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Fundamentals of WiMAX

Prerequisites: Basic understanding of wireless, radio communications is recommended.

Course Description: WiMAX (Worldwide Interoperability for Microwave Access- IEEE 802.16) is a standards-based wireless technology (an implementation of 802.16) that provides high-throughput broadband connections. WiMAX can be used for a number of applications, including "last mile" broadband connections, hotspot and cellular backhaul, and high-speed enterprise connectivity for businesses.

This course provides an understanding of WiMax technologies, applications and standards. Other important topics such as protocol layers, quality of service, throughput, coverage, interoperability, interference and security are discussed. Basic RF theory, microwave, propagation, l/Link budget math, troubleshooting.

Course Objectives:
After successfully completing the course the student will:

- Understand the basic concepts of 802.16
- Understand 802.16 air interface specification
- Understand 802.16 RF concepts and issues
- Be able to understand the technical implementation of different types of 802.16
- Gain a general understanding of WiMax systems coverage and capacity
- Be able to select the most effective WiMax type from a wide assortment of recent and emerging implementations
- Be able to perform a more efficient design and operational support of WiMax

Course Outline:

Day 1

Broadband Wireless Access: an introduction to WiMAX and IEEE 802.16

- WiMAX as a Wireless MAN Technology
- 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
- 802.16
- 802.16a
- 802.16-2004 (802.16)
- 802.16e
- 802.16f
- Industry Trends

WiMax Technical Information

- WiMax Forum
- The Interoperability Challenge
- The original 802.16 standard and the 10-66GHz frequency band
- 802.16a amendment: 2 to 11GHz
- IEEE 802.16a and ETSI HiperMAN standards
- System Profiles for 2 - 11 GHz

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- 802.16a and HiperMAN standards
- The MAC profiles for both WirelessMAN (Licensed) and WirelessHUMAN (License-exempt)
- System Profiles for 10-66 GHz
- 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

802.16 Physical Layer Procedures and Mechanisms

- WiMAX's technology for LOS and NLOS environments
- PHY Considerations
- Effect of multipath
- High Capacity Links on both the Uplink and the Downlink
- What are Nonline-of-sight Connections?
- Time Division Duplexing (TDD)
- Frequency Division Duplexing (FDD)
- Hand-off Between 802.16 Base Stations
- Radio Frequency (RF) technology, coding algorithms, Medium Access Control (MAC) protocols
- The Physical Medium Dependent Layer
- Physical Layer (PHY) specifications
- Channel Spacing, Modulation
- Physical Layer Architecture
- Physical Layer Operations

Day 2

802.16 Physical Layer Procedures and Mechanisms (cont)

- 802.16 PHY (OFDM, OFDMA)
- 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)
- 16-Quadrature Amplitude Modulation (QAM)
- 64-QAM
- DES encryption/decryption
- Variable-rate Read-Solomon (RS)/Convolutional Coding (CC) scheme
- ARQ active on all connections
- Symmetric UL/DL traffic
- 256 point FFT OFDM PHY mode
- Space Time Coding (STC)
- Adaptive Antenna Systems (AAS)
- Multiple Input, Multiple Output (MIMO)
- Spatial Division Multiple Access (SDMA)

802.16 Medium Access Control (MAC)

- MAC Layer Operations
- MAC Frame Structure
- Framing in Detail
- MAC Frame Type and Classes
- Access Methods

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- Security
- Synchronization
- Power management
- Variable Length Protocol Data Unit (PDU)
- Link adaptation and Automatic Repeat Request (ARQ) functions
- 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

Day 3

WiMAX vs WCDMA

- Attenuation
- Multipath Interference
- Frequency Offset and Phase Noise
- Adaptive Modulation and Coding
- Spectral Efficiency and Frequency Reuse
- QoS

WiMAX vs. Wi-Fi

- Range
- Coverage
- Scalability
- Bit rate
- QoS

Introduction to 802.16 Network Planning and Design

- Requirements Analysis Steps
- Defining 802.16 Requirements
- Subscriber Station (SS)
- Base Station (BS)
- Base Stations Locations
- Frequency Assignments
- Adequate Capacity
- Propagation and coverage
- Link Budget Analysis
- Complete coverage of target space
- Consideration of high- and low-density areas Throughput