

MKA: Introduction to mobile systems

Online course specification

Target audience:

This e-learning course is designed for those who are, or intend to be, involved in the planning, installation, provisioning, or maintenance of mobile systems. It is suggested this course is studied with its companion course "Mobile radio communications" as preparation for the more advanced PTT courses covering mobile networks.

Course aim:

This course introduces concepts which are used in mobile systems, like handover and roaming, and cellular traffic handling. The course also reviews the various generations and types of mobile system and their capabilities and facilities.

Course level: Introductory

An explanation of PTT course levels is given at the end of this document

Pre-requisites:

You will get the most out of this course if you already have a basic understanding of the principles, capabilities, and applications of wireless communications. The PTT online course "Wireless communications" provides the information you need.

Course structure:

The course consists of the following 4 modules:

1. Mobile concepts and standards
2. User mobility
3. Cellular networks
4. Mobile generations

Module 1: Mobile concepts and standards

Module aim: To introduce mobile communications concepts, the challenges faced by designers of mobile systems, and the role of standardisation bodies in the evolution of mobile systems.

After completing this module, a trainee will be able to:

- differentiate between mobile and nomadic communications.
- describe the concept of cells and handover between cells.
- describe the purpose of location tracking.
- explain how location-based services achieve a greater position accuracy than provided by location tracking.
- describe and compare the role, components, and architecture of the radio access networks employed by the various generations of mobile system.
- describe the requirements of the various services offered by a mobile system in terms of minimum data transfer speeds and tolerance to system delay and digital errors.
- describe how the characteristics of the air interface limit the achievable performance of a mobile service.
- describe the role and working methods of the 3GPP in the development of mobile systems with reference to the relationship between mobile generations and 3GPP Releases.

Module 2: User mobility

Module aim: To introduce the concepts and network operation relating to a mobile device joining and moving within a mobile network and between networks.

After completing this module, a trainee will be able to:

- explain that several mobility states have been defined which determine a mobile device's use of mobile system resources.
- explain the role of cell groupings in minimising location reporting from a mobile device in Idle mode.
- explain what is meant by handover, and the reasons for handover, and the various types of handover.
- describe the functions of the core network of a mobile system including handover management, location tracking, and provision of connections to services.
- explain the role of Authentication, Authorisation and Accounting with reference to the user data that is referred to and stored while carrying out these processes.
- describe the functions of, and interactions between, the various network elements involved in handover with reference to the benefits of inter base station communication links.
- describe and compare home routed roaming, local breakout roaming, and eSIM roaming giving the benefits and disadvantages of each.
- describe the role of roaming hubs and IP Exchange (IPX) networks in facilitating roaming.
- describe the format and role of the hierarchical numbering scheme employed by mobile systems.

Module 3: Cellular networks

Module aim: To describe cellular system traffic handling and how expansion may be provided.

After completing this module, a trainee will be able to:

- describe the factors that affect cell size and shape.
- explain the factors that determine how many mobile users can simultaneously access a service within a given area.
- describe ways of separating the transmissions to and from mobiles in a cell.
- explain frequency allocation in mobile systems with reference to frequency re-use patterns.
- describe how cell sectoring and cell splitting may be used to increase traffic carrying capacity and explain the advantages and disadvantages of each.
- describe how beam forming can reduce co-channel interference and increase cell capacity.
- explain that UMTS systems use encryption to allow a frequency reuse factor of 1 while minimising co-channel interference.
- describe the methods employed by LTE and 5G systems to minimise co-channel interference.
- describe and compare the use of picocells and femtocells in providing extra capacity and coverage.

Module 4: Mobile generations

Module aim: To describe the evolution of generations of mobile systems with reference to the drivers for performance improvements, the technological changes that provided those improvements, and a comparison of the performance of mobile systems at different stages of their evolution.

After completing this module, a trainee will be able to:

- explain that technological advances coupled with changes to users' expectations and the need of service providers to reduce costs while serving more customers has driven the evolution of mobile systems.
- describe the evolution of the core network of mobile systems from the use of circuit switching to packet switching with reference to the advantages of employing Internet protocol techniques.
- describe how mobile systems has evolved from 2G through to 5G to meet the demands for high data transfer speeds and low latency.
- compare the facilities, performance and use of the various generations of mobile system.
- explain that the 3GPP has released improvements to the performance of the various generations of mobile systems over their operational life, giving examples of such enhancements.
- explain that 5G mobile systems have been designed to meet the needs of a greater range of types of service including those involving machine to machine communications.
- explain the role of 5G non standalone service provision in providing higher data transfer speeds for customers while minimising implementation costs.

Course access requirements:

To access the course, a computer running a browser such as Google Chrome, Safari etc is required. The computer should have Internet access. A screen resolution of at least 1024x768 is necessary.

Learning facilities:

This online course employs interactive simulations, hypertext links to an online glossary and multiple-choice question sessions to fully involve the trainee in the learning experience. Each module provides revision links to previously studied, relevant topics. A record of progress and level of achievement is recorded for each trainee. Once studied as a structured, assessed course, the content can be browsed for revision or reference.

PTT course levels:

PTT online courses are categorised by one of three levels according to the depth of treatment they provide:

1. Introductory:

PTT Introductory courses are designed for those with no previous experience or knowledge of telecommunications. These courses provide an overview of telecommunications or discuss the fundamentals of electronic communications. The study of general science at secondary (high) school is a typical pre-requisite for PTT Introductory courses.

PTT Introductory courses are suitable for those joining the telecommunications sector particularly those in an apprenticeship programme.

2. Intermediate:

PTT Intermediate courses are designed for technicians and engineers requiring an understanding of a certain aspect of telecommunications. Those planning to study an Intermediate course should have an understanding of the basic principles of electronic communications.

The depth of treatment provided by Intermediate courses is typically equivalent to level 3 of a UK national vocational qualification (NVQ). PTT Intermediate courses can be used to support the attainment of a Communications Technology NVQ at level 3.

3. Advanced:

PTT Advanced courses are designed for those who require an in-depth treatment of a certain aspect of telecommunications. Such courses are suitable for system designers as well as those who will be responsible for the maintenance of the system described in the course.

Those planning to study a PTT Advanced course should have a background in telecommunications, and an understanding of telecommunications fundamentals and the principles of the type of telecommunications system described in the course.

PTT
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