5G NR - Radio Technology & Parameters Optimization

SYNOPSIS

- **Introduction Seminar**: 5G Radio and Core Technologies and IMS Telephony.
- **Hands-on Seminar**: NR air interface technology, physical layer, radio channel structure, physical layer procedures and radio parameters tuning.
- Focus on Physical Layer Procedures and Radio Resource Management.
- Focus on NR radio resource management and lower layer radio protocols.
- Focus on SA NR Technology, and NR deployment.
- Discuss performance tuning parameters and KPI.

DURATION

- 5   Days

PREREQUISITES

- LTE Essentials seminar or equivalent knowledge.

TARGET AUDIENCE

- Software and hardware engineers, tester, system architects, electronic warfare and interception engineers.
- Field engineers, troubleshooters, technical staff being responsible for O&M.

COURSE TARGETS

- The Introduction participants would become familiar with 5G Radio and 5G Core technologies and learn IMS fundamentals, protocols and IMS Multimedia Telephony and Voice Call Mobility Scenarios over NR and LTE.
- The participants would be able to develop, deploy, test and optimize NR transceivers and and troubleshoot NR protocol software (Layer-2 and RRC).
- Mapping between 5G architecture and procedures and LTE.
- Detailed discussion and intuitive understanding of radio procedures, connection and bearer setup,
  NR-NR mobility and NR-LTE mobility scenarios.
  - Recognize radio parameters that influence the Mobile's behavior.
  - Recognize radio parameters that impact performance, QoS and reliability.
- Participants would gain experience in analyzing NR Radio Protocol trace logs and become familiar with RRC functionality (NGAP, XnAP overview).

5G Radio Technology Introduction – 1 Day Session

Session 1: 5G and NR Technology Overview

1A. 5G Technology Introduction

    a. NR-5GC Architecture & Interfaces

    b. EN-DC Architecture - SA and NSA Protocol Stack

    c. SA NR Basic Service Scenarios (high level) – compared to NSA

    d. 5G Enablers (OFDMA, MIMO, SbA, Slicing, CUPS)

    e. 5G Release Evolution to 5G-Advanced (R15..R18)

1B. NR Radio Channels

    a. Pilot and Cell Detection, Measurements)

    b. NR Radio Channels and Ref-Signals dimensioning (time/frequency/code domains, PD-CCH Aggregation)

    c. Channel Raster and Numerology

    d. FDD and TDD Transmission and Reception (Radio Frames, slot configuration, synchronization)

    e. mm-Wave Operation and Multi-Beam Principles

    f. NR Channels applicable for EN-DC Secondary Cell

1C. NR Radio Operation Principles

    a. NR Cell Coverage and **Radio Link Budget** (FR1/FR2 Coverage and Capacity)

    b. SA NR Idle Mode Operation Principles

    c. SA NR Connected Mode Operation Principles

    d. NSA NR Operation – in relation to SA NR Operation

SA NR Optimization Sessions

Session 1:   Cell Configuration Parameters
- a. gNB Cell/Channel Configuration (Dimensioning, Power Offset)
- b. CU/DU Split Architecture
- c. SSB and Cell Detection
- d. Cell Identity and Color Allocation
- e. Broadcast Channel and SIB Parameters
- f. Optimization Cycle: KPI Report and Parameters Tuning
- g. **Optimization Cycle**: PD-CCH and PD-SCH Dimensioning
- h. 5G RAN Sharing

Session 2:   RRC Parameters and Trace Analysis
- a. NR Radio Protocol Stack
- b. RRC Protocol and State Model (Multi-RAT)
- c. Connection and Bearer Allocation Flows (Setup and Reconfig in SA and NSA)
- d. Tools for Log Capturing (on N1/N2/N3 and F1)
- e. Connection/Bearer Tuning Parameters and KPI
- f. Optimization Cycle: Connection Statistics, Overload.
- g. **RRC Log Analysis Hands-On**

Session 3: SA NR Idle/Connection-Setup Radio Procedures Optimization   3.5H
- a. Measurements for Cell Selection (SA and NSA)
- b. NR RACH Operation and Parameters and KPI
- c. **Optimization Cycle**: RACH Load and Success Rate
- d. NR Paging/DRX Operation and Parameters and KPI
- e. NR Timing Adjust Procedure and Tuning Parameters

NSA NR Optimization Sessions

Session 4: NSA NR Idle Radio Procedures Optimization

a. Multi Carrier/Band Operation and Frequency Hopping
b. NSA Idle Mode – PLMN/RAT/Cell Selection Parameters
c. NSA Coverage Edge Scenarios - NR to LTE
d. **Optimization Cycle**: NSA Cell Coverage and Load Sharing
e. NSA Connection Setup, Accessibility Parameters and KPI
f. **Optimization Cycle**: SgNB Addition Threshold
g. SmartNoise and Battery Saving

Session 5: NSA NR QoS and Throughput Optimization

a. Bearer and Flow Adaptation Parameters
b. NSA NR Cell - NR Utilization and Throughput KPI
c. UE Measurements for Resource Allocation & Adaptation
d. Capacity Utilization, Admission Control & Link Adaptation Algorithm
e. Uplink and Downlink Scheduling Principles (SPS)
f. Bearer QoS mapping – end to end
g. **Optimization Cycle**: Tuning for Throughput

NSA NR Optimization Sessions

Session 6: NSA NR Robust Connection Optimization

a. NR-EPC Radio Bearer

b. HARQ and RLC Retransmission Parameters and KPI

c. Power Control Parameters Tuning

d. Robust Connection KPI

e. Radio Link Failure and Re-Establish Parameters (and RLF Scenario in NSA)

f. Optimization Cycle: Tuning for Robust Connection

Session 7: NSA NR Handover and ReEstablish Optimization

a. Intra/Inter Cell Handover Scenarios

b. Inter-RAT Mobility (NR-LTE)

c. NSA Handover Scenarios

d. UE Measurements for Mobility - Tuning Trigger Events

e. NSA Handover Scenarios - NR to NR

f. NSA Mobility KPI

g. Optimization Cycle: Handover Success Rate