Unit 2: Networking

Unit code	**H/615/1619**
Unit type	**Core**
Unit level	**4**
Credit value	**15**

Introduction

Computer networks are the driving force behind the evolution of computer systems and allow users to access data, hardware and services regardless of their location. Being knowledgeable about the underlying principles of networking is of vital importance to all IT professionals. Networking is an environment that is increasingly complex and under continuous development.

Complex computer networking has connected the world by groups of small networks through internet links to support global communications. It supports access to digital information anytime, anywhere using many applications like e-mail, audio and video transmission, including the World Wide Web, and this has opened the floodgates to the availability of information.

The aim of this unit is to provide students with wider background knowledge of computer networking essentials, how they operate, protocols, standards, security considerations and the prototypes associated with a range of networking technologies.

Students will explore a range of hardware, with related software, and will configure and install these to gain knowledge of networking systems. A range of networking technologies will be explored to deliver a fundamental knowledge of Local Area Networking (LAN), Wide Area Networking (WAN) and their evolution to form large-scale networks and the protocol methodologies related to IP data networks will be explored.

On successful completion of this unit students will gain knowledge and skills to successfully install, operate and troubleshoot a small network; and the operation of IP data networks, router, switching technologies, IP routing technologies, IP services and basic troubleshooting. Supporting a range of units in the Higher National suite, this unit underpins the principles of networks for all and enables students to work towards their studies in vendor units, if applicable.

Students will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

LO1. Examine networking principles and their protocols.

LO2. Explain networking devices and operations.

LO3. Design efficient networked systems.

LO4. Implement and diagnose networked systems.

Essential Content

LO1 **Examine networking principles and their protocols**

Role of networks:

Purpose, benefits, resource implications, communications, working practice, commercial opportunity, information sharing, collaboration.

System types:

Peer-based, client-server, cloud, cluster, centralised, virtualised.

Networking standards:

Conceptual models e.g. OSI model, TCP/IP model; standards: e.g. IEEE 802.x.

Topology:

Logical e.g. Ethernet, Token Ring; physical e.g. star, ring, bus, mesh, tree, ring.

Protocols:

Purpose of protocols; routed protocols e.g. IPv4, IPv6, IPv6 addressing, Global unicast, Multicast, Link local, Unique local, EUI 64, Auto configuration, FTP, HTTP, SMTP, POP3, SSL; management of protocols for addressing.

LO2 **Explain networking devices and operations**

Networking devices:

Servers; hub, routers; switches; multilayer switch, firewall, HIDS, repeaters; bridges; wireless devices; access point (wireless/wired), content filter, Load balancer, Modem, Packet shaper, VPN concentrator.

Networking software:

Client software, server software, client operating system, server operating system, Firewall.

Server type:

Web, file, database, combination, virtualisation, terminal services server.

Server selection:

Cost, purpose, operating system requirement.

Workstation:

Hardware e.g. network card, cabling; permissions; system bus; local-system architecture e.g. memory, processor, I/O devices.

LO3 **Design efficient networked systems**

Bandwidth:

Expected average load; anticipated peak load; local internet availability; cost constraints, throughput.

Users:

Quality expectations, concept of system growth.

Networking services and applications:

DHCP; static vs dynamic IP addressing, reservations, scopes, leases, options (DNS servers, Suffixes), IP helper, DHCP relay, DNS records, Dynamic DNS.

Communications:

Suited to devices, suited to users, supportive of lifestyle desires, supportive of commercial requirements, security requirements, quality of service needs.

Scalable:

Able to support device growth, able to support addition of communication devices, able to cope with bandwidth use and trend changes, protocol utilisation, addressing.

Selection of components:

Supporting infrastructure needs; supporting connectivity requirements.

LO4 **Implement and diagnose networked systems**

Devices:

Installation of communication devices, allocation of addresses, local client configuration, server configuration, server installation, security considerations.

Verification of configuration and connectivity:

Installation of internet work communication medium, ping, extended ping, traceroute, telnet, SSH.

System monitoring:

Utilisation, bandwidth needs, monitoring user productivity and security of the system.

Maintenance schedule:

Backups, upgrades, security, auditing.

Diagnose and resolve layer 1 problems:

Framing, CRC, Runts, Giants, Dropped packets, late collisions, Input/Output errors.

Policy review:

Bandwidth, resource availability.

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Examine networking principles and their protocols</td><td rowspan="4">LO1 & 2
D1 Critically evaluate the topology protocol selected for a given scenario to demonstrate the efficient utilisation of a networking system.</td></tr>
<tr><td>P1 Discuss the benefits and constraints of different network types and standards.
P2 Explain the impact of network topology, communication and bandwidth requirements.</td><td>M1 Compare common networking principles and how protocols enable the effectiveness of networked systems.</td></tr>
<tr><td colspan="2">LO2 Explain networking devices and operations</td></tr>
<tr><td>P3 Discuss the operating principles of networking devices and server types.
P4 Discuss the inter-dependence of workstation hardware with relevant networking software.</td><td>M2 Explore a range of server types and justify the selection of a server, considering a given scenario regarding cost and performance optimisation.</td></tr>
<tr><td colspan="2">LO3 Design efficient networked systems</td><td rowspan="2">D2 Design a maintenance schedule to support the networked system.</td></tr>
<tr><td>P5 Design a networked system to meet a given specification.
P6 Test and evaluate the design to meet the requirements and analyse user feedback with the aim of improving efficiency.</td><td>M3 Install and configure network services and applications on your choice.</td></tr>
<tr><td colspan="2">LO4 Implement and diagnose networked systems</td><td rowspan="2">D3 Use critical reflection to evaluate own work and justify valid conclusions.</td></tr>
<tr><td>P7 Implement a networked system based on a prepared design.
P8 Document and analyse test results against expected results.</td><td>M4 Recommend potential enhancements for the networked systems.</td></tr>
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Recommended Resources

Textbooks

Burgess, M. (2003) *Principles of Network and System Administration*. 2nd Ed. John Wiley and Sons Ltd.

Hallberg, B. (2005) *Networking: A Beginner's Guide*. 4th Ed. Osborne/McGraw-Hill US.

Limoncelli, T. and Hogan, C. (2001) *The Practice of System and Network Administration*. Addison-Wesley.

Lowe, D. (2005) *Networking All-in-One Desk Reference for Dummies*. 2nd Ed. Hungry Minds Inc.

Olifer, N. and Olifer, V. (2005) *Computer Networks: Principles, Technologies and Protocols for Network Design*. John Wiley and Sons Ltd.

Stallings, W. (2003) *Data and Computer Communications*. 7th Ed. (Prentice Hall)

Subramanian, M. (2000) *Network Management: An Introduction to Principles and Practice.* Addison-Wesley.

Tanenbaum, A. (2002) *Computer Networks*. Prentice Hall PTR.

Journals

The Institute of Engineering and Technology

Links

This unit links to the following related units:

Unit 8: Computer Systems Architecture

Unit 15: Transport Network Design

Unit 17: Network Security

Unit 35: Network Management

Unit 36: Client/Server Computing Systems