TCF: "Hybrid fibre coax systems"
Online course specification

Course aim:

By the end of this course trainees will be able to describe the operation, components and capabilities of hybrid fibre coax cable systems with reference to the provision of television, video on demand and broadband services.

Target audience:

This course is designed in particular for technicians and engineers responsible for the design and maintenance of hybrid fibre coax (HFC) systems.

Course level: Intermediate

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

Course pre-requisites:

A basic understanding of digital transmission techniques. It is suggested that the PTT e-learning course SRB: "Transmission fundamentals" is completed before attempting this course.

An understanding of data communications. It is suggested that the PTT course SRC: "Data communication principles" is completed before attempting this course.

Course access requirements:

There are two versions of this course, one designed for access on a PC or laptop, the other designed for access on a tablet.

PC version:

This version requires a PC or laptop running a browser such as Internet Explorer 6 or above, Firefox 2 or above, Google Chrome or Safari is required. The PC should have Internet access and be running Flash version 8 or above. A screen resolution of at least 1024x768 is necessary.

Tablet version:

This version of the course is designed for study on a tablet through the learntelecoms™ App which is available for Apple® iPad® and for Android™.

Minimum requirements:

learntelecoms App for Android: 7in tablet or larger with ARMv7 processor running Android 2.3 or higher.

learntelecoms App for iPad running iOS 6.1 or higher.

Course structure:

The course consists of the following four modules:

1. Hybrid fibre coax
2. Television services
3. Broadband services
4. Enhancing cable services

Module 1: Hybrid fibre coax

Module aim: To introduce the components and structure of hybrid fibre coax systems and the services HFC systems provide.

By the end of this module, you will be able to:

- describe how coax cable systems have evolved over the years from providing analogue television services to digital TV and broadband.
- describe the structure of a coaxial cable system with reference to the roles of RF amplifiers, splitters and taps.
- describe the characteristics of coaxial cable with reference to the factors that determine its characteristic impedance and loss.
- explain the advantages of including optical fibre in a coax cable system.
- describe the topology of a hybrid fibre coax system with reference to the role of the optical node.
- compare the advantages of a tree and branch topology with a star topology.
- explain that various types of service can be provided by an HFC system including digital TV, video on demand, telephony and broadband services.
- explain that the DOCSIS standards have been developed for the provision of broadband services over HFC systems.
- describe how bidirectional operation can be provided by allocating different radio frequency bands for upstream and downstream traffic.

Module 2: Television services

Module aim: To describe the techniques used to deliver digital television services over an HFC system and the role of the DVB and MPEG standards.

By the end of this module, you will be able to:

- describe how compression techniques reduce the bit rate requirement for the transmission of digital TV with reference to the significance of the compression ratio.
- explain that the motion picture experts group (MPEG) has published various versions of standards for video and audio compression over the years with progressive improvements in performance.
- explain that a digitised TV programme is transmitted as an MPEG programme stream consisting of two or more packetised elementary streams.
- explain the benefits of combining two or more TV programmes into a single MPEG transport stream.
- describe the role of the various fields in a transport stream packet header including the packet identifier and the programme clock reference.
- describe how programme association tables and programme map tables allow a receiver to extract the information necessary to receive and decode a particular TV programme.
- explain that the digital video broadcasting (DVB) project have developed the DVB-C standard for the transmission of digital TV over HFC systems.
- describe the role of the various service information tables employed in a DVB-C system including the NIT, EIT and SDT.
- describe the role and basic operation of a DVB conditional access system.

- explain that a video on demand service depends on access to an upstream radio frequency channel.

Module 3: Broadband services

Module aim: To describe the operation and role of the components of a system that conforms to the EuroDOCSIS standard for the provision of a broadband service over an HFC system.

By the end of this module, you will be able to:

- describe the principles of the modulation techniques employed to transport digital information over a cable system with reference to their noise immunity and data transfer rates.
- explain that various versions of the DOCSIS standards have been published over the years with a progressive improvement in performance.
- describe the main differences between DOCSIS and EuroDOCSIS standards.
- describe the role of the components of a DOCSIS system including the cable modem termination system (CMTS) and the cable modem.
- describe the role of, and relationship between, the various protocols employed to provide a broadband service including Ethernet and the Internet Protocol (IP).
- describe the role of the DOCSIS media access control (MAC) information added to Ethernet frames.
- explain that downstream IP traffic is segmented into MPEG transport streams which can be interleaved with DVB-C traffic.
- describe the process of granting upstream transmission opportunities to a cable modem with reference to the role of bandwidth allocation maps.
- describe the role of the sync and ranging request messages in synchronising transmissions between the CMTS and a cable modem.
- describe the role of the various messages exchanged between the CMTS and a cable modem when the modem joins the cable network.
- describe methods of maximising data transfer rates including channel bonding and the use of higher order modulation.
- explain the relevance of the contention ratio on the achievable sustainable data transfer rate available to customers.

Module 4: Enhancing cable services

Module aim: To describe how the performance of hybrid fibre coax (HFC) systems can be improved to meet customer expectations in the years to come.

By the end of this module you will be able to …

- explain the limits to improving data transfer rates by techniques such as bonding extra RF channels, using higher order modulation and increasing the RF bandwidth.
- describe the benefits of employing more efficient video compression techniques.
- describe the principles of, and benefits of employing, a switched digital video service.
- describe how the service provided to customers can be improved by implementing optical node splitting.
- describe the transmission techniques employed by DOCSIS 3.1 broadband systems and the benefits offered by such systems.
- explain how existing DOCSIS 3.0 systems may be upgraded to DOCSIS 3.1 in a staged implementation process.

- explain that a DVB-C2 digital TV system uses transmission techniques that are equivalent to those used by DOCSIS 3.1 to make more efficient use of the available RF bandwidth.
- explain the benefits of migrating to all IP environment where all cable services including broadcast TV, video on demand, telephony and broadband are delivered over a packet switched network.

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 – Providers of Telecommunications Training

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