CCNA 200-301

Hands-on Mastery with Packet Tracer

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RONALD WONG

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Anthony Sequeira (CCIE No. 15626) began his IT career in 1994 with IBM in Tampa, Florida. He quickly formed his own computer consultancy, Computer Solutions, and then discovered his true passion: teaching and writing about Microsoft and Cisco technologies. Anthony has lectured to massive audiences around the world while working for Mastering Computers. He has never been happier in his career than he is now as a senior technical instructor at ACI Learning. ACI is a leader in audit, cybersecurity, and IT pro training in self-paced and instructor-led formats. Follow Anthony today on X @compsolv or Facebook at facebook.com/compsolv.

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Dedications

This book is dedicated to the countless CCNA students I have enjoyed helping over the decades I have worked in this industry. Keep up the inspired work!

—Anthony

To my family, friends, and co-workers, who somewhat pretended to be interested every time I talked about this book I was co-writing. Thanks for faking it so well! Someone owes me 50 bucks!

—Ronald

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Thanks so much to Brett Bartow of Pearson for sharing our vision for this text. Also, huge thanks to Wes Bryan who meticulously edited every technical detail of this text.

Contents at a Glance

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Contents

Command Syntax Conventions

The conventions used to present command syntax in this book are the same conventions used in the IOS Command Reference. The Command Reference describes these conventions as follows:

- **Boldface** indicates commands and keywords that are entered literally as shown. In actual configuration examples and output (not general command syntax), boldface indicates commands that are manually input by the user (such as a **show** command).
- *Italic* indicates arguments for which you supply actual values.
- Vertical bars (|) separate alternative, mutually exclusive elements.
- Square brackets ([ ]) indicate an optional element.
- Braces ({ }) indicate a required choice.
- Braces within brackets ([{ }]) indicate a required choice within an optional element.

Preface

Why is this book so valuable? Why is it an excellent resource to use prior to taking the CCNA 200-301 exam? Let us outline it for you here:

- This book balances the two potential areas of expertise you need for each exam topic. You either need to focus on just the theory of a technology or you need to be able to demonstrate a comprehensive understanding of configuration, verification, and troubleshooting in addition to the theory. You can trust this text to guide you through the precise knowledge you need, topic by topic.
- As alluded to above, this text is tightly focused on the exam. Whereas larger texts might provide background or peripheral information about a topic, this book is laser-focused on just those topics you need to comprehend for success in the exam environment. I certainly encourage the reading and study of larger works for those who require it.
- We have specialized in writing about and training candidates in all things CCNA since the inception of the certification in 1998. This book's technical reviewer also possesses vast knowledge in networking and cloud topics.
- We have taken the actual CCNA exam each and every revision since the certification's inception. We are therefore intimately familiar with the exam as well as with Cisco's testing techniques.
- This book is filled with valuable resources to assist you immediately in getting a passing score; these resources include quizzes, review questions, practice exams, and, of course, many hands-on labs using the superb Packet Tracer tool.

Introduction

Welcome to *CCNA 200-301 Hands-on Mastery with Packet Tracer*! This book covers the newly updated CCNA 200-301 certification exam. This new "one CCNA exam to rule them all" is more important than ever before in Cisco's overall certification strategy. It covers the information you need to build a strong foundation for the varied CCNP certification tracks from Cisco Systems.

Whether this is your first or your fifteenth *CCNA textbook*, you'll find information here that will ensure your success as you pursue knowledge, experience, and certification. This Introduction covers how this text can help you prepare for the CCNA exam.

This Introduction discusses the basics of the CCNA exam. Included are sections covering preparation, how to take an exam, a description of this book's contents, how this book is organized, and, finally, author contact information.

Each chapter in this book contains practice questions. There are also two full-length Practice Exams at the end of the book. Practice Exams in this book should help you accurately assess the level of expertise you need in order to pass the test. Answers and explanations are included for all test questions. It is best to obtain a level of understanding equivalent to a consistent pass rate of at least 90% on the Review Questions and Practice Exams in this book before you take the real exam.

Let's begin by looking at preparation for the exam.

How to Prepare for the Exam

This text follows the official exam objectives closely to help ensure your success. The official objectives from Cisco Systems can be found at https://www.cisco.com/c/en/us/training-events/training-certifications/exams/current-list/ccna-200-301.html.

As you examine the numerous exam topics now covered on the CCNA exam, resist the urge to panic! This book you are reading will provide you with the knowledge (and confidence) you need to succeed in taking this new CCNA exam. You just need to make sure you read it and follow the guidance it provides throughout your CCNA journey.

Practice Questions

This book is filled with practice questions to get you ready. Enjoy the following:

- **Chapter pretest questions at the beginning of each and every chapter:** These detailed, open-ended questions ensure that you really know the material. Some readers use these questions to "test out of" reading a particular section.
- **Topic-based quizzes ending each section:** These quizzes provide a chance to demonstrate your knowledge after completing a section.
- **Review questions ending each chapter:** These questions give you a final pass through the material covered in the chapter.

- **Two full practice exams:** The answer keys for the practice exams include explanations and tips for approaching each practice exam question.
- **Packet Tracer practice labs:** Every chapter challenges you with Packet Tracer practice labs. You simply download these labs from the book's companion website. These labs evaluate your progress and grade you when you complete each lab. Working through the practice labs will give you the knowledge and confidence you need in the actual exam.

Taking a Certification Exam

When you have prepared for the CCNA 200-301 exam, you must register with Cisco Systems to take the exam. The CCNA exam is given at Pearson VUE testing centers. Check the Pearson VUE website at www.pearsonvue.com to get specific details.

You can register for an exam online or by phone. After you register, you will receive a confirmation notice. Some areas may have limited testing centers available, so you should schedule your exam in advance to make sure you can get the specific date and time you would like.

Note You can now take the CCNA exam from your home or office. If you choose this option, be sure to review the requirements to ensure that you have no issues taking your exam in the privacy of your home or office.

Arriving at the Exam Location

As with any other examination, you should arrive at the testing center early. Be prepared! You need to bring two forms of identification (one with a picture). The testing center staff requires proof that you are who you say you are and that someone else is not taking the test for you. Arrive early because if you are late, you will be barred from entry and will not receive a refund for the cost of the exam.

Note You'll be spending a lot of time in the exam room. Plan on using the full two hours of time allotted for your exam and surveys. Policies differ from location to location regarding bathroom breaks, so check with the testing center before beginning the exam.

In the Testing Center

You will not be allowed to take into the examination room study materials or anything else that could raise suspicion that you're cheating. This includes practice test material, books, exam prep guides, and other test aids. The testing center will provide you with scratch paper and a pen or pencil—or possibly an erasable whiteboard.

After the Exam

Examination results are available immediately after the exam. If you pass the exam, you will simply receive a passing grade; your exact score will not be provided. Candidates who do not pass will receive a complete score breakdown by domain. This allows those individuals to see what areas they are weak in.

About This Book

The ideal reader for this text is someone seeking the CCNA certification. However, it should be noted that this book is very easily readable, and it rapidly presents facts. Therefore, this book is also extremely useful as a quick reference manual.

This book includes other helpful elements in addition to the actual logical, step-by-step learning progression of the chapters themselves. *There are plenty of quiz and review questions as well as plenty of labs to ensure that you are fully comprehending the material as you go*. This text also includes a very helpful Glossary to assist you.

Note Bulleted lists, numbered lists, tables, and graphics are also used where appropriate. A picture can paint a thousand words sometimes, and tables can help to associate different elements with each other visually.

Remember that you do not have to build your own Packet Tracer labs when using this book. We have built them for you. Be sure to visit the companion website for this text in order to download the Packet Tracer labs.

The Exam Blueprint

The table that follows outlines the CCNA exam domains and objectives and maps each objective to the chapter in the book that covers it in detail.

Exam Domain	Objective	Chapter in Book That Covers It
Network Fundamentals	Explain the role and function of network components	Appendix A
Network Fundamentals	Describe characteristics of network topology architectures	Appendix A
Network Fundamentals	Compare physical interface and cabling types	Chapter 5
Network Fundamentals	Identify interface and cable issues	Chapter 5
Network Fundamentals	Compare TCP to UDP	Appendix A
Network Fundamentals	Configure and verify IPv4 addressing and subnetting	Chapter 6

Exam Domain	Objective	Chapter in Book That Covers It
Network Fundamentals	Describe the need for private IPv4 addressing	Chapter 6
Network Fundamentals	Configure and verify IPv6 addressing and prefix	Chapter 7
Network Fundamentals	Describe IPv6 address types	Chapter 7
Network Fundamentals	Verify IP parameters for Client OS	Chapter 6
Network Fundamentals	Describe wireless principles	Chapter 8
Network Fundamentals	Explain virtualization fundamentals	Appendix A
Network Fundamentals	Describe switching concepts	Chapter 9
Network Access	Configure and verify VLANs spanning multiple switches	Chapter 10
Network Access	Configure and verify interswitch connectivity	Chapter 10
Network Access	Configure and verify Layer 2 discovery protocols	Chapter 11
Network Access	Configure and verify EtherChannel	Chapter 10
Network Access	Interpret basic operations of Rapid PVST+ Spanning Tree Protocol	Chapter 12
Network Access	Describe Cisco Wireless Architectures and AP modes	Chapter 13
Network Access	Describe physical infrastructure connections of WLAN components	Chapter 13
Network Access	Describe network device management access connections	Appendix A
Network Access	Interpret the wireless LAN GUI configuration for client connectivity, such as WLAN creation, security settings, QoS profiles, and advanced settings	Appendix A
IP Connectivity	Interpret the components of a routing table	Chapter 14
IP Connectivity	Determine how a router makes a forwarding decision by default	Chapter 14
IP Connectivity	Configure and verify IPv4 and IPv6 static routing	Chapter 15
IP Connectivity	Configure and verify single area OSPFv2	Chapter 16

Exam Domain	Objective	Chapter in Book That Covers It
IP Connectivity	Describe the purpose, functions, and concepts of first hop redundancy protocols	Appendix A
IP Services	Configure and verify inside source NAT using static and pools	Chapter 17
IP Services	Configure and verify NTP operating in a client and server mode	Chapter 18
IP Services	Explain the role of DHCP and DNS within the network	Chapter 19
IP Services	Explain the function of SNMP in network operations	Chapter 20
IP Services	Describe the use of syslog features including facilities and levels	Chapter 20
IP Services	Configure and verify DHCP client and relay	Chapter 19
IP Services	Explain the forwarding per-hop behavior for QoS, such as classification, marking, queuing, congestion, policing, and shaping	Appendix A
IP Services	Configure network devices for remote access using SSH	Chapter 20
IP Services	Describe the capabilities and function of TFTP/FTP in the network	Chapter 20
Security Fundamentals	Describe key security concepts	Appendix A
Security Fundamentals	Describe security program elements	Appendix A
Security Fundamentals	Configure and verify device access control using local passwords	Chapter 21
Security Fundamentals	Describe security password policies elements, such as management, complexity, and password alternatives	Chapter 21
Security Fundamentals	Describe IPsec remote access and site-to-site VPNs	Appendix A
Security Fundamentals	Configure and verify access control lists	Chapter 22
Security Fundamentals	Configure and verify Layer 2 security features	Chapter 23
Security Fundamentals	Compare authentication, authorization, and accounting concepts	Appendix A

Exam Domain	Objective	Chapter in Book That Covers It
Security Fundamentals	Describe wireless security protocols	Chapter 24
Security fundamentals	Configure and verify WLAN within the GUI using WPA2 PSK	Chapter 24
Automation and Programmability	Explain how automation impacts network management	Appendix A
Automation and Programmability	Compare traditional networks with controller-based networking	Appendix A
Automation and Programmability	Describe controller-based, software-defined architecture	Appendix A
Automation and Programmability	Explain AI and machine learning in network operations	Appendix A
Automation and Programmability	Describe characteristics of REST-based APIs	Appendix A
Automation and Programmability	Recognize the capabilities of configuration management mechanisms, such as Ansible and Terraform	Appendix A
Automation and Programmability	Recognize components of JSON-encoded data	Appendix A

Other Book Elements

There are various important elements that are not part of the standard chapter format. These elements apply to the book as a whole.

- **Practice Exams:** In addition to including exam-preparation questions at the end of each chapter, this book provides two full Practice Exams.
- **Answers and explanations for practice exams:** An Answer Key follows each practice exam, providing answers to and explanations for the questions in the exams.
- **Glossary:** The Glossary defines important terms used in this book.
- **Companion website:** The companion website for this book allows you to access several digital assets that come with your book:
  - Pearson Test Prep software (both online and Windows desktop versions)
  - Key Terms Flash Cards application
  - A PDF version of the Command Reference
- The Packet Tracer Hands-On Labs

How to Access the Companion Website

Register this book to get access to the Pearson IT Certification test engine and other study materials, as well as additional bonus content. Be sure to check the box indicating that you would like to hear from us to receive updates and exclusive discounts on future editions of this product or related products.

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Step 3. Answer the challenge question as proof of purchase.

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Please note that many of our companion content files can be very large, especially image and video files.

If you are unable to locate the files for this title by following the steps above, please visit www.ciscopress.com/support. Our customer service representatives will assist you.

Pearson Test Prep Practice Test Software

As noted previously, this book comes complete with the Pearson Test Prep practice test software, containing two full exams. These practice tests are available to you either online or as an offline Windows application. To access the practice exams that were developed with this book, please see the instructions below.

How to Access the Pearson Test Prep (PTP) App

You have two options for installing and using the Pearson Test Prep application: a web app and a desktop app. To use the Pearson Test Prep application, start by finding the registration code that comes with the book. You can find the code in these ways:

- You can get your access code by registering the print ISBN (9780135313091) on ciscopress.com/register. Make sure to use the print book ISBN regardless of whether you purchased an eBook or the print book. After you register the book, your access code will be populated on your account page under the Registered Products tab. Instructions for how to redeem the code are available on the book's companion website by clicking the Access Bonus Content link.

Note After you register your book, your code can always be found in your account on the Registered Products tab.

Once you have the access code, to find instructions about both the Pearson Test Prep web app and the desktop app, follow these steps:

Step 1. Open this book's companion website, as shown earlier in this Introduction, under the heading, "How to Access the Companion Website."

Step 2. Click the **Practice Test Software** button.

Step 3. Follow the instructions listed there for both installing the desktop app and using the web app.

Note that if you want to use the web app only at this point, just navigate to pearsontestprep.com, log in using the same credentials used to register your book, and register this book's practice tests using the registration code you just found. The process should take only a couple of minutes.

Customizing Your Exams

When you are in the exam settings screen, you can choose to take exams in one of three modes:

- **Study mode:** Allows you to fully customize your exams and review answers as you are taking the exam. This is typically the mode you would use first to assess your knowledge and identify information gaps.
- **Practice Exam mode:** Locks certain customization options, as it is presenting a realistic exam experience. Use this mode when you are preparing to test your exam readiness.
- **Flash Card mode:** Strips out the answers and presents you with only the question stem. This mode is great for late-stage preparation when you really want to challenge yourself to provide answers without the benefit of seeing multiple-choice options. This mode does not provide the detailed score reports that the other two modes do, so you should not use it if you are trying to identify knowledge gaps.

In addition to these three modes, you will be able to select the source of your questions. You can choose to take exams that cover all of the chapters, or you can narrow your selection to just a single chapter or the chapters that make up specific parts in the book. All chapters are selected by default. If you want to narrow your focus to individual chapters, simply deselect all the chapters; then select only those on which you wish to focus in the Objectives area.

You can also select the exam banks on which to focus. Each exam bank comes complete with a full exam of questions that cover topics in every chapter. You can have the test engine serve up exams from all banks or just from one individual bank by selecting the desired banks in the exam bank area.

There are several other customizations you can make to your exam from the exam settings screen, such as the time of the exam, the number of questions served up, whether to randomize questions and answers, whether to show the number of correct answers for multiple-answer questions, and whether to serve up only specific types of questions. You can also create custom test banks by selecting only questions that you have marked or questions on which you have added notes.

Updating Your Exams

If you are using the online version of the Pearson Test Prep software, you should always have access to the latest version of the software as well as the exam data. If you are using the Windows desktop version, every time you launch the software while connected to the Internet, it checks if there are any updates to your exam data and automatically downloads any changes that were made since the last time you used the software.

Sometimes, due to many factors, the exam data may not fully download when you activate your exam. If you find that figures or exhibits are missing, you may need to manually update your exams. To update a particular exam you have already activated and downloaded, simply click the **Tools** tab and click the **Update Products** button. Again, this is only an issue with the desktop Windows application.

If you wish to check for updates to the Pearson Test Prep exam engine software, Windows desktop version, simply click the **Tools** tab and click the **Update Application** button. This ensures that you are running the latest version of the software engine.

Packet Tracer Hands-On Labs

Remember, the Packet Tracer labs are available for download from the companion website for this book.

If you do not have Packet Tracer (or if you have an older version that does not work with our files), be sure to register and download the latest free version from Cisco Networking Academy (https://www.netacad.com). As of this writing, Packet Tracer is available at https://skillsforall.com. Chapter 1 of this text walks you through the download and installation of this powerful network simulator.

Once you have Packet Tracer installed, you can simply double-click one of the PKA files to launch the topology and preexisting configurations in your version of Packet Tracer.

Contacting the Authors

Hopefully, this book provides you with the tools you need to pass the CCNA exam. Feedback is appreciated. You can contact the authors at ptracerbook@ajsnetworking.com.

Thank you for selecting our book; we have worked hard to apply the same concepts in this book that we have used in the hundreds of training classes we have taught. Spend your study time wisely and you, too, can become a CCNA. Good luck with the exam, although if you carefully work through this text, you will certainly minimize the amount of luck required!

Credits

Cover: simonkr/E+/Getty Images

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Chapter 16

Configure and Verify Single Area OSPFv2

This chapter covers the following official CCNA 200-301 exam topic:

- Configure, verify, and troubleshoot single area OSPFv2 for IPv4

This chapter ensures that you understand OSPFv2 for the CCNA 200-301 exam from Cisco Systems. It is wonderful to see Cisco Systems finally bidding farewell to RIP when it comes to dynamic routing protocol coverage in the CCNA exam. Instead, the focus now is on a very scalable, exciting, and popular modern routing protocol option: OSPF version 2. This is the OSPF version designed for IPv4.

This chapter covers the following essential terms and components:

- OSPFv2
- **`network`** command
- Process ID
- Router ID
- Designated router (DR)
- Backup designated router (BDR)
- Point-to-point network type
- Broadcast network type
- Point-to-multipoint network type
- Non-broadcast network type
- Point-to-multipoint non-broadcast network type

Chapter Pretest

1. What aspect of OSPF makes the protocol hierarchical and permits the creation of very scalable networks?

   _____

2. What single OSPF router configuration command allows the assignment of OSPF area 0 to all interfaces in the range 10.0.0.0 to 10.255.255.255?

   _____

Answers

1. OSPF areas
2. `network 10.0.0.0 0.255.255.255 area 0`

Configure, Verify, and Troubleshoot Single Area OSPFv2 for IPv4

Open Shortest Path First (OSPF) is a beloved link-state routing protocol that is extremely configurable and scalable. It uses *areas* to reduce the size of convergence domains in the topology and ensure that scalability can be maintained. Remember that a convergence domain describes the set of routers that need to update their routing information whenever there is a change within that set.

OSPF version 2 is the current IPv4-only version of OSPF. OSPF version 3 is a standard for routing either IPv4 or IPv6 or both IPv4 and IPv6 simultaneously.

Figure 16.1 shows a sample topology, and Example 16.1 shows the configuration of OSPF in a single area of this topology, using the **`network`** command.

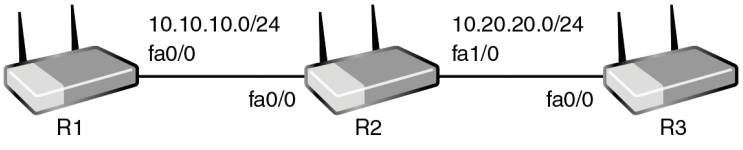

Figure 16.1 *Sample OSPF Topology*

Example 16.1 *Configuring Single Area OSPFv2 Using the* `network` *Command*

```
R1#
R1# configure terminal
R1(config)# router ospf 1
R1(config-router)# network 10.10.10.1 0.0.0.0 area 0
R1(config-router)# network 1.1.1.1 0.0.0.0 area 0
R1(config-router)# end
```

```
R1#
R2#
R2# configure terminal
R2(config)# router ospf 1
R2(config-router)# network 10.0.0.0 0.255.255.255 area 0
R2(config-router)# network 2.2.2.2 0.0.0.0 area 0
R2(config-router)# end
R2#
R3#
R3# configure terminal
R3(config)# router ospf 1
R3(config-router)# network 10.20.20.3 0.0.0.0 area 0
R3(config-router)# network 3.3.3.3 0.0.0.0 area 0
R3(config-router)# end
R3#
```

Notice the following details in the configuration in Example 16.1:

- **`router ospf 1:`** This command enters router configuration mode for OSPFv2 and sets a process ID of 1; this number is locally significant and does not need to match on the neighboring router.
- **`network 10.10.10.1 0.0.0.0 area 0:`** The **`network`** command sets the interface(s) that will run OSPF for this process; note that the wildcard mask 0.0.0.0 indicates that OSPF will run on the specific interface that has the IP address 10.10.10.1 (fa0/0); notice also that this interface participates in area 0, which is the backbone or core area for OSPF; all other areas must have contact with this backbone.

Example 16.2 shows how to easily verify OSPF.

Example 16.2 *Verifying Single Area OSPF*

```
R1#
R1# show ip ospf neighbor
Neighbor ID  Pri    State      Dead Time Address   Interface
2.2.2.2       1      FULL/BDR  00:00:37   10.10.10.2 FastEthernet0/0
R1# show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
        i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
        o - ODR, P - periodic downloaded static route, + - replicated route
```

```
Gateway of last resort is not set

    1.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       1.1.1.0/24 is directly connected, Loopback0
L       1.1.1.1/32 is directly connected, Loopback0
    2.0.0.0/32 is subnetted, 1 subnets
O       2.2.2.2 [110/2] via 10.10.10.2, 00:32:13, FastEthernet0/0
    3.0.0.0/32 is subnetted, 1 subnets
O       3.3.3.3 [110/3] via 10.10.10.2, 00:19:12, FastEthernet0/0
    10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
C       10.10.10.0/24 is directly connected, FastEthernet0/0
L       10.10.10.1/32 is directly connected, FastEthernet0/0
O       10.20.20.0/24 [110/2] via 10.10.10.2, 00:32:33, FastEthernet0/0
R1# ping 3.3.3.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max &#61; 20/52/64 ms
R1#
```

Example 16.2 includes the following commands:

- **`show ip ospf neighbor:`** This command permits you to verify that you have an OSPF adjacency with your neighbor(s).
- **`show ip route:`** This command permits you to see the OSPF learned route information.
- **`ping 3.3.3.3:`** This command tests for full reachability; notice in Example 16.2, the R1 device is pinging an OSPF learned route from R3.

Note Several parameters must match in order for an OSPF neighborship to form:

- The area ID
- Authentication settings
- Hello and dead intervals
- Stub flag
- MTU size

The hello and dead intervals are manipulated in interface configuration mode with the following commands:

```
(config-if)# ip ospf hello-interval 10
(config-if)# ip ospf dead-interval 30
```

The values used here indicate seconds.

Example 16.3 demonstrates single area OSPF configuration without the use of the **network** command.

Example 16.3 *Configuring Single Area OSPF Without the Use of the* `network` *Command*

```
R1#
R1# configure terminal
R1(config)# interface fa0/0
R1(config-if)# ip ospf 1 area 0
R1(config-if)# interface lo0
R1(config-if)# ip ospf 1 area 0
R1(config-if)# end
R1#
R2#
R2# configure terminal
R2(config)# interface fa0/0
R2(config-if)# ip ospf 1 area 0
R2(config-if)# interface fa1/0
R2(config-if)# ip ospf 1 area 0
R2(config-if)# interface loopback 0
R2(config-if)# ip ospf 1 area 0
R2(config-if)# end
R2#
R3#
R3# configure terminal
R3(config)# interface fa0/0
R3(config-if)# ip ospf 1 area 0
R3(config-if)# interface loopback 0
R3(config-if)# ip ospf 1 area 0
R3(config-if)# end
R3#
```

Notice how simple it is to configure OSPF under the appropriate interfaces. As you can see, you do not have to enter OSPF router configuration mode at all for a basic configuration.

If you examine the **show ip ospf neighbor** command closely, you will notice some very interesting details in the output. First, note that the neighbor ID is listed. In Example 16.2, the neighbor ID value is `2.2.2.2`. This is actually the router ID value for the OSPF speaker. This value is very important for various functions in OSPF. In fact, the router ID can be used in the election process of the DR and BDR devices in certain types of OSPF network configurations. This concept is discussed later in this chapter.

You can manually set a router ID for an OSPF router by using the **router-id** command, or you can allow the router to self-assign this value. How does the router choose its own router ID? It follows this order:

1. Use the manually configured router ID (if you configured it).
2. Use the numerically highest IP address on a loopback interface.
3. Use the numerically highest IP address on a non-loopback interface.

The **show ip ospf neighbor** command also indicates the current state of the neighbor. If you examine the output shown in Example 16.2, you will notice the state listed as FULL/BDR.

OSPF uses the following states in its operation in order to build and maintain neighbor relationships:

- Down
- Attempt
- Init
- 2-Way
- Exstart
- Exchange
- Loading
- Full

If there is a problem with a configuration or the underlying network, you might run your neighbor verification command and learn that your OSPF routers are stuck in one of the states that was supposed to be a transition state from Down to Full. Obviously, such information can help you dramatically in your troubleshooting.

What about the BDR indication in the output in Example 16.2? This indicates that the peer router is fulfilling the role of the backup designated router (BDR). The designated router (DR) and the BDR are used in certain types of network configurations for OSPF. They try to make the operation of OSPF more efficient by reducing the number of advertisements that must be made when sharing network information. Here is a list of the network types that are possible in OSPF and whether each one uses a DR and BDR in the operations of the protocol:

- **Broadcast:** DR/BDR used
- **Non-broadcast:** DR/BDR used
- **Point-to-point:** No DR/BDR
- **Point-to-multipoint:** No DR/BDR
- **Point-to-multipoint non-broadcast:** No DR/BDR

Lab 16.1: OSPFv2

To complete this Hands-On Lab Practice Assignment, download the assigned Packet Tracer file from the book's companion website and perform the lab on your locally installed version of Packet Tracer. You will be following the instructions in the lab, and your performance will be evaluated.

In this lab, you will configure and verify OSPFv2 using the topology shown in Figure 16.2.

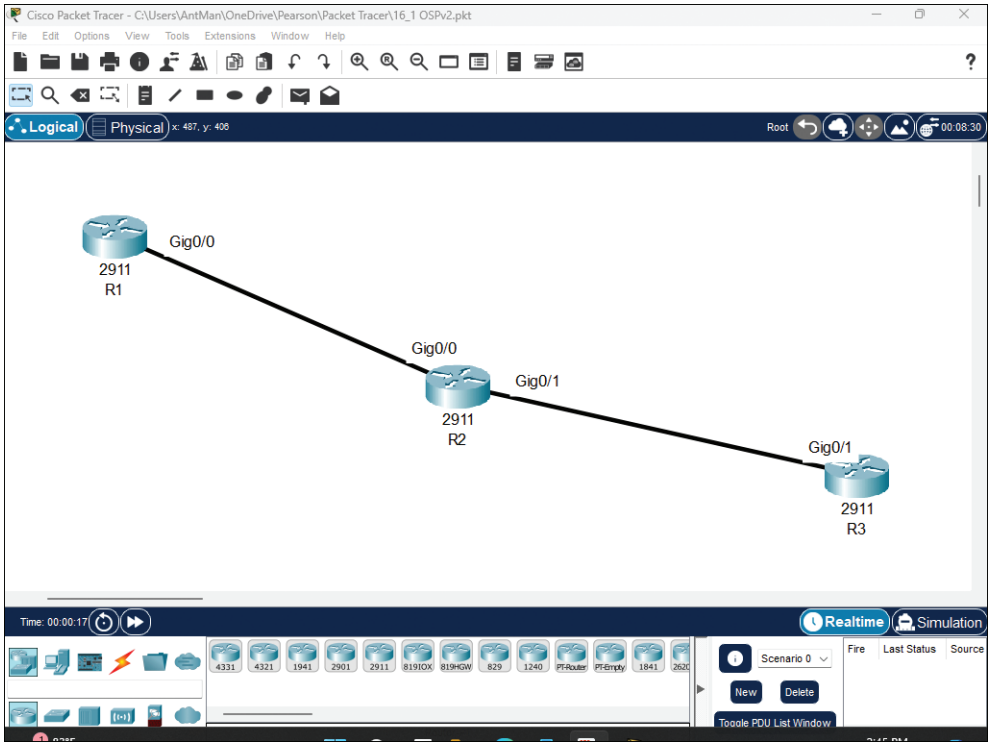

Figure 16.2 *The OSPFv2 Lab*

Topic Quiz

1. Which statement about OSPFv2 is true?

   A. The dead timers do not need to match between neighbors.

   B. The hello timers do not need to match between neighbors.

   C. The area ID must match between neighbors.

   D. The `network` command must be used.

2. What command can you use to verify neighbors in OSPFv2?

   A. `show ospf neighbors`

   B. `show ip ospf neighbors`

   C. `show ospf database neighbors`

   D. `show ospf peers`

Topic Quiz Answers

1. C is correct. Area ID and hello and dead timers must match between neighbors.
2. B is correct. The `show ip ospf neighbors` command permits the verification of OSPF peerings.

Lab 16.2: Chapter Review

To complete this Hands-On Lab Practice Assignment, download the assigned Packet Tracer file from the book's companion website and perform the lab on your locally installed version of Packet Tracer. You will be following the instructions in the lab, and your performance will be evaluated.

In this lab, you will demonstrate the skills covered in this chapter using the topology shown in Figure 16.3.

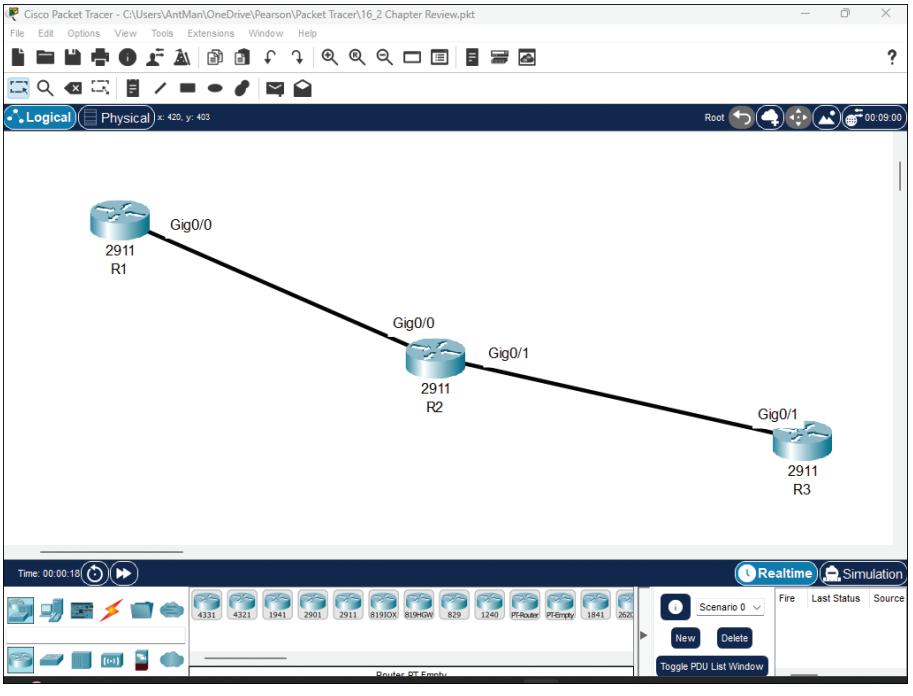

Figure 16.3 *The OSPFv2 Chapter Review Lab*

Review Questions

1. What command enters router configuration mode for OSPF version 2?

   A. `router ospf 1`

   B. `router ospf version 2`

   C. `ospf router version 1`

   D. `router ospf process 1 version 2`

2. You have configured OSPF on a router by using the command `network 10.10.0.0 0.0.255.255 area 0`. On which interface is OSPF running?

   A. Gi0/0: 10.0.0.1 255.255.0.0

   B. Gi0/1: 10.10.100.1 255.255.255.0

   C. Gi0/2: 10.1.10.100 255.0.0.0

   D. Gi0/3: 10.100.100.1 255.255.255.0

3. What does not have to match in order for an OSPF neighborship to form?

   A. Area ID

   B. MTU size

   C. Hello and dead intervals

   D. Use of the `network` command versus the `ip ospf` command

4. You have allowed a router to self-assign its router ID. What is the first option considered for the assignment on the device?

   A. A random router ID assignment

   B. The IP address on the highest-numbered interface name

   C. The highest IP address on a physical interface

   D. The highest IP address on a loopback interface

5. Which network type in OSPF features the use of a DR and a BDR?

   A. Point-to-point

   B. Broadcast

   C. Point-to-multipoint

   D. Point-to-multipoint non-broadcast

Answers to Review Questions

1. **A** is correct. The **`router ospf 1`** command enters router configuration mode for OSPF. It uses the local process ID 1.

2. **B** is correct. The **`network 10.10.0.0 0.0.255.255 area 0`** command ensures that OSPF runs on any interfaces that have IP addresses that have 10.10 in the first two octets. This is the Gi0/1 interface in this question.

3. **D** is correct. Neighborships can form in OSPF if one router uses the **`network`** command and the other uses the interface-level **`ip ospf`** command. Process IDs do not need to match between routers either.

4. **D** is correct. If you do not manually configure a router ID, the highest IP address on a loopback interface is used as the router ID. If there are no loopback interfaces, the router uses the highest IP address on a physical interface. If OSPF cannot find a configured IPv4 address, the OSPF process does not start.

5. **B** is correct. The DR and BDR devices are used in the broadcast and non-broadcast network types.

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