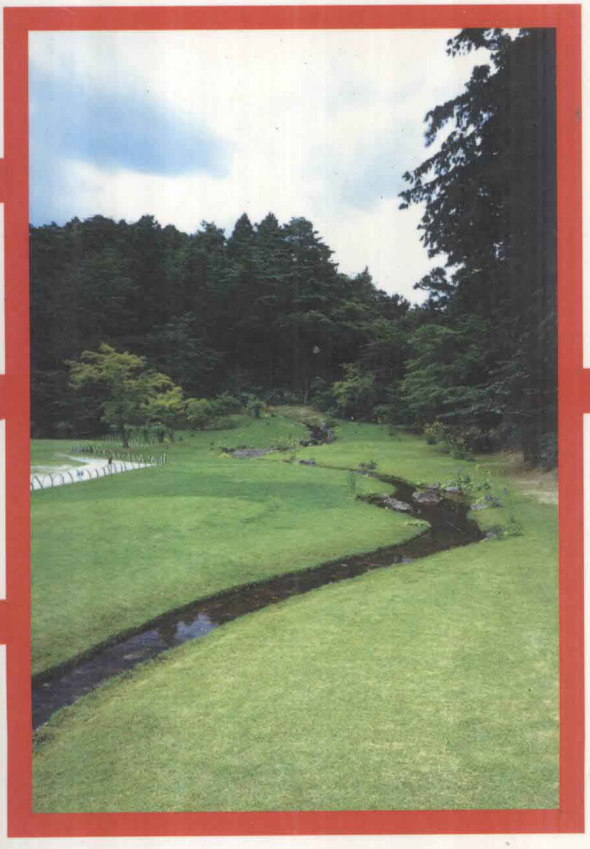
CCNA: Cisco Certified Network Associate
Study Guide Fourth Edition

CCNA

学习指南

(英文版)(640-801)



〔美〕 Todd Lammle 著

针对最新的CCNA考试全面更新

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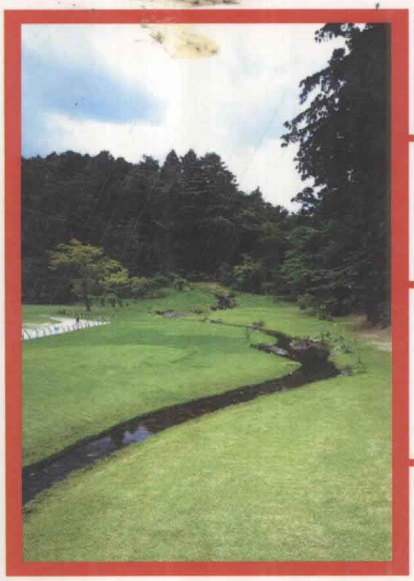

这本针对修订后的CCNA考试: 640-801的最畅销CCNA学习指南为读者提供了:

- 对每个CCNA考试目标的深入讲解
- 有关Cisco联网解决方案的实用信息
- 成百道富有挑战性的复习题
- 选配光碟中有最新的考试复习软件, 包括测试引擎、示例仿真题和电子闪存卡

作者简介:

Todd Lammle, CCNA, CCNP, 对于各种LAN和WAN有超过20年的经验, 并从1986年就开始涉足Cisco路由器网络。他是RouterSim和LLC公司的CEO和首席科学家, 并且是GlobalNet Training, Inc.的总裁。Todd还是“CertCities 2002读者票选大奖”所选出的“最佳学习指南作者”。

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CCNA学习指南（英文版）

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電子工業出版社
Publishing House of Electronics Industry
北京 · BEIJING

内容提要

世界著名的网络系统公司Cisco公司建立于20世纪80年代，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、广域网和因特网。在微软公司一方独大的互联网络世界中，Cisco却是路由和交换领域真正的无冕之王。由于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。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公司设立了一系列认证考试，不仅如此，其考试目标和内容也随其产品不断地发生变化。为覆盖其最新的考试目标，我们采用“原版引进，重新排版印刷”的方式以最快的速度出版Cisco认证考试系列相应科目的辅导丛书来满足读者的需求。本书作为系列中的一本，针对CCNA：640-801考试而推出。书中的内容从联网和TCP/IP的背景开始介绍，接着介绍了子网划分、Cisco网络操作系统和命令行界面，然后讲述了路由和交换，最后介绍了VLAN和WAN等内容。全书篇幅得当，内容新颖实用，不仅适用于网络管理人员、网络设计和开发人员，更是CCNA应试人员的必备材料。

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CCNA: Cisco Certified Network Associate Study Guide, 4th Edition

Exam 640-801

OBJECTIVE	CHAPTER
Planning & Designing	
Design a simple LAN using Cisco Technology	3, 5
Design an IP addressing scheme to meet design requirements	3, 5
Select an appropriate routing protocol based on user requirements	5, 6
Design a simple internetwork using Cisco technology	3, 5, 6
Develop an access list to meet user specifications	10
Choose WAN services to meet customer requirements	11
Implementation & Operation	
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Configure IP addresses, subnet masks, and gateway addresses on routers and hosts	4, 5
Configure a router for additional administrative functionality	4, 5
Configure a switch with VLANS and inter-switch communication	8
Implement a LAN	4, 8
Customize a switch configuration to meet specified network requirements	8
Manage system image and device configuration files	9
Perform an initial configuration on a router	4, 5
Perform an initial configuration on a switch	4, 5
Implement access lists	10
Implement simple WAN protocols	11
Troubleshooting	
Utilize the OSI model as a guide for systematic network troubleshooting	9
Perform LAN and VLAN troubleshooting	3, 5, 8, 9
Troubleshoot routing protocols	5
Troubleshoot IP addressing and host configuration	3, 5, 9
Troubleshoot a device as part of a working network	3, 5, 9
Troubleshooting	
Troubleshoot an access list	10
Perform simple WAN troubleshooting	11

OBJECTIVE	CHAPTER
Technology	
Describe network communications using layered models	1
Describe the Spanning Tree process	7
Compare and contrast key characteristics of LAN environments	1
Evaluate the characteristics of routing protocols	5
Evaluate TCP/IP communication process and its associated protocols	2, 3, 5
Describe the components of network devices	1
Evaluate rules for packet control	1, 10
Evaluate key characteristics of WANs	11

Exam objectives are subject to change at any time without prior notice and at Cisco's sole discretion. Please visit Cisco's web site (www.cisco.com/traincert) and click the Learning and Events link for the most current listing of exam objectives.

To Our Valued Readers:

Thank you for looking to Sybex for your CCNA exam prep needs. Computer Reseller News recently ranked the CCNA #3 in its list of the "10 Hot Certifications for 2003," and it's no wonder. While the CCNA is positioned as a first-tier internetworking certification, Cisco has gone to great lengths to ensure that the exam accurately validates practical knowledge and skills that companies are seeking today.

Sybex is proud to have helped hundreds of thousands of CCNA candidates prepare for their exams over the years. It has always been Sybex's mission to teach individuals how to utilize technologies in the real world, not to simply feed them answers to test questions. Just as Cisco is committed to establishing measurable standards for certifying internetworking professionals, Sybex is committed to providing those professionals with the means of acquiring the skills and knowledge they need to meet those standards.

The author, editors, and technical reviewers have worked hard to ensure that this 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 certification exam candidate, succeed in your endeavors.

Good luck in pursuit of your CCNA certification!

Neil Edde
Associate Publisher—Certification
Sybex, Inc.

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Acknowledgments

For trying to keep my path straight and focused, I need to thank Neil Edde, Maureen Adams and Jeff Kellum. This is no easy task for you and I applaud your patience and dedication to our vision.

Elizabeth Campbell was instrumental in the success of this book. Without her hard work and dedication to a flawless book, as well as her ability to dance long after the music has stopped, this book would never have come together as quickly as it has. The quality of this book comes directly from the dazzling performance of Elizabeth. Thank you!

As Pygmalion always strove for the ideal of perfection, I have currently had the privilege to work with the modern-day version in the name of an amazing tech editor named Toby Skandier. A superb person with an uncanny eye for the details that matter, Toby has contributed immensely to make this book the quality product it is. And not to forget the Eye of Accuracy—none other than the infallible Michael Woznicki. This man is the reason personified that this entire book was totally put together in precisely the way it should be. Kudos and many thanks to both of these adroit professionals—cheers guys!

Thanks also to the CD team whose hard work has resulted in a power-packed CD test engine. Thanks also to the compositors at Happenstance Type-O-Rama that laid out the fine pages you are reading. Suzanne Goraj's trained eye weeded out any grammar and spelling problems; Thanks Suzanne! Thanks also go to Craig Vazquez who gave the book its final technical once-over, and gave us his thumbs-up!

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.

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 seeking 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 make for 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. Now, you can become a Cisco Certified Network Associate for the meager cost of this book, plus $125 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, serial interfaces, Frame Relay, IP RIP, VLANs, 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).

How Do You Become a CCNA?

The way to become a CCNA is to pass one little test (CCNA exam 640-801). Then—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 what the test writers are saying (and to read between the lines—trust me).

However, Cisco has announced a two-step process that you can take in order to become a CCNA that may be easier then taking one longer exam. These tests are:

- Exam 640-811: Interconnecting Cisco Networking Devices (ICND)
- Exam 640-821: Introduction to Cisco Networking Technologies (INTRO)

You spend more money if you take these two exams instead of the 640-801 exam, but it may be easier to break up the exam into two smaller exams. That's a personal choice. Understand that this book is designed to prepare you to pass the 640-801 exam, although it will likely help you pass both 640-811 and 640-821 as well.

I can't stress this enough—it's critical that you have some hands-on experience with Cisco routers. If you can get 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 and CCSP). Each student gets hands-on experience by configuring at least three routers and two switches. See www.globalnettraining.com for more information.

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 I get my CCNA?" 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, attain 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:

At the time of this printing Sybex is working on a full complement of CCNP Study Guides for the new exams. Look for them in the bookstores in late 2003. Visit www.sybex.com for more information.

Exam 642-801: Building Scalable Cisco Internetworks (BSCI) 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.

Exam 642-811: Building Cisco Multilayer Switched Networks (BCMSN) This exam tests your knowledge of the Cisco Catalyst switches.

Exam 642-821: Building Cisco Remote Access Networks (BCRAN) This exam determines whether you really understand how to install, configure, monitor, and troubleshoot Cisco ISDN and dial-up-access products. You must understand PPP, ISDN, Frame Relay, and authentication.

Exam 642-831: Cisco Internet Troubleshooting (CIT) This exam tests you extensively 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.

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

And if you hate tests, you can take fewer of them by signing up for the CCNA exam and the BCRAN and the CIT exams, and then taking just one more long exam called the Composite exam (642-891). Doing this also gives you your CCNP, but beware—it's a really long test that fuses all the material from the BSCI and BCMSN exams into one exam and costs $187.50. Good luck!

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.

Cisco Certified Internetwork Expert (CCIE)

You've become a CCNP, and now your sights are fixed on getting your Cisco Certified Internetwork Expert (CCIE). What do you do next? Cisco recommends a *minimum* of two years of on-the-job experience for those seeking their CCIE. After jumping that hurdle, you then have to pass the written CCIE Qualification Exam before taking the actual lab.

How Do You Become a CCIE?

There are actually four CCIE certifications, and you must pass a written exam for each one of them before attempting the hands-on lab:

CCIE Service Provider The CCIE Communications and Services track covers IP and IP routing, optical networking, DSL, dial, cable, wireless, WAN switching, content networking, and voice.

CCIE Routing and Switching The CCIE Routing and Switching track covers IP and IP routing, non-IP desktop protocols such as IPX, and bridge- and switch-related technologies.

CCIE Security The CCIE Security track covers IP and IP routing as well as specific expert security components and maintenance on large internetworks.

CCIE Voice The CCIE Voice track covers the technologies and applications that make up a Cisco Enterprise VoIP solution.

Once you decide what CCIE track you are going to follow, here are the steps you should follow:

1. Attend the GlobalNet Training CCIE hands-on lab program described at www.globalnettraining.com. (Cisco doesn't actually recommend this step, but I do!)
2. Pass the qualification exam, administered by Prometric or Pearson VUE. (This costs $300 per exam, so hopefully you'll pass it the first time.)
3. Pass the one-day, hands-on lab at Cisco. This costs $1,250 per lab, and many people fail it two or more times. Some people never make it through—it's very difficult. Cisco has added and deleted testing sites, so it's best to check the Cisco website for the most current information and testing locations. Take into consideration that you might just need to add travel costs to that $1,250!

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).

The certifications will give you the knowledge you need 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 Design exam (640-861). 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 VLAN.
- Size networks.

The *CCDA: Cisco Certified Design Associate Study Guide, 2nd Edition* (Sybex, 2003) is the most cost-effective way to study for and pass your CCDA exam.

Cisco Certified Design Professional (CCDP)

To get your CCDP, you first get your CCNA or CCDA certification. Then you must take the Designing Cisco Network Service Architectures (642-871) exam, in addition to the BSCI and BCMSN exams, which were discussed earlier.

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

Cisco Certified Security Professional (CCSP)

Like the CCNP and CCDP, the CCSP was created to provide evidence of your technical worth in the area of security. The CCSP certification provides you with a way to demonstrate your skills in security by using Cisco gear, specifically IDS, PIX Firewall, and VPN Concentrators.

How Do You Become a CCSP?

You have to pass five exams to get your CCSP:

Exam 642-501: Securing Cisco IOS Networks (SECUR) This exam is the first test in the series that provides a background in securing Cisco IOS networks. Not only is this exam part of the CCSP certification track, it is also part of the Cisco Firewall Specialist, Cisco VPN Specialist, and Cisco IDS Specialist certifications, which are discussed below. To pass this exam, you must understand how to plug the holes in a Cisco IOS network.

Exam 642-521: Cisco Secure PIX Firewall Advanced (CSPFA) This is one of the exams associated with the Cisco Certified Security Professional and