O-RAN System Training
(with SD-RAN Hands-On)

Course Duration

Pre-recorded: 13 hours + quizzes + hands-on exercises
Instructor led: 3 days

Course Overview

The course covers joint design of technology and ecosystem aspects in Open RAN networks. The technology enablers include open networking, virtualization, HW/SW disaggregation, network intelligence. The course discusses Open RAN concept, architecture, use cases, functions and interfaces. The central point for the standardization of Open RAN is the O-RAN Alliance, but relation to other entities, like TIP (Telecom Infra Project), and 3GPP is also emphasized.

This course deals with O-RAN use cases, with particular emphasis on a traffic steering use case based by the O-RAN ALLIANCE standard. The main focus is the implementation within the Open Networking Foundation (ONF) SD-RAN project. This is provided with a step-by-step guidance on environment installation and xApp implementation. The course also includes simulation demonstrations in the xApp and RIC field along with hands-on part using Open RAN xApp demonstrator. The course covers xApps development for the µONOS RIC of the ONF's SD-RAN project.

Who Should Attend?

Participants with background in either system design, networks design should benefit from participation. The focus is on Open RAN networks and its relation to 5G and participants with general background in networks will be able to follow the course. This includes industry, networks operators, regulators and managers in this field as well as researchers, students and professors in academia.

The focus of the hands-on part is on Open RAN implementation, thus a prerequisite is that the participants poses basic programming skills in CI/CD-types of environments. Will utilize the knowledge from theoretical part of the design of the Open RAN system and xApps for the Near-Real-Time (Near-RT) RIC. The focus is on xApps development for the ONF's SD-RAN platform. Thus, an experience with the Ubuntu OS, Kubernetes tool and GO programming language will be helpful.

Course Agenda

5G and Private Mobile Networks (1.5 h)
- Mobile systems evolution
- 5G overview, 5G complexity and RAN split options

- X-Haul (FrontHaul, MidHaul, Backhaul)
- RAN disaggregation (CU, DU, RU)
- Private Mobile Networks
- Beyond 5G and towards Open RAN

Introduction to O-RAN (1.5 h)

- From RAN to O-RAN transition
- Pros & Cons of O-RAN
- Open RAN integration aspects
- O-RAN ecosystem and standardization (roles of O-RAN Alliance, 3GPP, TIP, O-RAN Software Community, ONF)
- O-RAN Alliance specifications and workgroups
- O-RAN timeline and developments around the World

O-RAN Architecture (1 h)

- Overall architecture of O-RAN
- 3GPP vs O-RAN architecture comparison
- Description of O-RAN functions / nodes
  o RAN Intelligent Controller (RIC) and decoupling onto Non-Real-Time RIC & Near-RT RIC
  o O-RAN central unit (O-CU) and decoupling onto O-CU-CP & O-CU-UP
  o O-RAN distributed unit (O-DU) and O-RAN remote unit (O-RU)
- Relevant interfaces in O-RAN architecture (A1, E2, O1, O2, Open FH)
- Implementation options and deployment scenarios

RAN Intelligent Controller (RIC) (2 h)

- Overview and functional split
- O-RAN control loops
- xApps vs rApps
- Non-RT RIC architecture and A1 interface
- Near-RT RIC architecture and E2 interface
- Service models, policies and procedures
- E2 key performance measurements (E2KPM)

O-RAN Use Cases (1.5 h)

- Overview of use cases and phases by O-RAN Alliance
- Open RAN Technical Priority Document
- Example use case details and requirements
  o Basic traffic steering and multi-access traffic steering
  o QoS-based Resource Optimization

Traffic Steering Use Case Analysis and Simulations (2 h)

- Traffic Steering (TS) mechanism
- Analysis of TS in O-RAN
- Example xApps implementations for TS use case

- Simulation studies and analysis of the TS scenarios
- Live demo & access to on-line simulator

SD-RAN Hands-on and xApp Installation (2.5 h)

- Environment preparation and installation process
- ONF's SD-RAN Introduction and software Installation
- SD-RAN RANSim deployment, API and laboratory tasks (Communication with the RAN Simulator, Network data displaying, Basic GUI creation)
- Installation of a simple application to communicate through API
- Step-by-step xApp deployment to communicate through E2 Interface and laboratory tasks (obtaining information about the network nodes through the E2 interface, Traffic Steering xApp testing)
- Traffic Steering xApp policy control over A1 Interface within SD-RAN (Demo)

Network Slicing in O-RAN (1 h)

- Network slicing concept in 3GPP and NGMN
- Network slicing in O-RAN (Reference architecture, slicing models)
- Use case: RAN Slice SLA Assurance
- Use Case: NSSI Resource Allocation Optimization