

Designing LTE and LTE Advanced Physical Layer Systems with MATLAB

Prerequisites

MATLAB Fundamentals and knowledge of wireless communications systems

Day 1 of 3

Introduction to 3GPP Long Term Evolution	<p>Objective: Provide an introduction to the LTE standard and its relationship to other 3GPP standards. Understand general requirements and objectives for LTE. Get an overview of different protocol layers within LTE.</p> <ul style="list-style-type: none">3GPP evolution from R5 to R11RequirementsSpectrum flexibilityGeneral characteristicsMulti-user schedulingResource allocationFrequency reuse planning
OFDM Theory Review	<p>Objective: Understand the basics of OFDM modulation, cyclic prefix insertion, and windowing.</p> <ul style="list-style-type: none">Motivation for multi-carrier vs single-carrierIntroduction to OFDMGeneration of OFDM symbols using the IFFTCyclic prefix (guard interval)Windowing to reduce out of band emissionsAdvantages and disadvantages of OFDM
LTE Frames, Slots and Resources	<p>Objective: Understand the concepts of frames, subframes, slots, and physical resource grids in LTE downlink and uplink.</p> <ul style="list-style-type: none">LTE generic frame structureDownlink and uplink slot formatsResource elements and resource blocksDownlink OFDM symbol constructionUplink SC-FDMA symbol constructionLTE downlink resource capacity

Day 2 of 3

Procedures	<p>Objective: Understand different physical layer procedures for both downlink and uplink specified in LTE.</p> <ul style="list-style-type: none">Cell searchCell identities in cell searchSymbol synchronizationFrame and cell synchronizationSystem information acquisition: MIBs and SIBsTiming synchronization proceduresUplink power control
-------------------	--

MIMO Background	<p>Objective: Understand different MIMO techniques namely diversity, beamforming, and spatial multiplexing. Learn about singular value decomposition as the solution to the generic MIMO problem.</p> <ul style="list-style-type: none"> Spectral efficiency and capacity Transmit and receive diversity The Alamouti Scheme Delay Diversity and Cyclic Delay Diversity Beamforming Spatial multiplexing Singular value decomposition Equalizing, predistortion, precoding, and combining
LTE Downlink Physical Layer Modulation	<p>Objective: Understand processing elements for different downlink physical channels and downlink physical signals. Learn about resource grid and control channel element.</p> <ul style="list-style-type: none"> Downlink physical channel processing chain Codewords and layers Scrambling and modulation Transmission schemes Diversity, spatial multiplexing, and beamforming Synchronization signals: PSS and SSS Reference signals: cell and UE specific, MBSFN Downlink physical channels: PBCH, PCFICH, PDSCH, and PDCCH Control region REGs and CCEs, PDCCH search spaces Resource grid mapping
MIMO in LTE R8	<p>Objective: Learn different MIMO techniques specified in the LTE standard.</p> <ul style="list-style-type: none"> Codewords to layers mapping Precoding for spatial multiplexing Precoding for transmit diversity Beamforming in LTE Cyclic Delay Diversity-based precoding Precoding codebooks

<p>LTE Multiplexing and Channel Coding</p>	<p>Objective: Understand the coding, multiplexing, and mapping to physical channels for all transport channels in downlink and uplink.</p> <p>Transport channels and control information: DL-SCH, PCH, BCH, DCI, CFI, HI, UL-SCH, and UCI</p> <p>Mapping of transport channels to physical channels</p> <p>CRC coding and masking</p> <p>Code block segmentation</p> <p>Convolutional and turbo coding</p> <p>Rate matching, bit selection and pruning</p> <p>Transport channels and control information processing chains</p> <p>HARQ: incremental redundancy, stop-and-wait</p>
<p>LTE Uplink Physical Layer Modulation</p>	<p>Objective: Understand processing elements for different uplink physical channels and uplink physical signals.</p> <p>Uplink physical channel processing chain</p> <p>Scrambling and modulation</p> <p>SC-FDMA review</p> <p>Uplink Reference signals: DRS and SRS</p> <p>Uplink physical channels: PUSCH, PUCCH, and PRACH</p> <p>Control information: CQI, RI, PMI, HI, and SR</p> <p>Control signaling on PUSCH and PUCCH</p> <p>PUCCH formats</p> <p>Uplink physical channels and physical signals</p>
<p>LTE Release 9</p>	<p>Objective: Learn about new features introduced in LTE Release 9.</p> <p>Release 9 features</p> <p>MBMS support</p> <p>Home eNodeB</p> <p>Positioning support</p> <p>Transmission schemes</p>
<p>LTE Advanced – Release 10</p>	<p>Objective: Learn about new features introduced in LTE Release 10.</p> <p>IMT-Advanced Technologies</p> <p>Carrier aggregation</p> <p>Uplink spatial multiplexing</p> <p>Spatial Orthogonal Resource Transmit Diversity</p> <p>Downlink enhanced MIMO</p> <p>CSI reference signals</p>