



## 5G NETWORKS: PLANNING, DESIGN AND OPTIMISATION - Foundation Level

Programme Modules:

- Radio Access Architecture
- Backbone and Core: Software Defined Networking
- IoT and Edge Computing
- 5G Security
- Operation Control and Management

Live Virtual Classroom (10 - 14 May 2021)

[telecomstechacademy.com/course/5g-network-planning-design-optimisation/](https://telecomstechacademy.com/course/5g-network-planning-design-optimisation/)



# 5G NETWORK PLANNING: DESIGN AND OPTIMISATION

With the technology offering faster speeds and more reliable connections than ever before, ultimately unlocking a diverse set of use cases from the Internet-of-Things (IoT) to mission-critical control, it is easy to understand the reasoning behind the hype. Yet, with the hype come high expectations on operators to deliver and, therefore, it is important that LTE operators contemplating the transition to 5G are prepared.

Through the utilisation of demonstrations, this 3-day programme offers delegates practical insight that will enable them to effectively.

## Is the course for you?

The course is designed for operators, vendors, regulators. Engineers as well as staff involved in the architecture, optimisation, management, monitoring or testing of the 5G network would benefit from attending this training programme.

“ 5G will account for a quarter of UK mobile data traffic by 2022 ”

- Mobile Visual Networking Index (VNI) Cisco

# PROGRAMME BENEFITS

This course will be one of the first of its kind to offer delegates an in-depth understanding on what they can do to prepare their network for the roll-out of 5G. Avoiding generalisations, the course provides delegates with skills that can directly be applied to their work.

Attendees will leave the course with a deeper understanding of:

- 5G concepts, enablers and main characteristics
- 5G backwards-compatibility
- Use Cases and their mapping to carriers and applications/services
- Spectrum, interfaces and coding in 5G New Radio
- Radio planning principles, challenges and methods for radio coverage and capacity
- Access network requirements and front-haul design methods
- Centralized/virtual Radio Access Network planning using clustering methods
- 5G core (5GC) architecture, network elements and compatibility with 4G EPC
- SDN, NFV and cloudification, benefits and user/control plane design
- Optical backbone transport, resilience and wavelength assignment
- Flow control, slicing and orchestration
- IoT radio access and design principles
- Purpose and functions of edge computing
- Requirements and challenges of 5G network management; Quality of Service and Service Level Agreements
- Big Data and machine learning in network diagnostics and fault detection
- 5G Security and the threats posed to the new technology
- Virtualisation and the use of multiple layers
- Use of Ranplan Wireless planning tool to demonstrate actual 5G planning



## COURSE DIRECTOR

**Paul Kilby**

Paul is responsible for the development and delivery of a wide variety of technical and management training programmes. Paul has a special interest in the radio air interface, forensic site survey and the forensic use of CDR records. He has worked extensively for mobile telecoms operators, law enforcement and government agencies around the world. Paul has specialized in the security aspects of mobile network technology, including air interface encryption and integrity protection along with system interface protection methods. As a consultant, he has worked performing threat and security assessment, fraud and revenue assurance work. He has also worked extensively as an expert witness for various law enforcement and security agencies within the UK and United States. Paul has worked all around the world as a telecom consultant since 1999, with a wide range of telecoms companies including network operators, vendors and chip set manufacturers. He has also worked as a project manager within large infrastructure projects. As well as holding a BEng degree in Electrical and Electronic Engineering, he studied at Cranfield University on their Executive MBA program which he completed in 2008. Paul now works within Informa Telecoms where he has access to many of the top industry analysts, research and data. He also enjoys the role of training programme director for many of the world's largest operators and vendors.

The Telecoms & Tech Academy have trained companies such as:

- Vodafone
- T-Mobile
- MTN
- Dialog
- Ooredoo
- Batelco
- Digicel
- Saudi Telecom
- BT
- Viva
- Du
- Liberty Global
- Bofinet
- Libyana
- Zain
- Mobily
- Google
- Microsoft



# PROGRAMME MODULES

10 - 14 May 2021

## DAY1

### Module1 – Radio Access Architecture

#### 5G Radio Interface

- Network elements: remote radio heads (RRH), base-band unit (BBU) and hotels (BBH); different types of radio units.

#### 5G New Radio: Spectrum Overview

- An information theoretic primer
- Non-standalone and standalone 5G
- Multiple access: OFDMA, NOMA
- Use Cases to carrier mapping
- Modulation schemes: PSK, QAM, APSK
- Error coding

#### 5G Radio Planning Overview

- Radio characteristics; fading, reflection, diffraction and scattering
- Clutter types, propagation models and link budgets
- Cells and antenna types
- Indoor coverage; small (micro, pico and femto) cells, Hetnets, Wifi off-loading
- Ad-hoc networking and D2D communication
- **ExercisewithRanplan Wireless planning tool**
  - Use of Radio Planning tool to simulate an actual planning session

## DAY2

### Centralized and virtualized radio (C-RAN/ vRAN)

- Technical requirements and limitations
- Benefits, costs and objective functions
- Clustering under constraints
- Baseband hotel selection
- Optimization methods

### Module2 – Backbone and Core I: Software Defined Networking

#### 5G core (5GC) network elements

- Interfaces and protocols in 5GC. Management and control functions: authentication, session management, mobility, quality of service (QoS) etc. Fixed/mobile access. Comparison with EPC and migration options.

#### SDN and NFV

- Difference between SDN, NFV and cloudification
- Resource pools
- Centralised and distributed control
- SDN Orchestration
- Flows in the user and control planes
- Resilience aspects and migration
- OpenFlow capabilities

# PROGRAMME MODULES



## DAY3

### Module 3 – SDN & NFV

- Difference between SDN, NFV and cloudification
- Resource pools
- Centralised and distributed control
- SDN Orchestration
- Flows in the user and control planes
- Resilience aspects and migration
- OpenFlow capabilities

### Telco Cloud Design

- Hypervisor considerations
- Fabric options
- Understanding East/West and North/South flows
- Designing for Mobile Applications onboarding
- Resource allocation control and data plane applications.

### Data Centers

- SDN and NFV in clouds. Job scheduling and load balancing algorithms. Online algorithms and repacking
- Load balancing

### Module 4 – IoT and Edge Computing

### Internet of Things

- IoT design aspects; lifetime, coverage and connectivity
- WSN radio interfaces
- Random network deployment and IoT protocols
- Mobility modeling
- Mobility: wearables and drones
- **Case study:** Energy efficient protocol for WSN, research project.

### Massive Machine Type Communications and Big Data

- Data representation and bandwidth
- Discretization
- Data sketches
- Approximate counting

### Edge Computing

- Edge compared to cloud (and fog) computing. Data pre-processing, cleansing and compression. Queries.

## DAY4

### Module 5 – 5G Security

### Front-Haul & Aggregation Layer Design

- 5G Core Security
- 3GPP Security standards
- Network Splicing Security
- Security control plane and management
- Signaling Security
- 5G RAN security
- Data confidentiality and handling (GDPR)

### Security Threats

- Understanding DDOS and the Types of different attacks
- IoT secure Architecture
- Security lifecycle management
- Holistic View
- **Exercise:** Students to prepare a generic security guideline for 5G



## DAY 5

### Module 6 – Operation, Control and Management

#### Service Levels & Resource Mapping

- Quality of Service, Quality of Experience and Service Level Agreements; requirements and realization of eMBB, mMTC and URLLC services.
- QoS and SLA monitoring and enforcement; statistics and hard limits
- Dynamic resource management
- Admission control, priority and preemption features
- Mission critical services (autonomous cars, telemedicine)

#### Network Management

- Challenges on network management in 5G: extreme throughputs, dense deployment, increased heterogeneity, and virtualization; Security aspects.
- Cognitive management
- Self-organization and self-optimization
- Orchestration and risk management
- Network Management as a Service (NmaaS)

Exercise: Delegates to prepare a list of 5 key points that they feel will be essential to 5G in the Future.

Summary, Q&A and discussion

### Big Data and Machine Learning Methods

- Traffic estimation and SLA enforcement, machine learning versus optimization.
- Data types in the 5G networks
- Heavy hitters
- Entropy
- Supervised and unsupervised learning
- Pattern recognition
- Network roll-out
- Global 5G roll-out status

# LIVE VIRTUAL CLASSROOM

## ENGAGING INSTRUCTOR-LED TRAINING

**All our training programmes are deliverable as engaging online learning courses via our live Virtual Classroom platform.**

Our cutting-edge instructor-led online virtual classroom solutions offer an engaging and enjoyable experience that replicates our face-to-face training experience to deliver knowledge and develop the competencies you need to succeed.

Our programmes are designed to ensure an optimal training experience - focusing on practical application of the concepts and topics covered.

We deliver the same market leading programmes online so you can benefit from the flexibility to take the training at a location of your choice without the need to travel!

### Why Choose a Virtual Classroom?

**Enjoy the same classroom learning experience online**

- Benefit from the same quality training programmes at a location of your choice.
- Minimise downtime with highly impactful training
- Cost effective training that saves on travel expenses and time.
- Experience an intimate class setting
- Interact with your course tutor and fellow students throughout the course including group exercises, file sharing and live Q&A's.
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