

## COURSE OUTLINE

### Introduction to Evolved Packet System (EPS)

- Evolution steps of the 3GPP systems, the goals for LTE
- E-UTRA and Evolved Packet Core network architecture
- Nodes: UE, eNB, SGW, MME and interfaces: Uu, X2, S1, S11
- Summary of the radio access techniques
- E-UTRAN protocol stack
- System parameters (bandwidths, bands, throughputs)

### Signal Processing for OFDMA, SC-FDMA and MIMO

- Fundamentals of multipath propagation (selectivity in time, frequency and space)
- OFDM transmission, orthogonality, subcarriers, separation between subcarriers
- Time-domain and frequency-domain representation of the OFDM signal
- Guard interval and Cyclic Prefix (CP) role
- Equalization for OFDM
- IDFT/DFT, IFFT/FFT
- Multiuser diversity and OFDMA
- SC-FDMA as a subclass of OFDMA, comparison between SC-FDMA and OFDMA
- Multiple antenna concept and related signal processing
- Open and closed loop spatial multiplexing
- Single-user and Multi-user MIMO

### Signal Processing for the Evolved Node B

- Architecture of the eNB transmitter and receiver including processing blocks and signals
- E-UTRA radio frame for FDD
- Downlink channel architecture
- eNB-originated signals and PHY channels: RS, P-SS, S-SS, PBCH, PCFICH, PHICH, PDCCH, PDSCH
- 3GPP Rel. 8 MIMO processing with layer mapping, pre-coding and feedback

### Signal Processing for the User Equipment

- LTE UE categories
- Architecture of the UE transmitter and receiver including processing blocks and signals
- Uplink channel architecture

- UE-originated signals and PHY channels: DRS, SRS, PUCCH, PUSCH, PRACH

### Evaluation of the eNB and UE Transceiver Operation Under Various Conditions

- Impact of uncorrected multipath channels
- Peak-to-average-power-ratio and its influence on the transmitted signal
- Pulse shaping and filtering in the time domain and its influence on the transmitted signal
- Synchronization mismatches in the time and frequency domain and their influence on the received signal
- Influence of various types of interferers (single-dominant, non-single-dominant) on the received signal

### Radio Interface Procedures

- Various traffic allocations for the FDD downlink and uplink E-UTRA radio frame
- Various traffic allocations for the TDD downlink and uplink E-UTRA radio frame
- Synchronization and random access procedures
- Scheduling for FDD
- ARQ operation and feedback consideration

### Processing Improvements in E-UTRA 3GPP Rel. 9 and Rel. 10

- Usage of 8 antennas in the downlink for spatial multiplexing
- Transmit diversity in the uplink
- Spatial multiplexing in the uplink
- Coordinated MIMO
- Bandwidth aggregation

Note: the course content is subject to minor changes and adaptations to the customer needs.