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LTE-Advanced
Rel 12 and Rel 13 specific enhancements

Course Duration:

- 2 days

Course Description:

- This course addresses the needs of technical engineering staff who work on the design, test, integration and validation of LTE-Advanced equipment esp. on the UE-side.

- The course has been designed to meet specifically the requirements of chipset verification, integration and testing.

- The course starts out with a description of the most important trends and visions, in the year 2016, namely the upcoming IoT, the increasing level of network virtualization, the migration towards 5G, the engagement between LTE and WiFi through different options like LTE-U, LAA or LWA and, last but not least, the ever increasing level of scope of carrier aggregation.

- Following this chapter, the course reviews the most relevant details of LTE from Rel. 8 up to Rel 11. Note that our trainer will tailor the level of detail and the time spent on this chapter depending on the existing knowledge of the course participants.

- The following two chapters are dedicated to a detailed description of the updates to LTE-A with Rel 12 and Rel 13. In these chapters, we cover the different levels of carrier aggregation enhancements with Rel 12 and 13, e.g. UL-CA, combined FDD/TDD-CA and the related constraints and practical implementation challenges.

- In this part of the course we also introduce dual connectivity and its specifics for the UE and for the network side as a new way to do intersite carrier aggregation.

- With Rel. 12, there is an exciting new market for 3GPP which is public safety, covered by the ProSe-, D2D- and sidelink- related parts of the specifications. We deal with this fascinating new technology and some of its specifics in this part of the course.

- Following a detailed analysis of various other enhancements like using 256-QAM modulation, the focus of the course changes to MTC and the IoT. We depict, which approach is taken by 3GPP to suit the needs of the IoT in a 3GPP-environment and point to alternative approaches like SigFox and Lora. The most important topics with respect to 3GPP, dealt with in detail are eDRX, PSM, SIM-less operation and the architecture and radio interface of the NB-IOT.

- Last but not least, the course focus is on LTE-U, LAA and LWA and depicts the pros and cons as well as the specifics of these three different approaches to combine LTE-A and WiFi.

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Prerequisites:

- The student should possess detailed knowledge about LTE in Rel 8, 9 and 10, in particular about the physical layer.

- We recommend to book our courses on LTE Rel 8/9 and LTE-A Rel 10/11 beforehand.

Some of your questions that will be answered:

- Which CA-related enhancements are part of Rel 12 and Rel 13?

- What are the implications of combined FDD/TDD carrier aggregation?

- Why is there currently no carrier aggregation FDD/TDD for the uplink?

- What are the differences and implications of dual connectivity vs plain carrier aggregation?

- What are the differences among the different options to combine LTE and WiFi? Are there any performance related differences?

- How do LAA, LWA and LTE-U operate?

- How does D2D communication work? How do sidelink channels operate? What are the different options for commercial and public safety services?

- What is eDRX and how does it operate? Which battery lifetimes are enabled by it?

- What is the radio interface structure of the NB-IOT and how does it differ from preceding IoT- and MTC-implementations of 3GPP-networks?

Course Target:

- The student is enabled to design, integrate, test and validate LTE-Advanced equipment with focus on 3GPP Release 11, 12 and 13

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Table of Content:

Chapter 3: Feature List and Description Rel 12 (6 – 8 hours)

- **FDD / TDD joint operation incl. carrier aggregation**

- **Carrier Aggregation enhancements**
  UL-CA, CA with up to 4 carriers

- **Small Cell Enhancements**
  Dual Layer Connectivity, Support of 256 QAM

- **The new EPDCCH**
  Motivation, detailed permutation and configuration rules, EREG and ECCE, setup, coding and modulation, assignment

- **NAICS (Network Assisted Interference Cancellation and Suppression)**
  Motivation, Differences to Release 10/11, Network Assistance, UE-requirements.

- **ue-Category Changes with Rel 12**
  UL/DL split, new UE-category 0

- **D2D / ProSe**
  Use Cases, Concepts, principle operation

- **Improvements for WiFi / LTE-A interworking**

- **LTE-U**
  Technology, LTE-U-forum, liabilities

- **HetNet Mobility Enhancements**

- **MTC-Enhancements**
  Power consumption optimization
  Signaling overhead reduction

- **Other Enhancements**
  Smart congestion mitigation (SCM), eIMTA (TDD only), Inter-eNB CoMP, eMBMS enhancements, DL-MIMO enhancements, MIMO OTA testing

Chapter 4: Feature List and Description Rel 13 (4 – 6 hours)

- **LTE in Unlicensed Spectrum: LAA (Licensed Assisted Access)**
  Operation, implications, differences to LTE-U

- **LTE in Unlicensed Spectrum: LWA (LTE + WiFi link aggregation)**
  Operation, implications, differences to LTE-U and LAA

- **Additional MTC enhancements**

- **3D-MIMO / Elavation Beamforming**

- **Network Virtualization**
  Operation and implications

- **NB-IOT (Narrow Band – Internet of Things)**
  Ideas and Background, technology and rollout of LPWA (Low Power Wire Area) networks, implications on M2M, timeline

- **Indoor Positioning**

- **Interesting Feasibility Studies and Study Items**
  Latency reduction, mission critical applications, …