

CCNA Cisco Certified Network Associate Study Guide
Third Edition

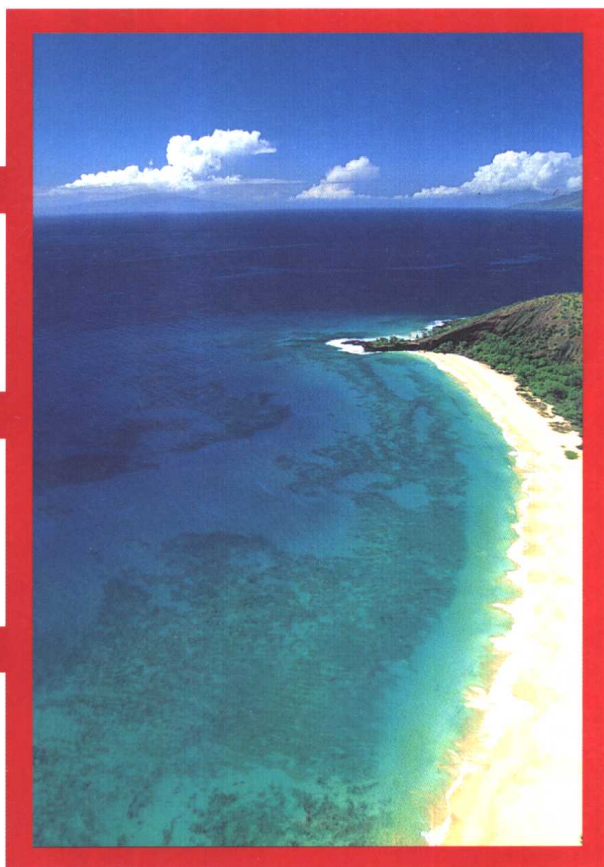
CCNA

学习指南

(2003英文升级版)

考试号 640-607

[美] Todd Lammle 著



電子工業出版社

Publishing House of Electronics Industry
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Cisco认证考试内容及考试学习图书

Cisco认证考试证书是当今计算机业内人士追求事业发展的最热的证书之一。取得相应的证书,就可证明你具有大企业所要求的专业能力

Cisco认证考试目前主要有网络安装与支持(Network Installation and Support)、网络工程与设计(Network Engineering and Design)、通信与服务(Communications and Services)等。下面又进一步细分为初级(如CCNA、CCDA)、中级(如CCNP、CCDP)和高级(如CCIE)等。

以下各表列出了升级后的主要考试科目及电子工业出版社最新翻译美国Sybex公司出版的“学习指南”中的相应图书,未注明的均为中文版。完整的考试清单及其他细节请访问Cisco公司的网站。

Cisco网络安装与支持认证考试主要包括CCNA、CCNP和CCIE。

CCNA只有一门考试

考试号	考试	可选图书
640-607	Cisco Certified Network Associate exam	CCNA学习指南(2003英文升级版) CCNA学习指南

CCNP主要有四门考试

640-901	BSCI	Building Scalable Cisco Internetworks	CCIP: BSCI学习指南
640-604	SWTCH	Switching	CCNP: 交换学习指南
640-605	RMTAC	Remote Access	CCNP: 远程访问学习指南
640-606	SUPRT	Support	CCNP: 支持学习指南

CCIE科目很多,主要有

350-001	Routing & Switching	CCIE C.C.IE学习指南
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Cisco网络工程与设计认证考试主要包括CCDA和CCDP。

CCDA只有一门考试

640-441	DCN	Designing Cisco Networks	CCDA: Cisco Certified Design Associate学习指南 CCDA: Cisco Certified Design Associate复习重点 及模拟试题
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CCDP主要有四门考试

640-901 BSCI	Building Scalable Cisco Internetworks	CCIP: BSCI学习指南
640-604 SWTCH	Switching	CCNP: 交换学习指南
640-605 RMTAC	Remote Access	CCNP: 远程访问学习指南
640-025 CID	Cisco Internetwork Design	CCDP: Cisco Internetwork Design学习指南

Cisco通信与服务认证考试主要包括CCIP。

CCIP核心考试 (Core Exams) 为必考, 只有两门

640-901 BSCI	Building Scalable Cisco Internetworks	CCIP: BSCI学习指南
640-905 MCAST+QOS	Implementing Cisco Multicast and Cisco QoS	

CCIP任选考试 (Elective Exams) 只需通过一门, 主要有

640-910 MPLS	Implementing Cisco MPLS	CCIP: MPLS学习指南
640-442 MCNS	Managing Cisco Network Security	CSSI/CCIP: Cisco安全专家学习指南

另外, 根据考生的要要, 已将CCNA/CCNP/CCDP/CCIP中的考题及解答整理成为英文版, 另成一册, 单独出版。

To Our Valued Readers:

Since its inception, the Cisco Certified Network Associate program has established itself as the premier internetworking certification. Sybex is proud to have helped hundreds of thousands of CCNA candidates prepare for their exams in recent years, and we are excited about the opportunity to continue to provide individuals with the knowledge and skills they'll need to succeed in the highly competitive IT industry.

With the recent revision of the CCNA exam, Cisco raised the bar considerably, adding simulation questions to verify the skills associated with hands-on router configuration. Sybex welcomes this new testing feature as we strongly advocate a comprehensive and practical instructional approach to certification exam preparation. It has always been Sybex's mission to teach exam candidates how new technologies work in the real world, not to simply feed them answers to test questions. Sybex was founded on the premise of providing technical skills to IT professionals, and we have continued to build on that foundation. Over the years, we have made significant improvements to our study guides based on feedback from readers, suggestions from instructors, and comments from industry leaders.

Cisco's new CCNA exam is indeed challenging. The author, renowned Cisco authority Todd Lammle, and Sybex's editors and technical reviewers have worked hard to ensure that this *CCNA: Cisco Certified Network Associate Study Guide* is comprehensive, in-depth, and pedagogically sound. We're confident that this book, along with the collection of cutting-edge software study tools included on the CD, will meet and exceed the demanding standards of the certification marketplace and help you, the CCNA exam candidate, succeed in your endeavors.

Good luck in pursuit of your CCNA certification!

Neil Edde
Associate Publisher—Certification
Sybex, Inc.

Acknowledgments

Elizabeth Campbell, Pete Gaughan, and Maureen Adams were instrumental in helping me get this book out in time, without stressing out too much, and working together as a well-oiled machine. Thank you.

I'd also like to thank Rod Jackson and Errol Robichaux, who scrutinized every word, figure, and line of code in the book for technical accuracy. (Of course, any mistakes remaining in the text are my responsibility, not theirs.) Additional thanks go out to Interactive Composition Corporation who carefully set every single page in the book; Yariv Rabinovitch, Nancy Riddiough, Sarah Tannehill, who all did marvelous jobs proofreading; Tony Jonick, who created all the great illustrations; and Ted Laux, who crafted the index. The book would not exist without all of you.

Introduction

Welcome to the exciting world of Cisco certification! You have picked up this book because you want something better; namely, a better job with more satisfaction. Rest assured that you have made a good decision. Cisco certification can help you get your first networking job, or more money and a promotion if you are already in the field.

Cisco certification can also improve your understanding of the internetworking of more than just Cisco products: You will develop a complete understanding of networking and how different network topologies work together to form a network. This is beneficial to every networking job and is the reason Cisco certification is in such high demand, even at companies with few Cisco devices.

Cisco is the king of routing and switching, the Microsoft of the internetworking world. The 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. By deciding that you want to become Cisco certified, you are saying that you want to be the best—the best at routing and the best at switching. This book will lead you in that direction.

How to Use This Book

If you want a solid foundation for the serious effort of preparing for the Cisco Certified Network Associate (CCNA) exam, then look no further. I have spent hundreds of hours putting together this book with the sole intention of helping you to pass the CCNA exam and learn how to configure Cisco routers and switches.

This book is loaded with lots of valuable information, and you will get the most out of your studying time if you understand how I put this book together.

To best benefit from this book, I recommend the following study method:

1. Take the assessment test immediately following this introduction. (The answers are at the end of the test.) It's OK if you don't know any of the answers; that is why you bought this book! Carefully read over the explanations for any question you get wrong and note which chapters the material comes from. This information should help you plan your study strategy.
2. Study each chapter carefully, making sure that you fully understand the information and the test objectives listed at the beginning of each chap-

ter. Pay extra-close attention to any chapter where you missed questions in the assessment test.

3. Complete each written lab at the end of each chapter. Do *not* skip this written exercise, as it directly relates to the CCNA exam and what you must glean from the chapter you just read. Do not just skim this lab! Make sure you understand completely the reason for each answer.
4. Complete all hands-on labs in the chapter, referring to the text of the chapter so that you understand the reason for each step you take. If you do not have Cisco equipment available, be sure to study the examples carefully, or use the Router Fundamentals Simulator found on the CD of this book. Also, check www.routersim.com for router simulator software that provides drag-and-drop networking configurations. This will help you gain hands-on experience configuring Cisco routers.
5. If you do not have Cisco equipment or the RouterSim Cisco simulator product, then go through all the core hands-on labs (contained in Appendix A) using the Router Fundamentals Simulator product found on the CD of this book. This will help you gain hands-on experience configuring Cisco routers. (The Router Fundamentals Simulator will not run the hands-on labs that are printed at the end of each chapter. Within the software product, only use the simulator's labs.)
6. Answer all of the review questions related to that chapter. (The answers appear at the end of the chapter.) Note the questions that confuse you and study those sections of the book again. Do not just skim these questions! Make sure you understand completely the reason for each answer.
7. Try your hand at the practice exams that are included on the companion CD. The questions in these exams appear only on the CD. This will give you a complete overview of what you can expect to see on the real CCNA exam. Check out www.lammleprep.com for more Cisco exam prep questions.
8. Also on the companion CD is a software simulation program that will help you prepare for the new simulation questions on the CCNA 607 exam. The router simulator on the CD or at www.routersim.com is the best form of study, but be sure and practice with the software simulation program as well.
9. Test yourself using all the flashcards on the CD. There are brand new and updated flashcard programs on the CD to help you prepare completely for the CCNA exam. These are a great study tool!



The electronic flashcards can be used on your Windows computer, Pocket PC, or on your Palm device.

10. Make sure you read the “Key Terms” and “Commands Used in This Chapter” lists at the end of the chapters. Appendix C lists all the commands used in the book, including an explanation for each command.

To learn every bit of the material covered in this book, you'll have to apply yourself regularly, and with discipline. Try to set aside the same time period every day to study, and select a comfortable and quiet place to do so. If you work hard, you will be surprised at how quickly you learn this material.

If you follow the steps listed above, and really study and practice the review questions, CD exams, electronic flashcards, and written and hands-on labs, it would be hard to fail the CCNA exam.

What's on the CD?

We worked hard to provide some really great tools to help you with your certification process. All of the following tools should be loaded on your workstation when studying for the test.

Router Fundamentals Simulator

The companion CD contains the Router Fundamentals Simulator, a “mini” version of Sybex's best-selling CCNA Virtual Lab e-trainer. The Virtual Lab is a stand-alone product that allows readers to gain hands-on experience without buying expensive Cisco gear. This practical experience is a must-have for anyone hoping to pass the CCNA exam. Its smaller counterpart, the Router Fundamentals Simulator bundled with this book's CD, covers the absolute essentials for the exam, represented by the 14 hands-on labs contained in Appendix A. (The Router Fundamental Simulator requires RealPlayer, which is also included on the CD.) You can find more router simulator software available for purchase at www.routersim.com.

The EdgeTest Test Preparation Software

The test preparation software, provided by EdgeTek Learning Systems, prepares you to pass the CCNA exam. In this test engine, you will find all the review and assessment questions from the book, plus five additional bonus exams that appear exclusively on the CD. You can take the assessment test, test yourself by chapter or by topic, take the practice exams, or take a randomly generated exam comprising all the questions.



NOTE

To find more test-simulation software for all Cisco and Microsoft exams, look for the exam link on www.lammleprep.com.

Electronic Flashcards for PC, Pocket PC, and Palm Devices

To prepare for the exam, you can read this book, study the review questions at the end of each chapter, and work through the practice exams included in the book and on the companion CD. But wait, there's more! You can also test yourself with the flashcards included on the CD. If you can get through these difficult questions and understand the answers, you'll know you're ready for the CCNA exam.

The flashcards include over 300 questions specifically written to hit you hard and make sure you are ready for the exam. Between the review questions, practice exams, and flashcards, you'll be more than prepared for the exam.

CCNA Study Guide in PDF

Sybex offers the *CCNA Study Guide* in PDF format on the CD so you can read the book on your PC or laptop. This will be helpful to readers who travel and don't want to carry a book, as well as to readers who prefer to read from their computer. (Acrobat Reader 5 is also included on the CD.)

Cisco—A Brief History

Many 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, and those of you who maybe have 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 Systems offers such a broad range of networking and Internet services and capabilities, users who need to regularly access their local network or the Internet 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 have more Cisco networks installed, ensure that the networks you install run properly.

Clearly, 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 very successful, primarily due to its extreme difficulty. Cisco continuously monitors the 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 seek-

ing to refine and promote your position, this is the book for you!

Cisco's Network Support Certifications

Initially, to secure the coveted CCIE, you took only one test and then you were faced with the (extremely difficult) lab, an all-or-nothing approach that made it tough to succeed. In response, Cisco created a series of new certifications to help you get the coveted CCIE, as well as aid prospective employers in measuring skill levels. With these new certifications, which added a better approach to preparing for that almighty lab, Cisco opened doors that few were allowed through before. So, what are these stepping-stone certifications and how do they help you get your CCIE?

Cisco Certified Network Associate (CCNA)

The CCNA certification was the first in the new line of Cisco certifications, and was the precursor to all current Cisco certifications. With the new certification programs, Cisco has created a type of stepping-stone approach to CCIE certification. Now, you can become a Cisco Certified Network Associate for the meager cost of this book, plus \$120 for the test. And you don't have to stop there—you can choose to 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 he or she needs 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.

Why Become a CCNA?

Cisco, not unlike Microsoft or Novell, has created the certification process to give administrators a set of skills and to equip prospective employers with a way to measure skills or match certain criteria. Becoming a CCNA can be the initial step of a successful journey toward a new, highly rewarding, and sustainable career.

The CCNA program was created to provide a solid introduction not only to the Cisco Internetwork Operating System (IOS) and Cisco hardware, but also to internetworking in general, making it helpful to you in areas that are not exclusively Cisco's. At this point in the certification process, it's not unrealistic to imagine that future network managers—even those without Cisco equipment—could easily require Cisco certifications for their job applicants.

If you make it through the CCNA and are still interested in Cisco and internetworking, you're headed down a path to certain success.

What Skills Do You Need to Become a CCNA?

To meet the CCNA certification skill level, you must be able to understand or do the following:

- Install, configure, and operate simple-routed LAN, routed WAN, and switched LAN and LANE networks.
- Understand and be able to configure IP, IGRP, IPX, serial, AppleTalk, Frame Relay, IP RIP, VLANs, IPX RIP, Ethernet, and access lists.
- Install and/or configure a network.
- Optimize WAN through Internet-access solutions that reduce bandwidth and WAN costs, using features such as filtering with access lists, bandwidth on demand (BOD), and dial-on-demand routing (DDR).
- Provide remote access by integrating dial-up connectivity with traditional, remote LAN-to-LAN access, as well as supporting the higher levels of performance required for new applications such as Internet commerce, multimedia, etc.

How Do You Become a CCNA?

The first step to becoming a CCNA is to pass one little test and—poof!—you're a CCNA. (Don't you wish it were that easy?) True, it's just one test, but you still have to possess enough knowledge to understand (and read between the lines—trust me) what the test writers are saying.

I can't stress this enough—it's critical that you have some hands-on experience with Cisco routers. If you can get a hold of some 2500 routers, you're set. But if you can't, we've worked hard to provide hundreds of configuration examples throughout this book to help network administrators (or people who want to become network administrators) learn what they need to know to pass the CCNA exam.

One way to get the hands-on router experience you'll need in the real world is to attend one of the seminars offered by GlobalNet Training Solutions, Inc., which is owned and run by myself. The seminars are 5 days and 11 days long and will teach you everything you need to become a CCNA (or even a CCNP). Each student gets hands-on experience by configuring at least two routers and a switch. See www.globalnettraining.com for more information.



NOTE

For hands-on training with Todd Lammle, please see www.globalnettraining.com.

Cisco Certified Network Professional (CCNP)

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

While 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 be able to do the following:

- Install, configure, operate, and troubleshoot complex routed LAN, routed WAN, and switched LAN networks, along with dial-access services.
- Understand 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, access lists, 802.10, FDDI, and transparent and translational bridging.
- Install and/or configure a network to increase bandwidth, quicker 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, the four exams you must take to get your CCNP are as follows:

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, route maps, BGP, EIGRP, OSPF, and route summarization. The *CCNP: Routing Study Guide* (Sybex) covers all the objectives you need to understand to pass the Routing exam.

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

Exam 640-506: Support This tests you on the Cisco troubleshooting skills needed for Ethernet and Token Ring LANs, IP, IPX, and AppleTalk networks,

as well as ISDN, PPP, and Frame Relay networks. The *CCNP: Support Study Guide* (Sybex) covers all the objectives you need to understand to pass the Support 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 *CCNP: Remote Access Study Guide* (Sybex) covers all the exam objectives.



www.routersim.com has a complete Cisco router simulator for all CCNP exams.

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 Routing, Switching, and Remote Access exams 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 that you would score higher in 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 website for the most up-to-date information (www.cisco.com).

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 the Cisco Internetwork Design (CID) exam (640-025) 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 (350-001) before taking the actual lab.

How Do You Become a CCIE?

To become a CCIE, Cisco recommends you do 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 one-day, hands-on lab at Cisco. This costs \$1,000 per lab, and many people fail two or more times. (Some never make it through!) Also, there are a limited number of places to take the lab: San Jose, California; Research Triangle Park, North Carolina; Sydney, Australia; Halifax, Nova Scotia; Tokyo, Japan; and Brussels, Belgium. This means that you might just need to add travel costs to that \$1,000. Cisco has added new sites lately for the CCIE lab; it is best to check the Cisco website for the most current information.



Cisco has changed the CCIE lab from a two-day to a one-day lab. Please see www.cisco.com for the latest 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 can easily do the following:

- Install, configure, operate, and troubleshoot complex routed LAN, routed WAN, switched LAN, and ATM LANE networks, and dial-access services.
- Diagnose and resolve network faults.
- Use packet/frame analysis and Cisco debugging tools.
- Document and report the problem-solving processes used.
- Understand general LAN/WAN characteristics, 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.
- Understand 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.
- Understand 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.
- Design, configure, install, and verify voice-over-IP and voice-over-ATM networks.