

# 5G ESSENTIALS

Course Code: 100414

Learn the design motivation and underlying technology of 5G service.

5G is the next-generation of mobile networks beyond the 4G LTE mobile networks existing today. The vision of 5G is becoming clearer and most experts say 5G will feature network speeds that are blazingly fast at 20 Gbps or higher and have low latency at mere milliseconds.

The entire 5G approach takes advantage of containers, virtualization, SDN and NFV. This section covers the design motivation and underlying technology of 5G service based architecture as well as new vocabulary terms you must learn. We will cover enough about 5G radio to understand the differences between 4G and 5G. All concepts will be explained with intuitive graphics. Each of the radio access methods explained below directly impacts specific components in the 5G core, so it is important to have a fundamental understanding of 5G radio prior to learning the 5G core. The 5G core is designed to support a service-based network architecture, so it looks very different than the 4G core. Nevertheless, we will assume that students are familiar with the 4G core, so this section will be taught in a fashion that constantly compares 5G core functions with an analogous 4G function. Each component in the 5G core will be covered from the perspective of what it is for, why it is there, and what it permits 5G to do that 4G could not. The goal is to more clearly see how the 5G accomplishes its goals by observing how it actually works.

## What You'll Learn

Students will cover the design motivation and underlying technology of 5G service-based architecture as well as new vocabulary terms. Students will learn enough about 5G radio to understand the differences between 4G and 5G, and finally, take a look at the 5G core in action. Sample message flows of typical 5G processes are covered message by message.

## Who Needs to Attend

Those interested in learning more about the 5G architecture and understanding the differences between 4G and 5G.

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## Virtual Classroom Live Outline

### 1. 5G Introduction

- Introducing 5G Features
- What a 5G “Service” is not
- Introducing the 5G Network Architecture
- Comparing 5G to 4G

### 2. Session and Service Continuity

- Session and Service Continuity (SSC) mode 1 and 2
- Session and Service Continuity (SSC) mode 3

### 3. Message Queuing

- Message Queuing (MQ) in a Nutshell
- Defining 3GPP Exposure
- Subscribe and Publish Message Flow
- Embedding JSON in HTTP Messages

### 4. The 5G Slice

- User Plane Function
- Why PFCP rather than OF (OpenFlow)
- N4 Interface - Packet Forwarding Control Plane Protocol (PFCP)
- Service Function Chaining (SFC) Architecture RFC 7665
- Network Slicing
- Tunneling
- The GTP Tunnel
- PDU Session Types

### 5. 5G Infrastructure

- 5G Changes to the Access Layer
- 5G Network Location of elements 1 of 5
- 5G Network Location of elements 2 of 5

- 5G Network Location of elements 3 of 5
  - 5G E2E Latency Requirements
  - 5G Network Location of elements 4 of 5
  - 5G Network Location of elements 5 of 5
6. Registration and Tracking Areas
- Registration and Tracking Areas
  - Registration and Tracking Area Rules
  - UE Moves to a new Tracking Area
  - Network Slice within a Tracking Area
  - Vertical and Horizontal Slices
7. 5G Cloud Based Services
- Service operation naming
  - Container-based Design of SBA (1 of 2)
  - Container-based Design of SBA (2 of 2)
  - HTTP Reverse Proxy
  - HTTP/2
  - JSON
  - JSON Algorithm
8. 5G Services
- Namf
  - UE Context in AMF (1 of 2) TS 23-502 Table 5.2.2.2.2-1
  - UE Context in AMF (2 of 2) TS 23-502 Table 5.2.2.2.2-1
  - NSSF
  - NEF (1 of 2)
  - NEF (2 of 2)
  - NRF
  - UDR
  - Front End and UDC
  - UDM
  - UDM Subscriber Data Management Data Types
  - AUSF Services
  - PCF Services
  - SMF Services
9. 5G Stacks
- Transport NAS and SMS over HTTP
  - PDU Session
  - N2 Interface
  - NG Application Protocol (NGAP) TS 38.413
  - Session Management Function
  - N11 Interface
  - Interworking with the EPC (TS 23.501 - 4.3.1.1)

10. EU and PDU Session States
  - 5GMM main states in the UE
  - 5GMM main states in the network
  - UE PDU Session States
  - SMF PDU Session States
  
11. New Radio
  - Sectors in New Radio
  - Beamforming
  - Pilot Signals
  - Pilot Signals
  - SU-MIMO vs MU-MIMO
  - Pilot Contamination
  - Pilot Contamination Solutions
  - Densification
  - 5G UE Radio Access Layers
  - Small Cell
  - Remote Radio Head
  - Base Band Unit
  - Common Public Radio Interface
  - Centralized Radio Access Network (C-RAN)
  - To CPRI or not to CPRI?
  - Functional Split
  - AAU, DU, and CU using the Option 2 Functional Split
  - Cloud-RAN
  
12. Multi-access Edge Computing
  - 8 Network Function Virtualization Components
  - Why Two Bridges?
  - Simple NFV (Network Function Virtualization) Example
  - OVS-based openstack “wiring”
  - MEC Reference Architecture in a NFV Environment
  - Mobile Edge Computing to Multi-access Edge Computing
  
13. Priority Paging and QoS
  - Paging Policy Differentiation (PPD)
  - Network Triggered Service Request
  - QoS Profile
  - QoS Flow Marking
  - Service Data Flow (SDF) Filter
  - 5QI (QoS Flow ID)
  - enhanced Multi-Level Precedence and Pre-emption service (eMLPP)
  
14. 5G Flow Diagrams
  - PDU Session Establishment (1 of 4)
  - PDU Session Establishment (2 of 4)

- PDU Session Establishment (3 of 4)
- PDU Session Establishment (4 of 4)
- Registration 1 of 3
- Registration 2 of 3
- Registration 3 of 3
- QoS Triggered PDU Modification (1 of 3)
- QoS Triggered PDU Modification (2 of 3)
- QoS Triggered PDU Modification (3 of 3)