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SQA Advanced Unit specification

General information

Unit title: Computer Networks: Building Local Area Networks

Unit code: HP2Y 47

Superclass: CB

Publication date: August 2017

Source: Scottish Qualifications Authority

Version: 01

Unit purpose

This Unit is suitable for candidates who wish to gain the skills and knowledge necessary for Local Area Network design and implementation. The Unit will provide the underpinning theoretical knowledge necessary for an understanding of Local Area Network devices, media, and protocols. The Unit will also look at design methods for Local Area Networks, and provide practical experience in connecting and testing small networks. The Unit will include coverage of network security, and the configuration of basic routers and firewalls. The Unit is intended for candidates who will be working in network support, installation or maintenance, or for those seeking practical and theoretical knowledge of Local Area Networks.

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

1 Describe Local Area Network devices, media, protocols, and safety issues.
2 Design and build Local Area Networks.

Recommended prior knowledge and skills

While entry is at the discretion of the centre, it is recommended that candidates should have relevant work experience or studied relevant Computing or Networking Units at Intermediate 2 or Higher levels. They would also be expected to have completed or be working towards the SQA Advanced Certificate Computing Units HP1T 47 *Computer Systems Fundamentals* and HP1V 47*Troubleshooting Computing Problems*.

Credit points and level

2 SQA 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 National 1 to Doctorates.*

Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the Support Notes of this Unit specification.

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.

This Unit is included in the framework for SQA Advanced Diploma in Computer Networking and SQA Advanced Diploma in Computing: Technical Support and it is recommended the Unit is taught within this context. This Unit could be delivered alongside SQA Advanced Units HP1T 47 *Computer Systems Fundamentals*, HP1V 47 *Troubleshooting Computing Problems*, and HP1M 48 *Networking Technology*.

Unit specification: statement of standards

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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 Local Area Network devices, media, protocols, and safety issues.

Knowledge and/or Skills

- Network models and protocols
- Local Area Network devices
- Local Area Network media
- Identify risks and use of safe working practices in LANs

Evidence Requirements

Evidence for the Knowledge/Skills in this Outcome will be demonstrated by means of a 36 question multiple-choice/multiple-response test, with questions drawn equally from the four bullet points above. The assessment will be closed book and should be completed within 1 hour and 30 minutes. The minimum pass mark is 60%.

The candidates' responses can be judged to be satisfactory when they demonstrate knowledge/skills by adequately describing the following:

- Network models and protocols

The OSI 7-layer network model, including purpose of model and main functions of each layer. The TCP/IP protocol suite model, including comparison with the OSI model, and description of protocols and protocol data Units at each layer. Physical and logical topology of modern Local Area Networks. The CSMA/CD protocol along with current versions of Ethernet, eg 100baseTX, 1000baseT. The operation of TCP at the Transport layer and IP at the Network layer. Current versions of IP addressing, eg IPv4 and IPv6.

- Local Area Network devices

The operation and function of Local Area Network devices should be described. Devices should include hubs/repeaters, switches, routers, network interface cards, and wireless access points. The operation of devices in regards to layers of the OSI and TCP/IP models should also be described.

- Local Area Network media

Types of media used in modern Local Area Networks should be described. This includes Twisted Pair and fibre optic cable, as well as wireless. Types of UTP used in variants of Ethernet, in the context of the different UTP categories and their relevant applications. Pin-outs and use of straight-through, crossover, and rollover UTP cable. A description should be made of the current EIA/TIA cabling standards. Patch panels and equipment racks should be described. Modes and types of fibre optic cable should be described, as well as currently used Wi-Fi standards, eg versions of 802.11.

- Identify risks and use of safe working practices in LANs

Health and Safety issues relating to working with Local Area Networks should be described. This includes protection of equipment from anti-static damage, and the prevention of injury from electric shock and fire. Portable Appliance Testing regulations should be described as should the use of plenum cabling and other measures to prevent the spread of smoke in the event of fire.

Outcome 2

Design and build Local Area Networks.

Knowledge and/or Skills

- Analyse user requirements and design appropriate Local Area Network solutions
- Prototype and test Local Area Network solutions

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- analyse user requirements and design appropriate Local Area Network solutions.

The candidate will be provided with a representative range of scenarios. At least one example of each of the following four different scenarios must be completed successfully:

1 Cabled LAN connected with a single hub or switch, or a Wireless LAN connected with a single Access Point.
2 Cabled LAN connected with a single hub or switch, and interconnected to a Wireless LAN connected with a single Access Point.
3 Two or more LANs interconnected through a router.
4 One or more LANs connected to the Internet through a firewall.

For each scenario, the candidate must produce a short report that analyses the user requirements and proposes a suitable outline design specification for a solution. This report must include:

(a) A summary of requirements, current provision and proposed solution.
(b) A specification of all additional equipment and software which will be required, including details of costs and suppliers.
(c) Physical and logical layout diagrams, cut sheet, and description of the proposed network design including hardware, cabling, installation and layout.
(d) A specification of all software and network protocols and configuration to be implemented.

♦ Prototype and test Local Area Network solutions

Once the design specification for each scenario has been successfully completed, the candidate should now implement a small prototype test network to simulate all the significant characteristics of the specification.

For each scenario, the candidate will submit evidence to satisfy this element in the form of at least one completed log for each item of work. Logs may be based on a pro-forma given to the candidate, but should include:

(a) A brief outline of the task presented.
(b) An outline note of all work carried out and any software configuration, (eg router and firewall set up) performed.
(c) Any relevant sketch diagrams, lists, tables etc., (eg equipment locations and interconnections, connector orientations, protocol configuration).
(d) Details and results of testing carried out.
(e) A note of problems (if any) encountered and their solutions.

As an alternative to paper-based methods, candidates can provide a digital record of evidence to demonstrate Knowledge and/or Skills. Suggested approaches are outlined in the Support Notes, *Guidance on the assessment of this Unit.*

Unit specification: support notes

Unit title: Computer Networks: Building Local Area Networks

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 OSI and TCP/IP models for networking should be introduced, and the functions of each layer explained. Network devices should be placed in context with the OSI and TCP/IP layers. The role of the Network/Internet and Transport layers should be discussed in detail, with particular reference to, and description of, networking systems and standards such as TCP/IP. In particular, current versions of IP, eg IPv4, IPv6 should be described in detail and candidates made familiar with concepts involved in IP sub-netting and routing. The CSMA/CD protocol should be described along with current versions of Ethernet, eg full-duplex, and Gigabit Ethernet.

Candidates should be made familiar with currently used network media including UTP, fibre optic and wireless. In particular candidates should be able to identify types of UPT cables by pin-out, eg straight-through, crossover, and rollover.

It is essential that candidates are made aware from the outset of the Health and Safety risks to themselves and others that can arise in working with electrical equipment. The risks to equipment from ESD should also be explained. Safe working practices, which balance these two problems, should then be explained and demonstrated. This is particularly important if candidates will be working in an anti-static environment or using anti-static equipment, which significantly increases Health and Safety risks if improperly used. The importance of strict adherence to safe working practices should be stressed throughout the programme of study.

While it is expected that candidates will work predominantly with Windows PCs, as wide a range of systems as is possible should be used. In particular, experience of mixed networking with PCs, Linux systems, and Apple Macs would be beneficial.

Guidance on the delivery of this Unit

Candidates should participate in exercises to connect at least two physically compatible networks segments together. Candidates should have the opportunity to work with a current UTP segment, eg 100baseTX or 1000baseT, and a wireless segment implemented with a current standard, eg 802.11n.

Candidates should interconnect two physically distinct LANs using a router. Candidates must have the opportunity to learn in detail how to configure such devices for basic routing. Industry-standard equipment such as Cisco is ideal, but centres will find that other systems, eg built around dual-homed PCs running Linux variants, or Windows Server will suffice.

Candidates should connect at least one LAN to the Internet using a router which is capable of being configured as a firewall. This could be an industry-standard router, eg Cisco, or a dedicated hardware device. The candidates should be able to configure the router for traffic filtering and Network Address Translation. Where a real Internet connection is not possible it is acceptable to simulate Internet access by access to a lab based PC.

Guidance on the assessment of this Unit

Candidates who have access to a suitable workplace can base their assessment work on suitable operational situations drawn from their place of work.

Where a workplace situation is used, care should be taken to ensure that it would provide candidates with sufficient opportunity to meet the Evidence Requirements of the Unit. It may be appropriate for the assessor concerned to ensure beforehand that a particular workplace will allow candidates to generate sufficient and suitable evidence. It will also be necessary to ensure that the required controlled conditions for assessment can be provided in order to ensure the validity of candidates' evidence.

Assessment Guidelines

Outcome 1

Centres are encouraged to explore opportunities for delivering the multiple-choice/multiple-response assessment online.

Outcome 2

It is important to distinguish between the specification required for a scenario and the test (or prototype) network constructed by the candidate. Regardless of the scale of the 'real' LAN which is designed, candidates must learn how to prototype and simulate this in the lab as closely as possible using only a few PCs and a minimum of equipment. This provides 'proof of concept' and permits safe and economical configuration and testing of the main hardware and software elements in the design. It is not expected that candidates should try to build the 'real' network in its entirety.

As an alternative to paper-based methods, candidates could provide a digital record of evidence to demonstrate Knowledge and/or Skills. This could include digital logs and screenshots, audio and video narratives, and methods for capturing desktop activity.

Online and Distance 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.

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).*

Opportunities for developing Core Skills

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.

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 to Unit

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: Computer Networks: Building Local Area Networks

This Unit is designed to enable you to work effectively in a network installation or technical support role. It prepares you for this task by providing you with the underpinning knowledge required to understand the operation of modern network equipment and software as well as Health and Safety issues, industrial practice and standards. You will then gain practical experience in implementing typical networks using industry-standard equipment and protocols, leading onto interconnecting networks at both the physical and logical levels, including routing and basic firewall implementation.

On completion of the Unit you should be able to:

1 Describe Local Area Network devices, media, protocols, and safety issues.
2 Design and build Local Area Networks.

There are two assessments. The first is a multi-choice assessment that tests your knowledge of Local Area Network devices, media, protocols, and safety issues. The minimum pass mark is 60%. The second contains a series of short assignments testing your practical abilities, and requires you to produce short design reports and complete a number of pro-forma log sheets to document your practical work. All assessment will be carried out in supervised conditions, and the written assessments will be closed book, (ie you will not be allowed to bring any notes, etc with you to the assessment event).

You will produce evidence for your success in practical tasks by maintaining a log using pro-forma record sheets. You will receive more detailed guidance on the content, style and quality required for your log entries during your progress though the Unit. Your assessor will observe you carrying out the assessment tasks, and will certify on each of your logs that it is your own work, whether it is satisfactory and whether you have carried out the work properly with regard to Health and Safety requirements.