

LTE Evolution and the Way to 5G

Course Duration:

- 2 days

Course Description:

- The main focus of this course is the evolution of the LTE system from LTE to LTE-Advanced (3GPP Rel. 10 and 11) *and* beyond.
- After a recap of the key parameter of the LTE access scheme, as well as MIMO, the course lists the motivating factors to migrate towards LTE-Advanced.
- As part of this section we elaborate how LTE-Advanced meets the ITU requirements for 4G systems. The section concludes by comparing LTE-Advanced with other radio solutions like WiMAX or WiFi.
- The enhanced radio concepts of LTE-Advanced, namely: carrier aggregation, enhanced multiple antenna techniques for downlink and uplink, coordinated multipoint transmission and reception (CoMP) plus mechanisms in order to reduce the latency are described in details in this section.
- The next section provides a detailed view on the architectural changes coming with LTE-Advanced. This includes the enhanced concept of Home eNodeB's (HeNB) and a detailed description of the operation and benefits of relay nodes.
- The following chapter outlines interworking options of LTE-Advanced with other Radio Access Technologies (RAT), namely GSM, UMTS, cdma2000 and WiFi. This section includes possible deployment scenarios and security aspects.
- The next chapter deals with the description, operation and benefits of Self Organizing Networks (SON), which have been partly implemented in LTE and have been developed alongside with the 3GPP releases.
- The final part provides an outlook beyond LTE-Advanced and pinpoints the current state of research on 5G and the related technologies and enhancements.

Suggested Prerequisites:

- The student must possess a thorough understanding of the LTE system.
- Long year experience with mobile radio systems such as UMTS, HSPA or GSM/GPRS is required to be able to follow the course.
- We recommend our course "LTE from A-Z reloaded" to be taken upfront this course.

Course Targets:

- The student will obtain detailed understanding of the leapfrogging from LTE to LTE-Advanced which enables her or him to contribute efficiently to all related job assignments.

- We enable the student to think beyond 4G and have an idea of the current state of research on 5G mobile networking.
- The student will be able to specify and describe the key features of LTE-Advanced and compare LTE and LTE-Advanced.
- The student will be able to describe possible interworking scenarios of LTE-Advanced with other radio access technologies.

Some of your Questions that will be answered:

- Can HSPA+ ever be considered as a 4G technology?
- What are the 4G targets with respect to e.g. throughput rate and spectral efficiency?
- What is a component carrier?
- What are the main improvements of LTE-Advanced compared to LTE?
- How does LTE-Advanced meet or even exceed the ITU 4G requirements?
- Which other technologies are there to address the ITU-T's 4G requirements?
- How do intra- and inter-band carrier aggregation work in detail?
- What is Coordinated Multipoint Transmission (CoMP) and how does it work?
- How does LTE-Advanced address issues like access network security, if another access network type like WiFi or WiMAX is used?
- What is the concept of heterogeneous networks?
- What are the business drivers of SON and where can SON help?
- What is today's assessment on 5G and the related technologies?

Who should attend this Course:

- The course is intended for people involved in engineering functions such as product management, design and deployment as well as those who need to understand LTE-Advanced and its position within the 4G wireless roadmap.
- Engineers and technical staff who require detailed inside knowledge of the LTE-Advanced standard and technology.

Table of Content:

Chapter 1: Review and Assessment

- **Technical Review of LTE**
LTE network architecture, LTE protocols, security and QoS, FDD and TDD modes, frequency bands / transmission modes, resource scheduling, smart antenna use
 - **LTE History**
Evolution path to 4G, 4G requirements, 4G solutions, summary of LTE-Advanced features
 - **Beyond our Plate**
WiMAX evolution (802.16m), WiFi evolution
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Chapter 2: Technical Details of LTE-Advanced

- **Wider Bandwidth**
Carrier aggregation, asymmetric bandwidth, spectrum flexibility, new bands
 - **Enhanced Transmission Schemes in DL and UL**
8 stream transmission (DL), 4 stream transmission (UL), reference signals, antenna configuration
 - **Enhanced Uplink Transmission Schemes**
Clustered SC-FDMA, transmit diversity for PUCCH, 4 stream transmission
 - **Coordinated Multipoint Transmission (CoMP)**
CoMP in downlink and uplink, CoMP and cell edge throughput, scheduler coordination
 - **Relay Nodes**
Benefits, donor cells, control signaling, security aspects
 - **Home eNodeB**
Closed subscriber groups, enhanced Home NodeB (eHNB)
 - **Summary & Conclusions**
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Chapter 3: Interworking between LTE-Advanced and other Radio Access Solutions

- **Interworking with GSM / UMTS**
Network structure, handover and cell reselection, security during interworking
- **The Future of Voice**
IMS based voice service, single radio voice call continuity (SRVCC), circuit-switched fallback (CSFB), other options
- **Interworking with WiFi and WiMAX**
Network structure, measurements and procedures, authentication and security

Chapter 4: Benefits of Self Organizing Networks (SON)

- **History of SON**
SON Features, SON in LTE, SON in 3GPP
 - **Detailed SON Features**
Neighbor list optimization, coverage and capacity optimization, mobility robustness optimization, user quality improvements, energy saving
 - **SON in LTE-Advanced**
 - **Summary & Conclusions**
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Chapter 5: The Future of LTE-Advanced and Shaping of 5G

- **Enhancements of 3GPP Release 11**
Radio enhancements, interconnection of IP services, feature studies and important features
- **Evolution towards 5G**
5G Requirements, MANET, mesh networking, envisaged differences compared to 4G
- **Summary & Conclusions**