHF
    - UHF/SHF
- Radio Frequency (RF) Transmission, Reception, and Propagation
  - Theory of RF 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 Affecting the Behavior of Radio Waves
  - Reflection
  - Refraction
  - Scattering
  - Diffraction
  - Earth 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 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
- Cellular Network System Fundamentals
  - Cellular design concepts
  - 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 (HLR)
  - Visitor Location Register (VLR)
  - Mobile Switching Center (MSC)
- Introduction to CDMA
  - General concept and history of CDMA
  - Performance comparisons with TDMA
  - Frequency hopping and direct sequence modulation
  - Spectrum sharing
  - Capacity gains with CDMA
  - Universal frequency reuse
  - Soft handoff
  - Power management and soft capacity definition
  - Spreading codes
    - Walsh codes
    - PN codes
  - Fading and multipath in CDMA networks
  - Power control and the near-far problem
  - Capacity calculations
  - Cell breathing in CDMA networks
  - Multipath and Delay Spread Rake Receiver
- cdmaOne (IS-95) Overview
  - Reverse link channelization
  - Forward link channelization
  - IS95B features
- cdma2000 and the 3G Evolution
  - 3GPP2 organization charter
  - Review of the 3GPP2 and cdma2000 standardization process
  - cdma2000 evolution
  - 1xRTT (cdma2000 Release 0)
  - cdma2000 Release A
  - cdma2000 Release B
  - cdma2000 Release C and D (1xEVDO)
  - cdma2000 vs. WCDMA
- cdma2000 Air Interface

- Adaptive modulation and coding
- Variable channelization and spreading
- Reverse and forward link physical channels
- Reverse and forward link channel coding
- Convolutional encoders
- Turbo encoders
- Reverse and forward link modulation
- cdma2000 Call Setup and Processing
  - Mobile station idle and initialization states
  - System access state
- Traffic Channels
  - Voice and data transmission
  - Traffic channel handoff algorithms
  - Traffic channel power control features
- cdma2000 Core Network Architecture
  - Network elements for packet data services
  - Legacy cdmaOne (IS95) network elements
  - cdma2000 Release A
  - cdma2000 Release B
  - cdma2000 Release C and D (1xEVDV)
- 1xEVDO Overview
- Introduction to EVDO and Relationship to IS856 (HRPD)
- Operational and Technical Benefits of 1xEVDO
- Evolution of 1xEVDO (Data Only)
  - EVDO Revision 0
  - EVDO Release A
  - EVDO Release B
  - EVDO Release C (UMB)
- 1xEVDO Air Interface
  - EVDO protocol structure
  - Physical and logical channelization
  - Forward link structure and channel descriptions
    - Pilot channel
    - Medium access control
    - Control channel
    - Traffic channel
  - Reverse link structure and channel descriptions
    - Reverse access channel mode
    - Reverse traffic channel mode
  - Forward physical channel structure
    - Forward traffic channel
    - Forward MAC channel

- Forward channel quadrature spreading and modulation
- Reverse physical channel structure
  - Reverse traffic channel
  - Reverse access channel
  - Reverse channel quadrature spreading and modulation
- Overview of 1xEVDO Release A of IS856
  - Advanced QoS features
    - Improved cell switching
  - Reverse link improvements
    - Higher rate physical layer packet transmission
    - Improved link adaptation
  - Forward link improvements
    - New physical layer packets
    - Multi-user data packets
    - Broadcast/multicast services
- 1xEVDO Release B Overview
  - Performance improvements over release A
  - Multi-carrier operation
    - Multi-carrier active set management
  - Hybrid frequency re-use
- 1xEVDO Release C Overview
  - Advanced Ultra Mobile Broadband (UMB) technologies
  - Higher mobile data rates
  - Introduction of OFDM, OFDMA air interface features
  - New antenna Multiple Input Multiple Output (MIMO) features
  - Support for VoIP
- Conclusion: Recap, Q/A, and Evaluation

**How You Will Learn**

- We will conduct this class in an interactive lecture format.
- Your lecturer will be someone who is knowledgeable and experienced in a wide range of CDMA-based technologies, both 2G and 3G, and is an excellent instructor.
- If you already know something about RF propagation, wireless network architecture, or CDMA, we will build on your existing knowledge, helping you learn the new material quickly and effectively.
- If you are in a less technical job, we will use meaningful and ingenious examples and analogies to simplify the complex subject matter.
- The participant handbooks will provide you with a structure to which you can add the information and insight acquired in real-time, turning it into a useful reference tool you can take back to your job.

*Revised*

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