

FROM ASTERISK TO ZEBRA WITH EASY-TO-USE RECIPES



# LINUX Networking Cookbook™

O'REILLY®

CARLA SCHRODER

FROM ASTERISK TO ZEBRA WITH EASY-TO-USE RECIPES

# LINUX NETWORKING COOKBOOK



This wide-ranging recipe collection covers everything you need to know to excel as a Linux network administrator, whether you're new to the job or have years of experience. With complete steps to carry out an array of tasks, *Linux Networking Cookbook* helps you dive straight into the gnarly hands-on work of building and maintaining a computer network. Each recipe includes a clear solution with tested code, plus a discussion on why and how it works.

Running a network doesn't mean you have all the answers. *Linux Networking Cookbook* has solutions that focus on connectivity: firewalls, wireless access points, secure remote administration, remote helpdesk, remote access for users, Virtual Private Networks (VPNs), authentication, system and network monitoring, and the rapidly growing world of Voice over IP (VoIP) services. You'll find recipes for:

- Building a gateway, firewall, and wireless access point on a Linux network
- Building a VoIP server with Asterisk
- Securing remote administration with SSH
- Building secure VPNs with OpenVPN, and a Linux PPTP VPN server
- Single sign-on with Samba for mixed Linux/Windows LANs
- Centralizing the network directory with OpenLDAP
- Network monitoring with Nagios or MRTG
- Getting acquainted with IPv6
- Setting up hands-free network installations of new systems
- Linux system administration via serial console

*Linux Networking Cookbook* also covers tasks such as networking Linux and Unix boxes, integrating Windows hosts, routing, user identification and authentication, sharing an Internet connection, connecting branch offices, name services, wired and wireless connectivity, security, monitoring, and troubleshooting. When you need to solve a network problem without delay, and you don't have the time or patience to comb through reference books or the Web for answers, this book has what you need.

## O'REILLY®

[www.oreilly.com](http://www.oreilly.com)

US \$44.99

CAN \$44.99

ISBN-10: 0-596-10248-8

ISBN-13: 978-0-596-10248-7



**Safari**®  
Books Online

**Free online edition**  
with purchase of this book.  
Details on last page.

---

# Linux Networking Cookbook™

*Carla Schroder*

O'REILLY®

Beijing • Cambridge • Farnham • Köln • Paris • Sebastopol • Taipei • Tokyo

---

## Linux Networking Cookbook™

by Carla Schroder

Copyright © 2008 O'Reilly Media, Inc. All rights reserved.  
Printed in the United States of America.

Published by O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472.

O'Reilly books may be purchased for educational, business, or sales promotional use. Online editions are also available for most titles (*safari.oreilly.com*). For more information, contact our corporate/institutional sales department: (800) 998-9938 or *corporate@oreilly.com*.

**Editor:** Mike Loukides

**Production Editor:** Sumita Mukherji

**Copyeditor:** Derek Di Matteo

**Proofreader:** Sumita Mukherji

**Indexer:** John Bickelhaupt

**Cover Designer:** Karen Montgomery

**Interior Designer:** David Futato

**Illustrator:** Jessamyn Read

### Printing History:

November 2007: First Edition.

Nutshell Handbook, the Nutshell Handbook logo, and the O'Reilly logo are registered trademarks of O'Reilly Media, Inc. The *Cookbook* series designations, *Linux Networking Cookbook*, the image of a female blacksmith, and related trade dress are trademarks of O'Reilly Media, Inc.

Java™ is a trademark of Sun Microsystems, Inc. .NET is a registered trademark of Microsoft Corporation.

Many of the designations used by manufacturers and sellers to distinguish their products are claimed as trademarks. Where those designations appear in this book, and O'Reilly Media, Inc. was aware of a trademark claim, the designations have been printed in caps or initial caps.

While every precaution has been taken in the preparation of this book, the publisher and author assume no responsibility for errors or omissions, or for damages resulting from the use of the information contained herein.



This book uses RepKover™, a durable and flexible lay-flat binding.

ISBN-10: 0-596-10248-8

ISBN-13: 978-0-596-10248-7

[M]

---

*To Terry Hanson—thank you!  
You make it all worthwhile.*



---

# Table of Contents

<b>Preface</b> .....	<b>xv</b>
<b>1. Introduction to Linux Networking</b> .....	<b>1</b>
1.0 Introduction	1
<b>2. Building a Linux Gateway on a Single-Board Computer</b> .....	<b>12</b>
2.0 Introduction	12
2.1 Getting Acquainted with the Soekris 4521	14
2.2 Configuring Multiple Minicom Profiles	17
2.3 Installing Pyramid Linux on a Compact Flash Card	17
2.4 Network Installation of Pyramid on Debian	19
2.5 Network Installation of Pyramid on Fedora	21
2.6 Booting Pyramid Linux	24
2.7 Finding and Editing Pyramid Files	26
2.8 Hardening Pyramid	27
2.9 Getting and Installing the Latest Pyramid Build	28
2.10 Adding Additional Software to Pyramid Linux	28
2.11 Adding New Hardware Drivers	32
2.12 Customizing the Pyramid Kernel	33
2.13 Updating the Soekris comBIOS	34
<b>3. Building a Linux Firewall</b> .....	<b>36</b>
3.0 Introduction	36
3.1 Assembling a Linux Firewall Box	44
3.2 Configuring Network Interface Cards on Debian	45
3.3 Configuring Network Interface Cards on Fedora	48
3.4 Identifying Which NIC Is Which	50

---

3.5	Building an Internet-Connection Sharing Firewall on a Dynamic WAN IP Address	51
3.6	Building an Internet-Connection Sharing Firewall on a Static WAN IP Address	56
3.7	Displaying the Status of Your Firewall	57
3.8	Turning an iptables Firewall Off	58
3.9	Starting iptables at Boot, and Manually Bringing Your Firewall Up and Down	59
3.10	Testing Your Firewall	62
3.11	Configuring the Firewall for Remote SSH Administration	65
3.12	Allowing Remote SSH Through a NAT Firewall	66
3.13	Getting Multiple SSH Host Keys Past NAT	68
3.14	Running Public Services on Private IP Addresses	69
3.15	Setting Up a Single-Host Firewall	71
3.16	Setting Up a Server Firewall	76
3.17	Configuring iptables Logging	79
3.18	Writing Egress Rules	80
<b>4.</b>	<b>Building a Linux Wireless Access Point</b> .....	<b>82</b>
4.0	Introduction	82
4.1	Building a Linux Wireless Access Point	86
4.2	Bridging Wireless to Wired	87
4.3	Setting Up Name Services	90
4.4	Setting Static IP Addresses from the DHCP Server	93
4.5	Configuring Linux and Windows Static DHCP Clients	94
4.6	Adding Mail Servers to dnsmasq	96
4.7	Making WPA2-Personal Almost As Good As WPA-Enterprise	97
4.8	Enterprise Authentication with a RADIUS Server	100
4.9	Configuring Your Wireless Access Point to Use FreeRADIUS	104
4.10	Authenticating Clients to FreeRADIUS	106
4.11	Connecting to the Internet and Firewalling	107
4.12	Using Routing Instead of Bridging	108
4.13	Probing Your Wireless Interface Card	113
4.14	Changing the Pyramid Router's Hostname	114
4.15	Turning Off Antenna Diversity	115
4.16	Managing dnsmasq's DNS Cache	117
4.17	Managing Windows' DNS Caches	120
4.18	Updating the Time at Boot	121



---

<b>5. Building a VoIP Server with Asterisk</b> .....	<b>123</b>
5.0 Introduction	123
5.1 Installing Asterisk from Source Code	127
5.2 Installing Asterisk on Debian	131
5.3 Starting and Stopping Asterisk	132
5.4 Testing the Asterisk Server	135
5.5 Adding Phone Extensions to Asterisk and Making Calls	136
5.6 Setting Up Softphones	143
5.7 Getting Real VoIP with Free World Dialup	146
5.8 Connecting Your Asterisk PBX to Analog Phone Lines	148
5.9 Creating a Digital Receptionist	151
5.10 Recording Custom Prompts	153
5.11 Maintaining a Message of the Day	156
5.12 Transferring Calls	158
5.13 Routing Calls to Groups of Phones	158
5.14 Parking Calls	159
5.15 Customizing Hold Music	161
5.16 Playing MP3 Sound Files on Asterisk	161
5.17 Delivering Voicemail Broadcasts	162
5.18 Conferencing with Asterisk	163
5.19 Monitoring Conferences	165
5.20 Getting SIP Traffic Through iptables NAT Firewalls	166
5.21 Getting IAX Traffic Through iptables NAT Firewalls	168
5.22 Using AsteriskNOW, “Asterisk in 30 Minutes”	168
5.23 Installing and Removing Packages on AsteriskNOW	170
5.24 Connecting Road Warriors and Remote Users	171
<b>6. Routing with Linux</b> .....	<b>173</b>
6.0 Introduction	173
6.1 Calculating Subnets with ipcalc	176
6.2 Setting a Default Gateway	178
6.3 Setting Up a Simple Local Router	180
6.4 Configuring Simplest Internet Connection Sharing	183
6.5 Configuring Static Routing Across Subnets	185
6.6 Making Static Routes Persistent	186
6.7 Using RIP Dynamic Routing on Debian	187
6.8 Using RIP Dynamic Routing on Fedora	191
6.9 Using Quagga’s Command Line	192

---

6.10	Logging In to Quagga Daemons Remotely	194
6.11	Running Quagga Daemons from the Command Line	195
6.12	Monitoring RIPD	197
6.13	Blackholing Routes with Zebra	198
6.14	Using OSPF for Simple Dynamic Routing	199
6.15	Adding a Bit of Security to RIP and OSPF	201
6.16	Monitoring OSPFD	202
<b>7.</b>	<b>Secure Remote Administration with SSH</b> .....	<b>204</b>
7.0	Introduction	204
7.1	Starting and Stopping OpenSSH	207
7.2	Creating Strong Passphrases	208
7.3	Setting Up Host Keys for Simplest Authentication	209
7.4	Generating and Copying SSH Keys	211
7.5	Using Public-Key Authentication to Protect System Passwords	213
7.6	Managing Multiple Identity Keys	214
7.7	Hardening OpenSSH	215
7.8	Changing a Passphrase	216
7.9	Retrieving a Key Fingerprint	217
7.10	Checking Configuration Syntax	218
7.11	Using OpenSSH Client Configuration Files for Easier Logins	218
7.12	Tunneling X Windows Securely over SSH	220
7.13	Executing Commands Without Opening a Remote Shell	221
7.14	Using Comments to Label Keys	222
7.15	Using DenyHosts to Foil SSH Attacks	223
7.16	Creating a DenyHosts Startup File	225
7.17	Mounting Entire Remote Filesystems with sshfs	226
<b>8.</b>	<b>Using Cross-Platform Remote Graphical Desktops</b> .....	<b>228</b>
8.0	Introduction	228
8.1	Connecting Linux to Windows via rdesktop	230
8.2	Generating and Managing FreeNX SSH Keys	233
8.3	Using FreeNX to Run Linux from Windows	233
8.4	Using FreeNX to Run Linux from Solaris, Mac OS X, or Linux	238
8.5	Managing FreeNX Users	239
8.6	Watching Nxclient Users from the FreeNX Server	240
8.7	Starting and Stopping the FreeNX Server	241

---

8.8	Configuring a Custom Desktop	242
8.9	Creating Additional Nxclient Sessions	244
8.10	Enabling File and Printer Sharing, and Multimedia in Nxclient	246
8.11	Preventing Password-Saving in Nxclient	246
8.12	Troubleshooting FreeNX	247
8.13	Using VNC to Control Windows from Linux	248
8.14	Using VNC to Control Windows and Linux at the Same Time	250
8.15	Using VNC for Remote Linux-to-Linux Administration	252
8.16	Displaying the Same Windows Desktop to Multiple Remote Users	254
8.17	Changing the Linux VNC Server Password	256
8.18	Customizing the Remote VNC Desktop	257
8.19	Setting the Remote VNC Desktop Size	258
8.20	Connecting VNC to an Existing X Session	259
8.21	Securely Tunneling x11vnc over SSH	261
8.22	Tunneling TightVNC Between Linux and Windows	262
<b>9.</b>	<b>Building Secure Cross-Platform Virtual Private Networks with OpenVPN</b>	<b>265</b>
9.0	Introduction	265
9.1	Setting Up a Safe OpenVPN Test Lab	267
9.2	Starting and Testing OpenVPN	270
9.3	Testing Encryption with Static Keys	272
9.4	Connecting a Remote Linux Client Using Static Keys	274
9.5	Creating Your Own PKI for OpenVPN	276
9.6	Configuring the OpenVPN Server for Multiple Clients	279
9.7	Configuring OpenVPN to Start at Boot	281
9.8	Revoking Certificates	282
9.9	Setting Up the OpenVPN Server in Bridge Mode	284
9.10	Running OpenVPN As a Nonprivileged User	285
9.11	Connecting Windows Clients	286
<b>10.</b>	<b>Building a Linux PPTP VPN Server</b>	<b>287</b>
10.0	Introduction	287
10.1	Installing Poptop on Debian Linux	290
10.2	Patching the Debian Kernel for MPPE Support	291
10.3	Installing Poptop on Fedora Linux	293
10.4	Patching the Fedora Kernel for MPPE Support	294
10.5	Setting Up a Standalone PPTP VPN Server	295

---

10.6	Adding Your Poptop Server to Active Directory	298
10.7	Connecting Linux Clients to a PPTP Server	299
10.8	Getting PPTP Through an iptables Firewall	300
10.9	Monitoring Your PPTP Server	301
10.10	Troubleshooting PPTP	302
<b>11.</b>	<b>Single Sign-on with Samba for Mixed Linux/Windows LANs</b> .....	<b>305</b>
11.0	Introduction	305
11.1	Verifying That All the Pieces Are in Place	307
11.2	Compiling Samba from Source Code	310
11.3	Starting and Stopping Samba	312
11.4	Using Samba As a Primary Domain Controller	313
11.5	Migrating to a Samba Primary Domain Controller from an NT4 PDC	317
11.6	Joining Linux to an Active Directory Domain	319
11.7	Connecting Windows 95/98/ME to a Samba Domain	323
11.8	Connecting Windows NT4 to a Samba Domain	324
11.9	Connecting Windows NT/2000 to a Samba Domain	325
11.10	Connecting Windows XP to a Samba Domain	325
11.11	Connecting Linux Clients to a Samba Domain with Command-Line Programs	326
11.12	Connecting Linux Clients to a Samba Domain with Graphical Programs	330
<b>12.</b>	<b>Centralized Network Directory with OpenLDAP</b> .....	<b>332</b>
12.0	Introduction	332
12.1	Installing OpenLDAP on Debian	339
12.2	Installing OpenLDAP on Fedora	341
12.3	Configuring and Testing the OpenLDAP Server	341
12.4	Creating a New Database on Fedora	344
12.5	Adding More Users to Your Directory	348
12.6	Correcting Directory Entries	350
12.7	Connecting to a Remote OpenLDAP Server	352
12.8	Finding Things in Your OpenLDAP Directory	352
12.9	Indexing Your Database	354
12.10	Managing Your Directory with Graphical Interfaces	356
12.11	Configuring the Berkeley DB	358
12.12	Configuring OpenLDAP Logging	363

---

12.13	Backing Up and Restoring Your Directory	364
12.14	Refining Access Controls	366
12.15	Changing Passwords	370
<b>13.</b>	<b>Network Monitoring with Nagios</b> .....	<b>371</b>
13.0	Introduction	371
13.1	Installing Nagios from Sources	372
13.2	Configuring Apache for Nagios	376
13.3	Organizing Nagios' Configuration Files Sanely	378
13.4	Configuring Nagios to Monitor Localhost	380
13.5	Configuring CGI Permissions for Full Nagios Web Access	389
13.6	Starting Nagios at Boot	390
13.7	Adding More Nagios Users	391
13.8	Speed Up Nagios with check_icmp	392
13.9	Monitoring SSHD	393
13.10	Monitoring a Web Server	397
13.11	Monitoring a Mail Server	400
13.12	Using Servicegroups to Group Related Services	402
13.13	Monitoring Name Services	403
13.14	Setting Up Secure Remote Nagios Administration with OpenSSH	405
13.15	Setting Up Secure Remote Nagios Administration with OpenSSL	406
<b>14.</b>	<b>Network Monitoring with MRTG</b> .....	<b>408</b>
14.0	Introduction	408
14.1	Installing MRTG	409
14.2	Configuring SNMP on Debian	410
14.3	Configuring SNMP on Fedora	413
14.4	Configuring Your HTTP Service for MRTG	413
14.5	Configuring and Starting MRTG on Debian	415
14.6	Configuring and Starting MRTG on Fedora	418
14.7	Monitoring Active CPU Load	419
14.8	Monitoring CPU User and Idle Times	422
14.9	Monitoring Physical Memory	424
14.10	Monitoring Swap Space and Memory	425
14.11	Monitoring Disk Usage	426
14.12	Monitoring TCP Connections	428
14.13	Finding and Testing MIBs and OIDs	429
14.14	Testing Remote SNMP Queries	430

---

14.15	Monitoring Remote Hosts	432
14.16	Creating Multiple MRTG Index Pages	433
14.17	Running MRTG As a Daemon	434
<b>15.</b>	<b>Getting Acquainted with IPv6</b> .....	<b>437</b>
15.0	Introduction	437
15.1	Testing Your Linux System for IPv6 Support	442
15.2	Pinging Link Local IPv6 Hosts	443
15.3	Setting Unique Local Unicast Addresses on Interfaces	445
15.4	Using SSH with IPv6	446
15.5	Copying Files over IPv6 with scp	447
15.6	Autoconfiguration with IPv6	448
15.7	Calculating IPv6 Addresses	449
15.8	Using IPv6 over the Internet	450
<b>16.</b>	<b>Setting Up Hands-Free Network Installations of New Systems</b> .....	<b>452</b>
16.0	Introduction	452
16.1	Creating Network Installation Boot Media for Fedora Linux	453
16.2	Network Installation of Fedora Using Network Boot Media	455
16.3	Setting Up an HTTP-Based Fedora Installation Server	457
16.4	Setting Up an FTP-Based Fedora Installation Server	458
16.5	Creating a Customized Fedora Linux Installation	461
16.6	Using a Kickstart File for a Hands-off Fedora Linux Installation	463
16.7	Fedora Network Installation via PXE Netboot	464
16.8	Network Installation of a Debian System	466
16.9	Building a Complete Debian Mirror with apt-mirror	468
16.10	Building a Partial Debian Mirror with apt-proxy	470
16.11	Configuring Client PCs to Use Your Local Debian Mirror	471
16.12	Setting Up a Debian PXE Netboot Server	472
16.13	Installing New Systems from Your Local Debian Mirror	474
16.14	Automating Debian Installations with Preseed Files	475
<b>17.</b>	<b>Linux Server Administration via Serial Console</b> .....	<b>478</b>
17.0	Introduction	478
17.1	Preparing a Server for Serial Console Administration	479
17.2	Configuring a Headless Server with LILO	483
17.3	Configuring a Headless Server with GRUB	485
17.4	Booting to Text Mode on Debian	487

---

17.5	Setting Up the Serial Console	489
17.6	Configuring Your Server for Dial-in Administration	492
17.7	Dialing In to the Server	495
17.8	Adding Security	496
17.9	Configuring Logging	497
17.10	Uploading Files to the Server	498
<b>18.</b>	<b>Running a Linux Dial-Up Server</b> .....	<b>501</b>
18.0	Introduction	501
18.1	Configuring a Single Dial-Up Account with WvDial	501
18.2	Configuring Multiple Accounts in WvDial	504
18.3	Configuring Dial-Up Permissions for Nonroot Users	505
18.4	Creating WvDial Accounts for Nonroot Users	507
18.5	Sharing a Dial-Up Internet Account	508
18.6	Setting Up Dial-on-Demand	509
18.7	Scheduling Dial-Up Availability with cron	510
18.8	Dialing over Voicemail Stutter Tones	512
18.9	Overriding Call Waiting	512
18.10	Leaving the Password Out of the Configuration File	513
18.11	Creating a Separate pppd Logfile	514
<b>19.</b>	<b>Troubleshooting Networks</b> .....	<b>515</b>
19.0	Introduction	515
19.1	Building a Network Diagnostic and Repair Laptop	516
19.2	Testing Connectivity with ping	519
19.3	Profiling Your Network with FPing and Nmap	521
19.4	Finding Duplicate IP Addresses with arping	523
19.5	Testing HTTP Throughput and Latency with httping	525
19.6	Using traceroute, tcptraceroute, and mtr to Pinpoint Network Problems	527
19.7	Using tcpdump to Capture and Analyze Traffic	529
19.8	Capturing TCP Flags with tcpdump	533
19.9	Measuring Throughput, Jitter, and Packet Loss with iperf	535
19.10	Using ngrep for Advanced Packet Sniffing	538
19.11	Using ntop for Colorful and Quick Network Monitoring	540
19.12	Troubleshooting DNS Servers	542
19.13	Troubleshooting DNS Clients	545
19.14	Troubleshooting SMTP Servers	546

---

19.15	Troubleshooting a POP3, POP3s, or IMAP Server	549
19.16	Creating SSL Keys for Your Syslog-ng Server on Debian	551
19.17	Creating SSL Keys for Your Syslog-ng Server on Fedora	557
19.18	Setting Up stunnel for Syslog-ng	558
19.19	Building a Syslog Server	560
<b>A.</b>	<b>Essential References</b>	<b>563</b>
<b>B.</b>	<b>Glossary of Networking Terms</b>	<b>566</b>
<b>C.</b>	<b>Linux Kernel Building Reference</b>	<b>590</b>
<b>Index</b>		<b>599</b>





# Preface

So there you are, staring at your computer and wondering why your Internet connection is running slower than slow, and wishing you knew enough to penetrate the endless runaround you get from your service provider. Or, you're the Lone IT Staffer in a small business who got the job because you know the difference between a switch and hub, and now you're supposed to have all the answers. Or, you're really interested in networking, and want to learn more and make it your profession. Or, you are already knowledgeable, and you simply have a few gaps you need to fill. But you're finding out that computer networking is a subject with reams and reams of reference material that is not always organized in a coherent, useful order, and it takes an awful lot of reading just to figure out which button to push.

To make things even more interesting, you need to integrate Linux and Windows hosts. If you want to pick up a book that lays out the steps for specific tasks, that explains clearly the necessary commands and configurations, and does not tax your patience with endless ramblings and meanderings into theory and obscure RFCs, this is the book for you.

## Audience

Ideally, you will have some Linux experience. You should know how to install and remove programs, navigate the filesystem, manage file permissions, and user and group creation. You should have some exposure to TCP/IP and Ethernet basics, IPv4 and IPv6, LAN, WAN, subnet, router, firewall, gateway, switch, hub, and cabling. If you are starting from scratch, there are any number of introductory books to get you up to speed on the basics.

---

If you don't already have basic Linux experience, I recommend getting the *Linux Cookbook* (O'Reilly). The *Linux Cookbook* (which I authored) was designed as a companion book to this one. It covers installing and removing software, user account management, cross-platform file and printer sharing, cross-platform user authentication, running servers (e.g., mail, web, DNS), backup and recovery, system rescue and repair, hardware discovery, configuring X Windows, remote administration, and lots more good stuff.

The home/SOHO user also will find some useful chapters in this book, and anyone who wants to learn Linux networking will be able to do everything in this book with a couple of ordinary PCs and inexpensive networking hardware.

## Contents of This Book

This book is broken into 19 chapters and 3 appendixes:

### Chapter 1, *Introduction to Linux Networking*

This is your high-level view of computer networking, covering cabling, routing and switching, interfaces, the different types of Internet services, and the fundamentals of network architecture and performance.

### Chapter 2, *Building a Linux Gateway on a Single-Board Computer*

In which we are introduced to the fascinating and adaptable world of Linux on routerboards, such as those made by Soekris and PC Engines, and how Linux on one of these little boards gives you more power and flexibility than commercial gear costing many times as much.

### Chapter 3, *Building a Linux Firewall*

Learn to use Linux's powerful *iptables* packet filter to protect your network, with complete recipes for border firewalls, single-host firewalls, getting services through NAT (Network Address Translation), blocking external access to internal services, secure remote access through your firewall, and how to safely test new firewalls before deploying them on production systems.

### Chapter 4, *Building a Linux Wireless Access Point*

You can use Linux and a routerboard (or any ordinary PC hardware) to build a secure, powerful, fully featured wireless access point customized to meet your needs, including state-of-the-art authentication and encryption, name services, and routing and bridging.

### Chapter 5, *Building a VoIP Server with Asterisk*

This chapter digs into the very guts of the revolutionary and popular Asterisk VoIP server. Sure, these days, everyone has pretty point-and-click GUIs for managing their iPBX systems, but you still need to understand what's under the hood. This chapter shows you how to install Asterisk and configure Asterisk

---

from scratch: how to create user's extensions and voicemail, manage custom greetings and messages, do broadcast voicemails, provision phones, set up a digital receptionist, do PSTN (Public Switched Telephone Network) integration, do pure VoIP, manage road warriors, and more.

Chapter 6, *Routing with Linux*

Linux's networking stack is a powerhouse, and it includes advanced routing capabilities. Here be recipes for building Linux-based routers, calculating subnets (accurately and without pain), blackholing unwelcome visitors, using static and dynamic routing, and for monitoring your hard-working little routers.

Chapter 7, *Secure Remote Administration with SSH*

OpenSSH is an amazing and endlessly useful implementation of the very secure SSH protocol. It supports traditional password-based logins, password-less public-key-based logins, and securely carries traffic over untrusted networks. You'll learn how to do all of this, plus how to safely log in to your systems remotely, and how to harden and protect OpenSSH itself.

Chapter 8, *Using Cross-Platform Remote Graphical Desktops*

OpenSSH is slick and quick, and offers both text console and a secure X Windows tunnel for running graphical applications. There are several excellent programs (FreeNX, rdesktop, and VNC) that offer a complementary set of capabilities, such as remote helpdesk, your choice of remote desktops, and Linux as a Windows terminal server client. You can control multiple computers from a single keyboard and monitor, and even conduct a class where multiple users view or participate in the same remote session.

Chapter 9, *Building Secure Cross-Platform Virtual Private Networks with OpenVPN*

Everyone seems to want a secure, user-friendly VPN (Virtual Private Network). But there is a lot of confusion over what a VPN really is, and a lot of commercial products that are not true VPNs at all, but merely SSL portals to a limited number of services. OpenVPN is a true SSL-based VPN that requires all endpoints to be trusted, and that uses advanced methods for securing the connection and keeping it securely encrypted. OpenVPN includes clients for Linux, Solaris, Mac OS X, OpenBSD, FreeBSD, and NetBSD, so it's your one-stop VPN shop. You'll learn how to create and manage your own PKI (Public Key Infrastructure), which is crucial for painless OpenVPN administration. And, you'll learn how to safely test OpenVPN, how to set up the server, and how to connect clients.

Chapter 10, *Building a Linux PPTP VPN Server*

This chapter covers building and configuring a Linux PPTP VPN server for Windows and Linux clients; how to patch Windows clients so they have the necessary encryption support, how to integrate with Active Directory, and how to get PPTP through an *iptables* firewall.

---

Chapter 11, *Single Sign-on with Samba for Mixed Linux/Windows LANs*

Using Samba as a Windows NT4-style domain controller gives you a flexible, reliable, inexpensive mechanism for authenticating your network clients. You'll learn how to migrate from a Windows domain controller to Samba on Linux, how to migrate Windows user accounts to Samba, integrate Linux clients with Active Directory, and how to connect clients.

Chapter 12, *Centralized Network Directory with OpenLDAP*

An LDAP directory is an excellent mechanism on which to base your network directory services. This chapter shows how to build an OpenLDAP directory from scratch, how to test it, how to make changes, how to find things, how to speed up lookups with smart indexing, and how to tune it for maximum performance.

Chapter 13, *Network Monitoring with Nagios*

Nagios is a great network monitoring system that makes clever use of standard Linux commands to monitor services and hosts, and to alert you when there are problems. Status reports are displayed in nice colorful graphs on HTML pages that can be viewed on any Web browser. Learn to monitor basic system health, and common servers like DNS, Web, and mail servers, and how to perform secure remote Nagios administration.

Chapter 14, *Network Monitoring with MRTG*

MRTG is an SNMP-aware network monitor, so theoretically it can be adapted to monitor any SNMP-enabled device or service. Learn how to monitor hardware and services, and how to find the necessary SNMP information to create custom monitors.

Chapter 15, *Getting Acquainted with IPv6*

Ready or not, IPv6 is coming, and it will eventually supplant IPv4. Get ahead of the curve by running IPv6 on your own network and over the Internet; learn why those very long IPv6 addresses are actually simpler to manage than IPv4 addresses; learn how to use SSH over IPv6, and how to auto-configure clients without DHCP.

Chapter 16, *Setting Up Hands-Free Network Installations of New Systems*

Fedora Linux and all of its relatives (Red Hat, CentOS, Mandriva, PC Linux OS, and so forth), and Debian Linux and all of its descendants (Ubuntu, Mepis, Knoppix, etc.) include utilities for creating and cloning customized installations, and for provisioning new systems over the network. So, you can plug-in a PC, and within a few minutes have a complete new installation all ready to go. This chapter describes how to use ordinary installation ISO images for network installations of Fedora, and how to create and maintain complete local Debian mirrors efficiently.

---

### Chapter 17, *Linux Server Administration via Serial Console*

When Ethernet goes haywire, the serial console will save the day, both locally and remotely; plus, routers and managed switches are often administered via the serial console. Learn how to set up any Linux computer to accept serial connections, and how to use any Linux, Mac OS X, or Windows PC as a serial terminal. You'll also learn how to do dial-up server administration, and how to upload files over your serial link.

### Chapter 18, *Running a Linux Dial-Up Server*

Even in these modern times, dial-up networking is still important; we're a long way from universal broadband. Set up Internet-connection sharing over dial-up, dial-on-demand, use *cron* to schedule dialup sessions, and set up multiple dial-up accounts.

### Chapter 19, *Troubleshooting Networks*

Linux contains a wealth of power tools for diagnosing and fixing network problems. You'll learn the deep dark secrets of *ping*, how to use *tcpdump* and Wireshark to eavesdrop on your own wires, how to troubleshoot the name and mail server, how to discover all the hosts on your network, how to track problems down to their sources, and how to set up a secure central logging server. You'll learn a number of lesser-known but powerful utilities such as *fping*, *htping*, *arping*, and *mtr*, and how to transform an ordinary old laptop into your indispensable portable network diagnostic-and-fixit tool.

### Appendix A, *Essential References*

Computer networking is a large and complex subject, so here is a list of books and other references that tell you what you need to know.

### Appendix B, *Glossary of Networking Terms*

Don't know what it means? Look it up here.

### Appendix C, *Linux Kernel Building Reference*

As the Linux kernel continues to expand in size and functionality, it often makes sense to build your own kernel with all the unnecessary bits stripped out. Learn the Fedora way, the Debian way, and the vanilla way of building a custom kernel.

## What Is Included

This book covers both old standbys and newfangled technologies. The old-time stuff includes system administration via serial console, dial-up networking, building an Internet gateway, VLANs, various methods of secure remote access, routing, and traffic control. Newfangled technologies include building your own iPBX with Asterisk, wireless connectivity, cross-platform remote graphical desktops, hands-free network installation of new systems, single sign-on for mixed Linux and Windows LANs, and IPv6 basics. And, there are chapters on monitoring, alerting, and troubleshooting.

---

## Which Linux Distributions Are Used in the Book

There are literally hundreds, if not thousands of Linux distributions: live distributions on all kinds of bootable media, from business-card CDs to USB keys to CDs to DVDs; large general-purpose distributions; tiny specialized distributions for firewalls, routers, and old PCs; multimedia distributions; scientific distributions; cluster distributions; distributions that run Windows applications; and super-secure distributions. There is no way to even begin to cover all of these; fortunately for frazzled authors, the Linux world can be roughly divided into two camps: Red Hat Linux and Debian Linux. Both are fundamental, influential distributions that have spawned the majority of derivatives and clones.

In this book, the Red Hat world is represented by Fedora Linux, the free community-driven distribution sponsored by Red Hat. Fedora is free of cost, the core distribution contains only Free Software, and it has a more rapid release cycle than Red Hat Enterprise Linux (RHEL). RHEL is on an 18-month release cycle, is designed to be stable and predictable, and has no packaged free-of-cost version, though plenty of free clones abound. The clones are built from the RHEL SRPMs, with the Red Hat trademarks removed. Some RHEL-based distributions include CentOS, White Box Linux, Lineox, White Box Enterprise Linux, Tao Linux, and Pie Box Linux.

Additionally, there are a number of Red Hat derivatives to choose from, like Mandriva and PCLinuxOS. The recipes for Fedora should work for all of these, though you might find some small differences in filenames, file locations, and package names.

Debian-based distributions are multiplying even as we speak: Ubuntu, Kubuntu, Edubuntu, Xandros, Mepis, Knoppix, Kanotix, and Linspire, to name but a few. While all of these have their own enhancements and modifications, package management with *aptitude* or Synaptic works the same on all of them.

Novell/SUSE is RPM-based like Red Hat, but has always gone its own way. Gentoo and Slackware occupy their own unique niches. I'm not even going to try to include all of these, so users of these distributions are on their own. Fortunately, each of these is very well-documented and have active, helpful user communities, and they're not that different from their many cousins.

## Downloads and Feedback

Doubtless this book, despite the heroic efforts of me and the fabulous O'Reilly team, contains flaws, errors, and omissions. Please email your feedback and suggestions to [netcookbook@bratgrrl.com](mailto:netcookbook@bratgrrl.com), so we can make the second edition even better. Be sure to visit <http://www.oreilly.com/catalog/9780596102487> for errata, updates, and to download the scripts used in the book.

---

## Conventions

### *Italic*

Used for pathnames, filenames, program names, Internet addresses, such as domain names and URLs, and new terms where they are defined.

### Constant Width

Used for output from programs, and names and keywords in examples.

### *Constant Width Italic*

Used for replaceable parameters or optional elements when showing a command's syntax.

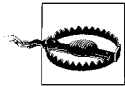
### **Constant Width Bold**

Used for commands that should be typed verbatim, and for emphasis within program code and configuration files.

Unix/Linux commands that can be typed by a regular user are preceded with a regular prompt, ending with \$. Commands that must be typed as *root* are preceded with a "root" prompt, ending with a #. In real life, it is better to use the *sudo* command wherever possible to avoid logging in as *root*. Both kinds of prompts indicate the username, the current host, and the current working directory (for example: `root@xena:/var/llibtftpboot #`).



This icon signifies a tip, suggestion, or general note.



This icon indicates a warning or caution.

## Using Code Examples

This book is here to help you get your job done. In general, you may use the code in this book in your programs and documentation. You do not need to contact us for permission unless you're reproducing a significant portion of the code. For example, writing a program that uses several chunks of code from this book does not require permission. Selling or distributing a CD-ROM of examples from O'Reilly books *does* require permission. Answering a question by citing this book and quoting example code does not require permission. Incorporating a significant amount of example code from this book into your product's documentation *does* require permission.

We appreciate, but do not require, attribution. An attribution usually includes the title, author, publisher, and ISBN. For example: "*Linux Networking Cookbook*, by Carla Schroder. Copyright 2008 O'Reilly Media, Inc., 978-0-596-10248-7."

---

If you feel your use of code examples falls outside fair use or the permission given above, feel free to contact us at [permissions@oreilly.com](mailto:permissions@oreilly.com).

## Comments and Questions

Please address comments and questions concerning this book to the publisher:

O'Reilly Media, Inc.  
1005 Gravenstein Highway North  
Sebastopol, CA 95472  
800-998-9938 (in the United States or Canada)  
707-829-0515 (international or local)  
707-829-0104 (fax)

We have a web page for this book, where we list errata, examples, and any additional information. You can access this page at:

<http://www.oreilly.com/catalog/9780596102487>

To comment or ask technical questions about this book, send email to:

[bookquestions@oreilly.com](mailto:bookquestions@oreilly.com)

For more information about our books, conferences, Resource Centers, and the O'Reilly Network, see the web site:

<http://www.oreilly.com>

## Safari® Books Online



When you see a Safari® Books Online icon on the cover of your favorite technology book, that means the book is available online through the O'Reilly Network Safari Bookshelf.

Safari offers a solution that's better than e-books. It's a virtual library that lets you easily search thousands of top tech books, cut and paste code samples, download chapters, and find quick answers when you need the most accurate, current information. Try it for free at <http://safari.oreilly.com>.



- [download The Pillars of Computation Theory: State, Encoding, Nondeterminism \(Universitext\) pdf, azw \(kindle\), epub, doc, mobi](#)
- [download online Unintended Consequences \(Stone Barrington\)](#)
- [Thieves in High Places for free](#)
- [An Imam in Paris: Account of a Stay in France by an Egyptian Cleric \(1826-1831\) pdf, azw \(kindle\)](#)
- [click Influencer: The Power to Change Anything](#)
  
- <http://cavalldecartro.highlandagency.es/library/The-Rain-Before-It-Falls.pdf>
- <http://conexdx.com/library/A-Matter-of-Degrees--What-Temperature-Reveals-about-the-Past-and-Future-of-Our-Species--Planet--and-Universe.pdf>
- <http://nexson.arzamashev.com/library/Learning-OpenGL-ES-for-iOS--A-Hands-on-Guide-to-Modern-3D-Graphics-Programming.pdf>
- <http://weddingcellist.com/lib/Great-Escapes.pdf>
- <http://www.celebritychat.in/?ebooks/Partial-Differential-Equations-2--Functional-Analytic-Methods--Universitext-.pdf>