

Christine Bresnahan and Richard Blum

LPIC-2

**Linux Professional Institute
Certification**

STUDY GUIDE

Second Edition

EXAM 201 AND EXAM 202

Covers 100% of exam objectives, including the Linux boot process, maintaining the system, kernel components, configuring RAID, basic network configuration, mail systems, basic DNS services, and much more...

Includes online interactive learning environment with:

- + 2 custom bonus exams
- + More than 300 electronic flashcards
- + Searchable key term glossary



SYBEX
A Wiley Brand

LPIC-2

Study Guide

Second Edition



LPIC-2: Linux Professional Institute Certification

Study Guide
Exam 201 and Exam 202
Second Edition



Christine Bresnahan
Richard Blum



Senior Acquisitions Editor: Kenyon Brown
Development Editor: Gary Schwartz
Technical Editor: Kevin Ryan
Production Editor: Christine O'Connor
Copy Editor: Linda Rectenwald
Editorial Manager: Mary Beth Wakefield
Production Manager: Kathleen Wisor
Executive Publisher: Jim Minatel
Book Designers: Judy Fung and Bill Gibson
Proofreader: Rebecca Rider
Indexer: John Sleeva
Project Coordinator, Cover: Brent Savage
Cover Designer: Wiley
Cover Image: Getty Images Inc./Jeremy Woodhouse
Copyright © 2016 by John Wiley & Sons, Inc., Indianapolis, Indiana

Published simultaneously in Canada

ISBN: 978-1-119-15079-4

ISBN: 978-1-119-15081-7 (ebk.)

ISBN: 978-1-119-15080-0 (ebk.)

Manufactured in the United States of America

No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning or otherwise, except as permitted under Sections 107 or 108 of the 1976 United States Copyright Act, without either the prior written permission of the Publisher, or authorization through payment of the appropriate per-copy fee to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, (978) 750-8400, fax (978) 646-8600. Requests to the Publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, (201) 748-6011, fax (201) 748-6008, or online at <http://www.wiley.com/go/permissions>.

Limit of Liability/Disclaimer of Warranty: The publisher and the author make no representations or warranties with respect to the accuracy or completeness of the contents of this work and specifically disclaim all warranties, including without limitation warranties of fitness for a particular purpose. No warranty may be created or extended by sales or promotional materials. The advice and strategies contained herein may not be suitable for every situation. This work is sold with the understanding that the publisher is not engaged in rendering legal, accounting, or other professional services. If professional assistance is required, the services of a competent professional person should be sought. Neither the publisher nor the author shall be liable for damages arising herefrom. The fact that an organization or Web site is referred to in this work as a citation and/or a potential source of further information does not mean that the author or the publisher endorses the information the organization or Web site may provide or recommendations it may make. Further, readers should be aware that Internet Web sites listed in this work may have changed or disappeared between when this work was written and when it is read.

For general information on our other products and services or to obtain technical support, please contact our Customer Care Department within the U.S. at (877) 762-2974, outside the U.S. at (317) 572-3993 or fax (317) 572-4002.

Wiley publishes in a variety of print and electronic formats and by print-on-demand. Some material included with standard print versions of this book may not be included in e-books or in print-on-demand. If this book refers to media such as a CD or DVD that is not included in the version you purchased, you may download this material at <http://booksupport.wiley.com>. For more information about Wiley products, visit www.wiley.com.

Library of Congress Control Number: 2016952321

TRADEMARKS: Wiley, the Wiley logo, and the Sybex logo are trademarks or registered trademarks of John Wiley & Sons, Inc. and/or its affiliates, in the United States and other countries, and may not be used without written permission. All other trademarks are the property of their respective owners. John Wiley & Sons, Inc. is not associated with any product or vendor mentioned in this book.

10 9 8 7 6 5 4 3 2 1

To those looking to further their knowledge of Linux. “A wise man is full of strength, and a man of knowledge enhances his might.” Prov 24:5 (ESV)

Acknowledgments

First, all glory and praise go to God, who through His Son, Jesus Christ, makes all things possible and gives us the gift of eternal life.

Many thanks go to the fantastic team of people at Sybex for their outstanding work on this project. Thanks to Kenyon Brown, the senior acquisitions editor, for offering us the opportunity to work on this book. Also thanks to Gary Schwartz, the development editor, for keeping things on track and making the book more presentable. Thanks, Gary, for all your hard work and diligence. The technical editor, Kevin E. Ryan, did a wonderful job of double-checking all of the work in the book in addition to making suggestions to improve the content. Thanks also goes to the young and talented Daniel Anez (theanez.com) for his illustration work. We would like to thank Carole Jelen at Waterside Productions, Inc., for arranging this opportunity for us and for helping us out in our writing careers.

Christine would particularly like to thank her husband, Timothy, for his encouragement, patience, and willingness to listen, even when he has no idea what she is talking about.

Rich would particularly like to thank his wife, Barbara, for enduring his grouchy attitude during this project and helping to keep up his spirits with baked goods.

About the Authors

Christine Bresnahan started working with computers more than 25 years ago in the IT industry as a systems administrator. Christine is an adjunct professor at Ivy Tech Community College, where she teaches Linux certification and Python programming classes. She also writes books and produces instructional resources for the classroom.

Richard Blum has worked in the IT industry for more than 25 years as both a system and network administrator, and he has published numerous Linux and open source books. Rich is an online instructor for Linux and web programming courses that are used by colleges and universities across the United States. When he is not being a computer nerd, Rich enjoys spending time with his wife, Barbara, and his two daughters, Katie and Jessica.

Contents at a Glance

<i>Introduction</i>		<i>xxiii</i>
<i>Assessment Test</i>		<i>xliii</i>
Part I	The LPI 201 Exam	1
Chapter 1	Starting a System	3
Chapter 2	Maintaining the System	37
Chapter 3	Mastering the Kernel	93
Chapter 4	Managing the Filesystem	139
Chapter 5	Administering Advanced Storage Devices	199
Chapter 6	Navigating Network Services	271
Part II	The LPI 202 Exam	315
Chapter 7	Organizing Email Services	317
Chapter 8	Directing DNS	371
Chapter 9	Offering Web Services	451
Chapter 10	Sharing Files	497
Chapter 11	Managing Network Clients	581
Chapter 12	Setting Up System Security	619
Appendix	Answers to Review Questions	655
<i>Index</i>		<i>691</i>

Contents

Introduction *xxiii*

Assessment Test *xliii*

Part I The LPI 201 Exam 1

Chapter 1 Starting a System 3

The Linux Boot Process	4
Following the Boot Process	4
Viewing the Boot Process	5
The Firmware Startup	6
The BIOS Startup	6
The UEFI Startup	7
Linux Bootloaders	8
GRUB Legacy	9
GRUB 2	12
Alternative Bootloaders	14
Secure Bootloaders	15
Process Initialization	16
The SysV Method	17
The systemd Method	21
The Upstart Method	26
System Recovery	27
Kernel Failures	27
Root Drive Failure	29
Summary	31
Exam Essentials	31
Review Questions	33

Chapter 2 Maintaining the System 37

Keeping Users Informed	38
Looking at Fluid Messaging	39
Looking at Static Messaging	47
Backing Up the System	51
Developing a Backup Strategy	51
Performing Backups	61
Installing Programs from Source	72
Obtaining the Installation Files	73
Unpacking the Installation Files	73
Reading Installation Documentation	74
Compiling Preparation	75

	Compiling the Program	76
	Completing the Installation	76
	Managing Resource Usage	79
	Measuring Resource Usage	79
	Predicting Resource Usage	83
	Troubleshooting Resource Usage	85
	Summary	87
	Exam Essentials	87
	Review Questions	89
Chapter 3	Mastering the Kernel	93
	What Is the Kernel?	94
	The Kernel Features	94
	Parts of the Kernel	104
	Kernel Versions	107
	Compiling a Kernel	108
	Obtaining Source Code	109
	Creating the Configuration File	110
	Compiling and Installing the Kernel	114
	Compiling and Installing Modules	116
	Creating an Initial RAM Disk	116
	Booting the New Kernel	118
	Creating a Kernel Package	119
	Maintaining the Kernel	120
	Working with Module Files	120
	Module Commands	120
	Working with Hardware	125
	Automatically Detecting Hardware	128
	Troubleshooting the Kernel	129
	Summary	132
	Exam Essentials	133
	Review Questions	135
Chapter 4	Managing the Filesystem	139
	Operating the Linux Filesystem	140
	Understanding Filesystem Structures	140
	Understanding Filesystem Types	141
	Making a Filesystem	144
	Attaching a Filesystem	146
	Exploring Additional Filesystem Topics	162
	Looking at Memory-Based Linux Filesystems	162
	Looking at the Btrfs Filesystem	163
	Exploring Btrfs Subvolumes	165
	Exploring Btrfs Snapshots	169

	Looking at Optical Filesystems	171
	Looking at Swap Filesystems	177
	Looking at Network-Based Filesystems	180
	Understanding Auto-Mounting	180
	Looking at Encrypted Filesystems	183
	Maintaining Linux Filesystems	185
	Adjusting a Filesystem	185
	Checking and Repairing a Filesystem	187
	Using SMART	189
	Summary	192
	Exam Essentials	192
	Review Questions	195
Chapter 5	Administering Advanced Storage Devices	199
	Configuring RAID	200
	Understanding RAID	200
	Implementing RAID on Linux	204
	Managing a RAID Array	216
	Adjusting Storage Devices	221
	Looking at Drive Interface Concepts	221
	Testing and Tuning Drives	223
	Implementing iSCSI	234
	Managing Logical Volumes	245
	Understanding LVM	245
	Creating Logical Volumes	246
	Supporting Logical Volumes	254
	Understanding the Device Mapper	263
	Summary	264
	Exam Essentials	264
	Review Questions	267
Chapter 6	Navigating Network Services	271
	Networking Basics	272
	The Physical Layer	272
	The Network Layer	274
	The Transport Layer	278
	The Application Layer	279
	Configuring Network Features	279
	Network Configuration Files	280
	Graphical Tools	282
	Command-Line Tools	284
	Basic Network Troubleshooting	288
	Checking the Log Files	288
	Viewing the ARP Cache	289

	Sending Test Packets	290
	Testing Network Routes	291
	Testing Client/Server Connectivity	293
	Finding Host Information	295
	Network Security	297
	Advanced Network Troubleshooting	297
	Viewing Open Network Connections	297
	Viewing Network Statistics	300
	Scanning the Network	302
	Capturing Network Traffic	303
	Summary	308
	Exam Essentials	308
	Review Questions	310
Part II	The LPI 202 Exam	315
Chapter 7	Organizing Email Services	317
	The Linux Mail System	318
	Mail Transfer Agent	319
	Mail Delivery Agent	321
	Mail User Agent	323
	Email Protocols	325
	Simple Mail Transfer Protocol	326
	Post Office Protocol	332
	Internet Message Access Protocol	334
	Using Email Servers	338
	Using Sendmail	338
	Using Postfix	342
	Local Email Delivery	351
	Procmail Basics	351
	Sieve	356
	Remote Email Delivery	359
	Using Courier	359
	Using Dovecot	360
	Summary	363
	Exam Essentials	364
	Review Questions	366
Chapter 8	Directing DNS	371
	Configuring a DNS Server	372
	Understanding DNS and BIND	372
	Configuring DNS on Linux	379
	Starting, Stopping, and Reloading BIND	395
	Configuring BIND Logging	398

	Creating and Maintaining DNS Zones	403
	Exploring BIND Zone Files	403
	Managing BIND Zones on Linux	417
	Securing a DNS Server	427
	Setting Up Basic Security	427
	Jailing BIND	431
	Using DNSSEC	434
	Connecting via TSIG	440
	Employing DANE	442
	Summary	445
	Exam Essentials	445
	Review Questions	447
Chapter 9	Offering Web Services	451
	What Is a Web Server?	452
	Web Server Basics	452
	The HTTP Standard	453
	Linux Web Servers	459
	The Apache Web Server	461
	Installing an Apache Server	462
	Configuring the Apache Server	464
	Hosting Dynamic Web Applications	472
	Creating a Secure Web Server	474
	Using a Proxy Server	482
	Installing Squid	482
	Configuring Squid	483
	Configuring Clients	486
	The Nginx Server	487
	Installing Nginx	487
	Configuring Nginx	488
	Summary	490
	Exam Essentials	491
	Review Questions	493
Chapter 10	Sharing Files	497
	Looking at Samba	498
	Understanding Samba	498
	Configuring Samba	500
	Troubleshooting Samba	527
	Looking at NFS	530
	Understanding NFS	530
	Configuring NFS	533
	Securing NFS	549
	Troubleshooting NFS	552

	Looking at FTP Servers	553
	Understanding FTP	554
	Configuring <i>vsftpd</i>	556
	Configuring Pure-FTPd	568
	Summary	575
	Exam Essentials	575
	Review Questions	577
Chapter 11	Managing Network Clients	581
	Assigning Network Addresses	582
	The DHCP Standard	583
	Linux DHCP Software	584
	Installing a Linux DHCP Server	585
	Configuring a DHCP Server	585
	Configuring Clients	590
	Authentication Service	591
	PAM Basics	591
	Configuring PAM	594
	Using PAM Application Files	595
	Network Directories	597
	LDAP Basics	597
	The OpenLDAP Server	601
	Implementing LDAP Clients	607
	Summary	613
	Exam Essentials	613
	Review Questions	615
Chapter 12	Setting Up System Security	619
	Server Network Security	620
	Port Scanning	620
	Intrusion Detection Systems	628
	External Network Security	631
	Using <i>iptables</i>	634
	Routing in Linux	639
	Connecting Securely to a Server	639
	OpenSSH	640
	OpenVPN	643
	Security Resources	646
	US-CERT	646
	SANS Institute	647
	Bugtraq	647
	Summary	648
	Exam Essentials	649
	Review Questions	651

Appendix	Answers to Review Questions	655
	Chapter 1: Starting a System	656
	Chapter 2: Maintaining the System	659
	Chapter 3: Mastering the Kernel	662
	Chapter 4: Managing the Filesystem	664
	Chapter 5: Administering Advanced Storage Devices	667
	Chapter 6: Navigating Network Services	670
	Chapter 7: Organizing Email Services	673
	Chapter 8: Directing DNS	676
	Chapter 9: Offering Web Services	678
	Chapter 10: Sharing Files	681
	Chapter 11: Managing Network Clients	684
	Chapter 12: Setting Up System Security	687
<i>Index</i>		691

Table of Exercises

Exercise	1.1	Using Rescue Mode	30
Exercise	2.1	Installing the Geany IDE from Source Code	77
Exercise	3.1	Creating a Kernel Configuration File	113
Exercise	4.1	Manually Mount a USB Flash Drive	152
Exercise	5.1	Adding and Removing Logical Volumes	262
Exercise	6.1	Determining the Network Environment	307
Exercise	7.1	Setting Up and Testing an Email Server	362
Exercise	8.1	Trying Out Troubleshooting Tools	426
Exercise	9.1	Testing a Web Server	489
Exercise	11.1	Setting Up and Testing a DHCP Server	612
Exercise	12.1	Setting Up and Testing a Firewall	647

Introduction

Welcome to the *LPIC-2: Linux Professional Institute Certification Study Guide*. If you used our *LPIC-1: Linux Professional Institute Certification Study Guide* to study for your LPIC-1 exam, welcome back! We're glad that you decided to stay with us for your LPIC-2 study resources.

Just like our LPIC-1 Study Guide, this book contains detailed explanations for all of the LPIC-2 exam objectives, along with example questions, flashcards for self-study, and practice questions. The purpose of this book is to help you pass both of the LPIC-2 exams, 201 and 202. These exams cover more advanced topics than the LPIC-1 exam, such as the Linux kernel, system startup, filesystems, network operations, DNS servers, web servers, file servers, email servers, network client management, and security. This book will walk you through all of these topics, helping prepare you for the LPIC-2 exam questions.

LPI's Certification Program

The purpose of the Linux Professional Institute's (LPI) LPIC-2 program is to define the basic knowledge required to administer small to medium-sized mixed (Microsoft and Linux) networks, focusing on the Linux operating system. The program guides professionals wishing to build on knowledge gained from the LPIC-1 program.

It is expected that you have already passed the LPI Linux Essentials (optional) exam and the LPIC-1 (or CompTIA Linux+) exam and have at least five years' experience in administering a Linux server(s) in a mixed network environment.

The successful LPIC-2 candidate should have at a minimum knowledge and experience concerning the following topics:

- Administering multiple Linux servers
- Advising management on computerization and purchasing
- Planning and managing a small, mixed-network environment, which includes the following:
 - LAN server:
 - Client management
 - DHCP
 - DNS
 - NFS
 - Samba
 - Internet gateway:
 - Firewall
 - Mail

- OpenSSH
- VPN
- Web cache/proxy
- Internet server:
 - FTP server
 - Web server
 - Web server with a reverse proxy
- Team supervision skills

If you've already passed the LPIC-1 exam, you've proven to the world that you're proficient with the basic operation of Linux, along with the basic Linux commands. But don't stop there. When you pass the LPIC-2 exam, that will demonstrate that you have the skills that companies look for when hiring Linux administrators. Having the LPIC-2 certification validates your skills, and it helps prepare you for working with Linux servers in a commercial environment.

How to Become Certified

The LPIC-2 certification is available to anyone who has an active LPIC-1 certification and who passes the two required exams: 201 and 202.

To take an LPI exam, you must first register with LPI to obtain an LPI ID number (if you already did this for the LPIC-1 exam, you must use your existing LPI ID number for the LPIC-2 exam). If you need to register, you can do this online at <https://cs.lpi.org/cafe/xamman/register>. LPI will email your LPI ID number to you. With that you can log into the LPI Marketplace to purchase an exam voucher.

The exams are administered by Pearson VUE. The exam can be taken at any Pearson VUE testing center. If you pass, you will get a certificate in the mail saying that you have passed. Call (877) 619-2096 for Pearson VUE contact information.

To register for the exam with Pearson VUE, go to <http://www.vue.com>. Enter the exam voucher number that you received from the LPI Marketplace, and schedule the time and place to take the exam.

Who Should Buy This Book

Anyone who wants to pass the LPIC-2 certification exams may benefit from this book. You should already have a basic knowledge of Linux, as covered by the LPIC-1 exam material. If not, you should start with our *LPIC-1: Linux Professional Institute Study Guide* book and then move on to this book. This book focuses on the more advanced Linux topics covered by the LPIC-2 201 and 202 exams. Once you obtain your certification, this book

will continue to be useful by serving as a handy resource for information on installing and maintaining Linux servers.

Even if you don't plan to take the LPIC-2 exams, this book makes an excellent resource for understanding advanced Linux server topics. It covers topics such as creating your own web server, email server, and file server. These skills are required by Linux administrators in small and medium-sized network environments.

This book is written with the assumption that you have a basic knowledge of Linux. You should be familiar with how Linux works and be able to work in the Linux command line, including the core commands such as `ls`, `cp`, `mv`, `cat`, `less`, `ps`, `free`, and `uptime`. You should also already know how to install a default Linux distribution environment, because that is not covered in this book.



You'll need a Linux system with which to practice and perform the chapter activities. Any Linux desktop or server distribution will work for the activities in this book; however, we focus on the Ubuntu and CentOS Linux desktop distributions for our examples.

How This Book Is Organized

This book consists of 12 chapters plus supplementary information: an online glossary, this introduction, and the assessment test after the introduction.

Part I of the book, Chapters 1 through 6, covers the LPIC-2 201 exam topics. Part II, Chapters 7 through 12, covers the 202 exam topics. Each chapter begins with a list of the exam objectives that are covered in that chapter. However, the book doesn't cover the objectives in order.

Part I: The LPI 201 Exam

Chapter 1: Starting a System This chapter covers how Linux boots from the system BIOS. It discusses the Linux bootloader program and how to create a dual-boot Linux environment.

Chapter 2: Maintaining the System This chapter describes how to install and manage resources on a Linux system. It also covers how to back up Linux systems and communicate with system users to warn of system issues or downtime.

Chapter 3: Mastering the Kernel This chapter focuses on the core of the Linux system—the kernel. It walks you through how to install a custom kernel, as well as how to create and maintain kernel modules required to support the hardware on your Linux system.

Chapter 4: Managing the Filesystem This chapter explores the different Linux filesystems and how to manage and maintain them, as well as how to troubleshoot them when problems occur.

Chapter 5: Administering Advanced Storage Devices This chapter takes a look at two of the more advanced storage methods used in Linux environments. It focuses on how to use RAID devices in Linux, either as hardware devices or using a software RAID emulator. It also demonstrates how to implement a Logical Volume Manager in a Linux environment.

Chapter 6: Navigating Network Services This chapter takes a deeper look at how Linux interacts in a network environment. It covers how to use the Linux command-line commands to set up a network interface and how to troubleshoot basic network problems.

Part II: The LPI 202 Exam

Chapter 7: Organizing Email Services This chapter examines how to run an Internet email server using Linux. It covers the two most popular email servers—sendmail and Postfix, as well as walking you through how to use the most popular Linux email client packages—Courier and Dovecot.

Chapter 8: Directing DNS This chapter covers the basics of the DNS system and how to configure your Linux server to offer DNS services on your network.

Chapter 9: Offering Web Services This chapter covers how to run your own web server using a Linux server. It discusses how to install and manage the Apache web server—the most popular web server on the Internet. It also covers the nginx web server, a newer up-and-coming web server that’s quickly gaining in popularity. Also, this chapter dives into the basics of Squid, a popular web proxy server used by many companies as a web firewall to block users from accessing inappropriate websites.

Chapter 10: Sharing Files This chapter discusses how to use your Linux server as a file server in a local network. It covers using both FTP and NFS to serve files, as well as the popular Samba package to serve files to Microsoft Windows clients on a network.

Chapter 11: Managing Network Clients This chapter explores how to use a Linux server to provide basic network services to clients on a local network. It shows how to create a DHCP server for serving dynamic IP addresses, how to create an LDAP server for providing simple network directory services, and how to use PAM to provide authentication services to local applications.

Chapter 12: Setting Up System Security This chapter explores some ways to use your Linux server security in a network environment. It covers using the `iptables` program as a firewall, OpenSSH for remote communication with clients, and OpenVPN to provide a secure tunnel for remote clients to get to your network.

At the end of each chapter, you’ll find a couple of elements that you can use to prepare for the exam:

Exam Essentials This section summarizes important information that was covered in the chapter. You should be able to perform each of the tasks or convey the information requested.

Review Questions Each chapter concludes with 20 review questions. You should answer these questions and check your answers against the ones provided after the questions. If

you can't answer at least 80 percent of these questions correctly, go back and review the chapter, or at least those sections that seem to be giving you difficulty.



The review questions, assessment test, and other testing elements included with this book are *not* derived from the actual exam questions, so don't memorize the answers to these questions and assume that doing so will enable you to pass the exam. You should learn the underlying topic, as described in the text of the book. This will let you answer the questions provided with this book *and* pass the exam. Learning the underlying topic is also the approach that will serve you best in the workplace—the ultimate goal of a certification.

To get the most out of this book, you should read each chapter from start to finish and then check your memory and understanding with the end-of-chapter elements. Even if you're already familiar with a topic, you should skim the chapter; Linux is complex enough that there are often multiple ways to accomplish a task, so you may learn something even if you're already competent in an area.

Interactive Online Learning Environment and Test Bank

The authors have worked hard to provide some really great tools to help you with your certification process. The interactive online learning environment that accompanies the *LPIC-2: Linux Professional Institute Certification Study Guide: Exam 201 and Exam 202* provides a test bank with study tools to help you prepare for the certification exams—and increase your chances of passing them the first time! The test bank includes the following:

Sample Tests All of the questions in this book are included, including the assessment test at the end of this introduction and the 240 questions from the review sections at the end of each chapter. In addition, there are two 72-question practice exams. Use these questions to test your knowledge of the study guide material. The online test bank runs on multiple devices.

Electronic Flashcards The online text bank includes over 300 flashcards specifically written to hit you hard, so don't get discouraged if you don't ace your way through them at first. They're there to ensure that you're really ready for the exams. And no worries—armed with the review questions, practice exams, and flashcards, you'll be more than prepared when exam day comes. Questions are provided in digital flashcard format (a question followed by a single correct answer). You can use the flashcards to reinforce your learning and provide last-minute test prep before the exam.

Glossary In addition, a glossary of key terms from this book is available as a fully searchable PDF.



Readers can access these tools by visiting <http://www.wiley.com/go/sybextestprep>.

Conventions Used in This Book

This book uses certain typographic styles in order to help you quickly identify important information and to avoid confusion over the meaning of words such as on-screen prompts. In particular, look for the following styles:

- *Italicized text* indicates key terms that are described at length the first time they are used in a chapter. (Italics are also used for emphasis.)
- A **monospaced font** indicates the contents of configuration files, messages displayed at a text-mode Linux shell prompt, filenames, text-mode command names, and Internet URLs.
- *Italicized monospaced text* indicates a variable—information that differs from one system or command run to another, such as the name of a client computer or a process ID number.
- **Bold monospaced text** is information that you're to type into the computer, usually at a Linux shell prompt. This text can also be italicized to indicate that you should substitute an appropriate value for your system. (When isolated on their own lines, commands are preceded by non-bold monospaced \$ or # command prompts, denoting regular user or system administrator use, respectively.)

In addition to these text conventions, which can apply to individual words or entire paragraphs, a few conventions highlight segments of text:



A note indicates information that's useful or interesting but that's somewhat peripheral to the main text. A note might be relevant to a small number of networks, for instance, or it may refer to an outdated feature.



A tip provides information that can save you time or frustration and that may not be entirely obvious. A tip might describe how to get around a limitation or how to use a feature to perform an unusual task.



Warnings describe potential pitfalls or dangers. If you fail to heed a warning, you may end up spending a lot of time recovering from a bug, or you may even end up restoring your entire system from scratch.