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5G RAN NR Air Interface

This course will offer delegates a good and deep understanding on 5G NR Radio Access Network (RAN) layer 1 channels, signals and procedures

COURSE REVIEW

This 5G training course leads the audience into a deep dive towards **5G RAN NR layer 1** (air interface) interface. It exploits the topic from initial access to resource allocation and from beam-forming to data transmissions.

It provides detailed descriptions and explanations of the radio interface channel and signal structure, the concepts of **OFDM (Orthogonal Frequency Division Multiplexing**), resource allocation, control signaling, channel coding, frame structure, slot structure, **FDD**, **TDD**, system information, and finally **Massive MIMO (Multiple Input Multiple Output**). The course is purely theoretical, however **it is supported by proper exercises** for better understanding of the topic.

AIMED AT

This course is mainly aimed at a technical audience. It is suitable for technical professionals, **RAN operators**, **Radio planning engineers**, **RAN optimization engineers**, **Research Institutes**, **defense sector**, who currently are or will be involved in deploying, designing, configuring and/or implementing **5G NR**.

Prerequisites: Those wishing to take this course should have a good and solid understanding of 5G technology, with good reference to **LTE air interface**.

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Course Benefits for individuals (Professionals)

- Understanding **5G RAN layer 1** requirements
- Learn how to configure **5G NR air interface** physical channel parameters and signals to exploit network performance
- Understand the principles behind the control channels and user data channels.
- Learn about massive **MIMO technology** and principles
- Understand the physical layer procedures

Course Benefits for your Organization

- Equip organization engineers with the necessary knowledge to understand **5G NR physical layer.**
- **Keep ahead of competitors** in properly configuring air interface parameters, contributing to high quality customers' 5G services
- Prepare for future network expansions and quality performance optimization

Training Format

Instructor-Led Training
On-Site Classroom: 3 days
Web delivered (Virtual): 3 days
Excellent and descriptive course material (pdf file) will be provided

Customer Tailored!

We can tailor the included topics, tech level, and duration of this course right to your team's technical requirements and needs

Section 1: 5G NR Air Interface Technology Review

Course Program Outline

Module 1: 5G New Radio (NR) Technology Preview

- 5G Air interface overview
- 5G NR FR1 and FR2 bands
- Scalable numerology
- NR frame structure
- FDD – TDD modes
- NR signals and channels review
- Stand-Alone (SA) architecture
- 5G SA Services: eMBB, massive IoT, URLLC

Module 2: 5G NR Physical Layer Structure

- 5G NR channel structure
- 5G NR Cell concept
- Introduction to OFDM principles
- Wireless channel characteristics and OFDM performance
- Explain the reason for flexible numerology
- Flexible numerology vs. wireless channel conditions

See next box

Module 2: 5G NR Physical Layer Structure

Cont'd from previous box

- Frequency domain physical layer structure
- Channel Bandwidth and bandwidth part (BWP) concept
- Time Domain physical layer structure and slot structure details
- Explain the concepts of channel coding and FEC (Forward Error Correction)
- LDPC coding description and performance
- Polar coding description and performance

Section 1: 5G NR Air Interface Technology Review

Course Program Outline

Module 3: mMIMO Technology overview

- LTE to 5G MIMO review
- MIMO principles
- MIMO channel rank, transmission rank, precoding and layers
- MIMO TM3, TM4, TM8-10 modes for NSA & SA deployment: gain and performance
- 3GPP Massive MIMO (mMIMO) standardization
- Beam-forming principles

see next box

Module 3: mMIMO Technology overview

Cont'd from previous box

- Active Antenna Systems; Active Antenna Units
- mMIMO channel rank, transmission rank, precoding and layers
- mMIMO codebook-based vs non-codebook based transmissions
- SU-MIMO and MU-MIMO in Mmimo
- mMIMO and CSI acquisition methods
- mMIMO beam management
- Practical exercises

Section 2: 5G NR Physical Layer Procedures

Course Program Outline

Module 4: Control Channels & Signals

- 5G NR sync signals and reference signals related to control plane
- Initial Cell search procedure
- PSS/SSS synchronization procedure
- SSB reading procedure
- MIB content and SIB1 CORESET0 determination
- SS/PBCH block sweeping procedure
- Random access procedure and initial beam establishment
- RACH procedure Msg1-Msg4 sequence and contents
- Timing Advance and Time synchronization

see next box

Module 4: Control Channels & Signals

Cont'd from previous box

- 5G NR PDCCH channel and DCI formats
- 5G NR PDCCH DCI format contents
- 5G NR PDCCH aggregation level and blind decoding
- 5G NR PDCCH parameter configuration
- 5G NR PUCCH formats
- 5G NR PUCCH UCI formats and signaling contents
- 5G NR PUCCH parameter configuration
- 5G NR PUCCH power control
- 5G NR SRS power control
- Practical Exercises using also trace log files

Section 2: 5G NR Physical Layer Procedures

Course Program Outline

Module 5: User Data Transmission Channels

- 5G NR reference signals related to control plane (DMRS, CSI-RS, TRS, PTRS)
- 5G NR reference signals parameters and configuration
- DMRS configuration vs. wireless channel conditions
- PTRS configuration vs. wireless channel conditions
- 5G NR Type A transmission
- 5G NR Type B transmissions
- 5G NR HARQ codebook principles and Code Block Group (CBG) based retransmissions
- 5G NR HARQ and CBG parameters
- 5G NR PUSCH power control
- Practical exercises using also trace log files

Module 6: 5G NR L1/L2 inter-operability

- 5G NR MAC scheduler principles
- 5G NR DL scheduling principles and resource allocation in frequency and time domain
- 5G NR PDSCH parameter configuration
- 5G NR UL scheduling principles and resource allocation in frequency and time domain
- 5G NR PUSCH parameter configuration
- Link adaptation principles
- Link Adaptation and PDSCH TBS
- Link Adaptation and PYSCH TBS
- Practical exercises using also trace log files