

UMTS, EGPRS & GSM

Updates with Rel. 5, 6, 7 & beyond

Course Duration:

- ▶ 3 days

Course Description:

- ▶ This course addresses the needs of engineers and technicians who need to understand the most important new features and enhancements of the 3GPP-Releases 5, 6 and 7 and the ideas of 3GPP with respect to the long term evolution (LTE).
- ▶ In that respect, the course contains tabular overview sections that outline which network parts are affected by a change and whether the changes are mandatory or optional. In the next part, the course provides a short overview of every feature and describes its operation and important characteristics.
- ▶ The course delves into more detail on some selected Release 5, 6 and 7-features. For Release 5, we explain in sufficient detail the IMS and HSDPA operation.
- ▶ For Release 6, a detailed introduction into HSUPA, MBMS and the adoption of alternative RAT's like WLAN or WIMAX as I-WLAN or GAN (formerly UMAN) is included.
- ▶ This part includes a detailed description of the operation of important authentication and tunnel setup procedures EAP-SIM, EAP-AKA and IKEv2.
- ▶ For Release 7, we describe the important enhancements in the IMS area plus we provide a description of how MIMO operates in general and how it shall be used within 3GPP-networks. In addition, we illustrate the operation downlink dual carrier operation for GERAN.
- ▶ The course concludes with a description of the long term evolution (LTE) concepts and ideas of 3GPP and an introduction to OFDM which will be used in 3GPP-networks.

Pre-Requisites:

- ▶ The student needs to have a *thorough* understanding of physical upper layer aspects of GSM, EGPRS and UMTS.
- ▶ Good comprehension of IP-stack issues in general and IP-security issues in particular is required.
- ▶ Practical design or test experience on GSM, EGPRS or UMTS equipment is a big plus.

Course Target:

- ▶ After the course the student will have a clear view of the evolutionary path of 3GPP-networks for the next 3 – 5 years.
- ▶ The student will understand the principles of MBMS, IMS-operation, OFDM, MIMO, HSDPA, SIP-signaling and HSUPA.
- ▶ The student will have a clear view on how alternative RAT's like WLAN or WIMAX can be integrated into the 3GPP-network environment, using the I-WLAN or the Generic Access (formerly UMA) approach.

Some of your questions that will be answered:

- ▶ What are the most important features and enhancements with 3GPP Release 5, 6 and 7?
- ▶ Which of these features overlap in which way? (Example: MBMS ⇔ IMS)
- ▶ How will the IMS influence the future evolution of GERAN and UTRAN?
- ▶ What is the difference between UMA, Generic Access, "I-WLAN direct IP-access" and "I-WLAN 3GPP IP-Access" ?
- ▶ How does EAP-SIM achieve mutual authentication although the SIM cannot provide it?
- ▶ How are IPsec-tunnels established between mobile station and network entities like GANC or PDG using IKEv2? How does IKEv2 operate in detail?
- ▶ How does HSDPA operate and how does it achieve its higher throughput rates? What are the new channels with HSDPA?
- ▶ How does HSUPA operate and how can it use a spreading factor of 2? Which new channels does HSUPA require and how do they operate?
- ▶ How does MBMS operate and what are the differences between MBMS and DVB-H? Which new channels does MBMS introduce in UTRAN and in GERAN?
- ▶ What is Downlink Dual Carrier Operation in GERAN Release 7 and how does it operate?
- ▶ How do MIMO-systems operate and how can they achieve their performance?
- ▶ How does E-UTRA apply OFDM?

Who should attend this class?

- ▶ Engineers, technicians and managers in charge who need to understand in detail the upcoming changes within 3GPP-networks and the implications for their work.
- ▶ Network Operators who need to know which features will become available in the medium term future and how to introduce them.

Table of Contents:

- **Major Architectural Changes**

- ⇒ GERAN in A/Gb- or Iu-Mode
- ⇒ Iu-Flex
- ⇒ The IP-Multimedia Subsystem
- ⇒ Iub- and Iu-CS-Interfaces IP-based
- ⇒ Upgrading the HLR to become the Home Subscriber Server

- **Major New Features**

- ⇒ HSDPA
- ⇒ SIP as IP-based Session Control Protocol
- ⇒ Additional Multislot Classes
Detailed Consideration of Selected Release 5 Enhancements and Features))))))

- **The IP-Multimedia Subsystem**

- ⇒ What is the IMS?
- ⇒ Service Perspective of the IMS
Service Types and Service Enablers, Conversational Services, Audiovisual Entertainment Services, Service Enablers
- ⇒ Description of the IMS-Network Architecture
Overview, The IMS within the 3GPP-Network Architecture
- ⇒ The Perspective of the IMS User Agent
Typical User Agents of the IMS, Mobile Handset - Today, Mobile Handset - Future, IMS-related User Identities
- ⇒ Protocols of the IMS (Perspective of User Agent)
SIP and SIP-Operation (Scope of SIP, Philosophy of SIP), Session Description Protocol (Media Description Example: AMR-Codec Definition for Audio Stream), Real-time Transport Protocol (RTP) (Format of the RTP-Header, Payload Type Examples), Session Setup Example through SIP (Resource Allocation if IP-CAN = GERAN/UTRAN)
- ⇒ GERAN-Operation in Iu-Mode
- ⇒ Core Network Interconnection using Iu-Interfaces
- ⇒ Protocol Stacks / Packet-Switched Domain
Control Plane, , , , , User Plane, , , , Physical Channels in Iu-Mode, Logical Channel Mapping Rules on DBPSCH, Logical Channel Mapping Rules on SBPSCH, Channel Mapping Example

- **The Iu-Flex Feature**

- ⇒ Packet-Switched Pool Areas
- ⇒ Circuit-Switched Pool Areas

- ⇒ Core Network Node Selection Function
- ⇒ Affected Network Nodes
- ⇒ HSDPA
- ⇒ Targets
- ⇒ Performance Figures
- ⇒ HARQ-Techniques with HSDPA
- ⇒ New Channels with HSDPA
- ⇒ Fast Resource Scheduling in HSDPA
- ⇒ Timing Relation between HS-DPCCH and HS-PDSCH
Overview of Important Release 6 Enhancements and Features))))))

- **Architectural Changes**

- ⇒ Adoption of Alternative RAT's
- ⇒ Access Network Sharing
Architecture Option 1: GWCN
- ⇒ Architecture Option 2: MOCN
- ⇒ Operation in case of MOCN
MBMS

- **Major New Features – UTRA-related**

- ⇒ Introducing HSUPA
- ⇒ Introducing Advanced Receiver Performance
- ⇒ The HSDPA-Enhancements
- ⇒ Additional Frequency Bands for UTRA

- **Major New Features – 2G and 2.5G Radio Related**

- ⇒ Packet-Switched Handover in A-/Gb-Mode of Operation
- ⇒ Operation / Message Flow
- ⇒ Multiple TBF's in A-/Gb-Mode of Operation
- ⇒ Flexible Layer One (FLO)

- **Major New Features – Upper Layers**

- ⇒ IMS-Enhancements
- ⇒ Generic Authentication Architecture (GAA)
- ⇒ UL-TDOA
- ⇒ W-AMR+ Codec
- ⇒ EAP-SIM and EAP-AKA

Detailed Consideration of Selected Release 6 Enhancements and Features))))))

- **MBMS**

- ⇒ Detailed View on the MBMS-Protocol Stack

- ⇒ User Service Level
Bearer Level

- ⇒ New Channels with MBMS

- **HSUPA**

- ⇒ Performance Considerations

- ⇒ Multicode Operation with HSUPA (Category 6 User Equipment with 4 x E-DPDCH)

- ⇒ The I/Q-Plane View of HSUPA: Is it really QPSK?

- ⇒ Practical Exercise: Determine the Sum-Signal of the Q-Branch for this Category 6 UE

- ⇒ The Protocol Stack of HSUPA

- ⇒ Operation of HSUPA

- Review: SIR Considerations in a CDMA-system, Resource Sharing of UL-Resources in HSUPA, Absolute Grants and Relative Grants

- ⇒ Description of the new Channels with HSUPA

- **Adoption of Alternative RAT's**

- ⇒ Interconnection Options for Alternative RAT's
I-WLAN Operation from the User's Perspective

- ⇒ Security Procedures in case of alternative RAT's
The EAP-SIM Procedure, The EAP-AKA Procedure, IKEv2 (The IKEv2-Procedure (Example: GAN/UMAN), The IKEv2-Procedure (Example: GAN/UMAN) (continued))

- ⇒ Details of GAN/UMAN-Access

- Network Architecture, Mobile Station Operation Modes, Protocol Stacks (Circuit-Switched Control Plane, Circuit-Switched User Plane, Packet-Switched Control Plane, Packet-Switched User Plane), Operation (GANC-Discovery and Registration, IMSI-Attachment / Location Update, Circuit-Switched Mobile Originating Voice Call)

- ⇒ Details of I-WLAN Direct IP-Access
Network Architecture, Attachment and Operation

- ⇒ Details of I-WLAN 3GPP IP-Access
Network Architecture, Protocol Stack, Attachment and Operation

- ⇒ Practical Exercise: Differentiation of Alternative RAT-Interconnection Options
Outlook to Rel. 7 and LTE (Long Term Evolution))))))

- **IMS-Enhancements with Release 7**

- **MIMO in 3GPP-Networks**

- ⇒ The Basics: Signal Fading Physics between Tx and Rx
- ⇒ Multiplexing Dimensions
- ⇒ The Multipath Dimension
 - Zoom into Rx1, Equalization – Distinction of Tx1 and Tx2, Characteristics of SAIC
- ⇒ Application in MIMO-Systems
- ⇒ Increased Spectral Efficiency and Higher Data Rates
- **The Look Ahead: 3GPP's Long Term Evolution**
 - ⇒ Overview
 - ⇒ The AIPN (All IP Network)
 - ⇒ E-UTRA
 - Objectives, Overview: OFDM (History and Use of OFDM, What is OFDM?, Summary: OFDM ..., Impact of Orthogonality in the Frequency Domain – 3 Steps, And finally: Why do we need IFFT for OFDM?)