

Unit 15: Networking Principles

Unit code: **T/601/3289**
QCF Level 2: **BTEC Specialist**
Credit value: **6**
Guided learning hours: **45**

Aim and purpose

This unit provides the basic knowledge to enable the learner to develop the skills and understanding required to safely install and maintain components in networking.

Unit introduction

Networking skills are particularly valued in the IT industry and this unit provides a solid foundation for learners to gain knowledge of different types of network and how they are controlled.

Learners will investigate the different network topologies, recognise interconnection devices and cabling and how to use them, and look at the advantages and limitations of peer-to-peer and client-server networks.

Some time will be spent working with null modems and discovering how networks deal with and prevent data collisions. How to control access to a network will also be considered.

Learning outcomes and assessment criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

On completion of this unit a learner should:

Learning outcomes	Assessment criteria
1 Know the OSI model and the TCP/IP suite	1.1 identify the function of the OSI model layers 1.2 list the TCP/IP protocols 1.3 list the types of addresses used on networks and why they are used
2 Know different network topologies and transmission systems	2.1 explain the logical network topologies as given in the IEEE802 standards for LANs and WANs 2.2 identify the following types of network cabling and connectors: <ul style="list-style-type: none"> • Cat 5 and RJ45 • Cat 5e and RJ45 • Cat 6 and RJ45 • thin co-axial and BNC connector • thick co-axial, and AUI transducer with patch cable • fibre optic cables and connectors 2.3 describe the different types of wireless LAN 2.4 describe the function of the following network devices: <ul style="list-style-type: none"> • interface controller • repeater • passive, active and intelligent hubs • bridge • switch router • gateway 2.5 explain the 5-4-3 rule of network design
3 Know the advantages and disadvantages of different types of network	3.1 list the properties, security and sharing advantages and disadvantages of: <ul style="list-style-type: none"> • peer-to-peer networks • client-server networks 3.2 list the uses and limitations of a null model connection

Learning outcomes	Assessment criteria
4 Know media access control methods used in local area networks	4.1 list the types of media access control methods used in LANs 4.2 explain what is meant by a collision and how network systems deal with them 4.3 explain the difference between a token bus and a token ring and how the token operates in each 4.4 explain the line encoding used in CSMA/CD and CSMA/CA networks 4.5 identify the limitations of CSMA/CA

Unit content

1 Know the OSI model and the TCP/IP suite

Network models: OSI 7 layer model; TCP/IP; standards and protocols; functions of models eg addressing, network, transport, application; addresses eg IP (Internet Protocol), network layer, MAC (Media Access Control)

2 Know different network topologies and transmission systems

Network topologies: types eg star, bus, circle; IEEE802 standards for LANs and WANs; logical networks eg Ethernet, LocalTalk, token ring; network design (5-4-3 rule)

Transmission systems: network cabling and connectors eg Cat5 and RJ45, Cat 5e and RJ45, Cat6 and RJ45, thin co-axial and BNC connector; thick co-axial and AUI transducer with patch cable, fibre optic cables and connectors; wireless LANs eg 802.11, infrared, Bluetooth, 3G

Interconnection devices: interface controller, repeater, passive, active and intelligent hubs, bridge, switch, router, gateway

3 Know the advantages and disadvantages of different types of network

Peer-to-peer networks: properties eg no centre, all devices equal, sharing network services, simple network infrastructure; advantages eg technologically simple, easy to install, operate and manage; disadvantages eg ability to scale (grow larger) restricted

Client-server networks: properties eg central control and management, manages peer connections, can handle a large number of devices, different operating systems and computers for the client and the server; advantages eg allows large number of devices, can be implemented on most standard operating systems, controls levels of access to data; disadvantages eg must run on a network operating system, may need a system with a higher-specification computer, needs a better-quality network/internet connection

Null modems: uses eg file transfer, hard disk mapping; limitations eg no/limited hardware handshaking, compatibility issues; virtual null modem

4 Know media access control methods used in local area networks

Media access control: Layer 2 of OSI model; Layer 1 of TCP/IP model; function eg transmitting and receiving packets; methods eg Ethernet, Frame Relay, Point-to-Point Protocol (PPP)

Collision: when two devices send data across the same line at the same time

Collision detection: CSMA/CD (carrier sense multiple access/collision detection), backoff algorithm used by Ethernet; CSMA/CA (collision avoidance), use in wireless systems eg Bluetooth; line encoding (comparing transmitted and received data), representation of digital signals in waveform, types eg UniPolar, Polar, BiPolar, and Manchester encoding

Token ring: packets of data sent when 'token' received (pass the parcel), LAN standard

Token bus: token passing on a bus network

Essential guidance for tutors

Delivery

It would be preferable for this unit to be delivered in conjunction with, or after the unit Introduction to Communication Technologies. This unit looks at the hardware and software associated with networks.

Although the unit content is theory-based, the emphasis in this unit should be on the practicality and application of different types of IT network and how they work. Together with focused visits to a workplace and demonstrations by experienced practitioners such as school or college network staff, talks by technicians are likely to be particularly valuable and will help to provide a realistic perspective. As many different types of network as possible (wired, wireless, LAN, WAN etc) should be experienced by learners.

Delivery can broadly follow the order of the unit content. However, introducing practical activities involving the identification of network components and the building of simple networks early in the unit would add motivation and interest as well as putting the theory in context. With this in mind it might be better to start with learning outcome 2 and consider network topologies and look at the cabling (physical examples wherever possible) and interconnection devices. A network technician should be able to provide valuable help with this work. Reference to the IEEE standards should be made wherever appropriate.

This leads into learning outcome 3 and the properties of peer-to-peer and client-server networks. Learners may have set up a peer-to-peer network (or a client-server network or both) in another unit, or if not could do so now, and the practical work will form a basis for the theory. Working with null modems can also be practically based with the theory extracted from the practical activities.

Getting to grips with the OSI model and TCP/IP will be easier after the practical work but is still very theoretical. Examples and internet research will help. At this level learners need only to be able to identify and list the protocols. Similarly, collision detection can be hard to understand. Learners acting as packets of data can introduce a fun element to this and token passing!

Diagrammatic representations of networks can be used throughout the delivery of the unit and simulation packages such as Cisco Packet Tracer used to support learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments. The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Introduction to the unit
<p>Network topologies and transmission systems</p> <ul style="list-style-type: none"> • Network topologies – tutor led, learner research IEEE standards, producing diagrams • Network hardware and software revision, identifying, produce wall charts • Cabling – tutor (technician) led, identifying, learner research • Building a network – practical • Wireless systems – research • Network devices – tutor/technician led, identifying, producing leaflet • Network design – speaker, research
Assignment 1 - Topologies and cabling
<p>Types of networks</p> <ul style="list-style-type: none"> • Peer-to-peer networks – learner research, build activity • Client-server networks – learner research, build activity • Null modem cables – practical work, research
<p>Media access control methods</p> <ul style="list-style-type: none"> • MAC methods – tutor led, learner research • Collision and collision detection – tutor led, role play • Token bus and ring – tutor led, role play • CSMA encoding – tutor led, research
Assignment 2 - Networks and media access control
<p>OSI and TCP/IP</p> <p>OSI model – tutor led, learner research</p> <p>TCP/IP – tutor led, learner research</p> <p>Network addressing – learner research, practical exercises</p>
Assignment 3 - OSI and TCP/IP

Assessment

Evidence for assessment could be a combination of work sheets, presentations and leaflets or any other medium as appropriate.

It is suggested that this unit is assessed using three assignments as summarised in the *Programme of suggested assignments* table.

Learning outcome 1 lends itself to a gapped worksheet (paper based or electronic), as learners need only 'list' and 'identify'. When identifying the function of the OSI model layers, learners do not need to go into great detail, a brief description that demonstrates an understanding of the function is sufficient.

2.4 also lends itself to this method of assessment and could be added to learning outcome 1 or produced as a separate sheet. More space would be required for learners to add their responses for 2.4 as they need to 'describe' and 'explain', thus an electronic version may be preferable. A developed question and answer sheet is suggested in the PSA.

2.1 (explain logical topologies) could be presented as a leaflet or information sheet with suitable illustrations.

2.2 would best be evidenced with a witness statement. Learners should be presented with a set of cabling and connectors and can verbally identify each one. If learners are undertaking practical networking tasks, this evidence may be collected then.

Alternatively, learners could produce an illustrated information sheet aimed at helping new technicians identify these components or show the new technicians the parts and talk about them as part of a presentation.

Learning outcomes 3 and 4 are more theoretical and generating an illustrated presentation could make this more interesting. 'List' for 3.1 and 3.2 could be presented as a table – no comparison is required. Explaining collision detection, token passing and line encoding for learning outcome 4 presents more of a challenge and although learners need not give the presentation they may find it easier to talk about these than write about them. In this case a witness statement would also be needed as evidence to support the presentation material.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the assessment criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
2.1, 2.2, 2.3, 2.4, 2.5	Topologies and cabling	You have been asked to help with training a new intake of network technicians at your centre. You are to produce information sheets and demonstrate /show them network devices and cabling.	Information sheets. Witness statements.
3.1, 3.2, 4.1–4.5	Networks and media access control	Now you are to give the new recruits an introduction to networks and media access control.	Presentation. Witness statement.
1.1 – 1.3, 2.4	OSI, TCP/IP and network devices	Develop a question and answer sheet on models and protocols for the new recruits.	Q/A worksheet.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC in IT sector suite. This unit has particular links with:

Level 1	Level 2	Level 3
	An Introduction to Communication Technologies	Networking Principles
	Setting up an IT Network	Communication Technologies
		Computer Networks
		Core Network Techniques
		Managing Networks

This unit maps to some of the underpinning knowledge from the following areas of competence in the Level 2 National Occupational Standards for IT (ProCom):

- 4.7 Systems Design
- 5.1 Systems Development
- 5.3 IT/Technology Solution Testing.

Employer engagement and vocational contexts

The use of vocational context is essential in the delivery and assessment of this unit. Learners will require access to computer equipment to enable them to gain a practical awareness and enable them to apply their knowledge and understanding in a practical situation.

There is a range of organisations that may be able help centres to engage and involve local employers in the delivery of this unit, for example:

- Learning and Skills Network – www.vocationallearning.org.uk
- Local, regional business links – www.businesslink.gov.uk
- National Education and Business Partnership Network – www.nebpn.org
- Network for Science, Technology, Engineering and Maths Network Ambassadors Scheme – www.stemnet.org.uk
- Work-based learning guidance – www.aimhighersw.ac.uk/wbl.htm
- Work experience/workplace learning frameworks – Centre for Education and Industry (CEI University of Warwick) – www.warwick.ac.uk/wie/cei

Indicative reading for learners

Textbooks

Hallberg B – *Networking: A Beginner's Guide, 5th Edition* (Osborne/McGraw-Hill US, 2009) ISBN-10 0071633553, ISBN-13 978-0071633550

Lowe D – *Networking All-in-One Desk Reference for Dummies, 3rd Edition* (John Wiley & Sons, 2008) ISBN-10 0470179155, ISBN-13 978-0470179154

Journal

Network World

Websites

www.howstuffworks.com

www.webopedia.com

Functional Skills – Level 2

Skill	When learners are ...
ICT - Finding and selecting information	
Use appropriate search techniques to locate and select relevant information	explaining the logical network topologies as given in the IEEE802 standards for LANs and WANs describing network devices
Select information from a variety of sources to meet requirements of a complex task	explaining network collision
ICT - Developing, presenting and communicating information	
Combine and present information in ways that are fit for purpose and audience	identifying the functions of the OSI model and TCP/IP suite.