

3GPP LTE Physical Layer (3 DAY COURSE)



SYLLABUS

Introduction to 3GPP Long Term Evolution

- 3GPP evolution from R5 to R10
- Requirements
- Spectrum flexibility
- General characteristics
- Multi-user scheduling
- Resource allocation
- Frequency reuse planning

OFDM Theory Review

- Motivation for multi-carrier vs single-carrier
- Introduction to OFDM
- The structure of an OFDM signal
- Generation of OFDM symbols using the IFFT
- Cyclic prefix (guard interval)
- Windowing to reduce out of band emissions
- Oversampling and upconversion
- Peak-to-average power ratio (PAR)
- Techniques for reducing PAR

LTE Frames, Slots and Resources

- LTE Generic Frame Structure
- Downlink and uplink slot formats
- Resource elements and resource blocks
- Physical channels and signals

LTE Multiplexing and Channel Coding

- Transport channels and control information: DL-SCH, PCH, BCH, DCI, CFI, HI, UL-SCH and UCI
- Mapping of transport channels to physical channels
- CRC coding
- CRC masking of DCI messages
- BCH coding
- Code block segmentation
- Convolutional and turbo coding
- Rate matching, bit selection and pruning
- Transport channels and control information processing chains
- HARQ: incremental redundancy, stop and wait

LTE Downlink Physical Layer Modulation

- Downlink physical channel processing chain
- Codewords and layers
- Scrambling and modulation
- Downlink multi-antenna processing
- Transmission schemes
- Diversity, spatial multiplexing and beamforming
- Synchronisation signals: PSS and SSS
- Reference signals: cell and UE specific, MBSFN
- Downlink physical channels: PBCH, PCFICH, PDSCH and PDCCH
- The control region
- REGs and CCEs, PDCCH search spaces
- Resource grid mapping

MIMO Background

- Spectral efficiency and capacity
- Transmit and receive diversity
- The Alamouti Scheme
- Delay Diversity and Cyclic Delay Diversity
- Beamforming
- Spatial multiplexing
- Singular Value Decomposition
- Equalising and predistortion in MIMO systems
- Precoding and combining in MIMO systems
- Codebooks for MIMO

MIMO in LTE

- Codewords to layers mapping
- Precoding for spatial multiplexing
- Precoding for transmit diversity
- Beamforming in LTE
- Cyclic delay diversity based precoding
- Precoding codebooks

LTE Uplink Physical Layer Modulation

- Uplink physical channel processing chain
- Scrambling and modulation
- SC-FDMA review
- Single carrier FDMA symbol construction
- Uplink Reference signals: DRS and SRS
- Uplink physical channels: PUSCH, PUCCH, PRACH
- Control information: CQI, RI, PMI, HI and SR
- Control signalling on PUSCH and PUCCH
- PUCCH formats
- Uplink physical channels physical signals

Procedures

- Cell search
- Cell identities in cell search
- Symbol synchronisation
- Frame and cell synchronisation
- System information acquisition: MIBs and SIBs
- Timing synchronisation procedures
- Uplink power control

Release 9

- Release 9 features
- MBMS support
- Home eNodeB
- Positioning support
- Transmission schemes

LTE Advanced

- IMT Advanced Technologies
- LTE Release 10 features
- Carrier aggregation
- Spatial multiplexing
- Uplink multi-antenna transmission
- Downlink multipoint transmission