Fedora 18
Installation Guide

Installing Fedora 18 on x86, AMD64, and Intel 64 architectures

Fedora Documentation Project
Fedora 18 Installation Guide
Installing Fedora 18 on x86, AMD64, and Intel 64 architectures
Edition 1.0

Author
Fedora Documentation Project

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Provides documentation for the installation process.
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Preface

1. Document Conventions
This manual uses several conventions to highlight certain words and phrases and draw attention to specific pieces of information.

In PDF and paper editions, this manual uses typefaces drawn from the *Liberation Fonts* set. The Liberation Fonts set is also used in HTML editions if the set is installed on your system. If not, alternative but equivalent typefaces are displayed. Note: Red Hat Enterprise Linux 5 and later includes the Liberation Fonts set by default.

1.1. Typographic Conventions
Four typographic conventions are used to call attention to specific words and phrases. These conventions, and the circumstances they apply to, are as follows.

**Mono-spaced Bold**

Used to highlight system input, including shell commands, file names and paths. Also used to highlight keycaps and key combinations. For example:

To see the contents of the file `my_next_bestselling_novel` in your current working directory, enter the `cat my_next_bestselling_novel` command at the shell prompt and press Enter to execute the command.

The above includes a file name, a shell command and a keycap, all presented in mono-spaced bold and all distinguishable thanks to context.

Key combinations can be distinguished from keycaps by the hyphen connecting each part of a key combination. For example:

Press Enter to execute the command.

Press `Ctrl+Alt+F2` to switch to the first virtual terminal. Press `Ctrl+Alt+F1` to return to your X-Windows session.

The first paragraph highlights the particular keycap to press. The second highlights two key combinations (each a set of three keycaps with each set pressed simultaneously).

If source code is discussed, class names, methods, functions, variable names and returned values mentioned within a paragraph will be presented as above, in *mono-spaced bold*. For example:

File-related classes include `filesystem` for file systems, `file` for files, and `dir` for directories. Each class has its own associated set of permissions.

**Proportional Bold**

This denotes words or phrases encountered on a system, including application names; dialog box text; labeled buttons; check-box and radio button labels; menu titles and sub-menu titles. For example:

Choose `System` → `Preferences` → `Mouse` from the main menu bar to launch `Mouse Preferences`. In the `Buttons` tab, click the `Left-handed mouse` check box and click

1 https://fedorahosted.org/liberation-fonts/
Close to switch the primary mouse button from the left to the right (making the mouse suitable for use in the left hand).

To insert a special character into a gedit file, choose Applications → Accessories → Character Map from the main menu bar. Next, choose Search → Find… from the Character Map menu bar, type the name of the character in the Search field and click Next. The character you sought will be highlighted in the Character Table. Double-click this highlighted character to place it in the Text to copy field and then click the Copy button. Now switch back to your document and choose Edit → Paste from the gedit menu bar.

The above text includes application names; system-wide menu names and items; application-specific menu names; and buttons and text found within a GUI interface, all presented in proportional bold and all distinguishable by context.

**Mono-spaced Bold Italic or Proportional Bold Italic**

Whether mono-spaced bold or proportional bold, the addition of italics indicates replaceable or variable text. Italics denotes text you do not input literally or displayed text that changes depending on circumstance. For example:

To connect to a remote machine using ssh, type ssh **username@domain.name** at a shell prompt. If the remote machine is example.com and your username on that machine is john, type ssh **john@example.com**.

The **mount -o remount file-system** command remounts the named file system. For example, to remount the **/home** file system, the command is **mount -o remount /home**.

To see the version of a currently installed package, use the **rpm -q package** command. It will return a result as follows: **package-version-release**.

Note the words in bold italics above — username, domain.name, file-system, package, version and release. Each word is a placeholder, either for text you enter when issuing a command or for text displayed by the system.

Aside from standard usage for presenting the title of a work, italics denotes the first use of a new and important term. For example:

Publican is a **DocBook** publishing system.

**1.2. Pull-quote Conventions**

Terminal output and source code listings are set off visually from the surrounding text.

Output sent to a terminal is set in **mono-spaced roman** and presented thus:

<table>
<thead>
<tr>
<th>books</th>
<th>Desktop</th>
<th>documentation</th>
<th>drafts</th>
<th>mss</th>
<th>photos</th>
<th>stuff</th>
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<tr>
<td>books_tests</td>
<td>Desktop1</td>
<td>downloads</td>
<td>images</td>
<td>notes</td>
<td>scripts</td>
<td>svgs</td>
<td></td>
</tr>
</tbody>
</table>

Source-code listings are also set in **mono-spaced roman** but add syntax highlighting as follows:

```java
package org.jboss.book.jca.ex1;

import javax.naming.InitialContext;
```
public class ExClient {
    public static void main(String args[])
        throws Exception {
        InitialContext iniCtx = new InitialContext();
        Object         ref    = iniCtx.lookup("EchoBean");
        EchoHome       home   = (EchoHome) ref;
        Echo           echo   = home.create();

        System.out.println("Created Echo");
        System.out.println("Echo.echo('Hello') = " + echo.echo("Hello"));
    }
}
3. Acknowledgments

Introduction

This guide covers installation of Fedora, a Linux distribution built on free and open source software. This manual helps you install Fedora on desktops, laptops, and servers. The installation system is easy to use even if you lack previous knowledge of Linux or computer networks. If you select default options, Fedora provides a complete desktop operating system, including productivity applications, Internet utilities, and desktop tools.

This document details the full range of installation options, including those that apply only in limited or unusual circumstances. The Fedora 18 Installation Quick Start Guide provides a much-abbreviated set of instructions for downloading Fedora, creating an installation disc, and installing Fedora on a typical desktop or laptop computer. The Fedora 18 Installation Quick Start Guide is available from http://docs.fedoraproject.org/installation-quick-start-guide/.

1. Background

1.1. About Fedora
To find out more about Fedora, refer to http://fedoraproject.org/. To read other documentation on Fedora related topics, refer to http://docs.fedoraproject.org/.

1.2. Getting Additional Help
For information on additional help resources for Fedora, visit http://fedoraproject.org/wiki/Communicate.

2. About This Document

2.1. Goals
This guide helps a reader:

1. Understand how to locate the Fedora distribution online
2. Create configuration data that allows a computer to boot Fedora
3. Understand and interact with the Fedora installation program
4. Complete basic post-installation configuration of a Fedora system

Other Sources of Documentation

This guide does not cover use of Fedora. To learn how to use an installed Fedora system, refer to http://docs.fedoraproject.org/ for other documentation.

2.2. Audience
This guide is intended for Fedora users of all levels of experience. However, it treats the installation process and its many options in far greater detail than most novice users are likely to require. You do
not need to read and understand this entire document to install Fedora on a computer. This document is most likely to help experienced users perform advanced and unusual installations.
Quick Start for Experts

This section offers a very brief overview of installation tasks for experienced readers who are eager to get started. Note that many explanatory notes and helpful hints appear in the following chapters of this guide. If an issue arises during the installation process, consult the appropriate chapters in the full guide for help.

Experts Only

This section is intended only for experts. Other readers may not be familiar with some of the terms in this section, and should move on to Chapter 2, Obtaining Fedora instead.

1.1. Overview

The installation procedure is fairly simple, and consists of only a few steps:

1. Download files to make media or another bootable configuration.
2. Prepare system for installation.
3. Boot the computer and run the installation process.
4. Reboot and perform post-installation configuration.

1.2. Download Files

Do any one of the following:

Verify your downloads

Downloads may fail for any number of reasons. Always verify the sha256sum of the downloaded files.

1. Download the ISO image for a Live image. Create CD media from the ISO file using your preferred application. You may also use the livecd-tools package to write the image to other bootable media such as a USB flash disk. To install the distribution to your hard disk, use the shortcut on the desktop after you log in.

2. Download the ISO images for the full distribution on DVD. Create DVD media from the ISO files using your preferred application, or put the images on a Windows FAT32 or Linux ext2, ext3, or ext4 partition.

3. Download the boot.iso image for a minimal boot CD or USB flash drive. Write the image to the appropriate physical media to create bootable media. The boot media contains no packages but must be pointed at a hard disk or online repository to complete the installation.

4. Download the vmlinuz kernel file and the initrd.img ramdisk image from the distribution's isolinux/ directory. Configure your operating system to boot the kernel and load the ramdisk
image. For further information on installation without media, refer to Chapter 12, Installing Without Media.

For information on setting up a network boot server from which you can install Fedora, refer to Chapter 13, Setting Up an Installation Server.

To learn how to turn ISO images into CD or DVD media, refer to Making Fedora Discs available from http://docs.fedoraproject.org/readme-burning-isos/.

### 1.3. Prepare for Installation

Back up any user data you need to preserve.

**Resizing Partitions**

The installation program provides functions for resizing ext2, ext3, ext4, and NTFS formatted partitions. Refer to Section 9.13, “Creating a Custom Partition Layout” for more information.

### 1.4. Install Fedora

Boot from the desired media, with any options appropriate for your hardware and installation mode. Refer to Chapter 11, Boot Options for more information about boot options. If you boot from the Live CD, select the Install to Hard Disk option from the desktop to run the installation program. (Alternatively, the option can be found in Applications → System Tools.) If you boot from minimal media or a downloaded kernel, select a network or hard disk resource from which to install.

Proceed through all the steps of the installation program. The installation program does not change your system until you make a final confirmation to proceed. When installation is finished, reboot your system.

### 1.5. Perform Post-installation Steps

After the system reboots, it displays additional configuration options. Make appropriate changes to your system and proceed to the login prompt.

Refer to Chapter 17, Firstboot or the Firstboot page on the Fedora wiki: http://fedoraproject.org/wiki/FirstBoot for more detail.
Chapter 2.

Obtaining Fedora

This chapter explains how to get the files you need to install and run Fedora on your computer. Concepts in this chapter may be new, especially if this is your first free and open source operating system. If you have any trouble with this chapter, find help by visiting the Fedora Forums at http://www.fedoraforum.org/.

The Fedora Project distributes Fedora in many ways, mostly free of cost and downloaded over the Internet. The most common distribution method is CD and DVD media. There are several types of CD and DVD media available, including:

- A full set of the software on DVD media
- Live images you can use to try Fedora, and then install to your system if you so choose
- Reduced-size bootable CD and USB flash disk images you can use to install over an Internet connection
- Source code on DVD media

Most users want the Fedora Live image or the full set of installable software on DVD. The reduced bootable images are suitable for use with a fast Internet connection and install Fedora on one computer. Source code discs are not used for installing Fedora, but are resources for experienced users and software developers.

Users with a broadband Internet connection can download ISO images of CD and DVD media or images of USB flash disks. An ISO image is a copy of an entire disc in a format suitable for writing directly to a CD or DVD. A USB flash disk image is a copy of an entire disk in a format suitable for writing directly to a USB flash disk.

For more information on burning CDs and DVDs, refer to Chapter 3, Making Media.

If downloading the Fedora ISO images and burning them to CD or DVD is impossible or impractical for you, refer to Section 2.2, “Obtaining Fedora on CD or DVD” to learn about other ways that you can obtain Fedora.

2.1. Downloading Fedora

2.1.1. How Do I Download Installation Files?

**Download Links**

To follow a Web-based guide to downloading, visit http://get.fedoraproject.org/. For guidance on which architecture to download, refer to Section 2.1.2, “Which Architecture Is My Computer?”.

Fedora software is available for download at no cost in a variety of ways.

2.1.1.1. From a Mirror
Chapter 2. Obtaining Fedora

The Fedora installation files are freely available from web servers located in many parts of the world. These servers mirror the files available from the Fedora Project. If you visit http://download.fedoraproject.org/, you are redirected to a mirror, based on a calculation of which mirror is likely to offer you the best download speed. Alternatively, you can choose a mirror from the list maintained at http://mirrors.fedoraproject.org/publiclist. This page lists mirrors according to geographic location. The mirrors geographically closest to you are likely to provide you with the fastest downloads. If the company or organization that provides your internet access maintains a mirror, this mirror is likely to provide you with the fastest downloads of all.

Mirrors publish Fedora software under a well-organized hierarchy of folders. For example, the Fedora 18 distribution normally appears in the directory fedora/linux/releases/18/. This directory contains a folder for each architecture supported inside that folder, in a folder called iso/. For example, you can find the file for the DVD distribution of Fedora 18 for x86_64 at fedora/linux/releases/18/Fedora/x86_64/iso/Fedora-18-x86_64-DVD.iso.

2.1.1.2. From BitTorrent

BitTorrent is a way to download information in cooperation with other computers. Each computer cooperating in the group downloads pieces of the information in a particular torrent from other peers in the group. Computers that have finished downloading all the data in a torrent remain in the swarm to seed, or provide data to other peers. If you download using BitTorrent, as a courtesy you should seed the torrent at least until you have uploaded the same amount of data you downloaded.

If your computer does not have software installed for BitTorrent, visit the BitTorrent home page at http://www.bittorrent.com/download/ to download it. BitTorrent client software is available for Windows, Mac OS, Linux, and many other operating systems.

You do not need to find a special mirror for BitTorrent files. The BitTorrent protocol ensures that your computer participates in a nearby group. To download and use the Fedora BitTorrent files, visit http://torrent.fedoraproject.org/.

Minimal Boot Images

Minimal boot CD and USB flash disk images are not available through BitTorrent.

Verify your download

Once you have downloaded an ISO, verify it for security and integrity. To follow a web-based guide, visit https://fedoraproject.org/en/verify.

2.1.2. Which Architecture Is My Computer?

Releases are separated by architecture, or type of computer processor. Use the following table to determine the architecture of your computer according to the type of processor. Consult your manufacturer's documentation for details on your processor, if necessary.
Table 2.1. Processor and architecture types

<table>
<thead>
<tr>
<th>Processor manufacturer and model</th>
<th>Architecture type for Fedora</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intel Atom (see note below,) Core series, Pentium 4, and recent vintage Xeon; AMD Athlon, Duron, some Semprons; and older; VIA C3, C7</td>
<td>1386</td>
</tr>
<tr>
<td>Intel Atom (See note below), Core 2 series, Core i series and Xeon; AMD: Athlon 64, Athlon II, Sempron64, Phenom series, Fusion series, Bulldozer series and Opteron; Apple MacBook, MacBook Pro, and MacBook Air</td>
<td>x86_64</td>
</tr>
</tbody>
</table>

- **1386 Works for Most Windows Compatible Computers**

  If you are unsure what type of processor your computer uses, choose 1386.

  The exception is if your computer is a non-Intel based Apple Macintosh. Refer to [http://fedoraproject.org/wiki/Architectures/PowerPC](http://fedoraproject.org/wiki/Architectures/PowerPC) for more information on using Fedora on these systems.

- **Intel Atom Processor Architectures Vary**

  The Z Series and N200 Series Atom processors are based on the 1386 architecture. The 230 and 330 Series and the rest of the N Series Atom processors are based on the x86_64 architecture. Refer to [http://ark.intel.com/products/family/29035](http://ark.intel.com/products/family/29035) for more details.

### 2.1.3. Which Files Do I Download?

You have several options to download Fedora. Read the options below to decide the best one for you.

Each file available for download in a Fedora distribution includes the architecture type in the file name. For example, the file for the DVD distribution of Fedora 18 for x86_64 is named "Fedora-18-x86_64-DVD.iso". Refer to Section 2.1.2, “Which Architecture Is My Computer?” if you are unsure of your computer's architecture.

- **Full Distribution on DVD**

  If you have plenty of time, a fast Internet connection, and wish a broader choice of software on the install media, download the full DVD version. Once burned to DVD, the media is bootable and includes an installation program. The DVD version contains a mode to perform rescue operations on your Fedora system in an emergency. You can download the DVD version directly from a mirror, or via BitTorrent.

- **Live Image**

  If you want to try Fedora before you install it on your computer, download the Live image version. If your computer supports booting from CD or USB, you can boot the operating system without making any changes to your hard disk. The Live image also provides an Install to Hard Disk desktop shortcut (alternatively, the shortcut can be found in Applications ➔ System Tools). If you decide you like what you see, and want to install it, simply activate the selection to copy Fedora to your hard disk. You can download the Live image directly from a mirror, or using BitTorrent.
Chapter 2. Obtaining Fedora

For more detailed instructions on setting up a Live image installation, including selecting a language for the installation process, refer to the Fedora Installation Quick Start Guide.

**Minimal Boot Media**
If you have a fast Internet connection but do not want to download the entire distribution, you can download a small boot image. Fedora offers images for a minimal boot environment on CD. Once you boot your system with the minimal media, you can install Fedora directly over the Internet. Although this method still involves downloading a significant amount of data over the Internet, it is almost always much less than the size of the full distribution media. Once you have finished installation, you can add or remove software to your system as desired.

**Download Size**

Installing the default software for Fedora over the Internet requires more time than the Live image, but less time than the entire DVD distribution. Actual results depend on the software you select and network traffic conditions.

The following table explains where to find the desired files on a mirror site. Replace arch with the architecture of the computer being installed.

### Table 2.2. Locating files

<table>
<thead>
<tr>
<th>Media type</th>
<th>File locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full distribution on DVD</td>
<td><code>fedora/linux/releases/18/Fedora/arch/iso/Fedora-18-arch-DVD.iso</code></td>
</tr>
<tr>
<td>Live image</td>
<td><code>fedora/linux/releases/18/Live/arch/iso/Fedora-18-arch-Live.iso, fedora/linux/releases/18/Live/arch/iso/Fedora-18-KDE-arch-Live.iso</code></td>
</tr>
<tr>
<td>Minimal CD boot media</td>
<td><code>fedora/linux/releases/18/Fedora/arch/os/images/boot.iso</code></td>
</tr>
</tbody>
</table>

**2.2. Obtaining Fedora on CD or DVD**
If you do not have a fast Internet connection, or if you have a problem creating boot media, downloading may not be an option. Fedora DVD and CD distribution media is available from a number of online sources around the world at a minimal cost. Use your favorite Web search engine to locate a vendor, or refer to [http://fedoraproject.org/wiki/Distribution](http://fedoraproject.org/wiki/Distribution).
### Making Media

Use the methods described in this section to create the following types of installation and boot media:

- an installation DVD
- a USB flash drive to use as an installation source
- a minimal boot CD or DVD that can boot the installer
- a USB flash drive to boot the installer

The following table indicates the types of boot and installation media available for different architectures and notes the image file that you need to produce the media.

**Table 3.1. Boot and installation media**

<table>
<thead>
<tr>
<th>Architecture</th>
<th>Installation DVD</th>
<th>Installation USB flash drive</th>
<th>Boot CD or boot DVD</th>
<th>Boot USB flash drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS-based 32-bit x86</td>
<td>x86 DVD ISO image file</td>
<td>x86 DVD ISO image file</td>
<td>boot.iso</td>
<td>boot.iso</td>
</tr>
<tr>
<td>UEFI-based 32-bit x86</td>
<td>Not available</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOS-based AMD64 and Intel 64</td>
<td>x86_64 DVD ISO image file (to install 64-bit operating system) or x86 DVD ISO image file (to install 32-bit operating system)</td>
<td>x86_64 DVD ISO image file (to install 64-bit operating system) or x86 DVD ISO image file (to install 32-bit operating system)</td>
<td>boot.iso</td>
<td>boot.iso</td>
</tr>
<tr>
<td>UEFI-based AMD64 and Intel 64</td>
<td>x86_64 DVD ISO image file</td>
<td>Not available</td>
<td>Not available</td>
<td>efiboot.img (from x86_64 DVD ISO image file)</td>
</tr>
</tbody>
</table>

### 3.1. Making an installation DVD

You can make an installation DVD using the disc burning software on your computer.

The exact series of steps that produces a DVD from an ISO image file varies greatly from computer to computer, depending on the operating system and disc burning software installed. Use this procedure as a general guide. You might be able to omit certain steps on your computer, or might have to perform some of the steps in a different order from the order described here.

Make sure that your disc burning software is capable of burning discs from image files. Although this is true of most disc burning software, exceptions exist.

In particular, note that the disc burning feature built into Windows XP and Windows Vista cannot burn DVDs; and that earlier Windows operating systems did not have any disc burning capability installed by default at all. Therefore, if your computer has a Windows operating system prior to Windows 7 installed on it, you need a separate piece of software for this task. Examples of popular disc burning software for Windows that you might already have on your computer include Nero Burning ROM and Roxio Creator.
Chapter 3. Making Media

The Disk Utility software installed by default with Mac OS X on Apple computers has the capability to burn discs from images built into it already. Most widely-used DVD burning software for Linux, such as Brasero and K3b, also includes this capability.

1. Download an ISO image file of a Fedora 18 disc as described in Chapter 2, Obtaining Fedora.

2. Insert a blank, writeable disc into your computer’s disc burner. On some computers, a window opens and displays various options when you insert the disc. If you see a window like this, look for an option to launch your chosen disc burning program. If you do not see an option like this, close the window and launch the program manually.

3. Launch your disc burning program. On some computers, you can do this by right-clicking (or control-clicking) on the image file and selecting a menu option with a label like Copy image to DVD, or Copy CD or DVD image. Other computers might provide you with a menu option to launch your chosen disc burning program, either directly or with an option like Open With. If none of these options are available on your computer, launch the program from an icon on your desktop, in a menu of applications such as the Start menu on Windows operating systems, or in the Mac Applications folder.

4. In your disc burning program, select the option to burn a DVD from an image file. For example, in Nero Burning ROM, this option is called Burn Image and is located on the File menu.

   Note that you can skip this step when using certain DVD burning software; for example, Disk Utility on Mac OS X does not require it.

5. Browse to the ISO image file that you downloaded previously and select it for burning.

6. Click the button that starts the burning process.

On some computers, the option to burn a disc from an ISO file is integrated into a context menu in the file browser. For example, when you right-click an ISO file on a computer with a Linux or UNIX operating system that runs the GNOME desktop, the Nautilus file browser presents you with the option to Write to disk.

3.2. Preparing a USB flash drive as an installation source

Ensure your USB media has sufficient space

Your USB media will need free space equal to the size of the ISO you obtained in Chapter 2, Obtaining Fedora. For example, a 2.2GB DVD ISO will need 2.2GB of free space on the USB drive, but having slightly more free space on the drive is ideal.

Unusual USB Media

In a few cases with oddly formatted or partitioned USB media, image writing may fail.

You can install Fedora on 32-bit x86 systems and BIOS-based AMD64 and Intel 64 systems using a USB flash drive, provided that your hardware supports booting from this type of device. Note that you
cannot install Fedora on UEFI-based AMD64 and Intel 64 systems from a USB flash drive, although you can use a USB flash drive to boot the Fedora installer on UEFI-based AMD64 and Intel 64 systems — refer to Section 3.3, “Making Minimal Boot Media”.

### 3.2.1. Making Fedora USB Media on a Windows Operating System

**Note — This Method Is Not Destructive**

This method is not destructive, so existing data on the media is not harmed. Nevertheless, it is always a good idea to back up important data before performing sensitive disk operations.

The most straightforward way to place a Fedora image on USB media using a Windows operating system is to transfer the Fedora live image to the USB device with the **LiveUSB Creator** tool.

Note that the `dd` tool discussed in Section 3.2.2, “Making Fedora USB Media in UNIX, Linux, and Similar Operating Systems” is also available for Windows. Follow the instructions in that section to use an implementation of `dd` for Windows operating systems. The instructions in this section assume that you will use **LiveUSB Creator**.

1. Download the **LiveUSB Creator** program for Windows from [http://fedorahosted.org/liveusb-creator](http://fedorahosted.org/liveusb-creator).

2. **LiveUSB Creator** can create live USB media either from an image file that you downloaded previously, as described in Section 2.1.3, “Which Files Do I Download?”, or it can download an image file from the Internet. Either:
   - click the **Browse** button under the **Use existing LiveCD** label, browse to the location where you previously downloaded a Fedora Live ISO file, and select that file.
   - select a Fedora Live ISO file from the drop-down menu that **LiveUSB Creator** presents under the **Download Fedora** label. Note that image files are large and that it is probably impractical to use **LiveUSB Creator** to download an image file if you do not have a broadband connection to the Internet.

3. Click **Create Live USB**.

### 3.2.2. Making Fedora USB Media in UNIX, Linux, and Similar Operating Systems

A graphical tool is available to create Fedora USB media on systems that run Fedora or operating systems derived from Fedora. To create Fedora USB media on other UNIX or Linux operating systems (including Mac OS X), use the command-line method described in Section 3.2.2.1.3, “Making Fedora USB Media with `dd`”.

#### 3.2.2.1. Creating Fedora USB Media in Fedora and similar Linux distributions

Graphical and command-line tools are available to create Fedora USB media on computers that run Fedora and Linux distributions derived from Fedora. The command line tools work with both Fedora DVD and live images, but the graphical tool works only with live images. To create Fedora USB media
from the distribution image or minimal boot media image, use one of the command line methods described in Section 3.2.2.1.2, “Making Fedora USB Media with livecd-tools” and Section 3.2.2.1.3, “Making Fedora USB Media with dd”.

### 3.2.2.1.1. Making Fedora USB Media with a graphical tool

**Important — Enable Extra Packages for Enterprise Linux**

To perform this procedure on Linux distributions derived from Fedora, enable the Extra Packages for Enterprise Linux (EPEL) repository. Refer to http://fedoraproject.org/wiki/EPEL/FAQ#howtouse for instructions.

**Note — This Method Is Not Destructive**

This method is not destructive, so existing data on the media is not harmed. Nevertheless, it is always a good idea to back up important data before performing sensitive disk operations.

1. Install the `liveusb-creator` on your system with your graphical package manager, or the following command:

   
   ```bash
   su -c 'yum -y install liveusb-creator'
   ```

2. Plug in your USB media.

3. Launch LiveUSB Creator, either from a menu or by entering `liveusb-creator` on the command line. Enter the root password for your system when LiveUSB Creator prompts you for it.

4. LiveUSB Creator can create live USB media either from an image file that you downloaded previously, as described in Section 2.1.3, “Which Files Do I Download?”, or it can download an image file from the Internet. Either:

   • click the Browse button under the Use existing LiveCD label, browse to the location where you previously downloaded a Fedora Live ISO file, and select that file.

   • select a Fedora Live ISO file from the drop-down menu that LiveUSB Creator presents under the Download Fedora label. Note that image files are large and that it is probably impractical to use LiveUSB Creator to download an image file if you do not have a broadband connection to the Internet.

5. Click Create Live USB.
3.2.2.1.2. Making Fedora USB Media with livecd-tools

**Important — Enable Extra Packages for Enterprise Linux**

To perform this procedure on Linux distributions derived from Fedora, enable the *Extra Packages for Enterprise Linux* (EPEL) repository. Refer to [http://fedoraproject.org/wiki/EPEL/FAQ#howtouse](http://fedoraproject.org/wiki/EPEL/FAQ#howtouse) for instructions.

**Note — This Method Is Not Destructive**

This method is not destructive, so existing data on the media is not harmed. Nevertheless, it is always a good idea to back up important data before performing sensitive disk operations.

1. Install the *livecd-tools* package on your system with your graphical package manager, or the following command:

   ```bash
   su -c 'yum -y install livecd-tools'
   ```

2. Plug in your USB media.

3. Find the device name for your USB media. If the media has a volume name, use it to look up the device name in `/dev/disk/by-label`, or use the `findfs`:

   ```bash
   su -c 'findfs LABEL="MyLabel"
   ```

   If the media does not have a volume name, or you do not know it, consult the `/var/log/messages` log for details:

   ```bash
   su -c 'less /var/log/messages'
   ```

4. Use the `livecd-iso-to-disk` command to write the ISO image to the media:

   ```bash
   su -c 'livecd-iso-to-disk the_image.iso /dev/sdX1'
   ```

   Replace `sdX1` with the device name for the partition on the USB media. Most flash drives and external hard disks use only one partition. If you have changed this behavior or have oddly partitioned media, you may need to consult other sources of help.
3.2.2.1.3. Making Fedora USB Media with dd

⚠️ Warning — These instructions could destroy data

When you perform this procedure any data on the USB flash drive is destroyed with no warning. Make sure that you specify the correct USB flash drive, and make sure that this flash drive does not contain any data that you want to keep.

Note

The Fedora Project recommends using `livecd-tools` rather than `dd` for creating USB media whenever possible.

1. Plug in your USB flash drive.
2. Become root:
   ```bash
   su -
   ```
3. Your flash drive must have a single partition with a vfat file system. To determine how it is formatted, find the name of this partition and the device itself by running `dmesg` shortly after connecting the drive. The device name (similar to `/dev/sdc`) and the partition name (similar to `/dev/sdc1`) both appear in several lines towards the end of the output.
4. Use the partition name to ensure that the file system type of the USB flash drive is vfat.
   ```bash
   # blkid partition
   ```
   You should now see a message similar to:
   ```plaintext
   LABEL="LIVE" UUID="6676-27D3" TYPE="vfat"
   ```
   If TYPE is anything other than vfat (for example, TYPE="iso9660"), clear the first blocks of the USB flash drive:
   ```bash
   # dd if=/dev/zero of=partition bs=1M count=100
   ```
5. Use the `dd` command to transfer the boot ISO image to the USB device:
   ```bash
   # dd if=path/image_name.iso of=device
   ```
   where `path/image_name.iso` is the boot ISO image file that you downloaded and `device` is the device name for the USB flash drive. Ensure you specify the device name, not the partition name. For example:
3.2.2.2. Making Fedora USB Media in other Linux Distributions

To create Fedora USB media from a DVD or live image on a computer that uses a Linux distribution other than Fedora and those derived from Fedora, use one of the command-line procedures detailed in this section.

3.2.2.2.1. Making Fedora USB Media with livecd-tools

Note — This Method Is Not Destructive

This method is not destructive, so existing data on the media is not harmed. Nevertheless, it is always a good idea to back up important data before performing sensitive disk operations.

This method works only on Linux operating systems.

1. Download a DVD or live ISO image for Fedora as shown in Section 2.1.3, “Which Files Do I Download?”

2. Plug in your USB media.

3. Find the device name for your USB media. If the media has a volume name, look up the name in /dev/disk/by-label, or use the findfs:

   ```
   su -c 'findfs LABEL="MyLabel"'
   ```

   If the media does not have a volume name, or you do not know it, consult the /var/log/messages log for details:

   ```
   su -c 'less /var/log/messages'
   ```

4. Many Linux distributions automatically mount USB media devices when you connect the device to your computer. If this is the case, unmount the device. The specific method to do this varies widely between Linux distributions and desktops. Some common methods include:

   - select File > Unmount if the operating system presents you with a window that displays the contents of the device.
   - right-click on an icon of the device and click Unmount.
   - click on an icon that represents ejecting the media — commonly, an upward-pointing triangle.

5. At a command line, type su - to become root, and enter the root password when your system prompts you.

6. Create a mount point for the image that you downloaded. For example, to use /tmp/livecd as the mount point, type mkdir /tmp/livecd and press Enter.
Chapter 3. Making Media

7. Mount the image with the following command: `mount -o loop /path/to/image/file/imagefile.iso /path/to/mount/point`, where /path/to/image/file is the location of the image file that you downloaded, imagefile.iso is the image file, and /path/to/mount/point is the mount point that you just created.

8. Change directory to the LiveOS directory of the image that you just mounted. Mount point where you just mounted the Fedora image. For example, `cd /tmp/livecd/LiveOS`.

9. Run the following command: `.livecd-iso-to-disk /path/to/image/file/imagefile.iso device`, where /path/to/image/file is the location of the image file that you downloaded, imagefile.iso is the image file, and device is the USB media device.

Example 3.1. Mounting a Fedora live image file and using livecd-iso-to-disk to create live USB media

You have downloaded a Fedora live image, `Fedora-18-i686-Live.iso`, to a folder named Downloads in your home directory. You have a USB flash drive plugged into your computer, named /dev/sdc, with a partition named /dev/sdc1

Become root:

```
su -
```

Make a mount point for the image:

```
mkdir /mnt/livecd
```

Mount the image:

```
mount -o loop /home/Username/Downloads/Fedora-18-i686-Live.iso /mnt/livecd
```

Change into the LiveOS directory of the live CD image:

```
cd /mnt/livecd/LiveOS
```

Run `livecd-iso-to-disk` to transfer the live image to the partition on your flash drive and make the flash drive bootable:

```
./livecd-iso-to-disk /home/Username/Downloads/Fedora-18-i686-Live.iso /dev/sdc1
```

3.2.2.2.2. Making Fedora USB Media with dd

⚠️ Warning — These instructions could destroy data

When you perform this procedure any data on the USB flash drive is destroyed with no warning. Make sure that you specify the correct USB flash drive, and make sure that this flash drive does not contain any data that you want to keep.
Note

The Fedora Project recommends using `livecd-tools` rather than `dd` for creating USB media whenever possible.

Use this method for the distribution image, the minimal boot media image, or on systems with a UNIX operating system (including Mac OS X).

1. Plug in your USB flash drive.
2. Become root:
   ```
   su -
   ```
3. Your flash drive must have a single partition with a vfat file system. To determine how it is formatted, find the name of this partition and the device itself by running `dmesg` shortly after connecting the drive. The device name (similar to `/dev/sdc`) and the partition name (similar to `/dev/sdc1`) both appear in several lines towards the end of the output.
4. Use the partition name to ensure that the file system type of the USB flash drive is vfat.
   ```
   # blkid partition
   ```
   You should now see a message similar to:
   ```
   LABEL="LIVE" UUID="6676-27D3" TYPE="vfat"
   ```
   If TYPE is anything other than vfat (for example, TYPE="iso9660"), clear the first blocks of the USB flash drive:
   ```
   # dd if=/dev/zero of=partition bs=1M count=100
   ```
5. Use the `dd` command to transfer the boot ISO image to the USB device:
   ```
   # dd if=path/image_name.iso of=devicename
   ```
   where `path/image_name.iso` is the boot ISO image file that you downloaded and `device` is the device name for the USB flash drive. Ensure you specify the device name, not the partition name. For example:
   ```
   # dd if=/Download/Fedora-18-x86_64-DVD.iso of=/dev/sdc
   ```

3.3. Making Minimal Boot Media

A piece of minimal boot media is a CD, DVD, or USB flash drive that contains the software to boot the system and launch the installation program, but which does not contain the software that must be transferred to the system to create a Fedora installation.
Use minimal boot media:

- to boot the system to install Fedora over a network
- to boot the system to install Fedora from a hard drive
- to use a kickstart file during installation (refer to Section 15.8.1, “Creating Kickstart Boot Media”)
- to commence a network or hard-drive installation or to use an anaconda update or a kickstart file with a DVD installation.

You can use minimal boot media to start the installation process on 32-bit x86 systems, AMD64 or Intel 64 systems, and POWER systems. The process by which you create minimal boot media for systems of these various types is identical except in the case of AMD64 and Intel 64 systems with UEFI firmware interfaces — refer to Section 3.3.1, “UEFI-based systems”.

To make minimal boot media for 32-bit x86 systems, BIOS-based AMD64 or Intel 64 systems, and POWER systems:

1. Download the ISO image file named boot.iso that is available at the same location as the images of the Fedora 18 installation DVD — refer to Chapter 2, Obtaining Fedora.
2. Burn boot.iso to a blank CD or DVD using the same procedure detailed in Section 3.1, “Making an installation DVD” for the installation disc, or transfer the boot.iso file to a USB device with the dd command as detailed in Section 3.2, “Preparing a USB flash drive as an installation source”. As the boot.iso file is only around 200 MB in size, you do not need an especially large USB flash drive.

### 3.3.1. UEFI-based systems

The Fedora Project does not provide an image to produce minimal boot CDs or DVDs for UEFI-based systems. Use a USB flash drive (as described in this section) to boot the Fedora 18 installer. The full DVD installation image should function as expected.

Use the efidisk.img file in the images/ directory on the Fedora 18 installation DVD to produce a bootable USB flash drive for UEFI-based systems.

1. Download an ISO image file of the Fedora 18 installation DVD as described in Chapter 2, Obtaining Fedora.
2. Become root: `su -`
3. Create a mount point for the ISO image file: `# mkdir /mnt/dvdiso`
4. Mount the image file: `# mount DVD.iso /mnt/dvdiso -o loop`
   Where DVD.iso is the name of the ISO image file, for example Fedora18-x86_64-DVD.iso.
5. Transfer efidisk.img from the ISO image file to your USB flash drive:
For example:

```
# dd if=/mnt/dvdiso/images/efidisk.img of=/dev/sdc
```

6. Unmount the ISO image file:

```
# umount /mnt/dvdiso
```
Part I. Installation and Booting

This part of the Fedora Installation Guide details the installation process itself, from various methods of booting the installer up to the point where the computer must restart to finalize the installation. This part of the manual also includes a chapter on troubleshooting problems with the installation process.
Planning for Installation on the x86 Architecture

4.1. Upgrade or Install?
For information to help you determine whether to perform an upgrade or an installation refer to Chapter 19, Upgrading Your Current System.

4.2. Is Your Hardware Compatible?
Hardware compatibility is particularly important if you have an older system or a system that you built yourself. Fedora 18 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 in the Release Notes for Fedora 18, available at http://docs.fedoraproject.org/release-notes.

4.3. RAID and Other Disk Devices

Important — Systems with Intel BIOS RAID sets
Fedora 18 uses mdraid instead of dmraid for installation onto Intel BIOS RAID sets. These sets are detected automatically, and devices with Intel ISW metadata are recognized as mdraid instead of dmraid. Note that the device node names of any such devices under mdraid are different from their device node names under dmraid. Therefore, special precautions are necessary when you migrate systems with Intel BIOS RAID sets.

Local modifications to /etc/fstab, /etc/crypttab or other configuration files which refer to devices by their device node names will not work in Fedora 18. Before migrating these files, you must therefore edit them to replace device node paths with device UUIDs instead. You can find the UUIDs of devices with the blkid command.

4.3.1. Hardware RAID
RAID, or Redundant Array of Independent Disks, allows a group, or array, of drives to act as a single device. Configure any RAID functions provided by the mainboard of your computer, or attached controller cards, before you begin the installation process. Each active RAID array appears as one drive within Fedora.

On systems with more than one hard drive you may configure Fedora to operate several of the drives as a Linux RAID array without requiring any additional hardware.
4.3.2. Software RAID
You can use the Fedora installation program to create Linux software RAID arrays, where RAID functions are controlled by the operating system rather than dedicated hardware. These functions are explained in detail in Section 9.13, “Creating a Custom Partition Layout”.

4.3.3. FireWire and USB Disks
Some FireWire and USB hard disks may not be recognized by the Fedora installation system. If configuration of these disks at installation time is not vital, disconnect them to avoid any confusion.

Post-installation Usage

You can connect and configure external FireWire and USB hard disks after installation. Most such devices are recognized by the kernel and available for use at that time.

4.4. Do You Have Enough Disk Space?

Nearly every modern-day operating system (OS) uses disk partitions, and Fedora is no exception. When you install Fedora, 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 A, An Introduction to Disk Partitions before proceeding.

The disk space used by Fedora 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 64 systems, at least two partitions (/ and swap) must be dedicated to Fedora.

Before you start the installation process, you must

• have enough unpartitioned disk space for the installation of Fedora, or
• have one or more partitions that may be deleted, thereby freeing up enough disk space to install Fedora.

To gain a better sense of how much space you really need, refer to the recommended partitioning sizes discussed in Section 9.13.5, “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 Fedora installation, refer to Appendix A, An Introduction to Disk Partitions.

4.5. Selecting an Installation Method

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

---

1 Unpartitioned disk space means that available disk space on the hard drives 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.
Choose a boot method

**DVD**
If you have a DVD drive and the Fedora DVD you can use this method. Refer to Section 8.1.1, “Installing from DVD”, for DVD installation instructions.

If you booted the installation from a piece of media other than the installation DVD, you can specify the DVD as the installation source with the `linux repo=cdrom:/device` boot option, or by selecting **Local CD/DVD** on the **Installation Method** menu (refer to Section 8.1, “Installation Method”).

**Live CD**
If you have a CD drive and the Fedora live CD you can use this method. The live CD desktop includes an icon labeled **Install to Hard Drive**. Refer to Section 8.1.1, “Installing from DVD” for CD installation instructions.

**Hard Drive**
If you have copied the Fedora ISO images to a local hard drive, you can use this method. You need a boot CD-ROM (use the `linux repo=hd:/device` boot option), or by selecting **Hard drive** on the **Installation Method** menu (refer to Section 8.1, “Installation Method”). Refer to Section 8.1.2, “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 Fedora, you can use this method. You need a boot CD-ROM (use the `linux repo=nfs:server:/path` boot option, or the **NFS directory** option on the **Installation Method** menu described in Section 8.1, “Installation Method”). Refer to Section 8.1.3, “Installing via NFS” for network installation instructions. Note that NFS installations may also be performed in GUI mode.

**URL**
If you are installing directly from an HTTP (Web) server or FTP server, use this method. You need a boot CD-ROM (use the `linux repo=ftp://user:password@host/path`, or `linux repo=http://host/path` boot option, or the **URL** option on the **Installation Method** menu described in Section 8.1, “Installation Method”). Refer to Section 8.1.4, “Installing via FTP or HTTP”, for FTP and HTTP installation instructions.

### 4.6. Choose a boot method

You can use several methods to boot Fedora.

Installing from a CD-ROM or DVD requires that you have a Fedora 18 CD-ROM or DVD, and you have a DVD/CD-ROM drive on a system that supports booting from it.

Your BIOS may need to be changed to allow booting from your DVD/CD-ROM drive. For more information about changing your BIOS, refer to Section 7.1.1, “Booting the Installation Program on x86, AMD64, and Intel 64 Systems”.

Other than booting from an installation CD or DVD, you can also boot the Fedora installation program from **minimal boot media** in the form of a bootable CD or USB flash drive. After you boot the system with a piece of minimal boot media, you complete the installation from a different installation source, such as a local hard drive or a location on a network. Refer to Section 3.3, “Making Minimal Boot Media” for instructions on making boot CDs and USB flash drives.
Finally, you can boot the installer over the network from a *preboot execution environment* (PXE) server. Refer to *Chapter 13, Setting Up an Installation Server*. Again, after you boot the system, you complete the installation from a different installation source, such as a local hard drive or a location on a network.
Preparing for Installation

5.1. Preparing for a Network Installation

Note

Make sure no installation DVD (or any other type of DVD or CD) is in your system's CD or DVD drive if you are performing a network-based installation. Having a DVD or CD in the drive might cause unexpected errors.

Ensure that you have boot media available on CD, DVD, or a USB storage device such as a flash drive.

The Fedora installation medium 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, network-accessible server. It must provide the complete contents of the installation DVD-ROM.

Note

The Fedora 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. We recommend 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 discs). To use this test, type the following command at the boot: prompt:

```
linux rd.live.check
```
Chapter 5. Preparing for Installation

Note

The public directory used to access the installation files over FTP, NFS, or HTTP is mapped to local storage on the network server. For example, the local directory `/var/www/inst/Fedora18` on the network server can be accessed as `http://network.server.com/inst/Fedora18`.

In the following examples, the directory on the installation staging server that will contain the installation files will be specified as `/location/of/disk/space`. The directory that will be made publicly available via FTP, NFS, or HTTP will be specified as `/publicly_available_directory`. For example, `/location/of/disk/space` may be a directory you create called `/var/ios`. `/publicly_available_directory` might be `/var/www/html/Fedora18`, for an HTTP install.

In the following, you will require an **ISO image**. An ISO image is a file containing an exact copy of the content of a DVD. To create an ISO image from a DVD use the following command:

```
  dd if=/dev/dvd of=/path_to_image/name_of_image.iso
```

where `dvd` is your DVD drive device, `name_of_image` is the name you give to the ISO image file, and `path_to_image` is the path to the location on your system where the resulting ISO image will be stored.

To copy the files from the installation DVD to a Linux instance, which acts as an installation staging server, continue with either Section 5.1.1, “Preparing for FTP and HTTP installation” or Section 5.1.2, “Preparing for an NFS installation”.

### 5.1.1. Preparing for FTP and HTTP installation

Extract the files from the ISO image of the installation DVD and place them in a directory that is shared over FTP or HTTP.

Next, make sure that the directory is shared via FTP or HTTP, and verify client access. Test to see whether the directory is accessible from the server itself, and then from another machine on the same subnet to which you will be installing.

### 5.1.2. Preparing for an NFS installation

For NFS installation it is not necessary to extract all the files from the ISO image. It is sufficient to make the ISO image available on the network server via NFS.

1. Transfer the ISO image to the NFS exported directory. On a Linux system, run:

   ```
   mv /path_to_image/name_of_image.iso /publicly_available_directory/
   ```

   where `path_to_image` is the path to the ISO image file, `name_of_image` is the name of the ISO image file, and `publicly_available_directory` is a directory that is available over NFS or that you intend to make available over NFS.
2. Use a SHA256 checksum program to verify that the ISO image that you copied is intact. Many SHA256 checksum programs are available for various operating systems. On a Linux system, run:

```
$ sha256sum name_of_image.iso
```

where `name_of_image` is the name of the ISO image file. The SHA256 checksum program displays a string of 64 characters called a hash. Compare this hash to the hash displayed for this particular image on the GPG Keys page on the Fedora Project site at http://fedoraproject.org/en/keys. The two hashes should be identical.

3. Ensure that an entry for the publicly available directory exists in the `/etc/exports` file on the network server so that the directory is available via NFS.

To export a directory read-only to a specific system, use:

```
/publicly_available_directory client.ip.address (ro)
```

To export a directory read-only to all systems, use:

```
/publicly_available_directory * (ro)
```

4. On the network server, start the NFS daemon (on a Fedora system, use `/sbin/service nfs start`). If NFS is already running, reload the configuration file (on a Fedora system use `/sbin/service nfs reload`).

5. Be sure to test the NFS share following the directions in the Fedora Deployment Guide. Refer to your NFS documentation for details on starting and stopping the NFS server.

**Note**

The Fedora 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. We recommend 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 discs). To use this test, type the following command at the boot: prompt:

```
linux rd.live.check
```

5.2. Preparing for a Hard Drive Installation
Chapter 5. Preparing for Installation

Note — Not all file systems supported

Hard drive installations only work from ext2, ext3, ext4, or FAT file systems. You cannot use a hard drive formatted for any other file system as an installation source for Fedora.

To check the file system of a hard drive partition on a Windows operating system, use the Disk Management tool. To check the file system of a hard drive partition on a Linux operating system, use the fdisk tool.

Cannot Install from LVM Partitions

You cannot use ISO files on partitions controlled by LVM (Logical Volume Management).

Use this option to install Fedora on systems without a DVD drive or network connection.

Hard drive installations use an ISO image of the installation DVD. An ISO image is a file that contains an exact copy of the content of a DVD.

With these files present on a hard drive, you can choose Hard drive as the installation source when you boot the installation program (refer to Section 8.1, “Installation Method”).

Ensure that you have boot media available on CD, DVD, or a USB storage device such as a flash drive.

To prepare a hard drive as an installation source, follow these steps:

1. Obtain an ISO image of the Fedora installation DVD (refer to Chapter 2, Obtaining Fedora). Alternatively, if you have the DVD on physical media, you can create an image of it with the following command on a Linux system:

   ```bash
   dd if=/dev/dvd of=/path_to_image/name_of_image.iso
   ```

   where dvd is your DVD drive device, name_of_image is the name you give to the give to the resulting ISO image file, and path_to_image is the path to the location on your system where the resulting ISO image will be stored.

2. Transfer the ISO image to the hard drive.

   The ISO image must be located on a hard drive that is either internal to the computer on which you will install Fedora, or on a hard drive that is attached to that computer by USB.

3. Use a SHA256 checksum program to verify that the ISO image that you copied is intact. Many SHA256 checksum programs are available for various operating systems. On a Linux system, run:

   ```bash
   $ sha256sum name_of_image.iso
   ```

   where name_of_image is the name of the ISO image file. The SHA256 checksum program displays a string of 64 characters called a hash. Compare this hash to the hash displayed for this
particular image on the GPG Keys page on the Fedora Project site at http://fedoraproject.org/en/keys. The two hashes should be identical.

**Note**

The Fedora 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. We recommend 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 discs). To use this test, type the following command at the boot: prompt:

```bash
linux rd.live.check
```
System Specifications List

The installation program automatically detects and installs your computer’s hardware. Although you should make sure that your hardware meets the minimum requirements to install Fedora (refer to Section 4.2, “Is Your Hardware Compatible?”) you do not usually need to supply the installation program with any specific details about your system.

However, when performing certain types of installation, some specific details might be useful or even essential.

• If you plan to use a customized partition layout, record:
  • The model numbers, sizes, types, and interfaces of the hard drives attached to the system. For example, Seagate ST3320613AS 320 GB on SATA0, Western Digital WD7500AAKS 750 GB on SATA1. This will allow you to identify specific hard drives during the partitioning process.

• If you are installing Fedora as an additional operating system on an existing system, record:
  • The mount points of the existing partitions on the system. For example, `/boot` on `sda1`, `/` on `sda2`, and `/home` on `sdb1`. This will allow you to identify specific partitions during the partitioning process.
  • Whether the hardware clock uses local time or UTC. In Linux systems, this information can be found in `/etc/adjtime`. Changing the hardware clock setting in Section 9.5, “Date and time” may cause unexpected behavior in Fedora.

• If you plan to install from an image on a local hard drive:
  • The hard drive and directory that holds the image.

• If you plan to install from a network location:
  • The make and model numbers of the network adapters on your system. For example, Netgear GA311. This will allow you to identify adapters when manually configuring the network.
  • IP, DHCP, and BOOTP addresses
  • Netmask
  • Gateway IP address
  • One or more name server IP addresses (DNS)

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

• If you plan to install from a network location:
  • The location of the image on an FTP server, HTTP (web) server, or NFS server – see Section 8.1.4, “Installing via FTP or HTTP” and Section 8.1.3, “Installing via NFS” for examples.

• If your computer is part of a domain:
  • You should verify that the domain name will be supplied by the DHCP server. If not, you will need to input the domain name manually during installation.
Booting the Installer

**Important — UEFI for 32-bit x86 systems**

Fedora 18 does not support UEFI booting for 32-bit x86 systems. Only BIOS booting is supported.

**Important — UEFI for AMD64 and Intel 64**

Note that the boot configurations of UEFI and BIOS differ significantly from each other. Therefore, the installed system must boot using the same firmware that was used during installation. You cannot install the operating system on a system that uses BIOS and then boot this installation on a system that uses UEFI.

Fedora 18 supports version 2.2 of the UEFI specification. Hardware that supports version 2.3 of the UEFI specification or later should boot and operate with Fedora 18, but the additional functionality defined by these later specifications will not be available. The UEFI specifications are available from [http://www.uefi.org/specs/agreement/](http://www.uefi.org/specs/agreement/)

To start the installation program from a Fedora DVD or from minimal boot media, follow this procedure:

1. Disconnect any external FireWire or USB disks that you do not need for installation. Refer to Section 4.3.3, "FireWire and USB Disks" for more information.
2. Power on your computer system.
3. Insert the media in your computer.
4. Power off your computer with the boot media still inside.
5. Power on your computer system.

You might need to press a specific key or combination of keys to boot from the media. On most computers, a message appears briefly on the screen very soon after you turn on the computer. Typically, it is worded something like **Press F10 to select boot device**, although the specific wording and the key that you must press varies widely from computer to computer. Consult the documentation for your computer or motherboard, or seek support from the hardware manufacturer or vendor. On Apple computers, the **C** key boots the system from the DVD drive. On older Apple hardware you might need to press **Cmd+Opt+Shift+Del** to boot from the DVD drive.

If your computer does not allow you to select a boot device as it starts up, you might need to configure your system's **Basic Input/Output System** (BIOS) to boot from the media.

To change your BIOS settings on an x86, AMD64, or Intel 64 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 DVD 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 DVD drive for bootable media; if it does not find bootable media on the DVD 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.

**Note — Aborting the Installation**

To abort the installation, either press Ctrl + Alt + Del or power off your computer with the power switch. You may abort the installation process without consequence at any time prior to selecting Write changes to disk on the Write partitioning to disk screen. Fedora makes no permanent changes to your computer until that point. Please be aware that stopping the installation after partitioning has begun can leave your computer unusable.

### 7.1. Starting the Installation Program

**Important — UEFI for 32-bit x86 systems**

Fedora 18 does not support UEFI booting for 32-bit x86 systems. Only BIOS booting is supported.

**Important — UEFI for AMD64 and Intel 64**

Note that the boot configurations of UEFI and BIOS differ significantly from each other. Therefore, the installed system must boot using the same firmware that was used during installation. You cannot install the operating system on a system that uses BIOS and then boot this installation on a system that uses UEFI.

Fedora 18 supports version 2.2 of the UEFI specification. Hardware that supports version 2.3 of the UEFI specification or later should boot and operate with Fedora 18, but the additional functionality defined by these later specifications will not be available. The UEFI specifications are available from [http://www.uefi.org/specs/agreement/](http://www.uefi.org/specs/agreement/)

To start, first make sure that you have all necessary resources for the installation. If you have already read through *Chapter 4, Planning for Installation on the x86 Architecture*, 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 Fedora DVD or any boot media that you have created.
7.1.1. Booting the Installation Program on x86, AMD64, and Intel 64 Systems

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

- **Fedora DVD** — Your machine supports a bootable DVD drive and you have the Fedora installation DVD.
- **Fedora live CD** — Your machine supports a bootable CD drive and you have a Fedora live CD.
- **Boot CD-ROM** — Your machine supports a bootable CD-ROM drive and you want to perform network or hard drive installation.
- **USB flash drive** — Your machine supports booting from a USB device.
- **PXE boot via network** — Your machine supports booting from the network. This is an advanced installation path. Refer to Chapter 13, Setting Up an Installation Server for additional information on this method.

To create a boot CD-ROM or to prepare your USB flash drive for booting or installation, refer to Section 3.3, “Making Minimal Boot Media”.

Insert the boot media and reboot the system.

You might need to press a specific key or combination of keys to boot from the media. On most computers, a message appears briefly on the screen very soon after you turn on the computer. Typically, it is worded something like **Press F10 to select boot device**, although the specific wording and the key that you must press varies widely from computer to computer. Consult the documentation for your computer or motherboard, or seek support from the hardware manufacturer or vendor. On Apple computers, the C key boots the system from the DVD drive. On older Apple hardware you might need to press **Cmd+Opt+Shift+Del** to boot from the DVD drive.

If your computer does not allow you to select a boot device as it starts up, you might need to configure your system’s **Basic Input/Output System** (BIOS) to boot from the media.

To change your BIOS settings on an x86, AMD64, or Intel 64 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 DVD 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 DVD drive for bootable media; if it does not find bootable media on the DVD 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, the graphical boot screen appears, which contains information on a variety of boot options. Installation program automatically begins if you take no action within the first minute. For a description of the options available on this screen, refer to Section 7.1.2, “The Boot Menu”.

Alternatively, press the **Esc** key to access the boot : prompt, at which you can enter additional boot options as described in Section 7.1.3, “Additional Boot Options”.

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7.1.2. The Boot Menu

The boot media displays a graphical boot menu with three options:

Install Fedora
Choose this option to install Fedora onto your computer system using the graphical installation program.

Test this media and install Fedora
This option is the default. Choose this option to first test the integrity of the installation media before installing Fedora onto your computer system using the graphical installation program.

Troubleshooting
This option leads to a menu with several additional boot options.

If no key is hit within 60 seconds, the default boot option runs. To choose the default, either wait for the timer to run out or hit Enter on the keyboard. To choose another option, use the arrow keys on your keyboard and hit Enter when Troubleshooting is highlighted. If you want to customize the boot options for a particular option, press the Tab key. To access the boot: prompt at which you can specify custom boot options, press the Esc key and refer to Section 7.1.3, “Additional Boot Options”.

Figure 7.1. The boot screen

For a listing and explanation of common boot options, refer to Chapter 11, Boot Options.

The boot options in the Troubleshooting menu are:

Install Fedora in basic graphics mode
This option allows you to install Fedora in graphical mode even if the installation program is unable to load the correct driver for your video card. If your screen appears distorted or goes blank when using the Install Fedora option, restart your computer and try this option instead.
Rescue a Fedora system
Choose this option to repair a problem with your installed Fedora system that prevents you from booting normally. Although Fedora is an exceptionally stable computing platform, it is still possible for occasional problems to occur that prevent booting. The rescue environment contains utility programs that allow you fix a wide variety of these problems.

Run a memory test
This option runs an exhaustive test on the memory on your system. For more information, refer to Section 11.6.1, "Loading the Memory (RAM) Testing Mode".

Boot from local drive
This option boots the system from the first installed disk. If you booted this disc accidentally, use this option to boot from the hard disk immediately without starting the installer.

7.1.3. Additional Boot Options

While it is easiest to boot using a DVD 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 Fedora.

To pass options to the boot loader on an x86, AMD64, or Intel 64 system, press the Esc key at boot time. The boot: prompt appears, at which you can use the boot loader options described below.

Refer to Chapter 8, Configuring Installation Source for boot options to specify your installation source, or to Chapter 11, Boot Options for additional boot options not covered in this section.

Note

Boot options are not available during live image installations.

- To perform a text mode installation, at the installation boot prompt, type:

  linux text

- ISO images have an SHA256 checksum embedded in them. To test the checksum integrity of an ISO image, at the installation boot prompt, type:

  linux rd.live.check

This checksum operation can be performed on any Fedora DVD. It is strongly recommended to perform this operation on any Fedora DVD that was created from downloaded ISO images. This command works with the DVD, hard drive ISO, and NFS ISO installation methods.

- If you need to perform the installation in serial mode, type the following command:

  linux console=<device>
Chapter 7. Booting the Installer

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
```

### 7.1.3.1. Kernel Options
Options can also be passed to the kernel. For example, to apply updates for the anaconda installation program from a USB storage device enter:

```
linux updates
```

For text mode installations, use:

```
linux text updates
```

This command results in a prompt for the path to the device that contains updates for `anaconda`. It is not needed if you are performing a network installation and have already placed the updates image contents in `/rhupdates/` on the server.

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 9.10.1, “x86, AMD64, and Intel 64 Boot Loader Installation” for more information).

For more information on kernel options refer to Chapter 11, Boot Options.

### 7.2. Booting from the Network using PXE
To boot with PXE, you need a properly configured server, and a network interface in your computer that supports PXE. For information on how to configure a PXE server, refer to Chapter 13, Setting Up an Installation Server.

Configure the computer to boot from the network interface. This option is in the BIOS, and may be labeled **Network Boot** or **Boot Services**. Once you properly configure PXE booting, the computer can boot the Fedora installation system without any other media.

To boot a computer from a PXE server:
Booting from the Network using PXE

1. Ensure that the network cable is attached. The link indicator light on the network socket should be lit, even if the computer is not switched on.

2. Switch on the computer.

3. A menu screen appears. Press the number key that corresponds to the desired option.

If your PC does not boot from the netboot server, ensure that the BIOS is configured to boot first from the correct network interface. Some BIOS systems specify the network interface as a possible boot device, but do not support the PXE standard. Refer to your hardware documentation for more information.

**Note — Multiple NICs and PXE installation**

Some servers with multiple network interfaces might not assign eth0 to the first network interface as the firmware interface knows it, which can cause the installer to try to use a different network interface from the one that was used by PXE. To change this behavior, use the following in `pxelinux.cfg/*` config files:

```
IPAPPEND 2
APPEND ksdevice=bootif
```

These configuration options above cause the installer to use the same network interface the firmware interface and PXE use. You can also use the following option:

```
ksdevice=link
```

This option causes the installer to use the first network device it finds that is linked to a network switch.
Configuring Installation Source

Before the graphical installation program starts, you may need to configure the installation source depending on the method you are using.

8.1. Installation Method

If you are installing from DVD, additional configuration will not be required unless the DVD drive is not detected. If you booted the installation from minimal boot media, use a boot prompt to select an installation method.

8.1.1. Installing from DVD

To install Fedora from a DVD, place the DVD in your DVD drive and boot your system from the DVD. Even if you booted from alternative media, you can still install Fedora from DVD media.

The installation program then probes your system and attempts to identify your DVD drive. It starts by looking for an IDE (also known as an ATAPI) DVD drive.

**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 Write changes to disk screen. Refer to Section 9.14, “Begin installation” for more information.

If your DVD drive is not detected, and it is a SCSI DVD, 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.

If you booted the installer from other media and wish to use a DVD as your installation source, use the following boot option:

```
linux repo=cdrom:device
```

If you later encounter problems with the installer, you should reboot and perform the media check by running the boot option `linux rd.live.check` before seeking support.

8.1.2. Installing from a Hard Drive

To specify a partition from which to install Fedora, use the `linux repo=` boot option:

```
linux repo=hd:device
```
Chapter 8. Configuring Installation Source

Select the partition containing the ISO files from the list of available partitions. Internal IDE, SATA, SCSI, and USB drive device names begin with /dev/sd. Each individual drive has its own letter, for example /dev/sda. Each partition on a drive is numbered, for example /dev/sda1.

Also specify the full directory path from the drive that contains the ISO image files. The following table shows some examples of how to enter this information:

<table>
<thead>
<tr>
<th>Partition type</th>
<th>Volume</th>
<th>Original path to files</th>
<th>Directory to use</th>
</tr>
</thead>
<tbody>
<tr>
<td>VFAT</td>
<td>D:\</td>
<td>D:\Downloads</td>
<td>Downloads/Fedora18</td>
</tr>
<tr>
<td>ext2, ext3, ext4</td>
<td>/home</td>
<td>/home/user1/Fedora18</td>
<td>user1/Fedora18</td>
</tr>
</tbody>
</table>

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/.

**Use a leading slash**

An entry without a leading slash may cause the installation to fail.

After entering the `linux repo=` boot command, proceed with Chapter 9, Using the Fedora installer.

### 8.1.3. Installing via NFS

To specify an installation source for Fedora accessible by NFS, use the `linux repo=` boot option. To specify an expanded tree of installation files, type:

```
linux repo=nfs:options:server:/path
```

To specify an ISO image file, type:

```
linux repo=nfsiso:options:server:/path
```

- **options** — specify any NFS mount options that you require. Refer to the man pages for `mount` and `nfs` for a comprehensive list of options.

- **server** — 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`.

- **path** — the path to the exported directory.
  - If the NFS server is exporting a mirror of the Fedora installation tree, enter the directory which contains the root of the installation tree.
  - If the NFS server is exporting the ISO image of the Fedora DVD, enter the directory which contains the ISO image.
If you followed the setup described in Section 5.1.2, “Preparing for an NFS installation”, the exported directory is the one that you specified as `publicly_available_directory`.

After entering the `linux repo=` command, proceed with Chapter 9, Using the Fedora installer.

### 8.1.4. Installing via FTP or HTTP

#### Important — you must specify the protocol

When you provide a URL to an installation source, you must explicitly specify `http://` or `ftp://` as the protocol.

To specify an installation source for Fedora that is available over the Internet, use the `linux repo=` boot option:

```
linux repo={ftp|http}://URL
```

For `URL`, enter the name or IP address of the FTP or HTTP site from which you are installing, and the name of the directory that contains the `/images` directory for your architecture. For example:

```
http://name.example.com/fedora/linux/releases/18/Fedora/x86_64/iso/
```

If your FTP or HTTP server requires user authentication, specify user and password as part of the URL as follows:

```
{ftp|http}://<user>:<password>@<hostname>[:<port>]/<directory>/
```

For example:

```
http://install:fedora18pw@name.example.com/fedora/linux/releases/18/Fedora/x86_64/iso/
```

After entering the `linux repo=` command, proceed with Chapter 9, Using the Fedora installer.
Chapter 9.

Using the Fedora installer
This chapter describes an installation using the graphical user interface of anaconda.

9.1. The Text Mode Installation Program User Interface

Important — Graphical installation recommended

We recommend that you install Fedora using the graphical interface. If you are installing Fedora on a system that lacks a graphical display, consider performing the installation over a VNC connection – see Chapter 14, Installing Through VNC. If anaconda detects that you are installing in text mode on a system where installation over a VNC connection might be possible, anaconda asks you to verify your decision to install in text mode even though your options during installation are limited.

If your system has a graphical display, but graphical installation fails, try booting with the xdriver=vesa option – refer to Chapter 11, Boot Options

Important — Graphical Interface on the Installed System

Installing in text mode does not prevent you from using a graphical interface on your system once it is installed.

Apart from the graphical installer, anaconda also includes a text-based installer.

If one of the following situations occurs, the installation program uses text mode:

• The installation system fails to identify the display hardware on your computer
• You choose the text mode installation by entering the following command at the boot: prompt

    linux text

While text mode installations are not explicitly documented, those using the text mode installation program can easily follow the GUI installation instructions. However, because text mode presents you with a simpler, more streamlined installation process, certain options that are available in graphical mode are not also available in text mode. These differences are noted in the description of the installation process in this guide, and include:

• configuring advanced storage methods such as LVM and RAID.
• customizing the partition layout
• customizing the bootloader layout
• selecting packages during installation
Chapter 9. Using the Fedora installer

- configuring the installed system with firstboot

If you choose to install Fedora in text mode, you can still configure your system to use a graphical interface after installation. Refer to Section 18.3, “Switching to a Graphical Login” for instructions.

To configure options not available in text mode, consider using a boot option. For example, the `linux ip` option can be used to configure network settings. Refer to Section 11.1, “Configuring the Installation System at the Boot Menu” for instructions. Alternatively, consider a kickstart installation. Refer to Section 15.4, “Kickstart Options” for available kickstart options.

**Note**

Not every language supported in graphical installation mode is also supported in text mode. Specifically, languages written with a character set other than the Latin or Cyrillic alphabets are not available in text mode. If you choose a language written with a character set that is not supported in text mode, the installation program will present you with the English versions of the screens.

### 9.1.1. 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 **Shift-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.

**Warning**

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).

### 9.2. 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.
9.2.1. Screenshots during installation

Anaconda allows you to take screenshots during the installation process. At any time during installation, press Shift+Print Screen and anaconda will save a screenshot to /root/anaconda-screenshots.

If you are performing a Kickstart installation, use the autostep --autoscreenshot option to generate a screenshot of each step of the installation automatically. Refer to Section 15.3, "Creating the Kickstart File" for details of configuring a Kickstart file.

9.2.2. A Note about Virtual Consoles

The Fedora 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 Fedora. Messages displayed on the installation or system consoles can help pinpoint a problem. Refer to Table 9.1, "Console, Keystrokes, and Contents" 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 #6) for graphical installations unless you are attempting to diagnose installation problems.

<table>
<thead>
<tr>
<th>console</th>
<th>keystrokes</th>
<th>contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ctrl+alt+f1</td>
<td>standard output</td>
</tr>
<tr>
<td>2</td>
<td>Ctrl+alt+f2</td>
<td>shell prompt</td>
</tr>
<tr>
<td>3</td>
<td>Ctrl+alt+f3</td>
<td>installation log</td>
</tr>
<tr>
<td>4</td>
<td>Ctrl+alt+f4</td>
<td>storage log</td>
</tr>
<tr>
<td>5</td>
<td>Ctrl+alt+f5</td>
<td>external program log</td>
</tr>
<tr>
<td>6</td>
<td>Ctrl+alt+f6</td>
<td>graphical display</td>
</tr>
</tbody>
</table>

9.3. Language Selection

At the Welcome to Fedora 18 screen, use your mouse to select the language (for example, English (United States)) you would prefer to use for the installation and as the system default.

Alternatively, type your preferred language into the search box (refer to the figure below).

To also set the keyboard layout to the default for your selected language, click the checkbox below the search box.

Once you have made your selection, click Continue.
Chapter 9. Using the Fedora installer

Figure 9.1. Language Configuration

9.4. The Installation Summary Menu

The Installation Summary Menu is the central screen for setting up an installation.
Instead of directing you through consecutive screens, the Fedora installer allows you to configure your installation in the order you choose.

Use your mouse to select a menu item to configure a section of the installation. When you have completed configuring a section, or if you would like to complete that section later, click **Done**.

Only sections marked with a warning symbol are mandatory. A note at the bottom of the screen warns you that these sections must be completed before the installation can begin. The remaining sections are optional. Beneath each section’s title, the current configuration is summarised. Using this you can determine whether you need to visit the section to configure it further.

Once all required sections are complete, click **Begin Installation** (refer to Section 9.14, “Begin installation”).

To cancel the installation, click **Quit**.

---

**Note**

When related background tasks are being run, certain menu items may be temporarily grayed out and unavailable.

9.5. Date and time
Select **Date and Time** from the Installation Summary Menu.

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

Specify a time zone even if you plan to use NTP (Network Time Protocol) to maintain the accuracy of the system clock.

There are two ways for you to select a city:

- Using your mouse, click on the interactive map to select a specific city. A red pin appears indicating your selection.
- You can also scroll through the **Region** and **City** drop-down menus at the top of the screen to select your time zone.

If your city is not available on the map or in the drop-down menu, select the nearest major city in the same timezone.

To set the date and time using NTP, leave the **Network Time** switch in the **ON** position and click the configuration icon to select which NTP servers Fedora should use. To set the date and time manually, move the switch to the **OFF** position. The system clock should use your time zone selection to display the correct date and time at the bottom of the screen. If they are still incorrect, adjust them manually.

Once you have made your selection, click **Done** to return to the Installation Summary Menu.
9.6. Keyboard Configuration

Select Keyboard from the Installation Summary Menu.

In the left-hand pane, English (United States) is listed as the keyboard layout, unless you clicked the checkbox in Section 9.3, “Language Selection” to set the keyboard layout to the default for your selected language. If so, you may still want to select a more specific layout. For example, if you selected French as the language for this installation, the layout listed in the left-hand pane will be French (French). However, you may want to change it to French (French (Canada)).

![Figure 9.4. Keyboard Configuration](image)

To change the layout or add additional layouts, click the + button and select from the list. To delete a layout, select it and click the - button. Use the arrow buttons to arrange the layouts in order of preference. For a visual preview of the keyboard layout, select it and click the keyboard button.

To test a layout, use the mouse to click inside the text box at the right. Type some text to confirm that your selection functions correctly.

To test additional layouts, you will need to set up a keyboard combination to toggle between them. Click Options to open the Layout Switching Options dialog and choose a combination from the list by selecting its check box. The combination will then be displayed above the Options button. This...
combination applies both during the installer and on the installed system, so you must configure a combination here in order to use one after installation.

<table>
<thead>
<tr>
<th>Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>If you use a layout that cannot accept Roman/ASCII characters, such as Russian, you are advised to also add the English (United States) layout and configure a keyboard combination to switch between the two layouts. If you select only your native layout or do not configure a layout switch combination, you may be unable to enter a valid root password or user credentials later in the installation process. This may prevent you from completing the installation.</td>
</tr>
</tbody>
</table>

Once you have made your selection, click **Done** to return to the Installation Summary Menu.

<table>
<thead>
<tr>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>To change your keyboard configuration after you have completed the installation, visit the <strong>Keyboard</strong> (in GNOME) or <strong>Input Devices</strong> (in KDE) section of the <strong>System Settings</strong> menu.</td>
</tr>
</tbody>
</table>

Fedora includes support for more than one keyboard layout for many languages. In particular, most European languages include a **latin1** option, which uses dead keys to access certain characters, such as those with diacritical marks. When you press a dead key, nothing will appear on your screen until you press another key to "complete" the character. For example, to type é on a latin1 keyboard layout, you would press (and release) the ' key, and then press the E key. By contrast, you access this character on some other keyboards by pressing and holding down a key (such as **Alt-Gr**) while you press the E key. Other keyboards might have a dedicated key for this character.

### 9.7. Installation Source

Select **Installation Source** from the Installation Summary Menu.

In this section you can specify the location you want to install Fedora from. Choose between locally available installation media (such as a DVD or an ISO file) or a network location.
Select one of the following options:

**Auto-detected install media**

If you initiated the installation using locally available media, the installer will detect it and display it graphically under this option. Select the media to use it as the installation source, and click **Verify** to check that the file is suitable for installation.

**ISO file**

If installation media has not been detected automatically, this option will be available for you to specify a locally-stored ISO file. Select this option and browse to the file’s location on your system. Click **Verify** to check that the file is suitable for installation.

**On the network**

To specify a network location, select this option and choose from the following options in the drop-down menu:

- **Closest mirror**
- **http://**
- **https://**
- **ftp://**
- **nfs**

Using your selection as the start of the location URL, type the rest into the address box. (If you selected **Closest mirror**, an address is not required.) If you choose NFS, the address box will be grayed out and another box will appear for you to specify any NFS mount options.

To configure a proxy, click **Proxy setup** unless you are installing via FTP and NFS (proxies are unavailable for these methods). Check **Enable HTTP proxy** and type the URL into the **Proxy URL** box. If your proxy requires authentication, check **Use Authentication** and enter a username and password. Click **Add**.
Once you have selected your installation source, click **Done** to return to the Installation Summary Menu.

### 9.8. Network Configuration

Select **Network Configuration** from the Installation Summary Menu.

Detected network connections will be listed in the left-hand pane. To read more details about a connection, select it with your mouse and they will appear to the right. To activate or deactivate a network connection, move the switch in the top-right of the screen to either **ON** or **OFF**.

![Network Configuration](image)

**Figure 9.6. Network configuration**

Enter a host name for this computer in the **Hostname** box. The hostname can be either a **fully-qualified domain name** (FQDN) in the format `hostname.domainname` or a **short host name** in the format `hostname`. Many networks have a **Dynamic Host Configuration Protocol** (DHCP) service that automatically supplies connected systems with a domain name. To allow the DHCP service to assign the domain name to this machine, specify the short host name only.

![Valid Hostnames](image)

**Valid Hostnames**

You may give your system any name provided that the full hostname is unique. The hostname may include letters, numbers and hyphens. Various programs provided by the Fedora distribution may prefer or require a FQDN as opposed to a short host name.
If your Fedora system is connected directly to the Internet, you must pay attention to additional considerations to avoid service interruptions or risk action by your upstream service provider. A full discussion of these issues is beyond the scope of this document.

### Modem Configuration

The installation program does not configure modems. Configure these devices after installation with the **Network** utility. The settings for your modem are specific to your particular Internet Service Provider (ISP).

### 9.8.1. Edit Network Connections

#### Note

You can also use **Network Manager** to change your network configuration after you have completed the installation.

To configure the selected network connection manually, click the **Configure** button. A **Network Manager** dialog appears that allows you to configure the selected connection. The configuration options presented will depend on whether the connection is wired, wireless, mobile broadband, VPN, or DSL. A full description of all configurations possible with **NetworkManager** is beyond the scope of this guide. This section only details the most typical scenario of how to configure wired connections during installation. Configuration of other types of network is broadly similar, although the specific parameters that you must configure are necessarily different.

When you have finished editing network settings, click **Save** to save the new configuration. If you reconfigured a device that was already active during installation, you must restart the device in order to use the new configuration in the installer environment. Use the **ON/OFF** switch on the **Network Configuration** screen to restart the device.

#### Note

When configuring a wireless connection that you also intend to use during the installation, you will not be prompted for a password as you would on an installed system. You must specify a password in the **Wireless Security** tab in **NetworkManager**. Once you have saved the configuration, the installer will establish the wireless connection.

### 9.8.1.1. Options common to all types of connection

Certain configuration options are common to all connection types.

Specify a name for the connection in the **Connection name** name field.

Select **Connect automatically** to start the connection automatically when the system boots.
When NetworkManager runs on an installed system, the **Available to all users** option controls whether a network configuration is available system-wide or not. During installation, ensure that **Available to all users** remains selected for any network interface that you configure.

### 9.8.1.2. The Ethernet tab

Use the **Ethernet** tab to specify or change the *media access control* (MAC) address for the network adapter, and set the *maximum transmission unit* (MTU, in bytes) that can pass through the interface either manually or automatically.

![Editing Wired connection 1](image)

**Figure 9.7. The Ethernet tab**
9.8.1.3. The 802.1x Security tab

Use the 802.1x Security tab to configure 802.1X port-based network access control (PNAC). Select **Use 802.1X security for this connection** to enable access control, then specify details of your network. The configuration options include:

**Authentication**
Choose one of the following methods of authentication:

- **MD5** for the *MD5 Message-Digest Algorithm*
- **TLS** for *Transport Layer Security*
- **FAST** for *Flexible Authentication via Secure Tunneling*
- **Tunneled TLS** for *Tunneled Transport Layer Security*, otherwise known as TTLS, or EAP-TTLS
- **Protected EAP (PEAP)** for *Protected Extensible Authentication Protocol*

**Identity**
Provide the identity of this server.

**User certificate**
Browse to a personal X.509 certificate file encoded with *Distinguished Encoding Rules* (DER) or *Privacy Enhanced Mail* (PEM).

**CA certificate**
Browse to a X.509 *certificate authority* certificate file encoded with *Distinguished Encoding Rules* (DER) or *Privacy Enhanced Mail* (PEM).

**Private key**
Browse to a private key file encoded with *Distinguished Encoding Rules* (DER), *Privacy Enhanced Mail* (PEM), or the *Personal Information Exchange Syntax Standard* (PKCS#12).

**Private key password**
The password for the private key specified in the **Private key** field. Select **Show password** to make the password visible as you type it.
9.8.1.4. The IPv4 Settings tab

Use the **IPv4 Settings tab** to configure the IPv4 parameters for the previously selected network connection.

Use the **Method** drop-down menu to specify which settings the system should attempt to obtain from a *Dynamic Host Configuration Protocol (DHCP)* service running on the network. Choose from the following options:

**Automatic (DHCP)**
- IPv4 parameters are configured by the DHCP service on the network.

**Automatic (DHCP) addresses only**
- The IPv4 address, netmask, and gateway address are configured by the DHCP service on the network, but DNS servers and search domains must be configured manually.

**Manual**
- IPv4 parameters are configured manually for a static configuration.

**Link-Local Only**
- A *link-local* address in the 169.254/16 range is assigned to the interface.
Shared to other computers

The system is configured to provide network access to other computers. The interface is assigned an address in the 10.42.x.1/24 range, a DHCP server and DNS server are started, and the interface is connected to the default network connection on the system with network address translation (NAT).

Disabled

IPv4 is disabled for this connection.

If you selected a method that requires you to supply manual parameters, enter details of the IP address for this interface, the netmask, and the gateway in the Addresses field. Use the Add and Delete buttons to add or remove addresses. Enter a comma-separated list of DNS servers in the DNS servers field, and a comma-separated list of domains in the Search domains field for any domains that you want to include in name server lookups.

Optionally, enter a name for this network connection in the DHCP client ID field. This name must be unique on the subnet. When you assign a meaningful DHCP client ID to a connection, it is easy to identify this connection when troubleshooting network problems.

Deselect the Require IPv4 addressing for this connection to complete check box to allow the system to make this connection on an IPv6-enabled network if IPv4 configuration fails but IPv6 configuration succeeds.
9.8.1.4.1. Editing IPv4 routes

Fedora configures a number of routes automatically based on the IP addresses of a device. To edit additional routes, click the Routes button. The Editing IPv4 routes dialog appears.
Click Add to add the IP address, netmask, gateway address, and metric for a new static route.

Select Ignore automatically obtained routes to make the interface use only the routes specified for it here.

Select Use this connection only for resources on its network to restrict connections only to the local network. Unlike additional routes added in this dialog, this setting will be transferred to the installed system and applies to the entire connection. It can be selected even if no additional routes have been configured.

### 9.8.1.5. The IPv6 Settings tab

Use the IPv6 Settings tab to configure the IPv6 parameters for the previously selected network connection.

Use the Method drop-down menu to specify which settings the system should attempt to obtain from a Dynamic Host Configuration Protocol (DHCP) service running on the network. Choose from the following options:

**Ignore**

IPV6 is ignored for this connection.

**Automatic**

NetworkManager uses router advertisement (RA) to create an automatic, stateless configuration.

**Automatic, addresses only**

NetworkManager uses RA to create an automatic, stateless configuration, but DNS servers and search domains are ignored and must be configured manually.

**Automatic, DHCP only**

NetworkManager does not use RA, but requests information from DHCPv6 directly to create a stateful configuration.
Manual
IPv6 parameters are configured manually for a static configuration.

Link-Local Only
A link-local address with the fe80::/10 prefix is assigned to the interface.

If you selected a method that requires you to supply manual parameters, enter details of the IP address for this interface, the netmask, and the gateway in the Addresses field. Use the Add and Delete buttons to add or remove addresses. Enter a comma-separated list of DNS servers in the DNS servers field, and a comma-separated list of domains in the Search domains field for any domains that you want to include in name server lookups.

Optionally, enter a name for this network connection in the DHCP client ID field. This name must be unique on the subnet. When you assign a meaningful DHCP client ID to a connection, it is easy to identify this connection when troubleshooting network problems.

Deselect the Require IPv6 addressing for this connection to complete check box to allow the system to make this connection on an IPv4-enabled network if IPv6 configuration fails but IPv4 configuration succeeds.

Figure 9.11. The IPv6 Settings tab
9.8.1.5.1. Editing IPv6 routes
Fedora configures a number of routes automatically based on the IP addresses of a device. To edit additional routes, click the Routes button. The Editing IPv6 routes dialog appears.

![Editing IPv6 routes for Wired connection 1](image)

**Figure 9.12. The Editing IPv6 Routes dialog**

Click **Add** to add the IP address, netmask, gateway address, and metric for a new static route.

Select **Use this connection only for resources on its network** to restrict connections only to the local network.

9.9. Software Selection

**Installing in text mode**

If you install Fedora in text mode, you cannot make package selections. The installer automatically selects packages only from the base and core groups. These packages are sufficient to ensure that the system is operational at the end of the installation process, ready to install updates and new packages. To change the package selection, complete the installation, then use the Add/Remove Software application to make desired changes.
To specify which packages Fedora will install, select **Software Selection** from the Installation Summary Menu.

By default, Fedora installs the GNOME Desktop Environment, but in **Software Selection** you can choose from a range of other environments and customise additional packages to be installed as add-ons. Available environments are listed in the left-hand pane. To select an environment, click the radio button that corresponds to one of the following options:

**Graphical Desktops (multiple options, one radio button each)**

Fedora offers a variety of graphical desktop environments, which can be enhanced with add-ons such as the **LibreOffice** productivity suite, graphical tools such as the **GIMP**, and multimedia applications. The available environments are:

- GNOME Desktop
- KDE Plasma Workspaces
- Xfce Desktop
- LXDE Desktop
- Cinnamon Desktop
- MATE Desktop
- Sugar Desktop Environment

**Figure 9.13. Software Selection**
Development and Creative Workstation
This option provides the necessary tools to compile software and develop graphics and other content on your Fedora system.

Web Server
This option provides the Apache web server.

Infrastructure Server
This option provides a server for operating network infrastructure services.

Basic X Window System
This option provides the X Window System without a full graphical desktop environment.

Minimal Install
This option provides only the packages essential to run Fedora. A minimal installation provides the basis for a single-purpose server or desktop appliance and maximizes performance and security on such an installation.

Note
Only one desktop environment can be selected at install time. To install additional environments once Fedora is installed, use the Software tool or the `yum groupinstall` command.

Fedora will automatically install the base and mandatory packages for the environment you select, but you can select additional package groups, or add-ons, from the right-hand pane. The list of add-ons is refreshed when a new environment is selected. Add-ons range from common utilities such as Administrative Tools and LibreOffice to specialist tools such as Medical Applications and Robotics.

To specify add-ons for installation as part of the environment, select the check box next to each add-on.

Once you have selected an environment and any additional packages you may wish to install, click Done to return to the Installation Summary Menu.

The packages that you select are not permanent. After you boot your system, use the Add/Remove Software tool to either install new software or remove installed packages. To run this tool, from the main menu, select System → Administration → Add/Remove Software. The Fedora software management system downloads the latest packages from network servers, rather than using those on the installation discs.

### 9.9.1. Core Network Services

All Fedora installations include the following network services:

- centralized logging through syslog
- email through SMTP (Simple Mail Transfer Protocol)
- network file sharing through NFS (Network File System)
- remote access through SSH (Secure SHell)
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• resource advertising through mDNS (multicast DNS)

The default installation also provides:

• network file transfer through HTTP (HyperText Transfer Protocol)
• printing through CUPS (Common UNIX Printing System)
• remote desktop access through VNC (Virtual Network Computing)

Some automated processes on your Fedora system use the email service to send reports and messages to the system administrator. By default, the email, logging, and printing services do not accept connections from other systems. Fedora installs the NFS sharing, HTTP, and VNC components without enabling those services.

You may configure your Fedora system after installation to offer email, file sharing, logging, printing and remote desktop access services. The SSH service is enabled by default. You may use NFS to access files on other systems without enabling the NFS sharing service.

9.10. Storage and partitioning

Warning — Back up your data

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 storage devices. Mistakes do happen and can result in the loss of all your data.

Important — Installing in text mode

If you install Fedora in text mode, you can only use the default partitioning schemes described in this section. You cannot add or remove partitions or file systems beyond those that the installer automatically adds or removes. If you require a customized layout at installation time, you should perform a graphical installation over a VNC connection or a kickstart installation.

Furthermore, advanced options such as LVM, encrypted filesystems, and resizable filesystems are available only in graphical mode and kickstart.
Important — Booting from RAIDs

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 manually edit your /boot/ partition (refer to Section 9.13, “Creating a Custom Partition Layout”.

Select Installation Destination from the Installation Summary Menu to select and partition the disks Fedora will be installed on.

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 A, An Introduction to Disk Partitions for more information.

![Disk Partitioning Setup](image)

Figure 9.14. Disk Partitioning Setup

On this screen you can choose to create the default partition layout automatically, or choose to partition storage devices manually to create a custom layout.
If you do not feel comfortable with partitioning your system, choose automatic partitioning and let the installation program partition the storage devices for you.

Choose the disks to install Fedora on by clicking their graphical representations from the pane at the top of the screen. Each disk is marked with its label and size. Hold down Ctrl or Shift while clicking on the disks to select or unselect multiple disks.

To encrypt all partitions except the /boot partition, select Encrypt my data. I'll set a passphrase later. Refer to Appendix C, Disk Encryption for information on encryption.

Click Continue once you have made your selections.

The Installation Options dialog now appears, informing you if there is enough space on the selected drive to install Fedora.

If there is sufficient space to install Fedora, choose from the following paths:

- click Cancel & add more disks if you would like to add more storage space
- click Continue to allow Fedora to automatically configure the partitions for you and return to the Installation Summary Menu
- check the box labeled Let me customize the partitioning of the disks instead if you want to create and edit the partitions yourself, then click Continue to reach the Manual Partitioning section (refer to Section 9.13, “Creating a Custom Partition Layout”)
INSTALLATION OPTIONS

Your current Fedora software selection requires 3 GB of available space. The disks you've selected have the following amounts of free space:

You don’t have enough space available to install Fedora, but we can help you reclaim space by shrinking or removing existing partitions.

969.23 KB Free space available for use.
439 MB Free space unavailable but reclaimable from existing partitions.
15.36 GB Space in selected disks reclaimable by deleting existing partitions.

Figure 9.16. Installation Options dialog with option to reclaim space

If there is not enough space and there are existing filesystems on the selected disk, you will be informed how much space could be reclaimed by shrinking or deleting these filesystems. The potential space is presented in three categories:

- Free space available for use
- Free space unavailable but reclaimable from existing partitions
- Space in selected disks reclaimable by deleting existing partitions

Choose from the following paths to generate sufficient space to install Fedora:

- click **Cancel & add more disks** if you would like to add more storage space
- click **Modify software selection** to reduce the number of packages to be installed, which may free enough space for the installation to proceed (refer to Section 9.9, “Software Selection”)
- click **Reclaim space** to choose how to reassign space from other filesystems to this installation (refer to Section 9.12, “Reclaim disk space”)
- check the box labeled **I don’t need help; let me customize disk partitioning** to edit the existing filesystems manually and click **Reclaim space** to reach the Manual Partitioning section (refer to Section 9.13, “Creating a Custom Partition Layout”)

If you chose to encrypt your data, you will be prompted to create a passphrase when you click **Continue** or **Reclaim space** (refer to Section 9.11, “Encrypt Partitions”).

Optionally, click **Partition Scheme Configuration** in the Installation Options dialog to choose a partitioning scheme. This will apply to both automated and manually-generated partitions, although individual partitions can later be modified during the manual partitioning process. Choose from:

- **Standard Partition** (as described in Appendix A, An Introduction to Disk Partitions)
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• BTRFS (B-Tree File System, as described in Section 9.13.1.1, “File System Types”)

• LVM (Logical Volume Management, as described in Appendix D, Understanding LVM. This is the default scheme.)

**Important — chain loading**

To configure the Fedora boot loader to chain load from a different boot loader, you must specify the boot drive manually by selecting Full disk summary and options from the Installation Destination screen. Refer to Section 9.10.1, “x86, AMD64, and Intel 64 Boot Loader Installation” for instructions on specifying a boot drive.

**Important — Mixing multipath and non-multipath devices**

When you install Fedora on a system with multipath and non-multipath storage devices, the automatic partitioning layout in the installer might create volume groups that contain a mix of multipath and non-multipath devices. This defeats the purpose of multipath storage.

We advise that you select only multipath or only non-multipath devices on the Installation Destination screen. Alternatively, proceed to manual partitioning (refer to Section 9.13, “Creating a Custom Partition Layout”).

9.10.1. x86, AMD64, and Intel 64 Boot Loader Installation

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 Windows, by loading another boot loader). Note that Fedora 18 uses GRUB 2. GRUB Legacy is no longer actively developed.¹

If there are no other operating systems on your computer, or you are completely removing any other operating systems the installation program will install GRUB as your boot loader without any intervention.

You may have a boot loader installed on your system already. An operating system may install its own preferred boot loader, or you may have installed a third-party boot loader. If your boot loader does not recognize Linux partitions, you may not be able to boot Fedora. Use GRUB as your boot loader to boot Linux and most other operating systems. Follow the directions in this chapter to install GRUB.

Installing GRUB

If you install GRUB, it may overwrite your existing boot loader.

The installation program installs GRUB in the master boot record, or MBR, of the device for the root file system.

If you have other operating systems already installed, Fedora attempts to automatically detect and configure GRUB to boot them. You may manually configure any additional operating systems if GRUB does not detect them.

<table>
<thead>
<tr>
<th>Boot</th>
<th>Description</th>
<th>Capacity</th>
<th>Free</th>
<th>Id</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td>ATA QEMU HARD_DISK</td>
<td>15.36 GB</td>
<td>15.36 GB</td>
<td>QM00001</td>
</tr>
<tr>
<td></td>
<td>ATA QEMU HARD_DISK</td>
<td>8.19 GB</td>
<td>8.19 GB</td>
<td>QM00002</td>
</tr>
<tr>
<td></td>
<td>QEMU QEMU HARD_DISK</td>
<td>12.28 GB</td>
<td>12.28 GB</td>
<td>drive-scsi0-0-0</td>
</tr>
</tbody>
</table>

Figure 9.17. Summary of selected disks

To specify which device the bootloader should be installed on, select Full disk summary and options at the bottom of the Installation Destination screen. The Selected Disks dialog will appear. If you are partitioning the drive manually (refer to Section 9.13, “Creating a Custom Partition Layout”), this dialog can be reached by clicking Storage device/s selected on the Manual Partitioning screen.

In the boot column, a green tick will mark one of the devices as the intended boot device. To change the boot device, select a device from the list and click Set as Boot Device to install the boot loader there instead.

To decline installation of a new boot loader, select the ticked device and click Do not install bootloader. This will remove the tick and ensure GRUB is not installed on any device.
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**Warning**

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!

**Note**

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

**9.10.1.1. Alternative Boot Loaders**

GRUB is the default bootloader for Fedora, but is not the only choice. A variety of open-source and proprietary alternatives to GRUB are available to load Fedora, including LILO, SYSLINUX, and Acronis Disk Director Suite.

**Important**

The Fedora Project does not support third-party boot loaders.

**9.11. Encrypt Partitions**

If you selected the **Encrypt my data** option, when you click to proceed to the next screen the installer will prompt you for a passphrase with which to encrypt the partitions on the system.

Partitions are encrypted using the **Linux Unified Key Setup** — refer to *Appendix C, Disk Encryption* for more information.
Reclaim disk space

DISK ENCRYPTION PASSPHRASE
You have chosen to encrypt some of your data. You will need to create a passphrase that you will use to access your data when you start your computer.

Passphrase: **************

Strong

Confirm: **************

Warning: Your current keyboard layout is English (US). If you change your keyboard layout, you may not be able to decrypt your disks after install.

Figure 9.18. Enter passphrase for encrypted partition

Choose a passphrase and type it into each of the two fields in the dialog box. If the passphrase is not strong enough, a warning symbol will appear and you will not be allowed to type in the second field. You must provide this passphrase every time that the system boots.

Warning — Do not lose this passphrase

If you lose this passphrase, any encrypted partitions and the data on them will become completely inaccessible. There is no way to recover a lost passphrase.

Note that if you perform a kickstart installation of Fedora, you can save encryption passphrases and create backup encryption passphrases during installation. Refer to Section C.3.2, “Saving Passphrases” and Section C.3.3, “Creating and Saving Backup Passphrases”.

9.12. Reclaim disk space

If there is insufficient space to install Fedora on the disks selected in Installation Destination (refer to Section 9.10, “Storage and partitioning”) and you selected Reclaim Space at the Installation Options dialog, you will be directed to the Reclaim Disk Space tool.
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RECLAIM DISK SPACE

You don’t have enough free space available for this installation.

You can remove existing filesystems you no longer need to free up space for this installation. Removing a filesystem will permanently delete all of the data it contains.

The existing filesystems Fedora has detected will be listed in a table as part of their respective disks. The **Reclaimable Space** column lists the space that could be reassigned to this installation. The **Action** column lists what action will be taken with the filesystem to reclaim space.

Beneath the table are two buttons:

- **Preserve**: leaves the filesystem intact and no data is deleted (this is the default action).
- **Delete**: removes the filesystem entirely. All the space it takes up on the disk will be made available for this installation.

Select a filesystem from the table with your mouse and click **Preserve** or **Delete**. The label in the **Action** column will change to match your selection and the amount of **Total selected space to reclaim** displayed beneath the table will increase or decrease in response. Beneath this value is the amount of space the installation requires based on the packages you have selected to install (refer to **Section 9.9, “Software Selection”**).

When enough space has been reclaimed for the installation to proceed, the **Reclaim Space** button will become available. Click this button to return to the Installation Summary Menu and proceed with the installation.

9.13. Creating a Custom Partition Layout
If you checked **Let me customize the partitioning of the disks instead** and clicked **Continue** in Section 9.10, “Storage and partitioning”, you will reach the **Manual Partitioning** screen.

By choosing to create a custom partitioning layout, you must now tell the installation program where to install Fedora. This is done by defining mount points for one or more disk partitions in which Fedora is installed. You may also need to create and/or delete partitions at this time.

If you have not yet planned how to set up your partitions, refer to Appendix A, An Introduction to Disk Partitions and Section 9.13.5, “Recommended Partitioning Scheme”. At a bare minimum, you need an appropriately-sized root partition, and usually a swap partition appropriate to the amount of RAM you have on the system.

The Fedora installer can handle the partitioning requirements for a typical installation.

The **Manual Partitioning** screen initially features a single pane on the left for partitions. This will either be empty except for information about creating mount points, or it will display existing partitions that the installer has detected. The total space and available space on the devices selected in Section 9.10, “Storage and partitioning” are displayed beneath this pane.

### 9.13.1. Adding and Configuring Partitions

Adding a partition is a two-step process. You first create the partition at a certain size and specify the mount point. The partition will appear in the left pane. Next, you customize it using the options in the right pane, where you can choose a name, device type, file system type, label, and whether to encrypt or reformat the partition. This differs from previous partitioning methods where the partition was created and customized in the same step.

If you have no existing partitions and want the system to create the required partitions and their mount points for you, use your mouse to click the link in the left pane for creating mount points automatically. This will generate a `/boot` partition, a `/ (root)` partition, and a swap partition proportionate to the size of the device. These are the recommended partitions for a typical installation (refer to Section 9.13.5, “Recommended Partitioning Scheme”), but you can add additional partitions if you need to.
Alternatively, create individual partitions using the + button at the bottom of the pane. The **Add a New Mount Point** dialog will open. Enter a path for the mount point (for example, enter `/` for the root partition, `/boot` for the boot partition, and so on) and the desired size of the partition in megabytes or gigabytes (for example, type "2GB" to create a 2 gigabyte partition). After entering these details, click **Add a mount point**. This action creates the partition.

To change which devices a non-LVM mount point should be located on, click the configuration button at the bottom of the pane to open the **Configure Mount Point** dialog. Select one or more devices and click **Select**.

At the bottom of the screen, a link will state how many storage devices were selected in **Installation Destination** (refer to *Section 9.10, “Storage and partitioning”*). This link opens the **Selected Devices** dialog, where you can specify which device the bootloader should be installed on. Refer to *Section 9.10.1, “x86, AMD64, and Intel 64 Boot Loader Installation”* for more information.

To customize a partition, select it in the left-hand pane and the following customizable features will appear to the right (click **Customize** to reveal them all):

- **Name**: Assign a name to the partition. Certain partitions will be named automatically when they are created and their name is unavailable for editing, such as `/home` being assigned the name `sda1`. Others can be named arbitrarily.

- **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. For a swap partition the mount point should not be set — setting the filesystem type to `swap` is sufficient.

- **Label**: Assign a label to the partition.
• **Desired capacity**: Enter the desired size (in megabytes) of the partition.

• **Device Type**: Choose between Standard Partition, LVM, and BTRFS. If two or more disks were selected for partitioning, RAID will also be available. For more information on these options, refer to Section 9.13.1.1, “File System Types”. Check the adjacent Encrypt box to encrypt the partition. You will be prompted to generate a password later.

• **File System**: Using the pull-down menu, select the appropriate file system type for this partition. For more information on file system types, refer to Section 9.13.1.1, “File System Types”. Check the adjacent Reformat box to format an existing partition, or leave it unchecked to retain your data.

Click **Apply Changes** to save your changes and select another partition to customize.

When all partitions have been created and customized, click **Finish Partitioning** to return to the Installation Summary Menu. If you chose to encrypt any partitions, you will now be prompted to create a passphrase (refer to Section 9.11, “Encrypt Partitions”). To partition any other devices, select them in Installation Destination, return to the Manual Partitioning screen, and follow the same process outlined in this section.

### 9.13.1.1. File System Types

Fedora allows you to create different partition types and file systems. The following is a brief description of the different partition types and file systems available, and how they can be used.

**Partition types**

• **standard partition** — A standard partition can contain a file system or swap space, or it can provide a container for software RAID or an LVM physical volume.

• **logical volume (LVM)** — Creating an LVM partition automatically generates an LVM logical volume. LVM can improve performance when using physical disks. To create a logical volume, refer to Section 9.13.3, “Create LVM Logical Volume”. For more information regarding LVM, refer to the Fedora Deployment Guide.

• **software RAID** — Creating two or more software RAID partitions allows you to create a RAID device. One RAID partition is assigned to each disk on the system. To create a RAID device, refer to Section 9.13.2, “Create Software RAID”. For more information regarding RAID, refer to the chapter RAID (Redundant Array of Independent Disks) in the Fedora Deployment Guide.

• **Btrfs** — Btrfs is under development as a file system with several device-like features, so is presented in the installer as a type of partition. It is capable of addressing and managing more files, larger files, and larger volumes than the ext2, ext3, and ext4 file systems. To create a Btrfs volume and read more information, refer to Section 9.13.4, “Create a Btrfs subvolume”.

**File systems**

• **ext4** — The ext4 file system is based on the ext3 file system and features a number of improvements. These include support for larger file systems and larger files, faster and more efficient allocation of disk space, no limit on the number of subdirectories within a directory, faster file system checking, and more robust journaling. The ext4 file system is selected by default and is highly recommended.

---

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

- **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.

- **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 *Fedora Deployment Guide* for additional information.

- **BIOS Boot** — A small partition requiring for booting a device with a GPT/GUID partition table.

- **xfs** — XFS is a highly scalable, high-performance file system that supports filesystems up to 16 exabytes (approximately 16 million terabytes), files up to 8 exabytes (approximately 8 million terabytes) and directory structures containing tens of millions of entries. XFS supports metadata journaling, which facilitates quicker crash recovery. The XFS file system can also be defragmented and resized while mounted and active.

- **vfat** — The VFAT file system is a Linux file system that is compatible with Microsoft Windows long filenames on the FAT file system.

### 9.13.2. Create Software RAID

*Redundant arrays of independent disks* (RAIDs) are constructed from multiple storage devices that are arranged to provide increased performance and — in some configurations — greater fault tolerance. Refer to the *Fedora Deployment Guide* for a description of different kinds of RAIDs.

In earlier versions of Fedora, RAID partitions and devices were created in separate steps. Now, the RAID device is created in one step and disks are added or removed as necessary. One RAID partition is allowed per disk for each device, so the number of disks available to the installer will determine which levels of RAID device are available to you.
Create Software RAID

Figure 9.21. Create a software RAID device

RAID configuration options will only be visible if you have selected two or more disks in Section 9.10, “Storage and partitioning”. At least two disks are required to create a RAID device.

To create a RAID device:

1. Create a partition as described in Section 9.13.1, “Adding and Configuring Partitions”. Configuring this partition will configure the RAID device.

2. Click the Device Type dropdown menu and select RAID.

3. Click the File System dropdown menu and select your preferred file system type (refer to Section 9.13.1.1, “File System Types”.

4. A group of checkboxes will have appeared beneath the File System dropdown menu. Choose the RAID level of the device by checking the required boxes. The level will be displayed at the right when these boxes have been checked.

   Next to each checkbox, any disk space that will be gained or lost by selecting that option will be displayed in red. Certain boxes may be grayed out and labeled not enough disks if that RAID level cannot be achieved with the available disks.

   The checkboxes required for each RAID level are:

   **Optimized performance (stripe) = RAID0**

   Distributes data across multiple storage devices. Level 0 RAIDs offer increased performance over standard partitions, and can be used to pool the storage of multiple devices into one large virtual device. Note that Level 0 RAIDS offer no redundancy and that the failure of one device in the array destroys the entire array. RAID 0 requires at least two RAID partitions.
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Redundancy (mirror) = RAID1
Mirrors the data on one storage device onto one or more other storage devices. Additional devices in the array provide increasing levels of redundancy. RAID 1 requires at least two RAID partitions.

Error detection (parity) = RAID4
Distributes data across multiple storage devices, but uses one device in the array to store parity information that safeguards the array in case any device within the array fails. Because all parity information is stored on the one device, access to this device creates a bottleneck in the performance of the array. RAID 4 requires at least three RAID partitions.

Optimized performance (stripe) and Distributed = RAID5
Distributes data and parity information across multiple storage devices. Level 5 RAIDs therefore offer the performance advantages of distributing data across multiple devices, but do not share the performance bottleneck of level 4 RAIDs because the parity information is also distributed through the array. RAID 5 requires at least three RAID partitions.

Redundant = RAID6
Level 6 RAIDs are similar to level 5 RAIDs, but instead of storing only one set of parity data, they store two sets. RAID 6 requires at least four RAID partitions.

Redundancy (mirror) and Optimized performance (stripe) = RAID10
Level 10 RAIDs are nested RAID5s or hybrid RAID5s. Level 10 RAIDs are constructed by distributing data over mirrored sets of storage devices. For example, a level 10 RAID constructed from four RAID partitions consists of two pairs of partitions in which one partition mirrors the other. Data is then distributed across both pairs of storage devices, as in a level 0 RAID. RAID 10 requires at least four RAID partitions.

Important

If both Redundancy (mirror) and Optimized performance (stripe) are checked but only two disks are included in the RAID device (refer to step 4), the resulting device will have a RAID 1 rather than RAID 10 level of data security. A genuine RAID 10 device will only be created if four disks are included. If you still choose to create a level 10 RAID with only two disks, you can add additional disks and make other RAID modifications after installation using the mdadm utility.

5. Keeping the partition selected in the left-hand pane, select the configuration button below the pane to open the Configure Mount Point dialog. Select which disks will be included in the RAID device and click Select.

   If fewer disks are included than the specified RAID level needs, a yellow notification bar at the bottom of the screen will inform you that Device reconfiguration failed. Clicking this warning prompts a dialog informing you how many disks are required.

6. Click Apply Changes to save your changes, and either continue with another partition or click Finish Partitioning to return to the Installation Summary Menu.
9.13.3. Create LVM Logical Volume

**Important — LVM Unavailable in Text-Mode Installations**

LVM initial set up is not available during text-mode installation. If you need to create an LVM configuration from scratch, press \texttt{Alt+F2} to use a different virtual console, and run the \texttt{lvm} command. To return to the text-mode installation, press \texttt{Alt+F1}.

Logical Volume Management (LVM) presents a simple logical view of underlying physical storage space, such as hard drives or LUNs. Partitions on physical storage are represented as physical volumes that can be grouped together into volume groups. Each volume group can be divided into multiple logical volumes, each of which is analogous to a standard disk partition. Therefore, LVM logical volumes function as partitions that can span multiple physical disks.

To read more about LVM, refer to the Fedora Deployment Guide. Note, LVM is only available in the graphical installation program.

![Figure 9.22. Configure a logical volume](image)

To create a logical volume and add it to a new or existing volume group:

1. Create a partition as described in Section 9.13.1, “Adding and Configuring Partitions”. Configuring this partition will configure the logical volume.

2. Click the Device Type dropdown menu and select LVM.

3. An additional dropdown menu will appear: Volume Group. The menu will display a newly-created volume group name. Either click the menu and select Create a new volume group or click Modify to configure the newly-created volume group, if you need to. If you are happy to accept the volume group the installer has created, skip to step 5.
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4. Both Create a new volume group and Modify lead to the Configure Volume Group dialog, where you can rename the logical volume group and select which disks will be included. Click Save when the group is configured.

5. Click Apply Changes to save your changes, and either continue with another partition or click Finish Partitioning to return to the Installation Summary Menu.

### 9.13.4. Create a Btrfs subvolume

#### Btrfs is still experimental

Fedora 18 includes Btrfs as a technology preview to allow you to experiment with this file system. You should not choose Btrfs for partitions that will contain valuable data or that are essential for the operation of important systems.

Btrfs is a type of file system, but has several features characteristic of a storage device. It is designed to make the file system tolerant of errors, and to facilitate the detection and repair of errors when they occur. It uses checksums to ensure the validity of data and metadata, and maintains snapshots of the file system that can be used for backup or repair.

During manual partitioning, you will create Btrfs subvolumes rather than volumes. The installer then automatically creates a Btrfs volume to contain these subvolumes. The sizes reported for each Btrfs mount point in the left pane of the Manual Partitioning screen will be identical because they reflect the total size of the volume rather than each individual subvolume.

![Figure 9.23.Configure a Btrfs volume](image-url)

<table>
<thead>
<tr>
<th>Name:</th>
<th>home</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mount Point:</td>
<td>/home</td>
</tr>
<tr>
<td>Label:</td>
<td>Desired Capacity (MB): 4332</td>
</tr>
<tr>
<td>Device Type:</td>
<td>BTRFS</td>
</tr>
<tr>
<td>File System:</td>
<td>btrfs</td>
</tr>
</tbody>
</table>

- Redundancy (mirror) +8.56 GB
- Optimized performance (stripe) +0 B

Figure 9.23. Configure a Btrfs volume
To create a Btrfs subvolume:

1. Create a partition as described in Section 9.13.1, "Adding and Configuring Partitions". Configuring this partition will configure the Btrfs subvolume.

2. Click the **Device Type** dropdown menu and select **BTRFS**.

3. Two checkboxes will appear beneath the **File System** dropdown menu, which is grayed out for Btrfs. If you want to add a RAID level to the subvolume, choose one by checking the required boxes. If not, skip to step 5.

   Next to each checkbox, any disk space that will be gained or lost by selecting that option will be displayed in red. Certain boxes may be grayed out and labeled **not enough disks** if that RAID level cannot be achieved with the available disks.

   The checkboxes required for each RAID level are:

   **Optimized performance (stripe) = RAID0**
   
   Distributes data across multiple storage devices. Level 0 RAIDs offer increased performance over standard partitions, and can be used to pool the storage of multiple devices into one large virtual device. Note that Level 0 RAIDS offer no redundancy and that the failure of one device in the array destroys the entire array. RAID 0 requires at least two RAID partitions.

   **Redundancy (mirror) = RAID1**
   
   Mirrors the data on one storage device onto one or more other storage devices. Additional devices in the array provide increasing levels of redundancy. RAID 1 requires at least two RAID partitions.

   **Redundancy (mirror) and Optimized performance (stripe) = RAID10**
   
   Level 10 RAIDs are **nested RAIDs or hybrid RAIDs**. Level 10 RAIDs are constructed by distributing data over mirrored sets of storage devices. For example, a level 10 RAID constructed from four RAID partitions consists of two pairs of partitions in which one partition mirrors the other. Data is then distributed across both pairs of storage devices, as in a level 0 RAID. RAID 10 requires at least four RAID partitions.

   **Important**

   If both **Redundancy (mirror) and Optimized performance (stripe)** are checked but only two disks are included in the RAID device (refer to step 4), the resulting device will have a RAID 1 rather than RAID 10 level of data security. A genuine RAID 10 device will only be created if four disks are included. If you still choose to create a level 10 RAID with only two disks, you can add additional disks and make other RAID modifications after installation using the **mdadm** utility.

4. Keeping the partition selected in the left-hand pane, select the configuration button below the pane to open the **Configure Mount Point** dialog. Select which disks will be included as part of the RAID on the subvolume and click **Select**.

   If fewer disks are included than the specified RAID level needs, a yellow notification bar at the bottom of the screen will inform you that **Device reconfiguration failed**. Clicking this warning prompts a dialog informing you how many disks are required.
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5. Click **Apply Changes** to save your changes, and either continue with another partition or click **Finish Partitioning** to return to the Installation Summary Menu.

![Important]

Placing `/boot` on a Btrfs subvolume may lead to instability and is not recommended.

### 9.13.5. Recommended Partitioning Scheme

#### 9.13.5.1. x86, AMD64, and Intel 64 systems

*Unless you have a reason for doing otherwise, we recommend that you create the following partitions for x86, AMD64, and Intel 64 systems:*

- A swap partition
- A `/boot` partition
- A `/` partition
- A `/home` partition
- A **swap partition (at least 256 MB)**

Swap partitions support virtual memory: data is written to a swap partition when there is not enough RAM to store the data your system is processing.

In years past, the recommended amount of swap space increased linearly with the amount of RAM in the system. Modern systems often include hundreds of gigabytes of RAM, however. As a consequence, recommended swap space is considered a function of system memory workload, not system memory.

The following table provides the recommended size of a swap partition depending on the amount of RAM in your system and whether you want sufficient memory for your system to hibernate. The recommended swap partition size is established automatically during installation. To allow for hibernation, however, you will need to edit the swap space in the custom partitioning stage.

**Table 9.2. Recommended System Swap Space**

<table>
<thead>
<tr>
<th>Amount of RAM in the system</th>
<th>Recommended swap space</th>
<th>Recommended swap space if allowing for hibernation</th>
</tr>
</thead>
<tbody>
<tr>
<td># 2GB</td>
<td>2 times the amount of RAM</td>
<td>3 times the amount of RAM</td>
</tr>
<tr>
<td>&gt; 2GB – 8GB</td>
<td>Equal to the amount of RAM</td>
<td>2 times the amount of RAM</td>
</tr>
<tr>
<td>&gt; 8GB – 64GB</td>
<td>0.5 times the amount of RAM</td>
<td>1.5 times the amount of RAM</td>
</tr>
<tr>
<td>&gt; 64GB</td>
<td>4GB of swap space</td>
<td>No extra space needed</td>
</tr>
</tbody>
</table>

At the border between each range listed above (for example, a system with 2GB, 8GB, or 64GB of system RAM), discretion can be exercised with regard to chosen swap space and hibernation support. If your system resources allow for it, increasing the swap space may lead to better performance.
Note that distributing swap space over multiple storage devices — particularly on systems with fast drives, controllers and interfaces — also improves swap space performance.

• **A /boot/ partition (250 MB)**
The partition mounted on `/boot/` contains the operating system kernel (which allows your system to boot Fedora), along with files used during the bootstrap process. For most users, a 250 MB boot partition is sufficient.

```
Note
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.
```

```
Note
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 (3.0 GB - 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 3.0 GB 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.

```
Root and /root

The / (or root) partition is the top of the directory structure. The /root directory/root (sometimes pronounced “slash-root”) directory is the home directory of the user account for system administration.
```

• **A home partition (at least 100 MB)**
To store user data separately from system data, create a dedicated partition within a volume group for the `/home` directory. This will enable you to upgrade or reinstall Fedora without erasing user data files.

Many systems have more partitions than the minimum listed above. Choose partitions based on your particular system needs. Refer to Section 9.13.5.1.1, “Advice on Partitions” for more information.

If you create many partitions instead of one large / partition, upgrades become easier.
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The following table summarizes minimum partition sizes for the partitions containing the listed directories. You do not have to make a separate partition for each of these directories. For instance, if the partition containing /foo must be at least 500 MB, and you do not make a separate /foo partition, then the / (root) partition must be at least 500 MB.

Table 9.3. Minimum partition sizes

<table>
<thead>
<tr>
<th>Directory</th>
<th>Minimum size</th>
</tr>
</thead>
<tbody>
<tr>
<td>/</td>
<td>250 MB</td>
</tr>
<tr>
<td>/usr</td>
<td>250 MB, but avoid placing this on a separate partition</td>
</tr>
<tr>
<td>/tmp</td>
<td>50 MB</td>
</tr>
<tr>
<td>/var</td>
<td>384 MB</td>
</tr>
<tr>
<td>/home</td>
<td>100 MB</td>
</tr>
<tr>
<td>/boot</td>
<td>250 MB</td>
</tr>
</tbody>
</table>

Leave Excess Capacity Unallocated

Only assign storage capacity to those partitions you require immediately. You may allocate free space at any time, to meet needs as they occur. To learn about a more flexible method for storage management, refer to Appendix D, Understanding LVM.

If you are not sure how best to configure the partitions for your computer, accept the default partition layout.

9.13.5.1.1. Advice on Partitions

Optimal partition setup depends on the usage for the Linux system in question. The following tips may help you decide how to allocate your disk space.

- Consider encrypting any partitions that might contain sensitive data. Encryption prevents unauthorized people from accessing the data on the partitions, even if they have access to the physical storage device. In most cases, you should at least encrypt the /home partition.

- Each kernel installed on your system requires approximately 10 MB on the /boot partition. Unless you plan to install a great many kernels, the default partition size of 250 MB for /boot should suffice.

- The /var directory holds content for a number of applications, including the Apache web server. It also is used to store downloaded update packages on a temporary basis. Ensure that the partition containing the /var directory has enough space to download pending updates and hold your other content.
Warning

The PackageKit update software downloads updated packages to /var/cache/yum/ 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.

- The /usr directory holds the majority of software content on a Fedora system. For an installation of the default set of software, allocate at least 4 GB of space. If you are a software developer or plan to use your Fedora system to learn software development skills, you may want to at least double this allocation.

Do not place /usr on a separate file system

If /usr is on a separate file system from /, the boot process becomes much more complex because /usr contains boot-critical components. In some situations (like installations on iSCSI drives), the boot process might not work at all.

- Consider leaving a portion of the space in an LVM volume group unallocated. This unallocated space gives you flexibility if your space requirements change but you do not wish to remove data from other partitions to reallocate storage.

- If you separate subdirectories into partitions, you can retain content in those subdirectories if you decide to install a new version of Fedora over your current system. For instance, if you intend to run a MySQL database in /var/lib/mysql, make a separate partition for that directory in case you need to reinstall later.

- Certain platforms have specific partitioning requirements:
  - An EFI boot disk must have an EFI System Partition (ESP) between 50MB and 200MB.
  - Power Systems servers must have one of the following partitions: /boot/efi with an HFS+ file system, Apple Bootstrap, or a PPC PReP boot partition.

The following table is a possible partition setup for a system with a single, new 80 GB hard disk and 1 GB of RAM. Note that approximately 10 GB of the volume group is unallocated to allow for future growth.

Example Usage

This setup is not optimal for all use cases.
Example 9.1. Example partition setup

Table 9.4. Example partition setup

<table>
<thead>
<tr>
<th>Partition</th>
<th>Size and type</th>
</tr>
</thead>
<tbody>
<tr>
<td>/boot</td>
<td>250 MB ext3 partition</td>
</tr>
<tr>
<td>swap</td>
<td>2 GB swap</td>
</tr>
<tr>
<td>LVM physical volume</td>
<td>Remaining space, as one LVM volume group</td>
</tr>
</tbody>
</table>

The physical volume is assigned to the default volume group and divided into the following logical volumes:

Table 9.5. Example partition setup: LVM physical volume

<table>
<thead>
<tr>
<th>Partition</th>
<th>Size and type</th>
</tr>
</thead>
<tbody>
<tr>
<td>/</td>
<td>13 GB ext4</td>
</tr>
<tr>
<td>/var</td>
<td>4 GB ext4</td>
</tr>
<tr>
<td>/home</td>
<td>50 GB ext4</td>
</tr>
</tbody>
</table>


When all required sections of the Installation Summary Menu have been completed, the yellow admonition at the bottom of the menu screen will disappear and the **Begin Installation** button can be selected.

![Figure 9.24. Ready to install](image-url)
If you have finished customizing your installation and are certain that you want to proceed, click **Begin Installation**.

**Last chance to cancel safely**

Up to this point in the installation process, the installer has made no lasting changes to your computer. When you click **Begin Installation**, the installer will allocate space on your hard drive and start to transfer Fedora into this space. Depending on the partitioning option that you chose, this process might include erasing data that already exists on your computer.

To revise any of the choices that you made up to this point, return to the relevant section of the Installation Summary Menu. To cancel installation completely, click **Quit** or switch off your computer. To switch off most computers at this stage, press the power button and hold it **down** for a few seconds.

After you click **Begin Installation**, allow the installation process to complete. If the process is interrupted (for example, by you switching off or resetting the computer, or by a power outage) you will probably not be able to use your computer until you restart and complete the Fedora installation process, or install a different operating system.

**9.15. The Configuration Menu and Progress Screen**

Once you click **Begin Installation** on the Installation Summary Menu, you will be directed to the Configuration Menu and Progress Screen. Fedora reports the installation progress on the screen as it writes the selected packages to your system.
For your reference, a complete log of your installation can be found in /root/install.log once you reboot your system.

While the packages are being installed, more configuration is required. Above the installation progress bar is the **Root Password** menu item. The root password can be configured either while the packages are being installed or afterwards, but you will not be able to complete the installation process until it has been configured.

### 9.15.1. Set the Root Password

Setting up a root account and password is one of the most important steps during your installation. 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.
The installation program requires you to set a root password for your system. You cannot proceed to the installation itself 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.

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

Type the system-config-users command in a shell prompt to launch the User Manager, a powerful user management and configuration tool. If you are not root, it prompts you for the root password to continue.

---

Note

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.

Note

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

---

A root password is the administrative password for your Fedora 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.
Chapter 9. Using the Fedora installer

Click the **Root Password** menu item and enter your nominated password into the **Root Password** field. Fedora displays the characters as asterisks for security. Type the same password into the **Confirm** field to ensure it is set correctly. After you set the root password, click **Done** to return to the Configuration Menu and Progress Screen.

9.16. Installation Complete

Congratulations! Now that you have configured the remaining settings, your Fedora installation is now complete!

Click **Reboot** to reboot your system and begin using Fedora. Remember to remove any installation media if it is not ejected automatically upon reboot.

After your computer’s normal power-up sequence has completed, Fedora loads and starts. By default, the start process is hidden behind a graphical screen that displays a progress bar. 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 Fedora system in run level 5 (the graphical run level), the **FirstBoot** tool appears, which guides you through the Fedora configuration. Using this tool, you can set your system time and date, install software, configure your machine to receive software updates, and more. **FirstBoot** lets you configure your environment at the beginning, so that you can get started using your Fedora system quickly.
Troubleshooting Installation on an Intel or AMD System

This section discusses some common installation problems and their solutions.

For debugging purposes, `anaconda` logs installation actions into files in the `/tmp` directory. These files include:

- `/tmp/anaconda.log`: general `anaconda` messages
- `/tmp/program.log`: all external programs run by `anaconda`
- `/tmp/storage.log`: extensive storage module information
- `/tmp/yum.log`: `yum` package installation messages
- `/tmp/syslog`: hardware-related system messages

If the installation fails, the messages from these files are consolidated into `/tmp/anaconda-tb-identifier`, where `identifier` is a random string.

All of the files above reside in the installer's ramdisk and are thus volatile. To make a permanent copy, copy those files to another system on the network using `scp` on the installation image (not the other way round).

10.1. You are unable to boot Fedora

10.1.1. 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.
10.1.2. Is Your System Displaying Signal 11 Errors?

A signal 11 error, commonly known as a segmentation fault, means that the program accessed a memory location that was not assigned to it. A signal 11 error may be due to a bug in one of the software programs that is installed, or faulty hardware.

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. Like other operating systems, Fedora 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. 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, if your system supports this. You could also try to swap your memory around in the motherboard slots to check if the problem is either slot or memory related.

Another option is to perform a media check on your installation DVD. Anaconda, the installation program, has the ability to test the integrity of the installation media. It works with the DVD, hard drive ISO, and NFS ISO installation methods. The Fedora Project 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 DVDs). To use this test, type the following command at the boot: or yaboot: prompt:

```
linux rd.live.check
```

For more information concerning signal 11 errors, refer to:

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

10.2. Trouble Beginning the Installation

10.2.1. 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 use only a basic video driver during installation. You can do this either by selecting Install Fedora in basic graphics mode on the boot menu, or using the xdriver=vesa boot option at the boot prompt. Alternatively, you can force the installer to use a specific screen resolution with the resolution= boot option. This option may be most helpful for laptop users. Another solution to try is the driver= option to specify the driver that should be loaded for your video card. If this works, you should report it as a bug, because the installer failed to detect your video card automatically. Refer to Chapter 11, Boot Options for more information on boot options.
10.3. Trouble During the Installation

10.3.1. No devices found to install Fedora Error Message

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

10.3.2. Reporting traceback messages

If the installer encounters an error during the graphical installation process, it presents you with a crash reporting dialog box:

![An unknown error has occurred](image)

This program has encountered an unknown error. You may report the bug below or quit the program.

Select **Report Bug** to report the problem using Bugzilla, or **Quit** to exit the installation.

Optionally, click **More Info** to display detailed output that may help determine the cause of the error. If you are familiar with debugging, click **Debug**. This will take you to virtual terminal tty1, where you can request more precise information that will enhance the bug report. To return to the graphical interface from tty1, type **continue** and press **Enter**.
Chapter 10. Troubleshooting Installation on an Intel or AMD System

Figure 10.2. The expanded Crash Reporting Dialog Box

If you select Report Bug, follow this procedure:

1. To report the bug to the Fedora Project, you first need to provide your Bugzilla credentials. Click Configure Bugzilla.

Figure 10.3. Configure Bugzilla prompt
2. If you already have a Bugzilla account, enter your username and password. If not, you will need to create one at https://bugzilla.redhat.com. After entering your credentials, click OK.

![Configure Bugzilla](image)

Figure 10.4. Configure Bugzilla

3. In the text box, explain the situation that generated the traceback message. Describe how it can be reproduced by explaining each step. Provide as much relevant detail as possible, including any you acquired when debugging. Be aware that the information you provide here may become publicly visible on the Bugzilla website.

   However, if you do not know what caused the traceback message, check the box at the bottom of the dialog.

   Click **Forward**.
4. Review the information that will be sent to Bugzilla. The explanation you provided is in the comment tab. Other tabs include such information as your hostname and other details of the installation environment. You can remove any items you do not want sent to Bugzilla, but be aware that providing less detail may affect the investigation of the issue.

Click Forward once the information is ready to be sent.
5. Review the list of files that will be sent to Bugzilla and included in the bug report as individual attachments. These files provide pertinent system information that will assist the investigation. If you do not wish to send certain files, uncheck the box next to each one. To provide additional files that may help fix the problem, click **Attach a file**.

Once you have reviewed the files, check the box labeled **I have reviewed the data and agree with submitting it**. Click **Forward** to send them to Bugzilla to generate a bug report.

![Figure 10.7. Review the files to be sent](image)

6. When the dialog reports that processing has finished, click **Show log** to view details of the process or **Close** to return to the initial crash reporting dialog box.

### 10.3.3. Trouble with Partition Tables

If you receive an error after setting up your partitions (**Section 9.10, “Storage and partitioning”**) that says 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.
10.3.4. 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.

10.3.5. Other Partitioning Problems

If you create partitions manually, but cannot return to the Installation Summary Menu, you probably have not created all the partitions necessary for installation to proceed.

You must have the following partitions as a bare minimum:

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

Note

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

10.4. Problems After Installation

10.4.1. 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, temporarily alter the setting at boot time before changing it permanently.

At boot time, press Esc to reach the GRUB splash screen. Select the GRUB line, and type e.

Edit the kernel line to remove rhgb.

Press Enter to exit the editing mode.

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

If your problems with GRUB are now resolved and you want to make the change permanent, become the root user and edit the /etc/default/grub file.

Within the grub file, comment out the line which begins with GRUB_TERMINAL=console by inserting the # character at the beginning of the line.

Refresh the grub.cfg file by running the following command with root privileges so the changes will take effect:
10.4.2. Blocked by a GRUB command line after upgrading?

If you have restarted your machine after upgrading Fedora but cannot progress beyond the GRUB command line, you will need to issue commands to boot the operating system and then make the changes persistent once Fedora has loaded.

1. At the GRUB command line, display the superseded GRUB configuration file with the following command:

   ```
cat (hdpartitionnumber,drivenumber)/grub/grub.conf
   
   partitionnumber and drivenumber refer to the location of your Fedora /boot directory. If you do not know the location, boot the machine using a Fedora live CD to find out and then reboot to return to the GRUB command line. Refer to Section E.4.1, “Device Names” for help with partition numbering.
   
   2. In the GRUB configuration file, locate the first linux and initrd lines and paste them as individual commands. For example:

   ```
   linux /vmlinuz-3.3.0-1.fc17.x86_64 ro root=/dev/mapper/VolGroup-lv_root rd_LVM_LV=VolGroup/lv_root rd_LVM_LV=VolGroup/lv_swap rd_NO_LUKS rd_NO_MD rd_NO_DM
   LANG=en_US.UTF-8 SYSFONT=latarcyrheb-sun16 KEYTABLE=us rhgb quiet
   initrd /initramfs-3.3.0-1.fc17.x86_64.img
   ```

3. Run the boot command.

4. Once Fedora has loaded, refresh the GRUB configuration file to make the changes persistent:

   ```
grub2-mkconfig --output=/boot/grub2/grub.cfg
   ```

10.4.3. 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 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 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.

### 10.4.4. 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 Fedora installation media 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.

Refer to [Section 18.3, “Switching to a Graphical Login”](#) for more detail on installing a desktop environment.

### 10.4.5. Problems with the X Server Crashing and Non-Root Users

If you are having trouble with the X server crashing when anyone 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:
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.

### 10.4.6. Problems When You Try to Log In

If you did not create a user account in the `firstboot` screens, switch to a console by pressing `Ctrl+Alt+F2`, 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`.

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.

### 10.4.7. Is Your RAM Not Being Recognized?

Sometimes, the kernel does not recognize all of your memory (RAM). The following procedure will allow you to confirm this and then adjust the kernel if necessary.

1. Run the `cat /proc/meminfo` command and verify that the displayed quantity is the same as the known amount of RAM in your system. If they are not equal, you can first make a temporary change to confirm whether editing the kernel will be effective.

2. Reboot, and once you have loaded the GRUB boot screen, type `e` for edit.
3. 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.

4. At the end of the `kernel` line, add

   ```
   mem=xxM
   ```

   where `xx` equals the amount of RAM in your system, then press `Enter` to exit edit mode.

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

6. Run `cat /proc/meminfo` again. If the known amount of RAM in your system is now displayed, add the following line to the `/etc/grub.d/10_linux` file to make the change permanent:

   ```
   mem=xxM
   ```

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

7. To update the `grub.cfg` file so that the change will take effect, run the following command with root privileges.

   ```
   grub2-mkconfig --output=/boot/grub2/grub.cfg
   ```

   In 10_linux, the above example would look similar to the following:

   ```
   default=0
   timeout=30
   splashimage=(hd0,1)/grub/splash.xpm.gz
   menuentry 'Fedora Linux, with Linux 3.1.0-0.rc6.git0.3.fc16.x86_64' 
   set root=(hd0,1)
   linux /vmlinuz-(2.6.32.130.el6.i686 ro root=UUID=04a07c13-e6bf-6d5a-b207-002689545705
   mem=8192M
   initrd /initrd-(2.6.32.130.el6.i686.img
   ```

10.4.8. 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.

10.4.9. Apache HTTP Server or Sendmail stops responding during startup

If Apache HTTP Server (httpd) or Sendmail stops responding during startup, make sure the following line is in the `/etc/hosts` file:

```
127.0.0.1 localhost.localdomain localhost
```
Part II. Advanced installation options

This part of the *Fedora Installation Guide* covers more advanced or uncommon methods of installing Fedora, including:

- boot options.
- installing without media.
- installing through VNC.
- using *kickstart* to automate the installation process.
Chapter 11.

Boot Options

The Fedora installation system includes a range of functions and options for administrators. To use boot options, enter `linux option` at the `boot:` prompt.

To access the `boot:` prompt on a system that displays a graphical boot screen, press the `Esc` key while the graphical boot screen is displayed.

If you specify more than one option, separate each of the options by a single space. For example:

```
linux option1 option2 option3
```

**Note**

Boot options are not available during live image installations.

**Anaconda Boot Options**

The anaconda installer has many boot options, most are listed on the wiki [http://fedoraproject.org/wiki/Anaconda/Options](http://fedoraproject.org/wiki/Anaconda/Options).

**Kernel Boot Options**


**Rescue Mode**

The Fedora installation and rescue discs may either boot with rescue mode, or load the installation system. For more information on rescue discs and rescue mode, refer to Section 11.6.3, “Booting Your Computer with the Rescue Mode”.

11.1. Configuring the Installation System at the Boot Menu

You can use the boot menu to specify a number of settings for the installation system, including:

- language
- display resolution
Chapter 11. Boot Options

- interface type
- Installation method
- network settings

11.1.1. Specifying the Language
To set the language for both the installation process and the final system, specify the ISO code for that language with the `lang` option. Use the `keymap` option to configure the correct keyboard layout.

For example, the ISO codes `el_GR` and `gr` identify the Greek language and the Greek keyboard layout:

```
linux lang=el_GR keymap=gr
```

11.1.2. Configuring the Interface
To use a specific display resolution, enter `resolution=setting` as a boot option. For example, to set the display resolution to 1024×768, enter:

```
linux resolution=1024x768
```

To run the installation process in text mode, enter:

```
linux text
```

To enable support for a serial console, enter `serial` as an additional option.

Use `display=ip:0` to allow 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.

11.1.3. Updating anaconda
You can install Fedora with a newer version of the `anaconda` installation program than the one supplied on your installation media.

The boot option

```
linux updates
```

presents you with a prompt that asks you for a disk image containing `anaconda` updates. You do not need to specify this option if you are performing a network installation and have already placed the updates image contents in `/rhupdates` on the server.

To load the `anaconda` updates from a network location instead, use:
Specifying the Installation Method

followed by the URL for the location where the updates are stored.

11.1.4. Specifying the Installation Method

The `askmethod` and `asknetwork` options are deprecated. Use `repo=` to specify the installation method, and see Section 11.1.5, “Specifying the Network Settings” to configure network interfaces.

To specify the installation method from the `boot:` prompt, use the `repo` option. Refer to Table 11.1, “Installation methods” for the supported installation methods.

<table>
<thead>
<tr>
<th>Installation method</th>
<th>Option format</th>
</tr>
</thead>
<tbody>
<tr>
<td>DVD drive</td>
<td><code>repo=cdrom:device</code></td>
</tr>
<tr>
<td>Hard Drive</td>
<td><code>repo=hd:device/path</code></td>
</tr>
<tr>
<td>HTTP Server</td>
<td><code>repo=http://host/path</code></td>
</tr>
<tr>
<td>FTP Server</td>
<td><code>repo=ftp://username:password@host/path</code></td>
</tr>
<tr>
<td>NFS Server</td>
<td><code>repo=nfs:server:/path</code></td>
</tr>
<tr>
<td>ISO images on an NFS Server</td>
<td><code>repo=nfsiso:server:/path</code></td>
</tr>
</tbody>
</table>

11.1.5. Specifying the Network Settings

Normally, `anaconda` prompts you to configure a network interface if one is needed during installation. However, if your network cannot be configured automatically via DHCP and you need a network connection from the beginning of the installation, you can provide network settings with the `ip` option at the `boot:` prompt. Such a connection may be required if you need to access an `updates.img` or kickstart file over a network, for example.

The syntax of the `ip` boot option is:

```
linux ip=<ipaddress>[:<dnsserver>][:<gateway>]:<netmask>[:<hostname>]:<network-interface>:[off|on|dhcp6|auto6]
```

The final value enables you to set DHCP or automatic network configuration for the installed system, even if such configuration is unavailable or undesired at the start of the installation. The available options are:

- **off**
  - Specifies static network configuration.

- **on**
  - Specifies DHCP IPv4 configuration.
Chapter 11. Boot Options

dhcp6
   Specifies DHCP IPv6 configuration.

auto6
   Specifies automatic IPv6 configuration.

The following example configures static network settings for an installation system that uses the IP address 192.168.1.10 and hostname server1 for network interface eth0 where the gateway is 192.168.1.1 and the netmask is 255.255.255.0:

```
linux ip=192.168.1.10:192.168.1.1:255.255.255.0:server1:eth0:off
```

If you specify the network configuration and network device at the boot: prompt, these settings are used for the installation process and the Networking Devices and Configure TCP/IP dialogs do not appear.

11.2. Enabling Remote Access to the Installation System

You may access a graphical interface for the installation system from any other system. To remotely access the graphical display of an installation system, use client software that supports the VNC (Virtual Network Computing) display protocol.

### Installing a VNC Client on Fedora

Fedora includes the VNC client `vncviewer`. To obtain `vncviewer`, install the `tigervnc` package.

The installation system supports two methods of establishing a VNC connection. You may start the installation, and manually login to the graphical display with a VNC client on another system. Alternatively, you may configure the installation system to automatically connect to a VNC client on the network that is running in listening mode.

11.2.1. Enabling Remote Access with VNC

To enable remote graphical access to the installation system, enter two options at the prompt:

```
linux vnc vncpassword=qwerty
```

The `vnc` option enables the VNC service. The `vncpassword` option sets a password for remote access. The example shown above sets the password as `qwerty`.

### VNC Passwords

The VNC password must be at least six characters long.
Specify the language, keyboard layout and network settings for the installation system with the
screens that follow. You may then access the graphical interface through a VNC client. The installation
system displays the correct connection setting for the VNC client:

```
Starting VNC...
The VNC server is now running.
Please connect to computer.mydomain.com:1 to begin the install...
Starting graphical installation...
Press <enter> for a shell
```

You may then login to the installation system with a VNC client. To run the vncviewer client on
Fedora, choose Applications → Accessories → VNC Viewer, or type the command vncviewer in
a terminal window. Enter the server and display number in the VNC Server dialog. For the example
above, the VNC Server is computer.mydomain.com:1.

### 11.2.2. Connecting the Installation System to a VNC Listener

To have the installation system automatically connect to a VNC client, first start the client in listening
mode. On Fedora systems, use the -listen option to run vncviewer as a listener. In a terminal
window, enter the command:

```
vncviewer -listen
```

**Firewall Reconfiguration Required**

By default, vncviewer uses TCP port 5500 when in listening mode. To permit connections to this
port from other systems, choose System → Administration → Firewall. Select Other ports,
and Add. Enter 5500 in the Port(s) field, and specify tcp as the Protocol.

Once the listening client is active, start the installation system and set the VNC options at the boot:
prompt. In addition to vnc and vncpassword options, use the vncconnect option to specify the
name or IP address of the system that has the listening client. To specify the TCP port for the listener,
add a colon and the port number to the name of the system.

For example, to connect to a VNC client on the system desktop.mydomain.com on the port 5500,
enter the following at the boot: prompt:

```
linux vnc vncpassword=qwerty vncconnect=desktop.mydomain.com:5500
```

### 11.2.3. Enabling Remote Access with ssh

To enable remote access to a text mode installation to monitor and debug the installer, use the
sshd=1 option at the boot: prompt:

```
linux sshd=1
```
Chapter 11. Boot Options

You can then connect to the installation system with the **ssh** utility. The **ssh** command requires the name or IP address of the installation system, and a password if you specified one (for example, in a kickstart file).

### 11.3. Logging to a Remote System During the Installation

By default, the installation process sends log messages to the console as they are generated. You may specify that these messages go to a remote system that runs a **syslog** service.

To configure remote logging, add the **syslog** option. Specify the IP address of the logging system, and the UDP port number of the log service on that system. By default, syslog services that accept remote messages listen on UDP port 514.

For example, to connect to a syslog service on the system `192.168.1.20`, enter the following at the `boot:` prompt:

```
linux syslog=192.168.1.20:514
```

### 11.3.1. Configuring a Log Server

Fedora uses **rsyslog** to provide a syslog service. The default configuration of **rsyslog** rejects messages from remote systems.

**⚠️ Only Enable Remote Syslog Access on Secured Networks**

The **rsyslog** configuration detailed below does not make use of any of the security measures available in **rsyslog**. Crackers may slow or crash systems that permit access to the logging service, by sending large quantities of false log messages. In addition, hostile users may intercept or falsify messages sent to the logging service over the network.

To configure a Fedora system to accept log messages from other systems on the network, edit the file `/etc/rsyslog.conf`. You must use **root** privileges to edit the file `/etc/rsyslog.conf`. Uncomment the following lines by removing the hash preceding them:

```
$ModLoad imudp.so
$UDPServerRun 514
```

Restart the **rsyslog** service to apply the change:

```
su -c '/sbin/service rsyslog restart'
```

Enter the root password when prompted.
Automating the Installation with Kickstart

11.4. Automating the Installation with Kickstart

You can allow an installation to run unattended by using Kickstart. A Kickstart file specifies settings for an installation. Once the installation system boots, it can read a Kickstart file and carry out the installation process without any further input from a user.

Every Installation Produces a Kickstart File

The Fedora installation process automatically writes a Kickstart file that contains the settings for the installed system. This file is always saved as `/root/anaconda-ks.cfg`. You may use this file to repeat the installation with identical settings, or modify copies to specify settings for other systems.

Important — Kickstart installations and firstboot

Firstboot does not run after a system is installed from a Kickstart file unless a desktop and the X Window System were included in the installation and graphical login was enabled. Either specify a user with the `user` option in the Kickstart file before installing additional systems from it (refer to Section 15.4, “Kickstart Options” for details) or log into the installed system with a virtual console as root and add users with the `adduser` command.

Fedora includes a graphical application to create and modify Kickstart files by selecting the options that you require. Use the package `system-config-kickstart` to install this utility. To load the Fedora Kickstart editor, choose Applications → System Tools → Kickstart.

Kickstart files list installation settings in plain text, with one option per line. This format lets you modify your Kickstart files with any text editor, and write scripts or applications that generate custom Kickstart files for your systems.

To automate the installation process with a Kickstart file, use the `ks` option to specify the name and location of the file:

```
linux ks=location/kickstart-file.cfg
```

You may use Kickstart files that are held on either removable storage, a hard drive, or a network server. Refer to Table 11.2, “Kickstart sources” for the supported Kickstart sources.
Table 11.2. Kickstart sources

<table>
<thead>
<tr>
<th>Kickstart source</th>
<th>Option format</th>
</tr>
</thead>
<tbody>
<tr>
<td>DVD drive</td>
<td>ks=cdrom:/directory/ks.cfg</td>
</tr>
<tr>
<td>Hard Drive</td>
<td>ks=hd:/device/directory/ks.cfg</td>
</tr>
<tr>
<td>Other Device</td>
<td>ks=file:/device/directory/ks.cfg</td>
</tr>
<tr>
<td>HTTP Server</td>
<td>ks=<a href="http://server.mydomain.com/directory/ks.cfg">http://server.mydomain.com/directory/ks.cfg</a></td>
</tr>
<tr>
<td>FTP Server</td>
<td>ks=ftp://server.mydomain.com/directory/ks.cfg</td>
</tr>
<tr>
<td>NFS Server</td>
<td>ks=nfs:server.mydomain.com:/directory/ks.cfg</td>
</tr>
</tbody>
</table>

To obtain a Kickstart file from a script or application on a Web server, specify the URL of the application with the `ks=` option. If you add the option `kssendmac`, the request also sends HTTP headers to the Web application. Your application can use these headers to identify the computer. This line sends a request with headers to the application `http://server.mydomain.com/kickstart.cgi`:

```bash
linux ks=http://server.mydomain.com/kickstart.cgi kssendmac
```

### 11.5. Enhancing Hardware Support

By default, Fedora attempts to automatically detect and configure support for all of the components of your computer. Fedora supports the majority of hardware in common use with the software drivers that are included with the operating system. To support other devices you may supply additional drivers during the installation process, or at a later time.

#### 11.5.1. Overriding Automatic Hardware Detection

For some models of device automatic hardware configuration may fail, or cause instability. In these cases, you may need to disable automatic configuration for that type of device, and take additional steps to manually configure the device after the installation process is complete.

> ![Check the Release Notes](checkReleaseNotes.png)

Refer to the Release Notes for information on known issues with specific devices.

To override the automatic hardware detection, use one or more of the following options:

Table 11.3. Hardware Options

<table>
<thead>
<tr>
<th>Compatibility</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disable all hardware detection</td>
<td>noprobe</td>
</tr>
<tr>
<td>Disable graphics, keyboard, and mouse detection</td>
<td>headless</td>
</tr>
<tr>
<td>Disable passing keyboard and mouse information to stage 2 of the installation program</td>
<td>nopass</td>
</tr>
<tr>
<td>Use basic VESA driver for video</td>
<td>xdriver=vesa</td>
</tr>
<tr>
<td>Disable shell access on virtual console 2 during installation</td>
<td>noshell</td>
</tr>
<tr>
<td>Disable advanced configuration and power interface (ACPI)</td>
<td>acpi=off</td>
</tr>
</tbody>
</table>
Using the Maintenance Boot Modes

### Compatibility

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>disable machine check exception (MCE) CPU self-diagnosis.</td>
<td>nomce</td>
</tr>
<tr>
<td>disable non-uniform memory access on the AMD64 architecture</td>
<td>numa-off</td>
</tr>
<tr>
<td>force kernel to detect a specific amount of memory, where xxx is a</td>
<td>mem=xxxmb</td>
</tr>
<tr>
<td>value in megabytes</td>
<td></td>
</tr>
<tr>
<td>enable DMA only for IDE and SATA drives</td>
<td>libata.dma=1</td>
</tr>
<tr>
<td>disable BIOS-assisted RAID</td>
<td>nodmraid</td>
</tr>
<tr>
<td>disable Firewire device detection</td>
<td>nofirewire</td>
</tr>
<tr>
<td>disable parallel port detection</td>
<td>noparport</td>
</tr>
<tr>
<td>disable PC Card (PCMCIA) device detection</td>
<td>nopcmcia</td>
</tr>
<tr>
<td>disable all probing of network hardware</td>
<td>nonet</td>
</tr>
</tbody>
</table>

### Additional Screen

The **isa** option causes the system to display an additional text screen at the beginning of the installation process. Use this screen to configure the ISA devices on your computer.

### Important

Other kernel boot options have no particular meaning for **anaconda** and do not affect the installation process. However, if you use these options to boot the installation system, **anaconda** will preserve them in the bootloader configuration.

## 11.6. Using the Maintenance Boot Modes

### 11.6.1. Loading the Memory (RAM) Testing Mode

Faults in memory modules may cause your system to freeze or crash unpredictably. In some cases, memory faults may only cause errors with particular combinations of software. For this reason, you should test the memory of a computer before you install Fedora for the first time, even if it has previously run other operating systems.

Fedora includes the **Memtest86+** memory testing application. To boot your computer in memory testing mode, choose **Run a memory test** at the boot menu. The first test starts immediately. By default, **Memtest86+** carries out a total of ten tests.

In most cases, a single successful pass with **Memtest86+** is sufficient to verify that your RAM is in good condition. In some rare circumstances, however, errors that went undetected on the first pass might appear on subsequent passes. To perform a thorough test of the RAM on an important system, leave **Memtest86+** running overnight or for a few days.

To halt the tests and reboot your computer, enter Esc at any time.

11.6.2. Verifying boot media

You can test the integrity of an ISO-based installation source before using it to install Fedora. These sources include DVD, and ISO images stored on a hard drive or NFS server. Verifying that the ISO images are intact before you attempt an installation helps to avoid problems that are often encountered during installation.

Fedora offers you two ways to test installation ISOs:

• select OK at the prompt to test the media before installation when booting from the Fedora DVD

• boot Fedora with the rd.live.check option.

11.6.3. Booting Your Computer with the Rescue Mode

You may boot a command-line Linux system from either a rescue disc or an installation disc, without installing Fedora on the computer. This enables you to use the utilities and functions of a running Linux system to modify or repair systems that are already installed on your computer.

The rescue disc starts the rescue mode system by default. To load the rescue system with the installation disc, choose Rescue a Fedora system from the boot menu.

Specify the language, keyboard layout and network settings for the rescue system with the screens that follow. The final setup screen configures access to the existing system on your computer.

By default, rescue mode attaches an existing operating system to the rescue system under the directory /mnt/sysimage/.
Chapter 12.

Installing Without Media

This section discusses how to install Fedora on your system without making any additional physical media. Instead, you can use your existing GRUB boot loader to start the installation program.

12.1. Retrieving Boot Files

To perform an installation without media or a PXE server, your system must have two files stored locally, a kernel and an initial RAM disk.

Copy the vmlinuz and initrd.img files from a Fedora DVD (or DVD image) to the /boot/ directory, renaming them to vmlinuz-install and initrd.img-install. You must have root privileges to write files into the /boot/ directory.

12.2. Editing the GRUB Configuration

The GRUB boot loader uses the configuration files /etc/default/grub and the scripts in etc/grub.d/. To configure GRUB to boot from the new files, add a boot stanza to /etc/grub.d/40_custom that refers to them.

A minimal boot stanza looks like the following listing:

```plaintext
menuentry "Fedora Linux" {
    set root=(hd0,1)
    linux /vmlinuz-install
    initrd /initrd.img-install
}
```

You will also need to specify the location of the second stage installer image by adding an option to the end of the linux line of the boot stanza. For example:

```plaintext
linux /vmlinuz-install stage2=http://my.internal.server/17/x86_64/os/
```

If the second stage image and the package repositories you will be downloading from are on the same server, use the repo= option instead.

You may wish to add additional options to the end of the linux line, which will set preliminary options in Anaconda that the user normally sets interactively. For a list of available installer boot options, refer to Chapter 11, Boot Options.

The following options are generally useful for medialess installations:

- `ip=`
- `repo=`
Chapter 12. Installing Without Media

- `lang=`
- `keymap=`
- `ksdevice=` (if installation requires an interface other than eth0)
- `vnc` and `vncpassword=` for a remote installation

When you are finished, run the following command with root privileges to refresh the `grub.cfg` file:

```
grub2-mkconfig --output=/boot/grub2/grub.cfg
```

Next, open `grub.cfg` to view the updated configuration. Locate your new menu entry stanza and determine its place in the stanza order.

Finally, change the `GRUB_DEFAULT` option in `/etc/default/grub` to point to the new stanza you added. 0 will refer to the first stanza, 1 to the second, and so on. For example:

```
GRUB_DEFAULT=0
```

Alternatively, specify the menu entry title. This is particularly useful if you have a number of menu entries across the various script files.

```
GRUB_DEFAULT="Fedora Linux"
```

12.3. Booting to Installation

Reboot the system. GRUB boots the installation kernel and RAM disk, including any options you set. You may now refer to the appropriate chapter in this guide for the next step. If you chose to install remotely using VNC, refer to Section 11.2, “Enabling Remote Access to the Installation System” for assistance in connecting to the remote system.
Chapter 13.

Setting Up an Installation Server

Experience Required

This appendix is intended for users with previous Linux experience. If you are a new user, you may want to install using minimal boot media or the distribution DVD instead.

Warning

The instructions in this appendix configure an automated install server. The default configuration includes destruction of all existing data on all disks for hosts that install using this method. This is often different from other network install server configurations which may provide for an interactive installation experience.

Fedora allows for installation over a network using the NFS, FTP, or HTTP protocols. A network installation can be started from a boot CD-ROM, a bootable flash memory drive, or by using the `repo=` boot option with the Fedora DVD. Alternatively, if the system to be installed contains a network interface card (NIC) with Pre-Execution Environment (PXE) support, it can be configured to boot from files on another networked system rather than local media such as a DVD.

For a PXE network installation, the client's NIC with PXE support sends out a broadcast request for DHCP information. The DHCP server provides the client with an IP address, other network information such as name server, the IP address or hostname of the tftp server (which provides the files necessary to start the installation program), and the location of the files on the tftp server. This is possible because of PXELINUX, which is part of the syslinux package.

In the past, administrators needed to perform a great deal of manual configuration to produce an installation server. However, if you have a server running Fedora or a similar operating system on your local network, you can use cobbler to perform these tasks. To configure a PXE server manually, see Section 13.5, “Manually configure a PXE server”.

To perform the tasks in this section, switch to the root account with the command `su -`. As an alternative, you can run a command with the `-c` option, using the form `su -c 'command'`.

13.1. Setting Up cobbler

To install cobbler use the following command:

```
yum -y install cobbler
```

The cobbler command can check its own settings for validity and report the results. Run the following command to check the settings:

```
cobbler check
```

Verify SELinux is configured for cobbler:
setsebool -P httpd_can_network_connect_cobbler 1

Other SELinux booleans may apply, and can be listed with:

getsebool -a|grep cobbler

Change the settings in the /etc/cobbler/settings file to reflect the IP address information for the server. You must change at least the server and next_server options, although these options may point to the same IP address.

If you are not already running a DHCP server, you should also change the manage_dhcp option to 1. If you are running a DHCP server, configure it according to the instructions found in the syslinux package documentation. For more information, refer to your local files /usr/share/doc/syslinux-version/syslinux.doc and /usr/share/doc/syslinux-version/pxelinux.doc.

13.2. Setting Up the Distribution
To set up a distribution from a full Fedora DVD or ISO image, use this procedure.

1. If you are using a DVD disc or ISO image, Create a directory mount point:

    mkdir /mnt/dvd

    To mount a physical DVD disc, use the following command:

    mount -o context=system_u:object_r:httpd_sys_content_t:s0 /dev/dvd /mnt/dvd

    To mount a DVD ISO image, use the following command:

    mount -ro loop,context=system_u:object_r:httpd_sys_content_t:s0 /path/to/image.iso /mnt/dvd

    If SELinux enabled, use the default label

    If SELinux is enabled, use the default iso9660_t label instead of httpd_sys_content_t.

2. To support NFS installation, create a file /etc/exports and add the following line to it:

    /mnt/dvd *(ro,async)
Start the NFS server using the following commands:

```
/sbin/service rpcbind start /sbin/service nfs start
```

3. To support HTTP installation, use `yum` to install the Apache web server if it is not already installed:

```
yum -y install httpd
```

Make a link to the mounted disc in the Apache public content area:

```
ln -s /mnt/dvd /var/www/html/distro
```

### 13.3. Mirroring a Network Location

If you do not have discs or ISO images for a distribution, you can use `cobbler` to create an installation server. The `cobbler` command can fetch the distribution over the network as part of the import process.

Locate the distribution on the network. The location may be on the local network or reached at a remote site via FTP, HTTP, or rsync protocols.

### 13.4. Importing the Distribution

To offer a distribution through more than one installation method, perform additional `cobbler import` tasks using a different name for each method. For best results, use the installation method as part of the name, so it appears in the client's boot menu.

1. To import the DVD disc or ISO distribution into `cobbler`, run this command:

```
cobbler import --path=/mnt/dvd --name=distro_name
```

For `distro_name`, substitute a meaningful name for the distribution.

To import a local or remote network distribution into `cobbler`, run this command. Replace `network_URI` with the URI you found in Section 13.3, “Mirroring a Network Location”, and `distro_name` as above:

```
cobbler import --path=network_URI --name=distro_name
```

**Importing a Source**

When `cobbler` imports a distribution with the commands above, it copies all the files to the server's local storage, which may take some time.

If you do not want to make local copies of the distribution because clients can already reach its location, use the `--available-as` option.

```
cobbler import --path=/mnt/dvd --name=distro_name --available-as=network_URI
```
Chapter 13. Setting Up an Installation Server

For `network_URI`, substitute the appropriate network location of the distribution. This URI indicates how the server makes the distribution available to its clients. The examples above assume that your `cobbler` server reaches the mirror location at the same URI as the clients. If not, substitute an appropriate URI for the `--path` option. The following examples are URI locations that work if you have been following the procedures in this section, and your server's IP address is 192.168.1.1:

- `nfs://192.168.1.1:/mnt/dvd`
- `http://192.168.1.1:/distro`

If necessary, replace `192.168.1.1` with the IP address for your `cobbler` server.

2. Run the command `cobbler sync` to apply the changes. To check that your `cobbler` server is listening on the correct ports, use the `netstat -lp` command.

**Firewall Considerations**

Depending on your server's configuration, you may need to use the `system-config-securitylevel` command to permit access to some or all of these network services:

- 67 or bootps, for the DHCP/BOOTP server
- 69 or tftp, for providing the PXE loader
- 80 or http, if the `cobbler` server is to provide HTTP installation service
- 20 and 21 or ftp, if the `cobbler` server is to provide FTP installation service
- 111 or sunrpc, if the `cobbler` server is to provide NFS installation service

### 13.5. Manually configure a PXE server

The following steps must be performed to prepare for a PXE installation:

1. Configure the network (NFS, FTP, HTTP) server to export the installation tree.
2. Configure the files on the `tftp` server necessary for PXE booting.
3. Configure which hosts are allowed to boot from the PXE configuration.
4. Start the `tftp` service.
5. Configure DHCP.
6. Boot the client, and start the installation.

#### 13.5.1. Setting up the Network Server
First, configure an NFS, FTP, or HTTP server to export the entire installation tree for the version and variant of Fedora to be installed. Refer to Section 5.1, “Preparing for a Network Installation” for detailed instructions.

13.5.2. PXE Boot Configuration

The next step is to copy the files necessary to start the installation to the tftp server so they can be found when the client requests them. The tftp server is usually the same server as the network server exporting the installation tree.

BIOS and EFI configuration differs for this procedure.

13.5.2.1. Configuring for BIOS

1. If tftp-server is not yet installed, run yum install tftp-server.
2. In the tftp-server config file at /etc/xinet.d/tftp, change the disabled parameter from yes to no.
3. Configure your DHCP server to use the boot images packaged with SYSLINUX. (If you do not have a DHCP server installed, refer to the DHCP Servers chapter in the Fedora Deployment Guide.)

A sample configuration in /etc/dhcp/dhcpd.conf might look like:

```plaintext
option space pxelinux;
option pxelinux.magic code 208 = string;
option pxelinux.configfile code 209 = text;
option pxelinux.pathprefix code 210 = text;
option pxelinux.reboottime code 211 = unsigned integer 32;

subnet 10.0.0.0 netmask 255.255.255.0 {
    option routers 10.0.0.254;
    range 10.0.0.2 10.0.0.253;

    class "pxeclients" {
        match if substring (option vendor-class-identifier, 0, 9) = "PXEClient";
        next-server 10.0.0.1;

        if option arch = 00:06 {
            filename "pxelinux/bootia32.efi";
        } else if option arch = 00:07 {
            filename "pxelinux/bootx64.efi";
        } else {
            filename "pxelinux/pxelinux.0";
        }
    }
}

host example-ia32 {
    hardware ethernet XX:YY:ZZ:11:22:33;
    fixed-address 10.0.0.2;
}
```

4. You now need the pxelinux.0 file from the SYSLINUX package installed with Fedora. Create a pxelinux directory within tftpboot and copy pxelinux.0 into it:
Chapter 13. Setting Up an Installation Server

5. Create a **pxelinux.cfg** directory within **pxelinux**:

   ```
   mkdir /var/lib/tftpboot/pxelinux/pxelinux.cfg
   ```

6. Add a config file to this directory. The file should either be named **default** or named after the IP address. For example, if your machine's IP address is 10.0.0.1, the filename would be **0A000001**.

   A sample config file at **/var/lib/tftpboot/pxelinux/pxelinux.cfg/default** might look like:

   ```
   default vesamenu.c32
   prompt 1
   timeout 600
   display boot.msg

   label linux
   menu label ^Install or upgrade an existing system
   menu default
   kernel vmlinuz
   append initrd=initrd.img repo=http://dl.fedoraproject.org/pub/fedora/linux/releases/18/Fedora/x86_64/os/
   label vesa
   menu label Install system with ^basic video driver
   kernel vmlinuz
   append initrd=initrd.img xdriver=vesa nomodeset repo=http://dl.fedoraproject.org/pub/fedora/linux/releases/18/Fedora/x86_64/os/
   label rescue
   menu label ^Rescue installed system
   kernel vmlinuz
   append initrd=initrd.img rescue
   label local
   menu label Boot from ^local drive
   localboot 0xffff
   label memtest86
   menu label ^Memory test
   kernel memtest
   append -
   ```

   If both the stage 2 installer image and the package repositories you intend to download from are on the same server, use the **repo=** boot option. If they are on separate servers, use **stage2=** instead.

   For instructions on how to specify the installation source, refer to Chapter 8, Configuring Installation Source

7. Copy the splash image into your **tftp** root directory:

   ```
   cp /boot/grub/splash.xpm.gz /var/lib/tftpboot/pxelinux/splash.xpm.gz
   ```

8. Copy the boot images into your **tftp** root directory:
9. Reboot the system, and select the network device as your boot device when prompted.

### 13.5.2.2. Configuring for EFI

1. If `tftp-server` is not yet installed, run `yum install tftp-server`.

2. In the `tftp-server` config file at `/etc/xinet.d/tftp`, change the `disabled` parameter from `yes` to `no`.

3. Create a directory path within `tftpboot` for the EFI boot images, and then copy them from your boot directory:

   ```
   mkdir /var/lib/tftpboot/pxelinux
   mkdir /var/lib/tftpboot/pxelinux/bootx64.efi
   cp /boot/efi/EFI/redhat/grub.efi /var/lib/tftpboot/pxelinux/bootx64.efi
   ```

4. Configure your DHCP server to use the EFI boot images packaged with GRUB. (If you do not have a DHCP server installed, refer to the `DHCP Servers` chapter in the `Fedora Deployment Guide`.)

   A sample configuration in `/etc/dhcp/dhcpd.conf` might look like:

   ```
   option space PXE;
   option PXE.mtftp-ip code 1 = ip-address;
   option PXE.mtftp-cport code 2 = unsigned integer 16;
   option PXE.mtftp-sport code 3 = unsigned integer 16;
   option PXE.mtftp-tmout code 4 = unsigned integer 8;
   option PXE.mtftp-delay code 5 = unsigned integer 8;
   option arch code 93 = unsigned integer 16; # RFC4578
   subnet 10.0.0.0 netmask 255.255.255.0 {
     option routers 10.0.0.254;
     range 10.0.0.2 10.0.0.253;
     class "pxeclients" {
       match if substring (option vendor-class-identifier, 0, 9) = "PXEClient";
       next-server 10.0.0.1;
       if option arch = 00:06 {
         filename "pxelinux/bootia32.efi";
       } else if option arch = 00:07 {
         filename "pxelinux/bootx64.efi";
       } else {
         filename "pxelinux/pxelinux.0";
       }
     }
   }
   host example-ia32 {
     hardware ethernet XX:YY:ZZ:11:22:33;
     fixed-address 10.0.0.2;
   }
   ```
Chapter 13. Setting Up an Installation Server

Configuring a DHCP server for IPv6 differs slightly. Crucially, the `filename` option must be replaced with a `bootfile-url` string. Both identify the boot file that the PXE `tftp` process should download, but each is specific to the version of the IP protocol being used. `bootfile-url` specifies an IPv6 network location for the boot file.

A sample configuration in `/etc/dhcp/dhcep6.conf` might look like:

```
default-lease-time 2592000;
preferred-lifetime 604800;
option dhcp-renewal-time 3600;
option dhcp-rebinding-time 7200;
option dhcp6.name-servers 3ffe:501:ffff:100::200:ff:fe00:3f3e;
option dhcp6.domain-search "test.example.com","example.com";
option dhcp6.info-refresh-time 21600;
dhcpv6-lease-file-name "/var/lib/dhcpd/dhcpd6.leases";

subnet6 3ffe:501:ffff:100::/64 {
  range6 3ffe:501:ffff:100:10 3ffe:501:ffff:100::;
  range6 3ffe:501:ffff:100:: temporary;
  prefix6 3ffe:501:ffff:100:: 3ffe:501:ffff:111:: /64;
  option dhcp6.bootfile-url "tftp://[3ffe:501:ffff:100::1]/grubx64.efi";
  option dhcp6.name-servers 3ffe:501:ffff:100::1;
}
```

In a Secure Boot environment, the configuration file must specify that the `shim` utility be downloaded rather than the GRUB image. No other file can be downloaded via `tftp` in Secure Boot mode. `shim` is specified using the `filename` option in IPv4 configurations and the `bootfile-url` option in IPv6 configurations.

Once the `shim` utility is downloaded and validated, it will automatically download the GRUB image. This image must be named either `grub.elfi` or `grubx64.efi` and be available at the same location as `shim` and be accessible by `tftp`.

The `shim-signed` package is available in the Fedora yum repository. For more information on Secure Boot, refer to the `Fedora UEFI Secure Boot Guide`.

5. Create a `pxelinux.cfg` directory within `pxelinux`:

```
mkdir /var/lib/tftpboot/pxelinux/pxelinux.cfg
```

6. Add a config file to this directory. The file should either be named `efidefault` or named after the IP address. For example, if your machine's IP address is 10.0.0.1, the filename would be `0A000001`.

A sample config file at `/var/lib/tftpboot/pxelinux/pxelinux.cfg/efidefault` might look like:

```
default=0
timeout=1
splashimage=(nd)/splash.xpm.gz
hiddenmenu
title RHET
   root (nd)
   kernel /rawhide-x86_64/vmlinuz
```
Starting the \texttt{tftp} Server

<table>
<thead>
<tr>
<th>\texttt{initrd /rawhide-x86_64/initrd.img}</th>
</tr>
</thead>
</table>

For instructions on how to specify the installation source, refer to \textit{Chapter 8, Configuring Installation Source}

7. Copy the splash image into your \texttt{tftp} root directory:

\begin{verbatim}
    cp /boot/grub/splash.xpm.gz /var/lib/tftpboot/pxelinux/splash.xpm.gz
\end{verbatim}

8. Copy the boot images into your \texttt{tftp} root directory:

\begin{verbatim}
    cp /path/to/x86_64/os/images/pxeboot/{vmlinuz,initrd.img} /var/lib/tftpboot/pxelinux/rawhide-x86_64/
\end{verbatim}

9. Reboot the system, and select the network device as your boot device when prompted.

13.5.3. Starting the \texttt{tftp} Server

On the DHCP server, verify that the \texttt{tftp-server} package is installed with the command \texttt{rpm -q tftp-server}.

\texttt{tftp} is an xinetd-based service. Configure xinetd to process tftp requests by editing \texttt{/etc/xinetd.d/tftp} so that \texttt{disable = no}.

Start the \texttt{tftp} service with the following commands:

\begin{verbatim}
    systemctl start xinetd.service
    systemctl enable xinetd.service
\end{verbatim}

These commands configure the \texttt{tftp} and \texttt{xinetd} services to immediately turn on and also configure them to start at boot.

13.5.4. Adding a Custom Boot Message

Optionally, modify \texttt{/tftpboot/linux-install/msgs/boot.msg} to use a custom boot message.

13.5.5. Performing the PXE Installation

For instructions on how to configure the network interface card with PXE support to boot from the network, consult the documentation for the NIC. It varies slightly per card.

If your NIC does not support PXE booting, you can still PXE boot your system by using the \texttt{gPXE} bootloader. The Fedora Project does not distribute \texttt{gPXE} — refer to the Etherboot Project website at \url{http://etherboot.org/wiki/start} for more information.

After the system boots the installation program, refer to the \textit{Chapter 9, Using the Fedora installer}. 
Installing Through VNC

The Fedora installer (anaconda) offers you two interactive modes of operation. The original mode is a text-based interface. The newer mode uses GTK+ and runs in the X Window environment. This chapter explains how you can use the graphical installation mode in environments where the system lacks a proper display and input devices typically associated with a workstation. This scenario is typical of systems in datacenters, which are often installed in a rack environment and do not have a display, keyboard, or mouse. Additionally, a lot of these systems even lack the ability to connect a graphical display. Given that enterprise hardware rarely needs that ability at the physical system, this hardware configuration is acceptable.

Even in these environments, however, the graphical installer remains the recommended method of installation. The text mode environment lacks a lot of capabilities found in the graphical mode. Many users still feel that the text mode interface provides them with additional power or configuration ability not found in the graphical version. The opposite is true. Much less development effort is put in to the text-mode environment and specific things (for example, LVM configuration, partition layout, package selection, and bootloader configuration) are deliberately left out of the text mode environment. The reasons for this are:

- Less screen real estate for creating user interfaces similar to those found in the graphical mode.
- Difficult internationalization support.
- Desire to maintain a single interactive installation code path.

Anaconda therefore includes a Virtual Network Computing (VNC) mode that allows the graphical mode of the installer to run locally, but display on a system connected to the network. Installing in VNC mode provides you with the full range of installation options, even in situations where the system lacks a display or input devices.

14.1. VNC Viewer

Performing a VNC installation requires a VNC viewer running on your workstation or other terminal computer. Locations where you might want a VNC viewer installed:

- Your workstation
- Laptop on a datacenter crash cart

VNC is open source software licensed under the GNU General Public License.

- VNC clients are available in the repositories of most Linux distributions. Use your package manager to search for a client for your chosen distribution. For example, on Fedora, install the tigervnc package:

```
# yum install tigervnc
```

- TightVNC is available for Windows at http://www.tightvnc.com/

- MacOS X includes built-in VNC support as of version 10.5. In the Finder, click the Go menu and choose Connect to Server. In the server address field, you can type vnc://SERVER:DISPLAY, where SERVER is the IP address or DNS host name of the VNC server you wish to connect to and DISPLAY is the VNC display number (usually 1), and click Connect.

Once you have verified you have a VNC viewer available, it's time to start the installation.
14.2. VNC Modes in Anaconda

Anaconda offers two modes for VNC installation. The mode you select will depend on the network configuration in your environment.

14.2.1. Direct Mode

Direct mode VNC in anaconda is when the client initiates a connection to the VNC server running in anaconda. Anaconda will tell you when to initiate this connection in the VNC viewer. Direct mode can be activated by either of the following commands:

- Specify `vnc` as a boot argument.
- Specify the `vnc` command in the kickstart file used for installation.

When you activate VNC mode, anaconda will complete the first stage of the installer and then start VNC to run the graphical installer. The installer will display a message on the console in the following format:

```
Running anaconda VERSION, the PRODUCT system installer - please wait...
```

Anaconda will also tell you the IP address and display number to use in your VNC viewer. At this point, you need to start the VNC viewer and connect to the target system to continue the installation. The VNC viewer will present anaconda to you in graphical mode.

There are some disadvantages to direct mode, including:

- Requires visual access to the system console to see the IP address and port to connect the VNC viewer to.
- Requires interactive access to the system console to complete the first stage of the installer.

If either of these disadvantages would prevent you from using direct mode VNC in anaconda, then connect mode is probably more suited to your environment.

14.2.2. Connect Mode

Certain firewall configurations or instances where the target system is configured to obtain a dynamic IP address may cause trouble with the direct VNC mode in anaconda. In addition, if you lack a console on the target system to see the message that tells you the IP address to connect to, then you will not be able to continue the installation.

The VNC connect mode changes how VNC is started. Rather than anaconda starting up and waiting for you to connect, the VNC connect mode allows anaconda to automatically connect to your view. You won't need to know the IP address of the target system in this case.

To activate the VNC connect mode, pass the `vnc vncconnect` boot parameter:

```
boot: linux vnc vncconnect=HOST[:port]
```

Replace HOST with your VNC viewer’s IP address or DNS host name. Specifying the port is optional. Before starting the installation process on the target system, start up your VNC viewer and have it wait for an incoming connection.

Start the installation and when your VNC viewer displays the graphical installer, you are ready to go.
14.3. Installation Using VNC

Now that you have installed a VNC viewer application and selected a VNC mode for use in anaconda, you are ready to begin the installation.

14.3.1. Installation Example

The easiest way to perform an installation using VNC is to connect another computer directly to the network port on the target system. The laptop on a datacenter crash cart usually fills this role. If you are performing your installation this way, make sure you follow these steps:

1. Connect the laptop or other workstation to the target system using a crossover cable. If you are using regular patch cables, make sure you connect the two systems using a small hub or switch. Most recent Ethernet interfaces will automatically detect if they need to be crossover or not, so it may be possible to connect the two systems directly using a regular patch cable.

2. Configure the VNC viewer system to use a RFC 1918 address with no gateway. This private network connection will only be used for the purpose of installation. Configure the VNC viewer system to be 192.168.100.1/24. If that address is in use, just pick something else in the RFC 1918 address space that is available to you.

3. Start the installation on the target system.
   a. Booting the installation DVD.

      If booting the installation DVD, make sure vnc is passed as a boot parameter. To add the vnc parameter, you will need a console attached to the target system that allows you to interact with the boot process. Enter the following at the prompt:

      boot: linux vnc

   b. Boot over the network.

      If the target system is configured with a static IP address, add the vnc command to the kickstart file. If the target system is using DHCP, add vnc vncconnect=HOST[:port] to the boot arguments for the target system. HOST is the IP address or DNS host name of the VNC viewer system. Specifying the port is optional. Enter the following at the prompt:

      boot: linux vnc vncconnect=HOST[:port]

4. When prompted for the network configuration on the target system, assign it an available RFC 1918 address in the same network you used for the VNC viewer system. For example, 192.168.100.2/24.

   Note

   This IP address is only used during installation. You will have an opportunity to configure the final network settings, if any, later in the installer.
5. Once the installer indicates it is starting anaconda, you will be instructed to connect to the system using the VNC viewer. Connect to the viewer and follow the graphical installation mode instructions found in the product documentation.

### 14.3.2. Kickstart Considerations

If your target system will be booting over the network, VNC is still available. Just add the `vnc` command to the kickstart file for the system. You will be able to connect to the target system using your VNC viewer and monitor the installation progress. The address to use is the one the system is configured with via the kickstart file.

If you are using DHCP for the target system, the reverse `vnc vncconnect` method may work better for you. Rather than adding the `vnc` boot parameter to the kickstart file, add the `vnc vncconnect=HOST[:port]` parameter to the list of boot arguments for the target system. For HOST, put the IP address or DNS host name of the VNC viewer system. Specifying the port is optional. See the next section for more details on using the vnccommand mode.

### 14.3.3. Firewall Considerations

If you are performing the installation where the VNC viewer system is a workstation on a different subnet from the target system, you may run into network routing problems. VNC works fine so long as your viewer system has a route to the target system and ports 5900 and 5901 are open. If your environment has a firewall, make sure ports 5900 and 5901 are open between your workstation and the target system.

In addition to passing the `vnc` boot parameter, you may also want to pass the `vncpassword` parameter in these scenarios. While the password is sent in plain text over the network, it does provide an extra step before a viewer can connect to a system. Once the viewer connects to the target system over VNC, no other connections are permitted. These limitations are usually sufficient for installation purposes.

**Important**

Be sure to use a temporary password for the `vncpassword` option. It should not be a password you use on any systems, especially a real root password.

If you continue to have trouble, consider using the `vnc vncconnect` parameter. In this mode of operation, you start the viewer on your system first telling it to listen for an incoming connection. Pass `vnc vncconnect=HOST[:port]` at the boot prompt and the installer will attempt to connect to the specified HOST (either a hostname or IP address). Specifying the port is optional.

### 14.4. References

- Anaconda boot options: [http://fedoraproject.org/wiki/Anaconda/Options](http://fedoraproject.org/wiki/Anaconda/Options)
- Kickstart documentation: [http://fedoraproject.org/wiki/Anaconda/Kickstart](http://fedoraproject.org/wiki/Anaconda/Kickstart)
Kickstart Installations

15.1. What are Kickstart Installations?

Many system administrators would prefer to use an automated installation method to install Fedora on their machines. To answer this need, Red Hat created the kickstart installation method. Using kickstart, a system administrator can create a single file containing the answers to all the questions that would normally be asked during a typical installation.

Kickstart files can be kept on a single server system and read by individual computers during the installation. This installation method can support the use of a single kickstart file to install Fedora on multiple machines, making it ideal for network and system administrators.

Kickstart provides a way for users to automate a Fedora installation.

All kickstart scriptlets and the log files of their execution are stored in the /tmp directory to assist with debugging installation failures.

Note — /tmp/netinfo no longer used

Anaconda now configures network interfaces with NetworkManager. Consequently, kickstart users that referenced the network settings located in /tmp/netinfo in previous versions of Fedora must now source the ifcfg files in /etc/sysconfig/network-scripts.

15.2. How Do You Perform a Kickstart Installation?

Kickstart installations can be performed using a local DVD, a local hard drive, or via NFS, FTP, or HTTP.

To use kickstart, you must:

1. Create a kickstart file.
2. Create a boot media with the kickstart file or make the kickstart file available on the network.
3. Make the installation tree available.
4. Start the kickstart installation.

This chapter explains these steps in detail.

15.3. Creating the Kickstart File

The kickstart file is a simple text file, containing a list of items, each identified by a keyword. You can create it by using the Kickstart Configurator application, or writing it from scratch. The Fedora installation program also creates a sample kickstart file based on the options that you selected during installation. It is written to the file /root/anaconda-ks.cfg. You should be able to edit it with any text editor or word processor that can save files as ASCII text.

First, be aware of the following issues when you are creating your kickstart file:
Sections must be specified in order. Items within the sections do not have to be in a specific order unless otherwise specified. The section order is:

- Command section — Refer to Section 15.4, “Kickstart Options” for a list of kickstart options. You must include the required options.

- The `%packages` section — Refer to Section 15.5, “Package Selection” for details.

- The `%pre` and `%post` sections — These two sections can be in any order and are not required. Refer to Section 15.6, “Pre-installation Script” and Section 15.7, “Post-installation Script” for details.

- Items that are not required can be omitted.

- Omitting any required item results in the installation program prompting the user for an answer to the related item, just as the user would be prompted during a typical installation. Once the answer is given, the installation continues unattended (unless it finds another missing item).

- Lines starting with a pound (also known as hash) sign (`#`) are treated as comments and are ignored.

- For kickstart upgrades, the following items are required:
  - Language
  - Installation method
  - Device specification (if device is needed to perform the installation)
  - Keyboard setup
  - The `upgrade` keyword
  - Boot loader configuration

If any other items are specified for an upgrade, those items are ignored (note that this includes package selection).

### 15.4. Kickstart Options

The following options can be placed in a kickstart file. If you prefer to use a graphical interface for creating your kickstart file, use the Kickstart Configurator application. Refer to Chapter 16, Kickstart Configurator for details.

**Note**

If the option is followed by an equals mark (`=`), a value must be specified after it. In the example commands, options in brackets (`[]`) are optional arguments for the command.

**auth** or **authconfig** (required)

Sets up the authentication options for the system. It is similar to the `authconfig` command, which can be run after the install. By default, passwords are normally encrypted and are not shadowed.
• **--enablenis** — Turns on NIS support. By default, **--enablenis** uses whatever domain it finds on the network. A domain should almost always be set by hand with the **--nisdomain=** option.

• **--nisdomain=** — NIS domain name to use for NIS services.

• **--nisserver=** — Server to use for NIS services (broadcasts by default).

• **--useshadow** or **--enableshadow** — Use shadow passwords.

• **--enableldap** — Turns on LDAP support in `/etc/nsswitch.conf`, allowing your system to retrieve information about users (for example, their UIDs, home directories, and shells) from an LDAP directory. To use this option, you must install the **nss-pam-ldapd** package. You must also specify a server and a base DN (distinguished name) with **--ldapserver=** and **--ldapbasedn=**.

• **--enableldappath** — Use LDAP as an authentication method. This enables the **pam_ldap** module for authentication and changing passwords, using an LDAP directory. To use this option, you must have the **nss-pam-ldapd** package installed. You must also specify a server and a base DN with **--ldapserver=** and **--ldapbasedn=**. If your environment does not use TLS (Transport Layer Security), use the **--disableldaptls** switch to ensure that the resulting configuration file works.

• **--ldapserver=** — If you specified either **--enableldap** or **--enableldappath**, use this option to specify the name of the LDAP server to use. This option is set in the `/etc/ldap.conf` file.

• **--ldapbasedn=** — If you specified either **--enableldap** or **--enableldappath**, use this option to specify the DN in your LDAP directory tree under which user information is stored. This option is set in the `/etc/ldap.conf` file.

• **--enableldaptls** — Use TLS (Transport Layer Security) lookups. This option allows LDAP to send encrypted usernames and passwords to an LDAP server before authentication.

• **--disableldaptls** — Do not use TLS (Transport Layer Security) lookups in an environment that uses LDAP for authentication.

• **--enablekrb5** — Use Kerberos 5 for authenticating users. Kerberos itself does not know about home directories, UIDs, or shells. If you enable Kerberos, you must make users’ accounts known to this workstation by enabling LDAP, NIS, or Hesiod or by using the `/usr/sbin/useradd` command. If you use this option, you must have the **pam_krb5** package installed.

• **--krb5realm=** — The Kerberos 5 realm to which your workstation belongs.

• **--krb5kdc=** — The KDC (or KDCs) that serve requests for the realm. If you have multiple KDCs in your realm, separate their names with commas (,).

• **--krb5adminserver=** — The KDC in your realm that is also running kadmind. This server handles password changing and other administrative requests. This server must be run on the master KDC if you have more than one KDC.

• **--enablehesiod** — Enable Hesiod support for looking up user home directories, UIDs, and shells. More information on setting up and using Hesiod on your network is in `/usr/share/doc/glibc-2.x.x/README.hesiod`, which is included in the **glibc** package. Hesiod is an extension of DNS that uses DNS records to store information about users, groups, and various other items.
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- **--hesiodlhs** and **--hesiodrhs** — The Hesiod LHS (left-hand side) and RHS (right-hand side) values, set in `/etc/hesiod.conf`. The Hesiod library uses these values to search DNS for a name, similar to the way that LDAP uses a base DN.

To look up user information for the username `jim`, the Hesiod library looks up `jim.passwd<LHS><RHS>`, which should resolve to a TXT record that contains a string identical to an entry for that user in the `passwd` file: `jim:*:501:501:Jungle Jim:/home/jim:/bin/bash`. To look up groups, the Hesiod library looks up `jim.group<LHS><RHS>` instead.

To look up users and groups by number, make `501.uid` a CNAME for `jim.passwd`, and `501.gid` a CNAME for `jim.group`. Note that the library does not place a period (.) in front of the LHS and RHS values when performing a search. Therefore, if the LHS and RHS values need to have a period placed in front of them, you must include the period in the values you set for **--hesiodlhs** and **--hesiodrhs**.

- **--enablesmbauth** — Enables authentication of users against an SMB server (typically a Samba or Windows server). SMB authentication support does not know about home directories, UIDs, or shells. If you enable SMB, you must make users’ accounts known to the workstation by enabling LDAP, NIS, or Hesiod or by using the `/usr/sbin/useradd` command.

- **--smbservers=** — The name of the servers to use for SMB authentication. To specify more than one server, separate the names with commas (,).

- **--smbworkgroup=** — The name of the workgroup for the SMB servers.

- **--enablecache** — Enables the `nscd` service. The `nscd` service caches information about users, groups, and various other types of information. Caching is especially helpful if you choose to distribute information about users and groups over your network using NIS, LDAP, or Hesiod.

- **--passalgo=** — specify `sha256` to set up the SHA-256 hashing algorithm or `sha512` to set up the SHA-512 hashing algorithm.

**autopart** (optional)

Automatically create partitions — 1 GB or more root (/) partition, a swap partition, and an appropriate boot partition for the architecture. One or more of the default partition sizes can be redefined with the `part` directive.

- **--encrypted** — Should all devices with support be encrypted by default? This is equivalent to checking the Encrypt checkbox on the initial partitioning screen.

- **--passphrase=** — Provide a default system-wide passphrase for all encrypted devices.

- **--escrowcert=URL_of_X.509_certificate** — Store data encryption keys of all encrypted volumes as files in `/root`, encrypted using the X.509 certificate from the URL specified with `URL_of_X.509_certificate`. The keys are stored as a separate file for each encrypted volume. This option is only meaningful if **--encrypted** is specified.

- **--backuppassphrase=** — Add a randomly-generated passphrase to each encrypted volume. Store these passphrases in separate files in `/root`, encrypted using the X.509 certificate specified with **--escrowcert**. This option is only meaningful if **--escrowcert** is specified.

**autostep** (optional)

Similar to **interactive** except it goes to the next screen for you. It is used mostly for debugging.
• **--autoscreenshot** — Take a screenshot at every step during installation and copy the images over to /root/anaconda-screenshots after installation is complete. This is most useful for documentation.

**bootloader** (required)

Specifies how the boot loader should be installed. This option is required for both installations and upgrades.

**Important**

If you select text mode for a kickstart installation, make sure that you specify choices for the partitioning, bootloader, and package selection options. These steps are automated in text mode, and anaconda cannot prompt you for missing information. If you do not provide choices for these options, anaconda will stop the installation process.

• **--append** — Specifies kernel parameters. To specify multiple parameters, separate them with spaces. For example:

```bash
bootloader --location=mbr --append="hdd=ide-scsi ide=nodma"
```

• **--driveorder** — Specify which drive is first in the BIOS boot order. For example:

```bash
bootloader --driveorder=sda,hda
```

• **--location** — Specifies where the boot record is written. Valid values are the following: mbr (the default), partition (installs the boot loader on the first sector of the partition containing the kernel), or none (do not install the boot loader).

• **--leavebootorder** — Boot the drives in their existing order, to override the default of booting into the newly installed drive on Power Systems servers and EFI systems. This is useful for systems that, for example, should network boot first before falling back to a local boot.

• **--md5pass** — If using GRUB, similar to **--password** except the password should already be encrypted.

• **--password** — If using GRUB, sets the GRUB boot loader password to the one specified with this option. This should be used to restrict access to the GRUB shell, where arbitrary kernel options can be passed.

• **--timeout** — Specify the number of seconds before the bootloader times out and boots the default option. Specifying 0 will tell GRUB not to display these menus.

• **--upgrade** — Upgrade the existing boot loader configuration, preserving the old entries. This option is only available for upgrades.

**btrfs** (optional)

Create a BTRFS volume or subvolume. For a volume, the syntax is:

```bash
btrfs <mntpoint> --data=<level> --metadata=<level> --label=<label> <partitions>
```
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<partitions> denotes that multiple partitions can be listed and should list the BTRFS identifiers to add to the BTRFS volume.

For a subvolume, the syntax is:

```
  btrfs <mntpoint> --subvol --name=<path> <parent>
```

<parent> should be the identifier of the subvolume's parent volume.

None of the following options apply to subvolumes.

- **--data=** — RAID level to use for filesystem data (such as 0, 1, or 10).
- **--metadata=** — RAID level to use for filesystem/volume metadata (such as 0, 1, or 10).
- **--label=** — Specify a label for the BTRFS filesystem.
- **--noformat** — Use an existing BTRFS volume and do not reformat the filesystem.

**clearpart** (optional)

Removes partitions from the system, prior to creation of new partitions. By default, no partitions are removed.

**Note**

If the `clearpart` command is used, then the **--onpart** command cannot be used on a logical partition.

- **--all** — Erases all partitions from the system.
- **--drives=** — Specifies which drives to clear partitions from. For example, the following clears all the partitions on the first two drives on the primary IDE controller:

```
  clearpart --drives=hda,hdb --all
```

To clear a multipath device that does not use logical volume management (LVM), use the format `disk/by-id/dm-uuid-mpath-WWID`, where `WWID` is the world-wide identifier for the device. For example, to clear a disk with WWID `2416CD96995134CA5D787F00A5AA11017`, use:

```
  clearpart --drives=disk/by-id/dm-uuid-mpath-2416CD96995134CA5D787F00A5AA11017
```

Multipath devices that use LVM are not assembled until after anaconda has parsed the kickstart file. Therefore, you cannot specify these devices in the format `dm-uuid-mpath`. Instead, to clear a multipath device that uses LVM, use the format `disk/by-id/scsi-WWID`, where `WWID` is the world-wide identifier for the device. For example, to clear a disk with WWID `58095BEC5510947BE8C0360F604351918`, use:

```
  clearpart --drives=disk/by-id/scsi-58095BEC5510947BE8C0360F604351918
```
Warning — Never specify multipath devices by device names like mpatha

Device names like mpatha are not specific to a particular disk. The disk named /dev/mpatha during installation might not be the one that you expect it to be. Therefore, the clearpart command could target the wrong disk.

• **--initlabel** — Initializes the disk label to the default for your architecture (for example msdos for x86). It is useful so that the installation program does not ask if it should initialize the disk label if installing to a brand new hard drive.

• **--linux** — Erases all Linux partitions.

• **--none** (default) — Do not remove any partitions.

**cmdline** (optional)
Perform the installation in a completely non-interactive command line mode. Any prompts for interaction halts the install.

**device** (optional)
On most PCI systems, the installation program autoprobes for Ethernet and SCSI cards properly. On older systems and some PCI systems, however, kickstart needs a hint to find the proper devices. The **device** command, which tells the installation program to install extra modules, is in this format:

```
device <moduleName> --opts=<options>
```

• **<moduleName>** — Replace with the name of the kernel module which should be installed.

• **--opts=** — Mount options to use for mounting the NFS export. Any options that can be specified in /etc/fstab for an NFS mount are allowed. The options are listed in the nfs(5) man page. Multiple options are separated with a comma.

**driverdisk** (optional)
Driver diskettes can be used during kickstart installations. You must copy the driver diskettes’s contents to the root directory of a partition on the system’s hard drive. Then you must use the **driverdisk** command to tell the installation program where to look for the driver disk.

```
driverdisk <partition> --source=<url> --biospart=<biospart> [--type=<fstype>]
```

Alternatively, a network location can be specified for the driver diskette:

```
driverdisk --source=ftp://path/to/dd.img
driverdisk --source=http://path/to/dd.img
driverdisk --source=nfs:host:/path/to/img
```

• **<partition>** — Partition containing the driver disk.

• **<url>** — URL for the driver disk. NFS locations can be given in the form nfs:host:/path/to/img.
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- `<biospart>` — BIOS partition containing the driver disk (for example, `82p2`).
- `--type=` — File system type (for example, `vfat` or `ext2`).

**firewall** (optional)
This option corresponds to the **Firewall Configuration** screen in the installation program:

```
firwall --enabled|--disabled [--trust=] <device> [--port=]
```

- `--enabled` or `--enable` — Reject incoming connections that are not in response to outbound requests, such as DNS replies or DHCP requests. If access to services running on this machine is needed, you can choose to allow specific services through the firewall.
- `--disabled` or `--disable` — Do not configure any iptables rules.
- `--trust=` — Listing a device here, such as `eth0`, allows all traffic coming from that device to go through the firewall. To list more than one device, use `--trust eth0 --trust eth1`. Do NOT use a comma-separated format such as `--trust eth0, eth1`.

- `<incoming>` — Replace with one or more of the following to allow the specified services through the firewall.
  - `--ssh`
  - `--smtp`
  - `--http`
  - `--ftp`
  - `--port=` — You can specify that ports be allowed through the firewall using the port:protocol format. For example, to allow IMAP access through your firewall, specify `imap:tcp`. Numeric ports can also be specified explicitly; for example, to allow UDP packets on port 1234 through, specify `1234:udp`. To specify multiple ports, separate them by commas.

**firstboot** (optional)
Determine whether the **firstboot** starts the first time the system is booted. If enabled, the **firstboot** package must be installed. If not specified, this option is disabled by default.

- `--enable` or `--enabled` — The **Setup Agent** is started the first time the system boots.
- `--disable` or `--disabled` — The **Setup Agent** is not started the first time the system boots.
- `--reconfig` — Enable the **Setup Agent** to start at boot time in reconfiguration mode. This mode enables the language, mouse, keyboard, root password, security level, time zone, and networking configuration options in addition to the default ones.

**graphical** (optional)
Perform the kickstart installation in graphical mode. This is the default.

**halt** (optional)
Halt the system after the installation has successfully completed. This is similar to a manual installation, where anaconda displays a message and waits for the user to press a key before rebooting. During a kickstart installation, if no completion method is specified, this option is used as the default.

The **halt** option is equivalent to the **shutdown** `-h` command.
Kickstart Options

For other completion methods, refer to the `poweroff`, `reboot`, and `shutdown` kickstart options.

**ignoredisk (optional)**

Causes the installer to ignore the specified disks. This is useful if you use autopartition and want to be sure that some disks are ignored. For example, without `ignoredisk`, attempting to deploy on a SAN-cluster the kickstart would fail, as the installer detects passive paths to the SAN that return no partition table.

The syntax is:

```
ignoredisk --drives=drive1,drive2,...
```

where `driveN` is one of `sda`, `sdb`,..., `hda`,... etc.

To ignore a multipath device that does not use *logical volume management* (LVM), use the format `disk/by-id/dm-uuid-mpath-WWID`, where `WWID` is the *world-wide identifier* for the device. For example, to ignore a disk with WWID `2416CD96995134CA5D787F00A5AA11017`, use:

```
ignoredisk --drives=disk/by-id/dm-uuid-mpath-2416CD96995134CA5D787F00A5AA11017
```

Multipath devices that use LVM are not assembled until after *anaconda* has parsed the kickstart file. Therefore, you cannot specify these devices in the format `dm-uuid-mpath`. Instead, to ignore a multipath device that uses LVM, use the format `disk/by-id/scsi-WWID`, where `WWID` is the *world-wide identifier* for the device. For example, to ignore a disk with WWID `58095BEC5510947BE8C0360F604351918`, use:

```
ignoredisk --drives=disk/by-id/scsi-58095BEC5510947BE8C0360F604351918
```

**Warning — Never specify multipath devices by device names like mpatha**

Device names like `mpatha` are not specific to a particular disk. The disk named `/dev/mpatha` during installation might not be the one that you expect it to be. Therefore, the `ignoredisk` command could target the wrong disk.

- **--only-use** — specifies a list of disks for the installer to use. All other disks are ignored. For example, to use disk `sda` during installation and ignore all other disks:

  ```
  ignoredisk --only-use=sda
  ```

To include a multipath device that does not use LVM:

```
ignoredisk --only-use=disk/by-id/dm-uuid-mpath-2416CD96995134CA5D787F00A5AA11017
```

To include a multipath device that uses LVM:

```
ignoredisk --only-use=disk/by-id/scsi-58095BEC5510947BE8C0360F604351918
```
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**install** *(optional)*

Tells the system to install a fresh system rather than upgrade an existing system. This is the default mode. For installation, you must specify the type of installation from `cdrom`, `harddrive`, `nfs`, or `url` (for FTP or HTTP installations). The `install` command and the installation method command must be on separate lines.

- **cdrom** — Install from the first optical drive on the system.
- **harddrive** — Install from a Fedora installation tree on a local drive, which must be either vfat or ext2.
  - **--biospart=**
    BIOS partition to install from (such as 82).
  - **--partition=**
    Partition to install from (such as sdb2).
  - **--dir=**
    Directory containing the **variant** directory of the installation tree.

  For example:

  ```bash
  harddrive --partition=hdb2 --dir=/tmp/install-tree
  ```

- **nfs** — Install from the NFS server specified.
  - **--server=**
    Server from which to install (hostname or IP).
  - **--dir=**
    Directory containing the **variant** directory of the installation tree.
  - **--opts=**
    Mount options to use for mounting the NFS export. (optional)

  For example:

  ```bash
  nfs --server=nfsserver.example.com --dir=/tmp/install-tree
  ```

- **url** — Install from an installation tree on a remote server via FTP or HTTP.

  For example:

  ```bash
  url --url http://<server>/<dir>
  or:
  url --url ftp://<username>:<password>@<server>/<dir>
  ```
Kickstart Options

**iscsi (optional)**

```bash
iscsi --ipaddr= [options].
```

Specifies additional iSCSI storage to be attached during installation. If you use the `iscsi` parameter, you must also assign a name to the iSCSI node, using the `iscsiname` parameter earlier in the kickstart file.

We recommend that wherever possible you configure iSCSI storage in the system BIOS or firmware (iBFT for Intel systems) rather than use the `iscsi` parameter. Anaconda automatically detects and uses disks configured in BIOS or firmware and no special configuration is necessary in the kickstart file.

If you must use the `iscsi` parameter, ensure that networking is activated at the beginning of the installation, and that the `iscsi` parameter appears in the kickstart file before you refer to iSCSI disks with parameters such as `clearpart` or `ignoredisk`.

- **--port=** (mandatory) — the port number (typically, `--port=3260`)
- **--user=** — the username required to authenticate with the target
- **--password=** — the password that corresponds with the username specified for the target
- **--reverse-user=** — the username required to authenticate with the initiator from a target that uses reverse CHAP authentication
- **--reverse-password=** — the password that corresponds with the username specified for the initiator

**iscsiname (optional)**

Assigns a name to an iSCSI node specified by the `iscsi` parameter. If you use the `iscsi` parameter in your kickstart file, you must specify `iscsiname earlier` in the kickstart file.

**keyboard (required)**

Set the available keyboard layouts for the system and how to switch between them with the following syntax:

```bash
keyboard --vckeymap=<keymap>|--xlayouts=<layout1>,...,<layoutN>|<layout> [--switch=<option1>,...<optionN>]
```

- **--vckeymap=<keymap>** — specify a VConsole keymap to serve as the keyboard layout. Available keymap names are listed in `/usr/lib/kbd/keymaps/architecture` with the `.map.gz` extension removed.
- **--xlayouts=** — specify a list of X layouts as a comma-separated list with no spaces. Layouts come in one of the following formats: `layout` and `layout (variant)`. For example:

  ```bash
  keyboard --xlayouts=cz,'cz (qwerty)'
  ```

Refer to [https://fedoraproject.org/wiki/Anaconda/Kickstart](https://fedoraproject.org/wiki/Anaconda/Kickstart) for the available layouts.

- **<layout>** — an earlier format for specifying the keyboard layout. This format is still supported and accepts both VConsole keymap names and X layouts.
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- **switch** — specify keyboard shortcuts for switching between layouts. The list should be comma-separated with no spaces. Refer to [https://fedoraproject.org/wiki/Anaconda/Kickstart](https://fedoraproject.org/wiki/Anaconda/Kickstart) for the available options.

**lang** *(required)*

Sets the language to use during installation and the default language to use on the installed system. For example, to set the language to English, the kickstart file should contain the following line:

```
lang en_US
```

The file `/usr/share/system-config-language/locale-list` provides a list of the valid language codes in the first column of each line and is part of the `system-config-language` package.

Certain languages (for example, Chinese, Japanese, Korean, and Indic languages) are not supported during text-mode installation. If you specify one of these languages with the `lang` command, the installation process continues in English, but the installed system uses your selection as its default language.

**langsupport** *(deprecated)*

The langsupport keyword is deprecated and its use will cause an error message to be printed to the screen and installation to halt. Instead of using the langsupport keyword, you should now list the support package groups for all languages you want supported in the `%packages` section of your kickstart file. For instance, adding support for French means you should add the following to `%packages`:

```
@french-support
```

**logvol** *(optional)*

Create a logical volume for Logical Volume Management (LVM) with the syntax:

```
logvol <mntpoint> --vgname=<name> --size=<size> --name=<name> <options>
```

The options are as follows:

- **--noformat** — Use an existing logical volume and do not format it.
- **--useexisting** — Use an existing logical volume and reformat it.
- **--fstype** — Sets the file system type for the logical volume. Valid values are `xfs`, `ext2`, `ext3`, `ext4`, `swap`, `vfat`, and `hfs`.
- **--fsoptions** — Specifies a free form string of options to be used when mounting the filesystem. This string will be copied into the `/etc/fstab` file of the installed system and should be enclosed in quotes.
- **--grow** — Tells the logical volume to grow to fill available space (if any), or up to the maximum size setting.
- **--maxsize** — The maximum size in megabytes when the logical volume is set to grow. Specify an integer value here such as `500` (do not include the unit).
- **--recommended** — Determine the size of the logical volume automatically.
Kickstart Options

• **--percent=** — Specify the amount by which to grow the logical volume, as a percentage of the free space in the volume group after any statically-sized logical volumes are taken into account. This option must be used in conjunction with the **--size** and **--grow** options for **logvol**.

• **--encrypted** — Specifies that this logical volume should be encrypted, using the passphrase provided in the **--passphrase** option. If you do not specify a passphrase, **anaconda** uses the default, system-wide passphrase set with the **autopart --passphrase** command, or stops the installation and prompts you to provide a passphrase if no default is set.

• **--passphrase=** — Specifies the passphrase to use when encrypting this logical volume. You must use this option together with the **--encrypted** option; by itself it has no effect.

• **--escrowcert=URL_of_X.509_certificate** — Store data encryption keys of all encrypted volumes as files in /root, encrypted using the X.509 certificate from the URL specified with **URL_of_X.509_certificate**. The keys are stored as a separate file for each encrypted volume. This option is only meaningful if **--encrypted** is specified.

• **--backuppassphrase=** — Add a randomly-generated passphrase to each encrypted volume. Store these passphrases in separate files in /root, encrypted using the X.509 certificate specified with **--escrowcert**. This option is only meaningful if **--escrowcert** is specified.

• **--label=** — assign a label to an individual volume.

Create the partition first, create the logical volume group, and then create the logical volume. For example:

```
part pv.01 --size 3000
volgroup myvg pv.01
logvol / --vgname=myvg --size=2000 --name=rootvol
```

Create the partition first, create the logical volume group, and then create the logical volume to occupy 90% of the remaining space in the volume group. For example:

```
part pv.01 --size 1 --grow
volgroup myvg pv.01
logvol / --vgname=myvg --size=1 --name=rootvol --grow --percent=90
```

**logging (optional)**

This command controls the error logging of **anaconda** during installation. It has no effect on the installed system.

• **--host=** — Send logging information to the given remote host, which must be running a syslogd process configured to accept remote logging.

• **--port=** — If the remote syslogd process uses a port other than the default, it may be specified with this option.

• **--level=** — One of debug, info, warning, error, or critical.

Specify the minimum level of messages that appear on tty3. All messages will still be sent to the log file regardless of this level, however.

**mediacheck (optional)**

If given, this will force **anaconda** to run mediacheck on the installation media. This command requires that installs be attended, so it is disabled by default.
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monitor (optional)
If the monitor command is not given, anaconda will use X to automatically detect your monitor settings. Please try this before manually configuring your monitor.

- **--hsync=** — Specifies the horizontal sync frequency of the monitor.
- **--monitor=** — Use specified monitor; monitor name should be from the list of monitors in /usr/share/hwdata/MonitorsDB from the hwdata package. The list of monitors can also be found on the X Configuration screen of the Kickstart Configurator. This is ignored if --hsync or --vsync is provided. If no monitor information is provided, the installation program tries to probe for it automatically.
- **--noprobe=** — Do not try to probe the monitor.
- **--vsync=** — Specifies the vertical sync frequency of the monitor.

mouse (deprecated)
The mouse keyword is deprecated.

network (optional)
Configures network information for the target system and activates network devices in the installer environment. The device specified in the first network command is activated automatically if network access is required during installation, for example, during a network installation or installation over VNC. You can also explicitly require device to activate in the installer environment with the **--activate** option.

### How to manually input network settings

If you need to manually specify network settings during an otherwise-automated kickstart installation, do not use network. Instead, enter your network settings at the boot prompt (refer to *Section 15.10, "Starting a Kickstart Installation"* for available boot options).

Once the network connection is established, you can only reconfigure network settings with those specified in your kickstart file.

#### Note

You will only be prompted for information about your network:

- before fetching the kickstart file if you are using the asknetwork boot option
- when the network is first accessed once the kickstart file has been fetched, if the network was not used to fetch it and you have provided no kickstart network commands

- **--activate** — activate this device in the installer environment.

If you use the **--activate** option on a device that has already been activated (for example, an interface you configured with boot options so that the system could retrieve the kickstart file) the device is reactivated to use the details specified in the kickstart file.
Use the **--nodedefroute** option to prevent the device from using the default route.

The **activate** option is new in Fedora 16.

- **--biosdevname=0** — disables *consistent network device naming* (refer to *Appendix A* in the *Fedora System Administrators Guide*).

- **--bootproto=** — One of *dhcp, bootp, ibft, or static*.

The **ibft** option is new in Fedora 16.

The **bootproto** option defaults to *dhcp, bootp* and *dhcp* are treated the same.

The DHCP method uses a DHCP server system to obtain its networking configuration. As you might guess, the BOOTP method is similar, requiring a BOOTP server to supply the networking configuration. To direct a system to use DHCP:

```bash
network --bootproto=dhcp
```

To direct a machine to use BOOTP to obtain its networking configuration, use the following line in the kickstart file:

```bash
network --bootproto=bootp
```

To direct a machine to use the configuration specified in iBFT, use:

```bash
network --bootproto=ibft
```

The static method requires that you specify the IP address, netmask, gateway, and nameserver in the kickstart file. As the name implies, this information is static and is used during and after the installation.

All static networking configuration information must be specified on one line; you cannot wrap lines using a backslash as you can on a command line. A line that specifies static networking in a kickstart file is therefore more complex than lines that specify DHCP, BOOTP, or iBFT. Note that the examples on this page have line breaks in them for presentation reasons; they would not work in an actual kickstart file.

```bash
network --bootproto=static --ip=10.0.2.15 --netmask=255.255.255.0 --gateway=10.0.2.254 --nameserver=10.0.2.1
```

You can also configure multiple nameservers here. To do so, specify them as a comma-delimited list in the command line.

```bash
network --bootproto=static --ip=10.0.2.15 --netmask=255.255.255.0 --gateway=10.0.2.254 --nameserver 192.168.2.1,192.168.3.1
```

- **--device=** — specifies the device to be configured (and eventually activated) with the **network** command. For the first **network** command, **--device=** defaults (in order of preference) to one of:
  
  1. the device specified by the **ksdevice** boot option
  2. the device activated automatically to fetch the kickstart file
3. the device selected in the **Networking Devices** dialog

The behavior of any subsequent network command is unspecified if its **--device** option is missing. Take care to specify a **--device** option for any network command beyond the first.

You can specify a device in one of five ways:

- the device name of the interface, for example, eth0
- the MAC address of the interface, for example, 00:12:34:56:78:9a
- the keyword **link**, which specifies the first interface with its link in the **up** state
- the keyword **bootif**, which uses the MAC address that pxelinux set in the **BOOTIF** variable. Set **IPAPPEND 2** in your pxelinux.cfg file to have pxelinux set the **BOOTIF** variable.
- the keyword **ibft**, which uses the MAC address of the interface specified by iBFT

```bash
network --bootproto=dhcp --device=eth0
```

- **--ip**= — IP address of the device.
- **--ipv6**= — IPv6 address of the device, or **auto** to use automatic neighbor discovery, or **dhcp** to use DHCPv6.
- **--gateway**= — Default gateway as a single IPv4 or IPv6 address.
- **--nameserver**= — Primary nameserver, as an IP address. Multiple nameservers must each be separated by a comma.
- **--nodefroute** — Prevents the interface being set as the default route. Use this option when you activate additional devices with the **--activate**= option, for example, a NIC on a separate subnet for an iSCSI target.

The **nodefroute** option is new in Fedora 16.

- **--nodns** — Do not configure any DNS server.
- **--netmask**= — Network mask of the device.
- **--hostname**= — Hostname for the installed system.
- **--ethtool**= — Specifies additional low-level settings for the network device which will be passed to the ethtool program.
- **--onboot**= — Whether or not to enable the device at boot time.
- **--dhcpclass**= — The DHCP class.
- **--mtu**= — The MTU of the device.
- **--noipv4** — Disable IPv4 on this device.
- **--noipv6** — Disable IPv6 on this device.

**part** or **partition** (required for installs, ignored for upgrades)

Creates a partition on the system.
If more than one Fedora installation exists on the system on different partitions, the installation program prompts the user and asks which installation to upgrade.

**Warning**

As of Fedora 16, you need a biosboot partition in order to successfully install the bootloader on a disk that contains a GPT/GUID partition table. This includes disks initialized by the installer. This partition can be created with the kickstart option `part biosboot --fstype=biosboot --size=1`.

However, if the disk already has a biosboot partition, adding a "part biosboot" option is unnecessary.

**Warning**

All partitions created are formatted as part of the installation process unless `--noformat` and `--onpart` are used.

**Important**

If you select text mode for a kickstart installation, make sure that you specify choices for the partitioning, bootloader, and package selection options. These steps are automated in text mode, and anaconda cannot prompt you for missing information. If you do not provide choices for these options, anaconda will stop the installation process.

For a detailed example of `part` in action, refer to Section 15.4.1, "Advanced Partitioning Example".

- `<mntpointmultipath --name= --device= --rule=>` — The `<mntpoint>` is where the partition is mounted and must be of one of the following forms:
  - `/<path>`
    - For example, `/., /usr, /home`
  - `swap`
    - The partition is used as swap space.

  To determine the size of the swap partition automatically, use the `--recommended` option:

  ```
  swap --recommended
  ```

  The size assigned will be effective but not precisely calibrated for your system.
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To determine the size of the swap partition automatically but also allow extra space for your system to hibernate, use the `--hibernation` option:

```bash
swap --hibernation
```

The size assigned will be equivalent to the swap space assigned by `--recommended` plus the amount of RAM on your system.

For the swap sizes assigned by these commands, refer to Section 9.13.5, “Recommended Partitioning Scheme”

- `raid.<id>`
  
  The partition is used for software RAID (refer to `raid`).

- `pv.<id>`
  
  The partition is used for LVM (refer to `logvol`).

- `--size=␣— The minimum partition size in megabytes. Specify an integer value here such as 500 (do not include the unit).

  ☑️ Important - --size value must be high

  If the `--size` value is too small, the installation will fail. Set the `--size` value as the minimum amount of space you require. For size recommendations, refer to Section 9.13.5, “Recommended Partitioning Scheme”.

- `--grow` — Tells the partition to grow to fill available space (if any), or up to the maximum size setting.

  📝 Note

  If you use `--grow=␣` without setting `--maxsize=␣` on a swap partition, Anaconda will limit the maximum size of the swap partition. For systems that have less than 2GB of physical memory, the imposed limit is twice the amount of physical memory. For systems with more than 2GB, the imposed limit is the size of physical memory plus 2GB.

- `--maxsize=` — The maximum partition size in megabytes when the partition is set to grow. Specify an integer value here such as 500 (do not include the unit).

- `--noformat` — Specifies that the partition should not be formatted, for use with the `--onpart` command.

- `--onpart=` or `--usepart=` — Specifies the device on which to place the partition. For example:
## Kickstart Options

<table>
<thead>
<tr>
<th>partition /home --onpart=hda1</th>
</tr>
</thead>
<tbody>
<tr>
<td>puts /home on /dev/hda1.</td>
</tr>
<tr>
<td>The device must already exist on the system; the --onpart option will not create it.</td>
</tr>
</tbody>
</table>

- **--ondisk=** or **--ondrive=** — Forces the partition to be created on a particular disk. For example, **--ondisk=sdb** puts the partition on the second SCSI disk on the system.

To specify a multipath device that does not use **logical volume management** (LVM), use the format **disk/by-id/dm-uuid-mpath-**WWID**, where **WWID** is the **world-wide identifier** for the device. For example, to specify a disk with WWID **2416CD96995134CA5D787F00A5AA11017**, use:

| part / --fstype=ext3 --grow --asprimary --size=100 --ondisk=disk/by-id/dm-uuid-mpath-2416CD96995134CA5D787F00A5AA11017 |

Multipath devices that use LVM are not assembled until after **anaconda** has parsed the kickstart file. Therefore, you cannot specify these devices in the format **dm-uuid-mpath**. Instead, to specify a multipath device that uses LVM, use the format **disk/by-id/scsi-**WWID**, where **WWID** is the **world-wide identifier** for the device. For example, to specify a disk with WWID **58095BEC5510947BE8C0360F604351918**, use:

| part / --fstype=ext3 --grow --asprimary --size=100 --ondisk=disk/by-id/scsi-58095BEC5510947BE8C0360F604351918 |

---

### Warning — Never specify multipath devices by device names like mpatha

Device names like **mpatha** are not specific to a particular disk. The disk named **/dev/mpatha** during installation might not be the one that you expect it to be. Therefore, the **part** command could target the wrong disk or partition.

- **--asprimary** — Forces automatic allocation of the partition as a primary partition, or the partitioning fails.
- **--type=** (replaced by **fstype**) — This option is no longer available. Use **fstype**.
- **--fsoptions** — Specifies a free form string of options to be used when mounting the filesystem. This string will be copied into the **/etc/fstab** file of the installed system and should be enclosed in quotes.
- **--fsprofile** — Specifies a **usage type** to be passed to the program that makes a filesystem on this partition. A usage type defines a variety of tuning parameters to be used when making a filesystem. For this option to work, the filesystem must support the concept of usage types and there must be a configuration file that lists valid types. For ext2, ext3, and ext4, this configuration file is **/etc/mke2fs.conf**.
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- **--fstype=** — Sets the file system type for the partition. Valid values are xfs, ext2, ext3, ext4, swap, vfat, and hfs.

- **--recommended** — Determine the size of the partition automatically.

- **--onbiosdisk** — Forces the partition to be created on a particular disk as discovered by the BIOS.

- **--encrypted** — Specifies that this partition should be encrypted, using the passphrase provided in the **--passphrase** option. If you do not specify a passphrase, anaconda uses the default, system-wide passphrase set with the `autopart --passphrase` command, or stops the installation and prompts you to provide a passphrase if no default is set.

- **--passphrase=** — Specifies the passphrase to use when encrypting this partition. You must use this option together with the **--encrypted** option; by itself it has no effect.

- **--escrowcert=URL_of_X.509_certificate** — Store data encryption keys of all encrypted partitions as files in `/root`, encrypted using the X.509 certificate from the URL specified with `URL_of_X.509_certificate`. The keys are stored as a separate file for each encrypted partition. This option is only meaningful if **--encrypted** is specified.

- **--backuppassphrase=** — Add a randomly-generated passphrase to each encrypted partition. Store these passphrases in separate files in `/root`, encrypted using the X.509 certificate specified with **--escrowcert**. This option is only meaningful if **--escrowcert** is specified.

- **--label=** — assign a label to an individual partition.

**Note**

If partitioning fails for any reason, diagnostic messages appear on virtual console 3.

poweroff (optional)

Shut down and power off the system after the installation has successfully completed. Normally during a manual installation, anaconda displays a message and waits for the user to press a key before rebooting. During a kickstart installation, if no completion method is specified, the **halt** option is used as default.

The **poweroff** option is equivalent to the `shutdown -p` command.

**Note**

The **poweroff** option is highly dependent on the system hardware in use. Specifically, certain hardware components such as the BIOS, APM (advanced power management), and ACPI (advanced configuration and power interface) must be able to interact with the system kernel. Contact your manufacturer for more information on your system's APM/ACPI abilities.

For other completion methods, refer to the **halt**, **reboot**, and **shutdown** kickstart options.
**raid** (optional)
Assembles a software RAID device. This command is of the form:

```
raid <mntpoint> --level=<level> --device=<mddevice> <partitions*>)
```

- `<mntpoint>` — Location where the RAID file system is mounted. If it is `/`, the RAID level must be 1 unless a boot partition (`/boot`) is present. If a boot partition is present, the `/boot` partition must be level 1 and the root (`/`) partition can be any of the available types. The `<partitions*>` (which denotes that multiple partitions can be listed) lists the RAID identifiers to add to the RAID array.

- `--level=` — RAID level to use (0, 1, or 5).

- `--device=` — Name of the RAID device to use (such as md0 or md1). RAID devices range from md0 to md15, and each may only be used once.

- `--spares=` — Specifies the number of spare drives allocated for the RAID array. Spare drives are used to rebuild the array in case of drive failure.

- `--grow=` — Only supported for RAID0. Tells the RAID device to grow to fill available space (if any), or up to the maximum size setting.

- `--fsprofile` — Specifies a usage type to be passed to the program that makes a filesystem on this partition. A usage type defines a variety of tuning parameters to be used when making a filesystem. For this option to work, the filesystem must support the concept of usage types and there must be a configuration file that lists valid types. For ext2, ext3, and ext4, this configuration file is `/etc/mke2fs.conf`.

- `--fstype=` — Sets the file system type for the RAID array. Valid values are `xfs`, `ext2`, `ext3`, `ext4`, `swap`, `vfat`, and `hfs`.

- `--fsoptions=` — Specifies a free form string of options to be used when mounting the filesystem. This string will be copied into the `/etc/fstab` file of the installed system and should be enclosed in quotes.

- `--noformat` — Use an existing RAID device and do not format the RAID array.

- `--useexisting` — Use an existing RAID device and reformat it.

- `--encrypted` — Specifies that this RAID device should be encrypted, using the passphrase provided in the `--passphrase` option. If you do not specify a passphrase, `anaconda` uses the default, system-wide passphrase set with the `autopart --passphrase` command, or stops the installation and prompts you to provide a passphrase if no default is set.

- `--passphrase=` — Specifies the passphrase to use when encrypting this RAID device. You must use this option together with the `--encrypted` option; by itself it has no effect.

- `--escrowcert=URL_of_X.509_certificate` — Store the data encryption key for this device in a file in `/root`, encrypted using the X.509 certificate from the URL specified with `URL_of_X.509_certificate`. This option is only meaningful if `--encrypted` is specified.

- `--backuppassphrase=` — Add a randomly-generated passphrase to this device. Store the passphrase in a file in `/root`, encrypted using the X.509 certificate specified with `--escrowcert`. This option is only meaningful if `--escrowcert` is specified.
The following example shows how to create a RAID level 1 partition for /, and a RAID level 5 for /usr, assuming there are three SCSI disks on the system. It also creates three swap partitions, one on each drive.

```
part raid.01 --size=60 --ondisk=sda
part raid.02 --size=60 --ondisk=sdb
part raid.03 --size=60 --ondisk=sdc

part swap --size=128 --ondisk=sda
part swap --size=128 --ondisk=sdb
part swap --size=128 --ondisk=sdc

part raid.11 --size=1 --grow --ondisk=sda
part raid.12 --size=1 --grow --ondisk=sdb
part raid.13 --size=1 --grow --ondisk=sdc

raid / --level=1 --device=md0 raid.01 raid.02 raid.03
raid /usr --level=5 --device=md1 raid.11 raid.12 raid.13
```

For a detailed example of `raid` in action, refer to Section 15.4.1, "Advanced Partitioning Example".

`reboot` (optional)

Reboot after the installation is successfully completed (no arguments). Normally, kickstart displays a message and waits for the user to press a key before rebooting.

The `reboot` option is equivalent to the `shutdown -r` command.

For other completion methods, refer to the `halt`, `poweroff`, and `shutdown` kickstart options.

The `halt` option is the default completion method if no other methods are explicitly specified in the kickstart file.

**Note**

Use of the `reboot` option may result in an endless installation loop, depending on the installation media and method.

`repo` (optional)

Configures additional yum repositories that may be used as sources for package installation. Multiple repo lines may be specified.

```
repo --name=<repoid> [--baseurl=<url> | --mirrorlist=<url>]
```

- **--name=** — The repo id. This option is required.

- **--baseurl=** — The URL for the repository. The variables that may be used in yum repo config files are not supported here. You may use one of either this option or --mirrorlist, not both.

- **--mirrorlist=** — The URL pointing at a list of mirrors for the repository. The variables that may be used in yum repo config files are not supported here. You may use one of either this option or --baseurl, not both.
**rootpw** *(required)*

Sets the system's root password to the `<password>` argument.

```
rootpw [--iscrypted] <password>
```

- **--iscrypted** — If this is present, the password argument is assumed to already be encrypted.

**selinux** *(optional)*

Sets the state of SELinux on the installed system. SELinux defaults to enforcing in anaconda.

```
selinux [--disabled|--enforcing|--permissive]
```

- **--enforcing** — Enables SELinux with the default targeted policy being enforced.

**Note**

If the `selinux` option is not present in the kickstart file, SELinux is enabled and set to **--enforcing** by default.

- **--permissive** — Outputs warnings based on the SELinux policy, but does not actually enforce the policy.
- **--disabled** — Disables SELinux completely on the system.

For more information regarding SELinux for Fedora, refer to the *Fedora Deployment Guide*.

**services** *(optional)*

Modifies the default set of services that will run under the default runlevel. The list of disabled services is processed before the list of enabled services. Therefore, if a service appears on both lists, it is enabled.

- **--disabled** — Disable the services given in the comma separated list.
- **--enabled** — Enable the services given in the comma separated list.

**Do not include spaces in the list of services**

If you include spaces in the comma-separated list, kickstart will enable or disable only the services up to the first space. For example:

```
services --disabled auditd, cups, smartd, nfslock
```

will disable only the *auditd* service. To disable all four services, this entry should include no spaces between services:

```
services --disabled auditd,cups,smartd,nfslock
```
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shutdown (optional)
Shut down the system after the installation has successfully completed. During a kickstart installation, if no completion method is specified, the halt option is used as default.

The shutdown option is equivalent to the shutdown command.

For other completion methods, refer to the halt, poweroff, and reboot kickstart options.

skipx (optional)
If present, X is not configured on the installed system.

Package selection might configure X
If you install a display manager among your package selection options, this package will create an X configuration, and the installed system will default to run level 5. The effect of the skipx option is overridden.

sshpw (optional)
During installation, you can interact with anaconda and monitor its progress over an SSH connection. Use the sshpw command to create temporary accounts through which to log on. Each instance of the command creates a separate account that exists only in the installation environment. These accounts are not transferred to the installed system.

```
sshpw --username=<name> <password> [--iscrypted|--plaintext] [--lock]
```

- --username — Provides the name of the user. This option is required.
- --iscrypted — Specifies that the password is already encrypted.
- --plaintext — Specifies that the password is in plain text and not encrypted.
- --lock — If this is present, the new user account is locked by default. That is, the user will not be able to login from the console.

Important — You must boot with sshd=1
By default, the ssh server is not started during installation. To make ssh available during installation, boot the system with the kernel boot option sshd=1. Refer to Section 11.2.3, “Enabling Remote Access with ssh” for details of how to specify this kernel option at boot time.

text (optional)
Perform the kickstart installation in text mode. Kickstart installations are performed in graphical mode by default.
If you select text mode for a kickstart installation, make sure that you specify choices for the partitioning, bootloader, and package selection options. These steps are automated in text mode, and **anaconda** cannot prompt you for missing information. If you do not provide choices for these options, **anaconda** will stop the installation process.

---

### timezone (required)

Sets the system time zone to `<timezone>`. Refer to [https://fedoraproject.org/wiki/Anaconda/Kickstart](https://fedoraproject.org/wiki/Anaconda/Kickstart) for a list of supported timezones.

`timezone [--utc] [--nontp] [--ntpservers=server1[,server2,...,serverN]] <timezone>`

- **--utc** — If present, the system assumes the hardware clock is set to UTC (Greenwich Mean) time.
- **--nontp** — Disable the automatic activation of the NTP service.
- **--ntpservers=** — Specify a list of NTP servers to be used, separated by commas without spaces.

### upgrade (optional)

Tells the system to upgrade an existing system rather than install a fresh system. You must specify one of **cdrom**, **harddrive**, **nfs**, or **url** (for FTP and HTTP) as the location of the installation tree. Refer to **install** for details.

### user (optional)

Creates a new user on the system.

`user --name=<username> [--groups=<list>] [--homedir=<homedir>] [--password=<password>] [--iscrypted] [--shell=<shell>] [--uid=<uid>]`

- **--name=** — Provides the name of the user. This option is required.
- **--groups=** — In addition to the default group, a comma separated list of group names the user should belong to. The groups must exist before the user account is created.
- **--homedir=** — The home directory for the user. If not provided, this defaults to `/home/<username>`.
- **--password=** — The new user's password. If not provided, the account will be locked by default.
- **--iscrypted=** — Is the password provided by --password already encrypted or not?
- **--shell=** — The user's login shell. If not provided, this defaults to the system default.
- **--uid=** — The user's UID. If not provided, this defaults to the next available non-system UID.

### vnc (optional)

Allows the graphical installation to be viewed remotely via VNC. This method is usually preferred over text mode, as there are some size and language limitations in text installs. With no options,
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this command will start a VNC server on the machine with no password and will print out the command that needs to be run to connect a remote machine.

```
vnc [--host=<hostname>] [--port=<port>] [--password=<password>]
```

- **--host**= — Instead of starting a VNC server on the install machine, connect to the VNC viewer process listening on the given hostname.
- **--port**= — Provide a port that the remote VNC viewer process is listening on. If not provided, anaconda will use the VNC default.
- **--password**= — Set a password which must be provided to connect to the VNC session. This is optional, but recommended.

**volgroup** (optional)

Use to create a Logical Volume Management (LVM) group with the syntax:

```
volgroup <name> <partition> <options>
```

The options are as follows:

- **--noformat** — Use an existing volume group and do not format it.
- **--useexisting** — Use an existing volume group and reformat it.
- **--pesize**= — Set the size of the physical extents.

Create the partition first, create the logical volume group, and then create the logical volume. For example:

```
part pv.01 --size 3000
volgroup myvg pv.01
logvol / --vgname=myvg --size=2000 --name=rootvol
```

For a detailed example of **volgroup** in action, refer to Section 15.4.1, “Advanced Partitioning Example”.

**xconfig** (optional)

Configures the X Window System. If you install the X Window System with a kickstart file that does not include the **xconfig** command, you must provide the X configuration manually during installation.

Do not use this command in a kickstart file that does not install the X Window System.

- **--driver** — Specify the X driver to use for the video hardware.
- **--videoram**= — Specifies the amount of video RAM the video card has.
- **--defaultdesktop**= — Specify either GNOME or KDE to set the default desktop (assumes that GNOME Desktop Environment and/or KDE Desktop Environment has been installed through %packages).
- **--startxonboot** — Use a graphical login on the installed system.
**zerombr** (optional)

If **zerombr** is specified any invalid partition tables found on disks are initialized. This destroys all of the contents of disks with invalid partition tables.

Note that this command was previously specified as **zerombr yes**. This form is now deprecated; you should now simply specify **zerombr** in your kickstart file instead.

**%include** (optional)

Use the **%include /path/to/file** command to include the contents of another file in the kickstart file as though the contents were at the location of the **%include** command in the kickstart file.

### 15.4.1. Advanced Partitioning Example

The following is a single, integrated example showing the **clearpart**, **raid**, **part**, **volgroup**, and **logvol** kickstart options in action:

```bash
# Raid 1 IDE config
clearpart --drives=hda,hdc --initlabel
part raid.11    --size 1000     --asprimary     --ondrive=hda
part raid.12    --size 1000     --asprimary     --ondrive=hda
part raid.13    --size 2000     --asprimary     --ondrive=hda
part raid.14    --size 8000     --ondrive=hda
part raid.15    --size 16384 --grow             --ondrive=hda
part raid.21    --size 1000     --asprimary     --ondrive=hdc
part raid.22    --size 1000     --asprimary     --ondrive=hdc
part raid.23    --size 2000     --asprimary     --ondrive=hdc
part raid.24    --size 8000     --ondrive=hdc
part raid.25    --size 16384 --grow             --ondrive=hdc

# You can add --spares=x
raid /          --fstype ext3 --device md0 --level=RAID1 raid.11 raid.21
raid /safe      --fstype ext3 --device md1 --level=RAID1 raid.12 raid.22
raid swap       --fstype swap --device md2 --level=RAID1 raid.13 raid.23
raid /usr       --fstype ext3 --device md3 --level=RAID1 raid.14 raid.24
raid pv.01      --fstype ext3 --device md4 --level=RAID1 raid.15 raid.25

# LVM configuration so that we can resize /var and /usr/local later
volgroup sysvg pv.01
logvol /var             --vgname=sysvg  --size=8000     --name=var
logvol /var/freespace   --vgname=sysvg  --size=8000     --name=freespacetouse
logvol /usr/local       --vgname=sysvg  --size=1 --grow --name=usrlocal
```

This advanced example implements LVM over RAID, as well as the ability to resize various directories for future growth.

### 15.5. Package Selection
### Warning — do not install every available package

You can use a kickstart file to install every available package by specifying `@Everything` or simply `*` in the `%packages` section. However, using a kickstart file in this way will introduce package and file conflicts onto the installed system.

Use the `%packages` command to begin a kickstart file section that lists the packages you would like to install (this is for installations only, as package selection during upgrades is not supported).

You can specify packages by group or by their package names. The installation program defines several groups that contain related packages. Refer to the `variant/repoadata/comps-*.xml` file on the Fedora DVD for a list of groups. Each group has an id, user visibility value, name, description, and package list. If the group is selected for installation, the packages marked `mandatory` in the package list are always installed, the packages marked `default` are installed if they are not specifically excluded elsewhere, and the packages marked `optional` must be specifically included elsewhere even when the group is selected.

Specify groups, one entry to a line, starting with an `@` symbol, a space, and then the full group name or group id as given in the `comps.xml` file. For example:

```
%packages
@ X Window System
@ Desktop
@ Sound and Video
```

Note that the `Core` and `Base` groups are always selected by default, so it is not necessary to specify them in the `%packages` section.

Specify individual packages by name, one entry to a line. You can use asterisks as wildcards to glob package names in entries. For example:

```
sqlite
curl
aspell
docbook*
```

The `docbook*` entry includes the packages `docbook-dtds`, `docbook-simple`, `docbook-slides` and others that match the pattern represented with the wildcard.

Use a leading dash to specify packages or groups to exclude from the installation. For example:

```
-@ Graphical Internet
-autofs
-ipas*fonts
```

Using a kickstart file to install every available package by specifying `*` will introduce package and file conflicts onto the installed system. Packages known to cause such problems are assigned to the `@Conflicts (variant)` group, where `variant` is `Client`, `ComputeNode`, `Server` or `Workstation`. If you specify `*` in a kickstart file, be sure to exclude `@Conflicts (variant)` or the installation will fail:

```
*
```
Note that the Fedora Project does not support the use of * in a kickstart file, even if you exclude @Conflicts (variant).

The following options are available for the %packages option:

--nobase
Do not install the @Base group. Use this option to perform a minimal installation, for example, for a single-purpose server or desktop appliance.

--ignoremissing
Ignore the missing packages and groups instead of halting the installation to ask if the installation should be aborted or continued. For example:

%packages --ignoremissing

--multilib
Set the multilib_policy in /etc/yum.conf to "all", so that all architectural variants of a package are installed. The default is "best", where yum only installs the most suitable architectural variant available.

--resolvedeps
The --resolvedeps option has been deprecated. Dependencies are now always resolved automatically.

--ignoredeps
The --ignoredeps option has been deprecated. Dependencies are resolved automatically every time now.

15.6. Pre-installation Script

You can add commands to run on the system immediately after the ks.cfg has been parsed. This section must be placed towards the end of the kickstart file, after the kickstart commands described in Section 15.4, "Kickstart Options", and must start with the %pre command. If your kickstart file also includes a %post section, the order of the %pre and %post sections does not matter.

You can access the network in the %pre section; however, name service has not been configured at this point, so only IP addresses work.

Note
Note that the pre-install script is not run in the change root environment.

--interpreter /usr/bin/python
Allows you to specify a different scripting language, such as Python. Replace /usr/bin/python with the scripting language of your choice.

15.6.1. Example
Here is an example %pre section:
%pre
#!/bin/sh
hds=""
mymedia=""
for file in /proc/ide/h* do
  mymedia=`cat $file/media`
  if [ $mymedia == "disk" ]; then
    hds="$hds 'basename $file'"
  fi
done
set $hds
numhd=`echo $#`
drive1=`echo $hds | cut -d' ' -f1`
drive2=`echo $hds | cut -d' ' -f2`
#Write out partition scheme based on whether there are 1 or 2 hard drives
if [ $numhd == "2" ]; then
  # 2 drives
  echo "#partitioning scheme generated in %pre for 2 drives" > /tmp/part-include
  echo "clearpart --all" >> /tmp/part-include
  echo "part /boot --fstype ext3 --size 75 --ondisk hda" >> /tmp/part-include
  echo "part / --fstype ext3 --size 1 --grow --ondisk hda" >> /tmp/part-include
  echo "part swap --recommended --ondisk $drive1" >> /tmp/part-include
  echo "part /home --fstype ext3 --size 1 --grow --ondisk hdb" >> /tmp/part-include
else
  # 1 drive
  echo "#partitioning scheme generated in %pre for 1 drive" > /tmp/part-include
  echo "clearpart --all" >> /tmp/part-include
  echo "part /boot --fstype ext3 --size 75" >> /tmp/part-include
  echo "part swap --recommended" >> /tmp/part-include
  echo "part / --fstype ext3 --size 2048" >> /tmp/part-include
  echo "part /home --fstype ext3 --size 2048 --grow" >> /tmp/part-include
fi

This script determines the number of hard drives in the system and writes a text file with a different partitioning scheme depending on whether it has one or two drives. Instead of having a set of partitioning commands in the kickstart file, include the line:

```
%include /tmp/part-include
```

The partitioning commands selected in the script are used.

**Note**

The pre-installation script section of kickstart cannot manage multiple install trees or source media. This information must be included for each created ks.cfg file, as the pre-installation script occurs during the second stage of the installation process.

### 15.7. Post-installation Script

You have the option of adding commands to run on the system once the installation is complete. This section must be placed towards the end of the kickstart file, after the kickstart commands described in Section 15.4, “Kickstart Options”, and must start with the %post command. If your kickstart file also includes a %pre section, the order of the %pre and %post sections does not matter.

This section is useful for functions such as installing additional software and configuring an additional nameserver.
If you configured the network with static IP information, including a nameserver, you can access the network and resolve IP addresses in the `%post` section. If you configured the network for DHCP, the `/etc/resolv.conf` file has not been completed when the installation executes the `%post` section. You can access the network, but you can not resolve IP addresses. Thus, if you are using DHCP, you must specify IP addresses in the `%post` section.

The post-install script is run in a chroot environment; therefore, performing tasks such as copying scripts or RPMs from the installation media do not work.

---

**--nochroot**

Allows you to specify commands that you would like to run outside of the chroot environment.

The following example copies the file `/etc/resolv.conf` to the file system that was just installed.

```
%post --nochroot
    cp /etc/resolv.conf /mnt/sysimage/etc/resolv.conf
```

**--interpreter `/usr/bin/python`**

Allows you to specify a different scripting language, such as Python. Replace `/usr/bin/python` with the scripting language of your choice.

**--log `/path/to/logfile`**

Logs the output of the post-install script. Note that the path of the log file must take into account whether or not you use the **--nochroot** option. For example, without **--nochroot**:

```
%post --log=/root/ks-post.log
```

with **--nochroot**:

```
%post --nochroot --log=/mnt/sysimage/root/ks-post.log
```

### 15.7.1. Example

**Example 15.1.** Run a script named `runme` from an NFS share:

```
mkdir /mnt/temp
mount -o nolock 10.10.0.2:/usr/new-machines /mnt/temp
openvt -s -w -- /mnt/temp/runme
umount /mnt/temp
```
NFS file locking is not supported while in kickstart mode, therefore -o nolock is required when mounting an NFS mount.

15.8. Making the Kickstart File Available

A kickstart file must be placed in one of the following locations:

- On removable media, such as a floppy disk, optical disk, or USB flash drive
- On a hard drive
- On a network

Normally a kickstart file is copied to the removable media or hard drive, or made available on the network. The network-based approach is most commonly used, as most kickstart installations tend to be performed on networked computers.

Let us take a more in-depth look at where the kickstart file may be placed.

15.8.1. Creating Kickstart Boot Media

To perform a kickstart installation using removable media, the kickstart file must be named ks.cfg and must be located in the top-level directory of the disc.

Diskette-based booting is no longer supported in Fedora. Installations must use CD-ROM or flash memory products for booting. However, the kickstart file may still reside on a diskette's top-level directory, and must be named ks.cfg. Separate boot media will be required.

Refer to Section 3.3, “Making Minimal Boot Media” for instructions on creating boot media.

To perform a pen-based flash memory kickstart installation, the kickstart file must be named ks.cfg and must be located in the flash memory's top-level directory. Create the boot image first, and then copy the ks.cfg file.

Refer to Section 3.3, “Making Minimal Boot Media” for instructions on creating live USB media using the Fedora-version-architecture-format.iso image file that you can download from the Fedora Project site at http://download.fedoraproject.org/.

Note

Creation of USB flashdrives for booting is possible, but is heavily dependent on system hardware BIOS settings. Refer to your hardware manufacturer to see if your system supports booting to alternate devices.

15.8.2. Making the Kickstart File Available on the Network

Network installations using kickstart are quite common, because system administrators can quickly and easily automate the installation on many networked computers. In general, the approach most
commonly used is for the administrator to have both a BOOTP/DHCP server and an NFS server on the local network. The BOOTP/DHCP server is used to give the client system its networking information, while the actual files used during the installation are served by the NFS server. Often, these two servers run on the same physical machine, but they are not required to.

Include the `ks` kernel boot option in the `append` line of a target in your `pxelinux.cfg/default` file to specify the location of a kickstart file on your network. The syntax of the `ks` option in a `pxelinux.cfg/default` file is identical to its syntax when used at the boot prompt. Refer to Section 15.10, “Starting a Kickstart Installation” for a description of the syntax and refer to Example 15.2, “Using the `ks` option in the `pxelinux.cfg/default` file” for an example of an `append` line.

If the `dhcpd.conf` file on the DHCP server is configured to point to `/tftpboot/pxelinux.0` on the BOOTP server (whether on the same physical machine or not), systems configured to boot over the network can load the kickstart file and commence installation.

Example 15.2. Using the `ks` option in the `pxelinux.cfg/default` file
For example, if `foo.ks` is a kickstart file available on an NFS share at `192.168.0.200:/export/kickstart/`, part of your `pxelinux.cfg/default` file might include:

```
label 1
   kernel Fedora18/vmlinuz
   append initrd=Fedora18/initrd.img ramdisk_size=10000 ks=nfs:192.168.0.200:/export/kickstart/foo.ks
```

15.9. Making the Installation Tree Available

The kickstart installation must access an installation tree. An installation tree is a copy of the binary Fedora DVD with the same directory structure.

If you are performing a DVD-based installation, insert the Fedora installation DVD into the computer before starting the kickstart installation.

If you are performing a hard drive installation, make sure the ISO images of the binary Fedora DVD are on a hard drive in the computer.

If you are performing a network-based (NFS, FTP, or HTTP) installation, you must make the installation tree or ISO image available over the network. Refer to Section 5.1, “Preparing for a Network Installation” for details.

15.10. Starting a Kickstart Installation
Important — Kickstart installations and firstboot

Firstboot does not run after a system is installed from a Kickstart file unless a desktop and the X Window System were included in the installation and graphical login was enabled. Either specify a user with the user option in the Kickstart file before installing additional systems from it (refer to Section 15.4, “Kickstart Options” for details) or log into the installed system with a virtual console as root and add users with the adduser command.

To begin a kickstart installation, you must boot the system from boot media you have made or the Fedora DVD, and enter a special boot command at the boot prompt. The installation program looks for a kickstart file if the ks command line argument is passed to the kernel.

DVD and local storage

The linux ks= command also works if the ks.cfg file is located on a vfat or ext2 file system on local storage and you boot from the Fedora DVD.

With Driver Disk

If you need to use a driver disk with kickstart, specify the dd option as well. For example, if installation requires a kickstart file on a local hard drive and also requires a driver disk, boot the system with:

linux ks=hd:partition:[path]/ks.cfg dd

Boot CD-ROM

If the kickstart file is on a boot CD-ROM as described in Section 15.8.1, “Creating Kickstart Boot Media”, insert the CD-ROM into the system, boot the system, and enter the following command at the boot: prompt (where ks.cfg is the name of the kickstart file):

linux ks=cdrom:/ks.cfg

Other options to start a kickstart installation are as follows:

autostep
Make kickstart non-interactive.

dev
Start up pdb immediately.

dd
Use a driver disk.

dhcpclass=<class>
Sends a custom DHCP vendor class identifier. ISC’s dhcpcd can inspect this value using "option vendor-class-identifier".

dns=<dns>
Comma separated list of nameservers to use for a network installation.

driverdisk
Same as 'dd'.

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**expert**

Turns on special features:
- allows partitioning of removable media
- prompts for a driver disk

**gateway=\langle gw\rangle**

Gateway to use for a network installation.

**graphical**

Force graphical install. Required to have ftp/http use GUI.

**isa**

Prompt user for ISA devices configuration.

**ip=\langle ip\rangle**

IP to use for a network installation, use ‘dhcp’ for DHCP.

**ipv6=auto, ipv6=dhcp**

IPv6 configuration for the device. Use auto to specify automatic neighbor discovery or dhcp for a stateful configuration with DHCPv6. You cannot specify a static IPv6 address.

**keymap=\langle keymap\rangle**

Keyboard layout to use. Valid layouts include:
- **be-latin1** — Belgian
- **bg_bds-utf8** — Bulgarian
- **bg_pho-utf8** — Bulgarian (Phonetic)
- **br-abnt2** — Brazilian (ABNT2)
- **cf** — French Canadian
- **croat** — Croatian
- **cz-us-qwerty** — Czech
- **cz-lat2** — Czech (qwerty)
- **de** — German
- **de-latin1** — German (latin1)
- **de-latin1-nodeadkeys** — German (latin1 without dead keys)
- **dvorak** — Dvorak
- **dk** — Danish
- **dk-latin1** — Danish (latin1)
- **es** — Spanish
- **et** — Estonian
- **fi** — Finnish
• `fi-latin1` — Finnish (latin1)
• `fr` — French
• `fr-latin9` — French (latin9)
• `fr-latin1` — French (latin1)
• `fr-pc` — French (pc)
• `fr_CH` — Swiss French
• `fr_CH-latin1` — Swiss French (latin1)
• `gr` — Greek
• `hu` — Hungarian
• `hu101` — Hungarian (101 key)
• `is-latin1` — Icelandic
• `it` — Italian
• `it-ibm` — Italian (IBM)
• `it2` — Italian (it2)
• `jp106` — Japanese
• `ko` — Korean
• `la-latin1` — Latin American
• `mk-utf` — Macedonian
• `nl` — Dutch
• `no` — Norwegian
• `pl2` — Polish
• `pt-latin1` — Portuguese
• `ro` — Romanian
• `ru` — Russian
• `sr-cy` — Serbian
• `sr-latin` — Serbian (latin)
• `sv-latin1` — Swedish
• `sg` — Swiss German
• `sg-latin1` — Swiss German (latin1)
• `sk-qwerty` — Slovak (qwerty)
Starting a Kickstart Installation

- **slovene** — Slovenian
- **trq** — Turkish
- **uk** — United Kingdom
- **ua-utf** — Ukrainian
- **us-acentos** — U.S. International
- **us** — U.S. English

The file `/usr/lib/python2.6/site-packages/system_config_keyboard/keyboard_models.py` on 32-bit systems or `/usr/lib64/python2.6/site-packages/system_config_keyboard/keyboard_models.py` on 64-bit systems also contains this list and is part of the `system-config-keyboard` package.

### `ks=nfs:<server>:/<path>`

The installation program looks for the kickstart file on the NFS server `<server>`, as file `<path>`. The installation program uses DHCP to configure the Ethernet card. For example, if your NFS server is server.example.com and the kickstart file is in the NFS share `/mydir/ks.cfg`, the correct boot command would be `ks=nfs:server.example.com:/mydir/ks.cfg`.

### `ks=http://<server>:/<path>`

The installation program looks for the kickstart file on the HTTP server `<server>`, as file `<path>`. The installation program uses DHCP to configure the Ethernet card. For example, if your HTTP server is server.example.com and the kickstart file is in the HTTP directory `/mydir/ks.cfg`, the correct boot command would be `ks=http://server.example.com/mydir/ks.cfg`.

### `ks=hd:<device>:/<file>`

The installation program mounts the file system on `<device>` (which must be vfat or ext2), and looks for the kickstart configuration file as `<file>` in that file system (for example, `ks=hd:sda3:/mydir/ks.cfg`).

### `ks=bd:<biosdev>:/<path>`

The installation program mounts the file system on the specified partition on the specified BIOS device `<biosdev>`, and looks for the kickstart configuration file specified in `<path>` (for example, `ks=bd:80p3:/mydir/ks.cfg`). Note this does not work for BIOS RAID sets.

### `ks=file:/<file>`

The installation program tries to read the file `<file>` from the file system; no mounts are done. This is normally used if the kickstart file is already on the `initrd` image.

### `ks=cdrom:/<path>`

The installation program looks for the kickstart file on CD-ROM, as file `<path>`.

### `ks`

If `ks` is used alone, the installation program configures the Ethernet card to use DHCP. The kickstart file is read from NFS server specified by DHCP option server-name. The name of the kickstart file is one of the following:

- If DHCP is specified and the boot file begins with a `/`, the boot file provided by DHCP is looked for on the NFS server.

- If DHCP is specified and the boot file begins with something other than a `/`, the boot file provided by DHCP is looked for in the `/kickstart` directory on the NFS server.
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- If DHCP did not specify a boot file, then the installation program tries to read the file `/kickstart/1.2.3.4-kickstart`, where 1.2.3.4 is the numeric IP address of the machine being installed.

**ksdevice=<device>**

The installation program uses this network device to connect to the network. You can specify the device in one of five ways:

- the device name of the interface, for example, eth0
- the MAC address of the interface, for example, 00:12:34:56:78:9a
- the keyword `link`, which specifies the first interface with its link in the `up` state
- the keyword `bootif`, which uses the MAC address that `pxelinux` set in the `BOOTIF` variable. Set `IPAPPEND 2` in your `pxelinux.cfg` file to have `pxelinux` set the `BOOTIF` variable.
- the keyword `ibft`, which uses the MAC address of the interface specified by iBFT

For example, consider a system connected to an NFS server through the eth1 device. To perform a kickstart installation on this system using a kickstart file from the NFS server, you would use the command `ks=nfs:<server>:/<path> ksdevice=eth1` at the `boot:` prompt.

**kssendmac**

Adds HTTP headers to ks=http:// request that can be helpful for provisioning systems. Includes MAC address of all nics in CGI environment variables of the form: "X-RHN-Provisioning-MAC-0:eth0 01:23:45:67:89:ab".

**lang=<lang>**

Language to use for the installation. This should be a language which is valid to be used with the `lang` kickstart command.

**loglevel=<level>**

Set the minimum level required for messages to be logged. Values for `<level>` are debug, info, warning, error, and critical. The default value is info.

**mediacheck**

Activates loader code to test integrity of install source (if an ISO-based method).

**netmask=<nm>**

Netmask to use for a network installation.

**nofallback**

If GUI fails exit.

**nofb**

Do not load the VGA16 framebuffer required for doing text-mode installation in some languages.

**nofirewire**

Do not load support for firewire devices.

**noipv6**

Disable IPv6 networking during installation.
This option is not available during PXE installations

During installations from a PXE server, IPv6 networking might become active before `anaconda` processes the Kickstart file. If so, this option will have no effect during installation.

**nomount**
Don't automatically mount any installed Linux partitions in rescue mode.

**nonet**
Do not auto-probe network devices.

**noparport**
Do not attempt to load support for parallel ports.

**nopass**
Do not pass information about the keyboard and mouse from `anaconda` stage 1 (the loader) to stage 2 (the installer).

**nopcmcia**
Ignore PCMCIA controller in system.

**noprobe**
Do not automatically probe for hardware; prompt the user to allow `anaconda` to probe for particular categories of hardware.

**noshell**
Do not put a shell on tty2 during install.

**repo=cdrom**
Do a DVD based installation.

**repo=ftp://<path>**
Use `<path>` for an FTP installation.

**repo=hd:<dev>:\<path>**
Use `<path>` on `<dev>` for a hard drive installation.

**repo=http://<path>**
Use `<path>` for an HTTP installation.

**repo=nfs:<path>**
Use `<path>` for an NFS installation.

**rescue**
Run rescue environment.

**resolution=<mode>**
Run installer in mode specified, `1024x768` for example.

**serial**
Turns on serial console support.
skipddc
Do not probe the Data Display Channel (DDC) of the monitor. This option provides a workaround if the DDC probe causes the system to stop responding.

syslog=<host>[:<port>]
Once installation is up and running, send log messages to the syslog process on <host>, and optionally, on port <port>. Requires the remote syslog process to accept connections (the -r option).

text
Force text mode install.

Important
If you select text mode for a kickstart installation, make sure that you specify choices for the partitioning, bootloader, and package selection options. These steps are automated in text mode, and anaconda cannot prompt you for missing information. If you do not provide choices for these options, anaconda will stop the installation process.

updates
Prompt for storage device containing updates (bug fixes).

updates=ftp://<path>
Image containing updates over FTP.

updates=http://<path>
Image containing updates over HTTP.

upgradeany
Offer to upgrade any Linux installation detected on the system, regardless of the contents or the existence of the /etc/redhat-release file.

vnc
Enable vnc-based installation. You will need to connect to the machine using a vnc client application.

vncconnect=<host>[:<port>]
Connect to the vnc client named <host>, and optionally use port <port>.

Requires 'vnc' option to be specified as well.

vncpassword=<password>
Enable a password for the vnc connection. This will prevent someone from inadvertently connecting to the vnc-based installation.

Requires 'vnc' option to be specified as well.
**Kickstart Configurator**

*Kickstart Configurator* allows you to create or modify a kickstart file using a graphical user interface, so that you do not have to remember the correct syntax of the file.

*Kickstart Configurator* is not installed by default on Fedora 18. Run `su - yum install system-config-kickstart` or use your graphical package manager to install the software.

To launch *Kickstart Configurator*, boot your system into a graphical environment, then run `system-config-kickstart`, or click **Applications** → **System Tools** → **Kickstart** on the GNOME desktop or **Kickoff Application Launcher** → **Applications** → **System** → **Kickstart** on the KDE desktop.

As you are creating a kickstart file, you can click **File** → **Preview** at any time to review your current selections.

To start with an existing kickstart file, select **File** → **Open** and select the existing file.

### 16.1. Basic Configuration

![Basic Configuration](image)

Choose the language to use during the installation and as the default language to be used after installation from the **Default Language** menu.

Select the system keyboard type from the **Keyboard** menu.

From the **Time Zone** menu, choose the time zone to use for the system. To configure the system to use UTC, select **Use UTC clock**.
Enter the desired root password for the system in the **Root Password** text entry box. Type the same password in the **Confirm Password** text box. The second field is to make sure you do not mistype the password and then realize you do not know what it is after you have completed the installation. To save the password as an encrypted password in the file, select **Encrypt root password**. If the encryption option is selected, when the file is saved, the plain text password that you typed is encrypted and written to the kickstart file. Do not type an already encrypted password and select to encrypt it. Because a kickstart file is a plain text file that can be easily read, it is recommended that an encrypted password be used.

Choosing **Target Architecture** specifies which specific hardware architecture distribution is used during installation.

Choosing **Target Architecture** specifies which specific hardware architecture distribution is used during installation.

Choosing **Reboot system after installation** reboots your system automatically after the installation is finished.

Kickstart installations are performed in graphical mode by default. To override this default and use text mode instead, select the **Perform installation in text mode** option.

You can perform a kickstart installation in interactive mode. This means that the installation program uses all the options pre-configured in the kickstart file, but it allows you to preview the options in each screen before continuing to the next screen. To continue to the next screen, click the **Next** button after you have approved the settings or change them before continuing the installation. To select this type of installation, select the **Perform installation in interactive mode** option.

### 16.2. Installation Method

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<td>Pre-Installation Script</td>
<td></td>
</tr>
<tr>
<td>Post-Installation Script</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 16.2. Installation Method**
The **Installation Method** screen allows you to choose whether to perform a new installation or an upgrade. If you choose upgrade, the **Partition Information** and **Package Selection** options are disabled. They are not supported for kickstart upgrades.

Choose the type of kickstart installation or upgrade from the following options:

- **DVD** — Choose this option to install or upgrade from the Fedora DVD.

- **NFS** — Choose this option to install or upgrade from an NFS shared directory. In the text field for the NFS server, enter a fully-qualified domain name or IP address. For the NFS directory, enter the name of the NFS directory that contains the *variant* directory of the installation tree. For example, if the NFS server contains the directory `/mirrors/redhat/i386/Server/`, enter `/mirrors/redhat/i386/` for the NFS directory.

- **FTP** — Choose this option to install or upgrade from an FTP server. In the FTP server text field, enter a fully-qualified domain name or IP address. For the FTP directory, enter the name of the FTP directory that contains the *variant* directory. For example, if the FTP server contains the directory `/mirrors/redhat/i386/Server/`, enter `/mirrors/redhat/i386/Server/` for the FTP directory. If the FTP server requires a username and password, specify them as well.

- **HTTP** — Choose this option to install or upgrade from an HTTP server. In the text field for the HTTP server, enter the fully-qualified domain name or IP address. For the HTTP directory, enter the name of the HTTP directory that contains the *variant* directory. For example, if the HTTP server contains the directory `/mirrors/redhat/i386/Server/`, enter `/mirrors/redhat/i386/Server/` for the HTTP directory.

- **Hard Drive** — Choose this option to install or upgrade from a hard drive. Hard drive installations require the use of ISO images. Be sure to verify that the ISO images are intact before you start the installation. To verify them, use an **md5sum** program as well as the **linux rd.live.check** boot option as discussed in **Section 11.6.2, “Verifying boot media”**. Enter the hard drive partition that contains the ISO images (for example, `/dev/hda1`) in the **Hard Drive Partition** text box. Enter the directory that contains the ISO images in the **Hard Drive Directory** text box.
### 16.3. Boot Loader Options

**Figure 16.3. Boot Loader Options**

Please note that this screen will be disabled if you have specified a target architecture other than x86 / x86_64.

GRUB is the default boot loader for Fedora on x86 / x86_64 architectures. If you do not want to install a boot loader, select **Do not install a boot loader**. If you choose not to install a boot loader, make sure you create a boot diskette or have another way to boot your system, such as a third-party boot loader.

You must choose where to install the boot loader (the Master Boot Record or the first sector of the /boot partition). Install the boot loader on the MBR if you plan to use it as your boot loader.

To pass any special parameters to the kernel to be used when the system boots, enter them in the **Kernel parameters** text field. For example, if you have an IDE CD-ROM Writer, you can tell the kernel to use the SCSI emulation driver that must be loaded before using `cdrecord` by configuring `hdd=ide-scsi` as a kernel parameter (where `hdd` is the CD-ROM device).

You can password protect the GRUB boot loader by configuring a GRUB password. Select **Use GRUB password**, and enter a password in the **Password** field. Type the same password in the **Confirm Password** text field. To save the password as an encrypted password in the file, select **Encrypt GRUB password**. If the encryption option is selected, when the file is saved, the plain text password that you typed is encrypted and written to the kickstart file. If the password you typed was already encrypted, unselect the encryption option.

Whenever you are required to enter this password, you will also be asked for a username, which is **root**.

If **Upgrade an existing installation** is selected on the **Installation Method** page, select **Upgrade existing boot loader** to upgrade the existing boot loader configuration, while preserving the old entries.
16.4. Partition Information

Select whether or not to clear the Master Boot Record (MBR). Choose to remove all existing partitions, remove all existing Linux partitions, or preserve existing partitions.

To initialize the disk label to the default for the architecture of the system (for example, \texttt{msdos} for x86), select \textbf{Initialize the disk label} if you are installing on a brand new hard drive.

\textbf{Note} \hfill \begin{itemize}
\item Although \texttt{anaconda} and \texttt{kickstart} support Logical Volume Management (LVM), at present there is no mechanism for configuring this using the \texttt{Kickstart Configurator}.
\end{itemize}

16.4.1. Creating Partitions

To create a partition, click the \texttt{Add} button. The \textbf{Partition Options} window shown in Figure 16.5, “Creating Partitions” appears. Choose the mount point, file system type, and partition size for the new partition. Optionally, you can also choose from the following:

- In the \textbf{Additional Size Options} section, choose to make the partition a fixed size, up to a chosen size, or fill the remaining space on the hard drive. If you selected swap as the file system type, you can select to have the installation program create the swap partition with the recommended size instead of specifying a size.

- Force the partition to be created as a primary partition.

- Create the partition on a specific hard drive. For example, to make the partition on the first IDE hard disk (/dev/hda), specify \texttt{hda} as the drive. Do not include /dev in the drive name.
• Use an existing partition. For example, to make the partition on the first partition on the first IDE hard disk (/dev/hda1), specify hda1 as the partition. Do not include /dev in the partition name.

• Format the partition as the chosen file system type.

Figure 16.5. Creating Partitions

To edit an existing partition, select the partition from the list and click the Edit button. The same Partition Options window appears as when you chose to add a partition as shown in Figure 16.5, “Creating Partitions”, except it reflects the values for the selected partition. Modify the partition options and click OK.

To delete an existing partition, select the partition from the list and click the Delete button.

16.4.1.1. Creating Software RAID Partitions

To create a software RAID partition, use the following steps:

1. Click the RAID button.
2. Select **Create a software RAID partition**.

3. Configure the partitions as previously described, except select **Software RAID** as the file system type. Also, you must specify a hard drive on which to make the partition or specify an existing partition to use.

![Figure 16.6. Creating a Software RAID Partition](image)

Repeat these steps to create as many partitions as needed for your RAID setup. All of your partitions do not have to be RAID partitions.

After creating all the partitions needed to form a RAID device, follow these steps:

1. Click the **RAID** button.

2. Select **Create a RAID device**.

3. Select a mount point, file system type, RAID device name, RAID level, RAID members, number of spares for the software RAID device, and whether to format the RAID device.
4. Click **OK** to add the device to the list.

### 16.5. Network Configuration
If the system to be installed via kickstart does not have an Ethernet card, do not configure one on the Network Configuration page.

Networking is only required if you choose a networking-based installation method (NFS, FTP, or HTTP). Networking can always be configured after installation with the Network Administration Tool (system-config-network). Refer to the Fedora Deployment Guide for details.

For each Ethernet card on the system, click Add Network Device and select the network device and network type for the device. Select eth0 to configure the first Ethernet card, eth1 for the second Ethernet card, and so on.

16.6. Authentication
In the **Authentication** section, select whether to use shadow passwords and MD5 encryption for user passwords. These options are highly recommended and chosen by default.

The **Authentication Configuration** options allow you to configure the following methods of authentication:

- NIS
- LDAP
- Kerberos 5
- Hesiod
- SMB
- Name Switch Cache

These methods are not enabled by default. To enable one or more of these methods, click the appropriate tab, click the checkbox next to **Enable**, and enter the appropriate information for the authentication method. Refer to the Fedora Deployment Guide for more information about the options.

### 16.7. Firewall Configuration

The **Firewall Configuration** window is similar to the screen in the installation program and the **Security Level Configuration Tool**.
If **Disable firewall** is selected, the system allows complete access to any active services and ports. No connections to the system are refused or denied.

Selecting **Enable firewall** configures the system to reject incoming connections that are not in response to outbound requests, such as DNS replies or DHCP requests. If access to services running on this machine is required, you can choose to allow specific services through the firewall.

Only devices configured in the **Network Configuration** section are listed as available **Trusted devices**. Connections from any devices selected in the list are accepted by the system. For example, if **eth1** only receives connections from internal system, you might want to allow connections from it.

If a service is selected in the **Trusted services** list, connections for the service are accepted and processed by the system.

In the **Other ports** text field, list any additional ports that should be opened for remote access. Use the following format: `port:protocol`. For example, to allow IMAP access through the firewall, specify `imap:tcp`. Numeric ports can also be specified explicitly; to allow UDP packets on port 1234 through the firewall, enter `1234:udp`. To specify multiple ports, separate them with commas.

### 16.7.1. SELinux Configuration

Kickstart can set SELinux to **enforcing**, **permissive** or **disabled** mode. Finer grained configuration is not possible at this time.

### 16.8. Display Configuration

If you are installing the X Window System, you can configure it during the kickstart installation by checking the **Configure the X Window System** option on the **Display Configuration** window as shown in Figure 16.11, **“X Configuration”**. If this option is not chosen, the X configuration options are disabled and the **skipx** option is written to the kickstart file.
Select whether to start the Setup Agent the first time the installed system boots. The Setup Agent is disabled by default, but the setting can be changed to enabled or enabled in reconfiguration mode. Reconfiguration mode enables the language, mouse, keyboard, root password, security level, time zone, and networking configuration options in addition to the default ones.

16.9. Package Selection

The Package Selection window allows you to choose which package groups to install.
Package resolution is carried out automatically.

Currently, Kickstart Configurator does not allow you to select individual packages. To install individual packages, modify the `%packages` section of the kickstart file after you save it. Refer to Section 15.5, “Package Selection” for details.

### 16.10. Pre-Installation Script

You can add commands to run on the system immediately after the kickstart file has been parsed and before the installation begins. If you have configured the network in the kickstart file, the network is enabled before this section is processed. To include a pre-installation script, type it in the text area.

To specify a scripting language to use to execute the script, select the **Use an interpreter** option and enter the interpreter in the text box beside it. For example, `/usr/bin/python2.6` can be specified for a Python script. This option corresponds to using `%pre --interpreter /usr/bin/python2.6` in your kickstart file.

Only the most commonly used commands are available in the pre-installation environment:

```
arping, awk, basename, bash, bunzip2, bzcat, cat, chattr, chgrp, chmod, chown, chroot, chvt, clear, cp, cpio, cut, date, dd, df, dirname, dmesg, du, e2fsck, e2label, echo, egrep, eject, env, expr, false, fdisk, fgrep, find, fsck, fsck.ext2, fsck.ext3, ftp, grep, gunzip, gzip, hdparm, head, hostname, hwclock, ifconfig, insmod, ip, ipcalc, kill, killall, less, ln, load_policy, login, losetup, ls, lsattr, lsmod, lvm, md5sum, mkdir, mke2fs, mkfs.ext2, mkfs.ext3, mkinitfs, mkswap, mktemp, modprobe, more, mount, mt, mv, nslookup, openvt, pidof, ping, ps, pwd, readlink, rm, rmdir, rmmod, route, rpm, sed, sh, sha1sum, sleep, sort, swapoff, swapon, sync, tail, tar, tee, top, touch, true, tune2fs, umount, uniq, vconfig, vi, wc, wget, xargs, zcat.
```
16.11. Post-Installation Script

You can also add commands to execute on the system after the installation is completed. If the network is properly configured in the kickstart file, the network is enabled, and the script can include commands to access resources on the network. To include a post-installation script, type it in the text area.

**Important**

Do not include the `%post` command. It is added for you.
For example, to change the message of the day for the newly installed system, add the following command to the %post section:

```
echo "Hackers will be punished" > /etc/motd
```

**Note**

More examples can be found in Section 15.7.1, “Example”.

### 16.11.1. Chroot Environment

To run the post-installation script outside of the chroot environment, click the checkbox next to this option on the top of the Post-Installation window. This is equivalent to using the --nochroot option in the %post section.

To make changes to the newly installed file system, within the post-installation section, but outside of the chroot environment, you must prepend the directory name with /mnt/sysimage/.

For example, if you select **Run outside of the chroot environment**, the previous example must be changed to the following:

```
echo "Hackers will be punished" > /mnt/sysimage/etc/motd
```

### 16.11.2. Use an Interpreter

To specify a scripting language to use to execute the script, select the Use an interpreter option and enter the interpreter in the text box beside it. For example, /usr/bin/python2.2 can be specified for a Python script. This option corresponds to using %post --interpreter /usr/bin/python2.2 in your kickstart file.

### 16.12. Saving the File

To review the contents of the kickstart file after you have finished choosing your kickstart options, select File => Preview from the pull-down menu.
To save the kickstart file, click the **Save to File** button in the preview window. To save the file without previewing it, select **File => Save File** or press **Ctrl+S**. A dialog box appears. Select where to save the file.

After saving the file, refer to **Section 15.10, “Starting a Kickstart Installation”** for information on how to start the kickstart installation.
Part III. After installation

This part of the *Fedora Installation Guide* covers finalizing the installation, as well as some installation-related tasks that you might perform at some time in the future. These include:

- using a Fedora installation disk to rescue a damaged system.
- upgrading to a new version of Fedora.
- removing Fedora from your computer.
Firstboot

Important — Firstboot not available after text-mode installation

Firstboot is only available on systems after a graphical installation or after a kickstart installation where a desktop and the X window system were installed and graphical login was enabled. If you performed a text-mode installation or a kickstart installation that did not include a desktop and the X window system, the Firstboot configuration tool does not appear.

17.1. Welcome to Firstboot

Firstboot launches the first time that you start a new Fedora system. Use Firstboot to configure the system for use before you log in.

Welcome

There are a few more steps to take before your system is ready to use. The Setup Agent will now guide you through some basic configuration. Please click the "Forward" button in the lower right corner to continue.

Figure 17.1. Firstboot welcome screen

Select Forward to start Firstboot.
17.2. License Agreement

This screen displays the overall licensing terms for Fedora. Each software package in Fedora is covered by its own license. All licensing guidelines for Fedora are located at http://fedoraproject.org/wiki/Legal/Licenses.

![License Information]

Thank you for installing Fedora. Fedora is a compilation of software packages, each under its own license. The compilation is made available under the GNU General Public License version 2. There are no restrictions on using, copying, or modifying this code. However, there are restrictions and obligations that apply to the redistribution of the code, either in its original or a modified form. Among other things, those restrictions/obligations pertain to the licensing of the redistribution, trademark rights, and export control.

If you would like to understand what those restrictions are, please visit http://fedoraproject.org/wiki/Legal/Licenses/LicenseAgreement.

Understood, please proceed.

If you agree to the terms of the licence, click Forward.

17.3. Create User

Create a user account for yourself with this screen. Always use this account to log in to your Fedora system, rather than using the root account.
Figure 17.3. Firstboot create user screen

Enter a user name and your full name, and then enter your chosen password. Type your password once more in the Confirm Password box to ensure that it is correct.

Check the Add to Administrators group box if you would like administrative privileges. This will place you in the wheel group, which gives you access to all administrative functions, including installing and updating software, creating and altering configuration files, and administering other users.

To configure Fedora to use network services for authentication of user information, click Use Network Login. Refer to Section 17.3.1, “Authentication Configuration” for further details.

To create additional users or customise your first user account, click Advanced to open the User Manager.
In **User Manager** you can edit various properties, such as a private group for the user, the preferred login shell, and user and group IDs.

**Important — Create at least one user account**

If you do not create at least one user account in this step, you will not be able to log in to the Fedora graphical environment. If you skipped this step during installation, refer to Section 10.4.3, “Booting into a Graphical Environment”.

**Note — Creating Extra User Accounts**

To add additional user accounts to your system after the installation is complete, choose **System → Administration → Users & Groups**.

### 17.3.1. Authentication Configuration

If you clicked **Use Network Login** on the **Create User** screen, you must now specify how users are to be authenticated on the system. Use the drop-down menu to select from the following types of user database:
• **Local accounts only** (for use when the user database on the network is not accessible)

• **LDAP** (Lightweight Directory Access Protocol)

• **NIS** (Network Information Service)

• **Winbind** (for use with Microsoft Active Directory)

![Authentication Configuration](image)

**Figure 17.5. Firstboot Authentication Configuration screen**

When you select the type of user database appropriate for your network, you must provide additional details relevant to that database type. For example, if you select **LDAP**, you must specify the *base distinguished name* for LDAP searches, and the address of the LDAP server. You must also select an **Authentication Method** relevant to the type of user database that you chose, for example, a Kerberos password, LDAP password, or NIS password.

The **Advanced Options** tab lets you enable other authentication mechanisms, including fingerprint readers, smart cards, and local access control in `/etc/security/access.conf`. 
Figure 17.6. Firstboot authentication Advanced Options screen

The **Password Options** tab lets you set format requirements for user passwords, including minimum length and required character classes such as lower case, upper case, and numbers.
17.4. Date and Time

Use this screen to adjust the date and time of the system clock. To change these settings after installation, click System → Administration → Date & Time.
Chapter 17. Firstboot

Date and Time

Please set the date and time for the system.

Current date and time: Thu 18 Feb 2010 11:18:30 AM EST

☐ Synchronize date and time over the network

Manually set the date and time of your system:

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hour: 11</td>
</tr>
<tr>
<td></td>
<td>Minute: 14</td>
</tr>
<tr>
<td></td>
<td>Second: 57</td>
</tr>
</tbody>
</table>

Figure 17.8. Firstboot date and time screen

Click the Synchronize date and time over the network checkbox to configure your system to use Network Time Protocol (NTP) servers to maintain the accuracy of the clock. NTP provides time synchronization service to computers on the same network. Many public NTP servers are available on the Internet.

Click Finish to complete and exit Firstboot.
Your Next Steps

18.1. Updating Your System

The Fedora Project releases updated software packages for Fedora throughout the support period of each version. Updated packages add new features, improve reliability, resolve bugs, or remove security vulnerabilities. To ensure the security of your system, update regularly, and as soon as possible after a security announcement is issued. Refer to Section 18.4, “Subscribing to Fedora Announcements and News” for information on the Fedora announcements services.

An update applet reminds you of updates when they are available. This applet is installed by default in Fedora. It checks for software updates from all configured repositories, and runs as a background service. It generates a notification message on the desktop if updates are found, and you can click the message to update your system’s software.

To update your system with the latest packages manually, use Update System:

1. Choose System → Administration → Update System.
2. To review the list of updated packages, select Review.
3. Click Update System to begin the update process.
4. If one or more updates require a system reboot, the update process displays a dialog with the option to Reboot Now. Either select this option to reboot the system immediately, or Cancel it and reboot the system at a more convenient time.
5. If a reboot is not required the update will conclude with a dialog that indicates that the System Update Completed and all selected updates have been successfully installed as well as a button to Close Update System

To update packages from the command-line, use the yum utility. Type this command to begin a full update of your system with yum:

```
su -c 'yum update'
```
Enter the root password when prompted.

Refer to http://docs.fedoraproject.org/yum/ for more information on yum.

### Network Connection Required

Ensure that your system has an active network connection before you run the Update Software tool, or the yum utility. The update process downloads information and packages from a network of servers.

If your Fedora system has a permanent network connection, you may choose to enable daily system updates. To enable automatic updates, follow the instructions on the webpage http://docs.fedoraproject.org/yum/sn-updating-your-system.html.

### 18.2. Finishing an Upgrade

System Updates Recommended

Once you have rebooted your system after performing an upgrade, you should also perform a manual system update. Consult Section 18.1, "Updating Your System" for more information.

Most software repository configurations are stored in packages that end with the term release. Check the old package list for the repositories that were installed:

```
awk '{print $1}' ~/old-pkglist.txt | grep 'release$'
```

If necessary, retrieve and install these packages from their original sources on the Internet. Follow the instructions at the originating site to install the repository configuration packages for use by yum and other software management tools on your Fedora system.

Then run the following commands to make a list of other missing software packages:

```
awk '{print $1}' ~/old-pkglist.txt | sort | uniq > ~/old-pkgnames.txt
rpm -qa --qf '%{NAME}\n' | sort | uniq > ~/new-pkgnames.txt
diff -u ~/old-pkgnames.txt ~/new-pkgnames.txt | grep '^-' | sed 's/^-//' > /tmp/pkgs-to-install.txt
```

Now use the file /tmp/pkgs-to-install.txt with the yum command to restore most or all of your old software:

```
su -c 'yum install `cat /tmp/pkgs-to-install.txt`'
```
Missing Software

Due to changes in package complements between Fedora releases, it is possible this method may not restore all the software on your system. You can use the routines above to again compare the software on your system, and remedy any problems you find.

18.3. Switching to a Graphical Login

Important — Access to Software Repositories Might Be Required

To switch to a graphical environment, you might need to install extra software from a repository. You can access Fedora repositories through the Internet or use a Fedora installation DVD as a repository. Refer to Section 18.3.1, “Enabling Access to Software Repositories from the Command Line”.

If you installed using a text login and wish to switch to a graphical login, follow this procedure.

1. If you are not already root, switch users to the root account:

   su -

   Provide the administrator password when prompted.

2. If you have not already done so, install the X Window System and a graphical desktop environment. For example, to install the GNOME desktop environment, use this command:

   yum groupinstall "X Window System" Desktop

   To install the KDE desktop environment, use:

   yum groupinstall "X Window System" "KDE Desktop"

   This step may take some time as your Fedora system downloads and installs additional software. You may be asked to provide the installation media depending on your original installation source.

3. Run the following commands to change the run level:

   rm -f /etc/systemd/system/default.target
   ln -s /lib/systemd/system/graphical.target
   /etc/systemd/system/default.target

   Reboot the system using the reboot command. Your system will restart and present a graphical login.
Chapter 18. Your Next Steps

If you encounter any problems with the graphical login, refer to Chapter 10, Troubleshooting Installation on an Intel or AMD System.

18.3.1. Enabling Access to Software Repositories from the Command Line

The usual way to install new software on a Fedora system is through a software repository. You can access Fedora repositories through the Internet, or use a Fedora installation DVD as a repository. The software that you access through online repositories is more up-to-date than what is available on an installation DVD. Furthermore, configuring a Fedora system to access online repositories is generally easier than configuring the system to use an installation DVD as a repository, as long as you have an existing, wired network connection available.

18.3.1.1. Enabling Access to Software Repositories Through the Internet

By default, every Fedora installation is already configured to access Fedora repositories through the Internet. Therefore, all you must do is ensure that the system can access the Internet. If you have an existing, wired network connection available, this process is straightforward:

1. If you are not already root, switch users to the root account:

   su -

2. Ensure that the system is plugged into your network. Note that your network might be as small as two devices — a computer and an external modem/router.

3. Run `system-config-network`. The network configuration tool starts and displays the Select Action screen.

4. Select Device configuration and press Enter. The network configuration tool displays the Select A Device screen with a list of network interfaces present on your system. The first interface is named eth0 by default.

5. Select a network interface to configure and press Enter. The network configuration tool takes you to the Network Configuration screen.

6. You can manually configure a static IP, gateway, and DNS servers on this screen or leave these fields blank to accept the default values. When you have chosen a configuration, select OK, and press Enter. The network configuration tool takes you back to the Select A Device screen.

7. Select Save and press Enter. The network configuration tool takes you back to the Select Action screen.

8. Select Save&Quit and press Enter. The network configuration tool saves your settings and exits.

9. Run `ifup interface`, where interface is the network interface that you configured with the network configuration tool. For example, run `ifup eth0` to start eth0.

Configuration of dial-up or wireless Internet connections is more complicated and beyond the scope of this guide.

18.3.1.2. Using a Fedora Installation DVD as a Software Repository

To use a Fedora installation DVD as a software repository, either in the form of a physical disc, or in the form of an ISO image file.
1. If you are using a physical DVD, insert the disc into your computer.

2. If you are not already root, switch users to the root account:

   ```
su -
   ```

3. Create a mount point for the repository:

   ```
   mkdir -p /path/to/repo
   ```

   where `/path/to/repo` is a location for the repository, for example, `/mnt/repo`

4. Mount the DVD on the mount point that you just created. If you are using a physical disc, you need to know the device name of your DVD drive. You can find the names of any CD or DVD drives on your system with the command `cat /proc/sys/dev/cdrom/info`. The first CD or DVD drive on the system is typically named `sr0`. When you know the device name, mount the DVD:

   ```
   mount -r -t iso9660 /dev/device_name /path/to/repo
   ```

   For example: `mount -r -t iso9660 /dev/sr0 /mnt/repo`

   If you are using an ISO image file of a disc, mount the image file like this:

   ```
   mount -r -t iso9660 -o loop /path/to/image/file.iso /path/to/repo
   ```

   For example: `mount -r -o loop /home/root/Downloads/Fedora18-Server-i386-DVD.iso /mnt/repo`

   Note that you can only mount an image file if the storage device that holds the image file is itself mounted. For example, if the image file is stored on a hard drive that it not mounted automatically when the system boots, you must mount the hard drive before you mount an image file stored on that hard drive. Consider a hard drive named `/dev/sdb` that is not automatically mounted at boot time and which has an image file stored in a directory named `Downloads` on its first partition:

   ```
   mkdir /mnt/temp
   mount /dev/sdb1 /mnt/temp
   mkdir /mnt/repo
   mount -r -t iso9660 -o loop /mnt/temp/Downloads/Fedora-18-i386-DVD.iso /mnt/repo
   ```

   If you are not sure whether a storage device is mounted, run the `mount` command to obtain a list of current mounts. If you are not sure of the device name or partition number of a storage device, run `fdisk -l` and try to identify it in the output.

5. Create a new repo file in the `/etc/yum.repos.d/` directory. The name of the file is not important, as long as it ends in `.repo`. For example, `dvd.repo` is an obvious choice.

   1. Choose a name for the repo file and open it as a new file with the `vi` text editor. For example:

      ```
      vi /etc/yum.repos.d/dvd.repo
      ```

   2. Press the I key to enter insert mode.

   3. Supply the details of the repository. For example:
Chapter 18. Your Next Steps

```plaintext
[dvd]
baseurl=file:///mnt/repo/Server
enabled=1
gpgcheck=1
gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-fedora-$basearch
```

The name of the repository is specified in square brackets — in this example, `[dvd]`. The name is not important, but you should choose something that is meaningful and recognizable.

The line that specifies the `baseurl` should contain the path to the mount point that you created previously, suffixed with `/Server` for a Fedora server installation DVD, or with `/Client` for a Fedora client installation DVD.

4. Press the **Esc** key to exit **insert** mode.

5. Type `:wq` and press the **Enter** key to save the file and exit the **vi** text editor.

6. After installing or upgrading software from the DVD, delete the repo file that you created.

### 18.4. Subscribing to Fedora Announcements and News

To receive information about package updates, subscribe to either the announcements mailing list, or the RSS feeds.

**Fedora Project announcements mailing list**

[https://www.redhat.com/mailman/listinfo/fedora-announce-list](https://www.redhat.com/mailman/listinfo/fedora-announce-list)

**Fedora Project RSS feeds**

[http://fedoraproject.org/infofeed/](http://fedoraproject.org/infofeed/)

The announcements mailing list also provides you with news on the Fedora Project, and the Fedora community.

#### Security Announcements

Announcements with the keyword `[SECURITY]` in the title identify package updates that resolve security vulnerabilities.

### 18.5. Finding Documentation and Support

Members of the Fedora community provide support through mailing lists, Web forums and Linux User Groups (LUGs) across the world.


The following resources provide information on many aspects of Fedora:

- The FAQ on the Fedora Project website
  [http://fedoraproject.org/wiki/FAQ](http://fedoraproject.org/wiki/FAQ)

- The documents available from the Fedora Documentation Project Web site
  [http://docs.fedoraproject.org/](http://docs.fedoraproject.org/)
• The Linux Documentation Project (LDP)
  http://www.tldp.org/

• The Red Hat Enterprise Linux documentation, much of which also applies to Fedora
  http://www.redhat.com/docs/manuals/enterprise/

Many other organizations and individuals also provide tutorials and HOWTOs for Fedora on their Web sites.

18.6. Joining the Fedora Community
The Fedora Project is driven by the individuals that contribute to it. Community members provide support and documentation to other users, help to improve the software included in Fedora by testing, and develop new software alongside the programmers employed by Red Hat. The results of this work are available to all.

To make a difference, start here:

http://join.fedoraproject.org/
Upgrading Your Current System

This chapter explains how to upgrade your Fedora system.

19.1. Determining Whether to Upgrade or Re-Install

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

Before you choose 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.

- Third party or ISV applications may not work correctly following the upgrade.

- If you have additional third-party package repositories (such as rpmfusion) enabled, note that software installed from those repositories may not function properly after a system upgrade. Fedora does not maintain third-party packages and cannot guarantee that such repositories are up-to-date.

Upgrading your system installs 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.

Although less convenient, re-installing rather than upgrading Fedora guarantees that all packages are equipped with the latest default settings. If a package does not migrate settings when it is upgraded, then the package’s configuration may become outdated while the package itself does not. This is unlikely, but if you are concerned about configuration settings and are willing to spend more time setting up the latest version of Fedora, you may want to consider re-installing.

Warning

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.
Chapter 19. Upgrading Your Current 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 256 MB), it is recommended that you add this swap file.

19.2. Upgrading Your System

Note

fedup replaces both the preupgrade tool and the facility to upgrade using the installer. Anaconda no longer detects and upgrades existing Fedora installations.

In most cases, the simplest way to upgrade an existing Fedora installation is with the fedup tool. When a new version of Fedora is available, fedup downloads the packages necessary to upgrade your installation, and initiates the upgrade process.

1. Install fedup with your graphical package manager, or type `yum install fedup` at the command line and press Enter.
2. The command to run fedup will depend on where you choose to source packages from. Run one of the following commands as root and press Enter:
   - To upgrade using a network source:
     ```
     sudo fedup --network 18 --debuglog fedupdebug.log
     ```
   - To upgrade using a Fedora 18 ISO file you have downloaded:
     ```
     sudo fedup --iso /path/to/isofile.iso --debuglog=fedupdebug.log
     ```
   - To upgrade using a mounted storage device such as optical or USB media:
     ```
     sudo fedup --device /path/to/mountpoint --debuglog=fedupdebug.log
     ```

If the system you are updating has network access, the latest updates will also be installed regardless of which package source you specify.

3. If fedup runs successfully without errors, reboot your system.
4. In the GRUB menu at startup, select the new entry: System Upgrade.
5. fedup will now upgrade your system. It will again reboot the system on completion, and an option to boot Fedora 18 will then be present in the GRUB menu.

Once Fedora has been upgraded, update the GRUB bootloader. This is not mandatory, but is recommended for BIOS systems and strongly recommended for EFI systems.

On a BIOS system, run the following commands, where `disk` is the device or partition you want to boot from:

```
To update GRUB on EFI systems, GRUB2 must be installed (GRUB Legacy is no longer used on EFI systems beginning with Fedora 18), which makes this update particularly important. Follow this procedure to install GRUB2:

1. Install GRUB2 for EFI by running the following command:
   ```
sudo yum install grub2-efi
   ```

2. After the package has been installed, you will need to add a new EFI boot entry. You can base it on the command used when Fedora was first installed, which can be found in `/var/log/anaconda/anaconda.program.log` and should end with a command similar to:
   ```
   efibootmgr -c -w -L Fedora -d /dev/sdX -p Y -l \EFI\redhat\grub.efi
   ```
   Make a note of this command.

3. Find the current boot number for Fedora using `efibootmgr`:
   ```
   efibootmgr -v
   ```
   In the output, look for a line similar to the following:
   ```
   Boot0012* Fedora  HD(1,000,34800,6733749f-b42a-4b8c-a0de-5a1d3505f8af)File(\EFI\fedora\grubx64.efi)
   ```
   In this example, the boot number is 0012.

4. Remove the old boot entry with the following command:
   ```
   efibootmgr -b bootnumber -B
   ```

5. You can now create a new boot entry for `grub2-efi`. The command is run as root or `sudo` and is a modification of the command generated in step 2 appended with the boot number. The path to the `.efi` file is edited to reflect GRUB2 and must be in quotation marks or the system will not boot:
   ```
   sudo efibootmgr -c -w -L Fedora -d /dev/sdX -p Y -l '\EFI\fedora\grubx64.efi' -b bootnumber
   ```

6. Finally, refresh the `grub.cfg` file and establish a symlink to `/etc/grub2-efi.cfg`:
   ```
   grub2-mkconfig -o /boot/efi/EFI/fedora/grub.cfg
   ```
   After the next reboot, your system will be using `grub2-efi`. 

```
grub2-install disk
grub2-mkconfig -o /boot/grub2/grub.cfg
ln -sf /boot/grub2/grub.cfg /etc/grub2.cfg
```
### fedup can only upgrade from Fedora 17

Currently, `fedup` can only upgrade to Fedora 18 from Fedora 17. If you are upgrading from an earlier version than Fedora 17, you will first need to upgrade to Fedora 17 using `preupgrade` or the Fedora 17 installer and then use `fedup` to upgrade to Fedora 18.

Upgrading to each version incrementally is otherwise unnecessary. For example, you can upgrade from Fedora 14 to Fedora 17 directly.

### Note

If the contents of your `/etc/fedora-release` file have been changed from the default, your Fedora installation may not be found when attempting an upgrade to Fedora 18.

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 Fedora installation was not given as an option to upgrade.
Removing Fedora

We respect your freedom to choose an operating system for your computer. This section explains how to uninstall Fedora.

⚠️ These instructions may destroy data!

If you have data from Fedora that you want to keep, back it up before you proceed. Write your data to CD, DVD, external hard disk, or other storage device.

As a precaution, also back up data from any other operating systems that are installed on the same computer. Mistakes do happen and can result in the loss of all your data.

If you back up data from Fedora to be used later in another operating system, make sure that the storage medium or device is readable by that other operating system. For example, without extra third-party software, Microsoft Windows cannot read an external hard drive that you have formatted with Fedora to use the ext2, ext3, or ext4 file system.

To uninstall Fedora from your x86-based system, you must remove the Fedora boot loader information from your master boot record (MBR) and remove any partitions that contain the operating system. The method for removing Fedora from your computer varies, depending on whether Fedora is the only operating system installed on the computer, or whether the computer is configured to dual-boot Fedora and another operating system.

These instructions cannot cover every possible computer configuration. If your computer is configured to boot three or more operating systems, or has a highly-customized partition scheme, use the following sections as a general guide to partition removal with the various tools described. In these situations, you will also need to learn to configure your chosen bootloader. See Appendix E, The GRUB Boot Loader for a general introduction to the subject, but detailed instructions are beyond the scope of this document.

Legacy versions of Microsoft operating systems

Fdisk, the disk partitioning tool provided with MS-DOS and Microsoft Windows, is unable to remove the file systems used by Fedora. MS-DOS and versions of Windows prior to Windows XP (except for Windows 2000) have no other means of removing or modifying partitions. Refer to Section 20.3, “Replacing Fedora with MS-DOS or legacy versions of Microsoft Windows” for alternative removal methods for use with MS-DOS and these versions of Windows.

20.1. Fedora is the only operating system on the computer

If Fedora is the only operating system on your computer, use the installation media for the replacement operating system to remove Fedora. Examples of installation media include the Windows XP installation CD, Windows Vista installation DVD, or the installation CD, CDs, or DVD of another Linux distribution.

Note that some manufacturers of factory-built computers pre-installed with Microsoft Windows do not supply the Windows installation CD or DVD with the computer. The manufacturer may instead have
supplied their own “system restore disk”, or have included software with the computer that allowed you to create your own “system restore disk” when you first started the computer. In some cases, the system restore software is stored on a separate partition on the system’s hard drive. If you cannot identify the installation media for an operating system that was pre-installed on your computer, consult the documentation supplied with the machine, or contact the manufacturer.

When you have located the installation media for your chosen operating system:

1. Back up any data that you want to keep.
2. Shut down the computer.
3. Boot your computer with the installation disk for the replacement operating system.
4. Follow the prompts presented during the installation process. Windows, OS X, and most Linux installation disks allow you to manually partition your hard drive during the installation process, or will offer you the option to remove all partitions and start with a fresh partition scheme. At this point, remove any existing partitions that the installation software detects or allow the installer to remove the partitions automatically. “System restore” media for computers pre-installed with Microsoft Windows might create a default partition layout automatically without input from you.

**Warning**

If your computer has system restore software stored on a partition on a hard drive, take care when removing partitions while installing an operating system from other media. Under these circumstances, you could destroy the partition holding the system restore software.

### 20.2. Your computer dual-boots Fedora and another operating system

If your computer is configured to dual-boot Fedora and another operating system, removing Fedora without removing the partitions containing the other operating system and its data is more complicated. Specific instructions for a number of operating systems are set out below. To keep neither Fedora nor the other operating system, follow the steps described for a computer with only Fedora installed: *Section 20.1, “Fedora is the only operating system on the computer”*
Your computer dual-boots Fedora and a Microsoft Windows operating system

20.2.1. Your computer dual-boots Fedora and a Microsoft Windows operating system


Warning

Once you commence this process, your computer may be left in an unbootable state until you complete the entire set of instructions. Carefully read the steps below before beginning the removal process. Consider opening these instructions on another computer or printing them so that you have access to them at all times during the process.

This procedure relies on the Windows Recovery Console that loads from the Windows installation disk, so you will not be able to complete the procedure without access to this disk. If you start this procedure and do not complete it, you could leave your computer in a condition where you cannot boot it. The "system restore disk" supplied with some factory-built computers that are sold with Windows pre-installed on them might not include the Windows Recovery Console.

During the process outlined in these instructions, the Windows Recovery Console will prompt you for the Administrator password for your Windows system. Do not follow these instructions unless you know the Administrator password for your system or are certain that an Administrator password has never been created, even by the computer manufacturer.

1. Remove the Fedora partitions

   a. Boot your computer into your Microsoft Windows environment.

   b. Click Start>Run..., type diskmgmt.msc and press Enter. The Disk Management tool opens.

      The tool displays a graphical representation of your disk, with bars representing each partition. The first partition is usually labeled NTFS and corresponds to your C: drive. At least two Fedora partitions will be visible. Windows will not display a file system type for these partitions, but may allocate drive letters to some of them.

   c. Right-click on one of the Fedora partitions, then click Delete Partition and click Yes to confirm the deletion. Repeat this process for the other Fedora partitions on your system. As you delete partitions, Windows labels the space on the hard drive previously occupied by those partitions as unallocated.

2. Enable Windows to use the space on your hard drive vacated by Fedora (optional)
This step is not required to remove Fedora from your computer. However, if you skip this step, you will leave part of your hard drive’s storage capacity unusable by Windows. Depending on your configuration, this might be a significant portion of the storage capacity of the drive.

Decide whether to extend an existing Windows partition to use the extra space, or create a new Windows partition in that space. If you create new a Windows partition, Windows will allocate a new drive letter to it and will interact with it as if it is a separate hard drive.

**Extending an existing Windows partition**

The **diskpart** tool used in this step is installed as part of the Windows XP and Windows 2003 operating systems. If you are performing this step on a computer running Windows 2000 or Windows Server 2000, you can download a version of **diskpart** for your operating system from the Microsoft website.

a. Click **Start>Run...**, type **diskpart** and press **Enter**. A command window appears.

b. Type **list volume** and press **Enter**. **Diskpart** displays a list of the partitions on your system with a volume number, its drive letter, volume label, filesystem type, and size. Identify the Windows partition that you would like to use to occupy the space vacated on your hard drive by Fedora and take note of its volume number (for example, your Windows C: drive might be "Volume 0”).

c. Type **select volume N** (where N is the volume number for the Windows partition that you want to extend) and press **Enter**. Now type **extend** and press **Enter**. **Diskpart** now extends your chosen partition to fill the remaining space on your hard drive. It will notify you when the operation is complete.

**Adding a new Windows partition**

a. In the **Disk Management** window, right-click on disk space that Windows labels as **unallocated** and select **New Partition** from the menu. The **New Partition Wizard** starts.

b. Follow the prompts presented by the **New Partition Wizard**. If you accept the default options, the tool will create a new partition that fills all available space on the hard drive, assigns it the next available drive letter, and formats it with the NTFS file system.

3. **Restore the Windows bootloader**

   a. Insert the Windows installation disk and restart your computer. As your computer starts, the following message will appear on the screen for a few seconds:

```
Press any key to boot from CD
```
Your computer dual-boots Fedora and a Microsoft Windows operating system.

Press any key while the message is still showing and the Windows installation software will load.

b. When the **Welcome to Setup** screen appears, you can start the **Windows Recovery Console**. The procedure is slightly different on different versions of Windows:
   - On Windows 2000 and Windows Server 2000, press the **R** key, then the **C** key.
   - On Windows XP and Windows Server 2003, press the **R** key.

c. The **Windows Recovery Console** scans your hard drives for Windows installations, and assigns a number to each one. It displays a list of Windows installations and prompts you to select one. Type the number corresponding to the Windows installation that you want to restore.

d. The **Windows Recovery Console** prompts you for the Administrator password for your Windows installation. Type the Administrator password and press the **Enter** key. If there is no administrator password for this system, press only the **Enter** key.

e. At the prompt, type the command **fixmbr** and press the **Enter**. The **fixmbr** tool now restores the Master Boot Record for the system.

f. When the prompt reappears, type **exit** and press the **Enter** key.

g. Your computer will restart and boot your Windows operating system.

### 20.2.1.2. Windows Vista and Windows Server 2008

**Warning**

Once you commence this process, your computer may be left in an unbootable state until you complete the entire set of instructions. Carefully read the steps below before beginning the removal process. Consider opening these instructions on another computer or printing them so that you have access to them at all times during the process.

This procedure relies on the **Windows Recovery Environment** that loads from the Windows installation disk and you will not be able to complete the procedure without access to this disk. If you start this procedure and do not complete it, you could leave your computer in a condition where you cannot boot it. The "system restore disk" supplied with some factory-built computers that are sold with Windows pre-installed on them might not include the **Windows Recovery Environment**.

1. Remove the Fedora partitions
   a. Boot your computer into your Microsoft Windows environment.
   b. Click **Start** then type **diskmgmt.msc** into the **Start Search** box and press **Enter**. The **Disk Management** tool opens.

      The tool displays a graphical representation of your disk, with bars representing each partition. The first partition is usually labeled **NTFS** and corresponds to your **C**: drive. At least two
Fedora partitions will be visible. Windows will not display a file system type for these partitions, but may allocate drive letters to some of them.

c. Right-click on one of the Fedora partitions, then click Delete Partition and click Yes to confirm the deletion. Repeat this process for the other Fedora partitions on your system. As you delete partitions, Windows labels the space on the hard drive previously occupied by those partitions as unallocated.

2. Enable Windows to use the space on your hard drive vacated by Fedora (optional)

   ![Note]

   This step is not required to remove Fedora from your computer. However, if you skip this step, you will leave part of your hard drive’s storage capacity unusable by Windows. Depending on your configuration, this might be a a significant portion of the storage capacity of the drive.

   Decide whether to extend an existing Windows partition to use the extra space, or create a new Windows partition in that space. If you create new a Windows partition, Windows will allocate a new drive letter to it and will interact with it as if it is a separate hard drive.

   **Extending an existing Windows partition**
   
   a. In the Disk Management window, right-click on the Windows partition that you want to extend and select Extend Volume from the menu. The Extend Volume Wizard opens.

   b. Follow the prompts presented by the Extend Volume Wizard. If you accept the defaults that it offers you, the tool will extend the selected volume to fill all available space on the hard drive.

   **Adding a new Windows partition**
   
   a. In the Disk Management window, right-click on disk space that Windows labels as unallocated and select New Simple Volume from the menu. The New Simple Volume Wizard starts.

   b. Follow the prompts presented by the New Simple Volume Wizard. If you accept the default options, the tool will create a new partition that fills all available space on the hard drive, assigns it the next available drive letter, and formats it with the NTFS file system.

3. Restore the Windows bootloader

   a. Insert the Windows installation disk and restart your computer. As your computer starts, the following message will appear on the screen for a few seconds:

   ```
   Press any key to boot from CD or DVD
   ```

   Press any key while the message is still showing and the Windows installation software will load.

   b. In the Install Windows dialog, select a language, time and currency format, and keyboard type. Click Next

   c. Click Repair your computer.
d. The Windows Recovery Environment (WRE) shows you the Windows installations that it can detect on your system. Select the installation that you want to restore, then click Next.

e. Click Command prompt. A command window will open.

f. Type `bootrec /fixmbr` and press Enter.

g. When the prompt reappears, close the command window, then click Restart.

h. Your computer will restart and boot your Windows operating system.

20.2.2. Your computer dual-boots Fedora and Mac OS X

The procedure to remove Fedora from a system that dual-boots Fedora and Mac OS X varies depending on whether you have installed Boot Camp on your computer:

You are not using Boot Camp on your computer
1. Open the Disk Utility in /Applications/Utilities.
2. Select the entry on the left for the disk volume containing Fedora.
3. Click the Partition tab on the right side of the dialog.
4. Select the Fedora partitions and click the minus button below the partition layout diagram.
5. Resize your OS X partition to include the newly freed space.

You are using Boot Camp on your computer
1. Open the Boot Camp Assistant in /Applications/Utilities.
2. Select Create or remove a Windows partition and click Next.
3. If your computer has a single internal disk, click Restore.
4. If your computer has multiple internal disks, select the Linux disk, and then select Restore to a single Mac OS partition. Click Continue.

20.2.3. Your computer dual-boots Fedora and a different Linux distribution

Because of the differences between the many different Linux distributions, these instructions are a general guide only. Specific details vary according to the configuration of your particular system and the Linux distribution that dual-boots with Fedora.

1. Procedure 20.1. Remove Fedora partitions
   1. Boot your Fedora installation.
   2. As root or with `sudo`, run `mount`. Note the partitions that are mounted. In particular, note the partition that is mounted as the root of the filesystem. The output of `mount` on a system where the root of the filesystem is on a standard partition such as `/dev/sda2` might resemble:

```
/dev/sda2 on / type ext4 (rw)
proc on /proc type proc (rw)
sysfs on /sys type sysfs (rw)
devpts on /dev/pts type devpts (rw,gid=5,mode=620)
tmpfs on /dev/shm type tmpfs (rw,rootcontext="system_u:object_r:tmpfs_t:s0")
/dev/sda1 on /boot type ext4 (rw)
```
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The output of `mount` on a system where the root of the filesystem is on a logical volume might resemble:

```
/dev/mapper/VolGroup00-LogVol00 on / type ext4 (rw)
proc on /proc type proc (rw)
sysfs on /sys type sysfs (rw)
devpts on /dev/pts type devpts (rw,gid=5,mode=620)
tmpfs on /dev/shm type tmpfs (rw,rootcontext="system_u:object_r:tmpfs_t:s0")
/dev/sda1 on /boot type ext4 (rw)
none on /proc/sys/fs/binfmt_misc type binfmt_misc (rw)
sunrpc on /var/lib/nfs/rpc_pipefs type rpc_pipefs (rw)
```

3. Ensure that any data on this system that you still require is backed up to another system or storage location.

4. Shut down the system and boot the Linux distribution that you want to keep on the system.

5. As root or with `sudo`, run `mount`. If any of the partitions that you previously noted as used for Fedora are mounted, review the contents of these partitions. If you no longer require the contents of these partitions, unmount them with the `umount` command.

6. Remove any unwanted and unnecessary partitions, for example, with `fdisk` for standard partitions, or `lvremove` and `vgremove` to remove logical volumes and volume groups.

2. Remove Fedora entries from your bootloader

Example only

These instructions assume that your system uses the GRUB bootloader. If you use a different bootloader (such as LILO) consult the documentation for that software to identify and remove Fedora entries from its list of boot targets and to ensure that your default operating system is correctly specified.

a. At the command line, type `su -` and press Enter. When the system prompts you for the root password, type the password and press Enter.

b. Type `gedit etc/grub.d/10_linux` and press Enter. This opens the `10_linux` file in the gedit text editor.

c. A typical Fedora entry in the `10_linux` file consists of four lines:

```
Example 20.1. Example Fedora entry in 10_linux
menuentry "Fedora (2.6.32.130.el6.i686)"
  set root=(hd0,1)
  linux /vmlinuz-2.6.32.130.el6.i686 ro root=UUID=04a07c13-e6bf-6d5a-b207-002689545705 rhgb quiet
  initrd /initrd-2.6.32.130.el6.i686.img
```
Depending on the configuration of your system, there may be multiple Fedora entries in **10_linux**, each corresponding to a different version of the Linux kernel. Delete each of the Fedora entries from these files.

Save the updated **10_linux** file and close **gedit**.

d. Type `gedit etc/default/grub` and press **Enter**.

e. The file **etc/default/grub** contains a line that specifies the default operating system to boot, in the format `default=N` where `N` is a number equal to or greater than 0. If `N` is set to 0, **GRUB** will boot the first operating system in the list. If `N` is set to 1, it will boot the second operating system, and so forth. Alternatively, the default value can be the full menu entry.

Identify the entry for the operating system that you want **GRUB** to boot by default and note its place in the order within the list.

Make sure that the `default=` line contains the number **one below** the number of your chosen default operating system in the list.

Save the updated **grub** file and close **gedit**. If you have Fedora entries in the other script files in the **/etc/grub.d** directory, use this procedure to remove them in the same way.

3. **Make space available to your operating system**

   **Note**

   This step is not required to remove Fedora from your computer. However, if you skip this step, you will leave part of your hard drive's storage capacity unusable by your other Linux operating system. Depending on your configuration, this might be a significant portion of the storage capacity of the drive.

   **Note**

   To carry out this step, you require live media for a Linux distribution, for example, the Fedora Live CD or the Knoppix DVD.

   The method to make the space freed by removing the Fedora partitions available to your other Linux operating system differs, depending on whether your chosen operating system is installed on disk partitions configured to use Logical Volume Management (LVM) or not.

   • **If you do not use LVM**
     a. Boot your computer from Linux live media, and install **parted** if it is not already present.

     b. As root or with **sudo**, run **parted disk**, where **disk** is the device name of the disk that contains a partition that you want to resize, for example, **/dev/sda**.
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c. At the (parted) prompt, enter **print**. The parted tool displays information about the partitions on your system, including their partition numbers, their sizes, and their positions on the disk.

d. At the (parted) prompt, enter **resize number start end**, where *number* is the partition number, *start* is the location on the disk at which the partition begins, and *end* is the location on the disk at which you want the partition to end. Use the start position that you previously obtained with the print command, and refer to the parted documentation for different ways to specify the end parameter.

e. When parted finishes resizing the partition, enter **quit** at the (parted) prompt.

f. Run **e2fsck partition**, where *partition* is the partition that you just resized. For example, if you just resized /dev/sda3, enter **e2fsck /dev/sda3**.

Linux now checks the file system of the newly-resized partition.

g. When the file system check finishes, type **resize2fs partition** at a command line and press Enter, where *partition* is the partition that you just resized. For example, if you just resized /dev/sda3, type **resize2fs /dev/sda3**.

Linux now resizes your file system to fill the newly-resized partition.

h. Restart your computer. The extra space is now available to your Linux installation.

• If you use LVM

  a. Boot your computer from Linux live media and install fdisk and lvm2 if they are not already present.

  b. Create a new partition in the free space on the disk

     i. As root or with sudo, run **fdisk disk**, where *disk* is the device name of the disk where you want to create new space, for example, /dev/sda.

     ii. At the prompt **Command (m for help):**, enter **n** to create a new partition. Refer to the fdisk documentation for options.

  c. Change the partition type identifier

     i. At the prompt **Command (m for help):**, enter **t** to change a partition type.

     ii. At the prompt **Partition number (1-4):**, type the number of the partition that you just created. For example, if you just created partition /dev/sda3, type the number 3 and press Enter. This identifies the partition whose type fdisk will change.

     iii. At the prompt **Hex code (type L to list codes):**, enter 8e to create a Linux LVM partition.

     iv. At the prompt **Command (m for help):**, enter **w** to write the changes to disk and exit fdisk.

  d. Expand the volume group

     i. At the command prompt, type **lvm** and press Enter to start the lvm2 tool.

     ii. At the lvm> prompt, type **pvcreate partition** and press Enter, where *partition* is the partition that you recently created. For example, **pvcreate /dev/sda3**. This creates /dev/sda3 as a physical volume in LVM.
Replacing Fedora with MS-DOS or legacy versions of Microsoft Windows

iii. At the lvm> prompt, type `vgextend VolumeGroup partition` and press Enter, where `VolumeGroup` is the LVM volume group on which Linux is installed and `partition` is the partition that you recently created. For example, if Linux is installed on `/dev/VolumeGroup00`, you would type `vgextend /dev/VolumeGroup00 /dev/sda3` to extend that volume group to include the physical volume at `/dev/sda3`.

iv. At the lvm> prompt, type `lvextend -l +100%FREE LogVol` and press Enter, where `LogVol` is the logical volume that contains your Linux filesystem. For example, to extend `LogVol00` to fill the newly-available space in its volume group, `VolGroup00`, type `lvextend -l +100%FREE /dev/VolGroup00/LogVol00`.

v. At the lvm> prompt, type `exit` and press Enter to exit lvm2.

e. Type `e2fsck LogVol` at the command line and press Enter, where `LogVol` is the logical volume that you just resized. For example, if you just resized `/dev/VolumeGroup00/LogVol00`, you would type `e2fsck /dev/VolumeGroup00/LogVol00`.

Linux now checks the file system of the newly-resized logical volume.

f. When the file system check finishes, type `resize2fs LogVol` at a command line and press Enter, where `LogVol` is the partition that you just resized. For example, if you just resized `/dev/VolumeGroup00/LogVol00`, you would type `resize2fs /dev/VolumeGroup00/LogVol00`.

Linux now resizes your file system to fill the newly-resized logical volume.

g. Restart your computer. The extra space is now available to your Linux installation.

20.3. Replacing Fedora with MS-DOS or legacy versions of Microsoft Windows

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 Fedora DVD and boot your system. When the boot prompt appears, 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 Fedora.

Next, a screen appears telling you that the program attempts to find a Fedora 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 Fedora 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`, `ext4` 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`.
Part IV. Technical appendixes

The appendixes in this section do not contain instructions that tell you how to install Fedora. Instead, they provide technical background that you might find helpful to understand the options that Fedora offers you at various points in the installation process.
Appendix A. 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.

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

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

A.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 A.1, "An Unused Disk Drive", shows a brand-new, unused disk drive.

![Figure A.1. An Unused Disk Drive](image)

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.

A.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.
Appendix A. An Introduction to Disk Partitions

As Figure A.2, “Disk Drive with a File System”, 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 A.3, “Disk Drive with a Different File System”, 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, Fedora supports a wide variety of file systems (including many commonly used by other operating systems), making data interchange between different file systems easy.

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.

As Figure A.4, “Disk Drive with Data Written to It”, 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

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.
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.

A.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.

As Figure A.5, "Disk Drive with Partition Table" 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 A.6, “Disk Drive With Single Partition”, for an example.

![DOS Disk Drive With Single Partition](image)

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 A.1, “Partition Types”, it is adequate for the purposes of this discussion.

Table A.1, “Partition Types”, contains a listing of some popular (and obscure) partition types, along with their hexadecimal numeric values.

<table>
<thead>
<tr>
<th>Partition Type</th>
<th>Value</th>
<th>Partition Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty</td>
<td>00</td>
<td>Novell Netware 386</td>
<td>65</td>
</tr>
<tr>
<td>DOS 12-bit FAT</td>
<td>01</td>
<td>PIC/IX</td>
<td>75</td>
</tr>
<tr>
<td>XENIX root</td>
<td>02</td>
<td>Old MINIX</td>
<td>80</td>
</tr>
<tr>
<td>XENIX usr</td>
<td>03</td>
<td>Linux/MINUX</td>
<td>81</td>
</tr>
<tr>
<td>DOS 16-bit &lt;=32M</td>
<td>04</td>
<td>Linux swap</td>
<td>82</td>
</tr>
<tr>
<td>Extended</td>
<td>05</td>
<td>Linux native</td>
<td>83</td>
</tr>
<tr>
<td>DOS 16-bit &gt;=32</td>
<td>06</td>
<td>Linux extended</td>
<td>85</td>
</tr>
<tr>
<td>OS/2 HPFS</td>
<td>07</td>
<td>Amoeba</td>
<td>93</td>
</tr>
<tr>
<td>AIX</td>
<td>08</td>
<td>Amoeba BBT</td>
<td>94</td>
</tr>
<tr>
<td>AIX bootable</td>
<td>09</td>
<td>BSD/386</td>
<td>a5</td>
</tr>
<tr>
<td>OS/2 Boot Manager</td>
<td>0a</td>
<td>OpenBSD</td>
<td>a6</td>
</tr>
<tr>
<td>Win95 FAT32</td>
<td>0b</td>
<td>NEXTSTEP</td>
<td>a7</td>
</tr>
<tr>
<td>Win95 FAT32 (LBA)</td>
<td>0c</td>
<td>BSDI fs</td>
<td>b7</td>
</tr>
<tr>
<td>Win95 FAT16 (LBA)</td>
<td>0e</td>
<td>BSDI swap</td>
<td>b8</td>
</tr>
<tr>
<td>Win95 Extended (LBA)</td>
<td>0f</td>
<td>Syrinx</td>
<td>c7</td>
</tr>
</tbody>
</table>
### A.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 A.1, “Partition Types”, 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 A.7, “Disk Drive With Extended Partition”, shows a disk drive with one primary partition and one extended partition containing two logical partitions (along with some unpartitioned free space).

![Figure A.7. Disk Drive With Extended Partition](image)

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 Fedora.

### A.1.4. Making Room For Fedora
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 Fedora.

### A.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 A.8, “Disk Drive with Unpartitioned Free Space”*, shows what this might look like.

![Figure A.8. Disk Drive with Unpartitioned Free Space](image)

In *Figure A.8, “Disk Drive with Unpartitioned Free Space”*, 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 Fedora). Most pre-installed operating systems are configured to take up all available space on a disk drive (refer to *Section A.1.4.3, “Using Free Space from an Active Partition”*).

Next, we will discuss a slightly more common situation.

### A.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 A.9, “Disk Drive With an Unused Partition”*, illustrates such a situation.
In Figure A.9, “Disk Drive With an Unused Partition”, 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.

A.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.

Warning

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 Fedora installation. Figure A.10, “Disk Drive Being Destructively Repartitioned” shows this being done.
Appendix A. An Introduction to Disk Partitions

Figure A.10. Disk Drive Being Destructively Repartitioned

In Figure A.10, “Disk Drive Being Destructively Repartitioned”, 1 represents before and 2 represents after.

**Warning**

As Figure A.10, “Disk Drive Being Destructively Repartitioned”, 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.

**A.1.4.3.1. Compress existing data**

As Figure A.11, “Disk Drive Being Compressed”, 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 A.11. Disk Drive Being Compressed

In Figure A.11, “Disk Drive Being Compressed”, 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.

A.1.4.3.2. Resize the existing partition

Figure A.12, "Disk Drive with Partition Resized", 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.

In Figure A.12, "Disk Drive with Partition Resized", 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).

A.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 A.13, "Disk Drive with Final Partition Configuration", shows this being done.

In Figure A.13, "Disk Drive with Final Partition Configuration", 1 represents before and 2 represents after.

Note

The following information is specific to x86-based computers only.
Appendix A. An Introduction to Disk Partitions

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 Fedora, 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.

A.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.

Fedora 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 Fedora. Of course, this does not mean that Fedora 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 Fedora requires.

A.1.6. Disk Partitions and Other Operating Systems

If your Fedora 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.

A.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/gdm/custom.conf 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.

A.1.8. How Many Partitions?

At this point in the process of preparing to install Fedora, 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/, and / (root).
Appendix A. An Introduction to Disk Partitions

For more information, refer to Section 9.13.5, “Recommended Partitioning Scheme”.
Appendix B. ISCSI disks

*Internet Small Computer System Interface* (iSCSI) is a protocol that allows computers to communicate with storage devices by SCSI requests and responses carried over TCP/IP. Because iSCSI is based on the standard SCSI protocols, it uses some terminology from SCSI. The device on the SCSI bus to which requests get sent (and which answers these requests) is known as the *target* and the device issuing requests is known as the *initiator*. In other words, an iSCSI disk is a target and the iSCSI software equivalent of a SCSI controller or SCSI Host Bus Adapter (HBA) is called an initiator. This appendix only covers Linux as an iSCSI initiator: how Linux uses iSCSI disks, but not how Linux hosts iSCSI disks.

Linux has a software iSCSI initiator in the kernel that takes the place and form of a SCSI HBA driver and therefore allows Linux to use iSCSI disks. However, as iSCSI is a fully network-based protocol, iSCSI initiator support needs more than just the ability to send SCSI packets over the network. Before Linux can use an iSCSI target, Linux must find the target on the network and make a connection to it. In some cases, Linux must send authentication information to gain access to the target. Linux must also detect any failure of the network connection and must establish a new connection, including logging in again if necessary.

The discovery, connection, and logging in is handled in userspace by the `iscsiadm` utility, and the error handling is also handled in userspace by `iscsid`.

Both `iscsiadm` and `iscsid` are part of the `iscsi-initiator-utils` package under Fedora.

### B.1. iSCSI disks in anaconda

Anaconda can discover (and then log in to) iSCSI disks in two ways:

1. When anaconda starts, it checks if the BIOS or add-on boot ROMs of the system support iSCSI Boot Firmware Table (iBFT), a BIOS extension for systems which can boot from iSCSI. If the BIOS supports iBFT, anaconda will read the iSCSI target information for the configured boot disk from the BIOS and log in to this target, making it available as an installation target.

2. If you select the Specialized Storage Devices option during installation, the storage device selection screen presents you with an Add Advanced Target button. If you click this button, you can add iSCSI target information like the discovery IP address. Anaconda probes the given IP address and logs in to any targets that it finds.

While anaconda uses `iscsiadm` to find and log into iSCSI targets, `iscsiadm` automatically stores any information about these targets in the iscsiadm iSCSI database. Anaconda then copies this database to the installed system and marks any iSCSI targets not used for `/` so that the system will automatically log in to them when it starts. If `/` is placed on an iSCSI target, `initrd` will log into this target and anaconda does not include this target in start up scripts to avoid multiple attempts to log into the same target.

If `/` is placed on an iSCSI target, anaconda sets NetworkManager to ignore any network interfaces that were active during the installation process. These interfaces will also be configured by `initrd` when the system starts. If NetworkManager were to reconfigure these interfaces, the system would lose its connection to `/`.

### B.2. iSCSI disks during start up

iSCSI-related events might occur at a number of points while the system starts:

1. The init script in the `initrd` will log in to iSCSI targets used for `/` (if any). This is done using the `iscsistart` utility (which can do this without requiring `iscsid` to run).  

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Appendix B. ISCSI disks

2. When the root filesystem has been mounted and the various service initscripts get run, the **iscsid**
initscript will get called. This script will then start **iscsid** if any iSCSI targets are used for `/`, or if any targets in the iSCSI database are marked to be logged in to automatically.

3. After the classic network service script has been run (or would have been run if enabled) the iscsi initscript will run. If the network is accessible, this will log in to any targets in the iSCSI database which are marked to be logged in to automatically. If the network is not accessible, this script will exit quietly.

4. When using **NetworkManager** to access the network (instead of the classic network service script), **NetworkManager** will call the iscsi initscript. See: `/etc/NetworkManager/dispatcher.d/04-iscsi`

    **Important**

    Because **NetworkManager** is installed in `/usr`, you cannot use it to configure network access if `/usr` is on network-attached storage such as an iSCSI target.

If **iscsid** is not needed as the system starts, it will not start automatically. If you start **iscsiadm**, **iscsiadm** will start **iscsid** in turn.
Appendix C. Disk Encryption

C.1. What is block device encryption?
Block device encryption protects the data on a block device by encrypting it. To access the device’s decrypted contents, a user must provide a passphrase or key as authentication. This provides additional security beyond existing OS security mechanisms in that it protects the device’s contents even if it has been physically removed from the system.

C.2. Encrypting block devices using dm-crypt/LUKS
Linux Unified Key Setup (LUKS) is a specification for block device encryption. It establishes an on-disk format for the data, as well as a passphrase/key management policy.

LUKS uses the kernel device mapper subsystem via the dm-crypt module. This arrangement provides a low-level mapping that handles encryption and decryption of the device’s data. User-level operations, such as creating and accessing encrypted devices, are accomplished through the use of the cryptsetup utility.

C.2.1. Overview of LUKS

• What LUKS does:
  • LUKS encrypts entire block devices
  • LUKS is thereby well-suited for protecting the contents of mobile devices such as:
    • Removable storage media
    • Laptop disk drives
  • The underlying contents of the encrypted block device are arbitrary.
    • This makes it useful for encrypting swap devices.
  • This can also be useful with certain databases that use specially formatted block devices for data storage.
  • LUKS uses the existing device mapper kernel subsystem.
    • This is the same subsystem used by LVM, so it is well tested.
  • LUKS provides passphrase strengthening.
    • This protects against dictionary attacks.
  • LUKS devices contain multiple key slots.
    • This allows users to add backup keys/passphrases.

• What LUKS does not do:
  • LUKS is not well-suited for applications requiring many (more than eight) users to have distinct access keys to the same device.
  • LUKS is not well-suited for applications requiring file-level encryption.

More detailed information about LUKS is available from the project website at http://code.google.com/p/cryptsetup/.
C.2.2. How will I access the encrypted devices after installation? (System Startup)

During system startup you will be presented with a passphrase prompt. After the correct passphrase has been provided the system will continue to boot normally. If you used different passphrases for multiple encrypted devices you may need to enter more than one passphrase during the startup.

**Tip**

Consider using the same passphrase for all encrypted block devices in a given system. This will simplify system startup and you will have fewer passphrases to remember. Just make sure you choose a good passphrase!

C.2.3. Choosing a Good Passphrase

While dm-crypt/LUKS supports both keys and passphrases, the anaconda installer only supports the use of passphrases for creating and accessing encrypted block devices during installation.

LUKS does provide passphrase strengthening but it is still a good idea to choose a good (meaning “difficult to guess”) passphrase. Note the use of the term “passphrase”, as opposed to the term “password”. This is intentional. Providing a phrase containing multiple words to increase the security of your data is important.

C.3. Creating Encrypted Block Devices in Anaconda

You can create encrypted devices during system installation. This allows you to easily configure a system with encrypted partitions.

To enable block device encryption, check the "Encrypt System" checkbox when selecting automatic partitioning or the "Encrypt" checkbox when creating an individual partition, software RAID array, or logical volume. After you finish partitioning, you will be prompted for an encryption passphrase. This passphrase will be required to access the encrypted devices. If you have pre-existing LUKS devices and provided correct passphrases for them earlier in the install process the passphrase entry dialog will also contain a checkbox. Checking this checkbox indicates that you would like the new passphrase to be added to an available slot in each of the pre-existing encrypted block devices.

**Tip**

Checking the "Encrypt System" checkbox on the "Automatic Partitioning" screen and then choosing "Create custom layout" does not cause any block devices to be encrypted automatically.
What Kinds of Block Devices Can Be Encrypted?

Most types of block devices can be encrypted using LUKS. From anaconda you can encrypt partitions, LVM physical volumes, LVM logical volumes, and software RAID arrays.

C.3.2. Saving Passphrases

If you use a kickstart file during installation, you can automatically save the passphrases used during installation to an encrypted file (an escrow packet) on the local file system. To use this feature, you must have an X.509 certificate available at a location that anaconda can access. To specify the URL of this certificate, add the --escrowcert parameter to any of the autopart, logvol, part or raid commands. During installation, the encryption keys for the specified devices are saved in files in /root, encrypted with the certificate.

You can save escrow packets during installation only with the use of a kickstart file — refer to Chapter 15, Kickstart Installations for more detail. You cannot save an escrow packet during an interactive installation, although you can create one on an installed system with the volume_key tool. The volume_key tool also allows you to use the information stored in an escrow packet to restore access to an encrypted volume. Refer to the volume_key manpage for more information.

C.3.3. Creating and Saving Backup Passphrases

If you use a kickstart file during installation, anaconda can add a randomly generated backup passphrase to each block device on the system and save each passphrase to an encrypted file on the local file system. Specify the URL of this certificate with the --escrowcert parameter as described in Section C.3.2, “Saving Passphrases”, followed by the --backuppassphrase parameter for each of the kickstart commands that relate to the devices for which you want to create backup passphrases.

Note that this feature is available only while performing a kickstart installation. Refer to Chapter 15, Kickstart Installations for more detail.

C.4. Creating Encrypted Block Devices on the Installed System After Installation

Encrypted block devices can be created and configured after installation, using either the following method or Disk Utility.

C.4.1. Create the block devices

Create the block devices you want to encrypt by using parted, pvcreate, lvcreate and mdadm.

C.4.2. Optional: Fill the device with random data

Filling <device> (eg: /dev/sda3) with random data before encrypting it greatly increases the strength of the encryption. The downside is that it can take a very long time.
Appendix C. Disk Encryption

Warning

The commands below will destroy any existing data on the device.

- The best way, which provides high quality random data but takes a long time (several minutes per gigabyte on most systems):

  dd if=/dev/urandom of=<device>

- Fastest way, which provides lower quality random data:

  badblocks -c 10240 -s -w -t random -v <device>

C.4.3. Format the device as a dm-crypt/LUKS encrypted device

Warning

The command below will destroy any existing data on the device.

cryptsetup luksFormat <device>

Note

For more information, read the `cryptsetup(8)` man page.

After supplying the passphrase twice the device will be formatted for use. To verify, use the following command:

cryptsetup isLuks <device> && echo Success

To see a summary of the encryption information for the device, use the following command:

cryptsetup luksDump <device>

C.4.4. Create a mapping to allow access to the device’s decrypted contents

To access the device’s decrypted contents, a mapping must be established using the kernel `device-mapper`. 
Create filesystems on the mapped device, or continue to build complex storage structures using the mapped device

It is useful to choose a meaningful name for this mapping. LUKS provides a UUID (Universally Unique Identifier) for each device. This, unlike the device name (e.g: /dev/sda3), is guaranteed to remain constant as long as the LUKS header remains intact. To find a LUKS device's UUID, run the following command:

```bash
cryptsetup luksUUID <device>
```

An example of a reliable, informative and unique mapping name would be `luks-<uuid>`, where `<uuid>` is replaced with the device's LUKS UUID (e.g: `luks-50ec957a-5b5a-47ee-85e6-f8085bbc97a8`). This naming convention might seem unwieldy but is it not necessary to type it often.

```bash
cryptsetup luksOpen <device> <name>
```

There should now be a device node, `/dev/mapper/<name>`, which represents the decrypted device. This block device can be read from and written to like any other unencrypted block device.

To see some information about the mapped device, use the following command:

```bash
dmsetup info <name>
```

**Tip**

For more information, read the `dmsetup(8)` man page.

**C.4.5. Create filesystems on the mapped device, or continue to build complex storage structures using the mapped device**

Use the mapped device node (`/dev/mapper/<name>`) as any other block device. To create an `ext2` filesystem on the mapped device, use the following command:

```bash
mke2fs /dev/mapper/<name>
```

To mount this filesystem on `/mnt/test`, use the following command:

```bash
mount /dev/mapper/<name> /mnt/test
```

**Important**

The directory `/mnt/test` must exist before executing this command.

**C.4.6. Add the mapping information to `/etc/crypttab**

In order for the system to set up a mapping for the device, an entry must be present in the `/etc/crypttab` file. If the file doesn't exist, create it and change the owner and group to root (`root:root`) and change the mode to `0744`. Add a line to the file with the following format:
Appendix C. Disk Encryption

### Appendix C. Disk Encryption

The `<device>` field should be given in the form "UUID=<luks_uuid>", where `<luks_uuid>` is the LUKS uuid as given by the command `cryptsetup luksUUID <device>`. This ensures the correct device will be identified and used even if the device node (eg: `/dev/sda5`) changes.

**Tip**

For details on the format of the `/etc/crypttab` file, read the `crypttab(5)` man page.

#### C.4.7. Add an entry to `/etc/fstab`

Add an entry to `/etc/fstab`. This is only necessary if you want to establish a persistent association between the device and a mountpoint. Use the decrypted device, `/dev/mapper/<name>` in the `/etc/fstab` file.

In many cases it is desirable to list devices in `/etc/fstab` by UUID or by a filesystem label. The main purpose of this is to provide a constant identifier in the event that the device name (eg: `/dev/sda4`) changes. LUKS device names in the form of `/dev/mapper/luks-<luks_uuid>` are based only on the device's LUKS UUID, and are therefore guaranteed to remain constant. This fact makes them suitable for use in `/etc/fstab`.

**Tip**

For details on the format of the `/etc/fstab` file, read the `fstab(5)` man page.

#### C.5. Common Post-Installation Tasks

The following sections are about common post-installation tasks.

**C.5.1. Set a randomly generated key as an additional way to access an encrypted block device**

These sections are about generating keys and adding keys.

**C.5.1.1. Generate a key**

This will generate a 256-bit key in the file `$HOME/keyfile`.

```
dd if=/dev/urandom of=$HOME/keyfile bs=32 count=1
chmod 600 $HOME/keyfile
```

**C.5.1.2. Add the key to an available keyslot on the encrypted device**

```
cryptsetup luksAddKey <device> ~/keyfile
```
C.5.2. Add a new passphrase to an existing device

```
cryptsetup luksAddKey <device>
```

After being prompted for any one of the existing passphrases for authentication, you will be prompted to enter the new passphrase.

C.5.3. Remove a passphrase or key from a device

```
cryptsetup luksRemoveKey <device>
```

You will be prompted for the passphrase you wish to remove and then for any one of the remaining passphrases for authentication.
Appendix D. Understanding LVM

LVM (Logical Volume Management) partitions provide a number of advantages over standard partitions. LVM partitions are formatted as physical volumes. One or more physical volumes are combined to form a volume group. Each volume group's total storage is then divided into one or more logical volumes. The logical volumes function much like standard partitions. They have a file system type, such as ext4, and a mount point.

To understand LVM better, imagine the physical volume as a pile of blocks. A block is simply a storage unit used to store data. Several piles of blocks can be combined to make a much larger pile, just as physical volumes are combined to make a volume group. The resulting pile can be subdivided into several smaller piles of arbitrary size, just as a volume group is allocated to several logical volumes.

An administrator may grow or shrink logical volumes without destroying data, unlike standard disk partitions. If the physical volumes in a volume group are on separate drives or RAID arrays then administrators may also spread a logical volume across the storage devices.

You may lose data if you shrink a logical volume to a smaller capacity than the data on the volume requires. To ensure maximum flexibility, create logical volumes to meet your current needs, and leave excess storage capacity unallocated. You may safely grow logical volumes to use unallocated space, as your needs dictate.

LVM and the Default Partition Layout

By default, the installation process creates / and swap partitions within LVM volumes, with a separate /boot partition.
Appendix E. The GRUB Boot Loader

When a computer running Linux is turned on, the operating system is loaded into memory by a special program called a boot loader. A boot loader usually exists on the system's primary hard drive (or other media device) and has the sole responsibility of loading the Linux kernel with its required files or (in some cases) other operating systems into memory.

E.1. Boot Loaders and System Architecture

Each architecture capable of running Fedora uses a different boot loader. The following table lists the boot loaders available for each architecture:

<table>
<thead>
<tr>
<th>Architecture</th>
<th>Boot Loaders</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMD® AMD64</td>
<td>GRUB</td>
</tr>
<tr>
<td>IBM® eServer™ System p™</td>
<td>yaboot</td>
</tr>
<tr>
<td>IBM® System z®</td>
<td>z/IPL</td>
</tr>
<tr>
<td>x86</td>
<td>GRUB</td>
</tr>
</tbody>
</table>

This appendix discusses commands and configuration options for the GRUB boot loader included with Fedora for the x86 architecture.

E.2. GRUB

The GNU GRand Unified Boot loader (GRUB) is a program which enables the selection of the installed operating system or kernel to be loaded at system boot time. It also allows the user to pass arguments to the kernel.

E.2.1. GRUB and the boot process on BIOS-based x86 systems

This section describes the specific role GRUB plays when booting a BIOS-based x86 system. For a look at the overall boot process, refer to Section F.2, “A Detailed Look at the Boot Process”.

GRUB consists of the following images:

- **boot.img**: the first image to load in GRUB on BIOS-based x86 systems, which is written to either a master boot record (MBR) or the boot sector of a partition.\(^1\) Because a PC boot sector is 512 bytes, the size of this image is exactly 512 bytes.

  BIOS cannot read partition tables or file systems. It initializes the hardware, reads the MBR, then depends entirely on **boot.img** to continue the boot process. This image is similar to Stage 1 in GRUB Legacy.

- **diskboot.img**: the first sector of the core image once the system boots from a hard disk. It reads the remaining parts of the core image to memory before initializing the kernel.

\(^1\) For more on the system BIOS and the MBR, refer to Section F.2.1.1, “BIOS-based x86 systems”.

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Appendix E. The GRUB Boot Loader

- **cdboot.img**: the first sector of the core image once the system is booted from a CD-ROM drive, similar to `diskboot.img`.

- **core.img**: GRUB's core image, built dynamically by the `grub-mkimage` program using the kernel image and a list of modules. It typically has sufficient modules to access `/boot/grub2`, and loads the rest from the file system at run-time.

- **kernel.img**: the location of GRUB's basic run-time functions. Although built into all core images, it is rarely used directly.

- ***.mod**: the remainder of GRUB is located in dynamically loadable modules. These modules load automatically or are built into the core image if they are essential, or can be initialized manually by the `insmod` command.

The method used to boot Linux is called direct loading because the boot loader loads the operating system directly. There is no intermediary between the boot loader and the kernel.

The boot process used by other operating systems may differ. For example, the Microsoft® Windows® operating system, as well as other operating systems, are loaded using chain loading. Under this method, the MBR points to the first sector of the partition holding the operating system, where it finds the files necessary to actually boot that operating system.

GRUB supports both direct and chain loading boot methods, allowing it to boot almost any operating system.

**Warning**

During installation, Microsoft's DOS and Windows installation programs completely overwrite the MBR, destroying any existing boot loaders. If creating a dual-boot system, it is best to install the Microsoft operating system first.

### E.2.2. GRUB and the boot process on UEFI-based x86 systems

This section describes the specific role GRUB plays when booting a UEFI-based x86 system. For a look at the overall boot process, refer to Section F.2, “A Detailed Look at the Boot Process”.

GRUB loads itself into memory in the following stages:

1. The UEFI-based platform reads the partition table on the system storage and mounts the **EFI System Partition** (ESP), a VFAT partition labeled with a particular globally unique identifier (GUID). The ESP contains EFI applications such as bootloaders and utility software, stored in directories specific to software vendors. Viewed from within the Fedora 18 file system, the ESP is `/boot/efi/`, and EFI software provided by Red Hat is stored in `/boot/efi/EFI/fedora/`.

2. The `/boot/efi/EFI/fedora/` directory contains `grub.efi`, a version of GRUB compiled for the EFI firmware architecture as an EFI application. In the simplest case, the EFI boot manager selects `grub.efi` as the default bootloader and reads it into memory.

   If the ESP contains other EFI applications, the EFI boot manager might prompt you to select an application to run, rather than load `grub.efi` automatically.

3. GRUB determines which operating system or kernel to start, loads it into memory, and transfers control of the machine to that operating system.
Because each vendor maintains its own directory of applications in the ESP, chain loading is not normally necessary on UEFI-based systems. The EFI boot manager can load any of the operating system bootloaders that are present in the ESP.

E.2.3. Features of GRUB

GRUB contains several features that make it preferable to other boot loaders available for the x86 architecture. Below is a partial list of some of the more important features:

• **GRUB provides a true command-based, pre-OS environment on x86 machines.** This feature affords the user maximum flexibility in loading operating systems with specified options or gathering information about the system. For years, many non-x86 architectures have employed pre-OS environments that allow system booting from a command line.

• **GRUB supports Logical Block Addressing (LBA) mode.** LBA places the addressing conversion used to find files in the hard drive's firmware, and is used on many IDE and all SCSI hard devices. Before LBA, boot loaders could encounter the 1024-cylinder BIOS limitation, where the BIOS could not find a file after the 1024 cylinder head of the disk. LBA support allows GRUB to boot operating systems from partitions beyond the 1024-cylinder limit, so long as the system BIOS supports LBA mode. Most modern BIOS revisions support LBA mode.

• **GRUB can read ext2 partitions.** This functionality allows GRUB to access its configuration file, `/boot/grub2/grub.cfg`, every time the system boots, eliminating the need for the user to write a new version of the first stage boot loader to the MBR when configuration changes are made. The only time a user needs to reinstall GRUB on the MBR is if the physical location of the `/boot/` partition is moved on the disk. For details on installing GRUB to the MBR, refer to Section E.3, “Installing GRUB”.

E.3. Installing GRUB

If GRUB was not installed during the installation process, it can be installed afterward. Once installed, it automatically becomes the default boot loader.

Before installing GRUB, make sure to use the latest GRUB package available or use the GRUB package from the installation DVD. For instructions on installing packages, refer to the chapter titled Package Management with RPM in the Fedora Deployment Guide.

Once the GRUB package is installed, open a root shell prompt and run the command `grub2-install <location>`, where `<location>` is the location that the GRUB Stage 1 boot loader should be installed (specifying it is not required on EFI systems). For example, the following command installs GRUB to the MBR of the master IDE device on the primary IDE bus on a BIOS system:

```
grub2-install /dev/hda
```

The next time the system boots, the GRUB graphical boot loader menu appears before the kernel loads into memory.
Important

Beginning in Fedora 18, GRUB2 can no longer be installed to a partition.

E.4. GRUB Terminology

One of the most important things to understand before using GRUB is how the program refers to devices, such as hard drives and partitions. This information is particularly important when configuring GRUB to boot multiple operating systems.

E.4.1. Device Names

When referring to a specific device with GRUB, do so using the following format (note that the parentheses and comma are very important syntactically):

\[(<type-of-device><bios-device-number>,<partition-number>)\]

The \(<type-of-device>\) specifies the type of device from which GRUB boots. The two most common options are \(hd\) for a hard disk or \(fd\) for a 3.5 diskette. A lesser used device type is also available called \(nd\) for a network disk. Instructions on configuring GRUB to boot over the network are available online at http://www.gnu.org/software/grub/manual/.

The \(<bios-device-number>\) is the BIOS device number. The primary IDE hard drive is numbered 0 and a secondary IDE hard drive is numbered 1. This syntax is roughly equivalent to that used for devices by the kernel. For example, the \(a\) in \(hda\) for the kernel is analogous to the \(0\) in \(hd0\) for GRUB, the \(b\) in \(hdb\) is analogous to the \(1\) in \(hd1\), and so on.

The \(<partition-number>\) specifies the number of a partition on a device. Unlike the \(<bios-device-number>\), most types of partitions are numbered starting at 1. However, BSD partitions are specified using letters, with \(a\) corresponding to 1, \(b\) corresponding to 2, and so on.

Note

The numbering system for devices under GRUB always begins with 0, not 1. Failing to make this distinction is one of the most common mistakes made by new users.

GRUB2 features new partition numbering

Fedora 18 incorporates GRUB2, which numbers partitions and devices differently. Instead of 0, partition numbering begins at 1. However, device numbering still begins at 0.
To give an example, if a system has more than one hard drive, GRUB refers to the first hard drive as \((hd0)\) and the second as \((hd1)\). Likewise, GRUB refers to the first partition on the first drive as \((hd0,1)\) and the third partition on the second hard drive as \((hd1,3)\).

In general the following rules apply when naming devices and partitions under GRUB:

- It does not matter if system hard drives are IDE or SCSI, all hard drives begin with the letters `hd`. The letters `fd` are used to specify 3.5 diskettes.

- To specify an entire device without respect to partitions, leave off the comma and the partition number. This is important when telling GRUB to configure the MBR for a particular disk. For example, \((hd0)\) specifies the MBR on the first device and \((hd3)\) specifies the MBR on the fourth device.

- If a system has multiple drive devices, it is very important to know how the drive boot order is set in the BIOS. This is a simple task if a system has only IDE or SCSI drives, but if there is a mix of devices, it becomes critical that the type of drive with the boot partition be accessed first.

### E.4.2. File Names and Blocklists

When typing commands to GRUB that reference a file, such as a menu list, it is necessary to specify an absolute file path immediately after the device and partition numbers.

The following illustrates the structure of such a command:

\((<device-type><device-number>,<partition-number>)<path/to/file>\)

In this example, replace `<device-type>` with `hd`, `fd`, or `nd`. Replace `<device-number>` with the integer for the device. Replace `<path/to/file>` with an absolute path relative to the top-level of the device.

It is also possible to specify files to GRUB that do not actually appear in the file system, such as a chain loader that appears in the first few blocks of a partition. To load such files, provide a blocklist that specifies block by block where the file is located in the partition. Since a file is often comprised of several different sets of blocks, blocklists use a special syntax. Each block containing the file is specified by an offset number of blocks, followed by the number of blocks from that offset point. Block offsets are listed sequentially in a comma-delimited list.

The following is a sample blocklist:

\(0+50,100+25,200+1\)

This sample blocklist specifies a file that starts at the first block on the partition and uses blocks 0 through 49, 100 through 124, and 200.

Knowing how to write blocklists is useful when using GRUB to load operating systems which require chain loading. It is possible to leave off the offset number of blocks if starting at block 0. As an example, the chain loading file in the first partition of the first hard drive would have the following name:

\((hd0,1)+1\)
The following shows the `chainloader` command with a similar blocklist designation at the GRUB command line after setting the correct device and partition as root:

```
chainloader +1
```

### E.4.3. The Root File System and GRUB

The use of the term *root file system* has a different meaning in regard to GRUB. It is important to remember that GRUB's root file system has nothing to do with the Linux root file system.

The GRUB root file system is the top level of the specified device. For example, the image file `(hd1,1)/grub/splash.xpm.gz` is located within the `/grub/` directory at the top-level (or root) of the `(hd1,1)` partition (which is actually the `/boot/` partition for the system).

Next, the `linux` command is executed with the location of the kernel file as an option. Once the Linux kernel boots, it sets up the root file system that Linux users are familiar with. The original GRUB root file system and its mounts are forgotten; they only existed to boot the kernel file.

Refer to the `root` and `linux` commands in Section E.6, “GRUB Commands” for more information.

### E.5. GRUB Interfaces

GRUB features three interfaces which provide different levels of functionality. Each of these interfaces allows users to boot the Linux kernel or another operating system.

The interfaces are as follows:

**Note**

The following GRUB interfaces can only be accessed by pressing any key within the three seconds of the GRUB menu bypass screen.

**Menu Interface**

This is the default interface shown when GRUB is configured by the installation program. A menu of operating systems or preconfigured kernels are displayed as a list, ordered by name. Use the arrow keys to select an operating system or kernel version and press the Enter key to boot it. If you do nothing on this screen, then after the time out period expires GRUB will load the default option.

Press the `e` key to enter the entry editor interface or the `c` key to load a command line interface.

Refer to Section E.7, “GRUB Menu Configuration File” for more information on configuring this interface.

**Menu Entry Editor Interface**

To access the menu entry editor, press the `e` key from the boot loader menu. The GRUB commands for that entry are displayed here, and users may alter these command lines before booting the operating system by adding a command line (`o` inserts a new line after the current line and `O` inserts a new line before it), editing one (`e`), or deleting one (`d`).

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After all changes are made, the b key executes the commands and boots the operating system. The Esc key discards any changes and reloads the standard menu interface. The c key loads the command line interface.

Note

For information about changing runlevels using the GRUB menu entry editor, refer to Section E.8, “Changing Runlevels at Boot Time”.

Command Line Interface

The command line interface is the most basic GRUB interface, but it is also the one that grants the most control. The command line makes it possible to type any relevant GRUB commands followed by the Enter key to execute them. This interface features some advanced shell-like features, including Tab key completion based on context, and Ctrl key combinations when typing commands, such as Ctrl+a to move to the beginning of a line and Ctrl+e to move to the end of a line. In addition, the arrow, Home, End, and Delete keys work as they do in the bash shell.

Refer to Section E.6, “GRUB Commands” for a list of common commands.

E.5.1. Interfaces Load Order

When GRUB loads its second stage boot loader, it first searches for its configuration file. Once found, the menu interface bypass screen is displayed. If a key is pressed within three seconds, GRUB builds a menu list and displays the menu interface. If no key is pressed, the default kernel entry in the GRUB menu is used.

If the configuration file cannot be found, or if the configuration file is unreadable, GRUB loads the command line interface, allowing the user to type commands to complete the boot process.

If the configuration file is not valid, GRUB prints out the error and asks for input. This helps the user see precisely where the problem occurred. Pressing any key reloads the menu interface, where it is then possible to edit the menu option and correct the problem based on the error reported by GRUB. If the correction fails, GRUB reports an error and reloads the menu interface.

E.6. GRUB Commands

GRUB allows a number of useful commands in its command line interface. Some of the commands accept options after their name; these options should be separated from the command and other options on that line by space characters.

The following is a list of useful commands:

- **boot** — Boots the operating system or chain loader that was last loaded.

- **chainloader** `<path/to/file>` — Loads the specified file as a chain loader. If the file is located on the first sector of the specified partition, use the blocklist notation, `+1`, instead of the file name.

The following is an example chainloader command:
Appendix E. The GRUB Boot Loader

- **displaymem** — Displays the current use of memory, based on information from the BIOS. This is useful to determine how much RAM a system has prior to booting it.

- **initrd */path/to/initrd* — Enables users to specify an initial RAM disk to use when booting. An initrd is necessary when the kernel needs certain modules in order to boot properly, such as when the root partition is formatted with the ext3 or ext4 file system.

The following is an example initrd command:

```ini
initrd /initrd-2.6.8-1.523.img
```

- **install <stage-1> <install-disk> <stage-2> p config-file** — Installs GRUB to the system MBR.

  - **<stage-1>** — Signifies a device, partition, and file where the first boot loader image can be found, such as `(hd1,1)/grub/stage1`.

  - **<install-disk>** — Specifies the disk where the stage 1 boot loader should be installed, such as `(hd0)`.

  - **<stage-2>** — Passes the stage 2 boot loader location to the stage 1 boot loader, such as `(hd1,1)/grub/stage2`.

  - **p <config-file>** — This option tells the install command to look for the menu configuration file specified by <config-file>, such as `(hd0,1)/grub/grub.conf`.

**Warning**

The install command overwrites any information already located on the MBR.

- **linux */path/to/linux* <option-1> ...** — Specifies the kernel file to load when booting the operating system. Replace */path/to/linux* with an absolute path from the partition specified by the root command. Replace <option-1> with options for the Linux kernel, such as `set root=/dev/VolGroup00/LogVol00` to specify the device on which the root partition for the system is located. Multiple options can be passed to the kernel in a space separated list.

The following is an example kernel command:

```ini
linux /vmlinuz-2.6.8-1.523 ro root=/dev/VolGroup00/LogVol00
```

The option in the previous example specifies that the root file system for Linux is located on the hd1a5 partition.
• set root=\(<device-type><device-number>,<partition>\) — Configures the root partition for GRUB, such as (hd1,1), and mounts the partition.

The following is an example root command:

```bash
set root=(hd0,1)
```

Other commands are also available; type help -all for a full list of commands. For a description of all GRUB commands, refer to the documentation available online at http://www.gnu.org/software/grub/manual/.

E.7. GRUB Menu Configuration File

The configuration file (/boot/grub2/grub.cfg), which is used to create the list of operating systems to boot in GRUB’s menu interface, essentially allows the user to select a pre-set group of commands to execute. The commands given in Section E.6, “GRUB Commands” can be used, as well as some special commands that are only available in the configuration file. Changes to grub.cfg are enacted by editing etc/default/grub and files in the etc/grub.d directory, particularly 10_linux and 40_custom, and then running the following command with root privileges:

```
grub2-mkconfig --output=/boot/grub2/grub.cfg
```

E.7.1. Configuration File Structure

The GRUB menu interface configuration file is /boot/grub2/grub.cfg. The commands to set the global preferences for the menu interface are placed at the top of the file, followed by stanzas for each operating kernel or operating system listed in the menu.

The following is a very basic GRUB menu configuration file designed to boot Fedora:

```bash
menuentry 'Fedora Linux, with Linux 3.1.0-0.rc6.git0.3.fc16.x86_64'
set root='(hd0,1)'
linux /vmlinuz-2.6.27.19-170.2.35.fc18.i686 ro root=UUID=04a07c13-e6bf-6d5a-b207-002689545705 rhgb quiet
initrd /initramfs-3.1.0-0.rc6.git0.3.fc16.x86_64.img
```

Configuring a GRUB menu configuration file to boot multiple operating systems is beyond the scope of this chapter. Consult Section E.9, “Additional Resources” for a list of additional resources.

E.7.2. Configuration File Directives

The following are directives commonly used in the GRUB menu configuration file:

• chainloader \(<\text{path/to/file}>\) — Loads the specified file as a chain loader. Replace \(<\text{path/to/file}>\) with the absolute path to the chain loader. If the file is located on the first sector of the specified partition, use the blocklist notation, \(+1\).

• color \(<\text{normal-color}> <\text{selected-color}>\) — Allows specific colors to be used in the menu, where two colors are configured as the foreground and background. Use simple color names such as red/black. For example:
Appendix E. The GRUB Boot Loader

| color red/black green/blue |

- **default=<integer>** — Replace `<integer>` with the default entry title number to be loaded if the menu interface times out.

- **fallback=<integer>** — Replace `<integer>` with the entry title number to try if the first attempt fails.

- **hiddenmenu** — Prevents the GRUB menu interface from being displayed, loading the `default` entry when the `timeout` period expires. The user can see the standard GRUB menu by pressing the **Esc** key.

- **initrd */path/to/initrd* **— Enables users to specify an initial RAM disk to use when booting. Replace */path/to/initrd* with the absolute path to the initial RAM disk.

- **linux */path/to/linux* <option-1> <option-N>** — Specifies the kernel file to load when booting the operating system. Replace */path/to/linux* with an absolute path from the partition specified by the root directive. Multiple options can be passed to the kernel when it is loaded.

These options include:

- **rhibg (Red Hat graphical boot)** — displays an animation during the boot process, rather than lines of text.

- **quiet** — suppresses all but the most important messages in the part of the boot sequence before the graphical boot animation begins.

- **password=<password>** — Prevents a user who does not know the password from editing the entries for this menu option.

Optionally, it is possible to specify an alternate menu configuration file after the **password=<password>** directive. In this case, GRUB restarts the second stage boot loader and uses the specified alternate configuration file to build the menu. If an alternate menu configuration file is left out of the command, a user who knows the password is allowed to edit the current configuration file.

For more information about securing GRUB, refer to the chapter titled *Workstation Security* in the *Fedora Deployment Guide*.

- **map** — Swaps the numbers assigned to two hard drives. For example:

  | map (hd0) (hd3) |
  | map (hd3) (hd0) |

assigns the number 0 to the fourth hard drive, and the number 3 to the first hard drive. This option is especially useful if you configure your system with an option to boot a Windows operating system, because the Windows boot loader must find the Windows installation on the first hard drive.

For example, if your Windows installation is on the fourth hard drive, the following entry in grub.conf will allow the Windows boot loader to load Windows correctly:

| title Windows |
| map (hd0) (hd3) |
| map (hd3) (hd0) |
Changing Runlevels at Boot Time

- **menuentry "title"** — Specifies a title to be used with a particular group of commands used to load a kernel or operating system.

- **root (device-type<device-number>,<partition>)** — Configures the root partition for GRUB, such as (hd1,1), and mounts the partition.

- **rootnoverify (device-type<device-number>,<partition>)** — Configures the root partition for GRUB, just like the root command, but does not mount the partition.

- **timeout=<integer>** — Specifies the interval, in seconds, that GRUB waits before loading the entry designated in the default command.

- **splashimage=<path-to-image>** — Specifies the location of the splash screen image to be used when GRUB boots.

To add human-readable comments to the menu configuration file, begin the line with the hash mark character (#).

**E.8. Changing Runlevels at Boot Time**

Under Fedora, it is possible to change the default runlevel at boot time.

To change the runlevel of a single boot session, use the following instructions:

- At boot time, press the Esc key to reach the GRUB splash screen, then press any key to enter the GRUB menu (within the first three seconds).

- Press the a key to append to the linux command.

- Add <space><runlevel> at the end of the boot options line to boot to the desired runlevel. For example, the following entry would initiate a boot process into runlevel 3:

  ```
  grub append> ro root=/dev/VolGroup00/LogVol00 rhgb quiet 3
  ```

**E.9. Additional Resources**

This chapter is only intended as an introduction to GRUB. Consult the following resources to discover more about how GRUB works.

**E.9.1. Installed Documentation**

- `/usr/share/doc/grub-<version-number>/` — This directory contains good information about using and configuring GRUB, where `<version-number>` corresponds to the version of the GRUB package installed.

- `info grub` — The GRUB info page contains a tutorial, a user reference manual, a programmer reference manual, and a FAQ document about GRUB and its usage.
Appendix E. The GRUB Boot Loader

E.9.2. Useful Websites

- [http://www.gnu.org/software/grub](http://www.gnu.org/software/grub)\(^2\) — The home page of the GNU GRUB project. This site contains information concerning the state of GRUB development and an FAQ.

\(^2\) [http://www.gnu.org/software/grub](http://www.gnu.org/software/grub)
Appendix F. Boot Process, Init, and Shutdown

An important and powerful aspect of Fedora is the open, user-configurable method it uses for starting the operating system. Users are free to configure many aspects of the boot process, including specifying the programs launched at boot-time. Similarly, system shutdown gracefully terminates processes in an organized and configurable way, although customization of this process is rarely required.

Understanding how the boot and shutdown processes work not only allows customization, but also makes it easier to troubleshoot problems related to starting or shutting down the system.

F.1. The Boot Process

Below are the basic stages of the boot process:

1. The system loads and runs a boot loader. The specifics of this process depend on the system architecture. For example:
   - BIOS-based x86 systems run a first-stage boot loader from the MBR of the primary hard disk that, in turn, loads an additional boot loader, GRUB.
   - UEFI-based x86 systems mount an EFI System Partition that contains a version of the GRUB boot loader. The EFI boot manager loads and runs GRUB as an EFI application.

2. The boot loader loads the kernel and a small, read-only filesystem into memory. This filesystem, or initramfs, contains all the tools required for the kernel to continue the boot process.

3. The kernel transfers control of the boot process to the system daemon, systemd.

4. systemd loads needed services and user-space tools, and mounts filesystems listed in /etc/fstab.

5. The user is presented with a login screen for the freshly booted Linux system.

Because configuration of the boot process is more common than the customization of the shutdown process, the remainder of this chapter discusses in detail how the boot process works and how it can be customized to suit specific needs.

F.2. A Detailed Look at the Boot Process

The beginning of the boot process varies depending on the hardware platform being used. However, once the kernel is found and loaded by the boot loader, the default boot process is identical across all architectures. This chapter focuses primarily on the x86 architecture.

F.2.1. The firmware interface

F.2.1.1. BIOS-based x86 systems
Appendix F. Boot Process, Init, and Shutdown

The Basic Input/Output System (BIOS) is a firmware interface that controls not only the first step of the boot process, but also provides the lowest level interface to peripheral devices. On x86 systems equipped with BIOS, the program is written into read-only, permanent memory and is always available for use. When the system boots, the processor looks at the end of system memory for the BIOS program, and runs it.

Once loaded, the BIOS tests the system, looks for and checks peripherals, and then locates a valid device with which to boot the system. Usually, it checks any optical drives or USB storage devices present for bootable media, then, failing that, looks to the system's hard drives. In most cases, the order of the drives searched while booting is controlled with a setting in the BIOS, and it looks for bootable media in the specified order.

A disk may either have a Master Boot Record (MBR) or a GUID Partition Table (GPT). The MBR is only 512 bytes in size and contains machine code instructions for booting the machine, called a boot loader, along with the partition table. The newer GPT serves the same role and allows for more and larger partitions, but is generally used on newer UEFI systems. Once the BIOS finds and loads the boot loader program into memory, it yields control of the boot process to it.

This first-stage boot loader is a small machine code binary on the MBR. Its sole job is to locate the second stage boot loader (GRUB) and load the first part of it into memory.

F.2.2. UEFI-based x86 systems

The Unified Extensible Firmware Interface (UEFI) is designed, like BIOS, to control the boot process (through boot services) and to provide an interface between system firmware and an operating system (through runtime services). Unlike BIOS, it features its own architecture, independent of the CPU, and its own device drivers. UEFI can mount partitions and read certain file systems.

When an x86 computer equipped with UEFI boots, the interface searches the system storage for a partition labeled with a specific globally unique identifier (GUID) that marks it as the EFI System Partition (ESP). This partition contains applications compiled for the EFI architecture, which might include bootloaders for operating systems and utility software. UEFI systems include an EFI boot manager that can boot the system from a default configuration, or prompt a user to choose an operating system to boot. When a bootloader is selected, manually or automatically, UEFI reads it into memory and yields control of the boot process to it.

F.3. The Boot Loader

F.3.1. The GRUB2 boot loader for x86 systems

The system loads GRUB2 into memory, as directed by either a first-stage bootloader in the case of systems equipped with BIOS, or read directly from an EFI System Partition in the case of systems equipped with UEFI.

GRUB2 has the advantage of being able to read a variety of open filesystems, as well as virtual devices such as mdadm RAID arrays and LVM.

GRUB2 mounts a designated partition and load its configuration file — /boot/grub2/grub.cfg (for BIOS) or /boot/efi/EFI/redhat/grub.cfg (for UEFI) — at boot time. Refer to Section E.7, “GRUB Menu Configuration File” for information on how to edit this file.

Once the second stage boot loader is in memory, it presents the user with a graphical screen showing the different operating systems or kernels it has been configured to boot (when you update the kernel,
the boot loader configuration file is updated automatically). On this screen a user can use the arrow keys to choose which operating system or kernel they wish to boot and press Enter. Typically, if no key is pressed, the boot loader loads the default selection after a configurable period of time has passed.

Once the second stage boot loader has determined which kernel to boot, it locates the corresponding kernel binary in the /boot/ directory. The kernel binary is named using the following format — /boot/vmlinuz-<kernel-version> file (where <kernel-version> corresponds to the kernel version specified in the boot loader’s settings).

The boot loader is also used to pass arguments to the kernel it loads. This allows the system to operate with a specified root filesystem, enable or disable kernel modules and system features, or configure booting to a specific runlevel. For instructions on using the boot loader to supply command line arguments to the kernel, refer to Appendix E, The GRUB Boot Loader. Specific kernel parameters are described in /usr/share/doc/kernel-doc-*/Documentation/kernel-parameters.txt, which is provided by the kernel-doc package. For information on changing the runlevel at the boot loader prompt, refer Section E.8, “Changing Runlevels at Boot Time”.

The boot loader then places one or more appropriate initramfs images into memory. The initramfs is used by the kernel to load drivers and modules necessary to boot the system.

Once the kernel and the initramfs image(s) are loaded into memory, the boot loader hands control of the boot process to systemd.

For a more detailed overview of the GRUB2 boot loader, refer to Appendix E, The GRUB Boot Loader.

### F.3.2. Boot Loaders for Other Architectures

Once the kernel loads and the boot process continues, the process of bringing up the system is the same. The main difference between each architecture’s boot process is in the application used to find and load the kernel.

For example, the IBM eServer pSeries architecture uses yaboot, and the IBM System z systems use the z/IPL boot loader. Configuration of alternative bootloaders is outside the scope of this document.

### F.4. The Kernel

When the kernel is loaded, it immediately initializes and configures the computer’s memory and configures the various hardware attached to the system, including all processors, I/O subsystems, and storage devices. It then loads the initramfs image(s) from disk and decompresses it into a tmpfs as the acting root filesystem. The initramfs contains programs and kernel modules required to continue booting the system, such as those used to initialize virtual devices related to file systems, like LVM or software RAID.

The kernel uses the initramfs to continue the boot process, and when the final root device is available, the initramfs is unmounted and the real root filesystem is mounted in its place.

At this point, the kernel is loaded into memory and operational. However, since there are no user applications that allow meaningful input to the system, not much can be done with the system.

To set up the user environment, the kernel executes the system daemon, systemd.

### F.5. Booting with systemd
systemd is the first process started by the kernel. It replaces the venerable SysVinit program (also called init) and the newer Upstart init system. systemd coordinates the rest of the boot process and configures the environment for the user.

systemd improves on other init systems with increased parallelization. It starts the process of loading all programs it launches immediately, and manages information between interdependent programs as they load. By dissociating programs and their means of communication, each program is able to load without waiting for unrelated or even dependent programs to load first.

The Boot Process

- A socket is created for each daemon that will be launched. The sockets allow daemons to communicate with each other and userspace programs. Because the sockets are abstracted from the processes that use them, interdependent services do not have to wait for each other to come up before sending messages to the socket.

- New processes are started by systemd. The processes are assigned to Control Groups, or cgroups. Processes in a cgroup are isolated to resources allotted by the kernel, and the restrictions are inherited by newly spawned processes. Communication with outside processes will be handled by the kernel through sockets.

- As they load, processes connect to their sockets to receive any waiting messages and communicate with other sockets. systemd handles dependencies between programs, but does not need a preconfigured boot order. Userspace tools are loaded as the devices and services they depend on become available.

- The user is presented with a login screen for the freshly booted Linux system.

F.6. systemd units

Functions administered by systemd are referred to as units. Each unit has a name and a type, and is described in a file that follows the convention of unit-name.type. The configuration file defines the relationship between a unit and its dependencies. Let's look at the different types of units:

<table>
<thead>
<tr>
<th>unit type</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>socket</td>
<td>These provide an endpoint for interprocess communication. Messages can be transported through files, or network or Unix sockets. Each socket has a corresponding service.</td>
</tr>
<tr>
<td>service</td>
<td>These are traditional daemons. Service units are described in simple configuration files that define the type, execution, and environment of the program, as well as information regarding how systemd should monitor it.</td>
</tr>
<tr>
<td>device</td>
<td>These are automatically created for all devices discovered by the kernel. These units are provided for services that are dependent on devices, or for virtual devices that are dependent on services, as with a network block device.</td>
</tr>
<tr>
<td>mount</td>
<td>These units allow systemd to monitor the mounting and unmounting of filesystems, and allow units to declare relationships with the filesystems they use.</td>
</tr>
<tr>
<td>automount</td>
<td>These units facilitate dynamic mounting of filesystems when their mountpoint is accessed. They are always paired with a mount unit.</td>
</tr>
</tbody>
</table>
unit type  |  Role
------|------
target | These are logical groupings of units that are required for userspace functionality. Some are large, such as `multi-user.target`, which defines a full graphical user environment, or more topical, such as `bluetooth.target`, which provides the services a user expects to be available when using Bluetooth devices.

snapshot | snapshots allow the user to save the state of all units with the command `systemctl snapshot` and return to that state with `systemctl isolate`. This is useful for temporary adjustments that don't merit reconfiguration of a target.

Although `systemd` units will ultimately be available for all services, it retains support for legacy init scripts. units are dynamically created for services without native configurations, with dependencies inferred from LSB headers in the script. There are drawbacks to this method, so it is best to have a native `systemd` unit file.

The function and usage of legacy init systems and their configuration files is outside of the scope of this document.

### F.7. systemd targets

`systemd` replaces traditional `SysVinit` runlevels with predefined groups of units called targets. Targets are usually defined according to the intended use of the system, and ensure that required dependencies for that use are met.

The system boots to the target described in `/lib/systemd/system/default.target`. This file is a symlink that can be changed when booting to a different target is desired. Appending `systemd.unit=custom.target` to the kernel's boot arguments will override the default target.

The following table shows some standard preconfigured targets, the `sysVinit` runlevels they resemble and the use case they address.

<table>
<thead>
<tr>
<th>Runlevel</th>
<th>Target</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,single</td>
<td>rescue.target</td>
<td>single user mode, for recovery of critical system components or configuration</td>
</tr>
<tr>
<td>3</td>
<td>multi-user.target</td>
<td>Non-graphical multi-user console access, via local TTYs or network.</td>
</tr>
<tr>
<td>5</td>
<td>graphical.target</td>
<td>A GUI session. Typically provides the user with a fully featured desktop environment.</td>
</tr>
<tr>
<td>4</td>
<td>custom.target</td>
<td><code>systemd</code> allows any number of custom defined targets.</td>
</tr>
</tbody>
</table>

### F.8. Running Additional Programs at Boot Time
Historically, those wishing to execute additional programs at boot could insert commands into `/etc/rc.local`. While `systemd` will use this file, writing `unit` files can be simple, effective, and much more flexible. Consider this example `unit` file:

```
# cat /lib/systemd/system/example.service
[Unit]
Description=A service that executes a user script on startup
Wants=network.target

[Service]
ExecStart=/opt/domain/bin/example
Type=oneshot

[Install]
WantedBy=multi-user.target
Alias=illustration.service
```

The `[Unit]` section has a short description, and dependencies on other targets. The various types of dependencies and attributes used in this section are described in `man systemd.unit`

The `[Service]` section establishes the actual command to be executed, and describes how `systemd` should handle the process. Options for this section are described in `man systemd.service`

The `[Install]` sets relationships with targets and similar behaviors. Options for this section are also described in `man systemd.unit`

### F.9. Administering services with systemd

The move to `systemd` also brought new administration utilities to Fedora. Administrators have the ability to start, stop, and restart services as with `sysVinit`, but also have access to much more information and functionality.

⚠️ **Expect legacy commands to be deprecated!**

`systemctl` fully replaces traditional utilities like `service` and `chkconfig`. While some services can still be administered with these legacy commands, **all** services can be administered with `systemctl`.

`/usr/bin/systemctl` does most of the heavy lifting when starting and stopping services, or configuring them to run at boot. Let us look at what `systemctl` can do:

### F.9.1. Checking up on services
The command `systemctl status sshd.service` can tell us much more than if the service is running. In this example with `sshd`, we can see that the service is enabled but not active. We know how the service was invoked, what the PID was, and when it was stopped. We can also see the last portion of the service's log.

### F.9.2. Starting and stopping services

- `systemctl start sshd.service`
- `systemctl stop sshd.service`
- `systemctl restart sshd.service`

These commands will start, stop, and restart the service. The commands may not report the success or failure of the intended action, so we can check the status of the service with `systemctl status`. `systemctl` might report helpful information about a misbehaving application in the status, but the application's own logs are more relevant.

### F.9.3. Running services automatically

- `systemctl enable sshd.service`
- `systemctl disable sshd.service`

A service that is enabled will start automatically when the system boots. A service that is disabled will not start at boot. These commands are manipulating symbolic links in `/lib/systemd/system/` and `/lib/systemd/user/` while retaining the relationships with other units established in the `.service` file. While the symlinks can be manipulated manually, `systemctl` also rebuilds the `systemd` configuration, saving the extra step of invoking `systemctl daemon-reload`.

### F.9.4. Killing and Masking services

- `systemctl kill sshd.service`
Appendix F. Boot Process, Init, and Shutdown

```
systemctl kill -s USR1 daemon.service
```

With the first command, `systemctl` kills all processes and child processes of the `sshd` service. The second command demonstrates how any Unix signal can be sent to the processes of a service.

```
systemctl mask sshd.service
```

Masking a service prevents the service from being started manually or automatically. For this example, `systemctl` is creating a symlink from `/etc/systemd/system/sshd.service` to `/dev/null`. Targets in `/etc/systemd` override those provided by packages in `/lib/systemd`. `systemd` recognizes the symlink and will not start the service.

### F.9.5. Getting more from `systemctl`

`systemctl` works with not only services but all other unit types, and is a valuable tool when monitoring or troubleshooting a system. It can list all known units, limit the results to a single unit type, show only failed units, or examine unit relationships. The table below shows some useful `systemctl` features and should help system administrators replace their old workflow in `sysVinit`.

#### Table F.2. `systemctl` command reference

<table>
<thead>
<tr>
<th>sysVinit command</th>
<th>systemctl command</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>service sshd start</td>
<td>systemctl start sshd.service</td>
<td>Used to start a service (not reboot persistent)</td>
</tr>
<tr>
<td>service sshd stop</td>
<td>systemctl stop sshd.service</td>
<td>Used to stop a service. (not reboot persistent)</td>
</tr>
<tr>
<td>service sshd restart</td>
<td>systemctl restart sshd.service</td>
<td>Used to start and stop a service.</td>
</tr>
<tr>
<td>service sshd reload</td>
<td>systemctl reload sshd.service</td>
<td>When supported, reloads the config file without interrupting pending operations.</td>
</tr>
<tr>
<td>service sshd condrestart</td>
<td>systemctl condrestart sshd.service</td>
<td>Restarts if the service is already running.</td>
</tr>
<tr>
<td>service sshd status</td>
<td>systemctl status sshd.service</td>
<td>Tells whether a service is currently running.</td>
</tr>
<tr>
<td>ls /etc/rc.d/init.d/</td>
<td>systemctl list-unit-files --type=service</td>
<td>Lists all available services.</td>
</tr>
<tr>
<td>chkconfig sshd on</td>
<td>systemctl enable sshd.service</td>
<td>Always run the service at this target (runlevel.)</td>
</tr>
<tr>
<td>chkconfig sshd off</td>
<td>systemctl disable sshd.service</td>
<td>Do not automatically run the service at this target (runlevel.)</td>
</tr>
<tr>
<td>chkconfig --list</td>
<td>systemctl list-units -t service --all</td>
<td>Print a table of available services and their status.</td>
</tr>
<tr>
<td>chkconfig sshd --list</td>
<td>ls /etc/systemd/system/ * .wants/sshd.service</td>
<td>Lists the targets that will include the service.</td>
</tr>
<tr>
<td>chkconfig sshd --add</td>
<td>systemctl daemon-reload</td>
<td>Used when you create a service file or modify any configuration.</td>
</tr>
<tr>
<td>telinit 3</td>
<td>systemctl isolate multi-user.target</td>
<td>Move system into another target (change runlevels.)</td>
</tr>
<tr>
<td>sysVinit command</td>
<td>systemd command</td>
<td>Notes</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------</td>
<td>-------</td>
</tr>
<tr>
<td>[no comparable command]</td>
<td>systemctl show -p &quot;Wants&quot; multi-user.target</td>
<td>Lists units pulled in by a given target.</td>
</tr>
<tr>
<td>[no comparable command]</td>
<td>systemctl show -p &quot;After&quot; sshd.service</td>
<td>Shows dependent services and other targets.</td>
</tr>
<tr>
<td>[no comparable command]</td>
<td>systemctl --test --system --unit=multi-user.target</td>
<td>Simulates booting the system to a given target.</td>
</tr>
<tr>
<td>[no comparable command]</td>
<td>systemd-analyze plot &gt; boot.svg</td>
<td>Generates a diagnostically useful graphical representation of the boot process.</td>
</tr>
<tr>
<td>ps xawf -eo pid,user,group, args</td>
<td>systemd-cgls</td>
<td>Display control group process tree.</td>
</tr>
</tbody>
</table>
Appendix G. Logging the Installation

Anaconda tracks all of its activities in logs. This includes:

- Changing installation steps. The steps roughly correspond to the different screens in the graphical installer.
- Detection and manipulation of storage devices.
- Installation media detection.
- Network initialization.
- Kernel messages
- Calls to critical methods within anaconda.
- Calls to external programs.

G.1. Log files and formats

G.1.1. Logging on the installed system

During the installation, logs are stored in the /tmp directory. After the installation, the files can be found in the /var/log/anaconda directory. Another set of logs is stored in in the /root directory of the target filesystem, and can be found at /mnt/sysimage/root during the installation. Some logs are also written to the virtual terminals.

<table>
<thead>
<tr>
<th>Table G.1. anaconda log files</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Logs in /tmp, /var/log/anaconda</strong></td>
</tr>
<tr>
<td><strong>Filename</strong></td>
</tr>
<tr>
<td>anaconda.log</td>
</tr>
<tr>
<td>storage.log</td>
</tr>
<tr>
<td>program.log</td>
</tr>
<tr>
<td>syslog</td>
</tr>
<tr>
<td>yum.log</td>
</tr>
</tbody>
</table>

| **Logs in /root, /mnt/sysimage/root** |
| **Filename** | **Usage** |
| install.log | The log of the package installation process |
| install.log.syslog | Messages from installation chroot logged through the system’s syslog. Mostly information about users and groups created during yum’s package installation. |

G.2. Remote logging with rsyslog
G.3. Remote logging via virtio
Appendix H. Other Technical Documentation

To learn more about anaconda, the Fedora installation program, visit the project Web page: http://www.fedoraproject.org/wiki/Anaconda.

Both anaconda and Fedora systems use a common set of software components. For detailed information on key technologies, refer to the Web sites listed below:

Boot Loader
Fedora uses the GRUB boot loader. Refer to http://www.gnu.org/software/grub/ for more information.

Disk Partitioning
Fedora uses parted to partition disks. Refer to http://www.gnu.org/software/parted/ for more information.

Storage Management
Logical Volume Management (LVM) provides administrators with a range of facilities to manage storage. By default, the Fedora installation process formats drives as LVM volumes. Refer to http://www.tldp.org/HOWTO/LVM-HOWTO/ for more information.

Audio Support
The Linux kernel used by Fedora incorporates PulseAudio audio server. For more information about PulseAudio, refer to the project documentation: http://www.pulseaudio.org/wiki/Documentation.

Graphics System
Both the installation system and Fedora use the Xorg suite to provide graphical capabilities. Components of Xorg manage the display, keyboard and mouse for the desktop environments that users interact with. Refer to http://www.x.org/ for more information.

Remote Displays
Fedora and anaconda include VNC (Virtual Network Computing) software to enable remote access to graphical displays. For more information about VNC, refer to the documentation on the RealVNC Web site: http://www.realvnc.com/documentation.html.

Command-line Interface
By default, Fedora uses the GNU bash shell to provide a command-line interface. The GNU Core Utilities complete the command-line environment. Refer to http://www.gnu.org/software/bash/bash.html for more information on bash. To learn more about the GNU Core Utilities, refer to http://www.gnu.org/software/coreutils/.

Remote System Access
Fedora incorporates the OpenSSH suite to provide remote access to the system. The SSH service enables a number of functions, which include access to the command-line from other systems, remote command execution, and network file transfers. During the installation process anaconda may use the scp feature of OpenSSH to transfer crash reports to remote systems. Refer to the OpenSSH Web site for more information: http://www.openssh.com/.

Access Control
SELinux provides Mandatory Access Control (MAC) capabilities that supplement the standard Linux security features. Refer to the SELinux Project Pages for more information: http://docs.fedoraproject.org/selinux-guide.
Firewall

The Linux kernel used by Fedora incorporates the netfilter framework to provide firewall features. The Netfilter project website provides documentation for both netfilter, and the iptables administration facilities: http://netfilter.org/documentation/index.html.

Software Installation

Fedora uses yum to manage the RPM packages that make up the system. Refer to http://docs.fedoraproject.org/yum/ for more information.

Virtualization

Virtualization provides the capability to simultaneously run multiple operating systems on the same computer. Fedora also includes tools to install and manage the secondary systems on a Fedora host. You may select virtualization support during the installation process, or at any time thereafter. Refer to the Fedora Virtualization Guide available from http://docs.fedoraproject.org/ for more information.
Appendix I. Contributors and production methods

I.1. Contributors

- Fabian Affolter\(^1\) (translator - German)
- Amanpreet Singh Alam\(^2\) (translator - Punjabi)
- Jean-Paul Aubry (translator - French)
- David Barzilay (translator - Brazilian Portuguese)
- Domingo Becker\(^3\) (translator - Spanish)
- Subhransu Behera (translator - Oriya)
- Michal Bentkowski (translator - Polish)
- Rahul Bhalerao (translator - Marathi)
- Runa Bhattacharjee (translator - Bengali (India))
- Teta Bilianou\(^4\) (translator - Greek)
- Vitor Vilas Boas (translator - Brazilian Portuguese)
- Lucas Brausch (translator - German)
- Hector Daniel Cabrera\(^5\) (translator - Spanish)
- David Cantrell\(^6\) (writer - VNC installation)
- Guido Caruso (translator - Italian)
- Guillaume Chardin (translator - French)
- Nikos Charonitakis\(^7\) (translator - Greek)
- Chester Cheng (translator - Chinese (Traditional))
- Tom K. C. Chiu\(^8\) (translator - Chinese (Traditional))
- Glaucia Cintra (translator - Brazilian Portuguese)
- Fabien Decroux (translator - French)

\(^1\) http://fedoraproject.org/wiki/User:Fab
\(^2\) http://fedoraproject.org/wiki/AmanAlam
\(^3\) http://fedoraproject.org/wiki/User:Beckerde
\(^4\) http://fedoraproject.org/wiki/TetaBilianou
\(^5\) http://fedoraproject.org/wiki/User:Logan
\(^6\) https://fedoraproject.org/wiki/DavidCantrell
\(^7\) http://fedoraproject.org/wiki/NikosCharonitakis
\(^8\) http://fedoraproject.org/wiki/Tomchiukc
Appendix I. Contributors and production methods

- **Hans De Goede** (writer - iSCSI)
- Claudio Rodrigo Pereyra Diaz (translator - Spanish)
- **Piotr Drąg** (translator - Polish)
- **Damien Durand** (translator - French)
- **Stuart Ellis** (writer, editor)
- **Ali Fakoor** (translator - Persian)
- Felix I (translator - Tamil)
- Tony Fu (translator - Chinese (Simplified))
- **Paul W. Fields** (writer, editor)
- Paul Gampe (translator - Japanese)
- Sree Ganesh (translator - Telugu)
- **Dimitris Glezos** (translator - Greek)
- **Guillermo Gómez** (translator - Spanish)
- **Igor Gorbounov** (translator - Russian)
- **Rui Gouveia** (translator - Portuguese)
- Kiyoto James Hashida (translator - Japanese)
- Severin Heiniger (translator - German)
- Xi Huang (translator - Chinese (Simplified))
- Ryuichi Hyugabaru (translator - Japanese)
- Jayaradha N (translator - Tamil)
- Chris Johnson (writer)
- Eunju Kim (translator - Korean)
- Michelle J Kim (translator - Korean)
- **Miloš Komarčević** (translator - Serbian)

---

9 https://fedoraproject.org/wiki/HansdeGoede
10 http://fedoraproject.org/wiki/PiotrDr%C4%85g
11 http://fedoraproject.org/wiki/DamienDurand
12 https://fedoraproject.org/wiki/StuartEllis
14 https://fedoraproject.org/wiki/User:Pfrields
15 http://fedoraproject.org/wiki/DimitrisGlezos
16 http://fedoraproject.org/wiki/GuillermoGomez
17 http://fedoraproject.org/wiki/IgorGorbounov
18 http://fedoraproject.org/wiki/RuiGouveia
19 http://translate.fedoraproject.org/people/kmilos
• Alexey Kostyuk (translator - Russian)
• Daniela Kugelmann (translator - German)
• Rüdiger Landmann⁴⁰ (writer, editor)
• Magnus Larsson⁴¹ (translator - Swedish)
• Christopherus Laurentius⁴² (translator - Indonesian)
• Florent Le Coz (translator - French)
• Erick Lemon (writer)
• Andy Liu (translator - Chinese (Traditional))
• Wei Liu (translator - Chinese (Simplified))
• Yelitza Louze (translator - Spanish)
• Gan Lu (translator - Chinese (Simplified))
• Jens Maucher⁴³ (translator - German)
• Igor Miletić⁴⁴ (translator - Serbian)
• Noriko Mizumoto (translator - Japanese)
• Jeremy W. Mooney (writer)
• Enikő Nagy (translator - Hungarian)
• Igor Nestorović (translator - Serbian)
• David Nalley⁴⁶ (writer, editor)
• John Nguyen (writer)
• Manuel Ospina (translator - Spanish)
• Janis Ozolins (translator - Latvian)
• Ankit Patel (translator - Gujarati)
• Davidson Paulo⁴⁶ (translator - Brazilian Portuguese)
• Ani Peter (translator - Malayalam)
• Amitakhya Phukan⁴⁷ (translator - Assamese)

⁴⁰ https://fedoraproject.org/wiki/User:Rlandmann
⁴¹ http://translate.fedoraproject.org/people/raada
⁴² https://fedoraproject.org/wiki/ChristopherusLaurentius
⁴³ http://fedoraproject.org/wiki/User:Jensm
⁴⁴ http://fedoraproject.org/wiki/IgorMiletic
⁴⁵ https://fedoraproject.org/wiki/User:ke4qqq
⁴⁶ http://fedoraproject.org/wiki/User:Dpaulo
⁴⁷ https://translate.fedoraproject.org/people/aphukan
Appendix I. Contributors and production methods

- **Silvio Pierro**²⁸ (translator - Italian)
- **Micha Pietsch**²⁹ (translator - German)
- José Nuno Pires (translator - Portuguese)
- Piotr Podgórski (translator - Polish)
- Yulia Poyarkova (translator - Russian)
- Shankar Prasad (translator - Kannada)
- Rajesh Ranjan (translator - Hindi)
- **Jack Reed**³⁰ (writer, editor)
- **Tommy Reynolds**³¹ (writer)
- Tim Richert (translator - German)
- **Dominik Sandjaja**³² (translator - German)
- **Sharuzzaman Ahmat Raslan**³³ (translator - Malay)
- **Mohsen Saeedi**³⁴ (translator - Persian)
- **Tian Shixiong**³⁵ (translator - Chinese (Simplified))
- Audrey Simons (translator - French)
- Keld Simonsen (translator - Danish)
- **Jared K. Smith**³⁶ (writer, editor)
- Espen Stefansen (translator - Norwegian Bokmål)
- **Sulyok Péter**³⁷ (translator - Hungarian)
- **Sümegi Zoltán**³⁸ (translator - Hungarian)
- **Francesco Tombolini**³⁹ (translator - Italian)
- Timo Trinks (translator - German)
- **Dimitris Typaldos**⁴⁰ (translator - Greek)

²⁹ https://fedoraproject.org/wiki/User:Barney
³⁰ https://fedoraproject.org/wiki/User:jjr
³¹ https://fedoraproject.org/wiki/TommyReynolds
³² http://fedoraproject.org/wiki/DominikSandjaja
³³ http://translate.fedoraproject.org/people/szaman
³⁴ https://fedoraproject.org/wiki/User:Saeedi
³⁵ https://fedoraproject.org/wiki/User:Tiansworld
³⁶ https://fedoraproject.org/wiki/User:Jsmith
³⁷ https://fedoraproject.org/wiki/User:Peti
³⁹ https://fedoraproject.org/wiki/User:Tombo
⁴⁰ http://fedoraproject.org/wiki/DimitriosTypaldos
Production methods

Writers produce the Install Guide directly in DocBook XML in a revision control repository. They collaborate with other subject matter experts during the beta release phase of Fedora to explain the installation process. The editorial team ensures consistency and quality of the finished guide. At this point, the team of translators produces other language versions of the release notes, and then they become available to the general public as part of Fedora. The publication team also makes the guide, and subsequent errata, available via the Web.

I.2. Production methods

http://docs.fedoraproject.org/install-guide/

Göran Uddeborg (translator - Swedish)

Michaël Ughetto41 (translator - French)

Francesco Valente (translator - Italian)

Karsten Wade42 (writer, editor, publisher)

Sarah Saiying Wang (translator - Chinese (Simplified))

Geert Warrink43 (translator - Dutch)

Elizabeth Ann West (editor)

Tyronne Wickramarathne (translator - Sinhalese)

Ben Wu (translator - Chinese (Traditional))

Xiaofan Yang (translator - Chinese (Simplified))

Yuan Yijun44 (translator - Chinese (Simplified))

Diego Bírigo Zacarão45 (translator - Brazilian Portuguese)

Izaac Zavaleta46 (translator - Spanish)

41 http://fedoraproject.org/wiki/MichaelUghetto
42 http://fedoraproject.org/wiki/KarstenWade
43 http://fedoraproject.org/wiki/GeertWarrink
44 http://translate.fedoraproject.org/people/bbbush
45 http://fedoraproject.org/wiki/DiegoZacarao
Appendix J. Revision History

Revision 1.0-0  Tue Jan 13 2013  Jack Reed jreed@redhat.com
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