DURATION | TECHNICAL LEVEL
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4 days | 1 2 3 4 5

COURSE DESCRIPTION
Designed to give a thorough understanding of the Architecture, Protocols and Operation of the GSM and GPRS networks, this course explains the concepts and implementation of the network in detail. Presented in a clear concise format, this course explores the technology in a logical format, including the Radio Access Network, Core Network, and the required underlying systems. The protocols are examined in depth and signalling flows are used where necessary to illustrate the operation.

Each training session is thoroughly reviewed to help understanding, and with the aid of the trainer, delegates are asked to complete a network map showing how the interfaces, protocols, and each part of the architecture fit together the in overall system.

PRE-REQUISITES
A basic appreciation of telecommunications is an advantage but is not essential.

COURSE OBJECTIVES:
At the end of the course, the delegate will be able to:

- Create a diagramatic representation of the GSM System Architecture, describing the role and basic operation of each element.
- Describe the structure and main features of the GSM radio interface, understanding the options available in terms of voice coding, user data rates, resource allocation, and channel mapping
- Explain the terms physical and logical channels as applied the GSM air interface and describe how logical channels are mapped to physical channels
- Identify the role of each protocol in the GSM air interface stack
- Follow and describe the basic GSM procedures, including mobility management, connection management and security functions
- Explain the main issues regarding interworking with external networks, including the PSTN and other GSM networks
- Discuss with confidence basic GSM procedures including Handovers and Location Updates
- List the different protocols used within a GPRS network, describing the role each plays within the overall system and the interfaces to which they are applicable
- Describe the structure and main features of the GSM GPRS radio interface, understanding the options available in terms of coding schemes, user data rates, resource allocation, and channel mapping
- Follow and describe the basic GPRS procedures, including connection and location management, context activation and security
- Explain the main issues regarding interworking with external networks, including the Internet, other GSM / GPRS networks (Roaming and the GPRS Roaming Exchange(GRX)), addressing issues and the provision of SMS over GPRS
- Discuss with confidence potential GPRS services, including GPRS mobile devices and class of operation, quality of service issues, network rollout, billing options, and service concepts
- Follow the core network signalling procedures for both simple service control and mobility scenarios in a GSM network
CONTENTS

Section 1 - GSM Introduction and Network Architecture
- Historical perspective
- Regulatory bodies
- Development and Specifications
- Other Second Generation Technologies
- Mobile station
- SIM
- Base Station Subsystem
- Network Switching Subsystem
- Interconnections
- Operations and Maintenance
- Air Interface
- Radio Spectrum

Section 2 - An introduction to Radio Channels and the GSM Radio Spectrum
- The Electromagnetic Wave
- Radio Spectrum
- The GSM radio Spectrum 900/1800 MHz
- Propagation
- Cellular principles
- C/I ratio
- Traffic and Grade of Service
- Path Loss and Cell Planning Tools

Section 3 - GSM Air Interface
- Time Division Multiple Access
- Physical channel
- Structure of Air Burst
- Traffic channels - 26 frame multiframe
- Signalling channels - 51 frame multiframe
- Typical cell example
- Introduction to Network Planning
- Example E1 link network planning calculation

Section 4 - GSM Procedures, Features and Services
- Idle mode operation
- Dedicated mode operation
- Power measurement report
- Drive Test Equipment
- Handovers
- Mobility management
- Summary of other procedures
- Teleservices, Bearer Services and Supplementary Services
- Voice Services
- Voice coding Principles
- Short Message Service
- Authentication and encryption
- Data over GSM
- Billing options

Section 5 - Introduction to the GSM Protocol Stack
- The OSI 7 Layer Model
- The GSM Protocol Stack
- The Physical Layer
- Data Link Layer 2 (LAPDm)
- The Network Layer 3 (CC, MM, RR)

Section 6 - GSM Layer 2 (LAPDm)
- Typical Layer 2 Functions and Procedures
- LAPDm Frame Formats and Fields
- Setting up a Datalink
- Numbered Information Frame Exchange
- Terminating a Datalink

Section 7 - GSM Layer 3
- RR Procedures and Messages
  Assignment to Channel
  Channel Modification
  Channel Release
- MM Procedures and Messages
  Service Request
  Identification and Authentication
  Location Updating
- CC Procedures and Messages
  Mobile Originating Call
  Mobile Terminating Call
  SS Service Modification
- SMS Procedures and Messages
  SMS Protocol Stack
  Mobile Originating SMS
  Mobile Terminating SMS

Section 8 - Layer 3 Example Signalling Sequences
- Mobile Originating Call, Successful / Abnormal
- Mobile Terminating Call, Successful / Abnormal
Section 9 - Evolving Mobile Technology
- High Speed Circuit Switched Data (HSCSD)
- Packet Switching and Circuit Switching Principles
- General Packet Radio Service (GPRS)
- Enhanced Data Rates for Global Evolution (EDGE)
- Wireless Access Protocol (WAP)
- Intelligent Networks & CAMEL
- SIM Application Toolkit
- Bluetooth
- Intelligent Networks and CAMEL
- Summary of other relevant technologies

Section 10 - GPRS Protocols
- The OSI 7 Layer Model
- GPRS and the OSI 7 Layer Model
- GPRS Tunneling Protocol GTP
- Routing Function of GGSN
- GTP Header
- TCP / UDP
- IP Header
- Sub Network Dependent Convergence Protocol SNDCP
- Routing from SGSN to MS
- SNDCP Header
- Logical Link Control LLC
- Base Station System GPRS Protocol BSSGP
- Network Service
- Frame Relay
- Signalling Protocol Stacks

ANNEX TO SECTION 2
- The Overall Protocol Architecture

Section 12 - General Information
- Cell Selection and Reselection
- GPRS Mobility Management
- Location Management
- Paging
- PDP Contexts
- Handovers
- GPRS Terminals and Device Classes
- Quality of Service
- GPRS Multislot Operation
- Authentication and Ciphering

Section 13 - Internet Protocol (IP) and GPRS
- Services Offered by the Internet - Email, World Wide Web, Newsgroups and Chat rooms, File Download
- Internet Infrastructure / Architecture
- Internet Addressing and the Domain Names System
- Intranet and Internet Access
- “Push” and “Pull” Services
- Roaming in GPRS – PLMN and ISP
- Roaming
- Intra and Inter PLMN Backbone Networks
- Mobile IP
- Nomadic Operation
- Billing – General Issues
- Billing – Technical Issues

Section 14 - SS7 in Mobile Networks
- The Intelligent Network Concept
- The Standard IN Architecture
- The Intelligent Network Application Part (INAP) and Messages
- The Use of SS7 in Support Of Intelligent Networks
- Example Procedures and the Use of SS7 Protocols - INAP, TCAP, SCCP, and MTP
- The GSM / UMTS Architecture – A Basic View
  Interfaces and Messages
- Basic GSM and UMTS Operation (Call Control, Mobility, and Service Support)
- The Mobile Application Part (MAP)
- The Use of SS7 in Support Of Mobile Networks
  Example Procedures and the Use of SS7 Protocols - MAP, TCAP, SCCP, and MTP
- The Role of CAMEL
- The Modified Mobile Architecture - Incorporating CAMEL into GSM and UMTS
- The CAMEL Application Part (CAP) and Messages
- The Use of SS7 in Support Of Intelligent Networks
  - Example Procedures and the Use of SS7 Protocols - CAP, TCAP, SCCP, and MTP

**Section 15 - Third Generation**
- Universal Mobile Telecommunications System UMTS
- Other 3G technologies
- Code Division Multiple Access CDMA
- Spectrum and Licensing status
- UMTS Terrestrial Radio Access UTRA – key features
- UMTS Radio Spectrum
- GSM Evolution to 3G