Long Term Evolution - LTE L10
Training Programs

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Introduction

Ericsson has developed a comprehensive Training Programs service to satisfy the competence needs of our customers, from exploring new business opportunities to expertise required for operating a network. The Training Programs service is delineated into packages that have been developed to offer clearly defined, yet flexible training to target system and technology areas. Each package is divided into flows, to target specific functional areas within your organization for optimal benefits.

Service delivery is supported using various delivery methods including:

<table>
<thead>
<tr>
<th>Icon</th>
<th>Delivery Method</th>
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<tbody>
<tr>
<td>📋</td>
<td>Instructor Led Training (ILT)</td>
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<tr>
<td>🗣️</td>
<td>Seminar (SEM)</td>
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<td>Web Based Learning/eLearning (WBL)</td>
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<td>📰</td>
<td>Structured Knowledge Transfer (SKT)</td>
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Delivery Enablers

Remote Training Lab (RTL)
Description
Are you ready to introduce LTE/SAE (Long Term Evolution/System Architecture Evolution)? We will give you a kick-start on how to handle the different business aspects covering both opportunities and challenges for LTE/SAE.

The impact of introducing LTE/SAE on existing networks is examined and different network considerations related to Radio, Transport and Core are presented.

A high level LTE/SAE network overview is provided as an introduction.

Learning objectives
On completion of this course the participants will be able to:

1 Have LTE/SAE overview
   1.1 Explain the evolution of cellular networks GSM, WCDMA, CDMA, TD-SCDMA
   1.2 Name different driving factors behind LTE/SAE
   1.3 Have high level understanding of LTE radio fundamentals
   1.4 Explain the architecture of EPS (E-UTRAN and EPC)
   1.5 List a selection of more important key LTE/SAE features

2 Discuss LTE/SAE Business Environment
   2.1 Explore current Market outlook
   2.2 Identify key business challenges
   2.3 Get familiar with various end user services and trends
   2.4 Distinguish different revenue and price models
   2.5 Explore various LTE device concepts

3 Examine LTE/SAE Network Considerations
   3.1 Discuss general Network Deployment Aspects
   3.2 Outline different Radio Network Considerations
   3.3 Outline different Transport Network Considerations
   3.4 Outline different Core Network Considerations
   3.5 Have a high level understanding of Voice over LTE
Target audience
The target audience for this course is: Business Developer and Fundamentals. This audience is typically working in Marketing and Sales or as Operation Managers.

Prerequisites
A general knowledge in cellular systems and radio technology.

Duration and class size
The length of the course is 2 days and the maximum number of participants is 16.

Learning situation
This course is based on theoretical instructor-led lessons and theoretical exercises given in a classroom environment.
Time schedule

The time required always depends on the knowledge of the attending participants and the hours stated below can be used as estimate.

<table>
<thead>
<tr>
<th>Day</th>
<th>Topics in the course</th>
<th>Estimated time</th>
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<td>1</td>
<td>LTE/SAE overview:</td>
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<td>Evolution of Cellular Networks</td>
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<tr>
<td></td>
<td>Driving factors behind LTE/SAE</td>
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<td></td>
<td>LTE Radio fundamentals</td>
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<td></td>
<td>Architecture of EPS (E-UTRAN and EPC)</td>
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<td>LTE/SAE Business aspects:</td>
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<td>Market Outlook</td>
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<td>Market Trends</td>
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<td>Key Business Challenges</td>
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<td></td>
<td>End User Services and Applications</td>
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<tr>
<td></td>
<td>Devices</td>
<td>0,5 hour</td>
</tr>
<tr>
<td></td>
<td>Revenue and pricing models</td>
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<td>2</td>
<td>Network Considerations:</td>
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<td></td>
<td>Network Deployment considerations</td>
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<td></td>
<td>Radio Network Considerations</td>
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<td>Transport Network Considerations</td>
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<tr>
<td></td>
<td>Core Network Considerations</td>
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<td></td>
<td>Exercise</td>
<td>2 hours</td>
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<tr>
<td></td>
<td>Summary and Conclusion</td>
<td>1 hour</td>
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LTE/SAE – System Overview

Description
If you want to know what LTE/SAE (Long Term Evolution / System Architecture Evolution) is, this course will give you an overview of the new radio technology and protocols involved in the E-UTRAN (Evolved UTRAN, also referred to as LTE) and the architecture behind EPC (Evolved Packet Core, also referred to as SAE – System Architecture Evolution).

The course also provides descriptions of operation and maintainsce and RBS hardware.

Learning objectives
On completion of this course the participants will be able to:

1. Explain the background and architecture of E-UTRAN and EPC
   1.1 Describe the evolution of cellular networks
   1.2 Summarize the evolution of 3GPP releases, from release 99 to release 8
   1.3 Explain the logical architecture of EPS (E-UTRAN and EPC)
   1.4 Give an overview of the QoS framework

2. Describe the EPC Architecture
   2.1 Describe the interfaces in EPS
   2.2 Describe the Evolved Packet Core (EPC)
   2.3 Describe the role of the MME, S-GW and PDN-GW
   2.4 Describe the S1 (and X2) protocol stacks
   2.5 Explain the interaction with IMS on an overview level

3. Describe the E-UTRAN principles
   3.1 List the radio interface protocols
   3.2 Describe the radio interface techniques used in uplink and downlink
   3.3 Describe the channel structure of the radio interface
   3.4 Explain the OFDM principle and benefits
   3.5 Detail the reference symbols in DL
   3.6 Describe MIMO
   3.7 Explain the SC-FDMA principle and benefits

4. Describe on an overview level the RBS HW and O&M (Operation and Maintenance)
   4.1 Describe the RBS hardware in LTE
   4.2 Explain the concepts related to Smart Simplicity, Self Organizing Networks (SON), Automated Provisioning of RBS (APR), Automated Neighbor Relations (ANR)
   4.3 Describe the overall role and function of OSS-RC

Target audience
The target audience for this course is:

Network Engineer
Service Engineer
Service Design Engineer
Network Design Engineer

Prerequisites
A general knowledge in cellular systems and radio technology.

Duration and class size
The length of the course is 2 days and the maximum number of participants is 16.

Learning situation
This course is based on theoretical instructor-led lessons and theoretical exercises given in a classroom environment.

Time schedule
The time required always depends on the knowledge of the attending participants and the hours stated below can be used as estimate.

<table>
<thead>
<tr>
<th>Day</th>
<th>Topics in the course</th>
<th>Estimated time</th>
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</thead>
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<tr>
<td>1</td>
<td>Course Introduction, LTE/SAE Introduction</td>
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<tr>
<td></td>
<td>EPC Architecture</td>
<td>3 hours</td>
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<tr>
<td>2</td>
<td>Radio Interface principles</td>
<td>3 hours</td>
</tr>
<tr>
<td></td>
<td>Operation and Maintenance and RBS HW</td>
<td>3 hours</td>
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</tbody>
</table>
LTE 10 Air Interface

Description

This course reveals the radio technology involved in E-UTRAN (Evolved UTRAN, also referred to as LTE – Long Term Evolution).

The course provides detailed descriptions and explanations of the radio interface channel structure and explains the concepts of channel coding, modulation, OFDM (Orthogonal Frequency Division Multiplexing), SC-FDMA (Single-Carrier Frequency Division Multiple Access), MIMO (Multiple Input Multiple Output), Resource Blocks, Scheduling, control signaling, System Information, FDD, TDD. Mobility, paging, cell search and random access is also explained on an overview level.

Learning objectives

On completion of this course the participants will be able to:

1. Explain the LTE Radio Interface general principles
   1.1 Describe the evolution of cellular networks
   1.2 Summarize the evolution of 3GPP releases, from release 99 to release 8
   1.3 Describe the radio interface techniques
   1.4 Explain the difference between the FDD and TDD mode
   1.5 Describe the flexible spectrum usage
   1.6 Explain the concepts of channel coding and FEC (Forward Error Correction)
   1.7 Describe the principle for OFDM
   1.8 Describe the principle for SC-FDMA

2. Detail the Radio Interface Channel Structure and Signaling
   2.1 Detail the channel structure of the radio interface
   2.2 Describe the physical signals in UL and DL
   2.3 Detail the radio interface protocols
   2.4 Detail the time-domain structure in the radio interface in UL and DL for both FDD and TDD mode
   2.5 Detail the downlink transmission technique
   2.6 Have a good understanding of the OFDM principle, signal generation and processing
   2.7 Detail the reference symbols in DL
   2.8 Detail the DL control signaling and formats
   2.9 Detail the paging procedures
   2.10 Explain HARQ
   2.11 Explain the cell search procedure
   2.12 Detail the uplink transmission technique
   2.13 Have a good understanding of the SC-FDMA principle, signal generation and processing
   2.14 Explain the pros and cons with OFDM and SC-FDMA
   2.15 Detail the UL control signaling and formats
   2.16 Detail the random access procedure
   2.17 Describe the Power Control in UL
3 Describe Scheduling MIMO, and Mobility
3.1 Describe UL and DL Scheduling and signaling
3.2 Explain the concepts of dynamic and persistent scheduling
3.3 Describe the concepts of layers, channel rank, spatial multiplexing, open and closed loop spatial multiplexing, TX diversity, beamforming, SU-MIMO and MU-MIMO
3.4 Describe intra-LTE mobility in ECM-CONNECTED and ECM-IDLE mode

Target audience
The target audience for this course is:
Network Engineer
Service Engineer
Service Design Engineer
Network Design Engineer

Prerequisites
Successful completion of the following course:
LTE/SAE Overview Lzu 108 7020
Attendees should have a general knowledge in cellular systems and radio technology. An in-depth knowledge in WCDMA, HSPA and/or GSM radio interface is profitable.

Duration and class size
The length of the course is 3 days and the maximum number of participants is 16

Learning situation
This course is based on theoretical instructor-led lessons and theoretical exercises given in a classroom environment.
Time schedule
The time required always depends on the knowledge of the attending participants and the hours stated below can be used as estimate.

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<th>Day</th>
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<td>1</td>
<td>• Introduction, Radio Interface general principles</td>
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<td></td>
<td>• Radio Interface Channel Structure and signaling</td>
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<td>2</td>
<td>• Radio Interface Channel Structure and signaling continued</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>• Scheduling MIMO and Mobility</td>
<td>6</td>
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LTE L10 Protocols and Procedures

Description
This course covers the LTE RAN protocols and procedures. It gives an in-depth understanding of the LTE Systems radio access network architecture and signaling, as well as the EPS Bearer Service, End-to-End service from QoS aspects. It covers the LTE radio access interfaces, such as X2 and S1, and corresponding controlling protocols X2AP and S1AP. Also covered in this course are the protocols used over these interfaces: RRC, PDCP, RLC, MAC and the physical layer for the radio interface.

The purpose of the course is to enable the students to understand complete traffic cases in EPS.

Learning objectives
On completion of this course the participants will be able to

1. **Explain the EPS Architecture**
   - 1.1 State the main functions of the network elements
   - 1.2 List the interfaces

2. **Explain the Main Functions of the Protocols Involved in EPS.**
   - 2.1 Explain how signaling takes place between the UE and the EPC
   - 2.2 State the main functions of Radio Resource Control (RRC), Packet Data Convergence Protocol (PDCP), Radio Link Control (RLC), Medium Access Control (MAC), the physical layer and their relations
   - 2.3 Explain the interaction of the eUTRAN protocols and the mapping of logical, transport and physical channels

3. **Explain the LTE/SAE Quality of Service**
   - 3.1 Explain the purpose of EPS Bearer Services and eUTRA Radio Bearer
   - 3.2 List the different attributes of the eUTRA Radio Bearer and explain how they are used

4. **Explain the RRC Protocol**
   - 4.1 Explain the interaction between RRC and the lower layers in the control plane
   - 4.2 Explain the RRC layer structure
   - 4.3 Explain the RRC Service States and the difference between connected and idle mode
   - 4.4 Explain the functions and services of RRC such as System Information Broadcast, Paging, Cell Selection and Mobility

5. **Explain the PDCP Protocol**
   - 5.1 Explain the PDCP functions and services such as header compression and ciphering

6. **Explain the RLC and MAC Protocols**
   - 6.1 Explain the RLC functions.
   - 6.2 List the different modes of RLC (transparent, unacknowledged and acknowledged mode) and explain the structure of the PDU involved in these cases.
6.3 Explain the MAC functions such scheduling, HARQ
6.4 Explain the MAC architecture, its entities and their usage for the mapping of transport channels.
6.5 List the contents of the MAC Packet Data Unit (PDU).

7 Explain the X2/S1 Interface and the X2AP/S1AP Protocol
7.1 Explain the main functions and procedures of X2AP signaling protocol.
7.2 Explain the main functions and procedures of S1AP signaling protocol.
7.3 Explain the main functions and procedures of the user plane protocols GTP.

8 Explain the most Important Configuration Cases
8.1 Auto configuration of the eNodeB

9 Explain Mobility in LTE
9.1 X2 Handover
9.2 S1 Handover
9.3 IRAT Handover

Target audience
The target audience for this course is:
Service Design Engineer
Network Design Engineer
System Engineer

Prerequisites
The participants should be familiar with radio interface solution for LTE or successful completion of the following course:

LTE L10A Air Interface
LZU 108 7260

Duration and class size
The length of the course is 3 days and the maximum number of participants is 16.

Learning situation
This course is based on theoretical instructor-led lessons and theoretical exercises given in a classroom environment
**Time schedule**

The time required always depends on the knowledge of the attending participants and the hours stated below can be used as estimate.

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<tr>
<th>Day</th>
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<th>Estimated time</th>
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<tbody>
<tr>
<td>1</td>
<td>• EPS Architecture</td>
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<tr>
<td></td>
<td>• Explain the main functions of the protocols involved in EPS</td>
<td>2 hours</td>
</tr>
<tr>
<td></td>
<td>• Explain the LTE/SAE Quality of Service</td>
<td>2 hours</td>
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<tr>
<td>2</td>
<td>• Explain the RRC Protocol</td>
<td>4.5 hours</td>
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<tr>
<td></td>
<td>• Explain the PDCP Protocol</td>
<td>1.5 hours</td>
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<tr>
<td>3</td>
<td>• Explain the RLC and MAC Protocols</td>
<td>2 hours</td>
</tr>
<tr>
<td></td>
<td>• Explain the X2/S1 Interface and the X2AP/S1AP Protocol</td>
<td>2 hours</td>
</tr>
<tr>
<td></td>
<td>• Explain the most important configuration cases</td>
<td>0.3 hour</td>
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<tr>
<td></td>
<td>• Explain Mobility in LTE</td>
<td>1.7 hours</td>
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LTE L10 Functionality

LZU1087262 R1A

Description

Do you want to have full and detailed understanding of the Ericsson E-UTRAN features and functionalities? If so, the LTE L10A Radio Network Functionality course will give you all that. This course describes the Idle Mode Behavior, how Radio Connection Supervision is carried out, Power Control settings, calculations and functions. The Capacity Management functions and Handover as well as Channel Switching algorithms will definitely boost your competence and understanding of the Ericsson E-UTRAN solution.

Learning objectives

On completion of this course the participants will be able to:

1 Explain the logical architecture of E-UTRAN and introduce Radio Functionality
   1.1 Detail the logical architecture of the Ericsson E-UTRAN
   1.2 List the Radio Functionality supported in the Ericsson E-UTRAN

2 Describe the purpose and function of Idle Mode Behavior
   2.1 Explain PLMN and Cell selection and reselection
   2.2 Explain registration updating procedures
   2.3 Explain paging procedures
   2.4 Describe the organization of system information

3 Explain the purpose and function of Radio Connection Supervision
   3.1 Explain how the radio connection supervision is carried out
   3.2 Explain how in-synch and out-of-synch is determined by the radio link monitoring algorithm in the RBS

4 Describe the purpose and use of the function Power Control, Link Adaptation and Scheduling
   4.1 Explain open loop power control for initial access
   4.2 Configure the power of common channels
   4.3 Explain uplink power control for PUSCH and PUCCH
   4.4 Explain the interaction between Power Control, Link Adaptation and Scheduling
   4.5 Explain the impact of MIMO
5 Describe the purpose and function of the Capacity Management
5.1 Describe the interaction between the Monitored System Resources (MSRs) and the different algorithms
5.2 Explain the static and dynamic MSRs
5.3 Explain Admission Control
5.4 Explain Congestion Control
5.5 Explain the interaction with QoS

6 Explain the purpose and function of Intra-LTE Handover, Inter-Radio Access Technologies (IRAT) Handover and IRAT Session Continuity
6.1 Explain Intra LTE mobility
6.2 Explain Coverage Triggered Session Continuity (GSM, WCDMA and CDMA2000)
6.3 Distinguish between release with redirect and handover
6.4 Detail what type of events trigger measurement reports to be sent to the eNB
6.5 Describe the purpose of the handover evaluation algorithm and Best Cell Evaluation

7 Explain the purpose and function of Automated Neighbor Relations (ANR)
7.1 Explain the detection and adding of external RBS
7.2 Explain the detection and adding of external cells
7.3 Explain the detection and adding of cell relations
7.4 Explain the detection and adding X2 connections

Target audience
The target audience for this course is: Service Design Engineers and Network Design Engineers.

Prerequisites
Successful completion of the following courses:

- LTE/SAE System Overview Lzu 108 7020
- LTE L10 Air Interface Lzu 108 7260
- LTE L10 Protocols and Procedures Lzu 108 7261

Duration and class size
The length of the course is 2 days and the maximum number of participants is 16.

Learning situation
This course is based on theoretical instructor-led lessons and theoretical exercises given in a classroom environment.
Time schedule

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<th>Day</th>
<th>Topics in the course</th>
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<tr>
<td>1</td>
<td>Introduction of the course and Radio Network Solution</td>
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<td>Idle Mode Behavior</td>
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<td>Link Adaptation</td>
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<td>2</td>
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<td>Scheduling</td>
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<td>Capacity Management</td>
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<td>Handover</td>
<td>2 hours</td>
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<td>ANR</td>
<td>1 hour</td>
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LTE L10 Radio Network Design

Description

What is the 3GPP Long Term Evolution (LTE) strategy for the UMTS Network? What are the nodes and interfaces that make up this Evolved Packet System (EPS)? How does Orthogonal Frequency Division Multiplexing (OFDMA) and Single-Carrier Frequency Division Multiple Access (SC-FDMA) used in the evolved UMTS Terrestrial Radio Access Network (eUTRAN) produce data rates in excess of 100 Mbps? What types of traffic are carried by the LTE Network? How is the coverage and capacity of an LTE cell calculated? How is the LTE Radio Network implemented with Ericsson hardware?

This LTE L10A Network Design course introduces attendees to the concepts of LTE and the operation of OFDMA and SC-FDMA. With this knowledge they will be guided through the LTE Radio Network dimensioning process and given the opportunity to perform sample LTE dimensioning exercises. They will also be introduced to the TEMS CellPlanner LTE module and the hardware that supports the Ericsson LTE Revision L10A network.

Learning objectives

On completion of this course the participants will be able to:

1. Explain the reasons behind the 3GPP Long Term Evolution (LTE) strategy for UMTS.
   1.1 Describe the structure of the Evolved Packet System (EPS).
   1.2 List the nodes and interfaces that make up the evolved UTRAN (eUTRAN).
   1.3 Explain the LTE UE states and area concepts.

2. Describe the LTE air interface structure.
   2.1 Explain the principles of OFDMA and SC-FDMA.
   2.2 Explain the coding and modulation adaptation used in LTE.
   2.3 List the LTE logical, transport and physical channels.
   2.4 Explain how the LTE downlink and uplink data rates are achieved.
   2.5 List the LTE UE category capabilities.

3. Describe the different types of traffic carried by LTE networks.
   3.1 Explain the protocols that support the various LTE traffic types.
   3.2 Explain the operation of TCP, UDP, HTTP and FTP Internet Protocols.
   3.3 Explain the issues surrounding Voice over LTE.

4. Explain the Ericsson LTE dimensioning process.
   4.1 Perform uplink and downlink coverage and capacity calculations for LTE.

5. Explain the tools and hardware associated with LTE cell planning.
   5.1 Explain the downlink and uplink analysis supported by the TEMS CellPlanner LTE module.
5.2 List the Ericsson products in the RBS 6000 family.

5.3 Explain the hardware structure and capabilities of the RBS 6201 and 6102.

**Target audience**

The target audience for this course is: Service Planning Engineers, Service Design Engineers and Network Design Engineers.

This audience is responsible for the dimensioning and design of the LTE Radio Access Network.

**Prerequisites**

The participants should be familiar with the Ericsson WCDMA RAN and have an interest in LTE dimensioning. Background knowledge of WCDMA and/or GSM Radio Network design would be an advantage.

**Duration and class size**

The length of the course is 2 days and the maximum number of participants is 16.

**Learning situation**

This course is based on theoretical instructor-led lessons with practical exercises using a calculator or PC.

**Time schedule**

The time required always depends on the knowledge of the attending participants and the hours stated below can be used as estimate.

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<tr>
<td>1</td>
<td>LTE/SAE Introduction</td>
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<tr>
<td></td>
<td>LTE Air Interface</td>
<td>2 hours</td>
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<td></td>
<td>LTE Traffic</td>
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<tr>
<td>2</td>
<td>LTE Dimensioning</td>
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<tr>
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<td>LTE Cell Planning and Hardware</td>
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</table>
TEMS CellPlanner 8 Operation for LTE

Description
How is LTE Cell planning carried out using TEMS CellPlanner version 8.1? How path loss predicted using the Ericsson 9999 propagation model for LTE and how can this model be tuned? What LTE analysis plots and reports can be produced using the TEMS CellPlanner LTE module?

This course will explain the operation of TEMS CellPlanner LTE module and guide students through a series of practical exercises that take them through all the stages of LTE cell planning from setting up a project to producing detailed traffic analysis plots and reports.

Learning objectives
On completion of this course the participants will be able to:

1. Explain the operation of the TEMS CellPlanner LTE module.
   1.1 Describe the Ericsson 9999 propagation model.
   1.2 Explain how the TEMS CellPlanner LTE module performs downlink traffic analysis.
   1.3 Explain the operation of the ‘Monte Carlo’ LTE analysis function.
   1.4 Explain how the TEMS CellPlanner LTE module performs uplink traffic analysis.

2. Create a new TEMS CellPlanner project.
   2.1 Define the LTE System and data services.
   2.2 Define the LTE Equipment used in a project.
   2.3 Create LTE Equipment Templates.
   2.4 Add, move and delete LTE sites in a project.

3. Perform downlink LTE traffic analysis using TEMS CellPlanner.
   3.1 Use the TEMS CellPlanner LTE module to perform pathloss predictions for a number of LTE sites.
   3.2 Produce LTE best server and downlink interference analysis plots using TEMS CellPlanner.
   3.3 Use the TEMS CellPlanner LTE module to produce downlink traffic analysis plots and reports.

4. Perform uplink LTE traffic analysis using TEMS CellPlanner.
   4.1 Use the TEMS CellPlanner LTE module to produce uplink traffic analysis plots and reports.
   4.2 Use the TEMS CellPlanner LTE module to perform neighbor cell analysis.

Target audience
The target audience for this course is: Service Planning Engineers, Service Design Engineers and Network Design Engineers.
This audience is responsible for the dimensioning and design of the LTE Radio Access Network.

**Prerequisites**

The participants should be familiar with the Ericsson WCDMA RAN and ideally should have attended the following course:

LTE L10 Radio Network Design (LZU 108 7263)

Previous experience with TEMS Cellplanner is not essential but would be an advantage.

**Duration and class size**

The length of the course is 2 days and the maximum number of participants is 8.

**Learning situation**

This course is based on theoretical instructor-led lessons with practical exercises using TEMS Cellplanner running locally on the student’s PC.

**Time schedule**

The time required always depends on the knowledge of the attending participants and the hours stated below can be used as estimate.

<table>
<thead>
<tr>
<th>Day</th>
<th>Topics in the course</th>
<th>Estimated time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TEMS CellPlanner LTE Module Introduction</td>
<td>2 hours</td>
</tr>
<tr>
<td></td>
<td>TEMS CellPlanner LTE Project Creation</td>
<td>4 hours</td>
</tr>
<tr>
<td>2</td>
<td>TEMS CellPlanner LTE Downlink Analysis</td>
<td>4 hours</td>
</tr>
<tr>
<td></td>
<td>TEMS CellPlanner LTE Uplink Analysis</td>
<td>2 hours</td>
</tr>
</tbody>
</table>
LTE/SAE– System Overview, WBL

Description
If you want to know what LTE/SAE (Long Term Evolution / System Architecture Evolution) is, this course will give you an overview of the new radio technology and protocols involved in the E-UTRAN (Evolved UTRAN, also referred to as LTE) and the architecture behind EPC (Evolved Packet Core, also referred to as SAE – System Architecture Evolution).

Learning objectives
On completion of this course the participants will be able to:

1. **Explain the background and architecture of E-UTRAN and EPC**
   1.1 Describe the evolution of cellular networks
   1.2 Summarize the evolution of 3GPP releases
   1.3 Describe the flexible spectrum usage

2. **Describe the EPS Architecture**
   2.1 Explain the logical architecture of EPS (E-UTRAN and EPC)
   2.2 Give an overview of the interfaces in EPS
   2.3 Describe the radio interface techniques
   2.4 Explain the difference between the FDD and TDD mode
   2.5 Detail the terminal states
   2.6 Describe the Evolved Packet Core
   2.7 Describe the role of the MME and the S-GW
   2.8 Detail the S1 and X2 interfaces and their protocol stacks

3. **Describe the Air Interface**
   3.1 Explain the radio interface structure
   3.2 Detail the channel structure of the radio interface
   3.3 Describe the physical signals in UL and DL
   3.4 Detail the time-domain structure in the radio interface in UL and DL for both FDD and TDD mode
   3.5 Detail the downlink transmission technique
   3.6 Have a good understanding of the OFDM principle, signal generation and processing
   3.7 Detail the reference symbols in DL
   3.8 Detail the control signaling in DL
   3.9 Detail the uplink transmission technique
   3.10 Have a good understanding of the SC-FDMA principle, signal generation and processing
   3.11 Explain the pros and cons with OFDM and SC-FDMA
   3.12 Detail the control signaling in UL
   3.13 Describe the concepts of layers, channel rank, spatial multiplexing, SU-MIMO and MU-MIMO
4  **Detail the Radio Resource Management and Mobility**

4.1  Describe the Radio Resource Management
4.2  Describe UL and DL scheduling and signaling
4.3  Explain the concepts of dynamic and persistent scheduling
4.4  Describe LTE Mobility
4.5  Describe intra-LTE mobility in ECM_CONNECTED and ECM_IDLE mode
4.6  Explain inter-working with 2G/3G

**Target audience**

The target audience for this course are:

Network Engineer
Service Engineer
Service Design Engineer
Network Design Engineer

**Prerequisites**

A general knowledge in cellular systems and radio technology.

**Duration and class size**

The length of the course is 3 hours.

**Learning situation**

This is a web-based interactive training course with multimedia content.
LTE L10 eNode B Commissioning

LZU1087409-R1A

Description
Do you need to understand how to integrate LTE eNode B (RBS 6000)?

This course provides the participants with hands-on experience of the procedures that need to be performed for the commissioning and integration of the eNode B.

Learning objectives
On completion of this course the participants will be able to:

1. **Explain the principle of integration in LTE Radio Access Network**
   1.1 List the steps involved in integrating the eNode B in the LTE RAN
   1.2 Explain which management tools are needed for each step of the integration
   1.3 Examine the pre-configuration activities performed in the Core Network before the eNode B integration

2. **Perform Initial Configuration of the eNode B**
   2.1 Configure the Thin Client to connect to the eNode B
   2.2 Load software to the node
   2.3 Perform basic hardware configuration using the Cabinet Equipment Wizard

3. **Perform Site Basic Configuration of the eNode B**
   3.1 Configure the O&M access for the eNode B using the O&M Access Configuration Wizard
   3.2 Verify synchronization status to ensure stability of the node before continuing integration

4. **Perform Site External Configuration on the node**
   4.1 Integrate the external hardware for site, sectors and cells using the Site External Configuration Wizard
   4.2 List the steps needed and perform site-external configuration on the node
   4.3 Load Site Specific Transport and Radio Network scripts

5. **Perform Configuration Validation**
   5.1 Validate IP connectivity
   5.2 Verify eNode B local cell
   5.3 Verify LED status

Target audience
The target audience for this course is: Network Deployment Engineer, Field Technician and System Technician.

This audience is responsible for configuration of the eNode B.

Prerequisites
Successful completion of the following courses:

LTE/SAE Overview                               LZU1087020
RBS6000 Overview                                LZU1087503

Or

LTE/SAE Overview, WBL                           LZU1087318
RBS 6000 in a Nutshell                          LZU1087504

Duration and class size
The length of the course is 1 day and the maximum number of participants is 8.

Learning situation
This course is based on theoretical and practical instructor-led lessons given in both classroom and in a technical environment using equipment and tools.
**Time schedule**

The time required always depends on the knowledge of the attending participants and the hours stated below can be used as estimate.

<table>
<thead>
<tr>
<th>Day</th>
<th>Topics in the course</th>
<th>Estimated time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>• Introduction</td>
<td>0.5 hour</td>
</tr>
<tr>
<td></td>
<td>• eNode B Management Applications</td>
<td>0.5 hour</td>
</tr>
<tr>
<td></td>
<td>• eNode B Integration theory</td>
<td>1 hour</td>
</tr>
<tr>
<td></td>
<td>• Perform Initial Configuration</td>
<td>1 hour</td>
</tr>
<tr>
<td></td>
<td>• Perform Site Basic Configuration</td>
<td>1 hour</td>
</tr>
<tr>
<td></td>
<td>• Perform Site External Configuration</td>
<td>1 hour</td>
</tr>
<tr>
<td></td>
<td>• Perform Configuration Validation</td>
<td>1 hour</td>
</tr>
</tbody>
</table>
LTE L10 Operation

Description
Do you have sufficient skills to operate your Long Term Evolution (LTE) radio access network?

This course covers common operational tasks in the LTE radio network that NOC and OMC personnel come across in their daily work. Hardware, Software, Configuration, Fault and Performance Management concepts are covered. Practical exercises, based on work-order like instructions, contribute to the understanding of LTE network operations. OSS-RC tools and Element Management tools relevant for LTE are used where applicable.

Learning objectives
On completion of this course the participants will be able to:

1 Explain the LTE network architecture and the Operation and Maintenance (OaM) support
   1.1 Describe the nodes that build up LTE/SAE
   1.2 Describe on an overview level the OaM infrastructure
   1.3 Describe the Operation and Maintenance architecture of an RBS6000 and where to find documentation about the Managed Object Model

2 Perform Hardware and Software Management on a LTE RAN
   2.1 Explain the hardware building practice of RBS6000 (MPE, DUL, RUL) and which ways OaM connectivity can be established to the node
   2.2 Display, export and handle hardware and software resources in an RBS6000 via OSS-RC and EMAS
   2.3 Describe the file system in an RBS6000
   2.4 Describe the Configuration Version concepts
   2.5 Manage Configuration Versions and file system using OSS-RC, EMAS, COLI and AMOS
   2.6 Describe the Upgrade process for a batch of RBS6000 nodes

3 Perform Fault Management on a LTE RAN
   3.1 Explain the Fault Management Model
   3.2 Describe the Fault Management process in the LTE RAN
   3.3 Solve some common alarms by following Procedural Information, and using OSS (Alarm List Viewer, Alarm Log Browser and Alarm Status Matrix), AMOS and EM in the process
   3.4 Describe the function of the command line interface (CLI) and Node Command Line Interface (NCLI)

4 Perform Performance Management on the LTE RAN
4.1 Describe what Observability of the LTE RAN means and how this is related to Key Performance Indicators
4.2 Describe the E-UTRAN PM solution
4.3 Describe the performance statistics generated in the LTE RAN (Counter collection, Cell Traffic Recording, User Equipment Traffic Recording)
4.4 Explain the Subscription Profile principle
4.5 Get an overview of statistics and recording concepts in the LTE, and use the OSS-RC to initiate UE Tracing

5 Perform basic RBS6000 Configuration procedures using OSS-RC and Element Manager
5.1 Describe the main steps in RBS6000 Integration
5.2 Explain Radio Network Handling in OSS-RC
5.3 Be familiar with the different ways configuration could be performed and changed in an RBS6000, and perform a parameter change using EM, AMOS and BCM

Target audience
The target audience for this course is: System Engineers and Service Engineers

This audience is responsible for operation of the LTE RAN, most likely from a Network Management Center or OMC.

Prerequisites
Successful completion of the following courses:

- LTE/SAE Overview
- RBS6000 Overview
- LTE/SAE Overview, WBL
- RBS 6000 in a Nutshell

Or

- Lzu1087020
- Lzu1087503
- Lzu1087318
- Lzu1087504

Duration and class size
The length of the course is 3 days and the maximum number of participants is 8.

Learning situation
The course is based on theoretical and practical instructor-led lessons given in both classroom and a technical environment using equipment and tools, which can be accessed remotely.
Time schedule

The time required always depends on the knowledge of the attending participants and the hours stated below can be used as estimate.

<table>
<thead>
<tr>
<th>Day</th>
<th>Topics in the course</th>
<th>Estimated time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>• Network architecture and LTE features</td>
<td>1 hour</td>
</tr>
<tr>
<td></td>
<td>• RBS6000 Hardware and Software concepts and related OSS-RC tools</td>
<td>3 hours</td>
</tr>
<tr>
<td></td>
<td>• Operational exercises (ALEX library and MOM documentation familiarization)</td>
<td>0,5 hour</td>
</tr>
<tr>
<td></td>
<td>• Operational exercises (HW and SW management)</td>
<td>1,5 hours</td>
</tr>
<tr>
<td>2</td>
<td>• Operational exercises (HW and SW management) continued</td>
<td>1,5 hours</td>
</tr>
<tr>
<td></td>
<td>• Fault Management</td>
<td>1 hour</td>
</tr>
<tr>
<td></td>
<td>• Operational exercises (Fault management)</td>
<td>2 hours</td>
</tr>
<tr>
<td></td>
<td>• LTE Performance Management</td>
<td>1 hour</td>
</tr>
<tr>
<td></td>
<td>• Operational exercises (Performance Management)</td>
<td>0,5 hours</td>
</tr>
<tr>
<td>3</td>
<td>• LTE Configuration Management</td>
<td>1 hour</td>
</tr>
<tr>
<td></td>
<td>• Operational exercises (Configuration Management)</td>
<td>3 hours</td>
</tr>
<tr>
<td></td>
<td>• Operational exercises summary</td>
<td>1 hour</td>
</tr>
</tbody>
</table>
LTE L10 Configuration

LZU1087411-R1A

Description

This course describes how to integrate an RBS6000 from scratch in the L10 version of LTE RAN. The course includes theoretical parts covering how the integration should be carried out step by step to bring the RBS into service. The tools used in this process are described and exercises give the participant the possibility to investigate how the different configuration files and tools are used. Apart from this, Ethernet and the IP suite of protocols used to configure the Transport Network in an RBS6000 are described along with the related Managed Objects required for configuration.

After this course, the participants will be familiar with how to bring an RBS6000 into service both manually and by using the Auto Integration feature.

Learning objectives

After completing the course the student will be able to:

1 Explain LTE L10 interfaces and the integration of RBS6000
   1.1 Describe the interfaces S1, X2 and Mul to an eNodeB in LTE L10.
   1.2 Explain on an overview level the integration process of an RBS6000 and in which ways this process can be carried out (manual, auto-integration).
   1.3 Describe which tools that could be used in the different steps of the integration procedure.
   1.4 Explain what the MOM is, why it is important in configuration and where to find information about it

2 Explain Ethernet, IP Suite and related MOs in L10
   2.1 Explain the IP Functionality of the L10 RAN Transport Network.
   2.2 Explain how IP and Ethernet fit into the protocol layers in the LTE L10 RAN.
   2.3 Explain the basic structure of an IP Packet and Ethernet frame and how switching is done on Layer 2 and 3.
   2.4 Explain how Quality of Service (QoS) is supported by IP and Ethernet
   2.5 Describe the hardware used to support IP/Ethernet transmission in RBS6000.
   2.6 Explain how generic IP and Ethernet concepts are related to the MicroCPP MOM in L10.

3 Integrate an RBS6000
   3.1 Describe the integration process of an RBS6000 in detail
   3.2 Perform the on-site integration of an RBS6000 manually with the Site Installation file, the Site Basic file and the Site External file.
   3.3 Configure the Transport Network carrying S1 and X2 user plane and control plane traffic to an RBS6000.
3.4 Configure the Radio Network in an RBS6000.
3.5 Configure QoS parameters in RBS6000.
3.6 Configure the RBS6000 with the Auto Integration feature.

Prerequisites
Successful completion of the following courses:

- LTE L10 Network Operation  L Zu 1087410
- LTE 10A Air Interface  L Zu 1087260

Target audience
The target audience for this course is: Service Planning Engineer, Service Design Engineer and Network Design Engineer.

Duration and class size
The length of the course is 2 days and the maximum number of participants is 8.

Learning situation
This course is based on theoretical and practical instructor-led lessons given in both classroom and in a technical environment using equipment and tools.
Time schedule

The time required always depends on the knowledge of the attending participants and the hours stated below can be used as estimate.

<table>
<thead>
<tr>
<th>Day</th>
<th>Topics in the course</th>
<th>Estimated time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Course introduction and introduction of LTE/SAE, the integration procedure of an RBS6000 and the Managed Object Model</td>
<td>1,5 hours</td>
</tr>
<tr>
<td></td>
<td>Ethernet, IP Suite and the RBS6000 IP related MOM</td>
<td>3,5 hours</td>
</tr>
<tr>
<td></td>
<td>Manual on-site configuration of the RBS6000</td>
<td>1 hour</td>
</tr>
<tr>
<td></td>
<td>Manual on-site configuration of the RBS6000 (cont.)</td>
<td>1 hour</td>
</tr>
<tr>
<td>2</td>
<td>Configuration of the S1 and X2 interfaces</td>
<td>1,5 hours</td>
</tr>
<tr>
<td></td>
<td>Configuration of the Radio Network and QoS</td>
<td>1,5 hours</td>
</tr>
<tr>
<td></td>
<td>Auto-integration of RBS6000</td>
<td>1,5 hours</td>
</tr>
<tr>
<td></td>
<td>Summary of the course</td>
<td>0,5 hour</td>
</tr>
</tbody>
</table>
LTE/SAE in Nutshell

Description
Do you want to know what LTE/SAE is all about. This eLearning course will give you an overview on end user experience of Long Term Evolution (LTE) in terms of services and applications, speed and capacity as well as network setup. The course will also highlight the mobile technology evolution. The course content is a simple explanation of the next generation technology with a focus on a non technical target audience.

Learning objectives
On completion of this course the participants will have answers to the following questions:

5 What is LTE/SAE?
5.1 How fast is LTE?
5.2 What is included in the Mobile Technology Evolution?

6 What is the end user experience?
6.1 What are possible services and application?
6.2 What is the speed and capacity?
6.3 Is it better than 3G?
6.4 How much does it cost?
6.5 Do I need a new phone?
6.6 Is the coverage and mobility better then today?

7 How does LTE/SAE work?
7.1 Which Frequencies are used?
7.2 Which nodes are included in the Radio Network?
7.3 Which nodes are included in the Core Network?

8 What is the meaning of the typical LTE related abbreviations?

Target audience
The target audience for this course is: System Technicians, Service Technicians, Field Technicians, System Administrators, Application Developers, Business Developers, Customer Care Administrators.

The main focus of this course is on non techical personnel.

Prerequisites
None

Duration and class size
The length of the course is 1 hour.
Learning situation

This is a web-based interactive training course with multimedia content.
RBS 6000 in a Nutshell

LZU1087504-R1A

Description
This WBL course is intended to give the participant an overview of the RBS 6000 series. Are you interested in the latest RBS technology from Ericsson. The RBS 6000 Overview course will guide you thought the concept and explain you the main benefits of the new architectures. You will learn how the multi-standard concept is implemented, more room for expansion is generated and how you can lower the power consumption of your network for greater sustainability.

Learning objectives
On completion of this course the participants will be able to:

1 Describe on an overview level the RBS 6000 Platform
   1.1 Describe the generic building and form structure used in RBS 6000
   1.2 Describe on an overview level the building practice
   1.3 Explain the advantages of multi-standard RBS
   1.4 Describe how more room for expansions is generated
   1.5 Compare the power consumption of a RBS 6000 to today’s technologies

2 Understand how WCDMA is implemented in the RBS 6000
   2.1 Describe on block level which boards and units gives the WCDMA Functionality

3 Understand how LTE is implemented in the RBS 6000
   3.1 Describe on block level which boards and units gives the LTE Functionality

4 Understand how GSM is implemented in the RBS 6000
   4.1 Describe on block level which boards and units gives the LTE Functionality

Target audience
The target audience for this course are:
System Technician
Service Technician
System Engineers
Service Engineers

Prerequisites
The participants should be familiar with the WCDMA, GSM and LTE on overview level.
Duration
The length of the course is 1 hour.

Learning situation
This is a web-based interactive training course with multimedia content.
LTE Access Transport Network Dimensioning

Description

Dimensioning the transport network in LTE (Long Term Evolution) is a challenge. Not only is all the traffic packet switched to its nature, LTE also provides very high peak rates that have to be taken care of by the backbone network. Also the RBS6000 hardware has to be dimensioned in such a way that it can handle the high baseband processing loads.

This course explains the methods of dimensioning the L10A version of the E-UTRAN nodes. Co-siting with WCMDA or GSM nodes is not covered in this version of the course, which means that the focus is on the actual RBS6000 for LTE and the dimensioning of the node hardware and the transport interfaces towards the SAE (System Architecture Evolved).

Learning objectives

On completion of this course the participants will be able to:

1. Describe the EPC Architecture
   1.1 Describe the interfaces in EPS (Evolved Packet System)
   1.2 Describe the Evolved Packet Core (EPC)
   1.3 Describe the role of the MME, S-GW and PDN-GW
   1.4 Describe the S1 (and X2) protocol stacks
   1.5 Describe the EPS bearer and what traffic types and services can be expected in LTE L10A

2. Explain the IP Functionality of the L10A LTE RAN Transport Network
   2.1 Explain how IP and Ethernet fit into the protocol layers in the LTE RAN.
   2.2 Explain the basic structure of an IP Packet and Ethernet frame.
   2.3 Explain IP concepts such as IPSec, MPLS, VLAN and routing and how they impact the dimensioning of the network.
   2.4 Explain how Quality of Service (QoS) is achieved using IP and Ethernet and how DSCP values are mapped to Pbit values.

3. Perform link dimensioning in LTE L10A
   3.1 Explain terms and concepts related to dimensioning
   3.2 Describe the dimensioning process
   3.3 Perform Transport Network overhead calculations
   3.4 Perform last mile and mobile backhaul dimensioning

4. Perform node dimensioning for RBS6000
   4.1 Describe the RBS6000 hardware in LTE
   4.2 Dimension the RBS6000 hardware
Target audience
The target audience for this course is:
Service Planning Engineer
Service Design Engineers
Network Design Engineer
This audience is responsible for the dimensioning and design of the LTE Access Transport Network.

Prerequisites
It is an advantage if the participants are familiar with IP and dimensioning of e.g. WCDMA RAN networks.

Duration and class size
The length of the course is 1 day and the maximum number of participants is 16.

Learning situation
This course is based on theoretical instructor-led lessons.
**Time schedule**

The time required always depends on the knowledge of the attending participants and the hours stated below can be used as estimate.

<table>
<thead>
<tr>
<th>Day</th>
<th>Topics in the course</th>
<th>Estimated time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EPC architecture and IP network overview</td>
<td>1 hour</td>
</tr>
<tr>
<td></td>
<td>IP Transport Network Functionality</td>
<td>2 hours</td>
</tr>
<tr>
<td></td>
<td>IP Link Dimensioning with Link Dimensioning exercise</td>
<td>2 hours</td>
</tr>
<tr>
<td></td>
<td>Node dimensioning with Node HW dimensioning exercise</td>
<td>1 hour</td>
</tr>
</tbody>
</table>
KPIs in LTE/SAE Network

Description

How can the performance of the Ericsson LTE/SAE network be monitored? What E-UTRAN Key Performance Indicator (KPI) categories have been specified by the 3GPP? How are these KPIs realized using Ericsson eNodeB counters? How are these counters triggered?

This ‘KPIs in LTE/SAE Network’ course will allow students to become familiar with the Accessibility, Retainability, Integrity, Mobility and Availability KPI categories specified by the 3GPP along with the Ericsson System Utilization category. They will also learn how to create KPIs to measure the E-UTRAN performance in each of these categories using Ericsson eNodeB counters. They will also be given the background information on how these counters are triggered, collected and stored in the LTE/SAE network.

The knowledge gained in this ‘KPIs in LTE/SAE Network’ course will enable Engineers to efficiently measure the performance of the LTE Network and make more efficient use of their time during network optimization.

Learning objectives

On completion of this course the participants will be able to:

   1.1 List the nodes that make up the LTE/SAE Network.
   1.2 Explain the LTE UE states, area and Enhanced RAB (E-RAB) concepts.
   1.3 Describe the E-UTRAN counter collection and storage process.
   1.4 Contrast the different counter types collected by the eNodeB.
   1.5 Explain the 3GPP and Ericsson KPI categories.

   2.1 Describe the E-RAB setup procedure and associated counters.
   2.2 Use eNodeB counters to create E-RAB Accessibility KPIs.

   3.1 Describe the E-RAB release procedure and associated counters.
   3.2 Use eNodeB counters to create E-RAB Retainability KPIs.

   4.1 Explain the structure of the LTE air interface.
   4.2 Describe how the coding and modulation is adapted to the radio environment.
   4.3 Explain the relationship between Data Radio Bearer throughput and SINR in LTE.
   4.4 Describe the operation of the E-UTRAN Integrity counters.
   4.5 Use eNodeB counters to create E-UTRAN Integrity KPIs.

5. Measure LTE Mobility performance.
   5.1 Explain the intra LTE handover procedure and associated counters.
   5.2 Use eNodeB counters to create E-UTRAN Mobility KPIs.
6 Measure cell Availability and System Utilization performance.
6.1 Use eNodeB counters to create Cell Availability KPIs.
6.2 Describe the Ericsson System utilization measurements.
6.3 Use eNodeB counters to create System Utilization KPIs.

Target audience
The target audience for this course is: Service Planning Engineers, Service Design Engineers, Network Design Engineers, System Engineers and Service Engineers.

This audience is responsible for LTE Optimization.

Prerequisites
The participants should be familiar with Radio Access Network performance management and have a basic knowledge of Microsoft Excel.

Duration and class size
The length of the course is 2 days and the maximum number of participants is 16.

Learning situation
This course is based on theoretical instructor-led lessons with practical exercises using Microsoft Excel.
## Time schedule

The time required always depends on the knowledge of the attending participants and the hours stated below can be used as estimate.

<table>
<thead>
<tr>
<th>Day</th>
<th>Topics in the course</th>
<th>Estimated time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LTE Performance Management</td>
<td>2 hours</td>
</tr>
<tr>
<td></td>
<td>LTE Accessibility Performance</td>
<td>2 hours</td>
</tr>
<tr>
<td></td>
<td>LTE Retainability Performance</td>
<td>2 hours</td>
</tr>
<tr>
<td>2</td>
<td>LTE Integrity Performance</td>
<td>2 hours</td>
</tr>
<tr>
<td></td>
<td>LTE Mobility Performance</td>
<td>2 hours</td>
</tr>
<tr>
<td></td>
<td>LTE Availability and System Utilization Performance</td>
<td>2 hours</td>
</tr>
</tbody>
</table>