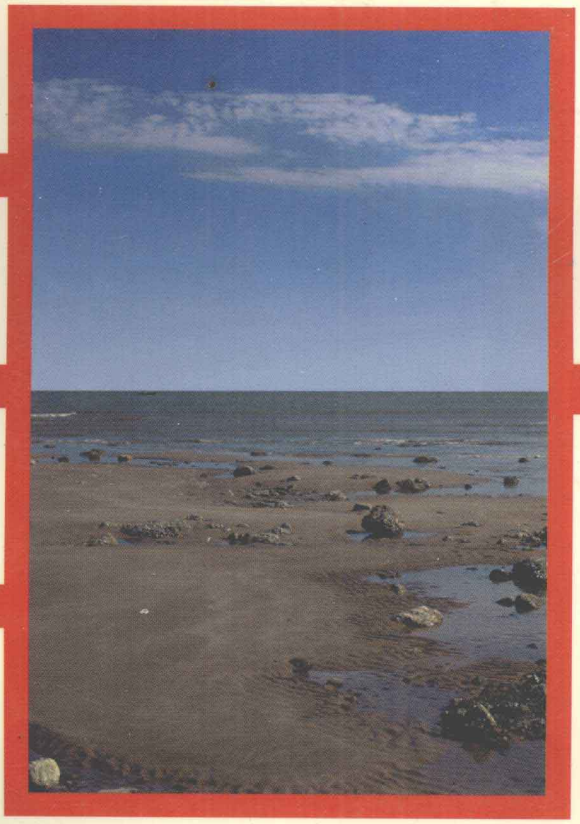
CCNP: Switching Study Guide

CCNP: Switching



学习指南

（英文原版）

考试号 640-504

〔美〕 Todd Lammle
Kevin Hales 著

美迪亚 SYBEX PHEI

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Cisco认证考试系列丛书说明

Cisco认证考试及其背景

当前，计算机系统及其网络系统的开发、管理、使用和维护需要大量不同层次的专业技术人员。真实地评价各种技术人员的技术水平是一件既复杂而又必不可少的工作。为此，许多世界著名的大公司和厂家纷纷推出了各自的认证考试方案。如Microsoft公司的MCSE、MCSD，Novell公司推出的CNE/CNA等。世界著名的网络系统公司——Cisco公司，则推出了其CCNA、CCDA、CCNP、CCDP、CCIE认证考试方案。那么，Cisco公司认证考试的意义、考试内容及其做法是怎样的呢？

Cisco公司建立于20世纪80年代初期，主要致力于开发、生产、销售高档网关、路由器和网络互联设备，其产品广泛应用于局域网、广域网和Internet等领域。基于Cisco产品领先的技术、优异的性能和良好的服务，Cisco公司的产品遍及世界各地，其业务量每年以非常高的速度递增，该公司的股票也以极高的速度逐年攀升。可以说，Cisco公司是计算机，特别是网络时代所创造的又一个奇迹。

Cisco公司的产品不同于普通的计算机软、硬件产品，它的技术含量高，原理复杂，因此学习和掌握其工作原理及使用方法需要许多相关知识和实践经验，需要高层次、高技术水准的技术人员。为保证使用、管理或提供Cisco产品服务的技术人员能够具备相应的技术水平，Cisco公司设立了一整套认证考试方案（见图0.1）。可以坦言，Cisco考试的难度高于其他公司，自然通过其考试后也更容易得到一些高薪的职位。也许是高难度的挑战所带来的诱惑，也许是高薪职位的吸引，目前参加或准备参加Cisco认证考试的人员正在逐年增加。

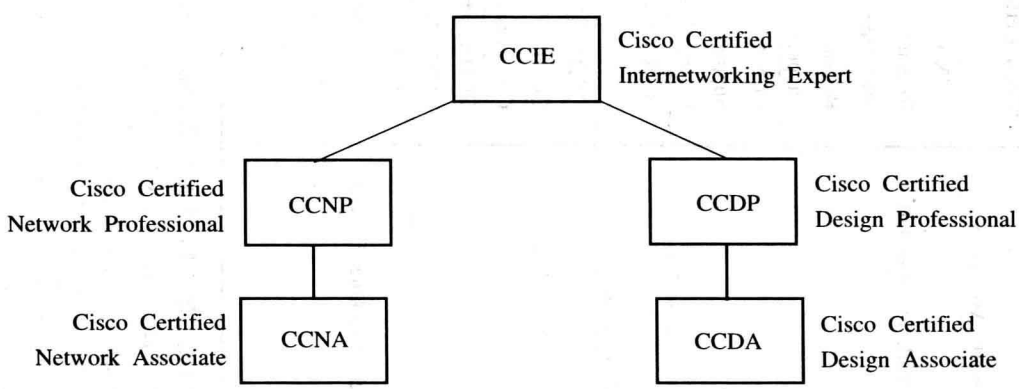

图0.1　Cisco认证考试由高及低的层次结构

通过各项认证考试的具体要求见表0.1中所示。

表0.1 CISCO认证证书及考试要求

证书名称	考试要求和考试科目	考试代码	注释
CCNA (Cisco Certified Network Associate)	Cisco Certified Network Associate	Exam 640-507	
CCNP (Cisco Certified Network Professional)	CCNA证书 Routing Switching Remote Access Support	 Exam 640-503 Exam 640-504 Exam 640-505 Exam 640-506	①
	CCNA证书 Support F R/S (Foundation Routing and Switching)	 Exam 640-506 Exam 640-509	②
CCDA (Cisco Certified Design Associate)	DCN (Designing Cisco Networks)	Exam 640-441	
CCDP (Cisco Certified Design Professional)	CCDA证书 CCNP证书 CID (Cisco Internetwork Design)	 Exam 640-025	③
	CCDA证书 CCNP的四门考试		④ 见CCNP
CCIE (Cisco Certified Internetworking Expert)	CCNP证书 CID (Cisco Internetwork Design) IMCR (Installing and Maintaining Cisco Router)课程 Cisco实际上机考核 CCIE-R/S (Exam Qualification)	 Exam 640-025 Exam 350-001	⑤

注释： ① 要获取CCNP证书，需先具有CCNA证书，并通过四门考试。

② 获取CCNP证书，也可采取第二种方法，即先获取CCNA证书，再通过Support考试和FR/S考试、后者是一个相当长的测试过程，内容涵盖了在前面①列出的几项考试内容，选择此方式比前者节省约100美元。

③ 要获取CCDP证书，需先具有CCDA和CCNP证书，再经过CID考试。

④ 如果尚不具备CCNP证书，可在具有CCDA证书的前提下，分别通过CCNP的四门考试。

⑤ 获得CCIE证书是一项非常艰难的过程，因此CCIE几乎成为了一种“出类拔萃”的标志。在进行严格的CISCO上机实验操作之前，CISCO推荐考生先完成CID并学习IMCR课程（本书写作时尚没有IMCR考试）。CISCO建议要有最少两年相关的工作经历，并通过上述考试后进行CCIE-R/S资格考试，再完成实际上机考核，并获得CCIE证书。

关于Cisco认证考试系列丛书

计算机认证考试是计算机业界人士和高等院校学生的一个“热点”，同时也是出版界的一个“时髦话题”。从1998年开始，我们在国内领先推出了“微软MCSE系列丛书”，结果非常成功。利用与国外出版公司的密切合作关系，加之我们认真负责的翻译、编辑和出版印刷方面努力，MCSE系列丛书以其快速的出版速度、较高的质量和适中的价格得到了广大读者的欢迎，取得了很好的社会效益和经济效益。借助过去的成功经验，我们再次引进Sybex公司的版权，采用“原版引进，重新排版印刷”的方式，出版Cisco认证考试系列丛书（英文版），为配合Cisco认证考试的升级（2.0版），我们及时出版了相应科目的最新辅导书，现已出版了Cisco认证考试的学习指南系列（见表0.2），以及Cisco认证考试的复习重点及模拟试题系列（见表0.3）。

表0.2 Cisco认证考试系列

书　　名	适用考试科目
CCNA: Cisco Certified Network Associate学习指南（英文升级版）	CCNA Exam 640-507
CCNP: Remote Access学习指南	CCNP Exam 640-505
CCNP: Support学习指南	CCNP Exam 640-506
CCDA: Cisco Certified Design Associate（CCDA）学习指南	CCDA Exam 640-441
CCDP: Cisco Internetwork Design（CID）学习指南	CCDP Exam 640-025

表0.3 Cisco认证考试复习重点及模拟试题系列

书　　名	适用考试科目
CCDA: Cisco Certified Design Associate复习重点及模拟试题	640-441
CCDP: Cisco Internetwork Design复习重点及模拟试题	640-025

以后，我们将推出其余认证考试科目的书籍。请读者留意书店内的销售广告或本系列书中的最新说明（恕不另行通知）。

最后，向支持和喜爱我们图书的广大读者表示感谢，并恳请读者对书中存在的问题提出批评和指正。

To my new friends at learnit.com. You're all awesome!
Todd Lammle

To Claudia, Christopher, and Clarissa—the balance in my life.
Kevin Hales

Acknowledgments

We would all be millionaires if we could bottle Jill Schlessinger's energy and great attitude. This project owes her a debt of gratitude. Thanks to Kevin Hales for hanging in there and adding the great material needed to make this book the best.

Todd Lammle

I would like to acknowledge the great support my wife has been. Again, thanks to Todd Lammle for including me on this project. A great deal of gratitude for all those at Sybex, especially Jill Schlessinger and Shannon Murphy.

Kevin Hales

We would both like to thank all the folks associated with Sybex who helped get this book on the shelves. Judy Flynn was a superb editor. This book would be a stack of typewritten pages without the layout finesse of Nila Nichols. Tony Jonick magically transformed sketches into works of art. Thanks to technical editors Errol Robichaux and Mark Tashiro for being our watchdogs. Finally, our other watchdogs are the proofreaders: thanks to Laurie O'Connell, Erika Donald, Nanette Duffy, Camera Obscura, and Laura Schattschneider.

Introduction

The new Cisco certifications reach beyond the popular certifications, such as the MCSE and CNE, to provide you with an indispensable factor in understanding today's network—insight into the Cisco world of internetworking. This book is intended to help you continue on your exciting new path toward obtaining CCNP and CCIE certification. Before reading this book, you should have at least read Sybex's *CCNA: Cisco Certified Network Associate Study Guide*. Although you can take the Cisco tests in any order, you should pass the CCNA exam before pursuing your CCNP. Many questions in the CCNP Switching exam (640-504) are built upon the CCNA material. However, we have done everything possible to make sure you can pass the 640-504 exam by reading this book and practicing with Cisco routers.

Cisco—A Brief History

A lot of readers may already be familiar with Cisco and what they do. However, those of you who are new to the field, just coming in fresh from your MCSE, or those of you who have maybe 10 or more years in the field but wish to brush up on the new technology, may appreciate a little background on Cisco.

In the early 1980s, Len and Sandy Bosack, a married couple who worked in different computer departments at Stanford University, were having trouble getting their individual systems to communicate (like many married people). So in their living room they created a gateway server that made it easier for their disparate computers in two different departments to communicate using the IP protocol. In 1984, they founded cisco Systems (notice the small *c*) with a small commercial gateway server product that changed networking forever. Some people think the name was intended to be San Francisco Systems but the paper got ripped on the way to the incorporation lawyers—who knows? In 1992, the company name was changed to Cisco Systems, Inc.

The first product the company marketed was called the Advanced Gateway Server (AGS). Then came the Mid-Range Gateway Server (MGS), the Compact Gateway Server (CGS), the Integrated Gateway Server (IGS), and the AGS+. Cisco calls these "the old alphabet soup products."

In 1993, Cisco came out with the amazing 4000 router and then created the even more amazing 7000, 2000, and 3000 series routers. These are still around and evolving (almost daily, it seems).

Cisco has since become an unrivaled worldwide leader in networking for the Internet. Its networking solutions can easily connect users who work from

diverse devices on disparate networks. Cisco products make it simple for people to access and transfer information without regard to differences in time, place, or platform.

In the big picture, Cisco provides end-to-end networking solutions that customers can use to build an efficient, unified information infrastructure of their own or to connect to someone else's. This is an important piece in the Internet/networking-industry puzzle because a common architecture that delivers consistent network services to all users is now a functional imperative. Because Cisco offers such a broad range of networking and Internet services and capabilities, users who need to access their local network or the Internet regularly can do so unhindered, making Cisco's wares indispensable.

Cisco answers this need with a wide range of hardware products that form information networks using the Cisco Internetwork Operating System (IOS) software. This software provides network services, paving the way for networked technical support and professional services to maintain and optimize all network operations.

Along with the Cisco IOS, one of the services Cisco created to help support the vast amount of hardware it has engineered is the Cisco Certified Internetwork Expert (CCIE) program, which was designed specifically to equip people to effectively manage the vast quantity of installed Cisco networks. The business plan is simple: If you want to sell more Cisco equipment and install more Cisco networks, ensure that the networks you install run properly.

However, having a fabulous product line isn't all it takes to guarantee the huge success that Cisco enjoys—lots of companies with great products are now defunct. If you have complicated products designed to solve complicated problems, you need knowledgeable people who are fully capable of installing, managing, and troubleshooting them. That part isn't easy, so Cisco began the CCIE program to equip people to support these complicated networks. This program, known colloquially as the Doctorate of Networking, has also been successful, primarily due to its extreme difficulty. Cisco continuously monitors the CCIE program, changing it as it sees fit, to make sure that it remains pertinent and accurately reflects the demands of today's internetworking business environments.

Building upon the highly successful CCIE program, Cisco Career Certifications permit you to become certified at various levels of technical proficiency, spanning the disciplines of network design and support. So whether you're beginning a career, changing careers, securing your present position, or seeking to refine and promote your position, this is the book for you!

Cisco's Network Support Certifications

Cisco has created new certifications that will help you get the coveted CCIE, as well as aid prospective employers in measuring skill levels. Before these new certifications, you took only one test and were then faced with the lab, which made it difficult to succeed. With these new certifications, which add a better approach to preparing for that almighty lab, Cisco has opened doors that few were allowed through before. So, what are these new certifications, and how do they help you get your CCIE?

Cisco Certified Network Associate (CCNA) 2.0

The CCNA certification is the first in the new line of Cisco certifications and is a precursor to all current Cisco certifications. With the new certification programs, Cisco has created a stepping-stone approach to CCIE certification. Now you can become a Cisco Certified Network Associate for the meager cost of Sybex's *CCNA: Cisco Certified Network Associate Study Guide*, plus $100 for the test. And you don't have to stop there—you can continue with your studies and achieve a higher certification called the Cisco Certified Network Professional (CCNP). Someone with a CCNP has all the skills and knowledge needed to attempt the CCIE lab. However, because no textbook can take the place of practical experience, we'll discuss what else you need to be ready for the CCIE lab shortly.

Check www.routersim.com for a cost-effective Cisco router simulator.

Cisco Certified Network Professional (CCNP) 2.0

Cisco Certified Network Professional (CCNP), Cisco's new certification, has opened up many opportunities for those individuals wishing to become Cisco-certified but lacking the training, the expertise, or the bucks to pass the notorious and often failed two-day Cisco torture lab. The new Cisco certifications will truly provide exciting new opportunities for the CNE and MCSE who are unsure of how to advance to a higher level.

So, you're thinking, "Great, what do I do after passing the CCNA exam?" Well, if you want to become a CCIE in Routing and Switching (the most popular certification), understand that there's more than one path to that much-coveted CCIE certification. The first way is to continue studying and become a Cisco Certified Network Professional (CCNP), which means four more tests, in addition to the CCNA certification.

The CCNP program will prepare you to understand and comprehensively tackle the internetworking issues of today and beyond—and it is not limited to the Cisco world. You will undergo an immense metamorphosis, vastly increas-

ing your knowledge and skills through the process of obtaining these certifications.

Todd Lammle offers a hands-on Cisco seminar (www.lammle.com) that provides two Cisco courses in one week of training. The Cisco CCNA/CCNP/CCDP seminars include CCNA/CCDA, Routing/Support, and Remote Access/Switching. Each course is six days long, and every student receives two routers and a switch to configure. Todd Lammle now offers a new three-day CCNA to help the busy professional.

Although you don't need to be a CCNP or even a CCNA to take the CCIE lab, it's extremely helpful if you already have these certifications.

What Skills Do You Need to Become a CCNP?

Cisco demands a certain level of proficiency for its CCNP certification. In addition to mastering the skills required for the CCNA, you should have the following skills for the CCNP:

- Installing, configuring, operating, and troubleshooting complex routed LAN, routed WAN, and switched LAN networks, along with dial-access services
- Understanding complex networks, such as IP, IGRP, IPX, Async Routing, AppleTalk, extended access lists, IP RIP, route redistribution, IPX RIP, route summarization, OSPF, VLSM, BGP, serial, IGRP, Frame Relay, ISDN, ISL, X.25, DDR, PSTN, PPP, VLANs, Ethernet, ATM LAN Emulation (LANE), access lists, 802.10, FDDI, and transparent and translational bridging

To meet the CCNP requirements, you must be able to perform the following:

- Install and/or configure a network to increase bandwidth, quicken network response times, and improve reliability and quality of service.
- Maximize performance through campus LANs, routed WANs, and remote access.
- Improve network security.
- Create a global intranet.
- Provide access security to campus switches and routers.
- Provide increased switching and routing bandwidth—end-to-end resiliency services.
- Provide custom queuing and routed priority services.

How Do You Become a CCNP?

After becoming a CCNA, you must take four exams to get your CCNP 2.0:

Exam 640-503: Routing This exam continues to build on the fundamentals learned in the CCNA course. It focuses on large multiprotocol internetworks and how to manage them with access lists, queuing, tunneling, route distribution, router maps, BGP, OSPF, and route

summarization. The forthcoming *CCNP: Routing Study Guide* covers all the exam objectives.

Exam 640-504: Switching This exam tests your knowledge of the 1900 and 5000 series of Catalyst switches. This book, *CCNP: Switching Study Guide*, covers all the objectives you need to understand to pass the Switching exam.

Exam 640-505: Remote Access This exam tests your knowledge of installing, configuring, monitoring, and troubleshooting Cisco ISDN and dial-up access products. You must understand PPP, ISDN, Frame Relay, and authentication. The new Sybex *CCNP: Remote Access Study Guide* covers all the exam objectives.

Exam 640-506: Support This exam tests you on the Cisco IOS troubleshooting information available. You must be able to troubleshoot Ethernet and Token Ring LANs, IP, IPX, and AppleTalk networks, as well as ISDN, PPP, and Frame Relay networks. The new Sybex *CCNP: Support Study Guide* covers all the exam objectives.

If you hate tests, you can take fewer of them by signing up for the CCNA exam and the Support exam and then taking just one more long exam called the Foundation R/S exam (640-509). Doing this also gives you your CCNP—but beware, it's a really long test that fuses all the material listed previously into one exam. Good luck! However, by taking this exam, you get three tests for the price of two, which saves you $100 (if you pass). Some people think it's easier to take the Foundation R/S exam because you can leverage the areas in which you would score higher against the areas in which you wouldn't.

Remember that test objectives and tests can change at any time without notice. Always check the Cisco Web site (www.cisco.com) for the most up-to-date information.

Cisco Certified Internetwork Expert (CCIE)

You've become a CCNP, and now you fix your sights on getting your Cisco Certified Internetwork Expert (CCIE) in Routing and Switching—what do you do next? Cisco recommends that before you take the lab, you take test 640-025: Cisco Internetwork Design (CID) and the Cisco authorized course called Installing and Maintaining Cisco Routers (IMCR). By the way, no Prometric test for IMCR exists at the time of this writing, and Cisco recommends a *minimum* of two years of on-the-job experience before taking the CCIE lab. After jumping those hurdles, you then have to pass the CCIE-R/S Exam Qualification (exam 350-001) before taking the actual lab.

To become a CCIE, Cisco recommends the following:

1. Attend all the recommended courses at an authorized Cisco training center and pony up around $15,000–$20,000, depending on your corporate discount.

2. Pass the Drake/Prometric exam ($200 per exam—so hopefully you'll pass it the first time).
3. Pass the two-day, hands-on lab at Cisco. This costs $1,000 per lab, which many people fail two or more times. (Some never make it through!) Also, you might just need to add travel costs to that $1,000 because you can currently take the exam only in San Jose, California; Research Triangle Park, North Carolina; Sydney, Australia; Halifax, Nova Scotia; Tokyo, Japan; or Brussels, Belgium. Cisco is adding new sites for the CCIE lab; it is best to check the Cisco Web site for the most up-to-date information.

What Skills Do You Need to Become a CCIE?

The CCIE Routing and Switching exam includes the advanced technical skills that are required to maintain optimum network performance and reliability, as well as advanced skills in supporting diverse networks that use disparate technologies. CCIEs just don't have problems getting jobs; these experts are basically inundated with offers to work for six-figure salaries! But that's because it isn't easy to attain the level of capability that is mandatory for Cisco's CCIE. For example, a CCIE must have the following skills down pat:

- Installing, configuring, operating, and troubleshooting complex routed LAN, routed WAN, switched LAN, and ATM LANE networks, along with dial-access services
- Diagnosing and resolving network faults
- Using packet/frame analysis and Cisco debugging tools
- Documenting and reporting the problem-solving processes used
- Having general LAN/WAN knowledge, including data encapsulation and layering; windowing and flow control and their relation to delay; error detection and recovery; link-state, distance vector, and switching algorithms; management, monitoring, and fault isolation
- Having knowledge of a variety of corporate technologies—including major services provided by Desktop, WAN, and Internet groups—as well as the functions, addressing structures, and routing, switching, and bridging implications of each of their protocols
- Having knowledge of Cisco-specific technologies, including router/switch platforms, architectures, and applications; communication servers; protocol translation and applications; configuration commands and system/network impact; and LAN/WAN interfaces, capabilities, and applications
- Designing, configuring, installing, and verifying voice-over-IP and voice-over-ATM networks

Check www.netfix.com for a great price on used Cisco gear that can help you build a home lab.

Cisco's Network Design Certifications

In addition to the network support certifications, Cisco has created another certification track for network designers. The two certifications within this track are the Cisco Certified Design Associate (CCDA) and Cisco Certified Design Professional (CCDP) certifications. If you're reaching for the CCIE stars, we highly recommend the CCNP and CCDP certifications before attempting the lab (or attempting to advance your career). Preparing for these certifications will give you the knowledge to design routed LAN, routed WAN, and switched LAN and ATM LANE networks.

Cisco Certified Design Associate (CCDA)

To become a CCDA, you must pass the DCN (Designing Cisco Networks) test (640-441). To pass this test, you must understand how to do the following:

- Design simple routed LAN, routed WAN, and switched LAN and ATM LANE networks.
- Use Network-layer addressing.
- Filter with access lists.
- Use and propagate VLANs.
- Size networks.

Sybex's *CCDA: Cisco Certified Design Associate Study Guide* is the most cost-effective way to study for and pass your CCDA exam.

Cisco Certified Design Professional (CCDP) 2.0

If you're already a CCNP and want to get your CCDP, you can simply take the CID 640-025 test. If you're not yet a CCNP, however, you must take the CCDA, CCNA, Routing, Switching, Remote Access, and CID exams.

CCDP certification skills include the following:

- Designing complex routed LAN, routed WAN, and switched LAN and ATM LANE networks
- Building upon the base level of the CCDA technical knowledge

CCDPs must also demonstrate proficiency in the following:

- Network-layer addressing in a hierarchical environment
- Traffic management with access lists
- Hierarchical network design
- VLAN use and propagation
- Performance considerations: required hardware and software; switching engines; memory, cost, and minimization

What Does This Book Cover?

This book covers everything you need to pass the CCNP Switching exam. The following list describes what you will learn in each chapter:

- Chapter 1 describes the traditional campus network model and moves into the new emerging campus model. Layer 2, 3, and 4 switching is also discussed. In addition, this chapter discusses the Cisco three-layer model, the Cisco switching product line, and how to build switch and core blocks.
- Chapter 2 describes the various Ethernet media types and how to log in and configure both a set-based and IOS-based Cisco Catalyst switch.
- Chapter 3 covers VLANs—how they work and how to configure them in a Cisco internetwork. Trunking and VLAN Trunk Protocol (VTP) will be described and implemented.
- Chapter 4 will give you an in-depth look at the Spanning Tree Protocol (STP), its timers, and how to configure STP in a switch.
- Chapter 5 shows you how to configure STP timers and includes a discussion of root bridge selection. Redundant links with STP will also be covered.
- Chapter 6 covers Inter-Switch Link (ISL) routing. Both internal route processors and external route processors are covered, as well as how to configure both internal and external route processors to connect multiple VLANs.
- Chapter 7 will provide the fundamentals of multi-layer switching on both internal and external route processors. In addition to covering IP routing with MLS, we'll show you how to configure the MLS engine.
- Chapter 8 gives you an extensive discussion of Hot Standby Routing Protocol (HSRP). The chapter provides HSRP as a solution to IP default gateway issues. Configuring HSRP is also covered.
- Chapter 9 covers the background of multicast addresses and how to translate from a layer 3 address to a layer 2 multicast address. Chapter 9 also covers IGMP and CGMP.
- Chapter 10 is about configuring multicast in a Cisco internetwork. Enabling multicast, joining a multicast group, and enabling CGMP are also covered.
- Chapter 11 ends this book by talking about access policies, how to create them, and how to implement them.
- Appendix A is a practice exam (see "How to Use This Book" later in this introduction for more on the practice exam).
- Appendix B includes all of the commands used in this book along with explanations of each command and how they are used with both access

layer and distribution layer switches.

- Appendix C is a list of all multicast addresses as listed in RFC 1112. It also includes a list of all the assigned multicast addresses.

Each chapter begins with a list of the topics covered related to the CCNP Switching test, so make sure to read them over before working through the chapter. In addition, each chapter ends with review questions specifically designed to help you retain the knowledge presented. To really nail down your skills, read each question carefully, and if possible, work through the chapters' hands-on labs.

Where Do You Take the Exams?

You may take the exams at any of the more than 800 Sylvan Prometric Authorized Testing Centers around the world. For the location of a testing center near you, call (800) 755-3926. Outside the United States and Canada, contact your local Sylvan Prometric Registration Center.

To register for a Cisco Certified Network Professional exam:

1. Determine the number of the exam you want to take. (The Switching exam number is 640-504.)
2. Register with the nearest Sylvan Prometric Registration Center. At this point, you will be asked to pay in advance for the exam. At the time of this writing, the exams are $100 each and must be taken within one year of payment. You can schedule an exam up to six weeks in advance or as soon as one working day prior to the day you wish to take it. If something comes up and you need to cancel or reschedule your exam appointment, contact Sylvan Prometric at least 24 hours in advance. Same-day registration isn't available for the Cisco tests.
3. When you schedule the exam, you'll get instructions regarding all appointment and cancellation procedures, the ID requirements, and information about the testing-center location.

Tips for Taking Your CCNP Exam

The CCNP Switching test contains about 70 questions to be completed in 90 minutes. However, the number of exam questions and time may vary.

Many questions on the exam have answer choices that at first glance look identical—especially the syntax questions! Remember to read through the choices carefully because "close enough" doesn't cut it. If you get commands in the wrong order or forget one measly character, you'll get the question wrong. So, to practice, do the hands-on exercises at the end of the chapters over and over again until they feel natural to you.

Unlike Microsoft or Novell tests, the exam has answer choices that are syntactically similar—although some syntax is dead wrong, it is usually just *sub-*