EDA: **Ethernet fundamentals**
Online course specification

Target audience:
Those responsible for the installation and maintenance of Ethernet local area networks.

Course aim:
To introduce the principles of operation of Ethernet local area networks and the role and characteristics of their functional components.

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. It is recommended that the PTT course "Data communication principles" is studied before attempting this course.

Course structure:
The course consists of the following four modules:
1. Introduction to Ethernet
2. Ethernet protocols
3. Ethernet switches
4. Ethernet LANs

Module 1: Introduction to Ethernet

Module aim: To describe the role of the components of an Ethernet LAN and the role of the various standards bodies in the evolution of standards for Ethernet LANs.

After completing this module, a trainee will be able to:
- describe the role of a local area network (LAN), giving typical applications.
- describe the role of the functional components of a simple LAN.
- describe the capabilities of modern LANs in terms of the achievable data transfer rates and maximum distance covered.
- explain the importance of standards for communications.
- describe the role of the various bodies responsible for formulating standards and the relationship between them.
- describe the history of the evolution of the Ethernet standards.
- describe the role of the IEEE working groups in formulating Ethernet standards.

Module 2: Ethernet protocols

Module aim: To describe the role of the protocols used by an Ethernet LAN and describe and compare the structure and facilities of the various types of Ethernet frame.

After completing this module, a trainee will be able to:
- describe the circumstances in which collisions between transmitted signals can occur in wired and wireless networks.
- describe how CSMA/CA avoids collisions in wireless (WiFi) networks.

- describe the role and operation of CSMA/CD in allowing devices to share the transmission medium on wired networks.
- describe the role of the various protocols used in Ethernet LANs including LLC and MAC.
- describe the format of the basic Ethernet 802.3 frame and the role of the individual fields.
- explain that the IEEE 802.3 standard allows the choice from two main types of frame format.
- describe the benefits of a Virtual LAN and the significance of class of service indicators.
- describe and compare the facilities and structure of the alternative Ethernet frame formats.
- explain how the different frame formats can be identified by information within the frames.

Module 3: Ethernet switches

Module aim: To describe and compare the operation, facilities, and limitations of Ethernet switches.

After completing this module, a trainee will be able to:
- explain the role and basic operation of an Ethernet switch with reference to the terms "port", "MAC address" and "segment".
- explain that a segment consists of two or four twisted pairs depending on the operating speed with a maximum length of 100 metres.
- describe how switches can be connected together to increase the capacity and coverage area of a local area network.
- define the terms collision domain and "late collisions".
- describe the techniques used by WiFi networks to avoid collisions between transmissions from "hidden nodes".
- describe the limitations of legacy equipment such as hubs with reference to maximum LAN size and half duplex operation.
- describe the facilities offered by switches including auto-negotiation of transmission parameters, errored frame rejection, and flow control.
- describe the benefits of full duplex over half duplex operation and explain in what circumstances full duplex operation may not be possible.
- describe the role and methods of providing "Power over Ethernet".

Module 4: Ethernet LANs

Module aim: To describe the physical media, topology and capabilities of the various types of Ethernet LAN from 10BASE-T to 10GBASE-LR with reference to design considerations.

After completing this module, a trainee will be able to:
- describe the role and operation of the "self-learning" facility of a switch.
- describe the problems associated with network loops including "MAC flapping" and broadcast storms.
- describe methods of the prevention of network loops.
- explain that standards exist for various categories of copper cable which each being capable of supporting a particular maximum data transfer rate.
- compare the capabilities of various Ethernet types in terms of the transmission media they use, their operating bit rate, and maximum segment length.
- explain the role of a network backbone and compare the topology of a distributed backbone and a collapsed backbone.

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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