此为试读,需要完整PDF请访问: www.ertongbook.com

BRIEF CONTENTS

Chapter 1 What Is the CCIE Certification? 1

Chapter 2 CCIE Qualification Exam 1 (Network Fundamentals). 15

Chapter 3 CCIE Qualification Exam 2 (Routing Fundamentals). 109

Chapter 4 CCIE Qualification Exam 3 (Cisco-Specific Technology) . . . 235

Chapter 5 CCIE Qualification Exam 4 (Desktop Protocols and Bridging). 317

Index 393

CONTENTS

Chapter 1 What Is the CCIE Certification? 1

Introduction 1

Thinking of Becoming a CCIE? 2

Steps in Becoming a CCIE 2

CCIE Qualification Exam Structure 4

CCIE Qualification Exam Blueprint 4

Chapter Format 6

CD-ROM 9

How to Prepare for the Exam 9

Chapter 2 CCIE Qualification Exam 1 (Network Fundamentals) 15

Introduction 15

OSI Reference Model 15

OSI Layers 16

Networking Protocols 17

Wide Area Networking Technologies 17

Point-to-Point Circuits 18

High-Level Data Link Control (HDLC) 18

Point-to-Point Protocol (PPP) 18

Packet Switching 20

Frame Relay 20

Asynchronous Transfer Mode (ATM) 24

Circuit Switching 25

Integrated Services Digital Network (ISDN) 26

Internet Protocol (IP) 28
IP Addressing 31
IP Address Classes 31
IP Subnet Addressing 32
Classless Interdomain Routing (CIDR) 33
Address Resolution Protocol (ARP) Architecture 34
ARP: Frame Encapsulation 34
ARP: Header Format 35
Reverse ARP 36
Proxy ARP 36
Inverse ARP 36
Internet Control Message Protocol (ICMP) 37
ICMP Encapsulation 37
Transmission Control Protocol (TCP) Protocol Overview 38
TCP Header Format 39
User Datagram Protocol (UDP) 41
UDP and the ISO Model 42
UDP Header Encapsulation 42
Questions 43
Answer Key 61
Answer Guide 65

Chapter 3 CCIE Qualification Exam 2 (Routing Fundamentals) 109

Introduction 109
Technology Overview 109
Static Routes 111
Dynamic Routing Protocols 112
Distance Vector Protocols 114
Routing Information Protocol (RIP) 115
Interior Gateway Routing Protocol (IGRP) 121
Enhanced Interior Gateway Routing Protocol (EIGRP) 125
Link State Protocols 134
OSPF 135
OSPF Protocol Packets 139
Integrated IS-IS 149
IS-IS Areas 151
Questions 153

Answer Key 176
Answer Guide 180

Chapter 4 CCIE Qualification Exam 3 (Cisco-Specific Technology) . . . 235
Introduction 235
Router Memory 235
Shared Memory Architecture 236
Run-from-RAM and Run-from-Flash Routers 237
IOS Naming Convention 238
Platform Identifiers 238
Cisco IOS Feature Identifier 238
Cisco Run Time and Memory Space Identifier 238
Password Recovery 244
Questions 246
Answer Key 268
Answer Guide 272

Chapter 5 CCIE Qualification Exam 4 (Desktop Protocols and Bridging) 317
Introduction 317
Technology Overview 317
Bridging 318
Transparent Bridging 318
Source-Route Bridging (SRB) 319
Routing Information Field (RIF) 320
Source-Route Transparent Bridging (SRT) 322
Translational Bridging 323
Data Link Switching (DLSw) 324
Novell NetWare 325
Internetwork Packet Exchange (IPX) 325
Service Advertisement Protocol (SAP) 326
IPX Routing Protocols 326
Questions 328
Answer Key 345
Answer Guide 349

Index 393

CHAPTER

What Is the CCIE Certification?

This chapter will cover:

- Steps in becoming a CCIE
- CCIE qualification exam structure
- Chapter format
- How to prepare for the exam

Introduction

The Cisco Certified Internetwork Expert (CCIE) certification is the crème de la crème of networking certifications. It is recognized throughout the industry as being the most valued and difficult to obtain of all network certifications. The aim of the program is to make you a Cisco expert.

In today's business world, whether you're on the IS staff of a corporation, an Internet service provider (ISP), or a network integrator, people are asking more and more of you. More network use is the norm. More bandwidth is the constant want. More reliability is expected. Companies are putting their most valuable commodity, information, in your hands.

The CCIE program is well named, because you will be an expert in the multitude of internetworking technologies in use today. Armed with knowledge gained from this book and on-the-job training, you will provide benefits to your superiors or your customers because you will be able to design, implement, and evolve networks more intelligently and efficiently than your colleagues.

Besides the recognition that accompanies your CCIE status, other benefits will come your way. CCIEs have the option to jump to second-level Cisco tech support for any

case of technical questions or problems. You can also participate in a special CCIE chat forum, and answer questions on a CCO open forum.

Thinking of Becoming a CCIE?

As stated earlier, the CCIE is an advanced certification program. The Cisco entry and intermediate certifications such as Cisco Certified Network Associate (CCNA), Cisco Certified Network Professional (CCNP), Cisco Certified Design Associate (CCDA), and Cisco Certified Design Professional (CCDP) can provide you with a Cisco certification career path towards the ultimate goal: becoming a CCIE. Cisco recommends that you complete the appropriate course work and obtain significant work experience before continuing on your journey to certification.

If you're looking for rough rules of thumb, Cisco recommends that you have two or more years of internetworking experience. A good understanding of Transmission Control Protocol/Internet Protocol (TCP/IP), local area network (LAN) and wide area network (WAN) protocols, the Open Systems Interconnection (OSI) reference model, the Internet, security, and client/server architecture is essential. The company also recommends you have experience with packet-level diagnosis, plus real-world experience with Cisco and non-Cisco products. Again, the goal of the CCIE certification is for you to become a networking expert, not to be introduced to intermediate networking subjects.

Steps in Becoming a CCIE

So what are the steps to becoming a CCIE? The CCIE exam consists of two parts: a qualification exam and a laboratory exam. The qualification exam is two hours long and consists of 100 multiple-choice questions. The student must score at least 65 percent on this test in order to pass and be eligible for the two-day hands-on lab exam. Immediately after your test is completed, you know whether or not you passed. In addition, your score of each section is broken down, giving you a good feedback tool for revisiting weaker areas before taking the lab exam.

The second part of the certification process is a two-day hands-on laboratory exam. During the hands-on exam each test candidate receives his or her own rack of equipment, cables, and patch panels. The candidate is also provided with a full set of Cisco documentation to use throughout the exam. No other material is allowed in the exam room.

Your first task will be to create a network to specification. This will take up all of the first day and half of the second day. Halfway through the second day, while you are out

此为试读，需要完整PDF请访问：www.ertongbook.com

of the room, the exam proctor will insert faults into your network, and you will have to find and fix them—as well as be able to document the problems and their resolutions.

The exam has a total of 100 possible points. To pass, you must achieve a score of 80 points or better. You must achieve a passing score on each section of the exam to be allowed to progress to the next. For example, a perfect score on the first day would be 45 points. You have to earn at least 30 points to be allowed to return for the first part of day two. Table 1-1 shows the scoring breakdown.

The lab starting time varies depending upon location, but will be somewhere between 8:00 A.M. and 9:00 A.M. each day and run for 7½ hours. You will have a half-hour break for lunch. A proctor will be in the room to clarify questions and handle any emergencies that may arise, but basically you are on your own.

The failure rate for this exam is high. According to Cisco, only about 20 percent of the candidates pass it on the first attempt. On average, CCIE candidates require two to three lab exams before they earn a passing score. Think of your first time as a learning experience, and if you manage to pass, that is a bonus. The number of times you can retake the exam is unlimited.

As with all certification exams, lab exam content and structure are subject to change, so when you are ready to consider taking the lab exam, it's best to get the latest information from Cisco. Cisco's Web site contains specific instructions about how to prepare for the CCIE lab and qualification exams. It cannot be stressed enough that you must have lots of hands-on practice if you hope to pass this exam. If you do not have equipment to practice on at work, you will have to set up a home lab or find another way to gain access to the equipment.

Qualification tests are administered via Sylvan Prometric, and are graded on a pass/fail basis. Each test costs $300; if you don't pass the first time, there is no limit (other than your pocketbook) to the number of times you can take the test. The lab exam is given on site at Cisco locations. You must score 80 percent or higher on the hands-on lab test to pass. The lab tests cost $1,200 each. If you do not pass the first lab test, you must wait 30 days until trying it again.

Table 1-1 CCIE Lab Exam Scoring

Day	Task	Points	Total So Far	Minimum Score to Continue
One	Build	45	45	30
Two (part I)	Build	30	75	55
Two (part II)	Troubleshooting	25	100	80 or better to pass

CCIE Qualification Exam Structure

The qualification exam is computer based and administered at one of the Cisco authorized testing centers listed in this chapter. The exam consists of 100 multiple-choice questions and is a closed-book exam; no reference materials are allowed in the exam room. The student is given two hours to complete the exam and must score at least 65 percent to pass. The passing score will be given on the Examination Score Sheet at the end of the exam along with your score. A grading of either pass or fail will also be given.

CCIE Qualification Exam Blueprint

The CCIE Routing and Switching exam covers IP and IP routing, non-IP desktop protocols such as Internetwork Packet Exchange (IPX), and bridging- and switching-related technologies. The exam will cover the following areas:

- **Cisco device operation** The student should understand the architecture and operation of the router. The student should also know router commands and be able to interpret the output from these commands.
- **General networking theory** The student should have an understanding of the OSI model with a detailed understanding of the functions provided by each layer.
- **General routing concepts** The student should have an understanding of basic routing concepts. The student should also understand the differences between switching and routing, various summarization techniques, and the differences between link state and distance vector protocols.
- **Protocol comparisons** The student should have an understanding of various networking protocols and differences between them. An example of this would be IP versus IPX or TCP versus User Datagram Protocol (UDP).
- **Protocol mechanics** The student should have a detailed understanding of protocol mechanics such as Windowing/Acknowledgements (ACK), fragmentation, maximum transmission unit (MTU), handshaking, and termination.
- **Bridging and LAN switching** The student should have a working knowledge of various bridging technologies such as
  - **Transparent bridging** IEEE/DEC spanning tree, translational bridging, bridging protocol data unit (BPDU), integrated routed and bridging (IRB), and concurrent routing and bridging (CRB)
  - **Source-route bridging** Source-route translational bridging (SRTB), source-route transparent bridging (SRT), data-link switching (DLSw), and remote source-route bridging (RSRB)

The student should also be responsible for understanding LAN switching and trunking technologies such as VLAN Trunk Protocol (VTP), inter-switch link (ISL), virtual LAN (VLAN), Fast Ether Channel (FEC), Cisco Discovery Protocol (CDP), and Cisco Group Management Protocol (CGMP).

- **IP** The student should have a working knowledge of IP addressing, classless interdomain routing (CIDR), subnetting, Address Resolution Protocol (ARP), network address translation (NAT), Hot Standby Router Protocol (HSRP), Domain Name System (DNS), Bootstrap Protocol (BOOTP), Dynamic Host Configuration Protocol (DHCP), and Internet Control Message Protocol (ICMP).
- **IP routing protocols** The student should have a working knowledge of the architecture and design of today's most popular routing protocols, including Open Shortest Path First (OSPF), Routing Information Protocol (RIP), RIPv2, Intermediate System to Intermediate System (IS-IS), Enhanced Interior Gateway Routing Protocol (EIGRP), Interior Gateway Routing Protocol (IGRP), and Border Gateway Protocol (BGP).
- **Desktop protocols** The student should have a working knowledge of desktop protocols, with a focus towards IPX, such as NetWare Link Services Protocol (NLSP), IPX-RIP, IPX-Service Advertising Protocol (SAP), IPX-EIGRP, Sequenced Packet Exchange (SPX), Network Control Protocol (NCP), IPXWAN, IPX addressing, Get Nearest Server (GNS), and Novell Directory Services (NDS) (routing and mechanisms).
- **Performance management** The student should have a working knowledge of the various traffic management mechanics used on a router, including all queuing techniques, Resource Reservation Protocol (RSVP), traffic shaping, and load balancing.
- **WAN (addressing, signaling, and framing)** The student should have a working knowledge of the addressing, signaling, and framing used by today's most popular wide area protocols. The exam will cover Integrated Services Digital Network (ISDN), frame relay, Asynchronous Transfer Mode (ATM), X25, High-level Data Link Control (HDLC), and Point-to-Point Protocol (PPP). The student will also be responsible for understanding the physical layer framing techniques and encoding.
- **LAN** The student should have working knowledge of data link layer addressing, Media Access Control (MAC), and Logical Link Control (LLC) techniques for all Ethernet and Token Ring technologies.
- **Security** The student should have an understanding of the security techniques used by a router. The student should know the general concepts and differences

between Remote Access Dial-In User Service (RADIUS) and Terminal Access Controller Access Control System (TACACS).

Chapter Format

The book is broken into multiple practice exams given one per chapter. The exams cover key areas that the student must master in order to pass the CCIE Routing and Switching qualification exam. The areas include networking fundamentals, routing and switching fundamentals, Cisco-specific technology, and bridging and desktop protocols.

The exam questions are multiple-choice with an answer sheet provided at the end of the questions as a quick reference. A detailed answer and analysis section follows each 100 question multiple-choice test. In this section each question is reviewed and answered in detailed. We not only tell you why a particular answer is correct, but we also explain the technology and review why the other answers are incorrect. We believe this is the most effective study format, allowing you to learn not only from getting the correct answer, but also from understanding why the answer is correct and why the other answers are incorrect.

Chapter 2 (Networking Fundamentals)

Chapter 2 focuses on the OSI model, circuit- and packet-switched technologies, wide area protocols, TCP/IP fundamentals, and protocol mechanics. The exam contains questions on the OSI model, namely the features provided by each layer and a comparison between layers. The exam also contains questions on the addressing, signaling, and framing used by today's most popular WAN protocols, including frame relay, ATM, PPP, and ISDN. Questions are also given on IP addressing, subnetting, and basic operation of TCP/IP. The goal is to test the user's aptitude of basic networking protocols, mechanics, and technologies. The following is a detailed breakdown of the topics covered in this chapter:

- **OSI model** Layer comparisons and functions
- **Protocol comparisons** IP versus IPX and TCP versus UDP
- **Protocol mechanics** Windowing/Acknowledgements, fragmentation, MTU, handshaking, and termination
- **Addressing** CIDR, subnetting, and ARP
- **Services** DNS, DHCP, and ICMP
- **Transport** IP fragmentation, sockets, and ports

- **ISDN** Link Access Procedure on the D channel (LAPD), Basic Rate Interface (BRI)/Primary Rate Interface (PRI) framing, signaling, mapping, dialer map, interface types, B/D channels, and Multilink PPP
- **Frame relay** Local Management Interface (LMI), Data Link Connection Identifier (DLCI), permanent virtual circuit (PVC), framing, traffic shaping, forward explicit congestion notification (FECN), backward explicit congestion notification (BECN), committed information rate (CIR), discard eligible (DE), mapping, and compression
- **ATM** Switched virtual connection (SVC)/PVC, ATM Adaptation Layer (AAL), user-network interface (UNI)/network-network interface (NNI), Interim Local Management Interface (ILMI), cell format, and private network-network interface (PNNI)
- **Leased-line protocols** HDLC, PPP, asynchronous modems, and compression

Chapter 3 (Routing Fundamentals)

Chapter 3 focuses on routing fundamentals and routing protocols. The goal of this practice exam is to test the user's aptitude on design fundamentals and operation of today's most popular routing protocols. The exam includes questions on OSPF, IS-IS, EIGRP, IGRP, and BGP. The following is a detailed breakdown of the topics covered in this chapter:

- **OSPF** Areas, virtual links, stub, not so stubby areas (NSSA), area border router (ABR)/autonomous system boundary router (ASBR) redistributions, media dependencies, external versus internal, and summarization
- **OSPF operation** Designated router (DR), backup designated router (BDR), adjacencies, link state advertisement (LSA) types, link state database, shortest path first (SPF) algorithm, and authentication
- **BGP** Peer groups, route reflectors, confederations, clusters, attributes, autonomous system (AS) operation, which includes route maps, filters, neighbors, decision algorithm, Interior Border Gateway Protocol (IBGP), and Exterior Border Gateway Protocol (EBGP)
- **EIGRP** Metrics, route types, and protocol mechanics
- **IS-IS** Metrics, route types, and protocol mechanics
- **RIP and RIPv2** Metrics, mechanics, and design

Chapter 4 (Cisco-Specific Technology)

Chapter 4 focuses on Cisco-specific topics including device operation, router commands, router components, performance management, and security. The exam contains questions on nonvolatile random access memory (NVRAM), flash memory, CPU, file system management, and configuration register settings. The exam also contains questions on the queuing techniques, traffic management techniques, command-line knowledge, and LAN switching basics. The goal is to test the user's aptitude on Cisco device operation and architecture as well as the student's knowledge of router commands and his or her ability to interpret the output of those commands. The following is a detailed breakdown of the topics covered in this chapter:

- **Commands** Show and debug
- **Infrastructure** NVRAM, flash memory, CPU, file system, and configuration register settings
- **Operations** File transfers, password recovery, Simple Network Management Protocol (SNMP), accessing devices, and security (passwords)
- **Traffic management** Queuing, weighted fair queuing (WFQ), traffic shaping, and load balancing
- **Authentication, authorization, and accounting (AAA), TACACS, and RADIUS** General concepts and usage comparisons
- **LAN switching** Trunking, VTP, ISL, VLAN, FEC, CDP, and CGMP

Chapter 5 (Desktop Protocols and Bridging)

Chapter 5 focuses on desktop protocols, bridging techniques, and LAN technologies. The exam contains questions on transparent bridging, BPDUs, DLSw, routing information field (RIF) format, IPX, and LAN technologies. The goal is to test the user's aptitude on bridging technologies and concepts, data link addressing, MAC, and LLC. The following is a detailed breakdown of the topics covered in this chapter:

- **Transparent bridging** IEEE/DEC spanning tree, translational bridging, configuration BPDU, IRB, CRB, and access lists
- **Source-route bridging** SRTB, SRT, DLSw, RSRB, and access lists
- **IPX** NLSP, IPX-RIP, SAP, IPX-EIGRP, IPXWAN, and IPX addressing
- **Data Link layer addressing**
- **Ethernet/Fast Ethernet/Gigabit Ethernet** Encapsulation, carrier sense multiple access collision detect (CSMA/CD), topology, speed, controller errors, limitations, and 802.3

此为试读，需要完整PDF请访问：www.ertongbook.com