SQA Advanced Unit specification: general information

Unit title: Networking Technology

Unit code: HP1M 48

Superclass: CB

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Unit purpose

The purpose of this unit is to enable candidates to work effective in a Local Area Network (LAN) installation or support role using networking computers. It is intended for candidates undertaking an SQA Advanced Diploma in Computing, Computer Networking or a related area, who require a broad understanding of Local Area Networks.

On completion of the unit the candidate should be able to:

1 describe the components of Local Area Networks and media.
2 describe the OSI and TCP/IP models, and their layers.
3 describe and use common addressing schemes and routing in a networked environment.
4 describe connectivity and transmission features, and operation of Local and Wide Area Networks.
5 configure, build and test a simple Local Area Network.

Recommended prior knowledge and skills

Access to this unit will be at the discretion of the centre. There are no specific requirements but candidates would benefit from knowledge of computer networks. This may be demonstrated by the possession of SQA Advanced Units such as Computer Networks: Building Local Area Networks (H17C 34).

Credit points and level

2 SQA Advanced Unit credit(s) at SCQF level 8: (16 SCQF credit points at SCQF level 8*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from National 1 to Doctorates.*

Core Skills
There is no automatic certification of Core Skills or Core Skill components in this unit.

Context for delivery
If this unit is delivered as part of a group award, it is recommended that it should be taught and assessed within the subject area of the group award to which it contributes.

Assessment
Evidence for the Knowledge and Understanding component of the unit must be produced using a set of 50 multiple-choice/multiple-response questions to assess candidates' capabilities. This should be administered as a single end-of-unit test covering all outcomes.

Candidates must answer at least 60% of the questions correctly in order to obtain a pass.

Testing must take place in a closed-book environment where candidates have no access to the internet, books, handouts, notes or other learning material. Testing can be done in either a machine-based or paper-based format and must be invigilated by an appropriate person. There must be no communication between candidates and communication with the invigilator must be restricted to matters relating to the administration of the test. The time allowed will be 1 hour 40 minutes.

If a candidate requires to be re-assessed, a different selection of questions must be used from all sections. A significant proportion of the questions used in the re-assessment must be different from those used in the original test.

If an outcome has a practical component, this may be assessed by having the candidate use a logbook to record the practical tasks successfully completed. The logbook can be in paper or electronic form and must be authenticated by the assessor, tutor or mentor. A suitable method of collecting practical evidence, which ensures authenticity of student work (to be authenticated by an assessor), should be used and this evidence must be logged/stored to allow internal/external verification procedures to be carried out if required. Tools such as virtualising software, camera recording software, or other recording tools to gather evidence of candidates completing the tasks required can be used.

Unit specification: statement of standards

Unit title: Networking Technology

The sections of the unit stating the outcomes, Knowledge and/or Skills, and Evidence requirements are mandatory.

Where evidence for outcomes is assessed on a sample basis, the whole of the content listed in the Knowledge and/or Skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Describe the components of Local Area Networks and media.

Knowledge and/or Skills

- Networking hardware
- Networking terminology
- Network architectures
- Networking protocols
- Protocol Suites
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Evidence requirements

The Evidence requirements for this outcome are found in the evidence requirements for the unit.

Assessment guidelines

The assessment guidelines for this outcome are found in the assessment guidelines for the unit.

Outcome 2

Describe the OSI and TCP/IP models, and their layers.

Knowledge and/or Skills

- The OSI model
- The TCP/IP model
- Application layer software, services and protocols
- Presentation layer function, services and protocols
- Session layer function, services and protocols
- Transport layer function, services and protocols
- Network layer function, hardware and protocols
- Data link layer function, hardware and standards
- Physical layer function, hardware and standards

Evidence requirements

The evidence requirements for this outcome are found in the evidence requirements for the unit.

Assessment guidelines

The assessment guidelines for this outcome are found in the assessment guidelines for the unit.

Outcome 3

Describe and use common addressing schemes and routing in a networked environment.

Knowledge and/or Skills

- Binary conversion — decimal to binary and binary to decimal for use in IP addressing
- Hexadecimal conversion — hexadecimal to decimal and decimal to hex for use in IP addressing
- IP v4 Addressing — design and calculation of IP v4 32bit addressing schemes including public and private address schemes
- IP v6 Addressing — describe IP v6 128 bit addressing scheme including identification of a valid address
- Subnetting — design and calculate subnets
- Routing tables — design routing tables in a networked environment

Evidence requirements

The Evidence requirements for this outcome are found in the Evidence requirements for the unit.

Assessment guidelines

The Assessment guidelines for this outcome are found in the Assessment guidelines for the unit.

Outcome 4

Describe connectivity and transmission features, and operation of Local and Wide Area Networks.

Knowledge and/or Skills

- Signals and noise
- LAN connectivity and transmission basics
- WAN connectivity and transmission basics
- Operation of Local Area Networks
- Operation of Wide Area Networks
- Differences between LAN/WAN operations and features

Evidence requirements

The evidence requirements for this outcome are found in the evidence requirements for the unit.

Assessment guidelines

The assessment guidelines for this outcome are found in the assessment guidelines for the unit.

Outcome 5
Configure, build and test a simple Local Area Network.

Knowledge and/or Skills
- Methods of testing LAN's
- Test and install LAN media
- Build a peer-to-peer network
- Build a small workgroup
- Build a small client server network

The examples given above are indicative of the typical learning content and are not intended to form a prescriptive list for the purpose of assessment.

Evidence requirements
The evidence requirements for this outcome are found in the evidence requirements for the unit.

Assessment guidelines
The assessment guidelines for this outcome are found in the assessment guidelines for the unit.

Evidence requirements for the unit
The assessment for the Knowledge and Understanding component of the unit must be undertaken at the end of the unit. The candidate's capabilities will be examined by 50 multiple-choice/multiple-response questions with appropriate sampling of the complete unit content. The sample must cover **all** outcomes with a suitable selection of at least 50% of the Knowledge and Skills points listed for each of the outcomes.

The assessment must be undertaken in a closed-book environment where candidates have no access to the internet, books, handouts, notes or other learning material. Testing can be done in either a machine-based or paper-based format and must be invigilated. There must be no communication between candidates and communication with the invigilator must be restricted to matters relating to the administration of the test. The time allowed will be 1 hour 40 minutes.

The questions presented must significantly change on **each** assessment occasion.

Candidates must answer at least 60% of the questions correctly in order to obtain a pass.

The practical exercise for Outcome 3 must be assessed by completion of a practical exercise that requires that the candidate can:

- design the IP addressing scheme for a given scenario

The practical exercise for Outcome 5 must be assessed by completion of practical tasks from the given scenario that requires the candidate to complete each of the four items listed below.

1 Test and install LAN media (non virtualised)

The candidate must install a standard length of UTP media into a patch panel and test the connection. Media testing methods used should be briefly described, together with the results of test, eg Time Domain Reflectometry and Frequency Based.

2 Build a peer-to-peer network (may be virtualised)

The candidate must build a simple peer-to-peer LAN using a cross over cable and two hosts.

3 Build a small workgroup network (may be virtualised)

The candidate must build a peer-to-peer LAN workgroup using straight through cables, switch/hub and hosts.

4 Build a small Client server network (may be virtualised)

The candidate must build a small client server network with at least two subnets using straight through cables (or any cables/media suited to the candidates particular network), switch/hub, router and hosts.

Assessment guidelines for the unit

It is suggested that all the above concepts be presented and explained within the context of current real-world practice and applications.

Testing for the knowledge component can be done in either a machine-based or paper-based format and must be invigilated by a tutor or appropriate person. There must be no communication between candidates and communication with the invigilator must be restricted to matters relating to the administration of the test. Centres are recommended to create a coverage grid to highlight which questions cover which knowledge bullet points to assist in the assessment process.

Outcomes 1-4 must be covered by an-end of-unit 50 question multiple-choice/multiple-response question test. The outcomes have been listed below with guidelines on topics.

The examples given below are indicative of the typical learning content and are not intended to form a prescriptive list for the purpose of assessment.

Assessments should sample from but not be restricted to the following:

Outcome 1

1 Networking hardware:

Common hardware used to connect a network, including but not restricted to Routers, Switches, Hubs, Bridges, Repeaters and NIC’s.

2 Networking terminology:

Common topologies, LAN, WAN, MAN, SAN, PAN, WLAN, Virtual Private Networks, Intranets.

3 Network architectures:

Fault tolerance, Scalability, Security, QOS (Quality of service), Circuit Switched and Packet Switched networks, Collision domains, segmentation, and broadcast domains.

Outcome 2

1 Describe differences between the OSI model and the TCP/IP Model; explain how the 7 layer model works within a networked environment, eg application layer software, services and protocols (DNS, HTTP, FTP and any other relevant protocols). Peer-to peer-applications.
2 Presentation layer function, services and protocols, eg compression, encryption, coding and conversion.
3 Session layer function, services and protocols, eg maintaining a dialogue between computers.
4 Transport Layer function, eg tracking communication between applications on the source and destination hosts, segmenting and managing data, reassembling the segments into streams of application data, Identifying application, services (port addressing) and protocols (TCP and UDP).
5 Network layer function, eg Addressing, Encapsulation, Routing, Decapsulation, Hardware can include (Layer 3 Routers, Switches or any other relevant hardware) and protocols can include (Internet Protocol version 4 (IPv4), Internet Protocol version 6 (IPv6), Novell Internetwork Packet Exchange (IPX), AppleTalk) or any other relevant protocols.
6 Data link layer function, eg: framing, access control and error handling) MAC, CSMA/CA, CSMA/CD, full/ half duplex link.
7 Logical link control and media access control, hardware (any level layer 2 hardware, layer 2 switching and switching modes) and Standards (ISO, IEEE, ITU and ANSI).
8 Physical layer function, eg encoding of data and control information, transmitter and receiver circuitry on the network devices), hardware (The physical media and associated connectors) and standards (cable, connectors and signals).

Outcome 3

1 Convert Decimal to Binary and Binary to Decimal for use in IP addressing.
2 Convert Hexadecimal to Decimal and Decimal to Hex for use in IP addressing.
3 Design and calculate IP v4 32bit Addressing scheme including public and private address schemes.
4 Describe IP v6 128 bit Addressing scheme including identification of a valid address.
5 Design and calculate subnets.
6 Design routing tables in a networked environment.

Practical assessment
The candidate is required to design an IP structure for the small client server network that they have to build in Outcome 5.

Outcome 4

1 Signals and noise, eg signalling over copper and fibre, attenuation, loss, noise, crosstalk.
2 LAN cabling, eg ethernet media, UTP (Categories 5, 5e, 6, and 7), fibre-optics, wireless devices (eg wireless router where cable is used to connect to LAN), LAN devices, MDI and MDIX.
3 WAN cabling, eg WAN serial communications, cable modems DSL modems, PPP, frame relay and any relevant WAN devices, eg DCE and DTE devices.

Practical assessment

This may be assessed by having the candidate use a logbook to record the practical tasks successfully completed. The descriptions of testing methods used could be incorporated as entries in the logs. The logbook can be in paper or electronic form and must be authenticated by the assessor. A suitable method of collecting practical evidence, which ensures authenticity of student work (to be authenticated by the assessor/tutor/mentor), should be used and this evidence must be logged/stored and retained to allow internal/external verification procedures to be carried out if required. Tools such as virtualising software, camera recording software, screenshot recording with audio or other recording tools to gather evidence of candidates completing the tasks required can be used.

Unit specification: support notes

Unit title: Networking Technology

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this unit is at the discretion of the centre, the notional design length is 80 hours.

Guidance on the content and context for this unit

The suggested time allocation for each outcome (including assessment) is as follows:

Outcome 1 15 hours
Outcome 2 15 hours
Outcome 3 15 hours
Outcome 4 15 hours
Outcome 5 20 hours

As it is likely that the bulk of the material in this unit will be delivered through lecturer exposition, it is important that every opportunity is taken to introduce real-world examples, opportunities for whole-class and group discussion and practical demonstrations wherever possible. Concepts and terminology should be presented in context throughout the unit. Video presentations should be used where appropriate for providing an alternative explanation of a difficult topic, or as a focus for class discussion or group work.

Given the theoretical elements in this unit, it is intended that a significant amount of time will be made available as a central part of the course for revision, tutorials and formative assessment exercises. Candidates should be strongly encouraged to undertake further reading and opportunities for individual or group research should be provided.

The most important overall emphasis should be on the relevance and currency of content in such a rapidly-evolving field.

This unit (in conjunction with the related Units: HP1J 48 Routing Technology, HP1L 48 Switching Technology and HP1N 48 Internetworking Technology) may assist candidates in preparing for Cisco examination 640-802: Cisco Certified Network Associate. In addition candidates may find this unit helpful in preparation for Cisco examination 640-811: Interconnecting Cisco Networking Devices and Cisco examination 640-821 Introduction to Cisco Networking Technologies. Candidates should be encouraged to check the latest information at **www.cisco.com** to ensure that all objectives have been covered.

Guidance on the delivery and assessment of this unit

The unit is primarily intended to provide candidates with an understanding of the general principles underlying Local Area Networks. As such only one outcome is practical based. Candidates completing this unit as part of the course should already be familiar with some of the concepts and terminology. Where this is the case, it is recommended that centres concentrate upon difficult areas of the curriculum such as subnetting and IPv6.

Outcome 1

Outcome 1 provides an overview of LANs and how a host may connect to the internet. Although this is a considerable range of areas to cover in a single outcome some candidates should already be familiar with these concepts from work completed during the first year of the SQA Advanced Diploma in Internetworking Technology (HP1N 48). This first outcome should be treated as revision material.

1 **Networking hardware**

The common hardware used to connect a network, including but not restricted to routers, switches, hubs, bridges, repeaters and NIC's should be delivered. It is important that candidates fully understand the hardware and how it works in relation to different types of network.

2 **Networking terminology**

Networking terminology should be introduced and should reflect current and emerging technologies. Common topologies should be introduced and should cover ring, star, bus and extended star. Definitions such as Local Area Networks (LANs), Wide Area Networks (WANs), Metropolitan Area Networks (MANs), Storage Area Networks (SANs) and Virtual Private Networks (VPNs) should be introduced and explained. The benefits of VPNs, Intranets and extranets should be described.

3 **Network architectures**

Common architectures such as circuit switched and packet switched networks, collision domains, segmentation, and broadcast domains should be described. The importance of how routers break up broadcast domains and manage broadcast traffic within a network should be emphasised. It is important candidates understand the significance of a switch in a shared media environment and its effect on collision domains, bandwidth domains, segmentation and broadcasts and also include the following, fault tolerance, scalability, security (identify and describe various networking threats, identify different methods of attack, describe security procedures and applications) and QOS (Quality of service).

4 **Network protocols**

Common network protocols such as the following although not restricted to should be described:

- HTTP (Hyper Text Transfer Protocol)
- SMTP (Simple Mail Transfer Protocol)
- FTP (File Transfer Protocol)
- TCP and IP
- DHCP (Dynamic Host Configuration Protocol)
- IMAP (Internet Message Access Protocol)
- ARCNET
- FDDI
- UDP
- X.25
- TFTP
- SNMP
- PPTP

5 **Protocol Suites and Industry Standards**

A brief overview of the OSI Model and TCP/IP models should be delivered in this outcome as it is covered in greater detail in Outcome 2. The centre should also deliver an overview of peer-to-peer communications and encapsulation as encapsulation is a characteristic feature of most networking models, including the OSI Model and TCP/IP Suite of protocols.

Outcome 2

Outcome 2 is the most difficult outcome of the unit. As such, a larger proportion of delivery time should be devoted to this than any other outcome.

Describe the OSI and TCP/IP models

Networking models should be introduced, indicating how layers may be used to analyse problems and to describe data communication.

The application layer

The operation of the application layer should include brief discussion of DNS, FTP, HTTP, SMTP, SNMP and Telnet.

The presentation layer

The operation of the presentation layer and its services and protocols, should include discussion of compression, encryption, coding and conversion.

The session layer

The operation of the session layer function, services and protocols (maintaining a dialogue between computers) should be discussed.

The transport layer

Flow control, session establishment, maintenance and termination, three-way handshake, windowing and acknowledgement are important topics that candidates should be aware of. Transmission Control Protocol (TCP), User Datagram Protocol (UDP) and their respective port numbers form the basis for further study in the unit Switching Technology, so it is important candidates understand this area.

The network layer
The operation of network layer functions (Addressing, Encapsulation, Routing and Decapsulation). Discussion on Hardware can include (Layer 3 Routers, Switches or any other relevant hardware) and protocols can include (Internet Protocol version 4 (IPv4), Internet Protocol version 6 (IPv6), Novell Internetwork Packet Exchange (IPX), AppleTalk) or any other relevant protocols.

The data link layer
The operation of and data link layer functions (framing, access control and error handling) MAC, CSMA/CA, CSMA/CD, full/ half duplex link should be discussed.

Additionally a discussion of logical link control and media access control, hardware (layer 2 hardware, layer 2 switching and switching modes) and standards (ISO, IEEE, ITU and ANSI) should take place.

The physical layer
The operation of the physical layer functions (encoding of data and control information, transmitter and receiver circuitry on the network devices), hardware (The physical media and associated connectors) and standards (cable, connectors and signals) should all be discussed fully.

Layer 1 copper media
Coverage of layer 1 copper media should include a brief description of voltage, resistance and impedance as these are crucial elements to understand cable testing. Common media types should be introduced including coaxial cable, shielded copper cable, and UTP cable.

Layer 1 optical media
Following this, new media types can be introduced beginning with optical media. The ray model of light, reflection, refraction and total internal reflection should be used to show how light can travel down multi-mode fibre or single-mode fibre cables.

Layer 1 wireless media
The other new medium included in this unit is wireless networking. Coverage in the context of this unit is intended as a brief overview. The 802.11 standards should be introduced. Common wireless devices such as NICs, access points and bridges should be described. WLAN topologies such as Basic Service Set and Extended Service Set should be included. How wireless LANs communicate and the general principles of authentication and association should be explained to give candidates a general overview of this new technology, including security problems.

Outcome 3

Candidates should find IP addressing, decimal and binary conversion, IPv4 addressing, Class A, B, C, D, and E IP addresses, reserved IP addresses, public and private IP addresses fairly straight forward. However, they are likely to find subnetting and the introduction to IPv6 more difficult.

Number systems should be introduced to help explain how TCP/IP represents network addresses. Thus binary representation of data, bits and bytes, base 10 number system, base 2 number system, converting decimal numbers to 8-bit binary numbers, converting 8-bit binary numbers to decimal numbers, four-octet dotted decimal representation of 32-bit binary numbers would provide a thorough grounding in this area and may complement core skills. Advanced concepts such as hexadecimal, Boolean logic, addresses and network masks should also be included.

Candidates will be required understand and configure IP v4 32bit addressing scheme including public and private address schemes, Understand IP v6 128 bit addressing scheme, Understand and configure subnets , Understand and convert decimal to binary and binary to decimal for use in IP addressing, Understand and convert hexadecimal to decimal and decimal to hex for use in IP addressing.

Configure routing in a networked environment. Candidates should understand the concepts of routing and fully understand routing tables. This may be supplemented with electronic simulators if the hardware is not readily available.

Outcome 4

Signals and noise
Signals and noise is intended to introduce candidates to the basic mechanisms to send a signal over copper and fibre media as well as common problems affecting the signal such as attenuation, noise, and crosstalk.

LAN cabling basics
The problems affecting the signal will define LAN cabling standards and equipment. For an ethernet network, common devices such as repeaters, hubs, wireless bridges, switches, and routers should be described. Wiring standards such as EIA/TIA 568 should be introduced. Ethernet media, UTP (Categories 5, 5e, 6, and 7), fibre-optics, wireless, LAN devices, MDI and MDIX should all be discussed.

WAN cabling basics
WAN cabling should be introduced, but this should be seen in the context of the unit as a brief overview. ISDN BRI and DSL connections, WAN devices should also be described. WAN serial communications, cable modems DSL modems, PPP, frame relay and any relevant WAN devices, eg DCE and DTE devices should all be discussed. The content taught in this outcome is the basis for learning Internetworking technology and any relevant candidates undertaking this particular unit should be aware of this.

Outcome 5

Outcome 5 is the only mainly practical outcome of the unit and is intended to allow candidates to complement the theoretical knowledge gained so far with practical experience**.** This outcome may be assessed via a series of small scenarios in which a small network can be seen to grow in size corresponding with each individual part of the outcome listed below.

Test and install LAN media

Candidates should normally test and install UTP copper LAN media. However, where resources permit fibre optic media should be considered. Generally candidates should install a standard length of UTP media into a patch panel and a telecom box and test the connection. Candidates can proceed to make various types of cable and use these to build small networks. Candidates should be aware of Time Domain Reflectometry and Frequency Based Cable Testing as common testing methods.

Build a peer-to-peer network

In building a simple peer-to-peer LAN, candidates can build a cross over cable, test this, configure a NIC on a host and then configure a pair of machines for access. Any common operating system may be used.

Build a small workgroup

This simple LAN should be expanded to a small workgroup, using straight through cables, a hub and hosts. Where resources permit, workgroups may be connected together using uplink ports on hubs. Network backbones and segments should be explained at this stage.

Build a small client server network

This simple LAN should be expanded to a small client server network, using cables of the candidates choice to connect at least two small networks using a router (either software or hardware based) where resources permit the network could be connected using switches/hubs and routers.

Guidance on the delivery and assessment of this unit using Cisco

The following notes are for guidance only please refer to Cisco documentation for further clarification as the mapping may not be 100% accurate. The outcomes and how they tie in with the SQA Advanced unit are indicated below.

Chapter 1 (Outcome 1) presents the basics of communication and how networks have changed our lives. Introduce the concepts of networks, data, Local Area Networks (LANs), wide area networks (WANs), quality of service (QOS), security issues, network collaboration services, and Packet Tracer activities. In the labs, candidates will learn how to set up a wiki and establish an instant messaging session.

Chapter 2 (Outcomes 1 and 2) focuses on how networks are modelled and used. The candidate will be introduced to the OSI and TCP/IP models and to the process of data encapsulation. The candidate will learn about the network tool Wireshark®, which is used for analysing network traffic, and will explore the differences between a real network and a simulated network. In the lab, the candidate will build a small peer-to-peer network.

Chapter 3 (Outcome 2) Using a top-down approach to teaching networking Chapter 3 introduces the candidate to the top network model layer, the application layer. In this context, the candidate will explore the interaction of protocols, services, and applications, with a focus on HTTP, DNS, DHCP, SMTP/POP, Telnet and FTP. In the labs, the candidate will practice installing a web server/client and use Wireshark® to analyse network traffic. The Packet Tracer activities let the candidate explore how protocols operate at the application layer.

Chapter 4 (Outcome 2) introduces the Transport layer and focuses on how the TCP and UDP protocols apply to the common applications. In the labs and activities, the candidate will incorporate the use of Wireshark®, the Windows utilities command netstat, and Packet Tracer to investigate these two protocols.

Chapter 5 (Outcome 2) introduces the OSI Network layer. The candidate will examine concepts of addressing and routing and learn about path determination, data packets, and the IP protocol. By the end of this chapter, the candidate will configure hosts to access the local network and explore routing tables.

Chapter 6 (Outcome 3) In Chapter 6, the candidate will focus on network addressing in detail and learn how to use the address mask, or prefix length, to determine the number of subnetworks and hosts in a network. The candidate will also be introduced to ICMP (Internet Control Message Protocol) tools, such as ping and trace.

Chapter 7 (Outcome 2) discusses the services provided by Data Linklayer. An emphasis is placed on the encapsulation processes that occur as data travels across the LAN and the WAN.

Chapter 8 (Outcome 2) introduces the physical layer. The candidate will discover how data sends signals and is encoded for travel across the network. The candidate will learn about bandwidth and also about the types of media and their associated connectors.

Chapter 9 (Outcome 3) In Chapter 9, the candidate will examine the technologies and operation of Ethernet. The candidate will use Wireshark®, Packet Tracer activities, and lab exercises to explore Ethernet.

Chapter 10 (Outcome 4) focuses on designing and cabling a network. The candidate will apply the knowledge and skills developed in the previous chapters to determine the appropriate cables to use, how to connect devices, and develop an addressing and testing scheme.

Chapter 11 (Outcome 5) In Chapter 11, the candidate will connect and configure a small network using basic Cisco IOS commands for routers and switches. Upon completion of this final chapter, the candidate will be prepared the candidate to go on to either CCNA Exploration Routing or CCNA Exploration Switching courses.

Open learning

If this unit is delivered by open or distance learning methods, additional planning and resources may be required for candidate support, assessment and quality assurance.

A combination of new and traditional authentication tools may have to be devised for assessment and re-assessment purposes. Open learning is possible but may complicated to arrange. Providing that assessment authenticity can be ensured, this unit could be delivered by online/distance methods. The practical elements (cabling patch panels) may prove difficult to invigilate, however the practical building of a network can be achieved via use of virtualised environments. For further information please refer to SQA Publication Assessment and Quality Assurance of Open and Distance Learning (Code, 2000)

Opportunities for the use of e-assessment

E-assessment may be appropriate for some assessments in this unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003), SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

Opportunities for developing Core Skills

There is no automatic certification of Core Skills or Core Skill components in this unit.

Equality and inclusion

This unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

History of changes

Version	Description of change	Date

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

FURTHER INFORMATION: Call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our Centre Feedback Form.

General information for candidates

Unit title: Networking Technology

This is a 2 SQA Credit unit at SCQF level 8, intended for candidates undertaking a Computing or IT-related qualification who require a broad understanding of computer networking. It is designed to develop an understanding of the issues involved in the design, installation and maintenance of computer networks. On completion of the unit you should be able to:

- describe the components of Local Area Networks and media.
- describe the OSI and TCP/ip models and their layers.
- describe and use common addressing schemes and routing in a networked environment.
- describe connectivity and transmission features, and operation of Local and Wide Area Networks.
- configure, build and test a simple Local Area Network.

In the first part of the course the candidate will learn about common networking hardware used to connect a network including but not restricted to routers, switches, hubs, bridges, repeaters and NICs. Networking terminology for example common topologies, LAN, WAN, MAN, SAN, PAN, WLAN, Virtual Private Networks and Intranets. Network architectures including fault tolerance, scalability, security, QOS (Quality of service), circuit switched and packet switched networks, collision domains, segmentation, and broadcast domains. Network protocols (common network protocols can include but not restricted to protocols such as TCP, IP, NETBUI, UDP). Protocol Suites and Industry Standards the OSI Model, TCP/IP model, peer-to-peer communications and encapsulation.

In the second part of the course the candidate will learn about each of the levels of the OSI model and its relationship to the TCP/IP protocol stack, the protocols at each level, the function of each level and the hardware used at the lower layers. This outcome covers the operation of the layers of the OSI model. This is designed to allow candidates to appreciate mechanisms used to deliver services to users at all layers of the OSI model and its comparison of with the TCP/IP protocol stack.

In the third part of the course The candidate will learn about the IP v4 32bit addressing scheme including public and private address schemes, the IP v6 128 bit addressing scheme, how to configure subnets, how to convert decimal to binary and binary to decimal for use in IP addressing, how to convert hexadecimal to decimal and decimal to hex for use in IP addressing and learn how configure routing in a networked environment. This section covers IP addressing. Common internet addressing is reviewed, as is how an organization might obtain such an address. IP routing protocols are introduced to provide an understanding of how packets can be routed through the internet. Subnetting is included to allow the design of an appropriate IP address scheme

In the fourth part of the course the candidate will learn about network cabling which will include signals and noise, signalling over copper and fibre, attenuation, loss, noise, crosstalk, LAN cabling, ethernet media, UTP (Categories 5, 5e, 6, and 7), fibre-optics, wireless, LAN devices, MDI and MDIX, WAN cabling, WAN serial communications, cable modems DSL modems, PPP, frame relay and any relevant WAN devices, eg DCE and DTE devices.

The fifth section covers building a LAN and is intended to allow the candidate to apply the knowledge gained during the earlier outcomes in a practical environment. The candidate will make and test different types of network cables. The candidate will learn how to build and configure a peer-to-peer network, how to build and configure a workgroup network and how build and configure a client server network using routing technologies.

There will be a closed-book multiple-choice/multiple-response assessment covering all outcomes. The candidate will be presented with 50 questions and expected to answer 60% of these correctly. The candidate will also be expected to keep a suitable record recording the practical tasks the candidate has carried out during the unit. The candidate must satisfy the requirements for these assessments in order to achieve the unit.

This unit (in conjunction with the related Units: HP1J 48 Routing Technology, HP1L 48 Switching Technology and HP1N 48 Internetworking Technology) may assist the candidate in preparing for Cisco examination 640-802: Cisco Certified Network Associate. In addition candidates may find this unit helpful in preparation for Cisco examination 640-811: Interconnecting Cisco Networking Devices and Cisco examination 640-821 Introduction to Cisco Networking Technologies. The candidate should check the latest information at **www.cisco.com** to ensure that all objectives have been covered.