SQA Advanced Unit specification: general information for centres

Unit title: Switching Technology

Unit code: HP1L 48

Superclass: CB

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Version: 01

Unit purpose

The purpose of this unit is to provide candidates with an understanding of how a switch communicates on a network, how switches are interconnected and configured with other networking devices in a small- or medium-sized business network, which includes implementing VLAN segmentation integrating wireless devices into a LAN. It is intended for candidates undertaking an SQA Advanced Certificate or SQA Advanced Diploma in Computing, Computer Networking or a related area, who require a detailed understanding of switching technology.

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

1 Describe LAN architecture.
2 Describe and configure basic switching technology.
3 Describe and configure advanced switching technologies.
4 Describe and configure basic wireless LANs.

Credit points and level

2 SQA credits 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.*

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 HP1M 48 Networking Technology and HP1J 48 Routing Technology.

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. 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 could 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.

Unit specification: statement of standards

Unit title: Switching 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 LAN architecture.

Knowledge and/or Skills

- Describe media access control on switched networks.
- Describe LAN architecture in switched networks.
- Describe concepts of LAN design.
- Interpret network diagrams.
- Select media, cables, ports and connectors used to connect switches to other network devices.

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 and configure basic switching technology.

Knowledge and/or Skills

- Describe switched LAN architecture
- Describe Ethernet LANs
- Describe frame forwarding techniques
- Describe frame management and security
- Configure basic switched Local Area Networks

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 configure advanced switching technologies.

Knowledge and/or Skills
- Describe virtual Local Area Networking concepts via switching.
- Describe VTP concepts and operation.
- Describe spanning tree concepts.
- Describe Inter-VLAN routing concepts and troubleshooting.
- Configure advanced switching.

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 and configure basic wireless LANs.

Knowledge and/or Skills
- Describe basic wireless LANs.
- Describe basic wireless LAN security.
- Configure basic wireless LANs.

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 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 skills component must be assessed by completion of a practical exercise that requires that the candidate can:

- select common equipment used to connect switches to other network devices. This should include:
  - media
  - cables
  - ports
  - connectors

- configure basic switched Local Area Networks.
  - This should include performing an initial switch configuration to allow communication between two hosts.

- configure advanced switching.
  - This should include initial switch configuration tasks including remote access management

- configure a basic wireless LAN.
  - This should include configuration of the basic parameters to configure a wireless network and the troubleshooting of common implementation issues.

Assessment guidelines for the unit

Testing for the knowledge component 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. Centres are recommended to create a coverage grid to highlight which questions cover which knowledge bullet points to assist in the assessment process.

The practical skills assessment could be evidenced by the completion of a logbook or observation checklist.

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

Unit specification: support notes

Unit title: Switching 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 10 hours
Outcome 2 20 hours
Outcome 3 30 hours
Outcome 4 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 HP1M 48 Networking Technology, HP1J 48 Routing Technology and HP1N 48 Internetworking Technology) may assist candidates in preparing for the Cisco Certified Network Associate examination. Candidates should be encouraged to check the latest information at www.cisco.com to ensure that all objectives have been covered.

The unit is primarily intended to provide candidates with detailed knowledge of basic and advanced switching and wireless techniques, as such there are three practical-based outcomes enabling candidates to apply the knowledge gained during this unit in a practical environment, detail of these are outlined later in these support notes.

Outcome 1

Outcome 1 concentrates on the architecture of switched networks and introduces candidates to the methods that hosts use to access media e.g. CSMA/CD. Candidates are introduced to the fundamental aspects of designing local area networks. In particular, hierarchical network design utilising the core-distribution-access layer model. Candidates also will learn how to select media, cables, ports and the common connectors used to connect switches to other network devices.

Outcome 2

Outcome 2 provides candidates with an introduction to basic switching techniques and provides them with the skills to configure them. In Outcome 2 the following items should be covered — switch forwarding methods such as fast forward, cut through and store and forward, symmetric and asymmetric switching, memory buffering, layer 2 and layer 3 switching.

The candidate should also perform the following practical tasks which should be recorded on a log book as well as an assessor checklist.

Performing an initial switch configuration to allow communication between two hosts including:

- clearing an existing configuration from a switch
- assignment of management IP address
- assignment of appropriate default gateway
- configuration of appropriate passwords on the switch
- verification of configuration

Outcome 3

Outcome 3 provides candidates with an introduction to advanced switching techniques. It presents four main important switching concepts, VLANs, VTP, STP and inter-VLAN routing.

VLANs

The candidate will learn about the types of VLANs used in modern switched networks. It is important that they understand the role of the default VLAN, user/data VLANs, native VLANs, the management VLAN, and voice VLANs. VLAN trunks with IEEE 802.1Q tagging facilitate inter-switch communication with multiple VLANs. The candidate will learn to configure, verify and troubleshoot VLANs and trunks.

VTP

VTP is used to exchange VLAN information across trunk links, reducing VLAN administration and configuration errors. VTP allows you to create a VLAN once within a VTP domain and have that VLAN propagated to all other switches in the VTP domain. VTP pruning limits the unnecessary propagation of VLAN traffic across a LAN by determining which trunk ports forward which VLAN traffic. Candidates will learn to configure, verify, and troubleshoot VTP implementations.

STP

STP makes it possible to implement redundant physical links in a switched LAN by creating a logical loop-free layer 2 topology. By default most switches implement STP in a per-VLAN fashion. The configuration of STP is fairly straightforward, but the underlying processes are quite complicated. IEEE 802.1D defined the original implementation of spanning tree protocol. IEEE 802.1w defined an improved implementation of spanning tree called rapid spanning tree protocol. RSTP convergence time is approximately five times faster than convergence with 802.1D. RSTP introduces several new concepts, such as link types, edge ports, alternate ports, backup ports, and the discarding state. The candidate will learn to configure both the original IEEE 802.1D implementation of STP as well as the newer IEEE 802.1w implementation of spanning tree.

Inter-VLAN Routing

Inter-VLAN routing is the process of routing traffic between different VLANs. The candidate will learn the various methods of inter-VLAN routing and how to implement inter-VLAN routing in the router-on-a-stick topology, where a trunk link connects a layer 2 switch to a router configured with logical subinterfaces paired in a one-to-one fashion with VLANs.

The candidate should also perform the following practical tasks which should be recorded on a log book as well as an assessor checklist:

- perform and verify initial switch configuration tasks, including remote access management
- configure, verify, and troubleshoot VLANs, VTP, trunking and inter-VLAN routing on a network with at least **five** hosts and **four** VLANs including the management VLAN

Outcome 4

In Outcome 4 the candidate will learn about wireless LAN standards. These standards are evolving for voice and video traffic, with newer standards being supported with quality of service. The candidate will learn that an access point connects to the wired LAN provides a basic service set to client stations that associate to it. SSIDs and MAC filtering are inherently insecure methods of securing a WLAN. Enterprise solutions such as WPA2 and 802.1x authentication enable very secure wireless LAN access. End users have to configure a wireless NIC on their client stations which communicates with and associates to a wireless access point. When configuring a wireless LAN, candidates will learn that they should ensure that the devices have the latest firmware so that they can support the most stringent security options.

The candidate should also perform the following practical tasks which should be recorded on a log book as well as an assessor checklist:

- configure the basic parameters to configure a wireless network
- troubleshoot common implementation issues

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 intermediate level; it is suggested that it be delivered only as part of a second year SQA Advanced Diploma program in Computing, Computer Networking or a related area. It should be delivered in tandem with other Computing Units and opportunities for teaching and assessment integration explored.

It is recommended the unit is delivered in the second year of the SQA Advanced Diploma program as candidates will already be exposed to some of the terminology and concepts. Candidates should complete HP1M 48 Networking Technology and HP1J 48 Routing Technology prior to beginning this unit.

Although the unit is expressed in generic terms, it could be used as a vehicle to deliver the Cisco Networking Academy Program CCNA Semester 3 syllabus in a classroom environment. It is consistent with the latest version of the CCNA Exploration curriculum.

It is recommended the unit should be assessed by two instruments of assessment, a multiple-choice/mulitiple-response test covering the knowledge and understanding and a checklist or logbook detailing the practical work undertaken. This approach to assessment is reflective of current professional exams in the IT industry and helps prepare candidates for vendor exams should they choose to undertake these.

The questions applicable to each outcome are to be used to form a single end-of-unit test comprising a total of fifty questions. Centres cannot deviate from this where they choose to devise their own instruments of assessment. A sample of 50% of knowledge areas should be examinable in any test set.

In order to complete practical elements of the course centres will need routers and switches. It is recommended as a minimum centres provide at least five routers and two switches per class. These may be supplemented with network simulation software.

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).

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 are no opportunities to develop Core Skills in this unit.

Equality and inclusion

The unit specifications making up this group award have been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners will 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: Switching Technology

This is a 2 SQC Credit unit at SCQF level 8 intended for candidates undertaking a Computing or IT-related qualification who requires an understanding of switched networks. It is designed to develop an understanding of the issues involved in installing, configuring and troubleshooting switched LANs. On completion of the unit you should be able to:

- Describe LAN architecture
- Describe and configure basic switching technology
- Describe and configure advanced switching technologies
- Describe and configure basic wireless LANs

In the first part of the course, you will study the principles of LAN architecture and design methods for switched networks.

In the second part of the course, you will learn about basic switching techniques and the practical skills you need to configure them. This includes such areas as switch forwarding methods such as fast forward, cut through and store and forward, symmetric and asymmetric switching, memory buffering, layer 2 and layer 3 switching.

The practical skills you will gain include performing an initial switch configuration to allow communication between two hosts including:

- clearing an existing configuration from a switch
- assignment of management IP address
- assignment of appropriate default gateway
- configuration of appropriate passwords on the switch
- verification of configuration

In the third part of the course you will learn about advanced switching techniques. This section covers four main important switching concepts, VLANs, VTP, STP and inter-VLAN routing.

You will also learn the following practical skills, perform and verify initial switch configuration tasks including remote access management, configure, verify, and troubleshoot VLANs, VTP, trunking and inter-VLAN routing on a network with at least **five** hosts and **four** VLANs including the management VLAN.

In the fourth part of the course you will learn about wireless LAN standards. These standards are evolving for voice and video traffic, with newer standards being supported with quality of service.

You will learn that an access point connects to the wired LAN provides a basic service set to client stations that associate to it. SSIDs and MAC filtering are inherently insecure methods of securing a WLAN. Enterprise solutions such as WPA2 and 802.1x authentication enable very secure wireless LAN access.

End users have to configure a wireless NIC on their client stations which communicates with and associates to a wireless access point.

When configuring a wireless LAN, candidates will learn that they should ensure that the devices have the latest firmware so that they can support the most stringent security options. You will also perform practical tasks that include:

- configuring the basic parameters to configure a wireless network
- how to troubleshoot common implementation issues

There will be a closed-book multiple-choice/multiple-response assessment covering all outcomes. You will answer at least 60% of the questions correctly in order to achieve a pass.