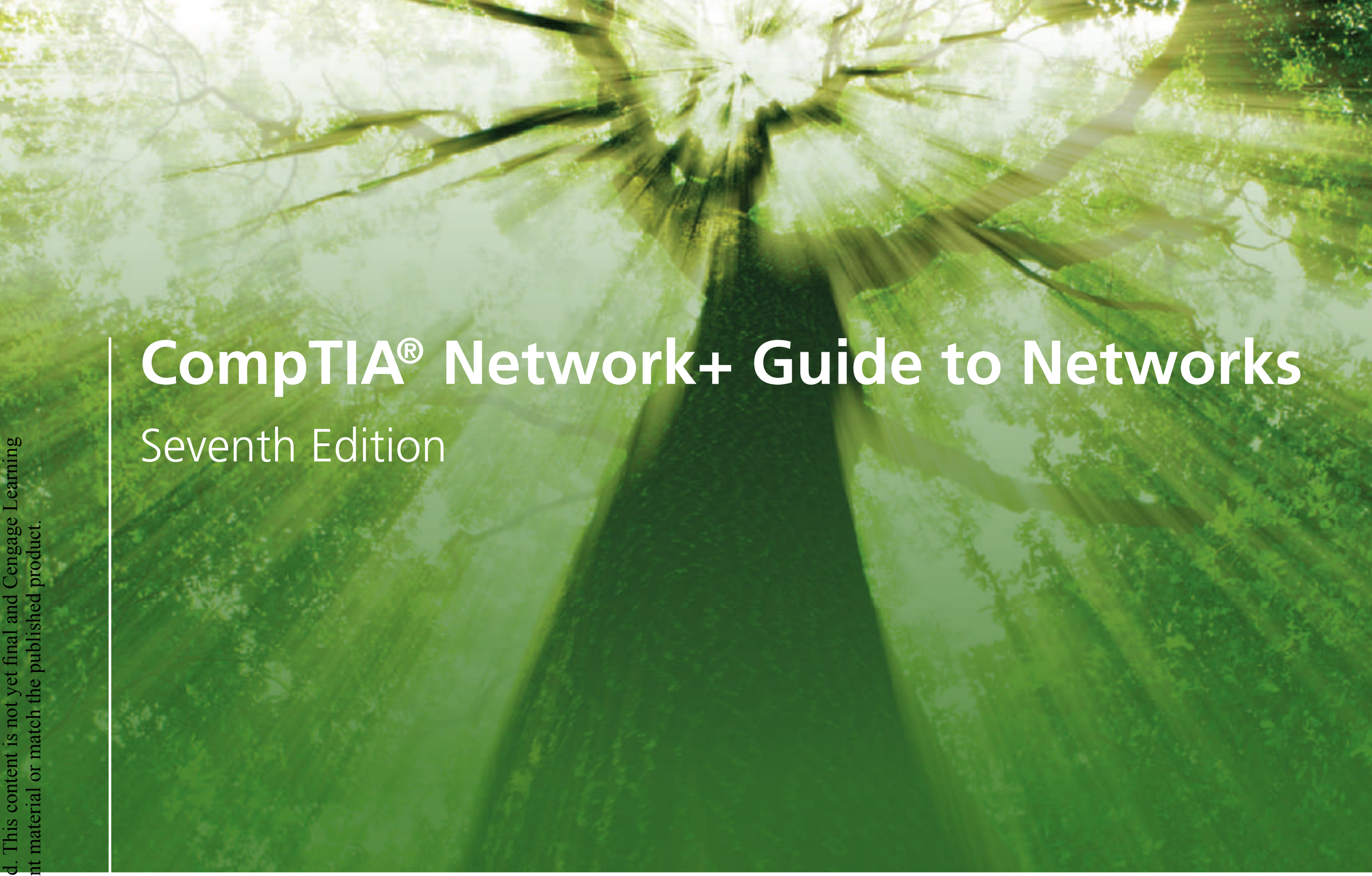

CompTIA® Network+ Guide to Networks

Seventh Edition

Jill West
Tamara Dean
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CompTIA® Network+ Guide to Networks, Seventh Edition
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Domain 2.0 Network operations—20% of Examination 645

Domain 3.0 Network security—18% of Examination 649

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Preface

Knowing how to install, configure, and troubleshoot a computer network is a highly marketable and exciting skill. This book first introduces the fundamental building blocks that form a modern network, such as protocols, media, topologies, and hardware. It then provides in-depth coverage of the most important concepts in contemporary networking, such as TCP/IP, Ethernet, wireless transmission, virtual networks, security, and troubleshooting. After reading this book and completing the end-of-chapter exercises, you will be prepared to select the best network design, hardware, and software for your environment. You will also have the skills to build a network from scratch and maintain, upgrade, troubleshoot, and manage an existing network. Finally, you will be well-prepared to pass CompTIA's Network+ N10-006 certification exam.

This book explains technical concepts logically and in a clear, approachable style. In addition, concepts are reinforced by real-world examples of networking issues from a professional's standpoint. Each chapter opens with an "On the Job" story from a network engineer, technician, or administrator. These real-world examples, along with Applying Concepts activities, Hands-On Projects, and Case Projects in each chapter, make this book a practical learning tool. The numerous tables and illustrations, along with the glossaries, appendices, and study questions, make the book a valuable reference for any networking professional.

Intended Audience

This book is intended to serve the needs of students and professionals who are interested in mastering fundamental, vendor-independent networking concepts. No previous networking experience is necessary to begin learning from this book, although knowledge of basic computer principles is helpful. Those seeking to pass CompTIA's Network+ certification exam will find the text's content, approach, and numerous study questions especially helpful. For more information on CompTIA® Network+ certification, visit CompTIA's Web site at *comptia.org*.

The book's pedagogical features are designed to provide a truly interactive learning experience, preparing you for the challenges of the highly dynamic networking industry. In addition to the information presented in the text, each chapter includes Applying Concepts activities and Hands-On Projects that guide you through software and hardware configuration in a step-by-step fashion. At the end of each chapter, you will also find Case Projects that place you in the role of problem solver, requiring you to apply concepts presented in the chapter to achieve a successful solution.

Chapter Descriptions

The following list summarizes the topics covered in each chapter of this book:

Chapter 1, "Introduction to Networking," begins by answering the question "What is a network?" Next, it presents the fundamental types of networks and describes the devices and topologies that create a network. This chapter also introduces the OSI model, best practices for safety when working with networks, and the seven-step troubleshooting model.

Chapter 2, "How Computers Find Each Other on Networks," describes addressing standards used by devices on a network and explains how host names and domain names work. It also discusses ports and sockets at the Transport layer and IP addresses at the Network layer. The chapter concludes with an introduction to commands used in troubleshooting networks.

Chapter 3, "How Data Is Transported Over Networks," describes the functions of the core TCP/IP protocols, as well as common IPv4 and IPv6 routing protocols. It also explains multiple TCP/IP utilities used for network discovery and troubleshooting.

Chapter 4, "Structured Cabling and Networking Elements," introduces best practices for managing network and cabling equipment, and explains issues related to managing power and the environment in which networking equipment operates. This chapter also describes characteristics of NIC and Ethernet interfaces, and explains how to create a network map that can be used in network troubleshooting.

Chapter 5, "Network Cabling," discusses basic data transmission concepts, including signaling, data modulation, multiplexing, bandwidth, baseband, and broadband. Next, it describes several Ethernet standards and compares the benefits and limitations of different networking media. The chapter explores connectors, converters, and couplers for each cabling type, and concludes with an examination of common cable problems and the tools used for troubleshooting those problems.

Chapter 6, "Wireless Networking," examines how nodes exchange wireless signals and identifies potential obstacles to successful wireless transmission. It describes WLAN (wireless LAN) architecture and specifies the characteristics of popular WLAN transmission methods. In Chapter 6, you will also learn how to install and configure wireless access points and clients, manage wireless security concerns, and evaluate common problems experienced with wireless networks.

Chapter 7, "Cloud Computing and Remote Access," identifies features and benefits of cloud computing and explains methods for remotely connecting to a network. It covers VPNs and their protocols as well as methods of encryption and user authentication. This chapter also helps you recognize symptoms of connectivity and security problems commonly encountered with remote connections.

Chapter 8, "Network Risk Management," covers common security needs and vulnerabilities of a network, including risks associated with people, hardware, software, and Internet access. Here you'll also learn the elements of an effective security policy and how to apply appropriate security measures and devices when designing a network. Finally, this chapter teaches you how to prevent and respond to malware infections.

Chapter 9, "Unified Communications and Network Performance Management," presents basic network management concepts and describes how to utilize system and event logs to evaluate, monitor, and manage network performance. It explores how unified communications, such as voice and video transmissions, affect a network's performance, and related quality of service issues. The chapter concludes with a discussion of network availability issues and options for network redundancy.

Chapter 10, "Network Segmentation and Virtualization," explores advanced concepts related to TCP/IP-based networking, such as subnetting, CIDR (Classless Interdomain Routing), and supernetting. It also explains virtualization and identifies characteristics of virtual network components. It describes techniques for incorporating virtual components into VLANs and explains advanced features of switches, including VLAN management. Chapter 10 concludes with a discussion on methods of combining VM and VLAN technologies.

Chapter 11, "Wide Area Networks," expands on your knowledge of networks by examining WAN (wide area network) topologies and characteristics, as well as connection and transmission methods, such as T-carriers, ISDN, DSL, broadband cable, and Metro Ethernet. It discusses wireless WAN technologies, such as WiMAX, HSPA+, LTE, and satellite communications, and concludes with an exploration of common problems with WAN connections.

Chapter 12, "Industrial and Enterprise Networking," describes significant components of an industrial control system or SCADA system. You'll also learn how to inventory and manage network assets, identify significant business documents, and create and follow appropriate change management procedures in an enterprise network environment. The chapter presents significant physical security controls, and then concludes by describing components of a reliable disaster recovery plan and a defensible incident response plan.

The four appendices at the end of this book serve as references for the networking professional:

Appendix A, "CompTIA Network+ N10-006 Certification Exam Objectives," provides a complete list of the latest CompTIA Network+ certification exam objectives, including the percentage of the exam's content that each domain represents and which chapters in the book cover material associated with each objective.

Appendix B, "Numbering Systems," teaches you step-by-step processes for manually converting between various numbering systems, as well as shortcut procedures for these conversions.

Appendix C, "Visual Guide to Connectors," provides a visual connector reference chart for quick identification of connectors and receptacles used in contemporary networking.

Appendix D, "CompTIA Network+ Practice Exam," offers a practice exam containing 100 questions similar in content and presentation to those you will find on CompTIA's Network+ examination.

New to This Edition

- Content maps completely to CompTIA's Network+ N10-006 exam for productive exam preparation.
- New arrangement of content consolidates similar concepts for efficient coverage, allowing for deeper investigation of particularly rich concepts and skills that are emphasized in the latest CompTIA Network+ N10-006 exam, including a stronger emphasis on security, troubleshooting, and virtualization, with added coverage of VLANs, industrial and enterprise networks, and fiber-optic technology.
- Interactive learning features throughout each chapter make essential information easily accessible and help in visualizing high-level concepts with insightful diagrams, useful tables for quick reference, and bulleted lists that present condensed information in easy-to-digest chunks.
- Applying Concepts activities embedded in each chapter help solidify concepts as you read through the chapter and provide immediate practice of relevant skills.
- OSI layer icons provide visual reinforcement of the link between concepts and the relevant layers of the OSI model.
- New and updated skills-based projects encourage hands-on exploration of chapter concepts.

Features

To aid you in fully understanding networking concepts, this book includes many features designed to enhance your learning experience.

Chapter Objectives—Each chapter begins with a list of the concepts to be mastered within that chapter. This list provides you with both a quick reference to the chapter's contents and a useful study aid.

On the Job stories—Each chapter begins with a story in a real-world context for the technology and concepts presented, giving you insight into a variety of modern computing environments from the various perspectives of many different professionals in the IT industry.

Applying Concepts activities—Embedded within each chapter are activities with step-by-step instructions to help you apply concepts as you learn them.

Illustrations, photos, tables, and bullet lists—Numerous full-color illustrations and photos of network media, methods of signaling, protocol behavior, hardware, topology, software screens, peripherals, and components help you visualize common network elements, theories, and concepts. In addition, the many tables and bulleted lists provide details and comparisons of both practical and theoretical information.

CompTIA Network+ Exam Tips and Notes—Each chapter's content is supplemented with Note features that provide additional insight and understanding, while CompTIA Network+ Exam Tips guide you in your preparations for taking the CompTIA Network+ certification exam.

Legacy Networking features—Older technology covered by the CompTIA Network+ exam provides historical reference to current technology.

Chapter Summaries—Each chapter's text is followed by a summary of the concepts introduced in that chapter. These summaries provide a helpful way to revisit the ideas covered in each chapter.

Review Questions—The end-of-chapter assessment begins with a set of review questions that reinforce the ideas introduced in each chapter. Many questions are situational. Rather than simply asking you to repeat what you've learned, these questions help you evaluate and apply the material you learned. Answering these questions will ensure that you have mastered the important concepts and provide valuable practice for taking CompTIA's Network+ exam.

Hands-On Projects—Although it is important to understand the theory behind networking technology, nothing can improve upon real-world experience. To this end, each chapter provides several Hands-On Projects aimed at providing you with practical software and hardware implementation experience as well as practice in applying critical thinking skills to the concepts learned throughout the chapter.

Case Projects—Each chapter concludes with two in-depth projects where you implement the skills and knowledge gained in the chapter through real design and implementation scenarios in a variety of computing environments. The Case Projects introduce you to a multitude of real-world software, hardware, and other solutions that increase your familiarity with these products in preparation for addressing workforce challenges.

Text and Graphic Conventions

Wherever appropriate, additional information and exercises have been added to this book to help you better understand the topic at hand. The following icons are used throughout the text to alert you to additional materials:

NOTE

The Note icon draws your attention to helpful material related to the subject being described.

NETWORK+ EXAM TIP

The CompTIA Network+ Exam Tip icon provides helpful pointers when studying for the exam.

7 APPLICATION
6 PRESENTATION
5 SESSION
4 TRANSPORT
3 NETWORK
2 DATA LINK
1 PHYSICAL

OSI model icons highlight the specific layers of the OSI model being discussed, and indicate when the layers of interest change throughout the chapter.

Enter
HANDS-ON PROJECTS

Each Hands-On Project in this book is preceded by both the Hands-On icon and a description of the project.

CASE PROJECTS

Case Project icons mark case projects, which are more in-depth assignments that require a higher level of concept application.

Network+

All of the content that relates to CompTIA's Network+ certification exam, whether it is a page or a sentence, is highlighted with a Network+ icon and the relevant objective number in the margin. This unique feature highlights the important information at a glance, so you can pay extra attention to areas of the certification material that you most need to study.

State of the Information Technology (IT) Field

Organizations depend on computers and information technology to thrive and grow. Globalization, or connecting with customers and suppliers around the world, is a direct result of the widespread use of the Internet. Rapidly changing technology further affects how companies do business and keeps the demand for skilled and certified IT workers strong across industries. Every sector of the economy requires IT professionals who can establish, maintain, troubleshoot, and extend their business systems.

Despite the economic downturn that began in 2007, employment in IT rebounded early and with vigor. The latest *Occupational Outlook Handbook* from the Bureau of Labor Statistics (part of the U.S. Department of Labor) reports that there were more than 365,000 network and computer systems administrator positions in 2012, the most recent year for which this information is available, with a predicted increase of 12 percent between 2012 and 2022 and the highest growth rate in positions related to cloud computing technology. Median pay for jobs in this sector is almost $73,000.

In any industry, a skilled workforce is important for continually driving business. Finding highly skilled IT workers can be a struggle for employers, given that technologies change approximately every two years. With such a quick product life cycle, IT workers must strive to keep up with these changes to continually bring value to their employers.

Certifications

Different levels of education are required for the many jobs in the IT industry. Additionally, the level of education and type of training required varies from employer to employer, but the need for qualified technicians remains a constant. As technology changes and advances in the industry evolve, many employers prefer candidates who already have the skills to implement these new technologies. Traditional degrees and diplomas do not identify the skills that a job applicant possesses. Companies are relying increasingly on technical certifications to adequately identify the quality and skill qualifications of a job applicant, and these certifications can offer job seekers a competitive edge over their competition.

Certifications fall into one of two categories: vendor-neutral and vendor-specific. Vendor-neutral certifications are those that test for the skills and knowledge required in specific industry job roles and do not subscribe to a vendor's specific technology solutions. Some examples of vendor-neutral certifications include all of the CompTIA certifications, Project Management Institute's certifications, and ISACA's certifications. Vendor-specific certifications validate the skills and knowledge necessary to be successful while utilizing a specific vendor's technology solution. Some examples of vendor-specific certifications include those offered by Microsoft, Red Hat, Oracle, and Cisco.

As employers struggle to fill open IT positions with qualified candidates, certifications are a means of validating the skill sets necessary to be successful within organizations. In most careers, salary and compensation are determined by experience and education, but in the IT field, the number and type of certifications an employee earns also determine salary and wage increases. For example, according to CompTIA, companies such as Dell, HP, Ricoh, Sharp, and Xerox recommend or require their networking technicians achieve CompTIA Network+ certification.

Certification provides job applicants with more than just a competitive edge over their noncertified counterparts competing for the same IT positions. Some institutions of higher education grant college credit to students who successfully pass certification exams, moving them further along in their degree programs. Certification also gives individuals who are interested in careers in the military the ability to move into higher positions more quickly. And many advanced certification programs accept, and sometimes require, entry-level certifications as part of their exams. For example, Apple accepts the CompTIA Network+ certification as part of one optional path for joining their Apple Consultants Network.

Career Planning

Finding a career that fits a person's personality, skill set, and lifestyle is challenging and fulfilling, but can often be difficult. What are the steps individuals should take to find that dream career? Is IT interesting to you? Chances are, that if you are reading this book, this question has already been answered. What is it about IT that you like? The world of work in the IT industry is vast. Some questions to ask yourself: Are you a person who likes to work alone, or do you like to work in a group? Do you like speaking directly with customers, or do you prefer to stay behind the scenes? Does your lifestyle encourage a lot of travel, or do you need to stay in one location? All of these factors influence your job decision. Inventory assessments are a good first step to learning more about you, your interests, work values, and abilities. A variety of Web sites can offer assistance with career planning and assessments.

What's New with CompTIA Network+ Certification

With its N10-006 Network+ exam, CompTIA has emphasized more hands-on experience and expanded the scope of the exam to include the latest network technologies. Objectives that used to require only identifying protocols, devices, and standards now require demonstrating an ability to install and configure connectivity devices or to apply protocols and standards. There's a stronger emphasis on security, virtualization, and troubleshooting. Some objectives have been added or expanded, such as coverage of fiber-optic technology, VLANs, and enterprise networks. A few older technologies have been dropped from the objectives. However, bear in mind that some legacy protocols and standards appear in the objectives' list of acronyms, and the CompTIA Network+ exam could refer to them.

As with the previous Network+ exam, the N10-006 version includes many scenario-based questions. Mastering, rather than simply memorizing, the material in this book will help you succeed on the exam and on the job.

Here are the domains covered on the new CompTIA Network+ exam:

Domain	% of Examination
Domain 1.0 Network architecture	22%
Domain 2.0 Network operations	20%
Domain 3.0 Network security	18%
Domain 4.0 Troubleshooting	24%
Domain 5.0 Industry standards, practices, and network theory	16%

How to Become CompTIA Certified

To become CompTIA certified, you must:

1. Select a testing center and a certification exam provider. For more information, visit the following Web site: *http://certification.comptia.org/getCertified/steps_to_certification.aspx*
2. Register for and schedule a time to take the CompTIA certification exam at a convenient location.
3. Take and pass the CompTIA certification exam.

For more information about CompTIA's certifications, please visit *http://certification.comptia.org/getCertified.aspx*

CompTIA is a nonprofit information technology (IT) trade association.

To contact CompTIA with any questions or comments, call 866-835-8020 or visit *http://certification.comptia.org/contact.aspx*. The Computing Technology Industry Association (CompTIA) is the voice of the world's information technology (IT) industry. Its members are the companies at the forefront of innovation and the professionals responsible for maximizing the benefits organizations receive from their investments in technology.

CompTIA is dedicated to advancing industry growth through its educational programs, market research, networking events, professional certifications, and public policy advocacy.

CompTIA is a not-for-profit information technology (IT) trade association. CompTIA's certifications are designed by subject matter experts from across the IT industry. Each CompTIA certification is vendor-neutral, covers multiple technologies, and requires demonstration of skills and knowledge widely sought after by the IT industry.

CompTIA

CompTIA Network+

Becoming a CompTIA Certified IT Professional is Easy

It's also the best way to reach greater professional opportunities and rewards.

Why Get CompTIA Certified?

Growing Demand

Labor estimates predict some technology fields will experience growth of over 20% by the year 2020.* CompTIA certification qualifies the skills required to join this workforce.

Higher Salaries

IT professionals with certifications on their resume command better jobs, earn higher salaries and have more doors open to new multi-industry opportunities.

Verified Strengths

91% of hiring managers indicate CompTIA certifications are valuable in validating IT expertise, making certification the best way to demonstrate your competency and knowledge to employers.**

Universal Skills

CompTIA certifications are vendor neutral—which means that certified professionals can proficiently work with an extensive variety of hardware and software found in most organizations.

Learn

Learn more about what the exam covers by reviewing the following:

- Exam objectives for key study points.
- Sample questions for a general overview of what to expect on the exam and examples of question format.
- Visit online forums, like LinkedIn, to see what other IT professionals say about CompTIA exams.

Certify

Purchase a voucher at a Pearson VUE testing center or at CompTIAstore.com.

- Register for your exam at a Pearson VUE testing center:
- Visit pearsonvue.com/CompTIA to find the closest testing center to you.
- Schedule the exam online. You will be required to enter your voucher number or provide payment information at registration.
- Take your certification exam.

Work

Congratulations on your CompTIA certification!

- Make sure to add your certification to your resume.
- Check out the CompTIA Certification Roadmap to plan your next career move.

Learn more: Certification.CompTIA.org/networkplus

* Source: CompTIA 9th Annual Information Security Trends study: 500 U.S. IT and Business Executives Responsible for Security
** Source: CompTIA Employer Perceptions of IT Training and Certification
*** Source: 2013 IT Skills and Salary Report by CompTIA Authorized Partner

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CompTIA Network+ Test Preparation Materials

CompTIA Network+ Guide to Networks, Seventh Edition is packed with tools to help students prepare for CompTIA's N10-006 Network+ exam, released in 2015. This book includes the Network+ icon in the margins highlighting relevant content, a table in Appendix A explaining where each exam objective is covered in the book, and a 100-question practice exam in Appendix D.

Instructor's Materials

Everything you need for your course is in one place! This collection of book-specific lecture and class tools is available online. Please visit *login.cengage.com* and log on to access instructor-specific resources on the Instructor Companion Site, which includes the Instructor's Manual, Solutions Manual, test creation tools, PowerPoint Presentations, Syllabus, and figure files.

- *Electronic Instructor's Manual*—The Instructor's Manual that accompanies this textbook includes additional instructional material to assist in class preparation, including suggestions for lecture topics.
- *Solutions Manual*—The instructor's resources include solutions to all end-of-chapter material, including Review Questions and Case Projects.
- *Cengage Learning Testing Powered by Cognero*—This flexible, online system allows you to do the following:
  - Author, edit, and manage test bank content from multiple Cengage Learning solutions.
  - Create multiple test versions in an instant.
  - Deliver tests from your LMS, your classroom, or wherever you want.

PowerPoint Presentations

This book comes with a set of Microsoft PowerPoint slides for each chapter. These slides are meant to be used as a teaching aid for classroom presentations, to be made available to students on the network for chapter review, or to be printed for classroom distribution. Instructors are also at liberty to add their own slides for other topics introduced.

Figure Files

All of the figures and tables in the book are reproduced. Similar to PowerPoint presentations, these are included as a teaching aid for classroom presentation, to make available to students for review, or to be printed for classroom distribution.

Total Solutions for CompTIA Network+

To access additional course materials, please visit *www.cengagebrain.com*. At the *CengageBrain.com* home page, search for the ISBN of your title (from the back cover of your book) using the search box at the top of the page. This will take you to the product page where these resources can be found. Additional resources include a MindTap, Lab Manual, CourseNotes, assessment, and digital labs.

Lab Manual for CompTIA Network+ Guide to Networks, Seventh Edition

This Lab Manual contains over 70 labs to provide students with additional hands-on experience and to help prepare for the CompTIA Network+ exam. The Lab Manual includes lab activities, objectives, materials lists, step-by-step procedures, illustrations, and review questions.

CourseNotes

This laminated quick reference card reinforces critical knowledge for the CompTIA Network+ exam in a visual and user-friendly format. CourseNotes serves as a useful study aid, as a supplement to the textbook, or as a quick reference tool during the course and afterward.

MindTap

MindTap is a personalized teaching experience with relevant assignments that guide students to analyze, apply, and improve thinking, allowing you to measure skills and outcomes with ease.

- *Personalized teaching*—Personalize your teaching with a Learning Path that is built with key student objectives. Control what students see and when they see it. Use it as is or match to your syllabus exactly—hide, rearrange, add, and create your own content.
- *Guide students*—Guide students with a unique Learning Path of relevant readings, multimedia, and activities that moves students up the learning taxonomy from basic knowledge and comprehension to analysis and application.
- *Promote better outcomes*—Empower instructors and motivate students with analytics and reports that provide a snapshot of class progress, time in course, engagement, and completion rates.

LabConnection

LabConnection provides powerful computer-based exercises, simulations, and demonstrations for hands-on, skills courses. It can be used as both a virtual lab and as a homework assignment tool, and provides automatic grading and student record maintenance. LabConnection maps directly to the textbook and provides remediation to the text and to the CompTIA Network+ certification exam. It includes the following features:

- *Enhanced comprehension*—Through LabConnection's guidance in the virtual lab environment, learners develop skills that are accurate and consistently effective.

- *Exercises*—LabConnection includes dozens of exercises that assess and prepare the learner for the virtual labs, establishing and solidifying the skills and knowledge required to complete the lab.
- *Virtual labs*—Labs consist of end-to-end procedures performed in a simulated environment where the student can practice the skills required of professionals.
- *Guided learning*—LabConnection allows learners to make mistakes but alerts them to errors made before they can move on to the next step, sometimes offering demonstrations as well.
- *Video demonstrations*—Video demonstrations guide the learners step-by-step through the labs, while providing additional insights to solidify the concepts.
- *Grades and record keeping*—LabConnection grades the exercises and records the completion status of the lab portion, easily porting to, and compatible with, distance learning platforms.

ExamConnection

The online testing system, ExamConnection, automatically grades students and keeps class and student records. ExamConnection tests against Cengage's textbook as well as against the CompTIA Network+ certification exam, including a quiz for each chapter in the book along with a midterm and final exam. ExamConnection is managed by the classroom instructor, who has 100 percent control, 100 percent of the time. It is hosted and maintained by dtiPublishing.

Web-Based Labs

Using a real lab environment over the Internet, students can log on anywhere, anytime via a Web browser to gain essential hands-on experience in networking using labs from *CompTIA® Network+ Guide to Networks, Seventh Edition*.

About the Authors

Jean Andrews has more than 30 years of experience in the computer industry, including more than 13 years in the college classroom. She has worked in a variety of businesses and corporations designing, writing, and supporting application software; managing a PC repair help desk; and troubleshooting wide area networks. She has written numerous books on software, hardware, and the Internet, including the best-selling *CompTIA A+ Comprehensive Guide to Managing and Maintaining Your PC, Eighth Edition*, *CompTIA A+ Guide to Hardware, Sixth Edition*, and *CompTIA A+ Guide to Software: Managing, Maintaining and Troubleshooting, Sixth Edition*. She lives in north Georgia.

Jill West brings a unique cross-section of experience in business, writing, and education to the development of innovative educational materials. She has taught multiple ages and content areas using a flipped classroom approach, distance learning, and educational counseling. Jill was instrumental in piloting a flipped classroom program for learning support courses at

North Georgia Technical College, and she has over a decade's experience working with Jean Andrews in textbook development. Jill and her husband Mike live in northwest Georgia where they homeschool their four children.

Tamara Dean has worked in the field of networking for nearly 20 years, most recently as a networking consultant, and before that, as the manager of Internet services and data center operations for a regional ISP. She has managed LANs at the University of Wisconsin and at a pharmaceutical firm, worked as a telecommunications analyst for the FCC, and cofounded a local radio station. Well published in networking, Ms. Dean also authored *Guide to Telecommunications Technology* for Cengage Learning.

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To the instructors and learners who use this book, we invite and encourage you to send suggestions or corrections for future editions. Please write to us at *jill.west@cengage.com*. We never ignore a good idea! And to instructors, if you have ideas for how to make a class in CompTIA Network+ preparation a success, please share your ideas with other instructors!

Dedication

This book is dedicated to the covenant of God with man on earth.

Jean Andrews, Ph.D.
Jill West

I'd like to say a personal thank you to the people in my life who make this work possible. To my children, Jessica, Sarah, Daniel, and Zack: Thank you for your patience and your hugs and kisses during the long work hours. To my husband, Mike: You mean the world to me. This is your accomplishment, too.

Jill West

Read This Before You Begin

The Applying Concepts activities, Hands-On Projects, and Case Projects in this book help you to apply what you have learned about computer networking. Although some modern networking components can be expensive, the projects aim to use widely available and moderately priced hardware and software. The following section lists the minimum hardware and software requirements that allow you to complete all the projects in this book. In addition to the following requirements, students must have administrator privileges on their workstations and, for some projects, on a second workstation, to successfully complete the projects.

Hardware Lab Requirements

- Each student workstation computer requires at least 1 GB of RAM, an Intel Pentium or compatible processor running at 500 MHz or faster, and a minimum of 500 MB of free space on the hard disk. Many projects also require workstations to have at least one installed NIC.
- Some projects require the use of a second workstation computer in order to create a network connection between computers. The second computer has the same minimum requirements as the first one.
- For installing computer equipment, students need a computer repair toolkit that includes a static mat and wrist guard, both flathead and Phillips screwdrivers, and a utility knife.
- For working with computer connectivity, each student needs a removable Ethernet NIC capable of 100-Mbps or faster throughput.
- For projects with physical transmission media, students require a workstation with a free PCI slot and a PCI NIC, plus a networking toolkit that includes the following cable-making supplies: at least 30 feet of Cat 5 or better cabling, at least six RJ-45 plugs, a wire cutter, a cable stripper, and a crimping tool.
- For configuring VLANs on a Cisco router, each class should have a router that runs the Cisco IOS or access to an emulator program and IOS image of a Cisco switch.
- For projects with wireless transmission, each class should have a wireless access point capable of 802.11g or 802.11n transmission and compatible wireless NICs for each student workstation.

- For implementing a basic client-server network, a class requires at least two Ethernet switches, each capable of 100-Mbps or faster throughput, and four or more Cat 5 or better straight-through patch cables that are each at least 3 feet long.

Software Lab Requirements

Most projects are written for workstations running either Windows 7, Windows 8.1, or a Linux operating system. Many include instructions for modifying the steps to work with computers running a different operating system than the one specified in that project. Software requirements include:

- Windows 7 or Windows 8.1 updated with the most current service packs for each student workstation
- The latest version of Ubuntu Desktop, which will be installed in a virtual environment
- Ubuntu Server operating system, which will be installed in a virtual environment
- The latest version of Chrome, Firefox, or Internet Explorer Web browser
- The latest version of WinZip file compression and expansion software
- The latest version of Adobe Acrobat Reader

To complete the virtual machine Case Projects, students will need Hyper-V on Windows 8.1 Professional, 64-bit version, or they can use Oracle VirtualBox on a Windows 7 or Windows 8.1 machine.