2G to 5G – Evolution, Architecture and Features

CONTENTS

This course presents an introduction to 3GPP networks, the system architecture and evolution, as well as selected network procedures and features.

The course presents similarities and differences between different 3GPP system generations. Basic architecture, terms, concepts, procedures, radio technologies, and the core network functions are introduced. With the 2G and 3G being phased out, the focus is on the newer 4G and 5G systems.

PREREQUISITES

Basic technical knowledge of telecoms is recommended.

History and Fundamentals

- From POTS to 1G Mobile Networks
- 2G: GSM and GPRS – high level network architecture
- From 2G to 5G: evolution of radio access and core networks
- Radio network structure
- Devices and cards: MS, UE, SIM, USIM, UICC, eUICC, eSIM, iSIM

Network Architecture

- 3GPP introduction, history, and system releases
- Basic elements of 2G, 3G, 4G, and 5G network architecture
- Control Plane and User Plane
- Detailed 4G and 5G network architectures
- Databases and subscriber data: HLR, HSS, UDM, UDR
- Roaming architecture for CS and PS services
- Dual Connectivity
- Selected 4G/5G Deployment Options
- Non-3GPP access to 3GPP networks
- IMS
- Radio access multiplexing technologies
- Carrier aggregation in 4G and 5G
- Other selected radio features

Services and Procedures

- Network services available from 2G and 5G
- Voice handling – CS-based and IMS controlled
- Short Message Service in different generations of 3GPP system
- Data connections to external data networks
- Quality of Service (QoS) – basic concepts and parameters used from 2G to 5G
- Service connections versus radio connections
- UE idle and UE connected
- Idle mode mobility procedures and registration areas in different 3GPP system generations
- A generic update procedure with a serving core network node change
- Periodic updates: in CS domain, in PS domain, and in IMS
- Connected mode mobility procedures: handover, conditional handover, redirection, cell change order.
- A handover procedure – basic concepts and execution
- IMS procedures and IMS related procedures
- Selected UE identifiers used in the core network, radio network, and IMS
- Authentication procedure between UE and 2G/3G/4G/5G network
- Ciphering and integrity protection across different system generations

Network Features

- Communication options: from transparent communication to edge computing and exposure functions
- Internet of Things (IoT) support – challenges and solutions
- Selected enhancements for IoT connectivity in 4G and 5G
- Non-Terrestrial Networks (NTN) in 3GPP: transparent and regenerative architectures, orbits, cells, access types, new procedures
- Dedicated Core Networks and Network Slicing
- Non-Public Networks a.k.a. Private Networks
- Mission Critical Services in 3GPP
- Non-service-related network functions