



Higher National Unit specification: general information

Unit title: Open Source Operating Systems: Advanced Server Administration

Unit code: H18D 35

Superclass: CD

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Unit purpose

This Unit is suitable for candidates who wish to build upon their existing Open Source Operating System skills and knowledge to learn important aspects of advanced server administration. The Unit is intended for candidates who will be working in an Open Source Operating System environment in technical support, software development, or who would like to gain advanced skills in operating a server running Open Source Operating System software.

This Unit provides a useful preparation for candidates going on to study the Unit *Open Source Operating Systems: Advanced Network Services Administration* H18F 35.

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

- 1 Configure the kernel and manage system startup.
- 2 Administer storage devices and filesystems.
- 3 Configure and troubleshoot network settings.

Recommended prior knowledge and skills

While entry is at the discretion of the centre, it is recommended that candidates should have relevant experience in working with an Open Source Operating System, or studied relevant HN Computing Units, eg *Open Source Operating Systems: Introduction to Command Line Administration* H18C 35, *Open Source Operating Systems: Basic Server Administration* H18E 35

General information (cont)

Credit points and level

1 Higher National Unit credit at SCQF level 8: (8 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 Access 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 as an option in the framework for HND Computing: Technical Support and it is recommended the Unit is taught within this context.

Higher National Unit specification: statement of standards

Unit title: Open Source Operating Systems: Advanced Server Administration

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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

Configure the kernel and manage system startup.

Knowledge and/or Skills

- ◆ Implement kernel components
- ◆ Carry out kernel compilation
- ◆ Patch a kernel
- ◆ Customise a kernel
- ◆ Manage and query kernel modules
- ◆ Customise system startup
- ◆ Perform system recovery

Evidence Requirements

Evidence for the Knowledge/Skills in this Outcome will be demonstrated by means of an 18 question multiple-choice/short-response test. The test should consist of approximately one third MCSA (multi-choice single answer), one third MCMA (multi-choice multiple answers), and one third short-response questions. The amount of questions which should be drawn from each of the bullet points above is given by the numbers in brackets. The assessment will be closed book and should be completed within 35 minutes. The minimum mark required to pass the test is 60%. The test could be incorporated into a single test which also covers Outcomes 2 and 3.

Questions should be drawn from the Knowledge and Skills areas as follows:

Implement kernel components (2)
Carry out kernel compilation (2)
Patch a kernel (1)
Customise a kernel (2)
Manage and query kernel modules (3)
Customise system startup (4)
Perform system recovery (4)

Higher National Unit specification: statement of standards (cont)

Unit title: Open Source Operating Systems: Advanced Server Administration

Outcome 2

Administer storage devices and filesystems.

Knowledge and/or Skills

- ◆ Configure and mount filesystems
- ◆ Maintain an open source filesystem
- ◆ Create and configure filesystems
- ◆ Use open source OS device manager
- ◆ Configure software RAID
- ◆ Configure storage device settings
- ◆ Manage logical volumes
- ◆ Build and install programs from source
- ◆ Carry out system backups

Evidence Requirements

Evidence for the Knowledge/Skills in this Outcome will be demonstrated by means of a 23 question multiple-choice/short-response test. The test should consist of approximately one third MCSA (multi-choice single answer), one third MCMA (multi-choice multiple answers), and one third short-response questions. The amount of questions which should be drawn from each of the bullet points above is given by the numbers in brackets. The assessment will be closed book and should be completed within 45 minutes. The minimum mark required to pass the test is 60%. The test could be incorporated into a single test which also covers Outcomes 1 and 3.

Questions should be drawn from the Knowledge and Skills areas as follows:

- Configure and mount filesystems (4)
- Maintain an open source filesystem (3)
- Create and configure filesystems (2)
- Use open source OS device manager (1)
- Configure software RAID (2)
- Configure storage device settings (1)
- Manage logical volumes (3)
- Build and install programs from source (4)
- Carry out system backups (3)

Higher National Unit specification: statement of standards (cont)

Unit title: Open Source Operating Systems: Advanced Server Administration

Outcome 3

Configure and troubleshoot network settings.

Knowledge and/or Skills

- ◆ Configure wired and wireless network connections
- ◆ Configure and troubleshoot advanced network setups
- ◆ Identify and correct common network problems
- ◆ Inform users about system issues
- ◆ Configure a basic DNS server
- ◆ Create and configure DNS zones
- ◆ Configure DNS server security

Evidence Requirements

Evidence for the Knowledge/Skills in this Outcome will be demonstrated by means of a 19 question multiple-choice/short-response test. The test should consist of approximately one third MCSA (multi-choice single answer), one third MCMA (multi-choice multiple answers), and one third short-response questions. The amount of questions which should be drawn from each of the bullet points above is given by the numbers in brackets. The assessment will be closed book and should be completed within 40 minutes. The minimum mark required to pass the test is 60%. The test could be incorporated into a single test which also covers Outcomes 1 and 2.

Questions should be drawn from the Knowledge and Skills areas as follows:

Configure wired and wireless network connections (3)
Configure and troubleshoot advanced network setups (4)
Identify and correct common network problems (5)
Inform users about system issues (1)
Configure a basic DNS server (2)
Create and configure DNS zones (2)
Configure DNS server security (2)

Higher National Unit specification: support notes

Unit title: Open Source Operating Systems: Advanced Server Administration

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 40 hours.

Guidance on the content and context for this Unit

This Unit is an optional Unit for HND Computing: Technical Support and it is expected it will be delivered in this context. It is also suitable for any candidates wishing to learn advanced usage of the UNIX/Linux command line environment.

The Unit *Open Source Operating Systems: Advanced Server Administration* H18D 35 should preferably be undertaken after the Units *Open Source Operating Systems: Introduction to Command Line Administration* H18C 35 Unit, and *Open Source Operating Systems: Basic Server Administration* H18E 35 though it is not a prerequisite.

The *Open Source Operating Systems: Advanced Server Administration* H18D 35 Unit covers the objectives of the LPIC-2 (Linux Professional Institute Certificate 2) exam 201. The objectives of the LPIC-2 exam 202 map to the Unit *Open Source Operating Systems: Advanced Network Services Administration* H18F 35.

The following is a list of suggested content for each Outcome. This includes activities which should help candidates achieve the relevant skills/knowledge, and also a list of files, terms and utilities which may be covered.

Outcome 1

Implement kernel components

Use kernel documentation (current versions kernel 2.6.x or kernel 3.x), and identify and implement various kernel images and modules suitable for specific hardware platforms and scenarios.

Files, terms and utilities could include:

- ◆ /usr/src/linux
- ◆ /usr/src/linux/Documentation
- ◆ zImage
- ◆ bzImage

Higher National Unit specification: support notes (cont)

Unit title: Open Source Operating Systems: Advanced Server Administration

Carry out kernel compilation

Compile/recompile Linux kernels (current versions kernel 2.6.x or kernel 3.x) and configure kernels to enable or disable features. Configure and use kernel make targets, GRUB boot loaders and initrd images.

Files, terms and utilities could include:

- ◆ mkinitrd
- ◆ mkinitramfs
- ◆ make
- ◆ make targets (config, xconfig, menuconfig, oldconfig, mrproper, zImage, bzImage, modules, modules_install)

Patch a kernel

Use kernel makefiles and patch/unpatch a kernel to support hardware changes.

Files, terms and utilities could include:

- ◆ patch
- ◆ gzip
- ◆ bzip2

Customise a kernel

Build and install new kernel (current versions kernel 2.6.x or kernel 3.x) including modules, and customise existing kernel for existing system requirements. Configure boot manager for kernel and associated files.

Files, terms and utilities could include:

- ◆ patch
- ◆ make
- ◆ module tools
- ◆ /usr/src/linux/*
- ◆ /usr/src/linux/.config
- ◆ /lib/modules/kernel-version/*
- ◆ /boot/*
- ◆ make targets: all, config, menuconfig, xconfig, gconfig oldconfig, modules, install, modules_install, depmod, rpm-pkg, binrpm-pkg, deb-pkg

Manage and query kernel modules

Query current versions of kernel (current versions kernel 2.6.x or kernel 3.x) and kernel modules. Determine module parameters and load/unload modules by filename or other name.

Higher National Unit specification: support notes (cont)

Unit title: Open Source Operating Systems: Advanced Server Administration

Files, terms and utilities could include:

- ◆ /lib/modules/kernel-version/modules.dep
- ◆ module configuration files in/etc
- ◆ /proc/sys/kernel/
- ◆ depmod
- ◆ insmod
- ◆ lsmod
- ◆ rmmod
- ◆ modinfo
- ◆ modprobe
- ◆ uname

Customise system startup

Customise system startup to query and modify system services at different runlevels. Configure init to initiate and change between different runlevels

Files, terms and utilities could include:

- ◆ /etc/inittab
- ◆ /etc/init.d/
- ◆ /etc/rc.d/
- ◆ chkconfig
- ◆ update-rc.d

Perform system recovery

Use init and inittab to control the system during boot process and recovery mode. Demonstrate understanding of use of GRUB in the boot process.

Files, terms and utilities could include:

- ◆ init
- ◆ mount
- ◆ fsck
- ◆ telinit

Higher National Unit specification: support notes (cont)

Unit title: Open Source Operating Systems: Advanced Server Administration

Outcome 2

Configure and mount filesystems

Configure and navigate the standard Linux filesystem and understand use of UUIDs (Universally Unique Identifiers). Configure fstab file and use tools and utilities to handle SWAP partitions and files.

Files, terms and utilities could include:

- ◆ /etc/fstab
- ◆ /etc/mtab
- ◆ /proc/mounts
- ◆ mount and umount
- ◆ sync
- ◆ swapon
- ◆ swapoff

Maintain an open source filesystem

Use system utilities to maintain Linux filesystems including ext2, ext3, ext4, ReiserFS, and XFS.

Files, terms and utilities used could include:

- ◆ fsck (fsck.*)
- ◆ badblocks
- ◆ mkfs (mkfs.*)
- ◆ dumpe2fs, xfsdump, xfsrestore
- ◆ debugfs, debugreiserfs
- ◆ tune2fs, reiserfstune
- ◆ mkswap
- ◆ xfs_info, xfs_check and xfs_repair

Create and configure filesystems

Use AutoFS to automatically mount filesystems for devices including CD-ROMs. Filesystems include UDF, ISO9660, HFS, and filesystem extensions Joliet, Rock Ridge and El Torito.

Files, terms and utilities used could include:

- ◆ /etc/auto.master
- ◆ /etc/auto.[dir]
- ◆ mkisofs
- ◆ dd
- ◆ mke2fs

Higher National Unit specification: support notes (cont)

Unit title: Open Source Operating Systems: Advanced Server Administration

Use open source OS device manager

Detect and manage devices using the udev device manager, and troubleshoot udev rules.

Files, terms and utilities used could include:

- ◆ udevmonitor
- ◆ /etc/udev

Configure software RAID

Configure and use software RAID (redundant array of Inexpensive Disks) levels 0, 1, and 5.

Files, terms and utilities used could include:

- ◆ mdadm.conf
- ◆ mdadm
- ◆ /proc/mdstat
- ◆ fdisk

Configure storage device settings

Configure kernel options and view and modify settings for various storage devices including IDE, ATAPI, SCSI, and SATA. Use tool and utilities including hdparm and sdparm.

Files, terms and utilities used could include:

- ◆ hdparm
- ◆ sdparm
- ◆ tune2fs
- ◆ sysctl
- ◆ /dev/hd* & /dev/sd*

Manage logical volumes

Create, remove, resize and rename logical and physical volumes and volume groups. Create backups using LVM (Logical Volume manager) snapshots.

Files, terms and utilities used could include:

- ◆ /sbin/pv*
- ◆ /sbin/lv*
- ◆ /sbin/vg*
- ◆ mount
- ◆ /dev/mapper/

Higher National Unit specification: support notes (cont)

Unit title: Open Source Operating Systems: Advanced Server Administration

Build and install programs from source

Use compression/decompression utilities to unpack file of sources. Run configure scripts to generate Makefile settings. Use make to build and install an executable file.

Files, terms and utilities used could include:

- ◆ /usr/src/
- ◆ gunzip
- ◆ gzip
- ◆ bzip2
- ◆ tar
- ◆ configure
- ◆ make
- ◆ uname
- ◆ install

Carry out system backups

Use system tools to back up files and system data to various backup media. Use open source backup solutions, eg Amanda, Bacula. Carry out full and partial backups and restores and verify integrity of backups.

Files, terms and utilities could include:

- ◆ /bin/sh
- ◆ cpio
- ◆ dd
- ◆ tar
- ◆ /dev/st* and /dev/nst*
- ◆ mt
- ◆ rsync

Higher National Unit specification: support notes (cont)

Unit title: Open Source Operating Systems: Advanced Server Administration

Outcome 3

Configure wired and wireless network connections

Configure network interface card IP and default gateway to connect to wired or wireless LANs (Local Area Networks), and WANs (Wide Area Networks). Communicate between various subnets within a single network including both IPv4 and IPv6 networks.

Files, terms and utilities could include:

- ◆ /sbin/route
- ◆ /sbin/ifconfig
- ◆ /sbin/ip
- ◆ /usr/sbin/arp
- ◆ /sbin/iwconfig
- ◆ /sbin/iwlist

Configure and troubleshoot advanced network setups

Configure a network device for network authentication and as VPN client. Configure a multi-homed device and manipulate routing tables. Monitor and analyse status of network devices and network TCP/IP traffic.

Files, terms and utilities could include:

- ◆ /sbin/route
- ◆ /sbin/ifconfig
- ◆ /bin/netstat
- ◆ /bin/ping
- ◆ /usr/sbin/arp
- ◆ /usr/sbin/tcpdump
- ◆ /usr/sbin/lsof
- ◆ /usr/bin/nc
- ◆ /sbin/ip
- ◆ /etc/openvpn/*
- ◆ openvpn
- ◆ nmap
- ◆ wireshark

Higher National Unit specification: support notes (cont)

Unit title: Open Source Operating Systems: Advanced Server Administration

Identify and correct common network problems

Troubleshoot common network problems and recognise locations of configuration files and commands. Configure the system initialisation (Sys V init) process. Use utilities to gain information about network configuration and hardware devices.

Files, terms and utilities could include:

- ◆ /sbin/ifconfig
- ◆ /sbin/route
- ◆ /bin/netstat
- ◆ /etc/network || /etc/sysconfig/network-scripts/
- ◆ System log files such as /var/log/syslog & /var/log/messages
- ◆ /bin/ping
- ◆ /etc/resolv.conf
- ◆ /etc/hosts
- ◆ /etc/hosts.allow & /etc/hosts.deny
- ◆ /etc/hostname | /etc/HOSTNAME
- ◆ /bin/hostname
- ◆ /usr/sbin/traceroute
- ◆ /usr/bin/dig
- ◆ /bin/dmesg
- ◆ /usr/bin/host

Inform users about system issues

Communicate with users through logon messages and inform users about system issues, eg system maintenance.

Files, terms and utilities could include:

- ◆ //etc/issue
- ◆ /etc/issue.net
- ◆ /etc/motd
- ◆ wall
- ◆ /sbin/shutdown

Configure a basic DNS server

Configure and manage BIND as a caching-only DNS server. Convert older BIND configurations to BIND 9.x. Configure logging and manage BIND configuration files, terms and utilities.

Files, terms and utilities could include:

- ◆ /etc/named.conf
- ◆ /var/named/*
- ◆ /usr/sbin/rndc
- ◆ kill

Higher National Unit specification: support notes (cont)

Unit title: Open Source Operating Systems: Advanced Server Administration

Create and configure DNS zones

Create zone files for forward or reverse zone or root level servers, and delegate zones to another DNS server. Set values for records, add hosts to zones, and use utilities to query DNS server. Know location of BIND configuration files, and use common terms and utilities.

Files, terms and utilities could include:

- ◆ /var/named/*
- ◆ zone file syntax
- ◆ resource record formats
- ◆ dig
- ◆ nslookup
- ◆ host

Configure DNS server security

Secure a DNS server by configuring it to run as non-root user, and run in a chroot jail. Configure BIND forwarders statement, and exchange data securely between DNS servers. Configure and use transaction signatures (TSIG, and sign zones using DNSSEC.

Files, terms and utilities could include:

- ◆ /etc/named.conf
- ◆ /etc/passwd
- ◆ DNSSEC
- ◆ dnssec-keygen

Guidance on the delivery of this Unit

Although there is no practical Outcome, it is recommended that candidates are given extensive hands-on experience using the UNIX/Linux command line. This will aid them to acquire the skills/knowledge required to complete the Unit. The Unit is generic and could be delivered using one of the many packages or versions of UNIX/Linux available. The choice of Operating System version is at the discretion of the delivering centre though care should be taken that the version chosen allows all Evidence Requirements to be achieved.

Guidance on the assessment of this Unit

Assessment for the Unit can take the form of credit transfer after successfully passing the LPIC-2 201 exam. Alternatively assessment could take the form of a centre devised multi-choice/short-response test that satisfactorily covers the Evidence Requirements described in the Outcome section earlier.

Assessment Guidelines

The assessments should be done under closed-book conditions. Centres are encouraged to explore opportunities for delivering the multi-choice/short-response test assessments online.

Higher National Unit specification: support notes (cont)

Unit title: Open Source Operating Systems: Advanced Server Administration

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 is no automatic certification of Core Skills or Core Skill components in this Unit.

Disabled candidates and/or those with additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website www.sqa.org.uk/assessmentarrangements

History of changes to Unit

Version	Description of change	Date

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General information for candidates

Unit title: Open Source Operating Systems: Advanced Server Administration

This Unit is designed to give you advanced skills and knowledge needed to operate a server using an Open Source Operating System environment.

The Unit will provide you with the underpinning theoretical knowledge necessary to perform operations, such as customise an open source kernel, manage storage devices and troubleshoot a network server. The Unit is intended for candidates who will be working in a Unix/Linux environment in technical support, or software development, or who would like to gain a practical understanding of operating a server in an Open Source OS environment.

On completion of the Unit you should be able to:

- 1 Configure the kernel and manage system startup.
- 2 Administer storage devices and filesystems.
- 3 Configure and troubleshoot network settings.

Outcome 1 includes the following:

- ◆ Implement kernel components
- ◆ Carry out kernel compilation
- ◆ Patch a kernel
- ◆ Customise a kernel
- ◆ Manage and query kernel modules
- ◆ Customise system startup
- ◆ Perform system recovery

Outcome 2 includes the following:

- ◆ Configure and mount filesystems
- ◆ Maintain an open source filesystem
- ◆ Create and configure filesystems
- ◆ Use open source OS device manager
- ◆ Configure software RAID
- ◆ Configure storage device settings
- ◆ Manage logical volumes
- ◆ Build and install programs from source
- ◆ Carry out system backups

Outcome 3 includes the following:

- ◆ Configure wired and wireless network connections
- ◆ Configure and troubleshoot advanced network setups
- ◆ Identify and correct common network problems
- ◆ Inform users about system issues
- ◆ Configure a basic DNS server
- ◆ Create and configure DNS zones
- ◆ Configure DNS server security

General information for candidates (cont)

Unit title: Open Source Operating Systems: Advanced Server Administration

Assessment is by a multi-choice/short response assessment that tests your knowledge and skills in using the items above. The assessment will be carried out in supervised conditions, and will be closed book, (ie you will not be allowed to bring any notes etc. with you to the assessment event). The minimum pass mark is 60%. Alternatively assessment for the Unit can take the form of credit transfer after successfully passing the LPIC-2 201 exam.