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Red Hat® Certified Technician Linux
Study Guide

RHCT ™

Exam RH202

100% Coverage—40+ Realistic RHCT Exam Labs
Updated for Red Hat Enterprise Linux 3

Michael Jang
RHCE, Linux+, LCP

- Two Complete RHCT Exams
- Complete Electronic Book

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RHCT™ Red Hat® Certified Technician Linux Study Guide

(Exam RH202)

Michael Jang

RHCT™ Red Hat® Certified Technician Linux Study Guide (Exam RH202)

ABOUT THE CONTRIBUTORS

Author

Michael Jang (RHCE, LCP, Linux+, MCSE) is currently a full-time writer, specializing in operating systems and networks. His experience with computers goes back to the days of jumbled punch cards. He has written other books on Linux certification, including *RHCE™ Red Hat® Certified Engineer Linux Study Guide*, *Linux+ Exam Cram*, and *Sair GNU/Linux Installation and Configuration Exam Cram*. His other Linux books include *Mastering Red Hat Linux 9*, *Mastering Red Hat Enterprise Linux 3*, and *Linux Networking Clearly Explained*. He has also written or contributed to books on Microsoft operating systems, including *MCSE Guide to Microsoft Windows 98* and *Mastering Windows XP Professional, Second Edition*.

In his previous life as a Boeing engineer, Michael worked a variety of jobs, including project manager for the first FAA type certified In-Seat Video Entertainment systems.

Technical Editor

Elizabeth Zinkann is a logical Linux catalyst, a freelance technical editor, and an independent computer consultant. She was a contributing editor and review columnist for *Sys Admin Magazine* for ten years. (Her most recent reviews have taken refuge at www.equillink.com.) Her articles have also appeared in *Performance Computing*, *Linux Magazine*, and *Network Administrator* magazines. As an independent computer consultant, she has built Linux servers; maintained computers utilizing Linux, Solaris, Macintosh, and Windows environments; programmed databases; and taught Linux, Unix, computer hardware basics, and Internet essentials. In a former life, she also programmed communications features, including ISDN at AT&T Network Systems.

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L inux is thriving. Red Hat is at the forefront of the Linux revolution. And Red Hat Certified Engineers, Technicians, and Architects are making it happen.

Even in the current economic recovery, business, education, and governments are cost-conscious. They want control of their operating systems. Linux—even Red Hat Enterprise Linux—saves money. The open source nature of Linux allows users to control and customize their operating systems. While there is a price associated with Red Hat Enterprise Linux (RHEL), it includes support and updates. As I describe shortly, there are freely available "rebuilds" of RHEL 3 that you can get without support from Red Hat.

on the **Job**
A "rebuild" is software that is built by a third party from the same source code. On the other hand, a "clone" is built from different source code.

Major corporations, from Home Depot to Toyota, and governments such as Germany, the Republic of Korea, and Mexico have made the switch to Linux. When faced with a Microsoft audit for licenses, the Portland, Oregon, school system switched to Linux. Major movie studios such as Disney and Dreamworks use Linux to create the latest motion pictures. IBM invested more than a billion dollars in this "free" operating system—just in 2001—and constantly features Linux in its advertising. HP reported 2.5 billion dollars in Linux-related revenue in 2003.

Security is another reason to move toward Linux. The U.S. National Security Agency has developed its own version of the Linux kernel; RHEL 3 has incorporated many of these improvements.

While there are Linux distributions available from a number of companies, Red Hat is far and away the market leader. There are three Red Hat credentials that can add to your credibility as a Linux professional:

- The Red Hat Certified Technician (RHCT) exam is intended to qualify Linux professionals at an intermediate level. As noted in Red Hat's description, "An RHCT can install and configure a new Linux system and attach it to the corporate network. Installation and core system administration concepts, tools, and troubleshooting are explored in depth."

■ The Red Hat Certified Engineer (RHCE) exam is intended to qualify Linux professionals at an advanced level. It includes all RHCT qualifications. In addition, an "RHCE can make decisions about which services should be deployed on the corporate network and how. DNS, NFS, Samba, Sendmail, Postfix, Apache, and the key security capabilities are all covered in detail."

■ The new Red Hat Certified Architect (RHCA) exam is intended to qualify Linux professionals to design enterprise-level networks and more. As noted in Red Hat's description, an "RHCA has RHCE skills plus deeper and additional skills needed to deploy and manage Red Hat Enterprise Linux throughout the enterprise in numerous and varied applications. The curriculum emphasizes technology and processes for software deployment and systems management, directory services and authentication, storage management, system monitoring, performance tuning, and advanced network services and security."

Historically, about 60 percent of the candidates pass the RHCE exam. The pass rate is lower for people taking the exam for the first time. There is no public historical data available for the RHCT exam. But do not be intimidated. While there are no guarantees, this book can help you prepare for and pass the Red Hat Certified Technician exam.

To study for the RHCT exam, you should have a network of at least two Linux or Unix computers. You need to install RHEL 3 on at least one of these computers. That will allow you to configure Linux and test the results. After configuring a service, it's important to be able to check your work from another computer.

Getting Red Hat Enterprise Linux 3

The Red Hat exams are based on your knowledge of Red Hat Enterprise Linux 3. When you take the RHCT exam, it'll be on a "standard" PC with Intel 32-bit (or compatible) personal computers. The CPU should have a speed of at least 700MHz, and the PC should have at least 256MB of RAM. There are four major versions of this operating system available; the price depends on your hardware and the amount of support you need:

■ RHEL 3 Advanced Server (AS) includes varying levels of support for high-end and mission-critical systems.

■ RHEL 3 Entry-level Server (ES) includes varying levels of support suitable for smaller or mid-range servers.

- RHEL 3 Workstation (WS) includes varying levels of support suitable for desktop computers and workstations.

- Red Hat Professional Workstation (RHPW) includes all software from RHEL 3 WS, without any support. The difference between RHPW and RHEL 3 ES is minimal. With a few downloadable RPM packages, you can use this to prepare for the RHCE exam fairly inexpensively. I describe the freely available packages that you need shortly.

If you want to prepare for the RHCT exam with the official RHEL 3 workstation operating system, you can purchase RHEL 3 WS. This allows you to download the four binary CDs associated with this operating system, in ISO format, with quarterly updates, as well as access to downloads through the Red Hat Update Agent. Naturally, as this is the least expensive Red Hat enterprise-level option, it does not include any other official level of support.

But you don't have to pay for the operating system to prepare for the RHCT exam. As of this writing, there are at least four efforts to distribute freely available "rebuilds" of Red Hat Enterprise Linux 3. The source code for almost all RHEL 3 RPM packages is released under the Linux General Public License (GPL) or related licenses. This gives anyone the right to build Red Hat Enterprise Linux 3 from the Red Hat released source code.

The source code is released in Source RPM package format, which means the RPM packages can be built using various **rpm** and **rpmbuild** commands. The four groups have all revised the source code to remove Red Hat trademarks. Some have used and added different versions of a limited number of RPM packages. As of this writing, the first three groups have consolidated the RHEL 3 software in three CDs. You can select and download the rebuild that most closely meets your needs. Alternatively, you can purchase the CDs of some rebuilds from a third party such as CheapBytes (www.cheapbytes.com) or Linux Mall (www.linuxmall.com). I have only tried the rebuilds as developed by the cAos group and White Box. However, there are good reports about all of these rebuilds. These rebuilds are free; however, you should have a high-speed Internet connection. These rebuilds do not use 100 percent RHEL 3 software, so be careful:

- **Community Linux**   The rebuild developed by the cAos group at www.caosity.org appears solid. As of this writing, this seems closest to the original RHEL 3 software.

- **TaoLinux**   The folks behind TaoLinux are based at Alfred University. You can find out more about TaoLinux at www.taolinux.org.

- **White Box Linux** This group was first with a "final" rebuild of RHEL 3. As of this writing, they've documented the different sources that they used on their first CD. You can find out more about this distribution at www.whiteboxlinux.org.

- **RHEL-Rebuild** This group is based out of the University of Innsbruck, Austria. While their rebuild of RHEL 3 is not available as of this writing, they have a complete HOWTO for rebuilding RHEL from source at www2.uibk.ac.at/zid/software/unix/linux/rhel-rebuild.htm.

Alternatively, you can work from RHEL 3 ES or AS. There are four binary CDs associated with RHEL 3 ES and RHEL 3 AS. The software on the final three CDs are identical. The first RHEL 3 ES and AS CDs include additional RPM packages, naturally related to a number of servers, which as far as I know, are not a part of the RHCT exam.

In This Book

This book is organized to serve as an in-depth review for the RHCT exam for both experienced Linux and Unix professionals. Each chapter covers a major aspect of the exam, with an emphasis on the "why" as well as the "how to" of working with and supporting RHEL 3 as a systems administrator or engineer. As the actual RHCT study points change with every release of RHEL, refer to www.redhat.com for the latest information.

This book includes relevant information from Red Hat Enterprise Linux 3 (RHEL 3). There are more than 100 major new features when compared to Red Hat Enterprise Linux 2.1. A few of the key features of RHEL 3 include

- A strong, stable Linux kernel. While the original version is 2.4.21-4.EL, it includes features "backported" from the latest 2.6 kernel, as well as features that improve stability of the operating system environment.

- A new NPTL (Native POSIX Threading Library), which improves the performance of multi-threaded applications.

- Improved support for Logical Volume Management (LVM).

- Performance and stability improvements for NFS.

- Support in high-performance enterprise computing environments.

- Tight integration and support of a number of enterprise-level applications by IBM, Oracle, Veritas, and more.

■ Samba version 3.0, which allows Linux to act as a Microsoft Windows PDC, as well as a member server on an Active Directory network.

■ A substantial number of GUI configuration utilities developed by Red Hat.

There are many more key features; those that I believe are relevant to the RHCT exam are also included in this book.

While it's not the best practice in service, it is fastest to administer RHEL 3 during the exam by logging into the root user account. The command prompt and PATH assumes use of that account. When you're logged into the root account, you'll see a command-line prompt similar to this:

```
[root@Enterprise3 root]#
```

As the length of this prompt would lead to a number of broken and wrapped code lines throughout this book, I've normally abbreviated the root account prompt as

```
#
```

Be careful. The hash mark (#) is also used as a comment character in Linux scripts and programs; for example, here is an excerpt from /etc/inittab:

```
# Default runlevel. The runlevels used by RHS are:
```

Where possible, I describe whether it's a comment character or a root command-line prompt.

When logged in as a regular user, the prompt is slightly different; for user michael, it would typically look like the following:

```
[michael@Enterprise3 michael]$
```

Similarly, I've abbreviated this as

```
$
```

There are a number of command lines and code interspersed throughout the chapters.

On the CD

For more information on the CD-ROM, please see Appendix A.

Exam Readiness Checklist

At the end of the Introduction, you will find an Exam Readiness Checklist. This table has been constructed to allow you to cross-reference the official exam objectives with the objectives as they are presented and covered in this book. The checklist also allows you to gauge your level of expertise on each objective at the outset of your studies. This should allow you to check your progress and make sure you spend the time you need on more difficult or unfamiliar sections. References have been provided for the objective exactly as the vendor presents it, the section of the study guide that covers that objective, and a chapter and page reference.

In Every Chapter

We've created a set of chapter components that call your attention to important items, reinforce important points, and provide helpful exam-taking hints. Take a look at what you'll find in every chapter:

■ Every chapter begins with the **Certification Objectives**—what you need to know in order to pass the section on the exam dealing with the chapter topic. The Objective headings identify the objectives within the chapter, so you'll always know an objective when you see it.

■ **Exam Watch** notes call attention to information about, and potential pitfalls in, the exam. These helpful hints are written by authors who have taken the exams and received their certification—who better to tell you what to worry about? They know what you're about to go through!

■ **Practice Exercises** are interspersed throughout the chapters. These are step-by-step exercises that allow you to get the hands-on experience you need in order to pass the exams. They help you master skills that are likely to be an area of focus on the exam. Don't just read through the exercises; they are hands-on practice that you should be comfortable completing. Learning by doing is an effective way to increase your competency with a product. Remember, the RHCT exam is entirely "hands-on"; there are no longer any multiple-choice questions on this exam.

on the Job

■ **On the Job** notes describe the issues that come up most often in real-world settings. They provide a valuable perspective on certification- and product-related topics. They point out common mistakes and address questions that have arisen from on-the-job discussions and experience.

■ **Inside the Exam** sidebars highlight some of the most common and confusing problems that students encounter when taking a live exam. Designed to anticipate what the exam will emphasize, getting inside the exam will help ensure you know what you need to know to pass the exam. You can get a leg up on how to respond to those difficult-to-understand labs by focusing extra attention on these sidebars.

■ **Scenario & Solution** sections lay out potential problems and solutions in a quick-to-read format.

■ The **Certification Summary** is a succinct review of the chapter and a restatement of salient points regarding the exam.

✓ ■ The **Two-Minute Drill** at the end of every chapter is a checklist of the main points of the chapter. It can be used for a last-minute review.

Q&A ■ The **Self Test** offers questions that solely review your mastery of the chapter. The answers to these questions, as well as explanations of the answers, can be found at the end of each chapter. By taking the Self Test after completing each chapter, you'll reinforce what you've learned from that chapter. There are no multiple-choice questions on the RHCT exam.

■ The **Lab Questions** at the end of the Self Test section offer a unique and challenging question format that require the reader to understand multiple chapter concepts to answer correctly. These questions are more complex and more comprehensive than the other questions, as they test your ability to take all the knowledge you have gained from reading the chapter and apply it to complicated, real-world situations. Most importantly, the RHCT exam contains only lab-type questions. I've tried to make these questions a bit more difficult than what you will find on the exam. If you can answer these questions, you have proven that you know the subject!

Some Pointers

Once you've finished reading this book, set aside some time to do a thorough review. You might want to return to the book several times and make use of all the methods it offers for reviewing the material:

1. *Reread all the Exam Watch notes.* Remember that these notes are written by authors who have taken the exam and passed. They know what you should expect—and what you should be on the lookout for.

2. *Review all the Scenario & Solution sections* for quick problem solving.

3. *Retake the Self Tests.* Taking the tests right after you've read the chapter is a good idea. Focus on the labs, as there are no multiple-choice questions on the RHCT exam. I've included multiple-choice questions just to test your mastery of the practical material in each chapter.

4. *Complete the exercises.* Did you do the exercises when you read through each chapter? If not, do them! These exercises are designed to cover exam topics, and there's no better way to get to know this material than by practicing. Be sure you understand why you are performing each step in each exercise. If there is something you are not clear on, reread that section in the chapter.

The RHCT Exam Challenge

This section covers the reasons for pursuing industry-recognized certification, explains the importance of your RHCT certification, and prepares you for taking the actual examination. It gives you a few pointers on how to prepare, what to expect, and what to do on exam day.

Leaping Ahead of the Competition!

The RHCT certification exam is a hands-on exam. As such, it is respected throughout the industry as a sign of genuine practical knowledge. If you pass, you will be head and shoulders above the candidate who has passed only a "standard" multiple-choice certification exam.

There are two parts to the RHCT exam, as follows. The requirements are detailed in the Exam Readiness Checklist later in this Introduction.

- **Section I** Troubleshooting and System Maintenance: 1.0 hours. As described in the Red Hat Exam Prep guide, RHCT candidates need to meet the requirements for both Red Hat certifications. RHCT candidates must solve *all five* Troubleshooting and System Maintenance problems within that hour. For simplicity, I refer to Section I throughout the book as the "Troubleshooting and System Maintenance" exam.

- **Section II** Installation and Configuration: 2.0 hours. As described in the Red Hat Exam Prep guide, RHCT candidates must get a grade of 70 or higher on the Installation and Configuration exam. For simplicity, I refer to Section II throughout the book as the "Installation and Configuration" exam.

Why a Hands-On Exam?

Most certifications today are based on multiple-choice exams. These types of exams are relatively inexpensive to set up and easy to proctor. Unfortunately, many people without real-world skills are good at taking multiple-choice exams. This results in problems on the job with "certified" engineers, who have an image as "paper tigers" who do not have any real-world skills.

In response, Red Hat wanted to develop a certification program that matters. For the most part, they have succeeded with the RHCT, RHCE, and RHCA exams.

Linux administrators frequently debug computers with problems. The challenges on the Troubleshooting and System Maintenance exam are based on real-world problems. As the typical Linux administrator has to work through multiple challenges on a daily basis, the RHCT Troubleshooting and System Maintenance exam provides a credible measure of real-world skills.

Linux administrators sometimes have to install Linux on a computer. Depending on the configuration, they may need to install Linux from a central source through a network. Installing Linux is not enough to make it useful. Administrators need to know how to configure Linux: add users, install and configure services, create firewalls, and more.

Linux administrators in the enterprise have a new credential to aspire to, the Red Hat Certified Architect (RHCA). Just announced in June of 2004, this credential will test candidate skills in the enterprise, as they relate to software deployment, systems management, directory services, authentication, storage management, system monitoring, performance tuning, advanced network services, and security.

As mentioned previously, while there is no public data on the pass rate for RHCTs, the overall pass rate for RHCE exam candidates has historically hovered around 60 percent. However, this includes candidates who are taking the exam for the first time and the second time (and later). In other words, the actual first-time pass rate may be well under 50 percent.

I've taken the RHCE course (RH300) and exam. By definition, it includes all RHCT components. Everyone in my class had practical experience administering Linux and/or Unix servers. However, I think the pass rate in my class closely matched the published statistics.

on the
ᎥᎧᏏ   *This exam is a Red Hat exam. Knowledge of System V or BSD-based Unix is certainly helpful. But it is important to know how to set up, configure, install, and debug systems under Red Hat Enterprise Linux 3.*

Preparing for the RHCT Exam

Work with Red Hat Enterprise Linux 3. Install it on a computer that you don't need for any other purpose. Configure the services described in this book. Find ways to make Linux unbootable, study the characteristics of the problem, and find different ways to fix the problem.

As you go through this book, you'll have the opportunity to install RHEL 3 several times. If you have more than one computer, you'll be able to install RHEL 3 over a network connection. Then you can work with the different network services. Test out each service as you configure it, preferably from another computer on your network. Testing your work becomes especially important when you start working with the security features of Linux.

Red Hat Certification Program

Red Hat offers several courses that can help you prepare for the RHCT. Most of these courses are four or five days long. In some cases, you can take parts of an individual course on an electronic basis. Table 1 illustrates the available hands-on, instructor-led courses that can also help you prepare for the RHCT exam. There are additional courses listed at www.redhat.com related to the RHCE and RHCA certifications.

Should You Take an RHCT Course?

This book is intended as a substitute for the Red Hat "crash course" (RH133/202). It covers the material described in the related RHCT Course Outlines, available at www.redhat.com. Red Hat provides excellent courses. The Red Hat instructors who teach this course are highly skilled. If you feel the need for classroom instruction, read this book and then take the course.

TABLE FM-I	Course	Description
Red Hat RHCT–Related Courses	RH033	Introduction to Linux: basic pre-system administration skills
	RH131	Basic system administration skills for installation and configuration (RH133 without the RHCT exam)
	RH133	Basic system administration skills for installation and configuration; includes the RHCT exam
	RH202	The RHCT exam

If you're not sure if you're ready for this course or book, read Chapter 1. It is a rapid overview of the prerequisites for the Red Hat certification courses. If you find the material in Chapter 1 to be overwhelming, consider one of the books noted near the start of the chapter, or one of the other Red Hat courses. However, if you are just less familiar with a few of the topics covered in Chapter 1, you're probably okay. Even experienced Linux administrators aren't familiar with everything. Just use the references noted at the beginning of Chapter 1 to fill in any gaps in your knowledge.

Alternatively, you may already be familiar with the material in this book. You may have the breadth and depth of knowledge required to pass the RHCT exam. In that case, use this book as a refresher to help you focus on the skills and techniques you need to pass the RHCT exam.

Signing Up for the RHCT Course and/or Exam

Red Hat provides convenient Web-based registration systems for the courses and test. To sign up for any of the Red Hat courses or the RHCT exam itself, navigate to www.redhat.com, click the link for Training and the RHCT Program, and select the desired course or exam. Alternatively, contact Red Hat Enrollment Central; in the U.S. you can call (866) 626-2994.

Final Preparations

The RHCT exam is grueling. Once you have the skills, the most important thing that you can take to the exam is a clear head. If you're tired or frantic, you may miss the easy solutions that are often available. Get the sleep you need the night before the exam. Eat a good breakfast. Bring snacks with you that can keep your mind in top condition.

Remember, the RHCT exam is three hours long. That is longer than a world-class marathon!

As I describe in Chapter 1, this is an advanced book. It is not designed for beginners to Unix or Linux. As Red Hat does not cover prerequisite skills in its prep course for the RHCT exam (RH133), I've only covered the tools associated with these skills briefly—mostly in Chapter 1. If you need more information on these prerequisite skills, please read the reference books I've cited in that chapter.

The RHCT exam assumes that you already have the prerequisite skills. I've cited them separately, as is done in the current version of the Red Hat Exam Prep guide. Watch for updates at www.redhat.com/training/rhce/examprep.html and www.redhat.com/training/rhce/courses/rhexam.html.