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> Trainer demonstrated a huge knowledge, no question unanswered. Easy to follow and understand this complex topic.

Watch our course intro video.

Cellular IoT System Engineering

Course Description

With the current increase in machine to machine communications or IoT, the 3GPP technologies have been enhanced to support this new type of data transfer. This course focuses on the 4G or LTE network and the various modifications which have been introduced in Release 12, 13 and 14. These include new network infrastructure, modified air interfaces (NB-IoT / LTE-M) not to mention support for NIDD or Non IP Data Delivery. Various network optimizations will also be addressed along with new procedures dealing with network monitoring. Finally, mobility will be reviewed before culminating with a brief look at how Cellular IoT interworks with legacy 2G and 3G networks.

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. Cellular IoT Network Landscape

Topic areas covered include:

- IoT Reference Model.
- The Cellular IoT Landscape:
  - 2G, 3G, 4G and 5G.
- Cellular IoT Network Architecture:
  - Device / Sensor:
    - ME, SIM, eSIM.
    - Remote SIM Provisioning.
  - E-UTRAN:
    - eNB.
  - Evolved Packet Core:
    - MME, S-GW, PDN-GW, HSS.
    - SMS over 4G.
  - Machine Type Communication Enhancements:
    - Direct Model.
    - Indirect Model.
  - Machine Type Communication Network Functions:
    - SCS, SCEF, MTC-IWF, MTC-AAA.
  - Dedicated Core Network.

2. Cellular IoT Air Interface

Topic areas covered include:

- Introduction:
  - LTE Air Interface – Key Features.
  - OFDMA Basics.
  - LTE Frame Structure.

Cellular IoT Air Interface (cont.)

- NB-IoT:
  - Flexible Deployment Options:
    - Guard-band, In-band and Standalone.
    - Permitted In-band Allocations.
    - Synchronization and Master Broadcast Information.
  - Enhanced Coverage:
    - 15kHz / 3.75kHz Uplink Frame Structures.
    - NB-IoT Frequency Band Allocations.
    - CE0, CE1, CE2.
  - Reduced Energy Consumption.
  - Cell Access:
    - System Information.
    - RRC Connection Establishment.
    - What NB-IoT Doesn't Support.
- LTE-M:
  - Coverage Enhancement:
    - CE Mode A.
    - CE Mode B.
  - Reduced Energy Consumption.
  - Reduced Complexity:
    - Cat-1, Cat-0, Cat-M1 and Cat-M2.
  - Re-Use Existing Infrastructure:
    - LTE-M Frequency Band Allocations.
  - Increased IoT Data Rates and Voice Support.

3. Cellular IoT Initial Procedures

Topic areas covered include:

- Attaching to the Network:
  - PLMN and Network Selection.
  - Cell Selection.
  - Registration.
- EPS Mobility Management:
  - EMM States.

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LiveOnsite, LiveOnline, OnlineAnytime

Cellular IoT Initial Procedures (cont.)

- EPS Session Management:
  - QoS Class Identifier.
- Attach and EPS Bearer Establishment:
  - EPS Mobility Management and State Transition.
  - Attach without PDN Connectivity (NB-IoT).
- Dedicated Core Network:
  - DECOR.
  - eDECOR.
- Cellular IoT Enhancements:
  - Power Save Mode.
  - Extended Discontinuous Reception.
  - Deploying PSM and eDRX.

4. Cellular IoT Operation – IP Data Delivery

Topic areas covered include:

- ECM Idle to ECM Connected Transition.
- Uplink IP Data Delivery:
  - Device Initiated Service Request.
  - Detailed Signalling Evaluation.
- Downlink IP Data Delivery:
  - Network Initiated Paging.
  - Detailed Signalling Evaluation.
- S1 Release:
  - eNB Triggered S1 Release.
  - MME Triggered S1 Release.
- Cellular IoT Optimization:
  - Control Plane CIoT EPS Optimization:
    - Uplink IP Data Delivery.
    - Downlink IP Data Delivery.
    - Detailed Signalling Evaluation.
  - User Plane CIoT EPS Optimization:
    - Connection Suspension.
    - Connection Resumption.
    - Connection Resumption on Different eNB.

5. Cellular IoT Operation – Non IP Data Delivery

Topic areas covered include:

- Non IP Data Delivery.
- SGi Based Delivery:
  - Reliable Data Service.
  - Uplink Non IP Data Delivery.
  - Downlink Non IP Data Delivery.
  - Detailed Signalling Evaluation.
- SCEF Based Delivery:
  - Connection Establishment:
    - NIDD Configuration / Onboarding.
  - Uplink Non IP Data Delivery.
  - Downlink Non IP Data Delivery.
  - Connection Release.
  - Detailed Signalling Evaluation.
- Serving PLMN and APN Rate Control:
  - Serving PLMN Rate Control.
  - APN Rate Control.

6. Cellular IoT Operation – Monitoring Devices

Topic areas covered include:

- Monitoring Devices.
- Event Monitoring Configuration:
  - Common Parameters.
  - Event Monitoring via HSS.
  - Event Monitoring direct with MME.
  - Event Monitoring Events from HSS or MME.
  - Event Monitoring via PCRF.
- Monitoring Scenarios:
  - Location Reporting:
    - Location Determination at MME.
    - Number of UEs Present in a Geographical Area.
  - Change in IMSI and IMEI/SV Association.
  - Availability after DDN Failure:
    - Notification of Availability after DDN Failure.
- Device Triggering:
  - Device Triggering Procedure.
- MSISDN-less MO-SMS.

7. Cellular IoT Mobility

Topic areas covered include:

- Introduction.
- NB-IoT Mobility:
  - Cell Reselection.
  - RRC Connection Resume.
  - Tracking Area Update.
- LTE-M Mobility:
  - X2 Handover.
  - S1 Handover.
- Roaming:
  - Interworking – SCEF.
  - SGi Based Roaming.

8. Cellular IoT – Interworking with 2G and 3G

Topic areas covered include:

- 2G and 3G Cellular IoT Architecture:
  - The 2G Options.
  - The 3G Options.
  - Machine Type Communication Enhancements.
- EC-GSM-IoT:
  - Extended Coverage.
  - Reduced Energy Consumption.
  - Re-use Existing Infrastructure.
  - Enhanced Security.

Cellular IoT – Interworking with 2G and 3G (cont.)

- Non IP Data Delivery on 2G and 3G:
  - Gi Based Delivery.
  - SCEF Based Delivery.

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