

Chapter 2

Linux Installation and Usage

At a Glance

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Lecture Notes

Overview

This chapter explores the concepts and procedures needed to install a Fedora Linux system. The latter half of the chapter explains the various components students will use when interacting with the operating system as well as how to enter basic shell commands, obtain help, and properly shut down the Linux system.

Chapter Objectives

In this chapter, your students will learn to:

- Prepare for and install Fedora Linux using good practices
- Outline the structure of the Linux interface
- Enter basic shell commands and find command documentation
- Properly shut down the Linux operating system

Teaching Tips

Installing Linux

1. Explain to students the importance of careful planning, the selection of an installation method and the configuration of the Linux operating system as part of the Linux installation process.

Preparing for Installation

1. Provide students with an overview of the interaction between the operating system and the computer hardware, and of the minimum hardware requirements necessary to successfully install Linux. Be sure that students recognize that these requirements are minimums only, and that a real production machine will usually require significantly higher resource levels in terms of RAM and CPU.
2. Provide students with resources for obtaining the minimum installation requirements, including a manual of a DVD installation kit, a file on an installation DVD, vendor Web sites, and Table 2-1.
3. Outline the purpose of a Hardware Compatibility List (HCL) as it relates to the hardware models that work in conjunction with Linux.

**Teaching
Tip**

The HCL for Fedora Linux can be found at:
<http://fedoraproject.org/wiki/HCL>.

4. Provide students with an overview of some of the different ways in which they could gather information about the hardware on a computer. Common examples include vendor component lists, physically opening the hardware, and using a variety of application utilities.
5. Explain the importance of identifying the software components that will be used in the Linux operating system, including the computer's host name, Internet or network configuration parameters, and the specific software packages that will be installed.
6. Provide students with an overview of the importance of creating a preinstallation checklist before starting the Linux installation process. Use Table 2-2 as an example.

Installation Methods

1. Provide students with an overview of the seven methods that can be used to install Linux.
2. Point out that the DVD based installation is the most common method, and provide a brief overview of the installation process for DVD based installations.

Performing the Installation

1. As part of explaining the process for installing Fedora Linux, walk students through the entire installation process step-by-step as each specific section is encountered. This will help to ensure that students are familiar with the process when completing the hands-on projects.
2. Explain the dynamic of installing the Linux operating system, including interaction with the installation program that prompts the user for information regarding the installation.
3. Provide students with an overview of each major section of the installation process, using the bullet points on Page 44 as a guide.

Starting the Installation

1. Start the installation demonstration by using a Fedora Linux DVD. Explain that, in most cases, booting from the DVD drive starts a Linux installation.
2. Explain the purpose of each of the options encountered on the Welcome to Red Hat Fedora Linux startup screen, and when each option would be most appropriate to use. Use the standard graphical mode setup to install Linux during the demonstration process.

3. Provide students with examples of scenarios in which a text mode install might be required.

Checking the Media for Errors

1. Demonstrate the screen asking the user to check the installation media for errors.
2. Explain the importance of performing the media check even though it is an optional installation step.

Choosing the Language, Keyboard, and Storage Type

1. Provide students with an overview of the different language options associated with Red Hat Fedora Linux, pointing out that different distributions from other vendors may provide a larger or smaller number of installable interface languages.
2. Walk students through the configuration of Linux keyboard settings, explaining the purpose of choosing a correct keyboard layout.
3. Walk students through the process of selecting the type of storage device that will be used to host the Linux OS. Explain when each option would be most appropriate to use.

<i>Teaching Tip</i>	When installing Linux on a brand-new hard disk, the user is prompted to initialize the drive. When installing Linux on a hard disk that already has a previous version of Linux, the user is prompted to choose between upgrading the system or performing a new installation.
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Selecting a Host Name, Time Zone, and Root Password

1. Outline the purpose of configuring the host name for the Linux system. Explain the difference between the default host name used by Fedora and the recommended host name used in a production environment.
2. Outline the importance of configuring the correct time zone on a Linux server, and demonstrate how this is accomplished.
3. Explain the concept of authentication, and how it is used by Linux.
4. Provide students with an overview of the purpose of the root user account on a Linux system, and the level of access this account has to a Linux system.
5. Demonstrate the process of configuring the root user account and a regular user account.

6. Outline the importance of associating a very secure and uncommon password with the root account. Provide students with an overview of the character elements that should be included when developing a secure password such as upper and lowercase and non-alphanumeric characters.

Configuring Storage Devices

1. Explain to students that the installation process requires the user to specify the location of storage devices that will be used to store the Linux OS.
2. Outline the basic differences between Parallel Advanced Technology Attachment (PATA) drives, Serial Advanced Technology Attachment (SATA) drives, and Small Computer Systems Interface (SCSI) drives, explaining the relative advantages and disadvantages of each.
3. Introduce students to the hard disk identification names used in Linux. Be sure that students clearly understand these references, as they will need to refer to them again later in the text.
4. Explain the concept of a partition, outlining the differences among primary partitions, extended partitions, and logical drives. Be sure that students understand that Linux does not use drive letters as a means to access a partition, but rather as a mount point. Provide examples as necessary.
5. Explain the purpose of the Master Boot Record (MBR) as it relates to providing an OS with information about existing partitions. Point out that larger hard disks use a GUID Partition Table (GPT) which is functionally equivalent to an MBR.
6. Provide an overview of the relative advantages and disadvantages of allowing the install program to automatically partition a disk.
7. Explain the concept of virtual memory, specifically with respect to the creation of a swap partition. Provide examples of how virtual memory is used on PC-based OSs like Linux and Windows, and why it is necessary. Be sure that students understand the differences between using RAM and virtual memory in terms of speed.
8. Provide students with an overview of the common Linux filesystems and sizes, as outlined in Table 2-5 in the text. Explain the purpose of allocating the suggested directories to their own partition, and why an administrator might be interested in doing this.
9. Provide students with an overview of the ext2, ext3, ext4, VFAT, and REISER file systems. Outline the advantages and disadvantages of each, including why an administrator might choose one filesystem over another.

10. Explain the concept of a journaling file system and the advantages that this model provides.
11. Provide students with a basic introduction to the concepts of logical volumes and of Redundant Array of Inexpensive Disks (RAID).
12. Provide students with a demonstration of using Disk Druid to create the partitions that will be required to complete the installation process. Be sure that students are now familiar with the partition referencing terms used by Linux.
13. Walk students through the configuration of at least one partition.

Configuring the Boot Loader

1. Outline the purpose of a boot loader in Linux, comparing it similar tools used on Windows systems like Windows 2000 or XP.
2. Provide students with an overview of the GRand Unified Boot Loader (GRUB) boot loader.
3. Explain the concept of dual booting as it relates to the boot process on computers containing more than one operating system.
4. Walk students through the configuration of boot loader settings in the Linux installation demonstration, outlining the purpose of each element encountered.

Selecting and Installing Packages

1. Provide students with an overview of the package group selection options during the Linux installation process. Explain the purpose of each, outlining how the packages selected are generally a function of the role that a server or workstation will play.
2. Demonstrate the process by which individual packages can be marked for installation on a Linux server. Outline the importance of understanding package dependencies, and how these will impact which packages will be installed.
3. Outline the importance of including individual development tools like gcc during the package installation process, pointing out that many of these tools are required to compile packages from source code.
4. Outline the importance of considering hard disk space when selecting packages, and provide guidelines for estimating the actual hard disk space which will be used for the installation, taking into consideration future applications, user data, log files, and working space.

Completing the Firstboot Wizard

1. Explain to students that some aspects of the installation are interactively configured on the first boot after installation using the firstboot wizard utility.
2. Explain and demonstrate the process of adding additional user accounts during installation process.
3. Outline how Linux users are authenticated by a password database on the local computer. Outline the various network authentication services commonly used with Linux systems including Network Information Service (NIS), Lightweight Directory Access Protocol (LDAP), Free Identity, Policy, and Audit (FreeIPA), and Winbind. Explain how these services relate to other Linux networking services.
4. Walk students through the process of configuring the date and time settings, and point out the importance of these settings for proper functionality of Linux.
5. Explain the importance of verifying that the hardware detected on the computer corresponds to the hardware in the preinstallation list.

Basic Linux Usage

1. Provide students with a basic introduction to both the Linux command line and X Windows interfaces. Outline the reasons why an administrator should be familiar with both environments.

Shells, Terminals, and the Kernel

1. Provide students with an explanation of the concept of a terminal, demonstrating how multiple terminal sessions can be associated with different network or even local users. Provide examples of how the ability to use multiple terminal sessions is useful for system administrators.
2. Outline the concept of a Linux shell, pointing out that the various shells available on Linux are generally associated with different command sets and environment variables of use to programmers, administrators, and so forth.
3. Provide students with an overview of the Bourne Again Shell (BASH) shell, explaining how a default shell can be configured as part of a user's profile.
4. Walk students through Figure 2-23 in the text, outlining how terminals, shells, and the Linux kernel interact with one another. Be sure that students are able to differentiate between a terminal and a shell.

5. Demonstrate the process of logging on to a Linux server using both the command line and graphical interfaces. Ensure that students understand how to switch between the two environments.
6. Demonstrate how a local user can switch between terminals using the Ctrl, Alt, and function keys.
7. Demonstrate the basic difference between the command prompt associated with the root user and a regular user in the BASH shell.
8. Walk students through the basics of accessing and using the command line from within a GUI environment.

Basic Shell Commands

1. Provide students with an overview of the differences among commands, options, and arguments. Use a common command like `ls` to demonstrate the differences among all three.
2. Ensure that students understand that commands in Linux are case sensitive. Demonstrate this by attempting to use the `ping` command with different upper and lower case key combinations.
3. Demonstrate the output of each of the common Linux commands listed in Table 2-7, explaining why each of these commands would be useful to a Linux system administrator.
4. Demonstrate the process of viewing additional screen information using the Shift and PgUp and PgDn keys from the Linux command line.

Shell Metacharacters

1. Provide students with an overview of the concept of a metacharacter and how these special keyboard characters are used on a Linux system.
2. Demonstrate the use of various BASH shell metacharacters listed in Table 2-8, such as the home directory variable and the piping command.
3. Explain and demonstrate how to use quotes or double quotes around potential metacharacters that you do not want to be treated as such, and specify the differences between using quotes and using double quotes.
4. Explain and demonstrate how to use the `\` character to protect potential metacharacters that you do not want to be treated as such.

Getting Command Help

1. Provide students with an overview of the Linux man pages, explaining that these pages form the basis of the Linux user help system.
2. Demonstrate the use of man pages, pointing out the command elements that represent options and arguments. Be sure that students understand that the man pages also provide examples of command syntax that can be useful in cases where a number of different options and/or arguments need to be supplied with a command.
3. Demonstrate the process of accessing the manual pages by section number, using the contents of Table 2-9 as a reference.
4. Demonstrate the process of searching the man pages from the command line.
5. Explain the purpose of info pages, outlining how these are different from the traditional Linux/UNIX man pages.
6. Demonstrate the use of both the info and help commands, such that students can understand the basic differences between both help systems.

Shutting Down the Linux System

1. Provide students with an overview of each of the commands that can be used to shutdown or restart a Linux server, as outlined in Table 2-10. Provide examples of when each of these commands would most commonly be used.
2. Demonstrate the shutdown, halt, and reboot commands on the instructor server.

Quick Quiz 1

1. What is the most common method for installing Linux?
 - a. From an HTTP server
 - b. From a DVD-ROM
 - c. From packages located on the hard disk
 - d. From an FTP serverAnswer: B
2. What type of hard disk can have no more than four units connected to the computer at the same time?
 - a. Serial Advanced Technology Attachment (SATA)
 - b. Small Computer Systems Interface (SCSI)
 - c. Parallel Advanced Technology Attachment (PATA)
 - d. Basic Input/Output System (BIOS)Answer: C

3. In which directory is the Linux kernel typically located?
 - a. /home
 - b. /opt
 - c. /var
 - d. /boot

Answer: D

Quick Quiz 2

1. Which keystroke combination should be used to access the tty3 terminal?
 - a. Ctrl+Alt+F7
 - b. Ctrl+Alt+F3
 - c. Ctrl+Delete+F2
 - d. Ctrl+Shift+F3
2. Which command can be issued to view all users currently logged on to a server and their tasks?
 - a. who
 - b. w
 - c. whoami
 - d. id
3. Which of the following are commands associated with help on a Linux system? (*Choose all that apply.*)
 - a. man
 - b. help
 - c. info
 - d. whatis

Answers: A, B, C

Class Discussion Topics

1. Have students discuss some of the reasons why they either do or do not enjoy working from a traditional computer command line. Have them discuss both the advantages and disadvantages of the command line from the point of view of speed, connection types, ability to remember commands, and so forth.
2. Have students discuss some of the user password policies that have existed at companies they have worked at in the past. What are some of the challenges that a company faces when it attempts to implement a very secure and stringent password policy?

Additional Projects

1. Have students use the man, info, and help pages to find the purpose of a list of common Linux commands not already covered in the text and supplied by you.
2. Have students research online to find sites that provide lists of essential commands that a new Linux system administrator should be familiar with. Compile this information into a master document to be distributed to all students.

Additional Resources

1. Linux Installation Primer: <http://www.linuxgazette.com/issue32/jenkins1.html>
2. Fedora Core Getting Started:
<http://www.johnmunsch.com/articles/FedoraCoreGettingStarted/>
3. Linux Install Guide: <http://www.cppsigs.org/links/linux/linuxInstall.html>
4. Fedora Project Homepage: <http://fedora.redhat.com/>

Key Terms

- **Advanced Technology Attachment (ATA)** *See also* Parallel Advanced Technology Attachment.
- **arguments** The text that appears after a command name, does not start with a dash “-” character, and specifies information the command requires to work properly.
- **authentication** The process whereby each user must log in with a valid user name and password before gaining access to the user interface of a system.
- **BASH shell** The Bourne Again Shell; it is the default command-line interface in Linux.
- **BIOS (Basic Input/Output System)** The part of a computer system that contains the programs used to initialize hardware components at boot time.
- **boot loader** A small program started by BIOS that executes the Linux kernel in memory.
- **command** A program that exists on the hard disk and is executed when typed on the command line.
- **dual booting** The process of installing more than one operating system on a computer. The user can then choose the operating system to load at system startup.
- **ext2** A nonjournaling Linux filesystem.
- **ext3** A journaling Linux filesystem.
- **ext4** An improved version of the ext3 filesystem with an extended feature set and better performance.
- **extended partition** A partition on a hard disk that can be further subdivided into components called logical drives.

- **filesystem** The way in which a hard disk partition is formatted to allow data to reside on the physical media; common Linux filesystems include ext2, ext3, ext4, REISER, and VFAT.
- **firstboot wizard** A configuration utility that is run at system startup immediately following a Fedora Linux installation.
- **Free Identity, Policy, and Audit (FreeIPA)** A set of security software that provides secure authentication across a network using several technologies that work together, including LDAP, Kerberos, NTP, and DNS.
- **GRand Unified Bootloader (GRUB)** A common boot loader used in Linux.
- **GUID Partition Table (GPT)** The area of a large hard disk (> 2TB) outside a partition that stores partition information and boot loaders.
- **Hardware Compatibility List (HCL)** A list of hardware components that have been tested and deemed compatible with a given operating system.
- **info pages** A set of local, easy-to-read command syntax documentation available by typing the `info` command.
- **Integrated Drive Electronics (IDE)** *See also* Parallel Advanced Technology Attachment.
- **journaling** A filesystem function that keeps a journal of the information that needs to be written to the hard disk; common Linux journaling filesystems include ext3, ext4, and REISER.
- **Lightweight Directory Access Protocol (LDAP)** A protocol that is used by services to query directory databases for purposes of authentication.
- **logical drives** The smaller partitions contained within an extended partition on a hard disk.
- **Logical Volume Manager (LVM)** A set of services that is used to manage logical volumes stored on one or more hard disks.
- **man pages** *See* manual pages.
- **manual pages** The most common set of local command syntax documentation, available by typing the `man` command. Also known as man pages.
- **Master Boot Record (MBR)** The area of a typical hard disk (< 2TB) outside a partition that stores partition information and boot loaders.
- **memtest86** A common RAM-checking utility.
- **metacharacters** The key combinations that have special meaning in the Linux operating system.
- **Network Information Service (NIS)** A set of services that is used to standardize the configuration and centralize the authentication of UNIX and Linux-based systems across a network.
- **Network Time Protocol (NTP)** A protocol that is used to synchronize the time on a computer from across a network such as the Internet.
- **options** The specific letters that start with a dash “-” or two and appear after the command name to alter the way the command works.
- **Parallel Advanced Technology Attachment (PATA)** A legacy hard disk technology that uses ribbon cables to typically attach up to four hard disk devices to a single computer.
- **partitions** A small section of an entire hard disk created to make the hard disk easier to use. Partitions can be primary or extended.

- **primary partitions** The separate divisions into which a hard disk can be divided (up to four are allowed per hard disk).
- **Redundant Array of Inexpensive Disks (RAID)** A type of storage that can be used to combine hard disks together for performance and/or fault tolerance.
- **REISER** A journaling filesystem used in Linux.
- **Serial Advanced Technology Attachment (SATA)** A hard disk technology that allows for fast data transfer along a serial cable. It is commonly used in newer workstation and serverclass computers.
- **shell** A user interface that accepts input from the user and passes the input to the kernel for processing.
- **Small Computer Systems Interface (SCSI)** A high-performance hard disk technology that is commonly used in server-class computers.
- **swap memory** *See also* virtual memory.
- **System Rescue** A feature that allows you to boot a small Linux system from DVD to repair a Linux system that resides on the hard disk.
- **terminal** The channel that allows a certain user to log in and communicate with the kernel via a user interface.
- **VFAT (Virtual File Allocation Table)** A nonjournaling filesystem that might be used in Linux.
- **virtual memory** An area on a hard disk, known as a swap partition, that can be used to store information that normally resides in physical memory (RAM), if the physical memory is being used excessively.
- **Winbind** A set of software components that allows Linux computers to authenticate against a Microsoft Active Directory database.

Technical Notes for Hands-On Projects

The Chapter 2 hands-on projects require that students have access to the Fedora 13 installation DVD, a Pentium 4 class or greater computer with at least 1GB of RAM, a 60GB hard disk, and a DVD drive, as well as access to the Internet, to complete the additional exercises outlined in this instructor's manual file.