JON BUHAGIAR

CompTIA Network+

REVIEW GUIDE

Fourth Edition

Provides a focused, concise review of CompTIA Network+ Exam objectives and complements the Sybex *CompTIA Network+ Study Guide, Fourth Edition* and *CompTIA Network+ Deluxe Study Guide, Fourth Edition.*

Includes interactive online learning environment and study tools with:

+ 2 custom practice tests
+ 200 electronic flashcards
+ Searchable key term glossary

EXAM N10-007

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Network+®

Review Guide

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I dedicate this book to my wife Teresa and my son Joseph. I love you both.
—JAB

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About the Author

Jon Buhagiar, BS/ITM, MCSE, CCNA is an information technology professional with two decades of experience in higher education and the private sector.

Jon currently serves as Supervisor of Network Operations at Pittsburgh Technical College. In this role, he manages datacenter and network infrastructure operations and IT operations and is involved in strategic planning of IT projects supporting the quality of education at the college. He also serves as an adjunct instructor in the college's School of Information Technology department, where he teaches certification courses for Microsoft and Cisco certifications. Jon has taught as an instructor for 18 years with several colleges in the Pittsburgh area, since the introduction of the Windows NT MCSE in 1998.

Jon earned his BS in Information Technology Management from Western Governors University. He also achieved an Associates in Business Management from Pittsburgh Technical College. He has recently earned his Windows Server 2012 R2 MCSE as well as Cisco CCNA Routing & Switching certification. Other certifications include CompTIA Network+, A+, and Project+.

In addition to his professional and teaching roles, he has authored *CCNA Routing and Switching Practice Tests: Exam 100-105*, *Exam 200-105, and Exam 200-125* (Sybex, 2016). He has also served as the technical editor for the second edition of the *CompTIA Cloud+ Study Guide* (Sybex, 2016), *CCNA Security Study Guide: Exam 210-260* (Sybex, 2018), and *CCNA Cloud Complete Study Guide: Exam 210-451 and Exam 210-455* (Sybex, 2018). He has spoken at several conferences about spam and email systems. He is an active radio electronics hobbyist and has held a ham radio license for the past 16 years (KB3KGS). He experiments with electronics and has a strong focus on the Internet of Things (IoT).

Contents at a Glance

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CompTIA

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**

* 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

Introduction

You may be new to the field of computer networking, or perhaps you are in pursuit of proving your knowledge and understanding of computer networking. In either case, the CompTIA Network+ certification exam is a great start to your professional development. The Network+ certification is considered by employers industry-wide to be proof of the knowledge of networking theory, skill, and systems. The Network+ certification is granted to those individuals who have attained this information and show a basic competency for meeting the needs of both personal and organization computing environments.

The CompTIA Network+ objectives have changed with the introduction of the CompTIA Network+ N10-007 certification exam. This change in objectives and topics from the prior exam was necessary to keep up with the latest technologies used in networks today. The foundation of networking concepts have remained relatively similar, despite the introduction of more advanced technologies. This is one of the reasons the CompTIA Network+ exam is so widely valued by employers. As of this writing, the objectives are current for the Network+ N10-007 certification exam as stated by CompTIA (`https://www.comptia.org`).

What Is Network+ Certification?

The Computing Technology Industry Association (CompTIA) developed the Network+ certification to be vendor neutral and recognized industry-wide. The Network+ certification is considered the benchmark of networking theory. Candidates who earn the Network+ certification have knowledge of the design, operation, maintenance, security, and troubleshooting of networks. Employers worldwide recognize Network+ certified individuals as having a basic vendor-agnostic networking theory that can be applied to any specific system.

The Network+ certification was originally sponsored by IT industry leaders like IBM, Microsoft, and Compaq, among others. The goal was to create a certification that would give recognition of individuals with a basic theory of networking. Today, more complex networking theory is required by employers, and Network+ has evolved into a comprehensive exam. The CompTIA Network+ Exam N10-007 tests five domains of network theory:

- Network Concepts
- Infrastructure
- Network Operations
- Network Security
- Network Troubleshooting and Tools

For the latest pricing on the exam and updates to the registration procedures, go to `www.vue.com`. You can register online for the exam. If you have further questions about the scope of the exam or related CompTIA programs, refer to the CompTIA website at `www.comptia.org`.

Is This Book for You?

The *CompTIA Network+ Review Guide: Exam N10-007, Fourth Edition* is designed to be a complete, portable exam review guide that can be used either in conjunction with a more complete study program (such as Sybex's *CompTIA Network+ Study Guide: Exam N10-007*, computer-based training courseware, or a classroom/lab environment) or as an exam review for those who don't need more extensive test preparation. The goal of this book to thoroughly cover those topics you can expect to be tested on.

Perhaps you've been working with information technologies for many years. The thought of paying lots of money for a specialized IT exam preparation course probably doesn't sound too appealing. What can they teach you that you don't already know, right? Be careful, though—many experienced network administrators have walked confidently into the test center only to walk sheepishly out of it after failing an IT exam. I've run across many of these network administrators throughout my 20 years of teaching networking. After you've finished reading this book, you should have a clear idea of how your understanding of networking technologies matches up with the expectations of the Network+ test writers.

The goal of the Review Guide series is to help Network+ candidates brush up on the subjects on which they can expect to be tested on the Network+ exam. For complete in-depth coverage of the technologies and topics involved, we recommend *CompTIA Network+ Study Guide* from Sybex.

How Is This Book Organized?

This book is organized according to the official objectives list prepared by CompTIA for the Network+ Exam N10-007. The chapters correspond to the five major domains of objective and topic groupings. The exam is weighted across these five domains:

- Domain 1.0 Network Concepts (23 percent)
- Domain 2.0 Infrastructure (18 percent)
- Domain 3.0 Network Operations (17 percent)
- Domain 4.0 Network Security (20 percent)
- Domain 5.0 Network Troubleshooting and Tools (22 percent)

In each chapter, the top-level exam objective from each domain is addressed in turn. This discussion also contains an Exam Essentials section. Here you are given a short list of topics that you should explore fully before taking the test. Included in the Exam Essentials are notations on key pieces of information you should have gleaned from *CompTIA Network+ Review Guide: Exam N10-007, Fourth Edition*. At the end of each chapter you'll find the "Review Questions" section. These questions are designed to help you gauge your mastery of the content in the chapter.

Interactive Online Learning Environment and Test Bank

The interactive online learning environment that accompanies *CompTIA Network+ Review Guide: Exam N10-007, Fourth Edition* provides a test bank with study tools to help you prepare for the certification exam, and it increases your chances of passing it the first time. The test bank includes the following:

Sample Tests All of the questions in this book are provided, including the chapter review tests at the end of each chapter. In addition, there are two practice exams. Use these questions to test your knowledge of the review guide material. The online test bank runs on multiple devices.

Flashcards Flashcard questions are provided in digital flashcard format (a question followed by a single correct answer). You can use the flashcards to reinforce your learning and prepare last minute before the exam.

Other Study Tools A glossary of key terms from this book and their definitions is available as a fully searchable PDF.

Go to `http://www.wiley.com/go/netplustestprep` to register and gain access to this interactive online learning environment and test bank with study tools.

Tips for Taking the Network+ Exam

Here are some general tips for taking your exams successfully:

- Bring two forms of ID with you. One must be a photo ID, such as a driver's license. The other can be a major credit card or a passport. Both forms must include a signature.
- Arrive early at the exam center so you can relax and review your study materials, particularly tables and lists of exam-related information.
- Read the questions carefully. Don't be tempted to jump to an early conclusion. Make sure you know exactly what the question is asking.
- Don't leave any unanswered questions. Unanswered questions give you no opportunity for guessing correctly and scoring more points.
- There will be questions with multiple correct responses. When there is more than one correct answer, a message on the screen will prompt you to either "Choose two" or "Choose all that apply." Be sure to read the messages displayed so that you know how many correct answers you must choose.

- Questions needing only a single correct answer will use radio buttons for selecting an answer, whereas those needing two or more answers will use checkboxes.
- When answering multiple-choice questions you're not sure about, use a process of elimination to get rid of the obviously incorrect answers first. Doing so will improve your odds if you need to make an educated guess.
- On form-based tests (nonadaptive), because the hard questions will eat up the most time, save them for last. You can move forward and backward through the exam.
- For the latest pricing on the exams and updates to the registration procedures, visit CompTIA's website at `www.comptia.org`.

How to Contact the Publisher

Sybex welcomes feedback on all of its titles. Visit the Sybex website at `www.sybex.com` for book updates and additional certification information. You'll also find forms you can use to submit comments or suggestions regarding this or any other Sybex titles.

The Exam Objectives

The following are the areas (referred to as domains by CompTIA) in which you must be proficient in order to pass the Network+ exam:

Domain 1.0: Network Concepts This domain begins with the descriptions of several protocols you will encounter as a network professional. The OSI layers and their specific function and purpose are then covered. The domain explores the basic concepts and characteristics of routing and switching. IP addressing, subnetting, and VLSM are covered to support routing and efficient network design. The domain also describes the various network topologies for both wired and wireless networking, as well as the technologies that support the Internet of Things (IoT). The domain also explores wireless technologies, their characteristics, and various configurations. Cloud computing concepts according to the NIST definitions are covered. The domain concludes with various network services that support IP addressing and name resolution.

Domain 2.0: Infrastructure This domain covers the various cabling media, specifications, standards, connectors, and transceivers that you will encounter in network infrastructure. The domain explores the basic building blocks of network devices, such as firewalls, routers, switches, and more. The domain then covers more advanced network devices, such as wireless controllers, multilayer switches, VPN concentrators, and more. The domain also explores virtualization and network storage concepts found in many networks today to support private cloud computing. The domain concludes with the coverage of various WAN technologies that are used today, along with their characteristics and common media.

Domain 3.0: Network Operations This domain covers the various diagram and documentation components so that network operations can be documented properly. The domain then explores availability concepts such as high availability and fault tolerance to support the network and its components. Recovery of sites and data are also covered to support the concepts of recovery from failure. The topics of scanning, monitoring, and patching are examined to support the concepts of secure operations and overall monitoring. The topic of remote access methods is also explored so you can understand how network operations are supported remotely. This domain concludes with the coverage of policies and best practices to support network operations.

Domain 4.0: Network Security This domain focuses on security for both the physical and nonphysical aspects of network design and operations. This domain covers the various detection and prevention methods of security. It then explores authorization, authentication, and accounting theory and practice, along with the various factors of security and access control systems. Wireless security is also covered in its entirety to support secure wireless communications. The domain examines the various network attacks that you may encounter in a network. The domain concludes with hardening techniques and mitigation techniques so that security problems can be avoided.

Domain 5.0: Network Troubleshooting and Tools This domain covers the various troubleshooting methodologies used to diagnose problems in a network. It then explores the various hardware and software tools that you will use to diagnose problems in both wired and wireless networks. The domain covers both wired and wireless connectivity issues and performance-related issues that you may encounter in your daily operations. The domain concludes with real-world application of the tools and troubleshooting methodologies used to diagnose problems in a network.

The Network+ Exam Objectives

At the beginning of each chapter, I have included a complete listing of the topics that will be covered in that chapter. These topic selections are developed straight from the test objectives listed on CompTIA's website. They are provided for easy reference and to assure you that you are on track with learning the objectives. Note that exam objectives are subject to change at any time without prior notice and at CompTIA's sole discretion. Please visit the Network+ Certification page of CompTIA's website (`https://certification.comptia.org/certifications/network`) for the most current listing of exam objectives.

Chapter 1: Domain 1.0: Networking Concepts

1.1 Explain the purposes and uses of ports and protocols.

- Protocols and ports
  - SSH 22
  - DNS 53
  - SMTP 25
  - SFTP 22
  - FTP 20, 21
  - TFTP 69
  - TELNET 23
  - DHCP 67, 68
  - HTTP 80
  - HTTPS 443
  - SNMP 161
  - RDP 3389
  - NTP 123
  - SIP 5060, 5061
  - SMB 445
  - POP 110
  - IMAP 143
  - LDAP 389
  - LDAPS 636
  - H.323 1720
- Protocol types
  - ICMP
  - UDP
  - TCP
  - IP
- Connection-oriented vs. connectionless

1.2 Explain devices, applications, protocols and services at their appropriate OSI layers.

- Layer 7 – Application
- Layer 6 – Presentation

- Layer 5 – Session
- Layer 4 – Transport
- Layer 3 – Network
- Layer 2 – Data link
- Layer 1 – Physical

1.3 Explain the concepts and characteristics of routing and switching.

- Properties of network traffic
  - Collision domains
  - Broadcast domains
  - CSMA/CD
  - CSMA/CA
  - Protocol data units
  - MTU
  - Broadcast
  - Multicast
  - Unicast
- Segmentation and interface properties
  - VLANs
  - Trunking (802.1Q)
  - Tagging and untagging ports
  - Port mirroring
  - Switching loops/spanning tree
  - PoE and PoE+ (802.3af, 802.3at)
  - DMZ
  - MAC address table
  - ARP table
- Routing
  - Routing types
    - Static
    - Dynamic
    - Default

    - Routing protocols (IPv4 and IPv6)
        - Distance-vector routing protocols
            - RIP
            - EIGRP
        - Link-state routing protocols
            - OSPF
        - Hybrid
            - BGP
- IPv6 concepts
    - Addressing
    - Tunneling
    - Dual stack
    - Router advertisement
    - Neighbor discovery
- Performance concepts
    - Traffic shaping
    - QoS
    - Diffserv
    - CoS
- NAT/PAT
- Port forwarding
- Access control list
- Distributed switching
- Packet-switched vs. circuit-switched network
- Software-defined networking

1.4 Given a scenario, configure the appropriate IP addressing components.

- Private vs. public
- Loopback and reserved
- Default gateway
- Virtual IP
- Subnet mask
- Subnetting
    - Classful
        - Classes A, B, C, D, and E

    - Classless
        - VLSM
        - CIDR notation (IPv4 vs. IPv6)
- Address assignments
    - DHCP
    - DHCPv6
    - Static
    - APIPA
    - EUI64
    - IP reservations

1.5 Compare and contrast the characteristics of network topologies, types, and technologies.

- Wired topologies
    - Logical vs. physical
    - Star
    - Ring
    - Mesh
    - Bus
- Wireless topologies
    - Ad-hoc
    - Infrastructure
    - Mesh
- Types
    - LAN
    - WLAN
    - WAN
    - MAN
    - CAN
    - SAN
    - PAN
- Technologies that facilitate the Internet of Things (IoT)
    - Z-Wave
    - Ant+
    - Bluetooth

- NFC
- IR
- RFID
- 802.11

1.6 Given a scenario, implement the appropriate wireless technologies and configurations.

- 802.11 standards
  - b
  - a
  - g
  - n
  - ac
- Cellular
  - TDMA
  - CDMA
  - GSM
- Frequencies
  - 2.4GHz
  - 5.0GHz
- Speed and distance requirements
- Channel bandwidth
- Channel bonding
- MIMO/MU-MIMO
- Unidirectional/omnidirectional
- Site surveys

1.7 Summarize cloud concepts and their purposes.

- Types of services
  - SaaS
  - PaaS
  - IaaS
- Cloud delivery models
  - Private
  - Public
  - Hybrid

- Connectivity methods
- Security implications/considerations
- Relationship between local and cloud resources

1.8 Explain the functions of network services.

- DNS service
  - Record types
    - A, AAAA
    - TXT (SPF, DKIM)
    - SRV
    - MX
    - CNAME
    - NS
    - PTR
  - Internal vs. external DNS
  - Third-party/cloud-hosted DNS
  - Hierarchy
  - Forward vs. reverse zone
- DHCP service
  - MAC reservations
  - Pools
  - IP exclusions
  - Scope options
  - Lease time
  - TTL
  - DHCP relay/IP helper
- NTP
- IPAM

Chapter 2: Domain 2.0: Infrastructure

2.1 Given a scenario, deploy the appropriate cabling solution.

- Media types
  - Copper
    - UTP

        - STP
        - Coaxial
    - Fiber
        - Single-mode
        - Multimode
- Plenum vs. PVC
- Connector types
    - Copper
        - RJ-45
        - RJ-11
        - BNC
        - DB-9
        - DB-25
        - F-type
    - Fiber
        - LC
        - ST
        - SC
            - APC
            - UPC
            - MTRJ
- Transceivers
    - SFP
    - GBIC
    - SFP+
    - QSFP
    - Characteristics of fiber transceivers
        - Bidirectional
        - Duplex
- Termination points
    - 66 block
    - 110 block
    - Patch panel
    - Fiber distribution panel

- Copper cable standards
  - Cat 3
  - Cat 5
  - Cat 5e
  - Cat 6
  - Cat 6a
  - Cat 7
  - RG-6
  - RG-59
- Copper termination standards
  - TIA/EIA 568A
  - TIA/EIA 568B
  - Crossover
  - Straight-through
- Ethernet deployment standards
  - 100BaseT
  - 1000BaseT
  - 1000BaseLX
  - 1000BaseSX
  - 10GBaseT

2.2 Given a scenario, determine the appropriate placement of networking devices on a network and install/configure them.

- Firewall
- Router
- Switch
- Hub
- Bridge
- Modems
- Wireless access point
- Media converter
- Wireless range extender
- VoIP endpoint

2.3 Explain the purposes and use cases for advanced networking devices.

- Multilayer switch
- Wireless controller
- Load balancer
- IDS/IPS
- Proxy server
- VPN concentrator
- AAA/RADIUS server
- UTM appliance
- NGFW/Layer 7 firewall
- VoIP PBX
- VoIP gateway
- Content filter

2.4 Explain the purposes of virtualization and network storage technologies.

- Virtual networking components
  - Virtual switch
  - Virtual firewall
  - Virtual NIC
  - Virtual router
  - Hypervisor
- Network storage types
  - NAS
  - SAN
- Connection type
  - FCoE
  - Fibre Channel
  - iSCSI
  - InfiniBand
- Jumbo frame

2.5 Compare and contrast WAN technologies.

- Service type
  - ISDN
  - T1/T3

    - E1/E3
    - OC-3 – OC-192
    - DSL
    - Metropolitan Ethernet
    - Cable broadband
    - Dial-up
    - PRI
- Transmission mediums
    - Satellite
    - Copper
    - Fiber
    - Wireless
- Characteristics of service
    - MPLS
    - ATM
    - Frame relay
    - PPPoE
    - PPP
    - DMVPN
    - SIP trunk
- Termination
    - Demarcation point
    - CSU/DSU
    - Smart jack

Chapter 3: Domain 3.0: Network Operations

3.1 Given a scenario, use appropriate documentation and diagrams to manage the network.

- Diagram symbols
- Standard operating procedures/work instructions
- Logical vs. physical diagrams
- Rack diagrams
- Change management documentation
- Wiring and port locations