

GSM/UMTS/LTE Basics

The “GSM/UMTS/LTE Basics” course presents in a concise form all the issues connected with modern cellular network, where GSM including GPRS/EDGE and UMTS including HSDPA/HSUPA services are commonly used and implementation of LTE together with IMS is a challenge of the following years.

During the training, all the radio access technologies i.e. GSM, UMTS and LTE and all types of services i.e. traditional telephony, packet transmission and IMS services are presented with the equal stress, since in the modern cellular network, all of them are run or will be run simultaneously in the near future.

Instead of presenting the topics in the traditional form, describing one technology after another, this course rather concentrates on common radio and network problems and on how this common problems are solved by GSM, UMTS and LTE. Thanks to, such form of the training, it becomes clear for the participants, that within 3GPP, there are no technologies that are fundamentally better or worsen than the others; each of them is optimized towards a certain environments and services; and all of them interwork with each other, creating one common, constantly evolving network.

With the “GSM/UMTS/LTE Basics” course participants may begin their cellular network education. Further, there are more advanced courses, which present aspects of GSM, UMTS and LTE technologies in greater detail.

Target audience

The course is intended for anyone who needs an introduction to aspects of GSM/UMTS/LTE architecture and functionality on a basic level. The detailed description of technical solutions is not included in the course.

Training contents

- **Introduction**
 - cellular concept
(cellular and non-cellular mobile systems, cell definition, cell and antenna types, frequency reuse patterns, relation between capacity and quality, increase of capacity),
 - analogue and digital signals
(analogue-to-digital conversion, sampling, quantisation, coding, digital transmission advantages),
 - speech compression
(types and properties of speech coders),
 - transmission systems basics
(E1/PCM link, transmission media: electrical cable, optical cable, microwave link),
 - switching
(circuit switching, packet switching, CSD & GPRS services).
- **Radio transmission**
 - transmission problems
(path loss, attenuation, shadowing, interferences, multipath propagation, time alignment),

- solutions to transmission problems
(power control, channel coding, interleaving, antenna diversity, frequency hopping, adaptive equalization, timing advance),
- duplex mode
(Frequency Division Duplex – FDD and Time Division Duplex – TDD),
- multiple access
(Frequency Division Multiple Access – TDMA, Time Division Multiple Access – TDMA, Code Division Multiple Access – CDMA, Orthogonal Frequency Division Multiple Access – OFDMA),
- modulation
(basic binary modulations, quadrature modulations, other high order modulations, relation between binary throughput and interference sensitivity, overview of modulations used in cellular systems: GMSK, QPSK, 8PSK, 16QAM, 32QAM, 64QAM, relation between symbol rate and channel width),
- radio link adaptation
(codec rate, modulation type and power level selection based on terminal and base station measurements reports),
- multiple antennas systems:
(multiple antennas system types, reception diversity, transmission diversity, Multiple Input Multiple Output – MIMO, advantages and disadvantages of multiple antennas systems, multiple antennas systems in cellular networks).
- **Radio Access Networks - RANs**
 - architecture
(GSM/EDGE Radio Access Network – GERAN: BTS and BSC, UMTS Terrestrial Access Network – UTRAN: NB and RNC, Evolved UTRAN – E-UTRAN: eNB),
 - radio and physical channels
(GERAN: frequency bands, radio channel, TDMA and physical channel, cell's radio resources, UTRAN: frequency bands, radio channel, signal spreading, CDMA and physical channel, orthogonal codes, Walsh tree, cell's radio resources; E-UTRAN: frequency bands, cell's radio resources),
 - logical channels
(traffic and control channels; broadcast, common and dedicated channels),
 - resource allocation
(resource/channel allocation for speech connection in GERAN and UTRAN, resource/channel allocation for packet connection in GERAN, UTRAN and E-UTRAN),
 - handover
(hard and soft handover, advantages and disadvantages off hard and soft handover, handover between GERAN cells, handover types in cellular systems).
- **Core Network - CN**
 - Circuit Switched (CS) CN domain
(R99- architecture: MSC/VLR, GMSC, HLR, EIR, AuC, routing of mobile terminated and mobile originated call, mobile-to-mobile call, subscriber profile transfer between HLR and VLRs; R4 architecture: MSC/GMSC Server, CS-MGW, IP/ATM transport network, advantages and disadvantages of R4 architecture; zalety i wady sieci o architekturze R4; R5 architecture: HSS; identification numbers: IMSI, MSISDN, MSRN, TMSI/P-TMSI/GUTI, IMEI),
 - Packet Switched (PS) CN domain
(SGSN, GGSN, IP transport network, GTP tunnels, APN, packet session establishment),
 - Evolved Packet Core (EPC) for LTE
(MME, S-GW, P-GW, PCRF, default and dedicated session establishment, cooperation between external servers and EPS access network, advantages of LTE/EPS CN in comparison to traditional CN),
 - location update and paging
(location/paging areas: LA, RA and TA, location update and paging procedure, advantages of location update procedure in LTE/EPS in comparison to traditional solutions),
 - security
(Auc and SIM, authentication, ciphering, equipment check, security procedures in cellular systems),



- international roaming
(international roaming for CS and PS services),
- SMS
(mobile originated and mobile terminated SMS, SMS Cell Broadcast – SMS CB),
- charging
(charging for CS and PS services),
- Intelligent Network – IN / CAMEL
(IN concept, basic IN services, architecture: gsmSSF, gsmSCF, SDP, SRF; IN parameters in HLR and VLR, IN service triggering, VPN service – example of IN service provisioning).
- **IP Multimedia Subsystem - IMS**
 - IMS concept
 - architecture
(P-CSCF, S-CSCF, I-CSCF, HSS, AS, MGCF, IM-MGW, BGCF, MRFC, MRFP),
 - identification and addressing parameters
(private and public user identity, ISIM card, ENUM translation),
 - traffic cases
(Quality of Service – QoS, protocols, IMS discovery, registration, security procedures, mobile-to-mobile call, mobile-to-PSTN),
 - other services
(presence service, push-to-talk over cellular, instant messaging, session based messaging, SMS, whiteboard communication).

Prerequisites

There are no prerequisites to attend the course.

Training method

Lectures, multimedia presentation (diagrams, animated diagrams, acoustic effects used as an analogy to radio signals) and theoretical exercises.

Duration

2 or 3 days (depends on participants' experience, needs and requirements; decided each time individually based on consultation with the client).

Level

Basic

