



## Higher National Unit specification: general information

**Unit title:** Open Source Operating Systems: Advanced Network Services Administration

**Unit code:** H18F 35

**Superclass:** CD

**Publication date:** March 2012

**Source:** Scottish Qualifications Authority

**Version:** 01

## 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 network services administration. The Unit is intended for candidates who will be working in an Open Source Operating System environment in technical support, or software development, or who would like to gain advanced skills in operating a server running Open Source Operating System software.

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

- 1 Configure network servers.
- 2 Manage secure network services.
- 3 Troubleshoot boot and system problems.

## 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 H18C 35 *Open Source Operating Systems: Introduction to Command Line Administration*, H18E 35 *Open Source Operating Systems: Basic Server Administration*, or H18D 35 *Open Source Operating Systems: Advanced Server Administration*.

## **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 Network Services Administration

**Unit code:** H18F 35

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 network servers.

#### Knowledge and/or Skills

- ◆ Install and configure a web server
- ◆ Manage a web server
- ◆ Install and configure a proxy server
- ◆ Install and configure a file server for windows clients
- ◆ Install and configure a network file server
- ◆ Manage an email server
- ◆ Manage an email client
- ◆ Manage remote email delivery

#### Evidence Requirements

Evidence for the Knowledge/Skills in this Outcome will be demonstrated by means of a 21 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 2 and 3.

## Higher National Unit specification: statement of standards (cont)

**Unit title:** Open Source Operating Systems: Advanced Network Services Administration

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

Install and configure a web server (3)  
Manage a web server (2)  
Install and configure a proxy server (1)  
Install and configure a windows client file server (4)  
Install and configure a network file server (4)  
Manage an email server (3)  
Manage an email client (2)  
Manage remote email delivery (2)

### Outcome 2

Manage secure network services.

#### Knowledge and/or Skills

- ◆ Configure a DHCP server
- ◆ Configure pluggable authentication modules
- ◆ Configure an LDAP client
- ◆ Configure a router
- ◆ Configure a secure FTP server
- ◆ Configure secure shell remote access
- ◆ Secure access to services using TCP wrapper
- ◆ Monitor system security

#### Evidence Requirements

Evidence for the Knowledge/Skills in this Outcome will be demonstrated by means of a 20 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 3.

## Higher National Unit specification: statement of standards (cont)

**Unit title:** Open Source Operating Systems: Advanced Network Services Administration

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

Configure a DHCP server (2)  
Configure pluggable authentication modules (3)  
Configure an LDAP client (2)  
Configure a router (3)  
Configure a secure FTP server (2)  
Configure remote access with secure shell (4)  
Secure access to services using TCP wrappers (1)  
Monitor system security (3)

### Outcome 3

Troubleshoot boot and system problems.

#### Knowledge and/or Skills

- ◆ Troubleshoot boot loader problems
- ◆ Troubleshoot general boot and run time issues
- ◆ Troubleshoot system resource problems
- ◆ Troubleshoot system and user environment issues

#### 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:

Troubleshoot boot loader problems (4)  
Troubleshoot general boot runtime issues (5)  
Troubleshoot system resource problems (5)  
Troubleshoot system and user environment issues (5)

## Higher National Unit specification: support notes

**Unit title:** Open Source Operating Systems: Advanced Network Services 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 H18F 35 *Open Source Operating Systems: Advanced Network Services Administration* should preferably be undertaken after the Units *Open Source Operating Systems: Introduction to Command Line Administration* H18C 35 35 Unit, *Open Source Operating System: Basic Server Administration* H18E 35, and *Open Source Operating System: Advanced Server Administration* H18D 35 though it is not a prerequisite.

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

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

##### Install and configure a web server

Install Apache 2.x (or current version of) web server, and use Apache configuration files, utilities, and log files. Configure support for scripting language modules, eg mod\_perl, PHP. Configure user authentication, and restrict access to resources based on options, eg maximum requests, minimum and maximum servers and clients.

Files, terms and utilities could include:

- ◆ access logs and error logs
- ◆ .htaccess
- ◆ httpd.conf
- ◆ mod\_auth
- ◆ htpasswd
- ◆ htgroup
- ◆ apache2ctl
- ◆ httpd

## Higher National Unit specification: support notes (cont)

**Unit title:** Open Source Operating Systems: Advanced Network Services Administration

### Manage a web server

Configure SSL (Secure Sockets Layer) on an Apache 2.x (or current version of) web server. Configure the web server to use virtual hosts, and to customise file access through redirect statements.

Files, terms and utilities could include:

- ◆ Apache2 configuration files
- ◆ /etc/ssl/\*
- ◆ openssl

### Install and configure a proxy server

Install proxy web server, eg Squid 2.x. (or current version). Configure for client authentication and control access with access control lists.

Files, terms and utilities could include:

- ◆ squid.conf
- ◆ acl
- ◆ http\_access

### Install and configure a file server for windows clients

Install a Samba 3.x (or current version) file server and configure for Windows and Linux clients. Mount Samba shares and map Windows usernames to Linux usernames. Set up Server workgroup and define security for shared directories and printers.

Files, terms and utilities could include:

- ◆ smbd, nmbd
- ◆ smbstatus, testparm, smbpasswd, nmblookup
- ◆ smbclient
- ◆ net
- ◆ /etc/smb/\*
- ◆ /var/log/samba/

## Higher National Unit specification: support notes (cont)

**Unit title:** Open Source Operating Systems: Advanced Network Services Administration

### Install and configure a network file server

Configure an NFS 4.x (or current version) file server and use NFS files and utilities. Implement access restrictions using TCP wrappers, export filesystems and mount NFS filesystem on client.

Files, terms and utilities could include:

- ◆ /etc/exports
- ◆ exportfs
- ◆ showmount
- ◆ nfsstat
- ◆ /proc/mounts
- ◆ /etc/fstab
- ◆ rpcinfo
- ◆ mountd
- ◆ portmapper

### Manage an email server

Configure an email server including email aliases, quotas, virtual email domains, and internal email relays. Monitor the email server and configure the Postfix mail transfer agent.

Files, terms and utilities could include:

- ◆ Configuration files and commands for postfix
- ◆ Basic configuration of sendmail
- ◆ /etc/aliases
- ◆ /etc/mail/\*
- ◆ /etc/postfix/\*
- ◆ sendmail emulation layer commands
- ◆ /var/spool/mail
- ◆ mail-related logs in /var/log/

### Manage an email client

Implement client email software, eg procmail, to filter, sort and monitor incoming user email.

Files, terms and utilities could include:

- ◆ ~/.procmail
- ◆ /etc/procmailrc
- ◆ procmail
- ◆ mbox and Maildir formats



## Higher National Unit specification: support notes (cont)

**Unit title:** Open Source Operating Systems: Advanced Network Services Administration

### Manage remote email delivery

Install and configure currently used versions of POP and IMAP, eg Courier, and Dovecot.

Files, terms and utilities could include:

- ◆ /etc/courier/\*
- ◆ dovecot.conf

### Outcome 2

#### Configure a DHCP server

Configure and maintain a DHCP server including dynamic IP range and subnet setup. Add static and BOOTP hosts, and configure a DHCP relay agent.

Files, terms and utilities could include:

- ◆ dhcpd.conf
- ◆ dhcpd.leases
- ◆ /var/log/daemon.log and /var/log/messages
- ◆ arp
- ◆ dhcpd

#### Configure pluggable authentication modules

Configure PAM authentication including use of passwd and shadow passwords.

Files, terms and utilities used could include:

- ◆ /etc/pam.d
- ◆ pam.conf
- ◆ nsswitch.conf
- ◆ pam\_unix, pam\_cracklib, pam\_limits, pam\_listfile

#### Configure an LDAP client

Perform queries and updates to an LDAP server, including importing and adding items. Manage users including adding and deleting users, and changing user passwords.

Files, terms and utilities used could include:

- ◆ ldapsearch
- ◆ ldappasswd
- ◆ ldapadd
- ◆ ldapdelete

## Higher National Unit specification: support notes (cont)

**Unit title:** Open Source Operating Systems: Advanced Network Services Administration

### Configure a router

Configure a device as a router to protect a network using NAT (network address translation). Configure port redirection, IP forwarding, and filter rules to permit or deny packets based on source or destination IP, port number, or protocol.

Files, terms and utilities used could include:

- ◆ /proc/sys/net/ipv4
- ◆ /etc/services
- ◆ iptables

### Configure a secure FTP server

Install and configure popular and currently available FTP servers, eg Pure-FTPd, vsftpd, ProFTPd. Configuration should include set up for anonymous uploads and downloads, and for passive and active connections.

Files, terms and utilities used could include:

- ◆ vsftpd.conf
- ◆ important Pure-FTPd command line options

### Configure remote access with secure shell

Configure currently available open source SSH application, eg OpenSSH, including use of SSH tunnels, multiple connections, and managing logins for normal and superusers. Configure ssh-agent and manage server and client authentication keys.

Files, terms and utilities used could include:

- ◆ ssh
- ◆ sshd
- ◆ /etc/ssh/sshd\_config
- ◆ Private and public key files
- ◆ ~/.ssh/authorized\_keys
- ◆ PermitRootLogin, PubKeyAuthentication, AllowUsers, PasswordAuthentication protocol

## Higher National Unit specification: support notes (cont)

**Unit title:** Open Source Operating Systems: Advanced Network Services Administration

### Secure access to services using TCP wrapper

Configure TCP wrapper to control access to servers based upon names, and host or subnet addresses etc. Configure the inetd super server.

Files, terms and utilities used could include:

- ◆ /etc/inetd.conf
- ◆ /etc/hosts.allow
- ◆ /etc/hosts.deny
- ◆ libwrap
- ◆ tcpd

### Monitor system security

Monitor security alerts from Internet sources, eg Bugtraq, CERT-CC, and CIAC. Apply security patches and updates. Configure intrusion detection systems, eg snort, and security scanners, eg OpenVAS, Nmap.

Files, terms and utilities used could include:

- ◆ telnet
- ◆ nmap
- ◆ snort
- ◆ fail2ban
- ◆ nc
- ◆ iptables

### Outcome 3

#### Troubleshoot boot loader problems

Identify errors in commonly used bootloaders, eg GRUB, LILO. Configure kernel loading and initialise and setup hardware and services. Configure bootloader options including install locations for hard disks and removable storage.

Files, terms and utilities could include:

- ◆ The contents of /boot/ and /boot/grub/
- ◆ GRUB
- ◆ grub-install
- ◆ initrd, initramfs
- ◆ Master boot record
- ◆ /etc/init.d
- ◆ lilo
- ◆ /etc/lilo.conf

## Higher National Unit specification: support notes (cont)

**Unit title:** Open Source Operating Systems: Advanced Network Services Administration

### Troubleshoot general boot and run time issues

Analyse log files and use various tools and utilities to identify and correct common boot and run time problems.

Files, terms and utilities could include:

- ◆ dmesg
- ◆ /sbin/lspci
- ◆ /usr/bin/lshw
- ◆ /sbin/lshw
- ◆ /sbin/modprobe
- ◆ /sbin/insmod
- ◆ /bin/uname
- ◆ strace
- ◆ strings
- ◆ ltrace
- ◆ lsof
- ◆ lsusb

### Troubleshoot system resource problems

Diagnose and correct common local system resource problems using a standard editor and common tools and utilities.

Files, terms and utilities could include:

- ◆ /bin/lm
- ◆ /bin/rm
- ◆ /sbin/ldconfig
- ◆ /sbin/sysctl
- ◆ /etc/profile
- ◆ /etc/profile.d/
- ◆ /etc/init.d/
- ◆ /etc/rc.\*
- ◆ /etc/sysctl.conf
- ◆ /etc/bashrc
- ◆ /etc/ld.so.conf

## Higher National Unit specification: support notes (cont)

**Unit title:** Open Source Operating Systems: Advanced Network Services Administration

### Troubleshoot system and user environment issues

Diagnose and correct common local system and user environment problems. Manage core system variables, user password storage and login process, init start process, and init and cron configuration files.

Files, terms and utilities could include:

- ◆ /etc/inittab
- ◆ /etc/rc.local
- ◆ /etc/rc.boot
- ◆ /var/spool/cron/crontabs/
- ◆ The default shell configuration file(s) in /etc/
- ◆ /etc/login.defs
- ◆ /etc/syslog.conf
- ◆ /etc/passwd
- ◆ /etc/shadow
- ◆ /etc/group
- ◆ /sbin/init
- ◆ /usr/sbin/cron
- ◆ /usr/bin/crontab

### 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-2 202 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.

## Higher National Unit specification: support notes (cont)

**Unit title:** Open Source Operating Systems: Advanced Network Services Administration

### 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.

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

## History of changes to Unit

Version	Description of change	Date

© Scottish Qualifications Authority 2012

This publication may be reproduced in whole or in part for educational purposes provided that no profit is derived from reproduction and that, if reproduced in part, the source is acknowledged.

Additional copies of this Unit specification can be purchased from the Scottish Qualifications Authority. Please contact the Business Development and Customer Support team, telephone 0303 333 0330.

## General information for candidates

### Unit title: Open Source Operating Systems: Advanced Network Services 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 configure and customise various network services, and troubleshoot boot and system problems. 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 network servers.
- 2 Manage secure network services.
- 3 Troubleshoot boot and system problems.

Outcome 1 includes the following:

- ◆ Install and configure a web server
- ◆ Manage a web server
- ◆ Install and configure a proxy server
- ◆ Install and configure a file server for windows clients
- ◆ Install and configure a network file server
- ◆ Manage an email server
- ◆ Manage an email client
- ◆ Manage remote email delivery

Outcome 2 includes the following:

- ◆ Configure a DHCP server
- ◆ Configure pluggable authentication modules
- ◆ Configure an LDAP client
- ◆ Configure a router
- ◆ Configure a secure FTP server
- ◆ Configure secure shell remote access
- ◆ Secure access to services using TCP wrapper
- ◆ Monitor system security

Outcome 3 includes the following:

- ◆ Troubleshoot boot loader problems
- ◆ Troubleshoot general boot and run time issues
- ◆ Troubleshoot system resource problems
- ◆ Troubleshoot system and user environment issues



## **General information for candidates (cont)**

**Unit title:** Open Source Operating Systems: Advanced Network Services 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-2 202 exam.