4G LTE-ADVANCED LTE IMS WIMAX 3G/UMTS/HSPA/HSPA+ GSM/GPRS/EDGE WIRELESS CONVERGENCE

# Telecom Training Catalog

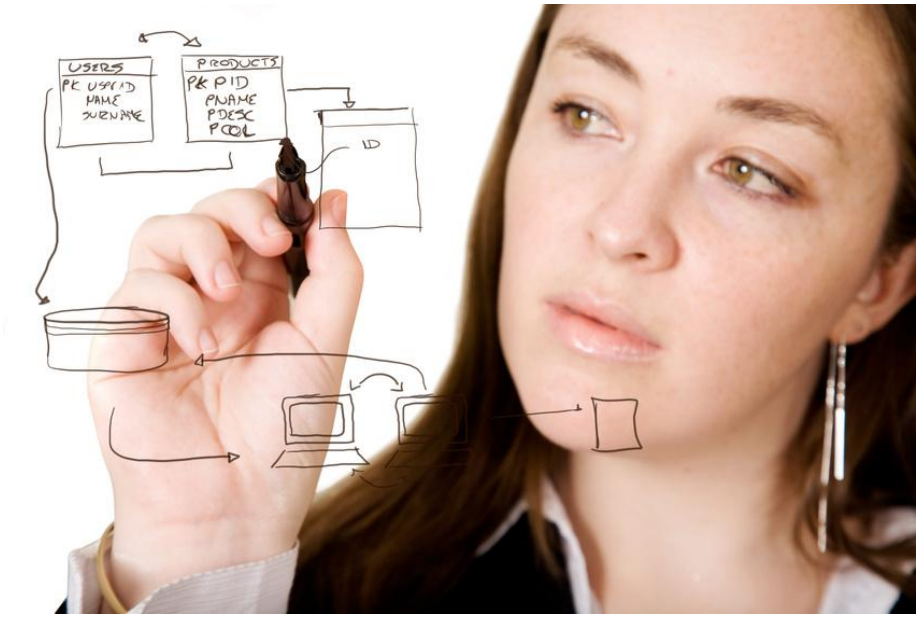
Discover Your Competitive Advantage

NgnGuru Solutions
Taking Communication Beyond Horizon

# Company Profile

**NGNGuru Solutions have a full suite of integrated services to assist in the creation and/or enhancement of your communications software and services.**

**NGNGuru Solutions with expertise in the telecom systems, protocols, processes and technology can help in increasing operational effectiveness and generating new revenue streams.**



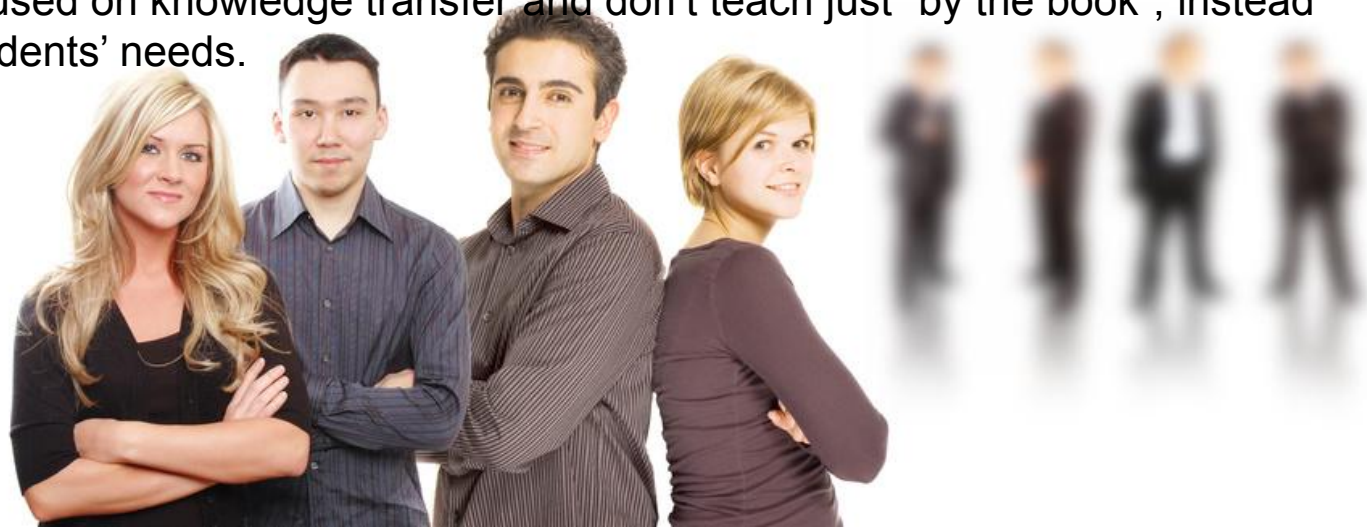

- **Our mission is to provide high quality training and solutions to fulfill our customer's telecom requirements with 100% satisfaction.**
- **We are fully equipped with highly experienced resources and services for your communications software and systems in GSM, GPRS, 3G, LTE, IMS, SS7 & VOIP space.**
- **Strong focus on Communication industry, Deployment & Integration services**
- **Vast Experience in Complete Product Life-cycle - Requirement Specifications, Product Architecture, Design, Implementation, Test, Integration, Sustenance and Support**
- **Rich experience in RF installations**
- **A experienced team to manage and handle large telecom projects**

# Why NGNGuru ?

- NGNGuru Solutions specializes in providing individual and corporate trainings in the area of cutting edge next generation wireless & network technologies like WiMAX, LTE, Femto Cell, GSM, GPRS, UMTS, SS7, IMS, CDMA, WCDMA, SIGTRAN, UMA/GAN and HSPA.

- As an industry leader in training, we can augment your team to extend your product portfolio or generate a new curriculum. We have experience in custom development solutions for Instructor Led, Web-based and eLearning training. Plus, we have the instructional design experience to plug in only those pieces that are important to you. These training programs are completely modular, and customizable for client's specific requirements.

- Our Instructors have an average of 10 years of experience in the telecom industry. Instructors are focused on knowledge transfer and don't teach just "by the book", instead adapting to the students' needs.



# Training Methodology

Following are the highlights of our approach.

- Start with fundamentals
- Customized for individual learning with detailed explanations
- Accurate, relevant content with insightful analogies
- Tailoring of the content during class based on the background and experience of the students
- Focus in areas important to the audience, to ensure that the students receive exactly what they need.
- Structured into manageable modules
- End of modules quizzes and tests

- **Classroom Training** - Participants can get their questions answered by the instructor during class, in one-on-one sessions, during breaks, and are invited to contact the instructors via e-mail at anytime after the course with any questions.
- **Web-based Online Training** - Web-based training is a way of delivering of NGNGuru's classroom Telecom courses via the Internet using online Web training tools. These full-day, online versions of NGNGuru's instructor-led programs are segmented into three 2-hour or two 3-hour sessions with 15 min break in between. Access to training presentations after delivery of training is also available.
- **E-Learning Solutions**– Designed to accommodate a wide variety of learning styles, our eLearning courses take full advantage of the multimedia medium. Each course provides students with full audio, narrated text and colorful animations to enhance the learning experience. For available E-Learning modules visit http://telecom-trainings.com/

# Motivation

- Build carrier in telecom domain and have better prospect of rising up in organizations than fellow workers.
- Cut through the buzzwords, jargon and vendor hype to gain the big picture view of communications and networking you can put to use today ... and into the future.
- Build the career-enhancing knowledge tools you need to succeed in the fast-changing world of communications.
- Build a structural understanding of telecommunications and networking, allowing you to make meaningful comparisons and informed decisions.
- Understand mainstream solutions to today's requirements
- Obtain detailed workbooks which will serve as a valuable reference for years.
- Fill in the gaps, and see how it all fits together.
- Develop a solid understanding of telecom, datacom, networking, wireless and next generation networks knowledge you can't get anywhere else.

# Audience

- Both engineering and non-engineering students/professionals needing an overview, good understanding, update
- For experienced professionals new to the business needing to get up to speed quickly on telecommunications, IP, networking, wireline, wireless, broadband, 3G, 4G, VoIP and next generation technologies.
- Project leaders/ Managers/ Executives responsible for dealing with standards, specification and implementation of communication and network projects.
- Non-technical personnel needing to be able to converse with "techies"... management, administration and finance personnel wanting to eliminate frustration when everyone else is talking in jargon and buzzwords.
- Technical sales and marketing personnel, customer configuration analysts and managers needing to fill in the gaps and build a structural knowledge of technologies, services, equipment and mainstream solutions.

# Telecom Courses

- 4G
  - LTE-Advanced Training (1 day)
  - LTE Essentials (1 day)
  - LTE Air Interface Training (2 days)
  - LTE E-UTRAN Training (2 days)
  - LTE Evolved Packet Core Training (2 days)
  - LTE RF Planning (2 days)
  - WiMAX Essentials (1 day)
- 3G
  - UMTS Fundamentals (2 days)
  - UMTS Air Interface (2 days)
  - HSPA (HSDPA, HSUPA) (1 day)
  - Explore HSPA + - R7 (1 day)
  - HSPA & HSPA+ - R5, R6, R7 (2 days)
  - HSPA, HSPA+ & Beyond (3 days)
  - UMTS, HSPA & HSPA+ (3 days)
  - 3G RF Planning & Optimization (2 days)
- 2G/2.5G
  - GSM Fundamentals (2 days)
  - GPRS/EDGE Fundamentals(2 days)
  - GSM/GPRS/EDGE (2 days)
  - 2G RF Planning & Optimization (2 days)
- FMC
  - IMS Essentials (1 day)
  - SIP/RTP Essentials (1 day)
  - Femtocell Essentials (1 day)
  - Sigtran Training (1 day)
  - Internet Protocol (0.5 day)
  - UMA/GAN Essentials (0.5 day)
- Telecom Basics
  - SS7 Essentials (1 day)
  - Telecom Fundamentals (0.5 day)
  - Wireless Fundamentals (0.5 day)
  - Transmission Fundamentals (0.5 day)

# LTE-Advanced Training (1 day)

4G

3GPP Release 9 expands the functionality of Release 8 as well as laying solid foundations for LTE-Advanced. 3GPP proposed LTE Release 10 & beyond (LTE-Advanced) as a candidate for IMT-Advanced which has been accepted by ITU. The new capabilities of LTE-Advanced is envisaged to handle a wide range of supported data rates with target peak data rates of up to approximately 100 Mbit/s for high mobility and up to approximately 1 Gbit/s for low mobility. In comparison to LTE, LTE-Advanced is wider than approximately 70 MHz in DL and 40 MHz in UL.

## Who Should Attend

Telecom developers, testers, managers and operational engineers involved in LTE & LTE-Advanced technologies.

## Objective

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

- Understand history & overview of LTE-Advanced
- Define LTE-Advanced Requirements
- Explain LTE-Advanced Features
- Describe LTE-Advanced Air Interface Enhancements
- Explain LTE-Advanced Procedures

## Course Contents

**LTE-Advanced Overview**

- History & Evolution
- Need of LTE-Advanced
- High Level Requirements
- LTE-Advanced Spectrum Allocation
- Overview of LTE-Advanced Features

Network Architecture Enhancements

- LTE R8/R9 Architecture
- HeNB Evolutions – LIPA/SIPTO
- Extended H(e)NB Features
- Relays for LTE
- Self-Organizing Networks (SON) Evolutions
- Network-Based Positioning

**E-UTRA Evolutions**

- Carrier Aggregation
- Enhanced Downlink Multiple Antenna Transmission
- Uplink Multiple Antenna Transmission
- LTE Spectrum Enhancements
- Latency Reductions

**Operations & Deployments**

- HeNB Mobility Enhancements
- Attach & Bearer Setup in LTE-Advanced
- Mobility in LTE-Advanced
- LTE-Advanced Interworking
- Migration to LTE-Advanced

# LTE Essentials (1 day)

4G

LTE (Long Term Evolution) is initiated by 3GPP to improve the mobile phone standard to cope with future technology evolutions and needs. This course provides a high level overview of LTE technology including its architectural and requirement details. Further it explains functional and protocol details of LTE nodes. A good knowledge of 3GPP technologies like UMTS would be beneficial for anyone attending this course.

## Who Should Attend

This is beginner level course and suitable for telecom professionals & students who have little or no understanding of LTE.

## Objective

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

- Understand history & overview of LTE
- Define LTE Architecture
- Explain LTE network elements
- Describe LTE Interfaces
- Explain basic signaling procedures

## Course Contents

**LTE Overview**

- Evolution
- Need of LTE
- High Level Requirements
- High level architecture for the evolved system
- LTE-SAE Nodes
- Functional Architecture E-UTRAN EPC
- LTE-SAE Interfaces

**Evolved UTRAN**

- EUTRAN Architecture
- eNode B Functions
- Radio Interface Control /User Plane
- Frame Structure
- OFDM/SC-FDMA/MIMO
- Physical channels/ Transport Channels
- MAC / RLC/PDCP / RRC Overview
- X2 Interface
- X2AP Protocol

**Evolved Packet Core**

- MME
- Serving Gateway (S-GW)
- PDN Gateway (P-GW)
- S1 Interface
- S1AP Protocol
- Security

**LTE Signaling**

- Random Access Procedure
- Attach/Detach Procedure
- Handover
- Voice over LTE

# LTE Air Interface Training (2 days)

4G

3GPP LTE air interface requirements include reduced cost per bit, higher data speed, flexibility of use of existing and new frequency bands. This course provides a good understanding of LTE air interface technologies e.g. OFDM, MIMO and protocols (e.g. RRC, RLC, MAC) including functional details. A basic understanding of 3GPP technologies like UMTS, LTE would be beneficial for anyone attending this course.

## Who Should Attend

This is advanced level course and suitable for telecom professionals including design, testing , support & sales engineers who already have some understanding of LTE & UMTS technologies.

## Objective

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

- Understand LTE Evolution & Architecture
- Explain LTE Air Interface technologies
- Define Air Interface Physical layer
- Describe LTE Air Interface protocols & functions
- Explain signaling procedures

## Course Contents

**LTE Overview**

- Evolution & High Level Requirements
- High level architecture for the evolved system
- LTE-SAE Nodes
- Functional Architecture E-UTRAN EPC
- LTE-SAE Interfaces

**Evolved UTRA**

- Air Interface Evolutions
- LTE Identities: GUTI, M-TMSI, S-TMSI and C-RNTI, TAI
- LTE-Advanced Enhancements
- E-UTRA Protocol Interface
- Air interface - Control/User Planes
- Air interface Protocols, functions and message details
  - RRC
  - PDCP
  - RLC
  - MAC

**Air Interface Physical Layer & Channels**

- Frame Structures
- Frequency Spectrum
- Physical Channels
- Logical Channels
- Transport Channels
- Channel Mappings

**Air Interface Technologies**

- OFDMA
- SC-FDMA
- MIMO
- Multiplexing
- Modulation, Coding, & Scrambling

**Air Interface Procedures & Signaling**

- Connection Setup & Deletion
- Mobility
- Monitoring & Measurements
- Interworking

**LTE QoS & Security**

# LTE E-UTRAN Training (2 days)

4G

3GPP LTE radio access network E-UTRAN is greatly simplified from it's predecessor UMTS by combining RAN & Node-B functionality in a new node called e-NodeB. This course provides a good understanding of LTE E-UTRAN S1, X2 interfaces, protocol architecture and functional details. A basic understanding of 3GPP technologies like UMTS, LTE would be beneficial for anyone attending this course.

## Who Should Attend

This is advanced level course and suitable for telecom professionals including design, testing , support & sales engineers who already have some understanding of LTE & UMTS technologies.

## Objective

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

- Understand LTE Evolution & Architecture
- Define LTE E-UTRAN Interfaces & Nodes (eNodeB)
- Describe LTE E-UTRAN Interface protocols (S1, X2) & functions
- Explain signaling procedures

## Course Contents

**LTE Overview**

- Evolution & High Level Requirements
- High level architecture for the evolved system
- LTE-SAE Nodes
- Functional Architecture E-UTRAN EPC
- LTE-SAE Interfaces

**Evolved UTRA**

- Air Interface Evolutions
- LTE Identities: GUTI, M-TMSI, S-TMSI and C-RNTI, TAI
- LTE-Advanced Enhancements
- E-UTRA Protocol Interface
- Air interface - Control/User Planes
- Air interface Protocols, functions

**Evolved UTRAN**

- EUTRAN Architecture
- eNodeB Functions
- X2 Interface
- S1 Interface
- X2AP Protocol functions & Messages
- S1AP Protocol functions & Messages
- UE, eNodeB states

**LTE E-UTRAN Functions & Procedures**

- LTE cell search, synchronization, cell selection
- Measurements
- Self Organizing Network (SON)
- Automatic Neighbor Relation (ANR) functions

**E-UTRAN procedures & Signaling**

- X2 Interface - Complete procedures & Signaling Scenarios
- S1 Interface - Complete procedures & Signaling Scenarios
- NAS Signaling
- Handovers

**LTE security**

- Architecture
- Authentication
- Encryption
- Integrity

# LTE Evolved Packet Core Training (2 days)

4G

With LTE 3GPP has taken out traditional circuit switched elements (MSC) from core network and packet core elements are evolved to provide enhanced data services with better user experience. This course provides a good understanding of LTE/SAE architecture, interfaces, elements (e.g. MME, S-GW, P-GW) and their functional details. A basic understanding of 3GPP technologies like UMTS, LTE would be beneficial for anyone attending this course.

## Who Should Attend

This is advanced level course and suitable for telecom professionals including design, testing , support & sales engineers who already have some understanding of LTE & UMTS technologies.

## Objective

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

- Understand LTE Evolution & Architecture
- Define LTE EPC Interfaces & Nodes (e.g MME)
- Describe LTE EPC Interface protocols & functions
- Explain signaling procedures

## Course Contents

**LTE Overview**

- Evolution & High Level Requirements
- High level architecture for the evolved system
- LTE-SAE Nodes
- Functional Architecture E-UTRAN EPC
- LTE-SAE Interfaces

**Evolved UTRAN**

- EUTRAN Architecture
- eNodeB Functions
- X2 Interface
- S1 Interface

**SAE Functions & Architecture**

- EPC/SAE Requirements
- SAE Elements & Functions
- HSS, MME, S-GW, PDN-GW, PCRF
- Interfaces and protocols

**SAE Identities & Procedures**

- SAE Identities (e.g EPS Bearer, GUTI, TAI)
- Registration
- Attach, Detach
- SAE Mobility

**Security**

- Integrity and Encryption
- AAA Procedures.
- Key Hierarchy.
- IPSec, ESP

**SAE QoS, Policy and Charging**

- Policy and Charging Control Architecture
- QoS & QoS Mapping
- QoS Profiles
- Charging

**SAE Interworking Architecture & Signaling**

- CS and PS Interworking
- Interworking with GSM/GPRS
- Interworking with UMTS

# LTE RF Planning (2 days)

4G

LTE (Long Term Evolution) is initiated by 3GPP to improve the mobile phone standard to cope with future technology evolutions and needs. The LTE RF planning goal is to achieve optimum use of resources and maximum revenue potential whilst maintaining a high level of system quality. This course provides a good understanding of LTE concepts, LTE planning process details. A good knowledge of telecommunication & GSM/UMTS technology would be beneficial for anyone attending this course.

## Who Should Attend

This is advanced level course and suitable for telecom professionals including design, testing , support & sales engineers requiring good RF planning & optimization knowledge.

## Objective

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

- Understand LTE architecture & concept
- Describe LTE Link Budget
- Define RF planning process
- Explain Coverage & Capacity Dimensioning

## Course Contents

**LTE Introduction**

- Evolution & High Level Requirements
- High level architecture for the evolved system
- LTE-SAE Nodes
- Functional Architecture (E-UTRAN/EPC)
- LTE-SAE Interfaces
- EUTRAN Architecture

**LTE Air Interface Technologies**

- OFDMA
- SC-FDMA
- MIMO
- Beamforming
- Transmission Modes

**LTE Air Interface Physical Layer & Channels**

- Frame Structures
- Frequency Spectrum
- Physical Channels
- Logical Channels
- Transport Channels
- Channel Mappings
- Reference Signals

**Radio Planning Process**

- Radio Planning Process Overview
- Dimensioning
- Nominal Planning
- Detailed Planning
- Pre-Launch Optimization

**Radio Propagation Fundamentals**

- Propagation Mechanisms
- Multipath & Fading
- Propagation Loss

**Link Budget for LTE**

- System parameter considerations
- Gains and losses
- Link Budget –DL
- Link Budget –UL

**Coverage & Capacity Planning**

- Coverage Dimensioning
- Propagation Models
- LTE vs 3G WCDMA
- Capacity Dimensioning
- Cell Capacity (Throughput)

**LTE Deployment Scenarios**

- Frequency Deployment Scenarios
- Cell Deployments
- Microcells/Macrocells/Indoor
- Co-Existence Scenarios
- Backhaul

# WiMAX Essentials (1 day)

4G

Based on IEEE 802.16 standard, WiMAX, the Worldwide Interoperability for Microwave Access provides wireless data over long distances in a variety of ways, from point-to-point links to full mobile cellular type access. This course provides a good understanding of WiMAX architecture, interfaces and their functional details. A basic understanding of IP protocol would be beneficial for anyone attending this course.

## Who Should Attend

This is beginner level course and suitable for telecom professionals & students who have little understanding of WiMAX.

## Objective

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

- Understand WiMAX architecture
- Describe function of WiMAX nodes
- Explain WiMAX Interfaces
- Define Protocol Architecture
- Describe WiMAX Air Interface & Procedures

## Course Contents

**WiMAX Overview**

- What is WiMAX ?
- WiMAX Advantages
- WiMAX specifications
- WiMAX spectrum
- WiMAX deployment

**WiMAX Architecture**

- ASN Reference Model
- Wi-MAX Base Station
- Access Service Network ASN Gateway
- Connectivity Service Network
- Network Access Provider
- Network Service Provider
- WiMAX AAA Framework

**WiMAX Air Interface**

- Air Interface Protocol Architecture
- Physical Layer
- Modulation
- Medium Access Layer

**WiMAX Protocol Architecture & Procedures**

- E2E Protocol Structure
- Network Discovery and Selection
- Authentication in WiMAX
- IP addressing in WiMAX
- Data Path Setup
- Subscriber Traffic Handling
- WiMAX QoS Architecture

**WiMAX Mobility**

- ASN Anchored
- CSN Anchored

# UMTS Fundamentals (2 days)

3G

3GPP UMTS (Universal Mobile Telecommunications System ) is designed to fulfill high quality of service requirements for rapidly growing internet applications and to provide higher data rates to access a full range of services and applications. This course provides a high level overview of UMTS technology including its architectural and requirement details. Further it explains functional and protocol details of UMTS nodes. A good knowledge of cellular technologies like GSM would be beneficial for anyone attending this course.

## Who Should Attend

This is beginner level course and suitable for telecom professionals & students who have no understanding of UMTS.

## Objective

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

- Understand UMTS Evolution & Architecture
- Define UMTS Interfaces (Iub, Iur, Iu) & Nodes (RNC, NodeB)
- Describe UMTS Interface protocols (e.g. RRC, RANAP) & functions
- Explain signaling procedures

## Course Contents

**UMTS Overview**

- What is UMTS ?
- Cellular Evolution
- UMTS network overview
- 3GPP UMTS Architecture
- UTRAN Interfaces

**UMTS Air Interface**

- Physical Radio channel
- Spreading
- OVSF code generation
- Scrambling codes
- UL/DL Physical Channels
- Physical Layer Procedures
- RLC/MAC/RRC

**UTRAN**

- 3GPP UTRAN Architecture
- Node B/RNC functions
- Serving/Drift concept
- UTRAN- SRNS Relocation
- Iub/Iur interface
- NBAP
- RNSAP

**UTRAN Iu Interface**

- Iu interface
- Iu-CS/PS Protocol structure
- RANAP
- UMTS CS/PS Control/User Plane

**UMTS Signaling**

- RRC Connection Establishment
- RRC/CN Connection Release
- Location Update
- CS/PS Call
- Soft/Hard Handover

# UMTS Air Interface (2 days)

3G

3GPP UMTS air interface uses WCDMA technology far different than ETSI GSM and brings a whole new set of CDMA features. This course provides a good understanding of UMTS air interface technologies e.g. WCDMA Spreading, Scrambling and protocols (e.g. RRC, RLC, MAC) including functional details. A basic understanding of 3GPP UMTS would be beneficial for anyone attending this course.

## Who Should Attend

This is advanced level course and suitable for telecom professionals including design, testing , support & sales engineers who already have some understanding of UMTS technologies.

## Objective

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

- Understand UMTS Architecture
- Describe Air interface channels/technology
- Describe protocols (e.g. RRC, RLC, MAC) & functions
- Explain UMTS procedures

## Course Contents

**UMTS Overview**

- What is UMTS ?
- Cellular Evolution
- UMTS network overview
- 3GPP UMTS Architecture
- UTRAN Interfaces

**UMTS Air Interface Architecture**

- Channel Types
- Radio Channels
- Logical Channels - Control and Traffic
- Transport - Common and Dedicated

**Physical Channels**

- Channel Mapping
- Physical Interface
- Spread Spectrum
- Scrambling Codes, Spreading Codes
- Rake Receiver
- Uplink and Downlink Code Processing

**Radio Resource Control**

- RRC Functions / Architecture.
- RRC Procedures
- Idle Mode Procedures
- RRC Connection.
- Radio Bearer Procedures.

**UMTS Procedures**

- PLMN Selection.
- Cell Selection Procedures, System Information.
- UMTS Mobility, Cell Reselection.
- Measurement Reporting.
- Handover Procedures
- Common Channel Procedures
- Power Control

**Interworking**

- Mobility
- Handover

# HSPA (HSDPA, HSUPA) (1 day)

3G

3GPP Release 5 & 6 introduce new DL/UL transport channels HSDPA & HSUPA that enhance support for high-performance packet data applications. Together these two technologies are known as High Speed Packet Access (HSPA). This course provides a good understanding of HSDPA & HSUPA air interface features and protocol (e.g. RLC, MAC) changes. A good knowledge of 3GPP UMTS would be beneficial for anyone attending this course.

## Who Should Attend

This is advanced level course and suitable for telecom professionals including design, testing , support & sales engineers who already have good understanding of UMTS technologies.

## Objective

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

- Understand HSPA features
- Describe HSDPA/HSUPA channels/technology
- Describe protocols (e.g. RLC, MAC) changes
- Explain Signaling procedures

## Course Contents

**UMTS Overview**

**HSPA**

- Overview of HSPA
- HSPA goals
- HSPA approach

**HSDPA**

- HSDPA Basics
- HSDPA in the UTRAN
- HSDPA channels
- HSDPA strategies
- High speed channel usage
- HS-DPCCH, CQI and H-ARQ
- HS-DSCH and HS-SCCH
- HSDPA UE categories
- HSDPA Traffic Operations
- HSDPA data transmission overview
- CQI reporting
- Node B DL scheduling

**HSUPA**

- Basics
- HSUPA in the UTRAN
- HSUPA channels
- HSUPA strategies
- HSUPA Channels
- Enhanced channel usage
- UL channels (E-DCH and E-DPCCH)
- DL channels (E-AGCH, E-RGCH and E-HICH)
- HSUPA UE categories
- HSUPA Traffic Operations
- HSDPA data transmission overview
- Scheduling request
- Uplink scheduling at Node B
- Grant allocation
- Data transmission and control
- H-ARQ – Node B to UE
- HSUPA Data Call Signaling
- RRC connection
- Radio bearer setup

# Explore HSPA + (R7) (1 day)



3GPP Release 7 Specifies HSPA Evolution (HSPA+), which includes higher order modulation and MIMO. Radio enhancements to HSPA include 64 QAM in the downlink DL and 16 QAM in the uplink. This course provides a good understanding of HSPA+ air interface technologies, protocols & architecture changes. A good knowledge of 3GPP UMTS/HSPA would be beneficial for anyone attending this course.

## Who Should Attend

This is advanced level course and suitable for telecom professionals including design, testing , support & sales engineers who already have good understanding of UMTS/HSPA technologies.

## Objective

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

- Understand HSPA+ features
- Describe HSPA+ channels/technology
- Describe protocols, architecture changes
- Explain Signaling procedures

## Course Contents

**UMTS Overview**

**HSPA**

- Overview of HSDPA/HSUPA
- HSPA goals
- HSPA approach

**HSPA+ Overview**

- Evolution
- HSPA+ challenges
- HSPA+ benefits
- Impact of HSPA+ on UE and network

**Throughput Enhancement Features**

- Multiple Input / Multiple Output (MIMO)
- Continuous Connectivity for Packet Data Users (CPC)
  - DTX
  - DRX
- 64 QAM for HSDPA in DL
- 16 QAM for HSUPA in UL
- Improved Layer-2 Support for High Data rates

**Evolved HSPA Architecture**

**Latency and Power Enhancement Features**

- Continuous Connectivity for Packet Data Users (CPC)
  - DTX
  - DRX
- Enhanced Cell FACH

**MAC Enhancements**

- Overview
- MAC-ehs architecture (UTRAN side)
- MAC-ehs architecture (UE side)

**Interworking, and Beyond Release 7**

- Interworking with legacy UTRAN nodes
- Signaling
- HSPA+ Release 8 enhancements

# HSPA & HSPA+ (R5, R6 & R7) (2 days)

3G

3GPP Release 5, 6 & 7 introduce new DL/UL transport channels and features including MIMO that enhance support for high-performance packet data applications. HSPA+ doubles the data speed supported by HSPA. This course provides a good understanding of HSDPA, HSUPA & HSPA+ air interface features and protocol (e.g. RLC, MAC) changes. A good knowledge of 3GPP UMTS would be beneficial for anyone attending this course.

## Who Should Attend

This is advanced level course and suitable for telecom professionals including design, testing , support & sales engineers who already have good understanding of UMTS technologies.

## Objective

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

- Understand HSPA/HSPA+ features
- Describe HSDPA/HSUPA/HSPA+ channels/technology
- Describe protocols (e.g. RLC, MAC) changes
- Explain Signaling procedures

## Course Contents

**UMTS Overview**

**HSDPA**

- Benefits
- Applications
- Architecture

**HSDPA Features**

- Shared channel transmission
- Adaptive Modulation and Coding (AMC)
- H-ARQ
- Fair and fast scheduling at Node B
- Fast cell selection (FCS)
- Short transmission time interval (TTI)

**HSDPA Channels**

- High Speed Shared Control Channel High Speed PDSCH
- High Speed DPCCH

**HSDPA Protocol Architecture**

**MAC Architecture**

**HSDPA Operations & Mobility Procedures**

**HSUPA**

**Introduction**

- HSUPA Overview
- HSUPA Enhancements
- UMTS Architecture with HSUPA

**HSUPA Features**

- Multi code transmission
- Short Transmission Time Interval
- Fast hybrid Automatic Repeat reQuest
- Fast scheduling

**HSUPA Channels**

- Enhanced Uplink Dedicated Channel E-DCH E-DPDCH
- E-DCH DPCCH

**UTRAN Iub/Iur Protocol Aspects**

**HSUPA Protocol Architecture**

**MAC Architecture**

**HSUPA Operations & Mobility Procedures**

- HSUPA Serving cell change
- Intra-Node B Synchronised serving E-DCH cell change
- Soft Handover

**HSDPA/HSUPA Terminals**

**HSPA+**

**HSPA+ Overview**

**Throughput Enhancement Features**

- Multiple Input / Multiple Output (MIMO)
- Continuous Connectivity for Packet Data Users (CPC)
- 64 QAM for HSDPA in DL
- 16 QAM for HSUPA in UL
- Improved Layer-2 Support for High Data rates

**Evolved HSPA Architecture**

**Latency and Power Enhancement** Features

- Continuous Connectivity for Packet Data Users (CPC)
- Enhanced Cell FACH

- MAC Enhancements

Interworking with legacy UTRAN nodes

HSPA+ Release 8 enhancements

# HSPA, HSPA+ & Beyond (3 days)

3G

3GPP Release 5, 6, 7 & 8 introduce HSPA & HSPA+ technology that include new DL/UL transport channels and features including MIMO to enhance support for high-performance packet data applications. HSPA+ doubles the data speed supported by HSPA. This course provides a good understanding of HSDPA, HSUPA & HSPA+ air interface features, protocol (e.g. RLC, MAC) changes & dual carrier technology. A good knowledge of 3GPP UMTS would be beneficial for anyone attending this course.

## Who Should Attend

This is advanced level course and suitable for telecom professionals including design, testing , support & sales engineers who already have good understanding of UMTS technologies.

## Objective

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

- Understand HSPA/HSPA+ features
- Describe MIMO & Dual-Cell concepts
- Describe protocols (e.g. RLC, MAC) changes
- Explain Signaling enhancements

## Course Contents

**UMTS Overview**

**HSDPA**

**Introduction**

- HSDPA Overview
- HSDPA Enhancements
- Architecture

**HSDPA Features**

- Shared channel transmission
- Adaptive Modulation and Coding (AMC)
- H-ARQ
- Fair and fast scheduling at Node B
- Fast cell selection (FCS)
- Short transmission time interval (TTI)

**HSDPA Channels**

**HSDPA Protocol Architecture**

**MAC Architecture**

**HSDPA Operations & Mobility Procedures**

**HSUPA**

**Introduction**

- HSUPA Overview
- HSUPA Enhancements
- UMTS Architecture with HSUPA

**HSUPA Features**

- Multi code transmission
- Short Transmission Time Interval
- Fast hybrid Automatic Repeat reQuest
- Fast scheduling

**HSUPA Channels**

**UTRAN Iub/Iur Protocol Aspects**

**HSUPA Protocol Architecture**

**MAC Architecture**

**HSUPA Operations & Mobility Procedures**

- HSUPA Serving cell change
- Intra-Node B Synchronised serving E-DCH cell change
- Soft Handover

**HSDPA/HSUPA Terminals**

**HSPA+ & Beyond**

**HSPA+ Overview**

**Throughput Enhancement Features**

- Multiple Input / Multiple Output (MIMO)
- Continuous Connectivity for Packet Data Users (CPC)
- 64 QAM for HSDPA in DL
- 16 QAM for HSUPA in UL
- Improved Layer-2 Support
- **Evolved HSPA Architecture**

**Latency and Power Enhancement** Features

- Continuous Connectivity (CPC)
- Enhanced Cell FACH

MAC Enhancements

Interworking with legacy UTRAN nodes

**Release 8 enhancements**

- Dual-Cell HSDPA operation on adjacent carriers
- 64QAM and MIMO for HSDPA
- Improved L2 for uplink
- Enhanced Uplink for CELL_FACH
- Enhanced UE DRX for FDD
- HSPA VoIP to WCDMA/GSM CS continuity
- HS-DSCH Serving Cell Change Enhancements

HSPA+ Release 9 enhancements

# UMTS, HSPA & HSPA+ (3 days)

3G

3GPP UMTS (Universal Mobile Telecommunications System ) is designed to fulfill high quality of service requirements for rapidly growing internet applications and to provide higher data rates to access a full range of services and applications. 3GPP Release 5, 6 & 7 introduce new DL/UL transport channels and features including MIMO that enhance support for high-performance packet data applications. A good knowledge of cellular technologies like GSM would be beneficial for anyone attending this course.

## Who Should Attend

This is beginner level course and suitable for telecom professionals & students who have no understanding of UMTS.

## Objective

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

- Understand UMTS architecture & protocols
- Define UMTS interfaces
- Describe HSDPA/HSUPA/HSPA+ enhancements
- Explain Signaling procedures

## Course Contents

**UMTS Overview**

**UMTS Air Interface**

- Physical Radio channel
- Spreading
- OVSF code generation
- Scrambling codes
- UL/DL Physical Channels
- Physical Layer Procedures
- RLC/MAC/RRC

**UTRAN Architecture & Functions**

**UTRAN Iu/Iur/Iub Interfaces**

**UMTS Signaling**

- RRC Procedures
- Location Update/ CS/PS Call
- Mobility

**HSDPA**

**HSDPA Features**

- Shared channel transmission
- Adaptive Modulation and Coding (AMC)
- H-ARQ
- Fair and fast scheduling at Node B
- Fast cell selection (FCS)
- Short transmission time interval (TTI)

**HSDPA Channels**

**HSDPA Protocol Architecture**

**MAC Architecture**

**HSDPA Operations & Mobility Procedures**

**HSUPA**

**HSUPA Features**

- Multi code transmission
- Short Transmission Time Interval
- Fast hybrid Automatic Repeat reQuest
- Fast scheduling

**HSUPA Channels**

**UTRAN Iub/Iur Protocol Aspects**

**HSUPA Protocol Architecture**

**MAC Architecture**

**UTRAN Iub/Iur Protocol Aspects**

**HSUPA Protocol Architecture**

**MAC Architecture**

**HSUPA Operations & Mobility Procedures**

**HSDPA/HSUPA Terminals**

**HSPA+**

**HSPA+ Overview**

**Throughput Enhancement Features**

- Multiple Input / Multiple Output (MIMO)
- Continuous Connectivity for Packet Data Users (CPC)
- 64 QAM for HSDPA in DL
- 16 QAM for HSUPA in UL
- Improved Layer-2 Support for High Data rates

**Evolved HSPA Architecture**

**Latency and Power Enhancement** Features

- Continuous Connectivity for Packet Data Users (CPC)
- Enhanced Cell FACH

- MAC Enhancements

**Interworking, and Beyond Release 7**

# 3G RF Planning & Optimization (2 days)

3G

Designing a UMTS cellular system with both Macrocellular and Microcellular networks is a delicate balancing exercise. The goal is to achieve optimum use of resources and maximum revenue potential whilst maintaining a high level of system quality. This course provides a good understanding of UMTS concepts, UMTS planning process & Optimization details. A good knowledge of telecommunication & GSM/UMTS technology would be beneficial for anyone attending this course.

## Who Should Attend

This is advanced level course and suitable for telecom professionals including design, testing , support & sales engineers requiring good RF planning & optimization knowledge.

## Objective

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

- Understand UMTS architecture & concept
- Describe RF wave & antenna properties
- Define RF planning process
- Explain optimization

## Course Contents

**UMTS Overview**

**UMTS Air Interface**

- Physical Radio channel
- Spreading
- OVSF code generation
- Scrambling codes
- UL/DL Physical Channels
- Physical Layer Procedures
- RLC/MAC/RRC

**UTRAN Architecture & Functions**

**UTRAN Iu/Iur/Iub Interfaces**

**RF Wave Propagation**

- Coverge Area
- Propagation Environnent
- Propagation Models
- Wave Propagation Effects
- Multipath, Fading
- Diversity

**Antenna Operations Fundamentals**

- Radio Link
- Antenna Types
- Radiation Pattern
- Antenna Gain / Antenna Characteristics

**3G RF Planning overview**

- Differences compared to 2G
- Air Interface WCDMA Vs GSM
- Service Classes in UMTS
- Planning Vs Optimization

**WCDMA & UTRAN concepts**

- Frequency Allocation
- Spreading
- Radio resource management
- Power Control Objectives
- Power Control
- Handover control
- Handover in network planning
- Congestion and Admission Control
- Packet Scheduler

**3G RF Planning Process**

- High level objectives for Planning
- Radio Network Planning Process
- Pre-planning Phase
- Traffic dimensioning
- WCDMA Link Budget
- Code & frequency planning
- Planning Antenna Height
- Planning Antenna tilt
- Transmission powers
- Pilot pollution
- Neighbor cell relations

**3G Optimization process**

- WCDMA Radio Network Optimization
- SHO optimization
- Packet Scheduling Optimization
- Power & Admission Control
- Tools For Planning Optimization & Data Post Processing

**Drive Testing**

- Drive Test Plan
- Drive Test Procedure
- Drive Testing and Analysis
- Drive Test Equipment

# GSM Fundamentals (2 days)

2G/2.5G

ETSI GSM today is the most widely deployed wireless network worldwide. This second generation mobile standard has revolutionized wireless industry since its inception. This course provides a good understanding of GSM history, technology, protocols, architecture and services. A good knowledge of telecommunication would be beneficial for anyone attending this course.

## Who Should Attend

This is advanced level course and suitable for telecom professionals including design, testing , support & sales engineers requiring good GSM knowledge.

## Objective

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

- Understand 2 G architecture, access and core network
- Define GSM interfaces
- Describe GSM location area / cell/frequency/frame/Modulation concepts
- Explain E2E signaling procedures and protocols

## Course Contents

**Introduction**

- History of wireless communications
- Motivation for GSM
- Current GSM status
- Key characteristics of a GSM network

**GSM Network Architecture**

- Radio Subsystem
- Network Subsystem (NSS)
- Operation Subsystem (OSS)
- BTS/BSC/MSC

**GSM Radio/Physical Layer**

- Concept of radio channels
- Time Slots, frames, and multiple access
- System acquisition
- Traffic channel operations

**GSM Protocols & Interfaces**

- SS7 protocols
- LAPDm/RR
- BTS-BSC Interface
- BSC-MSC Interface
- MS-MSC Interface
- Core Network

**GSM Network Mobility and Call Processing**

- Attach and location update
- MO/MT calls
- Handover
- Security in GSM

**GSM Services**

- Teleservices
- Bearer services
- Supplementary services
- Short message
- CAMEL and location services

# GPRS/EDGE Fundamentals(2 days)

2G/2.5G

To satisfy accelerated growth of data, ETSI evolved GSM and created GPRS standard. One of its kind in beginning GPRS paved the way for more data intensive standards. This course provides a good understanding of GPRS history, modulation, technology, protocols, architecture and services. A good knowledge of GSM technology would be beneficial for anyone attending this course.

## Who Should Attend

This is advanced level course and suitable for telecom professionals including design, testing , support & sales engineers requiring good (E)GPRS knowledge.

## Objective

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

- Understand (E)GPRS architecture, access and core network
- Define GPRS interfaces
- Describe routing area/ frame/Modulation concepts
- Explain E2E signaling procedures and protocols

## Course Contents

**Introduction**

- Motivation for GPRS and EDGE
- Efficient use of radio resources
- Evolution from existing networks
- Supported data rates
- 3G technology landscape

**Network Architecture**

- Evolution from GSM networks
- GPRS and EDGE Radio Network
- GPRS Nodes

**Physical layer operations**

- Error protection techniques
- GMSK and 8PSK modulation
- MCS and CS classes

**Physical and logical channels**

**GPRS Interface & Protocols**

- **RLC/MAC**
- **GMM/SM**
- **SNDCP**
- **Gb Interface**
- **GTP**
- **Gn Interface**

**GPRS Packet Network**

**Signaling**

- GPRS Attach/Detach
- PDP context activation/deactivation

**GPRS Mobility and Roaming**

- Cell update procedures
- RA update

**GPRS Services**

**GPRS Roaming**

**GPRS Concepts**

**Different classes of GPRS handsets**

# GSM/GPRS/EDGE (2 days)

2G/2.5G

GSM & GPRS one of the most deployed mobile standards provides both CS & PS services. EDGE enhances GPRS data services to provide higher speeds. This course provides a good understanding of GSM/GPRS history, modulations, technology, protocols, architecture and services. A good knowledge of telecommunication would be beneficial for anyone attending this course.

## Who Should Attend

This is advanced level course and suitable for telecom professionals including design, testing , support & sales engineers requiring good GSM/GPRS knowledge.

## Objective

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

- Understand GSM/(E)GPRS architecture, access and core network
- Define GSM/GPRS interfaces
- Describe location/routing area/ frame/Modulation concepts
- Explain E2E signaling procedures and protocols

## Course Contents

**Introduction**

- History of wireless communications
- Motivation for GSM
- Current GSM status
- Key characteristics of a GSM network
- Motivation for GPRS and EDGE
- Efficient use of radio resources
- Evolution from existing networks
- Supported data rates
- Evolution to 3G

**GSM Network Architecture**

- Radio Subsystem
- Network Subsystem (NSS)
- Operation Subsystem (OSS)
- BTS/BSC/MSC
- GPRS Nodes

**GSM Radio/Physical Layer**

- Concept of radio channels
- Time Slots, frames, and multiple access
- System acquisition
- Traffic channel operations

**GSM Protocols & Interfaces**

- SS7 protocols
- LAPDm/RR
- BTS-BSC Interface
- BSC-MSC Interface
- MS-MSC Interface
- Core Network

**GSM Network Mobility and Call Processing**

- Attach and location update
- MO/MT calls
- Handover
- Security in GSM

**GSM Services**

**GPRS Physical layer operations**

- Error protection techniques
- GMSK and 8PSK modulation
- MCS and CS classes

**GPRS Physical and logical channels**

**GPRS Interface & Protocols**

- **RLC/MAC**
- **GMM/SM**
- **SNDCP**
- **Gb Interface**
- **GTP**
- **Gn Interface**

**GPRS Packet Network**

**GPRS Signaling**

- GPRS Attach/Detach
- PDP context activation/deactivation

**GPRS Mobility and Roaming**

- Cell update procedures
- RA update

**GPRS Services**

**GPRS Roaming**

**GPRS Concepts**

**Different classes of GPRS handsets**

# 2G RF Planning & Optimization (2 days)

2G/2.5G

Designing a GSM cellular system with both Macrocellular and Microcellular networks is a delicate balancing exercise. The goal is to achieve optimum use of resources and maximum revenue potential whilst maintaining a high level of system quality. This course provides a good understanding of GSM concepts, RF planning process & Optimization details. A good knowledge of telecommunication & GSM technology would be beneficial for anyone attending this course.

## Who Should Attend

This is advanced level course and suitable for telecom professionals including design, testing , support & sales engineers requiring good RF planning & optimization knowledge.

## Objective

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

- Understand GSM architecture & concept
- Describe RF wave & antenna properties
- Define RF planning process
- Explain optimization

## Course Contents

**GSM Overview**

**GSM Network Architecture**

- Radio Subsystem
- Network Subsystem (NSS)
- Operation Subsystem (OSS)
- BTS/BSC/MSC

**GSM Radio/Physical Layer**

**GSM Protocols & Interfaces**

**GSM Network Mobility and Call Processing**

**RF Wave Propagation**

- Coverge Area
- Propagation Environnent
- Propagation Models
- Free space propagation
- Wave Propagation Effects
- Multipath, Fading
- Diversity

**Antenna Operations Fundamentals**

- Radio Link
- Antenna
- Antenna Types
- Radiation Pattern
- Antenna Gain
- Antenna Characteristics

**GSM Cell Concepts**

- Geographical Characteristics
- Location Information - GSM Service Area Hierarchy
- Cell Characteristics
- Cellular Concept
- Frequency Reuse
- Interference
- Co-channel Interference
- Decreasing the co-channel interference Sectorisation
- Adjacent-Channel Interference

**2G RF Planning**

- Radio Network planning process
- Establish Network Requirements
- Pre-planning Process
- Site Survey & Site Selection
- Frequency Plan & CI Analysis
- Parameter Planning
- Link budget calculation
- Important Components of Link Budget Calculations
- Output and Effect of Link Budget Calculations
- Frequency Hopping
- Coverage Planning
- Capacity Planning
- Traffic Estimates
- Average Antenna Height
- Frequency Usage and Re-use
- Spectrum Efficiency and Frequency Planning

**2G RF Optimization**

- Optimization - How?
- Optimizing - New Cell Site Location & Antenna Tilts
- Optimizing - Neighbor lists
- Optimizing - Handover Margin
- Optimization for Interference

**Drive Testing**

# IMS Essentials (1 day)

FMC

IMS architecture defined by the 3GPP/3GPP2 group, is designed to enable seamless deployment of applications across a core network based on the open standards of the Internet Protocol. This course provides a good understanding of IMS background, architecture, protocols, Nodes and services. A good knowledge of fixed and wireless networks would be beneficial for anyone attending this course.

## Who Should Attend

This is beginner level course and suitable for telecom professionals & students who have little or no understanding of IMS.

## Objective

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

- Understand IMS architecture
- Define IMS interfaces
- Describe SIP Protocol
- Explain IMS signaling procedures and protocols

## Course Contents

**IMS Introduction**

- What is IMS?
- What does IMS provide?
- IMS Benefits – For Carriers
- IMS Benefits – For Users
- High level requirements – IMS Applications

**SIP Overview**

- Where we can use SIP ?
- SIP Architecture
- SIP Messages

**IMS Networks Architecture**

- Reference Points
- 3GPP IMS Network Configuration
- Key IMS Concepts
- Call Session Control Function - P-CSCF, I-CSCF, S-CSCF
- Breakout Gateway Control Function (BGCF)
- Multimedia Resource Function (MRF)
- Home Subscriber Server (HSS)
- SGW/MGW
- Media Gateway Controller Function (MGCF)

**Interworking with CS Networks**

- Interworking Reference Model
- Interworking between IM CN subsystem and CS network

**IMS Procedures & Signaling Scenarios**

- Establishing IP-Connectivity Access Network (IP-CAN) bearer for IM CN Subsystem Related Signalling
- Proxy CSCF discovery
- Interrogating CSCF - Determine Serving CSCF
- Registration with S-CSCF

**Emergency service handling**

- Reference Architecture
- Emergency CSCF
- Location Retrieval Function

**TISPAN IMS**

- NGN Functional Architecture
- NGN IMS Overview

# SIP/RTP Essentials (1 day)

FMC

The Session Initiation Protocol (SIP) is a signaling protocol, widely used for setting up and tearing down multimedia communication sessions such as voice and video calls over the Internet. This course provides a good understanding of SIP/RTP architecture, protocol and services. A good knowledge of Internet Protocol would be beneficial for anyone attending this course.

## Who Should Attend

This is beginner level course and suitable for telecom professionals & students who have little or no understanding of SIP & RTP.

## Objective

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

- Understand SIP/RTP Overview & architecture
- Describe SIP/RTP Protocols
- Explain SIP/RTP Call Flows
- Describe usage in Telecom Networks

## Course Contents

**SIP Overview**

- What is SIP ?
- SIP History, Standards
- SIP working groups
- Why SIP ?
- SIP Features

**SIP Protocol Description**

- SIP Architecture
- Building blocks of SIP Network
- SIP Nodes
- SIP Messages
- Location service

**SIP Call Flow**

- SIP Registration
- SIP Session Establishment
- Session Establishment Proxies
- SIP REDIRECTION
- Unsuccessful Scenarios

**SIP Security**

**SIP in Telecom Networks**

**RTP/RTCP Overview**

- What is RTP ?
- RTP History, Motivation
- RTP Advantage

**What is RTCP ?**

**RTP/RTCP over Transport Protocols**

**RTP packet details**

**RTP/RTCP Functions**

**RTCP packet types**

**RTP Translators and Mixers**

**RTP Profiles**

**RTP Usage Scenarios**

# Femtocell Essentials (1 day)

FMC

Femtocell devices are used to improve mobile network coverage in small areas. Femtocells connect locally to mobile phones and similar devices through their normal GSM, UMTS or LTE air interface to provide quality coverage. This course provides a good understanding of Femtocell concepts, 3GPP Femtocell architecture, protocol and services. A good knowledge of Internet Protocol & UMTS would be beneficial for anyone attending this course.

## Who Should Attend

This is beginner level course and suitable for telecom professionals & students who have little or no understanding of Femtocell technology.

## Objective

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

- Understand Femto/HNB overview & architecture
- Functions of 3GPP HNB nodes/protocols
- Define 3GPP HNB Interfaces
- Describe SCTP/HNBAP/RUA protocols
- Explain 3GPP HNB signaling procedures

## Course Contents

**Femtocell/HNB Overview**

- What is Femtocell ?
- Femto cell advantage
- 3GPP Femtocell
- High level requirements
- Goals

**Femto/HNB Architecture & Nodes**

- 3GPP Iu-Based HNB Architecture
- 3GPP HNB Interfaces

**3GPP Femto logical entities details**

- Home Node B (HNB)
- Security Gateway (SeGW)
- HNB Management System (HMS)
- HNB Gateway (HNB-GW)

**Femto/HNB Protocols**

- **3GPP HNB Control Plane**
- **Iuh interface protocol stacks**
- **SCTP explained**
- Home Node B Application Part
- RANAP User Adaption
- O&M for HNB Provisioning Procedure

**Femto/HNB Signaling**

- HNB Registration
- HNB Deregistration
- UE Registration
- Direct Transfer
- Connectionless Transfer
- Disconnect HNB
- UE De-Registration

**Femto/HNB Interworking**

**Femto/HNB QoS & Security**

**Next generation LTE Femtocell (HeNB)**

**Femto/HNB Commercial Availability**

# Sigtran Training (1 day)

FMC

Sigtran is a set of protocols defined to transport SS7 messages over IP networks. SIGTRAN allows IP networks to inter-work with the traditional SS7 network and vice versa. SIGTRAN protocol stack consists of a common signaling transport protocol and an adaptation layer protocol. This course provides a good understanding of Sigtran application layers, transport SCTP protocol and deployment configurations. A good knowledge of Internet Protocol & SS7 would be beneficial for anyone attending this course.

## Who Should Attend

This is beginner level course and suitable for telecom professionals & students who have little or no understanding of Sigtran protocols.

## Objective

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

- Understand SIGTRAN functions
- Define Signaling Transport Components
- Describe SIGTRAN protocols - SCTP, IUA, M2UA, M2PA, M3UA, SUA
- Explain Sigtran Signaling Procedures

## Course Contents

**Sigtran Overview & Architecture**

- SIGTRAN Introduction
- SIGTRAN Functional Model
- Signaling Transport Components
- Sigtran Architecture
- Benefits
- Application

**Sigtran Protocols & Messages**

- SCTP
- M3UA
- M2UA
- M2PA
- SUA
- IUA

**Sigtran in Telecom Networks**

- Sigtran in 2G/3G Networks
- M3UA ISUP Message Transport
- M3UA SCCP User Transport
- M2UA SS7 Transport
- M2PA Signalling Transport
- SUA SCCP User Transport

**Sigtran Signaling**

- SCTP Startup
- SCTP Data Transfer
- SCTP Association Shutdown
- M3UA Establishment of Traffic
- M3UA Normal Withdrawal

**Sigtran & SS7 Interworking**

# Internet Protocol (0.5 day)

FMC

The Internet Protocol (IP) is a protocol used for communicating data across a packet-switched internetwork using the Internet Protocol Suite, also referred to as TCP/IP. This course provides a good understanding of IP protocol & IP user protocols TCP & UDP. IP is the primary protocol in the Internet Layer of the Internet Protocol Suite and has the task of delivering distinguished protocol datagrams (packets) from the source host to the destination host solely based on their addresses.

## Who Should Attend

This is beginner level course and suitable for telecom professionals & students who have little or no understanding of Internet Protocol.

## Objective

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

- Understand IP Overview & IP Subnets & Addresses
- Describe IP Routing & IP Header
- Explain ICMP Protocol
- Explain TCP Protocol
- Explain UDP Protocol

## Course Contents

**IP Overview**

- What is IP ?
- IP History/Functions
- IP Datagram Fragmentation

**IP Addresses**

- Format
- Address Class/usage
- IP Addressing
- Subnetting

- **IP Routing**
  - Processing & Delivery of IP datagram
  - Routing table
  - Route Aggregation
- **IP Header**
  - IP Packet Format
  - IP Header Format
- **Internet Control Message Protocol**
  - What is ICMP ?
  - ICMP Packet Format
  - ICMP Message Types
  - PING
- **Transmission Control Protocol**
  - What is TCP ?
  - TCP/IP Protocol Architecture
  - TCP services
  - TCP Header Format
- **User Datagram Protocol**
  - What is UDP ?
  - UDP/IP Protocol Architecture
  - UDP Header Format

# UMA/GAN Essentials (0.5 day)

FMC

Unlicensed Mobile Access or UMA, is the commercial name of the 3GPP Generic Access Network, or GAN standard. GAN is a telecommunication system which extends mobile services voice and data applications over IP access networks using WiFi. This course provides a good understanding of UMA/GAN history, technology, protocols, architecture and services. A good knowledge of fixed and wireless networks would be beneficial for anyone attending this course.

## Who Should Attend

This is beginner level course and suitable for telecom professionals & students who have little or no understanding of UMA/GAN Technology.

## Objective

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

- Understand UMA/GAN Overview & Architecture
- Describe Function of UMA/GAN nodes/protocols
- Define UMA/GAN Interfaces
- Define Protocol Architecture
- Explain Messages & Signaling Scenarios

## Course Contents

**UMA/GAN Overview**

- What is UMA/GAN?
- Advantage for carriers
- Advantage for subscribers

**UMA/GAN Architecture**

- UMA/GAN Functional Architecture
- UMA/GAN Features
- Access Point
- GANC/UNC
- Security Gateway
- Mobile Station

**UMA/GAN Protocols & Interfaces**

- UMA/GAN – Reused Protocols
- CS/PS Control Plane
- CS/PS User Plane
- Generic Access Resource Control
- Generic Access Circuit Switched Resources
- Generic Access Packet Switched Resources
- MS - Mode of operation

**UMA/GAN Signaling**

- EAP-SIM Authentication
- Discovery Procedure
- Registration procedure
- GA-CSR Connection Establishment
- GA-CSR Connection Release
- Mobile Originated Call
- Mobile Terminated Call
- Handover
- GA-PSR GPRS Signalling Procedures

UMA-3G Interworking

- Overview
- EAP-AKA
- Handover

# SS7 Essentials (1 day)

Basics

Common Channel Signaling System No. 7 (i.e., SS7 or C7) is a global standard for telecommunications defined by the International Telecommunication Union (ITU) Telecommunication Standardization Sector (ITU-T). The standard defines the procedures and protocol by which network elements in the public switched telephone network (PSTN) exchange information over a digital signaling network to effect wireless (cellular) and wireline call setup, routing and control. This course provides a good understanding of SS7 layers, functions and deployment configurations.

## Who Should Attend

This is beginner level course and suitable for telecom professionals & students who have little or no understanding of SS7 protocols.

## Objective

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

- Understand SS7 Network Architecture
- Define Signaling Network Elements
- Describe SS7 Protocols & Stacks
- Explain SS7 signaling
- Describe SS7 usage in Mobile Networks

## Course Contents

**SS7 Overview**

- What is SS7?
- SS7 History
- SS7 Objectives
- SS7 Network Elements
- SS7 Links
- OSI vs. SS7
- SS7 Protocol Layers
- SS7 Functional Architecture

- **SS7 Protocol Description**
  - MTP1
  - MTP2
  - MTP3
  - ISUP
  - TUP
  - SCCP
  - TCAP
- **SS7 in Telecom Networks**
  - In PSTN Network
  - SS7 in 2G/3G Networks
  - PSTN, PSTN-2G/3G Control Plane
  - 2G, 3G core network Control Plane
  - 2G/3G access network Control Plane
- **SS7 Signaling**
  - Normal Alignment
  - Signaling Link Activation
  - Signaling Link Handling
  - Basic Call Setup/Release
  - ISUP Maintenance
  - SCCP Signaling & Management
  - TCAP Dialog management

# Telecom Fundamentals (0.5 day)

Basics

Telecommunication has changed the world and it has tremendous contribution in growth of mankind. Starting from wireline to wireless, as of today many telecom standards exist but all follow basic fundamentals of communication. This course provides a good understanding of telecommunication concepts, functions, signals and network models.

## Who Should Attend

This is beginner level course and suitable for professionals & students who have little or no understanding of telecommunication concepts.

## Objective

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

- Understand Basic Concepts
- Describe Switching Concepts
- Define Communication Networks & Network Models
- Explain Data & Signals
- Describe Multiplexing & Modulation

## Course Contents

**Basic Concepts**

- What is telecommunication?
- Components of a Telecommunication System
- Data Flow
- Communication Node

**Switching Concepts**

- Switching Networks
- Circuit Switching
- Packet Switching

**Communication Networks**

- Data Networks
- Local Area Network
- Wide Area Network
- Metropolitan Area Network
- Internet

**Network Models**

- Different Layering Architectures
- OSI Model
- Layered Architecture
- TCP/IP Protocol Suite

**Data & Signals**

- Analog and Digital Signal
- Time and Frequency domain representation
- Transmission Impairment
- Modulation

**Multiplexing**

- Frequency Division Multiplexing
- Time Division Multiplexing
- Interleaving
- Transmission Techniques

**Signaling Concept**

**Modulation Overview**

**Telecom standards**

# Wireless Fundamentals (0.5 day)

Basics

Wireless has taken over the legacy wirleine technology as a primary medium of communication. Wireless standards like GSM & UMTS has very high growth in last 2 decades and with LTE same is expected to continue in Data domain. This course provides a good understanding of RF concepts, standards and wireless networks.

## Who Should Attend

This is beginner level course and suitable for professionals & students who have little or no understanding of telecommunication concepts.

## Objective

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

- Understand RF propagation
- Describe Antenna properties
- Define Wireless technologies
- Explain communication concepts

## Course Contents

**RF Wave Propagation**

- Overview
- Coverage Area
- Propagation Environnent
- Propagation Models
- Free space propagation
- Longley-Rice model
- Wave Propagation Effects
- Multipath
- Fading
- Diversity

**Antenna Operations Fundamentals**

- Radio Link
- Antenna
- Antenna Types
- Radiation Pattern
- Antenna Gain
- Antenna Characteristics

**Satellite Communication Basics**

- Overview
- Types
- Frequency Bands

**Analog Cellular Overview**

**WiFi Basics**

**Multiple Access**

**Digital Mobile Standards**

- GSM
- GPRS/EDGE
- UMTS
- CDMA

# Transmission Fundamentals (0.5 day)

Basics

For both wireless & wirline communication Transmission Systems are building blocks of underlying network. Transmission media can be a physical cable or optical fiber based or microwave systems. This course provides a good understanding of transmission technologies, characteristics & usage in communication network..

## Who Should Attend

This is beginner level course and suitable for professionals & students who have little or no understanding of Transmission systems.

## Objective

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

- Understand Basic Concepts
- Describe transmission types
- Define Networks & Network Models
- Explain optical & microwave transmission

## Course Contents

**Overview**

- What is transmission?
- History
- Evolution
- Transmission types
- Challenges
- Usage in networks
- Components of a Transmission System

**Transmission Systems Fundamentals**

- Overview
- Digital Signaling
- Microwave Systems
- Optical Systems
- PDH
- SONET /SDH
- AON
- PON

**Satellite Communication Basics**

- Overview
- Types
- Frequency Bands

**Wavelength Multiplexing**

**ATM overview**

# Contact Us

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