

# Next Generation Higher National Unit Specification

## Virtualisation Technologies (SCQF level 8)

**Unit code:** J7E0 48  
**SCQF level:** 8 (16 SCQF credit points)  
**Valid from:** session 2022–2023

### **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 specialist unit introduces learners to the key concepts and benefits of virtualised environments in modern computing. Learners experience virtualisation at the desktop level and gain competence in using virtualisation technologies for storage and processing. Learners also consider the contribution that virtualisation makes to cloud computing.

The unit should be of interest to a wide range of learners, but especially those studying computing science or other computing topics. Learners are not required to have prior experience of virtualised environments, although it is helpful if they already have an understanding of computer systems and networks at SCQF level 7.

When they complete the unit, learners can progress to other related topics such as cloud computing at SCQF level 8 and higher.

## Unit outcomes

Learners who complete this unit can:

- 1 describe key trends and benefits of virtualisation technologies
- 2 explain the functionalities of a range of virtualisation technologies
- 3 demonstrate the use of software as a service and compare SaaS providers
- 4 demonstrate virtualisation on a stand-alone computer
- 5 use platform as a service to build and deploy a virtual machine
- 6 demonstrate the use of a remote virtual machine

## Evidence requirements

Learners must provide knowledge and product evidence. The knowledge evidence must include all knowledge statements.

The knowledge evidence can be sampled when testing is used, but must include questions on:

- ◆ a key driver of virtualisation technologies
- ◆ a recent development in virtualisation technologies
- ◆ a benefit of using virtualisation technologies
- ◆ a security challenge relating to virtualisation technologies.
- ◆ a virtualisation product, choosing from VMware, Hyper-V or Citrix
- ◆ difference between virtualisation and containerisation
- ◆ characteristics of each of Software as a service (SaaS), Infrastructure as a service (IaaS) and Platform as a service (PaaS)
- ◆ a feature of application (app) virtualisation
- ◆ a feature of data virtualisation
- ◆ virtualisation challenges
- ◆ the function of hypervisors in cloud computing
- ◆ the function of software-defined networking
- ◆ a use of network function virtualisation
- ◆ a functionality of a kernel-based virtual machine (KVM)

Where sampling is used, learners must produce their knowledge evidence under test conditions in terms of location, timing, and access to reference materials.

The product evidence must include:

- ◆ the demonstration of the use of two SaaS services and a comparative report
- ◆ the demonstration of virtualisation on a personal computer
- ◆ the use of a cloud service to build and deploy a virtual machine
- ◆ the deployment of an app to a virtual machine
- ◆ the remote connection to a virtual machine to run an app
- ◆ the shutdown and de-allocation of a virtual machine

Learners can produce their product evidence over an extended period of time in lightly controlled conditions that give learners access to learning materials. Evidence produced in lightly controlled conditions must be authenticated. The [Guide to Assessment](#) provides further advice on methods of authentication.

## 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>◆ virtualisation, including:                             <ul style="list-style-type: none"> <li>— concepts</li> <li>— evolution, drivers, and trends</li> <li>— benefits (efficiency and scalability)</li> <li>— security and other issues</li> </ul> </li> <li>◆ storage virtualisation (server)</li> <li>◆ computer virtualisation, including:                             <ul style="list-style-type: none"> <li>— hypervisors (types 1 and 2)</li> <li>— desktops (local, and virtual desktop infrastructure (VDI))</li> <li>— central processing unit (CPU) and graphics processing unit (GPU)</li> </ul> </li> <li>◆ data virtualisation, including:                             <ul style="list-style-type: none"> <li>— data warehousing</li> <li>— data loading and data availability</li> </ul> </li> <li>◆ app virtualisation, including:                             <ul style="list-style-type: none"> <li>— app streaming</li> <li>— server-based apps</li> </ul> </li> <li>◆ networking and virtualisation, including:                             <ul style="list-style-type: none"> <li>— software-defined networking</li> <li>— network function virtualisation</li> </ul> </li> <li>◆ virtualisation challenges, including:                             <ul style="list-style-type: none"> <li>— security</li> <li>— Virtual machine (VM) threats</li> </ul> </li> <li>◆ virtualisation products, including:                             <ul style="list-style-type: none"> <li>— VMware (server, desktop, network and storage)</li> <li>— Hyper-V, (server, desktop)</li> <li>— Citrix (app, server, desktop)</li> </ul> </li> <li>◆ KVM, including:                             <ul style="list-style-type: none"> <li>— host CPU and guest OS</li> </ul> </li> <li>◆ virtual apps</li> </ul>	<p>Learners can:</p> <ul style="list-style-type: none"> <li>◆ demonstrate virtualisation on a personal computing device</li> <li>◆ demonstrate the use of a SaaS service</li> <li>◆ build and deploy a virtual machine using a cloud service (PaaS)</li> <li>◆ deploy a web server and connect it to a virtual machine.</li> <li>◆ connect remotely to a virtual machine</li> <li>◆ shut down and de-allocate a virtual machine</li> </ul>

<b>Knowledge</b>	<b>Skills</b>
<p>Learners should understand:</p> <ul style="list-style-type: none"><li>◆ virtualisation and cloud computing, including:<ul style="list-style-type: none"><li>— IaaS</li><li>— PaaS</li><li>— SaaS</li></ul></li><li>◆ the comparison between virtualisation and containerisation, including the comparison between hypervisor and container engine</li></ul>	

## Meta-skills

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

Meta-skills are developed throughout the delivery of the unit, especially when learners are collating product evidence.

## Social intelligence

This meta-skill includes:

- ◆ focusing: the capacity to receive complex information and apply it effectively
- ◆ adapting: working with others to collaborate on finding solutions to problems and sharing results
- ◆ initiative: showing empathy when addressing conceptual misunderstandings, with a readiness to get a solution

## Innovation

This meta-skill includes:

- ◆ curiosity: a desire to know how virtualisation technologies are used and deployed

## Delivery of unit

While the exact time allocated is at your centres discretion, the notional design length is 80 hours.

**Outcome 1** — Describe key trends and benefits of virtualisation technologies  
(15 hours)

**Outcome 2** — Describe the functionalities of a range of virtualisation technologies  
(20 hours)

**Outcome 3** — Demonstrate the use of SaaS and compare SaaS providers  
(10 hours)

**Outcome 4** — Demonstrate virtualisation on a stand-alone computer  
(5 hours)

**Outcome 5** — Use PaaS to build and deploy a VM  
(15 hours)

**Outcome 6** — Demonstrate the use of a remote VM  
(15 hours)



## Additional guidance

The guidance in this section is not mandatory.

### Content and context for this unit

The unit generates broader skills in learning for sustainability, especially in systems-thinking and skills for work. As virtualisation technologies are heavily used in industry, learners should consider how they can contribute to sustainability in a workplace context.

Learners must have access to hardware and software so that they can experience the power of virtualisation and acquire skills in the deployment of virtual machines. This includes hypervisors and cloud services (SaaS and PaaS).

Explain that the key benefits for virtualisation technologies are cost savings through reduction in hardware costs, better utilisation of computing resources, easier disaster recovery and improved security. Discuss recent trends in virtualisation, including container virtualisation, hybrid cloud, edge computing and multi-cloud services.

Explain how the combination of hardware advancements, increased demand for IT agility, cost savings, improved security, and the availability of open-source virtualisation solutions have all played a role in driving the development and adoption of virtualisation technology.

Explain the benefits of virtualisation technologies, including cost savings through reduced hardware and energy costs, a reduction in the number of physical servers, easier backup and restore of data, and easier deploy and scale of apps.

Teach learners about the security challenges that arise from virtualisation, including insecure networks, data breaches, and insider threats. Explain that virtual machines require management and configuration to ensure they remain isolated while sharing physical resources. Hypervisor vulnerabilities can also be exploited.

Explain that virtualisation and containerisation are two different approaches to software deployment and management. The key differences between them include resource utilisation, extent of isolation, resource overhead to run, portability and security. Virtualisation is well-suited for legacy apps, while containerisation is ideal for cloud apps and microservices.

SaaS provides access to software apps, PaaS provides a platform for app development and deployment, and IaaS provides access to computing resources.

Learners should experience the use of SaaS and PaaS, using web-based apps and apps hosted on a virtual desktop. You should cover the technology of app virtualisation, as well as its benefits, such as the elimination of compatibility issues and the ease of deployment. Explain app streaming and server-based apps and the difference between them in terms of where the app is run.

Explain that storage virtualisation abstracts physical storage resources into a virtual storage infrastructure. This makes virtualisation simpler to allocate, manage, and scale storage resources, based on the needs of the apps and services that are running on the virtualised

infrastructure. You should cover the characteristics and benefits of data virtualisation — that it enables the abstraction of data from its physical storage location and allows data from multiple sources to be integrated and accessed as if it were a single, unified data store. Benefits include better data governance and increased efficiency. You should also cover data warehousing, loading and data availability.

Explain the challenges of virtualisation, including the need for high performance hardware, security risks from shared resources, complexity of management, data protection, and licensing policies. You should cover the main functions and features of a hypervisor. You should also cover network architecture features such as software-defined networking (SDN) and network function virtualisation (NFV), and explain their contribution to implementation of cloud virtualisation.

Describe the KVM and its use in virtual server deployment and VDI. Describe its benefits and use cases.

There are a few ways to experiment with deploying a web server or connecting to a virtual machine without incurring a cost:

- ◆ Use a cloud-based platform: Some cloud providers, such as Amazon Web Services (AWS) and Google Cloud Platform, offer free tiers that allow learners to run web servers for a limited time without incurring a cost.
- ◆ Use virtual machines: Learners can use virtualisation software like VirtualBox or VMware Workstation to set up a virtual machine on their personal computer and experiment with deploying a web server on it.
- ◆ Use a pre-configured virtual machine image: There are many pre-configured virtual machine images available online that you can use to experiment with deploying a web server, such as Bitnami's LAMP (Linux, Apache, MySQL, PHP) stack.
- ◆ Use a free web hosting service: There are many free web hosting services that allow learners to host simple websites and experiment with deploying web servers. However, these services typically have limitations on the amount of storage and bandwidth available, as well as restrictions on the types of content that can be hosted.

By using one of these methods, learners can gain hands-on experience and build their skills in this area.

## **Approaches to assessment**

Learners can record their progress using digital means, for example an e-portfolio or blog. Knowledge evidence could take the form of a report or a presentation. Learners should demonstrate that they have carried out significant research using reliable sources. They should evaluate the information gathered in their report or presentation. The size of the report and the length of the presentation should be set at a level appropriate to SCQF level 8.

Alternatively, evidence could be generated by a question paper, taken under controlled conditions with no access to support or learning materials. In this case the exam should

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cover the minimum required for sampling as set out in the evidence requirements. A pass mark of 70% should be set for such tests.

While the product evidence could be obtained through a set of tasks or assignments, it is recommended that you assess learner knowledge and skills in creating and managing virtualisation environments by providing a scenario and a brief that requires learners generate all the product evidence that they require.

The software used when learning concepts and skills should be the primary tools required when generating product evidence. The recording of progress in completing the brief could be in an e-portfolio that includes images and videos that evidence the learner demonstrating the required knowledge and skills.

## **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:

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

## Information for learners

### Virtualisation Technologies (SCQF level 8)

This information 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

This specialist unit introduces you to the key concepts and benefits of virtualisation environments in modern computing. It is particularly suitable if you have a vocational interest in STEM-based subjects or wish to progress to higher education and/or vendor qualification-based computing subjects. You should have a basic understanding of computer systems and networks at SCQF level 7 before starting this unit.

You develop knowledge and skills in using various virtualisation technologies, as well as an understanding of the evolution and key developments with these technologies. Assessment involves demonstrating your practical skills and knowledge and understanding of the concepts and methods of virtualisation. Meta-skills in social intelligence and innovation are developed through building and deploying virtualisation technologies.

When you finish the unit, you have the competence to select, create and use a virtual machine at both desktop level and in the cloud.

The unit provides the knowledge and skills you need to proceed with more advanced units in virtualisation technologies and cloud computing.

# 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.