

Introduction

Cisco Networking Academy is a comprehensive e-learning program that delivers information technology skills to students around the world. The Cisco CCNA Exploration curriculum consists of four courses that provide a comprehensive overview of networking, from fundamentals to advanced applications and services. The curriculum emphasizes theoretical concepts and 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-size businesses, as well as enterprise and service provider environments. The Network Fundamentals course is the first course in the curriculum and is based on a top-down approach to networking.

Network Fundamentals, CCNA Exploration Companion Guide is the official supplemental textbook for the first course in v4.x of the CCNA Exploration online curriculum of the Networking Academy. 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 many alternate 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.

Goal of This Book

First and foremost, by providing a fresh, complementary perspective of the online content, this book helps you learn all the required materials of the first course in the Networking Academy CCNA Exploration curriculum. As a secondary goal, individuals who do not always have Internet access can use this text as a mobile replacement for the online curriculum. In those cases, you can read the appropriate sections of this book, as directed by your instructor, and learn the topics that appear in the online curriculum. Another secondary goal of this book is to serve as your offline study material to help prepare you for the CCNA exam.

Audience for This Book

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

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, tips, cautions, and warnings:** 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.



Readability

The authors have compiled, edited, and in some cases rewritten the material so that it has a more conversational tone that follows a consistent and accessible reading level. In addition, 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 more than 250 terms.

Practice

Practice makes perfect. This new Companion Guide offers you ample opportunities to put what you learn to 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, “Check Your Understanding and Challenge Questions Answer Key,” provides an answer key to all the questions and includes an explanation of each answer.
- **(NEW) Challenge questions and activities:** Additional—and more challenging—review questions and activities are presented at the end of chapters. These questions are purposefully designed to be similar to the more complex styles of questions you might see on the CCNA exam. This section might also include activities to help prepare you for the exams. Appendix A provides the answers.
- **Packet Tracer activities:** 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 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.

Packet Tracer
□ Activity

Labs and Study Guide

The supplementary book *Network Fundamentals, CCNA Exploration Labs and Study Guide*, by Cisco Press (ISBN: 1-58713-2036), contains all the labs from the curriculum plus additional challenge labs and study guide material. At the end of each chapter of this Companion Guide, icons indicate what hands-on activities, labs, and Packet Tracer activities are available in the Labs and Study Guide.



- **Lab and Activity references:** This icon notes the hands-on labs and other activities created for this chapter in the online curriculum. Within *Network Fundamentals, CCNA Exploration Labs and Study Guide*, you will also find additional labs and study guide material created by the authors of that book.
- **(NEW) Packet Tracer Companion activities:** Many of the hands-on labs include Packet Tracer Companion activities, where you can use Packet Tracer to complete a simulation of the lab. Look for this icon in *Network Fundamentals, CCNA Exploration Labs and Study Guide* for hands-on labs that have a Packet Tracer Companion.

Packet Tracer
□ Companion



- **(NEW) Packet Tracer Skills Integration Challenge activities:** These activities require you to pull together several skills learned from the chapter to successfully complete one comprehensive exercise. Look for this icon in *Network Fundamentals*, *CCNA Exploration Labs and Study Guide* for instructions on how to perform the Packet Tracer Skills Integration Challenge for this chapter.

A Word About Packet Tracer Software and Activities

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. Ask your instructor for access to Packet Tracer.

The course includes essentially three different types of Packet Tracer activities. This book uses an icon system to indicate which type of Packet Tracer activity is available to you. The icons are intended to give you a sense of the purpose of the activity and the amount of time you need to allot to complete it. The three types of Packet Tracer activities follow:



- **Packet Tracer Activity:** This icon identifies straightforward exercises interspersed throughout the chapters where you can practice or visualize a specific topic. The activity files for these exercises are available on the book’s CD-ROM. These activities take less time to complete than the Packet Tracer Companion and Challenge activities.



- **Packet Tracer Companion:** This icon identifies exercises that correspond to the hands-on labs of the course. You can use Packet Tracer to complete a simulation of the hands-on lab or complete a similar “lab.” The Companion Guide points these out at the end of each chapter, but look for this icon and the associated exercise file in *Network Fundamentals*, *CCNA Exploration Labs and Study Guide* for hands-on labs that have a Packet Tracer Companion.



- **Packet Tracer Skills Integration Challenge:** This icon identifies activities that require you to pull together several skills learned from the chapter to successfully complete one comprehensive exercise. The Companion Guide points these out at the end of each chapter, but look for this icon in *Network Fundamentals*, *CCNA Exploration Labs and Study Guide* for instructions on how to perform the Packet Tracer Skills Integration Challenge for this chapter.

How This Book Is Organized

This book covers the major topics in the same sequence as the online curriculum for the CCNA Exploration Network Fundamentals course. The online curriculum has 11 chapters for Network Fundamentals, so this book has 11 chapters with the same names and numbers as the online course chapters.

To make it easier to use this book as a companion to the course, the major topic headings in each chapter match, with just a few exceptions, the major sections of the online course chapters. However, the Companion Guide presents many topics in slightly different order inside each major heading. Additionally, the book occasionally uses different examples than the course. As a result, students get more detailed explanations, a second set of examples, and different sequences of individual topics, all to aid the learning process. This new design, based on research into the needs of the Networking Academies, helps typical students lock in their understanding of all the course topics.

Chapters and Topics

The book has 11 chapters, as follows:

- **Chapter 1, “Living in a Network-Centric World,”** presents the basics of communication and describes how networks support the way we live. This chapter introduces the concepts of data networks, scalability, quality of service (QoS), security issues, network collaboration tools, and Packet Tracer.
- **Chapter 2, “Communicating over the Network,”** introduces the devices, media, and protocols that enable network communication. This chapter introduces the OSI and TCP/IP models, the importance of addressing and naming schemes, and the process of data encapsulation. You also learn about the tools designed to analyze and simulate network functionality, such as Wireshark.
- **Chapter 3, “Application Layer Functionality and Protocols,”** introduces you to the top network model layer, the application layer. In this context, you will explore the interaction of protocols, services, and applications, with a focus on HTTP, DNS, DHCP, SMTP/POP, Telnet, and FTP.
- **Chapter 4, “OSI Transport Layer,”** focuses on the role of the transport layer as it provides the end-to-end transfer of data between applications. You learn how TCP and UDP apply to common applications.
- **Chapter 5, “OSI Network Layer,”** introduces the concepts of routing packets from a device on one network to a device on a different network. You learn important concepts related to addressing, path determination, data packets, and IP.

- **Chapter 6, “Addressing the Network: IPv4,”** focuses on network addressing in detail and 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 7, “OSI Data Link Layer,”** discusses how the OSI data link layer prepares network layer packets for transmission and controls access to the physical media. This chapter includes a description of the encapsulation processes that occur as data travels across the LAN and the WAN.
- **Chapter 8, “OSI Physical Layer,”** explores the functions, standards, and protocols associated with the physical layer (Layer 1). You discover how data sends signals and is encoded for travel across the network. You learn about bandwidth and also about the types of media and their associated connectors.
- **Chapter 9, “Ethernet,”** examines the technologies and operation of Ethernet. Topics include the evolution of Ethernet technologies, MAC, and Address Resolution Protocol (ARP).
- **Chapter 10, “Planning and Cabling Networks,”** focuses on designing and cabling a network. You will apply the knowledge and skills developed in the previous chapters to determine which cables to use, how to connect devices, and how to develop an addressing and testing scheme.
- **Chapter 11, “Configuring and Testing Your Network,”** describes how to connect and configure a small network using basic Cisco IOS commands for routers and switches.

This book also includes the following:

- **Appendix, “Check Your Understanding and Challenge Questions Answer Key,”** provides the answers to the Check Your Understanding questions that you find at the end of each chapter. It also includes answers for the challenge questions and activities that conclude most chapters.
- The **Glossary** provides a compiled list of all the key terms that appear throughout this book.

About the CD-ROM

The CD-ROM included with this book provides many useful tools and information to support your education:



- **Packet Tracer Activity files:** These are files to work through the Packet Tracer activities referenced throughout the book, as indicated by the Packet Tracer Activity icon.
- **Other files:** A couple files referenced in this book are on the accompanying CD-ROM:
VLSM_Subnetting_Chart.pdf
Exploration_Supplement_Structured_Cabling.pdf
- **Taking Notes:** This section includes a .txt file of the chapter objectives to serve as a general outline of the key topics of which you need to take note. The practice of taking clear, consistent notes is an important skill not only for learning and studying the material but for on-the-job success as well. Also included in this section is “A Guide to Using a Networker’s Journal” PDF booklet providing important insight into the value of the practice of using and organizing a professional journal and some best practices on what, and what not, to take note of in your journal.
- **IT Career Information:** This section includes a Student Guide to applying the toolkit approach to your career development. Learn more about entering the world of Information Technology as a career by reading two informational chapters excerpted from *The IT Career Builder’s Toolkit*: “Information Technology: A Great Career” and “Breaking into IT.”
- **Lifelong Learning in Networking:** As you embark on a technology career, you will notice that it is ever changing and evolving. This career path provides exciting opportunities to learn new technologies and their applications. Cisco Press is one of the key resources to plug into on your quest for knowledge. This section of the CD-ROM provides an orientation to the information available to you and tips on how to tap into these resources for lifelong learning.