SCOTTISH QUALIFICATIONS AUTHORITY

Higher National Unit Specification

General information for centres

Unit title: Network Concepts

Unit code: DF9P 34

Purpose: This Unit is designed to introduce candidates to the issues involved in installing and supporting computer networks, internal and external to an organisation. It is intended for candidates undertaking an HNC/D in Computing, Computer Networking or a related area who require a broad knowledge of computer networks.

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

1. Describe network media and topologies.
2. Describe network protocols and standards.
3. Implement local area networks.
4. Provide network support.

Credit value: 2 HN credits at SCQF level 7: (16 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.*

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 PC hardware and software. This may be demonstrated by the possession of HN Units DG0K 33 Hardware Concepts and DF0L 33 Operating System Concepts.

Core Skills statement: There may be opportunities to gather evidence towards core skills in this Unit, although there is no automatic certification of core skills or core skills components.

Context for delivery: This Unit is included in the framework of a number of HNC and HND group awards. It is recommended that it should be taught and assessed within the context of the particular group award to which it contributes.

Assessment: Evidence for the knowledge and/or skills for the entire Unit must be produced using a set of 50 restricted-response questions to assess candidates' knowledge and understanding. This may be administered as a single end-of unit test, or as several subtests, each covering one or more outcomes.

Candidates must answer at least 70% of the questions correctly in order to obtain a pass. If subtests are used, they must also score at least 70% in each subtest.

General information for centres (cont)

Testing must take place in a closed-book environment where candidates have no access to 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 a tutor or mentor. There must be no communication between candidates and communication with the administrator must be restricted to matters relating to the administration of the test.

If a candidate requires to be reassessed, a different selection of questions must be used. At least half the questions in the reassessment must be different from those used in the original test.

If an outcome has a practical component, this must 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 tutor or mentor.

For some outcomes only a sample of the practical tasks needs to be completed and recorded for assessment purposes, e.g. three out of five. This is clearly indicated in the logbook instructions for the outcomes involved. Where this occurs, tutors must inform candidates of the tasks to be completed.

Higher National Unit specification: statement of standards

Unit title: Network Concepts

Unit code: DF9P 34

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 network media and topologies.

Knowledge and/or skills

- Logical and physical topologies.
- Network technologies.
- Ethernet characteristics.
- Media types and connectors.
- Network components.

Evidence Requirements

Restricted response test

The knowledge and skills component of Outcome 1 must be examined by ten questions, two derived from each of the five items listed below. Each question must be derived from a single item.

1. Logical and physical topologies

   Star, hierarchical, bus, mesh, ring, wireless

2. Network technologies

   LLC, Ethernet, Token ring, wireless, FFDI

3. Ethernet characteristics

   Ethernet, 10BASE-T, 10BASE-TX, 10BASE2, 10BASE5, 100BASE-FX

4. Media types and connectors

   Coaxial, twisted pair, fibre, RJ-11, RJ-45, AUI, BNC, ST, SC

5. Network components

   Hubs, switches, routers, bridges, gateways, CSU/DSU, interface cards, ISDN adapters, system area network cards, wireless access points, modems

The test may be administered on its own as a subtest or be combined with other outcome subtests in the Unit.

Alternatively, the 10 questions for this outcome may contribute towards a single end-of-unit test of 50 questions.

Logbook

There are no practical tasks relating to Outcome 1.

Assessment guidelines

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

The suggested time allocation for a restricted response test is 2 minutes for each question plus 5 minutes starting-up time and 5 minutes finishing-off time, thus a total of 110 minutes should be allocated for a 50-question end-of-unit test.

Although individual outcome tests are permissible, it is suggested that if subtests are to be used, outcomes should be combined to produce tests of no fewer than 10 questions. A 10-question test would therefore have a time allocation of 30 minutes.

Outcome 2

Describe network protocols and standards.

Knowledge and/or skills

- Network protocols.
- TCP/IP protocols.
- OSI reference model.
- Network services.
- WAN technologies.
- Network security.
- Remote access.

Higher National Unit specification: statement of standards (cont)

Unit title: Network Concepts

Evidence requirements

Restricted response test

The knowledge and skills component of Outcome 2 must be examined by sixteen questions, two derived from five of the seven items listed below and three derived from each of the remaining two items. Each question must be derived from a single item.

1. Network protocols.

   TCP/IP, IPX/SPX, NetBEUI, routing, addressing schemes, interoperability, naming conventions

2. TCP/IP protocols.

   IP, TCP, UDP, FTP, TFTP, SMTP, HTTP, HTTPS, POP3/IMAP4, TELNET, ICMP, ARP, NTP

3. OSI reference model.

   OSI layers, operating levels of hubs, switches, bridges, routers, network interface cards.

4. Network services.

   DHCP/bootp, DNS, NAT/ICS, WINS, SNMP

5. WAN technologies.

   Packet switching, circuit switching, ISDN, FDDI, ATM, T1/E1, T3/E3, OCx, Frame Relay, Sonet/SDH

6. Network security.

   IPsec, L2TP, SSL, Kerberos

7. Remote access.

   RAS, PPP, PPTP, ICA

The test may be administered on its own as a subtest or be combined with other outcome subtests in the Unit.

Alternatively, the 16 questions for this outcome may contribute towards a single end-of-unit test of 50 questions.

Logbook

There are no practical tasks relating to Outcome 2.

Assessment guidelines

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

The suggested time allocation for a restricted response test is 2 minutes for each question plus 5 minutes starting-up time and 5 minutes finishing-off time, thus a total of 110 minutes should be allocated for a 50-question end-of-unit test.

Although individual outcome tests are permissible, it is suggested that if subtests are to be used, outcomes should be combined to produce tests of no fewer than 10 questions. A 10-question test would therefore have a time allocation of 30 minutes.

Outcome 3

Implement local area networks.

Knowledge and/or skills

- Server operating systems.
- Client workstations.
- VLANs.
- Network attached storage.
- Fault tolerance and disaster recovery.
- Firewalls and proxy Servers.
- Security measures.
- Remote access.
- Network configuration.

Evidence requirements

Restricted response test

The knowledge and skills component of Outcome 3 must be examined by eighteen questions, two derived from each of the nine items listed below. Each question must be derived from a single item.

Higher National Unit specification: statement of standards (cont)

Unit title: Network Concepts

1. Server operating systems

   Unix/Linux, Netware, Windows, Macintosh, client support, interoperability, authentication, file, print services, application support, security

2. Client workstations

   Connectivity, security, authentication

3. VLANs

Performance, manageability, network tuning, physical topology independence, security options, broadcast limitations, device limitations, port constraints

4. Network Attached Storage

   Optimised file server, reliability, availability, scalability, ease of management. File serving, server consolidation, backup/restore, replication and integration.

5. Fault tolerance and disaster recovery

   RAID1-7, RAID53, hot spare, hot plug/swap, clustering, scalability, high availability, UPS, back-up,

6. Firewalls and proxy servers.

   Firewalls: packet filtering, proxy server, stateful inspection, filters. Proxy Servers: IP, HTTP, FTP, SMTP

7. Security measures

   Blocking port numbers, encryption

8. Remote access

   IP, IPX, dial-up, PPPoE, authentication, physical connectivity

9. Network configuration

   DHCP, DNS, WINS, protocols, NETBIOS/hostname.

The test may be administered on its own as a subtest or be combined with other outcome subtests in the Unit.

Alternatively, the 18 questions for this outcome may contribute towards a single end-of-unit test of 50 questions.

Higher National Unit specification: statement of standards (cont)

Unit title: Network Concepts

Logbook

The logbook for Outcome 3 must record successful completion by the candidate of **both** of the tasks listed below.

- Configuring a remote access connection

  Documentary evidence that the candidate can configure a remote access connection in accordance with a given specification.

- Selecting network configuration settings

  Documentary evidence that the candidate can select network configuration settings in accordance with a given specification.

Assessment guidelines

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

The suggested time allocation for a restricted response test is 2 minutes for each question plus 5 minutes starting-up time and 5 minutes finishing-off time, thus a total of 110 minutes should be allocated for a 50-question end-of-unit test.

Although individual outcome tests are permissible, it is suggested that if subtests are to be used, outcomes should be combined to produce tests of no fewer than 10 questions. A 10-question test would therefore have a time allocation of 30 minutes.

Outcome 4

Provide network support.

Knowledge and/or skills

- Use TCP/IP utilities.
- Troubleshoot network problems.
- Configure clients to connect to servers.

Higher National Unit specification: statement of standards (cont)

Unit title: Network Concepts

Evidence requirements

Restricted response test

The knowledge and skills component of Outcome 4 must be examined by six questions, two derived from each of the three items listed below. Each question must be derived from a single item.

1. Use TCP/IP utilities

   Select appropriate utilities (tracert, ping, arp, netstart, nbtsat, ipconfig, winipcfg, nslookup). Identify and interpret output from utilities.

2. Troubleshoot network problems

   Troubleshooting strategy, troubleshoot problems in different topologies, identify cause of network failures, troubleshoot connectivity problems, interpret visual indicators, troubleshoot wiring/infrastructure problems, select tools.

3. Configure clients to connect to servers

   Unix/Linux, Netware, Windows, Macintosh

The test may be administered on its own as a subtest or be combined with other outcome subtests in the Unit.

Alternatively, the six questions for this outcome may contribute towards a single end-of-unit test of 50 questions.

Logbook

The logbook for Outcome 4 must record successful completion by the candidate of **each of** the three tasks listed below.

1. Use TCP/IP utilities

   Documentary evidence that the candidate can select at least five appropriate utilities (from: tracert, ping, arp, netstart, nbtsat, ipconfig, winipcfg, nslookup) for a specified purpose and identify and interpret the output from these utilities.

Higher National Unit specification: statement of standards (cont)

Unit title: Network Concepts

2. Troubleshoot network problems

   Documentary evidence that the candidate can troubleshoot problems in two different topologies (chosen from: bus, star/hierarchical, mesh, ring, wireless), identify two causes of network failures; troubleshoot two connectivity problems (from: authentication failure, protocol configuration, physical connectivity); interpret visual indicators (link lights, collision lights); troubleshoot wiring/infrastructure problems (bad media, interference, network hardware) and select appropriate tools (wire crimper, media tester/certifier, punch down tool, tone generator, optical tester).

3. Configure clients to connect to servers

   Documentary evidence that the candidate can configure clients to connect to servers, at least two of: Unix/Linux, Netware, Windows NT/2000/2003, Macintosh.

Assessment guidelines

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

The suggested time allocation for a restricted response test is 2 minutes for each question plus 5 minutes starting-up time and 5 minutes finishing-off time, thus a total of 110 minutes should be allocated for a 50-question end-of-unit test.

Although individual outcome tests are permissible, it is suggested that if subtests are to be used, outcomes should be combined to produce tests of no fewer than 10 questions. A 10-question test would therefore have a time allocation of 30 minutes.

Administrative Information

Unit code: DF9P 34

Unit title: Network Concepts

Superclass category: CB

Date of publication: May 2004

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Source: SQA

Additional copies of this Unit specification can be purchased from the Scottish Qualifications Authority. The cost for each Unit specification is £2.50. (A handling charge of £1.95 will apply to all orders for priced items.)

Higher National Unit specification: support notes

Unit title: Network Concepts

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.

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

Outcome 1:	Describe network media and topologies	16 hours
Outcome 2:	Describe network protocols and standards	16 hours
Outcome 3:	Implement local are networks	24 hours
Outcome 4:	Provide network support	24 hours

Guidance on content and context for this Unit

During the delivery of this unit 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.

Although formally taught in this unit, candidates should be aware of the Health and Safety risks to themselves and others that can arise when working with electrical equipment. The risk to equipment from ESD should also be explained. Safe working practices should be explained and demonstrated.

Given the theoretical nature of 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 may assist candidates in preparing for CompTIA examination N10-002: Network+. Vendor certifications can change rapidly and candidates should be encouraged the check the current details at **www.comptia.org** to ensure that all objectives have been covered. This examination can also contribute towards the Microsoft Certified Systems Administrator (MCSA) award.

Outcomes 1 and 2 address the theoretical aspects of the unit and wherever possible the hardware and software involved should be illustrated to candidates, whether by pictures, videos or reality. Where a centre has a network in use, full advantage should be taken of this as a teaching and learning medium. New and emerging aspects of networks should be introduced when they become available.

Higher National Unit specification: support notes (cont)

Unit title: Network Concepts

Outcome 1

Outcome 1 deals with network media and topologies.

1 Logical and physical topologies

Candidates should be aware of the common topologies: star, hierarchical, bus, mesh, ring and wireless and should know the advantages and disadvantages of each and when they should be chosen for uses and when not. Discussion about topologies should cover real world applications.

2 Network technologies

The main features of the technologies should be covered referring to the OSI Reference Model when appropriate. LLC, (802.2), Ethernet (802.3), Token Ring (820.2), Wireless (802.11b) and FDDI should be covered with reference to speed, access method, topology and media.

3 Ethernet characteristics

Characteristics (speed, length, topology, cable type, connector) of Ethernet, 10BASE-T, 100BASE-TX, 10BASE2, 10BASE5, 100BASE-FX should be considered, looking at when and where they should be used in network design. Advantages and disadvantages of cable types (coaxial, twisted pair and fibre optic) should be discussed in detail, with candidates having the opportunity to see and witness the use of different cable types.

4 Media types and connectors

Media type and connectors should be described. Candidates should be shown different connectors including, RJ-11, RJ-45, AUI, BNC, ST and SC and shown on what type of network they can be used.

5 Network components

The purpose, features and functions of network components should be disused and their purpose in a real world network illustrated. It is important that candidates are made aware of when certain components are used and understand how they relate to the OSI Reference Model. Hubs (standard and fast Ethernet), switches, bridges, routers (allowing 2 different network topologies), gateways (hardware and software), CSU/DSU, interface cards, ISDN adapters, System Area Networks, Wireless Access Points, modems (POTS/PSTN, DSL, Cable) should be looked at as to their suitability for various requirements.

Higher National Unit specification: support notes (cont)

Unit title: Network Concepts

Outcome 2

Outcome 2 deals with network protocols and standards. This outcome could be delivered by itself or parts of it can be introduced when covering Outcome 1.

1 Network protocols

Candidates should be able to differentiate between network protocols (TCP/IP, IPX/SPX, NetBEUI, AppleTalk) in terms of routing, addressing schemes, interoperability and naming conventions.

2 TCP/IP protocols

Candidates should be able to define the purpose, function and/or use of the following protocols within TCP/IP: IP, TCP, UDP, FTP, TFTP, SMTP, HTTP, HTTPS, POP3/IMAP4, TELNET, ICMP, ARP, NTP. They should also be able to define the function of TCP/UDP ports and identify well-known ports.

3 OSI reference model

Candidates should be able to identify the seven layers of the OSI model and their functions. Reference should be made to the seven layers of the OSI Model at all times, particularly when discussing hubs, switches, bridges, routers, network interface cards.

4 Network services

Various network services should be looked at (DHCP, DNS, NAT/ICS, WINS, SNMP) and their purpose identified. Candidates should be able to identify IP addresses (IPv4, IPv6) and their default subnet masks. They should also be able to identify the purpose of subnetting and default gateways and identify the differences between public vs. private networks.

5 WAN technologies

Candidates should be able to identify the basic characteristics of WAN technologies, (packet switching, circuit switching, ISDN, FDDI, ATM, Frame Relay, Sonet/SDH, T1/E1, T3/E3) and be able to identify their advantages and disadvantages in varying situations.

6 Network security

The purpose and function of security protocols should be identified and the support of those protocols by industry should be considered. Candidates should be able to identify the following security protocols and describe their purpose and function: IPSec, L2TP, SSL, Kerberos

7 Remote access

Candidates should be able to define the function of the following remote access protocols and services: RAS, PPP, PPTP, ICA.

Outcome 3

Outcome 3 deals with the implementation of local area networks. Candidates should be given the opportunity to install or witness the installation of a variety of LANs. The information learned in Outcomes 1 and 2 should be put to use here. Candidates should be taught how to analyse a client's requirements and be able to offer a number of appropriate solutions. This can be done manually using the advantages and disadvantages of media covered in outcome 1 and 2. Candidates should be able to say which networks are appropriate and why other networks are not appropriates for given situations.

1 Server operating systems

The basic capabilities of UNIX/Linux, NetWare, Windows and Macintosh operating systems should be investigated, looking at as many releases as is practical.

2 Client workstations

Capabilities of client workstations with regard to connectivity, local security and authentication should be discussed and candidate should be able to identify these and their suitability for given situations.

3 VLANs

Benefits of VLANs (bandwidth management, administration costs, workgroups, security) should be introduced.

4 Network attached storage

Characteristics of Network Attached Storage should be introduced and candidates should know how to install this type of storage device.

5 Fault tolerance and disaster recovery

The purpose and characteristics of fault tolerance and RAID hardware and software should be considered. Disaster recovery should be looked at in terms of its purpose and characteristics and how it fits into the network's fault tolerance plan.

6 Firewalls and proxy servers

Candidates should be able to identify the purpose, benefits and characteristics of using firewalls and proxy servers.

7 Security measures

Candidates should be able to identify the appropriate level of security for a given network and this should be implemented.

8 Remote access

Given a remote connectivity scenario (e.g., IP, IPX, dial-up, PPPoE, authentication, physical connectivity etc.) candidates should be able to configure the connection.

9 Network configuration

Candidates should be given as much exposure and practice to the installation of installation different network topologies. Given a network configuration, they should be able to select the appropriate NIC and network configuration settings (DHCP, DNS, WINS, protocols, NETBIOS/host name, etc.).

Outcome 4

1 Use TCP/IP utilities

In Outcome 4, candidates should be given exposure to the various TCP/IP utilities that are available for troubleshooting, specifically tracert, ping, arp, netstart, nbtsat, ipconfig, winipcfg, nslookup. They should be shown their use in problem situations. They should gain analytical skills in their approach to solving network problems and be able to use the most appropriate solution for a number of different situations.

2 Troubleshoot network problems

Candidates should be given exposure to a number of troubleshooting scenarios and be able to solve them both on paper and in reality. These scenarios should include:

- small office/home office network failure (e.g., xDSL, cable, home satellite, wireless, POTS)
- remote connectivity problems (e.g., authentication failure, protocol configuration, physical connectivity).
- examining visual indicators (e.g., link lights, collision lights, etc.)
- examining output from a diagnostic utility (e.g. tracert, ping, ipconfig, etc.)
- impact of modifying, adding, or removing network services (e.g., DHCP, DNS, WINS, etc.)

- networks with a particular physical topology (i.e., bus, star/hierarchical, mesh, ring, and wireless)
- client connectivity problem (e.g., incorrect protocol/client software/authentication configuration, or insufficient rights/permission
- wiring/infrastructure problem (e.g., bad media, interference, network hardware).

Candidates should select an appropriate course of action based on a general troubleshooting that includes the following steps:

1. Establish the symptoms
2. Identify the affected area
3. Establish what has changed
4. Select the most probable cause
5. Implement a solution
6. Test the result
7. Recognize the potential effects of the solution
8. Document the solution

The hardware implementation tasks using tools (wire crimper, media tester/certifier, punch down tool, tone generator, optical tester etc.) could be encompassed in Outcome 3 as part of installing the network, but they should also be used for a problem solving situation.

3 Configure clients to connect to servers

Candidates should be able to configure clients to connect to UNIX/Linux, Netware, Windows or Macintosh servers.

Guidance on the delivery and assessment of this unit

This Unit is likely to form part of a group award which is primarily designed to provide candidates with technical or professional knowledge and skills related to a specific occupational area. It is highly technical in content and should not be adopted by group awards in other areas or delivered as a stand-alone Unit without careful consideration of its appropriateness. It is a Unit which candidates are likely to find accessible at an introductory level; it is suggested that it be delivered part of an HNC or first-year HND program in Computing or a related area, giving candidates experience of basic background topics involved in the hardware and software aspects of computer networks

To minimise assessment overhead, sets of multiple choice questions are used to provide evidence of candidates' knowledge for all Outcomes. It is suggested that multiple-choice questions can be used as the preferred assessment method – as well as reducing the time required for assessment and marking, these reduce the need for candidates to memorise details and encourage understanding. The numbers of questions which must be answered correctly in each assessment correspond to 70% of those set in each case.

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.

For further information and advice, please see *Assessment and Quality Assurance for Open and Distance Learning* (SQA, February 2001 — publication code A1030).

Special needs

This Unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering special alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, 2001).

General information for candidates

Unit title: Network Concepts

This is a 2-credit unit at level 7 and is designed to introduce candidates to the issues involved in installing and supporting networked systems, internal and external to an organisation. It is intended for candidates undertaking an HND in Computing or a related area who require an broad knowledge of networking systems. On completion of the Unit the candidate should be able to:

- Describe network media and topologies
- Describe network protocols and standards
- Implement local area networks
- Provide network support

In the first section you will learn about network media and topologies, including logical and physical topologies (star, hierarchical, bus, mesh, ring and wireless) and the feature of technologies such as LLC, Ethernet, Token Ring, wireless and FDDI. You'll also learn about Ethernet characteristics, media types and connectors and network components such as hubs, switches, routers, bridges, gateways, CSU/DSU, interface cards, ISDN adapters, system area network cards, wireless access points, modems.

In the second section you'll learn about network protocols, including TCP/IP, IPX/SPX and NetBEUI, the seven layers of the OSI reference model, network services, WAN technologies, network security and remote access

In the third section you'll learn how to implement local area networks, including analysing client requirements and specifying appropriate solutions. You'll learn about server operating systems, client workstations, VLANs, network storage, fault tolerance, disaster recovery, security and network settings

In the final section you'll learn how to provide network support, including troubleshooting network problems, configuring servers and carrying out hardware implementation tasks.

There will be one or more closed-book restricted-response assessments covering all outcomes. You will be presented with a total of 50 questions and expected to answer 70% of these correctly. You will also be expected to keep a log book recording the practical tasks you have carried out during the Unit. You must satisfy the requirements for these assessments in order to achieve the Unit.

This Unit may assist you in preparing for CompTIA examination N10-002: Network+. Vendor certifications can change rapidly, so you should check the current details at **www.comptia.org** to ensure that all objectives have been covered. This examination can also contribute towards the Microsoft Certified Systems Administrator (MCSA) award.