National Unit specification: general information

Unit title: Network Fundamentals (SCQF level 6)

Unit code: H2N6 12

Superclass: CB

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Version: 01

Summary

This Unit introduces candidates to the theory of modern computer networks. Candidates are introduced to the basic concepts of computer networking such as the different types of networks, network devices and network media. The Unit also covers the theory which underpins the way data is transferred over a computer network and the use of the network protocols and network utilities in that data transfer.

This Unit is aimed at candidates who have at least a basic knowledge of computer hardware and computer software, and who are interested in computer networking.

This is a mandatory Unit in the National Progression Award (NPA) in Professional Computer Fundamentals, but can also be taken as a freestanding Unit.

Outcomes

1 Demonstrate knowledge and understanding of computer networks.
2 Demonstrate knowledge and understanding of network hardware.
3 Demonstrate knowledge and understanding of network services and protocols.

Recommended entry

While entry is at the discretion of the centre, it would be beneficial if candidates possessed basic ICT skills and had a working knowledge of computer hardware and software. This may be evidenced by achievement of the following, or equivalent Units:

F1KR 11 *Computing: Computer Hardware and Systems*
F3SY 12 *Computing: Computer Hardware and Systems*

It may also be beneficial for candidates to have some knowledge of computer networks. This may be evidenced by achievement of the following, or an equivalent Unit:

F1KH 11 *Computing: Computer Networking Fundamentals*

General information (cont)

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Credit points and level

1 National Unit credit at SCQF level 6: (6 SCQF credit points at SCQF level 6*)

**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 components in this Unit.

Opportunities for developing aspects of Core Skills are highlighted in the support notes of this Unit specification.

National Unit specification: statement of standards

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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 SQA.

Outcome 1

Demonstrate knowledge and understanding of computer networks.

Performance Criteria

(a) Identify and explain the main features of common network concepts.
(b) Identify and explain the common network topologies.
(c) Identify the common features of local and wide area networks.
(d) Describe the main uses of local and wide area networks.
(e) Describe the common features of wireless networks.
(f) Use correct terminology where appropriate, in describing features and uses of computer networks.

Outcome 2

Demonstrate knowledge and understanding of network hardware.

Performance Criteria

(a) Identify different types of network devices.
(b) Identify the physical features of common computer network hardware devices.
(c) Explain the functions of network hardware devices identified.
(d) Identify different types of network media.
(e) Describe the physical and operational characteristics of common types of computer network media.
(f) Use correct terminology where appropriate, in describing features and uses of network hardware devices.

Outcome 3

Demonstrate knowledge and understanding of network services and protocols.

Performance Criteria

(a) Describe the operation of a computer network using a networking model.
(b) Describe the process of data transfer using a protocol suite.
(c) Explain the role of logical network addressing on a computer network.
(d) Describe the process of name resolution on a computer network.
(e) Identify and explain the features of common network services.
(f) Use correct terminology where appropriate, in describing features and uses of network services and protocol.

National Unit specification: statement of standards (cont)

Unit title: Network Fundamentals (SCQF level 6)

Evidence Requirements for this Unit

Evidence is required to demonstrate that candidates have achieved all Outcomes and Performance Criteria.

All assessment will be produced under controlled, supervised, closed-book conditions.

For Outcome 1, written and/or oral evidence is required to demonstrate that candidates can:

- identify and describe at least two different network concepts
- identify and describe at least two different topologies of network
- identify and describe at least three features of a LAN
- identify and describe at least three features of a WAN
- identify and describe at least three features of a wireless network

For Outcome 2, written and/or oral evidence is required to demonstrate that candidates can:

- identify at least three different network devices
- identify at least four common features of network devices
- explain the function of each of the three network devices, including the common features identified
- identify at least three different types of network media
- identify and describe at least four different characteristics of network media

For Outcome 3, written and/or oral evidence is required to demonstrate that candidates can:

- identify and describe at least three different levels within a networking model
- identify and describe at least three features of a common network protocol suite
- identify and describe at least two different types of logical addressing and two features related to them
- identify and describe at least two different types of name resolution methods
- identify and describe at least two common network services

National Unit specification: support notes

Unit title: Network Fundamentals (SCQF level 6)

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

This is a mandatory Unit in the National Progression Award in Professional Computer Fundamentals, but can also be taken as a freestanding Unit. This Unit is aimed at providing candidates with the underpinning theory required for a career in network design and/or system administration. The Unit may be useful for any candidates who are preparing to undertake the Microsoft Technology Associate (MTA) exam (exam number: 98-366).

It is expected that the following content would be relevant to the delivery of Outcome 1:

- Modern network features such as — internet, intranet, extranet, firewalls, security zones and VPNs should be explained to the candidate.
- Common types of network include — Local Area Networks (LANs), Wide Area Networks (WANs), Wireless Local Area Networks (WLANs), Virtual LANs (VLANs) and others
- Common network topologies include — bus, ring, star, hierarchical star and mesh. Candidates should be aware that the physical topology of a network may be different from its logical topology, for example, a star-wired bus. Where possible these topologies should be linked to current network technologies, eg ethernet, Wi-Fi, FDDI.
- Details of how both wired and wireless LANs operate, their similarities and differences should be highlighted. Attention should be given to how wireless LANs are integrated onto a wired LAN.
- Common features of modern wireless networks should be described. Modern wireless standards as defined in 802.11x should be described and the term 'Wi-Fi' explained. Integration of wireless LANs onto a wired LAN in both ad hoc and infrastructure modes should be explained. The need for security on wireless networks should be emphasised as should the various security methods available — MAC filtering tables, SSID stealth modes, and encryption [WEP/WPA/WPA2]. The efficacy of each method should be discussed, eg noted weakness of WEP.
- Common WAN technologies. As it is unlikely that much of the range of necessary hardware for this will be available in the classroom then the internet can be a valuable research tool for these. The candidates should be made aware of the following technologies — POTS dialup, ISDN, leased lines, T1, T3, E1, E3, ADSL, cable, etc. Also, media types, characteristics, speeds (both up and down), availability and contention issues should be discussed.

It is expected that the following content would be relevant to the delivery of Outcome 2:

- Common network devices such as hubs, switches, Wireless Access Points and routers should be described and their usage placed in context. (In Outcome 3 when a networking model such as the OSI 7 layer model is discussed, the devices' operation could be described according to the layer in the model at which it operates.)

National Unit specification: support notes (cont)

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- The range of features available on the common hardware network devices and how they operate.
- The advantages that switches offer over the simpler hub should be explained. These advantages include — the filtering of traffic using hardware MAC frame addresses and the increasing of available bandwidth this leads to.
- The current range of operating speeds — 10/100/1000 mbps, move toward 10Gbps. How the internal backplane speed of the switch may differ from the external data-forwarding speed of the switch.
- The use of fast uplink ports to connect network segments upwards onto a hierarchical network.
- Additional features a managed switch may offer over an unmanaged switch — management interface, built-in DHCP services, VLANs, etc.
- The introduction of Layer 3 managed switches into large LANs.
- The role of routers on both LANs and WANs should be explained. Both static and dynamic routing should be discussed, with various dynamic routing protocols explained. The use of NAT on LANs should be explained as should the necessity of it.
- The wide range of different types of common networking media should be described. Candidates should be aware of each media type's physical characteristics, maximum segment lengths, maximum transmission speeds, shielding against both internal and external interference, etc. Media types should include, wireless transmission, coaxial cable (both thin and thick co-ax), the various categories of Twisted Pair cable (ie UTP/ScTP/STP, with particular emphasis on Cat5/Cat5e and of the gradual introduction of new variants such as Cat6a),and fibre optic cable (both single mode and multi-mode).

It is expected that the following content would be relevant to the delivery of Outcome 3:

- The OSI 7 layer model and its role understanding the structure of modern computer networks. Additionally what each of the seven layers covers including:
  - common network hardware devices and their position on the OSI 7 layer model
  - common network services and protocols and their position on the OSI 7 layer model
- The TCP IP Protocol stack. Candidates should be able to describe the four levels of the TCP/IP Model, and use the OSI 7 layer model to better understand them. They should be aware of both TCP and UDP as transport protocols and the differences in how they operate and are used.
- Common TCP/IP utilities such as — ipconfig, ping, tracert, path ping , telnet and netstat
- Well known TCP and UDP port assignments, including — but not limited to — HTTP, HTTPS, FTP, SMTP, Telnet, etc.
- Basic ‘Protocol Data Units’ and encapsulation in relation to both the OSI 7 layer model and TCP/IP — segments, packets, data frames, bits.
- Logical network addressing should be covered in detail, including both IPv4 and IPv6. The hierarchical nature of IP addressing and its role in routing should be emphasised.
  - For **IPv4** the following should be covered — IPv4 network classes A, B and C and their default subnet masks. The role of a subnet mask. Reserved ‘private’ IP ranges (ie 10.0.0.0 for Class A), and reserved ‘addresses’ within and network, ie the wire and broadcast addresses. The role of default gateways.

- — For **IPv6** the following should be covered — structure of IPv6 addressed, backward compatibility with IPv4 via the use of dual stacks or IP4 to ip6 tunnelling. Reserved IPv6 addresses such as the loopback address.
- — Candidates should be able to configure network addresses both statically and automatically. They should know the role of the following in the process — IP address, subnet mask, DNS server, default gateway and alternate IP address.

- ♦ The role of name resolution on a network should be discussed, as should the name resolution process, such as the use of a host and/or LMhosts file, DNS, and WINS.
- ♦ Networking services such as DHCP (including the role of APIPA addresses) and remote access.

Guidance on learning and teaching approaches for this Unit

This Unit provides underpinning theory required for a career in network design or system administration. While the main focus of this Unit is theoretical, it is expected that tutors will use practical and hands-on methods as part of their classes to ensure candidates see the theory in practice.

It is recommended that candidates are given the chance to participate in building and then extending a small network either as part of a group or on their own. A small network could be something as simple as two PCs connected via a hub/switch, using TCP/IP and configured as a workgroup. If the centre has access to a patch/panel, cabinet and wall mounted TOs then this could be used to show the structure of most business networks. The network could then be extended by attaching a WAP and allowing mobile computing devices to be attached. Security for the network should be configured.

Candidates should also be encouraged to look beyond the classroom and use computing magazines and the internet as a supplement to technical manuals and the library for independent study.

Guidance on approaches to assessment for this Unit

All assessment will be produced under controlled, supervised, closed-book conditions.

Evidence could be gathered via three separate assessment events, one per Outcome, or via a single end of Unit assessment event. Where assessing each Outcome separately, each assessment should last no more than 45 minutes. If a single assessment event is used then all of the assessment content must be combined into a single assessment instrument.

The assessment instrument should be attempted on a single occasion, with a different mix of questions used should re-assessment be required.

As this Unit is theory based, it may be appropriate for the evidence of this Unit to be produced using e-assessment. If presenting these assessments online, the following assessment methods may be selected, where appropriate:

- ♦ multiple choice
- ♦ drag and drop
- ♦ multiple response
- ♦ mix and match

or

- ♦ a combination of the above

National Unit specification: support notes (cont)

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While it is expected that the majority of the questions would be of the multiple choice variety should e-assessment be used, care must be taken to ensure that the questions presented and the range of alternative answers provided are valid and are at the appropriate level.

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 social software. 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

In this Unit, there are opportunities to develop aspects of the Core Skills of *Information and Communication Technology* in particular, and *Communication*. *Information and Communication Technology* skills will be developed naturally through the content of the Unit which focuses on the theory behind computer networks. *Communication* skills may be developed through written and/or verbal reporting throughout assessments.

Disabled candidates and/or those with additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website **www.sqa.org.uk/assessmentarrangements**

History of changes to Unit

Version	Description of change	Date