Procedures and Uses Cases of 5G O-RAN (Open RAN)

O-RAN (or Open RAN) accelerate innovation and commercialization in RAN domain with multi-vendor interoperable products and solutions that are easy to integrate in the operator's network and are verified for different deployment scenarios. O-RAN standards are freely accessible to all third-party software developers, who can develop new types of services and innovate on the RAN Intelligent Controller (RIC) by building xApps and rApps. This enables telcos to make their networks a much more relevant resource for both enterprise and consumer applications.

This training course of 5 days covers all the important topics that are required to have a good and comprehensive learning of the O-RAN technology. The relevant standards of the O-RAN alliance have been discussed to describe the O-RAN architecture and working, as well as the O-RAN open interfaces.

Objectives

- Open RAN Overview
- Open RAN design goals and challenges
- Open RAN deployment scenarios
- Evolution to O-RAN (vRAN, C-RAN, D-RAN, RAN Disaggregation)
- Detailed Architecture of Open RAN
- RAN Functional Split Options (specially option 7.2x)
- Enhanced CPRI (e-CPRI) Protocol
- Transport connectivity - Fronthaul and Midhaul
- Virtualization and Orchestration in Open RAN
- Open RAN in 5G Network and Telco Cloud
- Open RAN Use cases

Outline

1) Introduction to Open RAN

- Presentation of Open RAN
- Open RAN Terminologies
- Open RAN Standards

- Open RAN design goals
- O-RAN Alliance and its Working Groups
- Challenges with Open RAN
- Differences between Open RAN, O-RAN and OpenRAN

2) Evolution to Open RAN

- Traditional Radio Access Network (RAN)
- Stages of RAN Evolution
- Evolution to the Contemporary 4G/5G Networks
- Evolution to Virtualized RAN (vRAN)
- From Virtualized RAN (vRAN) towards Open RAN
- Difference Between Distributed RAN and Centralized RAN
- Difference Between Centralized RAN and Cloud RAN
- Path to 5G Open RAN: Horizontal Dis-aggregation

3) RAN Splits-Logical View

- Protocol Layer Overview and Functionnalities
- Different RAN Functional Splits
- RAN Splits Logical View
- RAN Split From Option 1 to 8
- Option 7.2x for Open RAN
- Enhanced CPRI (e-CPRI) Protocol

4) Overview of O-RAN Architecture

- Control Plane & User Plane Dis-aggregation in O-RAN
- Entities & Interfaces Introduced in O-RAN Alliance Architecture Functions
- Options For Aggregation of O-RAN Nodes
- O-RAN Control Loops
- Major Entities in O-RAN Ecosystems
- Open Distributed Unit (O-DU) Functionality
- Open Central Unit (O-CU) Functionality
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5) Virtualization techniques for O-RAN

- Evolution of Virtualization: Physical Network Functions (PNFs)
- Virtual Network Functions (VNFs)
- Monolithic Applications as VNFs
- Cloud Native Network Function-Distributed Applications
- O-Cloud Deployment Options
- DEVOPS CI-CD in O-RAN

- Network Automation to Reduce CAPEX and OPEX

6) Detailed O-RAN Architecture

- Service Management and Orchestration (SMO)
- Non Real Time RIC (non-RT RIC)
- JSON (JavaScript Object Notation) Format Example
- A1 Policy Format and Examples
- Near Real Time RIC
- Centralized and Distributed Near-RT RIC
- xApps - use case (Near real time RIC)
- rApps - use case (Non real time RIC)

7) Transport Connectivity in Open RAN

- Introduction to Transport Connectivity
- Transport connectivity – Fronthaul and Midhaul
- Fronthaul (eCPRI)
- Midhaul deployment options - Different frequency bands
- Options to achieve high capacity and availability with low latency in Midhaul

8) Network Slicing in 5G O-RAN

- What Is A Network Slice
- Example of Network Slicing in 5G
- Single Network Slice Selection Assistance Information (S-NSSAI)
- Network Slice Subnet Instance (NSSI)
- Network Slicing Management Model: CSMF, NSMF,NSSMF
- Network Slice Template (NST)
- Open Network Automation Platform (ONAP) Architecture
- ONAP based O-RAN Network Slicing Architecture
- Network Slice Instance Creation Procedure Using ONAP based Network Slicing

9) O-RAN Use Cases

- Traffic Steering Use Case
- NSSI Resource Allocation Optimization Use Case
- Flight Path Based Dynamic UAV Radio Resource Allocation Use Case
- 5G Massive MIMO Beamforming Optimization Use Case
- Massive MIMO Beamforming Optimization Procedure
- Demonstration of xApp Beamforming

10) Artifical Intelligence (AI) & Machine Learning (ML) in O-RAN

- Introduction to AI/ML
- Supervised Learning in Machine Learning
- Linear Regression and Its Application
- Classification using Neural Networks
- Training of Neural Networks using Gradient Descent
- Neural Networks usage Example in Mobile Networks
- Logistic Regression for Classification
- Unsupervised Learning: K-Mean Clustering and its Steps
- Example of K-Mean Clustering Usage in Mobile Networks
- Reinforcement Learning usage Examples in RAN
- AI/ML Application in Radio Access Network (RAN)
- AI/ML Framework for O-RAN
- ML Model Life-cycle Implementation Example