E-UTRAN/LTE Signalling

The course contains in-depth description of all interfaces, protocols and procedures within LTE RAN - E-UTRAN. The description of each protocol begins with theoretical instructor-led presentation closely followed by set of relevant practical exercises boosting students' attention and involvement. The vast majority of the exercises are based on real network traces presenting both fully successful procedures as well as some selected problematic cases. The training also contains an overview of the LTE/EPS architecture and functionality which is necessary to show E-UTRAN operation within the context of the entire system and to fully cover all aspects of E-UTRAN – EPC interworking.

Target audience:

Experienced network engineers, network planning, management and tuning staff, protocol stack developers and testers, as well as anyone with network experience who needs deep technical knowledge of E-UTRAN.

Duration:

4 days.

Contents:

Introduction

EPS Architecture, CSFB, SR-VCC, SON, EPS bearers, QoS, MME in pool, MOCN/MORAN, TA concept, identity numbers, OFDMA/SC-FDMA, MIMO, channels,

Traffic Cases

protocol states, attach and TA update, paging, service request, connection release, bearer activation, intra-LTE and inter-RAT handovers, ISR, CSFB call and SMS, SR-VCC PS to CS handover,

Security

HSS/AuC and USIM functionality, authentication and key agreement, key hierarchy, ciphering and integrity protection, KSN and local authentication, re-keying and key change, inter-RAT mobility,

NAS EPS Mobility Management (EMM)

signalling connection establishment, routing of initial NAS messages, signalling connection release, GUTI reallocation, authentication, security mode control, identification, information procedure, attach, detach, TA update, service request, extended service request, paging, SMS,

NAS EPS Session Management (ESM)

default and dedicated bearer activation, IP address allocation, bearer modification, bearer deactivation, UE requested PDN connectivity/disconnect, UE requested bearer resource allocation/modification, information request procedure,

Radio Resource Control (RRC)

protocol states, signalling and data radio bearers, system information, paging, connection establishment, reconfiguration, reestablishment, intra-LTE mobility, "forward and backward" handover, inter-RAT mobility, measurements and event reporting, connection release, idle mode mobility,

Packet Data Convergence Protocol (PDCP)

sequence control and duplicate detection, integrity protection, ciphering, status reporting, data retransmission during handover and reestablishment,

Radio Link Control (RLC)

RLC transmission modes: TM, UM and AM, error correction, concatenation, segmentation and reassembly of SDUs, re-segmentation and reordering of PDUs,

Medium Access Control (MAC)

contention based and non-contention based random access procedure, RNTIs, time alignment, DL/UL-SCH data transfer, HARQ operation, TTI bundling, adaptive and non-adaptive retransmissions, multiplexing and assembly of logical channels, QoS, SR, BSR and PHR reporting, DRX, SPS, VoLTE traffic handling,

Physical Layer – Downlink (PHY DL)

OFDM system model, CP length, radio frames, subframes and slots, resource grid, physical channel processing, scrambling, synchronisation and cell search, SCH channel, reference signals & channel estimation, PBCH, PCFICH, PHICH, PDCCH & REGs, DCI formats, resource allocation types, physical and virtual RBs, localised and distributed virtual RBs, PDSCH, MIMO, spatial layers, transmission rank, codewords, precoding matrix, transmission modes and schemes, channel coding, link adaptation, (a)periodic CQI/PMI reporting, measurements, UE capabilities,

Physical Layer – Uplink (PHY UL)

SC-FDMA system model, localised and distributed transmission, spectrum allocation, radio frames, subframes and slots, resource grid, physical channels, demodulation and sounding reference signals, PUSCH, resource allocation, inter / intra subframe hopping, PUCCH, resource allocations, UCI formats, PRACH & preamble formats, power control,

Stream Control Transmission Protocol (SCTP)

SCTP packet, chunk structure, multihoming, association establishment, transmission of data, retransmission, stream concept, shutdown and abort procedures,

GPRS Tunnelling Protocol – User Plane (GTP-U)

user data tunnelling, handling of sequence numbers, header format, path management messages,

S1 Application Part (S1AP)

SCTP as S1AP bearer, E-RAB setup/modification/release, NAS transport, initial context setup, context modification/release; intra-LTE, inter-RAT and SRVCC handover, path switch, paging, management procedures, UE capability info indication, trace procedures, location reporting,

X2 Application Part (X2AP)

SCTP as X2AP bearer, handover, path switch, data forwarding, load indication, error indication, X2 setup, reset, eNB configuration update, resource status reporting, mobility settings change, radio link failure indication, handover report.

Prerequisites:

General knowledge of EPS/LTE system architecture and functionality is required. Knowledge about GSM/UMTS GPRS services is very useful.

Completion of *EPS/LTE System Overview* course (or equivalent) is highly recommended.

Training method:

Lectures, multimedia presentations and practical exercises.