Course ID
WIMAX5D
Course Duration
5 days

Course Title
WiMAX/Mobile WiMAX (802.16/16e) Radio Planning and Optimization: A Comprehensive Workshop

Related Courses

- WiMAX and Mobile WiMAX: An Advanced Tutorial Including 802.16e (WIMAX-TECH, 3 days)
- RF Propagation Models, Fading Characteristics, and Link Budget (RFPROP, 3 days)
- Wireless Technologies: A Comparative Study (COMPARISON, 2-4 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)
- iDEN™: Network Architecture, Operation, and Design (IDEN, 4 days)
- 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 (UMTS-FDD, 3 days)
- UMTS-TDD: Network Architecture, Operation, and Design (UMTS-TDD, 2 days)
- HSDPA: Network Architecture, Operation, and Design (HSDPA, 2 days)
- HSUPA: Network Architecture, Operation, and Design (HSUPA, 2 days)
- 3G LTE/4G: The Next Generation Mobile Networks (3GLTE-4G, 2 days)

Aimed At

If you have existing radio planning background in a contemporary wireless technology such as GSM, cdmaOne, 1xRTT, or UMTS and are looking for a comprehensive how-to workshop on WiMAX engineering, this course is for you.

Group Size

5-25

Prerequisites

- Wireless Network Structure, Operation, and Technologies (WIRELESSNET, 3 days)
- At least one year experience in the field of communication engineering, fixed or wireless telephony, IT, or related fields.

Course In a Nutshell

This course offers a detailed technical treatment of the subject of WIMAX radio planning. It is an advanced course reviewing the technical specifications and standards from an RF network planning and implementation perspective.

The course provides an overview of the WIMAX/WiMAX Mobile technologies, standards, and applications. Important topics such as protocol layers, QoS, throughput, coverage, capacity planning, testing, interoperability, interference and security are thoroughly discussed. Basic RF theory, microwave, Line-of-Sight (LOS) and Non-Line-of-Sight (NLOS) links, link budget analysis, troubleshooting foundations, and site survey are also studied. The RF planning techniques taught in this course cover both the IEEE 802.16d and IEEE 802.16e standards. The course

uses hands-on exercises, case studies, and demos to make the content easier to apply back on your job.

Customize It!

We can tailor this course to your own requirements, whether network design or optimization, technology assessment or strategy, equipment or application development, sales and marketing, or business/operations support. While the presentation of this course generally assumes an engineering or other technical background, we can also present this course in versions suited to less technical audiences. We perform most course customization at no additional cost to the client.

Learn How To

- Explain what WiMAX is and how it fits into the technology landscape
- Compare the broadband wireless access (BWA) technologies now on the market with WiMAX for BWA service deployment
- Describe the WiMAX principles of operation
- Describe the WiMAX radio and core network architecture
- Explain the end-to-end operation of a WiMAX network
- Successfully carry out WiMAX radio planning projects
- Explain the challenges and trade-offs afforded by WiMAX as a broadband wireless access technology

Course Outline

- Broadband Wireless Access: Introduction to WiMAX and IEEE 802.16
  - WiMAX as a Wireless MAN Technology
  - Regulations
  - 802.16 Benefits
  - Application and Services
  - "Last Mile" Broadband Connections
  - Hotspot and Cellular Backhaul
  - High-speed Enterprise Connectivity
  - 802.16 Frequency Bands
  - 802.16 Family of Standards
  - Current Deployments
  - IEEE 802.16-2004 Enhanced Support for Indoor CPE
  - IEEE 802.16e as an Extension to IEEE 802.16-2004
  - Implementation Scenarios and Market Opportunities
  - System Profiles
- WiMAX Frequency Bands
  - 10-66 GHz Licensed Bands
  - Frequencies below 11 GHz
  - License-Exempt Frequencies below 11 GHz (Primarily 5-6 GHz)
  - 2.3, 2.5, 3.5 and 5.8 Bands
  - Air interface Nomenclature and PHY Compliance
  - Changes in 802.16e

- WiMax: More Detailed Specification
  - The Interoperability Challenge
  - 802.16a Amendment: 2 to 11GHz
  - IEEE 802.16a and ETSI HiperMAN Standards
  - System Profiles for 2 - 11 GHz
  - 802.16a and HiperMAN Standards
  - The MAC Profiles for both WirelessMAN (Licensed) and WirelessHUMAN (License-Exempt)
  - System Profiles for 10-66 GHz
  - IEEE 802.16c
  - 802.16-2004 and 802.16e
  - Basic ATM system MAC Profile
  - Basic IP system MAC Profile
  - 25 MHz Wide Channel for (Typically for U.S. Deployments) Use in the 10-66 GHz Range
  - 28 MHz Wide Channel for (Typically European Deployments) Use in the 10-66 GHz Range
  - Sub-profiles: FDD and TDD
- WiMAX Protocols
  - Physical Layer (PHY) Specifications
  - Channel Spacing, Modulation
  - Physical Layer Architecture
  - Physical Layer Operations
  - 802.16 PHY (SCa, FDMA, OFDMA and SOFDMA)
  - Orthogonal Frequency Division Multiplexing (OFDM)
  - Orthogonal Frequency Division Multiple Access (OFDMA)
  - Scheduling and Link Adaptation
  - Adaptive Modulation Scheme
  - Binary Phase Shift Keying (BPSK)
  - Quadrature Phase Shift Keying (QPSK)
  - Quadrature Amplitude Modulation (QAM)
  - Variable-Rate Read-Solomon (RS)/Convolutional Coding (CC) Scheme
  - ARQ Active on All Connections
  - TDD vs. FDD
  - Symmetric UL/DL Traffic
  - 256 point FFT OFDM PHY Mode
  - Scalable OFDMA (SOFDMA) Physical Layer in IEEE 802.16 WirelessMAN
  - STC and Other Standard-Compliant Diversity Schemes
  - Mutlicarrier Design Requirements and Tradeoffs
  - The Basics of OFDMA Frame Structure
  - Subcarrier Allocation Modes
  - Diversity Options
  - Ranging in OFDMA
  - Channel Coding
  - PHY Transmit Diversity in the Downlink (DL)

  - H-ARQ (Hybrid ARQ)
  - Space Time Coding (STC)
  - Adaptive Antenna Systems (AAS)
  - Multiple Input, Multiple Output (MIMO)
  - MIMO for Throughput and Range
  - Spatial Division Multiple Access (SDMA)
  - Other Diversity Schemes

- IEEE 802.16 Physical Layer Procedures (PHY)
  - The Original 802.16 Standard and the 10-66GHz Frequency Band
  - 802.16 Service Areas
  - WiMAX technology for LOS and NLOS environments
  - PHY Considerations
  - Effect of Multipath
  - High Capacity Links on both the Uplink and the Downlink
  - WirelessMAN-SC PHY
  - WirelessMAN-SCa PHY
  - WirelessMAN-FDMA PHY
  - WirelessMAN-OFDMA PHY
  - 802.16-2004 and 802.16e PHY
  - What Are Non Line-of-Sight (NLOS) Connections?
  - Time Division Duplexing (TDD)
  - Frequency Division Duplexing (FDD)
  - The 802.16e and Mobile 802.16 Clients
  - Hand-off between 802.16 Base Stations

- IEEE 802.16 Medium Access Control (MAC)
  - MAC Layer Operations
  - MAC Frame Structure
  - Framing in Detail
  - MAC Frame Type and Classes
  - Access Methods
  - Synchronization
  - Power Management
  - Variable Length Protocol Data Unit (PDU)
  - Self-Correcting Bandwidth Request/Grant Scheme
  - Link Adaptation and Automatic Repeat Request (ARQ) Functions
  - Fast Path activities (Such as Scheduling, Packing, Fragmentation, and ARQ)
  - UL and DL Schedulers
  - QoS on IEEE 802.16
  - High Bit Rates (up to 268 mbps Each Way)
  - Delivering ATM Compatible QoS: UGS, rtPS, nrtPS, and Best Effort
  - Implementation Challenges on MAC and QoS

- WiMAX RF Planning, Coverage and Capacity
  - RF and Capacity Planning
  - RF Theory to Link Budget Math
  - Equipment Manufacturers, Products, Systems and Services

- Spectrum Policies and Licensing
- Frequency, Capacity, Coverage and Interference
- Site Survey and Selection
- RF Engineering and Network Design
- Project Management, Vendor Selection, Installation, and Commissioning
- RF Optimization: Testing and Troubleshooting
- Requirements Analysis Steps
- Feasibility Analysis for 802.16
- Subscriber Station (SS)
- Base Station (BS)
- Base Stations Locations
- BS Frequency Assignments
- Complete Coverage (No Gaps)
- Adequate Capacity
- Design Based on Extensive Measurements
- Propagation and Coverage
- Complete Coverage of Target Space
- Interference Sources
- Capacity in 802.16
- Consideration of High- and Low-Density Areas Throughput
- Interworking and Coexistence with Mobile and Cellular Networks
- Complete 802.16 Link Budget Analysis and Modeling
- Fixed, Nomadic, and Mobile Channel Models
- How to Model a Radio Channel in WiMAX?
- Fixed and Nomadic Channel Models
- Fading Characteristics, Fade Distribution, K-Factor
- Modified Stanford University Interim (SUI) Channel Models
- SUI Channel Models Implementation
- Mobile Channel Models
- Mobile Channel Models Implementation
- Simulation Results
- Exercise: WiMAX Radio Dimensioning
- Exercise: Link Budget Analysis
- Exercise: WiMAX Case Study Using Planning Tool
- Exercise: Dimensioning WiMAX Services

- Implementing an 802.16 Network
  - Designing and Planning a 802.16
  - Preparing for Operational Support of a 802.16
  - Installing a 802.16
  - Service Classes
  - Fragmentation, Equalizers, and RAKE Receivers
  - Installation Options
  - Performance
  - Multivendor Operability
  - QoS Enhancements
  - Dynamic Frequency Selection, Transmit Power Control
  - Upcoming Standards and Future Trends

- Forthcoming IR standards
- Integration of WLAN and Cellular (Mobile Networks)
- 3GPP Standards and Mobile IP
- Performance Evaluation of Adaptive Modulation, Channel Coding, Space-Time Coding, and Equalization Techniques

- WIMAX RF Optimization
  - RF Optimization Principles
  - WiMax Optimization Parameters
  - Testing and Measurements
  - Simulation Approaches
  - Exercises: How Parameters Affect Performance
  - Case Studies
- WiMAX Operations
  - Network Entry
  - Downlink Channel Synchronization
  - Initial Ranging
  - Capabilities Negotiation
  - Authentication
  - Registration
  - IP Connectivity
  - Transport Connection Creation
- Wrap-up: Course Recap, Q/A, and Evaluations

How You Will Learn

- We will teach this course in lecture/workshop format with excellent opportunities for discussion of your specific issues.
- Your instructor will be someone who combines great teaching skills with experience in WiMAX, 3G, CDMA, OFDM, and other major wireless technologies.
- Along with lecture, we will use exercises, case studies, and demos to make the technical processes more practical and understandable.
- If you already know something about WiMAX or other wireless technologies, we will build on your existing understanding to make the new material easier to master as well as more job-pertinent.
- If you are a nontechnical professional, we will employ interesting examples and analogies to make the subject easier to understand and apply.

Revised *Oct 22, 2007 t451*