Corporate Training

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Basic Courses for Telecommunication

1. ABC OF TELECOMMUNICATION

The Telecommunication landscape is in a constant flow of change. Knowledge and competence is vital for professionals working in this ever-changing telecommunication industry. It is a three day course that provides executives with fundamental understanding and overview of modern telecommunication network in operation today.

Course Objective

After Completing the training, the participant will be able to:

- Understand the basics of telecommunication and how they are being used.
- Understand the vital links between wireless and wire line systems.
- Learn about the legacy and future of telecoms including LTE, LTE-A, IOT and many more.

Pre-Requisite

- Knowledge of fundamentals of Cellular network.

Who should do it?

Technical Professionals working in telecommunication industry, Non-Technical professionals working in telecommunication industry, anyone who wants to learn regarding telecom sector.

Course outline

Day 1

- Departments of Telecommunication
- Block Diagram of Communication System
- Electromagnetic Signals
- RF System components
- Modulation Techniques
- Multiplexing Techniques
- Switching Types
- RF Propagation
- Signalling Technologies
- OSI Reference Model

Day 2

- Cellular Communication vs Satellite Communication

- Transmission Technologies
- Wireless and Wired line Medium
- Microwave Transmission
- Fiber Optics and FTTx
- Networking Types and classification
- IPv4 and IPv6
- Voice Over IP Technology

Day 3

- Mobility and New Telecommunication Technologies
- Overview of GSM/GPRS/EDGE
- Overview of 3G, HSPA and HSPA+
- Overview of LTE and LTE-A
- IMS Overview
- Evolving Mobile Networks

2. OVERVIEW OF GSM NETWORK

The Telecommunication landscape is in a constant flow of change. Knowledge and competence is vital for professionals working in this ever-changing telecommunication industry. It is a five days course that provides introduction related to fundamentals of cellular and mobile networks and their associated technologies like 2G, 2.5G and 2.75G.

Course Objective

After attending the training, participants will be able to:

- Understand the fundamentals of cellular mobile network technologies.
- Understand the differences between different generations of cellular networks i.e. 2G
- Identify benefits of each generation of cellular network and how they inter-operate.
- Learn future trends of mobile communication.

Pre-Requisite

- Good Knowledge of fundamentals of Cellular Network.

Who should do it?

- Professionals from Customer Service and Support, sales and Marketing, Administrative and Support, procurement and various other departments of telecom and equipment vendors.
- People who wish to understand traditional cellular networks (3GPP network i.e. GSM) and also non 3GPP network i.e. Wi-Fi, WiMAX etc. of mobile communication that can provide voice and data services.
- Understand the fundamentals of cellular mobile network technologies.

COURSE OUTLINE

GSM OVERVIEW

- Introduction
- Why 2G?
- Systems of 2G technologies
- GSM main requirements
- GSM vs other Mobile technologies
- GSM Services & features
- Comparison of 2G technologies

GSM ARCHITECTURE OVERVIEW

- Network Architecture Evolution
- GSM/GPRS/EDGE Network Subsystems
- GSM/GPRS/EDGE Network Interfaces

GSM MOBILITY MANAGEMENT

- GSM Mobility Areas
- MS Identifications
- GSM Handover
- Location Updating

GSM CHANNELS

- Physical Resource
- TDMA/FDMA and ARFCN
- Time structure for FDD & TDD Mode
- Logical and Physical Channels

GSM PROTOCOL ARCHITECTURE

- MS Protocols
- MS to BTS Protocols
- BSC Protocols
- MSC Protocols

GSM CALL FLOW

- Mobile Originating Call Flow
- Mobile Terminating Call Flow

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3. OVERVIEW OF GPRS/EDGE

The Telecommunication landscape is in a constant flow of change. Knowledge and competence is vital for professionals working in this ever-changing telecommunication industry. It is a two days course that provides introduction related to fundamentals of cellular and mobile networks and their associated technologies like 2.5G and 2.75G.

Course Objective

After attending the training, participants will be able to:

- Understand the fundamentals of cellular mobile network technologies.
- Understand the differences between different generations of cellular networks i.e. 2.5G and 2.75G.
- Identify benefits of each generation of cellular network and how they inter-operate.

- Learn future trends of mobile communication.

Pre-Requisite

- Good Knowledge of GSM and Fundamentals of Cellular Network

Who should do it?

- Professionals from Customer Service and Support, sales and Marketing, Administrative and Support, procurement and various other departments of telecom and equipment vendors.
- People who wish to understand traditional cellular networks (3GPP network i.e. GPRS and EDGE) and also non 3GPP network i.e. Wi-Fi, WiMAX etc. of mobile communication that can provide voice and data services.
- Understand the fundamentals of cellular mobile network technologies.

COURSE OUTLINE

GPRS

- Introduction of GPRS to the GSM world
- GPRS network architecture
- IP over GPRS
- GPRS Air interfaces
- GPRS protocol stack
- GPRS air interface
- GPRS terminals
- GPRS Network Planning

GPS (GLOBAL POSITIONING SYSTEM) FUNDAMENTALS | GPS TRAINING

- GPS Fundamentals
- GPS Elements
- GPS System Operation
- Position and Time from GPS
- GPS Satellite Signal Characteristics
- Differential GPS (DGPS) Techniques
- GPS Trends

EDGE TRAINING

- Introduction
- EDGE technology
- Requirements on EDGE
- EDGE Physical Layer Technical Details
- Composition
- Transmission & Reception
- Channel codes
- RLC and MAC

4. OVERVIEW OF 3G/HSPA/HSPA+

The Telecommunication landscape is in a constant flow of change. Knowledge and competence is vital for professionals working in this ever-changing telecommunication industry. It is a five days course that provides introduction related to fundamentals of cellular and mobile networks and their associated technologies like 3G, 3.5G and 3.75G.

Course Objective

After attending the training, participants will be able to:

- Understand the fundamentals of cellular mobile network technologies.
- Understand the differences between different generations of cellular networks i.e. 3G, 3.5G and 3.75G.
- Identify benefits of each generation of cellular network and how they inter-operate.
- Learn future trends of mobile communication.

Pre-Requisite

- Good Knowledge of 2G(GSM, GPRS and EDGE) and Fundamentals of Cellular Network.

Who should do it?

- Professionals from Customer Service and Support, sales and Marketing, Administrative and Support, procurement and various other departments of telecom and equipment vendors.
- People who wish to understand traditional cellular networks (3GPP network i.e. UMTS/HSPA/HSPA+) and also non 3GPP network i.e. Wi-Fi, WiMAX etc. of mobile communication that can provide voice and data services.

COURSE OUTLINE

3G OVERVIEW

- Evolution from 2G to 3G
- Why 3G?
- UMTS main requirements
- UMTS versus other Mobile technologies
- UMTS key features
- Comparison of 3G Technologies

3G ARCHITECTURE OVERVIEW

- Network Architecture Evolution
- UMTS Network Subsystems
- UMTS Network Elements & its functions
- UMTS Network Interfaces

UMTS AIR INTERFACE

- WCDMA
- FDD and TDD Modes
- Frame Structure
- Types of Codes

UMTS MOBILITY MANAGEMENT

- RRC Modes, System Information
- Paging & Update procedures
- Cell Selection & Reselection
- RRC Connection Establishment
- Handover Process

UMTS CHANNELS

- Physical Resource
- Types Of Channels
  - Logical Channels
  - Transport Channels
  - Physical Channels
- Channel Mapping
- Cell Synchronization Process
- Physical Random Access

UMTS PROTOCOL ARCHITECTURE

- Radio Protocol Architecture
- High Level Function
- UMTS Domain and Strategies

UMTS OPERATIONAL PROCEDURES

- Mobile Originating Call Flow
- Mobile Terminating Call Flow
- Power Control

HSDPA OVERVIEW

- What is HSDPA?
- Why HSDPA?
- HSDPA Features
- HSDPA Channels
- Data Flow Signalling

HSUPA OVERVIEW

- What is HSUPA?
- Why HSUPA?
- HSUPA Features
- HSUPA Channels
- Data Flow Signalling
- Packet flows

HSPA+ PROTOCOLS, PROCEDURES AND SIGNALING (R7, R8 & R9) TRAINING

- Overview of HSPA+
- HSPA+ Features and Services
- HSPA+ Air Interface
- HSPA+ Operations and Procedures
- HSPA+ Protocols
- HSPA+ Signalling

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5. OVERVIEW OF LTE/LTE-A

This Course is designed to give an introduction to the Long Term Evolution – LTE system and its Interworking with other technologies. This course will look into various aspects of LTE evolution. It helps participants understand the line of evolution of mobile systems due to the data explosion and the role of LTE to provide for the data explosion foreseen in the market.

Course Objective

After attending the training, participants will be able to:

- Describe the features and benefits of LTE
- Identify LTE Network Components
- Understand LTE Architecture with Its Interfaces
- Understand Interworking requirements between LTE-2G/3G

Pre-Requisite

- Knowledge of 2G/3G
- Basic understanding of LTE

Who should do it?

Engineers, Network Designers, Planners, Design and Deployment Engineers, Network Integration and operations Engineers

COURSE OUTLINE

LTE/EPS OVERVIEW

- Why LTE?
- LTE main requirements
- LTE versus other Mobile technologies
- LTE Specification work
- LTE key features
- IMT-Advanced
- Comparison of 4G Technologies

LTE ARCHITECTURE OVERVIEW

- Network Architecture Evolution
- LTE/EPS Network Subsystems
- LTE/EPS Network Elements
- LTE/EPS Network Interfaces

LTE/EPS MOBILITY MANAGEMENT

- LTE/EPS Mobility Areas
- LTE Handovers
- Backhaul and Transport Network

LTE AIR INTERFACE

- Overview of OFDMA and SC-FDMA
- Inter Symbol Interference
- OFDM Problems
- LTE Frame Structure
- Modulation in LTE
- OFDM key parameters for FDD and TDD Modes
- Parameters for Calculating speed
- Radio Resources

LTE RADIO NETWORK ARCHITECTURE

- Bearers
- Radio and Network Identities
- Radio Interface Signalling
- E-UTRAN Protocols

LTE/EPS CONNECTION MANAGEMENT

- Default Bearer
- Dedicated Bearer
- LTE/EPS Procedures
- Connection Management Terminology

LTE CHANNELS

- Physical Channels
- Time Structure for FDD Mode
- Time Structure for TDD Mode

DOWNLINK SYNCHRONIZATION SIGNALS

- PSS & SSS structure
- Mapping to Resource Grid
- Cell Identity Group

MIMO FOR LTE

- Backward Compatibility
- Transmission Modes
- Transmission Diversity
- MIMO Modes
- Spatial Multiplexing

LTE PROTOCOL ARCHITECTURE

- Radio Protocols Architecture
- Data Flow in form of Signalling
- RRC States

LTE/EPS ROAMING

- LTE/EPS Roaming Architecture Overview
- Data Roaming Services
- Policy Charging and Ruling Function
- IMS Roaming Services

LTE RRM FUNCTIONALITY

- Radio Admission Functionality
- Scheduling
- Link Quality Control
- Mobility Management
- Discontinuous Transmission
- Difference between 3G RRM and LTE RRM

LTE & E-UTRA SECURITY

- Basic Security Concepts
- EPS Security Architecture
- Requirements and Features of EPS Security
- EPS Protection for Signalling and User Data
- Key Derivation Algorithms
- Interworking Security between EPS and Other Systems
- Security for IMS and Voice over LTE (VoLTE)

SELF ORGANIZING NETWORK (SON)

- LTE SON v/s LTE-Advanced SON.
- SON Architecture.
- Automatic Neighbour Relationship Procedures.

VOLTE PROTOCOLS AND SIGNALING TRAINING

- Overview of VoLTE
- LTE and IMS Network Architecture
- VoLTE Architecture
- VoLTE and IMS Procedures and Protocols
- IMS Operational Scenarios for VoLTE
- VoLTE Functionalists and Features
- VoLTE End to End Signalling

- LTE-EPC Network Architecture and Protocols
- VoLTE Call Setup Procedures
- IMS Security applied to VoLTE

6. 5G MOBILE NETWORK OVERVIEW

5G wireless training (5th generation wireless systems or mobile networks) covers next major phase of wireless and mobile telecommunications standards beyond the current 4G/IMT-Advanced standards. A team of expert academic and industrial lecturers will present their visions on the near future of wireless communication; explain the latest trends in advanced transmission, reception, coding, and cellular concepts that will shape 5G communication systems.

Course Objective

After Completing the training, the participant will be able to:

- Describe what 5G is
- Describe key 5G technology drivers
- Describe ITU 5G standards (IMT2020) along with NGMN alliance and 3GPP
- List the 5G wireless features and their benefits
- Describe 5G wireless communication networks cellular architecture and key technologies
- Explain the key RF, PHY, MAC and air interface changes required to support 5G
- Describe the conditions necessary to support 5G deployments

Pre-Requisite

- Knowledge of Core networking and functions
- Experience with IT infrastructure (i.e. Ethernet, Switches, Routers).
- Understanding of current 4G interface and Core Network technologies

Who should do it?

Radio, Packet Core Engineers and Managers involved in the planning and design of wireless networks, IP engineers, Regulators, Technical Product Marketing Professionals

COURSE OUTLINE

INTRODUCTION TO 5G WIRELESS COMMUNICATION

- 5th Generation Wireless technology
- 5G as a technology vision
- Why 5G?
- 5G high level requirements and features
- 5G technologies
- 5G technical objectives
- 3GPP
- ITU-T's IMT-2020, WRC-15

5G VISION

- Typical usage scenarios of 5G New RAT
- 5G New RAT
- Key technology drivers and innovations behind 5G wireless
- Next Wave of digital society
- Machine-type Communications
- Smart homes and buildings
- Smart grid
- Smart meters
- Intelligent Transportation Systems (ITS)
- Ultrahigh definition video
- Fiber-like user experience: 10 Gb/s data rates
- Virtualized and cloud-based radio access infrastructure

5G REQUIREMENTS, SPECIFICATIONS AND SERVICES

- Ultra Dense Networks
- Ultra low latency
- Ultra-reliable networks
- Bandwidth
- Power consumption
- Infrastructure
- Spectral efficiency
- Internet of Things
- Wearable devices with AI capabilities

5G AIR INTERFACE

- New access protocols and procedures for collaborative communications
- Composition
- Techniques used
- Composition
- Coding and modulation algorithms
- Interference management
- Performance
- Low Latency
- Capacity equation
- Advanced MIMO technology with wider bandwidths
- Sparse code multiple access (SCMA)
- 3D Beam forming & Diversity

5G OPERATIONAL SCENARIOS

- New access protocols and procedures for collaborative communications
- Composition
- Techniques used
- Composition
- Coding and modulation algorithms
- Interference management
- Performance
- Low Latency
- Capacity equation
- Advanced MIMO technology with wider bandwidths
- Sparse code multiple access (SCMA)
- 3D Beam forming & Diversity

5G STANDARDIZATION

- 3GPP 5G System Requirements
- 3GPP 5G System Architecture
- Heterogeneous Networks (HetNet)
- Discovery and Device to Device (D2D)
- Vehicle to Vehicle (V2V)
- Narrowband Internet of Things (NB-IoT)
- Enhancements for NB-IoT
- Enhancements to User Plane Congestion Management (UPCON)

7. NEXT GENERATION COMMUNICATION TECHNOLOGIES

Operators across the world are moving or considering moving their core networks and access to all-IP. This provides economies or operation as well as supporting services such as IPTV, multicast plus Internet access. The NGN training boot camp is one of the premier courses in advanced networking, wireless, mobile, applications and services, and IT/communications technologies, bringing together industry expert instructors and pioneering participants to explore, discuss and learn about the technologies, business opportunities and new applications for advanced networks.

Course Objective

After completing this course, the attendees will be able to:

- Understand the basic principle of optical fiber link
- Test and troubleshoot a PON system
- Find out the fault using OTDR
- Understand configuration of PON including FTTH , FTTN and FTTC.
- Understand the motivation for and goals of NGN
- Appreciate the architecture of NGN

Pre Requisite

Good knowledge of multiplexing techniques and Optical fiber Communication and some familiarization with IP generally is assumed

Who should do it?

Engineers, Installation Engineers, Testing Engineers, Planners and telecom professionals

COURSE OUTLINE

INTRODUCTION

- Why IP?
- Voice, Video and data over packets
- Overview of IP network
- Wireless and Wired systems
- IP Multimedia subsystem
- LTE and VoLTE
- Voice and Video over Wi-Fi

NETWORK EVOLUTION AND BROADBAND NEEDS

- Wireless Broadband
- Wireline Access Technologies
- Cable Networks- Components and Architecture
- Fiber Distribution
- Passive Optical Networks
- PON Components and Architecture

NGN REQUIREMENT, ARCHITECTURE AND PROTOCOLS

- NGN Requirements
- NGN Architecture and Protocols
- Network Management for NGN
- NGN Services
- Peer to Peer Networking
- FTTx (FTTH, FTTX, FTTB)
- APON, BPON, GPON, EPON, GEPON, CPON
- Time Division PON (TDM-PON)
- Wave Division Multiplexing PON (WDM-PON)
- Optical Splitters 1×8, 1×16, 1×32, 1×64, 2×64
- FSAN (Full service Access Network) NGA (Next Generation Access)
- Arrayed Waveguide Grating Splitters

GPON FIBER TERMINATION

- GPON field testing
- GPON field installation verification
- GPON Physical Layer Testing
- Optical Time Domain Reflectometer OTDR
- Optical Power Source
- Optical Power Meter
- Optical Return Loss (ORL)

GPON COMPONENTS

- GPON OLT
- GPON ONT
- GPON Encapsulation Method (GEM)

NEXT GENERATION NETWORK ARCHITECTURAL COMPONENTS

- NGN Core Network
- Overview of PSTN
- Overview of SS7
- Packet based network
- Packet and Optical Conversion
- Broadband, QoS enabled transport technologies

NGN STANDARDS AND PROTOCOLS

- 3GPP
- Internet Protocol standards
- Fixed Mobile Convergence
- Multiprotocol Label Switching
- Session Initiation Protocol (SIP)
- Media Gateway Control Protocol (MGCP)
- SIGTRAN

NETWORK SECURITY

- IPSec and Layer Security
- IPSec Components
- Security Associations
- Security Architecture Review

EMERGING TECHNOLOGIES

- 10G Access to Consumers
- 1T GigE
- Google and Verizon FiOS
- 5G Wireless
- Small Cells
- Heterogeneous Network (Hetnet)
- Mobile Applications
- M2M
- IoT
- Cloud Computing
- Big data

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8. IP FOR TELECOM PROFESSIONALS

This course includes basics of Internet Protocol, before progressing in depth and branching out to other modern IP technologies like IPv6, IPv6 networks and deployments, security, IP/MPLS networks. It also covers applications of IP protocols and equipments as well as the design and operation of these networks

Course Objective

After Completing this course, the attendees will be able to:

- Understand IP Network Architecture
- Understand IP based protocols and routing
- Understand IP/MPLS
- Understand How IP is applied and operated in Mobile and Fixed operator networks

Pre Requisite

- Good Knowledge of Packet Switching

Who should do it?

Network Engineers, Network Designers, Network Managers and Planners, IT professionals

COURSE OUTLINE

WIRELESS TELECOMMUNICATION

- Mobility & Cellular Fundamentals
- GSM and TDMA, UMTS and CDMA, 4G LTE
- Internet via Cellular Wi-Fi

IP NETWORK ARCHITECTURE

- Architecture of the Internet
- WANs, MANs, LANs, VLANs

- Functions of IP router
- IP protocol layers
- IP Addressing & routing
- IP Subnets
- IP Header
- Multicast and Broadcast

CHARACTERISTICS OF IP

- IP Addressing
- Different versions of IP
- Limitations of IPv4
- Features and benefits of IPv6

ETHERNET, LAN AND VLAN

- LAN fundamentals, Ethernet and 802 standards
- MAC addresses and MAC frames
- LAN switches, broadcast domains and VLANs

OSI LAYERS AND PROTOCOL STACKS

- Protocols and Standards
- OSI Model
- Protocol Stacks

IP FOUNDATION FOR MPLS

- IP routing and forwarding
- IP in ATM vs MPLS networks

MPLS NETWORKS

- MPLS domain
- Network Component (LER, LSR)
- Label Switched paths (LSP)
- Forward Equivalence Class (FEC)
- Structure of a Label

QOS IN IP NETWORKS

- Motivation for Quality of Service
  - Definition of Quality of Service
  - QoS parameters
  - Service examples
- QoS Requirements
  - Requirements of QoS
  - QoS process
  - Service Level Agreement (SLA)
  - Policy based QoS architecture
- QOS Models
  - Introduction to IP QoS models
  - Integrated Services (IntServ)
  - Differentiated Services (DiffServ)

INTRODUCTION TO IP VPNS

- Define VPN and its benefits
- Types of VPNs
  - Access, Intranet, Extranet
  - Layer 2 vs Layer 3

IP TUNNELING

- Purpose of Tunneling
- Protocols
  - IPSec
  - GRE
  - SSL/TLS
  - VLAN

REVIEW OF IPV4 NETWORK PROTOCOLS WITH RESPECT TO SECURITY ISSUES

- Address spoofing
- ARP protocol
  - ARP cache pollution
- UDP/TCP
  - Packet format errors
  - SYN floods
  - Scanning
- ICMP
  - Fishing for responses
- Static routes
  - Source-based routes
- Dynamic Routing
  - RIP
  - BGP
- Firewall Technologies
- Duties
  - Access Control
  - Address Translation
- Protocol Verification
- Architectures
  - Proxies
  - Packet Filtering
  - Hybrid Architectures

IP NETWORK MANAGEMENT

- Why is Network Management Needed?
- What is Network Management?
- Network Management Activities
- Network Monitoring
- Is interoperable management needed?
- Need for Management Standards

TCP AND TRANSPORT LAYER PROTOCOLS

- Overview of Transport Layer
- User Datagram Protocol
- Transmission Control Protocol
- System Control T

CORE NETWORK

CORE NETWROK TECHNOLOGY

This programme looks at the core network technologies and architectures currently being adopted by telecoms operators/Communication service Providers (CSPs) worldwide. After the competition of this course, participants will be able to define the core network technologies.

Pre-Requisite

Candidate should have clear understanding on mobile networks and its components – GSM and WCDMA.

Who should do it?

Regulators and enforcement engineers, Students, Fresh graduates, Technical Managers and anyone who have knowledge of GSM & UMTS.

COURSE INTRODUCTION

- Why change the UMTS Core?
- Overview of SAE
- Major Change Items
- Relationship to the Core of the LTE eNodeB

EVOLVED PACKET CORE

- Structure
- Main Components
- MME (Mobility Management Entity)
- SAE Gateway or SGW (Serving Gateway)
- PGW (PDN - Packet Data Network Gateway)
- HSS (The Home Subscriber Server)

REFERENCE POINTS AND INTERFACES

- Interfaces between EPC and the Access Network
- S1: Signalling between Evolved Node B and the Core Network
- EPC Internal Interfaces

INTRODUCTION TO IP MULTIMEDIA SUBSYSTEM (IMS)

- Introduction IMS Protocols and Messages
- IMS elements
- Service elements and functions
- Signalling and transport interworking elements

IMS ARCHITECTURE, INTERFACES AND PROTOCOLS

- IMS Architecture
- IP Multimedia service switching function (IM-SSF)
- SCIM, OSA-SCS, IM-SSF Addressing
- Media Resource Function Controller (MRFC)
- Service Oriented Interconnection
- Connectivity oriented Interconnected
- IMS Security Registration
- Call Origination and Termination
- Roaming and Handover
- IMS Session Establishment
- Defining IMS Related Interfaces

ADDITIONAL FEATURES OF SAE

- Interworking with UMTS
- Interworking with WLANs

IP Traffic & Signalling

1. MPLS & IP TRAFFIC ENGINEERING

Traffic engineering aims to ensure that individual flows of IP traffic achieve their QoS objectives, and that the utilization of the network capacity is optimized. It achieves this by a combination of design, capacity planning, and operational traffic management

Course Objective

After Completing the training, the participant will be able to:

- Implement advanced designs and configurations in MPLS networks
- Design and Implement VPN networks
- Understand the concept of MPLS, Labels
- Understand IP traffic engineering using MPLS
- Understand the working of OSI model and TCP/IP model
- Describe the functions of IP QoS

Pre Requisite

Good Knowledge of TCP/IP and IP Networking, Ethernet, WAN design and concepts, VLAN and also the knowledge of ATM.

Who should do it?

Backhaul Engineers, Transport Network Engineers, Transmission Engineers, Technical solution Architects, Deployment Engineers

COURSE OUTLINE

WHY MPLS?

- Advantages of MPLS
- New applications

IP FOUNDATION FOR MPLS

- Communication Overview
- IP routing and forwarding
- IP in ATM vs MPLS networks

MPLS NETWORKS

- MPLS domain
- Network components (LER, LSR)
- Label Switched Paths (LSP)
- Forward Equivalence Class (FEC)
- Structure of a label

MPLS LABELS

- MPLS label binding
- MPLS label distribution
- Label swapping and forwarding

MPLS PROTOCOLS

- Motivation for new protocols
- Label Distribution Protocol (LDP)
- RSVP
- BGP and MP-BGP

MPLS AND QOS

- Motivation for QoS
- Differentiated Services in MPLS

PACKET FORWARDING ALONG LSPS

- Label Forwarding Information Base (LFIB)
- Packet forwarding along LSPs
- Label stacking

MPLS AND TRAFFIC ENGINEERING

- Motivation for traffic engineering
- Traffic engineering
- Traffic engineering process
- Fast re-route

MPLS AND VIRTUAL PRIVATE NETWORKS

- VPNs support in MPLS
- Layer 3 and Layer 2 VPNs establishment in MPLS
- MPLS based L2 VPN solutions

2. IP ETHERNET BACKHAULING FOR 3G/4G NETWORKS

The Backhaul in mobile networks is the portion of the network comprises the intermediate links between the Core-Network and the Radio-Access-Network (RAN).Moving to 3G/4G mobile networks (like LTE) together with a wide range of new services that is offered, the Backhaul networks should accommodate an increased traffic volume created by cellular coverage areas and hence, the correct dimensioning is critical from the QoS and capacity point of view.

Course Objective

After Completing the training, the participant will be able to:

- Understand the working of Hubs, Switched and Routers
- Understand the working of OSI model and TCP/IP model
- Describe how TCP/IP addresses are structured
- Understand the functioning of TCP/IP routing protocols
- Describe security in IP networks

Pre Requisite

Good Knowledge of TCP/IP and IP Networking, Ethernet, WAN design and concepts, Ieee 802.1 standards, 3G Networks architecture

Who should do it?

Backhaul Engineers, Transport Network Engineers, Technical solution Architects, Deployment Engineers, Transmission Engineers, Sale Engineers, Managers, Technical Solutions Architects,

COURSE OUTLINE

OVERVIEW

- IP convergence
- Evolving radio technology
- 2G/3G/4G backhaul architecture
- IP Backhaul requirements
- Wireless Network Backhaul Options
- Overview of wireless backhaul
- Key Ethernet transport options
- Access network alternatives
- Aggregation network alternatives
- Global deployment landscape
- Overview of 3G and Beyond Networks
- The 3G Network Architecture
- Network Evolution of the 3G Network
- 4G/LTE Network - Key characteristics and technology
- Architecture - Capacity and throughput

MOBILE BACKHAUL EVOLUTION

- Mobile Backhaul general description
- Transport technologies landscape - Various L1 and L2 protocols
- “Access Network” transport solutions (e.g., TDM, ATM, Cable, and MW)
- Aggregation Network” transport solutions (e.g., SONET/SDH, MW and EPON)
- What is an IP/Ethernet backhaul network?
- Ethernet-Based Backhaul Solutions
- Ethernet basics
- Carrier Ethernet (CE) defined
- Ethernet Services Model (ESM)
- CE service attributes
- Circuit bonding
- Circuit emulation over Ethernet
- Timing considerations

MICROWAVE IN WIRELESS BACKHAUL

- Microwave network fundamentals recap
- Issues with Microwave access as a backhaul
- Microwave vs. WiMAX in wireless backhaul
- MPLS/Ethernet over Microwave

SDH AND ATM AS BACKHAUL SOLUTIONS

- Overview of SDH Operation
- Overview of ATM Operation
- Role of ATM in wireless backhaul
- ATM QoS concepts and the role of IMA

BACKHAUL EVOLUTION SCENARIOS FROM EXISTING SOLUTIONS TO TOMORROW’S IP/CARRIER ETHERNET BASED BACKHAUL SOLUTION

- PBB-TE Vs MPLS TP comparison
- Which should you choose?

- When to use which technology- depending on scenarios
- TDM to Ethernet evolution scenarios

BACKHAUL PLANNING

- 4G backhaul requirements
- LTE backhaul challenges
- Data Capacity planning
- Traffic Engineering,
- QoS and SLA assurance requirements
- Synchronization requirements
- Mini-Backhaul Capacity Planning Workshop – Exercises
- Exercise scenario description
- Exercise plan
- Subscriber forecasting
- Subscriber characterization
- Traffic modelling
- Traffic geography
- Effective bandwidth

SOLUTIONS FOR THE 3G/4G BACKHAUL

- MPLS Based Backhaul Solutions Overview
- IP routing and forwarding
- MPLS fundamentals and terminology -
- The MPLS forum –
- MPLS solutions description -
- MPLS TE, MPLS TP, L2/L3 VPNs (Pseudo wires, VPLS, H-VPLS)
- Carrier Ethernet-Based Backhaul Solutions -
- CE fundamentals and terminology - Metro Ethernet Forum (MEF) –
- The CE service attributes - Carrier Ethernet solutions briefing - MAC-in-MAC Provider Backbone Bridging (PBB)
- PBB-TE, Circuit Emulation (CE)
- Backhaul Evolution Scenarios from existing solutions to tomorrow's IP/Carrier Ethernet based backhaul solution
- PBB-TE Vs MPLS TP comparison - Which should you choose? - When to use which technology- depending on scenarios . TDM to Ethernet evolution scenarios

MOBILE BACKHAUL PLANNING FOR MULTIMEDIA SERVICES

- Network planning considerations overview
- Capacity planning issues
- Traffic characterization
- Subscriber forecasting
- Capacity Planning for Multimedia Wireless Backhaul
- Network planning overview
- Capacity planning issues
- Overview of wireless multimedia backhaul planning
- Traffic characterization
- Effective bandwidth
- Subscriber forecasting

LTE 4G

1. LTE TRANSMISSION AND CORE NETWORK PLANNING

The Telecommunication landscape is in a constant flow of change. Knowledge and competence is vital for professionals working in this ever-changing telecommunication industry. It is a five days course that provides introduction related to LTE performance, downlink and uplink speed, and poor MIMO performance related issues.

Course Objective

After attending the training, participants will be able to:

- Understand various LTE IP transport network solutions.
- Understand how to contribute in optimizing end to end user throughput.

Pre-Requisite

- Good Knowledge of LTE

Who should do it?

- Professionals from Customer Service and Support, sales and Marketing, Administrative and Support, procurement and various other departments of telecom and equipment vendors.
- Professionals from Technical department like RF planning Engineer, RF Drive Test Engineer and RF Optimization Engineer.
- Mobile Network Engineer

COURSE OUTLINE

LTE INTRODUCTION
- LTE Overview
- LTE Architecture and Interface
- LTE Channels
- S-OFDMA (LTE downlink) and SC-FDMA (LTE uplink)
- Overview of LTE and EPC Protocol Stacks
- LTE Features

IP OVERVIEW AND DESCRIPTION
- IPv4 & IPv6
- QoS in IP networks
- MPLS solution

SS7 SIGNALING
- SS7 Overview
- SS7 (Signalling System 7) Network Architecture
- Signalling Network Elements: SSPs, STPs and SCPs
- Signalling Network Structures
- SS7 Protocols & Protocol Stacks
- SS7 Signal Units
- Signalling Links
- Message Transfer Part (MTP) Level 1-3
- SCCP, TCAP and ISUP
- SS7 over IP

LTE TRANSMISSION MODES
- MIMO
- Physical channels and signals
- Uplink & Downlink transmission mode

LTE PROTOCOL ARCHITECTURE
- Protocol Architecture
- QoS and EPS Bearer
- E-UTRAN network interfaces
  - S1 Interface
  - X2 Interface

MICROWAVE TRANSMISSION OVERVIEW
- Introduction to Microwave
- Microwave Link Design
- Microwave Link Budget and System Evaluation
- Microwave Link Planning
- Microwave Network Deployment
- Microwave Testing and Troubleshooting

LTE BACKHAUL PLANNING
- Backhaul capacity
- Requirements for LTE
- Reliability and redundancy
- Radio link equipment
- Propagation and antenna
- Frequency planning for radio links

LTE RF LINK BUDGET PLANNING
- Effective Radiated Power
- Noise
- Noise Figure
- Ambient Noise
- Receive Diversity Gain
- System Gain and Losses
- Data rate (Mbps)
- Propagation (Path Loss) Models

- Neighbour Cell Lists for each site
- Detailed Coverage Predictions (e.g. Signal Strength (RSRP), Signal Quality (RSRQ) Best CINR, Best Server Areas, Uplink and Downlink Throughput)

LTE SMALL CELLS
- What are Small Cells?
- Impact of small cells.
- Coverage and Capacity

ADVANCED MIMO ANTENNAS FOR LTE
- Basic Antenna Types: isotropic and dipole
- Antenna diversity techniques
- MIMO Antennas for LTE
- Adaptive Arrays
- Beam forming
- Antenna Selection for LTE

CORE NETWORK PLANNING
- Core Network Planning Process
- Traffic planning and modeling
- Subscriber distribution in terms of CS and PS traffic
- Definition of traffic cases in the traffic model
- Calculation of CS and PS traffic distribution

CASE STUDIES USING ATOLL
- Creating a new LTE network
- Planning a LTE network
- Designing a LTE network
- Link-budget analysis of a LTE network
- Optimization a LTE network

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2. LTE RF PLANNING & DIMENSIONING

This Course is designed to give an introduction to the Long Term Evolution – LTE system also to accommodate the previous technologies like UMTS and GPRS and further preparing for LTE. Through this course participant will learn to calculate link budgets and as we know interference is also critical for throughput calculations. By learning these techniques, candidate will learn how to improve throughput optimization and end user experience.

Course Objective

After completing this course, the attendees will be able to:

- Understand the basic principles governing LTE
- Describe the features and benefits of LTE
- Identify LTE Network Components
- Understand various parameters like Link Budget, capacity coverage principles.
- Understand how to optimize radio access network with real traffic.
- Understand various KPI's and troubleshooting techniques

Pre-Requisite

- Knowledge of 2G/3G
- Understanding of LTE principles and LTE air interface

Who should do it?

Network Design & Optimization Engineers, Radio Network Planners, Design and Deployment Engineers, Network Integration and operations Engineers

COURSE OUTLINE

LTE/EPS OVERVIEW
- Why LTE/EPC?
- LTE/EPC main requirements
- LTE/EPC versus other Mobile technologies
- LTE/EPC Specification work

- LTE/EPC key features
- Standardization around LTE/EPC
- IMT-Advanced
- Comparison of 4G Technologies

LTE ARCHITECTURE OVERVIEW
- Network Architecture Evolution
- LTE/EPS Network Subsystems
- LTE/EPS Network Elements
- LTE/EPS Network Interfaces

LTE/EPC RRM FUNCTIONALITY
- LTE/EPC Mobility Areas
- LTE/EPC-UE Identifications
- LTE/EPC Handovers
- Radio Admission Control
- Scheduling
- Link Quality Control
- Handover Control
- Discontinuous Transmission (DTX)

LTE/EPC CONNECTION MANAGEMENT
- The EPS Default Bearer
- The EPS Dedicated Bearer
- Connection Management Terminology
- LTE/EPS Procedures

- Security: EPS Authentication and Key Agreement

LTE/EPC AIR INTERFACE
- Overview of OFDMA and SC-FDMA
- Inter Symbol Interference
- OFDM Problems
- LTE/EPC Frame Structure
- OFDM key parameters for FDD and TDD Modes
- Parameters for Calculating speed
- SC-FDMA and OFDMA Comparison

LTE/EPC CHANNELS
- Physical Resource
- Time Structure for FDD Mode
- Time Structure for TDD Mode
- Overview of FDD and TDD Physical Channels
- Reference Signals U/L & D/L

QOS IN LTE/EPC
- LTE/EPC Bearer Architecture
- LTE/EPC QoS Profiles
- LTE/EPC QoS Functional Architecture

LTE RF LINK BUDGET PLANNING
- Cell EDGE throughput Calculation
- Uplink & Downlink Budget
- Role of RRH and TMA
- Propagation (Path Loss) Models
- Detailed Coverage Predictions (e.g. Signal Strength (RSRP), Signal Quality (RSRQ) Best CINR, Best Server Areas, Uplink and Downlink Throughput)

LTE CAPACITY PLANNING
- Data traffic modelling
- Air interface capacity estimation
- Backhaul capacity planning
- Triggers for capacity planning

RF CONFIGURATION PARAMETERS
- Frequency Planning
- Sync Signal and PCI Planning
- Reference Signal Planning

CASE STUDIES USING ATOLL
- Creating a new LTE network
- Planning a LTE network
- Designing a LTE network
- Link-budget analysis of a LTE network
- Optimization of LTE network

3. LTE AND UMTS/GSM INTERWORKING

This course provides a comprehensive overview and a technical introduction to LTE Interworking with 3GPP networks. It is suitable for engineers in network planning and design, product design and development, network deployment, network performance, and network operations.

Course Objective

After completing this course, the attendees will be able to:
- Introduce the LTE interworking with 3GPP networks.
- Understand new interfaces, core network mechanism.
- Sketch interworking architecture of LTE and GeRAN/UTRAN
- List requirements for LTE and GERAN/UTRAN
- Understand IP mobility mechanism, security and QoS considerations.

Pre-Requisite
- Good Knowledge of LTE

Who should do it?

RF Planning Engineer, RF Optimization Engineer, Deployment Engineers, Technical Engineers

COURSE OUTLINE

INTERWORKING: LTE AND 3GPP 2G/3G NETWORKS
- Evolution from 2G/3G to LTE
- LTE/EPC network architecture
- 2G network architecture
- 3G network architecture
- Requirements for LTE interworking with 2G/3G
- Interworking architecture (Gn-SGSN and S4-SGSN)
- Voice and SMS interworking

INTERWORKING ARCHITECTURE
- Interworking architecture
- Interworking interfaces and protocols (EPC and UMTS/GERAN)
- Network Identifiers
- Roles of nodes such as MME, S-GW, P-GW, HSS, SGSN

BUILDING BLOCKS OF INTERWORKING

- Inter-Technology communication
- Interfaces (S3, S4, S12, Gn, Gp, Gr)
- RAN information management procedure
- Delivery of system information
- Convey the handover command
- Hybrid device capabilities
- Radio access network features
- Measurements control and report
- Handover algorithms
- Core network mechanisms
- IP mobility management mechanism
- Security/QoS consideration

INITIAL SESSION SETUP

- LTE EPS Attach Procedure
- EPS QoS
- UMTS QoS
- Access network discovery and selection
- Attach procedure
- PDN GW selection

IDLE MODE INTERWORKING

- Idle mode cell reselection
- Idle mode measurement
- SIB reports
- PLMN Selection

DEDICATED MODE INTERWORKING

- Handover
- Handover through different Interfaces
- LTE and UMTS measurements
- LTE-GERAN interworking

INTERWORKING/MOBILITY SCENARIOS AND MESSAGE FLOWS

- LTE UTRAN handover
- LTE <-> GERAN handover
- Idle mode cell reselection

LTE 2G/3G CS INTERWORKING

- IMS overview
- Single Radio Voice Call Continuity (SRVCC)
- Voice in LTE using IMS
- LTE Fallback on 2G/3G CS

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4. LTE RAN PERFORMANCE

The Telecommunication landscape is in a constant flow of change. Knowledge and competence is vital for professionals working in this ever-changing telecommunication industry. It is a five days course that provides introduction related to LTE performance, downlink and uplink speed, poor MIMO performance related issues.

Course Objective

After attending the training, participants will be able to:

- Understand various LTE KPIs and their operation
- Identify the events that lead to bearer drops
- Understand signalling event with their success and failure rate
- Define KPIs for handover and interworking performance

Pre-Requisite

- Good Knowledge of LTE

Who should do it?

Professionals from Customer Service and Support, sales and Marketing, Administrative and Support, procurement and various other departments of telecom and equipment vendors, Professionals from Technical department like RF planning Engineer, RF Drive Test Engineer and RF Optimization Engineer.

COURSE OUTLINE

LTE NETWORK ARCHITECTURE

- LTE Network Elements and Functions
- Identifiers
- Numbering, Addressing, and Identification in the IMS and Session Initiation Protocol (SIP)
- Circuit Switched Fall Back
- Multiple Access Methods

LTE RAN OPERATIONAL PROCEDURES

- RRC connection Establishment
- Radio Bearers in LTE
- Link Adaptation in LTE
- Cell Re-selection
- Access Bearing check
- Protocol data units, formats and parameters
- RRC information elements
- Troubleshooting LTE RAN

LTE RAN KPIS

- LTE RAN KPIs overview
- LTE signalling to KPI mapping

COVERAGE AND ACCESSIBILITY

- Defining “right” coverage
- RSRP, RSRQ and SINR measurements
- RRC connection and context setup performance

DROPS AND RETAINABILITY

- Radio link failures
- UE context and E-RAB drop KPIs

THROUGHPUT AND CAPACITY

- DL and UL operations
- CQI and MCS/MIMO selection
- RB utilization and capacity planning
- Interference Coordination (ICIC)

INTERWORKING AND HANDOVERS

- Intra- and inter-frequency handovers
- Idle mode IRAT selection
- Automatic Neighbour Relation (ANR)

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5. 4G LTE RADIO NETWORK PLANNING AND OPTIMIZATION

The Telecommunication landscape is in a constant flow of change. Knowledge and competence is vital for professionals working in this ever-changing telecommunication industry. It is a five days course that provides introduction related to how to plan and implement the 4G network. This course also covers the LTE link budget planning, capacity planning, coverage planning and KPI Analysis for Network performance. The attendees will also get hands on experience on using ATOLL for LTE Radio Network Planning and optimization.

Course Objective

After Completing the training, the participant will be able to:

- Understand LTE Architecture and Radio Interface
- Understand LTE Air Interface applied to RF Planning, Design and Optimization
- Understand concept of Coverage Planning, Capacity Planning and QoS Attributes for LTE
- Understand the issues related to planning 4G radio networks.
- Understand about the parameters to optimize the 4G performance.

Pre-Requisite

Good Knowledge of GSM and 3G Network Performance and 4G Fundamentals.

WHO SHOULD DO IT?

Development Manager, Radio Network Engineers, Technical Managers, RF Planning Engineers, RF Optimization Engineers.

COURSE OUTLINE

OVERVIEW OF 4G LONG TERM EVOLUTION (LTE)

- Introduction to Planning
- Detailed Planning.
- Optimization.

LTE NETWORK ARCHITECTURE

- Physical Channels
- Bearers
- Radio and Network Identities
- UE Context
- Radio Interface Signalling
- E-UTRAN Protocols

LTE AIR INTERFACE

- Overview of OFDMA and SC-FDMA
- Inter Symbol Interference
- OFDM Problems
- LTE Frame Structure
- Modulation in LTE
- OFDM key parameters for FDD and TDD Modes
- Parameters for Calculating speed
- Carrier Frequency and EARFCN
- Resource Blocks

LTE RF LINK BUDGET PLANNING

- Typical Parameter Values
- Uplink & Downlink Budget
- Propagation (Path Loss) Models
- Neighbour Cell Lists for each site
- Interworking with other technologies
- Detailed Coverage Predictions (e.g. Signal Strength (RSRP), Signal Quality (RSRQ) Best CINR, Best Server Areas, Uplink and Downlink Throughput)
- Fine Tuning and Optimization

LTE SMALL CELLS

- What are Small Cells?
- Impact of small cells.
- Coverage and Capacity

MIMO FOR LTE

- Backward Compatibility
- Transmission Modes
- Transmission Diversity
- MIMO Modes
- Spatial Multiplexing

QOS SERVICES AND ATTRIBUTES

- LTE Services.
- QoS Attributes.

LTE RADIO PROPAGATION

- E-UTRA Frequencies.
- Different Propagation Models for LTE.

LTE RADIO COVERAGE PLANNING

- Gains/Losses, Link Budgets.
- Antenna Considerations
- LTE Ue measurements (RSRP/RSRQ)
- RF Configuration parameters
- Antenna Options.
- Multi-Band Options
- LTE RF Channel performance prediction
- LTE Channel multiplexing
- MIMO in LTE
- LTE Resource plan

LTE CAPACITY PLANNING

- Coverage & Capacity Planning
- Cell and eNB Throughput.
- Factors Impacting Capacity.
- Configuring Planning Tool.

LTE KPI ANALYSIS AND NETWORK OPTIMIZATION

- Key Performance Indicators
- LTE Ue measurements (RSRP/RSRQ)
- LTE Capacity Planning
- LTE Cell selection/reselection planning
- LTE Radio Network KPIs
- LTE User-centric KPIs
- LTE Network performance KPIs
- LTE System utilization KPIs
- LTE RF Channel performance predictions
- LTE Resource Plan
- Radio Parameters Check
- Coverage problem analysis

CASE STUDIES USING ATOLL

- Creating a new LTE network
- Planning a LTE network
- Designing a LTE network
- Link-budget analysis of a LTE network
- Optimization of LTE network

6. 4G LTE SIGNALING, PROTOCOL AND PROCEDURES

LTE offers significantly higher packet data rates, enabling advanced multimedia applications and high-speed Internet access. This course takes a look at the LTE air interface and Non-Access Stratum (NAS) signalling operations used to establish and maintain LTE calls. The key LTE network components and interfaces are described, and then the steps involved in establishing and managing data calls are illustrated, highlighting the roles of each component and the flow of signalling and data across the network.

Course Objective

After completing this course, the attendees will be able to:

- Draw the LTE architecture with interfaces.
- Understand the DL and UL channels in LTE
- Understand the establishment of EPS bearers.
- Understand the cell selection and reselection processes for idle UEs
- Understand how handover is done between two antennas.

Pre requisite

- Good Knowledge of LTE

Who should do it?

RF Planning Engineers, RF Drive Test Engineers, RF Optimization Engineers Development Engineers

COURSE OUTLINE

LTE/EPS OVERVIEW

- Why LTE?
- LTE main requirements
- LTE versus other Mobile technologies
- LTE Specification work
- LTE key features
- IMT-Advanced
- Comparison of 4G Technologies

LTE ARCHITECTURE AND COMPONENTS

- Network Architecture Evolution
- LTE/EPS Network Subsystems
- LTE/EPS Network Elements
- LTE/EPS Network Interfaces

CORE NETWORK: SAE OVERVIEW

- Physical Channels

- Bearers
- Radio and Network Identities
- UE Context
- Radio Interface Signalling
- E-UTRAN Protocols

GENERIC LTE/SAE PROTOCOL ARCHITECTURE

- LTE protocol stack architecture
- Control plane protocol stack
- User plane protocol stack
- Protocol Format and structure
- Dual protocol stack operation

NON-ACCESS STRATUM - NAS SIGNALING

- NAS Protocol States and Transitions
- NAS Security
- Integrity Protection
- Non Access Stratum Protocols
  - Evolved Mobility Management - EMM
  - Evolved Session Management - ESM
- Mobility Management across EMM States
- EMM Procedures

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7. LTE-EPC NETWORKS AND SIGNALING

This is a specialized and detailed two day course which covers the major area of LTE's Signalling. There are number of protocols and signalling messages being passed during system operation, between Ue and eUTRAN as well as between eUTRAN and EPC.

Course Objective

After completing this course, the attendees will be able to:

- Understand Non Access Stratum Signalling
- Understand the roles of Radio Link Control, Radio Resource Control and Packet Data Control
- Follow message sequences on the S1 and X2 interfaces
- Understand interworking with earlier non-LTE 3GPP releases.

Pre-Requisite

The Attendees should have good knowledge of UMTS and LTE.

Who should do it?

Development Engineers, LTE Hardware and software development Engineers, RF optimization Engineers, Anyone who wants an in-depth understanding of the area of LTE's signalling

COURSE OUTLINE

LTE-EPC NETWORK ARCHITECTURE

- Key Requirements
- Network Architecture
- EPC Network Nodes
- Roaming Architecture
- Interworking Framework in EPC

LTE-EPC PROTOCOLS

- LTE Signalling Protocols
- X2-AP Protocol
- S1-AP Protocol
- Non-Access Stratum
- Stream Control Transmission Protocol
- GPRS Tunnelling Protocol
- Diameter (MME ← →HSS), (PCRF ←→PCEF)

LTE-EPC SIGNALING FUNDAMENTALS

- UE and EPC Identifiers
- PDN Connections and Access Point Names(APNs)
- EPS Bearer
- Signalling Bearer

SECURITY IN LTE-EPC

- Security Features in LTE-EPC
- UE ←→ Network Security
- EPS-AKA

NETWORK ACCESS ON LTE-EPC

- Overview of Initial Attach
- Initial Attach
- PDN Connectivity
- Default EPS Bearer Setup
- IP Address Allocation

QOS AND PCC FRAMEWORK IN LTE-EPC

- LTE QoS Model
- PCC Architecture
- Traffic Flow and Classification

SESSION ESTABLISHMENT AND PDN CONNECTIVITY

- Dedicated Bearer Establishment
- Multiple PDN Connectivity
- Idle Mode and EMM States
- Paging and Service Request
- Dedicated Bearer Deactivation

- Dedicated Bearer Modulation

INTRA-LTE MOBILITY
- Intra-LTE Handover Scenarios
- X2-based Mobility
- S1-based Mobility (Inter-MME Handover)
- Tracking Area Updates

IMS AND SUPPORT FOR VOICE
- Seamless Mobility
- IP Multimedia Subsystem (IMS)
- Circuit-Switched Fallback (CSFB)
- Voice Call Continuity (VCC)
- Single-Radio Voice Call Continuity (SR-VCC)

DEPLOYMENT CONSIDERATIONS
- Deployment Considerations
- Interworking with 3GPP
- Interworking with Release 8 3GPP
- Interworking with Pre-Release 8 3gpp

END-TO-END FLOW
- Data Call Scenario

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8. LTE ADVANCED

The Telecommunication landscape is in a constant flow of change. Knowledge and competence is vital for professionals working in this ever-changing telecommunication industry. It is a three days course that provides introduction related to LTE that LTE is an all-IP network without any circuit-switched network elements. The features in LTE-Advanced are backwards compatible with existing LTE capabilities, allowing service providers to provide an enhanced user experience while minimizing the cost of ownership.

Course Objective

After completing this course, the student will be able to:

- Identify the requirements and performance targets for LTE-Advanced
- Understand the features of LTE-Advanced
- Understand the important scenarios for LTE-A deployment

Pre-Requisite

- Good Knowledge of LTE.

WHO SHOULD DO IT?

- Deployment Engineers, Technical Engineers, RF Planning Engineers, RF Optimization Engineers, Non Technical Staff who need a high-level overview of LTE and IMS VoLTE network.

COURSE OUTLINE

OVERVIEW OF LTE-ADVANCED
- What is LTE-Advanced?
- Evolution from Release LTE 8/9 to Release 10/11/12/13/14/15 LTE-Advanced (4G LTE and evolution to 5G)
- IMT-Advanced requirements and LTE-A performance targets
- Spectrum Allocation
- Key LTE-Advanced features

LTE-ADVANCED NETWORK ARCHITECTURE
- E-UTRAN and EPC Architectures
- LTE Advanced Relays
- Ue categories for LTE-Advanced

LTE RRM FUNCTIONALITY
- Radio Admission Functionality
- Scheduling
- Link Quality Control
- Mobility Management
- Discontinuous Transmission
- Difference between 3G RRM and LTE RRM

AIR-INTERFACE ENHANCEMENTS
- Carrier Aggregation
- Cross carrier scheduling
- Acquisition and connection establishment
- UL transmitter and receiver enhancements
- Enhanced multiple antenna techniques

LTE CHANNELS
- Physical Channels
- Time Structure for FDD Mode
- Time Structure for TDD Mode

INITIAL ATTACH
- System acquisition
- Random access procedures
- RRC connection
- Initial attach
- Authentication and security
- Default bearer setup
- IP address allocation

MIMO ADVANCES AND THEIR IMPACT
- DL MIMO schemes; 8-antenna MIMO and enhanced MU-MIMO
- Coordinated multipoint (CoMP)

SELF-ORGANIZING NETWORKS AND HETEROGENEOUS NETWORKS IN LTE-ADVANCED

- SON Architectures with Interfaces
- HeNB Architecture
- HeNB Gateway Functionality
- HeNB Access Control
- HeNB Identification

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9. LTE TRANSPORT NETWORK DESIGN COURSE

The Telecommunication landscape is in a constant flow of change. Knowledge and competence is vital for professionals working in this ever-changing telecommunication industry. It is a three days course that provides introduction related to LTE that LTE is an all-IP network without any circuit-switched network elements. Transport network should accommodate the traffic created by cellular coverage areas, hence the correct dimensioning is critical for QoS and capacity point of view.

Course Objective

After completing this course, the student will be able to:

- Identify the requirements and performance targets for LTE
- Understand the general idea of LTE IP transport network solutions.
- Understand the importance of dimensioning for QoS and capacity point of view.

Pre-Requisite

- Good Knowledge of LTE Cell Planning and Dimensioning.

WHO SHOULD DO IT?

Deployment Engineers, Technical Engineers, RF Planning Engineers, RF Optimization Engineers, Mobile Network Engineers.

COURSE OUTLINE

LTE INTRODUCTION

- ATM technology overview
- ATM networking
- IP over ATM
- SDH/SONET

ATM TECHNOLOGY

- Network Architecture Evolution
- LTE/EPS Network Subsystems
- LTE/EPS Network Elements
- LTE/EPS Network Interfaces

IP OVERVIEW AND DESCRIPTION

- IPv4 & IPv6
- IPv6 Routing
- IPv6 Security
- QoS in IP networks
- MPLS solution
- Types of IP Address Allocation

IP MPBN (MOBILE PACKET BACKBONE NETWORK) TRANSMISSION OVERVIEW

- Introduction
- MPBN Concepts
- MPBN Transport backbone
- Circuit switching
- Packet Switching
- IP Networking

LTE IP TRANSMISSION DESIGN

- Mobile IP transmission networks
- UTRAN IP transports networks
- Layer 2(Ethernet) & Layer 3 (IP) QoS
- IP Link dimensioning
- Network control and node synchronization
- Flow control and retransmission options

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10. WIMAX DESIGN AND IMPLEMENTATION

WiMAX Training course is a course that introduces both technical aspects of WiMAX and 802.16 technologies. It enables participants to fully understand how WiMAX technology fits into the 4G wireless communications. In this course, attendees will learn about OFDM, MIMO, specifically for WiMAX network design.

Course Objective

After completing this course, the student will be able to:

- Understand the basic concept of 802.16
- Understand 802.16e protocols
- Understand OFDMA and SOFDMA techniques

- Perform more efficient design and operational support of 802.16e implementation of WiMAX
- Understand similarities and differences between 802.16e and WiBro

WHO SHOULD DO IT?

- RF Engineers, WiMAX Deployment Engineers, WiMAX Network Designers, Planning and Implementation engineers.

COURSE OUTLINE

INTRODUCTION TO WIMAX

- WiMAX as a Wireless MAN Technology
- WiMAX Spectrum and Regulatory
- 802.16 Benefits
- Application and Services
- Last Mile Broadband Connections
- Hotspot and Cellular Backhaul
- High-speed Enterprise Connectivity
- VoIP, IMS and IPTV
- Regulations
- WiMax Forum
- The Interoperability Challenge
- 802.16 Frequency Bands
- 802.16 Family of Standards
- Current Deployments
- Future Deployments

WIMAX TECHNICAL INTRODUCTION

- WiMAX Protocols
- The MAC and PHY Layers
- Basic ATM system MAC profile
- Basic IP system MAC profile
- Physical Layer (PHY) specifications
- Scheduling and Link Adaptation
- Adaptive Modulation Scheme
- H-ARQ (Hybrid ARQ)
- Space Time Coding (STC)
- Adaptive Antenna Systems (AAS)
- Multiple Input, Multiple Output (MIMO)
- Spatial Division Multiple Access (SDMA)
- OFDMA
- Other Diversity Schemes
- Security
- QoS
- WiMAX ASN Gateways

PHYSICAL LAYER PROCEDURES

- The original 802.16 standard and the 10-66GHz frequency band
- 802.16a Extension and a Lower Frequency of 2-11GHz
- Non line-of-sight (NLOS) Connections
- Wireless MAN-SC PHY
- Wireless MAN-FDMA PHY
- Wireless MAN-OFDMA PHY
- 802.16-2004 and 802.16e PHY
- The 802.16e and Mobile 802.16 Clients
- Hand-off Between 802.16 Base Stations

802.16 MEDIUM ACCESS CONTROL

- MAC Layer Operations
- MAC Frame Structure
- MAC Frame Type and Classes
- Access Methods
- Synchronization
- Power Management
- Link adaptation and Automatic Repeat Request (ARQ) functions
- Fast path activities (such as scheduling, packing, fragmentation, and ARQ)
- QoS on IEEE 802.16
- High bit rates (up to 268 mbps each way)
- Implementation Challenges on MAC and QoS
- 802.16e MAC enhancements

WIMAX PLANNING, COVERAGE AND CAPACITY

- RF and Core Network Capacity Planning
- Managing a 802.16 Implementation
- Managing 802.16e/Mobile WiMAX Implementation
- Requirements Analysis Steps
- Subscriber Station (SS)
- Base Station (BS)
- Network Design
- Base Stations Locations
- Access Point Frequency Assignments
- Complete Coverage (no gaps)
- Adequate Capacity
- Rules of Thumb Don't Work
- Design Based on Extensive Measurements

IMPLEMENTING A 802.16 NETWORK

- Designing and Planning a 802.16
- WiMAX Network Design
- Role of Antennas in WiMAX
- RF Design Principles for WiMAX
- WiMAX Link Budget Considerations
- Frequency Reuse in Fixed and Mobile WiMAX Networks
- Modelling tools
- Service Classes
- Performance
- Security
- QoS Enhancements
- Integration of WLAN and Cellular (Mobile Networks)

- Role of Radius, DHCP, and IGMP and the ASN Gateway

VOICE AND VIDEO OVER 802.16

- Delivery of Voice-over-IP (VoIP) Services
- QoS and VoIP
- Component of 802.16i for Reliable, High-quality Voice Transmission
- IMS and WiMAX
- Real Examples and Applications

WIMAX RF AND CORE OPTIMIZATION

- WiMax Optimization Parameters
- Testing and Measurements
- Simulation Approaches
- Case Studies

WIMAX OPERATIONS AND TRAFFIC CASES

- Network Entry
- Downlink Channel Synchronization
- Initial Ranging
- Capabilities Negotiation
- Authentication
- Registration
- IP Connectivity
- Transport Connection Creation

11. BACKHAUL PLANNING FOR LTE NETWORKS

This Course is designed to give an introduction to the Long Term Evolution – LTE system and its Interworking with other technologies. This course will look into various aspects of LTE evolution. It helps participants understand the line of evolution of mobile systems due to the data explosion and the role of LTE to provide for the data explosion foreseen in the market.

Course Objective

The aim of this course is to enable network planners to realize and maintain cost efficient LTE backhaul networks, which meet the necessary performance requirements. Through an introduction to the technology background, the economical modelling, the dimensioning theory relevant network management aspects, the reader shall obtain all relevant information to achieve good backhaul results in their own network environment.

Pre-Requisite

Candidate should have clear understanding on basic LTE network.

WHO SHOULD DO IT?

Regulators and enforcement engineers, LTE engineers, Technical Managers, Radio network engineers and anyone who works on LTE and network performance.

COURSE OUTLINE

INTRODUCTION TO THE BACKHAUL NETWORK

- The Overall Mobile Network
- Backhaul Network Requirements
- Link Requirements and Capacity Demand
- Architecture for Backhaul Networks
- Basic Backhaul Planning Processes

LTE PERFORMANCE

- Throughput
- Latency
- Standardization

LTE TRANSPORT INTERFACES AND PROTOCOLS

- Ethernet & IP Addressing
- Generic eNB Model
- Network Reference Configurations
- RAN Sharing
- IPv6

TRANSPORT QOS& OPERABILITY

- Mapping Radio QoS onto Transport QoS
- Packet scheduling
- Ethernet OAM
- IP Transport Network Measurement
- Transport Plug'n'Play (SON)
- Auto-Connection & Auto-Configuration

SYNCHRONIZATION

- GPS Based
- Ethernet/IP Based
- Solutions for co-location with legacy base stations

SITE SOLUTIONS

- Ethernet Switching
- Synchronization Hub

12. VOICE OVER LONG TERM EVOLUTION

The Telecommunication landscape is in a constant flow of change. Knowledge and competence is vital for professionals working in this ever-changing telecommunication industry. It is a three days course that provides introduction related to LTE that LTE is an all-IP network without any circuit-switched network elements, LTE subscribers must receive their voice services through voice over IP (VoIP). VoLTE (Voice over LTE) is based on the IMS (IP Multimedia Subsystem) framework and Session Initiation Protocol (SIP), and is the preferred solution for delivering voice in LTE networks.

Course Objective

After completing this course, the participant will be able to:

- Understand the LTE and IMS architecture for VoLTE
- Understand the end-to-end signalling and traffic paths for VoLTE
- Explain how VoLTE calls interwork with the PSTN and 3G networks

Pre-Requisite

- Good Knowledge of LTE

WHO SHOULD DO IT?

Deployment Engineers, Technical Engineers, RF Planning Engineers, RF Optimization Engineers, Non-Technical Staff who need a high-level overview of LTE and IMS VoLTE network.

COURSE OUTLINE

LTE/EPC VOLTE OVERVIEW
- What is VoLTE?
- Role of LTE and IMS for VoLTE
- State of VoLTE deployment

IMS ARCHITECTURE
- IMS network architecture
- Key IMS entities and protocols
- User addressing in IMS
- End-to-end signalling and traffic flow

VOLTE PRE-CALL FUNCTIONS
- PDN connection for IMS APN
- Default EPS bearer setup
- IMS registration
- IMS authentication

VOLTE CALL MANAGEMENT
- End to End VoLTE to VoLTE call setup
- PCC interactions
- Dedicated bearer setup
- SIP/SDP message details
- End-to-End signalling and traffic paths

VOLTE TO PSTN/3G CALLS
- IMS – PSTN interworking
- Role of MGCF and MGW
- Roaming in IMS
- End-to-End signalling and traffic paths

SMS OVER IP USING IMS
- SMS delivery architecture
- SMS origination and termination
- SMS interworking

IMS CHARGING ARCHITECTURE
- Overview of network nodes
- Offline and online charging

VOLTE DEPLOYMENT
- Device and Network Changes
- VoLTE KPIs
- VoLTE coverage requirements

Mobility

1. HETNET/ SMALL CELL PLANNING & NETWORK ARCHITECTURE

Small Cell course is designed for technical and non-technical professionals, especially anyone involved with planning, design, development, integration, and testing of small cell.

Course Objective

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

- Describe technologies behind HetNet and small cells
- List the various types of small cells and key challenges for its deployment
- Describe relationships between small cells, metro cells, macrocells, residential femtocells, enterprise femtocells and picocells
- Determine small cells coverage and capacity requirements
- Sketch the HetNet architecture
- Analyze and calculate capacity and coverage for a small cell

Pre-Requisite

Candidate should have clear understanding on cell planning & design.

WHO SHOULD DO IT?

Small Cells and HetNet and is intended for anyone involved in planning, design, architecture, deployment and testing.

COURSE OUTLINE

SMALL CELL RADIO PLANNING, NETWORK DESIGN & PLANNING

- Introduction to Small Cell
- Small Cell considerations
- Small cell RF design considerations
- Small cell radio network planning
- Network distribution system design
- Evaluate in-building network performance
- Link Budget for Small Cells
- Cell selection and re-selection
- Handover in small cells
- Carrier Aggregation (CA) with cross-carrier scheduling

SMALL CELL CAPACITY AND COVERAGE PREDICTIONS

- Coverage prediction
- Coverage and interference
- Network capacity analysis
- Indoor planning
- Small cell parameter configuration
- PCI planning
- Neighbor list planning
- Cell selection and reselection parameters
- Handover parameters

SMALL CELL TECHNOLOGIES AND NETWORK ARCHITECTURE

- Need of small cell
- Requirements for Small-Cell Network Architectures
- Small-Cell Architectures in Wireless Network Standards
- 3GPP LTE Small-Cell Architecture

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2. 3G UMTS NETWORK PLANNING AND OPTIMIZATION TRAINING

The Telecommunication landscape is in a constant flow of change. Knowledge and competence is vital for professionals working in this ever-changing telecommunication industry. It is a five days course that provides introduction related to how to plan and implement the 3G network. This course also covers 3G technologies such as WCDMA, HSDPA, and HSUPA, as well as services and applications.

Course Objective

After Completing the training, the participant will be able to:

- Understand the requirements for 3G network and discuss how these are being met in practice.
- Understand about the network architecture of evolving 3G system.
- Understand the issues related to planning 3G radio networks.
- Understand about the parameters to optimize the 3G performance.

Pre-Requisite

- Good Knowledge of GSM network performance and 3G Fundamentals.

WHO SHOULD DO IT?

Development Managers, Radio Network Engineers, Technical Managers, RF Planning Engineers, RF Optimization Engineers.

COURSE OUTLINE

3G OVERVIEW

- Evolution from 2G to 3G
- Why 3G?
- UMTS main requirements
- UMTS versus other Mobile technologies
- UMTS key features
- Comparison of 3G Technologies

3G ARCHITECTURE OVERVIEW

- Network Architecture Evolution
- UMTS Network Subsystems
- UMTS Network Elements
- UMTS Network Interfaces

UMTS AIR INTERFACE

- WCDMA
- Spreading
- Codes
- FDD and TDD Modes
- Radio Frame Structure
- Radio Resource Management
- Power Control

UMTS PROTOCOL ARCHITECTURE

- Radio Protocol Architecture
- High Level Function

3G UMTS NETWORK PLANNING

- Traffic Requirements
- WCDMA-specific parameters in the link budget
- Coverage and capacity planning
- Radio Parameter planning
- Planning Antenna Height
- Planning Antenna Tilt
- Transmission Power
- Neighbour cell relations
- Relation between coverage and service throughput
- WCDMA Planning environment and tools
- UMTS Radio Network Planning Practical scenario

HSPDA RADIO NETWORK PLANNING

- HSDPA features
- HSDPA Deployment Process
- Coverage and Throughput
- HSPDA – Uplink Link/Down Link Budget
- Key parameters
- Challenges and issues

UMTS KPI ANALYSIS & OPTIMIZATION PROCESS

- WCDMA radio network optimization
- SHO Optimization
- Packet Scheduling Optimization
- Power & Admission Control
- Key Performance Indicators
- Practical Targets.

CASE STUDIES USING ATOLL

- Creating a new 3G network
- Planning a 3G network
- Designing a 3G network
- Link-budget analysis of a 3G network
- Optimization of 3G network

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3. 3G NETWORK QOS AND PERFORMANCE MANAGEMENT

This Course is designed to give an introduction to the Long Term Evolution – LTE system and its Interworking with other technologies. This course will look into various aspects of LTE evolution. It helps participants understand the line of evolution of mobile systems due to the data explosion and the role of LTE to provide for the data explosion foreseen in the market.

Course Objective

By the end of the course participants will be able to:

- Describe the concept of QoS.
- Explain UMTS performance & RAN signaling.
- Know about the UMTS benchmarking.
- Explain the techniques used in improving network quality.

Pre-Requisite

Candidate should have clear understanding on mobile networks and its components – GSM and WCDMA.

WHO SHOULD DO IT?

Regulators and enforcement engineers, Network performance and QoS engineers, Technical Managers, Radio network engineers and anyone who works on QoS and network performance.

COURSE OUTLINE

UMTS QOS

- QoS Concept and its Importance
- QoS Monitoring Process
- QoS Categories in UMTS

CALL AND BEARER CONTROL

- Call and Bearer Control Protocols.
- ISDN User Part.
- ISUP Messages.
- Bearer Independent Call Control.
- BICC Serving Node.
- BICC Features and IEs.
- Bearer Control Protocols.
- Signalling Transport Converter.
- Signalling Association Identifiers.
- Generic Bearer Setup.

UMTS SIGNALING PROTOCOLS

- Short IP Overview.
- Access Point Name.
- GPRS Domain
- GPRS Roaming Exchange.
- Session Management.
- GPRS Tunnelling Protocol.
- GTP-C Functions.
- GTPS Tunnelling Capabilities.
- GTP Header.
- GTP Tunnel Setup Case..
- User IP Address Assignment.
- IMS Session with Policy Control.
- Diameter Protocol.
- Session Initiation Protocol (SIP).
- Session Description Protocol (SDP).
- SIP Multimedia Session Set-up.
- IMS Registration.
- IMS Session Setup.

UMTS BENCHMARKING

- Benchmarking
- Field measurements KPIs
- Classification of KPIs
- Capacity KPIs
- Quality KPIs
- Performance of Network
- Against other operators
- Between vendors
- Specific equipment

RF PERFORMANCE REQUIREMENTS FOR UMTS

- Introduction
- Frequency Bands and Channel Arrangements
- eNodeB RF Transmitter & Receiver
- eNodeB Demodulation Performance
- UE Design Principles and Challenges
- UE Demodulation Performance
- Requirements for Radio Resource Management
- Performance analysis of KPI's

RNC MONITORING COUNTERS

- RRC Connection Setup Success Rate(service)
- AMR RAB Assignment Success Rate
- VP RAB Setup Success Rate
- PS RAB Assignment Success Rate
- AMR Call Drop Rate
- VP Call Drop Rate
- CS Inter-RAT Handover Success Rate(from UTRAN to GSM)
- Inter-RAT Handover Success Rate(from UTRAN to GSM)

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4. 3G BENCHMARKING AND OPTIMIZATION

The Telecommunication landscape is in a constant flow of change. Knowledge and competence is vital for professionals working in this ever-changing telecommunication industry. It is a four day course that provides introduction to 3G benchmarking and performance parameters and how to optimize network if any problem occurs in the network.

Course Objective

After Completing the training, the participant will be able to:

- Understand about the need of performance measurement.
- Understand about the measurement limitations and how tolerances provide valuable information for validation and evaluation.
- Understand about how to measure performance of network using software.

- Understand about the parameters to optimize the 3G performance.

Pre-Requisite

- Good Knowledge of GSM network performance and 3G Fundamentals.

WHO SHOULD DO IT?

Deployment Managers, Radio Network Engineers, Technical Managers.

COURSE OUTLINE

3G OVERVIEW

- Overview on 3G
- Why 3G?
- Requirements of 3G
- Comparison wither mobile technologies
- Feature of 3G

3G ARCHITECTURE OVERVIEW

- Network Architecture Evolution
- UMTS Network Subsystems
- UMTS Network Elements
- UMTS Network Interfaces

UMTS AIR INTERFACE

- WCDMA
- FDD and TDD Modes
- Radio Frame Structure
- Radio Resources

UMTS PROTOCOL ARCHITECTURE

- Radio Protocol Architecture
- High Level Function
- Interface

5. 3G UMTS NETWORK PLANNING

- Planning methods
- Network Dimensioning
- Traffic Requirements
- Traffic types
- WCDMA-specific parameters in the link budget
- Coverage and capacity planning
- Radio Resource Planning
- Relation between coverage and service throughput

HSPDA RADIO NETWORK PLANNING

- HSDPA features
- HSDPA Deployment Process
- Coverage and Throughput
- HSPDA – Uplink Link/Down Link Budget

HSPA+ PROTOCOLS, PROCEDURES AND SIGNALING (R7, R8 & R9) TRAINING

- Overview of HSPA+
- HSPA+ Features and Services
- HSPA+ Air Interface
- HSPA+ Operations and Procedures
- HSPA+ Protocols
- HSPA+ Signalling

UMTS OPTIMIZATION PROCESS

- WCDMA radio network optimization
- SHO Optimization
- Packet Scheduling Optimization
- Power & Admission Control
- Practical Targets

3G BENCHMARKING

- • Benchmarking
- • Field measurements KPIs
- • Classification of KPIs
- • Capacity KPIs
- • Quality KPIs
- • Performance of Network
- • Against other operators
- • Between vendors

6. LTE QOS AND PERFORMANCE MANAGEMENT

This course is designed to let the attendees develop detailed understanding of LTE QoS mechanisms, functions of each network element and means to optimize them. This course is going to help engineers to achieve required QoS, and will help them to optimize the network with proper management. The Radio access as well as core network aspects will be addressed.

Course Objective

After Completing the training, the participant will be able to:

- Understand radio access network functions
- Understand air interface resource allocation in order to provide the required QoS
- Understand EPS bearers and QoS applied to different bearers and data flows
- Analyze VoIP and multimedia application specifications (including IMS & SIP)

- Compare LTE vs 3G QoS mechanism and optimization methodologies

Pre-Requisite

The Attendees should have basic knowledge of 3G and LTE.

WHO SHOULD DO IT?

Development Manager, Radio Network Engineers, Technical Managers, RF Planning Engineers, RF Optimization Engineers.

COURSE OUTLINE

LTE INTRODUCTION

- 3GPP standardization, LTE background and industry
- OFDMA downlink and SC-FDMA uplink access schemes
- Physical Layer numerology and LTE FDD/TDD
- Fundamentals of MIMO antenna technologies

PHYSICAL LAYER CHANNEL AND PROCEDURES

- Link adaptation with AMC, Hybrid ARQ and power control
- Downlink synchronization signals and initial cell search
- Physical data channels (PBCH, PDSCH, PMCH, PRACH, PDSCH)
- Physical control channel (PCFICH, PHICH, PDCCH, PUCCH)
- UE capabilities and system performance

RADIO PROTOCOL AND NETWORK ARCHITECTURE

- LTE/SAE network architecture and functional split
- QoS architecture and bearer/label concept
- Medium access control, radio link control, radio resource control
- Logical channel and transport channels

LTE CORE NETWORK

- Evolved Packet System (EPS) Key Concepts
- Basic LTE Mobility Principles
- Protocols in the Evolved Packet Core (EPC)
- Understanding IPv6
- Understanding GTP
- Understanding Radius and AAA Services
- Diameter Protocol
- Understanding Mobile IP and Dual Stack Mobile IPv6 (DSMIPv6) Protocols
- EPC Network Entities, Interfaces, and Configuration
- Long-Term Evolution and EPC Network Entities

LTE RADIO NETWORK ARCHITECTURE

- Physical Channels
- Bearers
- Radio and Network Identities
- UE Context

LTE BEARER &QOS

- EPS bearer and default bearer
- QoS parameters for default bearer
- QoS during interworking with UTRAN
- QoS rules
- Network v/s terminal initiated QoS control
- Application detection and control
- Usage monitored control
- QoS binding
- Update of binding

LTE PERFORMANCE MANAGEMENT

- Understand need for LTE RF performance management
- Difference between RF tuning and optimization in LTE network
- LTE RAN tuning and optimization process
- Understand important KPIs and counters for LTE RF optimization

PERFORMANCE MANAGEMENT PREPARATION

- Perform Audits and Consistency checks
- Conduct High Level Radio Design Review
- Define Clusters and Drive test routes
- Setup Drive Test Tools.

DATA ANALYSIS AND POST PROCESSING

- Understand Performance Management considerations
  • Verify Cell Coverage area
  • Identify and troubleshoot coverage problems
  • Signal Power
  • Interference
  • Swapped feeder
  • Overshooting
- Cell border analysis
- Tuning for Coverage & Capacity improvement
- Tuning and Optimization in hotspots area

KEY PERFORMANCE INDICATORS (KPIS)

- Get introduction of performance management using KPI
- Understand and improve Accessibility KPI
- Understand and improve Retain ability KPI
- Understand and improve Integrity KPI
- Understand and improve Mobility KPI

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7. LTE RADIO NETWORK DESIGN & OPTIMIZATION

This Course is designed to give an introduction to the Long Term Evolution – LTE system designing & Optimization. This course will look into various aspects of LTE evolution. It helps participants understand the basic principles governing LTE and also the benefits and features of LTE so as to optimize the network if any problem arises.

Course Objective

After completing this course, the attendees will be able to:

- Understand the basic principles governing LTE
- Describe the features and benefits of LTE
- Identify LTE Network Components
- Gain concepts and terminology specific to LTE-based broadband wireless systems

Pre-Requisite

- Knowledge of 2G/3G
- Basic understanding of LTE

WHO SHOULD DO IT?

Network Design & Optimization Engineers, Planners, Design and Deployment Engineers, Network Integration and operations Engineers

COURSE OUTLINE

LTE/EPS OVERVIEW

- Why LTE?
- LTE main requirements
- LTE versus other Mobile technologies
- LTE Specification work
- LTE key features
- IMT-Advanced
- Comparison of 4G Technologies

LTE ARCHITECTURE OVERVIEW

- Network Architecture Evolution
- LTE/EPS Network Subsystems
- LTE/EPS Network Elements
- LTE/EPS Network Interfaces

LTE/EPS MOBILITY MANAGEMENT

- LTE/EPS Mobility Areas
- LTE Handovers
- Backhaul and Transport Network

LTE AIR INTERFACE

- Overview of OFDMA and SC-FDMA
- Inter Symbol Interference
- OFDM Problems
- LTE Frame Structure
- Modulation in LTE
- OFDM key parameters for FDD and TDD Modes
- Parameters for Calculating speed
- Radio Resources

LTE/EPS CONNECTION MANAGEMENT

- Default Bearer
- Dedicated Bearer
- LTE/EPS Procedures
- Connection Management Terminology

LTE CHANNELS

- Physical Channels
- Time Structure for FDD Mode
- Time Structure for TDD Mode

LTE PROTOCOL ARCHITECTURE

- Radio Protocols Architecture
- Data Flow in form of Signalling
- RRC States

LTE NETWORK DESIGN AND SITE SELECTION

- Modelling the LTE Network
- Modelling user services and traffic
- RF Propagation Models
- Different signal level predictions
- RF design process and options
- Morphology definitions
- Coverage prediction

LTE PERFORMANCE MANAGEMENT

- Understand need for LTE RF performance management
- Difference between RF tuning and optimization in LTE network

PERFORMANCE MANAGEMENT PREPARATION

- Perform Audits and Consistency checks
- Conduct High Level Radio Design Review

- Define Clusters and Drive test routes
- Setup Drive Test Tools.

LTE DRIVE TEST
- LTE Traffic Simulation
- LTE Performance
- Drive Testing using Software (TEMS)

DATA ANALYSIS AND POST PROCESSING
- Understand Performance Management considerations
- Verify Cell Coverage area
- Identify and troubleshoot coverage problems
- Signal Power
- Interference
- Swapped feeder
- Overshooting
- Cell border analysis
- Tuning for Coverage & Capacity improvement
- Tuning and Optimization in hotspots area

Transmission Technologies

1. DWDM AND OPTICAL NETWORKING

In this course, the attendees will be cleared with the concepts of optical networking and dense wavelength division multiplexing. In this, they will be taught about the various optical network architectures and the various components of all-optical network like Optical Amplifiers, Optical Add/Drop Multiplexors, Optical Splitters etc.

Course Objective

After completing this course, participant will be able to:

- Understand advanced DWDM Network designs and Engineering
- Design optical amplifier-based links
- Understand technologies that make DWDM and optical network, including DWDM OADMs, Optical Amplifier.
- Evaluate optical components in a DWDM network
- Classify and design DWDM networks based on size and performance
- Know where optics are today and where optical technology is headed in the near future.

Pre-Requisite

The Attendees should have knowledge of Optical Fiber and SDH.

WHO SHOULD DO IT?

Technical Managers, Software Engineers, Marketing and Sales professionals, Optical Fiber Engineer, SDH & DWDM Engineer

COURSE OUTLINE

FUNDAMENTALS OF TRANSMISSION TECHNOLOGIES
- Introduction & Fundamentals of Telecommunication
- Transmission Network Media
- Wireless and Wired Transmission
- Transmission Network Performance
- Network Synchronization
- Security and Encryption

BASICS OF OPTICAL FIBER
- Introduction to Fiber Optics
- Why Optical Fiber Communication?
- Optical Sources and Detectors
- Fabrication and Cabling of Optical Fiber
- Optical Fiber and Its types
- Losses in Optical Fiber
- Laying and Marking of Optical Fiber
- Optical Fiber Splicing
- Optical Fiber Fault Detection using OTDR

INTRODUCTION TO DWDM
- Optical Networking and DWDM
- Optical Network Breakthroughs
- Optical Demultiplexers
- The Erbium-Doped Fiber Amplifier (EDFA)
- Optical Cross-Connects
- Optical Add-Drop Multiplexers

DWDM COMPONENTS
- DWDM Anatomy
- Multi wavelength Transmitters
- Multichannel Receivers
- DWDM Optical Amplifiers
- Wavelength Converters

- Optical Couplers
- Optical Power Attenuators
- Optical Equalizers
- Ring Resonators

DWDM SPAN ENGINEERING
- Engineering a DWDM link
- Power Budget Design
- Digital Modulation Formats
- Fiber Impairments
- Polarization Dependent Effects (PDL and PMD)

DWDM NETWORK
- Modulation: Direct and External
- Couplers and Circulators
- Cavities and Filter
- Complex Components: Transponders
- Optical Switches
- Micro-mechanical switches (MEMS)
- Electro-Optical and Thermo-Optical Switches
- Bubble Technology
- Liquid Crystal Switches

IMPAIRMENTS TO DWDM TRANSMISSION
- Bit Error Rate
- Eye Pattern
- Q-Factor
- Optical Signal-to-Noise Ratio
- Noise Figure

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2. SDH & DWDM FUNDAMENTALS

SDH and DWDM Training course provides an overview of SDH and DWDM networking elements, and their technologies. Wavelength Division multiplexing is a technology which multiplexes a number of optical carrier signals onto a number of carrier signals onto a single optical fiber by using different wavelengths of laser light.

Course Objective

After completing this course, the attendees will be able to:

- Understand SDH Technology
- Understand SDH Transmission Hierarchy
- Understand Digital Signal Synchronization
- Describe SDH network architecture and configuration using Terminal multiplexer, Regenerator, Add/Drop Multiplexer

Pre-Requisite

Candidate should have clear understanding about transmission technology like Optical fiber and Microwave transmission

WHO SHOULD DO IT?

Technical Managers, Consultants, communication Professional, software engineers, marketing and sales professionals, Transmission Network Designer

COURSE OUTLINE

FUNDAMENTALS OF TRANSMISSION TECHNOLOGIES
- Introduction & Fundamentals of Telecommunication
- Transmission Network Media
- Wireless & Wired Transmission
- Transmission Network Performance
- Network synchronization
- Security & Encryption

OVERVIEW OF OPTICAL FIBER COMMUNICATIONS
- Introduction to Fiber Optics
- Why Optical Fiber Communication?
- Optical Sources & Detectors
- Fabrication and Cabling of Optical Fiber
- Optical Fiber and its types
- Types of Fibers- MMF and SMF
- Losses in Optical Fiber
- Concept of Dispersion

MULTIPLEXING-PDH & SDH
- Multiplexing, PDH and SDH
- Multiplexing techniques- TDM & FDM
- SDH & PDH
- Limitations of PDH
- Synchronous and Asynchronous systems
- STm-1, STM-4, STM-16 and STM-64
- Functions of TM, ADM and REG
- SDH multiplexing structure (STM-1 frame structure)
- Function of SDH Overhead bytes

SDH ARCHITECTURE & SERVICES
- Evolving CPE/ILEC/IXC Infrastructure & Services
- Inter-Office & Core Networking with SDH
- SDH in the Feeder Section
- ADSL (Twisted Pair)
- FITL/FTTC/FTTH/FTTD (Fiber)
- Benefits of SDH

- SDH Frame Format Structure
- SDH Overhead

SDH SYNCHRONIZATION AND TIMING
- Stratum Clock
- Plesiochronous Clock
- Overview of BITS

SDH NETWORK ELEMENTS
- Terminal Multiplexer
- Regenerator
- Add/Drop Multiplexer
- Digital Cross-Connects
- Digital Loop Carrier
- Protection and Survivability
- Element Managers

SDH NETWORK TOPOLOGIES AND CONFIGURATIONS
- Point-to-Point
- Point-to-Multipoint
- Hub Architecture
- Ring Architecture

INTRODUCTION TO DWDM
- Optical Networking and DWDM
- Optical Components
- Optical Spectral Filters and Gratings
- Optical Demultiplexers
- The Erbium-Doped Fiber Amplifier (EDFA)
- The Tunable Laser Diode Operating at 1550 nm
- In-Fiber Bragg Grating

DWDM COMPONENTS AND ARCHITECTURE
- DWDM Anatomy
- DWDM Impairments
- DWDM Optical Amplifiers
- DWDM Filter Modules
- Wavelength Converters
- Integrated DWDM Modules
- Modal Effects

DWDM TESTING, MEASUREMENTS AND OAM&P
- Component conformance tests
- Parameter tests on optical fibers
- System installation tests
- System optimization tests
- System acceptance tests

3. FIBER OPTIC COMMUNICATION

This course includes the basic aspects of fiber-optic communication systems through which attendees will get to know how to design fiber optic network. Also, the attendees will be taught how to calculate losses in fiber network like fiber attenuation, connectors loss and splice loss.

Course Objective

After completing this, the attendees will be able to:
- Align light waves into small optical components with high precision
- Calculate and simulate the attenuation and signal degradation due to intermodal and intermodal distortion
- Calculate losses due to connectors, splices, source output pattern and fiber numerical aperture
- Understand, compute and simulate the modes in step index fiber and graded index fiber.
- Understand the reliability issues of highly delicate optical devices

Pre-Requisite

- Introduction to communication systems and electromagnetic fields and waves.
- Candidates should be familiar with analog and digital communication systems, Frequency Division and Time Division multiplexing techniques.

WHO SHOULD DO IT?

Transmission Engineer, Development Engineer, Field Engineer, Design Engineer

COURSE OUTLINE

FUNDAMENTALS OF TRANSMISSION TECHNOLOGIES
- Introduction & Fundamentals of Telecommunication
- Transmission Network Media
- Wireless and Wired Transmission
- Transmission Network Performance
- Network Synchronization
- Security and Encryption

BASICS OF OPTICAL FIBER
- Introduction to Fiber Optics
- Why Optical Fiber Communication?
- Optical Sources and Detectors

- Fabrication and Cabling of Optical Fiber
- Optical Fiber and Its types
- Concept of Modes
- Types of Fibers- MMF and SMF
- Losses in Optical Fiber
- Concept of Dispersion
- Types of Single Mode Fibers ITU-T Specification

FIBER OPTIC CABLES

- Optical Fiber cables
- Laying and Marking of Optical Cable
- Designs and materials for Cables
- Cable installation & laying methods and techniques
- Different Techniques for Joining fibers

FIBER OPTIC CONNECTORS/SPLICING/OT

- Fiber optic connectors
- Splicing – Mechanical and Fusion
- Elements of Fiber optic link
- Test and measurement of Fiber Optics networks using OTDR
- Passive Fiber Optic components

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4. MICROWAVE TRANSMISSION ENGINEERING AND LINK PLANNING

The Telecommunication landscape is in a constant flow of change. Knowledge and competence is vital for professionals working in this ever-changing telecommunication industry. It is a five days course that provides introduction related to how a communication network is being established i.e. how signal transmit from one antenna to another and how an effective microwave path is maintained.

Course Objective

After Completing the training, the participant will be able to:

- Understand the requirements of Transmission engineering and how to manage microwave networks.
- Understand how to design path with zero interference.
- Understand the importance of microwave path planning.

Pre-Requisite

Candidate should have clear understanding on Microwave link.

WHO SHOULD DO IT?

Engineers, Technician, Operation Engineers, Technical managers, Students from communication background.

COURSE OUTLINE

TRANSMISSION NETWORK FUNDAMENTALS

- Transmission Network Media
- Basic Terminology
- Transmission Network Topology
- Transmission Network Performance
- Network Synchronization
- Security and Encryption

INTRODUCTION TO MICROWAVE COMMUNICATIONS

- Overview
- Radio Fundaments
- Transmission Media
- Terrestrial Radio-relay links
- MW versus Optic Fibre
- Regulatory and Licensing

MICROWAVE LINK DESIGN

- LTE/EPS Mobility Areas
- LTE Handovers
- Backhaul and Transport Network

MICROWAVE LINK BUDGET AND SYSTEM EVALUATION

- The Link Budget
- System Gain and Loss
- Planning a Point to Point System
- Understanding Digital Microwave System Testing

MICROWAVE LINK PLANNING

- Microwave measurements
- Method of detection
- Microwave Topology and capacity planning
- LoS (line of sight) aspects
- Parameters affecting propagation
- Refraction
- Reflection
- Fading
- Attenuation
- Modulation Techniques
- QPSK
- 16 QAM Constellation diagram
- Microwave power measurements

- Impedance measurements
- Frequency measurements

MICROWAVE NETWORK DEPLOYMENT

- Digital Microwave Radio
- Digital Multiplexers
- Cabling and Signal Termination
- Microwave Antennas and Transmission Lines
- Field Surveys
- Digital Multiplexers
- Microwave Antenna Mounting Structures
- Power Supply and Battery Backup
- Grounding, Lightning, and Surge Protection
- Microwave Testing and Troubleshooting