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FPA: Telecommunications access networks

Online course specification

Target audience:
This course is designed for those who will be responsible for the installation, maintenance and repair of the telecoms access networks that provide fixed line broadband and telephony services to residential and business customers.
This course supports the delivery of the following knowledge elements of the Telecoms field operative apprenticeship standard: K1, K2, K3, K4, K5.

Course aim:
To introduce the role, capabilities, and components of the access networks that provide the copper and fibre connections to homes, businesses and mobile cell sites and explain the importance of ensuring the availability of telephony and broadband services provided by those connections.

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

Pre-requisites:
This course does not assume any prior knowledge of telecommunications.

Course structure:
The course consists of the following four modules:
1. Digital communications
2. Telecoms infrastructure
3. Copper access networks
4. Fibre access networks

Module 1: Digital communications

Module aim: To introduce the benefits, capabilities, and applications of digital communications, and explain the importance of telecommunications in everyone's lives.

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

- explain that telecoms services have rapidly evolved in the last 20 years to become indispensable to most people.
- explain that various types of media including speech, images and video can be combined and carried as a stream of binary ones and zeroes over a digital link.
- explain the significance of the speed at which information can be transferred over a communications link.
- explain that the term "bit rate" is a measure of the speed at which information can be transmitted over a communications link.
- explain the relationship between, and the significance of, the terms "bit rate" and "bandwidth".
- describe and compare the bandwidth and applications of the various types of fixed line and wireless communications link.
- explain the importance of universal and reliable access to high speed broadband services.

- describe the need for regulation of telecoms services with reference to the role of the UK national regulator, Ofcom.
- describe the possible impacts of loss or degradation of service both to customers and service provider with reference to the role of service level agreements and regulator stipulated compensation schemes.

Module 2: Telecoms infrastructure

Module aim: To introduce the infrastructure that provides telephony and broadband services and compare methods of providing high speed access to the Internet.

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

- describe and compare the role of core, metro and access networks in the provision of telephony and broadband services.
- describe how telephony provision has changed from the use of the public switched telephone network (PSTN) to an all IP-based infrastructure.
- describe how the access network has evolved to provide broadband services as well as telephony.
- describe the benefits of the use of optical fibre in the access network and explain that sharing the capacity of a fibre with customers in an area reduces costs.
- describe the benefits of combining existing copper cable connections with optical fibre with reference to fibre to the cabinet and hybrid fibre coax systems.
- explain that eventually, all telephone calls will be connected over broadband connections rather than over PSTN exchange lines.
- describe the importance of controlling access to critical telecommunications assets such as exchange buildings and the measures that are taken to protect those assets.
- explain that leased lines provide organisations with private connections between sites using a telecommunications service provider's copper or fibre cables.
- describe the role of a radio access network with reference to the concept of cells, the role of base stations and methods of connecting base stations to the core network.
- explain the role and aims of government intervention in the universal provision of broadband services.

Module 3: Copper access networks

Module aim: To introduce the structure and role of the components of an access network based on the use of copper wire pairs and compare the performance of the broadband services provided by such a network.

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

- describe the structure of a 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 how a conventional telephone line can be used to access the Internet and digital TV services.
- compare the capabilities of the various Digital Subscriber Line (DSL) services including ADSL and VDSL.
- describe the various factors that affect the broadband speed offered by a DSL service.
- describe the role of the various devices and cabling in a home or business premises necessary for access to telephony and broadband services.
- describe the principles and advantages of insulation displacement connections (IDC) with reference to where they are used in the access network.
- state that various categories of data cable are available and that an inappropriately chosen category for an installation will degrade the data transfer performance.

- describe and compare the role of a digital subscriber line access multiplexer (DSLAM) and a multiservice access node (MSAN).
- explain that the high bandwidth of coaxial cable is exploited to provide television broadcasts and Internet access.
- describe the structure of a hybrid fibre coax (HFC) system with reference to the role of splitters, branches, taps, and distribution and drop cables.

Module 4: Fibre access networks

Module aim: To introduce the structure and role of the components of an access network based on the use of optical fibre and compare the performance of the broadband services provided by such a network.

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

- explain the benefits offered by optical fibre for residential and business customers requiring access to data services.
- describe the role of an optical splitter in a passive optical network (PON).
- describe the role of an optical line terminal and optical distribution shelf in the access node of a PON.
- describe the physical structure of a PON in terms of feeder cables, distribution cables, drop cables, splitter nodes and fibre access terminals.
- compare the structure, components and capabilities of the various PON configurations: FTTB, FTTC, FTTH, FTTP and FTTdp (g.fast).
- describe the role of equipment in an FTTC cabinet and the relationship between it and a primary cross-connect point (PCP).
- describe the capabilities of G.fast broadband and the ways in which a G.fast service may be implemented.
- compare methods of upgrading HFC broadband service provision with reference to employing DOCSIS 4, RF over Glass, and FTTH.
- describe the role of the various devices and cabling in a home or business premises necessary for access to fibre-based broadband services including voice over broadband telephony.
- describe the various ways of giving competitors access to an incumbent's access network as required by national regulators.

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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