# A Practical Guide to the CompTIA® Linux+™ Exams LX0-101 and LX0-102

## BY

## Mark G. Sobell

*For use with*
*A Practical Guide to Fedora™ and Red Hat® Enterprise Linux™, Sixth Edition*
*and/or*
*A Practical Guide to Linux™ Commands, Editors, and Shell Programming, Third Edition*

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# ABOUT THIS DOCUMENT

*A Practical Guide to Fedora™ and Red Hat® Enterprise Linux®* and *A Practical Guide to Linux® Commands, Editors, and Shell Programming* are used as the adopted texts in many college classes. Because students who take these classes often seek Comptia certification, instructors have asked for a mapping of Comptia Exam objectives to the material covered in these books. This document is the resulting map.

As this document indicates, almost all of the exam objectives are covered in these two books. Where coverage is missing, this document provides URLs that point to Web sites where students and instructors can look for the missing information; see "Links to More Information," below.

This document points to two sources of information:

- *A Practical Guide to Fedora™ and Red Hat® Enterprise Linux®, Sixth Edition,* by Mark G. Sobell, Prentice Hall (August 2011). Page references to this book appear underlined in red and are followed by the letter F:
  - History page 319F
- *A Practical Guide to Linux® Commands, Editors, and Shell Programming, Second Edition,* Prentice Hall (October 2009). Page references to this book appear underlined in mauve and are followed by the letter C:
  - History page 326C

Please send comments, suggestions, and corrections to the author at **mgs** at **sobell** dot **com**. Pointers to Web pages that cover exam objectives clearly and thoroughly and that may help other students and instructors will be added to this document.

# LINKS TO MORE INFORMATION

For information that is not in the two books this document covers, refer to the following Web sites:

## GENERAL INFORMATION

Where to Find Documentation page 125F (in *A Practical Guide to Fedora* ...)

Where to Find Documentation page 33C (in *A Practical Guide to Linux Commands,* ...)

Linux man pages: linuxmanpages.com

Linux man pages: man.he.net

The Linux Documentation Project: www.tldp.org

GNU Documentation: www.gnu.org/doc

Linux Forums: www.linuxforums.org/forum

LinuxQuestions.org: www.linuxquestions.org/questions

## Fedora Information

Documentation: docs.fedoraproject.org

Mailing Lists: fedoraproject.org/wiki/Communicate#Mailing_Lists

IRC Channels: fedoraproject.org/wiki/Communicate#IRC_for_interactive_community_support

## Ubuntu Information

Documentation: help.ubuntu.com

Mailing Lists: lists.ubuntu.com

IRC Channels: wiki.ubuntu.com/IRC/ChannelList

Forums: ubuntuforums.org

Launchpad: answers.launchpad.net/ubuntu

## Debian Information

Documentation: www.debian.org/doc

Mailing Lists: www.debian.org/MailingLists/subscribe

IRC Channels: wiki.debian.org/IRC#Official_Debian_IRC_channels

Forum: forums.debian.net

Wiki: wiki.debian.org

## openSUSE Information

Documentation: doc.opensuse.org

Mailing Lists: lists.opensuse.org

IRC Channels: en.opensuse.org/openSUSE:IRC_list

Forums: forums.opensuse.org

# Certification Exam 1
# Objectives: LX0-101

# 101 System Architecture

## 101.1 Determine and Configure Hardware Settings

Enable and disable integrated peripherals

Configure systems with or without external peripherals such as keyboards

Differentiate between the various types of mass storage devices

Set the correct hardware ID for different devices, especially the boot device

Know the differences between coldplug and hotplug devices
- Hotplug page 516F

Determine hardware resources for devices

Tools and utilities to list various hardware information (e.g., lsusb, lspci, etc.)
- lsusb: Lists USB Devices page 649F
- lspci: Lists PCI Information page 648F

Tools and utilities to manipulate USB devices

Conceptual understanding of sysfs, udev page 516F, hald, dbus

The following is a partial list of the used files, terms, and utilities:
- **/sys**
  - **/sys** page 201F
  - **/sys** page 514F
  - **/sys** page 516F
- **/proc**
  - **/proc** page 201F
  - **/proc** page 512F
  - **proc** page 520F
- **/dev**
  - **/dev** page 200F
  - Device file page 232F
  - **/dev** page 503F
  - Device files page 516F
- modprobe
  - modprobe page 594F

- lsmod
  - lsmod page 594F
- lspci
  - lspci: Lists PCI Information page 648F
- lsusb
  - lsusb: Lists USB Devices page 649F

## 101.2 BOOT THE SYSTEM

Provide common commands to the boot loader and options to the kernel at boot time

- Modifying Boot Parameters (Options) page 67F
- GRUB: The Linux Boot Loader page 595F

Demonstrate knowledge of the boot sequence from BIOS to boot completion

- Booting the System page 449F
- GRUB: The Linux Boot Loader page 595F
- BIOS page 1153F (Glossary)
- BIOS page 1057C (Glossary)

Check boot events in the log file

- dmesg: Displays Kernel Messages page 597F
- dmesg page 787C (Command Reference section)

The following is a partial list of the used files, terms and utilities:

- **/var/log/messages**
  - page 1116F
- dmesg
  - dmesg: Displays Kernel Messages page 597F
  - dmesg page 787C (Command Reference section)
- BIOS
  - BIOS page 595F
  - BIOS page 1153F (Glossary)
  - BIOS page 1057C (Glossary)
- bootloader
  - GRUB: The Linux Boot Loader page 595F
- kernel
  - *See Chapter 15:* Building a Linux Kernel page 583F
  - kernel page 1172F (Glossary)
  - kernel page 1076C (Glossary)
- **init**
  - init daemon page 317F
  - The init Daemon page 426F
  - init daemon page 323C

# 101.3 Change Runlevels and Shutdown or Reboot System

Set the default runlevel

- Setting the Persistent Runlevel page 432F
- rc task and the runlevel event page 441F
- rcS task and inittab page 442F
- **/etc/inittab** page 507F

Change between runlevels including single user mode

- Changing the Current Runlevel page 432F
- Booting the System to Single-User/Rescue Mode page 450F
- Going to Graphical Multiuser Mode page 451F

Shutdown and reboot from the command line

- Bringing the System Down page 453F

Alert users before switching runlevels or other major system events

- Keeping Users Informed page 625F

Properly terminate processes

- kill: Aborting a Background Job page 243F
- kill: Sends a Signal to a Process page 470F
- killall: Kills a Command page 472F
- kill: Aborts a Process page 1028F
- Aborting Execution page 30C
- kill: Aborting a Background Job page 147C
- kill: Aborts a Process page 486C
- kill page 846C (Command Reference section)
- killall page 848C (Command Reference section)

The following is a partial list of the used files, terms and utilities:

- **/etc/inittab**
  - rcS task and inittab page 442F
  - **/etc/inittab** page 507F
- shutdown
  - Bringing the System Down page 453F
- **init**
  - The systemd init Daemon (Fedora) page 426F
  - The Upstart init Daemon (RHEL) page 436F
  - SysVinit (rc) Scripts: Start and Stop System Services (Fedora/RHEL) page 442F
- **/etc/init.d**
  - SysVinit (rc) Scripts: Start and Stop System Services (Fedora/RHEL) page 442F
- telinit
  - telinit page 449F

# 102 Linux Installation and Package Management

## 102.1 Design Hard Disk Layout

Allocate filesystems and swap space to separate partitions or disks

- Setting Up the Hard Disk page 34F

Tailor the design to the intended use of the system

- Planning the Installation page 28F

Ensure the /boot partition conforms to the hardware architecture requirements for booting

- Where to put the **/boot** partition page 39F
- LBA addressing mode and the /boot partition page 595F

The following is a partial list of the used files, terms and utilities:

- **/** (root) filesystem
  - **/** (root) page 38F
  - **/** (root) page 192F
  - **/** page 200F
  - root filesystem page 1186F (Glossary)
  - root filesystem page 1091C (Glossary)
- **/var** filesystem
  - **/var** page 39F
  - **/var** page 201F
- **/home** filesystem
  - **/home** page 40F
  - **/home** page 200F
- swap space
  - (swap) page 39F
  - swap page 513F
  - swap space page 1191F (Glossary)
  - swap space page 1096C (Glossary)
- mount points
  - Mount Points page 36F
  - Mount point page 521F

- partitions
  - Partitions page 34F
  - Partition table page 34F
  - Primary, Extended, and Logical Partitions page 35F
  - Default Partitioning page 37F
  - Manual Partitioning: Planning Partitions page 38F
  - Example minimum partition sizes page 41F
  - Working with Partitions page 74F
  - partition page 1180F (Glossary)
  - partition page 1085C (Glossary)

## 102.2 INSTALL A BOOT MANAGER

Providing alternative boot locations and backup boot options

Install and configure a boot loader such as GRUB

- GRUB: The Linux Boot Loader page 595F

Interact with the boot loader

- Booting the System to Single-User/Rescue Mode page 450F

The following is a partial list of the used files, terms, and utilities

- **/boot/grub/menu.lst**
  - Configuring GRUB page 596F
- grub-install
  - grub-install: Installs the MBR and GRUB Files page 597F
- MBR
  - Reinstalling the MBR page 456F
  - MBR page 595F
  - grub-install: Installs the MBR and GRUB Files page 597F
- superblock
  - superblock page 1191F (Glossary)
  - superblock page 1096C (Glossary)
- **/etc/lilo.conf**
- lilo

## 102.3 MANAGE SHARED LIBRARIES

Identify shared libraries

Identify the typical locations of system libraries

Load shared libraries

The following is a partial list of the used files, terms and utilities

- ldd
- ldconfig
- /etc/ld.so.conf
- LD_LIBRARY_PATH

## 102.4 Use Debian Package Management

Install, upgrade and uninstall Debian binary packages

- Using apt-get to Install, Remove, and Update Packages page 1035C

Find packages containing specific files or libraries which may or may not be installed

Obtain package information like version, content, dependencies, package integrity and installation status (whether or not the package is installed)

The following is a partial list of the used files, terms and utilities:

- **/etc/apt/sources.list**
  - sources.list: Specifies Repositories for apt-get to Search page 1038C
- dpkg
- dpkg-reconfigure
- apt-get
  - Using apt-get page 1034C
- apt-cache
- aptitude

## 102.5 Use RPM and YUM Package Management

*See Chapter 13: Finding, Downloading, and Installing Software* page 531F

Install, re-install, upgrade and remove packages using RPM and YUM

- JumpStart: Installing and Removing Packages Using yum page 534F
- Updating Packages page 539F
- Installing, Upgrading, and Removing Packages page 550F
- Using yum to Install, Remove, and Update Packages page 1028C

Obtain information on RPM packages such as version, status, dependencies, integrity and signatures

- Querying Packages and Files page 548F

Determine what files a package provides, as well as find which package a specific file comes from

- Finding the Package That Holds an Application or File You Need page 537F
- Querying Packages and Files page 548F

The following is a partial list of the used files, terms and utilities:

- rpm
  - Querying Packages and Files page 548F
- rpm2cpio
- **/etc/yum.conf**
  - yum.conf: Configures yum page 542F
  - **yum.conf** page 1032C
- **/etc/yum.repos.d/**
  - yum Repositories page 543F
  - **yum.repos.d** page 1033C

- yum
  - yum page 533F
  - JumpStart: Installing and Removing Packages Using yum page 534F
  - Finding the Package That Holds an Application or File You Need page 537F
  - yum: Keeps the System Up-to-Date page 538F
  - Using yum to Install, Remove, and Update Packages page 1028C
- yumdownloader
  - Downloading RPM Package Files with yumdownloader page 541F
  - Fedora yumdownloader page 586F


# 103 GNU AND UNIX COMMANDS

## 103.1 WORK ON THE COMMAND LINE

*See Chapter 7: The Shell* page 225F

*See Chapter 9: The Bourne Again Shell* page 279F

*See Chapter 27: Programming the Bourne Again Shell* page 969F

*See Chapter 5: The Shell* page 125C

*See Chapter 8: The Bourne Again Shell (bash)* page 275C

*See Chapter 10: Programming the Bourne Again Shell (bash)* page 417C

Use single shell commands and one line command sequences to perform basic tasks on the command line

- Chapter 5: : The Linux Utilities page 145F
- Chapter 3: The Utilities page 49C

Use and modify the shell environment including defining, referencing and exporting environment variables

- Parameters and Variables page 301F
- Parameters and Variables page 300C
- Variables page 467C

Use and edit command history

- History page 319F
- History page 326C

Invoke commands inside and outside the defined path

- Absolute versus relative pathnames page 230F
- PATH: Where the Shell Looks for Programs page 308F
- Absolute versus relative pathnames page 132C
- PATH: Where the Shell Looks for Programs page 308C

The following is a partial list of the used files, terms and utilities:


- .
  - . (Dot) or source: Runs a Startup File in the Current Shell page 284F
  - exec versus . (dot) page 1023F
  - . (Dot) or source: Runs a Startup File in the Current Shell page 280C
  - exec versus . (dot) page 481C
- bash
  - Chapter 7: The Shell page 225F
  - Chapter 9: The Bourne Again Shell page 279F
  - Chapter 27: Programming the Bourne Again Shell page 969F
  - Chapter 5: The Shell page 125C
  - Chapter 8: The Bourne Again Shell (bash) page 275C
  - Chapter 10: Programming the Bourne Again Shell (bash) page 417C
- echo
  - echo: Displays Text page 157F
  - **echo –e** page 996F
  - echo: Displays Text page 61C
  - echo: getting rid of the RETURN page 371C
  - **echo –e** page 445C
  - echo page 794C (Command Reference section)
- env
  - env**: Runs a Program in a Modified Environment** page 471C
- exec
  - Opening a file descriptor page 1003F
  - Duplicating a file descriptor page 1004F
  - exec: Executes a Command or Redirects File Descriptors page 1022F
  - Opening a File Descriptor page 453C
  - Duplicating a File Descriptor page 453C
  - exec: Executes a Command or Redirects File Descriptors page 480C
- export
  - declare and typeset: Assign Attributes to Variables page 306F
  - export page 1008F
  - readonly and export page 306C
  - export: Puts Variables in the Environment page 468C
- pwd
  - pwd page 190F
  - pwd page 86C
- set
  - set ±o: Turns Shell Features On and Off page 341F
  - set: Initializes Command-Line Arguments page 1014F
  - set ±o: Turns Shell Features On and Off page 350C
  - set: Initializes Positional Parameters page 460C
  - set: Works with Shell Features, Positional Parameters, and Variables page 472C

- unset
  - unset: Removes a Variable page 305F
  - unset: Removes a Variable page 304C
- man
  - man: Displays the System Manual page 126F
  - man: Displays the System Manual page 33C
  - man page 875C (Command Reference section)
- uname
  - uname: Displays System Information page 475F
- history
  - History page 319F
  - History page 326C
  - History page 374C (tcsh)

## 103.2 PROCESS TEXT STREAMS USING FILTERS

Send text files and output streams through text utility filters to modify the output using standard UNIX commands found in the GNU **textutils** package

- Redirection page 234F
- Pipes page 239F
- Filters page 241F
- Redirection page 135C
- Pipelines page 141C
- Filters page 144C

The following is a partial list of the used files, terms and utilities:

- cat
  - cat: Displays a Text File page 148F
  - cat page 233F
  - Redirection page 234F
  - cat: Displays a Text File page 52C
  - cat page 135C
  - Redirection page 135C
  - cat page 735C (Command Reference section)
- cut
  - cut page 766C (Command Reference section)
- expand
  - expand/unexpand page 796C (Command Reference section)
- fmt
  - fmt page 812C (Command Reference section)
- head
  - head: Displays the Beginning of a File page 152F
  - head: Displays the Beginning of a File page 56C
  - head page 841C (Command Reference section)

- od
  - od page 897C (Command Reference section)
- join
  - join page 843C (Command Reference section)
- nl
  - nl page 894C (Command Reference section)
- paste
  - paste page 905C (Command Reference section)
- pr
  - pr page 915C (Command Reference section)
- sed
  - Chapter 15: The sed Editor page 653C
- sort
  - sort: Displays a File in Order page 154F
  - sort: Displays a File in Order page 58C
  - sort page 942C (Command Reference section)
- split
  - split page 951C (Command Reference section)
- tail
  - tail: Displays the End of a File page 153F
  - tail: Displays the End of a File page 57C
  - tail page 965C (Command Reference section)
- tr
  - tr page 159F
  - tr page 239F
  - tr page 63C
  - tr page 142C
  - tr page 987C (Command Reference section)
- unexpand
  - expand/unexpand page 796C (Command Reference section)
- uniq
  - uniq: Removes Duplicate Lines from a File page 154F
  - uniq: Removes Duplicate Lines from a File page 58C
  - uniq page 996C (Command Reference section)
- wc
  - wc page 156F
  - wc page 1000C (Command Reference section)

# 103.3 Perform Basic File Management

Copy, move and remove files and directories individually
- cp: Copies a File page 149F
- mv, cp: Move or Copy Files page 198F
- mv: Changes the Name of a File page 150F
- mv: Moves a Directory page 199F
- rm: Deletes a File page 148F
- rm: Removes a Link page 218F
- rmdir: Deletes a Directory page 197F
- cp: Copies a File page 53C
- mv, cp: Move or Copy Files page 94C
- mv: Changes the Name of a File page 54C
- mv page 890C (Command Reference section)
- cp page 754C (Command Reference section)
- rm: Deletes a File page 52C
- rm: Removes a Link page 115C
- rm page 926C (Command Reference section)

Copy multiple files and directories recursively
- cp page 754C (Command Reference section)

Remove files and directories recursively
- rm page 926C (Command Reference section)

Use simple and advanced wildcard specifications in commands
- Filename Generation/Pathname Expansion page 244F
- Pathname Expansion page 352F
- Filename Generation/Pathname Expansion page 148C
- Pathname Expansion page 362C

Using find to locate and act on files based on type, size, or time
- find page 804C (Command Reference section)

Usage of tar, cpio, and dd
- tar: Packs and Unpacks Archives page 162F
- tar: Archives Files page 607F
- cpio: Archives Files page 609F
- tar: Packs and Unpacks Archives page 66C
- tar page 968C (Command Reference section)
- cpio page 758C (Command Reference section)

The following is a partial list of the used files, terms and utilities:


- cp
  - cp: Copies a File page 149F
  - mv, cp: Move or Copy Files page 198F
  - cp: Copies a File page 53C
  - mv, cp: Move or Copy Files page 94C
  - cp page 754C (Command Reference section)
- find
  - find page 804C (Command Reference section)
- mkdir
  - mkdir: Creates a Directory page 194F
  - mkdir: Creates a Directory page 90C
  - mkdir page 886C (Command Reference section)
- mv
  - mv: Changes the Name of a File page 150F
  - mv, cp: Move or Copy Files page 198F
  - mv: Moves a Directory page 199F
  - mv: Changes the Name of a File page 54C
  - mv, cp: Move or Copy Files page 94C
  - mv page 890C (Command Reference section)
- ls
  - ls: Lists the Names of Files page 148F
  - ls –l: Displays Permissions page 202F
  - ls: Lists the Names of Files page 52C
  - ls –l: Displays Permissions page 98C
  - Dereferencing Symbolic Links Using ls page 116C
  - ls page 861C (Command Reference section)
- rm
  - rm: Deletes a File page 148F
  - rm: Removes a Link page 218F
  - rm: Deletes a File page 52C
  - rm: Removes a Link page 115C
  - rm page 926C (Command Reference section)
- rmdir
  - rmdir: Deletes a Directory page 197F
  - rmdir: Deletes a Directory page 93C
  - rmdir page 928C (Command Reference section)
- touch
  - touch page 985C (Command Reference section)
- tar
  - tar: Packs and Unpacks Archives page 162F
  - tar: Archives Files page 607F
  - tar: Packs and Unpacks Archives page 66C
  - tar page 968C (Command Reference section)

- cpio
  - cpio: Archives Files page 609F
  - cpio page 758C (Command Reference section)
- dd
  - dd page 772C (Command Reference section)
- file
  - file: Identifies the Contents of a File page 156F
  - file: Identifies the Contents of a File page 60C
  - file page 802C (Command Reference section)
- gzip
  - gzip: Compresses a File page 161F
  - gzip: Compresses a File page 65C
  - gzip page 838C (Command Reference section)
- gunzip
  - gunzip and zcat page 161F
  - gunzip and zcat page 65C
  - gzip page 838C (Command Reference section)
- bzip2
  - bzip2: Compresses a File page 160F
  - bzip2: Compresses a File page 64C
  - bzip2 page 732C (Command Reference section)
- file globbing
  - Filename Generation/Pathname Expansion page 244F
  - Pathname Expansion page 352F
  - Filename Generation/Pathname Expansion page 148C
  - Pathname Expansion page 362C
  - globbing page 379C (tcsh)

## 103.4 USE STREAMS, PIPES AND REDIRECTS

Redirecting standard input, standard output and standard error

- Redirecting Standard Output page 234F
- Redirecting Standard Input page 236F
- Redirecting Standard Error page 285F
- redirection page 1184F (Glossary)
- standard input page 1190F (Glossary)
- standard output page 1190F (Glossary)
- standard error page 1190F (Glossary)
- Redirecting Standard Output page 136C
- Redirecting Standard Input page 137C
- Redirecting Standard Error page 282C
- redirection page 1089C (Glossary)
- standard input page 1095C (Glossary)
- standard output page 1095C (Glossary)
- standard error page 1095C (Glossary)

Pipe the output of one command to the input of another command
- | (Pipe): Communicates Between Processes page 156F
- Pipes page 239F
- Filters page 241F
- filter page 1164F (Glossary)
- pipe page 1181F (Glossary)
- | (Pipeline): Communicates Between Processes page 60C
- Pipelines page 141C
- Filters page 144C
- filter page 1069C (Glossary)
- pipeline page 1086C (Glossary)

Use the output of one command as arguments to another command
- xargs page 1005C (Command Reference section)

Send output to both stdout and a file
- tee: Sends Output in Two Directions page 242F
- tee page 145C
- tee page 973C (Command Reference section)

The following is a partial list of the used files, terms and utilities:
- tee
  - tee: Sends Output in Two Directions page 242F
  - tee page 145C
  - tee page 973C (Command Reference section)
- xargs
  - xargs page 1005C (Command Reference section)

## 103.5 Create, Monitor and Kill Processes

Run jobs in the foreground and background
- Running a Command in the Background page 242F
- Background process page 318F
- background process page 1153F (Glossary)
- foreground process page 1165F (Glossary)
- Running a Command in the Background page 146C
- Background process page 325C
- background process page 1057C (Glossary)
- foreground process page 1069C (Glossary)

Signal a program to continue running after logout
- nohup page 896C (Command Reference section)

Monitor active processes

- Process Identification page 317F
- ps page 470F
- Process Identification page 324C
- ps page 921C (Command Reference section)

Select and sort processes for display

- Process Identification page 317F
- ps page 470F
- top: Lists Processes Using the Most Resources page 616F
- Process Identification page 324C
- ps page 921C (Command Reference section)
- top page 981C (Command Reference section)

Send signals to processes

- Aborting Execution page 140F
- kill: Aborting a Background Job page 243F
- kill: Sends a Signal to a Process page 470F
- killall: Kills a Command page 472F
- Aborting Execution page 30C
- kill: Aborting a Background Job page 147C
- kill: Aborts a Process page 486C
- kill page 846C (Command Reference section)
- killall page 848C (Command Reference section)

The following is a partial list of the used files, terms and utilities:

- **&**
  - Running a Command in the Background page 242F
  - Background process page 318F
  - background process page 1153F (Glossary)
  - foreground process page 1165F (Glossary)
  - Running a Command in the Background page 146C
  - Background process page 325C
  - background process page 1057C (Glossary)
  - foreground process page 1069C (Glossary)
- bg
  - CONTROL-Z and bg page 243F
  - bg: Sends a Job to the Background page 297F
  - Moving a Job from the Foreground to the Background page 243F
  - background process page 1153F (Glossary)
  - Moving a Job from the Foreground to the Background page 147C
  - bg: Sends a Job to the Background page 296C
  - background process page 1057C (Glossary)

- fg
  - Foreground page 242F
  - Moving a Job from the Foreground to the Background page 243F
  - fg: Brings a Job to the Foreground page 296F
  - foreground process page 1165F (Glossary)
  - Foreground page 146C
  - Moving a Job from the Foreground to the Background page 147C
  - fg: Brings a Job to the Foreground page 295C
  - foreground process page 1069C (Glossary)
- jobs
  - Determining the number of a job using jobs page 244F
  - jobs: Lists Jobs page 296F
  - Determining the number of a job using jobs page 148C
  - jobs: Lists Jobs page 295C
- kill
  - kill: Aborting a Background Job page 243F
  - kill: Sends a Signal to a Process page 470F
  - Aborting Execution page 30C
  - kill: Aborting a Background Job page 147C
  - kill: Aborts a Process page 486C
  - kill page 846C (Command Reference section)
- nohup
  - nohup page 896C (Command Reference section)
- ps
  - Process Identification page 317F
  - ps page 470F
  - Process Identification page 324C
  - ps page 921C (Command Reference section)
- top
  - top: Lists Processes Using the Most Resources page 616F
  - top page 981C (Command Reference section)
- free
  - free: Displays Memory Usage Information page 74C
- uptime
  - uptime page 169F
  - uptime: Displays System Load and Duration Information page 72C
- killall
  - killall: Kills a Command page 472F
  - killall page 848C (Command Reference section)

## 103.6 MODIFY PROCESS EXECUTION PRIORITIES

Know the default priority of a job that is created
- Process Identification page 317F
- ps page 470F
- Process Identification page 324C
- ps page 921C (Command Reference section)

Run a program with higher or lower priority than the default
- nice page 892C (Command Reference section)

Change the priority of a running process
- renice page 925C (Command Reference section)

The following is a partial list of the used files, terms and utilities:
- nice
  - nice page 892C (Command Reference section)
- ps
  - Process Identification page 317F
  - ps page 470F
  - Process Identification page 324C
  - ps page 921C (Command Reference section)
- renice
  - renice page 925C (Command Reference section)
- top
  - top: Lists Processes Using the Most Resources page 616F
  - top page 981C (Command Reference section)

## 103.7 SEARCH TEXT FILES USING REGULAR EXPRESSIONS

*See Appendix A: Regular Expressions page 1105F and page 1011C*

Create simple regular expressions containing several notational elements
- Appendix A: Regular Expressions page 1105F
- Searching for a String page 184C (vim)
- Regular Expressions page 550C (Perl)
- Regular Expressions page 583C (Python)
- Patterns page 622C (gawk)
- Appendix A: Regular Expressions page 1011C

Use regular expression tools to perform searches through a filesystem or file content
- *See preceding entry.*

The following is a partial list of the used files, terms and utilities:
- grep
  - grep: Searches for a String page 152F
  - grep: Searches for a String page 56C
  - grep page 833C (Command Reference section)

- egrep
  - egrep and fgrep page 834C
- fgrep
  - egrep and fgrep page 834C
- sed
  - Chapter 15: The sed Editor page 653C
- regex(7)

## 103.8 PERFORM BASIC FILE EDITING OPERATIONS USING vi

*A Practical Guide to Fedora and Red Hat Enterprise Linux, Sixth Edition and A Practical Guide to Linux Commands, Editors, and Shell Programming, Second Edition cover the* vim *editor. All commands discussed here are compatible between* vi *and* vim.

*See Tutorial: Using vim to Create and Edit a File* page 172F
*See Chapter 6: The vim Editor* page 159C

Navigate a document using vi
- Moving the Cursor page 177F
- Command Mode: Moving the Cursor page 174C

Use basic vi modes
- Command and Input Modes page 174F
- Command and Input Modes page 163C
- Modes of Operation page 169C

Insert, edit, delete, copy and find text
- Entering Text page 175F
- Deleting Text page 178F
- Correcting Text page 178F
- Input Mode page 178C
- Command Mode: Deleting and Changing Text page 179C
- Copying, Moving, and Deleting Text page 190C
- Searching and Substituting page 183C

The following is a partial list of the used files, terms and utilities:
- vi
  - Tutorial: Using vim to Create and Edit a File page 172F
  - Chapter 6: The vim Editor page 159C
- /, **?**
  - . Any-Character Indicator page 185C
- **h**,**j**,**k**,**l**
  - Moving the Cursor page 177F
  - l/h page 175C
  - j/k page 176C

- **i**, **o**, **a**
  - Entering Text page 175F
  - Entering Additional Text page 178F
  - i/a (Input mode) page 164C
  - o/O (Open) page 167C
- **c**, **d**, **p**, **y**, **dd**, **yy**
  - Deleting Text page 178F
  - Change (c/C) page 181C
  - Delete (d/D) page 180C
  - Put (p/P) page 191C
  - Yank (y/Y) page 191C
  - Use **dd** to delete a single line page 180C
  - Use **yy** to yank one line page 191C
- **ZZ**, **:w!**, **:q!**, **:e!**
  - Ending the Editing Session page 179F
  - Ending the Editing Session page 168C
  - Exit (ZZ) page 193C
  - Abnormal Termination of an Editing Session page 172C
  - :e! page 200C

# 104 Devices, Linux Filesystems, Filesystem Hierarchy Standard

## 104.1 Create Partitions and Filesystems

Use various mkfs commands to set up partitions and create various filesystems such as:

- **ext2**
  - **ext2** page 519F
  - ext2 to ext3 page 527F
- **ext3**
  - **ext3** page 519F
  - ext3 to ext2 page 527F
- **xfs**
- **reiserfs v3**
- **vfat**

The following is a partial list of the used files, terms and utilities:

- fdisk
  - *See parted: Reports on and Partitions a Hard Disk* page 617F
- mkfs
  - mkfs: Creates a Filesystem page 472F
  - mkfs page 887C (Command Reference section)
- mkswap
  - **swap** page 513F

## 104.2 Maintain the Integrity of Filesystems

Verify the integrity of filesystems
- fsck: Checks Filesystem Integrity page 525F
- fsck page 814C (Command Reference section)

Monitor free space and inodes
- df page 775C (Command Reference section)

Repair simple filesystem problems
- fsck page 814C (Command Reference section)

The following is a partial list of the used files, terms and utilities:
- du
  - du page 791C (Command Reference section)
- df
  - df: shows where directory hierarchies are mounted page 794F
  - df page 775C (Command Reference section)
- fsck
  - fsck: Checks Filesystem Integrity page 525F
  - fsck page 814C (Command Reference section)
- e2fsck
  - fsck is a front end page 816C
- mke2fs
- debugfs
- dumpe2fs
- tune2fs
  - tune2fs: Changes Filesystem Parameters page 526F
  - tune2fs page 991C (Command Reference section)
- xfs tools (such as xfs_metadump and xfs_info)

## 104.3 Control Mounting and Unmounting of Filesystems

Manually mount and unmount filesystems
- mount: Mounts a Filesystem page 520F
- umount: Unmounts a Filesystem page 523F
- mount: Mounts a Directory Hierarchy page 797F
- Mounting Shares page 824F

Configure filesystem mounting on bootup
- fstab: Keeps Track of Filesystems page 524F
- fstab file page 797F
- /etc/fstab: Mounts Directory Hierarchies Automatically page 801F

Configure user mountable removeable filesystems
- Mount Options page 522F

The following is a partial list of the used files, terms and utilities:

- **/etc/fstab**
  - fstab: Keeps Track of Filesystems page 524F
  - fstab file page 797F
  - /etc/fstab: Mounts Directory Hierarchies Automatically page 801F
- **/media**
- mount
  - mount: Mounts a Filesystem page 520F
  - mount: Mounts a Directory Hierarchy page 797F
  - Mounting Shares page 824F
- umount
  - umount: Unmounts a Filesystem page 523F

## 104.4 Manage Disk Quotas

Set up a disk quota for a filesystem

- Disk Quota System page 634F

Edit, check and generate user quota reports

The following is a partial list of the used files, terms and utilities:

- quota
- edquota
- repquota
- quotaon

## 104.5 Manage File Permissions and Ownership

Manage access permissions on regular and special files as well as directories

- chmod: Changes Access Permissions page 203F
- chmod: Makes a File Executable page 288F
- chmod: Changes Access Permissions page 99C
- chmod: Makes a File Executable page 285C
- chmod page 741C (Command Reference section)

Use access modes such as suid, sgid and the sticky bit to maintain security

- Setuid and Setgid Permissions page 205F
- page 412F
- Setuid files page 631F
- setuid page 1187F (Glossary)
- setgid page 1187F (Glossary)
- Setuid and Setgid Permissions page 101C
- setuid page 1092C (Glossary)
- setgid page 1092C (Glossary)

Know how to change the file creation mask

- umask: Specifies the Permission Mask page 473F
- umask page 994C (Command Reference section)

Use the group field to grant file access to group members
- ls –l: Displays Permissions page 202F
- chmod: Changes Access Permissions page 203F
- **/etc/group** page 506F
- ls –l: Displays Permissions page 98C
- chmod: Changes Access Permissions page 99C
- chgrp page 739C (Command Reference section)
- chmod page 741C (Command Reference section)

The following is a partial list of the used files, terms and utilities:
- chmod
  - chmod: Changes Access Permissions page 203F
  - chmod: Makes a File Executable page 288F
  - chmod: Changes Access Permissions page 99C
  - chmod page 741C (Command Reference section)
- umask
  - umask: Specifies the Permission Mask page 473F
  - umask page 994C (Command Reference section)
- chown
  - chown page 746C (Command Reference section)
- chgrp
  - chgrp page 739C (Command Reference section)
  - Dereferencing Symbolic Links Using chgrp page 117C

## 104.6 Create and Change Hard and Symbolic Links

Create links
- ln: Creates a Hard Link page 214F
- ln: Creates Symbolic Links page 217F
- ln: Creates a Hard Link page 110C
- ln: Creates Symbolic Links page 113C
- ln page 856C (Command Reference section)

Identify hard and/or softlinks
- ls and link counts page 216F
- ls and inodes page 216F
- hard link page 1167F (Glossary)
- link page 1173F (Glossary)
- symbolic link page 1192F (Glossary)
- ls and link counts page 112C
- ls and inodes page 112C
- First character in a long ls display page 864C
- hard link page 1071C (Glossary)
- link page 1077C (Glossary)
- symbolic link page 1097C (Glossary)

Copying versus linking files
- cp Versus ln page 215F
- cp Versus ln page 111C

Use links to support system administration tasks

The following is a partial list of the used files, terms and utilities:
- ln
  - ln: Creates a Hard Link page 214F
  - ln: Creates Symbolic Links page 217F
  - ln: Creates a Hard Link page 110C
  - ln: Creates Symbolic Links page 113C
  - ln page 856C (Command Reference section)

## 104.7 Find System Files and Place Files in the Correct Location

Understand the correct locations of files under the FHS
- Important Standard Directories and Files page 199F
- Important Standard Directories and Files page 95C

Find files and commands on a Linux system
- whereis page 165F
- locate: Searches for a File page 166F
- which and whereis: Locate a Utility page 68C
- locate: Searches for a File page 70C
- find page 804C (Command Reference section)

Know the location and propose of important file and directories as defined in the FHS
- Important Standard Directories and Files page 199F
- Important Standard Directories and Files page 95C

The following is a partial list of the used files, terms and utilities:
- find
  - find page 804C (Command Reference section)
- locate
  - locate: Searches for a File page 166F
  - locate: Searches for a File page 70C
- updatedb
- whereis
  - whereis page 165F
  - which and whereis: Locate a Utility page 68C
- which
  - which page 164F
  - which and whereis: Locate a Utility page 68C
  - which page 1001C (Command Reference section)
- type
  - type: Displays Information About a Command page 1019F
  - type: Displays Information About a Command page 477C
- **/etc/updatedb.conf**

# Certification Exam 2
# Objectives: LX0-102

## 105 Shells, Scripting and Data Management

### 105.1 Customize and Use the Shell Environment

*See Chapter 9: The Bourne Again Shell* page 279F

*See Chapter 8: The Bourne Again Shell (bash)* page 275C

Set environment variables (e.g., **PATH**) at login or when spawning a new shell

- Startup Files page 282F
- Set **PATH** in **.bash_profile** page 283F
- Keyword variables page 302F
- Keyword Variables page 307F
- Startup Files page 278C
- Set **PATH** in **.bash_profile** page 279C
- Keyword variables page 301C
- Keyword Variables page 307C

Write bash functions for frequently used sequences of commands

- Functions page 338F
- Functions page 1009F
- Functions page 346C
- Variables in Functions page 475C

Maintain skeleton directories for new user accounts

- useradd: Adds a User Account page 604F

Set command search path with the proper directory

- PATH: Where the Shell Looks for Programs page 308F
- PATH: Where the Shell Looks for Programs page 308C
- path or PATH page 393C (tcsh)
- which page 1001C (Shows where in PATH a file is located.)

The following is a partial list of the used files, terms, and utilities:

- **/etc/profile**
  - **/etc/profile** page 282F
  - /etc/profile and /etc/profile.d page 509F
  - **/etc/profile** page 278C
- env
  - env: Runs a Program in a Modified Environment page 471C

- export
  - declare and typeset: Assign Attributes to Variables page 306F
  - export page 1008F
  - readonly and export page 306C
  - export: Puts Variables in the Environment page 468C
- set
  - set ±o: Turns Shell Features On and Off page 341F
  - set: Initializes Command-Line Arguments page 1014F
  - set ±o: Turns Shell Features On and Off page 350C
  - set: Initializes Positional Parameters page 460C
  - set: Works with Shell Features, Positional Parameters, and Variables page 472C
- unset
  - unset: Removes a Variable page 305F
  - unset: Removes a Variable page 304C
- **~/.bash_profile**
  - **.bash_profile .bash_login .profile** page 282F
  - **~/.bash_profile** page 502F
  - **.bash_profile, .bash_login, and .profile** page 278C
- **~/.bash_login**
  - **.bash_profile .bash_login .profile** page 282F
  - **.bash_profile, .bash_login, and .profile** page 278C
- **~/.profile**
  - **.bash_profile .bash_login .profile** page 282F
  - **.bash_profile, .bash_login, and .profile** page 278C
- **~/.bashrc**
  - **.bashrc** page 283F
  - **~/.bashrc** page 502F
  - **.bashrc** page 279C
- **~/.bash_logout**
  - **.bash_logout** page 282F
  - **.bash_logout** page 279C
- **function**
  - Functions page 338F
  - Functions page 1009F
  - Functions page 346C
  - Variables in Functions page 475C
- alias
  - Aliases page 334F
  - Alias Substitution page 345F
  - Aliases page 342C
  - Alias Substitution page 354C
- lists
  - Lists page 145C

# 105.2 Customize or Write Simple Scripts

*See Chapter 9: The Bourne Again Shell* page 279F

*See Chapter 27: Programming the Bourne Again Shell* page 969F

*See Chapter 8: The Bourne Again Shell (bash)* page 275C

*See Chapter 10: Programming the Bourne Again Shell (bash)* page 417C

Use standard sh syntax (loops, tests)
- Control Structures page 971F
- Control Structures page 418C

Use command substitution
- Command Substitution page 351F
- Command Substitution page 361C
- Command Substitution page 379C (tcsh)

Test return values for success or failure or other information provided by a command
- test builtin page 971F
- [] is a synonym for test page 974F
- test builtin page 986F
- test builtin page 419C
- [] is a synonym for test page 422C
- test builtin page 419C
- test page 978C (Command Reference section)

Perform conditional mailing to the superuser

Correctly select the script interpreter through the shebang (#!) line
- #! Specifies a Shell page 290F
- #! Specifies a Shell page 287C

Manage the location, ownership, execution and suid-rights of scripts

The following is a partial list of the used files, terms, and utilities:
- **for**
  - for...in page 983F
  - for page 984F
  - for...in page 431C
  - for page 433C
- **while**
  - while page 986F
  - while page 435C

- test
  - test builtin page 971F
  - [] is a synonym for test page 974F
  - test builtin page 986F
  - test builtin page 419C
  - [] is a synonym for test page 422C
  - test builtin page 419C
  - test page 978C (Command Reference section)
- **if**
  - if...then page 971F
  - if...then...else page 974F
  - if...then...elif page 976F
  - if...then page 419C
  - if...then...else page 423C
  - if...then...elif page 425C
- read
  - read: Accepts User Input page 1019F
  - read: Accepts User Input page 477C
- seq
  - seq page 357C

## 105.3 SQL Data Management

*See Chapter 16: MySQL* page 635F

*See Chapter 13: The MySQL Database Management System* page 595C

Use of basic SQL commands
- MySQL page 635F
- Notes page 596C

Perform basic data manipulation
- MySQL page 635F
- Examples page 605C

The following is a partial list of the used files, terms, and utilities:
- insert
  - Entering data page 640F
  - INSERT INTO page 607C
- update
  - Modifying data page 641F
  - UPDATE page 611C
- select
  - Selecting rows using LIKE page 641F
  - More queries page 642F
  - Retrieving Data page 608C
  - Joins page 613C

- delete
  - Deleting rows using a WHERE clause page 641F
  - DELETE FROM page 611C
- from
  - DELETE FROM page 611C
- where
  - Deleting rows using a WHERE clause page 641F
  - WHERE page 609C
- group by
- order by
  - page 609C
- join
  - Joins page 613C


# 106 User Interfaces and Desktops

## 106.1 Install and Configure X11

*See X Window System* page 258F

Verify that the video card and monitor are supported by an X server

Awareness of the X font server

Basic understanding and knowledge of the X Window configuration file

The following is a partial list of the used files, terms, and utilities:

- **/etc/X11/xorg.conf**
- xhost
  - xhost Grants Access to a Display page 261F
- **DISPLAY**
  - The DISPLAY Variable page 262F
- xwininfo
- xdpyinfo
- X
  - X Window System page 258F

## 106.2 Setup a Display Manager

Turn the display manager on or off

Change the display manager greeting

Change default color depth for the display manager

Configure display managers for use by X-stations

The following is a partial list of the used files, terms, and utilities:

- **/etc/inittab**
  - rcS task and inittab page 442F
  - **/etc/inittab** page 507F
- **xdm** configuration files
- **kdm** configuration files
- **gdm** configuration files

## 106.3 Accessibility

Keyboard Accessibility Settings (AccessX?)

Visual Settings and Themes

Assistive Technology (ATs)

The following is a partial list of the used files, terms, and utilities:

- Sticky/Repeat Keys
- Slow/Bounce/Toggle Keys
- Mouse Keys
- High Contrast/Large Print Desktop Themes
- Screen Reader
- Braille Display
- Screen Magnifier
- On-Screen Keyboard
- Gestures (used at login, for example gdm)
- Orca
- GOK
- emacspeak

# 107 Administrative Tasks

## 107.1 Manage User and Group Accounts and Related System Files

Add, modify and remove users and groups

- system-config-users: Manages User Accounts page 602F
- Managing User Accounts from the Command Line page 604F

Manage user/group info in password/group databases

Create and manage special purpose and limited accounts

The following is a partial list of the used files, terms, and utilities:

- **/etc/passwd**
  - **/etc/passwd** page 508F
- **/etc/shadow**
  - **/etc/shadow** page 511F
- **/etc/group**
  - **/etc/group** page 506F
- **/etc/skel**
- chage
  - chage page 605F
- groupadd
  - groupadd: Adds a Group page 605F
- groupdel
  - groupdel and groupmod: Remove and Modify a Group page 605F
- groupmod
  - groupdel and groupmod: Remove and Modify a Group page 605F
- passwd
  - Changing Your Password page 137F
- useradd
  - useradd: Adds a User Account page 604F
- userdel
  - userdel: Removes a User Account page 604F
- usermod
  - usermod: Modifies a User Account page 604F

## 107.2 Automate System Administration Tasks by Scheduling Jobs

Manage **cron** and at jobs

- crond and anacron: Schedule Routine Tasks page 611F
- at: Runs Occasional Tasks page 615F
- crontab page 763C (Command Reference section)
- at page 725C (Command Reference section)

Configure user access to **cron** and at services

- /etc/at.allow, /etc/at.deny, /etc/cron.allow, and /etc/cron.deny page 506F
- cron.allow, cron.deny page 765C
- at.allow and at.deny page 726C

The following is a partial list of the used files, terms, and utilities:

- **/etc/cron.{d,daily,hourly,monthly,weekly}**
  - Crontab directories page 764C
- **/etc/at.deny**
  - /etc/at.allow, /etc/at.deny, /etc/cron.allow, and /etc/cron.deny page 506F
  - at.allow and at.deny page 726C

- **/etc/at.allow**
  - /etc/at.allow, /etc/at.deny, /etc/cron.allow, and /etc/cron.deny page 506F
  - at.allow and at.deny page 726C
- **/etc/crontab**
  - **/etc/crontab** page 612F
  - Crontab directories page 764C
- **/etc/cron.allow**
  - /etc/at.allow, /etc/at.deny, /etc/cron.allow, and /etc/cron.deny page 506F
  - cron.allow, cron.deny page 765C
- **/etc/cron.deny**
  - /etc/at.allow, /etc/at.deny, /etc/cron.allow, and /etc/cron.deny page 506F
  - cron.allow, cron.deny page 765C
- **/var/spool/cron/***
  - Crontab Files page 611F
  - Notes page 763C
- crontab
  - User crontab files page 612F
  - crond and anacron: Schedule Routine Tasks page 611F
  - crontab page 763C (Command Reference section)
- at
  - at: Runs Occasional Tasks page 615F
  - at page 725C (Command Reference section)
- atq
  - atq page 727C
- atrm
  - atrm page 727C

## 107.3 Localization and Internationalization

Locale settings
- locale page 1173F (Glossary)
- Locale page 316C
- locale: Displays Locale Information page 318C
- locale page 1078C (Glossary)

Timezone settings
- Time page 320C

The following is a partial list of the used files, terms, and utilities:
- **/etc/timezone**
  - **/etc/timezone** page 322C
- **/etc/localtime**
  - **/etc/localtime** page 322C
- **/usr/share/zoneinfo**
  - **/usr/share/zoneinfo** page 322C

- Environment variables:
  - **LC_***: page 317C
  - **LC_ALL:** page 317C
  - **LANG:** page 1025C
- **/usr/bin/locale**
- tzselect
  - tzselect page 321C
- tzconfig
  - tzconfig page 321C
- date
  - date: Displays the Time and Date page 158F
  - date: Displays the Time and Date page 62C
  - date page 769C (Command Reference section)
- iconv
- UTF-8
  - UTF-8 page 1195F (Glossary)
  - UTF-8 page 1100C (Glossary)
- ISO-8859
- ASCII
  - ASCII page 1151F (Glossary)
  - ASCII page 1055C (Glossary)
- Unicode
  - Unicode page 1195F (Glossary)
  - Unicode page 1099C (Glossary)


# 108 ESSENTIAL SYSTEM SERVICES

## 108.1 MAINTAIN SYSTEM TIME

Set the system date and time


- Setting the system clock page 770C


Set the hardware clock to the correct time in UTC

Configure the correct timezone


- Time page 320C


Basic NTP configuration

Knowledge of using the pool.ntp.org service

The following is a partial list of the used files, terms, and utilities:


- **/usr/share/zoneinfo**
  - **/usr/share/zoneinfo** page 322C

- **/etc/timezone**
  - **/etc/timezone** page 322C
- **/etc/localtime**
  - **/etc/localtime** page 322C
- **/etc/ntp.conf**
- date
  - date: Displays the Time and Date page 158F
  - date: Displays the Time and Date page 62C
  - date page 769C (Command Reference section)
- hwclock
- **ntpd**
- ntpdate
- **pool.ntp.org**

## 108.2 SYSTEM LOGGING

Syslog configuration files
- **rsyslog.conf** page 623F

syslog
- rsyslogd: Logs System Messages page 623F

standard facilities, priorities and actions
- Selectors page 623F
- Facilities page 624F
- Priorities page 624F
- Actions page 624F

The following is a partial list of the used files, terms, and utilities:
- **syslog.conf**
  - **rsyslog.conf** page 623F
- **syslogd**
  - rsyslogd: Logs System Messages page 623F
- **klogd**
- logger

## 108.3 MAIL TRANSFER AGENT (MTA) BASICS

*See Chapter 20: sendmail: Setting Up Mail Servers, Clients, and More* page 729F

Create e-mail aliases
- **/etc/aliases** page 736F

Configure e-mail forwarding
- **~/.forward** page 737F

Knowledge of commonly available MTA programs (Postfix, **sendmail**, Qmail, **exim**) (no configuration)
- Alternatives to sendmail page 731F

The following is a partial list of the used files, terms, and utilities:

- **~/.forward**
  - **~/.forward** page 737F
- **sendmail** emulation layer commands
- newaliases
  - newaliases page 737F
- mail
- mailq
  - mailq page 738F
- Postfix
  - Postfix page 732F
- **sendmail**
  - Introduction to sendmail page 730F
  - Setting Up a sendmail Mail Server page 732F
  - JumpStart I: Configuring sendmail on a Client page 733F
  - JumpStart II: Configuring sendmail on a Server page 734F
  - Working with sendmail Messages page 735F
  - Configuring sendmail page 739F
- **exim**
  - **exim4** page 732F
- **qmail**
  - Qmail page 732F

## 108.4 MANAGE PRINTERS AND PRINTING

*See Chapter 14: Printing with CUPS* page 559F

Basic CUPS configuration (for local and remote printers)

- Fedora/RHEL Configures a Local Printer Automatically page 562F
- JumpStart I: Configuring a Printer Using system-config-printer page 562F
- JumpStart II: Setting Up a Local or Remote Printer page 565F
- Working with the CUPS Web Interface page 568F
- Configuring Printers page 570F

Manage user print queues

- Managing Print Queues page 575F

Troubleshoot general printing problems

Add and remove jobs from configured printer queues

- BSD and System V command-line print utilities page 578F

The following is a partial list of the used files, terms, and utilities:

- CUPS configuration files, tools and utilities
  - JumpStart I: Configuring a Printer Using system-config-printer page 562F
  - Working with the CUPS Web Interface page 568F
  - Sharing CUPS Printers page 576F

- **/etc/cups**
  - Example lpadmin Commands page 574F
- **lpd** legacy interface (lpr, lprm, lpq)
  - Traditional UNIX Printing page 577F

# 109 Networking Fundamentals

*See Chapter 10: Networking and the Internet* page 359F

## 109.1 Fundamentals of internet protocols

*See Network Protocols* page 370F

Demonstrate an understanding network masks
- Subnet mask page 378F
- network mask page 1178F (Glossary)
- subnet mask page 1096C (Glossary)

Knowledge of the differences between private and public “dotted quad” IP-Addresses
- Private address space page 650F
- private address space page 1182F (Glossary)
- private address space page 1086C (Glossary)

Seting a default route

Knowledge about common TCP and UDP ports (20, 21, 22, 23, 25, 53, 80, 110, 119, 139, 143, 161, 443, 465, 993, 995)
- Ports page 393F
- port page 1181F (Glossary)
- port page 1086C (Glossary)

Knowledge about the differences and major features of UDP, TCP and ICMP
- UDP page 370F
- UDP: User Datagram Protocol page 372F
- TCP page 370F
- TCP: Transmission Control Protocol page 371F
- ping: Tests a Network Connection page 386F
- UDP page 1194F (Glossary)
- TCP page 1192F (Glossary)
- ICMP page 1169F (Glossary)
- UDP page 1099C (Glossary)
- TCP page 1097C (Glossary)
- ICMP page 1073C (Glossary)

Knowledge of the major differences between IPv4 and IPv6
- IPv4 page 372F
- IPv6 page 373F

The following is a partial list of the used files, terms, and utilities:

- **/etc/services**
  - Network Services page 394F
  - **/etc/services** page 511F
- ftp
  - ftp: Transfers Files Over a Network page 385F
  - Chapter 19: FTP: Transferring Files Across a Network page 701F
  - ftp page 819C (Command Reference section)
- telnet
  - telnet: Logs In on a Remote System page 383F
  - telnet page 974C (Command Reference section)
- host
  - host and dig: Query Internet Nameservers page 388F
- ping
  - ping: Tests a Network Connection page 386F
- dig
  - host and dig: Query Internet Nameservers page 388F
  - dig page 855F
  - dig page 856F
- traceroute
  - traceroute: Traces a Route Over the Internet page 387F
- tracepath

## 109.2 BASIC NETWORK CONFIGURATION

Manually and automatically configure network interfaces

- Configuring the Systems page 650F
- NetworkManager: Configures Network Connections page 651F

Basic TCP/IP host configuration

The following is a partial list of the used files, terms, and utilities:

- **/etc/hostname**
- **/etc/hosts**
  - Hostnames page 380F
  - **/etc/hosts** page 507F
- **/etc/resolv.conf**
  - **/etc/resolv.conf** page 510F
- **/etc/nsswitch.conf**
  - nsswitch.conf: Which Service to Look at First page 494F
- ifconfig
- ifup
- ifdown
- route
- ping
  - ping: Tests a Network Connection page 386F

## 109.3 BASIC NETWORK TROUBLESHOOTING

Manually and automatically configure network interfaces and routing tables to include adding, starting, stopping, restarting, deleting or reconfiguring network interfaces

Change, view or configure the routing table and correct an improperly set default route manually

Debug problems associated with the network configuration

The following is a partial list of the used files, terms, and utilities:

- ifconfig
- ifup
- ifdown
- route
- host
  - host and dig: Query Internet Nameservers page 388F
- hostname
  - hostname: Displays the System Name page 149F
  - **/etc/sysconfig/network** page 512F
  - hostname: Displays the System Name page 53C
- dig
  - host and dig: Query Internet Nameservers page 388F
  - dig page 855F
  - dig page 856F
- netstat
- ping
  - ping: Tests a Network Connection page 386F
- traceroute
  - traceroute: Traces a Route Over the Internet page 387F

## 109.4 CONFIGURE CLIENT SIDE DNS

*See Chapter 24: DNS/BIND: Tracking Domain Names and Addresses* page 845F

Demonstrate the use of DNS on the local system

- JumpStart I: Setting Up a DNS Cache page 860F

Modify the order in which name resolution is done

- Resolver page 848F

The following is a partial list of the used files, terms, and utilities:

- **/etc/hosts**
  - Hostnames page 380F
  - **/etc/hosts** page 507F
- **/etc/resolv.conf**
  - **/etc/resolv.conf** page 510F
- **/etc/nsswitch.conf**
  - nsswitch.conf: Which Service to Look at First page 494F

# 110 Security

## 110.1 Perform Security Administration Tasks

Audit a system to find files with the suid/sgid bit set
- Listing setuid files page 459F
- Listing setgid files page 459F

Set or change user passwords and password aging information
- Changing Your Password page 137F
- Changing Your Password page 44C

Being able to use nmap and netstat to discover open ports on a system

Set up limits on user logins, processes and memory usage

Basic sudo configuration and usage
- Using sudo to Gain root Privileges page 415F
- su/sudo: Curbing Your Power (root Privileges) page 32C

The following is a partial list of the used files, terms, and utilities:
- find
  - find page 804C (Command Reference section)
- passwd
- lsof
  - lsof: Finds Open Files page 629F
- nmap
- chage
  - chage page 605F
- netstat
- sudo
  - Using sudo to Gain root Privileges page 415F
  - su/sudo: Curbing Your Power (root Privileges) page 32C
- **/etc/sudoers**
  - sudoers: Configuring sudo page 419F
- su
  - Using su to Gain root Privileges page 413F
  - su/sudo: Curbing Your Power (root Privileges) page 32C
- usermod
  - usermod: Modifies a User Account page 604F
- ulimit

## 110.2 SETUP HOST SECURITY

Awareness of shadow passwords and how they work
- **/etc/shadow** page 511F

Turn off network services not in use
- Configuring Daemons (Services) page 433F
- service: Configures Services I page 444F
- system-config-services: Configures Services II page 445F
- chkconfig: Configures Services III page 446F

Understand the role of TCP wrappers
- TCP Wrappers: Secure a Server (hosts.allow and hosts.deny) page 484F

The following is a partial list of the used files, terms, and utilities:
- **/etc/nologin**
  - Going to Single-User Mode page 454F
- **/etc/passwd**
  - **/etc/passwd** page 508F
- **/etc/shadow**
  - **/etc/shadow** page 511F
- **/etc/xinetd.d/***
  - **xinetd.d** page 482F
- **/etc/xinetd.conf**
  - **xinetd.conf** page 482F
- **/etc/inetd.d/***
- **/etc/inetd.conf**
- **/etc/inittab**
  - rcS task and inittab page 442F
  - **/etc/inittab** page 507F
- **/etc/init.d/***
  - SysVinit (rc) Scripts: Start and Stop System Services (Fedora/RHEL) page 442F
- **/etc/hosts.allow**
  - hosts.allow and hosts.deny page 484F
- **/etc/hosts.deny**
  - hosts.allow and hosts.deny page 484F

## 110.3 SECURING DATA WITH ENCRYPTION

Perform basic OpenSSH 2 client configuration and usage
- Configuring OpenSSH Clients page 678F
- Running the ssh, scp, and sftp OpenSSH Clients page 677F
- Configuring OpenSSH Clients page 692C
- Running the ssh, scp, and sftp OpenSSH Clients page 691C

Understand the role of OpenSSH 2 server host keys
- How OpenSSH Works page 675F
- Authorized Keys: Automatic Login page 689F
- How OpenSSH Works page 689C
- Authorized Keys: Automatic Login page 702C

Perform basic GnuPG configuration and usage

Understand SSH port tunnels (including X11 tunnels)
- Tunneling/Port Forwarding page 696F
- Tunneling/Port Forwarding page 706C

The following is a partial list of the used files, terms, and utilities:
- ssh
  - ssh: Logs in or Executes Commands on a Remote System page 681F
  - ssh: Logs In or Executes Commands on a Remote System page 694C
- ssh-keygen
  - ssh-keygen page 689F
  - ssh-keygen page 703C
- ssh-agent
  - ssh-agent: Holds Your Private Keys page 691F
  - ssh-agent: Holds Your Private Keys page 705C
- ssh-add
  - ssh-add page 692F
  - ssh-add page 705C
- **~/.ssh/id_rsa** and **id_rsa.pub**
  - **id_rsa, id_rsa.pub** page 677F
  - id_rsa and id_rsa.pub page 690F
  - **id_rsa, id_rsa.pub** page 690C
  - id_rsa and id_rsa.pub page 703C
- **~/.ssh/id_dsa** and **id_dsa.pub**
  - **id_dsa, id_dsa.pub** page 677F
  - **id_dsa, id_dsa.pub** page 690C
- **/etc/ssh/ssh_host_rsa_key** and **ssh_host_rsa_key.pub**
- **/etc/ssh/ssh_host_dsa_key** and **ssh_host_dsa_key.pub**
- **~/.ssh/authorized_keys**
  - ssh-copy-id page 690F
  - ssh-copy-id page 703C
- **/etc/ssh_known_hosts**
  - ssh_known_hosts page 680F
  - ssh_known_hosts page 693C
- gpg
- **~/.gnupg/∗**