LTE Technology
LTE Lab, Wireless Communication Centre
Faculty of Telecommunication Centre, UTM Skudai, 1-5 October 2012 (5 Days)

PROGRAMME AGENDA - DAY 1				
Time	Module/Activity	Trainer	Duration	
8.30 - 9.00am	Registration		30 mins	
9.00 - 9.20am	Opening Address		20 mins	
9.20 - 9.30am	Group Photo Session		10 mins	**Learning Objectives – Acquired sound Understanding on;**
9.30 - 10.00am	Pre-Assessment Test		30 mins	Participants will take a pre-assessment MCQ test to benchmark their current skills & knowledge in LTE
10.00 - 10.30am	Topic 1 – Introduction	Prof Tharek	30 mins	➢ The market for mobile broadband ➢ What is 4G? ➢ Course introduction & schedule ➢ Learning outcomes
10.30 – 11.00am	Tea Break		30 mins	
11.00am – 1.00pm	Topic 2 – Background to LTE	Prof Tharek	120 mins	➢ 3GSM Mobile Network Evolution ➢ 3GPP standardisation process ➢ Rationale for LTE ➢ LTE frequency spectrum & licensing ➢ LTE and LTE Advanced ➢ LTE vs HSPA+ ➢ LTE release features ➢ System key features
1.00pm – 2.00pm	Lunch		60 mins	

PROGRAMME AGENDA - DAY 1				
2.00 – 3.30pm	Topic 3 – LTE Network Architecture	Prof Tharek	90 mins	➢ Overview of LTE network architecture ➢ The Evolved Packet System (EPS) ➢ The E-UTRAN radio access network ➢ The Enhanced Packet Core (EPC) ➢ Principal components: eNodeB, MME, S-GW and P-GW ➢ Network interfaces ➢ Interconnect to 3G/UMTS and GSM/GPRS
3.30 – 4.00pm	Tea Break		30 mins	
4.00– 5.30pm	Lab Session 1 – Introduction & Tour of LTE Lab Ecosystem	Prof Tharek + Dr Leow	90 mins	➢ Overview of equipment ➢ Key LTE related functions of the FSQ, SMU and CMW ➢ Walkthrough of the FSQ and SMU features & menus ➢ Walkthrough of the CMW features & menus ➢ Scope of testing possible

PROGRAMME AGENDA - DAY 2

Time	Module/Activity	Trainer	Duration	Learning Objectives – Acquired sound Understanding on;
8.30 - 10.30am	Topic 4 – LTE Air Interface	Prof Tharek	120 mins	➢ Review of FDMA ➢ Introduction to OFDM and OFDMA ➢ Differences between OFDM & OFDMA ➢ Multi & single carrier usage ➢ OFDMA carrier usage ➢ OFDMA and Intersymbol Interference (ISI) ➢ OFDMA and Doppler effect
10.30 – 11.00am	Tea Break		30 mins	
11.00 - 1.00pm	Topic 4 – LTE Air Interface (continues)	Prof Tharek	120 mins	➢ OFDMA usage in the LTE downlink ➢ Peak to Average Power Ratio (PAPR) ➢ SC-FDMA overview ➢ Comparison of SC-FDMA and OFDMA ➢ SC-FDMA in the LTE uplink ➢ Transmitter & receiver RF requirements
1.00– 2.00pm	Lunch Break		60 mins	
2.00 – 3.30pm	Lab Session 2 – LTE Channel Signal Generation	Prof Tharek + Dr Leow	90 mins	➢ Generation of LTE OFDMA signals ➢ OFDMA LTE downlink ➢ SC-FDMA LTE uplink ➢ Exploration and modification of OFDMA parameters

PROGRAMME AGENDA - DAY 2			
3.30 – 4.00pm	Tea Break	30 mins	
4.00 – 5.30pm	Lab Session 3 – LTE Channel Signal Analysis	90 mins	➢ Key LTE radio network measurements ➢ Measurement & analysis of OFDMA signals ➢ Power measurements ➢ Spectral flatness measurement ➢ Signal quality ➢ Analysis of the subcarrier & symbols ➢ Comparison between OFDMA & SC-FDMA

PROGRAMME AGENDA - DAY 3				
Time	Module/Activity	Trainer	Duration	**Learning Objectives – Acquired sound Understanding on;**
8.30 - 10.30am	Topic 5 – LTE MIMO Antenna Systems		120 mins	Participants will acquire sound understanding on: ➢ Review of antennas ➢ Diversity & signal de-correlation ➢ Principles of MIMO ➢ Space Time Coding & Spatial Multiplexing ➢ Downlink/Uplink MIMO in LTE ➢ Single user & Multi-user MIMO ➢ Array antennas ➢ Beam forming
10.30– 11.00am	Tea Break		30 mins	
11.00 - 1.00pm	Lab Session 4 – LTE device MIMO analysis		120 mins	Participants will acquire sound understanding on: ➢ Generation of 2x2 MIMO antenna signals from a single base station ➢ Diversity gain ➢ Increased data rate with spatial multiplexing ➢ Comparison of diversity gain & multiplexing gain ➢ Downlink MIMO operation
1.00 – 2.00pm	Lunch Break		60 mins	

PROGRAMME AGENDA - DAY 3			
2.00 – 3.30pm	Topic 6 – LTE Physical Layer Operation	90 mins	Participants will acquire sound understanding on: ➢ Network interfaces & protocols ➢ TDD and FDD operation ➢ The LTE frame structure ➢ Resource blocks ➢ Reference signals & channel estimation ➢ Resource management & allocation policies ➢ Synchronisation ➢ Power management ➢ Handover control ➢ Mobile device UE types & device categories ➢ Measurement parameters ➢ Adaptive modulation & coding
3.30 – 4.00pm	Tea Break	30 mins	
4.00 – 5.30pm	Lab Session 5 – LTE Physical Layer Operation	90 mins	Participants will acquire sound understanding on: ➢ Analysis of frame structure ➢ Resource blocks ➢ Reference signals ➢ LTE synchronization ➢ Power measurements ➢ Emulation of multipath channel ➢ Mapping of modulation & coding schemes based on radio quality ➢ Analysis of modulation constellation diagrams ➢ Error performance (EVM & frequency errors) ➢ Throughput testing

PROGRAMME AGENDA - DAY 4				
Time	Module/Activity	Trainer	Duration	Learning Objectives – Acquired sound Understanding on;
8.30 - 10.30am	Topic 7 – LTE Radio Protocol Operation		120 mins	Participants will acquire sound understanding on: ➢ Radio protocol architecture ➢ Separation of user & control plane ➢ The Medium Access Control (MAC) layer ➢ The Radio Link Control (RLC) layer ➢ Acknowledgements & retransmission ➢ Header compression ➢ The Packet Data Convergence Protocol (PDCP) layer ➢ Radio Resource Control (RRC)
10.30 – 11.00am	Tea Break		30 mins	
11.00- 1.00pm	Topic 8 – LTE Connection Life Cycle		120 mins	Participants will acquire sound understanding on: ➢ Network interfaces & protocols ➢ EPS mobility management ➢ EPS session management ➢ Handovers & intersystem changes ➢ Quality of service framework ➢ Packet connections ➢ Security framework ➢ Example connection: Circuit switched fallback solution for voice over LTE
1.00– 2.00pm	Lunch Break		60 mins	

PROGRAMME AGENDA - DAY 4			
2.00– 3.30pm	Lab Session 6 – LTE Connection Life Cycle Analysis	90 mins	Participants will acquire sound understanding on: ➢ LTE connection life cycle ➢ LTE radio channel analysis ➢ Monitoring & analysis of control channels ➢ eNodeB configuration & signaling ➢ UE configuration & signaling
3.30 – 4.00pm	Tea Break	30 mins	
4.00 – 5.30pm	Lab Session 7 – LTE Application Analysis	90 mins	Participants will acquire sound understanding on: ➢ LTE application real-time demonstration: Video streaming and VoIP ➢ LTE application non-real-time demonstration: web access ➢ Inter-RAT and Intra-RAT handover demonstration

PROGRAMME AGENDA - DAY 5

Time	Module/Activity	Trainer	Duration	Learning Objectives – Acquired sound Understanding on;
8.30 - 10.30am	Topic 9 – Introduction to LTE Advanced		120 mins	➢ The IMT-Advanced process ➢ LTE-Advanced system capabilities ➢ LTE-Advanced features ➢ Summary of LTE-Advanced test equipment features
10.30 – 11.00am	Tea Break		30 mins	
11.00– 12.00pm	Conclusions, Summary and Q&A		60 mins	➢ Summary of learning outcomes ➢ LTE test & measurement ➢ Regulatory issues & challenges ➢ Global LTE market ➢ LTE market in Malaysia
12.00 - 12.30pm	Post Assessment Test		30 mins	Participants will take a MCQ test to assess their skills & knowledge developed throughout the training
12.30- 1.00pm	Certificate Presentation		30 mins	
1.00pm	Programme End			