

## **SQA Advanced Unit specification: general information**

**Unit title:** Routing Technology

**Unit code:** HP1J 48

**Superclass:** CB

**Publication date:** August 2017

**Source:** Scottish Qualifications Authority

**Version:** 01

### **Unit purpose**

The purpose of this unit is to provide candidates with an understanding of the basic theory of common contemporary interior gateway routing protocols and to implement these on routers designed to support small to medium-sized enterprises. It is intended for candidates undertaking an SQA Advanced Certificate or an SQA Advanced Diploma in Computer Networking, or a related area, who require a basic understanding of routing technology.

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

- 1 describe router fundamentals.
- 2 describe contemporary IP addressing schemes.
- 3 describe the operation of common contemporary interior gateway routing protocols.
- 4 implement a routed network topology.

### **Recommended prior knowledge and skills**

Access to the unit will be at the discretion of the centre. There are no specific requirements but candidates would benefit from possession of an SQA Advanced Unit in Networking Technology, or equivalent knowledge.

### **Credit points and level**

2 SQA credit(s) 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.*

## **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.

## **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 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. 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.

The skills component of the unit will be assessed by a practical exercise. This assessment could be evidenced by the completion of a logbook or a checklist.

## Unit specification: statement of standards

### Unit title: Routing 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 router fundamentals.

#### Knowledge and/or Skills

- ◆ Describe the purpose and functions of a router in a network.
- ◆ Describe router interfaces.
- ◆ Describe router system components and their functions.
- ◆ Describe a router boot-up process (sequence).
- ◆ Describe the layer 2 network discovery method.
- ◆ Explain a routing table structure.

#### 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 contemporary IP addressing schemes.

#### Knowledge and/or Skills

- ◆ Explain IPv4 classful and classless addressing.
- ◆ Explain IPv6 addressing.

#### 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 the operation of common contemporary interior gateway routing protocols.

#### Knowledge and/or Skills

- ◆ Explain static routing.
- ◆ Describe the classification of common contemporary routing protocols.
- ◆ Describe the features and operation of a range of contemporary interior gateway routing protocols.

#### 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

Implement a routed network topology.

#### Knowledge and/or Skills

- ◆ Design and justification of an IP addressing scheme for a given network topology.
- ◆ Selection and justification of an appropriate routing scheme for a given network topology.
- ◆ Implementation of a routed network for a given network topology.

#### 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 of the unit will be assessed by a practical exercise implementing a routed network topology. In the assessment candidates should be given a network scenario brief with the following minimum requirements to resolve:

- ◆ a requirement for at least two discrete local area networks to be connected via a routed topology.
- ◆ a requirement for at least two routers in the topology to be connected via WAN links.
- ◆ a requirement to implement a suitable IP addressing strategy taking into account the efficient use of IP address space.
- ◆ a requirement to implement a static/default/dynamic routing strategy.
- ◆ a requirement to verify successful inter and intra communication between hosts on the networks.

In addition the candidate must provide a brief justification (approximately 500 words) of the chosen IP addressing scheme and routing scheme.

## Assessment guidelines for the unit

Testing for the closed-book assessment can be done in either a machine-based or paper-based format and must be invigilated by a tutor or 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 for each assessment attempt to highlight which questions cover which knowledge and skills bullet points and to assist in the assessment and re-assessment process.

The skills component of the unit will be assessed by a practical exercise implementing a routed network topology. This assessment could be evidenced by the completion of a logbook. This may be supported by an observation checklist. A simple report could be suitable evidence for the justification. The logbook can be in paper or electronic form and must be authenticated by the assessor/tutor or mentor.

## Unit specification: support notes

### Unit title: Routing 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	20 hours
Outcome 2	10 hours
Outcome 3	30 hours
Outcome 4	20 hours

This unit is intended to provide candidates with the basic skills to configure a router for deployment in small to medium size enterprises. In addition to this specific skill set the unit is also intended to provide candidates with the basic understanding of the operation of contemporary dynamic routing protocols and under which circumstances to deploy them.

This unit, in conjunction with the related Units: Networking Technology, Switching Technology and Internetworking Technology, may assist candidates in preparing for the relevant Cisco Certified Network Associate (CCNA) examinations.

#### Outcome 1

The first outcome puts the unit into context for the candidate by describing the role of a router in a network. Primary functions such as packet forwarding and best path determination are introduced. Contemporary router LAN and WAN interfaces are described together with their respective media characteristics.

The router start-up process is described including operating system location and loading and the locating and configuring of specific router settings to allow routing to operate.

A Layer 2 OSI model network discovery method is described. This may be vendor specific or vendor neutral and will be dependent on the resources within centres.

The structure of a routing table is described with particular reference to the identification of routing table entries, their classification and associated metrics.

#### Outcome 2

Legacy IP addressing schemes such as IPv4 classful and classless are described. In particular the limitations of classful addressing and the requirement for VLSM and CIDR techniques are outlined.

The requirement for the IPv6 addressing scheme is described together with features such as address space, address assignment and simplified processing by routers.

### Outcome 3

The requirement for static routing is described. In addition the classification of legacy and contemporary routing protocols is defined, for example, Distance Vector and Link State, vendor-specific (EIGRP) and vendor-neutral (OSPF).

Contemporary interior gateway routing protocols are described. In particular, their choice and use of metrics, method of convergence, algorithm for path determination and mechanism to avoid common routing problems such as routing loops.

### Outcome 4

The culmination of this outcome will be the implementation of a routed network from a given scenario. This will involve the candidate in designing an appropriate IP addressing scheme to allow all end devices on the network to be able to communicate with each other. In tandem with this the candidate will require to choose a routing scheme, for example a combination of static and dynamic routing, to allow data to be routed between end devices.

The router user interface (CLI or GUI) and relevant commands are introduced and demonstrated.

## 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 knowledge and skills related to the support of computer networked environments. It is highly technical in content and should not be delivered as a stand-alone unit without careful consideration of its appropriateness.

It is recommended candidates seeking entry to this unit should have completed the SQA Advanced Unit HP1M 48 in Networking Technology.

The unit is expressed in generic terms and seeks to allow flexibility in delivery with respect to available resources.

The Routing content of the Cisco Networking Academy Programme CCNA Exploration curriculum may be used as a vehicle to deliver the unit content.

## Open learning

This unit could be delivered by distance learning. In this instance centres would have to ensure the authenticity of candidate evidence by applying the same assessment conditions to open learning students.

## 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

Outcomes 2 and 4 may allow candidates to develop numeric skills through the hexadecimal and binary numerical computations required in the design of IP addressing schemes.

## 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](http://www.sqa.org.uk/assessmentarrangements).



## History of changes

Version	Description of change	Date

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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: Routing Technology

This 2 SQA Credit, SCQF Level 8 unit is intended to provide you with the basic skills to configure a router for deployment in small- to medium-sized enterprises. In addition to this specific skill set the unit is also intended to provide you with the basic understanding of the operation of contemporary dynamic routing protocols and under which circumstances to deploy them.

The unit is intended for candidates undertaking a technical computing related qualification.

On completion of the unit you should be able to:

- ◆ describe router interfaces and system components.
- ◆ describe the role of a router in a network.
- ◆ describe router boot sequence.
- ◆ describe layer 2 network discovery method.
- ◆ describe routing table structure.
- ◆ describe ipv4 classful and classless addressing.
- ◆ describe ipv6 addressing.
- ◆ describe static routing.
- ◆ describe the classification of common contemporary routing protocols.
- ◆ describe the features and operation of a range of contemporary interior gateway routing protocols.

The routing content of the Cisco Networking Academy Programme CCNA Exploration curriculum, may be used as a vehicle to deliver the unit content.

### Outcome 1

The first outcome puts the unit into context by describing the role of a router in a network. Primary functions such as packet forwarding and best path determination are introduced. Contemporary router LAN and WAN interfaces are described together with their respective media characteristics.

The router start-up process is described including operating system location and loading and the locating and configuring of specific router settings to allow routing to operate.

A layer 2 OSI model network discovery method is described. This may be vendor specific or vendor neutral and will be dependent on the resources within centres.

The structure of a routing table is described with particular reference to the identification of routing table entries, their classification and associated metrics.

### Outcome 2

Legacy IP addressing schemes such as IPv4 classful and classless are described. In particular the limitations of classful addressing and the requirement for VLSM and CIDR techniques are outlined.

The requirement for the IPv6 addressing scheme is described together with features such as address space, address assignment and simplified processing by routers.

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### Outcome 4

The culmination of this outcome will be the implementation of a routed network from a given scenario. This will involve you in designing an appropriate IP addressing scheme to allow all end devices on the network to be able to communicate with each other. In tandem with this you will require to choose a routing scheme, for example a combination of static and dynamic routing, to allow data to be routed between end devices.

The router user interface (CLI or GUI) and relevant commands are introduced and demonstrated.

## Assessment

There will be two forms of assessment within this unit.

### Outcomes 1 to 3

The Knowledge and Understanding component of the unit will be assessed as a single end-of-unit test.

This format of this test will be decided by your centre and will be timed, supervised and conducted under closed-book conditions.

You must answer at least 60% of the questions correctly in order to obtain a pass.

### Outcome 4

This outcome will assess the skills component of the unit and will take the form of a practical activity where you will be required design and implement a routed network for a given scenario. The format of the evidence you must produce will be decided by your centre, but is likely to take the form of a logbook or observation checklist.