5G NR Optimization

DURATION: 3 days

COURSE OVERVIEW

5G has introduced a new way to plan and offer services in the mobile industry, introducing new concepts and technologies and creating a new way to represent 3GPP's new approach on cellular technology. The big impact on the next generation NG network planning and deployment, from both Radio's and Core's point of view, is not quite evident from first glance, introducing realistic difficulties om how to handle and optimize all new technologies for the stand alone network deployment or in the same network deployment with LTE for NSA architecture. Network optimization is both an art based on intuition as well as a solid part of engineering based on thorough knowledge of the technology which requires specific steps and compromises due to quite often contradicting results. An advanced understanding on how to optimize this evolutionary network design is quite demanding and sometimes tricky because the targets for different technologies might be contradicting.

This course differentiates from other similar topics in the market by introducing the attendant, apart from simplistic approaches and discussions of optimization steps, into the basic 5G theory and the necessary knowledge of 5G technology handling and impact on performance. Realistic simulation results as well as justified mathematical modeling is used for 3GPP parameter optimization, related also upon demand to vendor specific discussions and optional features. Both drive test analysis discussions on 3GPP parameters and procedures as well as 3GPP counter based KPI formulas will be covered and thoroughly discussed.

In order for the attendant to better understand the content of this topic, it is recommended to have prior attended following courses:

- 5G Network Overview – recommended
- 5G RAN Design – strongly recommended
- 5G Network Protocols & Signaling Procedures – recommended but not essential, at least the RAN part

It is also recommended to have a prior knowledge on LTE technology. Finally it is also important to mention that this course can be customized on customer requests and demands.

TECHNOLOGY FOCUS

5G Radio Access Network (RAN) must be properly designed to operate in a wide range of spectrum bands with diverse standards characteristics and operator specific requirements. From Operator's perspective it is equally important to develop, deploy and optimize 5G networks, tailor them into desired capability, performance and service diversity. This is a difficult goal to achieve binding together the planning principles with compromises and functional procedures on the same sector. This course will introduce participants on the methodology and algorithms of the art of network performance analysis and optimization, emphasizing on both the stand alone and non-stand alone deployments. Finally it is worthwhile to mention that the overall optimization will be supported by simulation results, mathematical analysis, non-linear regression algorithms to introduce the scheduler behavior and the beam management into the design process as well as practical examples.

WHO SHOULD ATTEND?

It is considered to be a valuable topic mainly for Radio Network Planners and Radio Network Optimizers who's daily job is to plan and optimize the network performance. It is also valuable for 5G System Architects, 3GPP consultants, 5G R&D Researchers, 5G System Analysts and 5G network consultants, contributing into further insight to the 5G technology's potentials and performance analysis requirements for services, optional feature enhancements and general E2E performance in the pathway towards 6G.

COURSE CONTENT – DAILY SCHEDULE

Section 1 – 5G NR Initial Tuning

5G New Radio (NR) Customer Initial Planning Review

- ✓ Idle mode measurements
  - ➢ SS-RSRP, SS-RSRQ, SS-SINR
  - ➢ CSI-RSRP, CSI-RSRQ, CSI-SINR
- ✓ Coverage Analysis
  - ➢ Pathloss Model Analysis
    - ✓ 3GPP pathloss models
    - ✓ Customized pathloss model analysis using ML
  - ➢ Channel model analysis
    - ✓ 3GPP Channel Models
    - ✓ Customized channel model analysis using ML
- ✓ Low/Mid/High bands configured & licensed parameters
  - ➢ Numerology ??
  - ➢ Channel Bandwidth ??
  - ➢ TDD or FDD ??
    - ✓ TDD patterns
    - ✓ TDD special slot
  - ➢ UL/DL spatial multiplexing layers ??
  - ➢ Digital Beamforming & number of beams ??
  - ➢ SU-MIMO or MU-MIMO ??
  - ➢ Capacity - RRC connected users ??
  - ➢ Cell peak throughput ??
- ✓ NSA or SA ??
  - ➢ NSA EN-DC PDCP aggregation
    - ✓ Number of Pcell and PScell DL CC licensed components
    - ✓ Number of Pcell and PScell UL CC licensed components
  - ➢ SA aggregation
    - ✓ Number of DL CC licensed components
    - ✓ Number of UL CC licensed components
- ✓ Low Band FDD MIMO antennas
  - ➢ FDD 400 MHz-2.6 GHz bands
  - ➢ 2T2R, 4T4R, 8T8R
    - ➢ TM3, TM4, TM7, TM8, TM9
- ✓ Mid Band TDD MIMO antennas
  - ➢ TDD 3.4-3.8 GHz & 5 GHz LAA bands
    - ✓ TDD patterns supported
  - ➢ 2T2R, 4T4R, 8T8R MIMO antennas
    - ✓ TM3, TM4, TM7, TM8, TM9
- ✓ Mid Band TDD mMIMO antennas
  - ➢ TDD 3.4-3.8 GHz & 5 GHz LAA bands
    - ✓ TDD patterns supported
  - ➢ 32T32R, 64T64R mMIMO AAS units
    - ✓ Elevation beamwidths vs. Azimuthial beamwidths
- ✓ High Band TDD massive MIMO antennas
  - ➢ TDD 24-38 GHz bands
    - ✓ TDD patterns supported
  - ➢ 32T32R, 64T64R, 256T256R AAS units
    - ✓ Elevation beamwidths vs. Azimuthial beamwidths
- ✓ CSI-RS based Beam Management
  - ➢ CSI-RS vendor equipment port configuration (8, 16, 32)
  - ➢ Number of available beams
  - ➢ Beamwidth granularity
- ✓ PCI planning 3GPP TS 28.541 spec
- ✓ RACH planning
  - ➢ UL/DL TDD Special Slot Pattern
  - ➢ RACH Preample pattern selection
  - ➢ RACH root sequence planning

5G New Radio (NR) SA idle Mode Optimization

- ✓ Idle mode behavior review
- ✓ Cell search procedure
- ✓ SSB synchronization
  - ➢ SSB Detection Probability vs. SINR
  - ➢ MIB & CORESET0 detection probabilty vs. SINR
  - ➢ SSB Coverage improvements
- ✓ Initial Cell Selection optimization

- Parameter check
- Optional features

- ✓ Initial Cell Reselection optimization
  - Parameter check (Priority, Inter RAT, etc)
  - SA Optional Features

5G New Radio (NR) SA Connected Mode Optimization

- ✓ Random Access succesful performance
  - msg1 Detection probability vs. SINR
  - msg1 accessibility vs. Cell capacity
  - msg2 Detection probability vs. SINR
  - msg3 Detection probability vs. SINR
  - msg4 Detection probability vs. SINR
- ✓ Random Access coverage improvements
  - RACH preample pattern vs. Cell range
- ✓ TDD frame structure optimization
  - TDD special slot vs. Cell range
- ✓ NR RB Throughput vs. SINR
  - Vendor specific curves
  - Practical Drive Test analysis using ML
- ✓ 5G SA Carrier Aggregation optimization
- ✓ Troubleshoot low DL/UL NR throughput
  - Cross-Link Interference detection and solution
  - TDD frames optimization
  - DL/UL unbalance
  - UE power saturated
- ✓ Troubleshoot NR interference
  - Check NR FDD/TDD frequency planning
  - Cross-Link Interference
  - TDD Adjacent Channel Interference
    - ✓ NR to NR TDD frame matching
    - ✓ NR to LTE TDD frame matching
  - NR hotspot interference
- ✓ SA Mobility Optimization

5G New Radio (NR) NSA Optimization

- ✓ 5G NSA EN-DC connectivity overview
  - 5G NSA EN-DC connectivity failure
  - EN-DC NR leg Radio Link Failure
  - EN-DC abnormal NR leg drop analysis
- ✓ 5G NSA re-establishment
  - EN-DC split bearer to LTE MCG bearer
  - Analysis & Optimization
- ✓ NSA mobility optimization
- ✓ 5G NSA aggregation optimization

Section 2 – 3GPP based KPI Analysis

5G NSA & SA Accessibility

- ✓ Performance analysis
  - LTE NSA accessibility success rate
  - 5G NSA accessibility success rate
  - 5G SA accessibility success rate
- ✓ optional : analysis on statistics log files

5G Retainability

- ✓ 5G NSA EN_DC establishment success rate
- ✓ 5G NSA EN_DC DRB retainability
- ✓ 5G NSA EN_DC mobility analysis (eNodeB & gNB)
- ✓ 5G SA mobility analysis
- ✓ Counter triggering analysis – signaling flow description
- ✓ optional : analysis on statistics log files

5G Throughput

- ✓ 5G NSA EN_DC DRB throughput rate rate
- ✓ 5G NSA EN_DC DRB round trip time
- ✓ 5G SA throughput analysis
- ✓ Counter triggering analysis – signaling flow description
- ✓ optional : analysis on statistics log files