

Course ID
LTE-C3DC
Course Duration
3 days

Course Title
LTE: A Comprehensive Three Day Course

Related Courses

- Principles of OFDM and MIMO (OM, 3 days)
- LTE: Technology, Business, and Competitive Landscape (LTE-BIZ, 2 days)
- LTE: A Comprehensive Tutorial (LTE-CT, 3 days)
- LTE Air Interface Techniques (LTEAI, 3 days)
- LTE Air Interface Techniques: A Comprehensive Course (LTEAI4D, 4 days)
- LTE Signaling and Functionality (LTESIG, 3 days)
- LTE Planning Considerations (LTEPLAN, 4 days)
- LTE Advanced System Techniques (LTE-ADV, 4 days)
- LTE/SAE: A Technology Overview (LTE-TECH, 3 days)
- LTE RF Network Planning Workshop (LTEWK, 5 days)
- LTE/4G: The Next Generation Mobile Networks (LTE4G, 2 days)
- LTE/4G: A Comprehensive Look at the Next Generation Mobile Networks (LTE4, 4 days)
- LTE Air Interface: An Advanced Course for Hardware/Software Developers (LTEHSW, 5-10 days)
- HSDPA: Network Architecture, Operation, and Design (HSDPA, 2 days)
- HSUPA: Network Architecture, Operation, and Design (HSUPA, 2 days)

Aimed At

This course is aimed at technical professionals who are familiar with 2G, 3G, and/or other 4G (such as WiMAX) wireless technologies and desire a comprehensive overview of the LTE technology.

Group Size

5-25

Prerequisites

Familiarity with 2G/3G technologies or WiMAX.

Course in a Nutshell

The course begins with a review of the digital modulation techniques, radio propagation characteristics, and the 3GPP WCDMA system. This is followed by a discussion of the principle of OFDM, multipath mitigation techniques, and the LTE system components. The course concludes with a comprehensive look at the various LTE system operation scenarios and a study of link budget and system capacity examples.

Customize It!

We can customize this course to suit the needs of audiences such as hardware designers, application developers, service designers, sales engineers, marketing/sales personnel, radio planners, and persons involved in defense and homeland security applications relating to LTE.

Course Outline

- **Digital Modulation Overview**
 - Complex Envelope Representation of Signals and Systems
 - Digital Modulation Theory
 - BPSK, QPSK, 16QAM and 64QAM
 - Pulse Shaping Filter Selection (Nyquist and Raised Cosine Filtering)
 - System Metrics: BER, SNR, Eb/No definitions
- **Radio Propagation Characterization**
 - Updated 3GPP Reference Channel Models
 - Comparison with Earlier HSPA Channel Model Versions
- **Performance Improvement Techniques**
 - Forward Error Correction
 - Convolutional: Viterbi Algorithm, Punctured Coding
 - Turbo: Encoder and Decoder
 - Interleaver/De-interleaver: Advantages and Disadvantages
 - Performance Comparisons
 - Antenna Receiver Diversity Techniques
 - Switching, Equal Gain, Maximal Ratio, Optimal Combining
 - Theoretical SNR improvement and BER Performance
- **3GPP WCDMA System Review**
 - 3GPP Release Overview (Release 99 to Release 8 Features)
 - High Speed Downlink Packet Access (HSDPA) Overview
 - High Speed Uplink Packet Access (HSUPA) Overview
 - Network Architecture (NodeB, RNC, CN)
 - Partitioning of Protocol Stack Across Network
- **OFDM Principles**
 - Transmission and Modulation: Subcarrier, IFFT, S/P, Etc.
 - Sub-carrier Discussion
 - Peak-to-Average Power Ratio (PAPR) Impact
 - Reception and Demodulation: FFT, P/S, Etc.
 - Purpose of Cyclic Prefix (CP)
 - Design Tradeoffs
- **Multipath Mitigation Techniques**
 - How Different Standards Resolve Multipaths
 - TDMA vs. CDMA vs. OFDMA Solutions
- **LTE System Components (Building Blocks)**
 - System Goals: Latency, Throughput, Etc.
 - Discussion: Trend toward IP Services
 - LTE Signaling Channels (UL and DL)
 - Logical Channels
 - Physical Channels
 - Network Architecture (E-UTRAN, EPC)

- Element Interfaces
- Protocol Architecture (RRC, RLC, MAC)
 - Partitioning of Protocol Stack Across Network
- OFDM Details for LTE
 - Transmission (IFFT, S/P, Etc.)
 - Sub-carrier Discussion
 - Reception and Demodulation (FFT, P/S, Etc.)
 - Values of Cyclic Prefix (CP)
 - OFDM Receiver
 - MIMO (Channel Capacity, MAP, MMSE Equalization, Etc.)
- FDD and TDD Modes
- **LTE System Scenarios**
 - Paging
 - Idle Mode States
 - Random Access Procedure
 - Link and Resource Adaptation
 - Security Architecture
 - Brief Comparison with WiMAX
 - Cell Search and Handoffs
 - Intra-Frequency Measurements
 - Call Flow Diagrams
 - Mobile Originated
 - Mobile Terminated
 - Antenna Transmit Diversity Techniques
 - Space Time Block Codes
 - Closed Loop Antenna Arrays
 - MIMO
- **Link Budget and System Capacity Examples**
 - Link Budget Methodology
 - Link Budget Equations
 - Rise Over Thermal Calculation
 - Example for Indoors and Outdoors Link (Excel Spreadsheet)
 - Cell Capacity Example
 - Targeted Frequency Bands
- **Wrap-up: Course Recap and Discussion**

**How You Will
Learn**

- A highly qualified engineer/instructor, well-versed in a number of 4G and 3G wireless technologies, will present this course in an interactive lecture format.
- Along with the lecture, we will employ discussion, group activities, and case studies to help you understand the major points.
- If you already know something about 3G/4G technologies, we will build on that knowledge base. We'll compare and contrast what's already known to you with what's new, making the new material easier to learn.
- If your background is less technical, we will use appropriate examples and analogies to convey the complex subject matter in understandable terms.
- You will receive a printed Participant Handbook which will help you remember and retain what you learned in class and use it on the job.

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