Vendor: SPLOTY	System: 5G
Level: **Intermediate**	Duration: **2 days**
Course Title: **5G Radio Planning**	

Description:

This training is an excellent choice for engineers responsible for the radio access network planning. Contrary to previous generations, 5G for the first time utilizes very high frequencies reaching 60GHz also called mmWave bands. These high frequency bands offer a wide spectrum that is vital for the improvement of the network performance. However, this comes at a cost. Free space propagation loss increases significantly for the high frequency bands. As a consequence cell radius is much smaller compared to former technologies. This network densification has a significant impact on the radio planning. New propagation models and planning techniques are required. Also other aspects like energy efficiency have to be taken into consideration. This course presents the latest developments in cell planning focused on 5G system.

Target audience:

The course is intended for 5G system technical staff responsible for radio network planning, design and optimisation.

Contents:

Introduction

3GPP mobile network evolution, 5G system performance, Standalone (SA) and Non-Standalone (NSA) implementation,

Architecture

5GS service based and reference point architecture, UDM, UDR, UDSF, 5G-EIR, AMF, SMF, UPF, multiple Packet Session Anchors, Session and Service Continuity, SMS over NAS, PCF, AF, IMS/VoLTE support, interworking with LTE/EPC, NEF, NWDAF, AUSF, N3IWF, NRF, LADN, international roaming, GTPv1-U tunnelling, protocol stacks; identifiers: SUPI/IMSI, SUCI, PEI/IMEI, 5G-GUTI, GPSI/MSISDN/external identifier, Internal-Group Identifier, External Group Identifier, DNN, DNAI,

NG-RAN

Separation of gNB-CU and gNB-DU, Separation of gNB-CU-CP and gNB-CU-UP, F1 and E1 interfaces, fronthaul options (CPRI, eCPRI, nFAPI), F1/E1 procedures: F1 startup and cells activation, gNB-CU-UP E1 Setup, UE Initial Access, Inter-gNB-DU Mobility, RRC-CONNECTED to RRC-INACTIVE state transition, RRC-INACTIVE to other RRC states transition, TNL associations, RAN virtualisation,

NR

Frequency bands (FR1/FR2), mmWave characteristics, propagation losses (free space loss, atmospheric attenuation, foliage losses, body losses, penetration losses), link budget, mobility related problems (Doppler shift and Doppler spread),

5G Cell Planning

Cell planning fundamentals (planning objectives, inputs and outputs to the planning process), Green Planning (energy metrics and throughput efficiency, optimum base station location for minimum energy consumption), planning of mmWave frequency bands, new propagation models for high frequencies (free space propagation loss including rain and foliage attenuation, Alpha-Beta-Gamma model), algorithms for optimum base station selection (elimination algorithm, evolutionary strategy-based algorithm), detailed analysis of 5G network coverage planning aspects, designing and antenna array (reducing grating lobes and side lobe's power), RF link budget analysis, SINR and signal strength simulations, higher order sectorisation, antenna downtilt optimisation, planning of cloud RAN (optimisation of the number of virtual Baseband Units – vBBUs), Automated Cell Planning (geographic information system, 3D building model), cell planning case studies discussion.

Prerequisites:

The participants should have general technical telecommunications/computer science knowledge on a degree level. Knowledge about radio planning methods for previous mobile technologies is very useful.

Training method:

Lectures and multimedia presentations.