

## 5G Development with Advanced C Programming

### Course Curriculum

#### Module 1: 5G N/W Requirements and Design

- Limitation of 4G and challenges for 5G
- Capacity and higher data rate
- QOE (Quality of Experience)
- Spectrum
- mMIMO(Massive multiple Input –Multiple Output)
- Device to Drive Communication
- Reduced Protocol Overhead
- Hydrogenous cell Architecture
- Network function Visualization

#### Module 2: 5G Software controlled Architecture

- Software in Radio access Network
- Software in mobile edge network
- Software in transport network
- 5G protocol stack Architecture
- Security in 5G Software Network
- Radio Access protocol in cloud RAN

#### Module 3: 5G Hardware Network Architecture 5G Cloud RAN

- Network Architecture Evolution from 4G to 5G
- End to End Network slicing
- 5G ---Cloud RAN
  - o Cloud RAN Advantage
  - o Advance Cloud RAN Architecture
  - o Cloud RAN and 5g

- o Functional split of Cloud RAN (real time) RT and NRT split
- o MultiRAT architecture for 4G /5G cloud RAN
- o Distributed RAN
- o Virtualization RAN

- Fixed Network

- o Heterogeneous access domain
- o Flexible metro domain
- o Integrations of access ,metro core Technologies

## **Module 4: 5G Data flow channels and channel coding**

- Logical Channel
- Transport Channel
- Physical Channel
- UL Mapping Of channels
- DL- mapping of Channels
- Channel coding
- Multiplexing
- Interleaving

## **Module 5: 5G Physical layer Design**

- Frame structure
- Slot structure and physical resources
- Reference signal
  - o UE specific reference signal XPDSCH
  - o UE Specific Reference signal XPDCCH
  - o CSI reference Signal
  - o Beam Reference signal
  - o Demultiplexing reference signal
- Synchronization signal

- o Primary Synchronization signal
  - o Secondary synchronization signal
  - o Extended synchronisation signal
- 5G Modulation
  - o BPSK—16QAM
  - o QPSK—64 QAM
- Physical channel
  - o Uplink XPUSCH, Uplink XPUCCH, Uplink XPRACH
- Downlink Physical channel
  - o XPDSCH
  - o XPBCH and Extended PBCH
  - o XPDCCH
- Mapping of channel to resource element

## **Module 6: Physical Layer Procedure**

- Synchronization procedure
- Beam Forming Procedure
- Power Control Procedure
- Physical Random Access Procedure

## **Module 7: 5G MAC Layer Design**

- Comparison of 5G MAC with UMTS and LTE MAC
- 5G – MAC Architecture
- 5G –MAC Service
- 5G – MAC Function
- Mapping of Transport channel and logical channel

## **Module 8: 5G MAC layer procedures**

- 5G Random Access Procedure
- XDL SCH Data Transfer
- XUL SCH Data Transfer
- Beam management
- 5G ---MAC Protocol Data Unit
- 5G---MAC format
- 5G---MAC Parameter

## **Module 9: 5G RLC Layer Design**

- Compare LTE , RLC and 5G RLC
- 5G---RLC Architecture
- Model of 5G-RLC sub layer
- RLC mode
- 5G --RLC service
- 5G –RLC function
- Data available for transmission

## **Module 10: 5G RLC procedures**

- Data transfer Procedure
- ARQ Procedure
- SDU Discard procedure
- Reestablishment Procedure
- 5G—RLC protocol data Unit
- 5G RLC Formats and Parameter

## **Module 11: 5G PDCP layer design**

- Compare 5G PDCP with LTE and UMTS PDCP
- 5G PDCP Architecture
- 5G PDCP Service
- 5G Function
- Data Available for Transmissions

## **Module 12: 5G PDCP layer Procedure**

- 5G PDCP Data Transfer procedure
- 5G PDCP States Report
- 5G PDCP Discard
- Ciphering and Deciphering
- Integrity Protection and Verification
- 5G PDCP Protocol data Unit
- 5G PDCP Format
- 5G PDCP Parameters

## **Module 13: RRC layer Design**

- RRC layer Architecture
- RRC States
- Signalling radio bearers
- 5G –RRC services
- 5G—RRC function

## **Module 14: RRC layer procedures**

- Broadcast system information
- RRC connection management
- RRC connection reconfiguration
- RRC connection Reestablishment
- RRC connection release
- RRC measurement procedure
- 5G- RRC Protocol data unit

## **Module 15: NAS Layer**

- Mobility Management
- Session Management function
- 5G-NAS State
- 5G- NAS MM Protocol
- 5G- NAS SM Protocol

## **Module 16: 5G-Variable, Timer and Constant**

- 5G-MAC Variable, timer and constant
- 5G-RLC Variable, timer and constant
- 5G-PDCP Variable, timer and constant
- 5G-RRC Variable, timer and constant

## **Module 17: 5G-Security design**

- 5G Security Network Architecture
- Domains in 5G security
- 5G Security software architecture
- Stratum
- Security control class(SCC)
- Security Realm(SR)
- 5G-Security methods

## Basic & Advanced C Programming Content

This course provides a thorough practical exposure to the C programming language, the workhorse of the UNIX operating system. The first two weeks will cover basic syntax and grammar which covers Basic C, Loops, Function, Array, Pointer, Structure and expose students to practical programming techniques. The remaining lectures will focus on more advanced concepts, such as dynamic memory allocation, memory management Data Structure, concurrency and synchronization, UNIX signals and process control, library development and usage. Daily programming assignments and weekly laboratory exercises are required. Knowledge of C is highly marketable for full-time positions in software and embedded systems development.