



## Who Should Attend?

The course is addressed to network engineers involved in the radio network planning and optimisation process, managerial staff responsible for network operation as well as anybody who requires detailed knowledge on the 5G radio interface structure and function.

## Course Scope

1. 5G system architecture
  - Overall network architecture
  - Functional split between NG-RAN and 5GC
  - Nodes functions (gNB and ng-eNB, AMF, UPF, SMF, PCF, AF, NEF, AUSF, UDM, NSSF, NRF) and interfaces
  - NR-RAN architecture
  - 5G identities
2. 5G protocol architecture
  - Introduction (protocols, SAP, OSI model)
  - NG-RAN protocol layer
  - Strata (NAS, AS)
  - User plane (SDAP, PDCP, RLC, MAC, PHY)
  - Control plane (RRC states, SRBs, system information, RRC connection establishment)
  - QoS (QoS concept, QoS flow, QoS profile, QoS architecture)
  - Radio interface structure
  - 3GPP TS for 5G
3. NR physical layer structure
  - Frequency range and frequency band
  - Bandwidth part
  - Basic time unit
  - Numerology and need for them
  - Time domain structure
  - Antenna ports
  - Channel mapping (logical channels, transport channels, physical channels and physical signals)
4. NR downlink physical layer
  - Cell search (SSB, P-SS, S-SS, PCI, PBCH)
  - PT-RS
  - DM-RS
  - CSI-RS
  - PDCCH (CCE, CORESET, PDCCH processing)
  - PDSCH (scrambling, modulation, layer mapping, antenna port mapping, mapping to virtual resource blocks, mapping to physical resource blocks)
5. NR uplink physical layer
  - PT-RS
  - DM-RS



- SRS
  - PUCCH
  - PUSCH
  - PRACH
6. Physical layer procedures
- Timing advance
  - Radio link monitoring
  - Uplink power control
  - Dual connectivity
  - Power headroom report
  - Random access procedure
  - HARQ operation
  - Massive MIMO and beamforming
  - Bandwidth part operation
7. Mobility
- Idle mode behaviour
  - Connected mode mobility (measurements, intra-RAT handover, inter-RAT handover)

## Course Objectives

The 5G NR Air Interface course offers a complete understanding of the radio interface in 5G NR technology. A general characteristic of 5G is presented with its architecture, interfaces and protocols. The course focuses on the physical channels structure and their processing. It also presents physical layer procedures including random access, power control, HARQ related to downlink and uplink transmission, massive MIMO and beamforming. The algorithms and procedures of idle mode behaviour and handover process are also discussed.

The course is based on the 3GPP Release 15 version September 2018 and it is equipment vendor independent.

## Prerequisites

Participation in the LTE Air Interface training would be beneficial.

## Training Structure

Three-day training divided into logical sessions.

## Methodology



Instructor-led training.