



Absolutely great intro to 5G System Engineering. Instructor really adapts his explanations to the audience. Top Class!



Watch our course intro video.

5G System Engineering

Course Description

5G is the next enhancement in mobile communications. This course, updated to 3GPP Release 17, introduces 5G technology from an end to end, architectural and operational perspective. In so doing, the 5G System architecture is examined in detail, both from a Non Standalone and Standalone perspective. The course then takes a “day in the life” approach to the 5G device, detailing typical activities such as Registration, Security, PDU Session Establishment and Mobility.

This course has no prerequisites.

2 day
(LiveOnsite,
LiveOnline)

12 hours
learning
(OnlineAnytime)

12

CPD Learning
Credits



Level: 2
(Intermediate)

This course will contain the following sections:

1. 5G Concepts and Drivers

Topic areas covered include:

- Driving Factors for 5G:
 - Technology Evolution.
 - Enhanced Mobile Broadband.
 - Massive Machine Type Communications.
 - Ultra Reliable and Low Latency Communication.
- 5G Standardization:
 - IMT 2020 Performance Capabilities.
 - 3GPP Technology Roadmap.
- Network Slicing:
 - Defining a Network Slice.
 - Deploying a Network Slice.
- Private 5G Networks:
 - Background for Private.
 - Deploying a 5G Private Network.
- eMBB Use Cases:
 - Fixed Wireless Access.
 - Streaming Services.
- MMTC Use Cases:
 - Smart City.
 - Wearables / Health.
- URLLC Use Cases:
 - Augmented and Virtual Reality.
 - V2X.

2. 5G System Architecture

Topic areas covered include:

- Positioning the 5G System:
 - The 5G System.
 - 5G Non Standalone Architecture.
 - 5G Standalone Architecture.
- User Equipment:
 - ME.
 - SIM.
- Next Generation – Radio Access Network:
 - gNB.
 - ng-eNB.
 - Tracking Areas.
- Centralized – Radio Access Network:
 - C-RAN Architecture.
 - C-RAN Protocol Split.
- 5G Core Network:
 - AMF, SMF, UPF, AUSF, PCF, NEF, UDM.
- Supplementary 5G Core Network Functions:
 - UDSF, NWDAF, NSSF, NRF, CHF, SEPP, SCP, SMSF.
- 5G Service Based Architecture:
 - SBA Model.
 - Virtualization and Cloud Native.
- Interworking:
 - Interworking with 4G.
 - Interworking with IMS.
 - Interworking with Wi-Fi.
 - Interworking with Wireline.
 - Interworking with Non Terrestrial Networks.

12

**CPD Learning
Credits**

ITP

**ITP accredited
course**



**LiveOnsite, LiveOnline,
OnlineAnytime**

3. 5G New Radio

Topic areas covered include:

- New Radio Air Interface:
 - NR Frequency Bands.
 - FDD and TDD.
 - Supplementary Uplink and Downlink.
- New Radio and OFDMA:
 - What is OFDMA?
 - Numerology and Channel Bandwidth.
 - NR Physical Resource Blocks and Bandwidth Parts.
- New Radio Frame Structure and Resources:
 - NR Frame Structure.
 - Adaptive Modulation and Coding.
 - NR Resource Allocation.
- Driving Up Bandwidth:
 - Carrier Aggregation.
 - Dual Connectivity.
- Massive MIMO and Beamforming:
 - Introducing MIMO.
 - Creating Beams.
 - NR Massive MIMO.

4. Non Standalone Operation

Topic areas covered include:

- Introduction:
 - 5G Non Standalone Architecture.
 - Splitting Bearers.
 - Option 3a and Option 3x.
- Initial Procedures:
 - Initial Attach Considerations.
 - Preparing for EN-DC in the RAN.
- Secondary Node Addition:
 - Scenario.
 - Procedure.
- Secondary Node Modification:
 - Scenario.
 - Procedure.
- Change of Secondary Node:
 - Scenario.
 - Procedure.

Non Standalone Operation (cont.)

- MeNB Handover with Secondary Node:
 - Scenario.
 - Procedure.
- Release of Secondary Node:
 - Scenario.
 - Procedure.

5. 5G Initial Procedures

Topic areas covered include:

- Registration and Connection Management:
 - Registration Management.
 - Connection Management.
 - RRC Idle, Inactive and Connected.
- Network Access:
 - PLMN and Access Network Selection.
 - Cell Selection.
 - RRC Connection Establishment.
- 5G Registration:
 - Scenario.
 - Procedure.
- 5G Deregistration:
 - Scenario.
 - UE Initiated Deregistration Procedure.
 - Network Initiated Deregistration Procedure.

6. 5G Security

Topic areas covered include:

- 5G Security:
 - Overview.
 - Mutual Authentication.
 - Encryption and Integrity Checking.
 - Protecting Service Based Interfaces.
 - Roaming Protection – SEPP, PRINS and IPUPS.
 - Protecting the Subscriber Identity.
- 5G Cryptographic Processes:
 - 5G Security Algorithms.
 - Authentication and Key Agreement.
 - AV Generation.

5G Security (cont.)

- 5G AKA:
 - High Level 5G AKA Procedure.
 - Generation of 5G SE AV.
 - Device Authentication.
 - Authentication Confirmation.
 - Key Derivation at the AMF.
- Security Procedures:
 - Key Distribution in 5G.
 - NAS Signalling Security.
 - RRC Signalling Security.
- Securing AN to CN Communication:
 - IPSec in 5G.
 - IPSec Basic Operation.
 - Establishment of gNB Security Associations.

7. Exchanging Data in 5G

Topic areas covered include:

- PDU Sessions:
 - PDU Session Connectivity.
 - Multi Access PDU Sessions and ATSSS.
 - PDU Session Connectivity (CIoT).
- PDU Session Types:
 - IPv4 and IPv6 PDU Sessions.
 - Ethernet PDU Sessions.
 - Unstructured Data PDU Sessions.
- QoS Model for 5G:
 - QoS Flows.
 - QoS Rules and Packet Detection Rules.
- 5G QoS Parameters:
 - 5G QoS Overview.
 - 5G QoS Identifier.
 - Allocation and Retention Priority.
 - Controlling Bit Rate.
 - Reflective QoS.
- Establishing a PDU Session:
 - Scenario.
 - Procedure.
- QoS Flow Establishment (Session Modification):
 - Scenario.
 - Procedure.

Exchanging Data in 5G (cont.)

- Utilizing PDU Sessions – Service Request:
 - Scenario.
 - Procedure.
- Utilizing PDU Sessions – Paging:
 - Scenario.
 - Procedure.
- Releasing the Access Network Resources:
 - Scenario.
 - procedure.

8. 5G Mobility

Topic areas covered include:

- CM Idle Mobility:
 - Discontinuous Reception.
 - Cell Reselection.
- Registration Update (Mobility):
 - Scenario.
 - Procedure.
- CM Connected Mobility:
 - Handover Phases.
 - Handover Overview.
- Xn Based Handover Procedure:
 - Scenario.
 - Procedure.
- N2 Handover:
 - Scenario.
 - Procedure.
- 4G to 5G Mobility:
 - 4G to 5G Idle Mode Mobility.
 - 4G to 5G Connected Mode Mobility.
- Roaming in 5G:
 - Home Routed Roaming.
 - Local Breakout Roaming.

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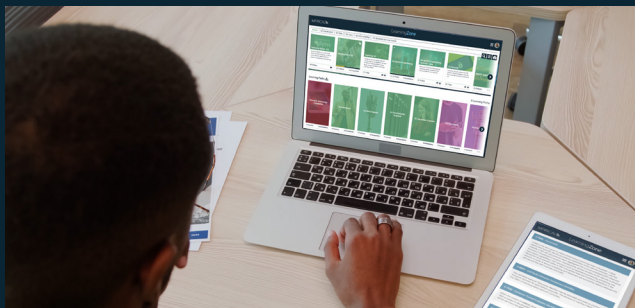
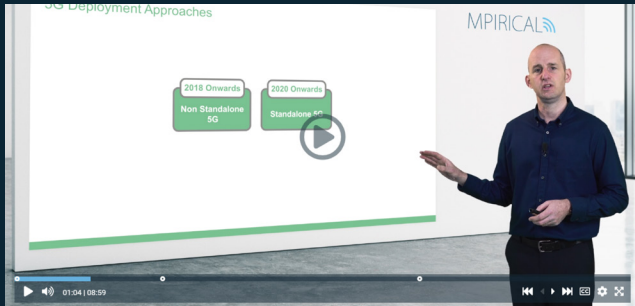
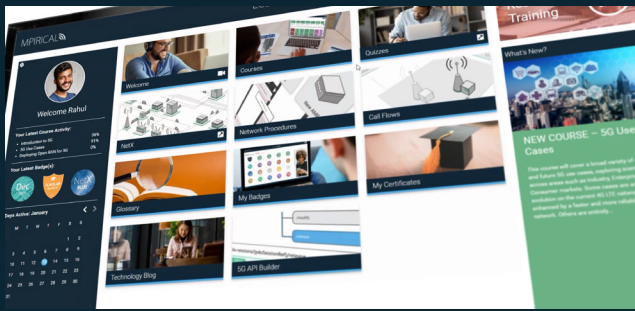
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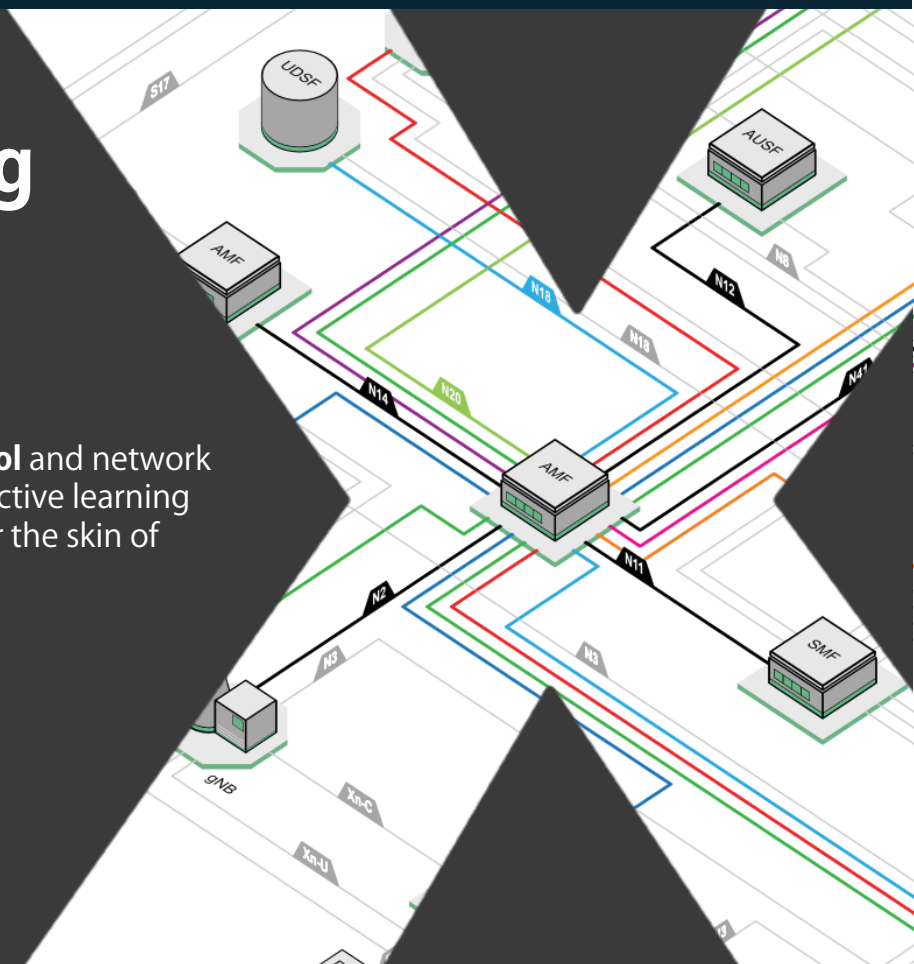


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+44(0)1524 844669



enquiries@mpirical.com

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