



2

Installation

CERTIFICATION OBJECTIVES

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Installation is one of the two parts of both the RHCE and the RHCT exams. To pass this part of each exam, you'll need to know a lot more than just the basic GUI installation process for a single computer! Once you've studied the installation chapters (Chapters 2 and 3), you'll be able to install Red Hat Enterprise Linux (RHEL) in a number of ways: over a network, directly from the CD, using boot disks, and with automated Kickstart-based tools.

While this chapter covers the “basics,” they are important. You'll learn the nuances of disk partitions. You'll learn to select between available installation classes. Both **fdisk** and Disk Druid are useful tools for configuring your hard drives. Both GRUB and LILO are popular and flexible options as boot loaders. And it's faster to install RHEL over most networks on the RHCE exam, as well as in real life on a group of computers on a LAN.

All you need to get started is sufficient unformatted free disk space (as well as 256MB of RAM). The easiest way to get this is by adding a new disk drive to your system. While the mechanics of adding a drive and setting your PC to boot from your CD-ROM bootable is beyond the scope of this book, neither operation is complicated. Once the new drive is installed and your system is configured to boot from the CD-ROM, just stick the first Red Hat Installation CD-ROM into the CD drive and reboot. Accept the defaults during the installation process and see what happens; it will probably just install, dual-boot automatically (assuming another operating system is already installed), and voilà! You are ready to play!

Time is of the essence on the Red Hat Installation and Configuration exams. You may be asked to install and configure some or all of the services described on the Red Hat Exam Prep guide (www.redhat.com/training/rhce/examprep.html). Use this chapter to understand the services that you can install with RHEL. The fastest way to install RHEL is in text mode.

However, there are two reasons why you may wish to install RHEL in the regular graphical screen. Text mode does not allow you to configure Logical Volume Management (LVM) partitions. It does not allow you to customize individual packages in the package groups that you may want to install.

This book assumes you're using Red Hat Enterprise Linux (RHEL) version 3. If you're using Fedora Linux or Red Hat Linux 9 to simulate an RHEL installation, select a Custom installation for the RHCE exam, and a Workstation installation for the RHCT exam.

INSIDE THE EXAM

Focus During Installation

Both the RHCE and RHCT exams include an installation section. You'll have to do more than just install Linux. You'll have a series of instructions. You'll be told to configure certain services. You may also have to configure different partitions.

Time limits are severe on these exams. Install and configure as much as you can when you install Red Hat Enterprise Linux on your computer. While you can configure and install most anything after Linux is installed, that can take more time than you have.

On the other hand, don't install everything. It takes time to install gigabytes of software over a network. If it's software that you don't need, that's time you can't get back during the exam.

As you read this chapter, learn every part of the installation process. Know what you need to install. For example, if you see a requirement to set up Apache and Samba servers, you'll want to install the Web Server and Windows File Server package groups when you install RHEL 3.

Studying for the Installation Exam

You can use Red Hat Linux 9 to study for the Installation portion of the RHCE and RHCT exams. The steps required are essentially identical to those for Red Hat Enterprise Linux 3. If you haven't been able to get RHEL 3 from Red

Hat or another source such as cAos, I've set up Appendix A as a pictorial-only guide to the RHEL 3 installation process. You can verify for yourself that the steps are essentially identical to those required to install Red Hat Linux 9.

CERTIFICATION OBJECTIVE 2.01

Disk Partitions and Block Devices

A disk drive requires a partition table. The *partition* is a logical sequence of cylinders on the disk, while a *cylinder* represents all the sectors that can be read by all heads with one movement of the arm that contains all these heads. While it's possible to create more, RHEL 3 will recognize only up to 16 partitions on any individual SCSI or an IDE

hard drive. But don't be too concerned about these details; I think it's highly unlikely that you'll have to create so many partitions on either exam.



The main Linux partition utility is `fdisk`. As you'll see in Chapter 3, it won't allow you to create more than 16 partitions on each physical hard disk.

Normally, you should create several partitions when preparing your hard drive to install Linux. This is a good idea for various reasons. First, RHEL 3 is normally configured with at least two filesystems: a Linux native filesystem and a Linux swap filesystem. Second, if you want to install RHEL 3 and another operating system on the same computer, you will have to configure separate partitions for each operating system. You can configure software RAID partitions on different hard drives during the RHEL 3 installation process. However, if you have a hardware RAID system, you'll need to configure it after RHEL 3 is installed.

exam

Watch

During the Installation and Configuration exam, pay careful attention to the instructions. Make sure that the partitions you create while installing RHEL

match any instructions you might see. It's much more difficult and much more time-consuming to revise partitions with utilities such as `fdisk` after RHEL is installed.

Naming Conventions

Linux has a simple naming standard for disk partitions: three letters followed by a number. The first letter identifies the type of drive (h is for IDE/EIDE, s is for SCSI). The second letter is d for disk, and the third letter represents the relative position of that disk, starting with "a." In other words, the first IDE drive is hda, followed by hdb, hdc, and hdd.

The number that follows is based on the relative position of the partition. There are primary, extended, and logical partitions. Primary partitions can contain the boot files for an operating system. Hard drives can also be configured with one extended partition, which can then contain up to 12 logical partitions.

You are limited to four primary partitions on each hard disk. But four partitions are often not enough. If you need more partitions on an IDE drive, substitute an extended partition for one primary partition. You can then configure the logical partitions that you need within the extended partition.

You can't install files directly in an extended partition. You must first allocate some extended partition space to at least one logical partition. You can then configure up to 11 logical partitions within that extended partition. In all cases, the first logical partition on the first IDE drive is hda5.



While you can actually configure more than 11 logical partitions in an IDE extended partition, that's as many as RHEL 3 will accept.

Each partition is associated with a Linux device file. At least this is straightforward; for example, the device filename associated with the first logical partition on the first IDE drive is `/dev/hda5`.

exam

Watch

You should know the device name associated with each partition, as well as the starting names and numbers of any logical partitions created on any basic

disk drive. Also remember that logical partitions on an IDE hard drive always start with number 5; on the first IDE hard drive on a PC, that is `hda5`.

EXERCISE 2-1

Partitioning

You may never have had to plan partitions on a basic Microsoft Windows desktop computer. On a real server, whether you're using Windows or Linux, you should preplan your disk usage and partitions very carefully. This is a preliminary exercise; be prepared to think more deeply about partitions later in this chapter and in Chapter 3.

1. On a piece of paper, draw a rectangle to represent each hard drive on your computer.
2. Label them in order just as Linux would (Hard Drive 1: `/dev/hda`, Hard Drive 2: `/dev/sda`, Hard Drive 3: `/dev/sdb`).
3. Use this diagram to plan how you are going to partition each drive. While this is a preview of future chapters, you should already know that Linux is set up in multiple directories. Each of these directories can be set up in its own partition. Think about how much space you want to allocate to several major directories, such as `/home`, `/var`, `/usr`, `/boot`. Don't forget to allocate some area for a swap partition.

Using this method, you can organize your data, keeping system or users' files together, as well as strategically plan where to place your swap partition(s).

Stability and Security

Linux is organized in a Filesystem Hierarchy Standard (FHS) which includes a number of directories described in Chapter 1. You can organize these directories into a few or many hard drive partitions. During the installation process, RHEL is by default organized into three partitions: the root directory, /, the /boot directory, and a swap partition. One recommended configuration for a Linux server includes separate partitions for each of the following directories: /, /boot, /usr, /tmp, /var, and /home. Other partitions may be appropriate for corporate data, database services, and even the Web and FTP sites if they are expected to be large.

Partitioning the hard drive in this manner keeps system, application, and user files isolated from each other. This helps protect the disk space used by the Linux kernel and various applications. Files cannot grow across partitions. For example, an application such as a Web server that uses huge amounts of disk space can't crowd out space needed by the Linux kernel. Another advantage is that if a bad spot develops on the hard drive, the risk to your data is reduced, as is recovery time. Stability is improved.

Security is also improved. Multiple partitions give you the ability to set up certain directories as read-only filesystems. For example, if there is no reason for any user (including root) to write to the /usr directory, mounting that partition as read-only will help protect those files from tampering.

While there are many advantages to creating many disk partitions, it isn't always the best solution. When hard drive space is limited, the number of partitions should be kept to a minimum. For example, if you have a 2GB hard drive and want to install 1500MB during RHEL installation, you may not want to dedicate extra space to the /var directory. You need room for swap space, additional programs, and your own personal files on other directories.

on the
Job

If you think you may need to reconfigure your Linux partitions in the future, learn more about Logical Volume Management (LVM) configuration. It can allow you to resize Linux partitions after installation.

exam

Watch

It can take considerable time to set up LVM partitions. Unless you know the process very well, the fastest way is through the RHEL installation program in graphical mode, which is available when

installing from CD or from an NFS server. (LVM configuration is not available via text mode RHEL installation.) Learn the process well, just in case you need to set up LVM during the Installation part of the exam.

Basic Space Requirements

Linux is a very flexible operating system. While a full installation of RHEL 3 requires several gigabytes of space, the Red Hat 1.44MB rescue disk that you can create during installation is also a complete operating system (in a minimalist fashion). Depending on your needs, you can install RHEL comfortably, without the GUI, on any hard drive larger than 1GB.

In Chapter 3, you'll learn about the different ways you can allocate space on partitions to several different Linux directories.



There is a Linux distribution on CD which can even be used to diagnose hard disk failures on Microsoft Windows PCs. For more information, see www.knoppix.net. But you won't be able to use the Knoppix CD on the Red Hat exams.

You should size your Linux partitions according to your needs and the function of the computer. For example, a mail server will require more space in /var, because mail files are stored in /var/spool/mail. You could create a separate partition for /var or even /var/spool/mail. In almost every case, it's a good idea to configure at least the /boot directory on a separate partition.

Example: File Server

If the Linux system you are installing is to be a file server, then you could configure your partitions as shown in Table 2-1.

The /usr filesystem is large enough to include key services such as Samba and the Linux graphical user interface. Most of the disk space has been allocated to /var, for the log files and for FTP and Web services, to /home for individual user files, and to /home/shared for common files. Of course, this is only an example. The amount of disk space you allocate for file sharing will depend on factors such as the number of users and the type of files they work on.

TABLE 2-1

Example Partition
Configuration
for a Linux
File Server

Filesystem	Size (MB)	Mounted Directory
/dev/sda1	100	/boot
/dev/sda2	400	/
/dev/sda5	2000	/var
/dev/sda6	300	/usr
/dev/sda7	60	Swap space
/dev/sda8	1000	/home
/dev/sda9	3000	/home/shared

Linux Swap Space

Linux uses the swap space configured on one or more hard drive partitions to store infrequently used programs and data. Swap space can extend the amount of effective RAM on your system. However, if you don't have enough actual RAM, Linux may use the swap space on your hard drive as virtual memory for currently running programs. Because hard drive access can be 1/100,000th the speed of RAM, this can cause significant performance problems.

But you can't just buy extra RAM and eliminate swap space. Linux moves infrequently used programs and data to swap space even if you have gigabytes of RAM.

Normally, Linux (on a 32-bit Intel-style computer) can use a maximum 4GB of swap space, in partitions no larger than 2GB. This 4GB can be spread over a maximum of eight partitions. The typical rule of thumb suggests that swap space should be two to three times the amount of RAM. However, at larger amounts of RAM, the amount of swap space that you need is debatable.

The way Red Hat assigns default swap space is based on the amount of RAM on your system and the space available in your hard drive. As discussed in Chapter 1, Red Hat requires at least 256MB of RAM on RHEL 3. If there's room available on your hard drives, Anaconda configures a swap partition of at least 512MB. For Intel 32-bit systems, Red Hat requires a swap partition at least equal to the amount of RAM on your system.



Red Hat RAM and swap space requirements vary if you're installing RHEL 3 on computers with non-Intel 32-bit CPUs.

In any case, you want to make the swap space you create as efficient as possible. Swap partitions near the front of a hard disk, thus on a primary partition, have faster access times. Swap partitions on different hard drives attached to separate disk controllers gives Linux flexibility on where to send swap data. Linux can start a program through one hard drive controller, and move files to and from swap space on a separate hard drive controller simultaneously.

BIOS Limits

Some computers built before 1998 may have a BIOS that limits access to hard disks beyond the 1,024th cylinder. Some older BIOSes report only 1,024 cylinders on a hard drive no matter how many actual cylinders there are. Computers that are subject to this limit can't see partitions beyond this cylinder. In this case, you should configure the

exam

Watch

Problems due to hardware limitations are common and difficult to troubleshoot if you don't know about them. Familiarize yourself with as many hardware

limitations as you can, including the 1,024-cylinder limit inherent in some older PC models. But don't overdo it; the Red Hat exams are focused on Linux, not PC hardware.

Linux /boot directory on its own partition. Make sure that partition is located within the first 1,024 cylinders of the hard drive. Otherwise, the BIOS won't be able to find the partition with the Linux kernel.

Logical Block Addressing (LBA)

Most PCs manufactured after 1998 have a built-in fix called *logical block addressing*, or LBA. A system that can report LBA will adjust the cylinder, head, and sector numbers such that the entire disk is available using these logical addresses.

Multiple Controllers

It is possible and desirable to use more than one disk controller interface card at the same time on the same PC. This is a common method to increase throughput on your system by reducing your read/write bottlenecks to the only disk.

You can use both SCSI and EIDE controllers in the same machine, but you should be aware of a few snags. The BIOS may only have access to the first two EIDE hard drives. Also, SCSI disks may not be accessible if EIDE drives are installed. The BIOS might have a setting to allow you to boot from SCSI hard disks. Make sure you understand which drives the BIOS will be able to access, because if you install /boot on an inaccessible drive, the BIOS won't be able to find your Linux boot files.

on the job

Many servers are set up with SCSI and EIDE hard drives. If you have one SCSI and two EIDE hard drives, and your computer is set up to boot Linux from a SCSI disk, the BIOS assigns the number 0x80 to /dev/sda (the SCSI disk) and 0x81 to /dev/hda (the first EIDE drive). Linux, however, assigns 0x80 to /dev/hda, 0x81 to /dev/hdb (the second EIDE disk), and 0x82 to the SCSI disk. There is a disagreement between the BIOS and the boot loader. Your boot loader (GRUB or LILO) will not find the boot sector on /dev/sda and, therefore, will not be able to boot Linux.

Partitioning Utilities

Many disk-partitioning utilities are available for Linux—even utilities that do not run under Linux. The basic Linux partitioning utility is **fdisk**. During installation, Red Hat gives you access to Disk Druid. They all work toward the same end, but Red Hat recommends you use Disk Druid during the installation. It is safer than **fdisk**, and it has an easier-to-read graphical interface. But Disk Druid is not available after RHEL is installed.



As it's not cited in any of the Red Hat requirements for the exams, I do not cover the parted utility. However, it is a viable option for managing your partitions.

CERTIFICATION OBJECTIVE 2.02

Downloading the Red Hat Installation CD-ROMs

To study for the RHCE or RHCT exam, you need to practice with a copy of a Red Hat Linux distribution. Ideally, you should work with a copy of Red Hat Enterprise Linux 3. Unfortunately, it is expensive. But assuming you have a high-speed connection, there are options.

RHEL 3 is based on Red Hat Linux 9. If you install and update this operating system, you can use Red Hat Linux 9 to study for the exams. Just be sure that you have the appropriate version of any software that you're studying. Alternatively, you could even use the version of Fedora Linux (Yarrow) released in November 2003. It's a mixed bag; that Fedora Linux release includes some updates that are in RHEL 3, and others that go beyond RHEL 3.

If you don't have a high-speed connection, downloading the gigabytes of files associated with the latest versions of RHEL can take several days. If Red Hat Linux 9 or Fedora Linux is all that you can or want to afford, and you can accept the differences with Red Hat Enterprise Linux 3, you can purchase downloaded CDs from a source such as CheapBytes (www.cheapbytes.com) or buy a book with the publisher's edition of Red Hat Linux 9. Alternatively, there are third parties who have built RHEL 3 from the publically available source RPMs. I describe these options in more detail in the Introduction to this book.

Generally, these downloaded CDs are available in ISO format, which you can process and write to CDs using the methods I describe in this section.

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W a t c h

To show you that you can use Red Hat Linux 9 or a third-party RHEL 3 rebuild to study for the RHCE and RHCT exams, I've illustrated the detailed installation process in screenshots in Appendix A.

Red Hat Enterprise Linux

As described in the introduction to this book, you can buy a copy of RHEL. Assuming you have a PC with an Intel-style 32-bit CPU, you can purchase the most inexpensive version of this server, Red Hat Enterprise Linux ES. As of this writing, you can purchase the Basic Edition with a one-year subscription to the Red Hat Network for \$349. At this price, RHEL ES 3 is available only by download in ISO format; for all practical purposes, this requires a high-speed connection.

While there are versions of RHEL available with packaged CDs, they are significantly more expensive. Once again, let me repeat my belief that you can use Red Hat Linux 9 or the RHEL rebuilds to study for the RHCE and RHCT exams based on RHEL 3.

Red Hat Enterprise Source RPMs

Red Hat provides free access to the source RPMs for Red Hat Enterprise Linux 3 (RHEL). You can download these source RPMs from ftp.redhat.com (or an FTP mirror site) for free. You can then build your own copy of RHEL using the instructions as described in the Red Hat Enterprise Linux Rebuild mini-HOWTO, available online from www2.uibk.ac.at/zid/software/unix/linux/rhel-rebuild.htm. My understanding is that once you've downloaded and prepared the source RPMs, it takes a couple of days for an average PC to process the source code into binary RPM packages which you can then install on your computer.

While I am not a lawyer, I understand that this is legal because the source code for almost all of the software included with RHEL 3 has been released through the Linux General Public License (GPL).

Third-Party Red Hat Enterprise Linux

As I've described in the introduction to this book, there are third-party versions of RHEL 3 available. They are built from the source code RPMs that Red Hat has made freely available, under the Linux General Public License (GPL). While I am not a

lawyer, my understanding is that these third parties have complied with the following guidelines:

- Software in RHEL 3 that is not licensed under the GPL must not be included. As I understand it, this includes some packages supplied by IBM.
- All software in the third-party version of RHEL 3 must be built from the source code (despite what you might see on eBay, my understanding is that you can't just resell copies of the RHEL binary RPMs, especially the installation CDs).
- References to "Red Hat" must be removed from the software.
- Binary updates, such as through **up2date** or the Red Hat Network, are not allowed. However, this does not exclude updates from revised GPL source code.

As I've described in the introduction, there are three major groups working on a rebuild of RHEL 3. As of this writing, each of these groups have made their work available in ISO format through their Web sites (and mirrors), which you can write to CDs using the techniques I describe shortly.



The work of these third parties are known as “rebuilt” because their versions of RHEL 3 are built from source RPMs. They are not “clones,” as they use the same basic source code used and released by Red Hat.

Red Hat Linux 9 or Fedora

RHEL 3 is based on Red Hat Linux 9. It includes some improvements that are included in the first release of Fedora Linux in late 2003. Therefore, you could prepare for the RHCE or RHCT exams using one or both of these operating system distributions.

However, these operating systems are not identical. For example, while Red Hat Linux 9 uses the samba-2.2.7 RPM package for sharing with Microsoft Windows computers, RHEL 3 uses the samba-3.0.0 RPM package. With the current Red Hat development model, Red Hat will use Fedora to test *some* future changes to RHEL. Today the differences between RHEL 3, Red Hat Linux 9, and the Fedora Linux released in late 2003 are fairly small. However, I believe that the differences between RHEL 4 and Fedora (or its successor) will be more substantial. I'm guessing RHEL 4 will be released in 2005.

If you don't have a copy of Red Hat Enterprise Linux 3, I recommend that you study with one of the third-party rebuilds of RHEL 3.

exam

Watch

If you're using Red Hat Linux 9 or Fedora Linux to simulate the conditions of RHEL 3, you may want to download and install some of the RHEL 3 source RPMs. For example, if you want to install the version of Samba

associated with RHEL 3 (3.0.0-14.3E), you can download the Samba source RPM from a Red Hat Rawhide server at ftp.redhat.com or one of the mirrors listed at www.redhat.com/download/mirror.html.

An Overview of the Download Process

If you have a high-speed connection, downloading Red Hat operating system CD-ROMs is fairly easy. If you've purchased Red Hat Enterprise Linux, follow the Red Hat Network download instructions. If you want to download the Red Hat Linux 9 or Fedora Installation CDs, just connect to ftp.redhat.com or one of the many mirrors such as Tucows Linux (www.tucows.com) or www.linuxiso.org, and start your download. If you're downloading a third-party rebuild of RHEL 3, navigate to their Websites for more information. Since FTP is optimized for file transfer, FTP clients are the best way to download a Linux distribution.

There are two ways to download and prepare Red Hat Installation files: as individual files or as ISO packages. You can install from ISO packages on a hard drive. You can also install from ISO packages or a directory of RPM files on an HTTP, FTP, or NFS server.

Once you've downloaded the installation files or ISOs, you're ready to install the Red Hat operating system, possibly with the help of the appropriate boot disk as described later in this chapter.

Downloading Installation Files

If you have 2GB of available disk space, you can download the Red Hat operating system installation files. Create a RedHat directory or subdirectory on your hard disk, and copy the files from the /RedHat directory on the FTP server. I'll show you shortly how you can use this to set up a network installation server.

On your computer, direct the download to a /RedHat directory (or subdirectory). Organize the files in the /RedHat directory with the same subdirectories that you can

find on a Red Hat installation CD. Make sure to include both the `/base` and `/RPMS` subdirectories. When you perform the download, make sure you also copy the hidden `.discinfo` file on the first installation CD.

Downloading Red Hat Linux on ISO Files

An ISO is a single file that is associated with a large package of files, usually on a CD. Once you download an ISO, you can use a number of tools to extract the files to a CD-ROM. There are four binary installation ISOs associated with Red Hat Enterprise Linux 3. Alternatively, the third-party rebuilds (as of this writing) have consolidated the RHEL 3 software on three binary installation ISOs.

As long as you have a high-speed connection, it's easy to download the appropriate ISOs. I describe the `lftp` client in Chapter 7. Once you've downloaded the three Red Hat installation ISOs, use the tool of your choice to extract the contents to a writeable CD. For example, the following command records the `/tmp/RedHat/rhcd1.iso` file, at 2x speed, to a blank writable CD on the first CD drive on your computer:

```
# cdrecord -v speed=2 dev=0,0,0 /tmp/RedHat/rhcd1.iso
```

If you need more information on recording CDs, refer to the CD-Writing HOWTO available from www.tldp.org. Alternatively, you can mount the ISO as if it were a CD. For example, the following command mounts the aforementioned ISO file:

```
# mount -t iso9660 -ro loop /tmp/RedHat/rhcd1.iso /mnt/cdrom
```

You don't even need to extract the files from the ISO. Just use the `/mnt/cdrom` directory as if it were a real CD.

It's easy to check the integrity of each installation CD. Reboot your computer with the first Red Hat Enterprise Linux installation CD. Type **linux mediacheck** at the prompt; the RHEL 3 installation program takes you to the screen shown in Figure 2-1 where you can test each CD.

exam

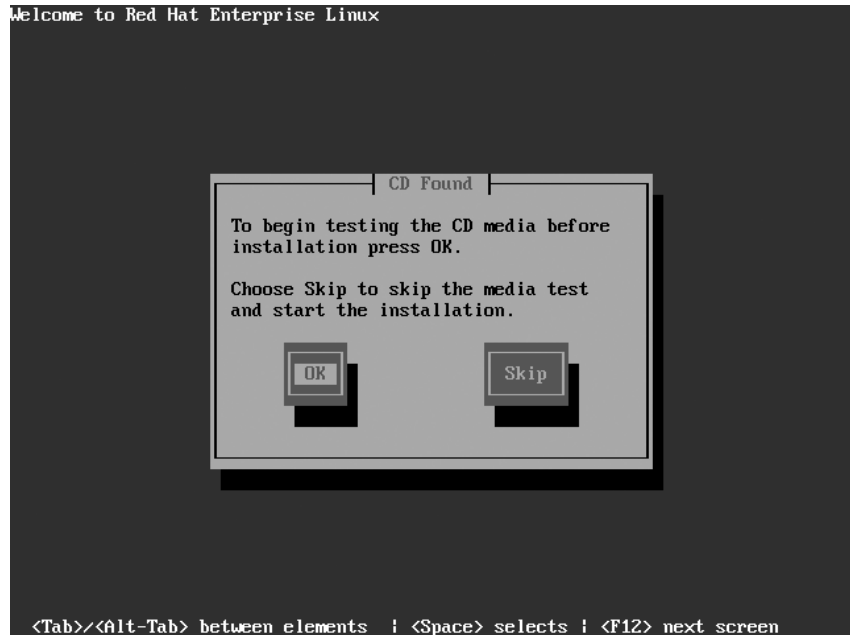
Watch

As you prepare for the RHCE or RHCT exams, remember to think in terms of what is practical. While it is important to know how to download and

set up a Red Hat installation CD, it wouldn't be practical for a group of test candidates to all be downloading the Red Hat installation CDs during an actual exam.

FIGURE 2-1

Ready to check
the integrity of an
installation CD



CERTIFICATION OBJECTIVE 2.03

Configuring a Network Installation

Most Linux users can install Red Hat Enterprise Linux from a CD-ROM. During the installation portion of the Red Hat exam, you'll probably want to save time by installing RHEL 3 over a network on an NFS, HTTP, or FTP server. As you'll want to practice network installations, you'll want to set up a network server. For completeness, you can also install RHEL from ISO images on a local hard disk.

Configuring a Network Installation Server

Once you have the Red Hat installation CDs, configuring a network installation server is a fairly easy process. All you need to do is copy the files from each CD's /RedHat directory to a common directory, configure sharing on the directory, and then activate the NFS, FTP, or HTTP network.

Before you set up a network installation source, you'll need a partition with about 2GB of free space (or more). I'll illustrate the process for an NFS server, and explain the variations for FTP and HTTP servers.

Creating an NFS Installation Server

In the following steps, I'll show you how to create a shared directory, copy the Red Hat installation files, and then set up the share through NFS. As NFS is the most efficient way to share files between Linux and Unix computers, I think it's the most likely option for network installations during the exam. You'll need the Red Hat Enterprise Linux installation CDs, or at least the ISO files associated with those CDs..

1. Create a directory for your installation files. With the following command, I can create the `/mnt/inst` directory:

```
# mkdir /mnt/inst
```
2. Insert the first Red Hat Enterprise Linux installation CD into its drive. Mount it with the following command. (If all you have are the ISO files, say in the `/tmp` directory, substitute `mount -t iso9660 -ro loop /tmp/firstcd.iso /mnt/cdrom`.)

```
# mount /mnt/cdrom
```
3. Copy the required files from the first Red Hat Enterprise Linux installation CD.

```
# cp -ar /mnt/cdrom/RedHat /mnt/inst
```
4. Copy the `.discinfo` file from the first Red Hat Enterprise Linux installation CD. This is required if you want to use **redhat-config-packages** (also known as the Red Hat Package Management tool) to add software using this installation server after Linux is installed. (While there are a number of other files on the first RHEL 3 installation CD, `.discinfo` is the only file that's absolutely required for an installation server.)

```
# cp /mnt/cdrom/.discinfo /mnt/inst
```
5. Unmount the first Red Hat Enterprise Linux installation CD.

```
# umount /mnt/cdrom
```
6. Repeat steps 2, 3, and 5 with the remaining Red Hat Enterprise Linux installation CDs.

7. Set up an NFS share. Add the following line to `/etc/exports`. You can do it with a text editor such as `vi` or the **redhat-config-nfs** utility (also known as the NFS Server Configuration tool) described in Chapter 9.

```
/mnt/inst          *(ro,sync)
```

8. Export the shared directory.

```
# exportfs -a
```

9. Make sure there's nothing blocking access to NFS. The default Red Hat Enterprise Linux firewall blocks access to an NFS server. While inelegant, the following command “flushes,” or turns off the standard Linux firewall from the local computer. I'll describe the **iptables** command in more detail in Chapter 10.

```
# iptables -F
```

10. Now you can activate the NFS service. The following commands assume that it's already running (which you can check with the **service nfs status** command):

```
# service nfs stop
```

```
# service nfs start
```

11. Finally, you can check the status of your share. If it's working, you should see the contents of the `/etc/exports` directory when you run the following command:

```
# showmount -e
```

When you install Red Hat Enterprise Linux from an NFS server, you'll need the name of the installation directory, in this case, `/mnt/inst`.



For an NFS connection, you don't need to copy the files from a CD. If you've downloaded ISOs of the RHEL installation CDs, all you need to do is copy them to the shared NFS directory, in this case, `/mnt/inst`. However, this does not work for FTP or HTTP servers.

Configuring Another Network Installation Server

The Red Hat exams test your knowledge of Linux. The most efficient way to share files between Linux computers is NFS. If you have a choice on the exams, install Red Hat Enterprise Linux over a network connection, using NFS. However, it's possible that you'll want or need to install Red Hat Enterprise Linux using one of the two other available protocols: HTTP or FTP.

HTTP Installation Server

The most popular Web server on the Internet is Apache, which you can easily install with Red Hat Enterprise Linux. The basic steps are the same as for the NFS server. The details are slightly different. I'm assuming that you've already installed the Apache Web server as described in Chapter 7. The basic Apache share directory corresponds to the DocumentRoot variable, which is by default the `/var/www/html` directory. In other words, you'd copy the Red Hat Installation files to a subdirectory of this directory. For the purpose of this chapter, I've created the `/var/www/html/test` directory. Here are the detailed steps:

1. Create a directory for your installation files. With the following command, I'm creating the `/var/www/html/test` directory. (If you get an error message, Apache may not be properly installed.)

```
# mkdir /var/www/html/test
```
2. Insert the first Red Hat Enterprise Linux installation CD into its drive. Mount it with the following command. (If all you have are the ISO files, say in the `/tmp` directory, you can mount the first Red Hat Enterprise Linux installation CD with the `mount -t iso9660 -ro loop /tmp/firstcd.iso /mnt/cdrom` command.)

```
# mount /mnt/cdrom
```
3. Copy the required files from the first Red Hat Enterprise Linux installation CD.

```
# cp -ar /mnt/cdrom/RedHat /var/www/html/test/
```
4. Copy the `.discinfo` file from the first Red Hat Enterprise Linux installation CD. This is required if you want to use **redhat-config-packages** (also known as the Red Hat Package Management tool) to add software using this installation server after Linux is installed. (While there are a number of other files on the first RHEL 3 installation CD, `.discinfo` is the only file that's absolutely required for an installation server.)

```
# cp /mnt/cdrom/.discinfo /var/www/html/test/
```
5. Unmount the first Red Hat Enterprise Linux installation CD.

```
# umount /mnt/cdrom
```
6. Repeat steps 2, 3, and 5 with the remaining Red Hat Enterprise Linux installation CDs.
7. Make sure there's nothing blocking access to your Apache server. While inelegant, the following command "flushes," or turns off the standard Linux

firewall from the local computer. I'll describe the **iptables** command in more detail in Chapter 10.

```
# iptables -F
```

8. Now you can activate the Apache service, **httpd**. The following commands assume that it's already running (which you can check with the **service httpd status** command):

```
# service httpd stop
```

```
# service httpd start
```

When you install Red Hat Enterprise Linux from an Apache HTTP server, you'll need to remember the directory with the Red Hat installation files. For an HTTP server, the right directory is relative to the DocumentRoot variable, `/var/www/html`. With these steps, the installation files are in `/var/www/html/test`; therefore, the correct directory is `/test`.

FTP Installation Server

One of the oldest protocols still in common use on the Internet is FTP, the File Transfer Protocol. It's efficient, it's easy to use, and now that Red Hat has implemented the very secure FTP (vsFTP) service on its systems, it's relatively secure.

The basic steps are the same as for the NFS server. I'm assuming that you've already installed the vsFTP server as described in Chapter 7. The basic FTP share directory is `/var/ftp/pub`. In other words, you'd copy the Red Hat Installation files to a subdirectory of this directory. For the purpose of this chapter, I've created the `/var/ftp/pub/test` directory. Here are the detailed steps:

1. Create a directory for your installation files. With the following command, I'm creating the `/var/ftp/pub/test` directory. (If you get an error message, Apache may not be properly installed.)

```
# mkdir /var/ftp/pub/test
```

2. Insert the first Red Hat Enterprise Linux installation CD into its drive. Mount it with the following command. (If all you have are the ISO files, say in the `/tmp` directory, you can mount the first RHEL installation CD with the **mount -t iso9660 -ro loop /tmp/firstcd.iso /mnt/cdrom** command.)

```
# mount /mnt/cdrom
```

3. Copy the required files from the first Red Hat Enterprise Linux installation CD.

```
# cp -ar /mnt/cdrom/RedHat /var/ftp/pub/test
```

4. Copy the `.discinfo` file from the first Red Hat Enterprise Linux installation CD. This is required if you want to use **redhat-config-packages** (also known as the Red Hat Package Management tool) to add software using this installation server after Linux is installed. (While there are a number of other files on the first RHEL 3 installation CD, `.discinfo` is the only file that's absolutely required for an installation server.)

```
# cp /mnt/cdrom/.discinfo /var/www/html/test/
```

5. Unmount the first Red Hat Enterprise Linux installation CD.

```
# umount /mnt/cdrom
```

6. Repeat steps 2, 3, and 5 with the remaining Red Hat Enterprise Linux installation CDs.
7. Make sure there's nothing blocking access to your Apache server. While inelegant, the following command “flushes,” or turns off the standard Linux firewall from the local computer. I'll describe the **iptables** command in more detail in Chapter 10.

```
# iptables -F
```

8. Now you can activate the FTP server, vsFTP. The following commands assume that it's already running (which you can check with the **service vsftpd status** command):

```
# service vsftpd stop
```

```
# service vsftpd start
```

When you install Red Hat Enterprise Linux from an FTP server, you'll need to remember the directory with the Red Hat installation files. For an FTP server, the right directory is relative to the basic `/var/ftp` directory. With these steps, the installation files are in `/var/ftp/pub/test`; therefore, the correct directory is `/pub/test`.

Requirements for Network Installations

Now that you've set up the Red Hat Enterprise Linux installation files on a network server, let's look at what else you'll need on the computer where you'll be installing Linux. Once Linux detects your network card, you'll need to configure that card to be a part of your network. It'll be done by a DHCP (Dynamic Host Configuration Protocol) server or by static IP addressing.

exam

Watch

The Red Hat Enterprise Linux installation program is also known as Anaconda. A DHCP server is based on the Dynamic Host Configuration Protocol. If you're going to install RHEL over a

network during the exam, your proctor will tell you that there's an DHCP server for your network, or should give you the static IP address information that you'll use.

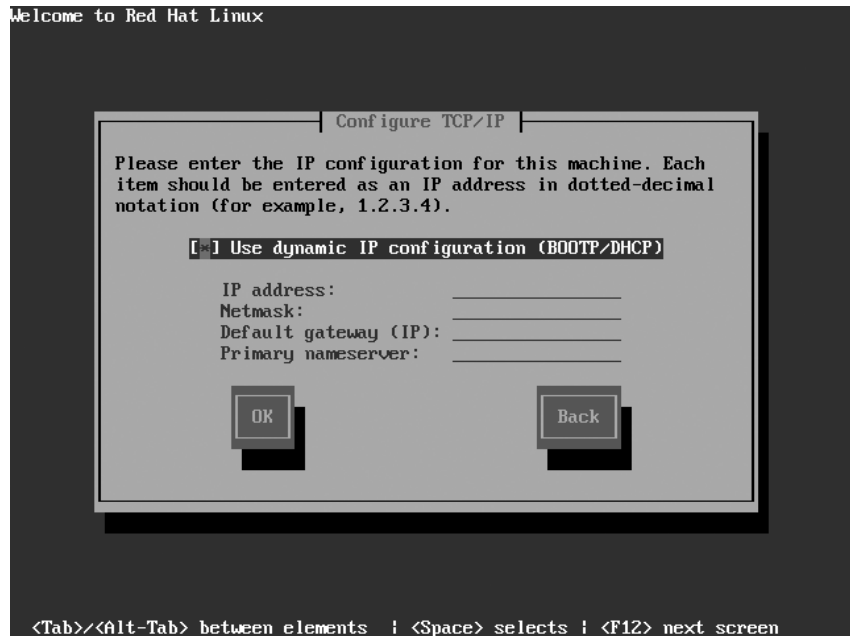
If there's a DHCP server for your network, this process is easy. All you'll need to do is set the Linux installation program to ask for your IP address information from that DHCP server. As long as there are no active firewalls between your computer and the DHCP server, you should not have any problems.

Otherwise, you'll need to configure your computer with static IP addresses. In this case, you'll need a valid, unused IP address, the local network mask, the default gateway IP address (if the installation files are on a different LAN), and optionally, the primary DNS IP address, a domain name such as example.com, and the hostname to use for the local computer.

As you can see in Figure 2-2, Anaconda allows you to get your IP address information from a DHCP server or enter the static IP address information yourself.

FIGURE 2-2

Configuring
TCP/IP on your
network card
during installation



You'll also need the hostname or IP address of the Red Hat Enterprise Linux installation server. If you have the hostname, you'll also need the IP address of the DNS server for the network used for the exam. As shown in Figure 2-2, this is also known as the *Primary nameserver*. If the DNS server is not on the LAN, you'll also need the *Default gateway* IP address.



If you're installing Red Hat Enterprise Linux from files on a network server, check the firewall on that server. The standard RHEL 3 and Red Hat Linux 9 firewalls cut off network communication to whatever FTP, HTTP, or NFS server you might be using to store the /RedHat directory tree.

CERTIFICATION OBJECTIVE 2.04

Customizing Your Installation

Before we install Red Hat Enterprise Linux on a computer, we'll look at some of the critical decisions that you'll need to make during the Red Hat exams. Time is of the essence on these exams. While you could just install everything, that could easily cost you 15 minutes or more. That may be the time that you need to configure the critical services required to pass the exam. By the time you're done with this section, you'll have the tools to select just the software that you need.

Red Hat Enterprise Linux includes its own installation program, known as Anaconda. RHEL 3 Workstation and RHEL 3 Server include different sets of default RPM packages. With Fedora Core 1 or Red Hat Linux 9, you can simulate these installations using the Workstation or Custom installation options. Naturally, RHEL Workstation is associated with the RHCT exam; RHEL Server is associated with the RHCE exams.



Even RHCEs need to know how to configure the X Window, as they are often expected to configure workstations for users who need graphical applications.

As the RHCE exam includes RHCT components, you may also need to configure your computer as a workstation. Don't be surprised if you install applications associated with the X Window System and GNOME or KDE desktop environments.

Depending on your needs, you can set up a system with anywhere from about 600MB to 4GB of files. In the real world, you'll need lots of

additional room for user files, log files, and any additional applications that you may want to install in the future.

The essence of each installation is in the installed package groups. As you examine each of the options, focus on the associated package groups. First, there are basic package groups that are included with every installation. Then, there are the package groups that you can select during the installation process.

Baseline Packages

Every installation of Red Hat Enterprise Linux gets a series of packages, organized into the Core and Base package groups. You can find a list of these on the first Red Hat Enterprise Installation CD-ROM in `/RedHat/base/comps.xml`, at the top of this text file. I've modified this file slightly, as shown in Figure 2-3, to list the first few base packages specified in this file.

FIGURE 2-3

Red Hat
Enterprise Linux
base packages

```
<group>
  <id>core</id>
  <name>Core</name>
  <default>true</default>
  <description>Smallest possible installation</description>
  <uservisible>false</uservisible>
  <packagelist>
    <packagereq type="default">ash</packagereq>
    <packagereq type="mandatory">basesystem</packagereq>
    <packagereq type="mandatory">bash</packagereq>
    <packagereq type="mandatory">coreutils</packagereq>
    <packagereq type="mandatory">cpio</packagereq>
    <packagereq type="mandatory">e2fsprogs</packagereq>
    <packagereq type="mandatory">ed</packagereq>
    <packagereq type="mandatory">efibootmgr</packagereq>
    <packagereq type="mandatory">elilo</packagereq>
    <packagereq type="mandatory">file</packagereq>
    <packagereq type="mandatory">filesystem</packagereq>
    <packagereq type="mandatory">glibc</packagereq>
    <packagereq type="mandatory" basearchonly="true">grub</packagereq>
    <packagereq type="mandatory">hdparm</packagereq>
    <packagereq type="mandatory">hotplug</packagereq>
    <packagereq type="mandatory">initscripts</packagereq>
    <packagereq type="mandatory">iproute</packagereq>
    <packagereq type="mandatory">iputils</packagereq>
    <packagereq type="mandatory">kbd</packagereq>
    <packagereq type="mandatory">kernel</packagereq>
    <packagereq type="mandatory">libgcc</packagereq>
    <packagereq type="mandatory">libtermcap</packagereq>
    <packagereq type="mandatory">losetup</packagereq>
    <packagereq type="mandatory">passwd</packagereq>
    <packagereq type="mandatory">procps</packagereq>
    <packagereq type="mandatory">raidtools</packagereq>
    <packagereq type="mandatory">readline</packagereq>
```

Default Packages

The RHEL 3 server installation process installs about 1.4GB of software by default. This includes several package groups that are suitable for some uses. If this is good enough for the requirements as presented on your particular exam, activate the Accept The Current Package List option and click Next to continue. In most cases, you'll want to select the Customize The Set Of Packages To Be Installed option.

As shown in Figure 2-4, they include the package groups described in Table 2-2. They actually include three other package groups, Graphical Internet, Text Internet, and Printing Support. I include a basic description of these Package Groups in Table 2-2 as well.

There are actually more default package groups, which you can review in the aforementioned comps.xml file. They include the following package groups: Printing Support, Dialup Networking Support, and Text-based Internet.



When you install RHEL 3, the Dialup Networking Support package group is automatically installed during the regular installation process. You're not even allowed to deselect it through the default version of Anaconda.

FIGURE 2-4

Red Hat
Enterprise Linux
default package
groups

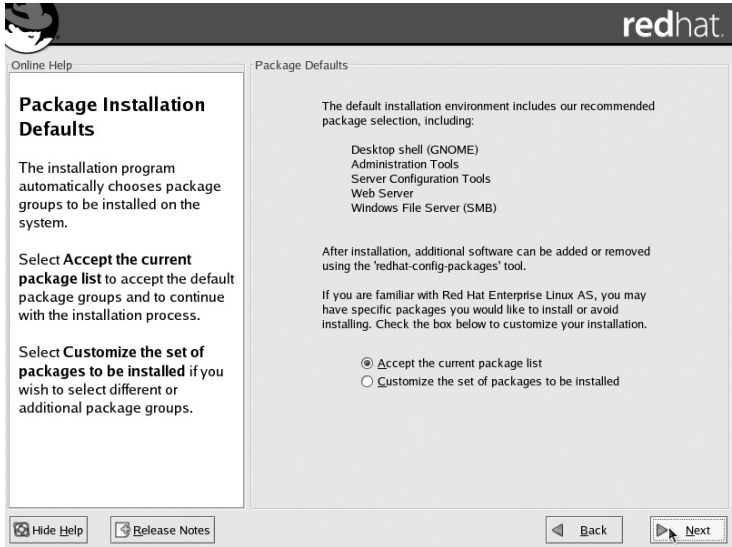


TABLE 2-2

Default Package Groups

Package Group	Description
Desktop shell (GNOME)	The default Red Hat Enterprise Linux GUI desktop. While it may not be required on the job for many servers, it is very likely that you'll need to install GNOME during the Red Hat exams.
Administration Tools	Includes Red Hat's basic GUI administration tools. Useful if you're going to configure Red Hat from the GUI.
Server Configuration Tools	Adds Red Hat's basic GUI configuration tools for many major servers.
Web Server	Installs basic packages associated with the Apache Web Server. Includes the Tux Web Server.
Windows File Server (SMB)	Includes the Samba client and server packages.
Graphical Internet	Graphical tools for connections and communication on TCP/IP networks.
Text Internet	Text-based tools for connections and communication on TCP/IP networks.
Printing Support	Basic software required to connect this computer to a printer and set it up as a print server.

Customizing Package Installation

In most cases, it will be best to customize the packages that you'll install during the Red Hat exams. Alternatively, you can use the **redhat-config-packages** (Red Hat Package Management) tool, described in more detail in Chapter 4. This section focuses on package groups. If you see requirements on your exam for a mail server, graphics applications such as The GIMP, and to recompile the kernel, you'll want to select the Mail Server, Graphics, and Kernel Development package groups.



The general option to select individual RPM packages during the Linux installation process is no longer available in RHEL (or in Fedora Linux). However, you can select some individual RPM packages as part of RHEL package groups during the graphical installation process.

Red Hat package groups are organized logically; for example, all of the packages associated with the GNOME desktop environment belong to one Red Hat package

group. It's important to pick only the package groups you need. Fewer installed packages means more room for personal files for you and your users, as well as the log files you need to monitor your system and actually get some use from your applications. On the exam, fewer installed packages leaves more time to configure the required services.



Understanding how these package groups work is important in a Kickstart installation, which is described in more detail in Chapter 3.

Package Groups

This section includes the briefest possible overview of each of the packages you can select during the RHEL installation process. Remember, some of these packages depend on others; for example, if you want to install the GNOME Desktop Environment package group, the Red Hat installation program will make sure that you install the X Window System package group as well.

For complete details of the RPMs associated with each package, go to the first RHEL installation CD, and read the `comps.xml` file in the `/RedHat/base` directory in the text editor or Web browser of your choice.

These packages, as well as the order in which they are presented, are based on Red Hat Enterprise Linux 3. If you're using Fedora, some other version of Red Hat Linux, or even one of the third-party rebuilds, the packages may vary. In any case, the best way to study what's in each package group is through the graphical installation.

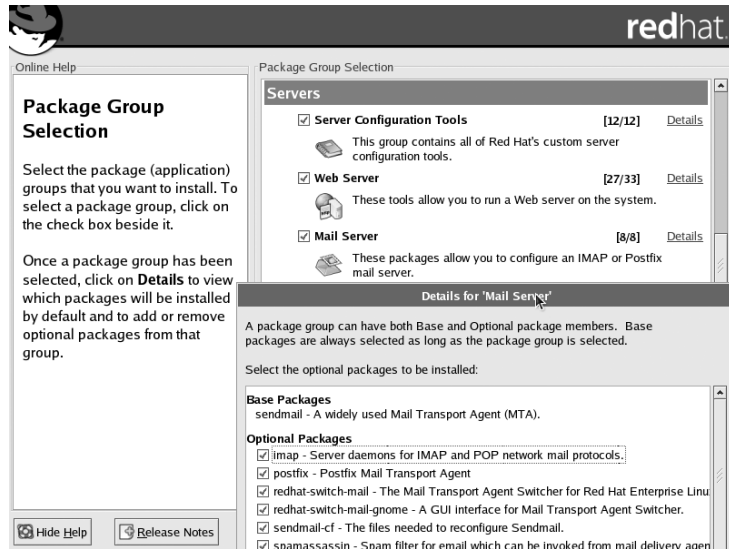
For example, Figure 2-5 illustrates the RHEL 3 installation, with a focus on the Mail Server package group. As you can see, two major mail servers, `sendmail` and `postfix`, are both installed by default when you select this package group.

Take some time with this screen. Examine the packages within each package group. You'll learn about the kinds of packages that are installed by default. If you don't add them during the installation process, it isn't the end of the world. You can still add them with the `rpm` commands described in Chapter 3, or the `redhat-config-packages` (Red Hat Package Management) tool described in Chapter 4. What you learn here can help you select the package groups to install during the RHCE or RHCT exam.

In the following sections, I describe each package group in more detail, based on what you see during the RHEL ES 3 Server graphical installation process. You won't see all of these package groups during a RHEL 3 Workstation or Red Hat Professional Workstation installation.

FIGURE 2-5

Red Hat
Enterprise Linux
Mail Server
package group
details



INSIDE THE EXAM

During the Installation Exam

Even if you're taking the RHCE exam, pay attention to the software associated with the Linux desktop environment. The RHCE exam includes RHCT components, which means that you'll also be tested on setting up Linux as a workstation.

That means you'll be installing a number of package groups that you would not install on a computer that's just being used as a server. When you take the exam, read the configuration requirements carefully. I would not be surprised if you see a requirement to install software

such as sound software and the OpenOffice.org suite.

But don't install everything. If you don't need to install the OpenOffice.org suite, you can save several minutes during the Installation exam. The time you save could allow you to configure a few more services, which could determine whether you pass the exam.

And if you make a mistake during the installation process, don't panic. You can use the **redhat-config-packages** tool after installation to add any package groups that you missed.

X Window System

This package group includes a number of basic Linux GUI fonts, libraries, and critical tools such as well as the Red Hat GUI Display Settings tool, which you can start with the `redhat-config-xfree86` command. It's required if you install the GNOME or KDE desktop environments.

As a Linux administrator, you may have confidence in your ability to configure Linux from the command line. In practice, you may install Linux on a number of computers without the GUI. However, even the RHCE exam includes an RHCT component, which tests your ability to create a Linux workstation for your users, which almost invariably includes a GUI.

exam

Watch

Since the RHCT exam requires you to configure a workstation, and you have to meet all RHCT

requirements during the RHCE exam, expect to install the GUI during the Installation and Configuration exam.

GNOME Desktop Environment

The GNOME group includes the basic packages required to install the GNOME Network Object Model Environment. While GNOME is the default GUI for RHEL 3, read the instructions on your exam carefully. It's possible that you'll be asked to install the other major GUI, the K desktop environment.

When you choose to install the GNOME Desktop Environment package group, all GNOME packages are installed by default.

KDE Desktop Environment

The KDE group includes the basic packages required to install the K Desktop Environment, which is the main alternative GUI for RHEL 3. It is the default GUI for a number of other Linux distributions.

When you choose to install the KDE Desktop Environment package group, not all of the KDE packages are installed by default. However, unless you're familiar and

exam

Watch

Read the instructions on the RHCE and RHCT installation exam carefully. As an example, if it requires you

to set up only KDE, it's a waste of time to accept the default GNOME desktop environment!

feel that you can use the KDE Administrative tools to help you configure RHEL, you won't need to change the defaults associated with this package group.

Editors

These include the basic text editors associated with Linux: vi and emacs. It also includes **nedit**, a Macintosh-style text editor. While it's essential that you know vi to use the Linux rescue mode, the emacs text editor may be the most popular text editor in the world of Linux and Unix. It also requires an extensive series of packages, which makes it impossible to include emacs on a rescue floppy that is limited to 1.44MB.

Engineering and Scientific

RHEL includes a group of packages for mathematical and scientific purposes, such as **gnuplot**, **pvm** and **units**.

Graphical Internet

Linux now includes a number of different GUI clients for Internet access, including the Mozilla Web browser, the **xchat** and **gaim** instant message utilities, and the Evolution personal information manager.

Text-Based Internet

Linux includes a number of different text-based clients for Internet access, including the **elinks** Web browser, and the **fetchmail** and **mutt** e-mail readers. This is closely related to the Graphical Internet package group.

Office/Productivity

This group includes the emerging standard for Linux office suites, OpenOffice.org, as well as related packages such as PDF viewers. It includes about 300MB of software. If you don't need these tools on your Linux computer, you should consider leaving this out of the installation.

exam

Watch

Time is of the essence on the Red Hat exams. Unless specifically required on your exam, don't install the

Office/Productivity package group. This can save you several minutes which you could use to meet other requirements on your exam.

Sound and Video

Not surprisingly, the Sound and Video group installs the packages required to allow you to use sound cards and interconnect the basic components of your sound and video system: sound card, speakers, microphone, and CD/DVD drive.

Don't dismiss this package group out of hand; I've heard that some people are asked to configure a sound card during the RHCE exam. Therefore, it's possible that you'll want to install this package group when you configure the Linux desktop environment.

Authoring and Publishing

The Authoring and Publishing group includes support for several documentation systems, such as DocBook and TeX.

Graphics

This package group automatically incorporates the X Window package and a number of graphical applications. This includes the most prominent Linux graphics application, The GIMP. Depending on whether you also install GNOME and/or KDE, this also installs graphical packages associated with each of these GUIs.

Games and Entertainment

Be careful with this package group. Do you really want to install games on a business computing system? Some believe that computer games are useful to help newer users become comfortable with Linux. While I doubt that you'll ever have to install this package group during the RHCE or RHCT exams, read the instructions that come with your exam.

Server Configuration Tools

Red Hat has developed a series of GUI server configuration tools. For expert users, it's faster to configure most services from the command line interface. In fact, I encourage you to learn to configure all Linux services in this way; you'll be a better administrator.

However, these tools are installed by default in RHEL 3. As the RHCE exam requires you to configure servers, I encourage you to install this package group. It includes about 6MB of files, so the time penalty during the installation process is trivial. If you're less certain about your skills in one or more of these services—or if nerves affect your skills during an exam—these GUI tools can be a lifesaver:

- **redhat-config-bind** Domain Name Service (DNS) configuration tool
- **redhat-config-httpd** HTTP (Apache) configuration tool
- **redhat-config-network** Network Configuration tool

- **redhat-config-nfs** NFS Server Configuration tool
- **redhat-config-printer** Printer Configuration tool
- **redhat-config-samba** Samba Server Configuration tool
- **redhat-config-securitylevel** Security Level Configuration tool
- **redhat-config-services** Service Configuration tool

Web Server

The Web Server group installs Apache, Squid, and the extensive array of supporting modules and configuration files. It's installed by default for RHEL 3. It's quite possible that you'll have to configure at least a Web server for the RHCE exam.

Mail Server

This group includes the packages required to configure a sendmail-based IMAP or a postfix mail server. While it is not installed by default, it is quite possible that you'll have to configure a mail server such as sendmail or postfix during the RHCE exam.

Windows File Server

This group includes the Samba packages required to set up Linux as a client and as a server on a Microsoft Windows-based network. It is installed by default, and it's quite possible that you'll have to configure Samba during both the RHCT and RHCE exams. RHEL 3 includes the Samba 3.0 file server; if you're using Red Hat Linux 9 to study for your exam, you'll have to upgrade accordingly from the RPM source code, using the techniques described in Chapter 4.

While I haven't seen any Microsoft Windows computers at Red Hat, it is possible to configure and test Samba clients and servers, using a second Linux computer as a client.

DNS Name Server

The DNS Name Server group includes the tools you need to configure and maintain a Domain Name System server on the local Linux computer. In the Linux world, a DNS server is also known as a nameserver, based on the Berkeley Internet Name Domain (bind). While it is not installed by default, it is quite possible that you'll have to configure a DNS server during the RHCE exam.

FTP Server

This includes the default Red Hat FTP server, the Very Secure FTP Daemon (**vsftpd**). While it is not installed by default, it is quite possible that you'll have to configure an

FTP server during the RHCE exam. It also happens to be the server that Red Hat uses for its own FTP sites.

SQL Database

The Structured Query Language (SQL) is one of the basic database languages. This group includes support for the PostgreSQL database system. It is not installed by default. As there is no reference to SQL or databases in any materials related to the RHCT or RHCE exams, I don't believe that you'll have to install this package group during either exam.

MySQL Database

The Structured Query Language (SQL) is one of the basic database languages. This group includes support for the MySQL database system. It is not installed by default. As there is no reference to SQL or databases in any materials related to the RHCT or RHCE exams, I don't believe that you'll have to install this package group during either exam.

News Server

This is a simple group, incorporating the inn (Internet Network News) server. It is not installed by default, and there is no reference to a News Server in the Red Hat Exam Prep guide.

Network Servers

This package group includes a number of smaller servers that are useful for running a network, including those associated with DHCP (Dynamic Host Configuration Protocol) and NIS (Network Information Service). It is not installed by default. When you select this package group during the RHEL 3 installation process, Red Hat installs DHCP and the NIS server.

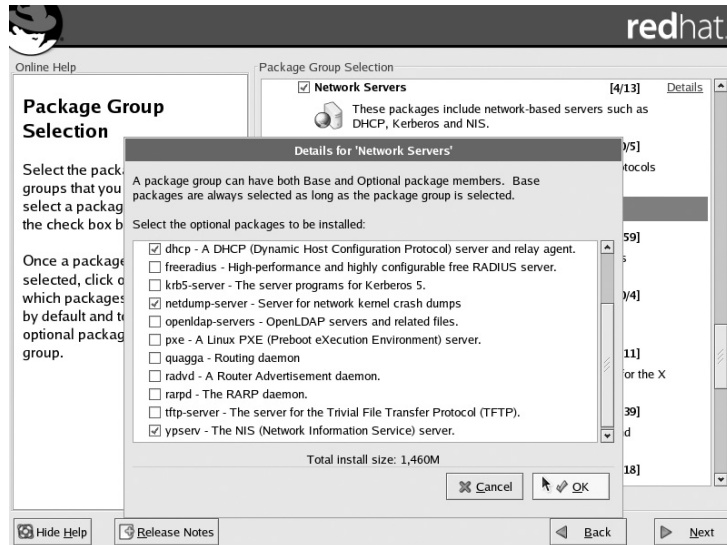
However, if you're asked to install other components of this package group during the RHCE Installation exam, you may want to customize details during the Anaconda installation process. You can then select the required servers as shown in Figure 2-6. Alternatively, you can just use the **rpm** command as described in Chapter 4 to install the appropriate packages after RHEL is installed. Servers with similar functionality are included in the Legacy Network Servers package group.

Legacy Network Servers

There are several legacy network servers. While some Linux gurus discourage their use due to security concerns, they remain popular. They include packages that allow you to install an RSH (Remote Shell), Telnet, and TFTP (Trivial File Transfer Protocol) server.

FIGURE 2-6

Network Servers
package group



Development Tools

This group includes a large number of development tools. Additional development tools are included when you install other packages such as GNOME Development, Graphics, Web Server, News Server, and more. As there is no reference to Development Tools packages in any materials related to the RHCT or RHCE exams, I don't believe that you'll have to install this package group during either exam.

Kernel Development

This group includes the very large Kernel source packages, which currently require over 500MB of disk space. There is no longer a specific requirement to recompile the Linux kernel during the Red Hat exams. As this group requires over 500MB of software, don't install this package group unless required on your specific exam.

X Software Development

The X Software Development group includes the basic packages such as XFree86-devel required to develop additional GUI applications. As there is no reference to X Software Development packages in any materials related to the RHCT or RHCE exams, I don't believe that you'll have to install this package group during either exam.

GNOME Software Development

The GNOME group includes the basic packages required to develop additional GTK+ and GNOME GUI applications. As there is no reference to GNOME Software Development

packages in any materials related to the RHCT or RHCE exams, I don't believe that you'll have to install this package group during either exam.

KDE Software Development

The KDE group includes the basic packages required to develop additional QT and KDE GUI applications. As there is no reference to KDE Software Development packages in any materials related to the RHCT or RHCE exams, I don't believe that you'll have to install this package group during either exam.

Legacy Software Development

Red Hat makes it possible to develop software on RHEL 3 for older versions of Red Hat Linux. The Legacy Software Development group includes support for older C and C++ language compilers. As there is no reference to these software development packages in any materials related to the RHCT or RHCE exams, I don't believe that you'll have to install this package group during either exam.

Administration Tools

Red Hat has developed a series of GUI administration tools. For expert users, it's faster to configure most services from the command line interface. In fact, I encourage you to learn to configure all Linux services in this way; in the long run, you'll be a better administrator.

However, these tools are installed by default in RHEL 3. For the purposes of the RHCE and RHCT exams, I encourage you to install this package group. If you're less certain about your skills in one or more of these services—or if nerves affect your skills during an exam—these GUI tools can be a lifesaver:

- **redhat-config-authentication** Supports configuration of NIS and Samba clients and more; also known as the Authentication Configuration tool.
- **redhat-config-date** Allows you to configure the time and date of your system; also known as the Date/Time Properties tool.
- **redhat-config-keyboard** Lets you select a different keyboard; also known as the Keyboard configuration tool.
- **redhat-config-kickstart** Opens a GUI for customizing a Kickstart file; also known as the Kickstart Configurator.
- **redhat-config-language** Supports configuration of the GUI in different languages; also known as the Language Selection tool.

- **redhat-config-nfs** Allows configuration of an NFS server; also known as the NFS Server Configuration tool.
- **redhat-config-packages** Lets you install packages after RHEL is installed. Very important; also known as the Package Management tool.
- **redhat-config-proc** Opens a GUI for customizing the kernel. Functionally similar to Microsoft's Registry Editor; also known as the Kernel Tuning tool.
- **redhat-config-rootpassword** Allows you to change the root password (no special name).
- **redhat-config-soundcard** Automatically configures most sound cards (no special name).
- **redhat-config-users** Supports creating and modifying users and groups; also known as the Red Hat User Manager.
- **redhat-logviewer** Provides a GUI for viewing standard log files; also known as the System Logs configuration tool.

System Tools

This package group includes a varied array of tools, from the ethereal network traffic reader to the zsh shell. This package group is not installed by default, and I believe it's unlikely that you'll have to install this package group during either exam. While the Samba client is part of this package group, you can also install it through the Windows File Server package group.

However, it's a good idea to review the details of this package group during your studies, just in case you need one of these packages during your exam.

Printing Support

Red Hat Enterprise Linux currently includes support for the Common Unix Printing System (CUPS). It supports the next-generation printing protocol, known as IPP. Once installed, it can help detect network printers, with the help of the **redhat-config-printers** (Printer Configuration) tool.



Red Hat no longer includes the Line Print Daemon (LPD) in the latest Linux distributions (RHEL 3 and Fedora Linux).

CERTIFICATION OBJECTIVE 2.05

Required Disk Space

Most new computers come with very large disks, easily supporting even the 4GB of files associated with a full installation of Red Hat Enterprise Linux. If you do not have this much space available, you should carefully consider the space requirements associated with each type of installation. When considering the following options, remember to leave adequate room for swap space, personal files, log files, and any applications that you may want to install after RHEL installation is complete.



It's common to install Linux on older computers with limited hard disk space. Linux functions quite well on older computers. It's common to configure such computers as servers for DNS, DHCP, NIS, and more. However, RHEL 3 does require at least Pentium-level 200 MHz CPU support, so you can't install it on the oldest computers

How Much More Space Is Needed?

The question of disk space needed over and above operating system needs is always relevant. Make sure to have extra room. The absolute minimum for a Red Hat Enterprise Linux OS is around 600MB of disk space, if you install Linux with few server services and without the X Window System. With 1000MB, you could probably sneak in X Window, but you still wouldn't have enough room for more than a few server services. You still should have at least 100MB or more to work with. And if you want GNOME or KDE, you'll need another 200MB or so.

You'll also need to add room for swap space. By default, Red Hat usually configures a swap partition that is about twice the amount of RAM on your computer. The minimum requirement in RHEL 3 is a swap partition that equals the amount of RAM on your system. The actual swap partition size depends on the RAM and the size of the hard disk on your system.

The actual amount of swap space that you may need is a highly debatable issue. Some suggest that Linux computers can use a swap partition that is up to three or even four times the amount of available RAM. Others suggest that at higher levels of RAM, 100MB of swap space is more than sufficient.

CERTIFICATION OBJECTIVE 2.06

Filesystems

By default, the RHEL installation program configures multiple volumes—separate volumes associated with different directories. The advantage of separate partitions for certain directories is that it limits the risks to your system. For example, many Webmasters configure their Web sites to write daily log files with data relating to all users who visit their sites. These files can become quite large, especially for large online merchants.

Before you decide how to set up partitions, you need to know about each of the major Linux directories. Linux directories are organized according to something known as the Filesystem Hierarchy Standard (FHS).

Filesystem Hierarchy Standard

The FHS is a standard for organizing directories for Linux- and Unix-based systems. Every FHS-compliant operating system starts with a top directory, root, symbolized by the forward slash. All other directories are subdirectories of root. The major FHS directories are described in Table 1-1 in Chapter 1.

Why Separate Filesystems?

Unix was developed when disk space was miniscule by today's standards.. As Unix became an operating system for larger companies and universities, administrators had access to multiple, separate physical disks for each Unix computer. They took advantage of the space by splitting up the filesystem into smaller, more manageable pieces. Different directories were mounted on different physical drives.

This has a number of advantages. Smaller partitions are easier to maintain. Smaller partitions are easier to back up and restore. The size of a partition can limit the space taken by any specific directory. You can set up specific partitions as “read-only” for additional security.

There is at least one case where you should not mount different Linux directories on different partitions. If you're limited to a smaller hard drive, you need all of the spare room that you can get. This may apply to an older laptop computer, or an older computer that you're using for a dedicated purpose, such as a DNS server or a gateway router.

Configuring Linux Filesystems on Different Partitions

When you set up an RHEL Server filesystem, you can let Red Hat configure the partitions for you. By default, Red Hat configures a root directory (/) and a /boot directory partition.

exam

Watch

As befits a standard Linux server, it's quite possible that you'll need to configure several filesystems on different partitions during the installation part of the Red Hat exams.

Additional filesystems can be mounted on separate partitions to meet additional or specific needs of related groups of users. Some examples include: /home, /usr, /var, /development, /dbms, /financials, /inventory. The /tmp directory is often also mounted on a separate partition, to limit the space allocated to what should be temporary storage.

Other Possible Separate Filesystems

Dedicated services are also good candidates for separate filesystems. For example, specific applications such as Web and FTP services can take up gigabytes of data. They store files in the /var/www/html and /var/ftp/pub directories.

You want to protect the rest of your computer if problems arise with a specific service. File and print sharing services such as NFS and Samba present security risks because they expose shared directories to other users. If you don't mount these services on separate partitions, anyone who uploads a large number of files could conceivably fill your hard disk.

If the number of files and users are large, you may even want to spread shared files over several partitions on different physical drives. In this situation, not every user will want data from the same drive all of the time. The load is shared by the different drives. Performance is improved.

CERTIFICATION OBJECTIVE 2.07

The Installation Process

You have many interrelated questions to answer during installation, just as you have many ways to access installation files, and many options on how to install the operating system. The following installation outline is designed to get you through the process in as simple a fashion as possible, with just enough detail to keep you going. While other sections and chapters address the special situations that you're more likely to encounter on the RHCE and RHCT exams, you need to know how to install Red Hat Enterprise Linux before you can work through the other installation scenarios.

During the RHCE or RHCT exams, you'll have access to the installation files. There are four methods that you can use to install RHEL Workstation or Server:

- From a copy of the Red Hat Enterprise Linux installation CDs
- Booting from the first RHEL installation CD
- Booting from a special RHEL boot CD
- Booting from a floppy designed to start the RHEL installation process

The last three options generally assume that you're going to install RHEL over a network. It's very possible that you'll see this option during the exam, which is why I described how to create a network installation server earlier in this chapter.

exam

Watch

Avoid installing RHEL 3 from the CDs if at all possible. The basic installation takes a longer time. And the

way the RHEL 3 installation packages are organized, you'll have to remove and insert your CDs several times.

Booting from the First CD-ROM

Most current Intel-based PC hardware systems allow you to boot directly from the CD drive. You can start the installation process by booting from the first Red Hat Enterprise Linux CD. The same basic process also works with older versions of Red Hat Linux as well as Fedora Linux.

If You Need an Installation Floppy or CD

If you don't have the first installation CD, you can start a network installation from a specialized boot floppy or CD. While one may be provided for you on the RHCE or RHCT exams, you'll need to know how to create one in order to practice for the exam.

It's easy to create an installation floppy or CD. You can do so from one of the files on the images directory on the first installation CD:

- **bootdisk.img** For a boot floppy
- **boot.iso** For a boot CD

The boot.iso file is small enough to fit on a credit-card sized CD. It contains all of the information in the bootdisk.img file as well as the driver images shown below.

Otherwise, if you create a boot floppy, you'll likely also need one or more of the following driver images on a floppy disk:

- **pcmciaadd.img** Additional support for PCMCIA adapters
- **drvblock.img** Additional drivers for special hardware
- **drvnet.img** Additional network card drivers

Creating Boot Floppies

There are two easy ways to project the boot images from the first Red Hat Installation CD-ROM onto a 1.44MB floppy disk.

In a Microsoft Windows–based operating system, open an MS-DOS window. Navigate to the drive associated with your CD. For example, if your CD is drive E: on your Microsoft-based system, change to that drive and enter the following command:

```
E:\> \dosutils\rawwrite.exe
```

The RAWRITE.EXE program prompts you for the filename to write to the floppy disk. Next, it prompts you for the target drive, normally the A: drive. At the first prompt, enter the full path to the desired filename as follows:

```
E:\images\filename.img
```

You can view the files on any of the floppies that you create with MS-DOS commands. You also must repeat this process for each image file you wish to create. Once the boot image is transferred to disk, you can use standard MS-DOS commands such as **dir** to read the file list.

Creating Diskette Images with Any Unix/Linux System

You can also create diskette images with the **dd** command from any running Unix or Linux computer, along with the desired image files on the CD-ROM. For example, the following commands mount the appropriate CD and “disk dumps” the image into a disk on a floppy drive.

```
# mount /mnt/cdrom
# dd if=/mnt/cdrom/images/bootdisk.img of=/dev/fd0
```

Alternatively, you can just **cat** the disk image of your choice directly to a floppy drive device. For example, the following command reads the laptop driver disk directly to the first floppy drive:

```
# cat /mnt/cdrom/images/pcmciaadd.img > /dev/fd0
```

You can also create a boot CD from the `boot.iso` file in the `/images` directory. With Linux, you can do this with the following command:

```
# cdrecord -v speed=1 dev=0,0,0 /mnt/cdrom/images/boot.iso
```

You may need to find a different setting for the `dev` switch; you'll get the information that you need from the `cdrecord --scanbus` command. The advantage to a boot CD is that all available boot drivers are included; you won't need separate floppy disks for your drivers.



Know how to create the right boot disk for your system. If you have a problem, the installation boot disk can also serve as a rescue disk. At the boot prompt, the `linux rescue` command will eventually bring you to a rescue mode that can help you mount your partitions or recover specific files or directories. I describe this process in Chapter 11.

Almost Ready to Install

Now you have the boot and driver media that you need. Your system is now configured to boot either from the CD-ROM directly or from one of the boot floppies created in the previous section. Now install your first RHEL Installation CD-ROM or boot disk, and reboot your computer.

Bootable CD-ROM

Most newer computers can be set to boot directly from the CD-ROM. Just after your computer reboots, go into your computer's BIOS menu. You should be able to change the boot order to look to the CD-ROM drive first. If this option is not available, you're just going to have to use an installation boot floppy.

CD-ROM or Boot Diskette Starts Installation

Now your PC should boot from the CD-ROM or the installation boot floppy. After a few files are opened and decompressed, a Red Hat Enterprise Linux installation screen should appear, with the following prompt:

```
[F1-Main] [F2-Options] [F3-General] [F4-Kernel] [F5-Rescue]
boot:
```

You are finally beginning to install Red Hat Enterprise Linux! Press the F2 key. As you can see in Figure 2-7, a number of options are available to you when you start the process.

FIGURE 2-7

Red Hat Installer
boot options

Installer Boot Options

- To disable hardware probing, type: **linux noprobe** <ENTER>.
- To test the install media you are using, type: **linux mediacheck** <ENTER>.
- To enable rescue mode, type: **linux rescue** <ENTER>. Press <F5> for more information about rescue mode.
- If you have a driver disk, type: **linux dd** <ENTER>.
- To prompt for the install method being used on a CD-ROM install, type **linux askmethod** <ENTER>.
- If you have an installer update disk, type: **linux updates** <ENTER>.

```
[F1-Main] [F2-Options] [F3-General] [F4-Kernel] [F5-Rescue]
boot: _
```

If you're working from installation CDs that you downloaded through the Internet, your first step should be to check the media. While Red Hat provides checksums that you can use for this purpose, the easiest way to check your CDs is with the **linux mediacheck** option. Type in that command at the boot: prompt, and you'll see an option to test the media as shown back in Figure 2-1. Follow the prompts to check your CDs.



If you have a problem with your graphics hardware, press F3 from the first screen. As described under the General Boot Help screen, you can try to force installation with a specific resolution with a command such as `linux resolution=800x600`.

To start the installation process from the boot: prompt, there are three basic options:

- **Graphical mode** By default, Red Hat is installed from the CDs in graphical mode. If you're installing from the CDs, just press the ENTER key at the boot: prompt. If you're installing over a network, graphical installations are supported over an NFS connection.
- **Text mode** The **linux text** option starts a low-intensity graphical installation known as text mode that all but the most graphically challenged computers can handle. If your computer can't even handle text mode, consider upgrading for RHEL.
- **Network installation** You can use the installation CD or boot floppy to install RHEL over a network connection. If you're booting from the installation CD, enter **linux askmethod** at the boot: prompt. This tells the RHEL installation CD to ask you whether you want to install from CD or from a network server.



It's also possible to install from files or ISOs on the local hard drive. For example, if you're dual-booting with another version of Linux, you can copy the files or ISOs to a specific directory on a specific partition. You can then use the `linux askmethod` command to get Anaconda to look for files on a certain directory on that partition. If you don't know the partition device, such as `/dev/hda8`, some trial and error may be required.

Basic Installation Overview

The basic RHEL installation is straightforward and should already be well understood by any RHCE candidate. The differences between the RHEL 3 and Red Hat Linux 9 installation process are almost trivial. Most of the steps are described here for reference; it's useful to remember this process as you work on advanced configuration situations such as Kickstart files, which are described in Chapter 5. I've detailed the RHEL 3 installation process in screenshots in Appendix B.

On the exam, you'll have a computer where you'll install RHEL 3. Therefore, I'm assuming that you're installing RHEL as the only operating system on the local computer (in other words, no dual-boots with Microsoft Windows). If you don't have a separate computer that you can use for testing purposes (that is, where you don't need any data), one very useful option is VMWare, which you can download from www.vmware.com. It allows you to set up RHEL 3 on a Virtual Machine, configured on a Linux or a Microsoft Windows 2000/XP computer.



As of this writing, you'll need to set up a virtual IDE drive on VMWare before installing Red Hat Enterprise Linux 3 on that type of Virtual Machine.

The most efficient, and thus in my opinion, the most likely way you'll install Red Hat Enterprise Linux during the RHCE and RHCT exams is with a graphical installation from a remote NFS server. Therefore, the instructions I present are based on that scenario. You'll have the opportunity to installing RHEL from a CD and from remote FTP or HTTP servers in exercises or labs later in this chapter.

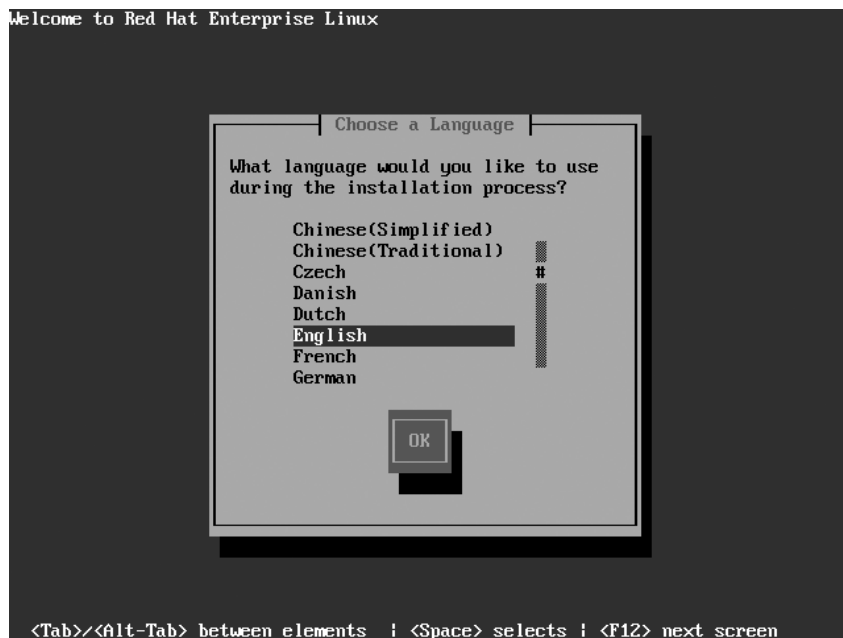
1. Boot your computer from the first RHEL CD or a boot floppy.
2. When you see the boot: prompt, enter the `linux askmethod` command. This temporarily starts the installation process in text mode (which is actually a low resolution graphical mode), as shown in Figure 2-8. Use the TAB key to switch between options.



While the `linux askmethod` command isn't required to start a network installation from a boot floppy, it still works as described.

FIGURE 2-8

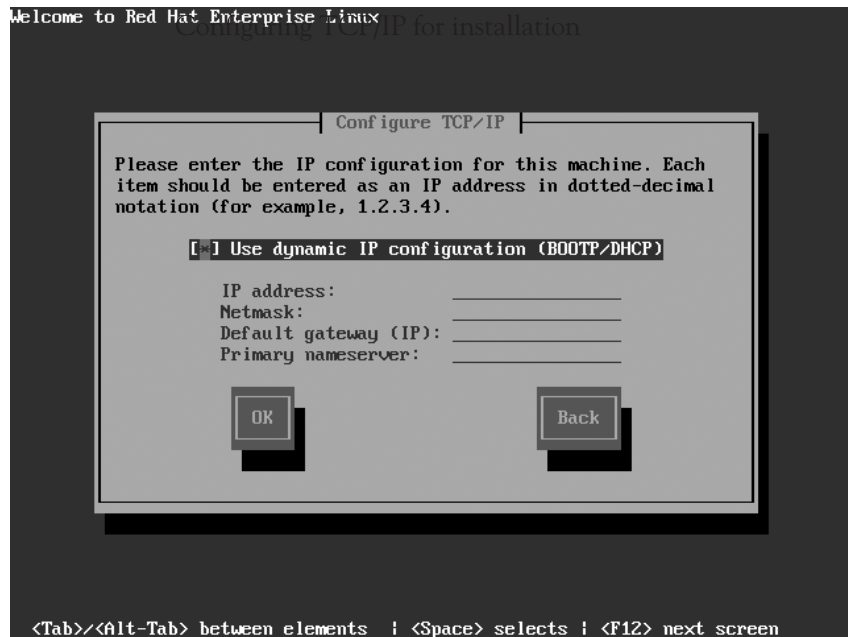
Starting the
installation
process



3. Select a language to use during the installation process. English is the default; 19 options are available.
4. Select a keyboard type; the default depends on the language you selected.
5. Choose your installation method. Earlier in this chapter, I described how to configure an NFS installation server. Therefore, select the NFS image option (the steps for installing from an HTTP or FTP server vary slightly).
 - a. If you started with a boot floppy, you'll probably have to insert a driver disk. Follow the prompts associated with the Use A Driver Disk option, and insert a driver floppy that you created earlier.
6. Configure your IP address information, as shown in Figure 2-9. If you have a DHCP server on your network, the default should be sufficient. Otherwise, deselect the Use Dynamic IP Configuration option, and enter at least an IP address and Netmask. (A Netmask is also known as an IPv4 Subnet Mask or a network mask.)
7. Next, you'll direct your computer to the remote NFS server. As shown in Figure 2-10, you can enter the hostname or IP address of the NFS server, as

FIGURE 2-9

Configuring TCP/
IP for installation



well as the shared directory. (If you enter a hostname, you'll need a working DNS server on your network.) If you set up an NFS installation server with the instructions earlier in this chapter, enter /mnt/inst in the Red Hat directory text box. (The corresponding HTTP and FTP figures are shown in Figures 2-11 and 2-12.)

8. Now you'll see the first Red Hat Enterprise Linux graphical installation screen. Click Next to continue. Since you've already selected a Keyboard and Language, RHEL skips those graphical screens that you'd otherwise see when installing from a CD.



If you're installing from an HTTP or FTP Server, installation proceeds in text mode. Red Hat Enterprise Linux 3 does not incorporate Fedora's ability to run graphical installations from these types of servers. Next, you'll get to select a mouse (or pointing device) for your system. If you have a mouse with a center wheel, press on it. If it clicks, you have a middle mouse button and need not select the Emulate 3 Buttons option. Make your selection and click Next to continue.

FIGURE 2-10

Connecting to
an NFS Server

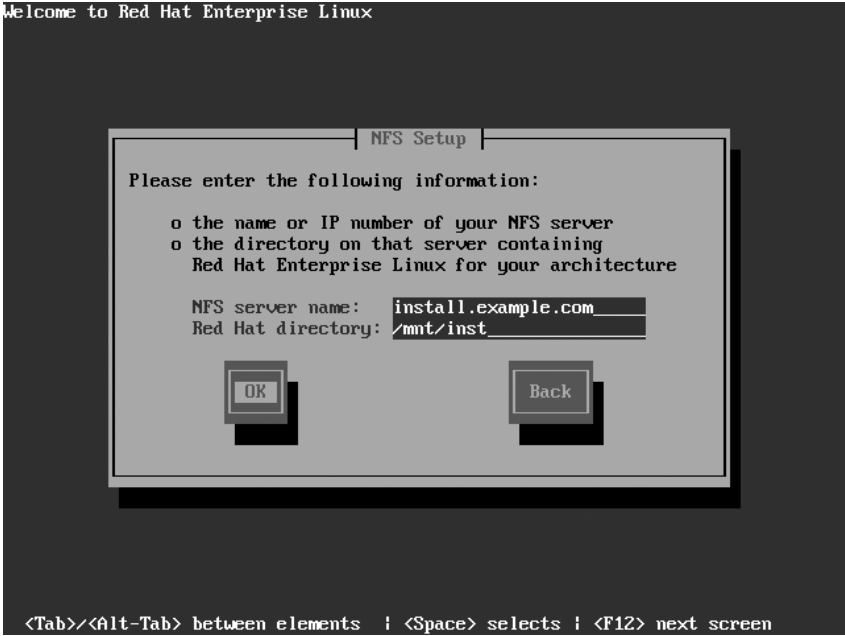


FIGURE 2-11

Connecting to
an HTTP Server

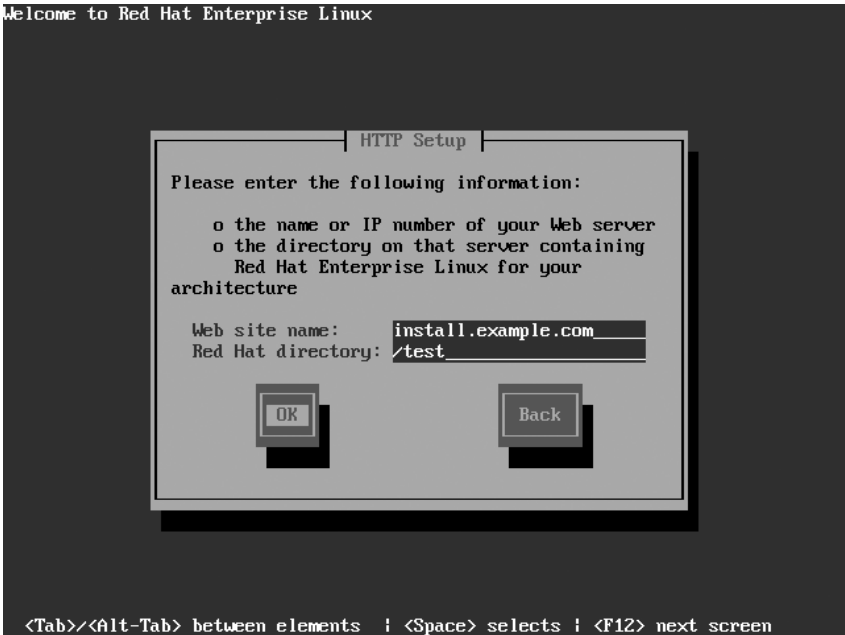
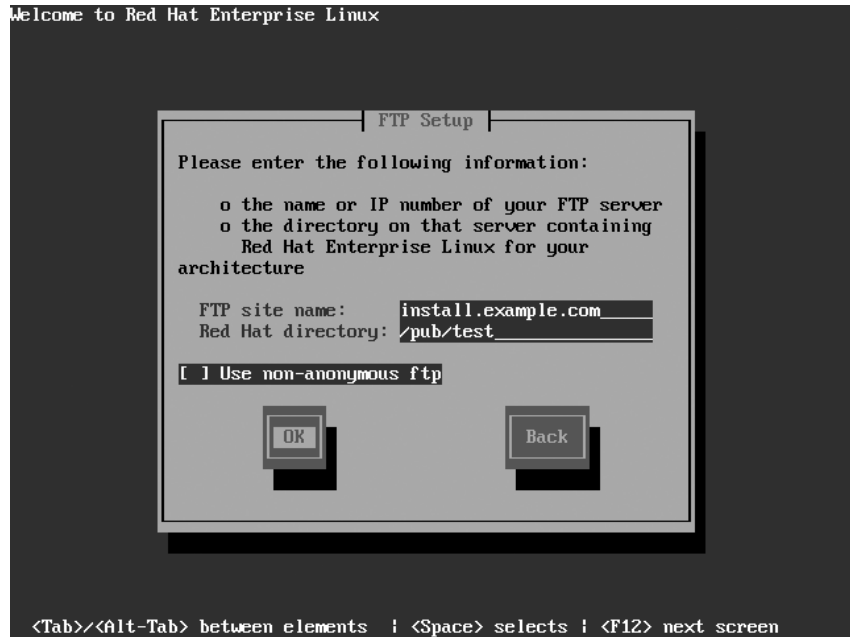


FIGURE 2-12

Connecting to
an FTP Server



If you're installing Red Hat Linux 9, the installation program checks for a previous version of Linux and then allows you to select between a Personal Desktop, Workstation, Server, or Custom installation.

9. Now you can select between automatic and manual partitioning. If you select Automatically Partition, you'll get the partition scheme described in Table 2-3 (small variations of a few MB do not matter). Chances are good that won't match the requirements on your RHCE or RHCT installation exam. Select the Manually Partition With Disk Druid option and click Next to continue.

TABLE 2-3

Result When
You Partition
Automatically

Location	Size
/boot	100MB
Swap	Twice available RAM (assuming sufficient hard drive space)
/	Remaining space on the drive

10. Now you can set up the partitions as desired. The graphical Disk Druid screen is shown in Figure 2-13. This is a good opportunity to run the following exercises, to see all that you can do with Disk Druid. Once you complete the exercises, you can continue with step 11. If you choose to do any or all of the exercises later, you'll need to repeat the first ten steps of the installation process.

on the
iob

Disk Druid brings up a menu that allows you to format your RAID system to the ext2, ext3, Linux swap, or VFAT filesystems. It also allows you to configure your partitions to RAID 0, RAID 1, or RAID 5.

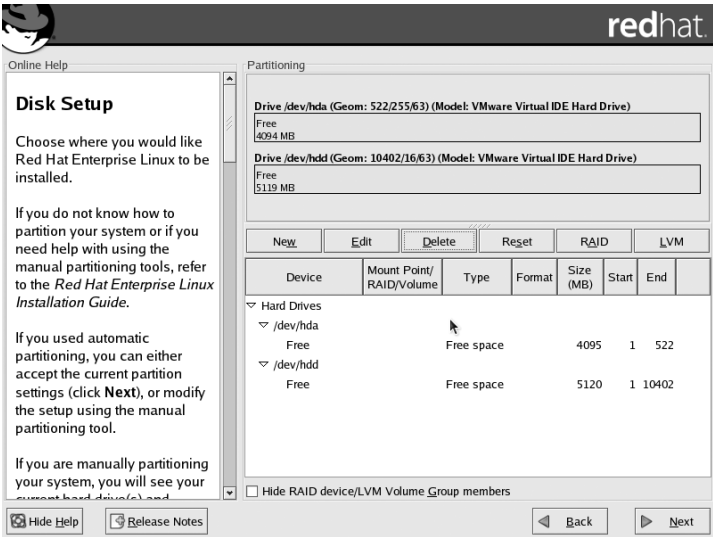
exam
watch

Learn how to use all features of Disk Druid. It's quite possible that you'll have to create all sorts of partitions during your

exam. The following three exercises are designed to help you practice and learn the major features of this disk configuration tool.

FIGURE 2-13

Disk Druid



EXERCISE 2-2

Basic Partitioning

This is an excellent opportunity to see how you can create a RAID array with what you can do with Disk Druid. In this exercise, you'll practice adding partitions to a computer with two hard drives. (If you don't have two hard drives, or a single hard drive with at least 9GB of free space, do your best. You may need to assign different sizes to each partition. That is okay. The point is to practice working with Disk Druid.)

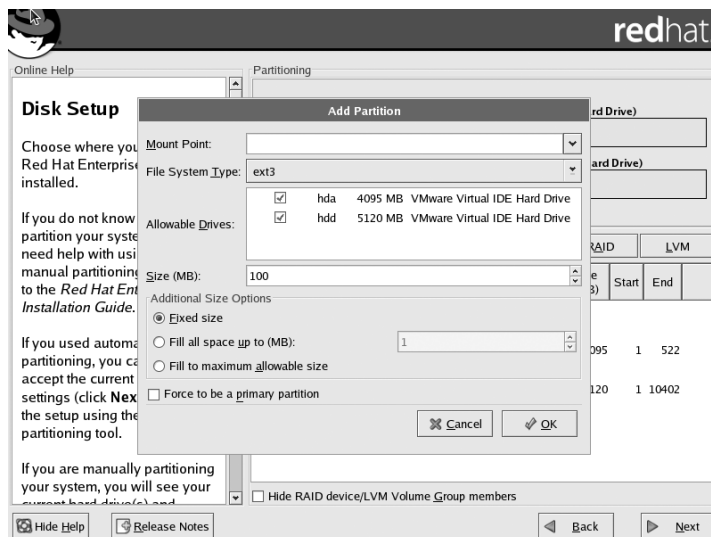
This illustrates what you would do if you are asked to create a /boot partition of 100MB, a /tmp partition of 500MB, a /var partition of 1000MB, a /home partition of 2000MB, and a swap partition of 512MB. Assign the remaining space to the root directory (/) partition. This starts with the scenario shown in Figure 2-13. The /boot partition must be a primary partition.

Before you get to step 1 in this exercise, you'll have to run the first ten steps of the Installation process described earlier in this section. When you're done, you should be able to reboot your computer with the CTRL-ALT-DEL command; alternatively, you can turn off your computer during the middle of the installation process.

1. Unless you're already in the Disk Druid menu, run the first ten steps of the RHEL installation process described in this chapter.
2. In the Disk Druid Menu, click New. This opens the Add Partition window shown in Figure 2-14.

FIGURE 2-14

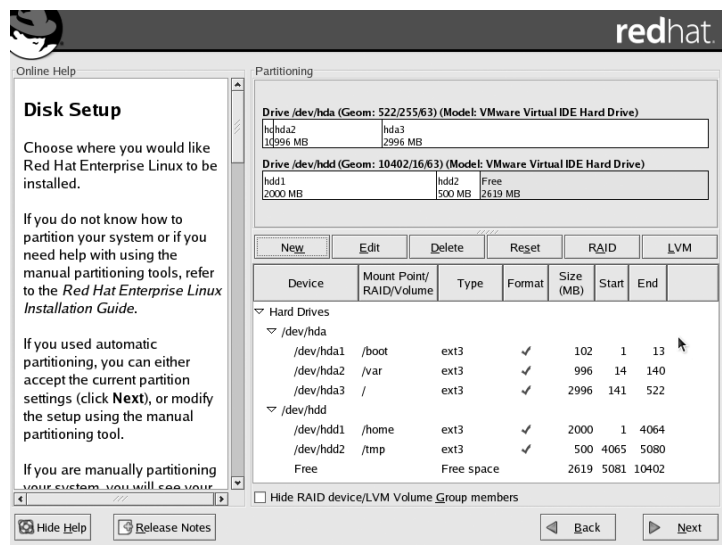
Adding a partition



3. Enter `/boot` in the Mount Point text box. Enter **100MB** in the Size(MB) text box. Select the Force To Be A Primary Partition option and click OK.
4. Repeat the basic process described in step 2 with the other noted partitions: `/tmp`, `/var`, and `/home`. As described earlier, these need not be primary partitions.
5. Now create a swap partition. Click New to open the Add Partition window. Click the File System Type drop-down box, and select Swap. As you'll see, the Mount Point text box is now grayed out. Enter the required size (**512MB**) in the Size(MB) text box, and click OK.
6. Allocate the remaining space to the root directory (`/`) partition. Click New to open the Add Partition window. Enter `/` in the Mount Point text box. Under Additional Size Options, select Fill To Maximum Allowable Size and click OK.
7. Observe the result in the Disk Druid screen. Note that Disk Druid may not follow your instructions exactly. For example, as shown in Figure 2-15, I end up with a `/boot` partition of 102MB. The error is trivial and depends on the geometry of your hard drive.
8. At this point, you have three options: continue with the next two exercises, continue the installation process with step 11, or stop the installation process completely by shutting down your computer.

FIGURE 2-15

Disk Druid
Exercise 2-2
results



EXERCISE 2-3**RAID Partitioning**

In this exercise, you'll follow up by setting up a RAID 1 software array. As described in Chapter 4, this is a disk mirror, where the same data is copied to both partitions in this array. For an effective RAID system, each partition in the array should be located on different physical hard drives. In that way, if one hard drive fails, you do not lose all of the data in the array.

I'll start by working with the results shown in Figure 2-15. Your situation may be different. While not recommended in practice, it's okay if you don't have two physical hard drives on your computer. It's certainly possible that you'll be asked to set up a RAID array on a computer with one physical hard drive during the exam. The point of this exercise is to learn how to set up a RAID array with Disk Druid.



In the real world, you should never configure different parts of a RAID array on the same hard drive. If you do, the failure of any single hard drive can lead to the loss of all of your data on that array.

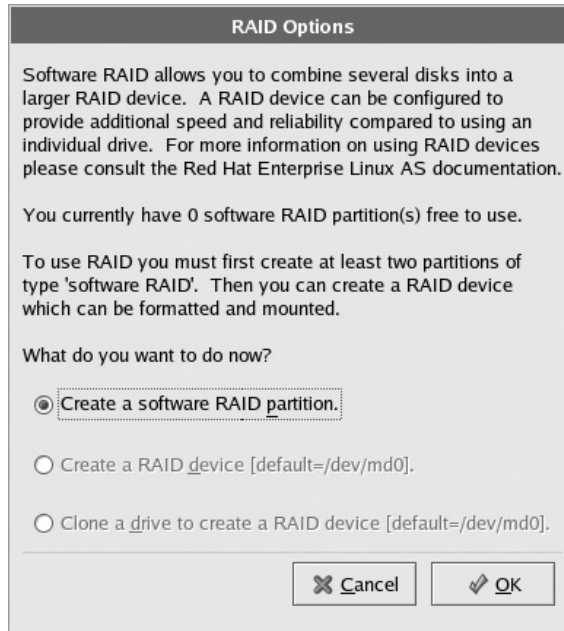
In this exercise, I'll set up a RAID 1 software array of 100MB for the /home/mj directory. In the case shown in Figure 2-15, I first need to make some room on the first hard drive, as represented by /dev/hda. In that way, I'll have free space on the two hard drives on this computer.

Before you get to step 1 in this exercise, you'll have to run the first ten steps of the Installation process described earlier in this section. When you're done, you should be able to reboot your computer with the CTRL-ALT-DEL command; alternatively, you can turn off your computer during the middle of the installation process.

1. please make sure /dev/hda isn't changed by Word's autocorrect feature to /dev/had. Unless you're already in the Disk Druid menu, run the first ten steps of the RHEL installation process described in this chapter.
2. Highlight the root directory partition on the first hard drive (/dev/hda), and click Edit. This opens the Edit Partition window, which is functionally identical to the Add Partition window shown back in Figure 2-14.
3. In the Size(MB) text box, enter a size for the root directory (/) partition smaller than what's currently configured. I've allocated 500MB for this purpose, leaving a root directory (/) partition size of 2500MB. Make sure the Fixed Size option is selected and click OK.

4. Click RAID. This opens the RAID Options menu shown here.

III 2-1



5. Select the Create A Software RAID Partition option and click OK. This opens the Add Partition window with a Software RAID File System Type. Select the first physical hard drive in the Allowable Drives list. Make sure that the size of this partition is fixed at 100MB. Click OK.
6. Repeat steps 3 and 4, making sure that the second RAID partition is located on the other physical hard drive.
7. Click RAID. Now you'll be able to select the Create A RAID Device [default=/dev/md0] option. Do so and click OK. This opens the Make RAID Device window shown here. As you can see, the size of the RAID members need not be identical.

III 2-2

The screenshot shows the 'Make RAID Device' dialog box. It contains the following fields and options:

- Mount Point:** An empty text box.
- File System Type:** A dropdown menu showing 'ext3'.
- RAID Device:** A dropdown menu showing 'md0'.
- RAID Level:** A dropdown menu showing 'RAID0'.
- RAID Members:** A list box containing two entries: 'hda2 102 MB' and 'hdd1 100 MB', both with checked checkboxes.
- Number of spares:** A spinner box set to '0'.
- Buttons:** 'Cancel' and 'OK' buttons at the bottom right.

8. Enter `/home/mj` in the Mount Point text box. Click the RAID Level drop-down box and select RAID1. If you had more than three RAID partitions, you could assign one as a spare. Click OK. Congratulations! You've just created a RAID array.
9. At this point, you have three options: continue with Exercises 2-2 and 2-4, continue the installation process with step 11, or stop the installation process completely by shutting down your computer.

EXERCISE 2-4

LVM Partitioning

In this exercise, you'll follow up by setting up a Logical Volume Management (LVM) system. As described in Chapter 4, this allows you to resize partitions after Linux is installed.

I'll start by working with the results shown previously in Figure 2-15. Your situation may be different. It's okay if you don't have two physical hard drives on your computer. The point of this exercise is to learn how to set up an LVM system with Disk Druid.

In this exercise, I'll set up an LVM system of 100MB for the `/home/angels` directory. In the case shown in Figure 2-15, I first need to make some room on the first hard drive, as represented by `/dev/hda`.

1. Before you get to step 1 in this exercise, you'll have to run the first ten steps of the Installation process described earlier in this section. When you're done, you should be able to reboot your computer with the CTRL-ALT-DEL command; alternatively, you can turn off your computer during the middle of the installation process. Unless you're already in the Disk Druid menu, run the first ten steps of the RHEL installation process described in this chapter.
2. Highlight the root directory partition on the first hard drive (`/dev/hda`), and click Edit. This opens the Edit Partition window, which is functionally identical to the Add Partition window shown previously in Figure 2-15.
3. In the Size(MB) text box, enter a size for the root directory (`/`) partition smaller than what's currently configured. I've allocated 500MB for this purpose, leaving a root directory (`/`) partition size of 2500MB. Make sure the Fixed Size option is selected and click OK.
4. Click New. In the Add Partition window that opens, click the File System Type drop-down box. Select Physical Volume (LVM). Select the first physical hard drive in the Allowable Drives list. Make sure that the size of this partition is fixed at 100MB. Click OK.
5. Repeat step 3. Repeat until you have four LVM partitions, two on each physical hard drive.
6. Click LVM. This opens the Make LVM Volume Group window shown here. Note that all of the available LVM partitions are selected in the Physical Volumes To Use text box. You're free to select or deselect the LVM partitions of your choice.

III 2-3

Make LVM Volume Group

Volume Group Name: Volume00

Physical Extent: 4 MB

Physical Volumes to Use:

☒	hda2	96.00 MB
☒	hda3	96.00 MB
☒	hdd1	92.00 MB
☒	hdd2	92.00 MB

Used Space: 0.00 MB (0.0 %)
 Free Space: 376.00 MB (100.0 %)
 Total Space: 376.00 MB

Logical Volumes

Logical Volume Name	Mount Point	Size (MB)

Add
Edit
Delete

Cancel OK

7. Click Add. This opens the Make Logical Volume window shown here. Enter `/home/angels` in the Mount Point text box. You can change the Logical Volume Name and Size as desired. Click OK.

III 2-4

Make Logical Volume

Mount Point:

File System Type: ext3

Logical Volume Name: LogVol00

Size (MB): 376

(Max size is 376 MB)

Cancel OK

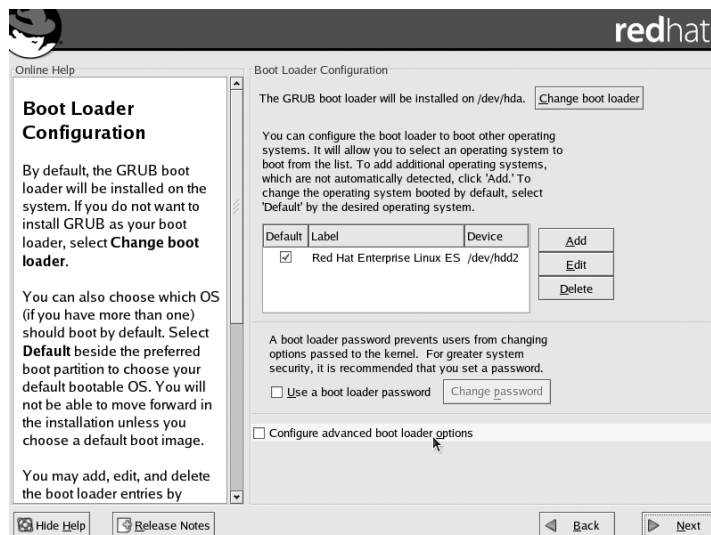


Do not set up the `/boot` directory on an LVM volume. Unless you have the `/boot` directory on a regular partition, you won't be able to start other LVM volumes.

8. Inspect the result in the Make LVM Group window. Click OK.
 9. Inspect the result in the Disk Druid window. Congratulations! You've just created an LVM system.
 10. At this point, you have three options: continue with Exercises 2-2 and 2-3, continue the installation process with step 11, or stop the installation process completely by shutting down your computer.
-
11. Now that you've reviewed the exercises, you should now be more comfortable with the Disk Druid process. You should be able to create the kinds of partitions that are required on the Red Hat exams. Once you've finished creating the desired partitions, click Next to continue.
 12. Next, you'll be able to configure the boot loader as shown in Figure 2-16. It can help you configure how your BIOS finds Linux (and possibly other operating systems) on your computer. GRUB is the default, which I describe in more detail in Chapter 3.
 - a. If you're instructed to configure LILO instead of GRUB (or no boot loader at all) during your exam, click Change Boot Loader.
 - b. You can also set up a boot loader password as shown in Figure 2-16.
 - c. If you select Configure Advanced Boot Loader Options, you're taken to a different menu before the next step, where you can place the boot loader

FIGURE 2-16

Configuring
a boot loader



on the first sector of the boot partition, force LBA32 addressing, needed for some older hard drives.

- d. You can also add kernel parameters of your choice with the Advanced Boot Loader Configuration menu.
13. Now you'll be able to configure this computer on your network. Assuming you've set up installation from a remote computer on the network, you'll see the settings that you previously entered in Figure 2-9. You can either configure the IP address information shown manually, or you can leave this task to a DHCP server. Some DHCP servers can assign hostnames as well. Make your selections and click Next to continue.

exam

Watch

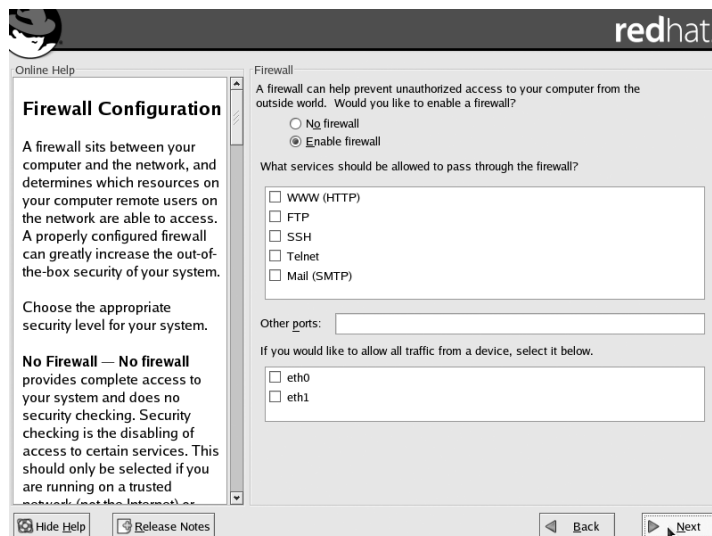
For the RHCE and RHCT installation exams, follow the IP address instructions carefully. If there's a DHCP server on your exam room's network,

make sure that the Network Configuration points to a DHCP server. In either case, you may get instructions to set up a specific hostname for your computer.

14. Next, you'll be able to configure a standard firewall for your computer. Generally, you won't need to configure a firewall for a workstation inside a LAN. Firewalls are generally located on computers that serve as junctions, or routers between networks such as a LAN and the Internet. Figure 2-17 illustrates a configuration

FIGURE 2-17

Configuring a
firewall



with two network cards, which are presumably connected to different networks. The options you see here are identical to those shown in the `redhat-config-securitylevel` (Security Level Configuration) tool, which I describe in Chapter 10.

on the
book

In older versions of Anaconda, from Red Hat Linux 9 and before, you used to be able to configure a firewall with a high or medium level of security. Those options are no longer available through the GUI. For more information on customizing your firewall read about iptables in Chapter 10.

15. In the Additional Language Support screen, you'll be able to add from a large number of different language sets, which is reflected on the command line and the GUI after installation. Make your selections and click Next to continue.
16. In the Time Zone Selection screen, select your time zone. Assuming this is the only operating system on this computer, activate the System Clock Uses UTC option. (This option causes problems on a computer that also has Microsoft Windows.) Make any needed changes and click Next to continue.
17. Type in the password that you'll use for the root user account in the text boxes provided and click Next to continue.

exam

Watch

If you get special instructions for the root user password, follow them carefully! A grader who can't

get into your root user account will have trouble grading your work and giving you the credit you deserve on the exam.

18. Now you'll see a Package Installation Defaults screen, similar to what you saw previously in Figure 2-4, with the default set of package groups associated with your installation. Unless this group meets *all* of the requirements of your particular exam, select the "Customize the set of packages to be installed" option and click Next to continue.

exam

Watch

The requirements of the Red Hat installation exams vary. Some may need to configure a Windows File Server and sound; others may need to

configure mail and print servers. On your exam, read your instructions carefully before selecting the package groups that you'll install.

19. In the Package Group Selection screen shown in Figure 2-18, select the package groups that you'll need for the requirements of your particular Installation exam. Make your selections and click Next to continue.
20. Finally, you're taken to a summary screen. You can click Back in this screen (or just about any time during the process) to return to a previous step. Otherwise, click Next to start the installation process.
21. Once the installation process is complete, you're taken to a screen where you can create a customized boot disk. On the job, this is an excellent idea. However, during the exam, unless specifically required, this takes time that you might not have. You can still create a custom boot floppy disk after installation with the following command:

```
# mkbootdisk --device /dev/fd0 `uname -r`
```

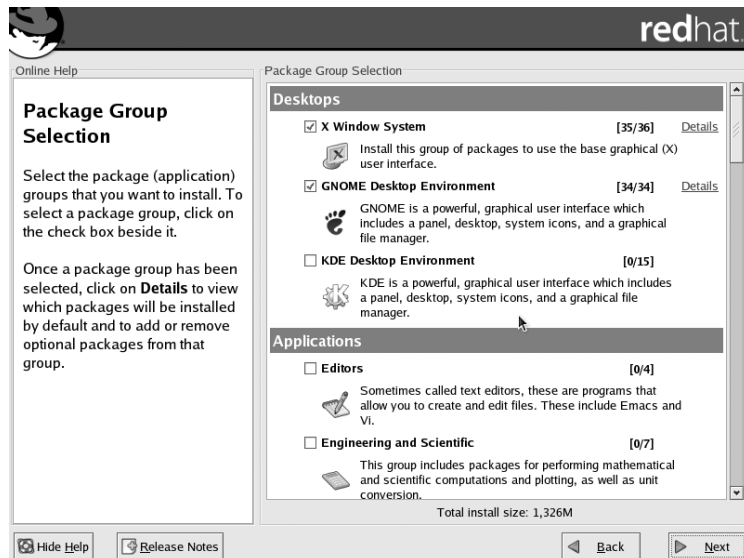
exam

Watch

While installation proceeds, you'll have a bit of "dead time." You can use this time to start configuring your RHEL 3 system. Just press the CTRL-ALT-F2 command and you'll see a shell. You'll find the standard root directory (/) mounted on the /mnt/sysimage subdirectory during the installation process. You can edit the files of your choice as soon as they're installed.

FIGURE 2-18

Selecting Package Groups



exam

watch

Unless specifically required by your Installation exam, don't create a boot floppy. This takes time that you may not have. You can use an installation boot floppy or the first installation CD as a

rescue disk, as described in Chapter 11. While it's a good idea to create a custom boot floppy in real life, not all real life practices are consistent with doing your best on the Red Hat exams.

22. Assuming you've installed GUI components such as the GNOME desktop, you'll get to configure your video card, as shown in Figure 2-19. A large number of different manufacturers, models, and generic options are available. You can also set the available memory in your video card as shown in the Graphical Interface (X) Configuration screen.
23. In the Monitor Configuration screen, you can set the make and model of your monitor. If you don't see your monitor in the list, there are also a large variety of generic CRT (standard) and LCD (flat panel/laptop) monitors available.
24. There is one more step in the installation process. In the Customize Graphics Configuration screen shown in Figure 2-20, *be careful!* While the default color depth and screen resolution should suffice, the login type is a critical choice during the Red Hat exams. If you select a graphical login by default, you'll have to go through the First Boot process described in later steps.

FIGURE 2-19

Configuring your graphics system

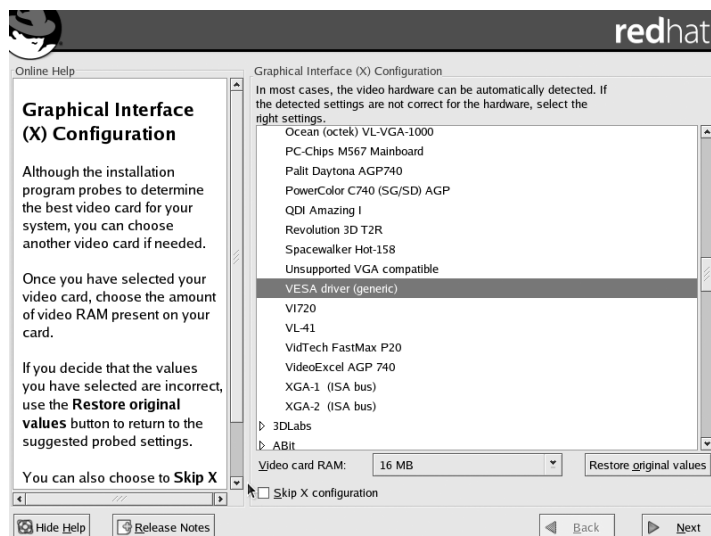
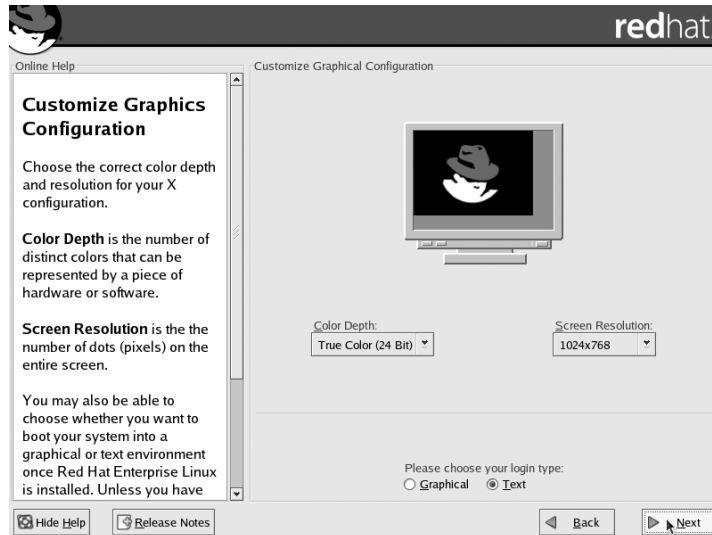


FIGURE 2-20

Customizing the graphics setup of your Linux system



exam

Watch

Near the end of the installation process, you'll see the *Customize Graphics Configuration* screen. Unless your exam requires to go through the *First Boot*

process, select a *Text* login type. Otherwise, you'll be wasting time on the *Installation* part of the exam that you could use to meet other requirements.

25. RHEL now reboots your computer. Red Hat Enterprise Linux is now installed! If you've selected a Text login type, you'll see something similar to the following login screen.

```
Red Hat Enterprise Linux ES release 3 (Taroon)
Kernel 2.4.21-4.EL on an i686
```

```
Enterprise3 login:
```

If you selected a Graphical login, I'd say congratulations, but you're not done yet.

26. The first time your computer boots into RHEL, you'll see the process known as First Boot. You'll get to configure a few more components during this process; they're summarized in the left pane of Figure 2-21. You may not see all of the options shown in the figure; for example, if your computer does not have a sound card, you won't see that option.

FIGURE 2-21

First Boot
configuration



27. If you're running RHEL 3, you'll need to agree to the license agreement. If you do not agree, you're prompted to shut down your system and uninstall the operating system.
28. In the Date and Time screen, you can set the date and time for your system. If you select the Enable Network Time Protocol option, you can synchronize your computer with a Network Time Protocol server. Red Hat provides two: clock.redhat.com and clock2.redhat.com. If you're not sure, you can return

exam

Watch

The Red Hat exams are closed book. While you can use available documentation such as the man pages, don't expect a connection to the Internet

during your exam. Therefore, I also believe it's highly unlikely that you'll have to connect to Internet sites such as a Red Hat time server or the Red Hat Network.

to this configuration screen with the `redhat-config-time` utility. Make any selections required by your exam, and click Next.

29. In the User Account screen, you can configure a regular account. You may be required to create regular users with a specific password during your exam. You can create additional users with the `redhat-config-users` (Red Hat User Manager) tool described in Chapter 3. Create a user if required and click Next.

exam

Watch

If you're required to set up users over a network, pay attention to the requirements of your exam. Click the Use Network Login button and study the Authentication Configuration window.

Are these users on a central NIS server or a Samba Primary Domain Controller (PDC)? For more information on the Authentication Configuration window, read Chapter 10.

30. Normally, Red Hat automatically detects sound cards. If successful, you can click the Play Test Sound button to confirm. Click Next to continue.
31. If you want to register with the Red Hat Network, select Yes and you'll see the Red Hat Network configuration screen where you can set up a connection. The defaults are generally sufficient. Alternatively, you can set up a Red Hat Network connection using the `up2date` utility described in Chapter 4.
32. Finally, if you have more software to install, such as from a Red Hat documentation CD, you'll get to do so in the Additional CDs window. Don't do so unless required by your particular exam. Click Next to continue.
33. You'll now see the Finish Setup screen, which tells you that "Your system is now set up and ready to use." Click Next to finish the process.
34. Congratulations! Installation is now complete. With the exception of the firewall security configuration options, the basic installation process for Red Hat Linux 9 is almost identical to RHEL 3, so you can use that freely available operating system to practice for the exam.

on the job

If you don't install the GUI during the installation process, make sure that you don't configure your system to boot from the GUI. If you do, you'll need to use the `linux rescue` mode discussed in Chapter 11 to boot into your system. Then you can edit `/etc/inittab` to make sure that you boot into text mode in the future.

Caveat Emptor on Installation

Do not worry if you make a mistake the first time you practice installing Linux on a test computer. Just redo the installation; it will be significantly faster and easier than trying to correct a problem. There are so many options and possibilities in the overview just presented that it is not possible to name them all or take them all into account. In most cases, the default is sufficient if you do not understand the question posed. You'll want to practice installing RHEL more than once.

exam

Watch

If you have to reinstall Linux on the RHCE Installation and Configuration exam, you may not have time to configure services

as required. You are not allowed to reinstall Linux on the RHCE or RHCT Troubleshooting and System Maintenance exam.

Although you have finished the installation and have worked with the concepts of partitioning (and possibly multiple operating system boots), there are still a few more details to note, such as GRUB configuration, LILO errors, BIOS issues, and others, all described in the following sections.

A Note on Boot Disks

One major danger with a floppy is the chance of damaging that boot disk. You may want to make multiple copies to minimize possible problems. You can use the **dd** command to make multiple copies of the disk. Here is an example of the commands needed to create a copy of the original diskette to a local file and how to create duplicates from this local file:

```
# dd if=/dev/fd0 of=diskboot.img # stores a copy of diskette
# dd if=/diskboot.img of=/dev/fd0 # makes the copy
```

As described earlier, the **mkbootdisk** utility can help you create a custom boot diskette from your running system with the required root and /boot partitions. In Red Hat Linux 9, this command does not require the **--device** switch. While this command needs the name of the running kernel, but you can have the command line shell generate that for you and insert it into the command line with the following command:

```
# # to create a boot disk for the 'current kernel number'
# mkbootdisk --device /dev/fd0 `uname -r`
```



If you have the prerequisite experience for this book, you should already understand the effects of double, single, and back quotes in the shell. Regular double quotes interpret only variables within before processing the result as standard input. Single quotes do not interpret the enclosed commands or variables. Back quotes process the enclosed command even if it's further contained within double quotes.

CERTIFICATION OBJECTIVE 2.08

Sample Installation Exercises

The following exercises are meant to provide you with a step-by-step set of progressively more complex installation exercises that cover everything from basic workstations to very specific and advanced server installations.



You should do these exercises on test machines only. One possible option is a virtual machine that can simulate a computer inside your operating system. An example of this is VMWare, available from www.vmware.com.

Introduction to Installation Exercises

All these exercises assume you have a basic PC available at your disposal to work with as a learning station. You do not want any important data on that PC. You do not need a network connection, nor do you need to know how to configure X for these exercises—you can simply select the default answers in most cases.

These exercises are designed to provide progressive development to help further your knowledge about installing Linux. If you're studying for the RHCT, you may not be able to go through all of the steps, especially with respect to server software that is not included on RHEL 3 Workstation.

If you're using Fedora Linux or Red Hat Linux 9 to run these exercises, the Workstation option is fine for the first exercise in this section; the Custom option is best for the final two exercises in this section.

In these exercises, you will be asked to configure the installation for a specific usage and customize the disk partition table to meet the needs of the intended usage. This will require that you do a Custom installation in all but one of the exercises.

These exercises also assume your machine boots from the floppy during a normal reboot, that there is no pertinent information on these test machines, and that you realize all data will be overwritten on these machines.

EXESRCISE 2-5

Advanced Workstation Installation

In this exercise, you will distribute your filesystem over more than just one partition. You will need to create the partitions on a 20GB or larger IDE hard disk (see Table 2-4).

- 1. Create a Linux installation floppy from the bootdisk.img image file, then reboot the system.
- 2. Select manual partitioning at the appropriate step.
- 3. Use Disk Druid to reconfigure the partition table.
- 4. Delete all partitions.
- 5. Create the first partition with 100MB of disk space, ext3, and assign to /boot.
- 6. Create the next primary partition, hda2, as Linux Swap, and assign to ID 83.
- 7. Create a third partition with about 5500MB of disk space, ext3, and assign it to the root directory, /.
- 8. Create an extended partition containing all the rest of the disk space. Make it *growable*.

TABLE 2-4 Custom Installation as a Workstation (No Other OS), 1.2 GHz Pentium, 20GB Single Disk, 256MB of Memory	Partition	Size	Use	Comment
	hda1	100MB	/boot	Maintains boot files
	hda2	512MB	swap	Plenty of space
	hda3	5.5GB	/	The root directory
	hda4	14GB	Extended partition	Solely a container for logical partitions
	hda5	4GB	/var	For print spool files
	hda6	5GB	/home	Web server—RAID 1
	hda7	5GB	/home	Web server—RAID 1



9. Create the first logical partition, fifth in number, with about 4GB, and assign it to /var.
10. Create two more logical partitions, hda6 and hda7. Split the remaining space between these two partitions (about 5GB each). Set it up with to a software RAID filesystem.
11. Make a RAID 1 device from the two new software RAID partitions, formatted to ext3, and assign it to /home.

In the real world, you should never configure different parts of a RAID array on the same hard drive. If you do, the failure of any single hard drive can lead to the loss of all of your data on that array. However, it may be necessary if the computer on your exam has only one physical hard drive.

12. Continue with the installation process, using your best judgment.
13. When asked to select packages, make sure that the OpenOffice.org suite as well as the Graphics, Graphical Internet, and Games packages are selected.
14. Finish the Workstation installation normally.
15. Reboot the computer and log in as the root user.

EXERCISE 2-6

Disk Partitioning a Server Installation

In this exercise, you will install Red Hat Enterprise Linux 3 to create a basic server. You can create a very similar installation using Red Hat Linux 9's custom installation option. You will need to create the partitions on a 10GB or larger hard disk (see Table 2-5).

1. Create a Linux installation floppy from the bootdisk.img image file, then reboot the system.
2. Select manual partitioning at the appropriate step.
3. When prompted, select Disk Druid to edit partitions.
4. Delete all partitions.
5. Create the first partition with 100MB of disk space, formatted to ext3, and assign it to /boot.

Custom Installation as a Server, 2 GHz Pentium, 10GB Single Disk, 256MB Memory	TABLE 2-5			
	Partition	Size	Use	Comment
	hda1	100MB	/boot	Maintains boot files
	hda2	500MB	swap	Probably plenty of space
	hda3	5GB	/	The root directory
	hda4	4500MB	Extended partition	Solely a container for logical partitions
	hda5	500MB	/var	For print spool files
	hda6	1000MB	/var/www	Web services
	hda7	2000MB	/home	No interactive users
	hda8	1000MB	/usr	Additional network services

- 6. Create the next primary partition, hda2, with about 500MB of disk space, as Linux Swap.
 - 7. Create third partition with about 5GB disk space, Linux Native, and assign to the root directory, /.
 - 8. Create an extended partition containing all the rest of the disk space, 4500MB.
 - 9. Create the first logical partition, hda5, with about 500MB, formatted to ext3, and assign to /var.
 - 10. Create the next logical partition, hda6, with about 1000MB, formatted to ext3, and assign it to /var/www.
 - 11. Create the next logical partition, hda7, with about 2000MB, formatted to ext3, and assign it to /home.
 - 12. Create the next logical partition, hda8, with about 1000MB, formatted to ext3, and assign to /usr.
 - 13. Continue with the installation process, using your best judgment.
 - 14. Choose to customize the package groups to be installed. On an exam, you may see a requirement to install a number of different services such as a Web server, communication with Windows PCs, an FTP server, as well as servers for DNS and DHCP.
 - 15. Finish the installation normally.
 - 16. Reboot when prompted and log in as the root user.
-

EXERCISE 2-7

Disk Partitioning Strategy for Database Server Installation

In this exercise, you will install Red Hat Enterprise Linux 3 to configure the partitions for an imaginary database server. You can create a very similar installation using Red Hat Linux 9’s custom installation option. In this exercise, you will need to create the partitions on a 25GB or larger hard disk (see Table 2-6). The main use for such a system is as a database, file, and print server, with few interactive users.

- 1. Create a Linux installation floppy from the bootdisk.img image file, then reboot the system.
- 2. Select manual partitioning at the appropriate step.
- 3. When prompted, select Disk Druid to edit partitions.
- 4. Delete all partitions.
- 5. Create the first partition with 100MB of disk space, formatted to ext3, and assign it to /boot.
- 6. Create the next primary partition, hda2, with about 1000MB of disk space, as Linux Swap.
- 7. Create third partition with about 10GB disk space, Linux Native, and assign to / (root).

TABLE 2-6

Custom
Installation
as a Server
(No Other OS),
2.4 GHz
Pentium II,
25GB Single Disk,
512MB Memory

Partition	Size	Use	Comment
hda1	100MB	/boot	Maintains boot files
hda2	1000MB	swap	Probably plenty of space
hda3	10GB	/	The root directory
hda4	14GB	Extended partition	Solely a container for logical partitions
hda5	3GB	/var	For print spool files
hda6	3.5GB	/opt	Database system using RAID 1
hda7	3.5GB	/opt	Database system using RAID 1
hda8	2GB	/usr	File services using RAID 0
hda9	2GB	/usr	File services using RAID 0

8. Create an extended partition containing all the rest of the disk space, about 14GB.
9. Create the first logical partition, hda5, with about 3GB, formatted to ext3, and assign it to /var.
10. Create the next two logical partitions, hda6 and hda7 with about 3.5GB each. Format each to the software RAID filesystem.



In the real world, you should never configure different parts of a RAID array on the same hard drive. If you do, the failure of any single hard drive can lead to the loss of all of your data on that array. However, it may be necessary if the computer on your exam has only one physical hard drive.

11. Use the Make RAID option to set up a RAID 1 array from these two partitions. Format it to ext3 and assign it to /opt.
12. Create the next two logical partitions, hda8 and hda9, with about 2GB each. Format each to the software RAID filesystem.
13. Use the Make RAID option to set up a RAID 0 array from these two partitions. Format it to ext3 and assign it to /usr.
14. Continue with the installation process, using your best judgment.
15. When asked to select packages, make sure to include the MySQL Database Server package group.
16. Finish the installation normally.
17. Reboot and log in as the root user.

CERTIFICATION SUMMARY

One of the three parts of the RHCE certification is an exam that tests your ability to install Linux in different situations. In this chapter, you learned to install RHEL over a network. You've also worked with the major configuration tools that are part of the installation process.

Generally, there is no easy way to resize a Linux partition. This makes hard drive partition planning quite important. How you assign partitions to directories depends on the size of your hard drives, what you plan to install, and the demands on the system.

Appropriately configured partitions can prevent overloads on key systems, allow for appropriate swap space, improve security on key files, and ensure that your BIOS can find the Linux /boot files.

It's easy to download the Red Hat CDs. Whether you're using Red Hat Linux 9, Fedora Linux, Red Hat Enterprise Linux, or Professional Workstation, the basic steps are the same. You'll download ISO files which you can then write to CDs.

In most cases, you'll install Red Hat Enterprise Linux over a network. I've shown you how to set up a network installation server in this chapter. The same basic lessons apply if you're studying for the RHCE or RHCT exams using Fedora Linux or Red Hat Professional Workstation.

There are a number of ways to customize your installation. The software is organized in package groups. Red Hat starts with baseline package groups, which are the minimum requirements for the operating system. These include default packages for a functional workstation or server. You can then customize by adding or subtracting the package groups of your choice. The selections you make are critical during the Red Hat installation exams.

Before you start your installation, you need to understand the relationship between the Filesystem Hierarchy Standard and Linux directories. You can then make intelligent decisions on what directories to mount on separate partitions.

Understanding the installation process is one of the keys to success on the RHCE exam. Find a spare computer. Practice every installation scenario that you can think of. Repeat this process as you work through the advanced installation scenarios in Chapter 3.



TWO-MINUTE DRILL

The following are some of the key points from the certification objectives in Chapter 2.

Disk Partitions and Block Devices

- ☐ Linux has a simple naming standard for disk partitions: three letters followed by a number. The first letter reflects the type of drive (h for IDE, s for SCSI). The second letter is d for drive. The third letter represents the relative position of the disk. The number that follows is based on the relative position of the partition on the disk.
- ☐ The first IDE drive would be hda and the next hdb, then hdc and hdd.
- ☐ It's helpful to configure separate partitions for important data such as Web services, databases, FTP sites, and e-mail.
- ☐ Unless you use LVM, there is no easy way to resize Linux partitions. Therefore, you need to consider your partition scheme carefully.
- ☐ Typically, swap space should be two to three times the amount of RAM. However, the amount of swap space you need is debatable when you have larger amounts of RAM.

Downloading the Red Hat Installation CD-ROMs

- ☐ Many candidates will want to study for the Red Hat exams using downloaded CDs.
- ☐ There are several distributions that you could use to study for the Red Hat exams. Ideally, you'll be able to get a copy of Red Hat Enterprise Linux for your studies.
- ☐ If you can't get a copy of RHEL, there are options, including the source RPMs, Red Hat Professional Workstation, or Fedora Linux.
- ☐ If you do download the Installation files, you can download the files themselves, or representations of installation CDs on special files known as ISOs.

Configuring a Network Installation

- ☐ It's quite possible that you'll end up installing Red Hat Enterprise Linux over a network during your exam.

- ☐ You can configure a Network Installation Server to work with an NFS, FTP, or HTTP connection.
- ☐ Network installations require static IP address information or a DHCP server on the network.

Customizing Your Installation

- ☐ There are baseline packages associated with every installation of RHEL, as defined by the `/RedHat/base/comps.xml` file on the first installation CD.
- ☐ There are default packages associated with and suitable for RHEL Server and Workstation.
- ☐ In most cases, it's likely that you'll need to customize the package groups for your installation—for the exam and in real life.
- ☐ The package groups you select is a critical choice during the Installation part of both Red Hat exams.

Required Disk Space

- ☐ Depending on your requirements, Red Hat Enterprise Linux installs between approximately 550MB and 4GB of files.
- ☐ When you plan space for any RHEL installation, remember to leave room for user data, additional applications, services, and a swap partition.

Filesystems

- ☐ To know how you want to set up partitions, you need to understand the Filesystem Hierarchy Standard (FHS).
- ☐ The FHS is a standard for organizing directories for Linux- and Unix-based systems.
- ☐ You can organize different directories within the FHS on different partitions. Such a configuration is easier to maintain and easier to secure.
- ☐ There are several filesystems that you should consider mounting on separate partitions: `/tmp`, `/boot`, `/usr/local`, `/var`, and `/home`.
- ☐ Depending on installed services such as Web, FTP, NFS, or Samba, it may be appropriate to configure other filesystems on separate partitions.

The Installation Process

- ☐ Boot disks are important but fragile; with the **dd** command, boot disks are easy to copy.
- ☐ You can usually start the RHEL 3 installation process directly from a bootable CD or an installation floppy.
- ☐ The installation process is fairly straightforward and self-explanatory.
- ☐ When you practice installing RHEL 3, don't worry if you make a mistake during the process. It is usually easiest to restart the process from the beginning.

Sample Installation Exercises

- ☐ One of the key decisions when you plan a Linux installation is partitioning. This section sets up a number of partitioning exercises for installing RHEL 3 in different scenarios.

SELF TEST

The following questions will help you measure your understanding of the material presented in this chapter. Read all the choices carefully, as there may be more than one correct answer. Don't focus exclusively on these questions. There are no longer any multiple choice questions on the Red Hat exams. These questions exclusively test your understanding of the chapter. It is okay if you have another way of performing a task. Getting results, not memorizing trivia, is what counts on the Red Hat exams.

Disk Partitions and Block Devices

1. Which of the following would be the Linux device name for the fourth logical partition on the second IDE drive?
 - A. hdb4
 - B. hdb8
 - C. hdb5
 - D. hdb9

Downloading the Red Hat Installation CD-ROMs

2. Which of the following commands would you use to write an ISO file to a CD?
 - A. cdburn
 - B. cdrecord
 - C. isorecord
 - D. xcdrecord

Configuring a Network Installation

3. Which of the following servers can you use to serve Red Hat Enterprise Linux installation files?
 - A. NFS
 - B. Samba
 - C. HTTP
 - D. FTP

4. During the installation, you are asked to configure static networking and access the installation source files from an NFS server. Assuming you already have the IP address and netmask for the local computer, what else do you need?
- A. DNS server IP, BOOTP server IP, NFS export name
 - B. DNS export name, BOOTP server IP, NFS server IP
 - C. DHCP server IP, DHCP name, NFS export name
 - D. NFS export name, NFS server IP address

Customizing Your Installation

5. A Windows administrator is puzzled by the amount of swap space configured and wants to know what is recommended for Linux.
- A. The same as RAM memory.
 - B. 40–90MB.
 - C. The same as the server uses.
 - D. Twice the amount of RAM.
 - E. There is no recommended amount of swap space.

Required Disk Space

6. You have a computer with a 4GB hard drive. Should you install everything from Red Hat Enterprise Linux on your computer?
- A. Yes, it's good to have everything installed from the CDs.
 - B. Yes, you'll still have plenty of room for other software.
 - C. No, you won't have room for any other software.
 - D. No, most users don't need many of the development packages included on the CDs.

Filesystems

7. Why would you organize different filesystems on different partitions?
- A. Because you barely have enough space to install Linux on your current hard drive
 - B. To make it easier to back up and restore your data
 - C. To limit the space taken by a specific directory
 - D. For a dedicated single-use computer such as a DNS server or a gateway router

8. What other situations might be a good candidate for a separate filesystem?
- A. A Web server
 - B. The `/bin` directory
 - C. A group of shared files
 - D. Users' home directories

The Installation Process

9. Which of the following steps can you take to test the integrity of your Installation CDs?
- A. Start the installation process with the **linux mediacheck** command.
 - B. Start the installation process with the **linux md5** command.
 - C. Nothing. You just have to run the installation CDs and hope there is no problem.
 - D. Get an official boxed set of Red Hat Enterprise Linux Installation CDs.
10. You did not create a boot disk during the installation process. After installation, you want a boot disk customized for your installation. What can you do?
- A. Use the **dd** command to create a boot disk from the `bootdisk.img` disk image file on the first Red Hat installation CD.
 - B. Use the **rawrite** command to create a boot disk from the `bootdisk.img` disk image file on the first Red Hat installation CD.
 - C. Use the **mkboot --device /dev/fd0 `uname -r`** command.
 - D. Use the **mkbootdisk --device /dev/fd0 `uname -r`** command.

LAB QUESTIONS

Lab 1

You need to test Red Hat Enterprise Linux 3 as a replacement for your current RH 7.2 installed Web server. But you do not want to lose the current 7.2 Web setup just yet. You just want to test RHEL 3 using the Web pages and CGI scripts to see if they will work. What can you do? (Note: Fresh installations from Red Hat Linux to RHEL 3 are recommended.)

Lab 2

You want to test the **linux rescue** option from a boot disk or Installation CD. To make this work, you'll need access to installation media locally (from a CD-ROM or hard disk) or over a network

(from an NFS, FTP, or HTTP server). If required, create a boot disk from the bootdisk.img file described earlier in this chapter.

1. Insert the appropriate installation media (boot floppy or CD) into the drive.
2. Reboot your computer. If necessary, adjust the boot order in your computer's BIOS menu to boot from the appropriate media.
3. When you see the first RHEL installation screen, type **linux rescue** and then press ENTER.
4. Go through the text mode prompts for language and keyboard.
5. If you booted from the first installation CD, the following screen allows you to start networking on this system. While it can be helpful, it's not required here. Select No and press ENTER to continue.
 - a. If you've started with a boot floppy, the next screen is entitled Rescue Method. Select the system (CD, hard disk, NFS, FTP, HTTP) with your installation media. (If you've started with the first RHEL installation CD, skip to step 7.)
6. Enter the data required to point the RHEL installation program at your installation media. The details vary with the method. For more information, refer to the appropriate sections earlier in this chapter.
7. You should now see a text mode Rescue screen. Select Continue and press ENTER to continue.
8. If successful, you'll see a message that "Your system has been mounted under /mnt/sysimage." Click OK to continue.
9. Run several commands to see what the rescue disk has done to your system: **df**, **ls -l /**, **ls -l /mnt /sysimage**. Observe the results.
10. Run the **vi /etc/inittab** command. This is a critical file. Observe the results. Why do you think the /etc/inittab file is empty?
11. Run the **chroot /mnt/sysimage** command. Run the commands shown in steps 9 and 10. What happened?
12. If you're feeling adventurous, repeat this process. At step 7, select Skip instead of Continue. What is the difference? Could you mount the partition with the root directory on the /mnt/sysimage directory? Remember, you can find partitions with the **fdisk** command and create directories with the **mkdir** command. (You might have to be adventurous during the Red Hat Troubleshooting and System Maintenance exams.)

Lab 3

You want to practice network installations. To do so, set up an FTP installation server on a different Linux computer using the instructions described earlier in this chapter. These instructions also work if you want to create an FTP installation server on Red Hat Linux 9.

If you don't have another Linux computer, you can set up an FTP server on Microsoft Windows 2000/XP Professional/2003 for this purpose.

For the purpose of this exercise, assume that you've been asked to install a Web server, a DNS server, an FTP server, and a mail server during the RHEL 3 installation process.

Lab 4

You want to practice network installations. To do so, set up an HTTP installation server on a Linux computer using the instructions described earlier in this chapter. These instructions also work if you want to create an HTTP installation server on Red Hat Linux 8 and 9.

If you don't have another Linux computer, you can set up an HTTP server on Microsoft Windows 2000/XP Professional/2003 for this purpose.

For the purpose of this exercise, assume that you've been asked to install a Samba server, a print server, and will need to recompile the kernel.

SELF TEST ANSWERS

Disk Partitions and Block Devices

1. ☒ **B.** By definition, the first logical partition on the second IDE drive on a computer is hdb5. Since logical partitions are then numbered in sequence, the fourth logical partition on this drive is hdb8.
☒ The other answers do not match the defined partition naming criteria for the fourth logical partition.

Downloading the Red Hat Installation CD-ROMs

2. ☒ **B.** The only valid command in the list is **cdrecord**.
☒ The other answers are not valid Linux commands.

Configuring a Network Installation

3. ☒ **A, C, and D.** You can install RHEL over an NFS, FTP, or HTTP server.
☒ **B.** You can't install Linux over a Samba network connection. (It was possible for older versions of Red Hat Linux.)
4. ☒ **D.** The IP address of the NFS server and the export directory name (as defined in `/etc/exports`). You must already have an IP address and netmask (as well as an optional gateway IP if the services are on another network).
☒ A DHCP or BOOTP server should share IP addresses to all computers on a given network. An active DNS server should share the names of all computers on the given network. You don't need the IP address of either type of server. Hence **A, B, and C** are all incorrect.

Customizing Your Installatoin

5. ☒ **D.** Generally, a swap partition equal to twice your RAM is standard; however, this is not an absolute rule.
☒ Technically speaking, all the other answers may be right, but **D** is the rule of thumb most commonly used.

Required Disk Space

6. ☒ **C and D.** There is 4GB of software on RHEL 3. If you install everything on a 4GB hard disk, you won't have room for anything else. And besides, most users don't need the development packages on the RHEL 3 CDs.
☒ **A and B.** Since 4GB leaves you no room, and includes software that you probably don't need, these answers are not correct.

Filesystems

7. ☒ **B** and **C**. Filesystems on different partitions allow you to back up and restore data, one partition at a time. The amount of space taken by a specific directory is limited by the size of the partition.
☒ **A** and **D** are incorrect. Extra partitions waste space. If you barely have enough space on the current hard drive, you may not be able to install Linux. If you have a dedicated single-use computer, the amount of data is small, so there is no reason for different partitions.
8. ☒ **A**, **C**, and **D**. Web servers take up lots of space, and the associated log files can grow quickly. Shared files on a separate partition reduce the security risk. A separate filesystem ensures that it won't crowd out other partitions.
☒ **B** is incorrect. If the `/bin` directory is mounted on a separate filesystem, you may not be able to get to the associated commands if you have to use a rescue disk.

The Installation Process

9. ☒ **A**. The `linux mediacheck` command adds a step where you can check the integrity of each of the RHEL installation CDs.
☒ **B**, **C**, and **D** are all wrong. There is no `linux md5` command. There is something you can do to check before you find a problem. And while official boxed sets are probably more reliable, getting such CDs does not by itself check their integrity.
10. ☒ **D**. Among the available choices, only the `mkbootdisk` command can create a boot disk customized to your installation.
☒ **A**, **B**, and **C** are not correct. The `dd` and `rawrite` commands, when applied to the standard `bootdisk.img` file, create a standard installation boot disk. The `mkboot` command is a little trickier, since that works in Debian (but not Red Hat) Linux.

LAB ANSWERS

Lab I

Scenario 1: Buy a new disk and add it to the system. Then do a custom install to create a new installation of RHEL 3 to partitions on the new disk, adding an entry to `/etc/grub.conf` to provide a boot option to both versions of Linux.

Scenario 2: No space on server. Hmm ... you've got to get creative and either find a test computer you can do the test install on or back up everything on the main server after taking it off line. Perform a new installation of RHEL 3. Copy your `httpd.conf` configuration file and see how it works. If it fails, you restore everything back to the way it was. Note: *Test your backups first* before overwriting an existing operating system.

Lab 2

This is a useful exercise in using the Linux rescue system. If the problem is relatively minor, the steps shown will create a RAM disk with some essential tools on the root (/) filesystem. You can use these tools to repair damaged filesystems or partitions on your hard disk. The man pages don't work right away, because what is normally your root (/) directory is actually mounted on /mnt/sysimage.

The **chroot /mnt/sysimage** command makes the /mnt/sysimage directory into your root (/) directory. Everything (such as man pages) should work normally now.

The other option, to skip the mount process during **linux rescue** setup, does not mount any of your partitions. You can now mount them individually. If you create a /mnt/sysimage directory, you can even mount them in the same way as you saw during the first part of this exercise. Since your partitions are not mounted, you can fix damaged filesystems with commands such as **fsck**.

Lab 3

As described earlier in this chapter, the standard Red Hat FTP server is vsFTP; the default location for download files is the /var/ftp/pub directory. You'll want to specify a subdirectory to copy the files from the /RedHat directory from the installation CDs.

As this is a book on RHEL, I do not describe the steps needed to create an alternate FTP server on a Microsoft Windows computer.

To install a Web server, a DNS server, an FTP server, and a mail server during the RHEL 3 installation process, you need to select the DNS Name Server, Web Server, FTP Server, and Mail Server package groups.

Lab 4

As described earlier in this chapter, the standard Red Hat HTTP server is Apache. The default location for download files is the /var/www/html directory. You'll want to specify a subdirectory to copy the files from the /RedHat directory from the installation CDs.

As this is a book on RHEL, I do not describe the steps needed to create an alternate HTTP server on a Microsoft Windows computer.

To install a Samba server, a print server, and the packages associated with recompiling the kernel during the RHEL 3 installation process, you need to select the Windows File Server, Printing Support, and Kernel Development package groups.