Red Hat Enterprise Linux 4

Installation Guide for x86, Itanium™, AMD64, and Intel® Extended Memory 64 Technology (Intel® EM64T)

**Red Hat Enterprise Linux 4: Installation Guide for x86, Itanium™, AMD64, and Intel®
Extended Memory 64 Technology (Intel® EM64T)**
Copyright © 2005 Red Hat, Inc.

Red Hat, Inc.

1801 Varsity Drive
Raleigh NC 27606-2072 USA
Phone: +1 919 754 3700
Phone: 888 733 4281
Fax: +1 919 754 3701
PO Box 13588
Research Triangle Park NC 27709 USA

Table of Contents

Introduction

Welcome to the *Red Hat Enterprise Linux Installation Guide*. This guide contains useful information to assist you during the installation of Red Hat Enterprise Linux 4. From fundamental concepts such as installation preparation to the step-by-step installation procedure, this book will be a valuable resource as you install Red Hat Enterprise Linux.

1. Document Conventions

When you read this manual, certain words are represented in different fonts, typefaces, sizes, and weights. This highlighting is systematic; different words are represented in the same style to indicate their inclusion in a specific category. The types of words that are represented this way include the following:

`command`

> Linux commands (and other operating system commands, when used) are represented this way. This style should indicate to you that you can type the word or phrase on the command line and press [Enter] to invoke a command. Sometimes a command contains words that would be displayed in a different style on their own (such as file names). In these cases, they are considered to be part of the command, so the entire phrase is displayed as a command. For example:

> Use the `cat testfile` command to view the contents of a file, named `testfile`, in the current working directory.

`file name`

> File names, directory names, paths, and RPM package names are represented this way. This style should indicate that a particular file or directory exists by that name on your system. Examples:

> The `.bashrc` file in your home directory contains bash shell definitions and aliases for your own use.

> The `/etc/fstab` file contains information about different system devices and file systems.

> Install the `webalizer` RPM if you want to use a Web server log file analysis program.

application

> This style indicates that the program is an end-user application (as opposed to system software). For example:

> Use **Mozilla** to browse the Web.

[key]

> A key on the keyboard is shown in this style. For example:

> To use [Tab] completion, type in a character and then press the [Tab] key. Your terminal displays the list of files in the directory that start with that letter.

[key]-[combination]

> A combination of keystrokes is represented in this way. For example:

> The [Ctrl]-[Alt]-[Backspace] key combination exits your graphical session and return you to the graphical login screen or the console.

text found on a GUI interface

A title, word, or phrase found on a GUI interface screen or window is shown in this style. Text shown in this style is being used to identify a particular GUI screen or an element on a GUI screen (such as text associated with a checkbox or field). Example:

Select the **Require Password** checkbox if you would like your screensaver to require a password before stopping.

top level of a menu on a GUI screen or window

A word in this style indicates that the word is the top level of a pulldown menu. If you click on the word on the GUI screen, the rest of the menu should appear. For example:

Under **File** on a GNOME terminal, the **New Tab** option allows you to open multiple shell prompts in the same window.

If you need to type in a sequence of commands from a GUI menu, they are shown like the following example:

Go to **Main Menu Button** (on the Panel) **=> Programming => Emacs** to start the **Emacs** text editor.

button on a GUI screen or window

This style indicates that the text can be found on a clickable button on a GUI screen. For example:

Click on the **Back** button to return to the webpage you last viewed.

`computer output`

Text in this style indicates text displayed to a shell prompt such as error messages and responses to commands. For example:

The `ls` command displays the contents of a directory. For example:

```
Desktop              about.html       logs          paulwesterberg.png
Mail                 backupfiles      mail          reports
```

The output returned in response to the command (in this case, the contents of the directory) is shown in this style.

`prompt`

A prompt, which is a computer's way of signifying that it is ready for you to input something, is shown in this style. Examples:

```
$
```

```
#
```

```
[stephen@maturin stephen]$
```

```
leopard login:
```

`user input`

Text that the user has to type, either on the command line, or into a text box on a GUI screen, is displayed in this style. In the following example, **`text`** is displayed in this style:

To boot your system into the text based installation program, you must type in the **`text`** command at the `boot:` prompt.

`replaceable`

Text used for examples, which is meant to be replaced with data provided by the user, is displayed in this style. In the following example, `<version-number>` is displayed in this style:

The directory for the kernel source is /usr/src/<*version-number*>/, where <*version-number*> is the version of the kernel installed on this system.

Additionally, we use several different strategies to draw your attention to certain pieces of information. In order of how critical the information is to your system, these items are marked as a note, tip, important, caution, or warning. For example:

Note

Remember that Linux is case sensitive. In other words, a rose is not a ROSE is not a rOsE.

Tip

The directory /usr/share/doc/ contains additional documentation for packages installed on your system.

Important

If you modify the DHCP configuration file, the changes do not take effect until you restart the DHCP daemon.

Caution

Do not perform routine tasks as root — use a regular user account unless you need to use the root account for system administration tasks.

Warning

Be careful to remove only the necessary Red Hat Enterprise Linux partitions. Removing other partitions could result in data loss or a corrupted system environment.

2. How to Use This Manual

This manual focuses on a CD-ROM-based installation and is ideal for users (both new and old) who want a quick and simple installation solution. It helps you prepare your system and walk you through the installation of Red Hat Enterprise Linux.

Red Hat Enterprise Linux includes multiple installation CD-ROMs. Note that only the first CD-ROM (CD #1) is bootable. The additional installation CD-ROMs are required, even for a minimal installation. Red Hat also provides supplementary CD-ROMs containing source RPMs and documentation for all the packages, as well as a Linux Applications CD (LACD).

Note

If you currently use Red Hat Enterprise Linux 2.1 (or greater) on an x86 system, you can perform an upgrade.

Although upgrades are supported by the Red Hat Enterprise Linux family on x86 processors, you are likely to have a more consistent experience by backing up your data and then installing this release of Red Hat Enterprise Linux over your previous Red Hat Enterprise Linux installation. This recommended reinstallation method helps to ensure the best system stability possible.

To perform an upgrade, type the following command at the boot prompt:

```
linux upgrade
```

Skim Chapter 2 *Steps to Get You Started* to review the basics, then read Chapter 4 *Installing Red Hat Enterprise Linux*, following the directions as you go. Once you have chosen to perform an upgrade in the installation program, refer to Appendix A *Upgrading Your Current System*.

If you are an experienced user and you do not need a review of the basics, you can skip ahead to Chapter 4 *Installing Red Hat Enterprise Linux* to begin the installation process.

2.1. We Need Feedback!

If you discover a typo in the *Red Hat Enterprise Linux Installation Guide* or have thought of a way to make this manual better, we would love to hear from you. Submit a bug report against the component rhel-ig-x8664 in Bugzilla at:

```
http://bugzilla.redhat.com/bugzilla/
```

When submitting a bug report, be sure to mention the manual's identifier:

```
rhel-ig-x8664(EN)-4-Print-RHI (2004-09-24T13:10)
```

If you have a suggestion for improving the documentation, try to be as specific as possible when describing it. If you have found an error, please include the section number and some of the surrounding text so we can find it easily.

If you have a support question (for example, if you need help configuring X, or if you are not sure how to partition your hard drive[s]), use the online support system by registering your subscriptions at:

```
http://www.redhat.com/apps/activate/
```

3. Accessibility Solutions

While the graphic user interface (GUI) is convenient for sighted users, it is often inhibiting to those with visual impairments because of the difficulty speech synthesizers have interpreting graphics. Red Hat Enterprise Linux is an ideal operating system for users with visual limitations because the GUI is not required by the kernel. Most modern tools including email, news, Web browsers, calendars, calculators, and much more can run on Linux without a graphical environment. The working environment can also be customized to meet the hardware or software needs of the user.

Red Hat, Inc. is the distribution of choice for people with special needs because of the outstanding support that is offered with the purchase of any boxed set. Many Linux distributions provide limited

or nonexistent support to customers. Red Hat's installation support is deliverable via email or via the telephone and special circumstances will be considered and addressed for users with physical limitations. Customers should inform the support technician if they require specialized support.

For more information, refer to:

- http://www.tldp.org/HOWTO/Accessibility-HOWTO/
- http://www.tldp.org/HOWTO/Keyboard-and-Console-HOWTO.html
- The `README-Accessibility` file provides more information and instructions for using some of the tools available for users with special needs. This file can be found in `/usr/share/doc/redhat-release-X/`, where `X` is the release number of your installed subscription.

Chapter 1.

Itanium System Specific Information

1.1. Itanium System Installation Overview

Installing Red Hat Enterprise Linux on an Itanium system is different from installing Red Hat Enterprise Linux on an x86-based system. In general, the sequence of steps to a successful installation are the following:

1. Boot into the Extensible Firmware Interface (EFI) Shell.

2. If you cannot boot from the CD-ROM, make an LS-120 diskette from the boot image file provided with Red Hat Enterprise Linux.

3. Using the EFI Shell and the ELILO boot loader, load and run the kernel, and boot into the Red Hat Enterprise Linux installation program.

1.2. Itanium Systems — The EFI Shell

Before you start to install Red Hat Enterprise Linux on an Itanium, you must have a basic understanding of the EFI Shell, what it does, and the information it can provide.

The EFI Shell is a console interface used to launch applications (such as the Red Hat Enterprise Linux installation program), load EFI protocols and device drivers, and execute simple scripts. It is similar to a DOS console and can only access media that is FAT16 (VFAT) formatted.

The EFI Shell also contains common utilities that can be used on the EFI system partition. These utilities include `edit`, `type`, `cp`, `rm`, and `mkdir`. For a list of utilities and other commands, type `help` at the EFI Shell prompt.

The EFI Shell contains a boot loader called ELILO. Additional information on EFI can be found at the following URL:

`http://developer.intel.com/technology/efi/index.htm`

1.2.1. Itanium Systems — EFI Device Names

The `map` command can be used to list all devices and file systems that EFI can recognize. When your Itanium system boots into the EFI shell, it probes your system in the following order:

1. LS-120 drive (if it contains media)

2. IDE hard drives on the primary IDE interface

3. IDE hard drives on the secondary IDE interface

4. SCSI hard drives on the SCSI interface

5. CD-ROM drives on the IDE interface

6. CD-ROM drives on the SCSI interface

To view the results of this system poll, type the following command at the EFI Shell prompt:

map

The output is listed in the order the system was probed. So, all FAT16 file systems are listed first, then IDE hard drives, then SCSI hard drives, then IDE CD-ROM drives, and finally SCSI CD-ROM drives.

For example, output of the map command might look like the following:

```
Device mapping table
  fs0  : VenHw(Unknown Device:00)/HD(Part1,Sig00000000)
  fs1  : VenHw(Unknown Device:80)/HD(Part1,Sig00000000)
  fs2  : VenHw(Unknown Device:FF)/CDROM(Entry1)/HD(Part1,Sig00000000)
  blk0 : VenHw(Unknown Device:00)
  blk1 : VenHw(Unknown Device:00)/HD(Part1,Sig00000000)
  blk2 : VenHw(Unknown Device:80)
  blk3 : VenHw(Unknown Device:80)/HD(Part1,Sig00000000)
  blk4 : VenHw(Unknown Device:80)/HD(Part2,Sig00000000)
  blk5 : VenHw(Unknown Device:80)/HD(Part3,Sig00000000)
  blk6 : VenHw(Unknown Device:80)/HD(Part3,Sig00000000)/HD(Part1,Sig725F7772)
  blk7 : VenHw(Unknown Device:FF)
  blk8 : VenHw(Unknown Device:FF)/CDROM(Entry1)
  blk9 : VenHw(Unknown Device:FF)/CDROM(Entry1)/HD(Part1,Sig00000000)
```

In this example, there is an LS-120 diskette in the LS-120 drive as well as a CD-ROM in the CD-ROM drive. All the listings beginning with fs are FAT16 file systems that EFI can read. All the listings beginning with blk are block devices that EFI recognizes. Both the file systems and block devices are listed in the order they are probed. Therefore, fs0 is the system partition on the LS-120, fs1 is the system partition on the hard drive, and fs2 is the system partition on the CD-ROM.

1.2.2. Itanium Systems — EFI System Partition

When partitioning your hard drive for Linux, you must create a system partition that is FAT16 (VFAT) formatted and has a mount point of /boot/efi/. This partition contains the installed Linux kernel(s) as well as the ELILO configuration file (elilo.conf). The elilo.conf file contains a list of kernels from which you can boot your system.

Chapter 2.

Steps to Get You Started

2.1. Where to Find Other Manuals

Red Hat Enterprise Linux manuals are available online or on the Red Hat Enterprise Linux Documentation CD included with your Red Hat Enterprise Linux subscription.

If you are a new user and need information on getting started with Red Hat Enterprise Linux, you may find the *Red Hat Enterprise Linux Step By Step Guide* to be helpful.

For an overview of system administration, refer to the *Red Hat Enterprise Linux Introduction to System Administration*. If you are looking for information on system configuration, you may find the *Red Hat Enterprise Linux System Administration Guide* to be helpful.

If you are a more experienced user looking for information on administration topics, you may find the *Red Hat Enterprise Linux Reference Guide* to be helpful.

If you need information on securing your system, refer to the *Red Hat Enterprise Linux Security Guide*.

HTML, PDF, and RPM versions of the manuals are available on the Red Hat Enterprise Linux Documentation CD and online at http://www.redhat.com/docs/.

Note

> Although this manual reflects the most current information possible, read the *Red Hat Enterprise Linux Release Notes* for information that may not have been available prior to our documentation being finalized. They can be found on the Red Hat Enterprise Linux CD #1 and online at http://www.redhat.com/docs/.

2.2. Is Your Hardware Compatible?

Hardware compatibility is particularly important if you have an older system or a system that you built yourself. Red Hat Enterprise Linux 4 should be compatible with most hardware in systems that were factory built within the last two years. However, hardware specifications change almost daily, so it is difficult to guarantee that your hardware is 100% compatible.

The most recent list of supported hardware can be found at:

```
http://hardware.redhat.com/hcl/
```

2.3. Do You Have Enough Disk Space?

Nearly every modern-day operating system (OS) uses *disk partitions*, and Red Hat Enterprise Linux is no exception. When you install Red Hat Enterprise Linux, you may have to work with disk partitions. If you have not worked with disk partitions before (or need a quick review of the basic concepts), refer to Appendix D *An Introduction to Disk Partitions* before proceeding.

The disk space used by Red Hat Enterprise Linux must be separate from the disk space used by other OSes you may have installed on your system, such as Windows, OS/2, or even a different version of Linux. For x86, AMD64, and Intel® Extended Memory 64 Technology (Intel® EM64T) systems, at least two partitions (/ and swap) must be dedicated to Red Hat Enterprise Linux. For Itanium systems, at least three partitions (/, /boot/efi/, and swap) must be dedicated to Red Hat Enterprise Linux.

Before you start the installation process, you must

- have enough *unpartitioned*[1] disk space for the installation of Red Hat Enterprise Linux, or
- have one or more partitions that may be deleted, thereby freeing up enough disk space to install Red Hat Enterprise Linux.

To gain a better sense of how much space you really need, refer to the recommended partitioning sizes discussed in Section 4.16.4 *Recommended Partitioning Scheme*.

If you are not sure that you meet these conditions, or if you want to know how to create free disk space for your Red Hat Enterprise Linux installation, refer to Appendix D *An Introduction to Disk Partitions*.

2.4. Can You Install Using the CD-ROM?

There are several methods that can be used to install Red Hat Enterprise Linux.

Installing from a CD-ROM requires that you have purchased a Red Hat Enterprise Linux 4 product, or you have a Red Hat Enterprise Linux CD-ROM, and you have a CD-ROM drive. Most new computers allow booting from the CD-ROM. If your system supports booting from the CD-ROM, it is an easy way to begin a local CD-ROM installation.

Your BIOS may need to be changed to allow booting from your CD-ROM drive. For more information about changing your BIOS, refer to Section 4.3.1 *Booting the Installation Program on x86, AMD64, and Intel® EM64T Systems*.

2.4.1. Alternative Boot Methods

Boot CD-ROM

   If you can boot using the CD-ROM drive, you can create your own CD-ROM to boot the in-stallation program. This may be useful, for example, if you are performing an installation over a network or from a hard drive. Refer to Section 2.4.2 *Making an Installation Boot CD-ROM* for further instructions.

USB pen drive

   If you cannot boot from the CD-ROM drive, but you can boot using a USB device, such as a USB pen drive, the following alternative boot method is available:

   To boot using a USB pen drive, use the dd command to copy the diskboot.img image file from the /images/ directory on CD-ROM 1. For example:
   dd if=diskboot.img of=/dev/sda

   Your BIOS must support booting from a USB device in order for this boot method to work.

---

1.   Unpartitioned disk space means that available disk space on the hard drive(s) you are installing to has not been divided into sections for data. When you partition a disk, each partition behaves like a separate disk drive.

2.4.2. Making an Installation Boot CD-ROM

`isolinux` (not available for Itanium systems) is used for booting the Red Hat Enterprise Linux installation CD. To create your own CD-ROM to boot the installation program, use the following instructions:

Copy the `isolinux/` directory from the Red Hat Enterprise Linux CD #1 into a temporary directory (referred to here as <*path-to-workspace*>) using the following command:

```
cp -r <path-to-cd>/isolinux/ <path-to-workspace>
```

Change directories to the <*path-to-workspace*> directory you have created:

```
cd <path-to-workspace>
```

Make sure the files you have copied have appropriate permissions:

```
chmod u+w isolinux/*
```

Finally, issue the following command to create the ISO image file:

```
mkisofs -o file.iso -b isolinux.bin -c boot.cat -no-emul-boot \
-boot-load-size 4 -boot-info-table -R -J -v -T isolinux/
```

> **Note**
>
> The above command was split into two lines for printing purposes only. When you execute this command, be sure to type it as a single command, all on the same line.

Burn the resulting ISO image (named `file.iso` and located in <*path-to-workspace*>) to a CD-ROM as you normally would.

2.5. Preparing for a Network Installation

> **Note**
>
> Make sure an installation CD (or any other type of CD) is not in your hosting partition's drive if you are performing a network-based installation. Having a CD in the drive may cause unexpected errors.

The Red Hat Enterprise Linux installation media must be available for either a network installation (via NFS, FTP, or HTTP) or installation via local storage. Use the following steps if you are performing an NFS, FTP, or HTTP installation.

The NFS, FTP, or HTTP server to be used for installation over the network must be a separate machine which can provide the complete `RedHat/` directory. Both the `RedHat/base/` and `RedHat/RPMS/` directories must be available and populated with all files from all installation CD-ROMs.

Note

The directory specified in the following refers to */location/of/disk/space/*. This means it is the directory up to, but *not* including, the `RedHat/` distribution directory. For example, if you have Red Hat Enterprise Linux 4 installation files located in `/export/rhel/` on the installation staging server, */location/of/disk/space/* would be `/export/rhel/`.

To copy the `RedHat/` directory from the installation CD-ROMs to a Linux machine which acts as an installation staging server, perform the following steps:

- For each binary CD-ROM, execute the following commands:

  - `mount /mnt/cdrom`

  - `cp -var /mnt/cdrom/RedHat /location/of/disk/space`

    where */location/of/disk/space/* is a directory you create such as `/export/rhel/`

  - `umount /mnt/cdrom/`

- Note that the Release Notes are not included in the `RedHat` directory. Unless they are specifically copied over, the Release Notes will not be available during your installation of Red Hat Enterprise Linux. The Release Notes are formatted in HTML files located at the root of the disc. Copy the files to your installation directory. For example:

  `cp /mnt/cdrom/RELEASE-NOTES*.html /location/of/disk/space/`

  The Release Notes are also available online from http://www.redhat.com/docs/.

- Next, make */location/of/disk/space/* available for network installation via NFS, FTP, or HTTP and verify access from a client system.

- For NFS, export the directory by adding an entry to `/etc/exports` to export to a specific system:

  `/location/of/disk/space client.ip.address(ro,no_root_squash)`

  To export to all machines (not appropriate for all NFS systems), add:

  `/location/of/disk/space *(ro,no_root_squash)`

  Start the NFS daemon (on a Red Hat Enterprise Linux machine, use `/sbin/service nfs start`). If NFS is already running, reload the configuration file (on a Red Hat Enterprise Linux system, use `/sbin/service nfs reload`).

  Be sure to test the NFS share following the directions in the *Red Hat Enterprise Linux System Administration Guide*.

  If the `RedHat/` directory does not appear in the NFS shared directory, the wrong path may have been mounted and/or exported.

- FTP and HTTP installations also support a second type of tree structure. To make it easier to access the contents of the installation CD-ROMs, mount each CD-ROM or ISO image with the following mount point on the FTP or HTTP server (where *X* is the number of the CD-ROM or ISO image):

  `/location/of/disk/space/disc`*X*`/`

  For example:

  `mount -o loop CD1.iso /location/of/disk/space/disc1/`

2.5.1. Using ISO Images for NFS Installs

NFS installations can use ISO (or CD-ROM) images rather than copying an entire installation tree. After placing the required ISO images (the binary Red Hat Enterprise Linux CD-ROMs) in a directory, choose to install via NFS. You will then point the installation program at that directory to perform the installation.

Verifying that the ISO images are intact before you attempt an installation will help to avoid problems that are often encountered during an NFS installation. To verify the ISO images are intact prior to performing an installation, use an md5sum program (many md5sum programs are available for various operating systems). An md5sum program should be available on the same server as the ISO images.

Note

The Red Hat Enterprise Linux installation program has the ability to test the integrity of the installation media. It works with the CD, DVD, hard drive ISO, and NFS ISO installation methods. Red Hat recommends that you test all installation media before starting the installation process, and before reporting any installation-related bugs (many of the bugs reported are actually due to improperly-burned CDs). To use this test, type the following command at the boot: prompt (prepend with elilo for Itanium systems):

```
linux mediacheck
```

Additionally, if a file called updates.img exists in the directory from which you install, then it will be used for installation program updates. Refer to the file install-methods.txt in the anaconda RPM package for detailed information on the various ways to install Red Hat Enterprise Linux, as well as how to apply the installation program updates.

Note

You can only have the ISO images for one release and one variant of Red Hat Enterprise Linux in the directory.

2.6. Preparing for a Hard Drive Installation

Note

Hard drive installations only work from ext2, ext3, or FAT file systems. If you have a file system other than those listed here, such as reiserfs, you will not be able to perform a hard drive installation.

Hard drive installations require the use of the ISO (or CD-ROM) images. An ISO image is a file containing an exact copy of a CD-ROM image. Because Red Hat Enterprise Linux has so many packages included with its distribution, there are several ISO images available. After placing the required ISO images (the binary Red Hat Enterprise Linux CD-ROMs) in a directory, choose to install from the hard drive. You can then point the installation program at that directory to perform the installation.

To prepare your system for a hard drive installation, you must set the system up in one of the following ways:

- Using a set of CD-ROMs — Create CD-ROM ISO image files from each installation CD-ROM. For each CD-ROM, execute the following command on a Linux system:

  ```
  dd if=/dev/cdrom of=/tmp/file-name.iso
  ```

- Using ISO images — transfer these images to the system to be installed.

  Verifying that ISO images are intact before you attempt an installation, helps to avoid problems. To verify the ISO images are intact prior to performing an installation, use an md5sum program (many md5sum programs are available for various operating systems). An md5sum program should be available on the same Linux machine as the ISO images.

> **Note**
>
> The Red Hat Enterprise Linux installation program has the ability to test the integrity of the installation media. It works with the CD, DVD, hard drive ISO, and NFS ISO installation methods. Red Hat recommends that you test all installation media before starting the installation process, and before reporting any installation-related bugs (many of the bugs reported are actually due to improperly-burned CDs). To use this test, type the following command at the boot: prompt (prepend with elilo for Itanium systems):
>
> **linux mediacheck**

Additionally, if a file called RedHat/base/updates.img exists in the directory from which you install, it is used for installation program updates. Refer to the file install-methods.txt in the anaconda RPM package for detailed information on the various ways to install Red Hat Enterprise Linux, as well as how to apply the installation program updates.

Chapter 3.

System Requirements Table

The most recent list of supported hardware can be found at http://hardware.redhat.com/hcl/.

This system requirements table will help you keep a record of your current system settings and requirements. Enter information about your system in the table provided as a handy reference to help make your Red Hat Enterprise Linux installation go more smoothly.

hard drive(s): type, label, size; ex: IDE hda=40 GB	
partitions: map of partitions and mount points; ex: `/dev/hda1=/home`, `/dev/hda2=/` (fill this in once you know where they will reside)	
memory: amount of RAM installed on your system; ex: 128 MB, 512 MB	
CD-ROM: interface type; ex: SCSI, IDE (ATAPI)	
SCSI adapter: if present, make and model number; ex: BusLogic SCSI Adapter, Adaptec 2940UW	
network card: if present, make and model number; ex: Tulip, 3COM 3C590	
mouse: type, protocol, and number of buttons; ex: generic 3 button PS/2 mouse, MouseMan 2 button serial mouse	
monitor: make, model, and manufacturer specifications; ex: Optiquest Q53, ViewSonic G773	
video card: make, model number and size of VRAM; ex: Creative Labs Graphics Blaster 3D, 8MB	

sound card: make, chipset and model number; ex: S3 SonicVibes, Sound Blaster 32/64 AWE	
IP, DHCP, and BOOTP addresses: four numbers, separated by dots; ex: 10.0.2.15	
netmask: four numbers, separated by dots; ex: 255.255.248.0	
gateway IP address: four numbers, separated by dots; ex: 10.0.2.245	
one or more name server IP addresses (DNS): one or more sets of dot-separated numbers; ex: 10.0.2.1	
domain name: the name given to your organization; ex: `example.com`	
hostname: the name of your computer; your personal choice of names; ex: `cookie`, `southpark`	

Table 3-1. System Requirements Table

If any of these networking requirements or terms are unfamiliar to you, contact your network administrator for assistance.

Chapter 4.

Installing Red Hat Enterprise Linux

This chapter explains how to perform a Red Hat Enterprise Linux installation from the CD-ROM, using the graphical, mouse-based installation program. The following topics are discussed:

- Becoming familiar with the installation program's user interface
- Starting the installation program
- Selecting an installation method
- Configuration steps during the installation (language, keyboard, mouse, partitioning, etc.)
- Finishing the installation

4.1. The Graphical Installation Program User Interface

If you have used a *graphical user interface (GUI)* before, you are already familiar with this process; use your mouse to navigate the screens, click buttons, or enter text fields.

You can also navigate through the installation using the keyboard. The [Tab] key allows you to move around the screen, the Up and Down arrow keys to scroll through lists, [+] and [-] keys expand and collapse lists, while [Space] and [Enter] selects or removes from selection a highlighted item. You can also use the [Alt]-[*X*] key command combination as a way of clicking on buttons or making other screen selections, where [*X*] is replaced with any underlined letter appearing within that screen.

Note

If you are using an x86, AMD64, or Intel® EM64T system, and you do not wish to use the GUI installation program, the text mode installation program is also available. To start the text mode installation program, use the following command at the `boot:` prompt:

`linux text`

Refer to Section 4.2 *The Text Mode Installation Program User Interface* for a brief overview of text mode installation instructions.

It is highly recommended that installs be performed using the GUI installation program. The GUI installation program offers the full functionality of the Red Hat Enterprise Linux installation program, including LVM configuration which is not available during a text mode installation.

Users who must use the text mode installation program can follow the GUI installation instructions and obtain all needed information.

Note

If you are using an Itanium system, and you do not wish to use the GUI installation program, the text mode installation program is also available. To start the text mode installation program, type the following command at the EFI Shell prompt:

```
elilo linux text
```

4.1.1. A Note about Virtual Consoles

The Red Hat Enterprise Linux installation program offers more than the dialog boxes of the installation process. Several kinds of diagnostic messages are available to you, as well as a way to enter commands from a shell prompt. The installation program displays these messages on five *virtual consoles*, among which you can switch using a single keystroke combination.

A virtual console is a shell prompt in a non-graphical environment, accessed from the physical machine, not remotely. Multiple virtual consoles can be accessed simultaneously.

These virtual consoles can be helpful if you encounter a problem while installing Red Hat Enterprise Linux. Messages displayed on the installation or system consoles can help pinpoint a problem. Refer to Table 4-1 for a listing of the virtual consoles, keystrokes used to switch to them, and their contents.

Generally, there is no reason to leave the default console (virtual console #7 for graphical installations) unless you are attempting to diagnose installation problems.

Console	Keystrokes	Contents
1	[Ctrl]-[Alt]-[F1]	installation dialog
2	[Ctrl]-[Alt]-[F2]	shell prompt
3	[Ctrl]-[Alt]-[F3]	install log (messages from installation program)
4	[Ctrl]-[Alt]-[F4]	system-related messages
5	[Ctrl]-[Alt]-[F5]	other messages
7	[Ctrl]-[Alt]-[F7]	X graphical display

Table 4-1. Console, Keystrokes, and Contents

4.2. The Text Mode Installation Program User Interface

The Red Hat Enterprise Linux text mode installation program uses a screen-based interface that includes most of the on-screen *widgets* commonly found on graphical user interfaces. Figure 4-1, and Figure 4-2, illustrate the screens that appear during the installation process.

Note

While text mode installations are not explicitly documented, those using the text mode installation program can easily follow the GUI installation instructions.
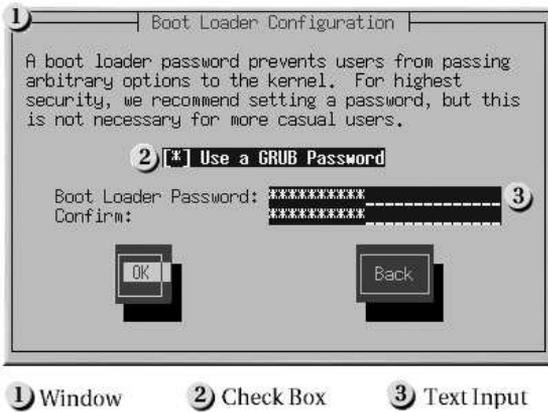
Figure 4-1. Installation Program Widgets as seen in Boot Loader Configuration
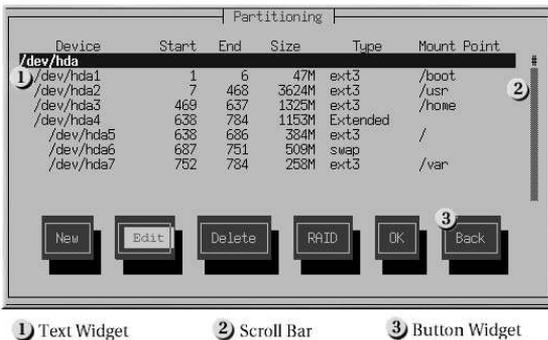
Figure 4-2. Installation Program Widgets as seen in Disk Druid

Here is a list of the most important widgets shown in Figure 4-1 and Figure 4-2:

- Window — Windows (usually referred to as *dialogs* in this manual) appear on your screen throughout the installation process. At times, one window may overlay another; in these cases, you can only interact with the window on top. When you are finished in that window, it disappears, allowing you to continue working in the window underneath.

- Checkbox — Checkboxes allow you to select or deselect a feature. The box displays either an asterisk (selected) or a space (unselected). When the cursor is within a checkbox, press [Space] to select or deselect a feature.

- Text Input — Text input lines are regions where you can enter information required by the installation program. When the cursor rests on a text input line, you may enter and/or edit information on that line.

- Text Widget — Text widgets are regions of the screen for the display of text. At times, text widgets may also contain other widgets, such as checkboxes. If a text widget contains more information

than can be displayed in the space reserved for it, a scroll bar appears; if you position the cursor within the text widget, you can then use the [Up] and [Down] arrow keys to scroll through all the information available. Your current position is shown on the scroll bar by a **#** character, which moves up and down the scroll bar as you scroll.

• Scroll Bar — Scroll bars appear on the side or bottom of a window to control which part of a list or document is currently in the window's frame. The scroll bar makes it easy to move to any part of a file.

• Button Widget — Button widgets are the primary method of interacting with the installation program. You progress through the windows of the installation program by navigating these buttons, using the [Tab] and [Enter] keys. Buttons can be selected when they are highlighted.

• Cursor — Although not a widget, the cursor is used to select (and interact with) a particular widget. As the cursor is moved from widget to widget, it may cause the widget to change color, or the cursor itself may only appear positioned in or next to the widget. In Figure 4-1, the cursor is positioned on the **OK** button. Figure 4-2, shows the cursor on the **Edit** button.

4.2.1. Using the Keyboard to Navigate

Navigation through the installation dialogs is performed through a simple set of keystrokes. To move the cursor, use the [Left], [Right], [Up], and [Down] arrow keys. Use [Tab], and [Alt]-[Tab] to cycle forward or backward through each widget on the screen. Along the bottom, most screens display a summary of available cursor positioning keys.

To "press" a button, position the cursor over the button (using [Tab], for example) and press [Space] or [Enter]. To select an item from a list of items, move the cursor to the item you wish to select and press [Enter]. To select an item with a checkbox, move the cursor to the checkbox and press [Space] to select an item. To deselect, press [Space] a second time.

Pressing [F12] accepts the current values and proceeds to the next dialog; it is equivalent to pressing the **OK** button.

Caution

> Unless a dialog box is waiting for your input, do not press any keys during the installation process (doing so may result in unpredictable behavior).

4.3. Starting the Installation Program

To start, first make sure that you have all necessary resources for the installation. If you have already read through Chapter 2 *Steps to Get You Started*, and followed the instructions, you should be ready to start the installation process. When you have verified that you are ready to begin, boot the installation program using the Red Hat Enterprise Linux CD-ROM #1 or any boot media that you have created.

Note

> Occasionally, some hardware components require a *driver diskette* during the installation. A driver diskette adds support for hardware that is not otherwise supported by the installation program. Refer to Appendix E *Driver Media* for more information.

4.3.1. Booting the Installation Program on x86, AMD64, and Intel® EM64T Systems

You can boot the installation program using any one of the following media (depending upon what your system can support):

- *Red Hat Enterprise Linux CD-ROM* — Your machine supports a bootable CD-ROM drive and you have the Red Hat Enterprise Linux CD-ROM set.
- *Boot CD-ROM* — Your machine supports a bootable CD-ROM drive and you want to perform network or hard drive installation.
- *USB pen drive* — Your machine supports booting from a USB device.

To create a boot CD-ROM or to prepare your USB pen drive for installation, refer to Section 2.4.2 *Making an Installation Boot CD-ROM*.

Insert the boot media and reboot the system. Your BIOS settings may need to be changed to allow you to boot from the CD-ROM or USB device.

Tip

To change your BIOS settings on an x86, AMD64, or Intel® EM64T system, watch the instructions provided on your display when your computer first boots. A line of text appears, telling you which key to press to enter the BIOS settings.

Once you have entered your BIOS setup program, find the section where you can alter your boot sequence. The default is often C, A or A, C (depending on whether you boot from your hard drive [C] or a diskette drive [A]). Change this sequence so that the CD-ROM is first in your boot order and that C or A (whichever is your typical boot default) is second. This instructs the computer to first look at the CD-ROM drive for bootable media; if it does not find bootable media on the CD-ROM drive, it then checks your hard drive or diskette drive.

Save your changes before exiting the BIOS. For more information, refer to the documentation that came with your system.

After a short delay, a screen containing the `boot:` prompt should appear. The screen contains information on a variety of boot options. Each boot option also has one or more help screens associated with it. To access a help screen, press the appropriate function key as listed in the line at the bottom of the screen.

As you boot the installation program, be aware of two issues:

- Once the `boot:` prompt appears, the installation program automatically begins if you take no action within the first minute. To disable this feature, press one of the help screen function keys.
- If you press a help screen function key, there is a slight delay while the help screen is read from the boot media.

Normally, you only need to press [Enter] to boot. Be sure to watch the boot messages to review if the Linux kernel detects your hardware. If your hardware is properly detected, continue to the next section. If it does not properly detect your hardware, you may need to restart the installation and use one of the boot options provided in Appendix F *Additional Boot Options*.

4.3.2. Booting the Installation Program on Itanium Systems

Your Itanium system should be able to boot the Red Hat Enterprise Linux installation program directly from the Red Hat Enterprise Linux CD #1. If your Itanium cannot boot the installation program from the CD-ROM (or if you want to perform a hard

drive, NFS, FTP, or HTTP installation) you must boot from an LS-120 diskette. Refer to Section 4.3.2.2 *Booting the Installation Program from an LS-120 Diskette* for more information.

4.3.2.1. Booting the Installation Program from the CD-ROM

To boot from the Red Hat Enterprise Linux CD #1 follow these steps:

1. Remove all media except Red Hat Enterprise Linux CD #1.
2. From the **Boot Option** menu choose **EFI Shell**.
3. At the Shell> prompt, change to the file system on the CD-ROM. For example, in the above sample map output, the system partition on the CD-ROM is fs1. To change to the fs1 file system, type fs1: at the prompt.
4. Type elilo linux to boot into the installation program.
5. Go to Chapter 4 *Installing Red Hat Enterprise Linux* to begin the installation.

4.3.2.2. Booting the Installation Program from an LS-120 Diskette

If your Itanium cannot boot from Red Hat Enterprise Linux CD #1, you must boot from an LS-120 diskette. If you want to perform a hard drive, NFS, FTP, or HTTP installation, you must boot from boot LS-120 diskette.

You must create an LS-120 boot image file diskette from the boot image file on CD #1: images/boot.img. To create this diskette in Linux, insert a blank LS-120 diskette and type the following command at a shell prompt:

```
dd if=boot.img of=/dev/hda bs=180k
```

Replace *boot.img* with the full path to the boot image file and **/dev/hda** with the correct device name for the LS-120 diskette drive.

If you are not using the Red Hat Enterprise Linux CD, the installation program starts in text mode and you must choose a few basic options for your system.

If you are using the CD-ROM to load the installation program, follow the instructions contained in Chapter 4 *Installing Red Hat Enterprise Linux*.

To boot from an LS-120 diskette follow these steps:

1. Insert the LS-120 diskette you made from the boot image file boot.img. If you are performing a local CD-ROM installation but booting off the LS-120 diskette, insert the Red Hat Enterprise Linux CD #1 also. If you are performing a hard drive, NFS, FTP, or HTTP installation, you do not need the CD-ROM.
2. From the **Boot Option** menu choose **EFI Shell**.
3. At the Shell> prompt, change the device to the LS-120 drive by typing the command fs0:, using the example map output above.
4. Type elilo linux to boot into the installation program.
5. Go to Chapter 4 *Installing Red Hat Enterprise Linux* to begin the installation.

4.3.3. Additional Boot Options

While it is easiest to boot using a CD-ROM and perform a graphical installation, sometimes there are installation scenarios where booting in a different manner may be needed. This section discusses additional boot options available for Red Hat Enterprise Linux.

For Itanium users:

To pass options to the boot loader on an Itanium system, enter the following at the EFI Shell prompt:

```
elilo linux option
```

For x86, AMD64, and Intel® EM64T users:

To pass options to the boot loader on an x86, AMD64, or Intel® EM64T system, use the instructions as provided in the boot loader option samples below.

Note

Refer to Appendix F *Additional Boot Options* for additional boot options not covered in this section.

- To perform a text mode installation, at the installation boot prompt, type:
  linux text
- ISO images have an md5sum embedded in them. To test the checksum integrity of an ISO image, at the installation boot prompt, type:
  linux mediacheck

  The installation program prompts you to insert a CD or select an ISO image to test, and select **OK** to perform the checksum operation. This checksum operation can be performed on any Red Hat Enterprise Linux CD and does not have to be performed in a specific order (for example, CD #1 does not have to be the first CD you verify). It is strongly recommended to perform this operation on any Red Hat Enterprise Linux CD that was created from downloaded ISO images. This command works with the CD, DVD, hard drive ISO, and NFS ISO installation methods.

- Also in the images/ directory is the boot.iso file. This file is an ISO image than can be used to boot the installation program. To use the boot.iso, your computer must be able to boot from its CD-ROM drive, and its BIOS settings must be configured to do so. You must then burn the boot.iso file onto a recordable/rewriteable CD-ROM.

- If you need to perform the installation in *serial mode*, type the following command:
  linux console=<device>

  For text mode installations, use:
  linux text console=<device>

  In the above command, <device> should be the device you are using (such as ttyS0 or ttyS1). For example, linux text console=ttyS0.

  Text mode installations using a serial terminal work best when the terminal supports UTF-8. Under UNIX and Linux, Kermit supports UTF-8. For Windows, Kermit '95 works well. Non-UTF-8 capable terminals works as long as only English is used during the installation process. An enhanced serial display can be used by passing the utf8 command as a boot-time option to the installation program. For example:
  ```
  linux console=ttyS0 utf8
  ```

4.3.3.1. Kernel Options

Options can also be passed to the kernel. For example, to instruct the kernel to use all the RAM in a system with 128 MB of RAM, at the installation boot prompt, enter:

```
linux mem=128M
```

For text mode installations, use:

```
linux text mem=128M
```

With most computers, there is no need to pass this argument to the kernel. The kernel detects the amount of memory your system has in most cases. However, using this command is often helpful for testing purposes. For example, you can boot with less memory by passing a `linux mem=64M` or `linux text mem=64M` option to the kernel.

After entering any options, press [Enter] to boot using those options.

If you need to specify boot options to identify your hardware, please write them down. The boot options are needed during the boot loader configuration portion of the installation (refer to Section 4.17 *x86, AMD64, and Intel® EM64T Boot Loader Configuration* for more information).

4.4. Selecting an Installation Method

What type of installation method do you wish to use? The following installation methods are available:

CD-ROM

> If you have a CD-ROM drive and the Red Hat Enterprise Linux CD-ROMs, you can use this method. Refer to Section 4.5 *Installing from CD-ROM*, for CD-ROM installation instructions.

Hard Drive

> If you have copied the Red Hat Enterprise Linux ISO images to a local hard drive, you can use this method. You need a boot CD-ROM. Refer to Section 4.6 *Installing from a Hard Drive*, for hard drive installation instructions.

NFS

> If you are installing from an NFS server using ISO images or a mirror image of Red Hat Enterprise Linux, you can use this method. You need a boot CD-ROM (use the `linux askmethod` boot option). Refer to Section 4.8 *Installing via NFS* for network installation instructions. Note that NFS installations may also be performed in GUI mode.

FTP

> If you are installing directly from an FTP server, use this method. You need a boot CD-ROM (use the `linux askmethod` boot option). Refer to Section 4.9 *Installing via FTP*, for FTP installation instructions.

HTTP

If you are installing directly from an HTTP (Web) server, use this method. You need a boot CD-ROM (use the `linux askmethod` boot option). Refer to Section 4.10 *Installing via HTTP*, for HTTP installation instructions.

4.5. Installing from CD-ROM

To install Red Hat Enterprise Linux from a CD-ROM, choose the **CD-ROM** option and select **OK**. When prompted, insert the Red Hat Enterprise Linux CD into your CD-ROM drive (if you did not boot from the CD). Once the CD is in the CD-ROM drive, select **OK**, and press [Enter].

Note

The first CD-ROM is required when booting the installation program, and again after subsequent CD-ROMs have been processed.

The installation program then probes your system and attempts to identify your CD-ROM drive. It starts by looking for an IDE (also known as an ATAPI) CD-ROM drive. If found, continue to the next stage of the installation process (refer to Section 4.12 *Language Selection*).

Note

To abort the installation process at this time, reboot your machine and then eject the boot media. You can safely cancel the installation at any point before the **About to Install** screen. Refer to Section 4.24 *Preparing to Install* for more information.

If your CD-ROM drive is not detected, and it is a SCSI CD-ROM, the installation program prompts you to choose a SCSI driver. Choose the driver that most closely resembles your adapter. You may specify options for the driver if necessary; however, most drivers detect your SCSI adapter automatically.

Tip

A partial list of optional parameters for CD-ROM drives can be found in the *Red Hat Enterprise Linux Reference Guide*, in the *General Parameters and Modules* appendix.

4.5.1. What If the IDE CD-ROM Was Not Found?

If you have an IDE (ATAPI) CD-ROM on an x86, AMD64, or Intel® EM64T system, but the installation program fails to find your IDE (ATAPI) CD-ROM and asks you what type of CD-ROM drive you have, try the following boot command. Restart the installation, and at the `boot:` prompt enter **linux hd*X*=cdrom**. Replace ***X*** with one of the following letters, depending on the interface the unit is connected to, and whether it is configured as master or slave (also known as primary and secondary):

- a — first IDE controller, master
- b — first IDE controller, slave
- c — second IDE controller, master
- d — second IDE controller, slave

If you have a third and/or fourth controller, continue assigning letters in alphabetical order, going from controller to controller, and master to slave.

4.6. Installing from a Hard Drive

The **Select Partition** screen applies only if you are installing from a disk partition (that is, if you selected **Hard Drive** in the **Installation Method** dialog). This dialog allows you to name the disk partition and directory from which you are installing Red Hat Enterprise Linux.
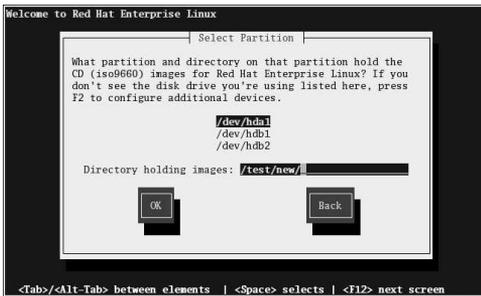
Figure 4-3. Selecting Partition Dialog for Hard Drive Installation

Enter the device name of the partition containing the Red Hat Enterprise Linux ISO images. There is also a field labeled **Directory holding images**.

If the ISO images are in the root (top-level) directory of a partition, enter a /. If the ISO images are located in a subdirectory of a mounted partition, enter the name of the directory holding the ISO images within that partition. For example, if the partition on which the ISO images is normally mounted as /home/, and the images are in /home/new/, you would enter /new/.

After you have identified the disk partition, the **Welcome** dialog appears.

4.7. Performing a Network Installation

If you are performing a network installation, the **Configure TCP/IP** dialog appears. This dialog asks for your IP and other network addresses. You can choose to configure the IP address and Netmask of the device via DHCP or manually. If manually, enter the IP address you are using during installation and press [Enter]. The installation program attempts to guess your Netmask based on your IP address; you may change the netmask if it is incorrect. Press [Enter]. The installation program guesses the Default gateway and Primary nameserver addresses from your IP address and netmask; you may change them if they are incorrect.

4.8. Installing via NFS

The NFS dialog applies only if you are installing from an NFS server (if you selected **NFS Image** in the **Installation Method** dialog).

Enter the domain name or IP address of your NFS server. For example, if you are installing from a host named `eastcoast` in the domain `example.com`, enter `eastcoast.example.com` in the **NFS Server** field.

Next, enter the name of the exported directory. If you followed the setup described in Section 2.5 *Preparing for a Network Installation*, you would enter the directory `/location/of/disk/space/` which contains the `RedHat/` directory.

If the NFS server is exporting a mirror of the Red Hat Enterprise Linux installation tree, enter the directory which contains the `RedHat/` directory. (If you do not know this directory path, ask your system administrator.) For example, if the NFS site contains the directory `/mirrors/redhat/arch/RedHat/`, enter `/mirrors/redhat/arch/` (where `arch` is replaced with the architecture type of your system, such as i386, ia64, ppc, or s390). If everything was specified properly, a message appears indicating that the installation program for Red Hat Enterprise Linux is running.
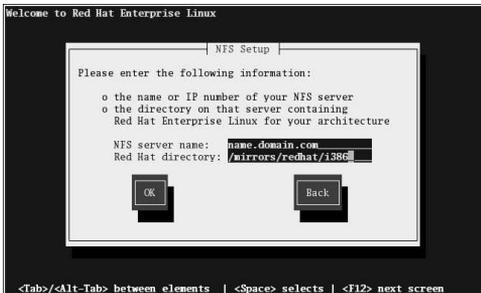
Figure 4-4. NFS Setup Dialog

If the NFS server is exporting the ISO images of the Red Hat Enterprise Linux CD-ROMs, enter the directory which contains the ISO images.

Next, the **Welcome** dialog appears.

4.9. Installing via FTP

The FTP dialog applies only if you are installing from an FTP server (if you selected **FTP** in the **Installation Method** dialog). This dialog allows you to identify the FTP server from which you are installing Red Hat Enterprise Linux.

Figure 4-5. FTP Setup Dialog

Enter the name or IP address of the FTP site you are installing from, and the name of the directory containing the RedHat/ installation files for your architecture. For example, if the FTP site contains the directory /mirrors/redhat/*arch*/RedHat/, enter /mirrors/redhat/*arch*/ (where *arch* is replaced with the architecture type of your system, such as i386, ia64, ppc, or s390). If everything was specified properly, a message box appears indicating that base/hdlist is being retrieved.
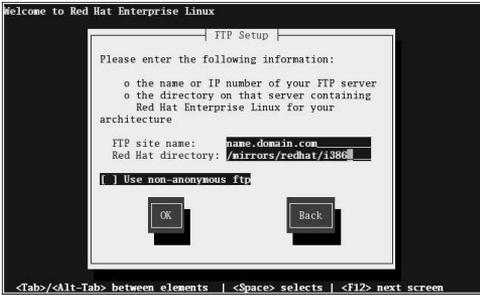
Next, the **Welcome** dialog appears.

Tip

You can save disk space by using the ISO images you have already copied to the server. To accomplish this, install Red Hat Enterprise Linux using ISO images without copying them into a single tree by loopback mounting them. For each ISO image:

```
mkdir discX

mount -o loop example-1.iso discX
```

4.10. Installing via HTTP

The HTTP dialog applies only if you are installing from an HTTP server (if you selected **HTTP** in the **Installation Method** dialog). This dialog prompts you for information about the HTTP server from which you are installing Red Hat Enterprise Linux.

Enter the name or IP address of the HTTP site you are installing from, and the name of the directory containing the RedHat/ installation files for your architecture. For example, if the HTTP site contains the directory /mirrors/redhat/*arch*/RedHat/, enter /mirrors/redhat/*arch*/ (where *arch* is replaced with the architecture type of your system, such as i386, ia64, ppc, or s390). If everything was specified properly, a message box appears indicating that base/hdlist is being retrieved.

Figure 4-6. HTTP Setup Dialog

Next, the **Welcome** dialog appears.

Tip

You can save disk space by using the ISO images you have already copied to the server. To accomplish this, install Red Hat Enterprise Linux using ISO images without copying them into a single tree by loopback mounting them. For each ISO image:

```
mkdir discX
```

```
mount -o loop example-1.iso discX
```

4.11. Welcome to Red Hat Enterprise Linux

The **Welcome** screen does not prompt you for any input. Read over the help text in the left panel for additional instructions and information on where to register your Red Hat Enterprise Linux product.

Notice the **Hide Help** button at the bottom left corner of the screen. The help screen is open by default. To minimize the help text, click on **Hide Help**.

Click on the **Next** button to continue.

4.12. Language Selection

Using your mouse, select a language to use for the installation (refer to Figure 4-7).

Selecting the appropriate language also helps target your time zone configuration later in the installation. The installation program tries to define the appropriate time zone based on what you specify on this screen.
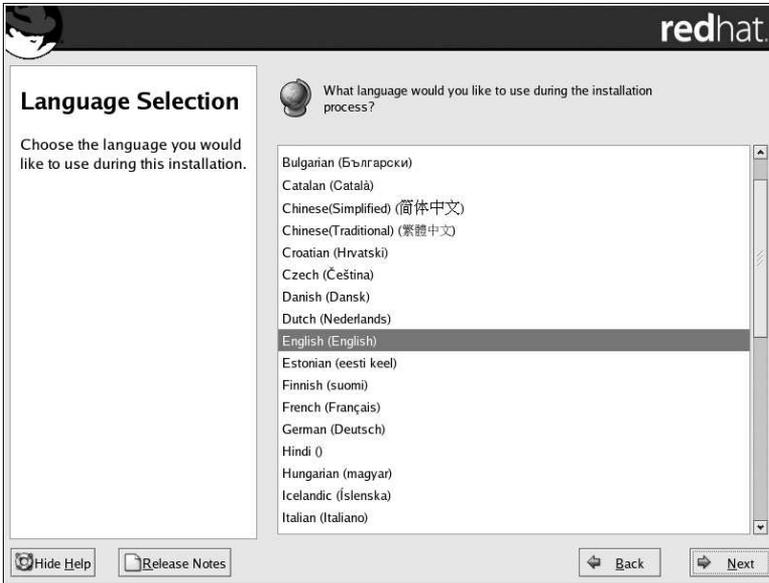
Figure 4-7. Language Selection

Once you select the appropriate language, click **Next** to continue.

4.13. Keyboard Configuration

Using your mouse, select the correct layout type (for example, U.S. English) for the keyboard you would prefer to use for the installation and as the system default (refer to Figure 4-8).

Once you have made your selection, click **Next** to continue.
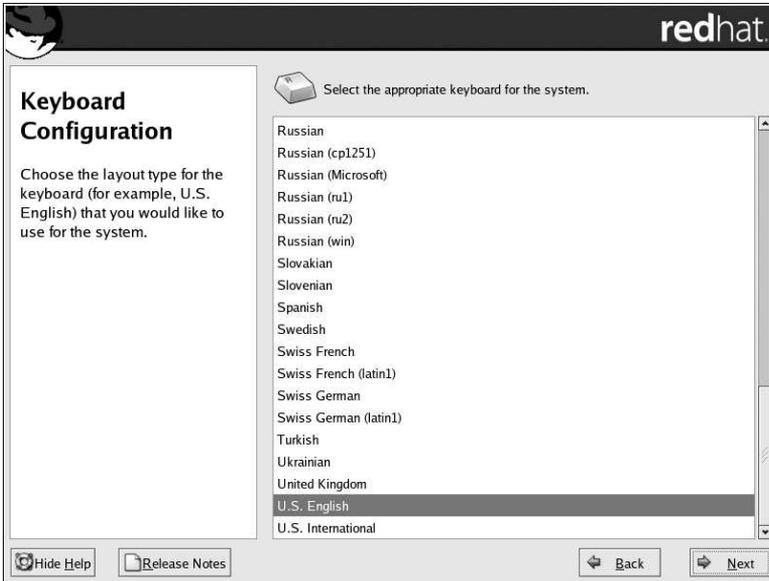
Figure 4-8. Keyboard Configuration

Tip

To change your keyboard layout type after you have completed the installation, use the **Keyboard Configuration Tool**.

Type the `system-config-keyboard` command in a shell prompt to launch the **Keyboard Configuration Tool**. If you are not root, it prompts you for the root password to continue.

4.14. Disk Partitioning Setup

Partitioning allows you to divide your hard drive into isolated sections, where each section behaves as its own hard drive. Partitioning is particularly useful if you run multiple operating systems. If you are not sure how you want your system to be partitioned, read Appendix D *An Introduction to Disk Partitions* for more information.

On this screen, you can choose to perform automatic partitioning, or manual partitioning using **Disk Druid**.

Automatic partitioning allows you to perform an installation without having to partition your drive(s) yourself. If you do not feel comfortable with partitioning your system, it is recommended that you *do not* choose to partition manually and instead let the installation program partition for you.

To partition manually, choose the **Disk Druid** partitioning tool.

⚠️ **Warning**

The **Red Hat Update Agent** downloads updated packages to `/var/spool/up2date/` by default. If you partition the system manually, and create a separate `/var/` partition, be sure to create the partition large enough (3.0 GB or more) to download package updates.
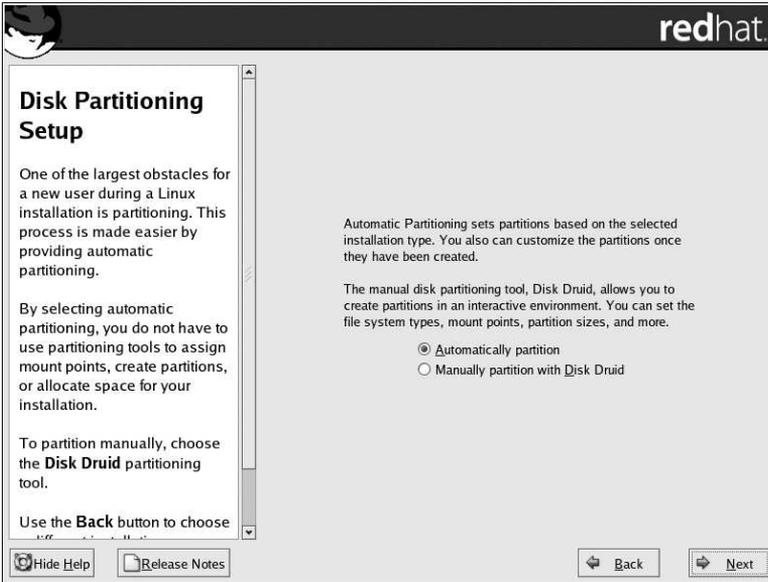
Figure 4-9. Disk Partitioning Setup

If you chose to manually partition using **Disk Druid**, refer to Section 4.16 *Partitioning Your System*.

⚠️ **Warning**

If you receive an error after the **Disk Partitioning Setup** phase of the installation saying something similar to

The partition table on device hda was unreadable. To create new partitions it must be initialized, causing the loss of ALL DATA on this drive.

you may not have a partition table on that drive or the partition table on the drive may not be recognizable by the partitioning software used in the installation program.

Users who have used programs such as **EZ-BIOS** have experienced similar problems, causing data to be lost (assuming the data was not backed up before the installation began).

No matter what type of installation you are performing, backups of the existing data on your systems should always be made.

4.15. Automatic Partitioning

Automatic partitioning allows you to have some control concerning what data is removed (if any) from your system. Your options are:

- **Remove all Linux partitions on this system** — select this option to remove only Linux partitions (partitions created from a previous Linux installation). This does not remove other partitions you may have on your hard drive(s) (such as VFAT or FAT32 partitions).

- **Remove all partitions on this system** — select this option to remove all partitions on your hard drive(s) (this includes partitions created by other operating systems such as Windows VFAT or NTFS partitions).

> 🛑 **Caution**
>
> If you select this option, all data on the selected hard drive(s) is removed by the installation pro-gram. Do not select this option if you have information that you want to keep on the hard drive(s) where you are installing Red Hat Enterprise Linux.

- **Keep all partitions and use existing free space** — select this option to retain your current data and partitions, assuming you have enough free space available on your hard drive(s).
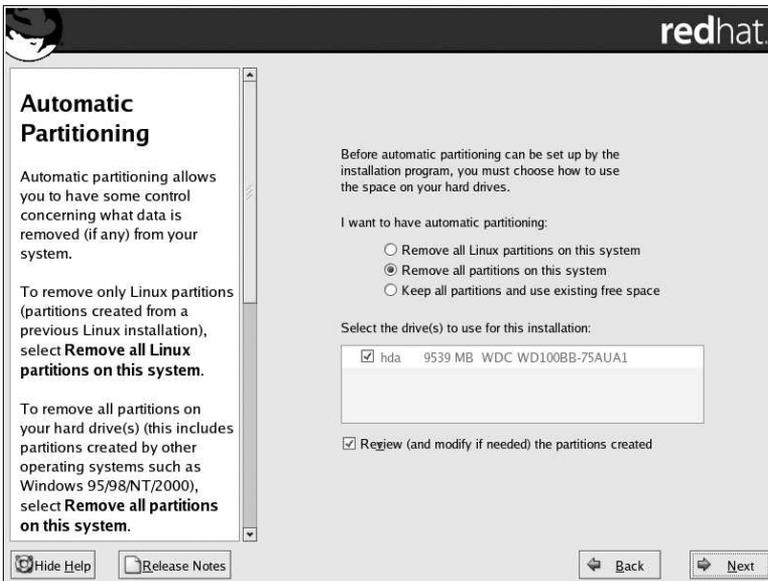

Figure 4-10. Automatic Partitioning

Using your mouse, choose the hard drive(s) on which you want Red Hat Enterprise Linux to be installed. If you have two or more hard drives, you can choose which hard drive(s) should contain this installation. Unselected hard drives, and any data on them, are not touched.

Caution

It is always a good idea to back up any data that you have on your systems. For example, if you are upgrading or creating a dual-boot system, you should back up any data you wish to keep on your hard drive(s). Mistakes do happen and can result in the loss of all your data.

Tip

If you have a RAID card, be aware that some BIOSes do not support booting from the RAID card. In cases such as these, the `/boot/` partition must be created on a partition outside of the RAID array, such as on a separate hard drive. An internal hard drive is necessary to use for partition creation with problematic RAID cards.

A `/boot/` partition is also necessary for software RAID setups.

If you have chosen to automatically partition your system, you should select **Review** and manually edit your `/boot/` partition.

To review and make any necessary changes to the partitions created by automatic partitioning, select the **Review** option. After selecting **Review** and clicking **Next** to move forward, the partitions created for you in **Disk Druid** appear. You can make modifications to these partitions if they do not meet your needs.

Click **Next** once you have made your selections to proceed.

4.16. Partitioning Your System

If you chose automatic partitioning and did not select **Review**, skip ahead to Section 4.18 *Network Configuration*.

If you chose automatic partitioning and selected **Review**, you can either accept the current partition settings (click **Next**), or modify the setup using **Disk Druid**, the manual partitioning tool.

If you chose to partition manually, you must tell the installation program where to install Red Hat Enterprise Linux. This is done by defining mount points for one or more disk partitions in which Red Hat Enterprise Linux is installed. You may also need to create and/or delete partitions at this time.

Note

If you have not yet planned how to set up your partitions, refer to Appendix D *An Introduction to Disk Partitions* and Section 4.16.4 *Recommended Partitioning Scheme*. At a bare minimum, you need an appropriately-sized root partition, and a swap partition equal to twice the amount of RAM you have on the system. Itanium system users should have a `/boot/efi/` partition of approximately 100 MB and of type FAT (VFAT), a swap partition of at least 512 MB, and an appropriately-sized root (`/`) partition.
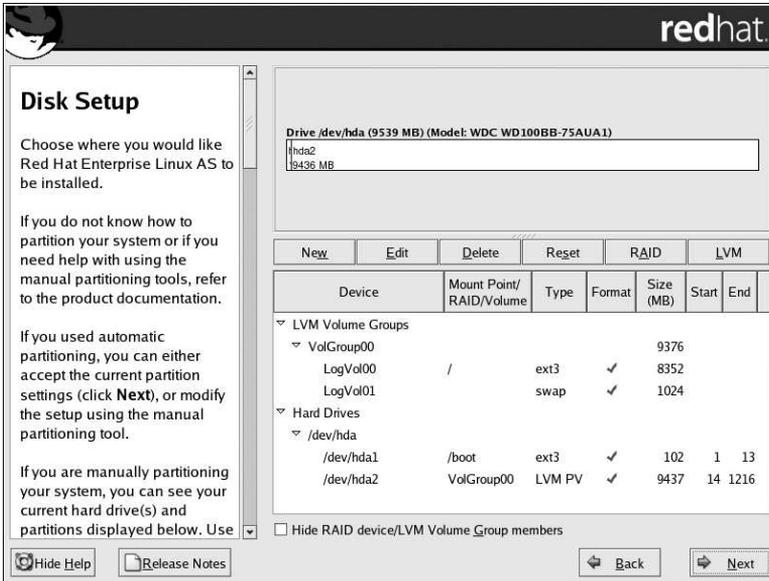
Figure 4-11. Partitioning with Disk Druid on x86, AMD64, and Intel® EM64T Systems
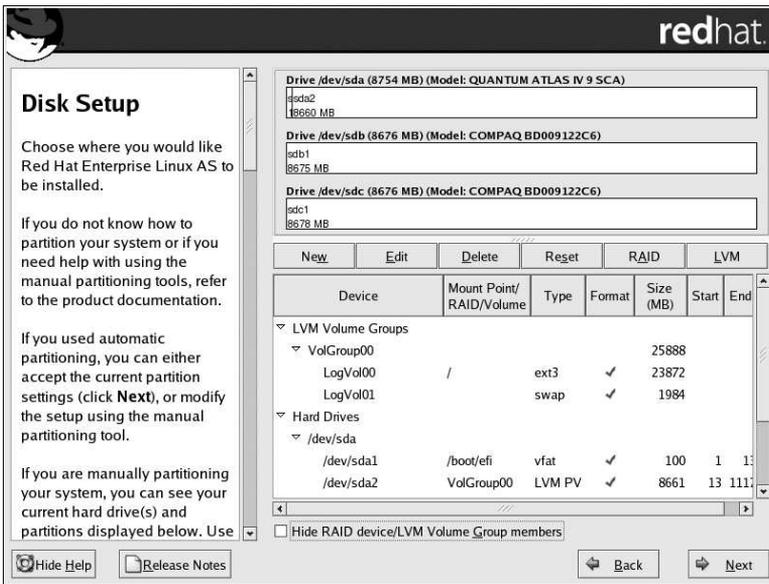

Figure 4-12. Partitioning with Disk Druid on Itanium Systems

The partitioning tool used by the installation program is **Disk Druid**. With the exception of certain esoteric situations, **Disk Druid** can handle the partitioning requirements for a typical installation.

4.16.1. Graphical Display of Hard Drive(s)

Disk Druid offers a graphical representation of your hard drive(s).

Using your mouse, click once to highlight a particular field in the graphical display. Double-click to edit an existing partition or to create a partition out of existing free space.

Above the display, you can review the **Drive** name (such as /dev/hda), the **Geom** (which shows the hard disk's geometry and consists of three numbers representing the number of cylinders, heads, and sectors as reported by the hard disk), and the **Model** of the hard drive as detected by the installation program.

4.16.2. Disk Druid's Buttons

These buttons control **Disk Druid's** actions. They are used to change the attributes of a partition (for example the file system type and mount point) and also to create RAID devices. Buttons on this screen are also used to accept the changes you have made, or to exit **Disk Druid**. For further explanation, take a look at each button in order:

- **New**: Used to request a new partition. When selected, a dialog box appears containing fields (such as the mount point and size fields) that must be filled in.
- **Edit**: Used to modify attributes of the partition currently selected in the **Partitions** section. Selecting **Edit** opens a dialog box. Some or all of the fields can be edited, depending on whether the partition information has already been written to disk.

  You can also edit free space as represented in the graphical display to create a new partition within that space. Either highlight the free space and then select the **Edit** button, or double-click on the free space to edit it.
- To make a RAID device, you must first create (or reuse existing) software RAID partitions. Once you have created two or more software RAID partitions, select **Make RAID** to join the software RAID partitions into a RAID device.
- **Delete**: Used to remove the partition currently highlighted in the **Current Disk Partitions** section. You will be asked to confirm the deletion of any partition.
- **Reset**: Used to restore **Disk Druid** to its original state. All changes made will be lost if you **Reset** the partitions.
- **RAID**: Used to provide redundancy to any or all disk partitions. *It should only be used if you have experience using RAID.* To read more about RAID, refer to the *Red Hat Enterprise Linux System Administration Guide*.

  To make a RAID device, you must first create software RAID partitions. Once you have created two or more software RAID partitions, select **RAID** to join the software RAID partitions into a RAID device.
- **LVM**: Allows you to create an LVM logical volume. The role of LVM (Logical Volume Manager) is to present a simple logical view of underlying physical storage space, such as a hard drive(s). LVM manages individual physical disks — or to be more precise, the individual partitions present on them. *It should only be used if you have experience using LVM.* To read more about LVM, refer to the *Red Hat Enterprise Linux System Administration Guide*. Note, LVM is only available in the graphical installation program.

To create an LVM logical volume, you must first create partitions of type physical volume (LVM). Once you have created one or more physical volume (LVM) partitions, select **LVM** to create an LVM logical volume.

4.16.3. Partition Fields

Above the partition hierarchy are labels which present information about the partitions you are creating. The labels are defined as follows:

- **Device**: This field displays the partition's device name.
- **Mount Point/RAID/Volume**: A mount point is the location within the directory hierarchy at which a volume exists; the volume is "mounted" at this location. This field indicates where the partition is mounted. If a partition exists, but is not set, then you need to define its mount point. Double-click on the partition or click the **Edit** button.
- **Type**: This field shows the partition's file system type (for example, ext2, ext3, or vfat).
- **Format**: This field shows if the partition being created will be formatted.
- **Size (MB)**: This field shows the partition's size (in MB).
- **Start**: This field shows the cylinder on your hard drive where the partition begins.
- **End**: This field shows the cylinder on your hard drive where the partition ends.

Hide RAID device/LVM Volume Group members: Select this option if you do not want to view any RAID device or LVM Volume Group members that have been created.

4.16.4. Recommended Partitioning Scheme

*Unless you have a reason for doing otherwise, we recommend that you create the following partitions for **Itanium** systems:*

- A `/boot/efi/` partition (100 MB minimum) — the partition mounted on `/boot/efi/` contains all the installed kernels, the initrd images, and ELILO configuration files.

> ⚠️**Warning**
>
> You must create a `/boot/efi/` partition of type VFAT and at least 100 MB in size as the first primary partition.

- A swap partition (at least 256 MB) — swap partitions are used to support virtual memory. In other words, data is written to a swap partition when there is not enough RAM to store the data your system is processing.

  If you are unsure about what size swap partition to create, make it twice the amount of RAM on your machine (but no larger than 2 GB). It must be of type swap.

  Creation of the proper amount of swap space varies depending on a number of factors including the following (in descending order of importance):

  - The applications running on the machine.
  - The amount of physical RAM is installed on the machine.
  - The version of the OS.

  Swap should equal 2x physical RAM for up to 2 GB of physical RAM, and then 1x physical RAM for any amount above 2 GB, but never less than 32 MB.

Using this formula, a system with 2 GB of physical RAM would have 4 GB of swap, while one with 3 GB of physical RAM would have 5 GB of swap. Creating a large swap space partition can be especially helpful if you plan to upgrade your RAM at a later time.

💡 **Tip**

> If your partitioning scheme requires a swap partition that is larger than 2 GB, you should create an additional swap partition. For example, if you need 4 GB of swap, you should create two 2 GB swap partitions. If you have 4 GB of RAM, you should create three 2 GB swap partitions. Red Hat Enterprise Linux supports up to 32 swap files.

For systems with really large amounts of RAM (more than 32 GB) you can likely get away with a smaller swap partition (around 1x, or less, of physical RAM).

• A `root` partition (500 MB - 5.0 GB) — this is where "/" (the root directory) is located. In this setup, all files (except those stored in `/boot/efi`) are on the root partition.

  A 500 MB partition allows you to install a minimal installation, while a 5.0 GB root partition lets you perform a full installation, choosing all package groups.

Unless you have a reason for doing otherwise, we recommend that you create the following partitions for x86, AMD64, and Intel® EM64T systems:

• A swap partition (at least 256 MB) — swap partitions are used to support virtual memory. In other words, data is written to a swap partition when there is not enough RAM to store the data your system is processing.

  If you are unsure about what size swap partition to create, make it twice the amount of RAM on your machine (but no larger than 2 GB). It must be of type swap.

  Creation of the proper amount of swap space varies depending on a number of factors including the following (in descending order of importance):

  • The applications running on the machine.

  • The amount of physical RAM is installed on the machine.

  • The version of the OS.

  Swap should equal 2x physical RAM for up to 2 GB of physical RAM, and then 1x physical RAM for any amount above 2 GB, but never less than 32 MB.

  Using this formula, a system with 2 GB of physical RAM would have 4 GB of swap, while one with 3 GB of physical RAM would have 5 GB of swap. Creating a large swap space partition can be especially helpful if you plan to upgrade your RAM at a later time.

  💡 **Tip**

  > If your partitioning scheme requires a swap partition that is larger than 2 GB, you should create an additional swap partition. For example, if you need 4 GB of swap, you should create two 2 GB swap partitions. If you have 4 GB of RAM, you should create three 2 GB swap partitions. Red Hat Enterprise Linux supports up to 32 swap files.

  For systems with really large amounts of RAM (more than 32 GB) you can likely get away with a smaller swap partition (around 1x, or less, of physical RAM).

• A `/boot/` partition (100 MB) — the partition mounted on `/boot/` contains the operating system kernel (which allows your system to boot Red Hat Enterprise Linux), along with files used during the bootstrap process. Due to the limitations of most PC BIOSes, creating a small partition to hold these files is a good idea. For most users, a 100 MB boot partition is sufficient.

Tip

If your hard drive is more than 1024 cylinders (and your system was manufactured more than two years ago), you may need to create a /boot/ partition if you want the / (root) partition to use all of the remaining space on your hard drive.

Tip

If you have a RAID card, be aware that some BIOSes do not support booting from the RAID card. In cases such as these, the /boot/ partition must be created on a partition outside of the RAID array, such as on a separate hard drive.

• A root partition (500 MB - 5.0 GB) — this is where "/" (the root directory) is located. In this setup, all files (except those stored in /boot) are on the root partition.

  A 500 MB partition allows you to install a minimal installation, while a 5.0 GB root partition lets you perform a full installation, choosing all package groups.

4.16.5. Adding Partitions

To add a new partition, select the **New** button. A dialog box appears (refer to Figure 4-13).

Note

You must dedicate at least one partition for this installation, and optionally more. For more information, refer to Appendix D *An Introduction to Disk Partitions*.

Figure 4-13. Creating a New Partition

- **Mount Point**: Enter the partition's mount point. For example, if this partition should be the root partition, enter **/**; enter **/boot** for the /boot partition, and so on. You can also use the pull-down menu to choose the correct mount point for your partition.
- **File System Type**: Using the pull-down menu, select the appropriate file system type for this partition. For more information on file system types, refer to Section 4.16.5.1 *File System Types*.
- **Allowable Drives**: This field contains a list of the hard disks installed on your system. If a hard disk's box is highlighted, then a desired partition can be created on that hard disk. If the box is *not* checked, then the partition will *never* be created on that hard disk. By using different checkbox settings, you can have **Disk Druid** place partitions where you need them, or let **Disk Druid** decide where partitions should go.
- **Size (MB)**: Enter the size (in megabytes) of the partition. Note, this field starts with 100 MB; unless changed, only a 100 MB partition will be created.
- **Additional Size Options**: Choose whether to keep this partition at a fixed size, to allow it to "grow" (fill up the available hard drive space) to a certain point, or to allow it to grow to fill any remaining hard drive space available.

  If you choose **Fill all space up to (MB)**, you must give size constraints in the field to the right of this option. This allows you to keep a certain amount of space free on your hard drive for future use.
- **Force to be a primary partition**: Select whether the partition you are creating should be one of the first four partitions on the hard drive. If unselected, the partition is created as a logical partition. Refer to Section D.1.3 *Partitions within Partitions — An Overview of Extended Partitions*, for more information.
- **OK**: Select **OK** once you are satisfied with the settings and wish to create the partition.
- **Cancel**: Select **Cancel** if you do not want to create the partition.

4.16.5.1. File System Types

Red Hat Enterprise Linux allows you to create different partition types, based on the file system they will use. The following is a brief description of the different file systems available, and how they can be utilized.

- **ext2** — An ext2 file system supports standard Unix file types (regular files, directories, symbolic links, etc). It provides the ability to assign long file names, up to 255 characters.
- **ext3** — The ext3 file system is based on the ext2 file system and has one main advantage — journaling. Using a journaling file system reduces time spent recovering a file system after a crash as there is no need to fsck[1] the file system. The ext3 file system is selected by default and is highly recommended.
- **physical volume (LVM)** — Creating one or more physical volume (LVM) partitions allows you to create an LVM logical volume. LVM can improve performance when using physical disks. For more information regarding LVM, refer to the *Red Hat Enterprise Linux System Administration Guide*.
- **software RAID** — Creating two or more software RAID partitions allows you to create a RAID device. For more information regarding RAID, refer to the chapter *RAID (Redundant Array of Independent Disks)* in the *Red Hat Enterprise Linux System Administration Guide*.
- **swap** — Swap partitions are used to support virtual memory. In other words, data is written to a swap partition when there is not enough RAM to store the data your system is processing. Refer to the *Red Hat Enterprise Linux System Administration Guide* for additional information.

---

1.   The fsck application is used to check the file system for metadata consistency and optionally repair one or more Linux file systems.

- **vfat** — The VFAT file system is a Linux file system that is compatible with Microsoft Windows long filenames on the FAT file system. This file system must be used for the `/boot/efi/` partition on Itanuim systems.

4.16.6. Editing Partitions

To edit a partition, select the **Edit** button or double-click on the existing partition.

✏️ **Note**

If the partition already exists on your hard disk, you can only change the partition's mount point. To make any other changes, you must delete the partition and recreate it.

4.16.7. Deleting a Partition

To delete a partition, highlight it in the **Partitions** section and click the **Delete** button. Confirm the deletion when prompted.

For further installation instructions for x86, AMD64, and Intel® EM64T systems, skip to Section 4.17 *x86, AMD64, and Intel® EM64T Boot Loader Configuration*.

For further installation instructions for Itanium systems, skip to Section 4.18 *Network Configuration*.

4.17. x86, AMD64, and Intel® EM64T Boot Loader Configuration

To boot the system without boot media, you usually need to install a boot loader. A boot loader is the first software program that runs when a computer starts. It is responsible for loading and transferring control to the operating system kernel software. The kernel, in turn, initializes the rest of the operating system.

GRUB (GRand Unified Bootloader), which is installed by default, is a very powerful boot loader. GRUB can load a variety of free operating systems, as well as proprietary operating systems with chain-loading (the mechanism for loading unsupported operating systems, such as DOS or Windows, by loading another boot loader).
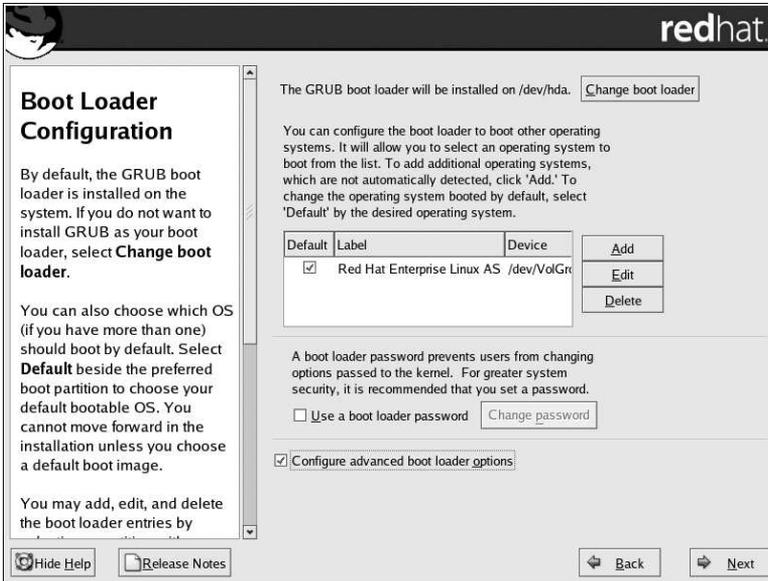
Figure 4-14. Boot Loader Configuration

If you do not want to install GRUB as your boot loader, click **Change boot loader**, where you can choose not to install a boot loader at all.

If you already have a boot loader that can boot Red Hat Enterprise Linux and do not want to overwrite your current boot loader, choose **Do not install a boot loader** by clicking on the **Change boot loader** button.

Caution

> If you choose not to install GRUB for any reason, you will not be able to boot the system directly, and you must use another boot method (such as a commercial boot loader application). Use this option only if you are sure you have another way of booting the system!

Every bootable partition is listed, including partitions used by other operating systems. The partition holding the system's root file system has a **Label** of `Red Hat Enterprise Linux` (for GRUB). Other partitions may also have boot labels. To add or change the boot label for other partitions that have been detected by the installation program, click once on the partition to select it. Once selected, you can change the boot label by clicking the **Edit** button.

Select **Default** beside the preferred boot partition to choose your default bootable OS. You cannot move forward in the installation unless you choose a default boot image.

Note

> The **Label** column lists what you must enter at the boot prompt, in non-graphical boot loaders, in order to boot the desired operating system.

> Once you have loaded the GRUB boot screen, use the arrow keys to choose a boot label or type
> [e] for edit. You are presented with a list of items in the configuration file for the boot label you have
> selected.

Boot loader passwords provide a security mechanism in an environment where physical access to your
server is available.

If you are installing a boot loader, you should create a password to protect your system. Without
a boot loader password, users with access to your system can pass options to the kernel which can
compromise your system security. With a boot loader password in place, the password must first be
entered before selecting any non-standard boot options. However, it is still possible for someone with
physical access to the machine to boot from a diskette, CD-ROM, or USB media if the BIOS supports
it. Security plans which include boot loader passwords should also address alternate boot methods.

If you choose to use a boot loader password to enhance your system security, be sure to select the
checkbox labeled **Use a boot loader password**.

Once selected, enter a password and confirm it.

To configure more advance boot loader options, such as changing the drive order or passing options
to the kernel, be sure **Configure advanced boot loader options** is selected before clicking **Next**.

4.17.1. Advanced Boot Loader Configuration

Now that you have chosen which boot loader to install, you can also determine where you want the
boot loader to be installed. You may install the boot loader in one of two places:

- The master boot record (MBR) — This is the recommended place to install a boot loader, unless
  the MBR already starts another operating system loader, such as System Commander. The MBR
  is a special area on your hard drive that is automatically loaded by your computer's BIOS, and is
  the earliest point at which the boot loader can take control of the boot process. If you install it in
  the MBR, when your machine boots, GRUB presents a boot prompt. You can then boot Red Hat
  Enterprise Linux or any other operating system that you have configured the boot loader to boot.

- The first sector of your boot partition — This is recommended if you are already using another
  boot loader on your system. In this case, your other boot loader takes control first. You can then
  configure that boot loader to start GRUB, which then boots Red Hat Enterprise Linux.
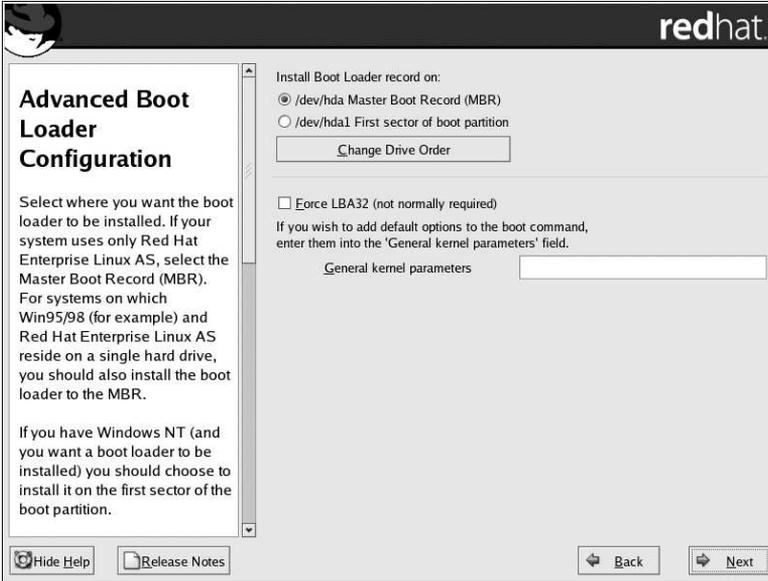
Figure 4-15. Boot Loader Installation

🛈 **Tip**

> If you have a RAID card, be aware that some BIOSes do not support booting from the RAID card. In cases such as these, the boot loader *should not* be installed on the MBR of the RAID array. Rather, the boot loader should be installed on the MBR of the same drive as the `/boot/` partition was created.

If your system only uses Red Hat Enterprise Linux, you should choose the MBR.

Click the **Change Drive Order** button if you would like to rearrange the drive order or if your BIOS does not return the correct drive order. Changing the drive order may be useful if you have multiple SCSI adapters, or both SCSI and IDE adapters, and you want to boot from the SCSI device.

The **Force LBA32 (not normally required)** option allows you to exceed the 1024 cylinder limit for the `/boot/` partition. If you have a system which supports the LBA32 extension for booting operating systems above the 1024 cylinder limit, and you want to place your `/boot/` partition above cylinder 1024, you should select this option.

🛈 **Tip**

> While partitioning your hard drive, keep in mind that the BIOS in some older systems cannot access more than the first 1024 cylinders on a hard drive. If this is the case, leave enough room for the `/boot` Linux partition on the first 1024 cylinders of your hard drive to boot Linux. The other Linux partitions can be after cylinder 1024.
>
> In `parted`, 1024 cylinders equals 528MB. For more information, refer to:
>
> `http://www.pcguide.com/ref/hdd/bios/sizeMB504-c.html`

To add default options to the boot command, enter them into the **Kernel parameters** field. Any options you enter are passed to the Linux kernel every time it boots.

4.17.2. Rescue Mode

Rescue mode provides the ability to boot a small Red Hat Enterprise Linux environment entirely from boot media or some other boot method instead of the system's hard drive. There may be times when you are unable to get Red Hat Enterprise Linux running completely enough to access files on your system's hard drive. Using rescue mode, you can access the files stored on your system's hard drive, even if you cannot actually run Red Hat Enterprise Linux from that hard drive. If you need to use rescue mode, try the following method:

- Using the CD-ROM to boot an x86, AMD64, or Intel® EM64T system, type `linux rescue` at the installation boot prompt. Itanium users should type `elilo linux rescue` to enter rescue mode.

For additional information, refer to the *Red Hat Enterprise Linux System Administration Guide*.

4.17.3. Alternative Boot Loaders

If you do not wish to use a boot loader, you have several alternatives:

LOADLIN

> You can load Linux from MS-DOS. Unfortunately, this requires a copy of the Linux kernel (and an initial RAM disk, if you have a SCSI adapter) to be available on an MS-DOS partition. The only way to accomplish this is to boot your Red Hat Enterprise Linux system using some other method (for example, from a boot CD-ROM) and then copy the kernel to an MS-DOS partition. LOADLIN is available from
> `ftp://metalab.unc.edu/pub/Linux/system/boot/dualboot/`
> and associated mirror sites.

SYSLINUX

> SYSLINUX is an MS-DOS program very similar to LOADLIN. It is also available from
> `ftp://metalab.unc.edu/pub/Linux/system/boot/loaders/`
> and associated mirror sites.

Commercial boot loaders

> You can load Linux using commercial boot loaders. For example, System Commander and Partition Magic are able to boot Linux (but still require GRUB to be installed in your Linux root partition).

Note

Boot loaders such as LOADLIN and System Commander are considered to be third-party boot loaders and are not supported by Red Hat.

4.17.4. SMP Motherboards and GRUB

This section is specific to SMP motherboards only. SMP, short for Symmetric Multiprocessing, is a computer architecture providing fast performance by making multiple CPUs available to complete individual processes simultaneously (multiprocessing).

If the installation program detects an SMP motherboard on your system, it automatically creates two boot loader entries.

> **Note**
>
> An SMP kernel is installed by default on Intel® Pentium® 4 systems with hyperthreading.

The two GRUB entries are `Red Hat Enterprise Linux (`*`kernel version`*`)` and `Red Hat Enterprise Linux (`*`kernel version`*`-smp)`. The `Red Hat Enterprise Linux (`*`kernel version`*`-smp)` boots by default. However, if you have trouble with the SMP kernel, you can elect to boot the `Red Hat Enterprise Linux (`*`kernel version`*`)` entry instead. You retain all the functionality as before, but only operate with a single processor.

4.18. Network Configuration

If you do not have a network device, this screen does not appear during your installation and you should advance to Section 4.19 *Firewall Configuration*.

Figure 4-16. Network Configuration

The installation program automatically detects any network devices you have and display them in the **Network Devices** list.

Once you have selected a network device, click **Edit**. From the **Edit Interface** pop-up screen, you can choose to configure the IP address and Netmask of the device via DHCP (or manually if DHCP is not selected) and you can choose to activate the device at boot time. If you select **Activate on boot**, your network interface is started when you boot. If you do not have DHCP client access or you are unsure what to provide here, please contact your network administrator.
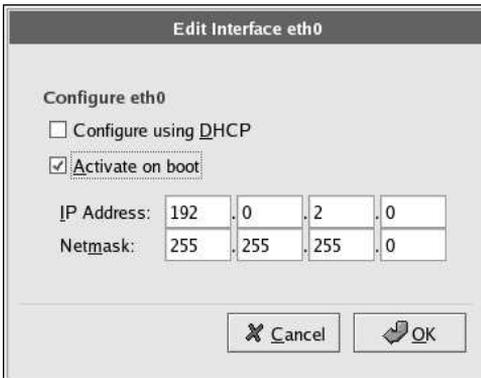

Figure 4-17. Editing a Network Device

Note

Do not use the numbers as seen in this sample configuration. These values will not work for your own network configuration. If you are not sure what values to enter, contact your network administrator for assistance.

If you have a hostname (fully qualified domain name) for the network device, you can choose to have DHCP (Dynamic Host Configuration Protocol) automatically detect it or you can manually enter the hostname in the field provided.

Finally, if you entered the IP and Netmask information manually, you may also enter the Gateway address and the Primary, Secondary, and Tertiary DNS addresses.

Tip

Even if your computer is not part of a network, you can enter a hostname for your system. If you do not take this opportunity to enter a name, your system will be known as `localhost`.

Tip

To change your network configuration after you have completed the installation, use the **Network Administration Tool**.

Type the `system-config-network` command in a shell prompt to launch the **Network Administration Tool**. If you are not root, it prompts you for the root password to continue.

4.19. Firewall Configuration

Red Hat Enterprise Linux offers firewall protection for enhanced system security. A firewall exists between your computer and the network, and determines which resources on your computer remote users on the network can access. A properly configured firewall can greatly increase the security of your system.
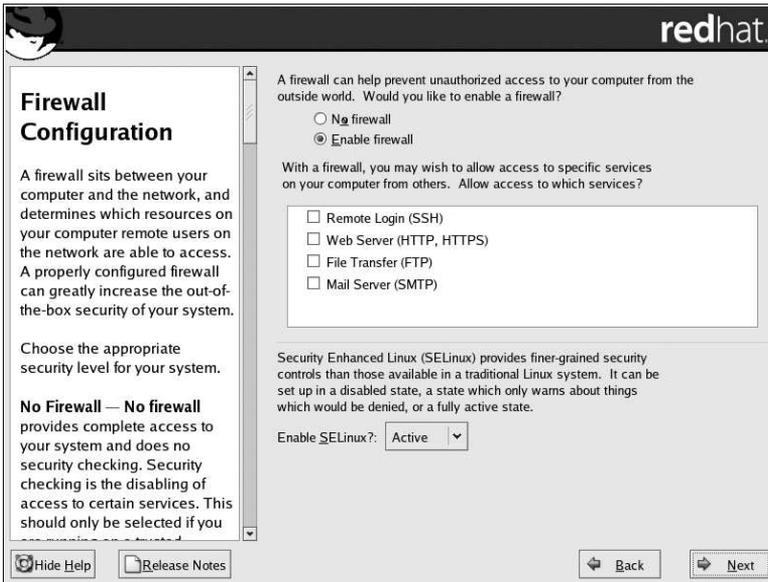
Figure 4-18. Firewall Configuration

Next, you can decide whether to enable a firewall for your Red Hat Enterprise Linux system.

No firewall

> **No firewall** provides complete access to your system and does no security checking. Security checking is the disabling of access to certain services. This should only be selected if you are running on a trusted network (not the Internet) or plan to do more firewall configuration later.

Enable firewall

If you choose **Enable firewall**, connections are not accepted by your system (other than the default settings) that are not explicitly defined by you. By default, only connections in response to outbound requests, such as DNS replies or DHCP requests, are allowed. If access to services running on this machine is needed, you can choose to allow specific services through the firewall.

If you are connecting your system to the Internet, this is the safest option to choose.

Next, select which services, if any, should be allowed to pass through the firewall.

Enabling these options allow the specified services to pass through the firewall. Note, these services may *not* be installed on the system by default. Make sure you choose to enable any options that you may need.

Remote Login (SSH)

*S*ecure *Sh*ell (SSH) is a suite of tools for logging in to and executing commands on a remote machine. If you plan to use SSH tools to access your machine through a firewall, enable this option. You need to have the `openssh-server` package installed in order to access your machine remotely, using SSH tools.

Web Server (HTTP, HTTPS)

The HTTP and HTTPS protocols are used by Apache (and by other Web servers) to serve webpages. If you plan on making your Web server publicly available, enable this option. This option is not required for viewing pages locally or for developing webpages. You must install the `httpd` package if you want to serve webpages.

File Transfer (FTP)

The FTP protocol is used to transfer files between machines on a network. If you plan on making your FTP server publicly available, enable this option. You must install the `vsftpd` package in order to publicly serve files.

Mail Server (SMTP)

If you want to allow incoming mail delivery through your firewall, so that remote hosts can connect directly to your machine to deliver mail, enable this option. You do not need to enable this if you collect your mail from your Internet Service Provider's server using POP3 or IMAP, or if you use a tool such as `fetchmail`. Note that an improperly configured SMTP server can allow remote machines to use your server to send spam.

> **Note**
>
> By default, the Sendmail mail transport agent (MTA) does not accept network connections from any host other than the local computer. To configure Sendmail as a server for other clients, you must edit `/etc/mail/sendmail.mc` and change the *DAEMON_OPTIONS* line to also listen on network devices (or comment out this option entirely using the `dnl` comment delimiter). You must then regenerate `/etc/mail/sendmail.cf` by running the following command (as root):
>
> ```
> make -C /etc/mail
> ```
>
> You must have the `sendmail-cf` package installed for this to work.

Additionally, you can now setup *SELinux* (Security Enhanced Linux) during your installation of Red Hat Enterprise Linux.

SELinux allows you to provide granular permissions for all subjects (users, programs, and processes) and objects (files and devices). You can safely grant an application only the permissions it needs to do its function.

The SELinux implementation in Red Hat Enterprise Linux is designed to improve the security of various server daemons while minimizing the impact on the day-to-day operations of your system.

Three states are available for you to choose from during the installation process:

- **Disable** — Select **Disable** if you do not want SELinux security controls enabled on this system. The **Disabled** setting turns enforcing off and does not set up the machine for the use of a security policy.
- **Warn** — Select **Warn** to be notified of any denials. The **Warn** state assigns labels to data and programs, and logs them, but does not enforce any policies. The **Warn** state is a good starting place for users who eventually want a fully active SELinux policy, but who first want to see what effects the policy would have on their general system operation. Note that users selecting the **Warn** state may notice some false positive and negative notifications.
- **Active** — Select **Active** if you want SELinux to act in a fully active state. The **Active** state enforces all policies, such as denying access to unauthorized users for certain files and programs, for additional system protection. Choose this state only if you are sure that your system can still properly function with SELinux fully enabled.

For additional information about SELinux, refer to the following URLs:

- http://www.redhat.com/docs/
- http://www.nsa.gov/selinux/

Tip

To change your security configuration after you have completed the installation, use the **Security Level Configuration Tool**.

Type the `system-config-securitylevel` command in a shell prompt to launch the **Security Level Configuration Tool**. If you are not root, it prompts you for the root password to continue.

4.20. Language Support Selection

You can install and support multiple languages for use on your system.

You must select a language to use as the default language. The default language is the language used on the system once the installation is complete. Typically, the default language is the language you selected to use during the installation.

If you choose to install other languages during this installation, you can change your default language after the installation. If you are only going to use one language on your system, selecting only that language saves significant disk space.

Caution

If you select only one language, you can only use that specified language after the installation is complete.
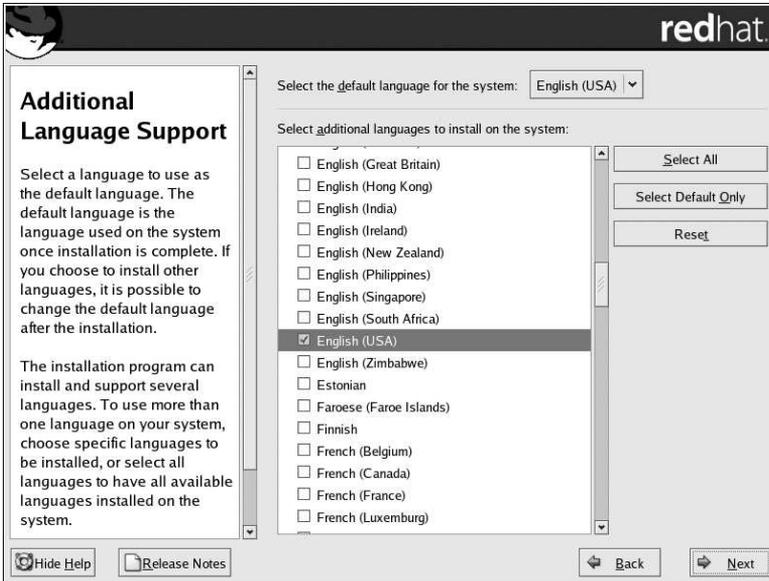
Figure 4-19. Language Support Selection

To use more than one language on your system, choose specific languages to be installed or select all languages to have all available languages installed on your Red Hat Enterprise Linux system.

Use the **Reset** button to cancel your selections. Resetting reverts to the default; only the language you selected for use during the installation is installed.

Tip

> To change the language configuration after you have completed the installation, use the **Language Configuration Tool**.
>
> Type the `system-config-language` command in a shell prompt to launch the **Language Configuration Tool**. If you are not root, it prompts you for the root password to continue.

4.21. Time Zone Configuration

Set your time zone by selecting the city closest to your computer's physical location.

There are two ways for you to select your time zone:

• Using your mouse, click on the interactive map to select a specific city (represented by a yellow dot). A red **X** appears indicating your selection.

• You can also scroll through the list at the bottom of the screen to select your time zone. Using your mouse, click on a location to highlight your selection.
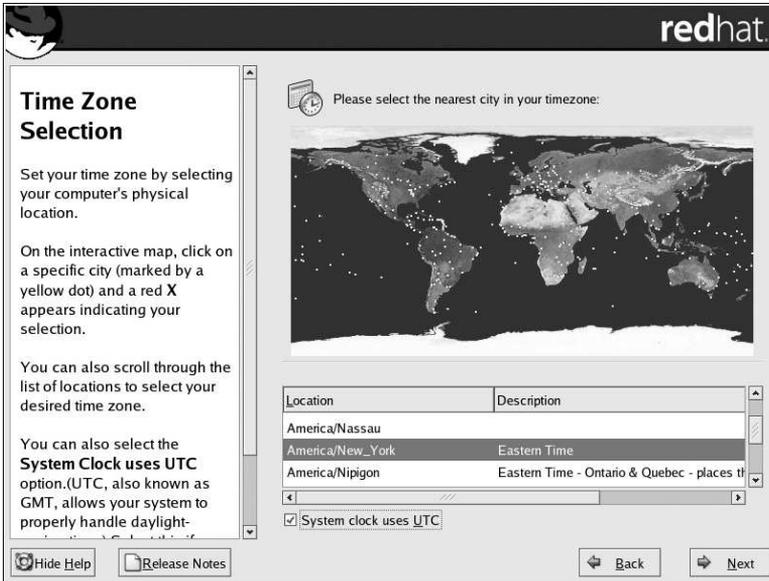
Figure 4-20. Configuring the Time Zone

Select **System Clock uses UTC** if you know that your system is set to UTC.

Tip

To change your time zone configuration after you have completed the installation, use the **Time and Date Properties Tool**.

Type the `system-config-date` command in a shell prompt to launch the **Time and Date Properties Tool**. If you are not root, it prompts you for the root password to continue.

To run the **Time and Date Properties Tool** as a text-based application, use the command `timeconfig`.

4.22. Set Root Password

Setting up a root account and password is one of the most important steps during your installation. Your root account is similar to the administrator account used on Windows NT machines. The root account is used to install packages, upgrade RPMs, and perform most system maintenance. Logging in as root gives you complete control over your system.

Note

The root user (also known as the superuser) has complete access to the entire system; for this reason, logging in as the root user is best done *only* to perform system maintenance or administration.
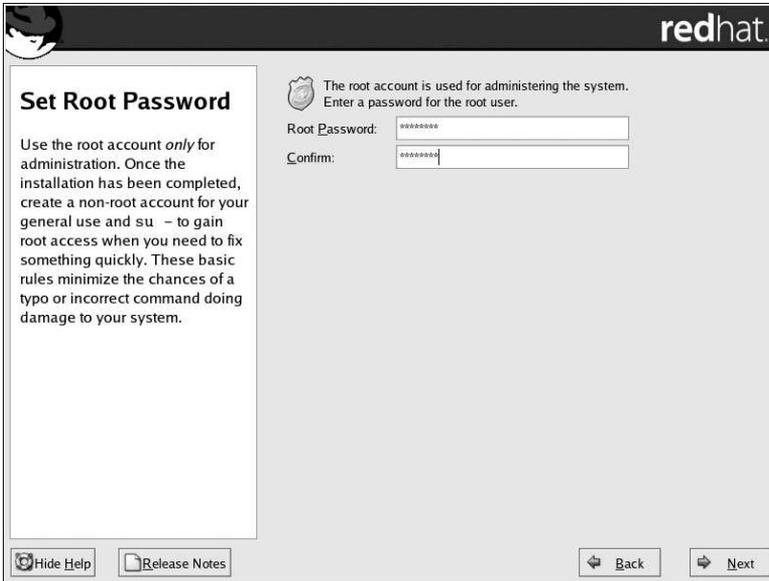
Figure 4-21. Root Password

Use the root account only for system administration. Create a non-root account for your general use and `su` – to root when you need to fix something quickly. These basic rules minimize the chances of a typo or an incorrect command doing damage to your system.

Tip

To become root, type `su` – at the shell prompt in a terminal window and then press [Enter]. Then, enter the root password and press [Enter].

The installation program prompts you to set a root password[2] for your system. *You cannot proceed to the next stage of the installation process without entering a root password.*

The root password must be at least six characters long; the password you type is not echoed to the screen. You must enter the password twice; if the two passwords do not match, the installation program asks you to enter them again.

You should make the root password something you can remember, but not something that is easy for someone else to guess. Your name, your phone number, *qwerty*, *password, root*, *123456*, and *anteater* are all examples of bad passwords. Good passwords mix numerals with upper and lower case letters and do not contain dictionary words: *Aard387vark* or *420BMttNT*, for example. Remember that the password is case-sensitive. If you write down your password, keep it in a secure place. However, it is recommended that you do not write down this or any password you create.

---

2. A root password is the administrative password for your Red Hat Enterprise Linux system. You should only log in as root when needed for system maintenance. The root account does not operate within the restrictions placed on normal user accounts, so changes made as root can have implications for your entire system.

Note

Do not use one of the example passwords offered in this manual. Using one of these passwords could be considered a security risk.

Tip

To change your root password after you have completed the installation, use the **Root Password Tool**.

Type the `system-config-rootpassword` command in a shell prompt to launch the **Root Password Tool**. If you are not root, it prompts you for the root password to continue.

4.23. Package Group Selection

Now that you have made most of the choices for your installation, you are ready to confirm the default package selection or customize packages for your system.

The **Package Installation Defaults** screen appears and details the default package set for your Red Hat Enterprise Linux installation. This screen varies depending on the version of Red Hat Enterprise Linux you are installing.

If you choose to accept the current package list, skip ahead to Section 4.24 *Preparing to Install*.

To customize your package set further, select **Customize the set of packages to be installed** option on the screen. Clicking **Next** takes you to the **Package Group Selection** screen.

You can select package groups, which group components together according to function (for example, **X Window System** and **Editors**), individual packages, or a combination of the two.

Note

Users of AMD64, Intel® EM64T, and Itanium systems who want support for developing or running 32-bit applications are encouraged to select the **Compatibility Arch Support** and **Compatibility Arch Development Support** packages to install architecure specific support for their systems.

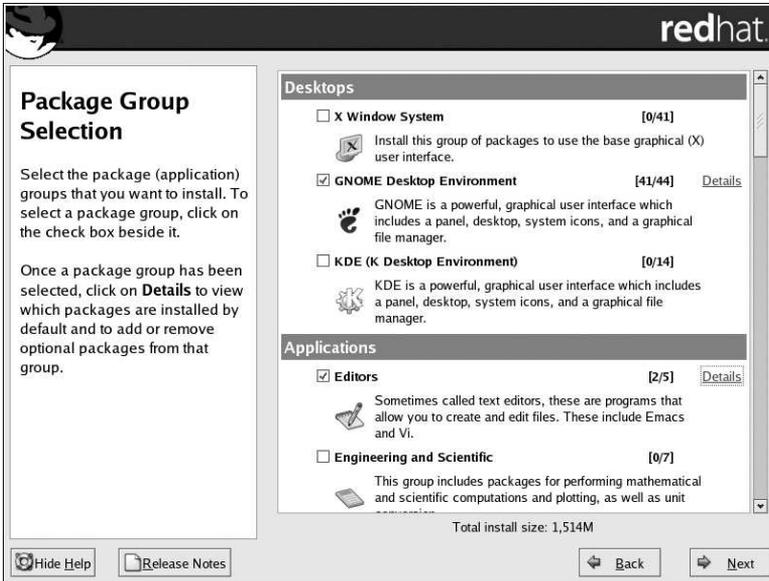To select a component, click on the checkbox beside it (refer to Figure 4-22).

Figure 4-22. Package Group Selection

Select each component you wish to install. Selecting **Everything** (at the end of the component list) installs all packages included with Red Hat Enterprise Linux.

Once a package group has been selected, click on **Details** to view which packages are installed by default, and to add or remove optional packages from that group.
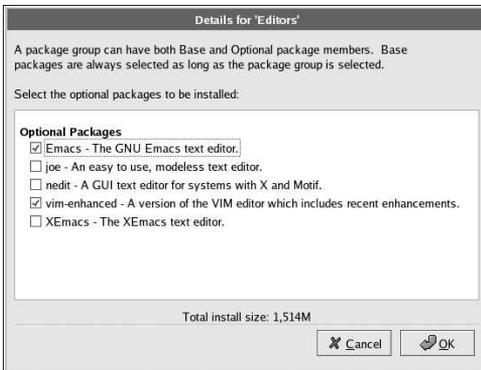

Figure 4-23. Package Group Details

4.24. Preparing to Install

A screen preparing you for the installation of Red Hat Enterprise Linux now appears.

For your reference, a complete log of your installation can be found in `/root/install.log` once you reboot your system.

⚠️**Warning**

> If, for some reason, you would rather not continue with the installation process, this is your last opportunity to safely cancel the process and reboot your machine. Once you press the **Next** button, partitions are written and packages are installed. If you wish to abort the installation, you should reboot now before any existing information on any hard drive is rewritten.

To cancel this installation process, press your computer's Reset button or use the [Control]-[Alt]-[Delete] key combination to restart your machine.

4.25. Installing Packages

At this point there is nothing left for you to do until all the packages have been installed. How quickly this happens depends on the number of packages you have selected and your computer's speed.

4.26. Installation Complete

Congratulations! Your Red Hat Enterprise Linux installation is now complete!

The installation program prompts you to prepare your system for reboot. Remember to remove any installation media if it is not ejected automatically upon reboot.

After your computer's normal power-up sequence has completed, the graphical boot loader prompt appears at which you can do any of the following things:

• Press [Enter] — causes the default boot entry to be booted.

• Select a boot label, followed by [Enter] — causes the boot loader to boot the operating system corresponding to the boot label.

• Do nothing — after the boot loader's timeout period, (by default, five seconds) the boot loader automatically boots the default boot entry.

Do whatever is appropriate to boot Red Hat Enterprise Linux. One or more screens of messages should scroll by. Eventually, a `login:` prompt or a GUI login screen (if you installed the X Window System and chose to start X automatically) appears.

The first time you start your Red Hat Enterprise Linux system in run level 5 (the graphical run level), the **Setup Agent** is presented, which guides you through the Red Hat Enterprise Linux configuration. Using this tool, you can set your system time and date, install software, register your machine with Red Hat Network, and more. The **Setup Agent** lets you configure your environment at the beginning, so that you can get started using your Red Hat Enterprise Linux system quickly.

For more information on using the **Setup Agent**, refer to the chapter titled *Getting Started* in the *Red Hat Enterprise Linux Step By Step Guide*.

For information on registering your Red Hat Enterprise Linux subscription, refer to Section 4.27 *Activate Your Subscription*.

4.27. Activate Your Subscription

Before you can access service and software maintenance information, and the support documentation included in your subscription, you must activate your subscription by registering with Red Hat. Registration includes these simple steps:

- Provide a Red Hat login
- Provide a subscription number
- Connect your system

The first time you boot your installation of Red Hat Enterprise Linux, you are prompted to register with Red Hat using the **Setup Agent**. If you follow the prompts during the **Setup Agent**, you can complete the registration steps and activate your subscription.

If you can not complete registration during the **Setup Agent** (which requires network access), you can alternatively complete the Red Hat registration process online at http://www.redhat.com/register/.

4.27.1. Provide a Red Hat Login

If you do not have an existing Red Hat login, you can create one when prompted during the **Setup Agent** or online at:

```
https://www.redhat.com/apps/activate/newlogin.html
```

A Red Hat login enables your access to:

- Software updates, errata and maintenance via Red Hat Network
- Red Hat technical support resources, documentation, and Knowledgebase

If you have forgotten your Red Hat login, you can search for your Red Hat login online at:

```
https://rhn.redhat.com/help/forgot_password.pxt
```

4.27.2. Provide Your Subscription Number

Your subscription number is located in the package that came with your order. If your package did not include a subscription number, your subscription was activated for you and you can skip this step.

You can provide your subscription number when prompted during the **Setup Agent** or by visiting http://www.redhat.com/register/.

4.27.3. Connect Your System

The Red Hat Network Registration Client helps you connect your system so that you can begin to get updates and perform systems management. There are three ways to connect:

1. During the **Setup Agent** — Check the **Send hardware information** and **Send system package list** options when prompted.

2. After the **Setup Agent** has been completed — From the **Main Menu**, go to **System Tools**, then select **Red Hat Network**.

3. After the **Setup Agent** has been completed — Enter the following command from the command line as the root user:

- `/usr/bin/up2date --register`

4.28. Itanium Systems — Booting Your Machine and Post-Installation Setup

This section describes how to boot your Itanium into Red Hat Enterprise Linux and how to set your EFI console variables so that Red Hat Enterprise Linux is automatically booted when the machine is powered on.

After you reboot your system at the end of the installation program, type the following command to boot into Red Hat Enterprise Linux:

```
elilo
```

After you type `elilo`, the default kernel listed in the `/boot/efi/elilo.conf` configuration file is loaded. (The first kernel listed in the file is the default.)

If you want to load a different kernel, type the label name of the kernel from the file `/boot/efi/elilo.conf` after the `elilo` command. For example, to load the kernel named `linux`, type:

```
elilo linux
```

If you do not know the names of the installed kernels, you can view the `/boot/efi/elilo.conf` file in EFI with the following instructions:

1. At the `Shell>` prompt, change devices to the system partition (mounted as `/boot/efi` in Linux). For example, if `fs0` is the system boot partition, type **`fs0:`** at the EFI Shell prompt.
2. Type `ls` at the `fs0:\>` to make sure you are in the correct partition.
3. Then type:
   ```
   Shell>type elilo.conf
   ```

   This command displays the contents of the configuration file. Each stanza contains a line beginning with `label` followed by a label name for that kernel. The label name is what you type after `elilo` to boot the different kernels.

4.28.1. Post-Installation Boot Loader Options

In addition to specifying a kernel to load, you can also enter other boot options such as **`single`** for single user mode or **`mem=1024M`** to force Red Hat Enterprise Linux to use 1024 MB of memory. To pass options to the boot loader, enter the following at the EFI Shell prompt (replace **`linux`** with the label name of the kernel you want to boot and **`option`** with the boot options you want to pass to the kernel):

`elilo linux option`

4.28.2. Booting Red Hat Enterprise Linux Automatically

After installing Red Hat Enterprise Linux you can type **`elilo`** and any boot options at the EFI Shell prompt each time you wish to boot your Itanium system. However, if you wish to configure your

system to boot into Red Hat Enterprise Linux automatically, you need to configure the **EFI Boot Manager**.

To configure the **EFI Boot Manager** (may vary slightly depending on your hardware):

1. Boot the Itanium system and choose **Boot option maintenance menu** from the **EFI Boot Manager** menu.

2. Choose **Add a Boot Option** from the Main Menu.

3. Select the system partition that is mounted as `/boot/efi/` in Linux.

4. Select the `elilo.efi` file.

5. At the `Enter New Description:` prompt, type **Red Hat Enterprise Linux 4**, or any name that you want to appear on the **EFI Boot Manager** menu.

6. At the `Enter Boot Option Data Type:` prompt, enter **N** for **No Boot Option** if you do not want to pass options to the ELILO boot loader. This option works for most cases. If you want to pass options to the boot loader, you can configure it in the `/boot/efi/elilo.conf` configuration file instead.

7. Answer **Yes** to the `Save changes to NVRAM` prompt. This returns you to the **EFI Boot Maintenance Manager** menu.

8. Next, you want to make the **Red Hat Enterprise Linux 4** menu item the default. A list of boot options appears. Move the **Red Hat Enterprise Linux 4** menu item up to the top of the list by selecting it with the arrow keys and pressing the [u] key to move it up the list. You can move items down the list by selecting it and pressing the [d] key. After changing the boot order, choose **Save changes to NVRAM**. Choose **Exit** to return to the Main Menu.

9. Optionally, you can change to boot timeout value by choosing **Set Auto Boot TimeOut => Set Timeout Value** from the Main Menu.

10. Return to the **EFI Boot Manager** by selecting **Exit**.

4.28.2.1. Using a Startup Script

It is recommended that you configure the ELILO Boot Manager to boot Red Hat Enterprise Linux automatically. However, if you require additional commands to be executed before starting the ELILO boot loader, you can create a startup script named `startup.nsh`. The last command should be `elilo` to boot into Linux.

The `startup.nsh` script should be in the `/boot/efi` partition (`/boot/efi/startup.nsh`) and contain the following text:

```
echo -off
your set of commands
elilo
```

If you want to pass options to the boot loader (refer to Section 4.28.1 *Post-Installation Boot Loader Options*) add them after **elilo**.

You can either create this file after booting into Red Hat Enterprise Linux or use the editor built into the EFI shell. To use the EFI shell, at the `Shell>` prompt, change devices to the system partition (mounted as `/boot/efi` in Linux). For example, if `fs0` is the system boot partition, type `fs0:` at the EFI Shell prompt. Type `ls` to make sure you are in the correct partition. Then type `edit startup.nsh`. Type the contents of the file and save it.

The next time the system boots, EFI detects the `startup.nsh` file and use it to boot the system. To stop EFI from loading the file, type [Ctrl]-[c]. This aborts the process, and returns you to the EFI shell prompt.

Appendix A.

Upgrading Your Current System

This appendix explains the various methods available for upgrading your Red Hat Enterprise Linux system.

A.1. Determining Whether to Upgrade or Re-Install

Although upgrades are supported from Red Hat Enterprise Linux versions 2.1 and 3 by the Red Hat Enterprise Linux family on x86 processors (or Red Hat Enterprise Linux 3 on an AMD64, EM64T or Itanimum system), you are more likely to have a consistent experience by backing up your data and then installing this release of Red Hat Enterprise Linux 4 over your previous Red Hat Enterprise Linux installation.

This recommended reinstallation method helps to ensure the best system stability possible.

For more information about re-installing your Red Hat Enterprise Linux system, refer to the Technical Whitepapers available online at http://www.redhat.com/docs/wp/.

If you currently use Red Hat Enterprise Linux version 2.1 or 3 on an x86 system (or Red Hat Enterprise Linux 3 on an AMD64, EM64T or Itanimum system), you can perform a traditional, installation program-based upgrade.

However, before you chose to upgrade your system, there are a few things you should keep in mind:

- Individual package configuration files may or may not work after performing an upgrade due to changes in various configuration file formats or layouts.
- If you have one of Red Hat's layered products (such as the Cluster Suite) installed, it may need to be manually upgraded after the Red Hat Enterprise Linux upgrade has been completed.
- Third party or ISV applications may not work correctly following the upgrade.

Upgrading your system installs the modular $2.6.x$ kernel as well as updated versions of the packages which are currently installed on your system.

The upgrade process preserves existing configuration files by renaming them with an `.rpmsave` extension (for example, `sendmail.cf.rpmsave`). The upgrade process also creates a log of its actions in `/root/upgrade.log`.

Caution

As software evolves, configuration file formats can change. It is very important to carefully compare your original configuration files to the new files before integrating your changes.

Note

It is always a good idea to back up any data that you have on your systems. For example, if you are upgrading or creating a dual-boot system, you should back up any data you wish to keep on your hard drive(s). Mistakes do happen and can result in the loss of all of your data.

Some upgraded packages may require the installation of other packages for proper operation. If you choose to customize your packages to upgrade, you may be required to resolve dependency problems. Otherwise, the upgrade procedure takes care of these dependencies, but it may need to install additional packages which are not on your system.

Depending on how you have partitioned your system, the upgrade program may prompt you to add an additional swap file. If the upgrade program does not detect a swap file that equals twice your RAM, it asks you if you would like to add a new swap file. If your system does not have a lot of RAM (less than 128 MB), it is recommended that you add this swap file.

A.2. Upgrading Your System

The **Upgrade Examine** screen appears if you have instructed the installation program to perform an upgrade.

> **Note**
>
> If the contents of your `/etc/redhat-release` file have been changed from the default, your Red Hat Enterprise Linux installation may not be found when attempting an upgrade to Red Hat Enterprise Linux 4.
>
> You can relax some of the checks against this file by booting with the following boot command:
>
> ```
> linux upgradeany
> ```
>
> Use the `linux upgradeany` command if your Red Hat Enterprise Linux installation was not given as an option to upgrade.

To perform an upgrade, select **Perform an upgrade of an existing installation**. Click **Next** when you are ready to begin your upgrade.

To re-install your system, select **Perform a new Red Hat Enterprise Linux installation** and refer to http://www.redhat.com/docs/wp/ as well as Chapter 4 *Installing Red Hat Enterprise Linux* for further instructions.

To perform a new installation of Red Hat Enterprise Linux on your system, select **Perform a new Red Hat Enterprise Linux installation** and refer to Chapter 4 *Installing Red Hat Enterprise Linux* for further instructions.

A.3. Upgrade Boot Loader Configuration

A software boot loader is used to start Red Hat Enterprise Linux on your x86-based system. It can also start other operating systems, such as Windows. If you are using a Red Hat Enterprise Linux software boot loader, such as GRUB, it is detected automatically.

> **Note**
>
> The boot loader information presented here is *not* applicable for Itanium, AMD64, or EM64T systems.

On the **Boot Loader Configuration Screen**, your options are:

Update boot loader configuration — Choose this option to keep your current boot loader configuration (GRUB or LILO depending on what you have currently installed) and have updates applied.

Skip boot loader updating — Choose this option if you do not want to make any changes to your current boot loader configuration. If you are using a third party boot loader, you should not update your boot loader.

Create new boot loader configuration — Choose this option if you want to create a new boot loader for your system (refer to Section 4.17 *x86, AMD64, and Intel® EM64T Boot Loader Configuration* for more information).

Once you have made your selection, click **Next** to continue.

A.4. Upgrading Packages

At this point, there is nothing left for you to do until all the packages have been upgraded or installed.

A.5. Upgrade Complete

Congratulations! Your Red Hat Enterprise Linux 4 upgrade is now complete!

The installation program prompts you to prepare your system for reboot. Remember to remove any installation media if it is not ejected automatically upon reboot.

After your computer's normal power-up sequence has completed, the graphical boot loader prompt appears at which you can do any of the following things:

• Press [Enter] — causes the default boot entry to be booted.

• Select a boot label, followed by [Enter] — causes the boot loader to boot the operating system corresponding to the boot label.

• Do nothing — after the boot loader's timeout period, (by default, five seconds) the boot loader automatically boots the default boot entry.

Do whatever is appropriate to boot Red Hat Enterprise Linux. One or more screens of messages should scroll by. Eventually, a `login:` prompt or a GUI login screen (if you installed the X Window System and chose to start X automatically) appears.

For information on registering your Red Hat Enterprise Linux subscription, refer to Section 4.27 *Activate Your Subscription*.

Appendix B.

Removing Red Hat Enterprise Linux

To uninstall Red Hat Enterprise Linux from your x86-based system, you must remove the Red Hat Enterprise Linux boot loader information from your master boot record (MBR).

Note

It is always a good idea to backup any data that you have on your system(s). Mistakes do happen and can result in the loss all of your data.

In DOS and Windows, use the Windows `fdisk` utility to create a new MBR with the *undocumented* flag `/mbr`. This *ONLY* rewrites the MBR to boot the primary DOS partition. The command should look like the following:

```
fdisk /mbr
```

If you need to remove Linux from a hard drive and have attempted to do this with the default DOS (Windows) `fdisk`, you will experience the *Partitions exist but they do not exist* problem. The best way to remove non-DOS partitions is with a tool that understands partitions other than DOS.

To begin, insert the Red Hat Enterprise Linux CD #1 and boot your system. Once you have booted off the CD, a boot prompt appears. At the boot prompt, type: **linux rescue**. This starts the rescue mode program.

You are prompted for your keyboard and language requirements. Enter these values as you would during the installation of Red Hat Enterprise Linux.

Next, a screen appears telling you that the program attempts to find a Red Hat Enterprise Linux install to rescue. Select **Skip** on this screen.

After selecting **Skip**, you are given a command prompt where you can access the partitions you would like to remove.

First, type the command `list-harddrives`. This command lists all hard drives on your system that are recognizable by the installation program, as well as their sizes in megabytes.

Warning

Be careful to remove only the necessary Red Hat Enterprise Linux partitions. Removing other partitions could result in data loss or a corrupted system environment.

To remove partitions, use the partitioning utility `parted`. Start `parted`, where */dev/hda* is the device on which to remove the partition:

```
parted /dev/hda
```

Using the `print` command, view the current partition table to determine the minor number of the partition to remove:

```
print
```

The `print` command also displays the partition's type (such as linux-swap, ext2, ext3, and so on). Knowing the type of the partition helps you in determining whether to remove the partition.

Remove the partition with the command `rm`. For example, to remove the partition with minor number 3:

```
rm 3
```

⭐**Important**

> The changes start taking place as soon as you press [Enter], so review the command before committing to it.

After removing the partition, use the `print` command to confirm that it is removed from the partition table.

Once you have removed the Linux partitions and made all of the changes you need to make, type `quit` to quit `parted`.

After quitting `parted`, type `exit` at the boot prompt to exit rescue mode and reboot your system, instead of continuing with the installation. The system should reboot automatically. If it does not, you can reboot your computer using [Control]-[Alt]-[Delete].

Appendix C.

Troubleshooting Your Installation of Red Hat Enterprise Linux

This appendix discusses some common installation problems and their solutions.

C.1. You are Unable to Boot Red Hat Enterprise Linux

C.1.1. Are You Unable to Boot With Your RAID Card?

If you have performed an installation and cannot boot your system properly, you may need to reinstall and create your partitions differently.

Some BIOSes do not support booting from RAID cards. At the end of an installation, a text-based screen showing the boot loader prompt (for example, GRUB:) and a flashing cursor may be all that appears. If this is the case, you must repartition your system.

Whether you choose automatic or manual partitioning, you must install your /boot partition outside of the RAID array, such as on a separate hard drive. An internal hard drive is necessary to use for partition creation with problematic RAID cards.

You must also install your preferred boot loader (GRUB or LILO) on the MBR of a drive that is outside of the RAID array. This should be the same drive that hosts the /boot/ partition.

Once these changes have been made, you should be able to finish your installation and boot the system properly.

C.1.2. Is Your System Displaying Signal 11 Errors?

A signal 11 error, commonly know as a *segmentation fault*, means that the program accessed a memory location that was not assigned.

If you receive a fatal signal 11 error during your installation, it is probably due to a hardware error in memory on your system's bus. A hardware error in memory can be caused by problems in executables or with the system's hardware. Like other operating systems, Red Hat Enterprise Linux places its own demands on your system's hardware. Some of this hardware may not be able to meet those demands, even if they work properly under another OS.

Ensure that you have the latest installation updates and images from Red Hat. Review the online errata to see if newer versions are available. If the latest images still fail, it may be due to a problem with your hardware. Commonly, these errors are in your memory or CPU-cache. A possible solution for this error is turning off the CPU-cache in the BIOS. You could also try to swap your memory around in the motherboard slots to check if the problem is either slot or memory related.

You can also try running the installation with only 256 MB of memory. This can be done by booting the installation program with the mem=256M boot option. To try this option, at the installation boot prompt, type:

```
mem=xxxM
```

where xxx should be replaced with the amount of memory in megabytes.

This command allows you to override the amount of memory the kernel detects for the machine. This may be needed for some older systems where only 16MB is detected by the installation program (but

more RAM is present in the system), and for some new machines where the video card shares the video memory with the main memory.

Another option is to perform a media check on your installation CD-ROMs. The Red Hat Enterprise Linux installation program has the ability to test the integrity of the installation media. It works with the CD, DVD, hard drive ISO, and NFS ISO installation methods. Red Hat recommends that you test all installation media before starting the installation process, and before reporting any installation-related bugs (many of the bugs reported are actually due to improperly-burned CDs). To use this test, type the following command at the `boot:` prompt (prepend with `elilo` for Itanium systems):

```
linux mediacheck
```

For more information concerning signal 11 errors, refer to:

```
http://www.bitwizard.nl/sig11/
```

C.2. Trouble Beginning the Installation

C.2.1. Is Your Mouse Not Detected?

If the **Mouse Not Detected** screen (refer to Figure C-1) appears, then the installation program was not able to identify your mouse correctly.

You can choose to continue with the GUI installation or use the text mode installation, which does not require using a mouse. If you continue with the GUI installation, you are prompted to provide the installation program with your mouse configuration information.

Figure C-1. Mouse Not Detected

C.2.2. Problems with Booting into the Graphical Installation

There are some video cards that have trouble booting into the graphical installation program. If the installation program does not run using its default settings, it tries to run in a lower resolution mode. If that still fails, the installation program attempts to run in text mode.

One possible solution is to try using the `resolution=` boot option. This option may be most helpful for laptop users. Refer to Appendix F *Additional Boot Options* for more information.

Note

To disable frame buffer support and allow the installation program to run in text mode, try using the `nofb` boot option. This command may be necessary for accessibility with some screen reading hardware.

C.3. Trouble During the Installation

C.3.1. `No devices found to install Red Hat Enterprise Linux` Error Message

If you receive an error message stating `No devices found to install Red Hat Enterprise Linux`, there is probably a SCSI controller that is not being recognized by the installation program.

Check your hardware vendor's website to determine if a driver diskette image is available that fixes your problem. For more general information on driver diskettes, refer to Appendix E *Driver Media*.

You can also refer to the *Red Hat Hardware Compatibility List*, available online at:

`http://hardware.redhat.com/hcl/`

C.3.2. Saving Traceback Messages Without a Diskette Drive

If you receive a traceback error message during installation, you can usually save it to a diskette.

If you do not have a diskette drive available in your system, you can `scp` the error message to a remote system.

When the traceback dialog appears, the traceback error message is automatically written to a file named `/tmp/anacdump.txt`. Once the dialog appears, switch over to a new tty (virtual console) by pressing the keys `[Ctrl]-[Alt]-[F2]` and `scp` the message written to `/tmp/anacdump.txt` to a known working remote system.

C.3.3. Trouble with Partition Tables

If you receive an error after the **Disk Partitioning Setup** (Section 4.14 *Disk Partitioning Setup*) phase of the installation saying something similar to

The partition table on device hda was unreadable. To create new partitions it must be initialized, causing the loss of ALL DATA on this drive.

you may not have a partition table on that drive or the partition table on the drive may not be recognizable by the partitioning software used in the installation program.

Users who have used programs such as **EZ-BIOS** have experienced similar problems, causing data to be lost (assuming the data was not backed up before the installation began) that could not be recovered.

No matter what type of installation you are performing, backups of the existing data on your systems should always be made.

C.3.4. Using Remaining Space

You have a `swap` and a `/` (root) partition created, and you have selected the root partition to use the remaining space, but it does not fill the hard drive.

If your hard drive is more than 1024 cylinders, you must create a `/boot` partition if you want the `/` (root) partition to use all of the remaining space on your hard drive.

C.3.5. Other Partitioning Problems for x86 System Users

If you are using **Disk Druid** to create partitions, but cannot move to the next screen, you probably have not created all the partitions necessary for **Disk Druid**'s dependencies to be satisfied.

You must have the following partitions as a bare minimum:

- A `/` (root) partition
- A <swap> partition of type swap

Tip

> When defining a partition's type as swap, do not assign it a mount point. **Disk Druid** automatically assigns the mount point for you.

C.3.6. Other Partitioning Problems for Itanium System Users

If you are using **Disk Druid** to create partitions, but cannot move to the next screen, you probably have not created all the partitions necessary for **Disk Druid**'s dependencies to be satisfied.

You must have the following partitions as a bare minimum:

- A `/boot/efi/` partition of type VFAT
- A `/` (root) partition
- A <swap> partition of type swap

Tip

> When defining a partition's type as swap, you do not have to assign it a mount point. **Disk Druid** automatically assigns the mount point for you.

C.3.7. Are You Seeing Python Errors?

During some upgrades or installations of Red Hat Enterprise Linux, the installation program (also known as **anaconda**) may fail with a Python or traceback error. This error may occur after the selection of individual packages or while trying to save the upgrade log in the `/tmp/` directory. The error may look similar to:

```
Traceback (innermost last):
  File "/var/tmp/anaconda-7.1//usr/lib/anaconda/iw/progress_gui.py",
```

```
line 20, in run
    rc = self.todo.doInstall ()
  File "/var/tmp/anaconda-7.1//usr/lib/anaconda/todo.py", line 1468, in
doInstall
    self.fstab.savePartitions ()
  File "fstab.py", line 221, in savePartitions
    sys.exit(0)
 SystemExit: 0

 Local variables in innermost frame:
 self: <fstab.GuiFstab instance at 8446fe0>
 sys: <module 'sys' (built-in)>
 ToDo object:
 (itodo
 ToDo
 p1
 (dp2
 S'method'
 p3
 (iimage
 CdromInstallMethod
 p4
 (dp5
 S'progressWindow'
 p6

 <failed>
```

This error occurs in some systems where links to /tmp/ are symbolic to other locations or have been changed since creation. These symbolic or changed links are invalid during the installation process, so the installation program cannot write information and fails.

If you experience such an error, first try to download any available errata for **anaconda**. Errata can be found at:

```
http://www.redhat.com/support/errata/
```

The **anaconda** website may also be a useful reference and can be found online at:

```
http://rhlinux.redhat.com/anaconda/
```

You can also search for bug reports related to this problem. To search Red Hat's bug tracking system, go to:

```
http://bugzilla.redhat.com/bugzilla/
```

Finally, if you are still facing problems related to this error, register your product and contact our support team. To register your product, go to:

```
http://www.redhat.com/apps/activate/
```

C.4. Problems After Installation

C.4.1. Trouble With the Graphical GRUB Screen on an x86-based System?

If you are experiencing problems with GRUB, you may need to disable the graphical boot screen. To do this, become the root user and edit the `/boot/grub/grub.conf` file.

Within the `grub.conf` file, comment out the line which begins with `splashimage` by inserting the `#` character at the beginning of the line.

Press [Enter] to exit the editing mode.

Once the boot loader screen has returned, type `b` to boot the system.

Once you reboot, the `grub.conf` file is reread and any changes you have made take effect.

You may re-enable the graphical boot screen by uncommenting (or adding) the above line back into the `grub.conf` file.

C.4.2. Booting into a Graphical Environment

If you have installed the X Window System but are not seeing a graphical desktop environment once you log into your Red Hat Enterprise Linux system, you can start the X Window System graphical interface using the command `startx`.

Once you enter this command and press [Enter], the graphical desktop environment is displayed.

Note, however, that this is just a one-time fix and does not change the log in process for future log ins.

To set up your system so that you can log in at a graphical login screen, you must edit one file, `/etc/inittab`, by changing just one number in the runlevel section. When you are finished, reboot the computer. The next time you log in, you are presented with a graphical login prompt.

Open a shell prompt. If you are in your user account, become root by typing the `su` command.

Now, type `gedit /etc/inittab` to edit the file with **gedit**. The file `/etc/inittab` opens. Within the first screen, a section of the file which looks like the following appears:

```
# Default runlevel. The runlevels used by RHS are:
#   0 - halt (Do NOT set initdefault to this)
#   1 - Single user mode
#   2 - Multiuser, without NFS (The same as 3, if you do not have networking)
#   3 - Full multiuser mode
#   4 - unused
#   5 - X11
#   6 - reboot (Do NOT set initdefault to this)
#
id:3:initdefault:
```

To change from a console to a graphical login, you should change the number in the line `id:3:initdefault:` from a `3` to a `5`.

⚠️**Warning**

Change *only* the number of the default runlevel from `3` to `5`.

Your changed line should look like the following:

```
id:5:initdefault:
```

When you are satisfied with your change, save and exit the file using the [Ctrl]-[Q] keys. A window appears and asks if you would like to save the changes. Click **Save**.

The next time you log in after rebooting your system, you are presented with a graphical login prompt.

C.4.3. Problems with the X Window System (GUI)

If you are having trouble getting X (the X Window System) to start, you may not have installed it during your installation.

If you want X, you can either install the packages from the Red Hat Enterprise Linux CD-ROMs or perform an upgrade.

If you elect to upgrade, select the X Window System packages, and choose GNOME, KDE, or both, during the upgrade package selection process.

C.4.4. Problems with the X Server Crashing and Non-Root Users

If you are having trouble with the X server crashing when anyone other than root logs in, you may have a full file system (or, a lack of available hard drive space).

To verify that this is the problem you are experiencing, run the following command:

```
df -h
```

The `df` command should help you diagnose which partition is full. For additional information about `df` and an explanation of the options available (such as the `-h` option used in this example), refer to the `df` man page by typing `man df` at a shell prompt.

A key indicator is 100% full or a percentage above 90% or 95% on a partition. The `/home/` and `/tmp/` partitions can sometimes fill up quickly with user files. You can make some room on that partition by removing old files. After you free up some disk space, try running X as the user that was unsuccessful before.

C.4.5. Problems When You Try to Log In

If you did not create a user account in the **Setup Agent**, log in as root and use the password you assigned to root.

If you cannot remember your root password, boot your system as `linux single`.

Itanium users must enter boot commands with `elilo` followed by the boot command.

If you are using an x86-based system and GRUB is your installed boot loader, type `e` for edit when the GRUB boot screen has loaded. You are presented with a list of items in the configuration file for the boot label you have selected.

Choose the line that starts with `kernel` and type `e` to edit this boot entry.

At the end of the `kernel` line, add:

single

Press [Enter] to exit edit mode.

Once the boot loader screen has returned, type `b` to boot the system.

Once you have booted into single user mode and have access to the `#` prompt, you must type `passwd root`, which allows you to enter a new password for root. At this point you can type `shutdown -r now` to reboot the system with the new root password.

If you cannot remember your user account password, you must become root. To become root, type `su –` and enter your root password when prompted. Then, type `passwd <username>`. This allows you to enter a new password for the specified user account.

If the graphical login screen does not appear, check your hardware for compatibility issues. The *Hardware Compatibility List* can be found at:

```
http://hardware.redhat.com/hcl/
```

C.4.6. Is Your RAM Not Being Recognized?

Sometimes, the kernel does not recognize all of your memory (RAM). You can check this with the `cat /proc/meminfo` command.

Verify that the displayed quantity is the same as the known amount of RAM in your system. If they are not equal, add the following line to the `/boot/grub/grub.conf`:

mem=*xx*M

Replace *xx* with the amount of RAM you have in megabytes.

In `/boot/grub/grub.conf`, the above example would look similar to the following:

```
#NOTICE: You have a /boot partition. This means that
#        all kernel paths are relative to /boot/
default=0
timeout=30
splashimage=(hd0,0)/grub/splash.xpm.gz
title Red Hat Enterprise Linux (2.6.9-1.641_EL)
        root (hd0,0)
        kernel /vmlinuz-2.6.9-1.641_EL ro root=/dev/hda3 mem=128M
```

Once you reboot, the changes made to `grub.conf` are reflected on your system.

Once you have loaded the GRUB boot screen, type `e` for edit. You are presented with a list of items in the configuration file for the boot label you have selected.

Choose the line that starts with `kernel` and type `e` to edit this boot entry.

At the end of the `kernel` line, add

mem=*xx*M

where *xx* equals the amount of RAM in your system.

Press [Enter] to exit edit mode.

Once the boot loader screen has returned, type `b` to boot the system.

Itanium users must enter boot commands with `elilo` followed by the boot command.

Remember to replace *xx* with the amount of RAM in your system. Press [Enter] to boot.

C.4.7. Your Printer Does Not Work

If you are not sure how to set up your printer or are having trouble getting it to work properly, try using the **Printer Configuration Tool**.

Type the `system-config-printer` command at a shell prompt to launch the **Printer Configuration Tool**. If you are not root, it prompts you for the root password to continue.

C.4.8. Problems with Sound Configuration

If, for some reason, you do not hear sound and know that you do have a sound card installed, you can run the **Sound Card Configuration Tool** (`system-config-soundcard`) utility.

To use the **Sound Card Configuration Tool**, choose **Main Menu => System Settings => Soundcard Detection**. A small text box pops up prompting you for your root password.

You can also type the `system-config-soundcard` command at a shell prompt to launch the **Sound Card Configuration Tool**. If you are not root, it prompts you for the root password to continue.

To run the text-based configuration tool, as root, type `sndconfig` in a terminal window. Note, the `sndconfig` application is not installed by default but can be found on the Red Hat Enterprise Linux CD-ROMs.

If the **Sound Card Configuration Tool** does not work (if the sample does not play and you still do not have audio sounds), there are alternatives, although they are not quite as simple as running the **Sound Card Configuration Tool**. You can edit your `modules.conf` file (this strategy is not recommended for most new users), or refer to the documentation that came with your sound card for more information.

C.4.9. Apache-based `httpd` service/Sendmail Hangs During Startup

If you are having trouble with the Apache-based `httpd` service or Sendmail hanging at startup, make sure the following line is in the `/etc/hosts` file:

```
127.0.0.1   localhost.localdomain   localhost
```

C.4.10. Trouble with NVIDIA chipset

If you have an NVIDIA chipset and have just updated your kernel, you may experience problems with the video card, such as not having any video output.

If you experience a similar problem, you should download the latest kernel drivers available for your NVIDIA chipset. For more information, refer to:

```
http://www.nvidia.com/view.asp?IO=linux_display_1.0-3123
```

Appendix D.

An Introduction to Disk Partitions

⬦ **Note**

This appendix is not necessarily applicable to non-x86-based architectures. However, the general concepts mentioned here may apply.

Disk partitions are a standard part of the personal computer landscape and have been for quite some time. However, with many people purchasing computers featuring pre-installed operating systems, relatively few people understand how partitions work. This chapter attempts to explain the reasons for and use of disk partitions so your Red Hat Enterprise Linux installation is as simple and painless as possible.

If you are reasonably comfortable with disk partitions, you could skip ahead to Section D.1.4 *Making Room For Red Hat Enterprise Linux*, for more information on the process of freeing up disk space to prepare for a Red Hat Enterprise Linux installation. This section also discusses the partition naming scheme used by Linux systems, sharing disk space with other operating systems, and related topics.

D.1. Hard Disk Basic Concepts

Hard disks perform a very simple function — they store data and reliably retrieve it on command.

When discussing issues such as disk partitioning, it is important to know a bit about the underlying hardware. Unfortunately, it is easy to become bogged down in details. Therefore, this appendix uses a simplified diagram of a disk drive to help explain what is really happening when a disk drive is partitioned. Figure D-1, shows a brand-new, unused disk drive.

Figure D-1. An Unused Disk Drive

Not much to look at, is it? But if we are talking about disk drives on a basic level, it is adequate. Say that we would like to store some data on this drive. As things stand now, it will not work. There is something we need to do first. . .

D.1.1. It is Not What You Write, it is How You Write It

Experienced computer users probably got this one on the first try. We need to *format* the drive. Formatting (usually known as "making a *file system*") writes information to the drive, creating order out of the empty space in an unformatted drive.
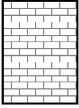
Figure D-2. Disk Drive with a File System

As Figure D-2, implies, the order imposed by a file system involves some trade-offs:

- A small percentage of the drive's available space is used to store file system-related data and can be considered as overhead.
- A file system splits the remaining space into small, consistently-sized segments. For Linux, these segments are known as *blocks*. [1]

Given that file systems make things like directories and files possible, these trade-offs are usually seen as a small price to pay.

It is also worth noting that there is no single, universal file system. As Figure D-3, shows, a disk drive may have one of many different file systems written on it. As you might guess, different file systems tend to be incompatible; that is, an operating system that supports one file system (or a handful of related file system types) may not support another. This last statement is not a hard-and-fast rule, however. For example, Red Hat Enterprise Linux supports a wide variety of file systems (including many commonly used by other operating systems), making data interchange between different file systems easy.
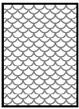
Figure D-3. Disk Drive with a Different File System

Of course, writing a file system to disk is only the beginning. The goal of this process is to actually *store* and *retrieve* data. Let us take a look at our drive after some files have been written to it.
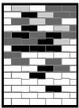
Figure D-4. Disk Drive with Data Written to It

As Figure D-4, shows, some of the previously-empty blocks are now holding data. However, by just looking at this picture, we cannot determine exactly how many files reside on this drive. There may only be one file or many, as all files use at least one block and some files use multiple blocks. Another important point to note is that the used blocks do not have to form a contiguous region; used and unused blocks may be interspersed. This is known as *fragmentation*. Fragmentation can play a part when attempting to resize an existing partition.

As with most computer-related technologies, disk drives changed over time after their introduction. In particular, they got bigger. Not larger in physical size, but bigger in their capacity to store information. And, this additional capacity drove a fundamental change in the way disk drives were used.

1.   Blocks really *are* consistently sized, unlike our illustrations. Keep in mind, also, that an average disk drive contains thousands of blocks. But for the purposes of this discussion, please ignore these minor discrepancies.

D.1.2. Partitions: Turning One Drive Into Many

As disk drive capacities soared, some people began to wonder if having all of that formatted space in one big chunk was such a great idea. This line of thinking was driven by several issues, some philosophical, some technical. On the philosophical side, above a certain size, it seemed that the additional space provided by a larger drive created more clutter. On the technical side, some file systems were never designed to support anything above a certain capacity. Or the file systems *could* support larger drives with a greater capacity, but the overhead imposed by the file system to track files became excessive.

The solution to this problem was to divide disks into *partitions*. Each partition can be accessed as if it was a separate disk. This is done through the addition of a *partition table*.

⬧ **Note**

> While the diagrams in this chapter show the partition table as being separate from the actual disk drive, this is not entirely accurate. In reality, the partition table is stored at the very start of the disk, before any file system or user data. But for clarity, they are separate in our diagrams.
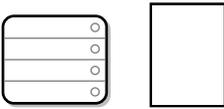
Figure D-5. Disk Drive with Partition Table

As Figure D-5 shows, the partition table is divided into four sections or four *primary* partitions. A primary partition is a partition on a hard drive that can contain only one logical drive (or section). Each section can hold the information necessary to define a single partition, meaning that the partition table can define no more than four partitions.

Each partition table entry contains several important characteristics of the partition:

- The points on the disk where the partition starts and ends
- Whether the partition is "active"
- The partition's type

Let us take a closer look at each of these characteristics. The starting and ending points actually define the partition's size and location on the disk. The "active" flag is used by some operating systems' boot loaders. In other words, the operating system in the partition that is marked "active" is booted.

The partition's type can be a bit confusing. The type is a number that identifies the partition's anticipated usage. If that statement sounds a bit vague, that is because the meaning of the partition type is a bit vague. Some operating systems use the partition type to denote a specific file system type, to flag the partition as being associated with a particular operating system, to indicate that the partition contains a bootable operating system, or some combination of the three.

By this point, you might be wondering how all this additional complexity is normally used. Refer to Figure D-6, for an example.
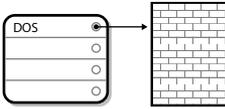
Figure D-6. Disk Drive With Single Partition

In many cases, there is only a single partition spanning the entire disk, essentially duplicating the method used before partitions. The partition table has only one entry used, and it points to the start of the partition.

We have labeled this partition as being of the "DOS" type. Although it is only one of several possible partition types listed in Table D-1, it is adequate for the purposes of this discussion.

Table D-1, contains a listing of some popular (and obscure) partition types, along with their hexadecimal numeric values.

Partition Type	Value	Partition Type	Value
Empty	00	Novell Netware 386	65
DOS 12-bit FAT	01	PIC/IX	75
XENIX root	02	Old MINIX	80
XENIX usr	03	Linux/MINUX	81
DOS 16-bit <=32M	04	Linux swap	82
Extended	05	Linux native	83
DOS 16-bit >=32	06	Linux extended	85
OS/2 HPFS	07	Amoeba	93
AIX	08	Amoeba BBT	94
AIX bootable	09	BSD/386	a5
OS/2 Boot Manager	0a	OpenBSD	a6
Win95 FAT32	0b	NEXTSTEP	a7
Win95 FAT32 (LBA)	0c	BSDI fs	b7
Win95 FAT16 (LBA)	0e	BSDI swap	b8
Win95 Extended (LBA)	0f	Syrinx	c7
Venix 80286	40	CP/M	db
Novell	51	DOS access	e1
PPC PReP Boot	41	DOS R/O	e3
GNU HURD	63	DOS secondary	f2
Novell Netware 286	64	BBT	ff

Table D-1. Partition Types

D.1.3. Partitions within Partitions — An Overview of Extended Partitions

Of course, over time it became obvious that four partitions would not be enough. As disk drives continued to grow, it became more and more likely that a person could configure four reasonably-sized partitions and still have disk space left over. There needed to be some way of creating more partitions.

Enter the extended partition. As you may have noticed in Table D-1, there is an "Extended" partition type. It is this partition type that is at the heart of extended partitions.

When a partition is created and its type is set to "Extended," an extended partition table is created. In essence, the extended partition is like a disk drive in its own right — it has a partition table that points to one or more partitions (now called *logical partitions*, as opposed to the four *primary partitions*) contained entirely within the extended partition itself. Figure D-7, shows a disk drive with one primary partition and one extended partition containing two logical partitions (along with some unpartitioned free space).
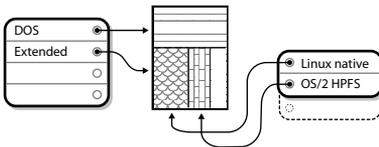
Figure D-7. Disk Drive With Extended Partition

As this figure implies, there is a difference between primary and logical partitions — there can only be four primary partitions, but there is no fixed limit to the number of logical partitions that can exist. However, due to the way in which partitions are accessed in Linux, you should avoid defining more than 12 logical partitions on a single disk drive.

Now that we have discussed partitions in general, let us review how to use this knowledge to install Red Hat Enterprise Linux.

D.1.4. Making Room For Red Hat Enterprise Linux

The following list presents some possible scenarios you may face when attempting to repartition your hard disk:

- Unpartitioned free space is available
- An unused partition is available
- Free space in an actively used partition is available

Let us look at each scenario in order.

Note

Keep in mind that the following illustrations are simplified in the interest of clarity and do not reflect the exact partition layout that you encounter when actually installing Red Hat Enterprise Linux.

D.1.4.1. Using Unpartitioned Free Space

In this situation, the partitions already defined do not span the entire hard disk, leaving unallocated space that is not part of any defined partition. Figure D-8, shows what this might look like.
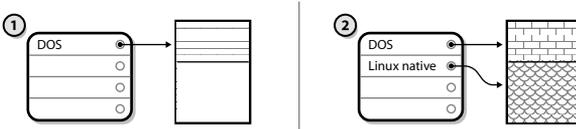
Figure D-8. Disk Drive with Unpartitioned Free Space

In Figure D-8, *1* represents an undefined partition with unallocated space and *2* represents a defined partition with allocated space.

If you think about it, an unused hard disk also falls into this category. The only difference is that *all* the space is not part of any defined partition.

In any case, you can create the necessary partitions from the unused space. Unfortunately, this scenario, although very simple, is not very likely (unless you have just purchased a new disk just for Red Hat Enterprise Linux). Most pre-installed operating systems are configured to take up all available space on a disk drive (refer to Section D.1.4.3 *Using Free Space from an Active Partition*).

Next, we will discuss a slightly more common situation.

D.1.4.2. Using Space from an Unused Partition

In this case, maybe you have one or more partitions that you do not use any longer. Perhaps you have dabbled with another operating system in the past, and the partition(s) you dedicated to it never seem to be used anymore. Figure D-9, illustrates such a situation.
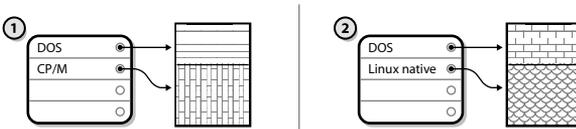
Figure D-9. Disk Drive With an Unused Partition

In Figure D-9, *1* represents an unused partition and *2* represents reallocating an unused partition for Linux.

If you find yourself in this situation, you can use the space allocated to the unused partition. You first must delete the partition and then create the appropriate Linux partition(s) in its place. You can delete the unused partition and manually create new partitions during the installation process.

D.1.4.3. Using Free Space from an Active Partition

This is the most common situation. It is also, unfortunately, the hardest to handle. The main problem is that, even if you have enough free space, it is presently allocated to a partition that is already in use. If you purchased a computer with pre-installed software, the hard disk most likely has one massive partition holding the operating system and data.

Aside from adding a new hard drive to your system, you have two choices:

Destructive Repartitioning

Basically, you delete the single large partition and create several smaller ones. As you might imagine, any data you had in the original partition is destroyed. This means that making a complete backup is necessary. For your own sake, make two backups, use verification (if available in your backup software), and try to read data from your backup *before* you delete the partition.

Caution

If there was an operating system of some type installed on that partition, it needs to be reinstalled as well. Be aware that some computers sold with pre-installed operating systems may not include the CD-ROM media to reinstall the original operating system. The best time to notice if this applies to your system is *before* you destroy your original partition and its operating system installation.

After creating a smaller partition for your existing operating system, you can reinstall any software, restore your data, and start your Red Hat Enterprise Linux installation. Figure D-10 shows this being done.
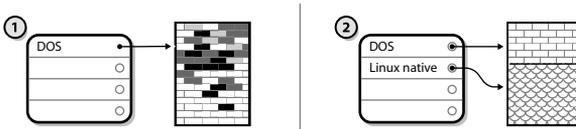
Figure D-10. Disk Drive Being Destructively Repartitioned

In Figure D-10, *1* represents before and *2* represents after.

Caution

As Figure D-10, shows, any data present in the original partition is lost without proper backup!

Non-Destructive Repartitioning

Here, you run a program that does the seemingly impossible: it makes a big partition smaller without losing any of the files stored in that partition. Many people have found this method to be reliable and trouble-free. What software should you use to perform this feat? There are several disk management software products on the market. Do some research to find the one that is best for your situation.

While the process of non-destructive repartitioning is rather straightforward, there are a number of steps involved:

• Compress and backup existing data

• Resize the existing partition

• Create new partition(s)

Next we will look at each step in a bit more detail.

D.1.4.3.1. Compress existing data

As Figure D-11, shows, the first step is to compress the data in your existing partition. The reason for doing this is to rearrange the data such that it maximizes the available free space at the "end" of the partition.
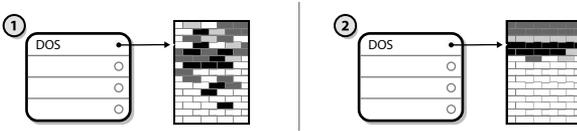
Figure D-11. Disk Drive Being Compressed

In Figure D-11, *1* represents before and *2* represents after.

This step is crucial. Without it, the location of your data could prevent the partition from being resized to the extent desired. Note also that, for one reason or another, some data cannot be moved. If this is the case (and it severely restricts the size of your new partition(s)), you may be forced to destructively repartition your disk.

D.1.4.3.2. Resize the existing partition

Figure D-12, shows the actual resizing process. While the actual result of the resizing operation varies depending on the software used, in most cases the newly freed space is used to create an unformatted partition of the same type as the original partition.
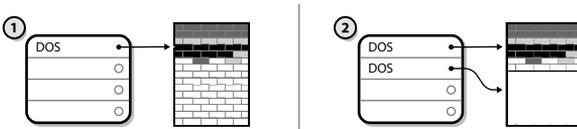
Figure D-12. Disk Drive with Partition Resized

In Figure D-12, *1* represents before and *2* represents after.

It is important to understand what the resizing software you use does with the newly freed space, so that you can take the appropriate steps. In the case we have illustrated, it would be best to delete the new DOS partition and create the appropriate Linux partition(s).

D.1.4.3.3. Create new partition(s)

As the previous step implied, it may or may not be necessary to create new partitions. However, unless your resizing software is Linux-aware, it is likely that you must delete the partition that was created during the resizing process. Figure D-13, shows this being done.
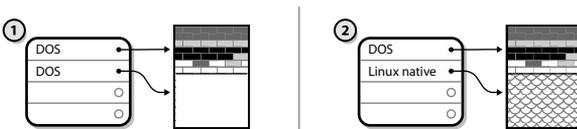
Figure D-13. Disk Drive with Final Partition Configuration

In Figure D-13, *1* represents before and *2* represents after.

Note

The following information is specific to x86-based computers only.

As a convenience to our customers, we provide the `parted` utility. This is a freely available program that can resize partitions.

If you decide to repartition your hard drive with `parted`, it is important that you be familiar with disk storage and that you perform a backup of your computer data. You should make two copies of all the important data on your computer. These copies should be to removable media (such as tape, CD-ROM, or diskettes), and you should make sure they are readable before proceeding.

Should you decide to use `parted`, be aware that after `parted` runs you are left with *two* partitions: the one you resized, and the one `parted` created out of the newly freed space. If your goal is to use that space to install Red Hat Enterprise Linux, you should delete the newly created partition, either by using the partitioning utility under your current operating system or while setting up partitions during installation.

D.1.5. Partition Naming Scheme

Linux refers to disk partitions using a combination of letters and numbers which may be confusing, particularly if you are used to the "C drive" way of referring to hard disks and their partitions. In the DOS/Windows world, partitions are named using the following method:

• Each partition's type is checked to determine if it can be read by DOS/Windows.

• If the partition's type is compatible, it is assigned a "drive letter." The drive letters start with a "C" and move on to the following letters, depending on the number of partitions to be labeled.

• The drive letter can then be used to refer to that partition as well as the file system contained on that partition.

Red Hat Enterprise Linux uses a naming scheme that is more flexible and conveys more information than the approach used by other operating systems. The naming scheme is file-based, with file names in the form of `/dev/xxyN`.

Here is how to decipher the partition naming scheme:

`/dev/`

This is the name of the directory in which all device files reside. Since partitions reside on hard disks, and hard disks are devices, the files representing all possible partitions reside in `/dev/`.

`xx`

The first two letters of the partition name indicate the type of device on which the partition resides, usually either `hd` (for IDE disks) or `sd` (for SCSI disks).

`y`

This letter indicates which device the partition is on. For example, `/dev/hda` (the first IDE hard disk) or `/dev/sdb` (the second SCSI disk).

N

The final number denotes the partition. The first four (primary or extended) partitions are numbered 1 through 4. Logical partitions start at 5. So, for example, `/dev/hda3` is the third primary or extended partition on the first IDE hard disk, and `/dev/sdb6` is the second logical partition on the second SCSI hard disk.

Note

There is no part of this naming convention that is based on partition type; unlike DOS/Windows, *all* partitions can be identified under Red Hat Enterprise Linux. Of course, this does not mean that Red Hat Enterprise Linux can access data on every type of partition, but in many cases it is possible to access data on a partition dedicated to another operating system.

Keep this information in mind; it makes things easier to understand when you are setting up the partitions Red Hat Enterprise Linux requires.

D.1.6. Disk Partitions and Other Operating Systems

If your Red Hat Enterprise Linux partitions are sharing a hard disk with partitions used by other operating systems, most of the time you will have no problems. However, there are certain combinations of Linux and other operating systems that require extra care.

D.1.7. Disk Partitions and Mount Points

One area that many people new to Linux find confusing is the matter of how partitions are used and accessed by the Linux operating system. In DOS/Windows, it is relatively simple: Each partition gets a "drive letter." You then use the correct drive letter to refer to files and directories on its corresponding partition.

This is entirely different from how Linux deals with partitions and, for that matter, with disk storage in general. The main difference is that each partition is used to form part of the storage necessary to support a single set of files and directories. This is done by associating a partition with a directory through a process known as *mounting*. Mounting a partition makes its storage available starting at the specified directory (known as a *mount point*).

For example, if partition `/dev/hda5` is mounted on `/usr/`, that would mean that all files and directories under `/usr/` physically reside on `/dev/hda5`. So the file `/usr/share/doc/FAQ/txt/Linux-FAQ` would be stored on `/dev/hda5`, while the file `/etc/X11/gdm/Sessions/Gnome` would not.

Continuing our example, it is also possible that one or more directories below `/usr/` would be mount points for other partitions. For instance, a partition (say, `/dev/hda7`) could be mounted on `/usr/local/`, meaning that `/usr/local/man/whatis` would then reside on `/dev/hda7` rather than `/dev/hda5`.

D.1.8. How Many Partitions?

At this point in the process of preparing to install Red Hat Enterprise Linux, you must give some consideration to the number and size of the partitions to be used by your new operating system. The question of "how many partitions" continues to spark debate within the Linux community and, without any end to the debate in sight, it is safe to say that there are probably as many partition layouts as there are people debating the issue.

Keeping this in mind, we recommend that, unless you have a reason for doing otherwise, you should at least create the following partitions: swap, /boot/ (or a /boot/efi/ partition for Itanium systems), a /var/ partition for Itanium systems, and / (root).

For more information, refer to Section 4.16.4 *Recommended Partitioning Scheme*.

Appendix E.

Driver Media

E.1. Why Do I Need Driver Media?

While the Red Hat Enterprise Linux installation program is loading, a screen may appear asking you for driver media. The driver media screen is most often seen in the following scenarios:

- If you need to perform an installation from a network device
- If you need to perform an installation from a block device
- If you need to perform an installation from a PCMCIA device
- If you run the installation program by entering **linux dd** at the installation boot prompt (Itanium users should enter **elilo linux dd**)
- If you run the installation program on a computer which does not have any PCI devices

E.1.1. So What Is Driver Media Anyway?

Driver media can add support for hardware that may or may not be supported by the installation program. Driver media could include a driver diskette or image produced by Red Hat, it could be a diskette or CD-ROM you make yourself from driver images found on the Internet, or it could be a diskette or CD-ROM that a hardware vendor includes with a piece of hardware.

Driver media is used if you need access to a particular device to install Red Hat Enterprise Linux. Drivers can be used for network (NFS) installations, installations using a PCMCIA or block device, non-standard or very new CD-ROM drives, SCSI adapters, NICs, and other uncommon devices.

> **Note**
>
> If an unsupported device is not needed to install Red Hat Enterprise Linux on your system, continue with the installation and add support for the new piece of hardware once the installation is complete.

E.1.2. How Do I Obtain Driver Media?

Driver images can be obtained from several sources. They may be included with Red Hat Enterprise Linux, or they may be available from a hardware or software vendor's website. If you suspect that your system may require one of these drivers, you should create a driver diskette or CD-ROM before beginning your Red Hat Enterprise Linux installation.

For users with x86-based systems, the Red Hat Enterprise Linux CD #1 includes driver images (including `images/drvnet.img` — network card drivers and `images/drvblock.img` — drivers for SCSI controllers) containing many drivers (both common and obscure).

Tip

It is also possible to use a driver image via a network file. Instead of using the `linux dd` boot command, use the `linux dd=url` command, where `url` is replaced by an HTTP, FTP, or NFS address of the driver image to be used.

Another option for finding specialized driver information is on Red Hat's website at

```
http://www.redhat.com/support/errata/
```

under the section called **Bug Fixes**. Occasionally, popular hardware may be made available after a release of Red Hat Enterprise Linux that does not work with drivers already in the installation program or included on the driver images on the Red Hat Enterprise Linux CD #1. In such cases, the Red Hat website may contain a link to a driver image.

E.1.2.1. Creating a Driver Diskette from an Image File

To create a driver diskette from a driver diskette image using Red Hat Enterprise Linux:

1. Insert a blank, formatted diskette (or LS-120 diskette for Itanium system users) into the first diskette (or LS-120) drive.

2. From the same directory containing the driver diskette image, such as *drvnet.img*, type `dd if=drvnet.img of=/dev/fd0` as root.

Tip

Red Hat Enterprise Linux supports using a USB pen drive as a way to add driver images during the installation process. The best way to do this is to mount the USB pen drive and copy the desired `driverdisk.img` onto the USB pen drive. For example:

```
dd if=driverdisk.img of=/dev/sda
```

You are then prompted during the installation to select the partition and specify the file to be used.

E.1.3. Using a Driver Image During Installation

If you need to use a driver image, such as during a PCMCIA device or NFS installation, the installation program prompts you to insert the driver (as a diskette, CD-ROM, or file name) when it is needed.

However, there are some cases where you must specifically tell the Red Hat Enterprise Linux installation program to load that driver diskette and use it during the installation process.

For example, to specifically load a driver diskette that you have created, begin the installation process by booting from the Red Hat Enterprise Linux CD #1 (or using boot media you have created). For x86-based systems, at the `boot:` prompt, enter **linux dd** if using an x86 or x86-64 system. Refer to Section 4.3.1 *Booting the Installation Program on x86, AMD64, and Intel® EM64T Systems* for details on booting the installation program. For Itanium systems, at the `Shell>` prompt, type **elilo linux dd**. Refer to Section 4.3.2 *Booting the Installation Program on Itanium Systems* for details on booting the installation program.

The Red Hat Enterprise Linux installation program asks you to insert the driver diskette. Once the driver diskette is read by the installation program, it can apply those drivers to hardware discovered on your system later in the installation process.

<div align="right">

Appendix F.

</div>

Additional Boot Options

This appendix discusses additional boot and kernel boot options available for the Red Hat Enterprise Linux installation program.

To use any of the boot options presented here, type the command you wish to invoke at the installation `boot:` prompt.

Boot Time Command Arguments

`askmethod`

This command asks you to select the installation method you would like to use when booting from the Red Hat Enterprise Linux CD-ROM.

`apic`

This x86 boot command works around a bug commonly encountered in the Intel 440GX chipset BIOS and should only be executed with the installation program kernel.

`apm=allow_ints`

This x86 boot command changes how the suspend service is handled (and may be necessary for some laptops).

`apm=off`

This x86 boot command disables APM (Advanced Power Management). It useful because some BIOSes have buggy power management (APM) and tend to crash.

`apm=power_off`

This x86 boot command makes Red Hat Enterprise Linux shutdown (power off) the system by default. It is useful for SMP systems that do not shutdown by default.

`apm=realmode_power_off`

Some BIOSes crash on x86-based systems when trying to shutdown (power off) the machine. This command changes the method of how this is done from the Windows NT way to the Windows 95 way.

`dd`

This argument causes the installation program to prompt you to use a driver diskette.

`dd=`*`url`*

This argument causes the installation program to prompt you to use a driver image from a specified HTTP, FTP, or NFS network address.

`display=`*`IP`*`:0`

This command allows remote display forwarding. In this command, *IP* should be replaced with the IP address of the system on which you want the display to appear.

On the system you want the display to appear on, you must execute the command `xhost +`*`remotehostname`*, where *`remotehostname`* is the name of the host from which you are running the original display. Using the command `xhost +`*`remotehostname`* limits access

to the remote display terminal and does not allow access from anyone or any system not specifically authorized for remote access.

`driverdisk`

This command performs the same function as the `dd` command and also prompts you to use a driver diskette during the installation of Red Hat Enterprise Linux.

`ide=nodma`

This command disables DMA on all IDE devices and may be useful when having IDE-related problems.

`linux upgradeany`

This command relaxes some of the checks on your `/etc/redhat-release` file. If your `/etc/redhat-release` file has been changed from the default, your Red Hat Enterprise Linux installation may not be found when attempting an upgrade to Red Hat Enterprise Linux 4. Use this option only if your existing Red Hat Enterprise Linux installation was not detected.

`mediacheck`

This command gives you the option of testing the integrity of the install source (if an ISO-based method). This command works with the CD, DVD, hard drive ISO, and NFS ISO installation methods. Verifying that the ISO images are intact before you attempt an installation helps to avoid problems that are often encountered during an installation.

`mem=`*`xxx`*`M`

This command allows you to override the amount of memory the kernel detects for the machine. This may be needed for some older systems where only 16 MB is detected and for some new machines where the video card shares the video memory with the main memory. When executing this command, *xxx* should be replaced with the amount of memory in megabytes.

`nmi_watchdog=1`

This command enables the built-in kernel deadlock detector. This command can be used to debug hard kernel lockups. By executing periodic NMI (Non Maskable Interrupt) interrupts, the kernel can monitor whether any CPU has locked up and print out debugging messages as needed.

`noapic`

This x86 boot command tells the kernel not to use the APIC chip. It may be helpful for some motherboards with a bad APIC (such as the Abit BP6) or with a buggy BIOS. Systems based on the NVIDIA nForce3 chipset (such as the ASUS SK8N) have been known to hang during IDE detection at boot time, or display other interrupt-delivery issues.

`noht`

This x86 boot command disables hyperthreading.

`nofb`

This command disables frame buffer support and allows the installation program to run in text mode. This command may be necessary for accessibility with some screen reading hardware.

`nomce`

This x86 boot command disables self-diagnosis checks performed on the CPU. The kernel enables self-diagnosis on the CPU by default (called *Machine Check Exception*). Early Compaq Pentium systems may need this option as they do not support processor error checking correctly. A few other laptops, notably those using the Radeon IGP chipset, may also need this option.

`nopass`

This command disables the passing of keyboard and mouse information to stage 2 of the installation program. It can be used to test keyboard and mouse configuration screens during stage 2 of the installation program when performing a network installation.

`nopcmcia`

This command ignores any PCMCIA controllers in system.

`noprobe`

This command disables hardware detection and instead prompts the user for hardware information.

`noshell`

This command disables shell access on virtual console 2 during an installation.

`nousb`

This command disables the loading of USB support during the installation. If the installation program tends to hang early in the process, this command may be helpful.

`nousbstorage`

This command disables the loading of the usbstorage module in the installation program's loader. It may help with device ordering on SCSI systems.

`numa=off`

Red Hat Enterprise Linux supports NUMA (Non-Uniform Memory Access) on the AMD64 architecture. While all CPUs can access all memory even without NUMA support, the NUMA support present in the updated kernel causes memory allocations to favor the CPU on which they originate as much as possible, thereby minimizing inter-CPU memory traffic. This can provide significant performance improvements in certain applications. To revert to the original non-NUMA behavior, specify this boot option.

`reboot=b`

This x86, AMD64, and Intel® EM64T boot command changes the way the kernel tries to reboot the machine. If a kernel hang is experienced while the system is shutting down, this command may cause the system to reboot successfully.

`rescue`

This command runs rescue mode. Refer to the *Red Hat Enterprise Linux System Administration Guide* for more information about rescue mode.

`resolution=`

Tells the installation program which video mode to run. It accepts any standard resolution, such as **640x480**, **800x600**, **1024x768**, and so on.

`serial`

This command turns on serial console support.

`skipddc`

This x86 boot command skips the `ddc` monitor probe which causes problems on some systems.

text

    This command disables the graphical installation program and forces the installation program to run in text mode.

updates

    This command prompts you to insert a floppy diskette containing updates (bug fixes). It is not needed if you are performing a network installation and have already placed the updates image contents in `RHupdates/` on the server.

vnc

    This command allows you to install from a VNC server.

vncpassword=

    This command sets the password used to connect to the VNC server.

Appendix G.

Additional Resources about Itanium and Linux

Other reference materials, related to running Red Hat Enterprise Linux on an Itanium system, are available on the Web. A few of the available resources are as follows:

- http://www.intel.com/products/server/processors/server/itanium/index.htm?iid=sr+itanium& — The Intel website on the Itanium Processor
- http://developer.intel.com/technology/efi/index.htm?iid=sr+efi& — The Intel website for the Extensible Firmware Interface (EFI)
- http://www.itanium.com/business/bss/products/server/itanium2/index.htm — The Intel website on the Itanium 2 processor

Index

Symbols

/boot/ partition
    recommended partitioning, 31
/boot/efi/, 31
/root/install.log
    install log file location, 50
/var/ partition
    recommended partitioning, 31

A

accessibility, iv
    boot option
        nofb, 88
activating your subscription, 51
adding partitions, 33
    file system type, 34
ATAPI CD-ROM
    unrecognized, problems with, 19
autoboot
    ELILO, 52
automatic partitioning, 25, 27

B

boot CD-ROM, 4
    creating, 5
boot loader, 35
    alternatives to, 39
        commercial products, 39
        LOADLIN, 39
        SYSLINUX, 39
    configuration, 35
    GRUB, 35
    installing on boot partition, 37
    MBR, 37
    password, 37
boot loader password, 37
boot methods
    boot CD-ROM, 4
    USB pen drive, 4
boot options, 17
    additional, 87
        kernel, 87
    boot.iso, 17
    linux mediacheck, 8
    mediacheck, 17
    serial mode, 17
        UTF-8, 17
    text mode, 17

boot.iso, 17
booting
    installation program
        from a CD-ROM, 16
        from an LS-120 diskette, 16
        Itanium, 15
        x86, AMD64 and Intel EM64T, 15

C

canceling the installation, 19
CD-ROM
    ATAPI, 19
        unrecognized, problems with, 19
    boot CD-ROM, creating, 5
    IDE, 19
        unrecognized, problems with, 19
    installation from, 19
    SCSI, 19
clock, 45
configuration
    clock, 45
    GRUB, 35
    hardware, 9
    network, 40
    time, 45
    time zone, 45
consoles, virtual, 12
conventions
    document, i

D

DASD installation, 20
Disk Druid
    adding partitions, 33
        file system type, 34
    buttons, 30
    deleting partitions, 35
    editing partitions, 35
    partitions, 28
disk partitioning, 25
disk space, 3
diskette
    media, 83
documentation
    other manuals, 3
driver diskette, 14
driver media, 83
    creating diskette from image, 84
    produced by others, 84
    produced by Red Hat, 83
    using a driver image, 84

Colophon

The manuals are written in DocBook SGML v4.1 format. The HTML and PDF formats are produced using custom DSSSL stylesheets and custom jade wrapper scripts. The DocBook SGML files are written in **Emacs** with the help of PSGML mode.

Garrett LeSage created the admonition graphics (note, tip, important, caution, and warning). They may be freely redistributed with the Red Hat documentation.

The Red Hat Product Documentation Team consists of the following people:

Sandra A. Moore — Primary Writer/Maintainer of the *Red Hat Enterprise Linux Installation Guide for x86, Itanium™, AMD64, and Intel® Extended Memory 64 Technology (Intel® EM64T)*; Primary Writer/Maintainer of the *Red Hat Enterprise Linux Installation Guide for the IBM® POWER Architecture*; Primary Writer/Maintainer of the *Red Hat Enterprise Linux Installation Guide for the IBM® S/390® and IBM® eServer™ zSeries® Architectures*

John Ha — Primary Writer/Maintainer of the *Red Hat Cluster Suite Configuring and Managing a Cluster*; Co-writer/Co-maintainer of the *Red Hat Enterprise Linux Security Guide*; Maintainer of custom DocBook stylesheets and scripts

Edward C. Bailey — Primary Writer/Maintainer of the *Red Hat Enterprise Linux Introduction to System Administration*; Primary Writer/Maintainer of the *Release Notes*; Contributing Writer to the *Red Hat Enterprise Linux Installation Guide for x86, Itanium™, AMD64, and Intel® Extended Memory 64 Technology (Intel® EM64T)*

Karsten Wade — Primary Writer/Maintainer of the *Red Hat SELinux Application Development Guide*; Primary Writer/Maintainer of the *Red Hat SELinux Policy Guide*

Andrius Benokraitis — Primary Writer/Maintainer of the *Red Hat Enterprise Linux Reference Guide*; Co-writer/Co-maintainer of the *Red Hat Enterprise Linux Security Guide*; Contributing Writer to the *Red Hat Enterprise Linux System Administration Guide*

Paul Kennedy — Primary Writer/Maintainer of the *Red Hat GFS Administrator's Guide*; Contributing Writer to the *Red Hat Cluster Suite Configuring and Managing a Cluster*

Mark Johnson — Primary Writer/Maintainer of the *Red Hat Enterprise Linux Desktop Configuration and Administration Guide*

Melissa Goldin — Primary Writer/Maintainer of the *Red Hat Enterprise Linux Step By Step Guide*

The Red Hat Localization Team consists of the following people:

Amanpreet Singh Alam — Punjabi translations

Jean-Paul Aubry — French translations

David Barzilay — Brazilian Portuguese translations

Runa Bhattacharjee — Bengali translations

Chester Cheng — Traditional Chinese translations

Verena Fuehrer — German translations

Kiyoto Hashida — Japanese translations

N. Jayaradha — Tamil translations

Michelle Jiyeen Kim — Korean translations

Yelitza Louze — Spanish translations

Noriko Mizumoto — Japanese translations

Ankitkumar Rameshchandra Patel — Gujarati translations

Rajesh Ranjan — Hindi translations

Nadine Richter — German translations

Audrey Simons — French translations

Francesco Valente — Italian translations

Sarah Wang — Simplified Chinese translations

Ben Hung-Pin Wu — Traditional Chinese translations