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FOB: Telecoms testing and fault-finding

Online course specification

Target audience:
Those responsible for the installation and maintenance of telecommunications networks. This course supports the attainment of some of the technical knowledge and understanding requirements of the Telecoms field operative apprenticeship standard.

Course aim:
This course describes how to follow a structured approach to fault finding and the role and significance of the various tests employed on telecommunications networks.

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

Pre-requisites:
An understanding of the basic principles of data communications would assist in understanding the content of this course. It is recommended that the PTT course "Data communications principles" is studied before attempting this course.

Support of telecoms field operative apprenticeships:
This course supports the delivery of the following knowledge elements of the Telecoms field operative standard: K9, K10
Other knowledge elements are covered by the PTT course "Telecommunications access networks"

Course structure:
The course consists of the following 4 modules:
1. Role of testing
2. Network performance
3. Fault-finding
4. Telecommunications testing

Module 1: Role of testing

Module aim: To describe the role of testing with reference to the network characteristics that affect network performance as experienced by users.

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

- describe and compare the role of, and services provided by, telecoms access networks, core networks, and wide area networks.
- summarise the role of protocols at the various OSIRM layers.
- explain that various types of network use the Ethernet and IP/TCP protocols.
- define the network characteristics line speed, information rate and throughput and explain the differences between them.
- define packet loss, delay, delay variation, bit error rate, and jitter and describe their effects on multimedia services.
- describe the role of testing in installing, commissioning and fault-finding a network.
- explain that a test can be carried out at one of the various protocol layers depending on the reason for the test.

- explain that software tools running on a computer have a role in fault-finding IP based networks.
- describe the role of a service level agreement with reference to quality of service (QofS) indicators.
- explain the importance of testing to international recognised standards with reference to the various organisations that publish those standards.

Module 2: Network performance

Module aim: To describe the factors that determine the performance of a network and the parameters used to assess performance.

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

- describe the factors that affect throughput and latency of a communications link.
- describe the causes of errors on wired, wireless, and optical communications links.
- describe the relationship between signal to noise ratio and error performance with reference to the significance of noise margin and receiver sensitivity.
- describe the use of a PRBS pattern in measuring error performance.
- define the terms “Errored Seconds”, “Severely Errored Seconds” and “Error Free Seconds” and explain their role in indicating the temporal distribution of errors
- define the terms circuit and virtual circuit and compare their characteristics.
- define, and explain the significance of, the key performance indicators (KPIs) CIR, CBS, EIR and EBS as used to assess a wide area network connection.
- describe how the performance of a network connection may be measured with reference to loop-back tests and remotely controlled bi-directional tests.
- explain that test equipment is often configured to carry out tests according to a relevant standard, giving examples of those standards.

Module 3: Fault-finding

Module aim: To describe the various methods employed in a structured approach to fault finding on a communications network with reference to the software that can aid the determination of the location and cause of a fault.

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

- describe the limitations of an intuitive approach to fault-finding.
- described the benefits of a structured approach to fault finding.
- describe the roles of information gathering, analysis, testing hypotheses and eliminating hypotheses.
- explain that testing at the different protocol layers in a certain sequence can assist in isolating a fault.
- describe and compare the “top down”, “bottom up” and “divide and conquer” protocol testing sequences.
- explain that identifying the network path involved in a reported fault can make fault-finding more manageable in large networks.
- describe the use of software utilities including Ping, Test-NetConnection and Traceroute in a structured approach to fault-finding.

Module 4 Telecommunications testing

Module aim: To describe the types of test carried out on telecommunications networks and the role, features and applications of various types of test equipment.

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

- explain that tests can be carried out on a physical line, communications link or a connection over a network.
- describe the use of DC testing of a copper line for fault-finding.
- describe the principles and role of time domain reflectometry in the testing of copper and optical fibre lines.
- describe the role and use of power meters in testing copper and optical fibre links.
- explain that test equipment must have the appropriate type of interface to match that employed by the link under test, giving examples of the various physical and data link protocols employed.
- describe various types of link test including error performance, FEC stress tests, jitter, alarm monitoring and simulation, and confirmation of multiplexing/demultiplexing.
- describe the use of specialised test equipment in the measurement of Ethernet key performance indicators, error performance and throughput.
- explain there are specialised test equipment available to test the various types of broadband service giving examples of measurements they make.
- explain the importance of storing test results, giving examples of methods of data storage.
- describe the role and facilities of remote network management and monitoring systems.

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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