



Lesson Plans

CompTIA's Linux+

(Exam XKO-002)

Version # 3.1

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Course Overview

This course prepares students for the CompTIA Linux+ Certification Exam XKO-002. It is also a good foundational course to help prepare students for the following Linux certifications:

- LPI Level 1
- Novell's CLE
- Red Hat's RHCE

The Linux+ course focuses on how to use Linux as a desktop and basic server administration tasks. Before beginning this course, students should have experience with:

- PC hardware and software configuration.
- Local area networking theory and configuration.

Module 1

Module 1 introduces the student to Linux and covers the history, architecture, licensing, and available distributions of Linux. Included is a comparison of functions and features of Linux to other operating systems. This module explains where to obtain a Linux distribution and how to install it.

Module 2

Module 2 focuses in on understanding the elements needed to use Linux. These include facts about the shell, command line syntax, navigating the file system, text editors, environment variables, script files, desktop environments and help.

Module 3

Module 3 discusses how to manage and secure the system with user and group accounts. It outlines where each is located and how to manipulate the data within each account. It also explains how to protect the root user account.

Module 4

Module 4 covers the types of Linux file system permissions and how to manage them. Topics include, converting permission strings into a binary number, permission commands, ownership commands, and file management commands.

Module 5

Module 5 describes the basics of services and processes. Topics also include runlevels, shell scripts, processes, process management commands, and cron.

Module 6

Module 6 discusses the elements of installing software. Topics include, software distributions, tarballs, package managers, and archive and backup.

Module 7

Module 7 discusses the installation of hardware. Topics include a basic overview of hardware installation, BIOS, CMOS, and memory, system resources such as IRQ, DMA, and I/O addresses, common hard drive interfaces such as IDE and SCSI, floppy devices, USB, Firewire, Parallel and Serial devices. Note that students should already be familiar with these concepts from either a previous A+ Hardware course or from equivalent experience prior to taking this class.

Module 8

Module 8 explains the basics managing devices. Topics include kernel modules, compiling the kernel, XWindows, printing, and multimedia.

Module 9

Module 9 discusses the details of disks and volumes. This includes common device files associated with storage media, volumes, partitions, and file systems supported by Linux.

Module 10

Module 10 covers the details of system boot and system shutdown. Topics include GRUB and LILO, two of the most popular boot loader utilities used to manage the loading of the operating system, and how to shut properly shutdown the system.

Module 11

Module 11 explains networking on the Linux system. This includes how networking is treated on the Linux system, the tools used to configure the network, the network services available for the Linux operating system, and setting up an NIS server to allow centralized logins. Note that students should already know much of the networking concepts included in this module.

Module 12

Module 12 explains security guidelines for a Linux system and common tools used to manage network security on a Linux system.

Module 13

Module 13 discusses troubleshooting of a Linux system. Topics include log files, configuration files, a suggested systematic method of troubleshooting the system, and common network troubleshooting utilities used to troubleshoot and diagnose problems in networking.

Section 1.1: Linux Overview

Preparation

Familiarize yourself with the courseware. Experiment with the simulations so you will be able to demonstrate them in class. The first simulations in the course are in Section 2.3: Viewing and Searching Files. You will recognize the simulations by the mouse icon to the left of the entry.

This section introduces the history of Linux and compares the different types of licensing available for software. Linux is distributed as Open Source software (meeting OSI standards) under the GNU General Public License (GPL).

Lecture Focus Questions:

- How are Linux and UNIX related?
- What is the difference between Linux licensing and Windows licensing?
- What is the difference between freeware and open source software?

Time

About 10 minutes

Section 1.2: Linux Architecture

Preparation

This section introduces the components that make up the Linux architecture. It also discusses files and the file system from the Linux point of view.

Lecture Focus Questions:

- What is the difference between the kernel, the shell, and daemons or services?
- Why is Linux built using a modular, component system?
- What are two common desktop environments available for Linux?
- What is the name of two common printing systems in Linux?
- What is the difference between a symbolic link and a hard link?
- How are character and block files used in Linux?
- In the Linux file system, what does / indicate?
- What type of files are typically stored in the /bin, /etc, and /sbin directories?

Time

About 1 hour

Section 1.3: Choosing Linux

Preparation

This section discusses the options that are available when choosing Linux. It explains the common deployments for Linux systems and the components they should include. Familiarize yourself with the main categories of Linux distributions available.

Linux+ Objectives:

- 1.5 Determine what software and services should be installed (for example: client applications for workstation, server services for desired task)
- 1.9 Manage packages after installing the operating systems (for example: install, uninstall, update) (for example: RPM, tar, gzip)
- 5.6 Access system documentation and help files (for example: man, info, readme, Web)

Lecture Focus Questions:

- What Linux components aren't needed when you are installing a server? What components are unique to a server?
- What is the difference between a computer used as a desktop system and one used as a workstation?
- What is the difference between a distribution and a package?
- What is one main difference between a SUSE distribution and a Gentoo distribution?

Time

About 15 minutes

Section 1.4: Installing Linux

Preparation

In this section, students will learn where to access the Linux source files and the installation steps and methods available.

Linux+ Objectives:

- 1.2 Determine appropriate method of installation based on the environment (e.g., boot disk, CD-ROM, Network (HTTP, FTP, NFS, SMB))
- 1.11 Select appropriate parameters for Linux installation (e.g., language, time zones, keyboard, mouse)

Lecture Focus Questions:

- What are the advantages of a disk imaging installation method?
- When would choosing a scripted installation be a good choice?
- What tasks should you complete prior to beginning the install program?
- What user account is always created during installation?

Time

About 45 minutes

Section 2.1: The Shell

Preparation

This section focuses on the basic facts about shells. Also, it introduces the syntax used with command line commands in Linux.

Linux+ Objectives:

2.23 Redirect output (for example: piping, redirection)

Lecture Focus Questions:

- How is the shell different or the same as the MS-DOS command prompt?
- What is the most common shell in most Linux distributions?
- What is the generic format for commands entered at a command prompt?
- How can you save typing when working at the command line?

Time

About 10 minutes

Section 2.2: Navigating the File System

Preparation

This section explains how to work within the Linux file system. Familiarize yourself with the lab activities and be able to demonstrate them, if necessary.

Linux+ Objectives:

2.23 Redirect output (for example: piping, redirection)

Lecture Focus Questions:

- What information is stored in the PATH variable?
- What is the working directory?
- What is the difference between an absolute path and a relative path?
- What command would you use to quickly change to your home directory?
- How are hidden files identified in Linux? Which command could you use to view a list that includes hidden files?

Time

About 40 minutes

Lab/Activity

- Find the Working Directory
- Find a Hidden File
- View File Information

Section 2.3: Viewing and Searching Files

Preparation

This section examines the most common Linux commands used to search and view files in the file system. Familiarize yourself with the commands and be prepared to demonstrate them, if necessary.

Linux+ Objectives:

- 2.4 Execute content and directory searches using `find` and `grep`
- 2.23 Redirect output (for example: piping, redirection)

Lecture Focus Questions:

- Use the `cat` command to view the contents of a text file.
- View the beginning or ending information in a file using the `head` and `tail` commands.
- Redirect command line output to a file, appending or overwriting information.
- Search files for text or patterns using the `grep` command.
- Search for files or folders.

Time

About 30 minutes

Lab/Activity

- View a List of Available Shells
- View the Contents of a File

Section 2.4: Text Editors

Preparation

This section examines the two common text editors, vi and nano. Practice editing a file with each text editor to become familiar with the differences between the text editors and how to function within each editor.

Linux+ Objectives:

2.15 Perform text manipulation (for example: sed, awk, vi)

Lecture Focus Questions:

- What is the difference between a modal and modeless text editor?
- Why is it a good idea to become familiar both types of text editors?

Time

About 30 minutes

Lab/Activity

- Modify an Existing File
- Create a New File

Section 2.5: Environment Variables

Preparation

This section discusses the common environment variables and how to set them. Practice setting environment variables and be prepared to demonstrate them, if necessary.

Linux+ Objectives:

- 3.12 Set up environment variables (for example: \$PATH, \$DISPLAY, \$TERM, \$PROMPT, \$PS1)

Lecture Focus Questions:

- What is the standard for writing variable names?

Time

About 20 minutes

Lab/Activity

- View Environment Variables

Section 2.6: Script Files

Preparation

This section examines common script files and the commands used to program these script files. Become familiar with the script files and the order in which they are executed.

Linux+ Objectives:

- 2.19 Create, modify, and use basic shell scripts
- 3.12 Set up environment variables (for example: \$PATH, \$DISPLAY, \$TERM, \$PROMPT, \$PS1)

Lecture Focus Questions:

- What is the difference between an alias and a function?
- For which users does the /etc/profile script run?
- How can you make your command aliases permanent?
- What comes at the end of an if/then statement in a script file?

Time

About 10 minutes

Section 2.7: Graphical Interfaces

Preparation

This section focuses in on the functionality of two popular desktop environments, GNOME and KDE.

Lecture Focus Questions:

- What are the common tasks performed in GNOME and KDE interfaces?
- How are GNOME and KDE similar?
- What are the major differences between GNOME and KDE?

Time

About 10 minutes

Section 2.8: Help

Preparation

This section discusses how to find command information through man pages, info pages, and the --help switch. It also discusses the help available on the Internet.

Linux+ Objectives:

- 5.6 Access system documentation and help files (for example: man, info, readme, Web)

Lecture Focus Questions:

- What is the difference between the information shown in a man page and that shown with the **--help** switch for a command?
- If the **-h** switch doesn't show information for a command, what else might you try?
- What URL would you use to find HOWTOs on common Linux tasks?
- What should you do before posting a question to a Linux user group?

Time

About 35 minutes

Lab/Activity

- Get Help 1
- Get Help 2
- Get Help 3

Section 3.1: Users and Groups

Preparation

This section explains how and where user and group accounts are stored and protected.

Linux+ Objectives:

- 2.20 Create, modify, and delete user and group accounts (for example: useradd, groupadd, /etc/passwd, chgrp, quota, chown, chmod, grpmod) using CLI utilities

Lecture Focus Questions:

- What UID identifies the root user? What IDs are typically available to assign to users you create?
- What is the difference between a primary group and a secondary group?
- Which file holds the passwords for users on most Linux implementations?
- If you wanted to add multiple members to a group to assign permissions, which group type would you use, primary or secondary?

Time

About 10 minutes

Section 3.2: User Management

Preparation

This section discusses the management of user account files. Students will learn how to create new user accounts, modify existing accounts, and delete accounts no longer needed.

Linux+ Objectives:

- 2.20 Create, modify, and delete user and group accounts (for example: useradd, groupadd, /etc/passwd, chgrp, quota, chown, chmod, grpmod) using CLI utilities

Lecture Focus Questions:

- When viewing the /etc/passwd file, what does an **x** indicate in the password field?
- What are the different methods available to manage user accounts and what are the recommended methods?

Time

About 45 minutes

Lab/Activity

- Create a User Account
- Rename a User Account
- Find the User ID
- Delete a User

Section 3.3: Group Management

Preparation

This section discusses the management of Linux groups. It details the content of the group files and how to understand and manipulate the data within these files.

Linux+ Objectives:

- 2.20 Create, modify, and delete user and group accounts (for example: useradd, groupadd, /etc/passwd, chgrp, quota, chown, chmod, grpmod) using CLI utilities

Lecture Focus Questions:

- You are viewing the /etc/gshadow file and see !! in the group password field. What does this indicate?
- What is the function of a group password?

Time

About 45 minutes

Lab/Activity

- Add Users to a Group
- View Group Membership
- Add a User to Additional Groups
- Remove a User from a Group
- Remove a User from All Groups
- Rename and Create Groups
- Delete a Group and Users

Section 3.4: Quota Management

Preparation

This section discusses how quotas are used to restrict the amount of hard disk space available to users or groups on a Linux system. It includes management topics such as types of quotas, quota entries and quota commands.

Linux+ Objectives:

- 2.20 Create, modify, and delete user and group accounts (for example: useradd, groupadd, /etc/passwd, chgrp, quota, chown, chmod, grpmod) using CLI utilities

Lecture Focus Questions:

- What are the two different ways you can limit the amount of information that can be stored?
- Are quotas set for a user on one volume the same on all volumes?
- What is the difference between a soft quota and hard quota?

Time

About 1 hour

Lab/Activity

- Find the User Quota
- Turn Quotas On
- Turn Quotas Off
- Edit Quotas 1
- Edit Quotas 2
- Generate a Quota Report

Section 3.5: User Account Security

Preparation

This section explains how to secure your Linux system. It includes topics such as root user management and introduces the commands to perform system tasks as a superuser.

Linux+ Objectives:

- 2.20 Create, modify, and delete user and group accounts (for example: useradd, groupadd, /etc/passwd, chgrp, quota, chown, chmod, grpmod) using CLI utilities
- 4.5 Use appropriate access level for login (for example: root level vs user level activities, su, sudo)

Lecture Focus Questions:

- Why should you spend most of your time logged in as a user other than root?
- What are characteristics of secure passwords?
- How can you enable shadow passwords on your system if they are not already enabled?
- How can you tell if shadow passwords are used by examining the /etc/passwd file?
- What does a ! in the password field for a user account indicate?

Time

About 1 hour

Lab/Activity

- Find the Login Name
- Switch Users for a Command
- Switch to the Root User
- Log Out of the System
- Change your Password
- Change a User's Password
- Lock and Unlock User Accounts

Section 4.1: Permission and Ownership Concepts

Preparation

This section discusses Linux file system permissions. It explains the three types of permissions and demonstrates how they can be referred to as an assigned letter in the permission string or in an octal format. Be prepared to demonstrate converting permission strings into a binary number.

Linux+ Objectives:

- 2.6 Modify file and directory permissions and ownership (for example: chmod, chown, sticky bit, octal permissions, chgrp) using CLI commands
- 4.6 Set process and special permissions (for example: SUID, GUID)

Lecture Focus Questions:

- What is the difference between the user owner and the group owner?
- What actions are allowed if someone has rw permissions?
- How do you enable a script file to be run?
- What does the x permission on a folder mean?
- What permissions are identified by the number 776?
- What are the default file and directory permissions assigned for new objects?
- What does a umask setting of 033 do to the default permissions?
- What bit must you change to allow users to run a file as if they owned the file?
- What permissions are identified by the number 6421?

Time

About 30 minutes

Section 4.2: Managing Permissions

Preparation

This section presents the commands/syntax used to change Linux file system permissions. Before class, practice setting and changing directory and file permissions and be prepared to demonstrate if necessary.

Linux+ Objectives:

- 2.6 Modify file and directory permissions and ownership (for example: chmod, chown, sticky bit, octal permissions, chgrp) using CLI commands
- 2.7 Identify and modify default permissions for files and directories (for example: umask) using CLI commands

Lecture Focus Questions:

- CHMOD allows changing of the permission by either using the letter form of the permissions (e.g. r,w,x) or by using the binary form (755). What is the most popular method of changing permissions when using CHMOD and why is it more commonly used?
- How do you set the default permissions on a file?

Time

About 45 minutes

Lab/Activity

- Set Directory Permissions
- Add File Permissions
- Set File Permissions
- Enable Directory Browsing
- Set the SUID Bit
- Remove SUID and GUID Permissions
- Change the Umask 1
- Change the Umask 2
- Change the Umask 3

Section 4.3: Managing Ownership

Preparation

This section explains how to change user and group ownership of files, permissions and how to set default directory permissions.

Linux+ Objectives:

- 2.6 Modify file and directory permissions and ownership (for example: chmod, chown, sticky bit, octal permissions, chgrp) using CLI commands
- 4.6 Set process and special permissions (for example: SUID, GUID)

Lecture Focus Questions:

- Which command can a user use to change the group ownership of a file and why would a user want to change the group ownership of a file?
- Why would you want to set the default file and directory permissions?

Time

About 25 minutes

Lab/Activity

- Change File Ownership
- Change Group Ownership for a File
- Change Directory Ownership

Section 4.4: Managing Files

Preparation

This section explains how to manage files such as creating, renaming, and deleting files and directories. Prior to class, practice management of files and directories and be able to demonstrate, if necessary.

Linux+ Objectives:

- 2.2 Mount and unmount varied filesystems (for example: Samba, NFS) using CLI commands
- 2.3 Create files and directories and modify files using CLI commands
- 2.5 Create linked files using CLI commands

Lecture Focus Questions:

- How are the Linux commands used to manage files similar to the DOS and Windows commands used to manage files?
- What does it mean if a file starts with a period (.)?
- What is the function of an alias?

Time

About 60 minutes

Lab/Activity

- Create Directories
- Delete Directories
- Delete Files
- Delete a Directory Structure
- Move Files
- Create a Hard Link
- Create a Soft Link
- Determine the Directory Size
- Determine the Amount of Free Disk Space

Section 5.1: Init and Runlevels

Preparation

This section describes init and the seven different runlevels. It also explains how and why to change the system runlevels.

Linux+ Objectives:

- 2.10 Manage runlevels and system initialization from the CLI and configuration files (for example: /etc/inittab and init command, /etc/rc.d, rc.local)
- 3.5 Configure files that are used to mount drives or partitions (for example: fstab, mtab, SAMBA, nfs, syntax)

Lecture Focus Questions:

- What is a runlevel?
- Which runlevel shuts down the system? Which runlevel is the single user runlevel?
- How are shell scripts, symbolic links, and runlevel directories used to start and stop services?
- What does the filename K05atd in a runlevel directory mean?

Time

About 1 hour

Lab/Activity

- Find the Runlevel
- Change the Runlevel
- Change the Default Runlevel
- Change a Service Runlevel

Section 5.2: Services

Preparation

In this section, students will learn how to start, stop, and restart services. Familiarize yourself with the commands and be prepared to demonstrate them, if necessary.

Linux+ Objectives:

- 2.10 Manage runlevels and system initialization from the CLI and configuration files (for example: /etc/inittab and init command, /etc/rc.d, rc.local)

Time

About 15 minutes

Lab/Activity

- Determine Service Status
- Restart a Service

Section 5.3: Managing Processes

Preparation

In this section, students will learn how to view and manage processes using commands such as ps, top, and kill.

Linux+ Objectives:

- 2.10 Manage runlevels and system initialization from the CLI and configuration files (for example: /etc/inittab and init command, /etc/rc.d, rc.local)
- 2.11 Identify, execute, manage and kill processes (for example: ps, kill, killall, bg, fg, jobs, nice, renice, rc)
- 2.12 Differentiate core processes from non-critical services (for example: init, [kernel processes], PID, and PPID values)
- 5.1 Establish and monitor system performance baseline (for example: top, sar, vmstat, pstree)
- 6.4 Configure advanced power management and Advanced Configuration and Power Interface (ACPI)

Lecture Focus Questions:

- Which process is known as *the mother of all processes*?
- What does the system use to identify processes?
- What is a parent process?
- What is a zombie process?
- What happens to child processes when you terminate a parent process?

Time

About 45 minutes

Lab/Activity

- Kill a Remote Terminal Services Session
- Stop a Zombie Process

Section 5.4: Scheduling Tasks

Preparation

In this section, students will learn how to schedule a task that will be performed one time or a reoccurring task that can be scheduled to run on a regular schedule.

Linux+ Objectives:

2.22 Schedule jobs to execute in the future using "at" and "cron" daemons

Lecture Focus Questions:

- What is the name of the two services (daemons) you can use to schedule jobs?
- What does the entry 15 23 * * * in a crontab file mean?
- Where are user crontab files located?
- You want to schedule a single job to run once. Which utility would be your best choice?

Time

About 30 minutes

Section 6.1: Software Distribution

Preparation

This section discusses the different methods available to install Linux applications and the limitations and advantages of each method.

Linux+ Objectives:

- 1.3 Install multimedia options (for example: video, sound, codecs)
- 1.9 Manage packages after installing the operating systems (for example: install, uninstall, update) (for example: RPM, tar, gzip)
- 3.4 Configure the system and perform basic makefile changes to support compiling applications and drivers

Lecture Focus Questions:

- What are some traditional problems with software installation in Linux?
- What are the advantages of using tarballs for software installation?
- What are the advantages of using a package manager for installing software?
- If you wanted to install software from the source code, which installation method would you most likely use?
- What is the difference between a tarball with a .tar, .gz, and a .bz2 extension?

Time

About 10 minutes

Section 6.2: Tarballs

Preparation

This section explains how to download, extract, and install software from a tarball.

Linux+ Objectives:

- 1.9 Manage packages after installing the operating systems (for example: install, uninstall, update) (for example: RPM, tar, gzip)
- 2.13 Repair packages and scripts (for example: resolving dependencies, repairing, installing, updating applications)
- 2.17 Perform remote management (for example: rsh, ssh, rlogin)
- 3.4 Configure the system and perform basic makefile changes to support compiling applications and drivers

Time

About 20 minutes

Section 6.3: Package Managers

Preparation

This section explains how to install, update, and remove software using a package manager.

Linux+ Objectives:

- 1.9 Manage packages after installing the operating systems (for example: install, uninstall, update) (for example: RPM, tar, gzip)
- 2.13 Repair packages and scripts (for example: resolving dependencies, repairing, installing, updating applications)
- 2.17 Perform remote management (for example: rsh, ssh, rlogin)
- 3.4 Configure the system and perform basic makefile changes to support compiling applications and drivers
- 5.5 Troubleshoot application errors using application logs (for example: tail, head, grep)

Lecture Focus Questions:

- What advantages do package managers provide over tarball installations?
- What features do package manager front ends provide?
- How do package managers track dependencies in software?
- Why should you never mix package manager and tarball installations of the same software?

Time

About 1 ¼ hours

Section 6.4: Archive and Backup

Preparation

This section explains how to archive and backup Linux files using the two most commonly used utilities, tar and dump.

Linux+ Objectives:

2.8 Perform and verify backups and restores (tar, cpio)

Lecture Focus Questions:

- Which switch would you use to zip a file using bzip2?
- What is the function of the **-C** switch with **tar**?
- Which directories would you back up most often? Which would you never back up?

Time

About 25 minutes

Lab/Activity

- Create a Tarball Archive File
- Create and Extract from Tarball Archive Files

Section 7.1: Installation Overview

Preparation

This section explains the basic steps to consider when installing hardware. It also covers the precautions that should be taken when working with hardware. Note that students should already be familiar with these concepts from either a previous A+ Hardware course or from equivalent experience prior to taking this class.

Linux+ Objectives:

- 6.1 Describe common hardware components and resources (for example: connectors, IRQs, DMA, SCSI, memory addresses)

Lecture Focus Questions:

- How does installing Plug-and-Play hardware differ from installing legacy hardware?
- Why might you need to set jumpers on legacy hardware prior to installation?
- Why is ESD a serious concern as you install and maintain hardware?
- What is your top priority in managing system hardware?
- When should you not use a grounding strap?

Time

About 10 minutes

Section 7.2: BIOS, CMOS, and Memory

Preparation

This section discusses the functions of BIOS and CMOS and provides an opportunity for the students to edit the BIOS, and to enable and disable common features. Students should already be familiar with these concepts.

Linux+ Objectives:

- 6.1 Describe common hardware components and resources (for example: connectors, IRQs, DMA, SCSI, memory addresses)

Lecture Focus Questions:

- What is the relationship between the BIOS, the CMOS, and the CMOS battery?
- How can you protect BIOS settings from modification?
- What is the difference between parity and ECC?
- Which type of RAM must usually be installed in pairs?

Time

About 25 minutes

Lab/Activity

- Change the Boot Device Order
- Disable Memory Tests
- Enable the Parallel Port

Section 7.3: System Resources

Preparation

This section reviews system resources detail that could appear on the Linux+ certification exam such as IRQ, I/O and DMA assignments. Students should already be familiar with these concepts.

Linux+ Objectives:

- 6.1 Describe common hardware components and resources (for example: connectors, IRQs, DMA, SCSI, memory addresses)

Lecture Focus Questions:

- What is the difference between IRQ, DMA, and I/O addresses?
- What task might you need to perform on legacy hardware devices?
- Which IRQ is the gateway to the upper-numbered IRQs? Which IRQ(s) is typically used by IDE controllers?
- Which I/O address range does the floppy device typically use?
- Which DMA channel is typically used by the sound card? The floppy device?

Time

About 25 minutes

Section 7.4: IDE, SCSI, and Floppy Devices

Preparation

This section discusses the two common types of hard drive interfaces and how to configure them. It also discusses facts about floppy devices. Students should already be familiar with these concepts.

Linux+ Objectives:

- 6.1 Describe common hardware components and resources (for example: connectors, IRQs, DMA, SCSI, memory addresses)

Lecture Focus Questions:

- How do you identify master/slave settings on IDE drives?
- How many SCSI devices can typically be added in a chain?
- What are the two most common problems with configuring SCSI?
- How does cable position effect floppy drive operation?

Time

About 35 minutes

Section 7.5: USB, Firewire, Parallel, and Serial Devices

Preparation

This section discusses two common types of buses used to attach devices. Students should be familiar with these concepts prior to taking this class.

Linux+ Objectives:

- 6.1 Describe common hardware components and resources (for example: connectors, IRQs, DMA, SCSI, memory addresses)
- 6.3 Identify and configure removable system hardware (for example: PCMCIA, USB, IEEE1394)

Lecture Focus Questions:

- What are the similarities and differences between USB and Firewire?
- How many devices can be on a USB or Firewire chain?
- What types of devices use parallel ports? What types of devices use serial ports?
- What should you try if your parallel device can't communicate with the system?
- What is the modem command to reset the modem?

Time

About 15 minutes

Section 8.1: Kernel Modules

Preparation

This section discusses how kernel modules are used to extend the capabilities of the kernel. The tools used to manage the kernel modules are also included in this section.

Linux+ Objectives:

- 3.4 Configure the system and perform basic makefile changes to support compiling applications and drivers

Lecture Focus Questions:

- When would you need to load additional kernel modules?
- What is the name of the file that stores the modules loaded at system startup?

Time

About 30 minutes

Lab/Activity

- Insert a Module into the Kernel
- Remove a Module from the Kernel

Section 8.2: Compiling the Kernel

Preparation

This section explains the logic behind the numbering system for Linux versions of the kernel. It also discusses the reasons for recompiling a kernel and where to obtain the newest versions of the kernel.

Linux+ Objectives:

- 3.4 Configure the system and perform basic makefile changes to support compiling applications and drivers

Lecture Focus Questions:

- What does an odd number in the kernel minor version number mean?
- Where is the kernel normally located on the system?
- Why might you need to recompile the kernel?
- What installation step can you skip with kernel version 2.5 and higher?

Time

About 30 minutes

Section 8.3: XWindows

Preparation

This section the basics of customizing XWindows settings by modifying the configuration file (XF86Config or Xorg). Examples of the most file common sections are provided.

Linux+ Objectives:

3.11 Configure the X Window system

Lecture Focus Questions:

- What is the relationship between the ServerLayout, Screen, Pointer, and Keyboard sections of the XF86Config file?
- Which XF86Config section would you edit to identify a mouse?
- Which XF86Config section would you edit to modify the color depth?
- What is the relationship between the Screen, Device, and Monitor sections of the XF86Config file?

Time

About 30 minutes

Section 8.4: Printing

Preparation

This section discusses the basics of the two main printing subsystems. It also examines how to configure and manage printing.

Linux+ Objectives:

- 1.12 Configure peripherals as necessary (for example: printer, scanner, modem)
- 2.16 Manage print jobs and print queues (for example: lpd, lprm, lpq, CUPS)
- 3.8 Configure Linux printing (for example: CUPS, BSD LPD, SAMBA)
- 3.9 Apply basic printer permissions

Lecture Focus Questions:

- What does the print queue do?
- Which Linux printing system can you administer through a Web browser?
- What is the URL to connect to the printing management system through a Web browser?

Time

About 30 minutes

Lab/Activity

- Print a File
- Remove a Print Job

Section 8.5: Multimedia

Preparation

This section summarizes the multimedia options available for a Linux system. Some of the most popular client media players are introduced.

Linux+ Objectives:

1.3 Install multimedia options (for example: video, sound, codecs)

Lecture Focus Questions:

- What is the latest sound server subsystem used in Linux?
- Which media player is the most popular for playing audio files and does not play video?
- What is the relationship between XINE and Totem?

Time

About 15 minutes

Section 9.1: Device Files

Preparation

This section explains the most common device files associated with hard drives and storage media. No specific objectives are linked to this section.

Lecture Focus Questions:

- What is the difference between a block device and a character device?
- Where are device files stored?
- You have a system with two hard disks on the first IDE controller. What is the device file for partition 2 on the second IDE hard disk?
- What is the device file for the floppy drive?
- How does SCSI device file names differ from IDE device file names?
- What is the device file for a SCSI tape backup device?

Time

About 20 minutes

Section 9.2: Volumes

Preparation

In this section discusses the types of volumes available in Linux, the steps to create a volume and the utility used to partition hard disks.

Linux+ Objectives:

- 1.6 Partition according to pre-installation plan using fdisk (for example: /boot, /usr, /var, /home, swap, RAID/volume, hot-spare, lvm)
- 2.1 Manage local storage devices and file systems (for example: fsck, fdisk, mkfs) using CLI commands

Lecture Focus Questions:

- What is a volume? A partition? A primary partition? An extended partition?
- How do you create a volume?
- What are the pros and cons of the different RAID configurations?

Time

About 45 minutes

Lab/Activity

- Find the Boot Device
- Find the Swap Device

Section 9.3: File Systems

Preparation

In this section students will learn many of the most common file systems that Linux supports. Also presented are the different format commands for these various file system types.

Linux+ Objectives:

- 1.7 Configure file systems (for example: (ext2) or (ext3) or REISER)
- 2.1 Manage local storage devices and file systems (for example: fsck, fdisk, mkfs) using CLI commands

Lecture Focus Questions:

- What features does ext3 add to the ext2 file system?
- What is the function of a swap partition?
- Which file system is quickly becoming the most popular file system in Linux?

Time

About 45 minutes

Lab/Activity

- Format a Hard Disk
- Format a Floppy Disk
- Format a Hard Disk with reiserfs
- Create a Swap Area

Section 9.4: Mounting

Preparation

In this section students will learn how to make a device accessible to users through the directory tree. Specific mounting files and commands are discussed.

Linux+ Objectives:

- 2.2 Mount and unmount varied filesystems (for example: Samba, NFS) using CLI commands
- 2.9 Access and write data to recordable media (for example: CDRW, hard drive, flash memory devices)
- 3.5 Configure files that are used to mount drives or partitions (for example: fstab, mtab, SAMBA, nfs, syntax)

Lecture Focus Questions:

- Why should the mount point be empty before mounting a volume?
- What is the purpose of the /etc/fstab file?
- What is the difference between /etc/fstab and /etc/mtab?
- What do the noexec, ro, and users options do when included in the /etc/fstab file?

Time

About 1 hour

Lab/Activity

- Mount a Volume
- Unmount a Volume
- Mount Devices

Section 9.5: Planning Partitions and Volumes

Preparation

In this section students will learn the guidelines to follow when planning partitions and volumes for a Linux system to create an efficient partition scheme.

Linux+ Objectives:

- 1.6 Partition according to pre-installation plan using fdisk (for example: /boot, /usr, /var, /home, swap, RAID/volume, hot-spare, lvm)
- 2.5 Create linked files using CLI commands

Lecture Focus Questions:

- Which directories must be located on the root partition?
- What mount options are recommended for the partition holding the /usr directory? The partition for the /home directory?
- Why would you mount the partition for the /tmp directory noexec?

Time

About 5 minutes

Section 10.1: System Boot

Preparation

In this section students will examine the fundamentals of the boot process and two of the most popular Linux boot loader utilities used to manage the loading of the operating system.

Linux+ Objectives:

- 1.8 Configure a boot manager (for example: LILO, ELILO, GRUB, multiple boot options)

Lecture Focus Questions:

- What are the advantages of using GRUB over LILO?
- Why must you run the **lilo** command after changing the lilo.conf file?
- Why is the boot loader process a two stage process?
- How do you change the default operating system in the lilo.conf file?
- How do you identify non-Linux operating systems in the lilo.conf file?

Time

About 40 minutes

Lab/Activity

- Read the Boot File

Section 10.2: System Shutdown

Preparation

In this section students will learn proper shutdown procedures depending upon the results desired when shutting down the system.

Linux+ Objectives:

- 2.10 Manage runlevels and system initialization from the CLI and configuration files (for example: `/etc/inittab` and `init` command, `/etc/rc.d`, `rc.local`)

Lecture Focus Questions:

- Why are different shutdown options available with Linux?
- What are the steps the system performs when the shutdown command is issued?

Time

About 25 minutes

Lab/Activity

- Shut Down Immediately
- Shut Down with Notification
- Shut Down and Reboot
- Control Shutdown Users

Section 11.1: Networking Concepts

Preparation

This section explains how networking is treated as a service on the Linux system and the tools used to configure a network. **Note:** Students should already know much of the information included in this section. It is included as a review of information that might appear on the Linux + certification exam. For more details, consult the TestOut for Network+ course.

Linux+ Objectives:

- 1.12 Configure peripherals as necessary (for example: printer, scanner, modem)
- 3.1 Configure client network services and settings (for example: settings for TCP/IP)
- 3.2 Configure basic server network services (for example: DNS, DHCP, SAMBA, Apache)
- 3.3 Implement basic routing and subnetting (for example: /sbin/route, IP forward statement)

Lecture Focus Questions:

- What is the difference between a protocol and a protocol suite?
- What is the protocol used on the Internet?
- What does SNMP do? What about SMTP?
- What is the network address for host 199.67.56.12 assuming the default address classes are used?
- What is the broadcast address for a host with address 111.55.165.78, assuming the default address class and mask are used?
- What type of twisted pair cable can be used with Fast Ethernet?
- What is the difference between an IP address and a MAC address?

Time

About 25 minutes

Section 11.2: Network Configuration

Preparation

In this section students will learn the files and commands used to configure the network services.

Linux+ Objectives:

- 1.12 Configure peripherals as necessary (for example: printer, scanner, modem)
- 3.1 Configure client network services and settings (for example: settings for TCP/IP)
- 3.2 Configure basic server network services (for example: DNS, DHCP, SAMBA, Apache)
- 3.3 Implement basic routing and subnetting (for example: /sbin/route, IP forward statement)
- 3.6 Implement DNS and describe how it works (for example: edit /etc/hosts, edit /etc/host.conf, edit /etc/resolv.conf, dig, host, named)

Lecture Focus Questions:

- What Linux command is similar to the Windows **ipconfig** command?
- What file must you edit to make IP address changes permanent?

Time

About 1 hour

Section 11.3: Network Services

Preparation

This section examines the most common network services available for the Linux operating system. Also discussed are super servers that start and stop services as necessary that can be used to reserve memory and other resources.

Linux+ Objectives:

- 1.10 Select appropriate networking configuration and protocols (for example: inetd, xinetd, modems, Ethernet)
- 2.18 Perform NIS-related domain management (yp commands)
- 2.21 Manage and access mail queues (for example: sendmail, postfix, mail, mutt) using CLI utilities
- 3.2 Configure basic server network services (for example: DNS, DHCP, SAMBA, Apache)

Lecture Focus Questions:

- What is the daemon name for the BIND DNS server? For the Apache Web server?
- What is pump used for?
- What services are provided by Squid?
- When would you choose Samba as a networking service?
- What does a RADIUS server allow you to do?

Time

About 90 minutes

Section 11.4: Centralized User Management

Preparation

In this section students will learn how to allow centralized logins by setting up an NIS server. They will learn how to install and configure the NIS server and how to configure the client computer to use the NIS server for authentication. No specific focus questions are linked to this section.

Linux+ Objectives:

2.18 Perform NIS-related domain management (yp commands)

Time

About 15 minutes

Section 11.5: Network Client Applications

Preparation

This section discusses the tools used to restrict access and to selectively delegate administrative tasks. Also discussed are some of the most common tools used to connect to and manage a remote system.

Linux+ Objectives:

2.17 Perform remote management (for example: rsh, ssh, rlogin)

Lecture Focus Questions:

- Which tool would you use to securely connect to a remote computer and perform command-line administration tasks?
- Which tool would you use to securely connect to a remote computer to transfer files?

Time

About 15 minutes

Section 12.1: Security Guidelines

Preparation

This section covers the guidelines for securing both the physical access and the user accounts of the Linux system. It examines the specific files that can be edited to control the actions of the users and what files to use to audit the system.

Linux+ Objectives:

- 3.10 Configure log files (for example: syslog, remote logfile storage)
- 4.1 Configure security environment files (for example: hosts.allow, sudoers, ftpusers, sshd_config, PAM)
- 4.4 Detect symptoms that indicate a machine's security has been compromised (for example: review logfiles for irregularities or intrusion attempts)
- 4.9 Implement security auditing for files and authentication
- 4.12 Identify security vulnerabilities within Linux services
- 4.13 Set up user-level security (for example: limits on logins, memory usage and processes)

Lecture Focus Questions:

- Why is setting passwords and configuring permissions insufficient to adequately protect your network?
- How can you protect servers from theft, damage, or intrusion attempts?
- Why should you keep a copy of backup media in a different location?
- What are the recommended requirements for complex (strong) passwords?
- What should you do when a user will be away for an extended period of time?
- How can you check to see which groups a user is a member of?
- How can you control who can shut down the system?
- Why is the working directory in the PATH variable a security risk?

Time

About 30 minutes

Section 12-2: Network Security

Preparation

This section discusses some of the most common tools used to manage network security. A list of port numbers that correspond to common Internet services is provided because network services use ports to identify services running on a computer and only the necessary ports should be opened. Also covered are encryption methods used to secure data.

Linux+ Objectives:

- 4.1 Configure security environment files (for example: hosts.allow, sudoers, ftpusers, sshd_config, PAM)
- 4.3 Given security requirements, implement appropriate encryption configuration (for example: blowfish 3DES, MD5)
- 4.7 Identify different Linux Intrusion Detection Systems (IDS) (for example: Snort, PortSentry)
- 4.8 Given security requirements, implement basic IP tables/chains (note: requires knowledge of common ports)
- 4.10 Identify whether a package or file has been corrupted / altered (for example: checksum, Tripwire)
- 4.12 Identify security vulnerabilities within Linux services

Lecture Focus Questions:

- What does a firewall do?
- What is the difference between a port scanner and a protocol analyzer?
- What features are provided by snort? How does this differ from features in nmap or Ethereal?
- Which port(s) should you open to enable FTP? HTTP?

Time

About 35 minutes

Section 13.1: System Performance Tools

Preparation

This section explains the basics of maintaining and troubleshooting your system using log files, /proc filesystem, and configuration files and directories. It discusses guidelines to make system documentation easier.

Linux+ Objectives:

- 3.5 Configure files that are used to mount drives or partitions (for example: fstab, mtab, SAMBA, nfs, syntax)
- 3.10 Configure log files (for example: syslog, remote logfile storage)
- 4.4 Detect symptoms that indicate a machine's security has been compromised (for example: review logfiles for irregularities or intrusion attempts)
- 4.9 Implement security auditing for files and authentication
- 5.1 Establish and monitor system performance baseline (for example: top, sar, vmstat, pstree)
- 5.2 Create written procedures for installation, configuration, security and management
- 5.3 Document installed configuration (for example: installed packages, package options, TCP/IP assignment list, changes -configuration and maintenance)
- 5.4 Troubleshoot errors using systems logs (for example: tail, head, grep)
- 5.5 Troubleshoot application errors using application logs (for example: tail, head, grep)
- 6.2 Diagnose hardware issues using Linux tools (for example: /proc, disk utilities, ifconfig, /dev, live CD rescue disk, dmesg)

Lecture Focus Questions:

- What are some good questions to ask as you begin the troubleshooting process?
- How can good documentation help you troubleshoot?
- What is the last step to perform using recommended troubleshooting processes?
- How can removing or replacing components help you troubleshoot hardware problems?
- Why should you test software before deploying it in a production environment?
- What type of information is shown with the dmesg command?
- Which log file would you consult to view messages about the boot process?
- What is the default log file?

- Which file could you view to see current information about the Linux version? CPU information?
- What is the purpose of the hosts.allow and hosts.deny files?

Time

About 1 hour

Lab/Activity

- View/proc Information 1
- View/proc Information 2

Section 13.2: System Troubleshooting

Preparation

This section discusses a systematic method of troubleshooting the system. It explains how to use Rescue mode to access your files when your system won't boot. It summarizes the basics of core dumps and how to successfully manage them.

Linux+ Objectives:

- 3.7 Configure a Network Interface Card (NIC) from a command line
- 6.2 Diagnose hardware issues using Linux tools (for example: /proc, disk utilities, ifconfig, /dev, live CD rescue disk, dmesg)

Lecture Focus Questions:

- What does an inode or block error indicate?
- Which tool is used most often to correct disk errors?
- What can you do if the superblock on a partition is corrupt?
- How do you make a bootable floppy?
- What do each of the letters in LILO mean during the LILO boot process?
- What should you do with core dump files?

Time

About 30 minutes

Section 13.3: Network Troubleshooting

Preparation

This section contains information on the most common network troubleshooting utilities used to troubleshoot and diagnose problems in networking.

Linux+ Objectives:

- 2.14 Monitor and troubleshoot network activity (for example: ping, netstat, traceroute)
- 3.6 Implement DNS and describe how it works (for example: edit /etc/hosts, edit /etc/host.conf, edit /etc/resolv.conf, dig, host, named)
- 3.7 Configure a Network Interface Card (NIC) from a command line

Lecture Focus Questions:

- What is the difference between **ping** and **traceroute**?
- What two tools can you use to check name resolution?
- What information is shown by the **netstat** command?
- How can a firewall affect your ability to connect to network services?

Time

About 30 minutes

Lab/Activity

- Start a NIC
- Stop a NIC

