

Unit 19: Computer Networking

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners examine modern computer networks design. They plan, install and manage a computer network system.

Unit introduction

Computer networks are increasingly changing the way we communicate, work, access resources, stay informed, collaborate and learn. Organisations rely heavily on computer networks to conduct their internal as well as external operations. From the smallest home computer network to the biggest computer network of them all (the internet), networks affect our social, commercial, political and personal interactions.

In this unit, you will learn about the major types and models of computer networks such as local area network (LAN), wide area network (WAN), peer-to-peer and client server. You will identify the computer network hardware and software components required to design and implement networks. You will learn network communication protocols and examine communication technologies used to connect computers to wired and wireless networks. You will learn to use network design strategies to develop, implement and manage a scalable, available, efficient and secure computer network to meet identified requirements.

Due to the huge impact of computer networking on our modern way of life, there is an increasing need for high-level computer networking knowledge and skills in this dynamic field. The successful completion of this unit will give you valuable skills to either progress to further or higher education studies, or pursue one of the many network support careers in the design, development and management of computer networking systems infrastructure.

Learning aims

In this unit you will:

- A** Investigate how computer networks use networking communications protocols to provide effective and secure access to networking services and resources
- B** Investigate computer network design to meet client requirements
- C** Develop a computer network to meet client requirements.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Investigate how computer networks use networking communications protocols to provide effective and secure access to networking services and resources	A1 Network types and models A2 Network components A3 Network communication standards and protocols A4 Networking infrastructure services and resources	A report explaining the types and characteristics of computer networks, the need to use networking standard protocols, and the networking hardware and software components to provide secure access to the networking services and resources.
B Investigate computer network design to meet client requirements	B1 Network design strategies and architectures B2 Network development planning B3 Network services and resources access	Learner-devised design documentation, including network diagrams and addressing scheme table arising from the identification of client requirements.
C Develop a computer network to meet client requirements	C1 Network implementation and configuration C2 Network testing and troubleshooting C3 Network performance monitoring C4 Evaluation and review of network design C5 Skills, knowledge and behaviours	Notes covering network design strategies and network development planning. Photographs and screenshots of network development, configuration testing, troubleshooting and optimisation, supported by assessor's observation or witness statement. Overall report evaluating and reviewing the design and implementation stages. Diary notes, witness testimony, audio/video recorded discussion demonstrating skills, knowledge and behaviours.

Content

Learning aim A: Investigate how computer networks use networking communications protocols to provide effective and secure access to networking services and resources

A1 Network types and models

- Network types and characteristics:
 - LAN, wireless local area network (WLAN), WAN, storage area network (SAN)
 - intranet, extranet, internet, cloud
 - wired and wireless integration.
- Network topologies:
 - physical topologies, e.g. star, extended star, hierarchical
 - logical topologies, e.g. Ethernet standards for wired and wireless (802 family).
- Network models:
 - Peer-to-peer
 - client/server
 - thin client.
- Modern networking trends and challenges, e.g. virtualisation, cloud computing, bring your own devices (BYOD), software-defined networking (SDN), storage-defined networks.

A2 Network components

- Hardware components, including:
 - End user devices, including mobile
 - connectivity devices, e.g. switches, routers, access points
 - connection media, e.g. cable, wireless, fibre.
- Software components, including:
 - networking systems software
 - network monitoring, management and troubleshooting tools, e.g. performance monitor. Events and logs viewer, packet sniffers
 - network applications, e.g. database, document management.

A3 Network communication standards and protocols

- Network communications standards and protocols, including:
 - OSI layers and protocols
 - TCP/IP stack, ports, sockets, packets, frames, bits, encapsulation
 - IEE 802 standards for wired and wireless Ethernet protocols.

A4 Networking infrastructure services and resources

- Network infrastructure services, including:
 - domain name service (DNS)
 - directory services (DS)
 - authentication services
 - Dynamic Host Configuration Protocol (DHCP) and network addressing services
 - routing and remote access services.
- Network services and resources
 - file and print services
 - web, mail and communications services.

Learning aim B: Investigate computer network design to meet client requirements

B1 Network design strategies and architectures

- Organisational and business goals, and technical requirements analysis.
- Network size, small office/home office (SOHO), small and medium-sized business (SMB), large enterprise.
- Design aims, strategies and requirement for LAN and WAN, e.g. scalability, availability, redundancy, performance, security, manageability adaptability, affordability and maintainability.
- Design constraints and trade-offs, e.g. budget, time, environment.
- Network physical design schemes, including:
 - flat design, hierarchical design, Enterprise Campus and Branch
 - network diagrams and physical layout
 - LAN/WAN equipment requirements, e.g. equipment features, LAN and WAN device selection.
- Logical network design, including:
 - IP addressing
 - IPV4 versus IPV6, private versus public IP
 - naming schemes
 - virtual LAN (VLAN) design issues.

B2 Network development planning

- Network components and services selection:
 - hardware components selection, e.g. server types and hardware requirement and selection, storage requirement, storage area networks (SANs), switching and routing requirement, e.g. layer 2, layer 3 and layer 4 switches, wireless AP requirements, routers and WAN devices
 - software components selection, e.g. operating systems (client/server), applications, network monitoring and management software
 - infrastructure services selection and requirement, e.g. DS, DNS, DHCP, web, mail, FTP.
- Network installation planning:
 - devices configuration planning, e.g. switches, routers, access point, prototyping and simulation
 - infrastructure services installation and test planning e.g. DNS, DHCP, NAT.
- LAN and WAN connectivity test plans.

B3 Network services and resources access

- Authentication planning, e.g. password policies, audit policies.
- Users and groups naming, structure and access rights.
- Planning access permissions to resources, e.g. directories, files, printers.

Learning aim C: Develop a computer network to meet client requirements

C1 Network implementation and configuration

- Configuration and testing of network hardware components:
 - prototype development, simulation testing
 - network devices connection and configuration, e.g. switches, routers, wireless devices and access point.
- Configuration of network software and infrastructure services:
 - create, configure and connect virtual or physical servers and clients
 - install and configure network services.
- Network resources configuration and access:
 - create users, groups, shared resources, access policies.

C2 Network testing and troubleshooting

- Network connectivity tests.
- Network infrastructure services implementation test.
- Network resources access tests.
- Troubleshooting results and documentation.

C3 Network performance monitoring

- Establishment of a network performance baseline.
- Monitoring network performance, e.g. bandwidth, storage, processing.
- Event views logs usage review.

C4 Evaluation and review of network design

- Network design evaluation against requirements and initial needs.
- Evaluation of network development and implementation.
- Evaluation and review of testing and troubleshooting results.
- Future enhancement area and plans.
- Network optimisation, e.g. improving performance, security, manageability and ease of access.

C5 Skills, knowledge and behaviours

- Planning, and recording, including the setting of relevant targets with timescales, and how and when feedback from others will be gathered.
- Reviewing and responding to outcomes, including the use of feedback from others.
- Demonstrate own behaviours and their impact on outcomes, including professionalism, etiquette, being supportive of others, timely and appropriate leadership, accountability.
- Evaluating outcomes to help inform high-quality, justified recommendations and decisions.
- Documenting processes and outcomes, e.g. diary notes, planning documents, witness testimonies, and discussion notes or recordings.
- Communication skills, including:
 - the ability to convey intended meaning, e.g. written (email, design documentation, recording documentation, reports, visual aids for presentation use), verbal communication requirements (one-to-one and group, informal and formal situations)
 - use of tone and language for verbal and written communications to convey intended meaning and make a positive and constructive impact on audience, e.g. positive and engaging tone, technical/vocational language suitable for intended audience, avoiding jargon.
- Responding constructively to the contributions of others, e.g. being supportive, managing contributions so all have the opportunity to contribute, responding to objections, managing expectation, resolving conflict.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Investigate how computer networks use networking communications protocols to provide effective and secure access to networking services and resources		A.D1 Evaluate different network models and their suitability to meet different client requirements.
A.P1 Explain the need for different computer network types and models. A.P2 Explain the characteristics and functions of network components.	A.M1 Analyse the functions of different network components required to construct different network types.	
Learning aim B: Investigate computer network design to meet client requirements		BC.D2 Evaluate the network design and the implemented optimised network against client requirements. BC.D3 Demonstrate individual responsibility and effective self-management in the planning and implementation of the network.
B.P3 Explain the need for network design and planning strategies. B.P4 Design a network to meet client requirements.	B.M2 Justify the design decisions made, showing how the design will fulfil its purpose and meet client requirements.	
Learning aim C: Develop a computer network to meet client requirements		
C.P5 Develop and configure a network to meet client requirements. C.P6 Test a network to ensure it meets client requirements. C.P7 Review the extent to which the network meets client requirements.	C.M3 Optimise a network to meet client requirements.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of two summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.M1, A.D1)

Learning aims: B and C (B.P3, B.P4, C.P5, C.P6, C.P7, B.M2, C.M3, BC.D2, BC.D3)

Further information for teachers and assessors

Resource requirements

For this unit, learners must have access to:

- a physical or virtualised networking environment that provides the necessary hardware and software required to build and test computer networks safely
- computer systems, switches, routers, wireless access points, cabling, and operating systems for clients and servers
- online resources for research and development.

Essential information for assessment decisions

Learning aim A

The evidence should cover network hardware and software, including protocols and how they are used to construct a variety of networks types and models.

For distinction standard, learners will provide a clear and balanced evaluation of the different network models, including peer-to-peer, client/server and thin client. They must consider a wide range of aspects, including ease of use, ease of set-up, performance and suitability for different types of applications. The evidence will provide reasoned examples of the suitability of the different models to different networking applications, and clearly explain each model's benefits and drawbacks. The evidence will demonstrate high-quality written or oral communication through use of accurate and fluent technical vocabulary to support a well-structured and considered response that clearly connects chains of reasoning.

For merit standard, learners will provide a thorough analysis of the key functions of networking hardware and software components, including those used in LAN, WAN and wireless networks. Learners will demonstrate accurate understanding of the importance of the use of protocols and standards to connect various types of computer networks as outlined in the content. They will provide appropriate examples and illustrations to demonstrate their understanding of the complex issue of how data gets transferred within and between computer networks. The evidence will be technically accurate and demonstrate good-quality written or oral communication.

For pass standard, learners will provide detailed explanations of why different types and models of computer networks are needed and how that impacts on the choice of the network type and model used. They will explain how networks are continually evolving and taking different shapes and forms, from LAN, WAN, intranet, extranet and internet to cloud computing. Learners must also explain the general characteristics and functions of the network hardware and software components used to build and connect computer networks as covered in the unit content. The evidence may have some inaccuracies and make limited use of examples as illustrations.

Learning aims B and C

Learners are expected to provide evidence that they have planned a network to meet specific client requirements and are then required to install and configure a computer network. They will collect the evidence required, showing that the network is functional according to given specification. The provided specification must be sufficiently complex to give the learner scope to demonstrate the appropriate range of skills. For example, it must include more than one network type, e.g. wired and wireless, and include user requirements such as shared files, folders and printers, email and intranet access.

Learners must also provide evidence that they have tested the network functionality. They also need to consider the degree to which the client requirements are met.

For distinction standard, learners will draw on, and show synthesis of, knowledge across the learning aims to evaluate both their design for the network and the implementation of it, with particular focus on how effectively the network met the client requirements. Learners will provide reasoned justification of their design.

Their evaluation must be supported by evidence from all stages of the project to reach conclusions and suggest future developments.

Learners will articulate their arguments and views concisely and professionally, and evaluate concepts, ideas and actions to reach reasoned and valid conclusions when justifying planning, configuration and implementation decisions in the development of a computer network. They will demonstrate individual responsibility and effective self-management when planning and implementing the network. Learners should provide evidence of their methods of working, which can be in the form of log books, annotated screen and diary notes, planning documents, witness testimonies and discussion notes or recordings.

For merit standard, learners will provide a reasoned justification for the decisions they have made in the network design, referring to both technical considerations and the need to meet the client requirements. Learners will apply their knowledge through selection and application of appropriate methodologies to design, develop, implement and optimise the network to meet client requirements. Learners must optimise the network, improving its performance, functionality or ease of use. The optimisation may be based on the testing done, which may reveal performance issues, security loopholes, usability issues or other aspects of the network that could be improved.

For pass standard, learners will explain the need to follow design strategies to produce an appropriate network design, taking into consideration organisation needs and design goals, such as scalability, availability and security. Learners must also explain the network development planning, including network component selection criteria, and logical and physical design schemes and diagrams used to plan and prepare for the development and deployment of the network. They will provide evidence of implementing the plan and provide a completed test plan to show that the network has been fully tested.

Learners must provide a review of their work, considering both positive and negative aspects of the outcomes, and how well it matches the client requirements, although their review may be unbalanced and/or superficial.

Links to other units

This unit links to:

- Unit 20: Managing and Supporting Systems
- Unit 21: Virtualisation
- Unit 29: Network Operating Systems
- Unit 30: Communication Technologies.

Employer involvement

This unit would benefit from employer involvement in the form of:

- guest speakers
- technical workshops involving staff from local organisations/businesses
- contribution of design/ideas to unit assignment/scenario/case study/project materials, including own organisation/business materials as exemplars where appropriate
- feedback from staff from local organisations/businesses on plans/designs/items developed
- opportunities for observation of organisational/business application during work experience
- support from local organisation/business staff as mentors.