apistraining

5G mMIMO RAN Design Principles – 2 days

CONTENTS

This 5G training course explains in detail the MIMO radio channel modeling as well as capacity and coverage impairments. The configuration of CSI-RS logical ports is discussed vs. channel estimation, SMUX and beamforming. Coverage Analysis and Throughput performance are evaluated and good planning hints are discussed and explained based on the requested achievable targets.

TARGET AUDIENCE

- 5G RAN Engineers
- Radio Network Optimization Engineers
- Radio Network (RAN) Planners
- 5G RAN Performance Analysis Engineers

PREREQUISITES

Understanding on 5G Physical Layer procedures, 5G RAN technology, 5G RAN Planning and Optimization principles.

COURSE OUTCOMES

- Ability to analytically interpret 5G mMIMO KPIs
- Clear understanding of CSI, SINR, and throughput coupling
- Improved system-level optimization decisions
- Capability to bridge theory with real network behavior

COURSE OUTLINE

5G Radio Channel, OFDM and Performance Foundations

- 5G NR radio channel fundamentals
- Large-scale vs small-scale fading
- Time, frequency, and spatial coherence
- OFDM waveform principles and guard intervals
- Physical Resource Block (PRB) structure
- Numerology and subcarrier spacing impact
- OFDM simulation models and channel assumptions
- Noise, interference, and SINR formulation
- Relationship between SINR, BLER, and throughput
- Introduction to system-level KPIs

Channel Estimation and CSI Fundamentals

- MIMO technology overview
- MIMO SMUX vs. Beamforming
- MIMO beamwidths and gains
- Beamforming Reference signals in 5G NR
- CSI-RS design and reporting framework
- Channel estimation accuracy limits
- Impact of mobility and Doppler
- Interpolation in time and frequency
- Effective SINR mapping concepts
- CSI feedback errors and performance loss

mMIMO and Beamforming Performance

- mMIMO channel matrix modeling
- Spatial correlation and rank
- Beamforming principles (digital, hybrid)

- CSI-based beam selection
- Impact of antenna count and array geometry
- Beamforming gain vs beam width
- Pilot contamination and reciprocity

Throughput, Capacity and Optimization
- Downlink and uplink throughput modeling
- Scheduler behavior and resource allocation
- Multi-layer transmission limits
- CSI quality vs achievable rank
- Load impact on mMIMO performance
- Energy efficiency considerations
- Realistic KPI interpretation and troubleshooting