

# Next Generation Higher National Unit Specification

## Cloud Computing (SCQF level 8)

**Unit code:** J6CC 48  
**SCQF level:** 8 (16 SCQF credit points)  
**Valid from:** session 2023–24

### **Prototype unit specification for use in pilot delivery only (version 1.0) June 2023**

This unit specification provides detailed information about the unit to ensure consistent and transparent assessment year on year.

This unit specification is for teachers and lecturers and contains all the mandatory information required to deliver and assess the unit.

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## **Unit purpose**

This unit introduces learners to the principles and practice of cloud computing in the context of various data science scenarios.

Although this is a non-specialist unit for learners with an interest in this area, it is particularly suitable for those studying a Higher National Diploma (HND) in Data Science. It may also be appropriate to deliver within other group awards, where there is a requirement for a more involved knowledge of the cloud.

The unit covers the principles of what the cloud is, as well as its uses in a networking, data storage, data security, auditing, and monitoring context. Learners are introduced to cloud service automation.

Completing this unit gives learners knowledge in using various cloud services to an intermediate level. They use that knowledge to configure solutions to a range of data science problems. This aids progression into mid-level vendor certification study.

## Unit outcomes

Learners who complete this unit can:

- 1 use cloud services to build LAN and WAN networks
- 2 use cloud services for secure and robust data storage
- 3 use tools to monitor cloud services
- 4 use commands to automate cloud service delivery

## Evidence requirements

Learners must provide both knowledge and product evidence.

### Knowledge evidence

Learners should produce the knowledge evidence without help. They must demonstrate that they have met all the knowledge points listed in the 'Knowledge and skills' section.

Knowledge evidence can be written, oral or a combination of both. The amount of evidence can be the minimum required to infer competence. When an exam is used, it must be carried out under supervised conditions and controlled in terms of location and time. Learners cannot access reference material under exam conditions.

### Product evidence

Product evidence must contain cloud configurations that include:

- ◆ configuration of a simple network infrastructure containing at least three virtual machines, only one of which is internet accessible, and:
  - is secure to all but required traffic
  - implements load balancing and DNS
  - shows evidence of server recovery
- ◆ configuration of a relational database to include redundancy and load balancing — a backup of the database should then be made, and disaster recovery performed and verified
- ◆ creation and testing of database queries to extract data from multiple tables, including some which span at least two separate relational databases
- ◆ configuration of cloud-based object storage to include replication and storage of previous versions of data
- ◆ configuration of individual cloud user accounts with different levels of service access — these should then be tested
- ◆ configuration of service monitoring to allow the maintenance of different user activity and configure appropriate events to mitigate against undesirable activity
- ◆ configuration of new or reconfigured existing cloud infrastructure using a command-line tool

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Learners can produce product evidence over an extended period, under lightly controlled conditions, with access to learning materials. Authentication is required.

The standard of evidence should be consistent with the SCQF level of this unit.

You should use appropriate level descriptors when making judgements about the evidence.

## Knowledge and skills

The following table shows the knowledge and skills covered by the unit outcomes:

Knowledge	Skills
<p>Learners should understand:</p> <ul style="list-style-type: none"> <li>◆ cloud network infrastructure components</li> <li>◆ cloud network infrastructure firewalls</li> <li>◆ cloud network load balancing</li> <li>◆ cloud data availability</li> <li>◆ cloud content delivery networks</li> <li>◆ cloud autoscaling</li> <li>◆ cloud relational database concepts</li> <li>◆ cloud non-relational database concepts</li> <li>◆ cloud database redundancy</li> <li>◆ cloud database autoscaling</li> <li>◆ cloud database load balancing</li> <li>◆ cloud disaster recovery mechanisms</li> <li>◆ cloud object-based storage</li> <li>◆ cloud storage access controls</li> <li>◆ cloud object-based storage replication</li> <li>◆ cloud object-based storage previous versions</li> <li>◆ the principles of cloud account management including user setup and access permissions</li> <li>◆ the importance of cloud usage monitoring</li> <li>◆ the importance of cloud monitoring events</li> <li>◆ how the command line can be used to automate cloud service configuration</li> </ul>	<p>Learners can:</p> <ul style="list-style-type: none"> <li>◆ configure and correctly place multiple cloud-based servers within a network infrastructure</li> <li>◆ configure cloud network access control mechanisms</li> <li>◆ configure network load balancing across multiple servers</li> <li>◆ configure a content delivery network</li> <li>◆ configure relational databases</li> <li>◆ configure non-relational databases</li> <li>◆ configure autoscaling of virtual servers and databases</li> <li>◆ configure redundancy in a database</li> <li>◆ configure autoscaling in a database</li> <li>◆ configure load balancing in a database</li> <li>◆ configure database backup and recovery</li> <li>◆ create and run queries using multiple tables across different databases</li> <li>◆ configure object-based storage</li> <li>◆ configure access controls for object-based storage</li> <li>◆ configure cross-replication for object-based storage</li> <li>◆ configure previous versions for object-based storage</li> <li>◆ configure cloud user accounts with different levels of service access</li> <li>◆ configure cloud service usage and data flows</li> <li>◆ configure event triggers and actions in response to undesirable events</li> <li>◆ configure cloud resources using a command-line interface</li> </ul>

## **Meta-skills**

Throughout the unit, learners develop meta-skills to enhance their employability in the data science sector.

### **Self-management**

Learners must select appropriate cloud service components and focus on the specific configurations necessary to solve a given problem. You should encourage them to research alternative cloud providers' solutions to problems to gain a more rounded awareness of what is available, while adhering to the cost implications of those alternatives.

### **Social intelligence**

Cloud computing offers natural opportunities for teamworking. An example of this could be different learners developing separate parts of an infrastructure, and connecting their configurations together to produce a solution.

### **Innovation**

Learners become aware of the power cloud computing services offer over more traditional physical alternatives. They develop the ability to evaluate cloud solutions over traditional solutions and be aware of which one is best in different circumstances.

## **Literacies**

Throughout this unit, learners have opportunities to develop their literacy skills.

### **Numeracy**

Learners need to understand cloud service costing calculations.

### **Communication**

You can give learners the opportunity to work together in teams and create a unified solution from their individual efforts.

### **Digital**

This unit contributes towards digital skills.

## Delivery of unit

This unit introduces learners to cloud services and does not rely on any previous knowledge or skills. You have opportunities to integrate this with networking and database classes and have the choice to use cloud services for these units.

We suggest the following distribution of time:

**Outcome 1** — Use cloud services to build LAN and WAN networks  
(20 hours)

**Outcome 2** — Use cloud services for secure and robust data storage  
(20 hours)

**Outcome 3** — Use tools to monitor cloud services  
(20 hours)

**Outcome 4** — Use commands to automate cloud service delivery  
(20 hours)

## Professional recognition

This unit does not aim towards any specific cloud service provider or their examinations, but it gives learners part of the knowledge required to take any of the entry-level certifications offered by cloud service providers.

## Additional guidance

The guidance in this section is not mandatory.

When delivering this unit, it is important that you introduce real-world examples of how cloud services can solve real-world problems. You should present concepts and terminology in a problem-solving context.

This unit is practical in nature, so you should make a significant amount of time for tutorials and to allow a level distribution of practical assessment. You should strongly encourage learners to do further reading of cloud service provider documents, and provide opportunities for individual or group research, particularly for the theoretical parts. Make learners aware that this unit teaches the basics, but each cloud service provides more advanced features, if required.

There are no restrictions on the cloud supplier you use and you should introduce alternatives. If centres choose to use Amazon Web Services (AWS) Educate, learners can complete all outcomes in an AWS environment at no cost. You can use the Microsoft Azure service as an alternative.

This unit may help learners partially prepare for vendor certifications, such as AWS Cloud Practitioner or Cloud Solutions Architect Associate. You can deliver this unit using vendor-supplied materials, however, as these materials are under continuous development, you should check carefully to ensure that they meet all the unit requirements. If you use vendor materials, some of the tasks involved may contribute towards the practical assessments.

We recommend that you deliver the outcomes in numerical order:

### **Use cloud services to build LAN and WAN networks (outcome 1)**

You should teach learners how to provision a variety of servers with different operating systems pre-installed on them. Teach them how to create networks that contain both public and private components, both as LAN and WAN configurations. They should then enhance these networks to incorporate load balancing and autoscaling.

Learners should be capable of provisioning a pair of load-balanced web servers containing basic websites, and configuring appropriate DNS infrastructure to facilitate ease of access.

They should also be familiar with virtual machine backup, backup management and restoration in the event of a disaster recovery.

If using the AWS service, learners should be familiar with the underlying network infrastructure components such as:

Virtual Private Cloud, Subnets, Internet Gateways, Security Groups, Network Access Control Lists, Elastic Load Balancing, Network-Address Translation Gateways and Amazon Elastic Compute Cloud (Amazon EC2) instances, running both Linux and Amazon EC2 operating systems.



## **Use cloud services for secure and robust data storage (outcome 2)**

You should teach learners how to provision and connect to both relational and non-relational cloud database services. They should configure these databases for failover, autoscaling and load balancing. Introduce them to the additional load balancing technique of creating a read-only database configuration.

Learners should understand the procedure for database backup and restoration and have the skills required to cope with disaster recovery.

They should be capable of configuring a load-balanced database to offer redundancy or availability and of autoscaling its storage to meet unexpected demand.

You should also teach learners database query techniques involving multiple tables distributed across several database instances.

You should emphasise security, to ensure only appropriate traffic passes through.

If using AWS Educate, learners should become familiar with the Amazon Relational Database Service (Amazon RDS) and how it can provide relational database functionality to end users. They can use a variety of database vendor software as a learning platform for the query element.

The non-relational database platform could be Amazon DynamoDB, which provides a simple, NoSQL platform that is easy to configure and query.

You should teach learners how to configure object storage on the cloud and how to secure access to it according to requirements. Discuss storage security encryption technologies, as well as ways of securing data as it is uploaded and downloaded between the client and the storage service. You should discuss data replication techniques, as well as the maintenance of previous versions for disaster recovery.

If using AWS Educate, learners should be familiar with the Amazon Simple Storage Service (Amazon S3) bucket service and its ability to support replication and previous versions.

## **Use tools to monitor cloud services (outcome 3)**

You should teach learners how to set up users with access to appropriate cloud services using permission controls. They should also be aware of their responsibility when using cloud services and the pitfalls of getting things wrong.

If using the AWS Educate service, learners should be familiar with the AWS Identity and Access Management (IAM) service and its ability to support the creation of users, groups, roles, and permissions.

Teach them how to monitor cloud account usage and traffic flows, including the creation of appropriate audit logs and traffic logs. They also need to know how to configure appropriate events to mitigate against undesirable service usage.

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If using the AWS Educate service, learners should be familiar with the AWS CloudWatch and CloudTrail services to monitor usage and trigger appropriate events in response to unexpected events. They can use the Amazon Simple Notification Service (SNS) to deal with notifications.

### **Use commands to automate cloud service delivery (outcome 4)**

Learners should be familiar with how to access the cloud using the command line. They should be able to perform basic cloud infrastructure automation tasks as well as resource management.

If using the AWS Educate service, learners should be familiar with the AWS Command-Line Interface (CLI) to create cloud infrastructure.

## **Possible assessment evidence**

### **Knowledge evidence**

Evidence for the entire unit can be produced using a set of 20 multiple-choice questions to assess knowledge and understanding.

This could be in either a machine-based or paper-based format, and there must be an invigilator. There must be no communication between learners, and communication with the invigilator must be restricted to matters relating to the administration of the exam.

If you need to re-assess a learner, you must use a different selection of questions.

### **Product evidence**

This evidence can be produced over an extended period of time, under lightly controlled conditions and learners can have access to learning materials. Authentication is required, for example learner initials should appear as part of all configuration evidence.

### **Outcome 1**

Learners configure a simple network infrastructure containing at least three virtual machines, for example, an internet accessible bastion host and two internal load-balanced web servers. The two web servers should be accessible only from the bastion host and learners should configure a cloud DNS service to facilitate this. One of the web servers should be backed up, and a restoration made. Apart from required traffic, learners should secure the network to minimise its attack surface.

### **Outcome 2**

Learners configure a relational database for redundancy and load balancing. They should make a backup of the database, and perform and verify disaster recovery.

Also, learners configure two separate relational databases with individual tables in each. They should run a selection of queries, joining together both tables.

Finally, learners create the configuration of a cloud-based object storage. They should configure replication and maintenance of previous versions in the object storage.

### **Outcome 3**

Learners configure individual cloud user accounts with different levels of service access. They should test these and log configurations.

Also, learners configure service monitoring to allow the logging of different user activity and appropriate events to mitigate against undesirable activity.

### **Outcome 4**

Learners use the cloud command line to create various cloud resources and verify their creation. They then perform a re-configuration using it, terminating resources at the command line.

To do this, learners could maintain a portfolio. They could produce it over the life of the unit, adding their best work as-and-when they produce it. This could be done under lightly controlled conditions, but authentication would be required.

Another way would be for learners to create a digital log to record their learning journey through the unit.

Alternatively, you could deliver the practical assessments holistically, for example, as part of a case study.

## **Equality and inclusion**

This unit is designed to be as fair and as accessible as possible with no unnecessary barriers to learning or assessment.

You should take into account the needs of individual learners when planning learning experiences, selecting assessment methods or considering alternative evidence.

Guidance on assessment arrangements for disabled learners and/or those with additional support needs is available on the [assessment arrangements web page](#).

## Information for learners

### Cloud Computing (SCQF level 8)

This section explains:

- ◆ what the unit is about
- ◆ what you should know or be able to do before you start
- ◆ what you need to do during the unit
- ◆ opportunities for further learning and employment

### Unit information

In this unit you learn the principles and practice of cloud computing. It is intended for those with an interest in the area, but with little or no previous knowledge, but who wish to learn cloud computing beyond the absolute basics. It is particularly suitable if you are studying a Higher National Diploma (HND) in Data Science. However, it may also be appropriate for other qualifications at SCQF level 8 that require a general knowledge of the cloud.

You cover the principles of what the cloud is, as well as its uses in networking and data storage, with the emphasis on its use in storing and analysing data. You also learn various security and monitoring techniques to allow you to use the cloud safely and securely, and the fundamentals of using commands to automate cloud tasks.

Although there is a theoretical part, the unit is mostly practical in nature. It places emphasis on teaching you how to use services that provide solutions to real-world problems in data science. On completion of this unit, you should have an understanding of how cloud services can solve data science problems.

Assessment can be a combination of a closed book, multiple-choice exam, and practical assessments. The multiple-choice exam covers the underpinning theory of the services discussed, while the practical assessments give you the opportunity to perform several cloud-oriented tasks.

The unit also provides opportunities for you to enhance your meta-skills in self-management, social intelligence, and innovation.

# Administrative information

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**Superclass:** CB

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## History of changes

Version	Description of change	Date

Note: please check [SQA's website](#) to ensure you are using the most up-to-date version of this document.