

5G RAN NR Air Interface Overview – 2 days

CONTENTS

This course provides a high-level, professional overview of the 5G New Radio (NR) air interface, focusing on the key principles that underpin modern radio access networks. It introduces the fundamental concepts of NR technology, including radio design, spectrum usage, and flexible deployment options.

Participants will gain an understanding of the NR physical layer framework, including frame structure, numerologies, and the role of advanced features such as beamforming and bandwidth adaptation. The course also outlines essential procedures such as synchronization, initial access, and system information acquisition. Core functionalities of control and data transmission are presented in a clear and structured way, along with the role of reference signals and measurements in enabling efficient communication. In addition, the course highlights key operational aspects such as scheduling, reliability mechanisms, and beam management.

An overview of MIMO and massive MIMO technologies is included, together with their impact on performance and capacity. The course concludes with a brief introduction to NR and LTE interworking, providing a complete picture of how 5G integrates into existing networks.

PREREQUISITES

Reasonably good technical knowledge of the LTE physical layer and the LTE radio protocols is highly recommended but not compulsory.

NR Overview

- Summary of radio techniques used in NR
- NR Channel Architecture
- Radio Resource Control protocol (for L1 operation)
- Medium Access Control protocol (for L1 operation)
- Overview of physical channels and signals

NR Physical Layer Design

- Spectrum allocation for 5G
- Bandwidth adaptation and Bandwidth Parts (BWP)
- OFDM numerologies for NR
- NR radio frame and subframe structure
- Slots and slot formats
- Self-contained slots for TDD operation

Synchronization and Initial Access

- SS/PBCH Blocks (mapping, transmission)
- Beamforming and beam sweeping
- PBCH processing and the MIB
- Common Control Resource Set 0 (CORESET #0)
- System Information Block 1
- PRACH and the random access procedure
- RACH accessibility overview
- Initial beam selection

Control Channels & Signals

- Layer 1 processing for PDCCH
- Layer 1 processing for PUCCH
- UE-specific CORESETs
- Coding and mapping of PDCCH
- PUCCH coding and resource selection
- DM-RS mapping for PDCCH and PUCCH

- CSI reporting and CSI-RS configuration
- SRS configuration and SRS triggering

Data Channels

- Layer 1 processing for DL-SCH and UL-SCH
- DM-RS mapping for PDSCH and PUSCH
- Scheduling and HARQ timing
- ACK/NACK signalling on PUCCH
- DCI formats for scheduling and other purposes
- Time and frequency domain resource allocation
- Beam adjustment
- Beam failure detection and recovery

MIMO/mMIMO overview

- MIMO principles & releases
- mMIMO evolution
- mMIMO beams and functionality
- Digital vs. Analog/Hybrid beamforming

NR/LTE Interworking

- EN-DC (DC between LTE and NR)
- Spectrum sharing between LTE and NR