

SYD: Optical networks

Online course specification

Target audience:

This course is designed for technicians and engineers involved in the design, commissioning and maintenance of optical transmission networks.

Course aim:

Telecoms service providers rely on metropolitan and national networks that employ optical links to provide the high capacity needed for modern communications. This course describes the capabilities, components and operation of these networks.

Course level: Advanced

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

Pre-requisites:

An appreciation of various types of optical interface and wavelength division multiplexing. The study of PTT course "Optical line systems" is recommended before attempting this course.

An understanding of the synchronous digital hierarchy (SDH) will also be an advantage. The PTT course "SDH principles" covers these topics.

An understanding of Ethernet protocols will also be of benefit. The study of the PTT course "Ethernet networks" is suggested.

Course structure:

The course consists of the following 7 modules:

1. Course introduction
2. SDH networks
3. IP over SDH
4. Ethernet networks
5. Ethernet over SDH
6. Protection schemes
7. Optical transport networks

Module 1: Course introduction

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

Module 2: SDH networks

Module aim: To describe the functions and capabilities of SDH network elements and the structure of SDH networks.

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

- describe and compare the role and capabilities of access, regional and core networks.
- describe the role of virtual containers in an SDH network with reference to path and section overheads and pointers.

- describe the different modes of operation of SDH multiplex equipment including drop and insert, drop and continue, hairpinning and terminal mux.
- describe the functions and capabilities of typical SDH drop and insert multiplex equipment.
- describe the provision of line and tributary protection.
- describe the role and capabilities of hubbing multiplexers and SDH cross-connect equipment.
- describe and compare the structure, capabilities and applications of networks based on ring structures and those that have a mesh topology.

Module 3: IP over SDH

Module aim: To describe the provision of point to point connections for IP packets over an SDH network.

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

- explain the need for high capacity connections for IP traffic over SDH networks.
- describe the functions and operation of the point to point protocol (PPP).
- describe the mapping of PPP frames into an SDH virtual container (VC-4).
- describe the structure of an HDLC frame transporting IP packets with reference to the role of the overhead bytes.
- describe the role of the PPP link control and network control protocols.
- describe the limitations of the PPP protocol.

Module 4: Ethernet networks

Module aim: To describe the characteristics and capabilities of, and services offered by, Metro Ethernet Networks.

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

- explain that Carrier Ethernet is a standardised service and network with characteristics that match the requirements of business users.
- describe the role of a user-network interface and a external network-network interface in a metro Ethernet network.
- describe the role and characteristics of the various types of Ethernet virtual connection (EVC).
- give typical applications of E-Line and E-LAN services.
- explain the benefits of a sub-rate service as defined by a traffic contract.
- define the various performance parameters included in a traffic contract including committed information rate and committed burst size.
- explain that a bandwidth profile can apply to a UNI, an EVC or a particular class of service.
- compare the various ways of transporting Ethernet signals over access, regional and core networks.

Module 5: Ethernet over SDH

Module aim: To describe methods of transporting Ethernet signals over an SDH network and aggregating SDH payloads to increase the capacity of Ethernet connections.

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

- describe the role and modes of operation of the Generic Framing Procedure (GFP).
- explain the advantages of GFP over PPP when transporting IP traffic over SDH networks.
- describe the structure of a GFP frame with reference to the role of its overheads.

- describe the principles and advantages of virtual concatenation when transporting IP traffic over an SDH network.
- describe the role and principles of the Link Capacity Adjustment Scheme (LCAS).
- describe the use of the IEEE 10GBASE-LW optical interface in interconnecting Ethernet networks using an SDH network.

Module 6: Protection schemes

Module aim: To describe the role and operation of the various methods of automatically providing alternative routes for traffic in SDH and Metro Ethernet networks when faults occur.

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

- explain the requirement for an Automatic Protection System (APS).
- explain that the degree of protection provided is a balance between network resilience and the efficient use of bandwidth.
- describe the principles and benefits of the various methods of protecting traffic in the event of line or equipment failure in an SDH network including end-to-end path protection, sub-network connection protection, multiplex section protection and span protection.
- describe and compare Ethernet linear protection and Ethernet ring protection as employed in Metro Ethernet networks.

Module 7: Optical transport networks

Module aim: To describe the role, operation and benefits of an optical transport network as defined by the ITU with reference to the elements of such a network.

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

- describe the benefits of an all-optical network.
- explain the principles of a MOEMS optical cross-connect.
- describe the role of the basic components of an all-optical network including optical add/drop multiplexers and cross-connect equipment.
- describe the structure and capabilities of an Optical Transport Network (OTN).
- explain the concepts of Optical channel Transport Units (OTU) and Optical Transport Modules (OTM).
- describe the provision and features of supervisory channels in an OTN.
- describe the role of optical channel protection and optical multiplex section protection.

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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