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TAH: Advanced IP networks
Online course specification

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

Course aim:
To describe the various methods of transporting traffic with particular quality of service requirements over an IP network.

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

Pre-requisites:
An understanding of the principles of the Internet Protocol and routing. It is recommended that PTT's "IP Networks" course is studied before attempting this course. The study of the PTT course "IP routing" would also be an advantage.

Course structure:
The course consists of the following 6 modules:

1. Course introduction
2. Resource reservation
3. Differentiated service
4. Label switching
5. Traffic Engineering
6. Transporting voice

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: Resource reservation

Module aim: To describe the role and operation of the Resource Reservation Protocol (RSVP) in reserving network resources for a traffic stream.

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

- explain that the connectionless operation of an IP network can be detrimental to certain types of traffic such as voice and video.
- describe how RSVP is used to reserve network resources for a traffic stream between the traffic source and receiver with reference to the roles of the Path and reservation Request messages.
- describe the function of the flowspec and filterspec in the Request message.
- explain that RSVP works in conjunction with conventional route discovery protocols such as OSPF.

- describe the role of the Common Open Policy Service (COPS) protocol.
- describe how RSVP can be used to reserve resources for multicasts.

Module 3: Differentiated service

Module aim: To describe how the DiffServ protocol allows a particular class of service to be provided for a traffic stream.

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

- describe the role of Diffserv.
- describe the operation of a Differentiated service with reference to the marking, policing and shaping functions and the role of the classifier.
- describe the features of typical Diffserv classes of service.
- describe the various ways of provisioning a differentiated service.
- compare the admission control aspects of Diffserv and the Resource Reservation Protocol (RSVP),
- describe how RSVP can be used in conjunction with Diffserv.

Module 4: Label switching

Module aim: To describe the facilities, operation and components of an IP network using Multiple Protocol Label Switching (MPLS).

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

- describe the benefits of integrating IP routing with high speed switching.
- describe the operation of Multi Protocol label switching MPLS).
- explain the concept and properties of a Label Switched Path (LSP).
- describe the function of Label Edge Routers (LERs) and Label Switch Routers (LSRs).
- explain the significance of a Forward Equivalence Class (FEC).
- explain the various ways that the establishment of an LSP can be initiated.
- describe the role and operation of the Label Distribution Protocol (LDP) with reference to its relationship with routing protocols such as OSPF.
- describe how MPLS can be used in conjunction with various data link layer protocols.

Module 5: Traffic Engineering

Module aim: To describe how traffic engineering considerations can be taken into account when provisioning MPLS label switched paths.

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

- explain the role of traffic engineering in an MPLS-based IP network.
- explain that the route taken by a Label Switched Path (LSP) can be based on the network's topology for a best-effort service or on traffic engineering considerations.
- describe the use of RSVP to establish an LSP.
- explain the concept of constraint-based routing.
- explain that extended versions of conventional routing protocols have been specified for constraint-based routing.
- explain that RSVP-TE allows explicit routing information to be passed to Label Switched Routers.

- describe the process of establishing a constraint-based LSP with reference to the roles of, and relationship between, OSPF-TE, RSVP-TE and constraint-based route calculation.
- describe alternative protection mechanisms offered by RSVP and its variants.

Module 6: Transporting voice

Module aim: To describe the transport of encoded voice samples over an IP network.

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

- explain that the transport of voice requires low transmission delay, low delay variation and the in-sequence delivery of packets.
- explain that using TCP to transport voice samples would result in excessive delay.
- describe the role and operation of the Real-time Transport Protocol (RTP) when transporting voice samples over an IP network.
- explain the concept of, and relationship between, media streams and RTP sessions with reference to telephone and video conference calls.
- describe the role of the RTP Control Protocol (RTCP).
- describe the relationship between RTP, RTCP, UDP and RSVP when transporting voice samples over an IP network.
- describe the role of, and relationship between the Session Initiation Protocol (SIP), Session Description Protocol (SDP) and RTP in a Voice over IP (VoIP) system that contains an IP Multimedia Sub-system (IMS).

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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