

EEE: Network testing and fault-finding

Online course specification

Target audience:

Those responsible for the installation and maintenance of local and wide area networks.

Course aim:

This course describes how to follow a structured approach to fault finding and maintenance, and the role and use of the various tests that can be employed on networks based on the Ethernet and IP suite of protocols.

Course level: Intermediate

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

Pre-requisites:

An understanding of the operation of, and protocols employed by, Ethernet local area networks. It is recommended that the PTT course “Ethernet networks” is studied before attempting this course.

Course structure:

The course consists of the following five modules:

1. Role of testing
2. Network performance
3. Fault-finding
4. Testing an Ethernet/IP network
5. Maintenance

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:

- summarise the role of protocols at the various OSI/RM 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.
- describe the causes of frame loss, delay and jitter and their effects on multimedia services.
- describe the role of a service level agreement with reference to quality of service (QoS) indicators.
- define, and explain the significance of, the QoS indicators CIR, CBS, EIR and EBS.
- describe the role of testing in installing, commissioning and fault-finding a network.
- explain that a variety of types of technical documentation are available that support maintenance activities.
- explain that a test can be carried out at one of the various protocol layers depending on the reason for the test.
- explain the importance of maintaining a record of network topology and configuration.

Module 2: Network performance

Module aim: To describe the factors that determine the performance of a network with reference to the various key performance indicators (KPIs) and describe tests that measure KPIs.

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

- describe the role of the components of a local area network and their effect on the performance of a network.
- explain that the throughput achieved over a network may be significantly reduced by excess traffic and describe possible sources of that traffic.
- describe the factors that affect the delay experienced by Ethernet frames as they traverse a network.
- describe the causes of frame errors on wired and wireless Ethernet segments.
- explain the effect of the TCP protocol on throughput with reference to the TCP window size.
- define, and explain the significance of, the key performance indicators (KPI) used to assess a wide area network connection.
- describe the use of specialised test equipment in the measurement of Ethernet KPIs, bit error rate and TCP throughput with reference to the role and use of applicable test standards.
- compare the features of the two standards for the measurement of Ethernet KPIs: RFC 2544 and Y1564.

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: Testing an Ethernet/IP network

Module aim: To describe the facilities, capabilities and uses of the various software utilities and test equipment that can assist in finding a fault in a network based on the Ethernet and IP suite of protocols.

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

- describe the role of ping switches that modify the characteristics of a test, giving examples of the use of these ping options in fault-finding.
- explain the use and interpretation of traceroute tests combined with ping tests in determining the source of packet errors or communication failure.

- describe the facilities and use of software utilities that check network element configuration settings and the operation of network services such as DHCP, DNS and ARP.
- describe an example of the use of a combination of software utilities in a structured approach to finding a fault in a network.
- describe the use and facilities of software utilities and test equipment that monitor and analyse traffic streams.
- describe the measures that must be taken to ensure all relevant traffic is monitored with reference to the promiscuous mode, switch monitor mode and network taps.
- describe typical facilities and applications of network test equipment.

Module 5: Maintenance

Module aim: To describe methods of assessing the probability of functional failure and compare the various types of maintenance strategy that minimise instances of failure.

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

- define the terms Mean Time Between Failure (MTBF), mean time to failure (MTTF). And Mean Time to Repair (MTTR).
- explain that the probability of functional failure changes over the lifetime of an asset.
- define and compare the role and benefits of corrective maintenance and preventative maintenance.
- explain the use of MTBF and MTTR in determining maintenance schedules and measuring the effectiveness of maintenance strategies.
- explain that by monitoring appropriate operating characteristics, future functional failure can be predicted.
- define, and compare the benefits of, scheduled maintenance, condition-based maintenance, predictive maintenance, and prescriptive maintenance.
- describe the role of a computerized maintenance management system (CMMS) in facilitating a preventative maintenance strategy.
- explain that the choice of maintenance strategy for an asset is dependent on various factors including the complexity and criticality of the asset.
- explain the importance of recording details of maintenance activities.

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.

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