

# Troubleshooting of the LTE Radio Interface – 4 days

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## CONTENTS

The course provides in-depth knowledge of protocols and procedures found on Evolved UTRAN (E-UTRAN) through theory combined with case studies and self-solved hands-on exercises. Complex practical troubleshooting and optimization activities are made simple using monitoring tools, such as TEMS Investigation, and log-files recorded in live networks. Throughout the course a number of signalling scenarios are analysed, showing both successful and failed scenarios.

## PREREQUISITES

Participants must hold basic knowledge of LTE/EPC network architecture, terminology and modes of operation. For required background knowledge, attending Apis' course LTE/EPC System Overview (or equivalent) is recommended. Additionally, familiarity with E-UTRA interface, protocols and signalling scenarios, so as with network monitoring tools, e.g. TEMS Investigation, would be beneficial.

## WHO SHOULD ATTEND

This course is targeted at telecom professionals working on troubleshooting, quality assessment, optimisation, and OAM of E-UTRA.

Note: Participants are required to have a Windows laptop.

## EPS Overview and E-UTRAN Protocol Architecture

- Mobile network evolution: GSM to EPS
- Network nodes, areas, bearer concepts and identity numbers introduced for EPS
- EPS interfaces and protocols
- E-UTRA frequency bands and UE capabilities
- Logical, Transport and Physical channels and their relation to the radio interface protocol stack
- X2, S1 and S11-interface protocol stacks

## Uu-Interface (E-UTRA Radio Interface) Protocols

- NAS procedures (EMM and ESM)
- RRC procedures
- UE states and state transitions (NAS and RRC)
- PDCP and RLC protocols
- MAC and E-UTRA Scheduling
- Dynamic scheduling and semi-persistent scheduling
- Hybrid-ARQ
- E-UTRA Physical Layer

## The X2 Interface

- X2 Application Protocol (X2AP) procedures
- Inter cell interference cooperation
- Data forwarding and in-order delivery of data PDUs at handover

## Mobility

- Cell Reselection procedure
- Tacking Area Update
- Measurement Control & Reporting

- LTE Events
- Handover between eNodeBs

### **Interworking**

- Interworking with legacy R8 or pre-R8 3GPP networks
- CS Fallback

### **E-UTRAN Signalling Procedures and Hands-on Exercises**

- Random access procedure
- RRC connection establishment
- Attach procedure, incl. establishment of default EPS bearer and security associations
- Dedicated Bearer activation
- Mobility and Interworking
- Troubleshooting Case Studies