

National Unit Specification: general information

UNIT **Computer Networking (Advanced Higher)**

NUMBER DF30 13

COURSE Computing (Advanced Higher)

SUMMARY

This Unit is designed to develop knowledge and understanding of the principles of networking and practical skills related to networking through the use of contemporary hardware and software. This knowledge, understanding and practical skill may then be applied by the candidate to solve practical problems related to networking.

It is designed as an option for candidates undertaking the Advanced Higher Computing Course, but it is also suitable for anyone wishing to extend and deepen their experience of computer networking beyond Higher level.

OUTCOMES

1. Demonstrate knowledge and understanding of a range of facts, ideas and terminology relevant to the principles, features and purposes of networking.
2. Demonstrate practical skills in the context of networking using contemporary hardware and software.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following, or equivalent:

- ◆ *Computer Networking* (Higher)Unit
- ◆ Higher Computing

Administrative Information

Superclass: CB

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National Unit Specification: general information (cont)

UNIT Computer Networking (Advanced Higher)

CREDIT VALUE

1 credit at Advanced Higher (8 SCQF credit points at SCQF level 7)*

**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 Access 1 to Doctorates.*

CORE SKILLS

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

National Unit Specification: statement of standards

UNIT Computer Networking (Advanced Higher)

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1

Demonstrate knowledge and understanding of a range of facts, ideas and terminology relevant to the principles, features and purposes of networking.

Performance criteria

- (a) A wide range of advanced computing terminology is used appropriately.
- (b) Technically accurate descriptions and explanations are related to familiar and unfamiliar contexts.
- (c) Conclusions, predictions and generalisations are made from knowledge and understanding.

Evidence requirements

Written or oral evidence that the candidate can describe and explain the principles, features and purposes of networking accurately and concisely. Evidence should be obtained using questions in a closed-book test, under supervision, lasting no more than 45 minutes. The test must sample across the range of content (see Computing (Advanced Higher) Course content) in each of the following areas:

- ◆ network protocols
- ◆ network applications
- ◆ network security
- ◆ data transmission.

(The content statements are also reproduced for convenience as a table in the support notes for this Unit).

The standard to be applied is illustrated in the National Assessment Bank items available for this Unit.

If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

National Unit Specification: statement of standards (cont)

UNIT Computer Networking (Advanced Higher)

OUTCOME 2

Demonstrate practical skills in the context of networking using contemporary hardware and software.

Performance criteria

- (a) A wide range of appropriate hardware is used effectively and efficiently.
- (b) A wide range of features of software is used effectively and efficiently.
- (c) Practical tasks are planned and organised independently.
- (d) Practical tasks are undertaken in an appropriate range of familiar and unfamiliar contexts.

Evidence requirements

Observation checklist showing that the candidate has demonstrated practical skills at an appropriate level in **two** of the following contexts:

- ◆ troubleshooting a network using the ping or trace route utilities
- ◆ creation of firewall rules to prevent unauthorised access
- ◆ creation of a complex web page using HTML

Hard copy evidence should be provided for **one** of these activities.

These practical skills may be demonstrated in a single extended task, or in a number of smaller tasks.

The practical skills should be demonstrated in the context defined in the content statements (see Advanced Higher Course content).

The candidate will be allowed access to books, notes and on-line help while completing the tasks.

(The content statements are also reproduced for convenience as a table in the support notes for this Unit)

The standard to be applied is illustrated in the National Assessment Bank items available for this Unit.

If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

National Unit Specification: support notes

UNIT Computer Networking (Advanced Higher)

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 40 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

The content for this Unit is detailed below (and also in the National Course Specifications: Course details.)

Content statements in the left-hand column describe the content covered in the corresponding Unit at Higher level, and are included here to clarify the context for the new learning for this Unit. They indicate the prior learning required by the candidate before undertaking new learning within this Unit.

Content in the right-hand column is the new content for this Unit.

Content Statements: Network protocols	
<i>Higher</i>	Advanced Higher
	Explanation of the need for organisations enforcing standards including ISO and IEEE.
<i>Name and description of the seven layers of the OSI model.</i>	Description of mapping TCP/IP layers to OSI model layers.
<i>Brief explanation of the purpose of common protocols (TELNET, HTTP, SMTP and FTP).</i>	Explanation of the purpose of common protocols (SMTP, POP and MIME).
<i>Description of an IP address:</i> <ul style="list-style-type: none">◆ <i>structure: 4 octets</i>◆ <i>classes: ABCD</i>◆ <i>limitations</i>	Description of CIDR and binary subnet masks. Description of Trace route and Ping in terms of troubleshooting.
<i>Description of name services (name resolution); DNS (domain names, host name resolution).</i>	

National Unit Specification: support notes (cont)

UNIT Computer Networking (Advanced Higher)

Content Statements: Network Applications	
<i>Higher</i>	Advanced Higher
	<p>Description of the parts of an e-mail message; header (recipients address and other info) and body (containing the message to be sent). Brief description of sending and receiving e-mail including the role of SMTP:</p> <ul style="list-style-type: none"> ◆ connection setup ◆ mail transfer ◆ connection termination
<p><i>Description of a web page using HTML tags (header, body, title, style, font size, alignment and section headers).</i></p>	<p>Description of a web page using HTML tags (start, header, body, title, style, font size, alignment, section headers, colours and hyperlinks). Combination of tags to create a single line of code.</p>
	<p>Description of the process of requesting a web page by a client from a server and its transfer using HTTP from a server to a client:</p> <ul style="list-style-type: none"> ◆ HTTP (overview, types of connections-end to end TCP connection and not end to end TCP connections, three forms of intermediate-proxy, gateway and tunnel) ◆ types of data transmitted ◆ messages (request from client to server and response from server to client, fields-request line, response line, general header, request header, response header, entity header, entity body).
<p><i>Explanation of the advantages and disadvantages of browsers and microbrowsers for use with wireless data (WAP). Description of a web page using WML tags (wireless markup language).</i></p>	<p>Description of commonly used plug-ins to enhance browser functionality for portable documents, multimedia elements and streaming audio/video, naming currently used examples. Description and uses of Java applets and ActiveX.</p>
<p><i>Description of the methods used by search engines to build its indexes (spiders, meta-search engines).</i></p>	
<p><i>Description of the advantages of e-commerce. Implication of fraud in e-sales payment and how it is overcome.</i></p>	<p>Description of a video telephone call and its technical implications (hardware, software, data transmission and data compression):</p> <ul style="list-style-type: none"> ◆ video telephony in the context of teleconferencing (quality of video-dpi, sample rate) ◆ need for compression of video signal

National Unit Specification: support notes (cont)

UNIT Computer Networking (Advanced Higher)

<i>Description of the implications of the Regulation of Investigatory Powers Act 2000.</i>	
<i>Description of the social implications of networks; information rich and information poor, the family, the community and employment.</i> <i>Description of the ethical implications of networks; personal privacy and censorship.</i>	

Content Statements: Network security	
<i>Higher</i>	<i>Advanced Higher</i>
<p><i>Description of security measures:</i></p> <ul style="list-style-type: none"> ◆ <i>user access rights to data-file and folder permissions</i> ◆ <i>user access rights to hardware</i> 	
<p><i>Description of computer and network security requirements (confidentiality, data integrity and availability).</i></p> <p><i>Description of threats to network security in terms of passive (monitoring of transmission) and active (modification of the data stream or the creation of a false stream) attacks.</i></p>	<p>Description of the following methods for network and communication security:</p> <ul style="list-style-type: none"> ◆ <i>conventional encryption (plaintext, encryption algorithm, secret key, ciphertext and decryption algorithm)</i> ◆ <i>message authentication (using conventional encryption and without message encryption)</i> ◆ <i>public-key encryption and digital signatures (plaintext, encryption algorithm, public and private key, ciphertext and decryption algorithm)</i> ◆ <i>Internet architecture security</i>
<p><i>Description of the denial of service attack:</i></p> <ul style="list-style-type: none"> ◆ <i>effect; disruption or denial of services to legitimate users.</i> ◆ <i>costs of attack; system downtime, lost revenue and labour involved in identifying and reacting to an attack.</i> ◆ <i>intent; malicious, personal or political.</i> ◆ <i>types of attacks; bandwidth consumption, resource starvation, programming flaws and routing and DNS attacks.</i> 	<p>Description of the generic denial of service attack and countermeasures taken:</p> <ul style="list-style-type: none"> ◆ <i>Smurf: (attacker sends spoofed ICMP ECHO packet to broadcast address of a network, amplification of attack, bandwidth consumption prevention: disable directed broadcast functionality of border router, configure operating system to silently discard broadcast ICMP ECHO packets)</i> ◆ <i>SYN Flood: (attacker sends SYN packet from spoofed address, recipient sends SYN/ACK packet to spoofed address, recipient does not receive ACK from spoofed address and connection remains until timed out; consequence usually a server is taken out: prevention: increase size of connection queue, decrease connection established timeout period, employ vendor specific patches)</i>

National Unit Specification: support notes (cont)

UNIT Computer Networking (Advanced Higher)

<i>Higher</i>	Advanced Higher
	<ul style="list-style-type: none"> ◆ DNS: (attacker can try to convince a target nameserver to cache information that maps to a nonexistent IP address effectively denying that service; prevention: upgrade to latest version of BIND)
<i>Comparison of Internet content filtering methods: firewalls, Internet filtering software and walled gardens.</i>	
<i>Description of how a firewall can protect a LAN with an internet connection from outside attacks.</i>	Description of a few simple firewall rules used to protect a LAN with an Internet connection from outside attacks.
<p><i>Description of disaster avoidance:</i></p> <ul style="list-style-type: none"> ◆ use of anti-virus software ◆ use of fault tolerance components ◆ use of uninterrupted power supply. ◆ regular maintenance <p><i>Description of backup strategy:</i></p> <ul style="list-style-type: none"> ◆ backup server ◆ mirror disks ◆ tape ◆ backup schedule 	Description of types of backup; full, incremental and differential.

Content Statements: Data transmission	
<i>Higher</i>	Advanced Higher
<i>Description of synchronous and asynchronous data transmission.</i>	Comparison of bandwidth of different transmission systems; UTP, co-axial, fibre and radio waves.
<i>Description of error checking in data transmission (parity and CRC).</i>	
<i>Description of the process of transmitting data over a network using TCP/IP.</i>	
<i>Description of CSMA/CD and its implications for network performance.</i>	
<i>Description of network switching (circuit and packet switching) and its implications for network performance.</i>	
<p><i>Description of the application of modern wireless communication methods:</i></p> <ul style="list-style-type: none"> ◆ WPAN-connect mobile phones, mobile computers and other portable handheld devices ◆ wireless LAN-connecting a mobile LAN ◆ wireless WAN-connection in rural and heavily built-up areas 	<p>Explanation of the advantages, disadvantages and characteristics (data transfer rate, range and frequency) of modern wireless communication methods.</p> <p>Description of data standards of modern wireless communication methods (802.11a, 802.11b, 802.11g, bluetooth, HiperLAN2 and Ultrawideband).</p> <p>Description of the security and performance issues of modern wireless communication methods (WPAN and wireless LAN).</p>

National Unit Specification: support notes (cont)

UNIT Computer Networking (Advanced Higher)

<i>Higher</i>	<i>Advanced Higher</i>
<i>Description of the speed and bandwidth of the types of internet connections (dialup, cable modem, leased line, ISDN and ADSL). Explanation of which type of connection would be most appropriate in a given context.</i>	Description of remote access: <ul style="list-style-type: none"> ◆ dial-up protocols; SLIP and PPP ◆ virtual private network protocols; PPTP and L2TP
<i>Description of function of network interface card. Explanation for the need of a MAC address when transmitting data over a network.</i>	

List of abbreviations:

Higher

ADSL	Asymmetric Digital Subscriber Line
CRC	Cyclic Redundancy Check
CSMA/CD	Carrier Sense Multiple Access/ Collision Detection
DNS	Domain Name System
FTP	File Transfer Protocol
HTML	HyperText Mark-up Language
HTTP	HyperText Transfer Protocol
ISDN	Integrated Services Digital Network
MAC	Media Access Control
TELNET	Standard network virtual terminal protocol
WAP	Wireless Application Protocol
WML	Wireless Markup Language
WPAN	Wireless Personal Area Network
WAN	Wide Area Network

Advanced Higher

BIND	Berkeley Internet Name Domain
CIDR	Classless Inter-Domain Routing
ICMP	Internet Control Message Protocol
IEEE	Institute of Electronic and Electrical Engineers
ISO	International Standards Organisation
LAN	Local Area Network
L2TP	Layer 2 Tunnelling Protocol
MIME	Multi-purpose Internet Mail Extender
OSI	Open Systems Interchange
PING	Packet Internet Groper
POP	Post Office Protocol
PPP	Point to Point Protocol
PPTP	Point to Point Tunnelling Protocol
SLIP	Serial Line Internet Protocol
SMTP	Simple Mail Transport Protocol
TCP/IP	Transmission Control Protocol/ Internet Protocol
UTP	Unshielded Twisted Pair
WPAN	Wireless Personal Area Network

National Unit Specification: support notes (cont)

UNIT Computer Networking (Advanced Higher)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Candidates will require individual access to appropriate computer hardware and software throughout this Unit. While the learning may be achieved in the context of one computer system, students will benefit from having some experience of alternative operating systems.

The two Outcomes should be delivered in an integrated way rather than sequentially. For Outcome 2, the practical activities should be taught and used to illustrate and exemplify the knowledge and understanding required for Outcome 1.

Candidates who have completed the *Computer Networking* Unit at Higher level should already have covered the content listed in the left-hand column of the content grids, but may need to revise this material before progressing to the right-hand column.

The amount of time spent on each area of content will vary depending on the teaching methodology used and the ability and prior experience of the candidates. However, the following times are suggested as a rough guide:

network protocols	6 hours
network applications	10 hours
network security	10 hours
data transmission	10 hours

1½ hours should be set aside to:

- ◆ administer the Outcome 1 test
- ◆ gather evidence for Outcome 2

A further 2 ½ hours is allowed for remediation and re-assessment if required.

If the Unit is delivered as part of a Course, the Course documentation will provide further information on teaching and learning in a Course context, including the identification of a number of ‘themes’ to facilitate holistic learning across the Course.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

National Assessment Bank tests have been created specifically to assess Outcome 1 of the Unit. This assessment consists of a closed-book test, and must be conducted under supervision. In order to gain success in this Outcome, the candidate must achieve at least the cut-off score for the test. If the centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

Outcome 2 requires the candidate to demonstrate practical skills while using contemporary hardware and software. These practical skills may be demonstrated in a single extended task or a number of relatively small tasks, undertaken by the candidate during the teaching and learning activities of the Unit, rather than as separate formal assessment activities. The candidate will be allowed access to books, notes and on-line help while completing the task(s).

National Unit Specification: support notes (cont)

UNIT Computer Networking (Advanced Higher)

To gain success in this Outcome, the candidate must demonstrate practical skills in **two** of the following contexts as defined in the content statements (see Computing (Advanced Higher) Course content):

- ◆ troubleshooting a network using the ping or trace route utilities
- ◆ creation of firewall rules to prevent unauthorised access
- ◆ creation of a complex web page using HTML

Hard copy evidence should be provided for **one** of these activities. Note that this evidence need not be a formal report; it could consist of a printout or a screen shot from any of the practical activities.

A pro-forma observation checklist for Outcome 2 is provided in the National Assessment Bank materials.

All evidence must be retained by the centre. The assessment of this Unit is subject to moderation by SQA.

CANDIDATES WITH ADDITIONAL SUPPORT NEEDS

This Unit Specification is intended to ensure that there are no artificial barriers to learning or assessment. The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative Outcomes for Units. For information on these, please refer to the document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* (SQA, 2004).