Introduction

The Cisco Networking Academy is a comprehensive e-learning program that provides students with Internet technology skills. A Networking Academy delivers web-based content, online assessment, student performance tracking, and hands-on labs to prepare students for industry-standard certifications. The CCNA curriculum includes four courses oriented around the topics of the Cisco Certified Network Associate (CCNA) certification.

Routing Protocols and Concepts, CCNA Exploration Labs and Study Guide is a supplement to your classroom and laboratory experience with the Cisco Networking Academy. To be successful on the exam and achieve your CCNA certification, you should do everything in your power to arm yourself with a variety of tools and training materials to support your learning efforts. This Labs and Study Guide is just such a collection of tools. Used to its fullest extent, it will help you gain the knowledge as well as practice the skills associated with the content area of the CCNA Exploration Routing Protocols and Concepts course. Specifically, this book will help you work on these main areas:

- Basic Routing and Packet-Forwarding Concepts
- Understanding and Configuring Static and Default Routes
- Distance Vector Routing Protocol Concepts
- RIPv1, RIPv2, and EIGRP Concepts and Configuration
- IP Addressing with VLSM
- Classful and Classless Routing
- Link-State Routing Protocol Concepts
- OSPF Concepts and Configuration
- Troubleshooting Routing Issues

Labs and Study Guides similar to this one are also available for the other three courses: *Network Fundamentals, CCNA Exploration Labs and Study Guide*; *LAN Switching and Wireless, CCNA Exploration Labs and Study Guide*; and *Accessing the WAN, CCNA Exploration Labs and Study Guide*.

A Word About Packet Tracer

Packet Tracer is a self-paced, visual, interactive teaching and learning tool developed by Cisco. Lab activities are an important part of networking education. However, lab equipment can be a scarce resource. Packet Tracer provides a visual simulation of equipment and network processes to offset the challenge of limited equipment. Students can spend as much time as they like completing standard lab exercises through Packet Tracer, and have the option to work from home. Although Packet Tracer is not a substitute for real equipment, it allows students to practice using a command-line interface. This "e-doing" capability is a fundamental component of learning how to configure routers and switches from the command line.

Packet Tracer v4.x is available only to Cisco Networking Academies through the Academy Connection website.

Goals and Methods

The most important goal of this book is to help you pass the CCNA exam (640-802). Passing this foundation exam means that you not only have the required knowledge of the technologies covered by the exam, but that you can also plan, design, implement, operate, and troubleshoot these technologies. In other words, these exams are rigorously application based. You can view the exam topics any time at http://www.cisco.com/go/certifications. The topics are divided into eight categories:

- Describe how a network works
- Configure, verify, and troubleshoot a switch with VLANs and interswitch communications
- Implement an IP addressing scheme and IP services to meet network requirements in a medium-size enterprise branch office network.
- Configure, verify, and troubleshoot basic router operation and routing on Cisco devices
- Explain and select the appropriate administrative tasks required for a WLAN
- Identify security threats to a network and describe general methods to mitigate those threats
- Implement, verify, and troubleshoot NAT and ACLs in a medium-size enterprise branch office network
- Implement and verify WAN links

The Routing Protocols and Concepts course focuses on the third and fourth bullets.

The Study Guide section offers exercises that help you learn the routing protocol concepts as well as the configurations crucial to your success as a CCNA exam candidate. Each chapter is slightly different and includes some or all of the following types of exercises:

- Vocabulary Matching and Completion
- Skill-Building Activities and Scenarios
- Configuration Scenarios
- Concept Questions
- Journal Entries
- Internet Research

In the configuration chapters, you'll find many Packet Tracer Activities that 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 on this book's CD-ROM; Packet Tracer software, however, is available through the Academy Connection website. Ask your instructor for access to Packet Tracer.

The Labs and Activities sections include a Command Reference table, all the online Curriculum Labs, and a Packet Tracer Skills Integration Challenge Activity. The Curriculum Labs are divided into three categories:

- **Basic:** The Basic Labs are procedural in nature and assume that you have no experience configuring the technologies that are the topic of the lab.
- **Challenge:** The Challenge Labs are implementation in nature and assume that you have a firm enough grasp on the technologies to "go it alone." These labs often only give you a general requirement that you must implement fully without the details of each small step. In other

words, you must use the knowledge and skills you gained in the chapter text, activities, and Basic Lab to successfully complete the Challenge Labs. Avoid the temptation to work through the Challenge Lab by flipping back through the Basic Lab when you are not sure of a command. Do not try to short-circuit your CCNA training. You need a deep understanding of CCNA knowledge and skills to ultimately be successful on the CCNA exam.

- **Troubleshooting:** The Troubleshooting Labs will ask you to fix a broken network. These labs include corrupted scripts you purposefully load onto the routers. Then you use troubleshooting techniques to isolate problems and implement a solution. By the end of the lab, you should have a functional network with full end-to-end connectivity.

Each of the hands-on labs include Packet Tracer Companion Activities, where you can use Packet Tracer to complete a simulation of the lab.

Each chapter also includes a culminating activity called the Packet Tracer Skills Integration Challenge. These activities require you to pull together several skills learned from the chapter—as well as previous chapters and courses—to successfully complete one comprehensive exercise.

Audience for This Book

This book's main audience is anyone taking the CCNA Exploration Routing Protocols and Concepts course of the Cisco Networking Academy curriculum. Many Academies use this textbook as a required tool in the course, while other Academies recommend the Companion Guides as an additional source of study and practice materials.

The secondary audiences for this book include people taking CCNA-related classes from professional training organizations. This book can also be used for college- and university-level networking courses, as well as for anyone wanting to gain a detailed understanding of routing.

How This Book Is Organized

Because the content of *Routing Protocols and Concepts, CCNA Exploration Companion Guide* and the online curriculum is sequential, you should work through this Labs and Study Guide in order, beginning with Chapter 1.

The book covers the major topic headings in the same sequence as the online curriculum for the CCNA Exploration Routing Protocols and Concepts course. This book has 11 chapters, with the same numbers and similar names as the online course chapters.

Each routing protocol chapter and the static routing chapter begin with a single topology that is used throughout the chapter. The single topology per chapter allows better continuity and easier understanding of routing commands, operations, and outputs. However, the topology is different than the one used in the online curriculum and the Companion Guide. A different topology affords you the opportunity to practice your knowledge and skills without just simply recording the information you find in the text.

- **Chapter 1, "Introduction to Routing and Packet Forwarding":** This chapter begins with several exercises devoted to reinforcing your understanding of the basic hardware and software components of a router as well as testing your knowledge of basic routing and packet forwarding. Then you will practice the basic addressing and configuration skills that are crucial to all future chapters. The Study Guide portion of the chapter ends with a review of routing principles

as well as explains how a router determines the path and switches the packet. The Lab portion includes two versions of the Basic Lab, a Challenge Lab, and the Packet Tracer Skills Integration Challenge Activity.

- **Chapter 2, "Static Routing":** The exercises in the first part of this chapter will help you understand basic router configuration and verification as well as the concept of directly connected networks. Then the exercises cover, in detail, static routes, summary routes, and default routes. The Lab portion of the chapter includes a Basic Lab, a Challenge Lab, a Troubleshooting Lab, and a Packet Tracer Skills Integration Challenge Activity.
- **Chapter 3, "Introduction to Dynamic Routing Protocols":** The exercises in this chapter focus on the concepts of dynamic routing, including basic concepts and advantages, classification, metrics, administrative distance, and routing table elements. The Lab section includes six subnetting scenarios to help you hone your IP addressing design skills. The Lab section also includes a Packet Tracer Skills Integration Challenge Activity.
- **Chapter 4, "Distance Vector Routing Protocols":** This chapter's exercises are devoted to the concepts of distance vector routing protocols, including their characteristics, how they maintain the routing table, and how they guard against routing loops. The Lab section includes a routing table interpretation activity and a Packet Tracer Skills Integration Challenge Activity.
- **Chapter 5, "RIP Version 1":** Exercises in this chapter focus on RIPv1 concepts, basic configuration, verification, troubleshooting, automatic summarization, and RIP default route propagation. The Lab portion of the chapter includes a Basic Lab, a Challenge Lab, a Troubleshooting Lab, and a Packet Tracer Skills Integration Challenge Activity.
- **Chapter 6, "VLSM and CIDR":** This chapter is a transition from classful routing to classless routing. Therefore, exercises focus on the concepts and skills necessary for implementing VLSM addressing schemes and CIDR. The Lab section includes three VLSM design scenarios and three route summarization scenarios. The Lab section also includes a Packet Tracer Skills Integration Challenge Activity.
- **Chapter 7, "RIPv2":** The exercises in this chapter cover the concepts and configurations of the classless version of RIPv2. First, you explore how RIPv2 addresses the limitations of RIPv1. Then you configure, verify, and troubleshoot RIPv2. The Lab portion of the chapter includes a Basic Lab, a Challenge Lab, a Troubleshooting Lab, and a Packet Tracer Skills Integration Challenge Activity.
- **Chapter 8, "The Routing Table: A Closer Look":** This chapter represents a pivotal point in your studies of routing protocols and concepts as you delve into exercises that take you deep into the structure of the routing table. Understanding exactly how the routing table is constructed and then used by the IOS provides a valuable tool in verifying and troubleshooting networks. The Lab portion of the chapter includes two routing table labs and a Packet Tracer Skills Integration Challenge Activity.
- **Chapter 9, "EIGRP":** Exercises in this chapter focus on EIGRP concepts, basic configuration, verification, troubleshooting, metric calculation, and DUAL operation as well as some more advanced EIGRP configurations. The Lab portion of the chapter includes a Basic Lab, a Challenge Lab, a Troubleshooting Lab, and a Packet Tracer Skills Integration Challenge Activity.
- **Chapter 10, "Link-State Routing Protocols":** The exercises in this chapter help you transition from distance vector routing protocols to link-state routing protocols. There are no labs for this chapter. However, there is a Packet Tracer Skills Integration Challenge Activity.

- **Chapter 11, "OSPF":** This chapter concludes your studies of routing protocols with exercises focusing on basic OSPF concepts and configurations, including the OSPF metric calculation, OSPF multiaccess networks, and some advanced OSPF configurations for single-area OSPF implementations. The Lab portion of the chapter includes a Basic Lab, a Challenge Lab, a Troubleshooting Lab, and a Packet Tracer Skills Integration Challenge Activity.

About the CD-ROM

The CD-ROM included with this book has all the Packet Tracer Activity, Packet Tracer Companion, and Packet Tracer Challenge files that are referenced throughout the book as indicated by the Packet Tracer Activity, Packet Tracer Companion, and Packet Tracer Challenge icons.

Updates to these files can be obtained from the website for this book, http://www.ciscopress.com/title/1587132044. The files will be updated to cover any subsequent releases of Packet Tracer.

About the Cisco Press Website for This Book

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