OBJECTIVE SYLLABUS - MBB: Mobile radio communications

This course is one of seven interactive, online PTT courses that discuss mobile communications.

Target audience:
The course is designed for those who are, or intend to be, involved in the planning, installation, provisioning or maintenance of mobile systems.

Course aim:
To provide an overview of the radio communications between a mobile user’s equipment and the fixed infrastructure provided by the mobile operator, that is, between a mobile and a base station.

Pre-requisites: Before studying this course you should have a clear understanding of the structure of mobile networks, including the components of the core network. You should also be familiar with the terms authentication and authorisation. The PTT course MBA: "Introduction to mobile systems" covers these topics.

Course structure:
The course consists of the following seven modules:

1. Course introduction
2. Propagation fundamentals
3. Fading, its causes and countermeasures
4. Mobile data communications
5. Multiple access methods
6. Frequency bands and duplexing methods
7. Security over the air interface

Course level: Introductory

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

Training delivery
To access the course, a PC running a browser such as Internet Explorer 6 or above, Firefox 2 or above, Google Chrome or Safari is required. The PC must have Internet access and run Flash version 8 or above. A screen resolution of at least 1024 X 768 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.
Detailed objectives

Module 1: Introduction

Module Aim: To summarise the aims of each module and introduce the navigation and learning facilities provided by the course.

Module 2: Propagation fundamentals

Module Aims: To define the air interface, to explain how a radio wave is affected by its environment and to introduce terminology for discussing radio wave propagation.

By the end of the module, a trainee will be able to:

- define the air interface as the link between a user’s equipment and the network infrastructure..
- describe factors that affect a conventional radio path including distance, obstructions, reflections and scattering/absorption.
- describe the factors that are particularly important to a mobile radio path including doppler shift, multipath and limited power output.
- explain the terms loss, gain, cochannel and adjacent channel interference and delay.

Module 3: Fading, its causes and countermeasures

Module Aims: To discuss different types of fading, their causes and methods used to reduce their effects.

By the end of the module, a trainee will be able to:

- define slow fading and its causes.
- define fast fading and its causes.
- describe how multipath propagation can cause fading and dispersion.
- explain the principles of space and frequency diversity and their practical application in mobile systems.
- explain the principles of ARQ (Automatic Repetition reQuest) and its application in mobile systems.
- explain the principles of FEC (Forward Error Correction) and its application in mobile systems.

Module 4: Mobile data communications

Module Aims: To explain the characteristics of data traffic and their impact on mobile networks.

By the end of the module, a trainee will be able to:

- describe the increasing importance of data communications including reference to Internet Protocol.
- explain data communication principles with reference to the OSIRM (Open System Interconnection Reference Model).
- describe the characteristics of data traffic which influence the design of mobile systems.
- explain how error correction techniques differ in their applicability to various classes of traffic with reference to symmetrical, asymmetrical and unidirectional data flows.
Module 5: Multiple access methods
Module Aim: To describe methods for providing access to and from a basestation by many mobiles.

By the end of the module, a trainee will be able to:

- explain the need for multiple access methods.
- describe and compare FDMA and TDMA multiple access methods and explain their combination.
- explain the principles of WCDMA and how it differs fundamentally from FDMA/TDMA.
- explain the principles and advantages of OFDM as used in LTE (4G) systems

Module 6: Frequency bands and duplexing methods
Module Aims: To review frequency bands in use, frequency allocation methods and considerations affecting how frequency bands are used.

By the end of the module, a trainee will be able to:

- describe the frequency bands used for mobile services with reference to geographical factors.
- explain Frequency Division Duplex (FDD) and Time Division Duplex (TDD), their relative advantages and paired and unpaired bands.
- describe the measures taken to provide sufficient radio spectrum for the expansion of mobile services.
- explain methods of allocating frequency bands including auctions.

Module 7: Security over the air interface
Module Aim: To describe the need for and methods of implementing secure communications over the air interface

By the end of the module, a trainee will be able to:

- explain the vulnerabilities of mobile communications to various forms of attack.
- describe the use of mobile station identity codes in user authentication.
- explain the use of IMEIs (International Mobile Equipment Identities) and EIRs (Equipment Identity Registers) in tracking stolen or lost mobiles.
- explain the use of an AuC (Authentication Centre).
- describe the principles of encryption of communications over the air interface.
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.

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