JNCIA: Juniper™ Networks Certified Internet Associate Study Guide

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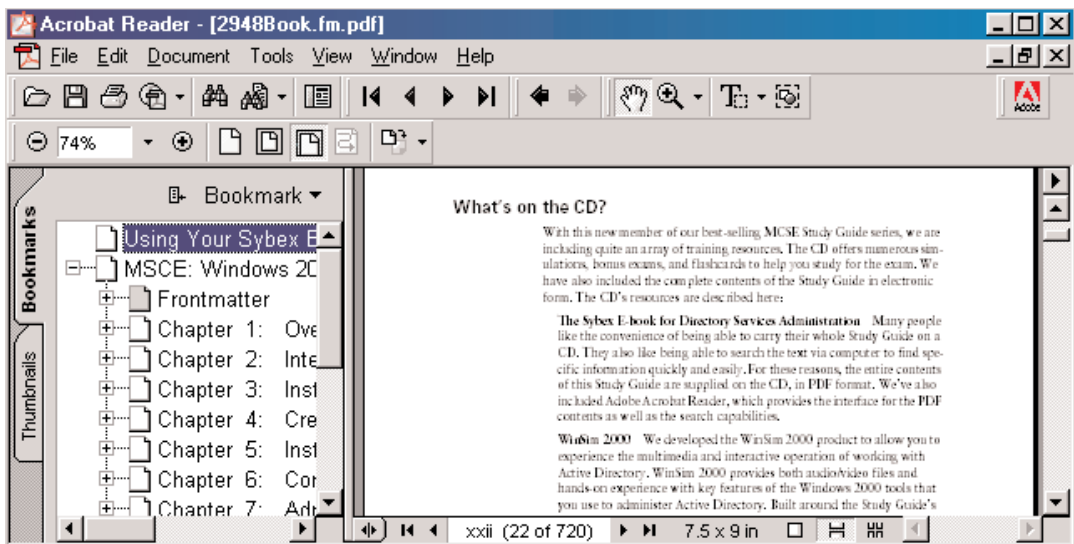
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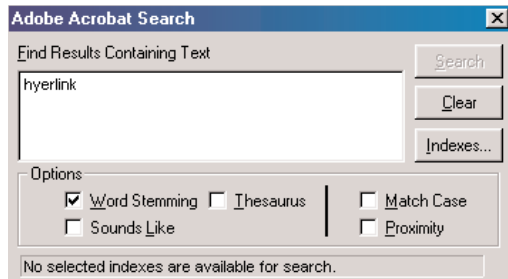
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JNCIA:

Juniper™ Networks Certified Internet Associate

Study Guide

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San Francisco • London

SYBEX

To Our Valued Readers:

As internetworking technologies continue to pervade nearly every aspect of public and private industry worldwide, the demand grows for individuals who can demonstrate they possess the skills needed to manage these technologies. Recognizing this need, Juniper Networks—the leading provider of Internet infrastructure solutions that enable ISPs and other telecommunications companies to meet the demands of Internet growth—recently restructured its certification program to provide a clear path for the acquisition of these skills. Sybex is proud to have partnered with Juniper Networks and worked closely with members of the Juniper Networks Technical Certification Program to develop this Official Study Guide for the Juniper Networks Certified Internet Associate certification.

Just as Juniper Networks is committed to establishing measurable standards for certifying those professionals who work in the cutting-edge field of internetworking, Sybex is committed to providing those professionals with the means of acquiring the skills and knowledge they need to meet those standards. It has long been Sybex's desire to help individuals acquire the technical knowledge and skills necessary to excel in the IT industry.

The authors and editors have worked hard to ensure that this Official Juniper Networks Study Guide is comprehensive, in-depth, and pedagogically sound. We're confident that this book will exceed the demanding standards of the certification marketplace and help you, the Juniper Networks certification candidate, succeed in your endeavors.

Good luck in pursuit of your Juniper Networks certification!

Neil Edde
Associate Publisher—Certification
Sybex, Inc.

This book is dedicated to my wife, Christine, whose patience and love has allowed me to pursue those things in my life that excite me. In addition, my family and friends have provided encouragement beyond words that have helped me reach this point in my life.
—Joseph M. Soricelli

To my beautiful wife of 33 years, Patricia. She deserves the best.
—John L. Hammond

I dedicate my work to my very special parents, my loving and devoted husband, and my children, David and Joseph, the angels of my life.
—Galina Diker Pildush

This is written for my lovely wife, Pam, and our daughter, Catherine Margaret—the cutest future engineer in the world!
—Thomas E. Van Meter

Acknowledgments

Introduction

Greetings and welcome to the world of Juniper Networks. This introductory section serves as a location to pass on to you some pertinent information concerning the Juniper Networks Technical Certification Program. In addition, you'll find information about how the book itself is laid out and what it contains. Finally, we'll review some technical information that you should already know before reading this book.

Juniper Networks Technical Certification Program

The Juniper Networks Technical Certification Program (JNTCP) consists of two platform-specific, multitiered tracks. Each exam track allows participants to demonstrate their competence with Juniper Networks technology through a combination of written proficiency and hands-on configuration exams. Successful candidates demonstrate a thorough understanding of Internet technology and Juniper Networks platform configuration and troubleshooting skills.

The two JNTCP tracks focus on the M-series Routers & T-series Routing Platforms and the ERX Edge Routers, respectively. While some Juniper Networks customers and partners work with both platform families, it is most common to find individuals working with only one or the other platform. The two different certification tracks allow candidates to pursue specialized certifications, which focus on the platform type most pertinent to their job functions and experience. Candidates wishing to attain a certification on both platform families are welcome to do so, but are required to pass the exams from each track for their desired certification level.

> **NOTE** This book covers the M-series & T-series track. For information on the ERX Edge Routers certification track, please visit the JNTCP website at `http://www.juniper.net/certification`.

M-series Routers & T-series Routing Platforms

The M-series Routers certification track consists of four tiers. They include the following:

Juniper Networks Certified Internet Associate (JNCIA)   The Juniper Networks Certified Internet Associate, M-series, T-series Routers (JNCIA-M) certification does not have any prerequisites. It is administered at Prometric testing centers worldwide.

Juniper Networks Certified Internet Specialist (JNCIS)   The Juniper Networks Certified Internet Specialist, M-series, T-series Routers (JNCIS-M) certification also does not have any prerequisites. Like the JNCIA-M, it is administered at Prometric testing centers worldwide.

Juniper Networks Certified Internet Professional (JNCIP)   The Juniper Networks Certified Internet Professional, M-series, T-series Routers (JNCIP-M) certification requires that candidates first obtain the JNCIS-M certification. The hands-on exam is administered at Juniper Networks offices in select locations throughout the world.

Juniper Networks Certified Internet Expert (JNCIE)   The Juniper Networks Certified Internet Expert, M-series, T-series Routers (JNCIE-M) certification requires that candidates first

obtain the JNCIP-M certification. The hands-on exam is administered at Juniper Networks offices in select locations throughout the world.

F I G U R E I . 1 JNTCP M-series Routers & T-series Routing Platforms certification track
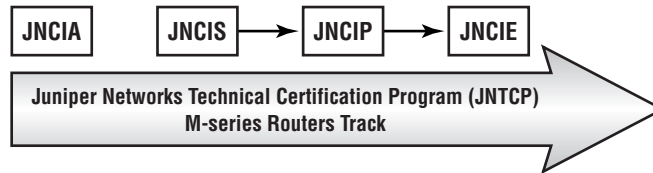
The JNTCP M-series Routers & T-series Routing Platforms certification track covers the M-series and T-series routing platforms as well as the JUNOS software configuration skills required for both platforms. The lab exams are conducted using M-series routers only.

Juniper Networks Certified Internet Associate

The JNCIA-M certification is the first of the four-tiered M-series Routers & T-series Routing Platforms track. It is the entry-level certification designed for experienced networking professionals with beginner-to-intermediate knowledge of the Juniper Networks M-series and T-series routers and the JUNOS software. The JNCIA-M (exam code JN0-201) is a computer-based, multiple-choice exam delivered at Prometric testing centers globally for U.S.$125. It is a fast-paced exam that consists of 60 questions to be completed within 60 minutes. The current passing score is set at 70 percent.

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70 Percent Seems Really Low!

The required score to pass an exam can be one indicator of the exam's difficulty, but not in the way that many candidates might assume. A lower pass score on an exam does *not* usually indicate an easier exam. Ironically, it often indicates the opposite—it's harder.

The JNTCP exams are extensively beta tested and reviewed. The results are then statistically analyzed based on multiple psychometric criteria. Only after this analysis is complete does the exam receive its appropriate passing score. In the case of the JNCIA-M exam, for example, requiring the passing score to be higher than 70 percent would mean that the exam's target audience would have been excluded from passing. In effect, the exam would have been more difficult to pass. Over time, as more exam statistics are collected, or the exam questions themselves are updated, the passing score may be modified to reflect the exam's new difficulty level. The end result is to ensure that the exams are passable by the members of the target audience for which they are written.

JNCIA-M exam topics are based on the content of the Introduction to Juniper Networks Routers, M-series (IJNR-M) instructor-led training course. Just as IJNR-M is the first class most students attend when beginning their study of Juniper Networks hardware and software, the JNCIA-M exam should be the first certification exam most candidates attempt. The study topics for the JNCIA-M exam include:

- System operation, configuration, and troubleshooting
- Routing protocols—BGP, OSPF, IS-IS, and RIP
- Protocol-independent routing properties
- Routing policy
- MPLS
- Multicast

> **NOTE** Please be aware that the JNCIA-M certification is *not* a prerequisite for further certification in the M-series Routers & T-series Routing Platforms track. The purpose of the JNCIA-M is to validate a candidate's skill set at the Associate level and it is meant to be a stand-alone certification fully recognized and worthy of pride of accomplishment. Additionally, it can be used as a stepping stone before attempting the JNCIS-M exam.

Juniper Networks Certified Internet Specialist

The JNCIS-M was originally developed as the exam used to prequalify candidates for admittance to the practical hands-on certification exam. While it still continues to serve this purpose, this certification has quickly become a sought-after designation in its own right. Depending on the candidates' job functions, many have chosen JNCIS-M as the highest level of JNTCP certification needed to validate their skill set. Candidates also requiring validation of their hands-on configuration and troubleshooting ability on the M-series and T-series routers and the JUNOS software use the JNCIS-M as the required prerequisite to the JNCIP-M practical exam.

The JNCIS-M exam tests for a wider and deeper level of knowledge than does the JNCIA-M exam. Question content is drawn from the documentation set for the M-series routers, the T-series routers, and the JUNOS software. Additionally, on-the-job product experience and an understanding of Internet technologies and design principles are considered to be common knowledge at the Specialist level.

The JNCIS-M (exam code JN0-302) is a computer-based, multiple-choice exam delivered at Prometric testing centers globally for U.S.$125. It consists of 75 questions to be completed in 90 minutes. The current passing score is set at 70 percent.

The study topics for the JNCIS-M exam include:

- Advanced system operation, configuration, and troubleshooting
- Routing protocols—BGP, OSPF, and IS-IS
- Routing policy

- MPLS
- Multicast
- Router and network security
- Router and network management
- VPNs
- IPv6

> **NOTE**   There are no prerequisite certifications for the JNCIS-M exam. While JNCIA-M certification is a recommended stepping stone to JNCIS-M certification, candidates are permitted to go straight to the Specialist (JNCIS-M) level.

Juniper Networks Certified Internet Professional

The JNCIP-M is the first of the two one-day practical exams in the M-series Routers & T-series Routing Platforms track of the JNTCP. The goal of this challenging exam is to validate a candidate's ability to successfully build an ISP network consisting of seven M-series routers and multiple EBGP neighbors. Over a period of eight hours, the successful candidate will perform system configuration on all seven routers, install an IGP, implement a well-designed IBGP, establish connections with all EBGP neighbors as specified, and configure the required routing policies correctly.

This certification establishes candidates' practical and theoretical knowledge of core Internet technologies and their ability to proficiently apply that knowledge in a hands-on environment. This exam is expected to meet the hands-on certification needs of the majority of Juniper Networks customers and partners. The more advanced JNCIE-M exam focuses on a set of specialized skills and addresses a much smaller group of candidates. You should carefully consider your certification goals and requirements, for you may find that the JNCIP-M exam is the highest-level certification you need.

> **NOTE**   The JNCIP-M certification is a prerequisite for attempting the JNCIE-M practical exam.

Juniper Networks Certified Internet Expert

At the pinnacle of the M-series Routers & T-series Routing Platforms track is the one-day JNCIE-M practical exam. The *E* stands for Expert and they mean it—the exam is the most challenging and respected of its type in the industry. Maintaining the standard of excellence established over two years ago, the JNCIE-M certification continues to give candidates the opportunity to distinguish themselves as the truly elite of the networking world. Only a few have dared attempt this exam, and fewer still have passed.

The new eight-hour format of the exam requires that candidates troubleshoot an existing and preconfigured ISP network consisting of 10 M-series routers. Candidates are then presented with additional configuration tasks appropriate for an expert-level engineer.

The JNCIE-M (exam code CERT-JNCIE-M) is delivered at one of several Juniper Networks offices worldwide for U.S.$1,250. The current passing score is set at 80 percent.

The study topics for the JNCIE-M exam *may* include:

- Expert-level system operation, configuration, and troubleshooting
- Routing protocols—BGP, OSPF, IS-IS, and RIP
- Routing protocol redistribution
- Advanced routing policy implementation
- Firewall filters
- Class of service
- MPLS
- VPNs
- IPv6
- IPSec
- Multicast

> **NOTE** Since the JNCIP-M certification is a prerequisite for attempting this practical exam, all candidates who pass the JNCIE-M will have successfully completed two days of intensive practical examination.

Registration Procedures

JNTCP written exams are delivered worldwide at Prometric testing centers. To register, visit Prometric's website at `http://www.2test.com` (or call 1-888-249-2567 in North America) to open an account and register for an exam.

The JNTCP Prometric exam numbers are:

- JNCIA-M—JN0-201
- JNCIS-M—JN0-302

JNTCP lab exams are delivered by Juniper Networks at select locations. Currently the testing locations are:

- Sunnyvale, CA
- Herndon, VA
- Amsterdam, Holland

Other global locations are periodically set up as testing centers based on demand. To register, send an e-mail message to Juniper Networks at `certification-testreg@juniper.net` and place one of the following exam codes in the subject field. Within the body of the message, indicate the testing center you prefer and which month you would like to attempt the exam. You will be contacted with the available dates at your requested testing center. The JNTCP lab exam numbers are:

- JNCIP-M—CERT-JNCIP-M
- JNCIE-M—CERT-JNCIE-M

Recertification Requirements

To maintain the high standards of the JNTCP certifications, and to ensure that the skills of those certified are kept current and relevant, Juniper Networks has implemented the following recertification requirements, which apply to both certification tracks of the JNTCP:

- All JNTCP certifications are valid for a period of two years.
- Certification holders who do not renew their certification within this two-year period will have their certification placed in *suspended mode*. Certifications in suspended mode are not eligible as prerequisites for further certification and cannot be applied to partner certification requirements.
- After being in suspended mode for one year, the certification is placed in *inactive mode*. At that stage, the individual is no longer certified at the JNTCP certification level that has become inactive and the individual will lose the associated certification number. For example, a JNCIP holder placed in inactive mode will be required to pass both the JNCIS and JNCIP exams in order to regain JNCIP status; such an individual will be given a new JNCIP certification number.
- Renewed certifications are valid for a period of two years from the date of passing the renewed certification exam.
- Passing an exam at a higher level renews all lower-level certifications for two years from the date of passing the higher-level exam. For example, passing the JNCIP exam will renew the JNCIS certification (and JNCIA certification if currently held) for two years from the date of passing the JNCIP exam.
- JNCIA holders must pass the current JNCIA exam in order to renew the certification for an additional two years from the most recent JNCIA pass date.
- JNCIS holders must pass the current JNCIS exam in order to renew the certification for an additional two years from the most recent JNCIS pass date.
- JNCIP and JNCIE holders must pass the current JNCIS exam in order to renew these certifications for an additional two years from the most recent JNCIS pass date.

> **NOTE**   The most recent version of the JNTCP Online Agreement must be accepted for the recertification to become effective.

JNTCP Nondisclosure Agreement

Juniper Networks considers all written and practical JNTCP exam material to be confidential intellectual property. As such, an individual is not permitted to take home, copy, or re-create the entire exam or any portions thereof. It is expected that candidates who participate in the JNTCP will not reveal the detailed content of the exams.

For written exams delivered at Prometric testing centers, candidates must accept the online agreement before proceeding with the exam. When taking practical exams, candidates are provided with a hard-copy agreement to read and sign before attempting the exam. In either case, the agreement can be downloaded from the JNTCP website for your review prior to the testing date. Juniper Networks retains all signed hard-copy nondisclosure agreements on file.

> **NOTE**   Candidates must accept the online JNTCP Online Agreement in order for their certifications to become effective and to have a certification number assigned. You can do this by going to the CertManager site at `http://www.certmanager.net/juniper`.

Resources for JNTCP Participants

Reading this book is a fantastic place to begin preparing for your next JNTCP exam. You should supplement the study of this volume's content with related information from various sources. The following resources are available for free and are recommended to anyone seeking to attain or maintain Juniper Networks certified status.

JNTCP Website

The JNTCP website (`http://www.juniper.net/certification`) is the place to go for the most up-to-date information about the program. As the program evolves, this website is periodically updated with the latest news and major announcements. Possible changes include new exams and certifications, modifications to the existing certification and recertification requirements, and information about new resources and exam objectives.

The site consists of separate sections for each of the certification tracks. The information you'll find there includes the exam number, passing scores, exam time limits, and exam topics. A special section dedicated to resources is also provided to supply you with detailed exam topic outlines, sample written exams, and study guides. The additional resources listed next are also linked from the JNTCP website.

CertManager

The CertManager system (`http://www.certmanager.net/juniper`) provides you with a place to track your certification progress. The site requires a username and password for access, and you typically use the information contained on your hard-copy score report from Prometric the first time you log in. Alternatively, a valid login can be obtained by sending an e-mail message to `certification@juniper.net` with the word **certmanager** in the subject field.

Once you log in, you can view a report of all your attempted exams. This report includes the exam dates, your scores, and a progress report indicating the additional steps required to attain a given certification or recertification. This website is where you accept the online JNTCP agreement, which is a required step to become certified at any level in the program. You can also use the website to request the JNTCP official certification logos to use on your business cards, resumes, and websites.

Perhaps most important, the CertManager website is where all your contact information is kept up-to-date. Juniper Networks uses this information to send you certification benefits, such as your certificate of completion, and to inform you of important developments regarding your certification status. A valid company name is used to verify a partner's compliance with certification requirements. To avoid missing out on important benefits and information, you should ensure your contact information is kept current.

Juniper Networks Training Courses

Juniper Networks training courses (`http://www.juniper.net/training`) are the best source of knowledge for seeking a certification and to increase your hands-on proficiency with Juniper Networks equipment and technologies. While attendance of official Juniper Networks training courses doesn't guarantee a passing score on the certification exam, it does increase the likelihood of your successfully passing it. This is especially true when you seek to attain JNCIP or JNCIE status, where hands-on experience is a vital aspect of your study plan.

Juniper Networks Technical Documentation

You should be intimately familiar with the Juniper Networks technical documentation set (`http://www.juniper.net/techpubs`). During the JNTCP lab exams (JNCIP and JNCIE), these documents are provided in PDF on your PC. Knowing the content, organizational structure, and search capabilities of these manuals is a key component for a successful exam attempt. At the time of this writing, hard-copy versions of the manuals are provided only for the hands-on lab exams. All written exams delivered at Prometric testing centers are closed-book exams.

Juniper Networks Solutions and Technology

To broaden and deepen your knowledge of Juniper Networks products and their applications, you can visit `http:///www.juniper.net/techcenter`. This website contains white papers, application notes, frequently asked questions (FAQ), and other informative documents, such as customer profiles and independent test results.

Group Study

The Groupstudy mailing list and website (`http://www.groupstudy.com/list/juniper.html`) is dedicated to the discussion of Juniper Networks products and technologies for the purpose of preparing for certification testing. You can post and receive answers to your own technical questions or simply read the questions and answers of other list members.

Tips for Taking Your Exam

Many questions on the exam have answer choices that at first glance look identical. Remember to read through all the choices carefully because "close" doesn't cut it. Although there is never any intent on the part of Juniper Networks to trick you, some questions require you to think carefully before answering. Also, never forget that the right answer is the *best* answer. In some cases, you may feel that more than one appropriate answer is presented, but the best answer is the *correct* answer.

Here are some general tips for exam success:

- Arrive early at the exam center, so you can relax and review your study materials.

- Read the questions *carefully*. Don't just jump to conclusions. Make sure that you're clear about *exactly* what each question asks.

- Don't leave any questions unanswered. They count against you.

- When answering multiple-choice questions that you're not sure about, use a process of elimination to eliminate the obviously incorrect answers first. Doing this greatly improves your odds if you need to make an educated guess.

- Mark questions that you're not sure about. If you have time at the end, you can review those marked questions to see if the correct answer "jumps out" at you.

After you complete the exam, you'll get immediate, online notification of your pass or fail status, a printed Examination Score Report that indicates your pass or fail status, and your exam results by section. (The test administrator will give you the printed score report.) Test scores are automatically forwarded to Juniper Networks within five working days after you take the test, so you don't need to send your score to them.

JNCIA Study Guide

Now that you know a lot about the JNTCP, we need to provide some more information about this text. We begin with a look at some topics and information you should already be familiar with and then examine what topics are in the book. Finally, we discuss how to utilize this resource and the accompanying CD.

What You Should Know Before Starting

If you are familiar with networking books, you might be a little surprised by the starting topic in Chapter 1. It is not the Open Systems Interconnection (OSI) model common to books in our industry, but instead the software that operates the router. In the following chapters, we dive headfirst into the details of running a network using the JUNOS software. This philosophy of *knowing the basics* is quite ingrained in the Juniper Networks Education courseware and certification exams, so we follow that assumption.

This means that you should be knowledgeable and conversant in the following topics:

OSI Model The OSI model defines seven different OSI layers—Physical, Data Link, Network, Transport, Session, Presentation, and Application. This model allows vendors and engineers to develop products designed for a specific OSI level. The segmentation this provides splits the overall "problem" of networking into smaller, more manageable pieces. Each layer of the model has certain responsibilities assigned to it and interacts with its neighboring levels in a predefined manner.

Switches Ethernet, Asynchronous Transfer Mode (ATM), and Frame Relay switches all operate at the Data Link layer (Layer 2) of the OSI model. You should understand the concept of a logical address and know how the local significance of those addresses plays a part in the scalability of the network.

Routers Routers operate at the Network layer (Layer 3) of the OSI model. They connect separate IP subnets together and route packets across a network in a hop-by-hop manner.

Ethernet Networks Ethernet networks are commonly referred to as a broadcast domain. This means that all connected hosts receive all transmissions on the physical media. Each host uses the destination Media Access Control (MAC) address of the Ethernet frame to determine which frame it should process. The MAC addresses on a segment are learned through the Address Resolution Protocol (ARP).

Point-to-Point Links Point-to-point links in a network are often referred to as wide area network (WAN) links. This generalized term is used to describe the nature of a point-to-point link—it contains no end IP hosts. In a core network, point-to-point links connect two network devices. These devices can be ATM switches, Frame Relay switches, or network routers. These network links have the ability to use one of many Layer 2 encapsulations, including ATM, Frame Relay, the Point-to-Point Protocol (PPP), and High-Level Data Link Control (HDLC).

IP Addressing and Subnetting IP hosts and routers use a common packet format for all data transmissions. This includes the destination and source IP address fields, which use a 32-bit address space. Humans often use a dotted decimal format to represent an IP address. The address contains a host portion and a network portion. For example, 192.168.1.1 /24 defines a network address of 192.168.1.0 and a host address of 1 on that subnet.

TCP The Transmission Control Protocol (TCP) operates at the Transport layer (Layer 4) of the OSI model. It defines a common header format, which includes destination and source port numbers. TCP provides a connection-oriented session between two end hosts that is established using a three-way handshake. TCP also uses a sliding window for flow control between the hosts.

UDP The User Datagram Protocol (UDP) also operates at the Transport layer (Layer 4) of the OSI model. Like TCP, it defines a common header format and uses destination and source port numbers. Unlike TCP, however, UDP provides a connectionless session between two end hosts that resembles a flowing packet stream. No reliability or flow control is provided to the hosts.

ICMP The Internet Control Message Protocol (ICMP) uses the IP packet format to perform its functions. Therefore, we often describe it as operating at the Network layer of the OSI model.

The main function of ICMP is to generate error messages that should be acted upon by network devices.

Network Troubleshooting   Network engineers use ping, a function of ICMP, to verify connectivity in the network. Should a problem be found, a second useful tool is traceroute. Traceroute sends UDP messages in a hop-by-hop fashion and provides you with the exact route, and possible trouble spot, through your network.

If you feel that you need a refresher on these topics, please visit the Core Routing website listed in the "About the Authors and Technical Editors" section later in this introduction. You will find resources there that you may use to complete your knowledge base.

Scope of the Book

While it's easy to say that the book covers the objectives for the JNCIA-M exam, we anticipate that this book, like the exam itself, is only the beginning of your reading and learning about Juniper Networks products and the JUNOS software. To that end, we tried to begin each chapter with some basic theory concepts. In addition, the foundation for future learning is laid out in the protocol packet formats and detailed explanations of what they include. From there, we begin to explore the implementation details of the JUNOS software in relation to the chapter subject.

> **NOTE**   All router output in the book was taken from JUNOS software versions 5.4 and 5.5.

To truly cover all there is to know about the JUNOS software and the Juniper Networks routers would take quite a few books. We currently have plans for writing only a few that relate, like this book, to the certification program. Therefore, you will notice a difference in the depth (or lack thereof) of detail from chapter to chapter. The material in some chapters is enough to satisfy your requirements for almost all of your certification needs, but is only the tip of the iceberg within that subject matter. In those cases, we discuss all we need and leave the rest to your own reading from other sources. Other topics, like routing protocols, require a deep understanding at all levels of the certification program. Those topics, in this book, are truly the basic concepts. We leave the rest of the knowledge needed to the forthcoming books in the series.

In the end, we hope that you get enough data to perform well on the JNCIA-M exam, but that you are left longing for more detailed and advanced information. That's a good sign; it is the mark of a great network engineer. Please know that additional resources are available to you and that more Sybex Study Guides are on the way to quench your thirst for knowledge.

What Does This Book Cover?

This book covers everything you need to know to pass the JNCIA-M exam. It teaches you how to configure and operate many protocols and features of the JUNOS software. While this material is helpful, we also recommend gaining some hands-on practice. We understand that accessing a live Juniper Networks router in a lab environment is difficult, but if you can manage it you'll retain this knowledge far longer in your career.

Each chapter begins with a list of the exam objectives covered, so make sure you read them over before getting too far into the chapter. The chapters end with some review questions that are specifically designed to help you retain the knowledge we discussed. Take some time to carefully read through the questions and review the sections of the chapter relating to any question you miss. The book consists of the following material:

- Chapter 1 introduces you to the basic components of the Juniper Networks Routers. We discuss the hardware composition of the chassis platforms and the details of the JUNOS software. This is where we discuss using the command-line interface (CLI) and how an IP packet flows through the router.

- Chapter 2 focuses on the types of interfaces supported by the JUNOS software. We discuss permanent and transient interfaces as well as provide configuration examples for both.

- Chapter 3 introduces you to a portion of the JUNOS software that affects the router as a whole—protocol-independent properties. Static, aggregate, generated, and Martian routes are some of the topics covered.

- Chapter 4 explores the basics of the JUNOS software policy framework. Routing policies on a Juniper Networks router are very powerful and perform numerous functions. We show you how to build and apply a policy on the router.

- Chapter 5 begins our journey into the IP routing protocols with the Routing Information Protocol (RIP). We attempt to discuss all aspects of RIP within the JUNOS software in this single chapter.

- Chapter 6 covers the Open Shortest Path First (OSPF) protocol. The format of the protocol packets, the basic operation, and some configuration details are discussed.

- Chapter 7 discusses the second link-state protocol used by the JUNOS software. Intermediate System to Intermediate System (IS-IS) is very similar to OSPF. We also discuss the packet formats, basic operations, and the configuration within the router. At the conclusion of the chapter, we compare and contrast IS-IS to OSPF.

- Chapter 8 explores the Border Gateway Protocol (BGP). BGP is an important portion of the JUNOS software, and we begin our coverage of it by detailing the protocol attributes. After a look at how BGP selects its routes, we discuss how to configure BGP in a multi-AS environment.

- Chapter 9 takes us in a bit of a different direction when we talk about multicast routing and forwarding on a Juniper Networks router. Multicast addresses for IP and Ethernet are explained as well as the forwarding differences between a dense-mode and a sparse-mode network. After that, we explore the operation and configuration of the Internet Group Management Protocol (IGMP) and Protocol Independent Multicast (PIM).

- Chapter 10 covers how the JUNOS software filters packets in an IP network. Firewall filters are similar to routing policies but are used for different purposes. In addition to packet filtering, you can sample, log, and rate-limit IP traffic.

- Chapter 11 ends the book with a discussion of Multiprotocol Label Switching (MPLS). This relatively new technology is growing ever more popular. We look at the reasons why it was created and the basics of its operation. Its implementation and configuration in the JUNOS software concludes the chapter.

How to Use This Book

This book can provide a solid foundation for the serious effort of preparing for the Juniper Networks Certified Internet Associate M-series routers (JNCIA-M) exam. To best benefit from this book, we recommend the following study method:

1. Take the Assessment Test immediately following this Introduction. (The answers are at the end of the test.) Carefully read over the explanations for any question you get wrong, and note which chapters the material comes from. This information should help you to plan your study strategy.

2. Study each chapter carefully, making sure that you fully understand the information and the test topics listed at the beginning of each chapter. Pay extra-close attention to any chapter where you missed questions in the Assessment Test.

3. Answer the review questions found at the conclusion of each chapter. (The answers appear at the end of the chapter, after the review questions.)

4. Note the questions that you answered correctly but that confused you. Also make note of any questions you answered incorrectly. Go back and review the chapter material related to those questions.

5. Before taking the exam, try your hand at the two bonus exams that are included on the CD accompanying this book. The questions in these exams appear only on the CD. This gives you a complete overview of what you can expect to see on the real thing. After all, the authors of this book are the people who wrote the actual exam questions!

6. Remember to use the products on the CD that is included with this book. The electronic flashcards and the Sybex exam-preparation software have all been specifically selected to help you study for and pass your exam.

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JUNOS software Documentation in PDF

Finally, the Juniper Networks documentation set for version 5.3 is included on the CD so that you can read these manuals on your PC or laptop. The documentation set is in Adobe Acrobat format. Acrobat Reader 5.1 with Search is also included on the CD.

About the Authors and Technical Editors

You can reach all of the authors and technical editors through the Core Routing website at `http://www.corerouting.net`. This website includes links to e-mail the authors, a list of known errata, and other study material to aid in your pursuit of all the Juniper Networks certifications.

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Assessment Test

1. Which BGP attribute is used, by default, only when multiple routes arrive from the same neighboring AS?

   A. Local Preference

   B. MED

   C. AS Path

   D. Origin

2. How many route entries are advertised in a single RIPv2 Response message when MD5 authentication is used in the network?

   A. 23

   B. 24

   C. 25

   D. 26

3. Which interface name correctly represents an Ethernet interface that is located in port 2 on a PIC that is in slot 3 of the FPC, which is in slot 4 in the chassis?

   A. `fe-2/3/4`

   B. `fe-4/3/2`

   C. `fe-2/4/3`

   D. `fe-3/4/2`

4. How are RIPv2 Response messages advertised, by default?

   A. Unicast

   B. Multicast

   C. Broadcast

   D. Anycast

5. You are using an MPLS network to support Layer 3 VPNs. By default, which routing table is used to store information in this environment?

   A. `inet.3`

   B. `mpls.0`

   C. `bgp.l3vpn.0`

   D. `bgp.l2vpn.0`

6. By default, how many next-hop entries are placed into the forwarding table for each valid route?

    A. 1

    B. 2

    C. 3

    D. 4

7. How many prefixes will match `route-filter 192.168.0.0/16 upto /17`?

    A. 1

    B. 2

    C. 3

    D. 4

8. Which software process is responsible for operating all routing protocols?

    A. mgd

    B. chassisd

    C. rpd

    D. pfed

9. What is the largest usable metric allowed in a RIP Response message?

    A. 10

    B. 15

    C. 20

    D. 25

10. Which PIM interface mode must be used in an Auto-RP environment?

    A. Sparse mode

    B. Dense mode

    C. Sparse-dense mode

    D. Dense-sparse mode

11. What OSPF adjacency state is a router in after it receives a hello packet with its own router ID listed as a neighbor?

    A. `Init`

    B. `Start`

    C. `Down`

    D. `2-Way`

12. Which command allows you to view the networks advertised by each router in the OSPF area?

   A. `show ospf neighbor`

   B. `show ospf database detail`

   C. `show ospf interface`

   D. `show ospf statistics`

13. What ASIC is responsible for creating J-cells?

   A. PIC I/O Manager ASIC

   B. I/O Manager ASIC

   C. Distributed Buffer Manager ASIC

   D. Internet Processor ASIC

14. What are the criteria for the election of the Designated Intermediate System (DIS) on a broadcast link?

   A. Highest priority followed by highest MAC address

   B. Lowest priority followed by highest MAC address

   C. Highest priority followed by lowest MAC address

   D. Lowest priority followed by lowest MAC address

15. What protocol family correctly configures an interface to support IS-IS within the JUNOS software?

   A. `iso`

   B. `isis`

   C. `clns`

   D. `clnp`

16. What CLI command allows the router to use all configuration changes you enter?

   A. `commit`

   B. `rollback`

   C. `save filename`

   D. `load filename`

17. Which configuration statement best summarizes the following routes and allows the router to forward IP traffic to the configured route?

- 172.16.13.0 /24
- 172.16.64.0 /19
- 172.16.32.0 /21
- 172.16.52.9 /32

A. `set aggregate route 172.16.0.0/17`

B. `set aggregate route 172.16.0.0/18`

C. `set generate route 172.16.0.0/17`

D. `set generate route 172.16.0.0/18`

18. By default, an IS-IS router will export which of the following routes from the routing table?

A. All `Direct` routes matching the IS-IS configuration

B. All IGP routes, including OSPF

C. All active routes in `inet.0`

D. No routes will be exported.

19. What protocol is used in a multicast network for communications between the hosts and the routers?

A. ICMP

B. IGMP

C. IRDP

D. IGRP

20. An IS-IS router uses which circuit ID to represent the loopback interface of the router?

A. 0x00

B. 0x01

C. 0x02

D. 0x03

21. What PIM state describes a source of 172.16.1.1 for the 228.202.100.1 /32 multicast group address?

A. (228.202.100.1, 172.16.1.1)

B. (228.202.100.1, 172.16.1.1, *)

C. (172.16.1.1, 228.202.100.1)

D. (*, 172.16.1.1, 228.202.100.1)

22. How would you get a Juniper Networks router to advertise IS-IS routes to an OSPF neighbor?

    A. Configure an import policy under `[edit protocols ospf]` that matches IS-IS routes and accepts them.

    B. Configure an export policy under `[edit protocols ospf]` that matches IS-IS routes and accepts them.

    C. Configure an import policy under `[edit protocols isis]` that matches IS-IS routes and accepts them.

    D. Configure an export policy under `[edit protocols isis]` that matches IS-IS routes and accepts them.

23. Where does a BGP router store information it should advertise to an EBGP peer?

    A. Adjacency-RIB-In

    B. Local-RIB

    C. Forwarding-RIB

    D. Adjacency-RIB-Out

24. You would like to implement a firewall filter to affect transit user traffic. On which interface should you apply the filter?

    A. `lo0.0`

    B. `fxp0.0`

    C. `fxp1.0`

    D. `fe-0/0/0.0`

25. Which firewall filter action drops packets that match a term and returns an ICMP message to the source of the packet?

    A. `accept`

    B. `discard`

    C. `dismiss`

    D. `reject`

26. Which of the following routers advertises a Type 7 LSA?

    A. ABR

    B. ASBR

    C. DR

    D. BDR

27. Which BGP attribute is set by the router that first announces a route and denotes the source of that route?

 A. Local Preference

 B. Origin

 C. MED

 D. AS Path

28. Which Juniper Networks router component is responsible for implementing a firewall filter?

 A. PIC I/O Manager ASIC

 B. I/O Manager ASIC

 C. Distributed Buffer Manager ASIC

 D. Internet Processor ASIC

29. An interface has multiple IP addresses configured within the same subnet. Which of the following statements is true concerning the interface's `preferred` address?

 A. It is the highest numbered address on the interface.

 B. It is the lowest numbered address on the interface.

 C. Each configured address is considered to be the `preferred` address.

 D. There is no `preferred` address.

30. What does an MPLS label value of 3 mean?

 A. IPv4 Explicit NULL

 B. Router Alert

 C. IPv6 Explicit NULL

 D. Implicit NULL

31. Which protocol can be used to set up a dynamic LSP using an explicit network path?

 A. IGP

 B. LDP

 C. BGP

 D. RSVP

32. Which of the following is a valid NET address?

 A. 49.0001.1921.6800.1001.01

 B. 49.1000.1111.0001.1921.6800.1001.00

 C. 49.abcd.efgh.1921.6800.1001.00

 D. 49.abcd.1921.6800.1001.01