LTE Training – LTE (Long Term Evolution) Training Bootcamp, Crash Course

Why should you choose LTE Training?

LTE Training is an intensive learning experience that cover the essential elements of Long Term Evolution (LTE). LTE Training Crash Course covers the foundation of LTE, LTE RAN, concepts behind OFDMA/SC-FDMA, Overview of MIMO, LTE Cell Planning, LTE Capacity Planning, EPC, IMS, Diameter, EPC Signaling, Security, Voice over LTE, LTE-Advacned, LTE Backhaul (both Microwave and Metro Ethernet), PPE-TE, MPLS-TP and more.

Long Term Evolution (LTE) training crash course – bootcamp introduces LTE and related technologies required to plan, design, implement and manage the evolution route for wireless and cellular network operators towards 4G broadband mobile networks. These courses range from basics technological overview programs to detailed engineering and design LTE courses.

Involved with over couple of dozens of LTE deployment worldwide, doing training for the engineers and non-engineers, LTE planning, architecture, systems engineering, design, implementation, security and OSS/network management.

LTE Training Boot Camp ® is the answer to your LTE-EPC/EPS technology needs. This innovative and intensive learning experience covers the essential elements of LTE and SAE/EPC/EPS in a nutshell by the industry experts.

Here is the schedule you can expect to follow during your boot camp:

Overview. We begin the seminar with an overview of LTE, its recent progression and what to expect during the seminar.

Body of Class. Throughout the seminar, we add a lot of detail to what we talked about in the overview. Expect comprehensive information that is current and relevant. Also expect to engage in hands-on activities and other interactive, real-world examples that make sense out of the information.

Wrap Up. The specialty course comes to a close, and clients receive their certificates. We provide both certificates and industry certificates for clients to have on file to show their completion of the LTE training programs.

By choosing our services for your company’s technology, management and training seminars, you are getting the most upto-date, highest quality boot camps possible. Our LTE courses are specifically designed by experts in the field, and they are continuously evaluated to ensure they are up to date. Contact usto learn more about our innovative

LTE training courses and the difference they can make for your employees.

LTE (Long Term Evolution) Training Bootcamp can combine the following training modules into a 4-days intense bootcamp based on the customer needs and requirements:

- OFDM and MIMO
- LTE Air Interface and Core Network
- LTE Core Network Planning and Design
- LTE RF Planning and Design
- LTE Protocols and Signaling
- LTE RAN Signaling and Operations
- LTE RF Performance
- LTE QoS
- LTE Capacity Planning and Traffic Engineering
- LTE Security
- LTE GSM/UMTS and EV-DO (eHRPD) Interworking
- IPv6 and MPLS
- LTE-Advanced (R10)
- IMS and Voice over IMS for LTE-EPC
- Voice over LTE (VolTE)
- SMS over LTE

LTE Training Crash Course Outline (base):

- Introduction to LTE (Long Term Evolution)
- Overview of IP Convergence in the mobile networks
- Introduction to LTE (Long Term Evolution) and SAE/ePC/EPS
- LTE Network Architecture
- LTE Interfaces and protocols
- LTE Packet Core (SAE/EPC and EPS)
- LTE/SAE/EPC Network Architecture
- Evolved UTRAN and Evolved Packet Core
- LTE/EPC Interworking
- LTE Protocol Stacks
- LTE Interfaces covered in details
- LTE-EPC Signaling
- IMS (IP Multimedia Subsystem) in LTE
- Overview of Diameter Protocol
- Diameter Applications in IMS
- LTE Operations and Procedures

- LTE Planning and Optimization
- Ethernet Backhaul for LTE
- QoS Applied to LTE-EPC
- PCC (Policy and Charging Control
- LTE and EPC Security
- Overview of LTE Air Interface; Overview of OFDM and MIMO
- LTE RF Planning and Design
- LTE Backhaul Requirements
- LTE Backhaul Aggregation Network Technology
- Overview of LTE-Advanced

Who Should Attend

Engineers and Non-Engineers professionals who need a through understanding of LTE, EPC, Services, Protocols, RF and Core Planning and Design, Backhaul, Capacity Planning, QoS, Security, VoLTE and LTE-Advanced,

Objectives

Upon completion of this training, the attendees will be able to :

- Understand HSPA/HSPA+ and Migration to LTE/EPC/EPS
- Understand how Different End User Services are Performed in LTE/EPC/EPS
- Understand and Comprehend the basics of LTE/EPC/EPS
- Understand LTE Architecture, Protocols and Signaling
- Understand LTE Network Architecture and Protocols (Radio and Core)
- Understand the Main Functionality in the Evolved UMTS Radio Access Network, E-UTRA/E-UTRAN or LTE
- Understand LTE Multiple Access Methods: OFDMA and SC-FDMA and MIMO
- Describe Evolved Packet Core (EPC), SAE (System Architecture Evolution) and Evolved Packet System (EPS)
- Describe UTRAN, All IP Network (AIPN) and E-UTRA/E-UTRAN architecture
- Highlight E-UTRA Air Interface and physical layer (downlink and uplink) functionalities and procedures
- Highlight E-UTRA Layer 2 and 3 Signaling Functionalities and Procedures
- Highlight LTE Radio and Core Network Planning and Design Procedures
- Highlight LTE Backhaul Requirements
- Describe LTE Backhaul Aggregation Network Technology
- Understand LTE Traffic Engineering
- Identify LTE Interworking
- Identify the following aspects of LTE networks: Quality of Service (QoS), Call setup procedures, Mobility support, LTE and EPC Security Architecture

- Describe Call flows and operational scenarios in HSPA/HSPA+ and LTE

Outline

LTE Training Modules (Customizable based on attendee's background, needs and objectives)

What is LTE (Long Term Evolution)?

- Evolution from GSM/GPRS and UMTS/HSPA to LTE and LTE Advanced
- GSM (Global System for Mobile Communications
- GPRS (General Packet Radio Service)
- EDGE and EDGE II
- UMTS (Universal Mobile Telecommunication System)
- HSPA/HSPA+
- LTE and LTE Advanced

Overview of IP Convergence in the mobile networks

- Wireless Internet Basics
- GSM/EGPRS/UMTS/HSPA/HSPA+
- Ethernet Backhaul for LTE
- LTE Protocols and Signaling
- Overview of LTE SAE, Evolved Packet Core (EPC) and EPS
- Overview of LTE-EPC Networks and Signaling
- LTE and 1x/1xEV-DO (eHRPD) Interworking
- LTE and GSM/UMTS Interworking
- IMS Architecture and Protocols Applied to LTE
- LTE and EPC Security
- QoS Applied to LTE-EPC

Introduction to LTE (Long Term Evolution) and EPC/EPS

- Long Term Evolution (LTE) as a new radio platform technology
- Support to achieve higher peak throughputs than HSPA+ in higher spectrum bandwidth
- LTE for mobile, fixed and portable wireless broadband access
- Optimized for IP-based traffic
- Increasing capacity
- Reducing network complexity
- Lowering deployment and operational costs
- Enhanced UMTS Air Interface (E-UTRA)

- System Architecture Evolution (SAE) and Evolved Packet Core (EPC)
- EUTRAN/LTE and the SAE/EPC as the Evolved Packet System (EPS)

LTE Network Architecture

- LTE Interfaces and protocols
- Introduction to E-UTRAN
- E-UTRAN network architecture
- E-UTRAN protocols
- Orthogonal Frequency Division Multiplexing (OFDM)
- Multiple Input/Multiple Output (MIMO)
- Architecture and node functions
- The LTE Evolved Packet System (EPS)
- LTE SAE Evolved Packet Core (EPC)
- LTE-EPC Network Architecture
- Network nodes and roles of HSS, MME, S-GW, P-GW, and PCRF
- Key interfaces: S1, S5, S6, S10 and S11
- Key features and services

LTE Packet Core (SAE/EPC and EPS)

- Mobility Management Entity (MME)
- User Plane Entity (UPE)
- Serving Gateway (S-GW), PDN-GW and enhanced Packet Data Gateway (ePDG)
- DIAMETER, IPv6, SIP, SCTP and SIGTRAN
- Role of IP Multimedia Subsystem (IMS)
- Co-existence and Inter-working with 3GPP Radio Access Technology (RAT)
- Architecture and migration

LTE/SAE/EPC Network Architecture

- New enhanced base station, “Evolved NodeB (eNodeB)
- LTE air interface and performs radio resource management for the evolved access system
- Access GateWay (AGW) and termination of the LTE bearer
- Key logical functions
- MME (Mobility Management Entity) for the Control
- SAE PDN GW (System Architecture Evolution Packet Data

- Network GateWay for the User Plane
- Comparing the functional breakdown with existing 3G architecture
- Radio Network elements functions,
- Radio Network Controller (RNC), the AGW and the enhanced BTS (eNodeB)
- Core Network elements functions
- SGSN and GGSN or PDSN (Packet Data Serving Node)
- Routers and the AGW
- Overview of E-UTRAN's Logical, Transport and Physical channels UE protocol stack
- Changes in MAC, RLC, RRC, NAS and PDCP

Evolved UTRAN and Evolved Packet Core

- Basic Concepts: bearers, Quality of Service
- NAS (Non Access Stratum) Protocols – EMM and ESM
- EPS Mobility Management (EMM) Procedures
- ESM Session Management (ESM) Procedures
- GTP – the GPRS Tunneling Protocol
- GTP-C and GTP-u
- Main GTP Procedures for EPS
- Mobility in EPS
- Multimedia over IP and IMS Basics
- EPS Security Mechanisms

LTE/EPC Interworking

- Interworking with 3GPP IP-access
- Interworking with Non-3GPP IP-access
- PCC (Policy and Charging Control)
- X2, S1 and S11-interface protocol stacks
- E-UTRA Layer 3 Protocols (NAS and RRC)
- Non Access Stratum protocols and procedures (EMM and ESM)
- Idle mode mobility mechanisms
- NAS security mechanisms
- The S1 and S11-Interface
- S1 Application Protocol (S1AP) procedures
- The GTP version 2 protocol (eGTP)
- X2 Application Protocol (X2AP) procedures

- Data forwarding and in-order delivery of data PDUs at handover
- Role of SCTP and IPv6 in LTE-EPC
- End-to-end signaling and traffic flow

Overview of LTE and EPC Protocol Stacks

- LTE-Uu Interface Protocols
- MAC, RLC, PDCP and RRC
- UE states and state transitions (NAS and RRC)
- Radio Resource Control (RRC) procedures
- Packet Data Convergence Protocol (PDCP)
- Radio Link Control Protocol (RLC)
- Medium Access Control Protocol (MAC)
- E-UTRAN and NAS Protocols
- S1 and X2 interfaces and protocol stack
- NAS states and functions
- NAS messaging
- Network identities of UE and EPC
- Connected Mode and UE States
- Attach to the Network
- Selection of MME, S-GW, and P-GW
- Authentication and IP address allocation
- Default bearer setup and registration
- LTE-EPC Protocols
- NAS protocol states
- Role of EMM and ESM
- GTPv2-C, GTP-U, Proxy-MIP (PMIPv6)

Overview of LTE and EPC Interfaces

- S1: S1-MME/S1AP (eNB - MME)
- S1-U (eNB-SGW)
- S2A, S2B
- X2 (eNB - eNB)
- X2AP (X2 Application Protocol)
- S3 (S4 SGSN - MME)
- S4 (S4 SGSN - SGW)

- S5 (SGW-PGW)
- S6A (HSS - MME)
- S6B (PGW - 3GPP AAA)
- S6D (HSS - S4 SGSN)
- S8 (SGW - PGW)
- S9 (PCRF - PCRF)
- S10 (MME - MME)
- S11 (MME - SGW)
- S12 (UTRAN - SGW)
- GX (PCRF - PGW)
- GXC (PCRF-SGW)
- RX (PCRF - IP APPLICATION [P-CSCF FOR IMS])
- GR (SGSN - HSS)
- GN (SGSN - MME / SGSN - PGW)
- GP (SGSN - PGW)
- SGi

LTE-EPC Signaling Principals

- Network identities and UE identities
- Signaling bearers
- Data bearers, EPS bearers
- PDN connections and APNs
- Intra-LTE Mobility
- X2-based handovers
- Intra and inter MME handovers
- Intra and inter S-GW handovers
- Tracking area updates
- IMS and Support for Voice
- IMS and seamless mobility
- Circuit-Switched Fallback (CSFB)
- Voice Call Continuity (VCC)
- Single Radio Voice Call Continuity (SRVCC)

IMS (IP Multimedia Subsystem) in LTE

- IP Multimedia Subsystem (IMS) Architecture

- P-CSCF (Proxy Call Session Control Function)
- CSCF (Interrogating Call Session Control Function)
- S-CSCF (Serving Call Session Control Function)
- BGCF (Breakout Gateway Control Function)
- MGCF (Media Gateway Control Function) / MGW (IMS-MGW)
- IMS Signaling Protocols
- IMS Scenarios & Operations
- IMS Quality of Service

Overview of Diameter Protocol

- Diameter and Related Interfaces
- Diameter Protocol
- Diameter Node
- Diameter Peer
- Client
- Server
- Agent
- Relay Agent
- Proxy Agent
- Redirect Agent
- Diameter Applications in EPS
- Diameter in EPS
- S6a between MME and HSS
- S6d between S4-SGSN and HSS
- S13 between MME and EIR
- S13 ’ between S4-SGSN and EIR
- S9 between Visited PCRF and Home PCRF
- Gx between PDN-GW and PCRF
- Gxx (Gxa, Gxb, Gxc) for policy control
- Gy between PDN-GW and OCS
- Gz between PDN-GW and OFCS
- Rx between P-CSCF and PCRF
- Sp between PCRF and SPR

Diameter Applications in IMS

- LIA: Location-Info-Answer
- LIR:Location-Info-Request
- MAA: Multimedia-Authentication-Answer
- MAR: Multimedia-Authentication-Request
- PPA: Push-Profile-Answer
- PPR: Push-Profile-Request
- RTA: Registration-Termination-Request
- RTR: Registration-Termination-Request
- SAA: Server-Assignment-Answer
- SAR: Server-Assignment-Request
- UAA: User-Authorization-Answer
- UAR: User-Authorization-Request

LTE Operations and Procedures

- System acquisition
- Idle mode operations
- Synchronization
- Cell search and random access
- RRC connection establishment
- Traffic operations in DL & UL
- Bearer setup and handover
- Power control
- LTE/SAE signaling
- EPC (MME) registration
- Security procedures

LTE Planning and Optimization

- Traffic and QoS considerations
- Security considerations
- Capacity planning considerations
- Planning tools
- Antenna selections
- Site location and integration

Ethernet Backhaul for LTE

- Wireless Networks Backhaul Overview
- GigE and Metro Ethernet
- IP and MPLS/GMPLS
- Ethernet Backhaul for LTE
- Carrier Ethernet in IP Backhaul
- Circuit Emulation (CESoE) and Circuit Bonding
- LTE Backhaul Evolution Scenario
- LTE Backhaul Capacity Planning

QoS Applied to LTE-EPC

- General Requirements for LTE QoS
- End User Requirements for QoS
- LTE End-to-End QoS Architecture
- LTE Service Establishment and QoS
- LTE QoS Parameters
- The class of QoS
- Guaranteed Bit Rate (GBR)
- Level of latency (delays in packet transmission)
- Jitter (variation in latency)
- Dropped packets
- EPS bearers, SDFs and TFTs
- PCC Architecture
- Service based Local Policy (SBLP)
- Policy Control Function (PCF)
- Technical Requirements for LTE QoS
- LTE Bearer Service Attributes
- Mapping QoS to LTE Services

PCC (Policy and Charging Control

- PCC architecture
- Policy and Charging Control Architecture
- Policy and Charging Rules Function – PCRF
- Subscriber Profile Repository (SPR)
- Application Function (AF)

- Policy and Charging Enforcement Function (PCEF)
- Gx, Rx and Sp interfaces
- Policy Control
- QoS handling and authorization
- Charging Control
- Roaming Scenarios and the S9 interface

LTE and EPC Security

- LTE Security Architecture
- UMTS and HSPA/HSPA+ Security Features
- Security in E-UTRAN
- Security in EPC/EPS
- Authentication and Key Management (AKA)
- AKA Algorithms
- LTE Security Procedures

Overview of LTE Air Interface; Overview of OFDM and MIMO

- LTE Air Interface
- Basics of OFDM and OFDMA
- Basics of SC-OFDMA
- LTE DL OFDMA
- LTE UL SC-OFDMA
- LTE Antenna Considerations
- Principles of MIMO
- Radio Resource Management requirements
- The eNB host functions
- Radio Resource Management
- Radio Bearer Control
- Radio Admission Control
- Connection Mobility Control
- Dynamic Resource Allocation (scheduling)

LTE RF Planning and Design

- Overview of LTE Radio Network Design and Engineering

- Link Budget for LTE
- LTE Capacity Planning
- LTE Design and Site Selection
- LTE Configuration Parameters
- LTE Operational Parameters
- KPIs in LTE Radio Network

LTE Backhaul Requirements

- LTE Services
- LTE User Download Speeds
- Estimated Net LTE User Data Peak Rates
- LTE Cell Site Backhaul Requirements
- Topologies for LTE Backhaul
- Hub and Spoke
- Tree/Tiered Networks
- Mesh And Ring Networks
- Ring Network Topology
- LTE Capacity Planning Models
- Statistical Traffic Distribution
- Traffic Dimensioning
- Traffic Asymmetry

LTE Backhaul Aggregation Network Technology

- Technologies
- RPR
- IP/MPLS and TP-MPLS
- VPWS/VPLS/H-VPLS
- GMPLS
- PBB-TE
- EPON
- Microwave wireless
- QoS support
- Backhaul migration
- IP/Ethernet backhaul
- Phased migration options

- Backhaul Evolution Strategies for LTE Operators
- Intelligent mobile core platform
- Metro IP edge router platform and
- Intelligent network management system
- IP/MPLS-based backhaul platform
- IP/GMPLS-based backhaul platform

Overview of LTE-Advanced

- IMT-Advanced by the International Telecommunication Union (ITU)
- LTE-Advanced in 3GPP in Release 10
- LTE-Advanced to qualify as IMT-Advanced/4G
- LTE-Advanced as a further evolution of LTE, an OFDMA-based technology, specified in Release 8 and 9
- Evolution of current OFDMA approaches
- High-order MIMO (e.g., 4X4)
- Wider radio channels (e.g., 50 to 100 MHz)
- Optimization in narrower bands (e.g., less than 20 MHz) due to spectrum constraints in some deployments
- Multi-channel operation in either same or different frequency bands
- Ability to share bands with other services
- IMT-2000 and IMT-Advanced
- 450 MHz band
- UHF band (689-960 MHz)
- 2.3 GHz band
- C-band (3 400-4 200 MHz