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PBG: Telecommunications networks

Online course specification

Target audience:
This course is designed for those who require an introduction to the fundamental technical concepts that underpin modern telecommunications. The course is suitable for those joining the industry in a technical role especially those in an apprenticeship.

Course aim:
Provides an overview of the role, structure, principles of operation, and capabilities of modern telecommunications networks.

Course level: Introductory
An explanation of PTT course levels is given at the end of this document

Pre-requisites:
An understanding of the principles of digital transmission. It is recommended that the PTT courses "Transmission fundamentals", "Modulation and multiplexing", and "Data communications principles" are studied before attempting this course.

Course structure:
The course consists of the following 5 modules:
1. Providing connections
2. Transmission links
3. Transmission networks
4. Public telephony networks
5. Access networks

Module 1: Providing connections

Module aim: To introduce the ways in which modern telecommunications networks provide connections for telecoms services and the standards that allow international operation.

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

- explain that telecommunications networks provide long distance connections for various types of telecommunications services.
- compare the features and roles of permanent and switched connections.
- describe the role of signalling in establishing a communications session.
- explain that a connection should provide enough bandwidth for the service using that connection as well as a low error rate and minimum delay.
- describe the role and relationship between transmission lines, network links and circuits.
- compare the features and benefits of connection-oriented and connectionless operation of networks.
- describe the concept, operation, and applications of virtual circuits.

Module 2: Transmission links

Module aim: To describe the features, capabilities and applications of wired and wireless transmission links.

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

- describe the functions of the basic components of an optical link including OLTE and repeaters.
- describe the capabilities and applications of optical links.
- describe the role of the main components of a submarine optical cable system.
- describe the features of examples of submarine cable systems in terms of total capacity, countries served, repeater spacing and system length.
- describe applications and features of point to point microwave links.
- describe and compare the features, facilities and applications of geostationary orbit and low earth orbit satellite systems.
- describe the functions of the main components and capabilities of point to point satellite links.
- describe the role of the various telecommunications standards bodies.

Module 3: Transmission networks

Module aim: To describe the capabilities, facilities, structure and operation of the networks that provide fixed line telecommunications services.

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

- explain that telecommunications networks must be reliable, resilient, secure and have enough resources to provide the required quality of service at the busiest periods.
- describe and compare the typical topologies and role of core, regional and access networks.
- describe the role of the operational layers of a modern telecommunication network in terms of packet transport, circuit provision, and optical transmission.
- describe the role of, and relationship between, the various protocols involved in the transmission of the traffic generated by telecoms services.
- describe the role and features of a network conforming to the synchronous digital hierarchy.
- describe the role and features of an optical transport network as defined by the ITU.
- describe the role of various types of switching equipment inc. terminal mux, cross-connects, and drop and insert mux with reference to electronic and optical switching.
- explain the role of automatic protection systems.
- describe the role of a network management system.

Module 4: Public telephony networks

Module aim: To describe the structure, features, and role of the elements, of networks that provide public telephony services.

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

- describe the role of the functional elements of a public switched telephone network (PSTN).
- explain the benefits of replacing access to a PSTN with a voice over IP (VoIP) service.
- describe the role of the functional elements of a system that delivers a public telephony service over an IP network.
- describe a possible architecture of a telecoms network providing VoIP telephony in terms of the functions of the various network nodes.
- describe the processes involved in initiating a VoIP call with reference to the interaction between the session control and transport functions.

- describe the structure of a mobile system in terms of the radio access network, backhaul connections, and core network.
- describe the role of authentication, mobility management, bearer establishment, and call control in a mobile system.
- describe the role of the functional elements of a mobile system that delivers a VoIP telephony service using an LTE system as an example.

Module 5: Access networks

Module aim: To describe the features, capabilities and role of the components of the networks that connect residential and business customers to telecommunications services.

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

- describe the structure of a copper-based local access network with reference to the role of the main distribution frame, primary cross-connect points, street cabinets, multipair cables and distribution points.
- explain that the speeds possible with broadband services delivered over copper wires are dependent on the length of the line.
- compare the reach, maximum data transfer rates and applications of the various types of digital subscriber line broadband services.
- compare the structure and relative advantages of fibre to the cabinet (FTTC) and fibre to the home (FTTH) systems.
- explain the benefits to both service providers and customers of replacing copper-based access to telephony and broadband services with optical fibre connections.
- describe the evolutionary steps involved in replacing a PSTN telephony service with a voice over fibre broadband service.
- describe the basic functions of the main components of a hybrid fibre cable (HFC) system with reference to the benefits of upgrading to an “RF over glass” or FTTH service.
- compare methods of delivering high speed communications for businesses.
- describe the advantages of the use of wireless communications in remote areas with reference to VSAT satellite services, point to multipoint LTE, and direct-to-device services.
- explain the factors that determine the broadband speeds possible over a mobile system’s radio access network.

Course access requirements:
To access the course, a computer/tablet running a browser such as Chrome, Safari, Edge etc is required. The device should have an active Internet connection and a screen resolution of at least 1024x768.

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 digital technology. Those planning to study an Intermediate course should understand the basic principles of computing or 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 level 3 digital apprenticeships.

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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