

NHA: Next generation networks

Online course specification

Target audience:

This PTT online course is aimed at those involved in the design and maintenance of telecommunications networks.

Course aim:

To introduce the advantages, architecture, key technologies and service capabilities of next generation networks.

Course level: Intermediate

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

Pre-requisites:

A basic understanding of the principles and features of packet and circuit switched networks. It is recommended that PTT's online course "Principles of Wide Area Networks" is studied before attempting this course.

For those planning to study Module 6 of this course, an understanding of Ethernet switching would be an advantage. It is recommended that PTT's online course "Ethernet networks" is studied before attempting this module.

Course structure:

The course consists of the following 7 modules:

1. Course introduction
2. The case for NGN
3. NGN architecture
4. Transport technologies
5. NGN virtual connections
6. Virtual network services
7. Software defined networking

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: The case for NGN

Module aim: To describe the technical, economic and service advantages of new generation networks.

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

- explain that a conventional telecommunications system uses separate networks for voice, data and Internet services.
- explain that in a conventional telecoms system facilities relating to the provision of a service are often integrated with the transmission infrastructure.

- explain the disadvantages of a conventional telecoms system in terms of maintenance costs and the provision of new services.
- explain that the success of the Internet is attributable in part to its separation between service provision and data transport.
- describe the aims of implementing a next generation network (NGN) including: reducing equipment count and maintenance costs, encouraging the implementation of new services, allowing user mobility, providing services that are independent of the access method (fixed or mobile).
- explain that the NGN core network employs the Internet Protocol (IP) to carry the traffic generated by all types of services.
- explain that in an NGN the transport layer is separate from the service layer allowing new IP-based services to be implemented without changing the NGN infrastructure.
- explain that the change from the connection-oriented networks of conventional telecommunications to a connectionless IP-based infrastructure requires consideration of several issues including security and quality of service guarantees.
- give examples of the services that are possible with an NGN including telephone services supporting user and terminal mobility.

Module 3: NGN architecture

Module aim: To describe the basic architecture of a next generation network (NGN) with reference to its service, control and transport layers.

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

- describe an NGN as consisting of a core network and access networks which all employ the Internet Protocol (IP).
- explain that access to NGN services can be provided by a variety of transmission technologies including FTTx, WiFi, WiMAX, ADSL2+ and VDSL2.
- explain that the ITU works with other standards bodies including ETSI, 3GPP and IETF to encourage the inter-operability of NGNs.
- describe the basic functions of the transport and service layers of an NGN.
- explain that the architecture of an NGN simplifies the introduction of new services and enables the separation of the roles of service provider and network operator.
- describe the roles of the Network Attachment Control Functions (NACF) and Resource and Admission Control Functions (RACF) of an NGN.
- describe the functions of the IP Multimedia Subsystem (IMS) with reference to the control of Voice over IP (VoIP) calls and the integration of fixed and mobile telephone services.
- describe the functions of gateways in connecting an NGN to other networks and systems.

Module 4: Transport technologies

Module aim: To describe the functions and facilities of the various technologies used to transport traffic over a next generation network (NGN) with reference to the relationship between them.

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

- compare the roles of the Internet Protocol (IP) with those of physical and data link protocols with reference to the OSI Reference Model (OSIRM).
- describe the benefits of using Ethernet in an NGN with reference to the provision of converged services, lower equipment costs and bandwidth efficiency.
- state that ITU-T recommendations cover all aspects of Synchronous Digital Hierarchy (SDH) networks including physical interfaces, Operations, Administration, and Maintenance (OAM), and automatic protection systems (APS).
- compare the use of SDH and Ethernet transmission links with reference to cost of deployment, bandwidth efficiency, service provisioning, quality of service guarantees, and OAM facilities.

- describe how SDH links carry Ethernet traffic in an NGN with reference to methods of improving bandwidth utilisation.
- describe the benefits of using Wavelength Division Multiplexing (WDM) to transport IP traffic over an NGN with reference to the function of an Optical Add-Drop Multiplexer (OADM).
- state that an Optical Transport Network (OTN) provides OAM and protection facilities which are comparable with those of an SDH network.
- explain that various types of traffic can be carried over an OTN including SDH, Ethernet and IP.
- describe the role of Multiprotocol Label Switching (MPLS) in an NGN.
- describe typical structures for NGNs giving reasons for the use of particular transmission techniques in the access and core network.

Module 5: NGN virtual connections

Module aim: To describe and compare the various methods of providing connection-oriented services over a Next Generation Network.

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

- explain that a conventional Internet Protocol (IP) network does not provide point to point connections with a defined Quality of Service (QoS).
- explain the need for point to point connections in a Next Generation Network (NGN) which provide a QoS that is suitable for a particular service.
- explain the concept of a virtual connection.
- explain that by using Class of Service (CoS) indicators, traffic carried over a particular virtual connection can be given priority over other traffic.
- explain that Multiprotocol Label Switching (MPLS) allows virtual connections to be provided over IP networks and is not confined to any specific data link layer technology.
- state that MPLS - Traffic Engineering (MPLS-TE) as documented by the IETF allows Quality of Service (QoS) requirements, network resource optimisation and path restoration to be taken into account when setting up a path over a network.
- state that the ITU Transport MPLS (T-MPLS) recommendations are based on the IETF MPLS standards though with amendments to meet the specific requirements of a connection-oriented national transport network.
- describe and compare the traffic protection schemes offered by the various types of MPLS network.

Module 6: Virtual network services

Module aim: To describe and compare various Next Generation Network (NGN) virtual network services with reference to typical applications.

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

- explain the concept of a virtual private network (VPN).
- explain the concept of a virtual local area network (VLAN).
- describe how Virtual LAN (VLAN) techniques can provide secure paths with a defined CoS over Ethernet links.
- explain that pseudowires allow various types of data service such as Frame Relay and Ethernet to be carried over an IP/MPLS network.
- explain the concept of a Virtual Private LAN service (VPLS) with reference to the use of Ethernet pseudowires.
- compare the use of VPN, VLAN and VPLS techniques giving examples of typical applications.

Module 7: Software defined networking

Module aim: To introduce the concepts, role, benefits, and applications of software defined networking (SDN) and network function virtualisation (NFV).

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

- explain the concept of software defined networking.
- describe the roles of the OpenFlow protocol and the SDN controller.
- explain the concept of network function virtualisation.
- describe the roles of virtual machines, hypervisor and vSwitch in NFV.
- describe the role and benefits of SDN and NFV in a data centre.
- describe the factors that determine which types of telecoms system components are suitable for virtualisation.
- describe the advantages and limitations of SDN and NFV in a telecoms environment.
- explain the advantages of distributing SDN control in a telecoms environment.
- give examples of the types of telecoms network functions that could be virtualised.

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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