TT 1608: LTE Air Interface
Foundations Explained

Contact:
hello@techtrained.com
469-619-7419
918-908-0336
Course Overview:

If you are trying to learn LTE and don’t know where to start. You or your technical staff is asking questions such as:

- What procedures take place on LTE Air Interface?
- What procedures are triggered in EPS network and how?
- How scheduling takes place in UL and DL?
- How a UE searches a cell and get connected upon power on and many more?

This training reveals information elements at each layer of the RAN side of LTE. It reveals the in depth information on LTE air interface, in terms of technology, protocols and procedures. It provides detailed description on LTE Radio interface, its structure. Physical layer procedures such channel coding, modulation, OFDM, resource blocks, signaling procedures and scheduling both in UL and DL. How security procedure takes place in LTE. What are the threats and counter measures? Behind these procedures what protocols are involved on the RAN side for L3 Signaling protocols and L2 transport protocols are discussed in details.
LTE Knowledge and Learning Objectives:

On completion of this training, the course participants will become familiar and be able to understand the following topics for LTE:

LTE Overview

1. LTE Network Architecture
   a. Physical Channels
   b. Bearers
   c. Radio and Network Identities
   d. UE Context
2. LTE Radio Interface Overview
3. E-UTRA Features and Interfaces
4. Radio Interface Techniques
5. FDD and TDD
6. Spectrum Usage in LTE
7. Radio and Network Identities

OFDM, OFDMA and SC-FDMA Basic Principles

1. OFDMA Principle
2. Signal generation and processing
3. Inter Symbol Interference
4. OFDM Problems
5. SC-FDMA
6. Frequency Hopping
7. Proposed use in LTE
8. Pros and Cons with OFDM and SC-FDMA
LTE Radio Interface and Signaling

1. Radio Frame Structure
   a. Types of radio frames
   b. Time domain structure of the Radio frame for UL and DL in TDD and FDD
   c. Slots and subframes
   d. Symbol and subcarrier
   e. Resource Grid
   f. Resource Blocks
   g. Downlink PRB Parameters
   h. Uplink PRB Parameters
   i. Resource Elements

2. Channels structure of the Radio Interface
   a. Logical Channels in DL and UL
   b. Transport Channels in DL and UL
   c. Physical channels in DL and UL
   d. Physical signals in DL and UL
   e. Mapping of Logical, Transport and Physical Channels

3. Control Region and Allocation
   a. Resource Element Groups (REG)
   b. Mapping of RE and RS
   c. VRB, DVRB and mapping
   d. Control Channel Element (CCE)
   e. PDCCH search spaces,
   f. Function of CFI
4. Cell Synchronization and Cell Search

a. PSS and SSS Structure
b. Mapping to Resource Grid
c. Timing Acquisition and Cell Search
d. MIB structure
e. PBCH mapping to Resource Grid
f. Cell Identities
g. Cell Identity Group
h. Identity within the Group
i. Mapping to Cell Search Procedure
j. Physical VRB, DVRB and mapping
LTE Air Interface
Vital Procedures

1. Timing
   a. Downlink and Uplink Timing
   b. Timing Relationship
   c. Timing Advance Calculation

2. Paging
   a. Paging Requirements
   b. Paging Parameters
   c. Paging Frame and Paging Occasion Computation

3. HARQ Operation
   a. MCS
   b. Timing Relationship and Time Advance Calculations

4. Random Access Procedure
   a. Contention Based Random Access
   b. Non Contention Based Random Access

5. Power Control
   a. Power Control in DL
   b. Power Control in UL (PUSCH, PUCCH)
   c. Preamble based Power Control PRACH)
Physical Layer Procedures (Layer 1)
1. Scrambling
2. Modulation
3. Interleaving
4. Pre-Coding
5. Resource Mapping

Multi-Antenna Techniques
1. Transmission Modes
2. Transmit Diversity
3. MIMO Modes
4. SU-MIMO
5. MU-MIMO
6. Spatial Multiplexing
7. Advanced MIMO
   a. MU-MIMO
   b. CoMP
   c. Beamforming and Dual Streams

Security in LTE
1. Authentication Procedure
2. Security Architecture
3. Implications
4. Attack Possibilities
5. Radio Access Security
   a. eNodeB Security
   b. eNodeB Threats
   c. Countermeasures
LTE RAN Protocols

1. L3 Signaling Protocols
2. L2 Transport Protocols
3. Use of NAS, RRC, PDCP, RLC and MAC
4. E-UTRA
   a. Stratum
   b. NAS Control Plane
   c. NAS User Plane
   d. NAS Messages
   e. EMM Messages
   f. ESM Messages

5. E-UTRA Protocols
   a. Radio Resource Control
   b. RRC Messages
   c. RRC States
   d. Establishment of an RRC Connection

6. Non-Access Stratum – NAS Signaling
   a. NAS Protocol States and Transitions
   b. NAS Security
   c. Integrity Protection
   d. Non Access Stratum Protocols
      i. EMM
      ii. ESM
Duration
The length of the class is 5 days and maximum number of participants for online and on-site classes is 12.

Target Participants:
The target audience for this course is:

• RF engineers
• Performance engineers
• Service engineers
• Network engineer
• Anyone looking to start on LTE RF projects

Learning Situation and Delivery:
The course is available for delivery as:

• On-site
• On-line
• Self-paced
Premium Request:

If you want this course customized specifically for your target audience in terms of:

- Number of students
- Course contents
- Time duration

Or for anything else, please send an email to

hello@techtrained.com
About TechTrained:
TechTrained is a learning and training services company that helps individuals learn technology better by integrating it with the principles of sales, psychology and persuasion.