Course Objective

5G Network deployments and operations require proven skills for professionals. This is because of very complex and stringent requirements, listed for different use case scenarios of 5G. This flagship online program is designed for upskilling RAN planning, implementation, and technical support professionals on 5G technology. This 5-hour "Advanced Certification in 5G" program is divided into 4 Modules named 5G Technologies and Network Architecture, Cloud Technologies in 5G Networks, Role of 5G in Industry Automation and Security in 5G Networks. This program provides a comprehensive understanding about 5G and comparing it with enhancements over 4G LTE technology.

Course Pre-requisites

The course is applicable to all technical professionals of any organization operating in mobile telecom technology domain. Professionals with good understanding of 4G LTE technology will be able to make most out of it.

Course Outline (Total duration: 5 hours)

1. 5G Technologies and Network Architecture (2 hrs.)
   - 5G Use Case Requirements (eMBB, mMTC, urLLC)
   - 5G Radio Access Technologies (Features that differentiate 5G NR and LTE)
     a. Flexible Spectrum, Waveform, Frame Structure
     b. Resource Block, Bandwidth Part, Mini Slot
     c. Supplementary Uplink, Duplex Mode
     d. Control Channels, Reference Signals, Channel Coding
     e. Code Block Group, PCI Planning
     f. Massive-MIMO, Beamforming
     g. Transmit Power Control
   - Transport Network Technologies
     a. Integrated Access and Backhaul
     b. Hybrid Fiber Coaxial or HFC, DOCSIS
     c. Passive Optical Network
     d. Ethernet based technologies
        i. Time sensitive networking
        ii. Radio Encapsulation Techniques
        iii. eCPRI, Fronthaul, Midhaul and Backhual
     e. Wavelength division multiplexing or WDM
   - 5G RAN Architecture
     a. Control and User Plane Separation (CUPS)
     b. User Plane and Control Plane protocol stacks
     c. CU-DU split – High Layer Split and Low Layer Split options
   - 5G Core Network Overview
     a. Service Based Architecture
     b. Reference Point Architecture

    c. Network Function overview (AMF, SMF, AUSF, UDM, NRF, PCF, NSSF, NEF, NWDAF, AF, N3IWF)

    d. Reference Point Interfaces (N1, N2, N3, N4, N6)

- Network Deployment Options (1, 2, 3, 3A, 4, 4A, 5, 6, 7, 7A)

2. **Cloud Technologies in 5G Networks (1 hr.)**
- Cloud Ecosystem
  a. Genesis of Cloud Computing
  b. Cloud Ecosystem Actors – CSU, CSP & CSN
  c. Cloud Service Models
     i. Software as a Service or SaaS
     ii. Platform as a Service or PaaS
     iii. Infrastructure as a Service or IaaS
  d. Cloud Deployment Models
     i. Private Cloud
     ii. Public Cloud
     iii. Hybrid Cloud
- Cloud Technologies and Features
  a. Virtualization
  b. Cloud vs. Virtualization
  c. Hypervisors
  d. Virtualization to Containerization
  e. OSGi or Open Service Gateway Initiative
  f. Open Stack Architecture, Components
  g. Software Defined Networking or SDN
  h. OpenFlow Concepts
     i. OpenFlow Configuration Protocol (OF-Config) and Open vSwitch (OVS)
     ii. Open Network Operating System (ONOS) and Open Daylight (ODL)
     iii. RESTful APIs
     iv. Disaggregation
     v. Bare Metal Switches
     vi. Open Network Linux (ONL)
- Cloud Resource Management & Orchestration
  a. ETSI NFV Framework
     i. High-Level NFV Framework
     ii. Reference Architectural Framework
  b. Management and Orchestration or MANO architectural framework
     i. Virtualized Infrastructure Manager or VIM
     ii. VNF Manager or VNFM
     iii. NFV Orchestrator or NFVO
     iv. Repositories - Network Services Catalog, VNF Catalog, NFV instances and NFVI resources
     v. Element Management or EM
     vi. OSS & BSS

3. **Role of 5G in Industry Automation (1 hr.)**

- The Business Need – The three Industrial Automation business drivers:
  a. Safety, Productivity and Efficiency
  b. The making of Industry 4.0
  c. Distributed cloud or edge computing framework
- 5G Enablers for Industrial Automation
  a. Radio Access Enablers
     i. Massive MIMO & Beamforming's
     ii. Unlicensed and Extended frequency bands
     iii. Communications - Device to Device (D2D) or Vehicle (D2V) to Everything
     iv. Integrated Access & Backhaul or IAB
     v. Side-link
     vi. NR Positioning & NR Light
  b. Network Enablers
     i. Edge Cloud & Distributed Cloud Architectures
     ii. Network Slicing Isolation
     iii. Time-Sensitive Networking or TSN
  c. Digital Enablers
     i. Machine Learning and AI concepts & Industrial Automation Scenarios
     ii. Self-Organizing Networks
- Planning and Applying Industrial Automation
  a. The Continuous Lifecycle:
     i. Audit and Analysis
     ii. Developing Need
     iii. Define Design Basis
     iv. Identify Project Constraints
     v. Migration Planning
  b. Components of industrial automation
     i. Control Systems
     ii. Control Networks
     iii. Other components
- Industrial Automation - the way forward (Major trends)
  a. Digital Acceleration
  b. Smart Factories
  c. 5G as growth multiplier
  d. Digital Twin
  e. Edge Computing
  f. AR/VR/MR technology adoption
  g. Rise of Robotics
  h. Drones
  i. Data Science
  j. HR Transformation
  k. Cyber Security

4. Security in 5G Networks (1 hr.)
- Security Overview and 5G Security Landscape

    a. Security concepts

    b. 5G Network security threats landscape structure defined by GSMA:

        i. Software and Virtualization

        ii. Cyber and Operational Security

        iii. Cloud Security

        iv. Device and IoT Security

        v. Signaling and interconnect

        vi. Securing 5G

        vii. Supply Chain and

        viii. Security skill shortage

- 5G Security Features

    a. 5G security architecture domains as per 3GPP technical specification release 15:

        i. Network access security

        ii. Network domain security

        iii. User domain security

        iv. Application domain security

        v. Service Based Architecture domain security

        vi. Visibility and configurability of security

    b. 5G UE Security Features include:

        i. Enhanced Subscriber Privacy

        ii. User Plane Integrity Protection

        iii. Stronger Roaming Authentication

        iv. Authentication Flexibility and

        v. Secondary Authentication and Authorization

    c. 5G RAN Security Features include:

        i. Restricting Sensitive Data and

        ii. RAN (read as ran) Interface Protection

    d. 5G CORE Security Features include:

        i. Security-Enhancing Network Functions

        ii. Service Based Architecture Protection and

        iii. Inter-Operator Security

- 5G System Security

    a. 3 basic security goals

    b. ITU-T proposed security dimensions: Access Control, Authentication, Non-Repudiation, Data Confidentiality, Communication Security, Data Integrity, Availability, Privacy

- 5G Security Orchestration and Analysis (SOAR) Overview

    a. Constantly measure security posture and risk levels

    b. Control and limit access to key operational systems and assets

    c. Detecting threats earlier in the mitigation chain and

    d. Rapid response to minimize the impact of cyber-attacks