LTE and 5G RAN Engineering: RF Planning, Signalling and Optimisation

17 – 21 May 2027
Paris - Right Bank business hotel

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Introduction:

LTE and 5G RAN engineering problems usually surface as dropped calls, weak indoor signal, congested cells and failed handovers, because sites were placed without a sound link budget, capacity was dimensioned on guesswork and drive-test data was never turned into corrective actions. This Core Concept course takes radio, operations and enterprise telecom staff from the evolution of GSM and GPRS through LTE and 5G NR, into the eNodeB, gNodeB and EPC architecture, attach, bearer and handover signalling, RF planning, in-building coverage and KPI-driven optimisation. Participants build a RAN Planning and Optimisation Workbook for a live coverage area.

Course Objectives:

- Explain how GSM, GPRS, UMTS, LTE and 5G NR differ in radio interface, core network design and service capability, and position an existing network on that evolution
- Trace LTE attach, default and dedicated bearer set-up, and X2 and S1 handover procedures across the eNodeB, MME, SGW and PGW
- Calculate uplink and downlink link budgets and derive cell range, site count and capacity for a target coverage area
- Design in-building coverage using passive or active distributed antenna systems and small cells for large venues and offices
- Analyse drive-test logs and network counters using RSRP, RSRQ, SINR, throughput, drop and handover success indicators to prioritise optimisation actions
- Prepare a RAN Planning and Optimisation Workbook covering spectrum, site plan, dimensioning, KPI targets and a 4G to 5G NSA and SA migration step

Target Audience:

- Radio network planning engineers who model coverage, dimension capacity and select sites for macro and small cell layers
- RAN operations and maintenance staff who configure eNodeB and gNodeB parameters and resolve cell-level faults
- Network optimisation engineers who run drive tests and turn counters and logs into parameter and antenna changes
- Enterprise and facilities telecom staff who specify and oversee in-building mobile coverage in campuses, hospitals, malls and towers
- Transmission, site acquisition and rollout engineers who coordinate new site builds and technology upgrades

Course Outline:

Day 1: Mobile Network Evolution from GSM to 5G NR

- GSM Radio Interface, TDMA Frames and the BTS, BSC and MSC Architecture
- GPRS Packet Core with SGSN and GGSN and the Move to Always-On Data
- UMTS WCDMA Radio Access and the Shift to Packet-Switched Services
- 3GPP Release 8 LTE Design Goals: OFDMA Downlink, SC-FDMA Uplink and Flat IP Architecture
- Technology Inventory Audit: Mapping 2G, 3G and 4G Layers of an Operating Network

Day 2: LTE E-UTRAN, EPC and 5G NR Architecture

- E-UTRAN Built from eNodeBs and the X2 Inter-eNodeB Interface
- EPC Nodes MME, SGW, PGW, HSS and PCRF and Their Reference Points S1-MME, S11, S5/S8 and Gx
- LTE Frame Structure, Resource Blocks and Physical Channels for Control and User Data
- 5G NR Release 15 Numerology, FR1 and FR2 Bands and the gNodeB
- Non-Standalone EN-DC Anchoring on LTE Versus Standalone Operation on a 5G Core Network

Day 3: LTE Signalling Procedures and RF Planning Calculations

- Attach Call Flow: RRC Connection, NAS Messages and Default Bearer Activation
- Dedicated Bearers, QoS Class Identifiers and Tracking Area Updates
- Intra-LTE Handover over X2 and S1 with Measurement Reports and Event Triggers
- Uplink and Downlink Link Budget: EIRP, Path Loss, Fade Margin and Receiver Sensitivity
- Coverage and Capacity Dimensioning Sheet: Cell Range, Site Count and Traffic per Sector

Day 4: In-Building Coverage, Spectrum, KPIs and Optimisation

- Passive and Active Distributed Antenna Systems and Small Cell Layers for Indoor Venues
- Spectrum Band Selection, Carrier Aggregation and Frequency Reuse Trade-Offs
- Site Planning Constraints: Antenna Height, Tilt, Azimuth and Neighbour Lists
- Drive-Test Analysis of RSRP, RSRQ and SINR with Throughput and Interference Mapping
- Accessibility, Retainability and Mobility KPIs for Drop, Block and Handover Failure Diagnosis

Day 5: RAN Modelling Build and Migration Planning

- Modelling Build: Link Budget and Site Count for an Urban and a Suburban Cluster
- Modelling Build: In-Building DAS Layout for a Multi-Storey Hospital or Shopping Mall
- Drive-Test Log Case: Diagnosing Pilot Pollution and Missing Neighbour Relations
- 4G to 5G Migration Roadmap: Anchor Band, NSA Rollout and SA Transition Steps
- RAN Planning and Optimisation Workbook Assembly and Peer Review Panel

Skills You Will Gain:

- Cellular Technology Evolution Mapping
- LTE Call Flow Tracing
- Link Budget Calculation
- Coverage and Capacity Dimensioning
- In-Building DAS Design
- Drive-Test Data Analysis
- RAN KPI Diagnosis
- 5G NSA and SA Migration Planning

Why Attend This Course:

- Take back a RAN Planning and Optimisation Workbook with a link budget, dimensioning sheet, KPI targets and migration steps for an area you manage
- Challenge vendor and contractor coverage predictions with your own calculations before sites and DAS equipment are ordered
- Read attach, bearer and handover signalling with enough fluency to locate where a failing procedure breaks
- Compare RAN practice with engineers from mobile operators, tower companies, integrators, utilities and large-venue owners

Conclusion:

Mobile networks perform when radio planning, signalling and optimisation are treated as one engineering chain. The week moves from GSM, GPRS and UMTS to LTE and 5G NR, through the E-UTRAN, EPC and gNodeB architecture, into attach, bearer and handover procedures, link budgets and capacity dimensioning. It then covers in-building DAS and small cells, spectrum and site constraints, drive-test analysis and KPI diagnosis, and closes with modelling builds and a RAN Planning and Optimisation Workbook that includes a 4G to 5G migration roadmap.