# Routing and Switching Essentials

## Companion Guide

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Cisco Networking Academy

**Cisco Press**

800 East 96th Street

Indianapolis, Indiana 46240 USA

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Outside of her academic responsibilities, Cheryl is currently pursuing a Ph.D. in information technology. She enjoys spending time with her family, grandkids, and granddog. She enjoys reading, biking, hiking, and puzzles.

## Icons Used in This Book


## Syntax Conventions

The conventions used to present command syntax in this book are the same conventions used in the IOS Command Reference. The Command Reference describes these conventions as follows:

- **Boldface** indicates commands and keywords that are entered literally as shown. In actual configuration examples and output (not general command syntax), boldface indicates commands that are manually input by the user (such as a **show** command).
- *Italics* indicate arguments for which you supply actual values.
- Vertical bars (|) separate alternative, mutually exclusive elements.
- Square brackets ([ ]) indicate an optional element.
- Braces ({ }) indicate a required choice.
- Braces within brackets ([{ }]) indicate a required choice within an optional element.

# Introduction

*Routing and Switching Essentials Companion Guide* is the official supplemental textbook for the Cisco Network Academy CCNA Routing and Switching Essentials course. Cisco Networking Academy is a comprehensive program that delivers information technology skills to students around the world. The curriculum emphasizes real-world practical application, while providing opportunities for you to gain the skills and hands-on experience needed to design, install, operate, and maintain networks in small- to medium-sized businesses, as well as enterprise and service provider environments.

As a textbook, this book provides a ready reference to explain the same networking concepts, technologies, protocols, and devices as the online curriculum. This book emphasizes key topics, terms, and activities and provides some alternative explanations and examples as compared with the course. You can use the online curriculum as directed by your instructor and then use this Companion Guide's study tools to help solidify your understanding of all the topics.

## Who Should Read This Book

This book is intended for students enrolled in the Cisco Networking Academy Routing and Switching Essentials course. The book, as well as the course, is designed as an introduction to data network technology for those pursuing careers as network professionals as well as those who need only an introduction to network technology for professional growth. Topics are presented concisely, starting with the most fundamental concepts and progressing to a comprehensive understanding of network communication. The content of this text provides the foundation for additional Cisco Academy courses, and preparation for the CCENT and CCNA Routing and Switching certifications.

## Book Features

The educational features of this book focus on supporting topic coverage, readability, and practice of the course material to facilitate your full understanding of the course material.

## Topic Coverage

The following features give you a thorough overview of the topics covered in each chapter so that you can make constructive use of your study time:

- **Objectives:** Listed at the beginning of each chapter, the objectives reference the core concepts covered in the chapter. The objectives match the objectives stated in the corresponding chapters of the online curriculum; however, the question format in the Companion Guide encourages you to think about finding the answers as you read the chapter.


- **"How-to" feature:** When this book covers a set of steps that you need to perform for certain tasks, the text lists the steps as a how-to list. When you are studying, the icon helps you easily refer to this feature as you skim through the book.
- **Notes:** These are short sidebars that point out interesting facts, timesaving methods, and important safety issues.
- **Chapter summaries:** At the end of each chapter is a summary of the chapter's key concepts. It provides a synopsis of the chapter and serves as a study aid.
- **Practice:** At the end of chapter there is a full list of all the Labs, Class Activities, and Packet Tracer Activities to refer back to for study time.

## Readability

The following features have been updated to assist your understanding of the networking vocabulary:

- **Key terms:** Each chapter begins with a list of key terms, along with a page-number reference from inside the chapter. The terms are listed in the order in which they are explained in the chapter. This handy reference allows you to find a term, flip to the page where the term appears, and see the term used in context. The Glossary defines all the key terms.
- **Glossary:** This book contains an all-new Glossary with almost 200 terms.

## Practice

Practice makes perfect. This new Companion Guide offers you ample opportunities to put what you learn into practice. You will find the following features valuable and effective in reinforcing the instruction that you receive:

- **Check Your Understanding questions and answer key:** Updated review questions are presented at the end of each chapter as a self-assessment tool. These

questions match the style of questions that you see in the online course. Appendix A, "Answers to the 'Check Your Understanding' Questions," provides an answer key to all the questions and includes an explanation of each answer.

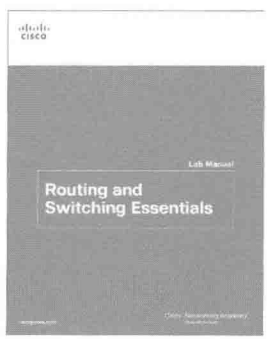
Packet Tracer
Activity

Video

- **Labs and activities:** Throughout each chapter, you will be directed back to the online course to take advantage of the activities created to reinforce concepts. In addition, at the end of each chapter, there is a "Practice" section that collects a list of all the labs and activities to provide practice with the topics introduced in this chapter. The labs and class activities are available in the companion *Routing and Switching Essentials Lab Manual* (ISBN 978-1-58713-320-6). The Packet Tracer Activities PKA files are found in the online course.
- **Page references to online course:** After headings, you will see, for example, (1.1.2.3). This number refers to the page number in the online course so that you can easily jump to that spot online to view a video, practice an activity, perform a lab, or review a topic.

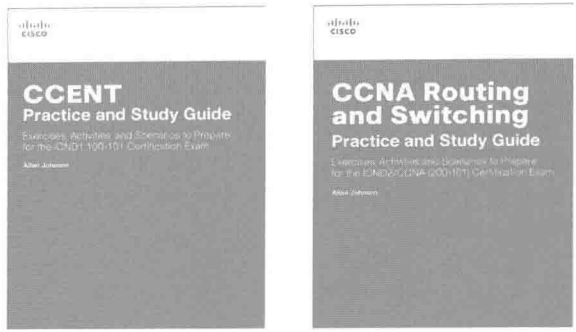
## Lab Manual

The supplementary book *Routing and Switching Essentials Lab Manual*, by Cisco Press (ISBN 978-1-58713-320-6), contains all the labs and class activities from the course.




## Practice and Study Guide

Additional Study Guide exercises, activities, and scenarios are available in the new *CCENT Practice and Study Guide* (978-158713-345-9) and *CCNA Routing and Switching Practice and Study Guide* (978-158713-344-2) books by Allan Johnson. Each Practice and Study Guide coordinates with the recommended curriculum sequence—the CCENT edition follows the course outlines for *Introduction to Networks* and *Routing and Switching Essentials*. The CCNA edition follows the course outlines for *Scaling Networks* and *Connecting Networks*.




## About Packet Tracer Software and Activities

Packet Tracer ☐ Activity

Interspersed throughout the chapters you'll find many activities to work with the Cisco Packet Tracer tool. Packet Tracer allows you to create networks, visualize how packets flow in the network, and use basic testing tools to determine whether the network would work. When you see this icon, you can use Packet Tracer with the listed file to perform a task suggested in this book. The activity files are available in the course. Packet Tracer software is available only through the Cisco Networking Academy website. Ask your instructor for access to Packet Tracer.

# How This Book Is Organized

This book corresponds closely to the Cisco Academy Routing and Switching Essentials course and is divided into 11 chapters, one appendix, and a glossary of key terms:

- **Chapter 1, "Introduction to Switched Networks"**: Introduces the concept of a switched network, reviews how a switch operates, and provides an overview of how the convergence of data, voice, and video traffic affects a switched network. Chapter 1 examines switch network design models and explains the benefits of implementing a switch network based on a hierarchical design. Switch features are also discussed.
- **Chapter 2, "Basic Switching Concepts and Configuration"**: Basic switch concepts covered include the following: what happens when power is applied to a switch, switch troubleshooting tips, best practices for switch security, and the purpose of assigning an IP address, mask, and default gateway to a switch. The chapter also presents IOS commands used to configure a switch with an IP address, mask, default, and gateway for remote access including SSH access.

- **Chapter 3, "VLANs":** Examines the features and benefits provided by switch VLANs and trunks. Specific concepts include native VLAN, DTP, security issues, and best practices for implementation. Hands-on activities include configuration and troubleshooting of VLANs and trunks.
- **Chapter 4, "Routing Concepts":** Introduces the lowest layer of the TCP/IP model: the transport layer. This layer is essentially the equivalent of the OSI data link layer and the physical layer. The chapter discusses how this layer prepares network layer packets for transmission, controls access to the physical media, and transports the data across various media. This chapter includes a description of the encapsulation protocols and processes that occur as data travels across the LAN and the WAN as well as the media used.
- **Chapter 5, "Inter-VLAN Routing":** Examines the methods used to route between VLANs including using a Layer 3 switch. Explores the concept of a Layer 3 routed port. Includes configuration of inter-VLAN routing using multiple interfaces, router-on-a-stick, and a Layer 3 switch. Issues related to routing between VLANs are also discussed.
- **Chapter 6, "Static Routing":** Introduces the function of the network layer—routing—and the basic device that performs this function—the router. The important routing concepts related to addressing, path determination, and data packets for both IPv4 and IPv6 will be presented. The chapter also introduces the construction of a router and the basic router configuration.
- **Chapter 7, "Routing Dynamically":** Introduces Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) and examines how each transports information across the network. It explores how TCP uses segmentation, the three-way handshake, and expectational acknowledgments to ensure reliable delivery of data. It also examines the best-effort delivery mechanism provided by UDP and describes when this would be preferred over TCP.
- **Chapter 8, "Single-Area OSPF":** Focuses on IPv4 and IPv6 network addressing, including the types of addresses and address assignment. It describes how to use the address mask or prefix length to determine the number of subnetworks and hosts in a network. This chapter also introduces Internet Control Message Protocol (ICMP) tools, such as ping and trace.
- **Chapter 9, "Access Control Lists":** Examines how to improve network performance by optimally dividing the IP address space based on network requirements. It explores the calculation of valid host addresses and the determination of both subnet and subnet broadcast addresses. This chapter examines subnetting for both IPv4 and IPv6.

- **Chapter 10, "DHCP":** Introduces DHCPv4 and DHCPv6 including explanation, configuration, and troubleshooting. The chapter examines the different methods an IPv6 client might obtain an IPv6 address with or without a DHCPv6 server.
- **Chapter 11, "Network Address Translation for IPv4":** Explains the concept of private and public IP addressing and when Network Address Translation (NAT) would be used. Advantages, disadvantages, and types of NAT are also covered. Configuration and troubleshooting of the various NAT types is an integral part of the chapter.
- **Appendix A, "Answers to the 'Check Your Understanding' Questions":** This appendix lists the answers to the "Check Your Understanding" review questions that are included at the end of each chapter.
- **Glossary:** The glossary provides you with definitions for all the key terms identified in each chapter.

# Contents at a Glance

# Contents