



## Introduction to 5G Cellular Networks Theory and Practice

### Description

As 5G cellular networks takes their place as the new cellular technology, we bring this course to introduce the 5G network architecture, new radio, operation and security. The course provides an overview of the 5G network architecture and applications, starting with introducing the motivation for the new technology, the network architecture and new components, basic network procedures and operation, security and compatibility issues.

### Course Objectives

Upon completing the course, the participants will be able to:

- Understand the architecture and components of 5G cellular networks
- Understand the principles of the new radio technologies in the 5G network
- Understand network functionality including network slicing and security
- Understand network features towards IoT technology

### Topics

The following topics are covered in the course

- 5G network architecture
- 5G New radio access
- 5G protocols, data flows and network slicing
- 5G security and R.16/R.17 features

### Target Audience

Network engineers, R&D, Tech-support and marketing

### Prerequisites

Basic understanding of previous cellular network architectures and radio technology

### Duration

1 Days

## Outline

1. 5G motivation and network objectives
  - From 4G to 5G, technology and standards
  - Network objectives – ultra-reliability, low-latency and how we achieve it
  - Service based architecture and network slicing
  - 5G applications – FRMCS (Rail communications), V2x, Satellite and WiFi access and others
  - Efficiency mechanisms – SON, eMIMO, localization, power consumption and more
  - A little bit about software – REST and RESTfull APIs
  - Standalone (SA) and Non-Standalone (NSA) access
  - Standards and standardization
2. Network architecture
  - 5G network architecture
  - Network elements/functions and reference points
  - Service-based architecture and Network Function Virtualization (NFV)
  - Network Bearers, PDU sessions and QoS flows
  - The protocol stacks
3. Network Slicing
  - Network Slicing Architectural Considerations
  - Network slicing operation
4. The New Radio Network
  - Spectrum and frequency bands
  - Coding and modulation
  - 3GPP R15 (Phase 1) and R16 (Phase 2)
  - New-Radio Multiple Access and CP-OFDM
  - Massive MIMO operation and Beamforming
  - Dual connectivity and User-Plane splitting
  - Cloud-RAN (C-RAN)
5. Network procedures and flows
  - Registration and connection management
  - Session management
  - Network access, PLMN and cell selection
  - Network functions selection

6. Non-Standalone operation and 4G interoperability
  - E-Utran New Radio Dual Connectivity (EN-DC) 4G-5G model
  - MCG/SCG bearers and split bearers
7. Interworking with Non-3GPP Networks
  - Architecture for Non-3GPP Accesses
  - Non-3GPP Access Registration
  - Establishing, modifying and terminating PDU Sessions
8. 5G security procedures
  - Security requirements and features
  - Security procedures between UE and 5G network functions
  - Security for non-3GPP access to the 5G core network
9. 5G advanced features
  - Machine Type Communications (MTC) and IoT
  - Service-Based Architecture and APIs exposure
  - Mobile Communications System for Railways (FRMCS)
  - Location and positioning services
  - Efficiency issues – SON, eMIMO and NR MIMO, Power consumption
  - Satellite access to 5G networks
  - NB-IoT and LTE-MTE enhancements