



# CCNP<sup>®</sup>

## Enterprise Certification

# STUDY GUIDE

**EXAM 350-401**

Includes one year of **FREE** access after activation to the  
interactive online learning environment and study tools:

**2 custom practice exams**

**100 electronic flashcards**

**Searchable key term glossary**

**BEN PIPER**

 **SYBEX<sup>®</sup>**  
A Wiley Brand



# **CCNP<sup>®</sup>**

## **Study Guide**





# CCNP®

## Enterprise Certification Study Guide



Ben Piper

Copyright © 2020 by John Wiley & Sons, Inc., Indianapolis, Indiana

ISBN: 978-1-119-65875-7

ISBN: 978-1-119-65882-5 (ebk.)

ISBN: 978-1-119-65880-1 (ebk.)

Manufactured in the United States of America

No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning or otherwise, except as permitted under Sections 107 or 108 of the 1976 United States Copyright Act, without either the prior written permission of the Publisher, or authorization through payment of the appropriate per-copy fee to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, (978) 750-8400, fax (978) 646-8600. Requests to the Publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, (201) 748-6011, fax (201) 748-6008, or online at <http://www.wiley.com/go/permissions>.

**Limit of Liability/Disclaimer of Warranty:** The publisher and the author make no representations or warranties with respect to the accuracy or completeness of the contents of this work and specifically disclaim all warranties, including without limitation warranties of fitness for a particular purpose. No warranty may be created or extended by sales or promotional materials. The advice and strategies contained herein may not be suitable for every situation. This work is sold with the understanding that the publisher is not engaged in rendering legal, accounting, or other professional services. If professional assistance is required, the services of a competent professional person should be sought. Neither the publisher nor the author shall be liable for damages arising herefrom. The fact that an organization or Web site is referred to in this work as a citation and/or a potential source of further information does not mean that the author or the publisher endorses the information the organization or Web site may provide or recommendations it may make. Further, readers should be aware that Internet Web sites listed in this work may have changed or disappeared between when this work was written and when it is read.

For general information on our other products and services or to obtain technical support, please contact our Customer Care Department within the U.S. at (877) 762-2974, outside the U.S. at (317) 572-3993 or fax (317) 572-4002.

Wiley publishes in a variety of print and electronic formats and by print-on-demand. Some material included with standard print versions of this book may not be included in e-books or in print-on-demand. If this book refers to media such as a CD or DVD that is not included in the version you purchased, you may download this material at <http://booksupport.wiley.com>. For more information about Wiley products, visit [www.wiley.com](http://www.wiley.com).

**Library of Congress Control Number:** 2020935632

**TRADEMARKS:** Wiley, the Wiley logo, and the Sybex logo are trademarks or registered trademarks of John Wiley & Sons, Inc. and/or its affiliates, in the United States and other countries, and may not be used without written permission. CCNP is a registered trademark of Cisco Technology, Inc. All other trademarks are the property of their respective owners. John Wiley & Sons, Inc. is not associated with any product or vendor mentioned in this book.

10 9 8 7 6 5 4 3 2 1

*I dedicate this book to the Lord Jesus Christ through Whom all things were  
created and in Whom all things hold together*





# Acknowledgments

I'd like to thank the following people who helped create this *CCNP Enterprise Certification Study Guide: Exam 350-401*. A special thanks to Kenyon Brown, senior acquisitions editor, for the opportunity to write this book. Thanks to John Sleeve, project editor, for pushing me to meet my deadlines. His suggestions and edits helped make this book more user friendly. Thanks also go to Christine O'Connor, production editor; Pete Gaughan, content enablement manager; and Louise Watson at Word One, proofreader.

Jon Buhagiar reviewed the chapters and questions for technical accuracy. His comments guided by his expertise helped make this book more practical, accurate, and well rounded.



# About the Author



**Ben Piper** is a networking and cloud consultant who has authored multiple books including the *AWS Certified Solutions Architect Study Guide: Associate SAA-C01 Exam, Second Edition* (Sybex, 2019), *AWS Certified Cloud Practitioner Study Guide: Foundational CLF-C01 Exam* (Sybex, 2019), and *Learn Cisco Network Administration in a Month of Lunches* (Manning, 2017). You can contact Ben by visiting his website <https://benpiper.com>.



# Contents at a Glance

<i>Introduction</i>	<i>xxi</i>
<i>Assessment Test</i>	<i>xxviii</i>
<b>Chapter 1</b>	Networking Fundamentals 1
<b>Chapter 2</b>	Spanning Tree Protocols 29
<b>Chapter 3</b>	Enterprise Network Design 67
<b>Chapter 4</b>	Wireless LAN (WLAN) 105
<b>Chapter 5</b>	Open Shortest Path First (OSPF) 135
<b>Chapter 6</b>	Enhanced Interior Gateway Routing Protocol (EIGRP) 171
<b>Chapter 7</b>	The Border Gateway Protocol (BGP) 197
<b>Chapter 8</b>	Network Address Translation and Multicast 233
<b>Chapter 9</b>	Quality of Service 275
<b>Chapter 10</b>	Network Virtualization 303
<b>Chapter 11</b>	Software-Defined Networking and Network Programmability 353
<b>Chapter 12</b>	Network Security and Monitoring 397
<b>Appendix</b>	Answers to Review Questions 443
<i>Index</i>	<i>463</i>



# Contents

*Introduction* *xxi*

*Assessment Test* *xxviii*

## **Chapter 1      Networking Fundamentals      1**

The OSI Model	2
The Upper Layers: Application, Presentation, and Session	4
Making Sense of Layers	4
The Lower Layers: Physical, Data Link, Network, and Transport	6
Layer 1: The Physical Layer	7
Layer 2: The Data Link Layer	8
A Brief History of Ethernet	8
The MAC Address Table	10
Maximum Transmission Unit	12
Subnet Limits	12
Layer 3: The Network Layer	13
Forwarding within a Subnet	14
Forwarding between Subnets	14
Address Resolution Protocol	16
Fragmentation	17
Routing vs. Forwarding	18
Layer 4: The Transport Layer	18
Transmission Control Protocol	19
Encapsulation and Decapsulation	21
Summary	22
Exam Essentials	22
Review Questions	24

## **Chapter 2      Spanning Tree Protocols      29**

The Need for Spanning Tree	31
VLANs and Trunking	32
Dynamic Trunking	34
Unconditional Trunking	35
Active and Allowed VLANs	36
Rapid Per-VLAN Spanning Tree	38
Electing the Root Bridge	38
Calculating the Root Ports	41
Calculating the Root Ports of Indirectly Connected Switches	44

Modifying Port Cost	46
Modifying Port Priority	47
Calculating Blocked Ports	48
Port States	49
Port Roles	49
Link Types	49
Multiple Spanning Tree	50
Root Bridges and Port Priority	52
Internal Spanning Tree	53
Native VLAN	54
Topology Change Detection	55
Spanning Tree Extensions	55
Root Guard	55
BPDU Guard and BPDU Filter	57
Unidirectional Link Detection	58
Loop Guard	58
Summary	58
Exam Essentials	59
Exercises	60
Review Questions	62
 <b>Chapter 3</b>	 <b>Enterprise Network Design</b>
	<b>67</b>
Physical Network Architectures	68
Comparing Campus and Data Center Networks	69
The Three-Tier Architecture	70
The Two-Tier Collapsed Core: A Cheaper Alternative	73
Layer 2 Design	74
Switched and Routed Interfaces	75
Switched Topologies	76
Routed Access Topology	81
EtherChannels	82
Load-Balancing Methods	83
Static EtherChannels	84
Port Aggregation Control Protocol	88
Link Aggregation Control Protocol	90
First-Hop Redundancy Protocols	91
Hot Standby Router Protocol	92
Virtual Router Redundancy Protocol	94
Gateway Load-Balancing Protocol	95
Summary	97
Exam Essentials	98
Review Questions	100



<b>Chapter 4</b>	<b>Wireless LAN (WLAN)</b>	<b>105</b>
	Radio Frequency Fundamentals	106
	Frequency and Amplitude	107
	Carrier Frequency	109
	Power Levels	110
	WLAN 802.11 Standards	115
	The Physical Layer: Frequencies and Channels	115
	Layer 2: 802.11 Media Access Control (MAC)	119
	Access Point Modes	124
	Autonomous	124
	Lightweight	124
	Wireless LAN Controller Selection Process	125
	Roaming and Location Services	126
	Roaming	126
	Location Services	128
	Summary	128
	Exam Essentials	129
	Review Questions	130
 <b>Chapter 5</b>	 <b>Open Shortest Path First (OSPF)</b>	 <b>135</b>
	Link-State Advertisements	136
	OSPF Areas	137
	LSA Types	137
	Neighbor Operations	141
	Configuring OSPF	142
	Configuring Area 0 on a Broadcast Network	142
	Viewing Neighbor Adjacencies	143
	Rigging the Designated Router Election	144
	Viewing and Understanding LSAs	146
	Authentication	154
	Passive Interfaces	158
	Injecting a Default Route	159
	Inter-Area Summarization	161
	Route Filtering	162
	Distribute Lists	162
	Summary	163
	Exam Essentials	164
	Exercises	164
	Review Questions	166

<b>Chapter 6</b>	<b>Enhanced Interior Gateway Routing Protocol (EIGRP)</b>	<b>171</b>
	EIGRP Fundamentals	172
	EIGRP Packet Types	172
	The Diffusing Update Algorithm (DUAL)	173
	Weighted Metrics	176
	Configuring EIGRP	178
	Equal Cost Multipathing	181
	Modifying Metrics	182
	Switching Types	186
	Unequal Cost Multipathing	187
	Summary	190
	Exam Essentials	190
	Exercises	191
	Review Questions	192
<b>Chapter 7</b>	<b>The Border Gateway Protocol (BGP)</b>	<b>197</b>
	BGP Fundamentals	198
	BGP AS Numbers	199
	BGP Session States	201
	Configuring BGP	202
	Advertising Prefixes	204
	Path Selection	205
	Route Redistribution among BGP, OSPF, and EIGRP	210
	Testing IP Reachability Using Tcl Scripts	214
	Troubleshooting	215
	Modifying Weight	218
	Advertising Summary Routes Using Route Aggregation	220
	Route Filtering Using Route Maps and Prefix Lists	222
	Summary	225
	Exam Essentials	226
	Exercises	226
	Review Questions	228
<b>Chapter 8</b>	<b>Network Address Translation and Multicast</b>	<b>233</b>
	Network Address Translation	234
	Address Types	234
	Static NAT	236
	Dynamic NAT	241
	NAT Overload with Port Address Translation	247
	Outside Static NAT	250
	Removing NAT Configurations	251

	Multicast	252
	IP Multicast	253
	LAN Multicast	253
	Multicast Routing	257
	Configuring PIM	258
	Configuring a Multicast Receiver	262
	IP Multicast and Ethernet	264
	Summary	265
	Exam Essentials	267
	Exercises	268
	Review Questions	270
<b>Chapter 9</b>	<b>Quality of Service</b>	<b>275</b>
	Understanding Quality of Service	276
	Classification and Marking	277
	Differentiated Services	277
	Layer 2 Marking	280
	Class Maps and Policy Maps	280
	Wireless QoS	281
	Policing	284
	Single-Rate, Two-Color Policing	284
	Single-Rate, Three-Color Policing	285
	Two-Rate Policing	287
	Queuing	288
	Class-Based Weighted Fair Queuing	288
	Low-Latency Queuing	293
	Explicit Congestion Notification	295
	Shaping	295
	Summary	297
	Exam Essentials	297
	Exercises	298
	Review Questions	299
<b>Chapter 10</b>	<b>Network Virtualization</b>	<b>303</b>
	Virtual Machines, Hypervisors, and Network Virtualization	304
	Virtual Machines and Server Virtualization	305
	Network Virtualization	307
	Generic Routing Encapsulation Tunnels	312
	Configuring a GRE Tunnel to Tunnel IPv4 and IPv6 over IPv4	312
	Recursive Routing	318
	IP Security	319
	Internet Key Exchange	320
	Encapsulating Security Payload	320

Configuring IPsec in Transport Mode with a GRE Tunnel	321
Configuring IPsec in Tunnel Mode	324
Location/ID Separation Protocol	326
LISP Terminology	328
Configuring LISP	328
Simulating IP Mobility	332
Is LISP a Routing Protocol?	334
Virtual Extensible Local Area Network	334
MAC Address Learning	335
Forwarding	335
Configuring VXLAN	336
VXLAN Control Planes	336
Configuring the Underlay	337
Configuring the Overlay	338
Configuring R1 and R2	339
Virtual Routing and Forwarding	340
Configuring a VRF	340
Configuring Multi-VRF EIGRP	342
Summary	345
Exam Essentials	345
Exercises	346
Review Questions	347
 <b>Chapter 11</b>	 <b>Software-Defined Networking and Network Programmability</b>
	<b>353</b>
What Is Software-Defined Networking?	355
Software-Defined Access	356
SD-Access Layers	357
Physical Layer	357
Network Underlay	358
Fabric Overlay	359
Controller Layer	363
Management Layer	364
Software-Defined WAN	369
vManage Network Management System	370
vSmart Controller	370
vBond Orchestrator	371
vEdge Routers	371
Network Programmability and Automation	372
The Cisco DNA Center Intent API	372
vManage REST API	379
NETCONF	383
Embedded Event Manager	386
Configuration Management Platforms	388

	Summary	391
	Exam Essentials	391
	Exercises	392
	Review Questions	393
<b>Chapter 12</b>	<b>Network Security and Monitoring</b>	<b>397</b>
	Infrastructure Security	398
	Device Access	399
	Authentication, Authorization, and Accounting	402
	Access Control Lists	407
	Control Plane Policing	412
	Cisco Security Products	414
	AnyConnect Secure Mobility Client	414
	Umbrella	414
	Advanced Malware Protection ThreatGrid	414
	Advanced Malware Protection for Endpoints	415
	Firepower Next-Generation Firewall	415
	TrustSec	416
	MAC Security	418
	Wireless Security	418
	WebAuth	418
	Configuring WPA2 with 802.1X	422
	Configuring 802.1X on the Client	422
	Configure Preshared Keys	424
	Monitoring	425
	Conditional Debugs	425
	Simple Network Management Protocol (SNMP)	425
	Syslog	426
	Network Time Protocol	428
	NetFlow and Flexible NetFlow	429
	Switched Port Analyzer	432
	IP Service Level Agreement	434
	Summary	436
	Exam Essentials	437
	Exercises	438
	Review Questions	439
<b>Appendix</b>	<b>Answers to Review Questions</b>	<b>443</b>
	Chapter 1: Networking Fundamentals	444
	Chapter 2: Spanning Tree Protocols	445
	Chapter 3: Enterprise Network Design	447
	Chapter 4: Wireless LAN (WLAN)	448
	Chapter 5: Open Shortest Path First (OSPF)	450

Chapter 6: Enhanced Interior Gateway Routing Protocol (EIGRP)	451
Chapter 7: The Border Gateway Protocol (BGP)	453
Chapter 8: Network Address Translation and Multicast	454
Chapter 9: Quality of Service	456
Chapter 10: Network Virtualization	457
Chapter 11: Software-Defined Networking and Network Programmability	459
Chapter 12: Network Security and Monitoring	460
<i>Index</i>	463

# Introduction

Networking is uniquely challenging in that it's not a single technology, but a collection of interdependent technologies that every other aspect of IT depends on. Without networking, there are no connected applications and that means there are no IT employees. Even if you're not sure that you want networking to become your permanent career, becoming an expert at networking will open the doors for other in-demand areas of IT, including security, software development, and cloud computing.

## Cisco's Professional Network Certifications

In 2019, Cisco announced updates to its Cisco Certified Network Professional (CCNP) certification program. There are six professional level certifications to choose from:

- CCNP Enterprise
- CCNP Data Center
- CCNP Security
- CCNP Service Provider
- CCNP Collaboration
- Cisco Certified DevNet Professional

Each certification requires passing one core exam and one concentration exam. The core exam for the CCNP Enterprise certification is 350-401 ENCOR, "Implementing Cisco Enterprise Network Core Technologies." The concentration exams let you focus on a specific specialty, such as routing, wireless, network design, automation, or software-defined networking (SDN). Regardless of the concentration exam you choose, you must pass the ENCOR exam to attain your CCNP Enterprise certification.

## Is CCNP Certification Right for You?

Many who attain the Cisco Certified Network Associate (CCNA) don't go on to pursue more advanced Cisco certifications. So why should you consider the CCNP Enterprise certification, and is it right for you? It may be right for you if

- You have a passion for networking.
- You want to set yourself apart as someone who has a passion for technology and isn't just in it for the money (although there is plenty of that!).
- You want to specialize in security, wireless, network automation, cloud, or software-defined networking.
- You enjoy tweaking the "nerd knobs" on individual technologies just to see what will happen.
- You love facing and overcoming the challenges of troubleshooting.

## Study Tips

Before taking the CCNP ENCOR exam, there are a few things to keep in mind. There's no reason that you can't pass the exam the first time. To help you do that, I want to share with you some study tips that have helped me pass several Cisco certification exams on the first try. One of the neglected skills required on any Cisco exam is speed. Being able to troubleshoot a 10-router Open Shortest Path First (OSPF) topology is good. Taking 15 minutes to do it is not so good. I can't stress enough the importance of spending quality time with the command-line interface (CLI). You should spend at least 50 percent of your study time on configuring and troubleshooting a variety of topologies and technologies.

There's an old Latin proverb that repetition is the mother of learning. Repetition—in terms of both study and practice—is going to be your best friend. Understanding networking requires making connections that aren't always obvious, and the more you practice and study, the more opportunities your mind has to make those connections. For years I've used SuperMemo (<https://super-memory.com>), a flashcard-like program that lets you create your own question-and-answer pairs, quizzes you, and shows you how well you're retaining the information. What makes SuperMemo superior to flashcards is that it identifies the information you've already retained, and it doesn't waste time continuing to quiz you on it. That means you can safely load your collection with hundreds of items while still using your time efficiently.

One last tip: As you read this study guide cover to cover, keep a running list of questions and things you're not sure about. Chances are if you find something confusing, a lot of other people did too, and that makes it good fodder for the exam. Be sure to visit <https://benpiper.com/encor> for book resources, updates, and errata.

## Prerequisites and Lab Requirements

The CCNA certification isn't required to attain the CCNP Enterprise certification. Nevertheless, I strongly recommend that you obtain your CCNA certification or the equivalent experience before embarking on your CCNP Enterprise journey. Refer to the CCNA exam blueprint ([www.cisco.com/c/en/us/training-events/training-certifications/certifications/associate/ccna.html](http://www.cisco.com/c/en/us/training-events/training-certifications/certifications/associate/ccna.html)) for a full list of topics you should already be familiar with. Because the CCNP Enterprise is a professional-level certification, I don't review some of the basics covered by the CCNA such as subnetting, IPv4, and IPv6 addressing.

You'll need a virtual or physical lab, which you should already have from your previous networking studies. Your lab should be able to support at least eight routers and two layer 3 switches running IOS version 15.2 or later. You should be able to configure your lab on your own by looking at layer 2 and layer 3 diagrams. Topology diagrams will be included in each chapter.

If your existing lab doesn't meet the requirement, Cisco Virtual Internet Routing Lab (<http://virl.cisco.com>) includes virtual machine images for a variety of switches and routers. These images are virtual machines that run using QEMU and are light on CPU and



memory, so you don't need a beast of a server to run simulations, although more resources always help. Other options, although not blessed by Cisco, are GNS3 (<https://gns3.com>) and EVE-NG ([www.eve-ng.net](http://www.eve-ng.net)).

## How to Use This Book

Hands-on experience is crucial for exam success. Each chapter in this study guide contains hands-on exercises that you should strive to complete during or immediately after your reading of the chapter. The exercises are there to test your understanding, and not to cover every possible permutation of configurations. The exercises are your foundation, and you should build on them by experimenting with them, breaking things, and then figuring out how to fix them.

Each chapter contains review questions to thoroughly test your understanding of the services and concepts covered in that chapter. They also test your ability to integrate the concepts with information from preceding chapters. I've designed the questions to help you realistically gauge your understanding and identify your blind spots. Once you complete the assessment in each chapter, referring to the answer key will give you not only the correct answers but a detailed explanation as to why they're correct. Even if you feel comfortable on a certain topic, resist the urge to skip over the pertinent chapter. I strongly encourage you to carefully read this book from cover to cover so that you can discover your strengths and weaknesses—particularly the ones you may not be aware of. Remember, even though you can't learn networking just by reading a book, it's equally true that you can't learn *without* reading a book.

The book also contains a self-assessment exam with 36 questions, two practice exams with 50 questions each to help you gauge your readiness to take the exam, and flashcards to help you learn and retain key facts needed to prepare for the exam.

## What Does This Book Cover?

This book covers topics you need to know to prepare for the CCNP ENCOR exam:

**Chapter 1: Networking Fundamentals** This chapter overviews the fundamentals of networking theory and network design.

**Chapter 2: Spanning Tree Protocols** This chapter covers Spanning Tree protocols, including Rapid Spanning Tree and Multiple Instance Spanning Tree. We also cover VLANs, trunking, and pruning.

**Chapter 3: Enterprise Network Design** In this chapter, you'll learn the advantages and disadvantages of different physical and layer 2 network designs. We also dive into EtherChannels and first-hop redundancy protocols.

**Chapter 4: Wireless LAN (WLAN)** This chapter explains the fundamentals of radio frequency, WLAN 802.11 standards, wireless security, and WLAN controller (WLC) design and deployment considerations.

**Chapter 5: Open Shortest Path First (OSPF)** In this chapter, you'll learn how to configure and troubleshoot OSPF adjacencies, authentication, route filtering, summarization, and more.

**Chapter 6: Enhanced Interior Gateway Routing Protocol (EIGRP)** This chapter covers advanced EIGRP concepts, including redistribution, multipathing, and path control.

**Chapter 7: The Border Gateway Protocol (BGP)** In this chapter, you'll learn all about BGP, including path selection, redistribution, summarization, and filtering.

**Chapter 8: Network Address Translation and Multicast** This two-for-the-price-of-one chapter gives you complete coverage of network address translation and multicast.

**Chapter 9: Quality of Service** This chapter covers QoS concepts, including queuing, policing, shaping, and classification.

**Chapter 10: Network Virtualization** This chapter dives deep into virtualization concepts such as server virtualization, network virtualization, generic routing encapsulation, IPsec, LISP, and VXLAN.

**Chapter 11: Software-Defined Networking and Network Programmability** In this chapter, you'll learn about Cisco's software-defined networking (SDN) solutions, SD-Access, Cisco DNA Center, and SD-WAN. You'll also learn about network automation tools such as Python, RESTCONF, NETCONF, Ansible, Chef, Puppet, and SaltStack.

**Chapter 12: Network Security and Monitoring** This chapter will show you how to implement infrastructure security best practices and wireless security configurations. You'll also learn about Cisco security products and how to monitor your network using NetFlow, IPSLA, debugs, Syslog, SNMP, and more.

## Interactive Online Learning Environment and Test Bank

The interactive online learning environment that accompanies this *CCNP Enterprise Certification Study Guide: Exam 350-401* provides a test bank with study tools to help you prepare for the certification exam—and increase your chances of passing it the first time! The test bank includes the following:

**Sample Tests** All the questions in this book are provided, including the assessment test at the end of this introduction and the chapter tests that include the review questions at the

end of each chapter. In addition, there are two practice exams with 50 questions each. Use these questions to test your knowledge of the study guide material. The online test bank runs on multiple devices.

**Flashcards** The online text banks include 100 flashcards specifically written to hit you hard, so don't get discouraged if you don't ace your way through them at first. They're there to ensure that you're really ready for the exam. And no worries—armed with the review questions, practice exams, and flashcards, you'll be more than prepared when exam day comes. 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 provide last-minute test prep before the exam.

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



Go to [www.wiley.com/go/sybextestprep](http://www.wiley.com/go/sybextestprep) to register and gain access to this interactive online learning environment and test bank with study tools.

## Exam Objectives

The CCNP ENCOR exam is intended for people who have experience implementing enterprise network technologies including IPv4 and IPv6 architecture, virtualization, monitoring, security, and automation. In general, you should have the following before taking the exam:

- A minimum of two years of hands-on experience configuring and troubleshooting routers and switches
- Ability to design and configure a network based on customer requirements
- Ability to provide implementation guidance
- A mastery of IPv4 and IPv6

The exam covers six different domains, with each domain broken down into objectives.

## Objective Map

The following table lists each domain and its weighting in the exam, along with the chapters in the book where that domain's objectives are covered.

Domain	Percentage of exam	Chapter
<b>Domain 1: Architecture</b>	<b>15%</b>	
1.1 Explain the different design principles used in an enterprise network		1, 3
1.2 Analyze design principles of a WLAN deployment		4
1.3 Differentiate between on-premises and cloud infrastructure deployments		11
1.4 Explain the working principles of the Cisco SD-WAN solution		11
1.5 Explain the working principles of the Cisco SD-Access solution		11
1.6 Describe concepts of wired and wireless QoS		9
1.7 Differentiate hardware and software switching mechanisms		1
<b>Domain 2: Virtualization</b>	<b>10%</b>	
2.1 Describe device virtualization technologies		10
2.2 Configure and verify data path virtualization technologies		10
2.3 Describe network virtualization concepts		10
<b>Domain 3: Infrastructure</b>	<b>30%</b>	
3.1 Layer 2		1, 2, 3
3.2 Layer 3		1, 5, 6, 7
3.3 Wireless		4
3.4 IP Services		3, 8, 12
<b>Domain 4: Network Assurance</b>	<b>10%</b>	
4.1 Diagnose network problems using tools such as debugs, conditional debugs, trace route, ping, SNMP, and syslog		12
4.2 Configure and verify device monitoring using syslog for remote logging		12

Domain	Percentage of exam	Chapter
4.3 Configure and verify NetFlow and Flexible NetFlow		12
4.4 Configure and verify SPAN/RSPAN/ERSPAN		12
4.5 Configure and verify IPSLA		12
4.6 Describe Cisco DNA Center workflows to apply network configuration, monitoring, and management		11
4.7 Configure and verify NETCONF and RESTCONF		11
<b>Domain 5: Security</b>	<b>20%</b>	
5.1 Configure and verify device access control		12
5.2 Configure and verify infrastructure security features		12
5.3 Describe REST API security		11
5.4 Configure and verify wireless security features		4, 12
5.5 Describe the components of network security design		4, 12
<b>Domain 6: Automation</b>	<b>15%</b>	
6.1 Interpret basic Python components and scripts		11
6.2 Construct valid JSON encoded file		11
6.3 Describe the high-level principles and benefits of a data modeling language, such as YANG		11
6.4 Describe APIs for Cisco DNA Center and vManage		11
6.5 Interpret REST API response codes and results in payload using Cisco DNA Center and RESTCONF		11
6.6 Construct EEM applet to automate configuration, troubleshooting, or data collection		11
6.7 Compare agent vs. agentless orchestration tools, such as Chef, Puppet, Ansible, and SaltStack		11

# Assessment Test

1. IP depends on which of the following?
  - A. Address Resolution Protocol
  - B. Data link layer
  - C. Network layer
  - D. Transport layer
2. Which is *not* a function of a bridge?
  - A. Simulating some properties of a shared physical Ethernet cable
  - B. MAC-based routing
  - C. Reducing the size of a broadcast domain
  - D. Frame check sequence validation
3. What are the purposes of TCP sequence numbers? (Choose two.)
  - A. Error control
  - B. Ordering
  - C. Flow control
  - D. Reliable delivery
4. Three switches are connected via 802.1Q trunk links. You need to prevent VLAN 25 traffic from reaching two of the switches. Which of the following can accomplish this? (Choose two.)
  - A. Prune VLAN 25 on the trunk links.
  - B. Use routed interfaces instead of trunks.
  - C. Configure Spanning Tree to block the ports to the switches.
  - D. Delete VLAN 25 on the switches.
5. Switch SW1 is running RPVST+ and is connected via a routed interface to SW2, which is running Multiple Spanning Tree. If you add VLAN 2 to both switches and map VLAN 2 to MST1 on SW2, which switch will necessarily be the root for VLAN 2?
  - A. SW1
  - B. SW2
  - C. The switch with the lowest bridge priority
  - D. Both SW1 and SW2
6. Which of the following can effectively prune a VLAN from a trunk?
  - A. BPDU Guard
  - B. BPDU Filter
  - C. Loop Guard
  - D. UDLD