SYA: Synchronous transmission principles
Online course specification

Target audience:
This course is designed for technicians and engineers involved in the design, commissioning and maintenance of synchronous transmission networks.

Course aim:
This course explains the principles of synchronous transmission and describes the role of the components of a transmission network.

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

Pre-requisites:
An understanding of the characteristics of digital signals. It is recommended that the PTT online course "Analogue and digital signals" is studied before attempting this "Synchronous transmission principles" course.

Course structure:
The course consists of the following 5 modules:
1. Introduction
2. Time division multiplexing
3. Frames and multiplexers
4. Synchronisation
5. Transmission networks

Module 1: Introduction

Module aim: To summarise the aims of each module and introduce the navigation and learning facilities provided by the course.

Module 2: Time division multiplexing

Module aim: To introduce the principles of time division multiplexing.

After completing this module, a trainee will be able to:
- explain the principles of Time Division Multiplexing (TDM) with reference to byte interleaving and the concept of timeslots.
- explain the principles of frame alignment with reference to the role of the frame alignment word.
- describe the role of a primary multiplexer with reference to the role and basic functions of the various types of primary multiplexer card.

Module 3: Frames and multiplexers

Module aim: To introduce the role of the timeslots in a frame of a 2 Mbit/s synchronous signal and describe the role of the various types of multiplexer in a synchronous network.

After completing this module, a trainee will be able to:
- describe the basic frame structure of a 2 Mbit/s synchronous signal conforming with ITU-T recommendations.
- explain the choice of repetition rate for a 2 Mbit/s frame.
- explain the principles and use of timeslot interchange.
- describe the role and basic operation of different types of synchronous equipment including terminal multiplexers, drop and insert multiplexers and cross-connect equipment.

Module 4: Synchronisation

Module aim: To introduce the principles of synchronisation and the hierarchical distribution of timing signals.

After completing this module, a trainee will be able to:
- explain the need for timing control in a synchronous transmission network.
- describe the causes and effects of jitter.
- describe the hierarchical structure of a timing distribution network.
- describe the roles of, and relationship between, primary and secondary timing sources with reference to their respective timing stabilities.
- give examples of the types of clock that can be used as a timing reference.
- explain how the jitter on a timing signal can be minimised.
- explain that timing can be extracted from a conventional synchronous signal.

Module 5: Transmission networks

Module aim: To describe and compare the main components, facilities, and structure of plesiochronous and synchronous networks.

After completing this module, a trainee will be able to:
- describe the role of the main components of a digital link including multiplexers, line equipment and repeaters.
- describe the structure and elements of a network based on the plesiochronous digital hierarchy (PDH) as recommended by ETSI.
- describe the structure and elements of a network based on the PDH as recommended by ANSI.
- describe how ETSI signals can be carried over a PDH network based on ANSI standards and vice-versa.
- Explain the benefits of a network based on the synchronous digital hierarchy (SDH).
- describe the structure and elements of a network based on the SDH.
- describe the structure and elements of a network based on SONET.

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
January 2014